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English for Veterinary students (advanced)

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Укладено для студентів освітньої програми Н6 «Ветеринарна медицина», які вивчають англійську мову за професійним спрямуванням. Його мета — сприяти підготовці майбутніх фахівців до роботи з оригінальною англомовною літературою у своїй галузі.

Призначений для аудиторної та самостійної роботи, містить лекції з лексико-граматичними вправами, тексти для домашнього читання із завданнями для самоконтролю, а також пояснення граматики англійської мови. Посібник укладено на матеріалах лекцій, практичних занять та презентацій: Басараб Т.П., Стефаник О.В., Личук М.Г., Мартинів Ю. В., Демус Н.В., Коломієць І.А., Турко Я.І., Сварчевський О.А. та Леськів Х.Ю.

Призначений для студентів Освітньої програми Н6 "Ветеринарна медицина" та вивчають англійську мову за професійним спрямуванням. Метою посібника є допомога майбутнім фахівцям у підготовці до опрацювання англійської оригінальної літератури за обраною спеціальністю.

Розрахований на аудиторні та самостійні заняття, має лекції з лексико-граматичними вправами, тексти для домашнього читання із завданнями для самоконтролю та англо-український довідник.

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CONTENT

PART 1

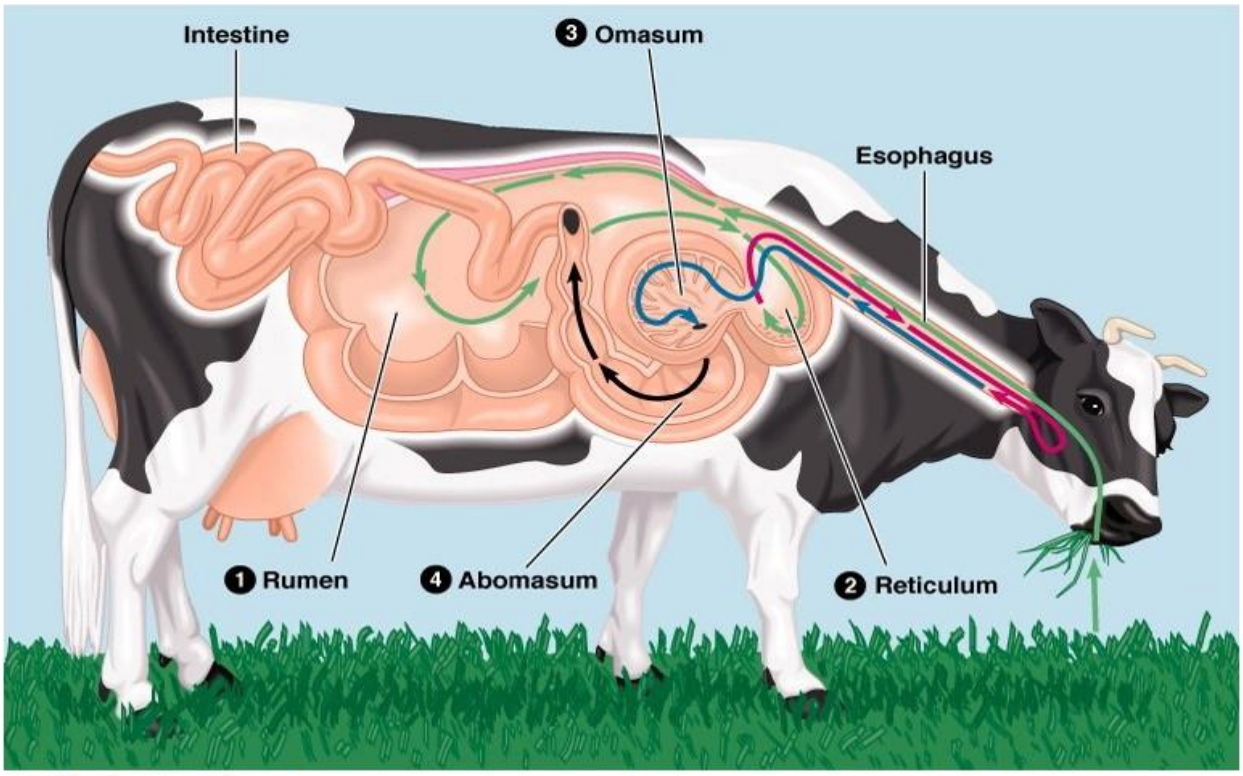
Anatomy and Physiology

Digestive tract

The rumen (on the left side of the animal) is the largest stomach compartment and consists of several sacs. It can hold 25 gallons or more of material depending on the size of the cow. Because of its size, the rumen acts as a storage or holding vat for feed.

Aside from storage, the rumen is also a fermentation vat. The rumen's environment favors the growth of microbes. These microbes digest or ferment feed within the rumen and make volatile fatty acids (VFAs). The rumen absorbs most of the VFAs from fermentation.

A good blood supply to the rumen walls improves absorption of VFAs and other digestion products. Tiny projections (papillae) line the rumen, which increases the rumen's surface area and the amount it can absorb.



The reticulum

The reticulum is a pouch-like structure in the forward area of the body, close to the heart. The tissues in the reticulum form a network similar to a honeycomb. A small tissue fold lies between the reticulum and rumen, but the two aren't separate compartments. Together they're called the rumino-reticulum.

Heavy or dense feed and metal objects eaten by the cow drop into this compartment. Nails and other sharp objects may work into the tissue and cause "hardware disease." You can use magnets to prevent disease or correct the problem through surgery. Leaving it untreated may lead to infection and possibly death.

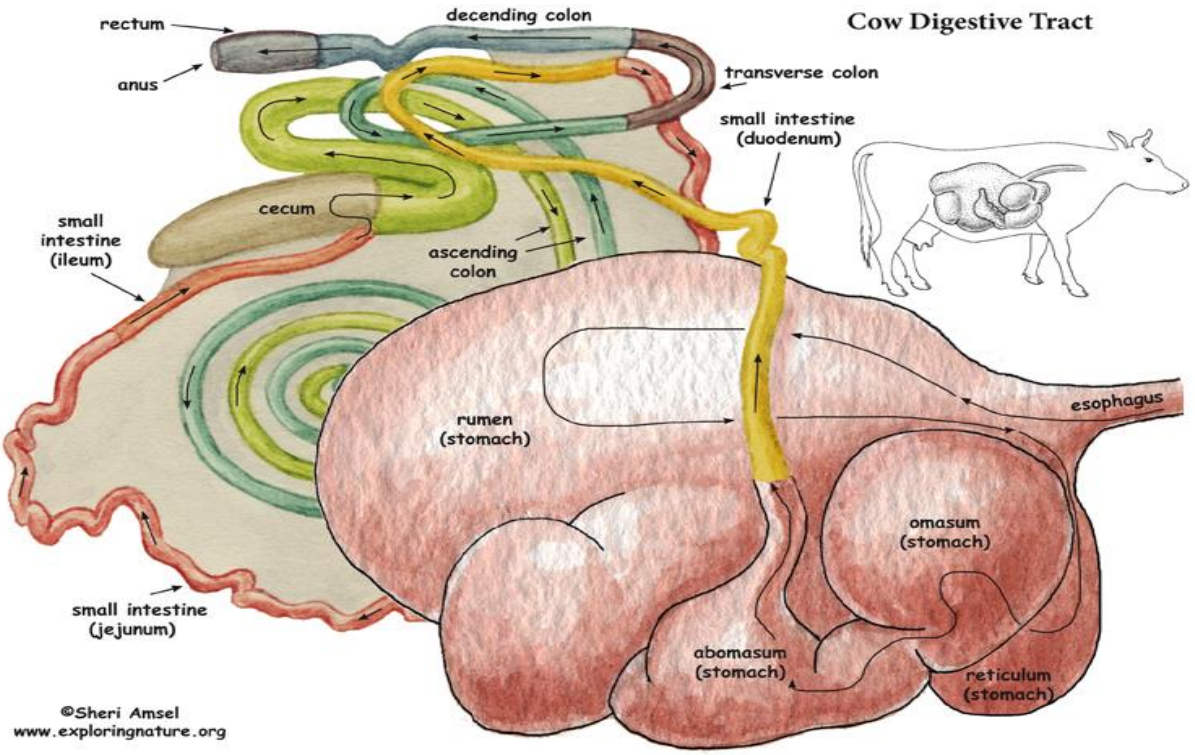
The omasum

The omasum is a globe-shaped structure containing leaves of tissue (like pages in a book). It absorbs water and other substances from digestive contents. Feed material (ingesta) between the leaves will be drier than ingesta found in the other compartments.

The abomasum

The abomasum is the only compartment lined with glands. These glands release hydrochloric acid and digestive enzymes, needed to breakdown feeds. The abomasum is similar to a nonruminant stomach.

The small intestine consists of three sections: the duodenum, jejunum and ileum. It measures about 20 times the length of the animal.



Secretions from the pancreas and gallbladder aid in digestion within the small intestine. The small intestine completes most of the digestive process and absorbs many nutrients through villi (small finger-like projections). From the villi the nutrients enter into the blood and lymphatic systems.

The cecum is the large area where the small and large intestine meet. The cecum breaks down some previously undigested fiber, but the exact importance of the cecum remains unknown.

The large intestine is the last section of the tract that undigested feedstuffs pass through. Microbes digest some undigested feed here, but the main digestive function of the large intestine is to absorb water.[1]

Exercise 1: Match the Word to Its Definition

Match the vocabulary word to the correct definition.

[1] https://extension.umn.edu/dairy-nutrition/ruminant-digestive-system

Words:
1. Rumen
2. Microbes
3. Papillae
4. Omasum
5. Abomasum
6. Reticulum
7. VFAs (Volatile Fatty Acids)
8. Villi
9. Cecum
10. Gallbladder

Definitions:
A. Tiny finger-like projections that increase surface area for absorption in the small intestine
B. First and largest compartment of a ruminant stomach; acts as a fermentation vat
C. Pouch-like compartment with honeycomb tissue, collects heavy materials
D. Chemical compounds produced during fermentation, absorbed by the rumen
E. Organ that stores bile to aid digestion
F. Microorganisms that help break down food in the digestive tract
G. Tissue projections lining the rumen walls to help absorb nutrients
H. Compartment that absorbs water from feed using tissue leaves
I. Last stomach compartment that produces acid and enzymes
J. Area between small and large intestines; breaks down fiber

Exercise 2: Fill in the Blanks
Fill in the blank with the correct word from the box:
Words: \[rumen, omasum, papillae, microbes, abomasum, reticulum, villi, VFAs]

1. The _____ is lined with glandular tissue and functions similarly to a human stomach.
2. _____ in the rumen help break down feed and produce volatile fatty acids.
3. The _____ has a honeycomb-like structure and collects dense feed and metal objects.
4. The _____ absorbs most of the VFAs created during fermentation.
5. _____ increase the surface area of the rumen to help with absorption.
6. The _____ is the compartment where feed becomes drier due to water absorption.
7. Small projections called _____ line the small intestine and absorb nutrients.
8. The by-products of microbial fermentation in the rumen are called _____.

Exercise 3: True or False

Write **T** for true or **F** for false.

1. The omasum has tissue folds that look like the pages of a book.
2. The reticulum is completely separate from the rumen.
3. VFAs are harmful waste products from digestion.
4. The abomasum produces enzymes and hydrochloric acid.
5. The cecum is responsible for digesting fats.
6. Villi are found in the rumen and aid in water absorption.

Exercise 4: Synonym Match (Conceptual)

Match each term to a concept it closely relates to.

Terms:

1. Rumen
2. Abomasum
3. Omasum
4. Reticulum
5. Villi
6. Cecum

Concepts:

A. Enzymatic digestion
B. Fermentation vat
C. Drying and water absorption
D. Microbial fiber digestion
E. Absorption in the small intestine
F. Metal object collection

Cooperative learning and Case study section.

1. Jigsaw Activity: "Digestive Tract Experts"

Objective: Each group becomes an expert on one digestive tract part and teaches the rest of the class.

Steps:

1. Divide students into 5 expert groups, each assigned to one section:
   * Rumen
   * Reticulum
   * Omasum
   * Abomasum
   * Small and large intestines (including cecum)
2. Each group reads and discusses their section, creates a **summary**, and notes **key functions, features, and risks**.
3. Regroup students into **mixed “teaching groups”** (1 member from each expert group per group).
4. Each student **teaches** their assigned part to the others in their group using visuals or notes.

2. Think-Pair-Share: What Happens Where?

Objective: Understand the function of each digestive compartment.

Steps:

1. Pose key questions like:
   * Where does fermentation occur?
   * What part absorbs most water?
   * What happens in the abomasum?
2. **Think individually**, then **pair up to discuss**, and finally **share answers** as a class.
3. Have pairs **justify** their answers with evidence from the text.

3. Digestive Tract Role Play Game

Objective: Reinforce the journey of food through the ruminant system.

Steps:

1. Assign each student a role: “Rumen,” “Reticulum,” “Omasum,” etc. Give each a sign or badge.
2. Use a soft object or labeled "feedball" to represent feed.
3. Pass the feedball through each student, with each role describing their **function** as the ball passes.
4. Introduce challenges (e.g., “The cow ate a nail!” – what happens now?) for discussion.

4. Concept Mapping in Groups

Objective: Visually organize the digestive process.

Steps:

1. In small groups, provide students with large paper and markers.
2. Ask them to draw a **concept map** showing the **sequence** and **function** of each compartment.
3. Include arrows, notes, and connections (e.g., "Rumen → fermentation → VFAs → absorbed by papillae").
4. Groups present their maps and explain the flow of digestion.

5. Problem-Solving Case Study: “The Sick Cow”

Objective: Apply knowledge to a real-life scenario.

Scenario: A cow shows signs of pain, and the vet suspects “hardware disease.”

Steps:

1. In teams, students read the case.
2. Use the text to answer:
   * What part is likely affected?
   * What causes this disease?
   * How can it be prevented or treated?
3. Groups propose a **treatment plan** and **present their reasoning**.

6. Create a Quiz Challenge (Peer Teaching)

Objective: Students quiz and learn from each other.

Steps:

1. In groups, students create **5 multiple-choice or true/false questions** about a specific digestive part.

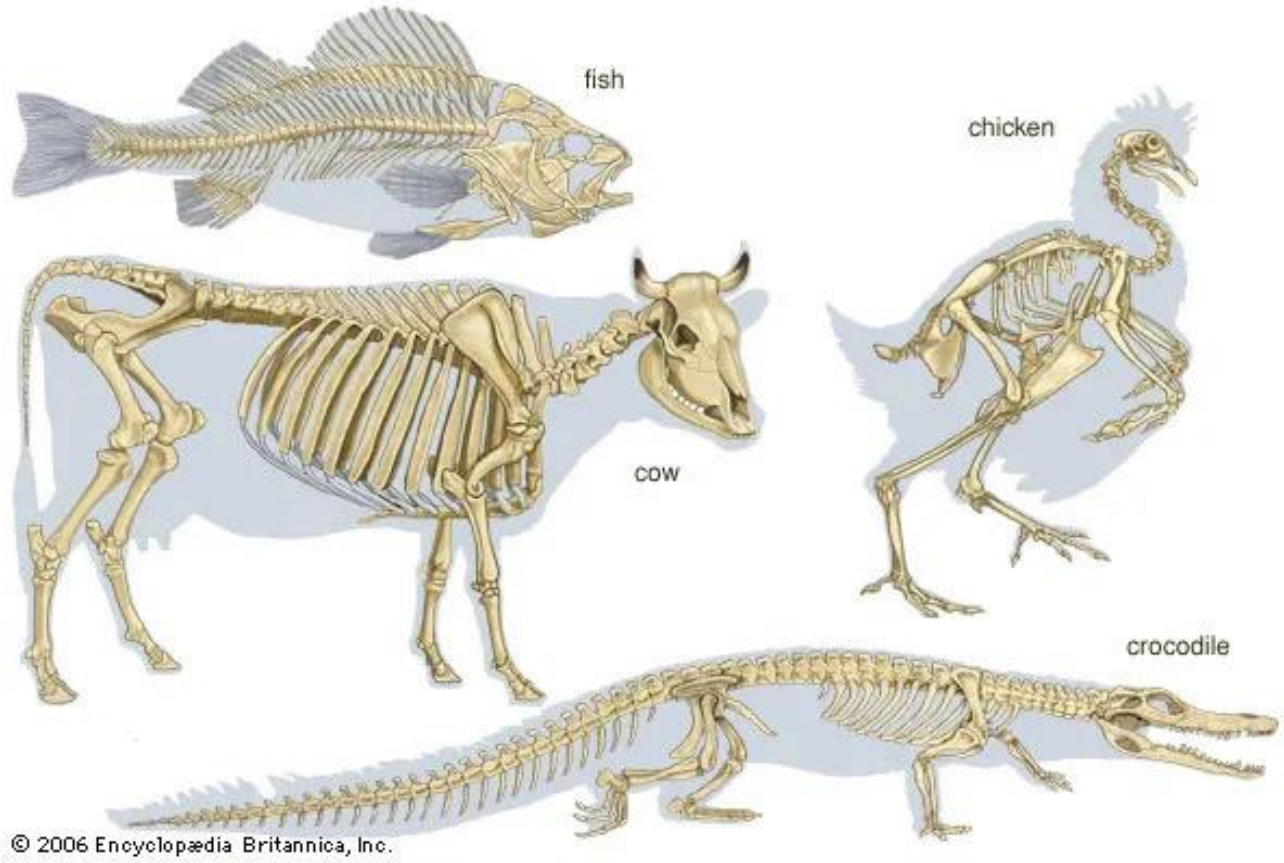
2. Exchange quizzes with another group.

3. Groups take each other's quizzes and **discuss answers together**.

The vertebrate skeleton

General characteristics

In vertebrates the adult skeleton is usually formed of bone or cartilage—living substances that grow with the animal, in contrast to the many types of invertebrate skeleton that do not grow or are dead secretions, deposits, or crystals. The internal position of bones and their central position in limbs provide firm support for small and large animals. Muscles can be inserted on all surfaces of the skeleton, in contrast to the limitations of the cuticular skeleton of arthropods, in which muscles occur on only one side. Antagonistic muscles are easily placed upon vertebrate bones to allow contrasting movements at the joints between them.



The component parts of the skeletons of vertebrates, although remarkably uniform in basic plan, are subject to wide superficial differences, which are associated with each class and with adaptations for particular habits or environments. The axial skeleton consists of the skull and the vertebral column. The appendicular skeleton supports the fins in fish and the legs in tetrapods (four-legged animals) and is associated with limb girdles, which become progressively more closely linked with the vertebral column in the higher vertebrates. Superficially there may be an exoskeleton of scales; some scales on the head may be incorporated into the skull.

Swimming of a typical fish occurs by undulations passing along a greater or lesser part of the body. The mechanism for caudal (tail) propulsion involves the vertebral column, the axial musculature, and the lateral surfaces of the body and caudal fin. The vertebral column of the fish can be regarded as a series of rigid units hinged to each other by surfaces that allow the body to bend only sideways. On each side of the vertebral chain lie the great axial muscles of the body; the fibres of this complex group of muscles are more or less parallel to the long axes of the vertebrae. One pair of vertebrae and its associated musculature form the fundamental unit of propulsion. The muscles on the two sides of each vertebral articulation shorten alternately, the surface of the body becoming concave, or bent inward, on the side on which the muscles are shortened and convex, or bent outward, on the side on which they are stretched. The whole tail of the fish is essentially a chain of such units in which the phase of muscular contraction at any one link is slightly ahead of that of the next posterior unit and slightly behind that of the next anterior unit. Each wave of contraction passes tailward along the body, which is thus propelled forward. The greatest thrust against the water is exerted by the tail end. Ribs of various kinds lie between and support the segmental muscles. The fins and their skeletal supports are used as balancing and steering organs. The paired fins are set horizontally in cartilaginous fish, which do not have a swim bladder, and vertically in most bony fishes, in which rapid vibrations or small angular movements provide exact steering. In the air-breathing lungfish, fins are used for stepping on the bottom in a manner that superficially resembles stepping by the legs of a salamander. Indeed, the land vertebrates evolved from extinct fishes that used their fins for stepping; the pentadactyl (i.e., with five digits) skeleton and the form of the forelegs and hind legs of land vertebrates similarly evolved from the fins of such fishes.

An unjointed elastic notochord is present in the protochordate amphioxus, in the tail of larval ascidians (tunicates), and in the adult cyclostomes (lamprey and hagfish), but there are no vertebrae. Segmental series of muscles are present as in fish, and the resultant swimming movements of these muscles, working with the elastic notochord, are similar to those in fish.

The lateral body undulations caused by the trunk musculature, as seen in fish, are the main propulsive agents in amphibians such as the newt. The feet raise the body from the ground but otherwise serve only to anchor the body, while the vertebral musculature allows forward progression by straightening the flank. The same propulsive mechanism serves for locomotion in water and on land. In the reptiles, birds, and mammals, a transition of the locomotory force from the body to the limbs occurs. When the vertebral muscles contract isometrically (i.e., against such great pressure that the muscle is unable to shorten) so as to prevent body undulations, the energy for propulsion comes from the limbs. Hands and feet are directed forward, as is the knee; and the elbow is directed backward. The limbs are no longer outstretched laterally but move ventrally below the body. The bones at the heel and elbow are extended to form levers that give origin to powerful extensor muscles of the foot and hand, thus contributing to a locomotory thrust against the ground. The elimination of lateral undulations of the vertebral column as the main propulsive agent is accompanied by the development of dorsoventral flexibility of the chain of

vertebrae; the distance between successive footfalls is less if the vertebral column remains rigid.

Swimming in whales is accomplished by means of dorsoventral tail beats, in contrast to swimming in fish, which beat the tail laterally. The swimming musculature of whales evolved from the nonswimming musculature of terrestrial ancestors. Long antagonistic muscles extend from the whale's skull to the tail and implement the dorsoventral motion, in contrast to propulsion by means of segmental muscles in fish.

The structure of the vertebrae provides a basis for many movements, including those mentioned above. Mobility sometimes is extreme, as in the necks of certain birds, in which the imbricating, or overlapping, centra (i.e., the main ventral portion of a vertebra that articulates with that of the adjacent vertebrae) can flex in any direction yet remain firmly interlocked, because the adjacent articular surface of the bony centra is saddle-shaped. The extensive mobility of snakes is mediated by their vertebral structure and their well-developed ribs; in this case, some mobility is lost, but greater stability is achieved by fusion of two or more vertebrae.

The limbs of tetrapods and their limb girdles have become much-modified in association with particular habits, such as rapid running, jumping, swimming, and burrowing. The limb bones remain relatively unspecialized in slow-moving animals and in those with climbing ability. Accomplished runners differ from humans and monkeys in that the proximal sector of the leg—humerus in the forelimb, femur in the hind limb; i.e., the portion closer to the limb's insertion in the body proper—is short. This sector carries many locomotory muscles but does not project far—if at all—from the trunk. Beyond the short, strong femur and humerus, the limb bones of running animals are elongated, slender, and strong. The distal part of the leg (i.e., that portion farther from the trunk) must be narrow and light if it is to move rapidly through a wide angle. The wrist and knee are far from the ground, and in horses and other ungulates (i.e., hoofed animals) the animal stands on its toenails and fingernails (hooves); the whole hand and foot are raised from the ground, thus contributing to leg length.[2]

Exercise 1: Match the Word to Its Definition

Words:

1. Vertebrate
2. Cartilage
3. Notochord
4. Antagonistic muscles
5. Axial skeleton
6. Appendicular skeleton
7. Caudal
8. Segmental
9. Locomotion
10. Extensor muscles

[2] https://www.britannica.com/facts/skeleton

Definitions:

A. Structure present in embryonic vertebrates and some adult chordates, providing basic support

B. Movement from one place to another

C. Muscle group that works opposite to another to produce movement

D. Skeleton comprising the skull and vertebral column

E. Animals with a backbone

F. Muscles that straighten a joint or limb

G. Toward or relating to the tail

H. The part of the skeleton supporting limbs or fins

I. Repeated in distinct sections or segments

J. Firm, flexible connective tissue found in joints and some skeletons

Exercise 2: Fill in the Blanks

Use these words to complete the sentences:

[**vertebrae, dorsoventral, imbricating, amphibians, girdles, limbs, locomotory, ribs, saddle-shaped, musculature**]

1. The vertebral _____ in birds are specially shaped to allow flexibility in the neck.
2. In snakes, well-developed _____ contribute to mobility along with their flexible spine.
3. Whales swim by _____ tail movements, rather than the lateral movements seen in fish.
4. In tetrapods, the limb _____ connect the appendages to the main skeleton.
5. The _____ system includes all the muscles involved in movement.
6. The _____ of the vertebral column allows mammals to run and jump efficiently.
7. The overlapping, or _____, centra of bird vertebrae allow motion in multiple directions.
8. In _____ like newts, body undulations provide propulsion on land and in water.
9. Animals that move quickly often have elongated, strong _____.
10. Articular surfaces between vertebrae may be _____ to allow both strength and flexibility.

Exercise 3: True or False

1. The appendicular skeleton includes the skull and vertebral column.
2. Antagonistic muscles are muscles that work in the same direction.
3. The pentadactyl limb evolved from fish fins.
4. In running animals, the distal leg bones are short and thick.
5. Cartilage is a living tissue that can grow.
6. The ribs in snakes help stabilize the body during movement.
7. The notochord is present in all adult vertebrates.

8. Whales swim using laterally undulating tail movements.
9. Tetrapod limbs are always highly specialized for one type of motion.
10. The humerus and femur are examples of distal limb bones.

Exercise 4: Word Association

Match each concept to the most relevant vocabulary word.

Concepts:

1. Elastic support in early vertebrates
2. Main movement structure in fish tails
3. Muscle type that extends limbs
4. Repeating muscle sections
5. Link between skeleton and limbs

Vocabulary:

A. Segmental
B. Notochord
C. Caudal
D. Girdle
E. Extensor

Exercise 5: Word Analysis – Prefix, Root, Suffix

Break down these words into their parts (prefix/root/suffix) and explain the meaning of each part.

1. **Pentadactyl**
2. **Locomotion**
3. **Appendicular**
4. **Isometric**
5. **Vertebrate**

(Example: *Pentadactyl* = **penta-** (five) + **-dactyl** (digit/finger) → having five fingers/toes)

Cooperative learning and Case study section.

Cooperative Learning Exercises

1. Jigsaw Activity: "Skeletons in Motion"

Objective: Understand the structure and function of different parts of the vertebrate skeleton across species.

Steps:

1. Divide the class into **expert groups**, each assigned one topic:
   * Axial vs. Appendicular skeleton
   * Fish propulsion and musculature
   * Evolution from fins to limbs
   * Vertebral adaptations (flexibility, rigidity, etc.)
   * Limb specialization in tetrapods
2. Each group:
   * Summarizes their section
   * Creates a **diagram or model**
   * Identifies **evolutionary significance** and **functional advantages**

3. Reassign students into **teaching groups** where each expert explains their topic.

4. End with a **group quiz** or **skeletal structure puzzle**.

2. Compare & Contrast Collaboration: "Movement Across Vertebrates"

Objective: Compare locomotion strategies in various vertebrates.

Steps:

1. Assign each group 2–3 vertebrate classes (e.g., fish, amphibians, reptiles, mammals, birds).

2. Groups create a **chart** comparing:

* Mode of locomotion
* Role of vertebral column
* Limb structure and function
* Key muscular systems involved

3. Have each group **present** and **defend** their findings.

3. Build-A-Vertebrate Challenge

Objective: Apply knowledge of form and function to "design" a vertebrate adapted for a specific environment.

Steps:

1. In groups, assign each team an **environment** (e.g., ocean, desert, rainforest canopy, Arctic, underground).

2. Each group creates a new vertebrate:

* Choose type of skeleton
* Describe axial and appendicular features
* Explain movement and muscular system
* Design adaptations (e.g., flexible vertebrae, long limbs, fins)

3. Present with a **sketch or model** and a **"species profile."**

Case Study Exercises

1. Case Study: "The Runner's Secret"

Scenario: A zoologist finds a fossilized limb with a short femur, elongated tibia, and a hoof-like structure. The skeleton has a rigid spine and extended heel bones.

Student Tasks:

* Deduce the likely class and type of animal
* Explain how the limb structure supports a **specific mode of locomotion**
* Compare it to human leg anatomy
* Predict its habitat and ecological role

2. Case Study: "Swimming Through Time"

Scenario: A marine biologist discovers a fish-like fossil with fins resembling primitive legs and bones that suggest the presence of a vertebral column with some flexibility.

Student Tasks:

* Analyze what stage of vertebrate evolution the fossil might represent

* Describe how the **axial and appendicular skeleton** reflect both swimming and stepping functions
* Discuss what environmental pressures might have driven the evolution

3. Case Study: "The Flexible Hunter"

Scenario: A bird is observed catching prey with sudden sharp turns of the head and neck. Dissection reveals saddle-shaped vertebrae in the neck.

Student Tasks:

* Explain how vertebral structure contributes to neck mobility
* Compare with the vertebral design in snakes
* Predict what evolutionary pressures led to this neck flexibility

4. Case Study: "The Whale's Muscle Mystery"

Scenario: Researchers compare muscle tissue in whales and find a long, antagonistic dorsal muscle extending from skull to tail.

Student Tasks:

* Infer how whale propulsion differs from fish
* Relate muscle and skeletal structure to swimming mechanics
* Explain what this tells us about **evolution from land to sea**

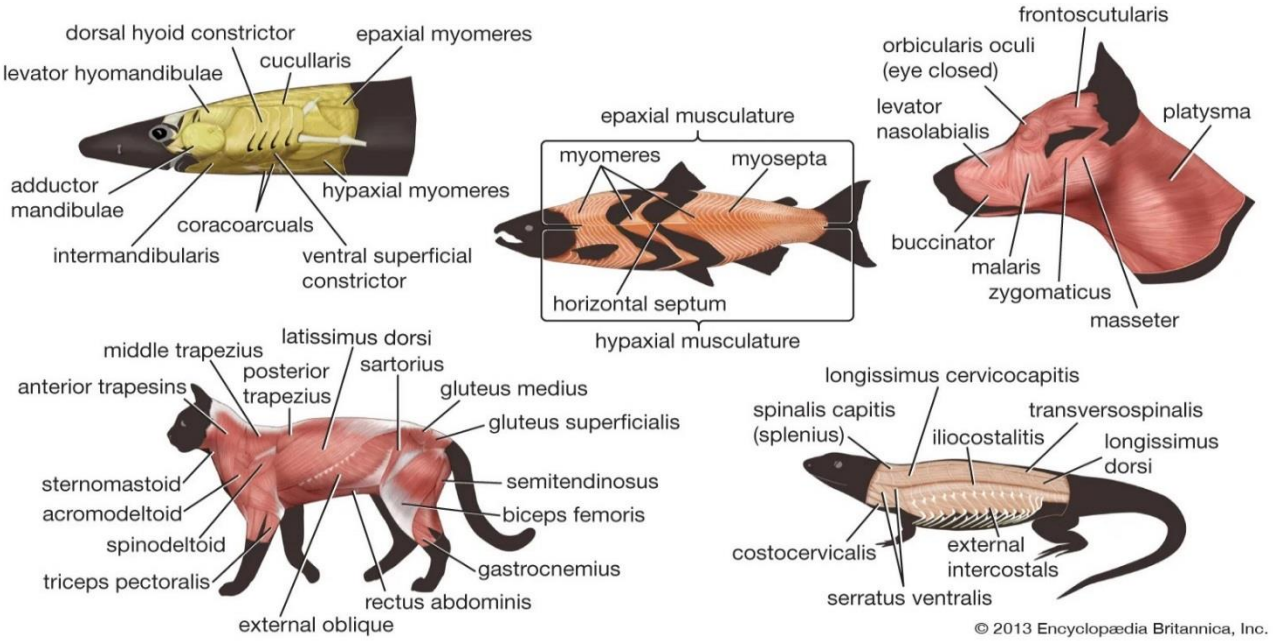
Major types of vertebrate muscles

In terms of its microscopic structure, the musculature of vertebrates is usually divided into three types: striated, cardiac, and smooth muscle. Smooth and cardiac muscle are under the control of the involuntary, or autonomic, nervous system. Striated muscle, on the other hand, is mainly under the control of the voluntary, or central, nervous system. Smooth and cardiac muscle are also similar in their development, being generally associated with the yolk sac. Striated muscle develops directly from the middle of the three embryonic layers, arising largely from the mesodermal somites (see below). In the adult, smooth and cardiac muscle are associated with organs or tubes (viscera), and striated (skeletal) muscle is associated with the bony or cartilaginous skeleton.

The two major divisions of the vertebrate musculature are the visceral musculature and the somatic musculature (the striated muscles of the body wall). Somatic musculature may be divided into appendicular, or limb, muscles and axial muscles. The axial muscles include the muscles of the tail, trunk, and eyeballs as well as a group of muscles called hypobranchial muscles, which separate and migrate from the others during development.

Vertebrate muscles are given names derived from Latin according to their attachments. In this system the Latin names of the bony points of attachment are either joined, as in sternocleidomastoid, naming the human muscle that runs from the sternum and clavicle to the mastoid region of the skull, or they may be named for their form or their gross function. There are several standard terms that describe form and function. A muscle may have more than one point of origin; thus, it may be described as having, for example, two "heads," as in biceps femoris (bi- for two, -ceps for heads, femoris meaning "of the femur"). It may be long, longus, or short, brevis. It may run transversely across a body segment, transversus, or obliquely,

obliquus. It may lie close to the surface, superficialis, or deep, profundus. In describing function, flexors are muscles that tend to close the angle made by the two bones to which they are attached; extensors tend to increase the angle. Adductors pull a bone or cartilage closer to the axis of the body, or limb, while abductors pull away from the axis. Rotators turn one bone or cartilage with respect to another or with respect to the midline. Pronators turn the sole of the foot or the palm of the hand to face the ground, while the opposite function is performed by supinators. Constrictors and sphincters diminish the volume of spaces or the area of structures, and dilators increase them. The names of muscles in humans often have been applied to grossly equivalent muscles in animals, a situation that often causes confusion.[3]



Exercise 1: Match the Definition

Instructions: Match each term with the correct definition.

Terms	**Definitions**
A. Striated muscle	1. Muscle controlled involuntarily and found in internal organs
B. Smooth muscle	2. Muscle with visible stripes, mostly under voluntary control
C. Cardiac muscle	3. Muscle type found only in the heart
D. Somatic musculature	4. Striated muscles of the body wall, including axial and appendicular parts
E. Visceral musculature	5. Muscles associated with internal organs or tubes
F. Flexor	6. A muscle that decreases the angle between two bones
G. Extensor	7. A muscle that increases the angle between two bones

[3] https://www.britannica.com/science/muscle/Vertebrate-muscle-systems

Exercise 2: Fill in the Blanks

Instructions: Complete the sentences using the correct words from the list.

Word Bank: mesodermal, involuntary, axial, hypobranchial, biceps, adductors, pronators, superficial

1. Striated muscle originates largely from the _____ somites.
2. Cardiac and smooth muscles are controlled by the _____ nervous system.
3. _____ muscles include those of the tail, trunk, and eyeballs.
4. _____ muscles separate from other muscles during development and migrate.
5. The _____ femoris has two heads and is located in the thigh.
6. _____ pull bones or cartilage toward the body's axis.
7. _____ turn the palm or sole to face the ground.
8. Muscles near the surface of the body are called _____.

Exercise 3: Word Formation

Instructions: Use the base word in parentheses to form a word that fits in the sentence.

1. The _____ (develop) of smooth muscle is associated with the yolk sac.
2. Muscles named for their _____ (attach) often use Latin terms.
3. A _____ (rotate) muscle helps turn bones or cartilage.
4. Some muscles are named based on their _____ (function), such as flexors or extensors.
5. Muscles may be _____ (describe) as "longus" or "brevis" based on length.

Exercise 4: True or False

Instructions: Decide whether each statement is **True** or **False** based on the text.

1. Smooth muscle is mainly under voluntary control.
2. Striated muscles are associated with the skeleton.
3. Appendicular muscles refer to muscles in the trunk and tail.
4. A sphincter is a muscle that increases the volume of a space.
5. Supinators turn the palm or sole away from the ground.

Cooperative learning and Case study section.

Cooperative Learning Activities

1. Muscle Match-Up (Think-Pair-Share + Card Sort)

Objective: Reinforce understanding of muscle types and functions.

Instructions:

* Prepare cards with **muscle names**, **types (striated, smooth, cardiac)**, **locations**, and **functions**.

* Students work in **pairs** to match each muscle name to its type, location, and function.

* After matching, **pairs share** one example and their reasoning with the whole class.
* Teacher clarifies misconceptions and connects concepts.

Example Card Sets:

* "Biceps femoris" → Striated → Limb → Flexor
* "Heart muscle" → Cardiac → Viscera → Involuntary contraction

2. Embryonic Origins Brainstorm (Jigsaw)

Objective: Understand muscle development from embryonic layers.

Instructions:

* Divide class into **three home groups**, each assigned a muscle type: striated, smooth, cardiac.
* Members move to **expert groups** to learn about their assigned muscle type's development and characteristics.
* Return to home groups and **teach** their findings to peers.
* Groups complete a **muscle development chart** comparing all three muscle types.

3. Latin Muscle Decoder Race

Objective: Learn muscle naming conventions and Latin terms.

Instructions:

* Provide groups with a list of real and made-up Latin muscle names (e.g., *pectoralis major*, *obliquus internus*, *flexor profundus*).
* Each team decodes the names using a **provided glossary** of Latin roots.
* Teams race to explain names accurately.
* Bonus: create their own new muscle names and meanings.

Case Study Exercises

1. Case Study: "A Muscle Misdiagnosis"

Scenario:

A patient presents with weakness in rotating their arm and trouble with pronation. A trainee misidentifies the affected muscle group as part of the visceral musculature.

Task:

* In small groups, analyze the case and identify:
  * Which muscle groups are likely involved.
  * Why the diagnosis was incorrect.
  * Correct classification based on muscle control and function.
* Each group presents their correction plan and supporting evidence from the text.

2. Case Study: "The Curious Case of the Fish Muscle"

Scenario:

A zoologist finds a new fish species with unexpected muscle structures. One muscle runs from deep near the spine to the base of a fin, and it's striated.

Task:

* Use the text to help classify:

* Type of muscle
* Whether it's part of the axial or appendicular musculature
* Likely embryonic origin

* Propose a Latin name based on its location and function.
* Share findings and compare with other groups.

3. Case Study: "Muscle Transplants in Bioengineering"

Scenario:

Bioengineers are developing synthetic muscles for limb prosthetics. They are choosing between designing striated, smooth, or cardiac-like tissue.

Task:

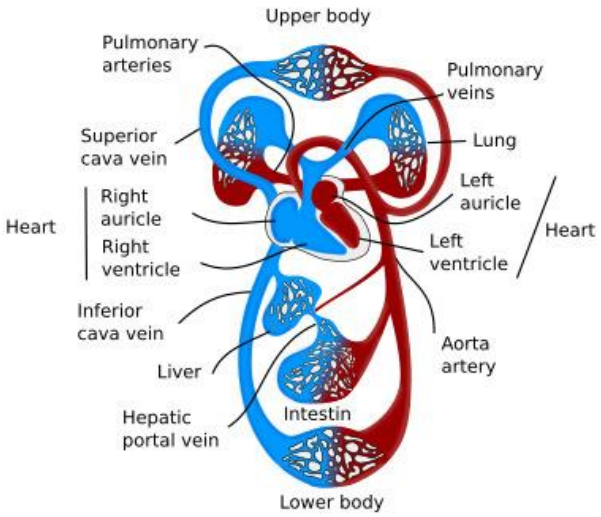
* Evaluate the pros and cons of each muscle type based on:
  * Voluntary/involuntary control
  * Association with limbs or viscera
  * Structural properties
* Make a group decision and justify which muscle type should be mimicked.
* Present a short pitch to the "Bioengineering Panel" (class or teacher).

Cardiovascular system

The circulatory system consists of the cardiovascular system and lymphatic system. The cardiovascular system conducts the blood and is composed of arteries, veins, capillary nets, and the heart. The lymphatic system conducts the lymph and is constituted by more heterogeneous structures like lymphatic vessels, lymphatic ganglia, nodules, and organs like the spleen and thymus.

The cardiovascular system is the main system for communication between the different inner parts of the body of animals. It pumps and conducts the blood to irrigate every body region. Blood is necessary for transporting food, waste products, oxygen, carbon dioxide, hormones, immune system cells, and to maintain pH balance. It also has other functions, like regulating the body temperature.

The cardiovascular system is a double circuit, one irrigating the lungs, and the other irrigating the rest of the body (Figure 1). Both begin and end in the heart, which is the organ in charge of keeping the blood in ceaseless motion. The pattern of blood vessels is the same in the two circuits: heart, arteries, arterioles, capillary net, small veins, veins, and heart again. Sometimes, arterioles or small veins may be found connecting two capillary nets. This is a portal system, like the hepatic portal system, which includes the intestine and liver.



The stalling of blood circulation leads to the death of tissues, mainly due to a lack of oxygen. Some tissues are more susceptible to damage caused by oxygen depletion. For instance, hands and kidneys may be viable after 1 hour without oxygen, whereas the cornea may

live for several hours out of the body. However, the heart and the brain develop damage after several minutes without blood circulation. Under some circumstances, there are animals that can change the normal blood flow to get adapted to low oxygen concentrations. For instance, during diving, the flow of blood that irrigates the vital organs is increased, and the less-vital organs receive lower blood flux. This is a reflex mediated by the brain. When seals are diving (not breathing), their heartbeat decreases about 10 times. Curiously, this reflex is present in fish taken out of the water, and it is also observed in hibernating animals. Although the blood pressure is maintained, the body temperature, metabolism, and heart rhythm are much lower.

The main blood vessels are arteries, veins, and capillaries. Arteries and veins are made up of three layers, or tunics: tunica intima, tunica media, and tunica adventitia. The tunica intima is the innermost layer, in contact with the blood, and it consists of a squamous simple epithelium (endothelium), a basal lamina, and a layer of loose connective tissue. The tunica media is mainly composed of smooth muscle cells. The tunica adventitia is the outermost layer, and it is connective tissue. Arteries and arterioles show thicker walls than veins and small veins, respectively, to resist stronger blood pressures because they are closer to the heart. Arteries usually have a smaller diameter than veins and, together with their thicker walls, make them more rounded in histological sections, whereas veins show more irregular shapes.[4]

Exercise 1: Match the Term to the Definition

Instructions: Match each term with its correct definition.

Terms	Definitions
A. Cardiovascular system	1. System responsible for conducting lymph and supporting immune function
B. Lymphatic system	2. The innermost layer of blood vessels
C. Arteries	3. Vessels that carry blood away from the heart
D. Capillaries	4. Tiny blood vessels where exchange of gases and nutrients occurs
E. Tunica intima	5. System composed of heart, blood vessels, and blood
F. Portal system	6. A circulation route connecting two capillary beds
G. Reflex	7. Involuntary response to a stimulus (e.g. diving response)

Exercise 2: Fill in the Blanks

Instructions: Use words from the box to complete the sentences.

Word Bank: oxygen, epithelium, heart, spleen, veins, metabolism, pH balance, liver

1. The _____ keeps the blood in constant motion.

[4] https://mmegias.webs.uvigo.es/02-english/2-organos-a/guiada_o_a_05cardiovascular.php

2. The blood helps transport _____ to cells and remove carbon dioxide.

3. One function of the cardiovascular system is to maintain _____ _____ in the body.

4. The _____ is a lymphatic organ involved in blood filtering and immune response.

5. The _____ is part of the hepatic portal system, receiving blood from the intestines.

6. _____ return blood to the heart and usually have thinner walls.

7. The tunica intima includes a layer of squamous _____.

8. In diving mammals, body temperature and _____ are significantly reduced.

Exercise 3: Word Formation

Instructions: Complete the sentences by changing the word in parentheses to its correct form.

1. The _____ (communicate) between organs is facilitated by the cardiovascular system.

2. Oxygen _____ (deplete) can damage tissues like the heart and brain quickly.

3. The _____ (adapt) of some animals to low oxygen involves changing blood flow.

4. The blood _____ (circulate) stops during cardiac arrest.

5. Veins have a more _____ (irregular) shape than arteries in tissue sections.

Exercise 4: True or False

Instructions: Write **True** or **False** next to each statement.

1. The lymphatic system is composed of arteries, veins, and the heart.
2. Arterioles connect to capillary networks.
3. The heart is part of both circuits in the cardiovascular system.
4. Arteries have thinner walls than veins.
5. The reflex seen in diving mammals also occurs in fish out of water.
6. Capillaries are made up of three layers called tunics.
7. Damage from lack of oxygen occurs more quickly in the cornea than in the kidneys.
8. The tunica media contains mostly smooth muscle cells.

Cooperative learning and Case study section.

Cooperative Learning Activities

1. “Vessel Detective” (Expert Jigsaw Activity)

Objective: Deepen understanding of blood vessels and their structure.

Instructions:

* Divide the class into 4 home groups. Assign each member a topic: arteries, veins, capillaries, or portal systems.
* Members join expert groups based on their topic. In their expert group, they:
  * Summarize the vessel's structure and function
  * Draw and label a diagram
  * Compare it to other vessel types
* Return to home groups and teach their findings.
* Home groups then create a composite chart comparing all vessel types.

2. "Double Circuit Flow" Simulation (Role-Playing)

Objective: Understand the path and logic of blood flow through the cardiovascular system.

Instructions:

* Assign students roles: **Heart**, **Arteries**, **Capillaries**, **Veins**, **Organs** (e.g., Lungs, Intestine, Brain, Liver).
* Use red (oxygenated) and blue (deoxygenated) ribbons or cards to represent blood.
* Students physically act out the double circuit (pulmonary and systemic).
* Pause at key points to discuss what's happening: oxygen exchange, nutrient delivery, waste removal.

3. "Layer It Up" (Team-Based Anatomy Challenge)

Objective: Identify and describe the structure of blood vessels.

Instructions:

* In small groups, students:
  * Construct 3D models of a blood vessel cross-section using craft materials or clay (tunica intima, media, adventitia).
  * Label each layer and describe its function.
  * Discuss differences between arteries and veins.
* Each group presents and explains their model to the class.

4. "Cardio Scenarios" – Think-Pair-Share

Objective: Explore real-world cardiovascular adaptations.

Instructions:

* Pose questions like:
  * "Why is blood redirected during diving?"
  * "How would vessel structure affect oxygen delivery in different tissues?"
* Students think individually, then pair to compare answers.
* Share responses with the class, supported by the text.

Case Study Exercises

1. Case Study: "Sudden Collapse"

Scenario:

A 60-year-old man suddenly collapses. Emergency responders note no heartbeat. CPR begins immediately. After 5 minutes, there's no response.

Tasks:

* In groups, use the text to answer:
  * Which tissues are likely already damaged? Why?
  * What role does oxygen play in this damage?
  * Why is time a critical factor?
* Groups develop a timeline of tissue viability post-circulatory failure.
* Present and justify findings.

2. Case Study: "Diving for Survival"

Scenario:

A marine biologist is studying seals' diving behavior. One seal can dive for 15 minutes without surfacing, yet shows no signs of organ damage.

Tasks:

* Analyze how the seal's cardiovascular system adapts.
* Identify physiological changes: heart rate, blood flow, oxygen prioritization.
* Compare this to hibernating mammals or fish out of water.
* Design a **poster** showing blood flow changes during diving.

3. Case Study: "Vein or Artery?"

Scenario:

A histology student is confused when viewing two vessels under the microscope. One appears round with a thick wall; the other is irregular with a thin wall.

Tasks:

* Using the description of vessel layers, identify which is the artery and which is the vein.
* Justify your answer based on wall structure and blood pressure.
* Create a diagnostic **checklist** for identifying vessel types in tissue sections.

4. Case Study: "The Hepatic Portal Mystery"

Scenario:

A medical student is puzzled by the hepatic portal system. Why does blood go from the intestines to the liver before returning to the heart?

Tasks:

* Explain the concept of a portal system using the hepatic example.
* Describe how this arrangement benefits the body (e.g., detoxification, nutrient processing).
* In groups, create an infographic or concept map illustrating this unique blood flow.

Respiratory systems in animals

Respiratory systems in animals are essential for meeting energy demands through the oxidation of food, primarily by supplying oxygen for metabolism and removing carbon dioxide, a waste product of this process. Different animals have evolved various specialized structures to efficiently extract oxygen from their

environments, which can be either air or water. For example, simple organisms like flatworms utilize diffusion through their body surface, while larger organisms require more complex systems. The primary types of gas exchange organs include gills for aquatic respiration, lungs for terrestrial breathing, and a unique tracheal system found in insects.

Gills are designed for water respiration, featuring structures like lamellae that maximize oxygen absorption through a countercurrent exchange system. In contrast, lungs, which can vary in complexity, contain alveoli that facilitate gas exchange with the blood. The insect tracheal system consists of a network of tubes that deliver air directly to body cells, bypassing the need for a circulatory system. Environmental factors such as barometric pressure, temperature, and humidity significantly affect respiratory efficiency, with water presenting unique challenges due to its lower oxygen content and higher viscosity than air. Overall, the mechanisms for respiration are finely tuned to each species' ecological niche, showcasing the diversity of evolutionary adaptations in animal respiratory systems.

Animals generally meet their energy needs by oxidation of food, and the respiratory system supplies the oxygen necessary for cell metabolism while removing its waste product, carbon dioxide. Oxygen is available either dissolved in water or as a component of the air, and animals have evolved special organ structures to effectively obtain oxygen from their environment.

Single-cell and simple organisms, such as flatworms and protozoa, can obtain sufficient oxygen to meet their energy demands by simple diffusion through their body surface. Some amphibians utilize gas exchange through their skin to supplement their lung respiration, but generally, larger, more complex animals require specialized organ systems with a large surface area for gas exchange and a circulatory system for distribution of oxygen to each cell. The basic mechanism, however, for gas exchange between the environment and the blood and between the blood and cells is by diffusion. The three major types of gas exchange organs are the gill for water respiration, the lung for air and, in some special cases, water respiration, and the tracheas system of tubules for air respiration in insects.[5]

Exercise 1: Match the Term to the Definition

Instructions: Match each term with its correct definition.

A. Diffusion	A process where gases move from high to low concentration
B. Gills	Respiratory organs for extracting oxygen from water
C. Lungs	Organs for gas exchange in terrestrial animals
D. Tracheal system	Air-filled tubes in insects that deliver oxygen directly to cells
E. Alveoli	Tiny sacs in lungs where gas exchange occurs with the blood

[5] https://www.ebsco.com/research-starters/anatomy-and-physiology/respiratory-systems-animals

F. Countercurrent	A system where water and blood flow in opposite directions to exchange gases efficiently
G. Metabolism	The chemical processes in cells that produce energy

Exercise 2: Fill in the Blanks

Instructions: Use the words from the box to complete the sentences.

Word Bank: oxygen, carbon dioxide, flatworms, viscosity, insects, skin, barometric, circulation

The respiratory system provides _____ for cell metabolism and removes _____.

Simple animals like _____ rely on diffusion across their body surface.

Amphibians may use their _____ to supplement lung breathing.

In _____, the tracheal system eliminates the need for a circulatory system.

Water has a higher _____ than air, making gas exchange more difficult.

_____ pressure, temperature, and humidity all affect breathing efficiency.

Larger animals require a system of _____ to distribute gases throughout the body.

Exercise 3: True or False

Instructions: Write True or False next to each statement.

Insects use lungs to breathe air.

Gills function best in air because they have many lamellae.

Diffusion is the main process for gas exchange in both simple and complex animals.

Alveoli are found in the lungs and are key for gas exchange.

The respiratory system also removes the waste product carbon dioxide.

Animals cannot use more than one type of gas exchange system.

Countercurrent exchange helps maximize oxygen absorption in gills.

Water has more oxygen than air, making it easier for animals to breathe underwater.

Exercise 4: Word Formation

Instructions: Complete the sentence by using the correct form of the word in parentheses.

Flatworms rely on _____ (diffuse) for oxygen intake.

Lungs have varying degrees of _____ (complex).

A system's _____ (efficient) depends on environmental factors like pressure and temperature.

The respiratory system supports _____ (metabolize) needs by supplying oxygen.

The _____ (adapt) of organs like gills and lungs reflects evolutionary responses to environment.

Bonus: Short Answer
Instructions: Answer briefly.
What are the three major types of gas exchange organs in animals?
Why do larger animals need specialized respiratory systems?
What is the purpose of the tracheal system in insects?

Cooperative learning and Case study section.
Cooperative Learning Activities
1. Jigsaw Activity – "The Big Breath"
Objective: Understand and explain the differences between various animal respiratory systems.
Instructions:
1. Divide the class into "home groups" of 4–5 students.
2. Assign each member of the group a different topic from the list below:
* Diffusion in simple organisms (e.g., flatworms, protozoa)
* Gills in aquatic animals
* Lungs in terrestrial animals
* Tracheal system in insects
* Environmental influences on respiration (pressure, temperature, etc.)
3. Students then join "expert groups" with others assigned the same topic to read, discuss, and prepare a short explanation or visual aid.
4. Students return to their **home group** and **teach their topic** to the others.
5. Wrap up with a group worksheet comparing and contrasting the systems and noting advantages/disadvantages of each.

2. Think-Pair-Share – "Gas Exchange in Action"
Prompt Question: Why is simple diffusion insufficient for large or complex animals?
Instructions:
1. **Think**: Students write a short individual answer.
2. **Pair**: Discuss with a partner, compare answers, and refine ideas.
3. **Share**: Volunteers or selected pairs share with the whole class.
4. Finish by compiling a list on the board of characteristics that necessitate specialized respiratory systems (e.g., body size, metabolic rate, surface area-to-volume ratio).

3. Concept Mapping – "Linking Respiratory Systems"
Objective: Connect types of respiratory organs with environments, mechanisms, and evolutionary adaptations.
Instructions:
* In small groups, students create a concept map linking the following terms:
* Diffusion
* Gills
* Lungs
* Tracheal system
* Oxygen
* Carbon dioxide

  * Circulatory system
  * Surface area
  * Water vs. air environments
* Each group presents and explains one key connection in their map.

Case Study Exercises

1. Case Study: "The Struggling Trout"

Scenario: A trout in a rapidly warming stream shows signs of oxygen stress.

Questions:

* How might temperature and oxygen solubility in water be affecting the trout?
* What adaptations do gills have to maximize oxygen absorption?
* Could a trout survive in a low-oxygen environment with only skin respiration like an amphibian? Why or why not?

Extension: Have students propose modifications to trout gills (realistic or speculative) that might help it cope with lower oxygen levels.

2. Case Study: "An Insect Out of Air"

Scenario: A researcher notices a large insect species has difficulty surviving at high altitudes.

Questions:

* How does the tracheal system of insects differ from lungs or gills?
* Why might high altitudes present a challenge for this insect's respiration?
* Could insects evolve circulatory-based oxygen delivery systems? What evolutionary pressures might lead to that?

Activity: Students design a hypothetical "super insect" that could live in high-altitude environments, describing respiratory adaptations.

3. Case Study: "The Amphibian Puzzle"

Scenario: A frog species that normally thrives in moist environments is now found in a drier habitat.

Questions:

* How do amphibians like frogs use their skin for respiration?
* What might happen to gas exchange efficiency as the environment dries out?
* What respiratory adaptations might evolve if this frog species continues to inhabit drier areas?

Task: Groups propose adaptive changes in behavior, skin texture, or internal organs that could help this species survive.

The nervous system

Coherent movement results only when the muscles receive a sensible pattern of activating signals (for example, antagonists must not be activated to contract simultaneously). Animals use specialized cells called neurons to coordinate their muscular activity; nerves are bundles of neurons or parts thereof. Neurons communicate between cells by chemical messengers, but within a single cell (often extremely long) they can send high-speed signals through a wave of ionic

polarization (analogous to an electric current) along their membranes, a property inherent in all cells but developed for speed in nerve cells by special modifications.

A system of communication requires three parts: a collector of outside information, an integrator to evaluate that information and decide upon its relevance, and a transmitter to convey the decision to the motor unit. In animals, sensory nerves and organs such as eyes collect the information; associative nerves usually concentrated into a brain integrate, evaluate, and decide its relevance; and effector or motor nerves convey decisions to the muscles or elsewhere. Although all three parts of the nervous system have kept pace with increases in the size and complexity of animals, the simplest systems found among animals (those of parazoans and coelenterates) are nevertheless capable of intricate feats of coordination. All ends of a coelenterate bipolar neuron can both receive and transmit an impulse, whereas the unipolar neurons of more derived animals receive only at one end (dendrite) and transmit at the other (axon). A neuron can have multiple dendrites and axons.

The earliest animals were probably radial in design, so that bipolar neurons arranged in a netlike pattern made sense. In such a design, a stimulus impinging at any point on the body can travel everywhere to alert a simple array of myofilaments to contract simultaneously. In the case of directed locomotion and relevant sensory input received at the head end of a bilateral animal, unidirectional transmission of nerve impulses to muscles becomes the only way to communicate effectively. The location of the brain in the head also reflects efficiency and the speed of receipt of information, because this position minimizes the distance between sensory and associative neurons as well as concentrates these two functions in a small, protected part of the body. In most animals nerve cells cannot be replaced if lost, although axons can be. Nerve cells tend to be concentrated centrally in ganglia or nerve cords, with long axons extending peripherally. Although certain animals may lose tails or limbs to predators or in accidents and then regenerate them, loss or damage to the central nervous system means death or paralysis.

The nervous system uses the transmission properties of neurons to communicate. Within a neuron, propagation of an impulse by an ion wave can be extremely rapid, but the wave can pass along the length of only one cell’s membrane. To pass to the next cell at a synapse, where an axon meets a dendrite, a chemical transmitter is required. This molecule diffuses to the dendrites of a connecting neuron, where it initiates an ionic wave that propagates along the length of the cell’s membrane. Although chemical transmission is considerably slower than the ionic wave, it is more flexible. For example, learning involves in part increasing the sensitivity of a particular nerve pathway to a stimulus. The sensitivity of a synapse can be altered by increasing the amount of transmitter released from the axon per impulse received, increasing the number of receptors in the dendrite, or changing the sensitivity of the receptors. Bridging the synapse directly by the formation of membrane-bound gap junctions, which connect adjacent cells, enables an impulse to pass unimpeded to a connecting cell. The increase in speed of transmission provided by a gap junction, however, is offset by a loss in flexibility; gap junctions essentially create a single neuron from several. The same result can be achieved more effectively by lengthening the axons or dendrites, making some nerve cells metres in length. Situations arise where gap junctions become desirable, however. Gap junctions are

found in vertebrate cardiac and smooth muscles, both of which transmit impulses along their cells to others. This ability makes these muscles somewhat independent of nervous-system control. A body can thus be kept partly functioning for some time without the activity of a brain.

Nerve impulses travel faster along axons of greater diameter or along those with good insulation against ion leakage (except at spaced nodes required for recharging). Vertebrates use their unique myelinated axons to increase the transmission rate of nerve impulses, whereas invertebrates are limited to using axons of greater diameter. As a result, vertebrates can concentrate more small neurons into a body of a particular size, with the potential for greater complexity of behaviour.[6]

Exercise 1: Match the Words with Their Definitions

Match the vocabulary word on the left with the correct definition on the right.

Vocabulary Word	Definition
1. Neuron	a. Chemical messengers used for communication
2. Axon	b. A nerve cell that transmits impulses
3. Synapse	c. A part of a neuron that receives signals
4. Dendrite	d. The junction between two neurons
5. Transmitter	e. The long fiber of a neuron that sends impulses
6. Ionic polarization	f. A process involving changes in ion concentration
7. Sensory nerve	g. A nerve that collects information from the environment
8. Ganglia	h. A cluster of nerve cells in the central nervous system

Exercise 2: Multiple Choice - Choose the Best Answer

1. What type of neuron has multiple dendrites and axons?
   a) Unipolar
   b) Bipolar
   c) Multipolar
   d) Radial
2. Which of the following speeds up nerve impulse transmission in vertebrates?
   a) Larger diameter axons
   b) Myelinated axons
   c) More dendrites
   d) Gap junctions
3. What role does the brain primarily serve according to the text?
   a) Collect sensory information
   b) Integrate and evaluate information
   c) Transmit impulses to muscles

[6] https://www.britannica.com/animal/animal/The-nervous-system

d) Repair damaged nerve cells

Exercise 3: Fill in the Blanks

Complete the sentences with the correct vocabulary word from the box:

(neuron, synapse, transmitter, dendrite, axon, ganglia, myelinated, ionic polarization)

1. The _____ carries electrical impulses away from the neuron's cell body.
2. A _____ is the site where one neuron passes a signal to another.
3. Chemical _____ diffuse across the synapse to transmit signals.
4. _____ are clusters of nerve cells located in the central nervous system.
5. _____ allows rapid transmission of nerve impulses by insulating axons.
6. The _____ receives incoming signals from other neurons.
7. Within a single neuron, signals travel by _____.
8. A _____ is a specialized nerve cell used for communication.

Exercise 4: True or False

Write True or False for each statement.

1. Gap junctions increase the flexibility of nerve transmission.
2. Vertebrates have myelinated axons to speed up impulse transmission.
3. Sensory nerves integrate and evaluate information in the brain.
4. Neurons can send high-speed signals via ionic polarization.
5. Damage to the central nervous system can result in paralysis.
6. Axons and dendrites can be meters long in some nerve cells.

Exercise 5: Word Formation

Write the correct form of the word in parentheses to complete the sentence.

1. Neurons communicate by releasing chemical _____ (transmit).
2. The brain is the main _____ (integrate) center in most animals.
3. The _____ (specialize) cells called neurons coordinate muscular activity.
4. Animals use sensory organs to _____ (collect) outside information.
5. Myelinated axons have _____ (insulate) to prevent ion leakage.

Cooperative learning and Case study section.

Cooperative Learning Activities

1. Jigsaw Activity – "The Nerve Circuit"

Objective: Understand the major components and functions of the nervous system.

Instructions:

1. Divide students into **home groups** of 4–5.
2. Assign each member a topic to research and explain:
   * **Structure and function of neurons**
   * **Signal transmission (ionic waves & synapses)**
   * **Sensory input and motor output**
   * **Nervous system evolution (radial vs. bilateral animals)**
   * **Myelination and impulse speed**
3. Students meet in expert groups to discuss and prepare a summary or diagram.
4. Return to home groups where each teaches their topic.
5. Complete a group worksheet mapping out the pathway of a nerve impulse from stimulus to response in vertebrates and invertebrates.

2. Think-Pair-Share – "Why Myelin Matters"

Prompt Question: Why are vertebrate nervous systems capable of more complex behaviors than invertebrates?

Instructions:

1. Students **individually reflect and write** a response.
2. **Pair up** and share ideas with a partner, refining their understanding.
3. **Share with the class** and build a concept map on the board showing how myelination, neuron size, and organization affect behavioral complexity.

3. Role Play – "Neural Relay Race"

Objective: Dramatize the flow of nerve signals in different systems.

Instructions:

* Assign roles: **sensory neuron, associative neuron, motor neuron, muscle, synapse, chemical transmitter, ion wave**.
* Act out the journey of a signal from the eye to a muscle.
* Repeat the role play for **radial animals** (e.g., jellyfish) and **bilateral animals** (e.g., human), comparing efficiency and directionality.
* Debrief with a discussion: How does structure determine function in different organisms?

Case Study Exercises

1. Case Study: "The Electric Jellyfish"

Scenario: A marine biologist discovers a jellyfish-like organism with unusually fast movement and suspects its nerve net has evolved for higher efficiency.

Questions:

* How do bipolar neurons differ from unipolar neurons in structure and function?
* Why might a nerve net be sufficient for jellyfish-like organisms?

* What adaptations might lead to increased nerve impulse speed in this species?

Activity: Groups propose a model of an evolved nerve net that allows fast movement and hypothesize about its ecological advantages.

2. Case Study: "A Gap in the Heart"

Scenario: A patient has a rare disorder affecting gap junctions in heart muscle cells.

Questions:

* What are gap junctions and how do they function in cardiac muscle?

* Why are gap junctions advantageous in muscle tissue but not in complex neural networks?

* What symptoms might arise if impulses cannot pass efficiently through cardiac muscle?

Task: Students draw a comparison chart showing **chemical synapse vs. gap junction**, including **speed, flexibility, and biological examples**.

3. Case Study: "The Unbreakable Axon"

Scenario: A large marine worm has neurons that stretch the entire length of its body. Scientists are investigating how impulses travel without signal loss.

Questions:

* What mechanisms do animals use to increase the speed of nerve impulse transmission?

* Why might myelination be preferable to just increasing axon diameter?

* What are the evolutionary trade-offs of having long neurons?

Challenge: Teams brainstorm a bioengineered solution to boost signal transmission in unmyelinated neurons, then compare it to vertebrate adaptations.

4. Case Study: "Brain vs. No Brain"

Scenario: Two animals—one with a brain and central nervous system, the other with only a nerve net—must escape a predator.

Questions:

* How would the signal transmission differ in each?

* What advantages does a brain provide in terms of response time and behavior?

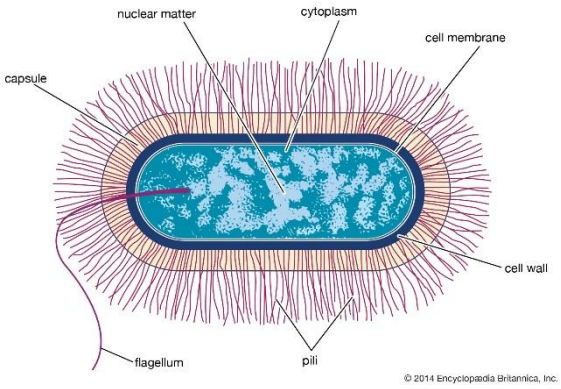
* What might happen if each loses part of their nervous system?

Extension: Students write a short "survival story" from the perspective of each animal, highlighting the role of their nervous system in the escape.

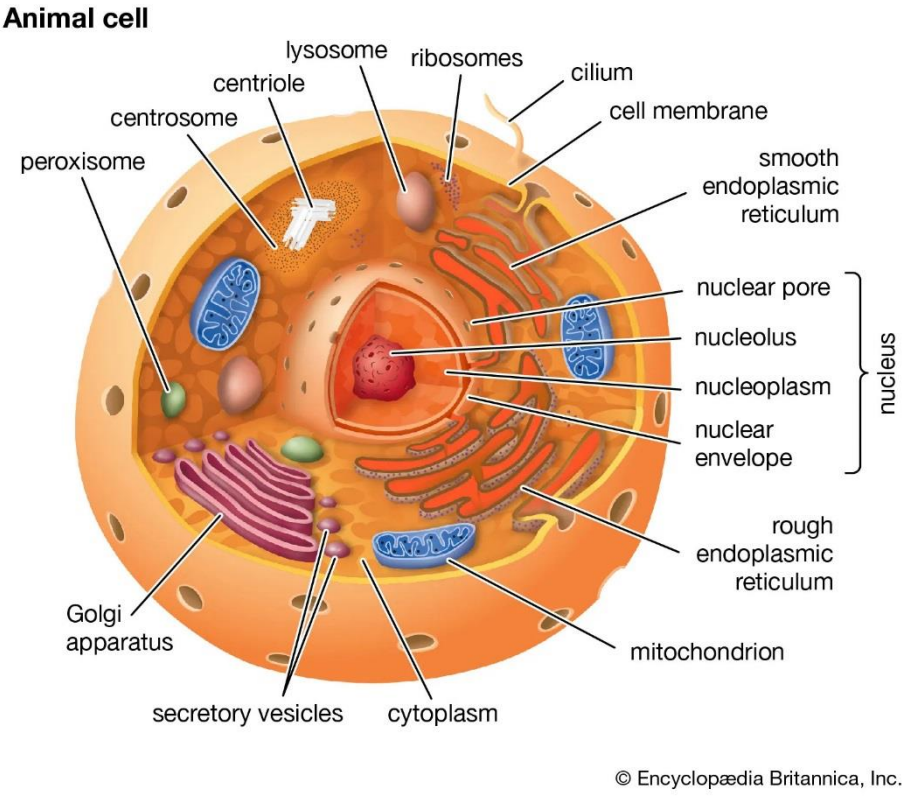
Histology

Cell, in biology, the basic membrane-bound unit that contains the fundamental molecules of life and of which all living things are composed. A single cell is often a complete organism in itself, such as a bacterium or yeast. Other cells acquire specialized functions as they mature. These cells cooperate with other specialized cells and become the building blocks of large multicellular organisms, such as humans and other animals. Although cells are much larger than atoms, they are still very small. The

smallest known cells are a group of tiny bacteria called mycoplasmas; some of these single-celled organisms are spheres as small as 0.2 μm in diameter (1μm = about 0.000039 inch), with a total mass of 10−14 gram—equal to that of 8,000,000,000 hydrogen atoms. Cells of humans typically have a mass 400,000 times larger than the mass of a single mycoplasma bacterium, but even human cells are only about 20 μm across. It would require a sheet of about 10,000 human cells to cover the head of a pin, and each human organism is composed of more than 30,000,000,000,000 cells.



As an individual unit, the cell is capable of metabolizing its own nutrients, synthesizing many types of molecules, providing its own energy, and replicating itself in order to produce succeeding generations. It can be viewed as an enclosed vessel, within which innumerable chemical reactions take place simultaneously. These reactions are under very precise control so that they contribute to the life and procreation of the cell. In a multicellular organism, cells become specialized to perform different functions through the process of cell differentiation. In order to do this, each cell keeps in constant communication with its neighbors. As it receives nutrients from and expels wastes into its surroundings, it adheres to and cooperates with other cells. Cooperative assemblies of similar cells form tissues, and a cooperation between tissues in turn forms organs, which carry out the functions necessary to sustain the life of an organism.



A cell is enclosed by a plasma membrane, which forms a selective barrier that allows nutrients to enter and waste products to leave. The interior of the cell is organized into many specialized compartments, or organelles, each surrounded by a separate membrane. One major organelle, the nucleus, contains the genetic information necessary for cell growth and reproduction. Each cell contains only one nucleus, whereas other types of organelles are present in multiple copies in the cellular contents, or cytoplasm. Organelles include mitochondria, which are responsible for the energy transactions necessary for cell survival; lysosomes, which

digest unwanted materials within the cell; and the endoplasmic reticulum and the Golgi apparatus, which play important roles in the internal organization of the cell by synthesizing selected molecules and then processing, sorting, and directing them to their proper locations. In addition, plant cells contain chloroplasts, which are responsible for photosynthesis, whereby the energy of sunlight is used to convert molecules of carbon dioxide (CO2) and water (H2O) into carbohydrates. Between all these organelles is the space in the cytoplasm called the cytosol. The cytosol contains an organized framework of fibrous molecules that constitute the cytoskeleton, which gives a cell its shape, enables organelles to move within the cell, and provides a mechanism by which the cell itself can move. The cytosol also contains more than 10,000 different kinds of molecules that are involved [7]in cellular biosynthesis, the process of making large biological molecules from small ones.

Exercise 1: Match the Word with Its Definition

Match the vocabulary word on the left with the correct definition on the right.

Vocabulary Word	Definition
1. Cell	a. The jelly-like fluid inside the cell
2. Organelles	b. Basic membrane-bound unit of life
3. Plasma membrane	c. Structures inside cells that perform specific functions
4. Cytoplasm	d. Membrane that controls what enters and leaves a cell
5. Nucleus	e. Framework that gives a cell its shape
6. Cytoskeleton	f. Contains genetic material for growth and reproduction
7. Mitochondria	g. Site of energy production in the cell
8. Lysosomes	h. Digestive organelles that break down waste
9. Chloroplasts	i. Organelles responsible for photosynthesis in plants
10. Differentiation	j. Process by which cells become specialized

Exercise 2: Multiple Choice - Choose the Best Answer

1. What is the main function of mitochondria?
   a) Store genetic information
   b) Produce energy for the cell
   c) Digest waste materials
   d) Capture sunlight for photosynthesis
2. What is the cytosol?
   a) The fluid part inside the cytoplasm
   b) The outer membrane of the cell
   c) A type of organelle for digestion
   d) The genetic material in the nucleus

[7] https://www.britannica.com/science/cell-biology

3. How do cells in multicellular organisms become specialized?
a) By digesting waste
b) Through cell differentiation
c) By producing energy
d) By replicating themselves

Exercise 3: Fill in the Blanks

Use the words in parentheses to complete the sentences correctly:
(plasma membrane, organelles, cytoskeleton, lysosomes, chloroplasts, nucleus)

1. The _____ controls what enters and leaves the cell.
2. The _____ contains the cell's DNA and directs growth.
3. _____ help the cell maintain its shape and move its parts.
4. _____ break down unwanted materials inside the cell.
5. Plant cells have _____ to carry out photosynthesis.
6. The cell contains many _____ that perform specialized tasks.

Exercise 4: True or False

Write True or False for each statement.

1. All living things are composed of cells.
2. The cytoplasm is surrounded by the nucleus.
3. The Golgi apparatus processes and sorts molecules inside the cell.
4. Cells do not communicate with each other in multicellular organisms.
5. The plasma membrane allows nutrients to enter and wastes to leave.
6. The cytosol contains molecules involved in cellular biosynthesis.

Exercise 5: Word Formation

Write the correct form of the word in parentheses to complete the sentence.

1. Cells _____ (specialize) through the process of differentiation.
2. The _____ (organize) of the cytoskeleton helps maintain the cell's shape.
3. Mitochondria are responsible for _____ (transact) necessary for cell survival.
4. Chloroplasts perform _____ (photosynthesis) in plant cells.
5. The plasma membrane acts as a selective _____ (barrier).

Cooperative learning and Case study section.

Cooperative Learning Exercises

These exercises are designed for small groups (3–5 students) to encourage discussion, teamwork, and peer teaching.

1. Jigsaw Activity: "Inside the Cell"

Objective: Students will become "experts" on different organelles and cellular structures.

Instructions:

* Divide the class into **home groups** of 4 students.
* Assign each student in the group one of the following topics:
  * Plasma membrane and cytosol
  * Nucleus and genetic material
  * Mitochondria, lysosomes, and energy/digestion
  * ER, Golgi, and molecule processing
* Students first meet with others who have the same topic (forming "expert groups") to study and discuss that section.
* Then they return to their **home group** and **teach their section** to their teammates.

Assessment: Each student writes a brief summary or creates a labeled diagram of a complete cell with all parts discussed.

2. Think-Pair-Share: “Specialization & Cooperation”

Prompt:

“How does cell specialization and communication support life in multicellular organisms?”

Instructions:

1. **Think** individually and jot down key ideas from the text.
2. **Pair** with a partner to share and compare thoughts.
3. **Share** with the class, highlighting how tissues and organs depend on cellular cooperation.

Follow-up Task: Design a concept map showing the path from **cell → tissue → organ → organism** and the role of communication in that pathway.

3. Role Play: “Cell City Council”

Objective: Understand the functions of different cell organelles through creative expression.

Instructions:

* Each group member takes on the role of a cell component (e.g., nucleus, mitochondrion, ER, etc.).
* Groups hold a "Cell City Council" meeting to discuss:
  * A crisis (e.g., “low oxygen supply”, “viral attack”, “broken membrane”).
  * Each member explains how their organelle would respond and collaborate to resolve the issue.

Outcome: A skit, presentation, or written script outlining the problem and cooperative response.

Case Study Exercises

These exercises challenge students to apply their knowledge to real-world or hypothetical scenarios.

Case Study 1: “The Shrinking Cell”

Scenario: A research team finds a cell with a diameter of only 0.3 μm and almost no organelles. It survives independently and reproduces in a nutrient-rich medium.

Questions:

1. Based on the text, what kind of organism might this cell be?
2. How does it differ from a typical human cell?
3. Why might it not require organelles like the ER or Golgi apparatus?
4. Would this cell be part of a multicellular organism? Why or why not?

Extension: Have students compare **mycoplasmas** with **eukaryotic cells** in a chart.

Case Study 2: "Organelles Under Attack"

Scenario: A toxin damages the **mitochondria** and **Golgi apparatus** in certain cells of the liver.

Tasks:

1. Predict what symptoms or issues this might cause in the organism.
2. Explain the impact on:
   * Energy production
   * Molecule processing and transport
3. Suggest how other organelles might try to compensate, if at all.
4. Discuss how this damage might affect tissue and organ function.

Group Presentation: Create a short clinical report or diagram explaining the cascade of cellular dysfunction.

Case Study 3: "Communication Breakdown"

Scenario: A mutation prevents cells from communicating with neighboring cells during early development.

Questions:

1. How would this affect cell specialization and tissue formation?
2. What part of the cell is most likely involved in this communication?
3. What are the consequences for the developing organism?
4. Could you design a potential gene therapy to address this issue?

Challenge: Work in teams to design a diagram showing normal vs. defective cellular communication during development.

Microbiology

Types of microorganisms

The major groups of microorganisms—namely bacteria, archaea, fungi (yeasts and molds), algae, protozoa, and viruses—are summarized below. Links to the more detailed articles on each of the major groups are provided.

Bacteria (eubacteria and archaea)

Microbiology came into being largely through studies of bacteria. The experiments of Louis Pasteur in France, Robert Koch in Germany, and others in the late 1800s established the importance of microbes to humans. As stated in the Historical background section, the research of these scientists provided proof for the germ theory of disease and the germ theory of fermentation. It was in their

laboratories that techniques were devised for the microscopic examination of specimens, culturing (growing) microbes in the laboratory, isolating pure cultures from mixed-culture populations, and many other laboratory manipulations. These techniques, originally used for studying bacteria, have been modified for the study of all microorganisms—hence the transition from bacteriology to microbiology.

The organisms that constitute the microbial world are characterized as either prokaryotes or eukaryotes; all bacteria are prokaryotic—that is, single-celled organisms without a membrane-bound nucleus. Their DNA (the genetic material of the cell), instead of being contained in the nucleus, exists as a long, folded thread with no specific location within the cell.

Until the late 1970s it was generally accepted that all bacteria are closely related in evolutionary development. This concept was challenged in 1977 by Carl R. Woese and coinvestigators at the University of Illinois, whose research on ribosomal RNA from a broad spectrum of living organisms established that two groups of bacteria evolved by separate pathways from a common and ancient ancestral form. This discovery resulted in the establishment of a new terminology to identify the major distinct groups of microbes—namely, the eubacteria (the traditional or "true" bacteria), the archaea (bacteria that diverged from other bacteria at an early stage of evolution and are distinct from the eubacteria), and the eukarya (the eukaryotes). Today the eubacteria are known simply as the true bacteria (or the bacteria) and form the domain Bacteria. The evolutionary relationships between various members of these three groups, however, have become uncertain, as comparisons between the DNA sequences of various microbes have revealed many puzzling similarities. As a result, the precise ancestry of today's microbes is very difficult to resolve. Even traits thought to be characteristic of distinct taxonomic groups have unexpectedly been observed in other microbes. For example, an anaerobic ammonia-oxidizer—the "missing link" in the global nitrogen cycle—was isolated for the first time in 1999. This bacterium (an aberrant member of the order Planctomycetales) was found to have internal structures similar to eukaryotes, a cell wall with archaean traits, and a form of reproduction (budding) similar to that of yeast cells.

The cells of eukaryotic microbes are similar to plant and animal cells in that their DNA is enclosed within a nuclear membrane, forming the nucleus. Eukaryotic microorganisms include algae, protozoa, and fungi. Collectively algae, protozoa, and some lower fungi are frequently referred to as protists (kingdom Protista, also called Protoctista); some are unicellular and others are multicellular. Unlike bacteria, algae are eukaryotes and, like plants, contain the green pigment chlorophyll, carry out photosynthesis, and have rigid cell walls. They normally occur in moist soil and aquatic environments.

Fungi are eukaryotic organisms that, like algae, have rigid cell walls and may be either unicellular or multicellular. Some may be microscopic in size, while others form much larger structures, such as mushrooms and bracket fungi that grow in soil or on damp logs. Unlike algae, fungi do not contain chlorophyll and thus cannot carry out photosynthesis. Fungi do not ingest food but must absorb dissolved nutrients from the environment. Of the fungi classified as microorganisms, those that are

multicellular and produce filamentous, microscopic structures are frequently called molds, whereas yeasts are unicellular fungi.[8]

Exercise 1: Matching Definitions

Match the word on the left with the correct definition on the right.

Word	Definition
1. Microorganism	a. An organism whose cells contain a nucleus
2. Prokaryote	b. The study of microscopic organisms
3. Eukaryote	c. Single-celled organism without a nucleus
4. Bacteria	d. Organisms like algae and fungi that have cell walls
5. Culture	e. A tiny living organism
6. Algae	f. Growing microbes in a lab
7. Fungi	g. Microbes that contain chlorophyll and do photosynthesis
8. Photosynthesis	h. Organisms that absorb nutrients instead of ingesting food
9. Protozoa	i. Unicellular or multicellular eukaryotes, often motile
10. Archaea	j. Microbes genetically distinct from true bacteria

Exercise 2: Fill in the blanks

Complete the sentences with the correct word from the box:

eukaryotes, prokaryotes, fungi, photosynthesis, archaea, algae, yeast, bacteria, nucleus

1. All _____ are single-celled organisms without a nucleus.
2. _____ contain DNA enclosed within a nuclear membrane.
3. Unlike algae, _____ do not perform photosynthesis.
4. _____ are bacteria that diverged early in evolution and are distinct from true bacteria.
5. _____ carry out photosynthesis and have rigid cell walls.
6. _____ are unicellular fungi often used in baking and brewing.
7. Louis Pasteur's experiments helped establish the importance of _____ in disease and fermentation.
8. The genetic material of bacteria exists as a folded thread with no specific location inside the cell, because they lack a _____.
9. Organisms such as protozoa and some fungi are classified as _____ because they have a nucleus.

Exercise 3: True or False

Write **True** or **False** next to each statement.

[8] https://www.britannica.com/science/microbiology/Types-of-microorganisms

1. Bacteria are eukaryotic microorganisms.

2. Fungi absorb dissolved nutrients from the environment rather than ingesting food.

3. Algae contain chlorophyll and can carry out photosynthesis.

4. Yeasts are multicellular fungi that produce mushrooms.

5. Protozoa are unicellular eukaryotic microbes.

6. The germ theory of disease was disproved by Louis Pasteur.

7. Eubacteria and archaea are two distinct groups of prokaryotes.

8. All microorganisms have a rigid cell wall.

Exercise 4: Word Form Practice

Fill in the blanks with the correct form of the word given in parentheses.

1. Microbiology is the _____ (study) of microorganisms.

2. Some fungi produce filamentous, microscopic _____ (structure).

3. The discovery challenged the previously accepted _____ (concept) about bacterial evolution.

4. Many microorganisms are _____ (unicellular), meaning they consist of a single cell.

5. The nucleus is a membrane-bound _____ (organize) inside eukaryotic cells.

6. Algae carry out _____ (photosynthesis) similar to plants.

7. The cells of prokaryotes lack a _____ (membrane).

8. Louis Pasteur's research provided proof for the germ _____ (theory) of disease.

Cooperative learning and Case study section.

Cooperative Learning Exercises

1. Expert Group Jigsaw: "Microbe Specialists"

Objective: Students become "experts" in one group of microorganisms and teach others.

Instructions:

* Divide the class into home groups of 5–6.

* Assign each student a type of microorganism:

  * Bacteria (eubacteria)

  * Archaea

  * Algae

  * Fungi (yeasts and molds)

  * Protozoa

  * Viruses

* Students meet in **expert groups** to read, research, and summarize their assigned group (from the provided text and, optionally, external sources).

* They then return to their home groups and **teach** their peers about their organism type.

Group Task: Each home group creates a comparison chart or infographic showing the main features of all six microorganism types: structure, cell type

(prokaryotic or eukaryotic), environment, energy source, reproduction, and real-world roles (disease, decomposition, fermentation, etc.).

2. Microbial Sorting Challenge

Objective: Develop classification skills by analyzing microbial traits.

Instructions:

* Provide groups with cards describing various microorganisms (based on the text), including ambiguous cases like the ammonia-oxidizing Planctomycete.
* Each card includes:
  * Cell structure description
  * Method of reproduction
  * Habitat
  * Special features
* Students work in teams to classify each organism into one of the six major groups and justify their reasoning.

Debrief: Discuss how ambiguous cases challenge scientific classification, referencing Carl Woese's discovery and the "blurred lines" between domains.

3. Debate: "Archaea – Ancient Ancestors or Misunderstood Cousins?"

Objective: Analyze evolutionary relationships between microbes.

Instructions:

* Split the class into two teams:
  * Team A: Argues that archaea are the true ancestors of all modern microbes.
  * Team B: Argues that eukaryotes evolved independently and archaea are a distinct branch.
* Use the text's discussion on Carl Woese's research and modern DNA comparisons.
* Each team presents evidence, counters the opposition, and concludes with their theory of microbial ancestry.

Follow-up: A reflective writing assignment on the complexity of microbial evolution and what it teaches us about the tree of life.

Case Study Exercises

Case Study 1: "The Mysterious Microbe"

Scenario: Scientists discover a new microorganism in a hot spring. It:

* Has no nuclear membrane
* Reproduces by budding
* Has internal compartments
* Has a cell wall with archaean traits
* Thrives in high temperatures and acidic environments

Tasks:

1. Based on the text, how would you **classify** this organism (bacteria, archaea, or something else)?
2. What features make classification difficult?
3. What evolutionary implications might this discovery have?

Extension: Students sketch a **phylogenetic tree** showing where they would place this organism and justify it with three traits.

Case Study 2: "Microbial Misidentification"

Scenario: A patient shows symptoms of a fungal infection, but initial lab tests identify algae in the sample.

Tasks:

1. Based on the structure and lifestyle of **algae and fungi**, what might have gone wrong in the diagnosis?
2. Compare and contrast algae and fungi using the following criteria:
   * Cell wall structure
   * Presence of chlorophyll
   * Nutrient acquisition
3. How would you design a follow-up test to properly identify the microorganism?

Group Task: Create a decision flowchart for differentiating algae, fungi, and bacteria in a clinical sample.

Case Study 3: "The Great Microbial Experiment"

Scenario: A team wants to study microbial evolution. They culture bacteria, archaea, and fungi under extreme conditions (high salt, heat, and acidity).

Tasks:

1. Predict which organisms will **survive** in each condition and why.
2. How do **archaea** differ from bacteria in terms of environmental adaptability?
3. What might you learn about evolution by observing these cultures over time?

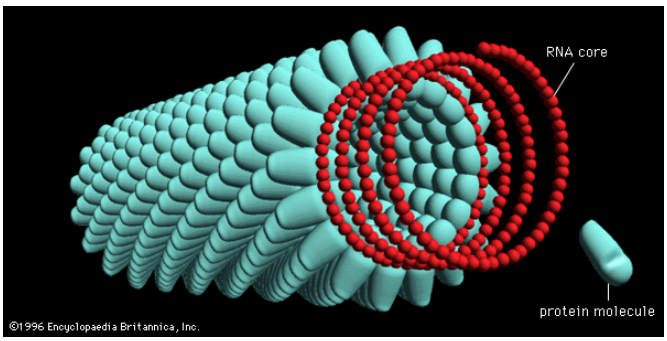
Creative Challenge: Design a research poster that summarizes the results, including:

* Organisms used
* Conditions tested
* Observations
* Evolutionary conclusions

Viruses

Viruses, agents considered on the borderline of living organisms, are also included in the science of microbiology, come in several shapes, and are widely distributed in nature, infecting animal cells, plant cells, and microorganisms. The field of study in which they are investigated is called virology. All viruses are obligate parasites; that is, they lack metabolic machinery of their own to generate energy or to synthesize proteins, so they depend on host cells to carry out these vital functions. Once inside a cell, viruses have genes for usurping the cell's energy-generating and protein-synthesizing systems. In addition to their intracellular form, viruses have an extracellular form that carries the viral nucleic acid from one host cell to another. In this infectious form, viruses are simply a central core of nucleic acid surrounded by a protein coat called a capsid. The capsid protects the genes outside

the host cell; it also serves as a vehicle for entry into another host cell because it binds to receptors on cell surfaces. The structurally mature, infectious viral particle is called a virion.



With the electron microscope it is possible to determine the morphological characteristics of viruses. Virions generally range in size from 20 to 300 nanometres (nm; billionths of a metre). Since most viruses measure less than 150 nm, they are beyond the limit of resolution of the light microscope and are visible only by electron microscopy. By using materials of known size for comparison, microscopists can determine the size and structure of individual virions.[9]

Exercise 1: Matching

Match each word to its correct definition.

Word	Definition
1. Virus	a. The study of viruses
2. Virology	b. The infectious form of a virus, consisting of nucleic acid and protein coat
3. Capsid	c. A microscopic particle that infects living cells
4. Virion	d. Protein coat that protects viral genetic material
5. Parasite	e. An organism that depends entirely on another for survival
6. Host cell	f. Cell that viruses infect to reproduce
7. Metabolic machinery	g. Systems within a cell that produce energy and synthesize proteins
8. Nucleic acid	h. Genetic material of viruses (DNA or RNA)
9. Receptor	i. Protein on a cell surface that viruses bind to for entry
10. Electron microscope	j. Tool used to see very small structures like viruses

Exercise 2: Fill in the blanks

Use the words from the box to complete the sentences:

virology, capsid, host, virion, obligate parasite, nucleic acid, receptor, intracellular, electron microscope

1. _____ is the field of science that studies viruses.

[9] https://www.britannica.com/science/microbiology/Protozoa

2. Viruses cannot produce energy or proteins on their own because they lack _____ machinery.

3. The _____ is the protein coat that surrounds and protects the viral genetic material.

4. Viruses must infect a _____ cell to reproduce and carry out vital functions.

5. The infectious viral particle outside the host cell is called a _____.

6. Viruses bind to specific _____ on the surface of the host cell to enter it.

7. The viral genetic material inside the host cell is called _____.

8. Viruses have an _____ form when inside the cell and an extracellular form when infecting new cells.

9. The _____ allows scientists to see viruses because they are too small for a light microscope.

Exercise 3: True or False

Write **True** or **False** for each statement.

1. Viruses can generate their own energy independently of host cells.

2. The capsid serves as protection for the viral nucleic acid outside the host cell.

3. Virions are visible with a standard light microscope.

4. All viruses are obligate parasites.

5. Viruses infect only animal cells.

6. The electron microscope can reveal the size and shape of viruses.

7. Viruses have metabolic machinery to synthesize proteins.

8. Viruses use receptors on the host cell to gain entry.

Exercise 4: Word Form Practice

Fill in the blanks with the correct form of the word in parentheses.

1. The study of viruses is called _____ (virology).

2. Viruses depend on host cells because they are _____ (oblige) parasites.

3. The viral genetic material is made up of _____ (nucleic acid).

4. The _____ (infect) particle outside the host cell is called a virion.

5. Viruses cannot produce their own energy because they lack _____ (metabolize) machinery.

6. The _____ (electron) microscope helps visualize viruses.

7. The _____ (protect) capsid surrounds the viral nucleic acid.

Cooperative learning and Case study section.

Cooperative Learning Exercise: "Virus Investigation Teams"

Objective:

Students will work in small groups to analyze key concepts related to viruses, reinforcing their understanding through collaboration and peer teaching.

Materials:

* Printed copies or digital access to the "Viruses" text

* Worksheet with guided questions
* Whiteboard or poster paper (optional for presentations)

Instructions:

1. Divide students into groups of 4-5.
2. Assign each group one of the following focus areas:
   * Group 1: Structural features of viruses (e.g., capsid, virion, size)
   * Group 2: Virus classification and the study of virology
   * Group 3: Virus-host interactions (e.g., obligate parasitism, entry into host)
   * Group 4: Virus life cycle and reproduction (intracellular vs. extracellular forms)
3. Group Tasks:
   * Read the text collaboratively.
   * Complete a worksheet with these questions:
     * What are the key facts or definitions related to your topic?
     * Why is this information important in understanding viruses?
     * How do these concepts apply to real-world examples (e.g., COVID-19, influenza)?
     * What questions remain unclear? (To ask the class)
4. Group Sharing:
   * Each group presents a short summary of their findings.
   * Other groups may ask questions or add details.
5. Whole-Class Reflection:
   * Discuss how viruses differ from other microorganisms.
   * Explore why understanding viruses is crucial in public health.

Case Study Exercise: "The Mystery Virus"

Scenario:

A research team has discovered a new infectious agent that cannot be seen under a light microscope and seems to rely on human cells to reproduce. It has no known metabolic activity and is made up of a protein coat surrounding genetic material.

Objectives:

Students will apply their knowledge of viruses to identify and explain the nature of the mystery pathogen.

Instructions:

1. **Distribute the Case:
   * Provide the above scenario along with guiding questions.
2. Guiding Questions:
   * Based on its characteristics, what is this agent most likely to be?
   * Why can’t it be classified as a living organism?
   * How does it reproduce, and why is a host cell necessary?
   * What part of the virus helps it enter host cells?
   * How would a researcher observe and measure this virus?

3. Individual or Pair Work:

* Students work alone or in pairs to analyze the case.

* Encourage them to use specific terms from the text: "virion," "capsid," "obligate parasite," etc.

What is animal welfare?

Animal welfare is a complex and multi-faceted subject with many definitions. One commonly cited definition from the World Organization for Animal Health (OIE) states:

Animal welfare refers to the physical and psychological wellbeing of an animal. The welfare of an animal can be described as good or high if the individual is fit, healthy, free to express natural behaviour, free from suffering and in a positive state of wellbeing.

The concept of animal welfare includes three elements: the animal's normal biological functioning (which means ensuring that the animal is healthy and well-nourished), their emotional state (including the absence of negative emotions, such as pain, stress, and chronic fear), and their ability to express certain normal behaviours.

High welfare means animals have agency and control over their own lives, including the ability to express their full range of natural behaviours, feel safe, have positive experiences, and have a good quality of life.

This applies to all animals – from cows, pigs, elephants, and dogs, to chickens, fish, parrots, and snakes!

World Animal Protection believes animal welfare, good and bad, is affected by the actions and relationships human beings have with animals and their environments. It is our duty to ensure all animals are treated humanely, responsibly, and with respect.

Animal welfare is a science. There is a large body of published research that addresses a wide range of topics from methods for assessing animal welfare, to evaluating and improving animal care (such as housing, husbandry, transport, and slaughter) to safeguarding the welfare of the impacted animal. Scientific research, among many other things, has helped to inform and influence legislation to better protect captive wildlife, and in developing standards of care for farmed and other animals under humans' care.

Determining how to evaluate animal welfare has been essential to this field of science and has led to the development of several methodologies, including frameworks such as the "Five Domains Model".

The Five Domains Model can be applied for an assessment of quality of life of an individual animal, and provide insightful information about husbandry practices that should contribute to a good quality of life for the animal and includes:

Nutrition: animals have opportunities to access unrestricted, sufficient, species-specific, balanced, varied, and clean food and water.

Environment: the animal's environment provides comfort through temperature, substrate, space, air, odor, noise, and predictability.

Health: animals are in good health, and illnesses and injuries are prevented, or immediately and appropriately treated.

Behaviour: animals are able to express a full range of natural behaviours such as exploration, foraging, bonding, playing, retreating, and others.

Mental State: by presenting positive situations and/or solutions in the previous four domains, the mental state of the animal should benefit from predominantly positive states, such as pleasure, comfort, or vitality while reducing or eliminating negative states such as fear, frustration, hunger, pain, or boredom.[10]

Exercise 1: Match the Word with its Definition

Match the vocabulary words (Column A) with their correct definitions (Column B).

Column A	Column B
1. Welfare	A. The ability to carry out natural activities or actions.
2. Psychological	B. The state of being healthy and well-nourished.
3. Agency	C. Related to the mind or emotions.
4. Husbandry	D. The care, cultivation, and breeding of animals.
5. Legislation	E. The general condition or well-being of someone or something.
6. Behaviour	F. Laws or rules created by authorities.
7. Nourished	G. The capacity to act independently and make choices.

Exercise 2: Fill in the Blanks

Use the words from the box to complete the sentences.

Words: welfare, behaviour, legislation, mental, environment, husbandry, agency

1. The animal's _____ includes the temperature, space, and noise around it.

2. Good animal _____ means the animal is healthy and free from pain.

3. The _____ of animals includes their emotional state and ability to express natural actions.

[10] https://www.worldanimalprotection.ca/blogs/what-is-animal-welfare/

4. Human _____ can protect animals by creating rules about their care.

5. Animals should have _____ over their own lives to express natural behaviour.

6. Proper _____ includes feeding, housing, and caring for animals responsibly.

7. The _____ state of an animal refers to its feelings like comfort or fear.

Exercise 3: True or False

Write **True** or **False** for each statement based on the text.

1. Animal welfare only refers to the physical health of animals.

2. The Five Domains Model includes nutrition, environment, health, behaviour, and mental state.

3. Animals should be free to express only some natural behaviours to have good welfare.

4. Scientific research has no role in improving animal welfare standards.

5. Humans have a responsibility to treat animals with respect and care.

6. Behavioural expression is not considered part of animal welfare.

7. Negative emotions like pain and fear should be reduced in animal welfare.

Exercise 4: Find Synonyms

Find words in the text that mean the same as the words below:

1. Healthy and well-fed = _____
2. Care and management of animals = _____
3. Emotional well-being = _____
4. Laws = _____
5. Comfortable and secure = _____
6. To stop or avoid = _____

Cooperative learning and Case study section.

Cooperative Learning Exercise: "Animal Welfare Task Force"

Objective:

Students will collaboratively analyze the concept of animal welfare by exploring its scientific, ethical, and practical aspects using the Five Domains Model as a framework.

Group Roles (4–5 students per group):

Assign or rotate these roles:

* Reader – reads the passage aloud
* Researcher – looks up unfamiliar terms or examples (if allowed)
* Presenter – shares the group's findings

Task:

Each group is assigned a domain or concept to explore in detail. Use the questions below to guide discussion and analysis.

Group Assignments:

Group	Focus Area	Guiding Questions
1	Definition and Scope of Animal Welfare	- What does animal welfare include? - Why is it considered both a science and a moral duty? - Who is responsible for ensuring animal welfare?
2	The Three Elements of Welfare	- What are the three key elements of animal welfare? - How do they interact? - Give real-world examples.
3	Five Domains Model – Overview	- What is the purpose of the Five Domains Model? - How is it used to assess animal welfare? - How does it improve animal care?
4	Individual Domains (Pick one or divide among members)	- What are the criteria for a good outcome in this domain? - What might poor welfare look like here? - Give real-world examples (e.g., in zoos, farms, homes).
5	Human Responsibility and Ethical Considerations	- How do human actions affect animal welfare? - What responsibilities do we have? - How does animal welfare relate to laws and ethics?

Activity Flow:

1. Group Work (20–25 minutes):
   * Read the passage together.
   * Answer the questions collaboratively.
   * Prepare a 2-minute presentation summarizing their section.
2. Group Presentations (10–15 minutes):
   * Each group presents.
   * Encourage Q\&A or discussion between groups.
3. Class Reflection (Optional):
   * Which domain seems most challenging to improve in practice?
   * How can we apply this knowledge in real-life decisions (e.g., pet ownership, food choices, zoo visits)?

Case Study Exercise: "Improving Life for Zara the Zoo Tiger"

Scenario:

Zara is a 6-year-old Bengal tiger living in a city zoo. Recently, keepers noticed signs of stress: repetitive pacing, loss of appetite, lack of interest in toys, and occasional aggression. The zoo wants to improve her welfare based on the Five Domains Model.

Objective:

Students apply their understanding of the Five Domains to assess Zara's situation and recommend science-based improvements.

Instructions:

1. Distribute the scenario and the Five Domains Model descriptions.
2. Students work in pairs or small groups to analyze the case.
3. Use these guiding questions:

Domain	Questions
Nutrition	Is Zara receiving appropriate, species-specific food and water? What changes might help?
Environment	Is her habitat spacious, clean, and enriched? What environmental changes could improve her comfort?
Health	Are her physical symptoms (e.g., weight loss) being addressed? How should health be monitored?
Behaviour	What behaviors show her stress or boredom? How can enrichment be improved to allow natural behaviors?
Mental State	Based on the other four domains, what emotional state is Zara likely in? What interventions might improve her wellbeing?

Deliverable:

Each group presents:

* Their analysis of Zara's current welfare status in each domain

* A short care plan with recommendations (e.g., improved diet, enrichment activities, more naturalistic habitat)

Optional Extension:

Invite students to reflect or write on:

* Should zoos be reformed or phased out based on animal welfare science?

* How does this case relate to animals we keep at home or see in entertainment?

PART 2

Veterinary surgery

Veterinary surgery is surgery performed on non-human animals by veterinarians, whereby the procedures fall into three broad categories: orthopaedics (bones, joints, muscles), soft tissue surgery (skin, body cavities, cardiovascular system, GI/urogenital/respiratory tracts), and neurosurgery. Advanced surgical procedures such as joint replacement (total hip, knee and elbow replacement), fracture repair, stabilization of cranial cruciate ligament deficiency, oncologic (cancer) surgery, herniated disc treatment, complicated gastrointestinal or urogenital procedures, kidney transplant, skin grafts, complicated wound management, and minimally invasive procedures (arthroscopy, laparoscopy, thoracoscopy) are

performed by veterinary surgeons (as registered in their jurisdiction). Most general practice veterinarians perform routine surgeries such as neuters and minor mass excisions; some also perform additional procedures.

The goal of veterinary surgery may be quite different in pets and in farm animals. In the former, the situation is more close to that with human beings, where the benefit to the patient is the important factor. In the latter, the economic benefit is more important.

Specialization in surgery

In the United States, Canada and Europe, veterinary surgery is one of 22 veterinary specialties recognized by the American Veterinary Medical Association respectively the European Board of Veterinary Specialisation. Those wishing to become board certified must undergo a one-year clinical internship program followed by three years of intensive training in a residency program under direct supervision of board certified veterinary surgeons, including performance of a large number of surgical procedures in such categories as abdominal surgery, surgical treatment of angular limb deformities, arthroscopic surgery, surgery of the foot, fracture fixation, ophthalmic surgery, urogenital surgery, and upper respiratory surgery, etc. Once the minimum requirements of training are met, residents are required to pass a rigorous certification examination before being admitted as members (diplomates) of the American College of Veterinary Surgeons or European College of Veterinary Surgeons.

Common veterinary surgeries

Sterilization surgery

A cat spay

One of the most common elective surgical procedures in animals are those that render animals incapable of reproducing. Neutering in animals describes spaying or castration (also please see castration). To spay (medical term: ovariectomy or ovario-hysterectomy) is to completely remove the ovaries and often the uterus of a female animal. In a dog, this is accomplished through a ventral midline incision into the abdomen. In a cat, this is accomplished either by a ventral midline abdominal incision, or by a flank incision (more common in the UK). With an ovariectomy, ligatures are placed on the blood vessels above and below the ovary and the organ is removed. With an ovariohysterectomy, the ligaments of the uterus and ovaries are broken down and the blood vessels are ligated and both organs are removed. The body wall, subcutis, and skin are sutured. To castrate (medical term: orchiectomy) is to remove the testicles of a male animal. Different techniques are used depending on the type of animal, including ligation of the spermatic cord with suture material, placing a rubber band around the cord to restrict blood flow to the testes, or crushing the cord with a specialized instrument like the Burdizzo.

Neutering is usually performed to prevent breeding, prevent unwanted behavior, or decrease risk of future medical problems. Neutering is also performed as an emergency procedure to treat certain reproductive diseases, like pyometra and testicular torsion, and it is used to treat ovarian, uterine, and testicular cancer. It is also recommended in cases of cryptorchidism to prevent torsion and malignant transformation of the testicles. Please see spaying and neutering for more information on the advantages and disadvantages of this procedure.

Laser surgery offers a number of benefits, including reduced risk of infection, less post-operative pain and swelling, reduced bleeding and improved visibility of the surgical field. Better hemostasis and visibility can in some cases minimize the need for anesthesia and/or reduce overall surgical time.

Controversial elective animal procedures

Other common elective surgical procedures in the United States are declawing in cats (onychectomy), ear-cropping in dogs, tail docking in dogs, horses, and dairy cattle, and livestock dehorning in cattle, sheep, and goats. These procedures have been controversial and recently debated among breeders, veterinary organizations, and animal welfare scientists. The controversy is different for each procedure, but issues arise based on reasons to perform the procedure, differing opinions on techniques and methods, perceived long-term benefits in individual animals, and the development of alternatives. Declawing, for example, consists of removal of the distal phalanges using either a scalpel, scissors or laser. It is typically performed to prevent property damage in house cats, but may also be performed in purebred dogs to to meet certain show requirements. Some procedures are illegal in some countries (in the UK, declawing is illegal and tail docking is only allowed in working dogs) and face ethical challenges in others.

Dental surgery

Common dental surgical procedures:

Horses - Floating (grinding down) of uneven teeth edges and removal of wolf teeth.

Dogs - Dental prophylaxis is commonly performed to remove tartar and treat periodontal disease. This procedure is usually performed under anesthesia. Other common procedures include extraction of abscessed or broken teeth, extraction of deciduous teeth, root canals, and removal of gingival hyperplasia and epulides.

Cats - Dental prophylaxis as described above for the dog and treatment and extraction of teeth with feline odontoclastic resorptive lesions (FORLs).

Surgical oncology

In older dogs and cats tumors are a common occurrence, and may involve any or multiple body systems: skin, musculoskeletal, gastrointestinal tract, urogenital tract, reproductive tract, cardiovascular system, spinal cord and peripheral nerves, the spleen and the lining of body cavities. Common skin tumors include lipomas, mast cell tumors, melanomas, squamous cell carcinomas, basal cell carcinomas, fibrosarcomas, and histiocytomas. Skin tumors are removed through either simple excisions or through excisions needing reconstructive plastic surgery. Common oral tumors include melanomas, fibrosarcomas, and squamous cell carcinomas, which are removed with as much surrounding tissue as possible, including parts of the mandible and maxilla. Other types of cancer requiring surgery include osteosarcomas, stomach and intestinal tumors, splenic masses, and urinary bladder tumors.

Ophthalmic surgery

Common ophthalmic surgeries in animals include:

Enucleation of the eye to treat glaucoma or eye proptosis.

Cataract surgery

Entropion surgery

Eyelid tumor removal

Cherry eye surgery

Exenteration (complete removal) of the orbit, especially for squamous cell carcinoma in the cat and cow.

Orthopedic surgery

X-ray of a dog with an artificial hip to repair hip dysplasia

A healthy tortoise-mix cat healed and adapted quickly to her new mobility after a hind leg was amputated.

Common orthopedic surgeries in animals include:

Ruptured cranial cruciate ligament repair

For hip dysplasia:

Femoral head osteotomy

Triple pelvic osteotomy

Hip replacement

Leg amputation

Bone fracture repair

Arthroscopy

MPL - medial patellar luxation

Cardiology surgery

Common cardiology surgeries in animals include:

Balloon valvuloplasty: Procedure used to alleviate pain symptoms from cardiac problems such as pulmonic, mitral, and tricuspid stenosis. The purpose of this procedure is to create a smoother blood flow throughout the body by reducing harmful effects from obstructed heart valves. It is considered a minimally invasive procedure. The procedure involves putting a balloon-like object inside of the animal's heart; the balloon inflates and deflates in order to alleviate pain and increase blood flow. Complications can occur if the animal's body rejects the balloon, forming a life-threatening allergic reaction.

Centesis: Procedure consisting of the removal of fluid from an animal's body in order to manage congestive heart failure. Draining fluid helps prevent tumors from growing around the heart. Animals undergo no anesthesia because little pain occurs during this operation. Catheters and needles of various sizes are punctured into the thoracic cavity. To remove the fluid, veterinarians will use a syringe suction or vacuum. Post-operatively, swelling might occur around the thoracic cavity or appear bruised, but this is normal and is rarely discomforting to the animal.

Devive Embolization of Persistent Ductus Arteriosus (PDA): PDA is caused by an abnormal blood flow from right to left inside the heart. This causes patients to develop left-sided congestive heart failure. In order to treat this condition, coils are placed inside ducts of the heart. The coils embolize into the pulmonary arteries. Both the ACDO device and the procedure itself are relatively inexpensive.

Other common procedures

Caesarean section

Caesarean sections are commonly performed in dogs, cats, horses, sheep, and cattle. Usually it is done as an emergency surgery due to difficulties in the birthing process. Certain dog breeds such as Bulldogs often need to have this surgery because of the size of the puppy's head relative to the width of the bitch's birth canal.

Surgery for gastric dilatation volvulus (bloat)

Gastric dilatation volvulus (bloat) is a common condition in dogs in which the stomach fills with gas, and can become torsed. This requires immediate surgical intervention to prevent necrosis of the stomach wall and death of the dog. During surgery, the stomach is deflated and put back into its normal position. A gastropexy may be performed, whereby the stomach is attached to the body wall to prevent this condition from recurring. A splenectomy or partial gastrectomy may also be required.

Cystotomy

Cystotomy to remove bladder stones

A cystotomy is a surgical opening of the urinary bladder. It is commonly performed in dogs and cats to remove bladder stones or tumors.

Wound repair

Sutured wound on the teats of a cow

Bite wounds from other animals (and rarely humans) are a common occurrence. Wounds from objects that the animal may step on or run into are also common. Usually these wounds are simple lacerations that can be easily cleaned and sutured, sometimes using a local anesthetic. Bite wounds, however, involve compressive and tensile forces in addition to shearing forces, and can cause separation of the skin from the underlying tissue and avulsion of underlying muscles. Deep puncture wounds are especially prone to infection. Deeper wounds are assessed under anesthesia and explored, lavaged, and debrided. Primary wound closure is used if all remaining tissue is healthy and free of contamination. Small puncture wounds may be left open, bandaged, and allowed to heal without surgery. A third alternative is delayed primary closure, which involves bandaging and reevaluation and surgery in three to five days.

Wounds occurring in the udder and teats of cows are more difficult to repair, due to the difficult access and sensitivity of the organ, and because deep anaesthesia may not be applied to cows.

Foreign body removal

Bottle top swallowed by a dog that had to be removed surgically

A variety of non-edible objects are commonly swallowed by dogs, cats, and cattle. These foreign bodies can cause obstruction of the gastrointestinal tract causing severe vomiting and resulting electrolyte imbalances. The stomach (gastrotomy) or intestine (enterotomy) can be surgically opened to remove the foreign body. Necrotic intestine can be removed (enterectomy) and repaired with intestinal anastomosis. Foreign bodies can also be removed by endoscopy, which although requires general anesthesia does not require surgery and significantly decreases recovery time. However, endoscopic foreign body retrieval is anatomically limited to objects lodged in the esophagus, the stomach or the colon. The condition in cattle is known as hardware disease.[11]

1. Matching: Match the term to its correct definition

Term	Definition
A. Ovariohysterectomy	1. A surgical removal of the eye
B. Arthroscopy	2. Surgery involving bones, joints, or muscles

[11] https://en.wikipedia.org/wiki/Veterinary_surgery

C. Enucleation	3. Use of a camera-equipped tool to view and treat joints
D. Orthopedic surgery	4. Complete removal of uterus and ovaries in females
E. Cryptorchidism	5. A condition where one or both testicles fail to descend

2. Fill in the blanks: Use the correct term from the word bank

Word Bank:

ligate, neutering, laparoscopy, thoracoscopy, mast cell tumor, spay, castration, prophylaxis

1. _____ is a common procedure done to prevent reproduction in animals.
2. A _____ involves removing a male animal's testicles.
3. Surgeons often _____ blood vessels during ovariohysterectomy to prevent bleeding.
4. A _____ is a type of cancer frequently found in the skin of older pets.
5. _____ is a dental procedure performed to prevent periodontal disease.
6. A _____ is a surgery that uses a camera through the abdominal wall.
7. In cats, to _____ means to remove the ovaries and sometimes the uterus.
8. _____ is a minimally invasive procedure that explores the chest cavity.

3. Multiple Choice: Choose the correct answer**

1. What is the **primary reason** neutering is performed?
   * A. Increase appetite
   * B. Prevent reproduction and certain diseases
   * C. Help hair growth
   * D. Improve bone structure

2. Which of the following is a **minimally invasive** surgical technique?
   * A. Amputation
   * B. Laparoscopy
   * C. Enucleation
   * D. Ovariohysterectomy

3. What condition is treated with **balloon valvuloplasty**?
   * A. Kidney stones
   * B. Eye cataracts
   * C. Obstructed heart valves
   * D. Ear infections

4. **Declawing** is controversial because:
   * A. It enhances immune response
   * B. It affects behavior positively
   * C. It involves amputation and has ethical concerns
   * D. It improves hunting skills

4. Short Answer

1. What does the surgical procedure **orchiectomy** involve?
2. Why is **gastropexy** performed after treating bloat in dogs?
3. Describe the difference between **floating** in horses and **dental prophylaxis** in dogs.
4. Why is **declawing** considered illegal in some countries?
5. What does **surgical oncology** deal with in veterinary medicine?

5. True or False

1. ___ Soft tissue surgery includes operations on the gastrointestinal and respiratory tracts.
2. ___ A triple pelvic osteotomy is used to treat eye problems in cats.
3. ___ The American College of Veterinary Surgeons certifies specialists after residency and exams.
4. ___ Spaying only removes the uterus in all cases.
5. ___ Cystotomy is used to remove bladder stones.

Cooperative learning and Case study section.

Cooperative learning exercises

1. Jigsaw: Types of Veterinary Surgery

Goal: Understand and teach each other the main categories and common procedures in veterinary surgery.

Steps:

1. Divide students into 5 expert groups, each assigned one topic:
   * Orthopedic surgery
   * Soft tissue surgery
   * Neurosurgery & surgical oncology
   * Ophthalmic & dental surgery
   * Controversial elective procedures & sterilization surgery
2. Each group studies their topic in detail, using the text.
3. Groups prepare:
   * A short summary (5 min presentation)
   * One example procedure: indication, technique (brief), and outcome
4. Re-form into **jigsaw groups** (one person from each expert group).
5. Each member teaches their topic to their new group.
6. Whole class discussion: reflect on differences in goals (pet vs. farm animals) and ethical considerations.

2. Think–Pair–Share: Ethical dilemmas

Prompt:

“Tail docking, declawing, and ear-cropping are elective procedures often performed for aesthetic or practical reasons. Should veterinarians agree to perform them?”

Steps:

1. Think individually and write down your thoughts (3 min)
2. Pair with a classmate to share and discuss (5 min)
3. Share your conclusions with the class
4. Teacher/facilitator summarizes different perspectives and presents current legal status in different countries.

3. Role play: Specialization decision

Scenario: You are a veterinary student deciding whether to specialize in surgery.

Steps:

1. Small groups (3–4 students): each person takes a role
   * Veterinary student interested in specialization
   * Family member worried about work-life balance
   * Mentor (board-certified surgeon)
   * Friend interested in another specialty (e.g., cardiology)
2. Discuss:
   * Pros & cons of specializing
   * Training requirements (internship, residency, exam)
   * Impact on lifestyle and future career
3. Present the group’s decision and reasons.

Case study exercises

Case Study 1: Foreign body in a dog

Scenario:

A 3-year-old Labrador presents with repeated vomiting and abdominal pain. X-ray reveals a bottle top lodged in the stomach.

Questions:

1. What are possible complications if the foreign body is not removed?
2. Which surgical options are available? Compare **gastrotomy** and **endoscopy**.
3. Discuss post-operative care and prognosis.

Case Study 2: Cranial cruciate ligament rupture

Scenario:

A 6-year-old mixed breed dog shows sudden lameness in the hind limb. Diagnosis: cranial cruciate ligament rupture.

Questions:

1. Explain why this ligament is important.
2. Discuss surgical options (e.g., stabilization techniques).
3. What are the expected outcomes and complications?

Case Study 3: Ethical dilemma — declawing

Scenario:

An owner insists on declawing her indoor-only cat to prevent damage to furniture.

Questions:

1. What is the surgical technique (onychectomy)?
2. Discuss ethical considerations: benefit to animal vs. human.
3. Are there alternatives to surgery? What would you recommend?

Case Study 4: Emergency caesarean in a bulldog

Scenario:

A pregnant bulldog has been in labor for several hours without progress.

Questions:

1. Why is caesarean section often required in brachycephalic breeds?
2. Describe key steps in performing a caesarean.
3. Discuss anesthetic considerations and neonatal care.

Case Study 5: Tumor on a dog's leg

Scenario:

A 10-year-old retriever has a fast-growing mass on the hind leg; biopsy shows fibrosarcoma.

Questions:

1. What surgical options are available?
2. Why might amputation be recommended?
3. Discuss owner counseling and quality of life after surgery.

Veterinary Anesthesia

Veterinary anesthesia is a specialization in the veterinary medicine field dedicated to the proper administration of anesthetic agents to non-human animals to control their consciousness during procedures. A veterinarian or a Registered Veterinary Technician administers these drugs to minimize stress, destructive behavior, and the threat of injury to both the patient and the doctor. The duration of the anesthesia process goes from the time before an animal leaves for the visit to the time after the animal reaches home after the visit, meaning it includes care from both the owner and the veterinary staff. Generally, anesthesia is used for a wider range of circumstances in animals than in people not only due to their inability to cooperate with certain diagnostic or therapeutic procedures, but also due to their species, breed, size, and corresponding anatomy. Veterinary anesthesia includes anesthesia of the major species: dogs, cats, horses, cattle, sheep, goats, and pigs, as well as all other animals requiring veterinary care such as birds, pocket pets, and wildlife.

Specialization in anesthesia

In North America, the American College of Veterinary Anesthesia and Analgesia is one of 22 specialty organizations recognized by the American Veterinary Medical Association. The ACVAA was recognized by the AVMA in 1975, despite attempts by the AVMA to include anesthesia as a subspecialty of surgery or medicine. As of 2016, there are more than 250 diplomates of the ACVAA. To become an ACVAA board-certified Diplomate, veterinarians must have at least one year of clinical practice experience followed by three years of anesthesia

residency training under the supervision of ACVAA Diplomates, have accepted for publication a scientific peer-reviewed research article, and passed both a written and clinical competency examination.

In Europe, the European College of Veterinary Anaesthesia and Analgesia (ECVAA) is one of 23 specialty organizations recognized by the European Board of Veterinary Specialization. As of 2018, there are over 4,000 active ECVA Diplomates.

Anesthesia technicians

Anesthesia which is supervised by a qualified technician is safer than anesthesia without a technician. In most private veterinary practices, the technician administers and monitors anesthesia with supervision from the attending veterinarian. In many academic institutions, anesthesia technicians are involved in working with and teaching veterinary students as well as supervising anesthetized cases. The Academy of Veterinary Technicians in Anesthesia and Analgesia is a provisional specialty academy of the North American Veterinary Technician Association and is responsible for licensing technicians as being specialized in anesthesia. For a technician to become specialized, they must be a licensed technician in their state, accumulate 6000 hours of work in veterinary medicine (at least 75% of which must be in anesthesia), 40 hours of continuing education related to anesthesia, demonstrate proficiency in anesthesia skills, and pass a comprehensive written examination.

Application in animals

Anesthesia is required for many surgical procedures which require the patient to be immobile, unaware, and without pain. Furthermore, anesthesia aims to minimize the surgical stress response. In addition, certain diagnostic procedures require anesthesia, notably stomach or airway endoscopy, bone marrow sampling, and occasionally ultrasound. Aggressive animals may require anesthesia in order to handle and perform a physical exam or obtain blood for testing. Exotic animals frequently require anesthesia for simple procedures (such as taking a radiograph or catheter placement) due to lack of domesticity. Animals may require anesthesia for therapeutic procedures, such as urinary catheterization to relieve obstruction, injection into a mass, or removing fluid from the eye to treat glaucoma. In addition to anesthesia, analgesia is often managed by anesthesiologists or is included in the considerations for anesthesia.

Techniques

Small animals

Cats and dogs are frequently anesthetized for surgical procedures. Small animals are most often placed under general anesthesia due to the types of procedures typically performed, the small size of the patient, their suitability to general anesthesia, and the greater degree of control. A balanced anesthesia protocol can be used whereby different drugs with different effects are used so that a high dose of just one drug can be avoided. For example, combining a sedative and an opioid will permit less inhalant anesthesia to be used, improving cardiovascular stability. A one-year study in a teaching hospital shows that dogs and cats typically experience a 1 in 9 chance of anesthetic complications, with a 1 in 233 risk of death. A larger-scale study states the risk of death in healthy dogs and cats as 1 in 1849 and 1 in 895 respectively. For sick dogs and cats, it was 1 in 75 and 1 in 71 respectively. For rabbits, the risk was 1 in 137 and 1 in 14 respectively for the healthy and sick groups.

Horses and ruminants

Many procedures can be performed on the standing horse with heavy sedation alone. Some procedures may require general anesthesia due to the location of surgery (for example, castration). Other procedures in horses require general anesthesia using an inhalant anesthetic. Horses, due to their complex physiology as performance animals, suffer a number of difficulties that can complicate anesthesia. This results in horses having a higher risk of perioperative fatality - approximately 1 in 400. The number of complications related to fractures or myopathies are approximately 32%

Most procedures in ruminants can be performed standing under sedation and/or local anesthesia. This strategy is manageable due to the types of procedures being performed, the larger size of the patient, the relative difficulty of general anesthesia, and the cost of the procedure versus the product value of the animal.

Categories of Anesthetic agents

Most anesthetic agents used in human medicine are also used in veterinary medicine. These drugs can be classified by level of sedation, method of providing anesthesia, and type of drug. Anesthetics can only be provided to a patient after a full physical examination, evaluation of temperament, and an overview of medical history are completed. After that, the required protocol, appropriate amounts of the drug or drugs, and proper equipment should be employed for optimal care and comfort for the animal.

Levels of Sedation

The type and level of anesthesia capabilities are another way to categorize anesthetics in veterinary medicine. The first level is called low fear, anxiety, and stress. This level is not a complete loss of consciousness, but a slowing of heart rate and behavior to make the animals easier to handle. Drugs like Gabapentin, Trazodone, or Alpha-2 Agonists can be used alone to produce these effects.

The second level is light sedation, where the patient is slightly under for a short period of time. Examples of anesthetics to achieve this level are opioids and benzodiazepine. In cats, opioids alone are used to produce this effect. In dogs, a combination of an opioid and benzodiazepine can be used.

The second to last level is moderate sedation, which occurs for longer periods of time with stronger sedatives. Anesthetics that fit this category are other opioids, tranquilizers, benzodiazepines, and alpha-2 agonists. Combinations of opioids and tranquilizers, opioids and alpha-2 agonists, or all three together can achieve this level of sedation.

Finally, the last level of sedation is heavy sedation, which is used for major procedures and lasts longer than the other three levels. Drugs that meet these needs are opioids, benzodiazepines, alpha-2 agonists, neurosteroids, and dissociatives. Alpha-2 agonists can be used alone in dogs and cats to produce this effect. A combination of Alpha-2 agonists and neurosteroids or dissociatives also achieve the same effect.

Methods of Administration

More generally, anesthetic agents can be categorized based on how they are administered to the patient. There are several ways to provide animal anesthesia depending on the animal and its size and breed, some methods are preferred over others.

The first category of anesthetics is inhalants, or drugs that are delivered in gas form through a mask or endotracheal tube. These drugs are administered in combination with oxygen, which is vaporized using a precision vaporizer. Some common examples of inhalant anesthetics are nitrous oxide, halothane, isoflurane, desflurane, and sevoflurane. Nitrous oxide is most commonly used, but recent consideration of its side effects and uses has rendered it controversial.

Another method of delivery is through injection. The injection can be considered intravenous, intramuscular, subcutaneous, intrathoracic, or intraperitoneal. Intravenous injection occurs when the needle is inserted into the veins and delivers the medication directly into the bloodstream. Intramuscular injection is the administration of a drug deep into the muscles via a needle, which allows the drug to go into the bloodstream as well. Subcutaneous injections occur when the needle is inserted between the skin and muscle, allowing the drug to be absorbed into the bloodstream over a prolonged period. Veterinarians use intrathoracic injections to deliver medication into the thoracic cavity, or the chest region, and right near the surface of the heart. Intraperitoneal injection is the method of injection where the needle is inserted into the peritoneal cavity, or a region in the lower abdomen. This method is generally used in rodents and other laboratory animals because of easier handling. Intravenous, Intramuscular, and Subcutaneous injections are more commonly used in veterinary medicine, as they are easier and more efficient.

The third method of administration is through the mouth or anus. Certified technicians or veterinarians mostly deliver liquid solutions through the mouth or anus. Not only is anesthesia delivered via these routes, but also some analgesics. These two routes provide a larger variety in responses in one breed due to the differences in absorption rates through tissue. Despite this, it is very commonly used.

The last common method of delivering anesthetics is by applying it topically or through small injections using local anesthetics like Lidocaine. This method is used during surgery to block the nerves in a certain region that is being operated on. In addition, topical ointments block the nerves in a specific region for shorter durations. One small injection could be at the sight of a nerve trunk, therefore blocking the nerves in that entire region.[12]

1. Matching: Match each term with its correct definition

Term	Definition
A. Analgesia	1. Drug administration into the peritoneal cavity
B. Endotracheal tube	2. Loss of pain sensation without loss of consciousness
C. Inhalant	3. A tube inserted into the trachea to maintain an open airway
D. Intraperitoneal injection	4. An anesthetic given as vapor or gas, usually via a mask or tube
E. Neurosteroid	5. A type of drug that modulates brain activity for sedation or anesthesia

[12] https://en.wikipedia.org/wiki/Veterinary_anesthesia

2. Fill in the blanks: Use the correct term from the word bank

Word Bank:

Alpha-2 agonist, Diplomate, Sedation, Lidocaine, Intramuscular, Balanced anesthesia, Thoracic cavity, Gabapentin

1. _____ is a commonly used local anesthetic for minor procedures.
2. _____ is a drug used to reduce fear, anxiety, and stress in animals.
3. A _____ protocol uses multiple drugs to achieve the desired anesthetic effect while minimizing side effects.
4. _____ injection is delivered deep into the muscles.
5. A veterinarian who has passed all requirements for specialization is referred to as a _____.
6. Drugs administered into the _____ help in treating conditions near the lungs or heart.
7. An _____ can be used alone or in combination to produce various depths of sedation or anesthesia.
8. The term _____ refers to the state of being calmed or less alert but not unconscious.

3. Multiple Choice: Choose the correct answer

1. What is the primary reason general anesthesia is more commonly used in small animals?
   * A. They are more aggressive
   * B. Their size allows more surgical complexity
   * C. It provides greater control during delicate procedures
   * D. They cannot feel pain otherwise
2. What is the **last and deepest** level of sedation used for major procedures?
   * A. Light sedation
   * B. Moderate sedation
   * C. Heavy sedation
   * D. Low fear and anxiety
3. Which method of drug administration **delivers the drug directly into the bloodstream**?
   * A. Intramuscular
   * B. Subcutaneous
   * C. Intravenous
   * D. Intraperitoneal
4. Which drug delivery method is **commonly used in rodents** due to easier access and handling?
   * A. Oral
   * B. Intravenous
   * C. Intraperitoneal
   * D. Inhalant

5. What is one of the **risks** associated with using inhalant anesthetics like nitrous oxide?

* A. High cost
* B. Complicated application
* C. Side effects and controversy in use
* D. Requires too many injections

4. True or False

Write **T** for True and **F** for False.

1. ___ Anesthesia technicians require certification and continuing education to specialize.
2. ___ All veterinary procedures require general anesthesia.
3. ___ Alpha-2 agonists can be used in both dogs and cats to achieve sedation.
4. ___ Inhalant anesthetics are delivered through the digestive tract.
5. ___ The risk of anesthesia-related death is higher in rabbits than in dogs or cats.

5. Short Answer Questions

1. What are the three **common methods** of anesthetic drug administration?
2. Why is a **balanced anesthesia protocol** preferred over a single high-dose drug?
3. What role do **anesthesia technicians** play in veterinary hospitals?
4. List two procedures in which anesthesia is necessary even though surgery is not being performed.
5. Explain why **general anesthesia** is more risky in horses compared to ruminants.

Cooperative learning and Case study section.

Cooperative Learning Exercises

1. Jigsaw: "Anesthesia in Veterinary Practice"

Objective: Each group becomes an expert on one aspect and teaches others.

Steps:

* Divide students into 5 groups. Assign each group a topic:
  1. Specialization in anesthesia (ACVAA, ECVAA, requirements)
  2. Role of anesthesia technicians
  3. Applications of anesthesia in different animals
  4. Levels of sedation and categories of anesthetic agents
  5. Methods of administration
* Each group reads their section carefully and prepares a 5-minute presentation (poster, slides, or drawing).
* Reorganize the class into new groups with one member from each original group.
* Each “expert” teaches their new group what they learned.
* As a whole class, create a concept map linking all topics.

2. Think–Pair–Share: "Why Anesthesia Differs Between Animals"

Prompt:

"Why is anesthesia used for a wider range of circumstances in animals compared to humans? Consider anatomy, cooperation, and species differences."

Steps:

* Think individually and write notes (2–3 min)
* Pair up and discuss answers (3–4 min)
* Share ideas with the whole class; instructor summarizes on the board.

3. Role Play: "Hospital Round"

Scenario:

Students simulate being in a veterinary hospital team:

* Roles: veterinarian, anesthesia technician, student intern, pet owner.

Task:

Discuss an upcoming procedure for:

* A cat requiring endoscopy
* An aggressive dog needing blood sampling
* A horse scheduled for castration

Each group:

* Decide on sedation level, anesthetic agents, and method of administration.
* Present to the class why they chose them and address owner's questions.

4. Gallery Walk: "Risks and Prevention"

Steps:

* Prepare posters on:
  1. Risks of anesthesia in small animals
  2. Risks in horses
  3. Prevention strategies and technician roles
* Groups circulate, read, and add sticky notes: questions, agreements, or suggestions.
* Groups return to their own poster and address feedback.

Case Study Exercises

Case Study 1: High-Risk Rabbit

A 2-year-old rabbit needs a radiograph after a suspected fracture. The rabbit has a mild respiratory infection.

Questions:

1. What is the risk of anesthesia in this rabbit compared to a healthy dog?
2. What level of sedation or anesthesia might be chosen?
3. Which methods of administration would likely be safest and why?
4. How would an anesthesia technician help reduce risk?

Case Study 2: Aggressive Dog

A large, aggressive dog needs a blood test and physical exam.

Questions:

1. Why might anesthesia be required here?

2. Which sedation level is likely appropriate?
3. Suggest a combination of drugs and method of administration.
4. What precautions should be taken for safety of staff and dog?

Case Study 3: Standing Horse Procedure

A standing dental procedure on a horse is planned.

Questions:

1. Why is standing sedation preferred?
2. Which sedatives might be used?
3. What complications must the team monitor for?
4. What is the role of an anesthesia technician in this procedure?

Case Study 4: Exotic Animal

A zoo veterinarian needs to take a blood sample from a flamingo.

Questions:

1. Why might general anesthesia be considered?
2. What administration method would you recommend?
3. What special considerations apply to wildlife compared to domestic animals?
4. How does balanced anesthesia help reduce risk?

Clinical diagnostics

Physical examination of animals is a crucial aspect of veterinary practice that helps in the diagnosis of various diseases and conditions. The examination provides valuable information about the animal's overall health status and helps the veterinarian to identify any problems or abnormalities.

Various methods of physical examination are used to assess different aspects of an animal's health. This includes visual inspection, palpation, percussion, and auscultation, among others. In this article, we will delve into the various methods of physical examination of animals, their significance, and the equipment required.

1. Taking of history:

The first step in conducting a physical examination of an animal is taking a history. This involves gathering information about the animal's symptoms, the duration of the illness, and any previous treatments that have been carried out.

History taking is an important aspect of the examination as it helps the veterinarian to locate the disease and determine its potential causes.

For example, if the animal is experiencing diarrhea, it could indicate a gastrointestinal disorder. Similarly, if the animal is lame, it could indicate a musculoskeletal or nervous system issue. By taking a complete history, the veterinarian can get a better understanding of the animal's condition and make an informed diagnosis.

2. Identification of the animal:

Identification of the animal is the first step in conducting a physical examination. It is important to identify the species, sex, age, color, and any particular characteristics of the animal, such as whether it is polled or horned. Additionally, it is

important to note the tag number or name of the animal to ensure accurate record keeping.

3. General examination:

A general physical examination is a necessary first step in the examination of an animal. This initial examination provides a general overview of the animal's health and allows the veterinarian to determine the degree of severity of any primary complaints.

It may also uncover secondary disorders that may be contributing to the animal's overall health. Following the general examination, the veterinarian can then conduct a more detailed examination of specific body systems.

In the general examination, the following are routinely examined;

Examination of the behavior (demeanor).

Examination of posture and gait.

Assessment of the nutritional state. (Body scoring system).

Breathing rate (thoracic, abdominal, or both).

Pulse rate.

Body temperature.

Behavior/demeanor:

Find out if the animal is dull or excitable (should be differentiated from nervousness) or if the demeanor is normal.

Find out if the animal is feeding, drinking, chewing the cud, or suckling.

Urination/defecation.

Find out if the animal responds to sight and sound in the environment.

Posture:

Posture lying down, sternal/lateral recumbency

Posture standing, lameness, arched back, and abducted elbows.

Breathing rate:

Can be taken by placing a hand in front of the muzzle.

Can be taken by standing behind the animal and a little to one side observing the coastal arch and flank.

Temperature and Pulse:

Temperature is taken in the rectum of an animal.

Pulse is taken in the coccygeal artery or median femoral artery.

One can proceed and examine any body system of choice

4. Integumentary system:

The integumentary system, which consists of the hair, skin, visible mucus membranes, horns, and subcutaneous tissues, is an important aspect of the animal's physical examination.

The hair's consistency and appearance, such as smooth or shaggy, can be evaluated, as well as its color and the presence of alopecia or parasites.

The skin's appearance, elasticity, odor, and presence of lesions, wounds, or cuts can also be assessed. The subcutaneous tissue can be evaluated for swelling, firmness, and edema. The visible mucus membranes, including the vulva, conjunctiva, and oral mucous membranes, can be evaluated for color changes and the presence of lesions.

These evaluations can provide valuable information about the animal's overall health and help in the diagnosis of various conditions.

5. Lymphatic system:

The lymphatic system is an important aspect of physical examination in animals. The parotid, prescapular, and precrural lymph nodes can be assessed for any signs of enlargement or edema.

Additionally, any other visible lymph nodes or vessels should be noted during the examination. A careful evaluation of the lymphatic system can provide valuable information about the animal's overall health status and help in the diagnosis of various conditions.

6. The Circulatory system:

The circulatory system is an important aspect of the physical examination of animals. The examination of the heart includes assessing the heart rate (number of heartbeats per minute), the amplitude (strength of the heartbeat), and the presence of any abnormal sounds such as murmurs.

The pulse rate, amplitude, and the presence of any visible blood vessels, such as the jugular, pulse, milk vein, and peripheral vasomotor tone, are also assessed. This includes checking the temperature of extremities such as ears and legs to determine if they are warm or cold.

7. The Respiratory system:

When examining the respiratory system of an animal, there are several factors to consider. During the visual inspection, it is important to observe for any discharges or lesions on the muzzle and to listen for any abnormal sounds such as coughing, sneezing, or stenosis sounds.

The character of respiration, whether it is thoracic or thoracoabdominal, should also be noted, as well as any unusual odor from the animal. During auscultation, the rate of breaths per minute should be recorded, and any abnormal sounds should be noted.

8. Digestive system:

When suspected of a digestive system (GIT) disease, it is important to gather a detailed history of the animal's diet and assess the quality and quantity of feed given.

During the examination, the animal's appetite, prehension, chewing, and discharges or salivation should be observed.

Additionally, any lesions on the muzzle or lips, as well as the cleanliness of the perineum, should be noted. The symmetry of the abdomen should also be assessed, including any distension on the left or right or bilateral distension.

During the examination of the oral cavity, the mucus membranes, teeth, cheeks, and tongue should be checked for any lesions or unusual odors. The frequency and strength of ruminal movements should also be observed. Feces should be examined for their amount, consistency, color, odor, and any abnormal constituents such as blood, sand, fibrin, or gas bubbles.

In some cases, a special examination may involve rectal palpation to examine internal organs such as the caecum, rumen, abomasum, and large intestines.

9. Urogenital system:

The urogenital system is an important aspect of the animal's physical examination. During this examination, the following points should be noted:

Visual Inspection: This includes checking the external genitalia, such as the scrotum, prepuce, and vulva for any wounds, lesions, discharge, and symmetry. The behavior of the animal when urinating and any signs of pain, such as an arched back, should also be observed. The quantity and quality of urine should also be noted.

Pregnancy diagnosis: The udder should be inspected for symmetry, lesions, and supra mammary teats. Palpation should be performed to check the consistency of the udder, test the patency of the teats, and examine the milk.

10. Musculoskeletal system:

The musculoskeletal system of an animal is an important aspect of its physical examination. If a disease of this system is suspected, the veterinarian should investigate the animal's history, including any recent transportation, falls, fights, or calving, as well as the housing environment.

Visual inspection is one of the methods used to assess the musculoskeletal system. During visual inspection, the veterinarian checks for swelling or sores on the limbs, posture at rest and standing, weight-bearing lameness, deviation of a limb from the normal axis, and gait.

Palpation is another method used to examine the musculoskeletal system, including the hoof, joints, and muscles. The hoof is examined by lifting the leg and washing the hoof, while the joints and muscles are examined through palpation.

11. The Nervous system:

The nervous system of animals is divided into two main systems: the central nervous system and the peripheral nervous system. The central nervous system examines the demeanor and reaction of the animal based on factors such as the rest of the herd/flock, strangers, and the environment, including appetite and prehension, urination and defecation, and locomotion and posture.

On the other hand, the peripheral nervous system examines sensitivity and response to reflexes and checks for flaccid paralysis and spastic paresis.

Additionally, visual inspection is done for abnormal muscle movements and coordination. The sensory organs such as the eyes and ears are also examined, including the corneal reflex and the response to sight and sound. The position and symmetry of the ears are also evaluated, as well as any discharge or injury/swelling.[13]

Vocabulary List (from the text)

1. Physical examination
2. Palpation
3. Auscultation
4. History taking
5. Demeanor
6. Recumbency
7. Integumentary system
8. Mucus membranes
9. Edema
10. Lymph nodes
11. Auscultation

[13] https://www.bivatec.com/blog/methods-of-physical-examination-of-animals

12. Pulse
13. Symmetry
14. Abdomen
15. Lesion
16. Perineum
17. Prepuce
18. Lameness
19. Reflex
20. Flaccid paralysis

Exercise 1: Match the Terms with Definitions
Match each term with its correct definition.

Term	Definition
1. Palpation	A. Listening to internal body sounds using a stethoscope
2. Auscultation	B. The act of feeling with hands to examine the body
3. Edema	C. An abnormal change in skin or tissue (e.g., a wound)
4. Lesion	D. Accumulation of fluid in body tissues causing swelling
5. Demeanor	E. The outward behavior or appearance of an animal

Exercise 2: Fill in the Blanks
Use the following words:
symmetry, **perineum**, **recumbency**, **pulse**, **reflex**
1. The veterinarian checked the _____ of the ears to see if they were evenly placed.
2. A weak or absent _____ might indicate poor blood circulation.
3. The animal was in lateral _____ and unable to rise.
4. The _____ area was examined for cleanliness and signs of diarrhea.
5. A normal _____ response is an indicator of a healthy nervous system.

Exercise 3: Multiple Choice Questions
1. **What is 'recumbency' in veterinary terms?**
   a) The rate of breathing
   b) The condition of lying down
   c) A type of reflex
   d) The act of urinating
2. **Which system involves hair, skin, and visible mucus membranes?**
   a) Musculoskeletal system
   b) Digestive system
   c) Integumentary system
   d) Circulatory system
3. **Auscultation is primarily used to examine which of the following?**

a) Hooves
b) Muscles
c) Heart and lungs
d) Bones

4. **Which of the following best describes 'flaccid paralysis'?**
a) Muscle stiffness
b) Weakness with no muscle tone
c) Loss of appetite
d) High fever

Exercise 4: Define the Terms

Write a short definition for each of the following terms in your own words:

1. History taking
2. Lymph nodes
3. Thoracoabdominal respiration
4. Prepuce
5. Peripheral nervous system

Exercise 5: Use in a Sentence

Use each of the following words in a complete sentence that shows you understand the meaning:

1. Palpation
2. Lesion
3. Auscultation
4. Symmetry
5. Lameness

Exercise 6: Clinical Matching

Match each term with the correct clinical function or description.

Term	Description
1. Auscultation	A. Technique involving listening to internal body sounds
2. Palpation	B. Visual inspection of skin, hair, and visible membranes
3. History taking	C. Identifying past illness, symptoms, and treatment
4. Demeanor	D. Method of assessment using touch
5. Integumentary system	E. General behavior and attitude of the animal

Exercise 7: Clinical Fill-in-the-Blanks

Use these terms to complete the sentences:

rectum, **edema**, **thoracoabdominal**, **prepuce**, **recumbency**

1. The animal was found in **_____**, unable to rise without assistance.

2. The breathing pattern was identified as **_____**, involving both the chest and abdomen.

3. A swollen limb indicated the possible presence of **_____**.

4. The veterinarian checked the temperature by inserting the thermometer into the **_____**.

5. The **_____** was examined for lesions or discharge during the urogenital inspection.

Exercise 8: Multiple Choice – Choose the Best Answer

1. **Which of the following arteries is commonly used to measure the pulse in cattle?**
   a) Radial artery
   b) Coccygeal artery
   c) Brachial artery
   d) Facial artery
2. **The term “alopecia” refers to:**
   a) Discoloration of mucus membranes
   b) Excessive mucus production
   c) Hair loss or baldness
   d) Crusting on the skin
3. **Which lymph nodes are examined during a routine physical exam?**
   a) Inguinal, femoral, and aortic
   b) Parotid, prescapular, precrural
   c) Submandibular, thoracic, lumbar
   d) Brachial, intercostal, abdominal
4. **Visual inspection of the animal includes checking for:**
   a) Internal organ integrity
   b) Reflexes and nerve conduction
   c) Discharge, lesions, and posture
   d) Hormone levels and enzymes

Exercise 9: Short Definitions (Veterinary-Focused)

Define the following in one or two veterinary-relevant sentences:

1. **Auscultation**
2. **Pulse amplitude**
3. **Symmetry of abdomen**
4. **Subcutaneous tissue**
5. **Spastic paresis**

Exercise 10: Clinical Sentence Writing

Use each of these veterinary terms in a sentence that reflects their real-life use in clinical practice:

1. **Palpation**
2. **Mucus membranes**
3. **Perineum**
4. **Lymph nodes**

5. **Ruminal movements**

Example: During palpation, the veterinarian detected swelling in the prescapular lymph node suggestive of infection.

Case-Based Application (Optional)

Case Scenario:

A 3-year-old cow presents with loss of appetite, lethargy, and unilateral abdominal distension. You are tasked with conducting a physical examination.

Questions:

1. Which systems would you prioritize in your examination and why?

2. What specific observations or techniques would you use to examine the digestive system?

3. What might asymmetrical abdominal distension suggest in this case?

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Think–Pair–Share: "The First Step: Taking History"

Task: Each student thinks of why history-taking is so important.

Pair: Share with a partner and discuss the challenges of getting history from animal owners.

Share: Groups share key points with the class, and the instructor lists common themes on the board.

2 Jigsaw Activity: "Systems in Focus"

Divide the class into expert groups, each focusing on one system from the text (e.g., integumentary, lymphatic, digestive, nervous, etc.).

Step 1 (Expert group): Study your assigned system, summarize its examination steps, what to look for, and why.

Step 2 (Mixed group): Reassemble into groups where each member teaches the others about their system.

Outcome: Each group builds a comprehensive overview of the whole clinical diagnostic process.

3 Role Play: "The Veterinarian and the Owner"

Groups: In groups of three: a veterinarian, an animal owner, and an observer.

Task: Practice history-taking for a fictional animal with signs of illness (e.g., coughing cow, lame goat).

Observer: Gives feedback on communication clarity, empathy, and completeness of questions.

4 Collaborative Concept Mapping

Task: In small groups, create a large concept map showing the flow of a full clinical diagnostic process, from identification to specialized system exams.

Include: tools/equipment, key observations, and types of abnormalities.

5 Gallery Walk

* Each group prepares a poster on one method (palpation, percussion, auscultation, visual inspection).

* Posters are displayed; students walk around, view, and add sticky notes with questions or connections.

Case Study Exercises

Case Study 1: "The Coughing Cow"

You are called to examine a dairy cow that has been coughing for two days.

The owner reports reduced milk production and occasional nasal discharge.

Questions for the group:

1. What history questions would you ask the owner?
2. How would you begin your general and specific examinations?
3. Which systems are most relevant to focus on?
4. What might you look for during auscultation and visual inspection?

Case Study 2: "The Lame Goat"

A farmer reports that his 3-year-old goat has become lame on the left forelimb.

Group tasks:

* Identify the history to take (housing, recent transport, trauma).
* Describe your approach: identification, general examination, and musculoskeletal system exam.
* List possible findings during palpation and inspection.
* Discuss differential diagnoses (trauma, infection, joint disease).

Case Study 3: "The Lethargic Dog"

A 6-year-old dog appears dull, eats poorly, and rarely plays.

Group discussion:

* How would you evaluate the animal's behavior and demeanor?
* What are the steps in a full general examination?
* Which systems might you examine in detail?
* Which history elements could be important (diet, vaccination, past illness)?

Case Study 4: "The Pregnant Cow"

During a routine herd check, a cow appears to have an enlarged udder and abnormal milk consistency.

Questions:

* Which part of the history is important?
* How would you conduct the urogenital system exam?
* What signs could suggest mastitis or other udder conditions?
* Which tools or tests might you use next?

Case Study 5: "The Sheep with Swellings"

A shepherd notices swellings behind the jaw of one of his sheep.

Task:

* Identify which lymph nodes are enlarged.
* What history would you collect?

* How would you perform palpation and inspection?
* Discuss possible systemic diseases indicated by lymph node enlargement.

Restraint of Animals

a) Restraint of Calves:

Calves can be restrained by controlling their head and neck using hands or a halter. Mechanical devices and rope casting are not necessary for calves. When dehorning, castration, branding, and examination is done, it is normally done by casting the calf.

b) Restraint of Very Young Calves:

Very young calves are usually restrained for castration or dehorning by bringing the animal down. The handler stands on one side of the calf, bends over, and reaches to pull the side closest to the body. The calf is then eased down to the ground with its weight against the handler's legs so that it falls over the knee or legs. Note: Never cast a calf by pulling its legs quickly, as this may injure the animal.

c) Restraint of Larger Calves (80-100 kg):

Larger calves (80-100 kg) can be cast by holding the lower jaw and ear and twisting the head fast to the left while standing in front of the animal. The animal will be thrown off balance and fall onto the ground. Once the animal is flat, control can be obtained by kneeling on the neck and pressing down on the head.

For castration, the rear legs can be pulled forward and held by tying them with a rope around the calf's neck or handled manually. Dehorning and vaccination may require driving the larger animals into a crush.

d) Restraint of Small Ruminants (Sheep and Goats):

When handling sheep and goats, they should be moved as a flock into a confined area where they can be caught and handled individually. They should be driven slowly and gently toward the confinement area and allowed to see the opening. When one enters, the rest will follow.

For handling large animals, especially for spraying and dehorning, a crush is normally used. For catching and holding individual animals, hand restraint is all that is necessary. After the flock is confined in a small area, individuals can be caught and held by placing one hand under the neck and the other hand under the rump. Do not catch them by their four legs.

Purpose of restraints.

Examination: The purpose of this restraint is to perform a clinical examination. The procedure involves placing the right hand on the jaw and the left hand behind the thigh of the animal. The right-hand stop forward movement and the left-hand stops backward movement.

Shearing: This restraint is used to put the animal in a 'sitting' position. The procedure involves twisting and lifting the head and neck of the animal, rotating it backward, and quickly throwing it off balance. The animal will sit on its rump between the feet of the handler, with its back against its legs and all four feet facing away from the handler.

Restraining for a drenching: The purpose of this restraint is to administer drugs to the animal. The animal is held with its neck between the handler's legs and its rump back in a corner or against a solid wall. The handler's legs hold the neck just in

front of the shoulders and push back slightly with one hand firmly grasping the lower jaw, giving complete control over the head and neck. The other hand is free to administer drugs orally.

Restraining for docking or castration: The purpose of this restraint is to dock or castrate lambs and kids. They are held by all four legs with their backs resting between the handler's legs and their rumps resting on solid raised objects, such as a table or large wooden block.

Restraining for vaccination: Lambs and kids are held in a sitting position with four legs held upward by the handler. Adult animals are held in a crush.

e) Restraining Pigs:

Pigs are the most difficult animals to restrain and require patience and a soft talking voice. When close contact is made with the pig, it should be scratched or rubbed behind the ears, on the forehead, or along the sides. Pigs can be driven or guided with gentle pressure behind the ears with a blunt object, like a finger or stick. Large pigs can be moved by placing a bucket over their head and moving it backward while guiding their posterior with their tail. Large pigs can also be restrained with a rope squeeze method.

Knots:

Before attempting to restrain animals, it is important to be familiar with commonly used knots, including square knots, reefer knots, surgeon knots, bowline knots, quick knots on a bight, Tom fool knots, halter ties, and highwayman's hitches. Ropes can be made of manila, hemp, sisal, or cotton and must be strong and in good condition.[14]

Exercise 1: Match the Vocabulary with Its Definition

Match the terms from Column A with the correct definitions in Column B.

Column A	Column B
1. Halter	A. A method of restraining animals using narrow passageways
2. Casting	B. A soft-fiber rope made from plant material like hemp or cotton
3. Crush	C. A headgear used to control animals, especially cattle
4. Castration	D. A technique to bring an animal down to the ground safely
5. Dehorning	E. The process of surgically or chemically removing the testicles
6. Ruminants	F. The process of removing horns from animals
7. Manila	G. Animals that chew cud and have a complex stomach (e.g., sheep, goats)

[14] Presentations on the subject "Therapy" and "Internal diseases" done by PhD Ostap Stefanyk and PhD Mykola Lychuk. Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv. 2025.

Exercise 2: Fill in the Blanks

Use the correct word from the box below to complete the sentences.

Word Bank:

casting, halter, jaw, restraint, crush, drenching, docking, dehorning, shearing

1. A _____ is used to control the head and neck of calves.
2. The process of _____ involves removing the horns of an animal.
3. _____ is the act of bringing an animal down to the ground safely.
4. Animals are placed in a _____ when restraining for spraying or vaccination.
5. _____ involves administering liquid medication orally to animals.
6. During _____, animals are put in a sitting position for wool removal.
7. The animal's _____ is firmly held when restraining for a clinical examination.
8. Lambs and kids are held by all four legs for _____ or castration.

Exercise 3: Synonyms or Closest Meaning

Choose the word or phrase that is closest in meaning to the bolded word.

1. Pigs are the most **difficult** animals to restrain.
   a) Calm
   b) Easy
   c) Challenging
   d) Simple
2. The animal is **thrown off balance** by twisting the head.
   a) Balanced
   b) Made unstable
   c) Calmed
   d) Lifted gently
3. Handlers should always be **gentle** with small ruminants.
   a) Rough
   b) Forceful
   c) Careful and kind
   d) Quick
4. Do not use **mechanical** devices on very young calves.
   a) Physical
   b) Animal-powered
   c) Electronic
   d) Machine-based

Exercise 4: Multiple Choice Questions

1. What is the purpose of restraining a calf during examination?
   a) To feed it

b) To clean it
c) To prevent movement during clinical assessment
d) To play with it

2. Which restraint method is recommended for very young calves?
a) Using a crush
b) Pulling the legs quickly
c) Easing them down with the handler's body
d) Using a rope squeeze

3. What is the correct method to handle sheep and goats?
a) Catching them by all four legs
b) Chasing them individually
c) Moving them gently into a confined area
d) Throwing them directly to the ground

4. Why should pigs be handled with patience?
a) Because they are slow
b) Because they are friendly
c) Because they are difficult to restrain
d) Because they are small

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Think–Pair–Share: "Why restrain?"

Think: Individually, students list at least three purposes of animal restraint (e.g., safety, examination, treatment).

Pair: Discuss with a partner and compare lists.

Share: Pairs share with the class; instructor writes key purposes and examples on the board.

2 Jigsaw: "Species-specific restraint"

Divide the class into expert groups, each assigned one animal category:

* Calves
* Small ruminants (sheep/goats)
* Pigs
* Knots and ropes

Step 1: Each expert group discusses:

* The proper methods for restraint
* Precautions to avoid injury
* Typical procedures performed while restrained

Step 2: Students reorganize into mixed groups where each student teaches their group about their animal.

Outcome: Each group builds a complete "Restraint Manual" covering all species.

3 Role Play & Demonstration

* In small groups, students role play being handler and animal (or use a model/dummy).

* Practice:
  * Casting a calf
  * Holding a sheep in sitting position
  * Restraining for drenching or vaccination
* Rotate roles so everyone practices and observes.

Discussion: After practice, groups reflect on what was easy, difficult, or surprising.

4 Collaborative Poster: "Safe and unsafe restraint"

* Groups create a poster showing:
  * Correct techniques
  * Unsafe practices to avoid (e.g., pulling a calf's legs quickly)
* Include drawings or step-by-step diagrams.
* Display and do a gallery walk where others add sticky notes with questions or comments.

Knot Workshop

* Instructor demonstrates each knot (e.g., bowline, square knot).
* Groups practice tying them.
* Groups challenge each other: "Which knot would you use and why?" for different scenarios (e.g., tying a calf, making a quick-release tie).

Case Study Exercises

Case Study 1: "The Nervous Calf"

A farmer asks you to restrain a 2-month-old calf for dehorning. The calf is nervous and weighs about 50 kg.

Questions for group discussion:

1. Which restraint method is most appropriate?
2. Should you use ropes or mechanical devices? Why or why not?
3. How do you ensure the calf doesn't injure itself during the procedure?
4. What knot might be useful if you need to tie something quickly?

Case Study 2: "Castrating a Young Goat"

A 2-week-old male kid needs castration.

Task:

* Describe step-by-step how to catch, hold, and restrain the kid safely.
* Explain why it's important not to pull legs roughly.
* Discuss how you would position the kid during the procedure.

Case Study 3: "Vaccinating Adult Sheep"

A flock of adult sheep needs vaccination.

Group discussion:

* What is the safest way to gather and restrain the flock?
* How do you hold individual animals for vaccination?
* What extra equipment might help if the sheep are agitated?

Case Study 4: "Handling a Large Pig"

A 100 kg pig must be moved from the pen to a treatment area and restrained for hoof trimming.

Questions:

1. What are safe ways to approach and calm the pig?
2. Which methods could you use to guide and restrain the pig?
3. Why is patience and a soft voice emphasized when handling pigs?

Case Study 5: "Knot Challenge"

You must restrain a calf using a rope, and you need to make a loop that won't tighten under tension.

Task:

* Identify the best knot (e.g., bowline).
* Explain why this knot is suitable.
* Demonstrate it to your group or on a dummy.

Veterinary Pathology

Pathology, medical specialty concerned with the determining causes of disease and the structural and functional changes occurring in abnormal conditions. Early efforts to study pathology were often stymied by religious prohibitions against autopsies, but these gradually relaxed during the late Middle Ages, allowing autopsies to determine the cause of death, the basis for pathology. The resultant accumulating anatomical information culminated in the publication of the first systematic textbook of morbid anatomy by the Italian Giovanni Battista Morgagni in 1761, which located diseases within individual organs for the first time. The correlation between clinical symptoms and pathological changes was not made until the first half of the 19th century.

The existing humoral theories of pathology were replaced by a more scientific cellular theory; Rudolf Virchow in 1858 argued that the nature of disease could be understood by means of the microscopic analysis of affected cells. The bacteriologic theory of disease developed late in the 19th century by Louis Pasteur and Robert Koch provided the final clue to understanding many disease processes.

Pathology as a separate specialty was fairly well established by the end of the 19th century. The pathologist does much of his work in the laboratory and reports to and consults with the clinical physician who directly attends to the patient. The types of laboratory specimens examined by the pathologist include surgically removed body parts, blood and other body fluids, urine, feces, exudates, etc. Pathology practice also includes the reconstruction of the last chapter of the physical life of a deceased person through the procedure of autopsy, which provides valuable and otherwise unobtainable information concerning disease processes. The knowledge required for the proper general practice of pathology is too great to be attainable by single individuals, so wherever conditions permit it, subspecialists collaborate. Among the laboratory subspecialties in which pathologists work are neuropathology, pediatric pathology, general surgical pathology, dermatopathology, and forensic pathology.

Microbial cultures for the identification of infectious disease, simpler access to internal organs for biopsy through the use of glass fibre-optic instruments, finer definition of subcellular structures with the electron microscope, and a wide array of chemical stains have greatly expanded the information available to the pathologist in determining the causes of disease. Formal medical education with the attainment of an M.D. degree or its equivalent is required prior to admission to pathology postgraduate programs in many Western countries. The program required for board certification as a pathologist roughly amounts to five years of postgraduate study and training.

Disease, any harmful deviation from the normal structural or functional state of an organism, generally associated with certain signs and symptoms and differing in nature from physical injury. A diseased organism commonly exhibits signs or symptoms indicative of its abnormal state. Thus, the normal condition of an organism must be understood in order to recognize the hallmarks of disease. Nevertheless, a sharp demarcation between disease and health is not always apparent.

The study of disease is called pathology. It involves the determination of the cause (etiology) of the disease, the understanding of the mechanisms of its development (pathogenesis), the structural changes associated with the disease process (morphological changes), and the functional consequences of those changes. Correctly identifying the cause of a disease is necessary to identifying the proper course of treatment.

Humans, other animals, and plants are all susceptible to diseases of some sort. However, that which disrupts the normal functioning of one type of organism may have no effect on the other types.

Exercise 1: Match the Vocabulary with Its Definition

Match each word to its correct definition.

Vocabulary	Definitions
1. Pathology	A. A detailed examination of a body after death to determine the cause of death
2. Autopsy	B. The science that studies the cause and effects of diseases
3. Etiology	C. The structural and functional result of a disease
4. Morphological changes	D. The origin or cause of a disease
5. Pathogenesis	E. The development and progression mechanism of a disease
6. Subspecialist	F. A medical expert who focuses on a narrow field within a broader specialty
7. Forensic Pathology	G. The field of pathology focused on legal investigations of death

Exercise 2: Fill in the Blanks

Choose the correct word from the box to complete each sentence.

Word Bank: *pathologist, autopsy, etiology, disease, biopsy, electron microscope, symptoms, forensic*

1. A _____ is a specialist who examines tissues and fluids to diagnose disease.
2. An _____ helps determine the cause of death by examining the body after death.
3. The _____ of an illness refers to its origin or cause.
4. A _____ involves removing a small piece of tissue for examination.
5. The _____ is used to study the fine details of cell structures.
6. _____ is any harmful deviation from the normal state of an organism.
7. Headache and fever are common _____ of viral infections.
8. _____ pathology is often used in criminal investigations.

Exercise 3: Synonyms or Closest Meaning

Choose the word that is **closest in meaning** to the bolded word.

1. The pathologist performed a **microscopic** examination of the tissue.
   a) Macroscopic
   b) Small-scale
   c) Rough
   d) External
2. Medical students must complete years of **postgraduate** training.
   a) Elementary
   b) Advanced
   c) Undergraduate
   d) Informal
3. The disease caused a **deviation** from normal body function.
   a) Improvement
   b) Return
   c) Change
   d) Stability
4. The discovery of microbes helped **expand** the field of pathology.
   a) Shrink
   b) Limit
   c) Broaden
   d) Ignore

Exercise 4: Multiple Choice Questions

Choose the correct answer for each question.

1. What major scientific advancement helped replace humoral theories in pathology?
   a) Herbal remedies
   b) Bloodletting
   c) Cellular theory and bacteriology
   d) Astrology

2. Who argued that disease could be understood through analysis of affected cells?

a) Louis Pasteur
b) Robert Koch
c) Giovanni Morgagni
d) Rudolf Virchow

3. What does the term **pathogenesis** refer to?

a) The death of the patient
b) The origin of disease
c) The development and mechanism of a disease
d) The treatment options available

4. Which of the following is **not** typically examined by a pathologist?

a) Blood
b) Skin
c) Glass fiber
d) Feces

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Timeline Puzzle: "History of Pathology"

Step 1: Instructor prepares cards, each describing a historical milestone (e.g., Morgagni's textbook, Virchow's cellular theory, Pasteur & Koch's bacteriology).

Step 2: Students work in small groups to arrange the cards in chronological order.

Step 3: Groups discuss:

How each discovery changed the understanding of disease.

Why each was significant in veterinary pathology.

Share: Groups present their timeline and insights.

2 Jigsaw: "Key Concepts of Pathology"

Divide students into *expert groups*, each focusing on one concept:

* Etiology (cause of disease)
* Pathogenesis (mechanism)
* Morphological changes (structural)
* Functional consequences

Step 1: Experts discuss definitions, examples, and why their concept is critical.

Step 2: Form *mixed groups* where each student teaches their concept to others.

Outcome: Each mixed group creates a summary table covering all four concepts with examples.

3 Concept Mapping: "Pathology Today"

* Groups draw a large concept map linking:
  * Pathology as a specialty
  * Laboratory subspecialties (e.g., neuropathology, forensic pathology)
  * Techniques and tools (e.g., electron microscope, stains, fibre-optic biopsy)

* Relationship to clinical medicine

* Use arrows to show connections (e.g., "Electron microscope → subcellular structures → helps in diagnosis").

Discussion: Groups compare maps and explain differences.

4 Role Play: "Pathologist & Clinician"

* In pairs, one student acts as a pathologist, the other as a clinician.
* Clinician presents a case (real or made-up).
* Pathologist explains how they would help:
  * What samples to examine
  * Which tests to run
  * What information an autopsy could provide

Rotate roles to give everyone practice.

5 "Disease Detective" Game

* Instructor describes symptoms and lab findings of an animal disease.
* Groups discuss:
  * Likely etiology
  * Possible morphological changes
  * Functional consequences
* Groups present reasoning, then the instructor reveals the actual disease.

Case Study Exercises

Case Study 1: "The Calf with Neurological Signs"

A calf shows neurological symptoms before dying. The clinician suspects a brain disease.

Discussion Questions:

1. Which subspecialty of pathology should be involved?
2. What samples should be collected for lab examination?
3. What tools or stains could be used to help identify the disease?

Case Study 2: "Unexplained Death in a Sheep Flock"

Several sheep have died suddenly without clear external injuries.

Tasks:

* Discuss why an autopsy is important.
* Explain what the pathologist might look for during autopsy.
* How could this information help the veterinarian prevent more deaths?

Case Study 3: "Linking Clinical Symptoms and Pathology"

A dog has chronic coughing and weakness. X-rays show lung changes.

Group Questions:

1. Describe how pathology helps correlate clinical signs with structural changes.
2. What could be the pathogenesis behind these signs?
3. How would the pathologist assist the clinician in confirming the diagnosis?

Case Study 4: "New Disease in Poultry"

A poultry farm experiences unexplained illness. Samples are sent to the lab.

Discussion:

* What steps would the pathologist take to identify the disease?
* Which modern techniques could help (e.g., microbial culture, microscopy)?
* Why is identifying the cause (etiology) essential?

Case Study 5: "The Grey Zone between Health and Disease"

Some animals in a herd show mild signs, while others appear healthy.

Group Discussion:

* Why can it be difficult to draw a clear line between disease and health?
* How could understanding pathogenesis and morphology help explain these mild cases?
* What should the vet monitor over time?

Inborn Errors of Metabolism - The Basis of Single-Gene Disorders

Genetic defects include anatomical malformations, inborn errors of metabolism, as well as increased susceptibility to disease. There is a considerable degree of overlap and all can have a metabolic basis:

Congenital skeletal malformations due to genetic defects have been clinically recognized for decades, but there are also many soft tissue and internal organ anomalies. Many are recognized at birth (congenital), but not all birth defects have a hereditary basis. Furthermore, some of the defects are associated with a single malformation, whereas others are part of a syndrome (chondrodysplastic Alaska malamute dwarf with stomatocytosis, group of mucopolysaccharidoses and other storage diseases in various animal species).

"Inborn errors of metabolism" (Sir Archibald Garrod, 1901) includes today all biochemical disorders due to a genetically determined, specific defect in the structure and/or function of a protein molecule. Aside from the classical enzyme deficiencies, genetic defects in structural proteins, receptors, plasma and membrane transport proteins, and other proteins, covered by this definition, will result in biochemical/metabolic disturbances. Currently inborn errors refer to single gene defects. With the better characterization of hereditary disorders practically all genetic defects could be considered to be inborn errors of metabolism including malformations and susceptibility to disease.

Increased susceptibility to disease has been recognized more recently to have a genetic basis. Single gene defects for a variety of genetic predispositions have been identified, whereas predispositions caused by complex/polygenic traits are being characterized and include predispositions to infections, inflammation, immune disorders, drug reactions, and neoplasia.

Certainly not all proteins are enzymes with catalytic function. Many proteins are structural or contractile in function, some represent receptors that mediate inter- or intracellular signals or endocytosis of nutrients, some are membrane ion channels or molecular transporters, others are adhesion proteins that mediate cell migration during embryologic development or inflammation. Proper function of any protein may depend not only on tissue specific or developmentally regulated transcription

and translation, but also on posttranslational modifications, proper subcellular localization or secretion of a protein, protein stability, substrate or ligand affinity, cofactor binding, and homeostatic regulation. Most of these characteristics of an expressed protein are determined by the amino acid sequence and the inherent secondary and tertiary folding of the protein in question. Thus, any mutation affecting the coding sequence in some way can produce any of a variety of malfunctions of the mature protein.

Furthermore, many enzyme functions depend on the availability of a vitamin or high energy intermediate compound (cofactors). Therefore, in addition to those in which a mutation has altered the affinity of an enzyme for the cofactor, the class of cofactor-responsive metabolic diseases includes some in which mutations in loci distinct from that of the enzyme affect the normal absorption or conversion to the active form of the required cofactors. Of the metabolic disorders, these are the most amendable to traditional forms of therapy (parenteral or megadose vitamin supplementation).

Inborn errors of metabolism may lead to the dysfunction of a biological system or pathway either under normal conditions or during more demanding situations such as the presence of concurrent disease, since many are in the catabolic pathways. Screening tests should lead to the detection of the failing system. Routine tests such as a complete blood count and a chemistry screen may reveal a specific metabolic problem such as inclusions in white blood cells or hyperlipidemia, respectively. Imaging techniques, gastrointestinal and liver function investigations as well as renal clearance function studies may more clearly define an organ failure, while for others the first clue is found only after pathologic examination of tissues.[15]

Exercise 1: Matching Definitions

Match the terms to their correct definitions.

Term	Definition
A. Inborn errors of metabolism	1. Genetic conditions where multiple abnormalities occur together as part of a recognizable pattern.
B. Cofactor	2. An inherited biochemical disorder caused by a defect in a single gene affecting protein structure or function.
C. Syndrome	3. A molecule required by an enzyme to function, often a vitamin or a high-energy compound.
D. Mutation	4. A change in the DNA sequence that can affect protein function.
E. Homeostatic regulation	5. The process of maintaining internal stability in a biological system.

15 https://www.vin.com/apputil/content/defaultadv1.aspx?pId=11203&catId=30944&id=3853856&ind=18&objTypeID=17

Exercise 2: Fill in the Blanks

Use the correct word from the box to complete each sentence.

Words: enzyme, susceptibility, transcription, hereditary, metabolism, structural, malformation, receptor

1. Some birth defects are _____, while others are caused by environmental factors.
2. A _____ is a protein that receives signals and helps transmit them inside or between cells.
3. Inborn errors of _____ often involve problems with how the body breaks down substances.
4. A _____ is an abnormality in the shape or structure of a body part.
5. Increased _____ to disease may be caused by a single gene defect.
6. _____ refers to the process where DNA is copied into RNA for protein production.
7. Not all proteins are enzymes; some have a _____ function, like building tissues.
8. An _____ helps speed up chemical reactions in the body.

Exercise 3: Multiple Choice

Choose the correct answer.

1. What type of proteins mediate cell signaling and uptake of nutrients?
   * A. Structural proteins
   * B. Receptors
   * C. Enzymes
   * D. Adhesion proteins
2. Which scientist coined the term "inborn errors of metabolism"?
   * A. Gregor Mendel
   * B. Sir Archibald Garrod
   * C. Watson and Crick
   * D. Louis Pasteur
3. What is the primary cause of inborn errors of metabolism?
   * A. Environmental toxins
   * B. Viral infections
   * C. Single gene mutations
   * D. Lifestyle factors
4. What kind of therapy might be effective for cofactor-responsive metabolic diseases?
   * A. Chemotherapy
   * B. Surgery
   * C. Vitamin supplementation
   * D. Antibiotic treatment

Exercise 4: Short Answer

Answer in 1–2 sentences.

1. Explain how mutations can lead to malfunctions in protein function.

2. Why might some inborn errors of metabolism only cause problems under stress or illness?

3. Name two types of proteins mentioned in the text and describe their functions.

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "Understanding the Spectrum"

Step 1: Form expert groups, each studies and prepares to explain:

* Group A: Congenital malformations & syndromes (e.g., mucopolysaccharidoses)

* Group B: Classical enzyme deficiencies vs. defects in structural proteins, receptors, and transporters

* Group C: Increased genetic susceptibility to disease (e.g., infections, neoplasia)

* Group D: Role of cofactors and cofactor-responsive diseases

Step 2: Form mixed groups** so each has one member from A, B, C, D.

Each “expert” teaches their topic to their group.

Step 3: Groups create a shared table:

| Category | Example | Mechanism | Key Features |

2. “Protein Pathways” Concept Map

Groups draw a concept map showing:

* How mutations → abnormal protein folding → malfunction (enzyme deficiency, receptor defect, etc.)

* Consequences: malformations, storage diseases, metabolic disturbances

* Role of cofactors and environmental stress

Tip: Use color codes:

* Structural proteins

* Enzymes

* Transporters/receptors

* Cofactor-related diseases

Groups share and explain.

3. “Mutation to Malfunction” Small Group Discussion

Instructor provides different gene mutation cards (e.g., coding mutation, splicing defect, posttranslational modification defect).

Groups discuss:

* What type of protein might be affected?

* Predict how this mutation could lead to disease (loss of function, gain of function, misfolding, reduced stability)

* Suggest diagnostic tests to confirm

Groups present conclusions.

4 Think–Pair–Share: "Beyond Enzymes"

Step 1: Think:

Why do inborn errors of metabolism include more than enzyme defects?

Step 2: Pair:

Discuss examples from the text (e.g., membrane ion channels, adhesion proteins).

Step 3: Share:

Each pair explains why considering non-enzymatic proteins is critical in veterinary pathology.

5 "Diagnosis Detective" Simulation

Scenario: A dog presents with recurrent infections and poor wound healing.

Groups:

* Identify potential single-gene defects behind the symptoms

* Decide which routine and advanced tests to run (CBC, imaging, enzyme assays, genetic testing)

* Discuss if this could be related to an inborn error of metabolism or immune-related genetic defect

Case Study Exercises

Case Study 1: "The Stunted Pup"

An Alaskan malamute pup shows dwarfism and red cell anomalies (stomatocytosis).

Questions:

1. Why is this considered a syndrome?
2. What type of genetic defect is likely involved?
3. How could lab tests help confirm the diagnosis?
4. Could this be part of inborn errors of metabolism? Why?

Case Study 2: "The Vitamin Solution"

A kitten has enzyme deficiency symptoms, but improves dramatically after high-dose vitamin supplementation.

Questions:

1. How does this illustrate a cofactor-responsive metabolic disorder?
2. Why do some genetic mutations respond to vitamin therapy?
3. What kinds of mutations might be involved (enzyme vs. absorption/activation)?

Case Study 3: "Hidden Disorder Revealed by Stress"

A young cow seems healthy but develops severe metabolic crisis after an unrelated illness.

Tasks:

* Discuss why the defect may only show during catabolic stress.

* Which metabolic pathway might be failing?

* What screening tests would help reveal the problem?

Case Study 4: "Unexpected Organ Failure"

A necropsy reveals severe storage of material in lysosomes of liver cells.

Group Questions:

1. Suggest possible inborn errors of metabolism involved.
2. Explain why the disease may have only been detectable at post-mortem.
3. Which protein types could be affected?

Case Study 5: "Structural vs. Functional"

Two calves: one has skeletal malformation; another has enzyme deficiency.

Compare & discuss:

* How the underlying gene defects differ
* The common metabolic basis
* Importance of amino acid sequence and folding in both

Inflammation

Inflammation is a rapid and coordinated response to microbial infection and tissue injury. These stimuli lead to the migration of immune cells to the site of infection and/or injury. For many, inflammation is regarded as an unwanted response, particularly as it can lead to serious consequences, such as immune dysfunction, further tissue damage, sepsis, organ failure, or even death. However, inflammation is a critical innate immune process that seeks to contain an infection, activate adaptive immunity, repair damaged tissue, and return to a homeostatic state. Rapid, targeted, effective and quick resolution are the hallmarks of a desired inflammatory response.

Inflammation is initiated by innate immune cells residing in the affected tissue(s). Innate cells such as dendritic, macrophages, and heterophils/neutrophils, including epithelial cells, express pattern recognition receptors (PRRs) that recognize highly conserved microbial molecular signatures referred to as microbe-associated molecular patterns or host-derived molecules (e.g., uric acid, ATP, DNA fragments, and mitochondrial contents), indicative of cell damage, known as damage-associated molecular patterns (DAMPs). Inflammatory processes are vital immune functions, which have been demonstrated to reduce susceptibility to a variety of important poultry and pig pathogens. Conversely, inflammation can lead to unnecessary tissue damage and nutrient diversion from productive purposes. Thus, pursuit of either pro- or anti-inflammatory focused products or strategies, in isolation, is likely to yield undesirable consequences (e.g., increased susceptibility to at least some ubiquitous pathogens). In fact, particularly in younger animals, a reliance on the better developed, more rapid innate immune response could make supporting related processes the sensible approach. Future studies, along with improved analytical techniques, will help to unravel the trade-offs between robust immune defense and optimum productive performance. This will lead to a better understanding of the pathways or processes that we should seek to influence to promote robust and efficient animal production.[16]

[16] https://www.zinpro.com/performance-solutions/managing-inflammation/

Exercise 1: Matching Terms with Definitions

Match each term with its correct definition.

Term	Definition
A. Inflammation	1. Immune cells that recognize pathogens and help activate other immune responses
B. DAMPs	2. The immune system's fast, localized response to infection or injury
C. PRRs	3. Molecules released by damaged or dying cells that trigger an immune response
D. Macrophages	4. Specialized receptors that identify microbial signatures and cellular damage
E. Sepsis	5. A life-threatening condition caused by an extreme immune response to infection

Exercise 2: Fill in the Blanks

Use the correct word from the box to complete the sentences.

Word Bank: innate, adaptive, pathogens, resolution, uric acid, neutrophils, tissue, productive

1. _____ immune cells act as the first line of defense in inflammation.
2. One goal of inflammation is the _____ of infection and restoration of balance.
3. _____ are a type of white blood cell that help fight infections early.
4. Microbe-associated molecular patterns help the immune system recognize _____.
5. Substances like ATP and _____ signal tissue damage to the immune system.
6. Inflammation often involves the recruitment of immune cells to the affected _____.
7. Inflammation that is not well-regulated can interfere with _____ functions in animals.
8. The _____ immune system is slower but more specific than the innate system.

Exercise 3: Multiple Choice

Choose the best answer.

1. What is the **main purpose** of inflammation?
   * A. To kill healthy cells
   * B. To trigger sepsis
   * C. To repair tissue and fight infection
   * D. To increase nutrient intake

2. What do **pattern recognition receptors (PRRs)** detect?

* A. Host cell receptors
* B. Hormones
* C. Pathogens and signs of cell damage
* D. Nutrients and vitamins

3. Which of the following is an example of a **DAMP**?

* A. A virus
* B. Uric acid
* C. Antibodies
* D. Bacterial flagella

4. What is a potential **negative effect** of excessive inflammation in livestock?

* A. Improved digestion
* B. Immune dysfunction and poor growth
* C. Resistance to all diseases
* D. Higher reproductive rates

Exercise 4: Short Answer

Answer the following in 1–2 sentences.

1. Why is inflammation considered both helpful and potentially harmful?
2. How do innate immune cells detect an infection or tissue injury?
3. What is the danger of using only pro- or anti-inflammatory strategies in isolation?
4. Why might younger animals rely more on the innate immune response?

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "The Faces of Inflammation"

Divide into expert groups:

* Group A: Benefits of inflammation (infection control, tissue repair, adaptive immunity activation)
* Group B: Risks of inflammation (tissue damage, sepsis, immune dysfunction, nutrient diversion)
* Group C: Key cellular players and PRRs (macrophages, dendritic cells, epithelial cells; PRRs recognizing PAMPs and DAMPs)
* Group D: Trade-offs in animal production (pro- vs anti-inflammatory strategies; impact on susceptibility and productivity)

Step 1: Each expert group studies and summarizes their topic.

Step 2: Form mixed groups, share expertise, and discuss:

"What would an ideal inflammatory response look like in livestock?"

Step 3: Each mixed group presents a visual: timeline, diagram, or flowchart.

2 "Pathway Map" Group Drawing

Each group creates a large flowchart starting from:

* Tissue injury/infection → PRR activation → immune cell recruitment → outcomes (contain infection, repair tissue, return to homeostasis OR excess tissue damage/sepsis)

Add:

* Where PAMPs vs DAMPs fit in
* Points where regulation is critical
* Potential interventions (feed additives, management)

Groups explain their maps to the class.

3 Think–Pair–Share: "Too Much or Too Little?"

Step 1 (Think):

Why is inflammation both essential and potentially harmful?

Step 2 (Pair):

Discuss real-life examples in poultry/pigs where over- or under-reactive inflammation causes issues.

Step 3 (Share):

Pairs report back, and the class builds a "double-edged sword" board listing pros/cons.

4 Debate: "Pro-Inflammatory vs Anti-Inflammatory Strategies"

Divide into two teams:

* Team Pro: Argues for supporting a stronger innate inflammatory response to protect against pathogens.
* Team Anti: Argues for focusing on limiting inflammation to protect growth and prevent tissue damage.

Each team:

* Prepares arguments and evidence
* Presents
* Class votes on which approach they'd choose in practice—and why

5 "Inflammation in Action" Simulation

Instructor describes a scenario:

"A pig farm faces frequent respiratory infections and slower growth rates."

Groups discuss:

* Possible roles of inflammation in this situation
* Which diagnostic tests/markers could help assess inflammation (e.g., acute phase proteins, histopathology)
* Balanced interventions to reduce disease risk while supporting growth

Groups write and share action plans.

Case Study Exercises

Case Study 1: "The Overzealous Response"

A flock of broiler chickens develops systemic inflammation after a mild bacterial infection. Mortality increases; growth rates drop.

Questions:

1. Why might inflammation cause mortality and poor growth?

2. Which cells and PRRs likely initiated this response?
3. Suggest ways to modulate inflammation without suppressing immunity.

Case Study 2: "The Silent Infection"

In a pig herd, pigs show minimal clinical signs but tests reveal chronic, low-level infection and tissue damage at slaughter.

Tasks:

* Discuss how insufficient inflammation might contribute to this scenario.
* Predict long-term impacts on production.
* Recommend management and nutrition changes to help.

Case Study 3: "The Trade-off"

A producer adds a strong anti-inflammatory feed additive. Inflammation markers drop, but pathogen-related lesions increase at slaughter.

Group questions:

1. Why might this happen?
2. Explain the balance between inflammation and disease resistance.
3. Suggest an adjusted strategy.

Case Study 4: "The Young and Vulnerable"

Piglets, relying mainly on innate immunity, experience higher mortality from bacterial infections.

Discuss:

* Why younger animals depend more on innate inflammatory responses.
* How interventions could support them without excessive inflammation.
* Possible markers to monitor immune readiness.

Case Study 5: "Recognizing Danger"

After tissue injury, animals show rapid inflammation—even without infection.

Questions:

* What molecules likely triggered the response (PAMPs vs DAMPs)?
* Which PRRs were activated?
* Explain why this is still beneficial.

Veterinary Pharmacology

ANTISEPTIC DRUGS (GROUP OF OXIDIZERS, IODINE, AND CHLORINE). ETHYL ALCOHOL.

Antiseptics are drugs that neutralize pathogenic microorganisms on the skin, in the wound, and at the site of animals' inflammation.

In the practice of veterinary medicine, effective antimicrobial agents are:

- Preparations from the halogens group (iodine and chlorine group) - alcohol iodine solution, Lugol's solution, iodinol, iodoform, iodonate, iodopyrone, iodicarin, chlorhexidine bigluconate, chloramine B.
- Oxidizers - hydrogen peroxide, potassium permanganate;
- Alcohol - ethyl alcohol in 60-70% concentration.

Oxidants in contact with body tissues decompose with the release of molecular (hydrogen peroxide) or atomic (potassium permanganate) Oxygen, which causes oxidation of the microbial substrate and leads to their death.

The hydrogen peroxide solution is concentrated (perhydrol). Contains 27.5-31% H_2O_2. It is used in a solution for rinsing and lubrication for sore throats and stomatitis to treat purulent wounds. In dermatology, as a depigmenting agent.

The official hydrogen peroxide solution contains 3% H_2O_2. It can be used mainly for rinsing the mouth and cleaning wounds to disinfect the skin. The drug has deodorizing properties.

Hydroperite. A complex compound of hydrogen peroxide with urea. Contains about 35% H_2O_2. To prepare a solution corresponding to about 1% H_2O_2 solution., 2 tablets [1 tablet corresponds to 15 ml of 3% hydrogen peroxide solution (0.45 g)] are dissolved in 100 ml of water.

Potassium permanganate forms a dark purple aqueous solution that can stain fabrics and clothing brown. Solutions of potassium permanganate diluting 1: 5000-1: 10000 for 1 hour cause many microorganisms' death. It is used for washing wounds (0.1-0.5% solution), and rinsing the mouth and throat (0.01-0.1%).

The mechanism of antimicrobial action of halogens (Cl, J) is that they interact with the amino groups of the protoplasm of microorganisms, causing denaturation of proteins in their body, which leads to disruption of life and death. Besides, Iodine and Chlorine react with the hydrogen of water and release atomic oxygen, which has a detrimental effect on microbes as a strong oxidant.

Doses inside 0.1-0.2% aqueous solution, ml: horses and cattle - 200-600; sheep and pigs, foals and calves - 50-100.

An alcoholic solution of iodine (5-10% on ethanol) is used as an antiseptic to treat intact skin and cuts. However, it interacts with hydroxyl groups of proteins and thus disrupts their structure.

Iodinol (1% aqueous solution contains 0.1% iodine, 0.3% potassium iodide, and 0.9% polyvinyl alcohol, which slows down the iodine release) for chronic tonsillitis, purulent otitis, purulent surgical diseases, trophic ulcers, burns.

Produced in bottles of 100 ml.

Doses inside, ml: calves 15-25; piglets 3-10; lambs 1-5; chickens 0.2-0.3 for treatment two or three times a day; for prophylactic purposes - once a day for ten consecutive days.

Iodonate (aqueous solution of a complex of surfactant with iodine) is used as an antiseptic to treat the operating field as a substitute for iodine's alcoholic solution.

Povidone-iodine (iodine complex with polyvinylpyrrolidone) is used for skin treatment, causing the death of vegetative forms and spores; its solutions can be contaminated with Pseudomonas species and other gram-negative bacteria.

Lugol's solution is used to treat mucous membranes.

Chlorine and its derivatives have bactericidal and deodorizing effects in a humid environment. When chlorine preparations interact with water, they form hydrochloric acid and atomic oxygen. Chlorine preparations are used to disinfect premises, surgical instruments, surgeon's hands, washing of infected wounds, and oral cavity.

Chloramine B (contains 25-29% of active chlorine) has antiseptic and deodorizing properties. Used to treat infected wounds (1.5-2% solution), hand disinfection (0.25-0.5%) and non-metallic instruments. For disinfection of care items and secretions for intestinal and airborne infections, use 1-3% solution; for tuberculosis infection - 5% solution.

Pantocide is produced in the form of tablets containing 3 mg of active chlorine. Used for disinfection of drinking water: 1 tablet per 0.5-0.75 liters of water, exposure 15 minutes

Chlorhexidine bigluconate (gibitan) is available in a 20% aqueous solution; it has a strong bactericidal property preserved in the presence of blood secretions of purulent exudate. To treat the operating field and sterilize instruments (for 5 minutes), use a 0.5% water-alcohol solution to treat wounds, burns - a 0.5% aqueous solution, and hand disinfection - 0.5% alcohol or 1 % aqueous solutions. In addition, 0.1% aqueous solution is used for disinfection of premises and equipment. Sibicort ointment (containing 1% chlorhexidine and 1% hydrocortisone) is used for eczema and dermatitis as an anti-inflammatory and antibacterial agent.

Ethyl alcohol. It has an antimicrobial effect in an alcohol concentration of about 20%. With increasing concentration, its antimicrobial effect increases, but at concentrations above 70%, alcohol's bactericidal effect decreases.

The antimicrobial action of alcohol is due to dehydration and coagulation of protein. Under the local act, alcohol irritates, followed by suppression of receptor sensitivity and pain weakening.

When used internally in 5-10% concentrations, alcohol enhances the secretion of glands and intestinal motility, and at higher concentrations - inhibits the secretion and coagulates mucus protein.

Ethyl alcohol is used intravenously (not more than 33%) for septic processes; externally as an antiseptic on the skin and mucous membranes, to treat the operating field and prepare the surgeon's hands for surgery, sterilization of instruments; inside - as an anti-fermentation, analgesic and ruminator.

Doses inside 40% alcohol, ml: cattle 150-200, sheep 60-100, dogs 30-50.[17]

Exercise 1: Match the Word to Its Definition

Match each word from the left column with the correct definition on the right.

Word	Definition
1. Antiseptic	a. A substance that kills or inhibits microorganisms
2. Oxidizers	b. A chemical process involving oxygen to destroy microbes
3. Halogens	c. Elements such as iodine and chlorine used for disinfection
4. Denaturation	d. The disruption of the natural structure of proteins

[17] Hunchak V.M., Leskiv Kh.Ya.“ Antimicrobial drugs ”Educational - methodical manual of laboratory and practical lessons for applicants the second level of education (master) specialty 211 "Veterinary medicine." in the discipline of "Veterinary Pharmacology". 2024 112 p

5. Deodorizing	e. Neutralizing or eliminating bad odors
6. Concentration	f. Amount of a substance in a given volume or solution
7. Purulent	g. Containing or producing pus
8. Antimicrobial	h. Capable of destroying or inhibiting microbes
9. Surfactant	i. A substance that reduces surface tension between liquids
10. Coagulation	j. The process of a liquid changing into a thickened or solid state

Exercise 2: Fill in the Blanks

Complete the sentences below with the correct word from the box:

(antiseptic, oxidation, halogens, hydrogen peroxide, denaturation, concentration, bactericidal, deodorizing, surfactant, coagulation)

1. _____ like iodine and chlorine are commonly used in veterinary medicine as disinfectants.
2. The release of oxygen during _____ helps destroy microbial cells.
3. _____ solutions can sometimes stain clothing purple or brown.
4. Alcohol causes _____ of proteins, which leads to microbial death.
5. The _____ of a drug refers to how much of it is present in a solution.
6. _____ agents kill bacteria effectively.
7. A _____ helps reduce the surface tension to allow better mixing of solutions.
8. The drug has _____ properties, eliminating unpleasant smells.
9. _____ is the thickening or solidifying of proteins or liquids.
10. An _____ is a drug that neutralizes harmful microorganisms on skin or wounds.

Exercise 3: True or False

Write **True** or **False** next to each statement.

1. Potassium permanganate solutions are used for washing wounds.
2. Denaturation strengthens the proteins in microorganisms.
3. Ethyl alcohol is most effective at concentrations above 70%.
4. Chloramine B contains active chlorine and is used for disinfecting hands and wounds.
5. Iodinol releases iodine slowly due to the presence of polyvinyl alcohol.
6. Chlorhexidine bigluconate has a weak bactericidal effect in the presence of blood.
7. Hydrogen peroxide solutions can be used for rinsing sore throats.
8. Halogens work by breaking down amino groups in microorganisms' proteins.
9. Purulent wounds are free from infection.
10. Povidone-iodine solutions can be contaminated with bacteria.

Exercise 4: Multiple Choice

Choose the correct answer.

1. Which of the following is NOT an oxidizer?
   a) Hydrogen peroxide
   b) Potassium permanganate
   c) Ethyl alcohol
   d) Chlorhexidine bigluconate
2. Lugol's solution is mainly used for:
   a) Treating mucous membranes
   b) Disinfecting surgical instruments
   c) Treating burns
   d) Deodorizing wounds
3. The antimicrobial effect of alcohol is mainly due to:
   a) Its ability to oxidize proteins
   b) Dehydration and coagulation of proteins
   c) Interaction with amino acids
   d) Formation of hydrochloric acid
4. Which compound contains both hydrogen peroxide and urea?
   a) Hydroperite
   b) Chloramine B
   c) Iodinol
   d) Pantocide
5. Chloramine B is used at what concentration for hand disinfection?
   a) 0.25-0.5%
   b) 1.5-2%
   c) 3-5%
   d) 5-10%

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "Know Your Antiseptic"

Divide the class into expert groups:

* Group A: Oxidizers (hydrogen peroxide, potassium permanganate, hydroperite)

* Group B: Iodine preparations (alcoholic iodine, iodinol, iodonate, povidone-iodine, Lugol's solution)

* Group C: Chlorine compounds (chloramine B, pantocide, chlorhexidine bigluconate)

* Group D: Ethyl alcohol

Each expert group:

* Summarizes their antiseptics: mechanism of action, veterinary uses, forms, concentrations, precautions.

* Prepares a mini-poster or slide.

Then:

* Form mixed groups where each "expert" teaches the others.

* Each mixed group creates a **comparison chart**: mode of action, spectrum, typical applications, pros/cons.

2 Matching Game: "What, Where, How"

Prepare cards:

* Names of antiseptics
* Uses (skin disinfection, wound lavage, mucous membrane treatment, etc.)
* Mechanism keywords (oxidation, protein coagulation, denaturation)
* Typical concentrations

Groups race to correctly match them on a board or table.

Discuss answers together.

3 Flowchart Design: "From Infection to Antiseptic"

Each group designs a flowchart:

1. Animal with infection/injury
2. Decide which antiseptic group is suitable (oxidizers, iodine, chlorine, alcohol)
3. Specify correct product, concentration, and application method

Groups present and justify choices.

4 Debate: "Old vs New"

* Team A: Advocates traditional agents (iodine, potassium permanganate, ethyl alcohol)
* Team B: Advocates modern agents (povidone-iodine, chlorhexidine bigluconate)

Debate which group is better in veterinary practice for efficacy, safety, convenience.

5 "Create a Label"

Each group invents an antiseptic product based on the text:

* Write: name, active ingredient, mechanism, concentration, indications, dosage for animals
* Design packaging or label
* Present as a short sales pitch

Case Study Exercises

Case Study 1: "The Deep Wound"

A cow suffers a deep purulent wound.

* Which antiseptics can be used? (consider tissue penetration, release of oxygen)
* Recommended concentrations?
* Risks of staining or tissue irritation?

Case Study 2: "Preparing for Surgery"

A vet is preparing to operate on a foal.

* Which antiseptics to use on the skin, surgeon's hands, and instruments?

* Concentrations and exposure times?
* Why might chlorhexidine be chosen over alcohol?

Case Study 3: "Mucous Membrane Lesion"
A sheep has stomatitis (mouth inflammation).
* Which antiseptic is best for mucous membranes?
* Why isn't concentrated ethyl alcohol suitable?
* Recommend product and dosage.

Case Study 4: "Drinking Water Safety"
In hot weather, water for pigs is suspected to be contaminated.
* Which chlorine-based antiseptic can disinfect it?
* Dosage and waiting time?
* Discuss possible taste or toxicity issues.

Case Study 5: "Chronic Ear Infection"
A dog has chronic purulent otitis externa.
* Which iodine preparation is suitable for chronic cases?
* Mechanism of antimicrobial effect?
* Explain how polyvinyl alcohol in iodinol helps.

DISINFECTANTS FROM THE GROUP OF PHENOL AND FORMALDEHYDE. ACIDS, ALKALINE, AND DETERGENTS.

Phenols and their substitutes are widely used as disinfectants and in small concentrations - as effective antiseptics. The drugs cause the denaturation of proteins and disrupt the cell wall structure. The direct use of phenol has been abandoned for a long time, but its derivatives (e.g., resorcinol, chlorophene, thymol, phenylsalicylate, salol) are used relatively often. Hexachlorophene is most active against staphylococci.

Phenol (carbolic acid) is used for disinfection of premises and disinsection. Readily absorbed through the skin and can cause toxic effects: dizziness, weakness, respiratory disorders, and collapse. Phenol is used to disinfect skin and care items. Colorless, very hygroscopic crystals with a specific odor, soluble in water (1:15), ethyl alcohol, and oil.

Under the influence of light, phenol is easily converted into quinone of pink color, which retains its antimicrobial action.

Creolin - for washing infected wounds (1-2% solution), preventing necrobacteriosis. Inside it is used as an anti-fermentation, antiseptic and ruminant.

Tricresol is used instead of phenol and for the preservation of injectable solutions.

Resorcinol is useful for skin diseases (eczema, seborrhea, itching, fungal infections) in aqueous or alcoholic solutions and ointments.

Inside are prescribed excessive fermentation processes in doses, r: horses 10-15; cattle 10-20; livestock and pigs 5-10; dogs 0.5-1.5.

Birch tar contains phenol, toluene, xylene, resins, and other substances and has antimicrobial, insecticidal, and irritant effects. It is a part of Wilkinson's ointment, a balsamic liniment according to A.V. Vyshnevsky.

Birch tar is a part of the liquid ointment of Vyshnevsky (Linimentum Wishnevski), which contains 94 gr of castor oil, 3 gr of birch tar, and 3 gr of xerox per 100 gr. It is used to treat animals for wounds, ulcers, bedsores, and eczema.

The tar is also part of the Unguentum Wilkinson ointment, which contains 15 parts of birch tar, 10 parts of calcium carbonate, 15 parts of purified sulfur or chalk sediment, 30 parts of green soap and naphthalene ointment, and 4 parts of water.

Apply it to treat animals with scabies, scratchy lichen, and other fungal skin lesions.

In its pure form, birch tar is used in orthopedic practice to treat animals for hoof damage and disinfect harnesses; in the form of 10% emulsion, prescribed internally as anti—throat agents by timing and flatulence.

Doses, g: horses and cattle 10-25; sheep and pigs 2-5; dogs 0.1-1.

Ichthyol contains 10.5% organically bound sulfur. It has anti-inflammatory, local anesthetic, and mild antiseptic properties. Ichthyol is used mainly externally in 10-30% ointment for dermatitis, eczema, phlegmon, boils, arthritis, tendinitis, mastitis, and antiseptic for - cattle is used orally for atony of the pancreas.

Aldehydes alkylate amino-, sulfhydryl, and carboxyl groups of proteins and lower molecular weight organic compounds, causing microorganisms' death. They are widely used as preservatives. The most well-known formaldehyde (8%) and glutaraldehyde (2-2.5%) - have an irritant effect (especially vapors), which limits their widespread use.

The antimicrobial action of formaldehyde is due to its ability to remove oxygen, bind to the amino groups of proteins, and precipitate them.

Formaldehyde solution has disinfectant and deodorizing properties. It is used for hand washing, disinfection of instruments, douching, treatment of hooves in animals. It is a part of drugs: formidron, formalin ointment.

Lysoform is a soap solution of formaldehyde. It is used for douching in obstetrics and gynecology, for disinfection of hands and premises.

Hexamethylenetetramine (urotropin) in the body's acidic environment is broken down with formaldehyde release, excreted in the urine, and has an antiseptic effect. It is used in infectious processes of the urinary and biliary tract, skin diseases. It is a part of the combined drugs: calcex, urobesal.

Ciminal is used to treat pyoderma, trophic ulcers, burns, and wounds to treat injuries infected with Pseudomonas aeruginosa.

Cimizol - an aerosol drug used to treat purulent skin diseases, trophic ulcers, burns, and bedsores. It also has an analgesic effect.

Acids. In aqueous solutions, acids dissociate to form cations and anions. The action of acids depends on the number of cations included.

According to the degree of dissociation, acids are divided into: strong - dissociate up to 50% or more (nitric, sulfuric, hydrochloric); medium - dissociate more than 1% (phosphorus); weak - dissociate up to 1% (boric acid). Therefore, all acids will have antimicrobial action.

Strong acids practically do not penetrate the skin and, depending on the concentration, have bactericidal, cauterizing, and irritating effects. Coagulation necrosis with scab formation forms on the skin surface.

Weak acids penetrate well into the tissue, dissolve in aqueous and lipid media and act as an astringent.

Boric acid has antiseptic activity. Applied in the form of solutions or powder on the skin and mucous membranes, but good absorption of the drug and slow excretion from the body limits its use.

Benzoic acid has antimicrobial and fungicidal action, and it is used as an antiseptic and a food preservative (0.1% solution).

Acetic acid in the form of a 0.25-2% solution is an antiseptic for treating the lower urinary tract's outer ear and irrigation, particularly active against gram-negative bacteria (e.g., Pseudomonas) aerobes.

Salicylic acid in alcoholic solutions (1-2%), powders, ointments, and pastes. It is used for dermatomycoses in areas prone to friction, has an antiseptic, irritating, and keratolytic effect, which depend on the concentration

Alkalis. The action of alkalis determines the presence in the chemical structure of a hydroxyl anion (OH). In addition to alkalis and salts formed from strong bases and weak acids (carbonates and hydrocarbons), they have alkaline properties. Alkalis soften the epidermis and quickly penetrate the skin, and in high concentrations, cause deep necrosis with the formation of a loose scab (colic necrosis). Carbonates and hydrocarbons do not cause inflammation but only wash the fat on the skin's surface. Alkalis are used to disinfect rooms and the environment, and hydrocarbons to neutralize acids in animals.

Ammonia solution (ammonia) (NH4OH) contains 9.5-10.5% ammonia, referred to as antiseptics from the group of alkalis, used to treat the surgeon's hands (0.5% solution).

Sodium hydroxide. Due to the strong irritant effect and the ability to cause tissue necrosis, the drug is used only to disinfect premises and livestock yards with animals' infectious diseases.

Sodium bicarbonate - has a slight antiseptic, anti-inflammatory, and acid-neutralizing effect. Softens and loosens the epidermis of the skin. It is used in 3% solution as an antiseptic and anti-catarrhal agent to treat the nose, mouth, and eyes' inflammatory processes.

Detergents - synthetic compounds with high surface activity, detergent and disinfectant properties. They dissolve proteins, fats, and keratinoids, cause protein dissociation, and inactivate bacteria. The mechanism of antimicrobial action of detergents is due to the ability to disrupt the surface tension and increase the permeability of the cell membrane of microorganisms, which leads to metabolic disorders and their death.

Soap green. It softens the epidermis of animal skin and the chitinous shell of parasites, emulsifies fats, cleanses the skin of impurities, and has an antiseptic effect.

The antimicrobial action of green soap is due to alkali's presence and the ability to emulsify fats. Other drugs: cerigel, K soap, medical soap, tar soap.[18]

Exercise 1: Match the Word with Its Definition

Word	Definition
1. Phenol	a. A toxic substance used in disinfection with a specific odor
2. Denaturation	b. The disruption of proteins' natural structure
3. Alkali	c. A chemical with hydroxyl ions that softens skin and neutralizes acids
4. Emulsify	d. To mix two substances that normally do not combine
5. Antiseptic	e. Substance that kills or prevents growth of microorganisms
6. Keratolytic	f. A substance that causes shedding or peeling of the outer skin layer
7. Formaldehyde	g. An aldehyde used as a disinfectant and preservative
8. Detergent	h. A synthetic compound that breaks down fats and proteins
9. Coagulation necrosis	i. Tissue death caused by protein coagulation and scab formation
10. Astringent	j. A substance that causes contraction of body tissues

Exercise 2: Fill in the Blanks

Choose the correct word from the box to complete the sentences:

(phenol, creolin, keratolytic, aldehydes, ammonia, formalin, detergents, boric acid, emulsion, antiseptic)

1. _____ solutions are often used for washing infected wounds.
2. _____ causes protein coagulation leading to microbial death.
3. _____ soften the epidermis and help remove dead skin cells.
4. _____ is a disinfectant that releases formaldehyde in the body's acidic environment.
5. _____ are synthetic compounds that dissolve fats and proteins to kill microbes.
6. _____ acid is a weak acid with antiseptic properties used on skin and mucous membranes.
7. _____ is toxic and can cause dizziness and respiratory issues if absorbed through the skin.
8. _____ is a soap solution of formaldehyde used for disinfection.

[18] Hunchak V.M., Leskiv Kh.Ya." Antimicrobial drugs "Educational - methodical manual of laboratory and practical lessons for applicants the second level of education (master) specialty 211 "Veterinary medicine." in the discipline of "Veterinary Pharmacology". 2024 112 p

9. Birch tar is often applied as a _____ (a mixture of oil and other substances).

10. _____ solution containing about 10% ammonia is used for hand disinfection.

Exercise 3: True or False

Write **True** or **False** next to each statement:

1. Phenol is still widely used directly in veterinary practice.
2. Hexachlorophene is effective against staphylococci bacteria.
3. Formaldehyde causes microbial death by binding to amino groups of proteins.
4. Strong acids easily penetrate the skin and cause deep tissue damage.
5. Sodium bicarbonate has acid-neutralizing and anti-inflammatory effects.
6. Alkalis cause irritation and soften the epidermis.
7. Detergents act by increasing the permeability of microbial cell membranes.
8. Birch tar has antimicrobial, insecticidal, and irritant properties.
9. Aldehydes are known for their pleasant odor and non-irritant nature.
10. Sodium hydroxide is used internally as an antiseptic.

Exercise 4: Multiple Choice

Choose the best answer:

1. Which substance is NOT an aldehyde?
   a) Formaldehyde
   b) Glutaraldehyde
   c) Creolin
   d) Hexamethylenetetramine
2. The main effect of detergents in disinfection is to:
   a) Denature proteins
   b) Neutralize acids
   c) Break down fats and increase cell membrane permeability
   d) Release formaldehyde
3. What is the purpose of keratolytic agents like salicylic acid?
   a) To disinfect wounds
   b) To remove dead skin cells and treat fungal infections
   c) To disinfect surgical instruments
   d) To neutralize alkalis
4. Birch tar is NOT used for:
   a) Treating hoof damage
   b) Disinfecting harnesses
   c) Internal treatment of urinary infections
   d) Treating eczema and bedsores
5. Which acid is considered a weak acid with antiseptic properties?
   a) Hydrochloric acid
   b) Sulfuric acid
   c) Boric acid
   d) Nitric acid

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "Meet the Disinfectants"

Divide the class into expert groups, each covering:

* Group A: Phenol and its derivatives (creolin, resorcinol, birch tar, etc.)
* Group B: Formaldehyde and aldehydes (formalin, lysoform, hexamethylenetetramine)
* Group C: Acids (boric, benzoic, acetic, salicylic)
* Group D: Alkalis (ammonia, sodium hydroxide, sodium bicarbonate)
* Group E: Detergents and soaps

Each expert group:

* Summarizes: mechanism of action, uses, safety notes, veterinary dosage/application
* Creates a one-page summary or mini-poster

Then, mixed groups are formed so each student teaches the others.

Finally, each mixed group prepares:

✓ A comparison table

✓ A top-three list of “most practical” disinfectants in vet practice (with reasons)

2 Matching Game: “What, How, Where”

Prepare cards with:

* Disinfectant names
* Mechanisms (protein denaturation, oxidation, membrane disruption, etc.)
* Veterinary uses (skin disinfection, instrument sterilization, treatment of wounds, hoof care, etc.)
* Safety/side effects

In groups, students race to match correctly.

Then discuss why certain disinfectants are better for certain tasks.

3 Create a “Disinfection Protocol”

Groups receive scenarios: e.g.

* Hoof disease outbreak in cattle shed
* Chronic skin infection in dogs
* Disinfection of surgical instruments
* Cleaning contaminated animal housing

Each group writes:

* Choice of disinfectant
* Concentration
* Method of application
* Safety measures

Groups present protocols and explain why they chose specific agents.

4 Debate: “Traditional vs Modern Disinfectants”

* Team A: Argues for phenol and aldehyde-based disinfectants
* Team B: Argues for acids, alkalis, and detergents as safer/more effective

They must use evidence from the text:
* Mechanisms
* Toxicity
* Ease of use
* Cost and practicality

5 "Label & Advertise"
Each group:
* Designs a label and product leaflet for one disinfectant
  Include:
  ✓ Active ingredient & concentration
  ✓ Veterinary uses
  ✓ Mechanism of action (simple language)
  ✓ Precautions & side effects
  ✓ Dosage/application instructions
Present as if marketing to a veterinary clinic.

Case Study Exercises
Case 1: "Deep hoof infection in cattle"
Farmer reports foul-smelling hoof lesions in several cows.
* Which disinfectants could help?
* Concentrations & application?
* Risks for skin irritation or toxicity?

Case 2: "Instrument sterilization before surgery"
Vet clinic needs to sterilize non-metallic instruments.
* Which disinfectant to use?
* How to avoid corrosion or damage?
* Contact time?

Case 3: "Chronic eczema in a dog"
Dog has chronic itchy skin with bacterial infection.
* Which phenol derivative or acid is suitable?
* Formulation: ointment, solution, or powder?
* Why not use strong acids?

Case 4: "Scabies outbreak in sheep"
Sheep with severe itching and skin lesions.
* Which traditional mixture is used? (Wilkinson's ointment, tar soap)
* Explain mechanism
* Application frequency & precautions

Case 5: "Disinfection of contaminated premises"
Pig barn contaminated after an infectious outbreak.
* Which disinfectant group is suitable (phenol, aldehyde, alkalis, etc.)?

* Concentration and method?
* Safety concerns for animals and workers?

Case 6: "Treating catarrhal inflammation"

A cow has mild inflammation of the mouth.

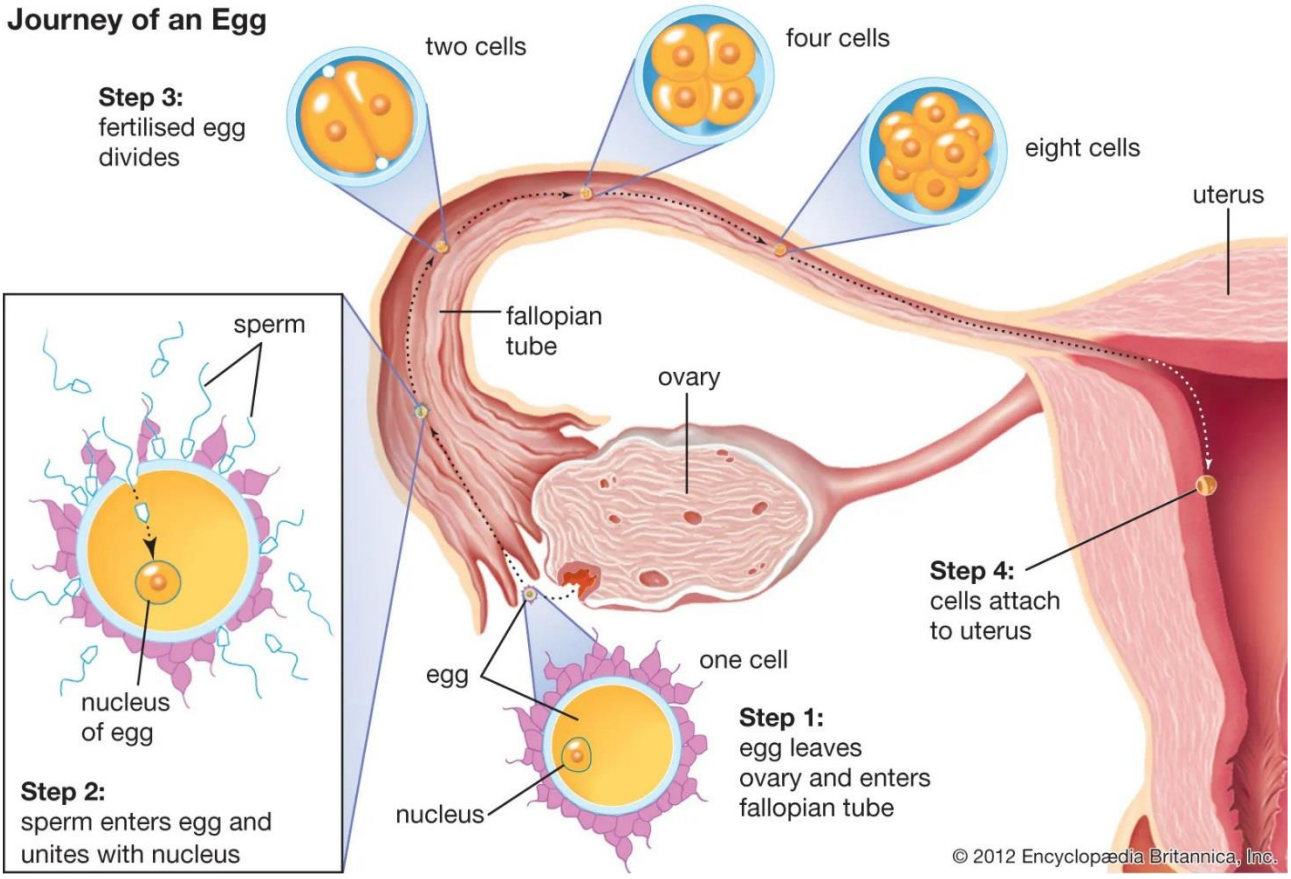
* Why might sodium bicarbonate be chosen?
* How does its mechanism differ from acids?

PART 3

Obstetrics

Animal reproductive system, any of the organ systems by which animals reproduce. The role of reproduction is to provide for the continued existence of a species; it is the process by which living organisms duplicate themselves. Animals compete with other individuals in the environment to maintain themselves for a period of time sufficient to enable them to produce tissue nonessential to their own survival but indispensable to the maintenance of the species. The additional tissue, reproductive tissue, usually becomes separated from the individual to form a new, independent organism.

This article describes the reproductive systems in metazoans (multicelled animals) from sponges to mammals, exclusive of humans. It focuses on the gonads (sex organs), associated ducts and glands, and adaptations that aid in the union of gametes—i.e., reproductive cells, male or female, that are capable of producing a new individual by union with a gamete of the opposite sex. Brief mention is made of how the organism provides for the development of embryos and of the regulatory role of gonads in vertebrate cycles. For discussion of reproduction in humans, see reproductive system, human.



Unlike most other organ systems, the reproductive systems of higher animals have not generally become more complex than those of lower forms. Asexual reproduction (i.e., reproduction not involving the union of gametes), however, occurs only in the invertebrates, in which it is common, occurring in animals as highly evolved as the sea squirts, which are closely related to the vertebrates. Temporary gonads are common among lower animals; in higher animals, however, gonads are permanent organs. Hermaphroditism, in which one individual contains functional reproductive organs of both sexes, is common among lower invertebrates; yet separate sexes occur in such primitive animals as sponges, and hermaphroditism occurs in animals more highly evolved—e.g., the lower fishes. Gonads located on or near the animal surface are common in the lowest invertebrates, but in higher animals they tend to be more deeply situated and often involve intricate duct systems. In echinoderms, which are among the highest invertebrates, the gonads hang directly into the sea and spill their gametes into the water. In protochordates, gametes are released into a stream of respiratory water that passes directly into the sea. Duct systems of the invertebrate flatworms (Platyhelminthes) are relatively complex, and those of specialized arthropods (e.g., insects, spiders, crabs) are more complex than those of any vertebrate. Copulatory organs occur in flatworms, but copulatory organs are not ubiquitous among vertebrates other than reptiles and mammals. The trend toward fewer eggs and increased parental care in higher animals may account for the relative lack of complexity in the reproductive systems of some advanced forms. Whereas trends toward increasing structural complexity have often been reversed during evolution, reproductive behaviour patterns in many phylogenetic (i.e., evolutionary) lines have become more complicated in order to enhance the opportunity for fertilization of eggs and maximum survival of offspring (see sex).

A direct relationship exists between behaviour and the functional state of gonads. Reproductive behaviour induced principally but not exclusively by organic substances called hormones promotes the union of sperm (spermatozoa) and eggs, as well as any parental care accorded the young. There are a number of reasons why behaviour must be synchronized with gonadal activity. Chief among these are the following:

Individuals of a species must congregate at the time the gonads contain mature gametes. This often entails migration, and some members of all major vertebrate groups migrate long distances to gather at spawning grounds or rookeries.

Individuals with gametes ready to be shed must recognize members of the opposite sex. Recognition is sometimes by external appearance or by chemical substances (pheromones), but sex-linked behaviour is often the only signal.

Geographical territories frequently must be established and aggressively defended.

The building of nests, however simple, is essential reproductive behaviour in many species.

When fertilization of aquatic forms is external, sperm and eggs must be discharged at approximately the same time into the water, since gametes may be quickly dispersed by currents. Courtship, often involving highly intricate behaviour patterns, serves to release the gametes of both mating individuals simultaneously.

When fertilization is internal, willingness of the female to mate is often essential. Female mammals not in a state of willingness to mate not only will not mate but may injure or even kill an aggressive male. The unwillingness of a female mammal to mate when mature eggs are not present prevents loss of sperm needed to preserve the species.

Parental care of fertilized eggs by one parent or the other has evolved in many species. Parental behaviour includes fanning the water or air around the eggs, thereby maintaining appropriate temperature and oxygen levels; secretion of oxygen from a parent's gills; transport of eggs on or in the parental body (including the mouth of some male parents); and brooding, or incubation, of eggs.

Some species extend parental care into the postnatal period, feeding and protecting the offspring. Such behaviour patterns are adaptations for survival and thus are essential; all are induced by the nervous and endocrine systems and are typically cyclical, because gonadal activity is cyclical[19].

Exercise 1: Match the Definitions

Match each term with its correct definition.

Word	Definition
1. Reproduction	A. Chemical substances released by animals to influence others of the same species
2. Gonads	B. The process by which organisms produce new individuals of the same kind
3. Gametes	C. The organs that produce reproductive cells (sperm or eggs)
4. Hermaphroditism	D. Reproductive cells such as sperm and eggs
5. Hormones	E. Having both male and female reproductive organs in one individual
6. Pheromones	F. Substances produced in the body that regulate activities like reproduction

Exercise 2: Fill in the Blanks

Complete each sentence with the correct vocabulary word from the box.

Box: gonads, fertilization, asexual, parental, copulatory, vertebrates

1. _____ reproduction does not involve the union of gametes.

2. In some animals, the _____ organs are temporary, while in others they are permanent.

3. _____ care involves protecting and nurturing the offspring.

4. Internal _____ requires mating behavior to synchronize the release of gametes.

5. _____ organs are used by some animals to transfer sperm directly.

[19] https://www.britannica.com/science/animal-reproductive-system/Arthropods

6. Fish, mammals, and birds are all classified as _____.

Exercise 3: Multiple Choice

Choose the correct option to answer each question.

1. What is the main purpose of reproduction?
   * A. To develop parental care
   * B. To ensure the species survives
   * C. To improve behavior
   * D. To grow individual organs
2. Which group typically shows *hermaphroditism*?
   * A. Mammals
   * B. Lower invertebrates
   * C. Birds
   * D. Reptiles
3. Which of the following is NOT typically a function of reproductive behavior?
   * A. Migration
   * B. Territorial defense
   * C. Gamete duplication
   * D. Nest building

Exercise 4: Synonyms and Context

Find a synonym (or close meaning word/phrase) for the following from the text.

1. **Indispensable** = _____
2. **Evolutionary** = _____
3. **Discharged** = _____
4. **Aggressively** = _____
5. **Cycle** (as used in “gonadal activity is cyclical”) = _____

Exercise 5: Short Answer

Use your own words to answer.

1. What is the function of **gametes** in reproduction?
2. Why is reproductive behavior often **synchronized** with gonadal activity?
3. How does **parental care** increase the chance of survival for offspring?
4. What is the role of **hormones** in animal reproductive systems?
5. Describe one adaptation that helps animals successfully reproduce.

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: “Pieces of Reproduction”

Divide the class into expert groups, each focusing on:

* Group A: Gonads and gametes – structure & function
* Group B: Duct systems & copulatory organs

* Group C: Hermaphroditism, asexual reproduction, and evolutionary trends
* Group D: Reproductive behavior & its hormonal regulation
* Group E: Parental care strategies

Each expert group:

* Reads & discusses its topic
* Prepares an illustrated summary (poster, slide, or concept map)
* Teaches the rest of the class in mixed groups

2 Concept Mapping: "From Gonads to Offspring"

In small groups, students create a concept map connecting:

* Gonads → Gametes → Copulatory organs / ducts → Fertilization → Embryo development → Parental care

They should highlight:

* The role of hormones & nervous system
* Behavioral adaptations that support reproduction

Groups present their maps, explaining key connections.

3 Timeline: "Evolutionary Journey of Reproductive Systems"

Groups build a timeline that shows:

* Primitive invertebrates (external gamete release, temporary gonads)
* Advanced invertebrates (complex ducts, copulatory organs)
* Vertebrates (permanent gonads, internal fertilization)
* Evolutionary trends (e.g., fewer eggs + increased parental care)

Each group illustrates why these trends evolved.

4 Debate: "Complex Behavior vs Complex Anatomy"

Team A argues that complex reproductive behaviors (courtship, migration, care) are more critical for survival.

Team B argues that complex anatomy (duct systems, copulatory organs) is more important.

They must use evidence: species examples, evolutionary reasons, survival impact.

5 Simulation: "The Breeding Season"

Groups design a breeding program for a species:

* Define when animals congregate
* How individuals recognize mates
* What behavioral cues trigger gamete release
* How parental care is provided

Groups present why these steps ensure reproductive success.

6 "Design a Species"

In groups, students invent a new animal species.

Decide:

* Gonad type & location
* Fertilization: internal/external?

* Copulatory organs?
* Parental care type
* Reproductive behavior patterns

Explain why these choices help survival in their environment.

Case Study Exercises

Case 1: "Spawning in Fish"

A fish species releases eggs & sperm into open water.

* Why must behavior and gamete maturation be synchronized?
* What environmental cues might trigger this?

Case 2: "Hermaphroditic Flatworms"

Some flatworms have both male & female organs.

* What evolutionary advantages does this provide?
* Are there any disadvantages?

Case 3: "Bird Nesting Behavior"

Birds build nests before laying eggs.

* How does this behavior support embryo survival?
* Which body systems control timing of nesting?

Case 4: "Female Mammals & Willingness to Mate"

Why is it evolutionarily important for females to mate only when eggs are mature?

* What would happen if this didn't happen?

Case 5: "Parental Mouthbrooding"

Some fish carry eggs in the mouth.

* How does this behavior increase survival?
* What might be the cost to the parent?

Case 6: "Migration to Spawning Grounds"

Salmon travel upstream to spawn.

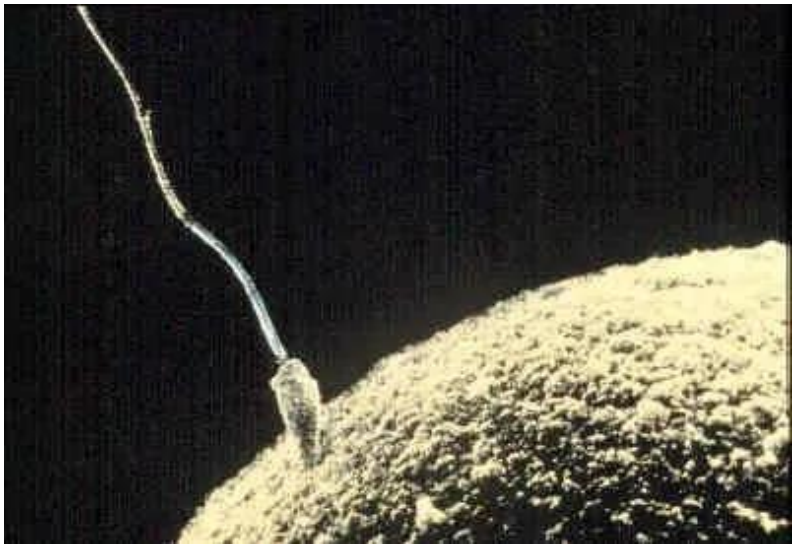
* Why do they do this despite the energy cost?
* How is this behavior connected to gonadal activity?

Sperm and Fertilization

Sperm, male reproductive cell, produced by most animals. With the exception of nematode worms, decapods (e.g., crayfish), diplopods (e.g., millipedes), and mites, sperm are flagellated; that is, they have a whiplike tail. In higher vertebrates, especially mammals, sperm are produced in the testes. The sperm unites with (fertilizes) an ovum (egg) of the female to produce a new offspring. Mature sperm have two distinguishable parts, a head and a tail.

The head of the sperm varies in shape for each animal species. In humans it is flattened and almond-shaped, four to five micrometres long and two to three micrometres wide (there are about 25,000 micrometres in an inch). The head portion

is mainly a cell nucleus; it consists of genetic substances, called chromosomes, which are responsible for transmitting specific characteristics of an individual, such as the colour of eyes, hair, and skin. In each body cell of healthy humans, there are 46 chromosomes, which are responsible for the individual's general physical makeup. The sperm cells have only 23 chromosomes, or half of the usual number. When a sperm cell unites with the ovum, which also has 23 chromosomes, the resulting 46 chromosomes determine the offspring's characteristics. The sperm cells also carry the X or Y chromosome that determines the sex of the future child.



Covering the head of the sperm is a cap known as the acrosome, which contains enzymes that help sperm to enter an egg. Only one sperm fertilizes each egg, even though 300,000,000 to 400,000,000 sperm are contained in an average ejaculation. Each egg and sperm produced has slightly different genetic information carried in the chromosomes; this accounts for the differences and similarities between children of the same parents.

A small middle portion of the sperm contains the mitochondria. The tail of the sperm, sometimes called the flagellum, is a slender, hairlike bundle of filaments that connects to the head and middle portion. The tail is about 50 micrometres long; its thickness of one micrometre near the mitochondria gradually diminishes to less than one-half micrometre at the end of the tail. The tail gives the sperm cell movement. It whips and undulates so that the cell can travel to the egg. Following sperm deposition in the female reproductive tract, activation of tail movement is suppressed until the sperm is carried to within a relatively short distance of the egg. This gives the sperm an increased chance of reaching the egg before exhausting its energy supplies.

The first significant event in fertilization is the fusion of the membranes of the two gametes, resulting in the formation of a channel that allows the passage of material from one cell to the other. Fertilization in advanced plants is preceded by pollination, during which pollen is transferred to, and establishes contact with, the female gamete or macrospore. Fusion in advanced animals is usually followed by penetration of the egg by a single spermatozoon. The result of fertilization is a cell (zygote) capable of undergoing cell division to form a new individual.

The journey of a fertilized egg in a woman. In mammals, eggs are released by the ovaries. If an egg meets a sperm cell, it may become fertilized. The fertilized egg travels to the uterus, where it grows and develops into a new individual.

The fusion of two gametes initiates several reactions in the egg. One of these causes a change in the egg membrane(s), so that the attachment of and penetration by more than one spermatozoon cannot occur. In species in which more than one spermatozoon normally enters an egg (polyspermy), only one spermatozoal nucleus

actually merges with the egg nucleus. The most important result of fertilization is egg activation, which allows the egg to undergo cell division. Activation, however, does not necessarily require the intervention of a spermatozoon; during parthenogenesis, in which fertilization does not occur, activation of an egg may be accomplished through the intervention of physical and chemical agents. Invertebrates such as aphids, bees, and rotifers normally reproduce by parthenogenesis.

In plants, certain chemicals produced by the egg may attract spermatozoa. In animals, with the possible exception of some cnidarians (coelenterates), it appears likely that contact between eggs and spermatozoa depends on random collisions. On the other hand, the gelatinous coats that surround the eggs of many animals exert a trapping action on spermatozoa, thus increasing the chances for successful sperm-egg interaction.[20]

Vocabulary Exercise 1: Match the Word with Its Definition

Match each vocabulary word on the left with the correct definition on the right.

Word	Definition
1. Sperm	a. A structure on sperm head containing enzymes
2. Ovum	b. The male reproductive cell
3. Chromosomes	c. The female reproductive cell (egg)
4. Acrosome	d. Genetic materials responsible for traits
5. Mitochondria	e. Organelles that produce energy in cells
6. Flagellum	f. The tail of a sperm that helps it move
7. Fertilization	g. Fusion of sperm and egg to form zygote
8. Zygote	h. The cell formed after fertilization

Vocabulary Exercise 2: Fill in the Blanks

Use the words in the box to complete the sentences below.

Words: sperm, chromosomes, mitochondria, fertilization, acrosome, flagellum, ovum, zygote

1. The _____ is the male reproductive cell that unites with the _____ to form a new individual.
2. The _____ contains enzymes that help the sperm enter the egg.
3. The _____ is the tail of the sperm that allows it to swim toward the egg.
4. Inside the sperm's head are _____ that carry genetic information.
5. The _____ provides energy for the sperm's movement.
6. The process of a sperm and an egg joining is called _____.
7. The fertilized egg is called a _____.

[20] https://www.britannica.com/science/sperm

Vocabulary Exercise 3: Multiple Choice

Choose the best answer for each question.

1. What part of the sperm contains genetic material?
   a) Tail
   b) Mitochondria
   c) Head
   d) Acrosome
2. How many chromosomes does a sperm cell carry?
   a) 46
   b) 23
   c) 50
   d) 100
3. Which structure helps sperm move?
   a) Nucleus
   b) Flagellum
   c) Acrosome
   d) Ovum
4. What is the name of the first cell formed after sperm fertilizes the egg?
   a) Gamete
   b) Zygote
   c) Embryo
   d) Nucleus
5. Which process allows the egg to prevent fertilization by more than one sperm?
   a) Activation
   b) Polyspermy
   c) Membrane fusion
   d) Enzyme release

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "Parts & Processes"

Divide students into expert groups. Each group studies and becomes the "teacher" of one topic:

* Group A: Structure of sperm (head, acrosome, middle piece, tail)
* Group B: Chromosomes & sex determination
* Group C: Tail movement and journey to the egg
* Group D: Steps & significance of fertilization (membrane fusion, zygote formation, egg activation)
* Group E: Parthenogenesis and polyspermy

After group discussion, mix into new groups where each student teaches their topic.

2 Build a Model: "Sperm & Egg Encounter"

In small groups, create a 3D model or drawing showing:

* Sperm cell (label: nucleus, acrosome, mitochondria, tail)

* Egg cell with membrane & jelly coat
* Steps of fertilization (contact, membrane fusion, prevention of polyspermy)

Groups present, explaining the function of each part and why each step is essential.

3 Concept Map: "From Gametes to New Individual"

Groups draw a concept map connecting:

* Chromosomes → Gametes → Fertilization → Zygote → Cell division → Offspring

Include side branches showing:

* Sex determination (X/Y)
* Random genetic variation
* Role of parthenogenesis

4 Debate: "Does Quantity Matter?"

* Team A argues that producing millions of sperm is essential to ensure fertilization.
* Team B argues that quality (structure & function) is more important than quantity.

Teams must use evidence: sperm energy, tail movement, acrosome, random collision, etc.

5 Storyboard: "The Journey of a Sperm"

Groups create a 6–8 panel comic or storyboard showing:

* Sperm leaving the male
* Traveling to the female reproductive tract
* Tail activation
* Finding the egg
* Fusion and zygote formation
* Beginning of cell division

Add captions describing each step.

6 "Design a Gamete"

Groups design a hypothetical super sperm or egg adapted to a harsh environment.

Decide:

* Shape, size, tail length
* Enzyme content in acrosome
* Number of mitochondria
* Defense against environmental stress

Explain why each design helps survival and fertilization.

Case Study Exercises

Case 1: "One Sperm, One Egg"

Why do humans (and many animals) have mechanisms to prevent polyspermy?

* What might happen if multiple sperm nuclei entered one egg?

Case 2: "Energy for the Journey"
Sperm tail activation is suppressed until close to the egg.
Why is this strategy important for sperm survival and success?

Case 3: "Random vs. Directed"
In many animals, sperm reach eggs by random collision.
* How do gelatinous coats help increase the chance of fertilization?
* Why might plants use chemicals instead?

Case 4: "Parthenogenesis"
Some insects reproduce without fertilization.
* What advantages does parthenogenesis offer?
* What genetic disadvantages could it have compared to normal fertilization?

Case 5: "Chromosome Mix"
Each sperm and egg has slightly different chromosomes.
* Why is this genetic variation important for a species?

Case 6: "Tail Defect"
Imagine a genetic defect shortens the sperm's tail.
* Predict the likely consequence for fertilization success.
* How might this affect population numbers?

Pregnancy and Birth

The normal events of pregnancy. Initiation of pregnancy

A new individual is created when the elements of a potent sperm merge with those of a fertile ovum, or egg. Before this union both the spermatozoon (sperm) and the ovum have migrated for considerable distances in order to achieve their union. A number of actively motile spermatozoa are deposited in the vagina, pass through the uterus, and invade the uterine (fallopian) tube, where they surround the ovum. The ovum has arrived there after extrusion from its follicle, or capsule, in the ovary. After it enters the tube, the ovum loses its outer layer of cells as a result of action by substances in the spermatozoa and from the lining of the tubal wall. Loss of the outer layer of the ovum allows a number of spermatozoa to penetrate the egg's surface. Only one spermatozoon, however, normally becomes the fertilizing organism. Once it has entered the substance of the ovum, the nuclear head of this spermatozoon separates from its tail. The tail gradually disappears, but the head with its nucleus survives. As it travels toward the nucleus of the ovum (at this stage called the female pronucleus), the head enlarges and becomes the male pronucleus. The two pronuclei meet in the centre of the ovum, where their threadlike chromatin material organizes into chromosomes.

Originally the female nucleus has 44 autosomes (chromosomes other than sex chromosomes) and two (X, X) sex chromosomes. Before fertilization a type of cell division called a reduction division brings the number of chromosomes in the female pronucleus down to 23, including one X chromosome. The male gamete, or sex cell, also has 44 autosomes and two (X, Y) sex chromosomes. As a result of a reducing

division occurring before fertilization, it, too, has 23 chromosomes, including either an X or a Y sex chromosome at the time that it merges with the female pronucleus.

How does a home pregnancy test work?

After the chromosomes merge and divide in a process termed mitosis, the fertilized ovum, or zygote, as it is now called, divides into two equal-sized daughter cells. The mitotic division gives each daughter cell 44 autosomes, half of which are of maternal and half of paternal origin. Each daughter cell also has either two X chromosomes, making the new individual a female, or an X and a Y chromosome, making it a male. The sex of the daughter cells is determined, therefore, by the sex chromosome from the male parent.

Fertilization occurs in the uterine tube. How long the zygote remains in the tube is unknown, but it probably reaches the uterine cavity about 72 hours after fertilization. It is nourished during its passage by the secretions from the mucous membrane lining the tube. By the time it reaches the uterus, it has become a mulberry-like solid mass called a morula. A morula is composed of 60 or more cells. As the number of cells in a morula increases, the zygote forms a hollow bubblelike structure, the blastocyst. The blastocyst, nurtured by the uterine secretions, floats free in the uterine cavity for a short time and then is implanted in the uterine lining. Normally, the implantation of the blastocyst occurs in the upper portion of the uterine lining.

Initiation of labour

Despite decades of research, the events leading to the initiation of labour in humans remain unclear. It is suspected that biochemical substances produced by the fetus induce labour. In addition, the timing of the production of these substances and their interaction with placental and maternal biochemical factors appear to influence this process. Among the most studied of these biochemical substances are fetal hormones such as oxytocin and placental inflammatory molecules. Increased placental and maternal production of inflammatory molecules in late pregnancy has been strongly linked to the initiation of labour. Hormonelike substances called prostaglandins, which are produced by the placenta in response to various biochemical signals, can induce inflammation and are present in increased levels during labour. Several factors that increase the production of prostaglandins include oxytocin, which stimulates the force and frequency of uterine contractions, and a fetal lung protein called surfactant protein A (SP-A). Surfactant production in the fetal lung does not begin until the last stages of gestation, when the fetus prepares for air breathing; this transition may act as an important labour switch.

The stages of labour

First stage: dilatation

Early in labour, uterine contractions, or labour pains, occur at intervals of 20 to 30 minutes and last about 40 seconds. They are then accompanied by slight pain, which usually is felt in the small of the back.

As labour progresses, those contractions become more intense and progressively increase in frequency until, at the end of the first stage, when dilatation is complete, they recur about every three minutes and are quite severe. With each contraction a twofold effect is produced to facilitate the dilatation, or opening, of the cervix. Because the uterus is a muscular organ containing a fluid-filled sac called the

amnion (or “bag of waters”) that more or less surrounds the child, contraction of the musculature of its walls should diminish its cavity and compress its contents. Because its contents are quite incompressible, however, they are forced in the direction of least resistance, which is in the direction of the isthmus, or upper opening of the neck of the uterus, and are driven, like a wedge, farther and farther into this opening. In addition to forcing the uterine contents in the direction of the cervix, shortening of the muscle fibres that are attached to the neck of the uterus tends to pull those tissues upward and away from the opening and thus adds to its enlargement. By this combined action each contraction of the uterus not only forces the amnion and fetus downward against the dilating neck of the uterus but also pulls the resisting walls of the latter upward over the advancing amnion, presenting part of the child.

Second stage: expulsion

About the time that the cervix becomes fully dilated, the amnion breaks, and the force of the involuntary uterine contractions may be augmented by voluntary bearing-down efforts of the mother. With each labour pain, she can take a deep breath and then contract her abdominal muscles. The increased intra-abdominal pressure thus produced may equal or exceed the force of the uterine contractions. These bearing-down efforts may double the effectiveness of the uterine contractions.

As the child descends into and passes through the birth canal, the sensation of pain is often increased. This condition is especially true in the terminal phase of the stage of expulsion, when the child’s head distends and dilates the maternal tissues as it is being born.[21]

Vocabulary Exercise 1: Match the Word with Its Definition

Match the vocabulary words on the left with the correct definitions on the right.

Word	Definition
1. Spermatozoon	a. Cell division process producing two daughter cells
2. Ovum	b. Male reproductive cell
3. Pronucleus	c. Female reproductive cell (egg) before fertilization
4. Morula	d. Hollow bubble-like structure formed after cell division
5. Blastocyst	e. Solid mass of 60 or more cells formed after fertilization
6. Fertilization	f. Fusion of sperm and ovum nuclei
7. Implantation	g. Attachment of blastocyst to the uterine lining
8. Uterus	h. Organ where fetal development occurs
9. Oxytocin	i. Hormone that stimulates uterine contractions
10. Prostaglandins	j. Chemicals that induce inflammation and affect labor

[21] https://www.britannica.com/science/pregnancy/Duration-of-pregnancy

Vocabulary Exercise 2: Fill in the Blanks

Use the words from the box to complete the sentences.

Words: fertilization, blastocyst, implantation, morula, oxytocin, pronucleus, uterus, prostaglandins, spermatozoon, labor

1. After fertilization, the zygote divides and forms a solid ball of cells called a _____.
2. The _____ is a hollow, fluid-filled structure that implants in the lining of the uterus.
3. The process of the blastocyst attaching to the uterine lining is called _____.
4. The male reproductive cell is called a _____.
5. The _____ are hormones that stimulate uterine contractions and inflammation during labor.
6. The _____ is the organ where the fertilized egg develops into a fetus.
7. The fusion of the male and female nuclei forms the _____.
8. The hormone _____ helps to stimulate the force and frequency of uterine contractions during labor.
9. The initial stage of labor where the cervix dilates is called _____.
10. The process where sperm and ovum unite is called _____.

Vocabulary Exercise 3: Multiple Choice

Choose the best answer.

1. What happens to the tail of the spermatozoon after fertilization?
   a) It remains attached to the ovum
   b) It disappears gradually
   c) It becomes the pronucleus
   d) It forms the blastocyst
2. The morula is:
   a) A single cell before fertilization
   b) A solid ball of cells formed after fertilization
   c) The fluid-filled sac surrounding the fetus
   d) The hormone that triggers labor
3. The hormone oxytocin:
   a) Causes dilation of the cervix
   b) Stimulates uterine contractions
   c) Prevents labor pains
   d) Is produced by the fetus’s lungs
4. What is the blastocyst?
   a) A fertilized egg before cell division
   b) A hollow structure that implants in the uterus
   c) A hormone produced during pregnancy
   d) The organ that produces eggs
5. The first stage of labor is called:
   a) Expulsion
   b) Implantation
   c) Dilatation

d) Fertilization

Vocabulary Exercise 4: True or False

Write **True** or **False**.

1. The pronuclei of sperm and ovum meet to form the zygote.
2. The blastocyst implants in the lower portion of the uterus.
3. Prostaglandins are produced by the placenta and help induce labor.
4. The cervix opens fully during the second stage of labor.
5. Oxytocin decreases the strength of uterine contractions.

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "From Zygote to Birth"

Divide students into expert groups to study and teach each stage:

Group A: Fertilization and formation of zygote → morula → blastocyst → implantation

Group B: Chromosomes, pronuclei, and sex determination

Group C: Initiation of labour: fetal, placental, maternal factors

Group D: Stages of labour: first stage (dilatation)

Group E: Stages of labour: second stage (expulsion)

Each group creates:

✓ A short teaching summary

✓ A diagram or chart

✓ 2 quiz questions for peers

Groups then reassemble and teach each other.

2 Timeline Activity: "Journey of New Life"

Groups build a visual timeline or flowchart starting from:

* Ovulation → fertilization → morula → blastocyst → implantation → pregnancy → initiation of labour → first & second stages of labour → birth

Add:

* Key events (chromosome merging, mitosis, sex determination)
* Biochemical factors (oxytocin, prostaglandins, SP-A)

Groups compare timelines to check completeness.

3 Model & Movement: "Birth Mechanisms"

In small groups:

* Use clay, models, or drawing to show:
  * Dilatation of cervix (first stage)
  * Expulsion with help of abdominal muscles (second stage)
* Demonstrate (with props) how uterine contractions push contents toward cervix and how muscles pull tissues upward

Present models & explain.

4 Debate: "Who Decides the Birth?"

Team A: Labour is mainly initiated by fetal factors.

Team B: Labour depends more on maternal/placental signals.

Students must use evidence (SP-A, oxytocin, prostaglandins, inflammatory molecules).

5 Concept Map: "The Biology of Birth"

Groups create a concept map connecting:

* Fertilization → zygote → morula → blastocyst → implantation
* Chromosomes & sex determination
* Hormones & biochemical triggers
* Stages of labour
* Mother's and fetus's roles

6 Comic Strip: "The Birth Story"

Create a 6–8 panel comic showing:

1. Fertilization
2. Zygote becoming morula & blastocyst
3. Implantation
4. Biochemical preparation for labour
5. First stage: dilatation
6. Second stage: expulsion & birth

Add captions explaining each step.

Case Study Exercises

Case 1: "A Delayed Journey"

A zygote takes longer than normal to reach the uterus and implants in the fallopian tube.

* What condition might result?
* Why does implantation usually occur in the uterine lining?

Case 2: "The Wrong Chromosome"

During reduction division, an ovum keeps both X chromosomes instead of one.

* What could happen if fertilized?
* How might this affect the new individual?

Case 3: "Timing the Switch"

A fetus produces SP-A earlier than usual.

* Predict what effect this might have on the timing of labour.
* Why is SP-A important?

Case 4: "Too Few Contractions"

A mother's uterus has weak contractions during the first stage.

* How could this affect cervical dilatation and progress of labour?
* What might doctors recommend?

Case 5: “Power of Two”

Explain why combining:

* Involuntary uterine contractions
* Voluntary abdominal muscle effort

in the second stage helps expel the baby.

Case 6: “Unexpected Twins”

Two sperm fertilize one egg (dispermy).

* What genetic problem could arise?
* Why does the egg normally block entry of multiple sperm?

Internal animal's diseases

Noninfectious Diseases of Animals

Even if it were possible, a world without pathogens would not be disease-free. Many animal diseases are caused by noninfectious factors such as an animal's environment, genetics, and nutrition. Heatstroke, for example, occurs when an animal is forced to endure high temperatures without access to water, adequate ventilation, or suitable shade. A common scenario involves an animal that has been locked inside a car without air-conditioning during hot weather. Conversely, extreme cold can lead tohypothermia or frostbite. Other environmental hazards include the vast array of products humans use to eliminate pests and weeds from homes, farms, and gardens. For example, rodenticide, poison used to kill rats and mice, can cause fatal internal hemorrhaging in any animal that ingests this toxic substance. Improper use of flea powders, sprays, dips, and collars can also cause illness. Automobile antifreeze is another well-known poison. Its sweet taste appeals to some animals, such as cats and dogs, but consuming only a small amount can result in death. Many plant species are also toxic to animals. Some, such as pokeweed and yew, commonly grow in pastures and yards.

Poor feeding practices can lead to diseases such as nutritional secondary hyperparathyroidism, a condition involving the muscles and bones of dogs that is associated with an all-meat diet. Large, rapidly growing puppies that consume too many calories and too much calcium can develop hypertrophic osteodystrophy, a disease resulting in lameness. Cats need sufficient amounts of an essential amino acid called taurine in their diets. Without it, they may develop eye problems. Not enough iodine intake can cause a goiter, or enlargement of the thyroid gland, in cows, horses, and other animals.

Trauma is a leading cause of injury and premature death in animals, especially pets that are allowed to roam free outdoors. Many animals are hit by cars or bitten by other animals. Farm animals may be attacked by predators, or they may harm themselves on sharp fencing or discarded nails. Untreated wounds can become infected and cause permanent damage.

Hip dysplasia, a painful and debilitating skeletal condition, is a noninfectious disease caused in part by heredity. Certain defects of the heart or palate, the roof of the mouth, may also be inherited. Some animals are genetically predisposed to diseases such as generalized demodectic mange, a skin disease caused by mites and characterized by hair loss and scaling around the eyelids, mouth, and front legs.

An animal's immune system is designed to detect and eliminate invading organisms. Occasionally, however, it behaves as though the animal's own body were the attacker, and it destroys healthy tissue. Diseases caused by this response, known asautoimmune diseases, include pemphigus foliaceous, a skin disease of dogs, cats, and horses; and rheumatoid arthritis, a severe type of arthritis that involves inflammation of the joints. In the autoimmune disease hemolytic anemia, the animal's own red blood cells are destroyed by its immune system.

Cancer exists in all animals. It is classified as either benign—that is, relatively noninvasive and unlikely to return after treatment; or as malignant—that is, aggressive and likely to spread. Any organ or system can be affected, either directly or through metastasis—when cancer cells from one part of the body spread to other areas of the body. Some forms of cancer are more widespread in animals of a particular breed, age, or sex, and even individuals of a specific color. For example, cancer of the mammary gland occurs more often in female animals, whilemelanoma, or skin cancer, is the most frequent tumor of elderly gray horses, and lymphosarcomas, tumors of the lymph nodes, are the most common type of specific tumor in cats. The study of cancer, known as oncology, is a growing field in veterinary medicine.

Non infectious diseases come in a variety of forms, ranging from easily treated, to conditions that need lifelong treatment and maintenance. A dog with a hampered immune system, or poor diet, is more likely to get an illness such as cardiovascular disease or arthritis. Keep an eye on your dog for the following non infectious dog diseases.

Heart Disease and Your Dog

Diseases that affect the heart and circulatory system prove highly challenging for dogs. Heart disease is normally classified as any abnormality of the heart. Some of these cardiac conditions are due to congenital defects or hereditary issues. Other heart conditions can be prevented or managed better with medication and/or lifestyle changes.

Examples of cardiovascular disease dogs may get:

High blood pressure

Clogged arteries

Lung malfunction

Congestive heart failure

Symptoms of canine cardiac problems:

Wheezing

Labored breathing

Agility problems

Abdominal swelling

Decreased appetite or weight loss

What to Know About Hypertension

Hypertension is also called high blood pressure. It can lead to stroke and heart failure, kidney renal disease and hardening of the arteries. A vet will check your dog's vital signs during an exam. Your dog's blood pressure is determined by the amount of blood his heart is pumping related to the resistance of this blood flow in his arteries.

Causes of high blood pressure:

Chronic kidney disease
Elevated sodium levels
Fluid retention
Increased heart rate
Overworked circulatory system
Cushing's disease
Tumors in the adrenal glands
Symptoms of high blood pressure:
Depression
Side effect of an underlying disease, such as an endocrine disorder
Sudden blindness
Behavioral changes
Diagnosis includes:

Gathering the medical history of your dog and getting a complete examination by a veterinarian. An examination includes the following:

Blood pressure is measured in dogs via a Doppler flow device or an oscillometric device
Evaluation of the nervous system
Inspection of the eyes
Monitoring the heart and kidneys
Taking the arterial blood pressure
Non Infectious Dog Disease: Diabetes

One disease that requires vast lifestyle changes in pets is diabetes. Unlike an infectious disease, a condition such as diabetes can develop gradually. There are two forms of this disease:

Diabetes insipidus: This disease is caused by lack of antidiuretic hormone in dogs. It is noticeable when your dog has heavy urine and excessive thirst.

Diabetes mellitus: When your dog has a deficiency of the hormone insulin in his body. Ultimately, he will not be able to digest sugars.

Any gender or breed can have diabetes. But it usually affects middle-aged dogs, females, and small breeds like Dachshunds, Cairn Terriers and Beagles.

Signs of canine diabetes:
Excessive urination
High blood sugar
Hunger
Thirst
Weight loss
Another Condition for Dogs: Arthritis

A degenerative joint disease like arthritis is more common in dogs who already have hip dysplasia, muscular dystrophy or other congenital issues. While some canines are born with arthritis, most develop it after other injuries or problems occur, such as:

Fractures
Ligament injury
Increased weight gain
Joint problems

Old age
Signs your dog may have arthritis:
Behavioral changes: disinterest in playing
Difficulty standing
Favoring one limb; limping
Lethargy
Overly tired
Sore joints
Unwillingness to climb stairs
Relieve the pain of arthritis with:
Heated bed or blanket
Orthopedic bed
Ramps in the house
Supplements/medication
Additional Non Infectious Dog Diseases
Atopy or air borne allergies
Dog seizures
Eye problems: hereditary cataracts
Food allergies
Heredity disorders
Inflammatory CNS disease: the non infectious form is likely from a breed-specific disorder
Primary seizures: juvenile epilepsy
Skin disorders/allergies[22]

Exercise 1: Match the Word to Its Definition

Match each word from the text to its correct definition.

Word	Definition
1. Pathogen	a. Condition of abnormally low body temperature
2. Hypothermia	b. Substance that is toxic and can cause illness
3. Rodenticide	c. An organism that causes disease
4. Hemorrhaging	d. Poison used to kill rats and mice
5. Toxic	e. Bleeding, especially internal bleeding
6. Taurine	f. An essential amino acid important for cats' health
7. Autoimmune	g. Disease caused by the immune system attacking itself
8. Malignant	h. Dangerous and likely to spread or get worse
9. Metastasis	i. Spread of disease from one part of the body to another
10. Congenital	j. Present from birth, often hereditary

[22] Presentations on the subject "Therapy" and "Internal diseases" done by PhD Ostap Stefanyk and PhD Mykola Lychuk. Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv. 2025.

Exercise 2: Fill in the Blanks

Fill in the blanks with the correct vocabulary word from the box below:

toxicity, hyperparathyroidism, autoimmune, hypothermia, benign, hypertension, arthritis, rodenticide, taurine, metastasis

1. _____ is a noninfectious disease where the immune system attacks the body's own tissues.
2. _____ occurs when an animal's body temperature drops dangerously low.
3. A _____ tumor is one that is usually noninvasive and unlikely to spread.
4. _____ is the spread of cancer cells from one part of the body to another.
5. _____ is a condition involving excessive calcium loss from bones in dogs.
6. _____ is a toxic substance used to kill rats and mice.
7. _____ is a heart condition characterized by high blood pressure.
8. _____ is a degenerative joint disease common in older dogs.
9. _____ deficiency in cats can cause eye problems.
10. Poisoning caused by harmful substances is known as _____.

Exercise 3: Multiple Choice

Choose the correct answer.

1. What causes heatstroke in animals?
   a) Low temperatures
   b) Lack of water, ventilation, or shade in hot weather
   c) Eating toxic plants
   d) Genetic defects
2. Which disease is caused by mites and results in hair loss and scaling?
   a) Demodectic mange
   b) Arthritis
   c) Hyperparathyroidism
   d) Cancer
3. What is a common symptom of canine diabetes?
   a) Excessive urination
   b) Hair loss
   c) Frostbite
   d) Fever
4. What does "congenital" mean?
   a) Caused by infection
   b) Occurs later in life
   c) Present from birth
   d) Caused by injury
5. Which animal disease is related to excessive calcium in a dog's diet?
   a) Arthritis
   b) Nutritional secondary hyperparathyroidism
   c) Hip dysplasia

d) Autoimmune disease

Exercise 4: True or False

Write True or False for each statement.

1. Frostbite is a condition caused by extreme cold.
2. Rodenticide is safe for all animals when used correctly.
3. Hip dysplasia is a noninfectious hereditary skeletal disease.
4. Malignant tumors are usually harmless and don't spread.
5. Hypertension in dogs can cause blindness and behavioral changes.
6. Diabetes mellitus involves a deficiency of insulin in the body.
7. Arthritis can develop from old age or joint injuries in dogs.
8. Taurine is a harmful substance found in some plants.
9. Metastasis means the immune system attacks healthy tissues.
10. Autoimmune diseases include rheumatoid arthritis and hemolytic anemia.

Exercise 5: Simple Definitions

Match the word to the easy meaning.

Word	Meaning
1. Heatstroke	a. When skin gets hurt by cold
2. Frostbite	b. When you feel sick
3. Poison	c. When the body is too hot
4. Bones	d. Something that can make you very sick
5. Disease	e. Hard parts inside your body

Exercise 6: Fill in the Blank

Choose the correct word to complete the sentence: **poison, cold, bones, water, sickness**

1. Heatstroke happens when animals don't have enough _____ on a hot day.
2. Frostbite can hurt your skin if you are outside in the _____.
3. Some plants and chemicals are _____ and can make animals sick.
4. Animals have _____ inside their bodies to help them stand and move.
5. A _____ is something that makes animals or people feel sick.

Exercise 7: True or False

Say if the sentence is true or false.

1. Animals can get sick from being too hot.
2. Frostbite happens when it is very warm outside.
3. Poison is safe for animals to eat.
4. Bones help animals to move.
5. Heatstroke can happen if an animal is in a car on a hot day.

Exercise 8: Match the Term to Its Precise Definition

Term	Definition
1. Hypertrophic osteodystrophy	a. Toxic chemical used to control rodent populations but harmful if ingested

2. Rodenticide	b. A skeletal disease causing lameness in rapidly growing dogs due to excess calcium and calories
3. Hyperparathyroidism	c. The spread of cancer cells from the primary site to distant body parts
4. Autoimmune disease	d. Condition characterized by abnormal calcium metabolism affecting bones and muscles
5. Metastasis	e. A disorder where the immune system attacks the animal's own tissues

Exercise 9: Advanced Fill in the Blanks

Complete the sentences with the correct vocabulary term:

autoimmune, hypothermia, congestive heart failure, taurine, malignant

1. _____ is a potentially fatal condition caused by prolonged exposure to extreme cold temperatures.
2. _____ diseases involve an immune system dysfunction attacking the host's own tissues.
3. Cats require sufficient _____ in their diet to prevent eye-related disorders.
4. _____ tumors are aggressive, invasive, and prone to spreading.
5. _____ is a common end-stage cardiac condition characterized by the heart's inability to pump efficiently.

Exercise 10: Multiple Choice

1. Which noninfectious disease is characterized by enlargement of the thyroid gland due to iodine deficiency?
   a) Goiter
   b) Hip dysplasia
   c) Arthritis
   d) Diabetes mellitus
2. What role does the immune system play in autoimmune diseases?
   a) Protects against all diseases without error
   b) Attacks only invading pathogens
   c) Mistakenly attacks healthy body tissues
   d) Causes infections directly
3. Which diagnostic method is used to measure blood pressure in dogs?
   a) Radiography
   b) Doppler flow device
   c) Ultrasonography
   d) Biopsy
4. Which dog breeds are more predisposed to developing diabetes mellitus?
   a) Dachshunds, Cairn Terriers, Beagles
   b) German Shepherds, Labradors, Golden Retrievers
   c) Huskies, Malamutes, Saint Bernards
   d) Poodles, Chihuahuas, Boxers
5. What is the primary symptom of nutritional secondary hyperparathyroidism in dogs?

a) Lameness and bone weakness
b) Skin hair loss
c) Excessive urination
d) High blood sugar

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "Explore the Noninfectious World"

Divide the class into expert groups. Each group focuses on one topic, prepares a mini-lesson (with diagrams or slides), then teaches the others.

Group	Topic
A	Environmental hazards & toxins (heatstroke, antifreeze, rodenticide, toxic plants)
B	Nutritional diseases (taurine deficiency, iodine deficiency, overfeeding issues)
C	Genetic & hereditary disorders (hip dysplasia, palate defects, demodectic mange)
D	Autoimmune diseases & cancer
E	Cardiovascular disease & hypertension
F	Diabetes & arthritis
G	Other noninfectious conditions: allergies, epilepsy, eye problems

Each group should:

✓ Explain causes & risk factors

✓ Describe symptoms & diagnosis

✓ Suggest prevention/management strategies

2 Carousel Brainstorm: "Why, How, What?"

Hang large posters around the room labeled:

Why do noninfectious diseases occur?

How do they affect animals?

What can owners do?

Groups rotate, adding notes at each station.

At the end, groups discuss and connect ideas.

3 Concept Map: "From Cause to Consequence"

Groups create a concept map linking:

* Noninfectious disease categories → causes (environmental, genetic, metabolic, immune)
* Signs & symptoms
* Diagnosis
* Prevention or management strategies

Compare maps and discuss.

4 Debate: "What's the Biggest Threat?"
Split class into teams:
Team A: Environmental & nutritional causes are the biggest risk
Team B: Genetic, autoimmune & hereditary factors matter more
Use evidence from the text to support arguments.

5□ Visual Workshop: "Symptoms & Stories"
In groups:
* Pick 3 diseases from the list (e.g., hip dysplasia, diabetes, arthritis)
* Draw simple diagrams of affected organs/body systems
* List main symptoms & how they might show in daily life
Groups explain their visuals to the class.

6 Create an Info Poster or Pamphlet
Design a poster titled:
✅ "Common Noninfectious Diseases in Pets"
Include:
* Top diseases & what causes them
* Key signs to watch for
* Prevention tips for owners
Display around class or share online.

Case Study Exercises
Case 1: "The Hot Car"
A dog is left inside a parked car on a warm day.
After rescue, it shows labored breathing, weakness, and collapses.
* What condition likely occurred?
* Why does this happen even if the window is slightly open?
* How could this have been prevented?

Case 2: "All Meat Diet"
An owner feeds their dog only cooked meat for months.
The dog becomes weak and shows bone problems.
* What disease might this be?
* Explain why balance in diet is important.

Case 3: "The Limping Puppy"
A large breed puppy grows rapidly, eats a high-calorie diet with lots of calcium, and develops lameness.
* What is the likely diagnosis?
* What dietary change would help?

Case 4: "Red Blood Cells Destroyed"
A cat develops pale gums, weakness, and lab tests show its immune system is attacking red blood cells.
* What type of disease is this?

* Explain what's happening inside the body.

Case 5: "The Couch Potato"
An older overweight dog becomes lethargic, has trouble breathing, and its belly is swollen.
* Which noninfectious disease could this be?
* What signs suggest heart failure?

Case 6: "The Sudden Blindness"
A dog suddenly becomes blind. Vet finds very high blood pressure.
* What disease is this?
* Name possible underlying causes of the high blood pressure.

Case 7: "Never Enough Water"
A middle-aged Beagle drinks and urinates a lot, loses weight, but still seems hungry.
* What disease is likely?
* How would this be diagnosed and treated?

Case 8: "Not Playing Anymore"
An older dog stops playing, limps, and avoids stairs.
* Which disease is likely?
* How can owners make the dog more comfortable?

TYPES OF THERAPY (SPECIFIC, SYMPTOMATIC, PATHOGENETIC, NONSPECIFIC)

The action of various drugs, physiological and mechanical agents used to treat animal. It can be directed to one or another part of the pathological process: the cause of the disease, its main pathogenetic mechanisms or symptoms.

Depending on this, there are three types of therapy:

1) causal or etiotropic,

2) pathogenetic;

3) symptomatic.

Etiotropic therapy is a set of measures aimed at reducing the effect or eliminating the cause of the disease.

In contrast to infectious and parasitic diseases caused by pathogens (bacteria, viruses, parasites, and other biotic factors) the etiology of internal non-infectious diseases is a crucial combination of internal and external factors, which are caused by conditional-pathogenic microflora, or diseases that occur due to impaired feeding and maintenance (poor quality feeding, lack of protein, carbohydrates, vitamins, macro- and micronutrients, overheating or hypothermia).

The etiotropic therapy includes:

1. Antimicrobial drugs (antibiotics, sulfonamides, nitrofurans and other chemotherapeutic drugs).

2. Specific hyperimmune sera.

3. Phagotherapy.

4. Interferon therapy.

5. Probiotic therapy.

6. Antidototherapy.

7. Anthelmintic and insecticidal drugs.

Etiotropic antibacterial therapy is a method of treating the pathogen with antibiotics. Unfortunately, this days many microorganisms have become resistant to antibacterial drugs.

In this point, the use of drugs must have the rational criteria before treatment:

Therapy should be started as early as possible, using a wide range of drugs until the pathogen is clarified.

Treatment should be carried out under conditions of constant laboratory and bacteriological control.

Dosage and dose interval should provide antibacterial concentrations at the site of infection during the course of therapy.

Antibacterial therapy lasts for a certain period (course of treatment) required for complete destruction of the pathogen and clinical recovery of the animal.

A few days of ineffectiveness is an indication to change the antibacterial drug to another, reviewing the treatment regimen.

Treatment should be accompanied by monitoring of the immune status, as it is possible to suppress the immune response under the action of antibiotics.

The effectiveness of antibiotic therapy is assessed by the general condition of the animal, normalization of body temperature and peripheral blood parameters, reduction of intoxication

The huge variety of antibiotics and the types of their effects on the animal's body has led to the classification and dividing of antibiotics into groups:

1. By the nature of the effect on the bacterial cell, antibiotics can be divided into two groups:

- bacteriostatic (bacteria remain alive but unable to multiply);
- bactericidal (bacteria die and then excreted from the body).

2. The chemical structure, which is widely used in veterinary practice, consists of the following groups:1. Beta-lactam antibiotics, divided into four subgroups:

1.1. Penicillins.

1.2. Cephalosporins.

1.3. Carbapenems.

1.4. Monobacts.

2. Macrolides.

3. Tetracyclines.

4. Aminoglycosides.[23]

5. Chloramphenicols.

6. Glycopeptide antibiotics.

7. Lincosamides.

8. Antibiotics of different groups.

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1. Match the word to its definition

Match the words on the left with their correct definitions on the right.

Words	Definitions
1. Etiotropic therapy	a) Process or study of disease mechanisms
2. Pathogenetic	b) Directed at symptoms rather than cause
3. Symptomatic	c) Drugs that kill bacteria
4. Antibiotics	d) Therapy involving beneficial microorganisms
5. Bacteriostatic	e) Therapy that stops bacteria from multiplying
6. Bactericidal	f) Directed at the cause of a disease
7. Probiotic therapy	g) Drugs that kill parasitic worms
8. Anthelmintic drugs	h) Therapy that kills bacteria

2. Fill in the blanks

Use the correct word from the list to fill in the blanks:

(etiotropic, pathogenetic, symptomatic, antibiotics, bactericidal, resistant, immune response)

1. _____ therapy aims to eliminate the cause of the disease.
2. _____ therapy focuses on relieving the symptoms of a disease.
3. _____ therapy targets the main mechanisms of disease development.
4. _____ are drugs used to treat bacterial infections.
5. _____ antibiotics kill bacteria directly.
6. Some bacteria have become _____ to certain antibiotics.
7. Antibiotic treatment can sometimes suppress the body's _____.

3. Multiple choice

Choose the correct answer:

1. Which type of therapy targets the cause of the disease?
   a) Symptomatic
   b) Etiotropic
   c) Pathogenetic
2. What type of antibiotic prevents bacteria from multiplying but does not kill them?
   a) Bactericidal
   b) Bacteriostatic
   c) Anthelmintic
3. Which is NOT a group of antibiotics mentioned in the text?
   a) Beta-lactams
   b) Macrolides
   c) Antihistamines
4. Which therapy uses beneficial bacteria to help the animal?
   a) Probiotic therapy

b) Antidote therapy
c) Phagotherapy

4. True or False

Write T for true or F for false next to each statement:

1. Etiotropic therapy is only used for infectious diseases.
2. Antibiotics can be divided based on their effect on bacteria.
3. Pathogenetic therapy treats the symptoms of a disease.
4. Bactericidal antibiotics kill bacteria, which are then excreted from the body.
5. Resistance means bacteria cannot be treated with antibiotics.
6. Anthelmintic drugs kill parasites like worms and insects.

Cooperative learning and Case study section.

Cooperative Learning Activities

Activity 1: "Therapy Sorting Challenge"

Goal: Identify and sort examples into etiotropic, pathogenetic, or symptomatic therapy.

Instructions:

1. Divide students into small groups.
2. Give each group cards with different therapy examples (e.g., antibiotics, probiotics, anti-inflammatory drugs, vitamins, antidotes, hyperimmune sera, analgesics, antipyretics).
3. Groups must discuss and sort each card into:
   * Etiotropic (targeting cause)
   * Pathogenetic (targeting mechanisms of disease)
   * Symptomatic (targeting symptoms)
4. Each group presents and explains why they sorted each card.

Variation: Include tricky cards (e.g., vitamin supplements, probiotics) to spark discussion.

Activity 2: "Design a Protocol"

Goal: Learn to plan rational etiotropic antibacterial therapy.

Instructions:

1. Groups receive a short clinical scenario (e.g., calf with bacterial pneumonia).
2. Each group develops a treatment protocol, including:
   * When to start antibiotics
   * Criteria for choosing initial antibiotics
   * Importance of lab/bacteriological monitoring
   * Duration of therapy
   * Criteria to evaluate effectiveness
3. Groups share and discuss their protocols; instructor highlights best practices.

Activity 3: "Antibiotic Detective"

Goal: Understand antibiotic classification and mechanisms.

Instructions:

1. Give groups a set of antibiotic names (e.g., amoxicillin, doxycycline, gentamicin, lincomycin, vancomycin).
2. Ask them to:
   * Classify each into chemical group (penicillins, tetracyclines, etc.).
   * Decide: bactericidal or bacteriostatic?
3. Groups draw a simple diagram to show where each group acts on bacterial cells.
4. Share findings with the class.

Case Study Exercises

Case Study 1: Mastitis in a dairy cow

A lactating cow shows signs of mastitis (swollen udder, high temperature, decreased milk).

Lab confirms Staphylococcus aureus. The herd is at risk; milk production is dropping.

Questions for groups:

* Identify the etiotropic therapy.
* Suggest pathogenetic therapy to reduce inflammation and tissue damage.
* Propose symptomatic therapy to reduce fever and pain.
* How would you choose and monitor antibiotic therapy?
* What if after 3 days the cow doesn't improve?

Case Study 2: Puppy with Parasitic Infection

A puppy presents with roundworm infection, mild diarrhea, poor coat condition.

Questions:

* What is the etiotropic therapy?
* What pathogenetic or supportive treatments could help the puppy recover faster?
* What symptomatic treatments might reduce discomfort?

Case Study 3: Horse with vitamin deficiency

A young horse is diagnosed with a vitamin deficiency affecting muscle function.

Questions:

* Is there an etiotropic therapy?
* What would pathogenetic therapy focus on?
* Are there symptomatic therapies needed?

Specific therapy

Specific therapy is the use of biological agents for the treatment of infectious diseases, and is based on the following principles:

treatment should be complex and take into account all possible factors

the purpose of the applied agents must be eliminating of the pathogen;

carrying out the immune correction

the treatment should be based on the form and period of the disease, the severity of clinical signs, assessment of the animal's condition and the presence of concomitant pathologies

Etiological agents of specific therapy include:

blood serum;

specific immunoglobulins;

bacteriophages;

vaccines;

monoclonal antibodies (antibacterial, antiviral and antitoxic sera).

Phage therapy

Phage therapy, viral phage therapy, or phagotherapy is the therapeutic use of bacteriophages for the treatment of pathogenic bacterial infections.

Bacteriophages, known as phages, are a form of virus that attach to bacterial cells and inject their genome into the cell. The bacteria's production of the viral genome interferes with its ability to function, halting the bacterial infection. The bacterial cell causing the infection is unable to reproduce, and instead produces additional phages.

Phage therapy has many potential applications in human medicine as well as dentistry, veterinary science, and agriculture.

Bacteriophages are used to treat Escherichia coli (colibacillosis) in calves, piglets, calf salmonellosis, and chicken pullorosis.

Probiotic therapy

Probiotics are biological drugs that are the stable cultures of symbiotic microorganisms. Probiotics may also include fermentation products of beneficial microorganisms, interferon inducers. Several strains of lacto- and bifidobacteria isolated from the species for which they are intended.

Etiotropic probiotic therapy is indicated for the treatment of intestinal dysbacteriosis. Eliminating the cause of the disease, probiotics also treat clinical signs. Probiotics contain bacteria and microorganisms that belong to the normal microflora of the intestinal tract. Their entry into the animal's body in adequate quantities allows you to normalize the gastrointestinal tract function, restore the microbiocenosis and speed up the recovery of the sick animal.

In addition to dysbacteriosis, the use of probiotics is indicated in the following cases:

- treatment of metabolic diseases;
- enzymatic age disorders;
- hypovitaminosis;
- immunodeficiency;
- anemia;
- regulation of post-stress state;
- restoration of intestinal microbiosis after antimicrobial therapy;
- stimulation of animal growth.

Antidote therapy

Antidote therapy – the use of drugs that counteract the effects of poisons or toxins.

The entry of toxic and poisonous substances into the animal's body requires the immediate removal of the latter. Some of these substances have antidotes that can neutralize the harmful effects of poisons.

The antidote is a substance that reacts with toxic drugs or other drugs, conducts a neutralization reaction, eliminates the negative effects of poisoning. Antidotes can be direct action or functional action. The most common direct-acting antidotes are

adsorbents (activated carbon, enterosorbent, enterosgel, sorbex, etc.), sodium thiosulfate, and unithiol. The most typical representatives of the antidotes of functional action are calcium chloride or calcium gluconate, used for organophosphorus compounds poisoning (OPCs).

Symptomatic therapy

Symptomatic therapy – the use of drugs aimed at eliminating or alleviating the most life-threatening symptoms of animals. As an independent method is not used, because the elimination of the symptom (cough, pain, diarrhea) is not an indicator of recovery. This type of therapy is used in combination with pathogenetic therapy. For example: for fever use an antipyretic.

Symptomatic drugs: antipyretics, sedatives, neuroleptics, astringents, analgesics, heart drugs and others.

Pathogenetic therapy

Pathogenetic therapy – therapy aimed at the mechanisms of action on the pathological process development, restoration of organ and tissue functions, normalization of the internal environment by affecting the nervous and endocrine systems, increasing nonspecific resistance

Pathogenetic therapy includes methods that regulate neurotrophic functions, non-specific stimulatory (protein, lysate, organ and tissue therapy), immunostimulatory and reflexotherapy.

Types of non-specific stimulant therapy:

1) Protein therapy.

2) Protein-free therapy.

Non-specific stimulant therapy / Protein therapy

Protein therapy – parenteral administration with the therapeutic purposes of various protein substances: blood, serum, milk. Depending on the type of substance, there are hemo-, sero- and lactotherapy.

Hemotherapy is a method of protein therapy that involves the use of blood (own blood, foreign blood, blood from convalescents, fresh blood, stabilized blood). There are three types of hemotherapy:

Autohemotherapy

Iso- or homohemotherapy

Heterohemotherapy

Autohemotherapy - the introduction of the animal's own blood. Use freshly drawn blood from a vein, which is stabilized to prevent coagulation with 5% sodium citrate solution (1:10), 20% sodium or potassium oxalate solutions (1:20), 10% trilon B solution (1:50), 0.5% heparin solution (1:50). Blood is injected subcutaneously or intramuscularly. The dose of blood for large animals - 30-150 ml (average - 50 ml), for small - 5-10 ml, calves - 0.3-0.4 ml/kg body weight per injection. Given that the reaction to the injected blood lasts 48 hours or more, injections are prescribed with an interval of 3-5 days (only 3-5 injections).

Iso- or homohemotherapy - the introduction of blood taken from animals of the same species. Newborn calves are injected intraperitoneally with glucose-citrate blood. Stabilized blood is injected subcutaneously, at a dose of 0.3 ml per 1 kg of body weight, 2-3 times

Heterohemotherapy - donor blood is injected into an animal of another species. Blood is injected once or twice with an interval of not more than 6 days to prevent anaphylaxis. The blood is treated with a 1% solution of chloramine or heated before administration to 55 ℃.

Serotherapy – a method of treating animals with serum. Allogeneic serum – obtained from animals clinically healthy donors tested for leukemia, tuberculosis, leptospirosis, brucellosis and piroplasmidosis are selected for its production. Serum is obtained by settling or centrifugation and defibrination of plasma

Hyperimmune serum containing a significant amount of specific antibodies to antigens. They are prepared by hyperimmunization of animals - repeated administration of antigen to animals for maximum immunological irritation, which is manifested by the accumulation in the blood of a significant number of specific antibodies.

A number of drugs are prepared from blood serum. The most common is:

- nonspecific and specific globulins;
- normal and nonspecific immunoglobulins;
- antidiarrheal drug (serohydrolysin).[24]

1. Match the word to its definition

Match the terms on the left with their correct definitions on the right:

Words	Definitions
1. Specific therapy	a) Therapeutic use of bacteriophages to fight bacterial infections
2. Bacteriophages	b) Treatment that targets symptoms, not causes
3. Phage therapy	c) Drugs that neutralize poisons or toxins
4. Probiotic therapy	d) Use of blood or blood products for therapy
5. Antidote therapy	e) Biological drugs that help normalize gut microflora
6. Symptomatic therapy	f) Serum with a high concentration of specific antibodies
7. Hemotherapy	g) Use of biological agents targeting infectious diseases
8. Hyperimmune serum	h) Viruses that infect and kill bacteria

2. Fill in the blanks

Use the correct word from the box to fill in the blanks:

(phage, probiotics, antidote, symptomatic, hemotherapy, antibodies, autohemotherapy, immune correction)

1. _____ therapy involves using viruses to kill harmful bacteria.

[24] Presentations on the subject "Therapy" and "Internal diseases" done by PhD Ostap Stefanyk and PhD Mykola Lychuk. Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv. 2025.

2. _____ contain beneficial microorganisms that help restore gut health.

3. An _____ is a substance that neutralizes poisons.

4. _____ therapy aims to relieve symptoms such as pain or fever.

5. _____ is a type of protein therapy using the animal's own blood.

6. _____ are proteins produced by the immune system to fight antigens.

7. Specific therapy includes measures for _____ to help regulate immune response.

8. _____ is the therapeutic use of blood and blood products.

3. Multiple Choice

Choose the best answer:

1. What is the main purpose of specific therapy?
   a) To relieve symptoms
   b) To eliminate the pathogen
   c) To strengthen the heart
2. What do bacteriophages do?
   a) Stimulate the immune system
   b) Infect and destroy bacteria
   c) Produce antibodies
3. Which therapy involves administering beneficial microorganisms?
   a) Phage therapy
   b) Probiotic therapy
   c) Antidote therapy
4. What is a hyperimmune serum?
   a) A serum with many antibodies against specific antigens
   b) A type of toxin
   c) A protein therapy using milk
5. Which is NOT part of symptomatic therapy?
   a) Antipyretics
   b) Vaccines
   c) Analgesics

4. True or False

Write **T** for true or **F** for false:

1. Phage therapy uses viruses to kill bacteria.
2. Antidote therapy works by neutralizing poisons or toxins.
3. Hemotherapy uses donor blood only from other species.
4. Autohemotherapy involves injecting the animal's own blood.
5. Probiotics can help restore intestinal microflora after antibiotic treatment.
6. Symptomatic therapy cures the disease by eliminating its cause.
7. Hyperimmune serum is created by repeated antigen administration to animals.

5. Short answer

Answer briefly:

1. What are bacteriophages?
2. Name two examples of direct-acting antidotes.
3. What is the main goal of probiotic therapy?
4. How often are autohemotherapy injections typically given?
5. What is the difference between isohemotherapy and heterohemotherapy?

Cooperative learning and Case study section.

Cooperative Learning Activities

Activity 1: "Therapy Match & Justify"

Goal: Understand and distinguish the types of therapy by real examples.

Instructions:

1. Split students into small groups.
2. Give each group a list of clinical interventions (e.g., antipyretics, phage therapy, probiotics, autohemotherapy, antitoxins, sedatives).
3. Groups sort each intervention into:

* Specific therapy
* Pathogenetic therapy
* Symptomatic therapy
* Nonspecific stimulant therapy

4. For each, they must justify why.
5. Groups present to the class; peers can challenge or ask clarifying questions.

Activity 2: "Therapy Flowchart"

Goal: Visualize the logical treatment plan.

Instructions:

1. Each group draws a flowchart starting from:

* Disease cause
* Pathogenetic mechanisms
* Symptoms
* Concomitant conditions

2. Then, map what therapy type targets what stage:

* Etiotropic (specific)
* Pathogenetic
* Symptomatic
* Nonspecific stimulant

3. Groups compare and discuss flowcharts.

Activity 3: "Debate: Which therapy first?"

Goal: Explore clinical decision-making.

Instructions:

1. Present a clinical scenario (e.g., calf with colibacillosis and high fever).
2. Half the class argues for starting with specific therapy first (e.g., phages or serum).

3. The other half argues for starting with pathogenetic + symptomatic therapy first.

4. After debate, discuss when and why different therapies might be prioritized.

Case Study Exercises

Case Study 1: Calf with bacterial diarrhea

A 1-week-old calf shows diarrhea, fever, and dehydration. Lab identifies E. coli infection.

Questions:

* What specific therapy options are available? (e.g., bacteriophages, hyperimmune serum)
* What symptomatic therapy should be used?
* What pathogenetic therapy could help?
* Would nonspecific stimulant therapy help? Which type?

Case Study 2: Dog poisoning

A dog accidentally ingests rat poison (anticoagulant).

Questions:

* What is the antidote? (specific therapy)
* What symptomatic therapy might be needed?
* What pathogenetic steps are important to prevent shock or organ damage?

Case Study 3: Horse after prolonged antibiotics

After a long antibiotic course, a horse develops intestinal dysbacteriosis.

Questions:

* Which therapy type is needed to restore gut microflora?
* How do probiotics act both as specific and pathogenetic therapy?
* What else might help recovery?

Special Focus Activity: Non-specific stimulant therapy (protein therapy)

Goal: Understand types and indications.

Instructions:

1. Divide into four groups. Each group takes:
* Autohemotherapy
* Iso-/homohemotherapy
* Heterohemotherapy
* Serotherapy
2. Groups answer:
* What is it?
* How is it done?
* When is it used?
* Risks & precautions?
3. Groups share and make a comparison table.

Kahoot quiz (can be copied into Kahoot or any quiz platform).

Kahoot Quiz: Types of Therapy in Veterinary Medicine

Q1:

Which therapy aims directly to eliminate the cause of a disease?

A) Pathogenetic therapy

B) Symptomatic therapy

✓ C) Specific (etiotropic) therapy

D) Nonspecific stimulant therapy

Explanation: Specific/etiotropic therapy targets the disease cause directly.

Q2:

Which of the following is an example of symptomatic therapy?

✓ A) Using antipyretics to reduce fever

B) Using hyperimmune serum

C) Giving probiotics after antibiotics

D) Using phage therapy

Explanation: Symptomatic therapy manages the signs, like fever, pain, diarrhea.

Q3:

Phage therapy belongs to which type of therapy?

A) Specific (etiotropic) therapy

B) Pathogenetic therapy

C) Symptomatic therapy

D) Nonspecific stimulant therapy

Explanation: Phages target and destroy specific bacteria.

Q4:

What is the purpose of pathogenetic therapy?

A) Remove the cause of disease

B) Only control symptoms

C) Influence disease mechanisms and restore function

D) Only stimulate immunity

Explanation: It targets mechanisms of disease to normalize organ/tissue functions.

Q5:

What does autohemotherapy use?

A) Serum from donor animals

B) The animal's own blood

C) Antibodies from vaccines

D) Plant extracts

Explanation: Autohemotherapy injects the animal's own blood to stimulate response.

Q6:

What is a hyperimmune serum?

A) Serum from healthy animals only

B) Serum with high specific antibodies from hyperimmunized animals

C) Blood with high sugar

D) Serum with hormones

Explanation: It contains many antibodies against specific pathogens.

Q7:

Probiotics mainly help by:
A) Restoring gut microflora and function
B) Killing all bacteria
C) Causing fever
D) Blocking nerve pain
Explanation: They rebalance the normal gut microbiome.
Q8:
Which of the following is a direct-acting antidote?
A) Activated charcoal
B) Calcium gluconate
C) Sedative
D) Antipyretic
Explanation: Activated charcoal adsorbs toxins directly in the gut.
Q9:
What type of therapy increases nonspecific resistance and stimulates recovery?
A) Symptomatic therapy
B) Specific therapy
C) Nonspecific stimulant therapy
D) Etiotropic therapy
Explanation: It stimulates overall immunity and recovery, e.g., protein therapy.
Q10:
Pathogenetic therapy includes:
A) Reflexotherapy, immunostimulatory drugs, neurotrophic regulation
B) Only giving vaccines
C) Only antipyretics
D) Only painkillers
Explanation: It acts on disease mechanisms and body regulation systems.

GENERAL PREVENTION OF INTERNAL ANIMAL DISEASES. DYSPANSERIZATION (CLINICAL EXAMINATION) OF FARM ANIMALS

In modern conditions of animal husbandry development, general prevention is of great importance in the prevention of internal diseases of animals. It is an important part of organizational and economic and veterinary and sanitary measures and is a systematic inspection of animal health, feeding and housing conditions.

In this case, the external environment should be understood as:

- soil and climatic conditions;
- condition of fodder base, quality;
- technology of preparation and methods of feed storage;
- conditions of keeping and economic use of animals

The basis of prevention of internal diseases of animals are: complete feeding, high quality feed and water, optimal indoor climate, systematic exercise, rational use of means of chemical and microbiological synthesis, control of metabolism and animal health (dyspanserization).

Dyspanserization is a system of planned diagnostic, preventive and therapeutic measures aimed at creating highly productive herds of animals.

The method of dyspanserization of animals is based on two principles:

sample population;

continuity.

In the conditions of large farms and complexes the principle of sample population is reached by inspection of control farms (yards, sections) and control groups of animals. Clinically healthy animals are selected for control groups.

The similarity of housing conditions and standardization of feeding provide a high probability of the results obtained and allow based on a sample study of several animals to draw conclusions about the health of the whole herd. Deviations from the optimal parameters of the microclimate, violations of feeding hygiene cause similar changes in the physiological state and therefore allow to make not an individual but a group diagnosis.

The principle of continuity is achieved through the planned medical examination. At breeding dairy farms, dyspanserization is performed quarterly, clinical examinations of newborn calves are performed 2-3 times a day, and laboratory blood tests are performed once a quarter.

Dyspanserization of calves is perfomed for the arrival of animals on the farm and their transfer to breeding groups, and young animals - at 6 and 12 months of age.

Dyspanserization of ewes is recommended before insemination (late August-early September), 3-4 weeks before lambing (December-January) and 3-4 weeks after (February-March).

Dyspanserization of high-value horses of state breeding farms, breeding farms, equestrian schools and racetracks is perfomed twice a year: in 1-2 months after transfer to the winter-stable keeping and in 1-2 months after transfer to summer keeping. The control groups in state breeding farms and breeding farms are breeding stallions, infertile, pregnant and lactating mares, foals 6, 12, 18, 24 and 30 months old; in equestrian schools and on racetracks - horses in preparation for performances and during recreation.

Dyspanserization of sows is perfomed twice a year - in October-November and March-April.

The main tasks of dyspanserization:

1) control over metabolism in animals;

2) timely diagnosis of latent and clinical forms of internal and other diseases;

3) establishing the main causes of diseases of animals in the herd;

4) development of measures for disease prevention;

5) definition and perfomed of therapeutic measures.

Dyspanserization consists of three stages:

1) diagnostic;

2) therapeutic;

3) preventive.

The diagnostic stage is perfomed according to the following plan: analysis of production indicators; determination of the clinical status of animals in the herd (on the farm); researches of blood, urine and other biological substrates; analysis of feed quality, feeding and keeping animals; analysis of the obtained results, conclusions and proposals for the prevention of major and concomitant diseases.

At the therapeutic stage of dyspanserization, group therapy is carried out, the methods and means of which are determined by the level of animal husbandry culture, feed preparation technology, and the availability of natural resources

At disturbance of a metabolism apply corrective group therapy which is perfomed taking into account the deficiency or excess in the feed, rations and body of animals of nutrients, mineral salts, vitamins and provitamins.

If there is a protein deficiency, the diet includes concentrated feed, hay legumes (clover, alfalfa, etc.), grass meal, protein hydrolysates, trace elements. It is necessary to monitor the sugar-protein ratio of rations, which should be in the range of 0.8-1.2. If the diet is deficient in carbohydrates, add roots (taking into account the sugar-protein ratio) and trace elements.

At the prophylactic stage of dyspanserization, group prophylaxis is carried out, for which it is necessary to create a full-fledged fodder base, which would correspond to the peculiarities of metabolism and the level of productivity of animals.

It is also necessary to ensure compliance of physiological parameters of the animal body with the hygienic conditions of their keeping and economic use.

At the therapeutic and prophylactic stages not only general (group) but also partial (individual) therapy and prevention of detected internal non-contagious diseases of animals are perfomed.

During the clinical examination, attention is paid to the habit, condition of the hair, skin, organs of movement, respiratory movements, appetite. Good general condition, lively and fast reaction to a sound, shine of a hair cover, average fatness, good appetite are characteristic of healthy animals. Dull hair and the so-called glaze of the hoof horn, folds of the horn shoe, exhaustion or obesity, pain when getting up and moving, crunchy joints, sagging back, stooping indicate a pathology of metabolism.[25]

Vocabulary Exercise 1: Match the Word with its Definition

Match each word from the text with its correct definition.

Word	Definition
1. Dyspanserization	a. The methods and measures taken to prevent disease
2. Metabolism	b. Identification of a disease or condition
3. Fodder	c. Conditions and practices that help maintain health and prevent disease
4. Therapeutic	d. A process of systematic diagnostic, preventive, and therapeutic care of animals
5. Prophylactic	e. Animal feed
6. Clinical	f. Systematic checks or examinations
7. Pathology	g. Relating to treatment of disease or health

[25] Presentations on the subject "Therapy" and "Internal diseases" done by PhD Ostap Stefanyk and PhD Mykola Lychuk. Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv. 2025.

8. Hygiene	h. Relating to the prevention of disease
9. Diagnosis	i. The study of diseases and their effects
10. Inspections	j. Related to the observation and examination of symptoms

Vocabulary Exercise 2: Fill in the Blanks

Use the correct word from the box to complete each sentence.

Words: dyspanserization, metabolism, prophylactic, clinical, fodder, therapeutic, diagnosis, hygiene, pathology, inspection

1. The _____ examination helps to detect early signs of disease in farm animals.
2. _____ measures include vaccinations and hygiene practices to prevent illness.
3. The balance of nutrients in the feed affects the animal's _____.
4. The veterinarian conducted a thorough _____ of the herd to ensure health standards.
5. _____ refers to the study and diagnosis of diseases affecting animals.
6. High-quality _____ is essential for the proper nutrition of animals.
7. The _____ stage involves treatment methods to help sick animals recover.
8. Proper feeding and housing improve animal health and reduce the risk of _____.
9. Early _____ allows farmers to take timely actions to control diseases.
10. _____ is a system of planned preventive and therapeutic measures in animal farming.

Vocabulary Exercise 3: True or False

Read the sentences and write **True** or **False**.

1. Dyspanserization is only about treating sick animals.
2. The term "fodder base" refers to the quality and availability of animal feed.
3. Clinical examinations are performed only once a year.
4. Metabolism control is one of the main tasks of dyspanserization.
5. Hygiene has no impact on animal health and disease prevention.
6. Prophylactic measures help prevent the occurrence of diseases.
7. Therapeutic measures are always applied individually, never in groups.
8. A dull coat and sagging back can be signs of metabolic disorders in animals.
9. Continuity and sample population are principles of dyspanserization.
10. Animals with shiny hair and good appetite are generally unhealthy.

Vocabulary Exercise 4: Synonyms and Antonyms

Write a synonym or antonym for the following words from the text.

1. Prevention

2. Diagnostic
3. Healthy
4. Deficiency
5. Therapeutic
6. Quality
7. Optimal
8. Excess
9. Disease
10. Examination

Vocabulary Exercise 5: Short Answer

Answer these questions using words from the text.

1. What is the main purpose of dyspanserization?
2. Name two principles on which dyspanserization is based.
3. What should be analyzed during the diagnostic stage?
4. What kind of therapy is used when metabolism is disturbed?
5. When is dyspanserization recommended for ewes?

Cooperative learning and Case study section.

Cooperative Learning Activities

Activity 1: "Design a Dyspanserization Plan"

Goal: Understand how to apply principles of dyspanserization.

Instructions:

1. Divide students into small groups.
2. Assign each group a different type of farm animal:

* Dairy cows
* Horses
* Sows
* Sheep
* Young calves

3. Each group must:

* Outline when dyspanserization should be done (time of year, age, physiological state).
* List diagnostic measures (lab tests, clinical signs, feed analysis).
* Plan therapeutic and preventive steps.

4. Groups present their plans and explain why they chose those measures.

Activity 2: "Farm Detective"

Goal: Practice identifying and preventing internal diseases.

Instructions:

1. Present a fictional farm scenario with:

* Poor feed quality
* Overcrowded barn
* High incidence of metabolic disorders

2. Groups analyze:

* What are possible causes of internal diseases?

* What steps of dyspanserization would help identify problems?
* What preventive measures should be taken?
3. Each group presents a short action plan.

Activity 3: "Prevention Pyramid"
Goal: Visualize prevention measures.
Instructions:
1. Groups draw a pyramid divided into 3 levels.
* Bottom: Basic herd management and environment
* Middle: Regular diagnostic and therapeutic measures
* Top: Targeted group and individual treatments
2. Groups fill each level with concrete examples:
* Feed quality, microclimate control, exercise (bottom)
* Quarterly lab tests, dyspanserization, clinical exams (middle)
* Treatment of deficiencies, group therapy (top)
3. Compare pyramids as a class and discuss differences.

Case Study Exercises
Case Study 1: Dairy farm metabolic problem
A large dairy farm reports frequent cases of ketosis and milk fever. Feed analysis shows imbalance in mineral content.
Questions:
* What stages of dyspanserization should be applied?
* Which lab tests could help detect these problems early?
* What therapeutic and preventive measures would you recommend?

Case Study 2: Sheep before lambing
On a sheep farm, ewes are scheduled for dyspanserization 3–4 weeks before lambing.
Questions:
* Why is this timing important?
* What should be checked during the clinical exam?
* How would you organize group therapy and prevention?

Case Study 3: Horses in equestrian school
Horses undergo dyspanserization after moving to winter stables.
Questions:
* What physiological risks increase with this housing change?
* What should be included in the diagnostic stage?
* Suggest therapeutic and preventive steps specific for sport horses.
Discussion & Reflection
Prompt:
"How do sample population and continuity principles make dyspanserization effective for large herds?"
Discuss in groups and share insights.

Mini-research task:

Groups answer:

* What are the signs of good general condition in animals?

* What clinical signs might show metabolic disorders?

Groups make a poster or slide summarizing their findings.

Clinical research

For clinical research, control groups of animals are selected, in which cows are selected for 1-2 weeks and two months of lactation, dry cows for two, and heifers - for three months before calving. 15-20 cows are examined in each group. Examine habitus, condition of hair, skin, conjunctiva, lymph nodes, heart, respiratory, digestive, liver, urinary, skeleton, mammary gland etc. In the hot season, when the animals may overheat, perform thermometry. The results of the clinical examination are recorded in a special journal or dispensary card.

Laboratory tests

Blood for researches is taken from animals of control groups that do not show signs of traumatic reticulitis, pericarditis, mastitis, endometritis, surgical infection and other primary diseases of organs and systems that may affect blood parameters. On farms with the same type of feeding, it is taken from 10-15 cows of each control group.

Blood tests are performed using unified methods or using modern automatic analyzers and special combined rapid tests. In the clinical interpretation of blood test results use regulatory data.

Common indicators are the determination of hemoglobin in the blood, the number of erythrocytes and leukocytes, in the serum - reserve alkalinity, total protein, total calcium, inorganic phosphorus, vitamin A and carotene; specific indicators - determination of ketone bodies, glucose, magnesium, trace elements, albumins, setting of protein-sediment samples, etc. Determination of calcium and phosphorus content is necessary to assess the state of mineral metabolism, trace elements - to diagnose microelementosis, vitamins - to diagnose hypovitaminosis, ketone bodies and glucose - ketosis, magnesium - to detect hypomagnesemia (pasture tetany), to determine albumin and albumin - to diagnose liver disease. Thyroid function is assessed by the level of thyroid hormones in the blood - T3 and T4.

Urine for the study is taken from 10-15 cows or heifers of each control group, which have no clinical signs of endometritis or purulent mastitis. It is examined directly on farms: conduct a physical examination (color, odor, transparency, consistency), determine the pH, the presence of ketone bodies, protein, glucose and, if necessary - bilirubin and other components. Urine is collected during natural urination or it is provoked in animals by a light massage of the skin in the area of the ventral part of the labia (the inner and outer folds of the vulva, at either side of the vagina). Indicator strips are used to examine the urine, which allows to obtain from 5 to 10 different indicators.

In the study of milk and colostrum conduct organoleptic evaluation, determine their acidity, chemical composition - fat, protein, ketone bodies, if necessary - immunoglobulins and vitamin A. It is important to determine the relationship between fat and protein in milk. It must be at least 1.2: 1. If the ratio is close to 1: 1,

you should review the structure of the diet, pay attention to the content of fiber, from which acetic acid is synthesized in the rumen, and from it - milk fat. Milk is examined once a month to diagnose mastitis in the subclinical stage, using reactions with mastidine or dimastin. If the reaction is positive, a bacteriological examination is performed.

Studies of the contents of the rumen are carried out in cases where the presence of acidosis or alkalosis of the rumen, chronic ruminitis. Investigate the rumen content of 5-7 cows: determine the odor, color, consistency, pH, number of ciliates (infusorias) and other indicators. The color of the contents of the rumen depends on the nature of the feed, the smell for acute acidosis or chronic ruminitis – acidic or sour, alkalosis - ammonia, putrefactive. The consistency of the contents of the rumen in healthy animals - pasty, semi-liquid; for ruminite - watery; alkalosis - watery with foam. The concentration of hydrogen ions is determined by a pH meter or indicator paper, reactive strips. The optimal pH value of the rumen content in cows and heifers is 6.5-7.2. A decrease in pH to 6.0 or less indicates the development of acidosis, an increase of more than 7.2 is characteristic of rumen alkalosis. The number of ciliates (infusorias) in the rumen content of healthy cows ranges from 500 to 1200 thousand/ml (determined in a chamber with a Goryaev grid). Their number decreases with hypotony, acidosis and rumen alkalosis.

The quality of feed is assessed by two main indicators: nutritional value and good quality. The first indicator is determined by laboratory tests or reference books, the second - by chemical, toxicological, microscopic studies, as well as organoleptically: by color, odor, taste, structure, purity, botanical composition, etc. The quality of feed is assessed in accordance with the requirements of state or industry standards.

During the analysis of animals keeping, a general hygienic assessment of farms is carried out, taking into account the condition of the floor, stalls, doors, ventilation and other structures. Individual links of technological process are studied. Control of microclimate parameters in the premises is carried out at several points. It is extremely important for cows and heifers to keep them in the delivery room, where microbial contamination should not exceed 50 thousand microbial bodies per 1 m3, ammonia concentration - 10 mg/m, carbon dioxide - 0.2%, relative humidity - 70%, and air exchange in winter is 17, in spring - 35 m3/h per 1 quintal of body weight.

After the examination, you should fill out the dispensary cards for each animal, and then analyze the results. Determine the percentage of animals of medium, lower and high fatness, with lesions of the cardiovascular system, respiratory system, hypotony and atony of the stomachs (less than three contractions of the rumen in 2 minutes), with enlargement and pain of the liver, signs of osteodystrophy, mastitis and other diseases. According to the results of the urine test, it should be clear how many samples (in percent) from each group of cows (dairy, dry) and heifers contain acetone bodies or protein in high concentrations, has a low or high pH. The results of the blood test are summarized in a table, determine the number of samples in percent with the deviation of the studied indicators from the norm.[26]

[26] Presentations on the subject "Therapy" and "Internal diseases" done by PhD Ostap Stefanyk and PhD Mykola Lychuk. Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies Lviv. 2025.

Vocabulary Exercise 1: Match the Word with its Definition

Match each word from the text with the correct definition.

Word	Definition
1. Lactation	a. Inflammation of the mammary gland
2. Heifer	b. The specific environmental conditions in a particular area or room
3. Thermometry	c. The period during which a cow produces milk
4. Ketosis	d. Microorganisms with hair-like structures found in the rumen
5. Urine	e. Related to sensory properties such as taste, color, odor
6. Acidosis	f. Excessive acidity in the rumen or body
7. Microclimate	g. Liquid waste excreted by animals
8. Mastitis	h. The process of measuring body temperature
9. Organoleptic	i. A metabolic disorder involving high levels of ketone bodies
10. Ciliates	j. A young female cow that has not yet calved

Vocabulary Exercise 2: Fill in the Blanks

Use the correct word from the box to complete the sentences.

Words: thermometry, ketosis, pH, ciliates, heifers, mastitis, lactation, acidosis, microclimate, organoleptic

1. During the hot season, farmers perform _____ to check if animals are overheating.
2. A drop in the _____ of rumen content below 6.0 indicates acidosis.
3. _____ are microorganisms living in the rumen important for digestion.
4. _____ refers to inflammation of the udder in cows, a common dairy disease.
5. Young female cows that have not yet calved are called _____.
6. The _____ evaluation helps assess milk by its color, smell, and taste.
7. _____ is a metabolic disorder caused by the buildup of ketone bodies in the blood.
8. The period when cows produce milk is called _____.
9. The quality of air, humidity, and temperature in barns is known as _____.
10. Urine tests check for the presence of _____ and protein to detect health issues.

Vocabulary Exercise 3: True or False

Write True or False for each statement.

1. Blood samples for tests are taken only from sick animals.
2. Milk should have a fat to protein ratio of at least 1.2:1.
3. The odor of rumen content can indicate acidosis or alkalosis.
4. The optimal pH value of rumen content is between 6.5 and 7.2.
5. Organoleptic evaluation refers to laboratory chemical tests only.
6. The quality of feed includes nutritional value and safety.
7. Microbial contamination in the delivery room should be very high to protect calves.
8. Ciliates numbers decrease in cases of rumen disorders.
9. Clinical research includes recording data in dispensary cards.
10. Ventilation and humidity do not affect the health of cows.

Vocabulary Exercise 4: Synonyms and Antonyms

Write a synonym or antonym for the following words.

1. Control (as in control group)
2. Deficiency
3. Consistency (of rumen content)
4. Increase
5. Healthy
6. Examine
7. Defect
8. Transparent
9. Disease
10. Quality

Vocabulary Exercise 5: Short Answer

Answer the questions using vocabulary from the text.

1. What does thermometry measure in animals?
2. What is tested in urine samples during clinical research?
3. Why is the fat to protein ratio in milk important?
4. What does the presence of ketone bodies in blood or urine indicate?
5. What environmental factors are monitored to ensure a good microclimate for cows?

Cooperative learning and Case study section.

Cooperative Learning Exercises

1 Jigsaw Activity: Clinical Research Steps

Objective: Understand each component of clinical research and laboratory testing.

Instructions:

* Divide students into groups of 4–5.
* Each member takes responsibility for one topic:
  * Clinical examination
  * Blood tests
  * Urine tests

  * Milk and rumen content analysis
  * Feed and microclimate assessment
* Each student reads their part, then meets with others who had the same topic to discuss and deepen understanding (expert groups).
* Return to the original groups and teach their topic to teammates.
* As a group, draw a big flowchart summarizing the entire process from clinical research to data analysis.

2 Think–Pair–Share: Key Indicators
Objective: Identify why each laboratory indicator is important.
Instructions:
* Individually: List as many indicators as you remember (e.g., ketone bodies, calcium, pH).
* Pair: Discuss why these indicators matter and what diseases or conditions they help detect.
* Share: As a class, create a master table of indicators, what they detect, and what abnormal results may suggest.

3 Role Play: Farm Visit Simulation
Objective: Practice clinical examination and interpretation.
Instructions:
* Divide into small groups. Assign roles: veterinarian, technician, farmer.
* Use provided case data (clinical signs, laboratory results, feed samples).
* Veterinarian and technician conduct the “farm visit”: interview the farmer, visually inspect animals, discuss lab tests.
* As a group, complete a dispensary card for three animals and present your conclusions to the class.

4 Concept Mapping: From Data to Diagnosis
Objective: Visualize the link between test results and diseases.
Instructions:
* In groups, create a concept map connecting:
  * Clinical signs
  * Laboratory results
  * Feed and housing factors
  * Possible diseases
* Highlight connections (e.g., low rumen pH → acidosis → diet high in concentrate, low fiber).

Case Study Exercises
Case Study 1: Detecting Ketosis
A dairy farm reports that some cows show reduced appetite and a drop in milk fat.
Blood test: Increased ketone bodies, low glucose.
Milk fat\:protein ratio = 1:1.
Tasks:
1. Identify the likely problem and explain its cause.

2. Suggest diet adjustments.
3. Decide what other tests you'd perform to confirm the diagnosis.

Case Study 2: Rumen pH Investigation
At another farm, several cows appear restless, saliva drips, and rumen contractions decrease.
Rumen pH: 5.8
Smell: sour.
Tasks:
1. Diagnose the problem.
2. Explain the effect of diet on rumen pH.
3. Propose practical changes in feed management.

Case Study 3: Urine Findings
Urine test results (10 cows):
* 40% of samples: ketone bodies (+++)
* 30%: protein (++)
Tasks:
1. Interpret the results.
2. What further examinations should be done?
3. What dietary or housing factors might contribute?

Case Study 4: Feed Quality
Farm reports problems with digestion and lower milk yield.
Feed analysis: mold odor, dark color, low nutritional value.
Tasks:
1. Assess risks to animal health.
2. Suggest additional lab tests on feed.
3. Recommend actions to improve feed quality.

Case Study 5: Summary & Reporting
After a full examination of a group of cows:
* 25% show low fatness
* 10%: enlargement/pain of liver
* 20%: hypotony of the stomachs
* 15%: mastitis
Tasks:
1. Summarize key herd health problems.
2. Discuss what factors (feeding, housing, microclimate) may contribute.
3. Propose a short action plan for the farm.

Epizootology

Infectious Diseases

Infections are caused by bacteria or viruses

Infections occur when one or more microorganisms such as bacteria or viruses enter the animal's body. Some bacteria or viruses can harm the animal, for example,

by creating toxins or destroying tissue. If the damage is extensive enough to be expressed as a symptom of illness, we speak of an infectious disease.

The immune system

To protect itself from infections, the body has an immune system. This immune system is mainly made up of immune cells and defense proteins. This system can recognize the foreign structures of bacteria and viruses, mark them and destroy the invaders. If the immune system is weak or the number of illness-causing bacteria too large, the bacteria or viruses can readily and explosively reproduce, leading to illness.

Therapeutic measures

In addition to general measures such as rest, keeping warm, etc., there is also a targeted way to combat the pathogens. To date, however, there are only very few drugs that attack viruses. If we assume that the infection is bacterial in nature, antibiotics can be administered. Antibiotics are drugs that disrupt the metabolism of the bacteria and in so doing stop their growth or even kill them. The immune system gains the upper hand once again and the infection is usually cured.

Important Infections

Respiratory diseases

Respiratory diseases, such as influenza or pneumonitis, are often caused by infections. Often viruses are the source. Bacteria almost always play an important part, however, because the mucous membranes that have been damaged by the viruses are subsequently very susceptible to bacterial infections. These so called secondary infections are combatted with antibiotics. Always see a veterinarian in the case of respiratory illness. The symptoms are often indicative of additional health problems such as allergies or heart disease.

Diarrhea

Diarrhea is often caused by viruses, but bacteria, metabolic toxins from bacteria and spoiled food can also cause harm. Food allergies in animals are on the increase. For this reason, putting the animal on a special diet is usually the first step in treating diarrhea. But be sure to consult your veterinarian. Diarrhea can often be indicative of a very serious illness.

Urinary tract infections

Urinary tract infections can often be traced to bacteria. Similar to infections in humans, infections in animals usually develop via the urethra. Treatment with antibiotics is very promising against this infection. Your veterinarian will prescribe the right antibiotic for your animal as soon as other causes of the infection, such as urolithiasis, have been ruled out.

Skin infections

Skin infections are quite rare because the healthy skin itself is a major protective organ against infections. However, bacterial infection is possible if the skin has previously been harmed in some other way such as through injury, parasites, or allergy. Here again, in addition to treating the bacterial infection with antibiotics, the cause of the skin problem must also be identified and treated. Contact your veterinarian immediately.

Vaccination

How does vaccination work?

Animals can be vaccinated against a number of dangerous infectious diseases. This is how vaccination works: inactivated or modified (to avoid causing actual disease) bacteria or viruses are administered to the animal by injection (with a sterile syringe and needle). The immune system then becomes activated and produces specific antibodies. These antibodies initiate a cascade which destroys the pathogens, such that in a later case of "true" infection, certain immune system cells called memory cells "remember" the infection. Now the immune system can react much more quickly and can successfully conquer the invaders - often even before the first symptoms appear.

Sustained protection

Two or more doses are usually needed to initiate an adequate immune response. Over time, however, the amount of antibodies produced by the activated immune system (the antibody titer) gradually declines. Therefore, a booster shot is needed at regular intervals. Protection against some diseases such as tetanus and rabies can be accomplished by boosting once a year. Others require more frequent intervals to provide adequate protection.

Vocabulary Exercise 1: Match the Word to Its Definition

Match the vocabulary words on the left with their correct definitions on the right.

Word	Definition
1. Infectious disease	a. The body's defense system against bacteria and viruses
2. Pathogen	b. A medication that kills bacteria or stops their growth
3. Antibiotic	c. A condition caused by harmful microorganisms causing illness
4. Immune system	d. Harmful microorganisms such as bacteria or viruses
5. Symptom	e. A sign or indication of illness
6. Vaccination	f. Injection of modified or inactivated pathogens to protect
7. Booster shot	g. Additional dose of vaccine to maintain immunity
8. Metabolism	h. The chemical processes in living organisms to sustain life

Vocabulary Exercise 2: Fill in the Blanks

Complete the sentences using the correct word from the box below:

immune system, antibiotics, vaccination, pathogen, symptoms, infection

1. The _____ protects the body by identifying and destroying harmful invaders.
2. When bacteria enter the body and multiply, they cause an _____.
3. _____ are drugs used to treat bacterial infections.
4. A _____ is any microorganism that causes disease.

5. Fever and coughing are common _____ of infectious diseases.

6. _____ helps prepare the body to fight off certain infectious diseases in the future.

Vocabulary Exercise 3: True or False

Write **True** or **False** for each statement based on the text.

1. Viruses can cause infections but antibiotics do not work against viruses.
2. The immune system destroys all bacteria before they can cause illness.
3. Booster shots are necessary because the amount of antibodies decreases over time.
4. Skin infections are common because skin is a weak protective barrier.
5. Memory cells help the immune system respond faster to infections after vaccination.
6. Diarrhea can only be caused by viruses.

Vocabulary Exercise 4: Multiple Choice

Choose the correct answer.

1. What is the primary purpose of antibiotics?
   a) To kill viruses
   b) To stop bacterial growth or kill bacteria
   c) To boost the immune system directly
   d) To prevent skin injuries
2. What is a secondary infection?
   a) An infection caused by parasites
   b) A bacterial infection occurring after a viral infection
   c) A skin infection caused by allergy
   d) An infection cured by vaccination
3. What is one reason for administering a booster shot?
   a) To cause a disease
   b) To reduce symptoms
   c) To maintain a high level of antibodies
   d) To treat skin infections

Vocabulary Exercise 5: Word Formation

Use the root words in parentheses to form the correct vocabulary word to complete the sentence.

1. The animal was given a _____ (vaccinate) to prevent illness.
2. If the _____ (infect) spreads rapidly, the animal will show many symptoms.
3. The veterinarian prescribed an _____ (antibiotic) to treat the bacterial infection.
4. An animal with a weak _____ (immune) system is more susceptible to diseases.
5. After several doses, the _____ (protect) provided by the vaccine is stronger.

Cooperative learning and Case study section.

Cooperative Learning Exercises

1 Jigsaw Activity: Understanding Infectious Diseases

Objective: Build a complete picture of infectious diseases and their management.

Instructions:

* Divide students into groups of 5–6.
* Assign each member one topic to study:
  1. How infections occur
  2. The immune system
  3. Therapeutic measures
  4. Important infections (respiratory diseases, diarrhea, urinary tract infections, skin infections)
  5. Vaccination and immune memory
* Members meet in "expert groups" with peers studying the same topic to discuss and prepare.
* Return to home groups to teach each other.
* As a group, create a mind map showing:
  * Causes of infection
  * Body's defenses
  * Treatments
  * Prevention
* Present mind maps to the class.

2 Think–Pair–Share: Bacteria vs. Viruses

Objective: Deepen understanding of how infections differ by cause.

Instructions:

* Think: Individually list at least three differences between bacterial and viral infections in animals.
* Pair: Discuss with a partner why treatment strategies differ (e.g., antibiotics vs. supportive care).
* Share: Groups write on the board key points; together the class creates a summary table comparing bacteria and viruses.

3 Debate: The Role of Vaccination

Objective: Critically evaluate vaccination benefits and limitations.

Instructions:

Split the class in two:

* Team A: Argues why vaccination is essential and safe.
* Team B: Presents possible limitations or concerns (e.g., cost, incomplete protection, over-vaccination).
* Each team prepares arguments and examples.
* Debate, then reflect together: when should vaccination be prioritized and how to educate animal owners.

4 Role Play: Veterinarian Consultation

Objective: Apply knowledge to communication.

Instructions:

* In groups of three: veterinarian, animal owner, assistant.
* Scenarios:
  * Owner brings animal with diarrhea.
  * Owner worries about yearly boosters.
* Veterinarian explains:
  * Possible causes of disease
  * Diagnostic steps
  * Treatment or vaccination plan
* Rotate roles so everyone plays veterinarian.

Case Study Exercises

Case Study 1: Respiratory Illness

A dog has a cough and fever. The owner says it started after contact with other dogs at a kennel.

The veterinarian diagnoses kennel cough (canine infectious tracheobronchitis).

Tasks:

1. Is the infection likely viral or bacterial?
2. Why might antibiotics still be prescribed?
3. How could vaccination have helped?

Case Study 2: Diarrhea Episode

A cat shows diarrhea after being given new canned food. Stool sample: no parasites.

Vet suspects food allergy, but keeps bacterial infection as a differential.

Tasks:

1. Explain why both allergy and infection are possible.
2. What diet changes might help?
3. When would antibiotics be needed?

Case Study 3: Urinary Tract Infection in a Mare

A mare shows frequent urination and mild fever. Lab tests reveal bacteria in the urine.

Vet prescribes antibiotics after ruling out stones.

Tasks:

1. How do bacteria usually enter the urinary tract?
2. Why is identifying the bacteria important before treatment?
3. What preventive measures might reduce recurrence?

Case Study 4: Skin Infection

A sheep has red, inflamed skin after scratching due to parasites.

Bacterial infection developed in the damaged area.

Tasks:

1. Why did bacteria infect previously healthy skin?

2. What should be treated first: parasites or bacterial infection?
3. Suggest a prevention strategy.

Case Study 5: Vaccination Plan

A farmer wants to protect his cows against clostridial diseases and rabies.
Vet recommends two initial doses, then yearly boosters.
Tasks:
1. Why are two doses needed at the start?
2. What happens to antibody levels over time?
3. Explain "memory cells" to the farmer.

THE 10 MOST COMMON ANIMAL DISEASES

It is important for the farmers to understand the most common animal diseases so as to identify them early and have idea on how to treat them.

Good husbandry, proper feeding, and hygiene are the main contributors to animal health on the farm, bringing economic benefits through maximised production. When, despite these precautions, animals still become sick, they are treated with veterinary medicines, by the farmer and the veterinarian. When farmers treat their own animals, they are required to follow the guidelines for treatment and to record the treatments given.

Animals are susceptible to a number of diseases and conditions that may affect their health. Some, like classical swine feverand scrapie are specific to one type of stock, while others, like foot-and-mouth disease affect all cloven-hoofedanimals. Where the condition is serious, governments impose regulations on import and export, on the movement of stock, quarantine restrictions and the reporting of suspected cases.

Vaccines are available against certain diseases, and antibiotics are widely used where appropriate. At one time, antibiotics were routinely added to certain compound foodstuffs to promote growth, but this practice is now frowned on in many countries because of the risk that it may lead to antibiotic resistance. Animals living under intensive conditions are particularly prone to internal and external parasites; increasing numbers of sea lice are affecting farmed salmon in Scotland. Reducing the parasite burdens of livestock results in increased productivity and profitability.

1. Anthrax

Anthrax, a highly infectious and fatal disease of cattle, is caused by a relatively large spore-forming rectangular shaped bacterium called Bacillus anthracis. Anthrax causes acute mortality in ruminants. The bacteria produce extremely potent toxins which are responsible for the ill effects, causing a high mortality rate. Signs of the illness usually appear 3 to 7 days after the spores are swallowed or inhaled. Once signs begin in animals, they usually die within two days.

Anthrax in cattle - Most common animal diseases

Hoofed animals, such as deer, cattle, goats, and sheep, are the main animals affected by this disease. They usually get the disease by swallowing anthrax spores while grazing on pasture contaminated (made impure) with anthrax spores. Inhaling (breathing in) the spores, which are odorless, colorless, and tasteless, may also cause infection in animals and people.

Symptoms:

· Sudden death (often within 2 or 3 hours of being apparently normal) is by far the most common sign;

· Very occasionally some animals may show trembling, a high temperature

· Difficulty breathing, collapse and convulsions before death. This usually occurs over a period of 24 hours;

· After death blood, may not clot, resulting in a small amount of bloody discharge from the nose, mouth and other openings

Treatment and control

· Due to the acute nature of the disease resulting in sudden death, treatment is usually not possible in animals even though Anthrax bacilli are clines. Treatment is of use in cases showing sub-acute form of the disease.

· In most cases, early treatment can cure anthrax. The cutaneous (skin) form of anthrax can be treated with common antibiotics.

Preventive measures:

· Regular annual vaccination of animals in endemic areas will prevent the disease from occurring.

· Vaccination may be carried out at least a month prior to expected disease occurrence in endemic areas.

· Never open a carcass of an animal suspected to have died from anthrax.

· Contact a veterinarian immediately if the following symptoms are seen and seek advice on control measures to be adopted.

2. Black quarter (black-leg)

It is an acute infectious and highly fatal, bacterial disease of cattle. Buffaloes, sheep and goats are also affected. Young cattle between 6-24 months of age, in good body condition are mostly affected. It is soil-borne infection which generally occurs during rainy season. In India, the disease is sporadic (1-2 animal) in nature.

Causal organism

it is a bacterial disease caused by Clostridium chauvoei

Symptoms:

· Fever (106-108°F), Loss of appetite, Depression and dullness

· Suspended rumination

· Rapid pulse and heart rates

· Difficult breathing (dyspnoea)

· Lameness in affected leg

· Crepitation swelling over hip, back & shoulder

· Swelling is hot & painful in early stages whereas cold and painless inter.

· Recumbency (prostration) followed by death within 12-48 hrs.

Treatment:

· Early treatment can be possible to complete cure of the animal.

· Consult with veterinarian immediately.

3. Rabies (Mad dog disease)

Rabies is a disease of dogs, foxes, wolves, hyaenas and in some places, it is a disease of bats which feed on blood.

The disease is passed to other animals or to people if they are bitten by an animal with rabies. The germs which cause rabies live in the saliva of the sick (rabid) animal. This is a killer disease but not every dog which bites is infected with rabies.

When the rabid animal bites another animal or human, the germs which live in its saliva pass into the body through the wound caused by the bite. The germs travel along the nerves to the brain. The time between the bite and the first appearance of signs that the bitten animal or human has been infected can take from 2 to 10 weeks or more. The time taken depends on the distance of the bite from the brain. If the bite is on the face or head, the bitten animal or human will quickly show signs, but if the bite is on the leg it will take much longer for signs to develop.

General signs of rabies

You should first look for the marks of the bite and discover where and when the animal was bitten. All rabid animals show similar signs in the beginning.

· they change their normal behaviour and behave very strangely.

· They stop eating or drinking.

· Male animal will try to mate (mount) other animals.

· there is no change in the body temperature.

· These signs will continue for 3 to 5 days. Then, before it dies, the animal will develop one or the other of two types of the disease:

· the furious (mad) type of the disease makes the animal aggressive and it will bite anything.

· The quiet (dumb) type when the animal is quiet and does not move.

Rabies in the dog

Dogs show either of the two types of rabies.

· a dog with the dumb or quiet type of the disease cannot move. It looks as if it has a bone stuck in the mouth and saliva drips from the mouth.

· rabies in the dog lasts about 10 days before the animal dies. If the animal does not die after this length of time then it may not be suffering from rabies.

Rabies in sheep, goats and cattle

Rabies is characterised by the animals becoming restless and excited. They may bite themselves and saliva drips from the mouth. The most important sign in cattle is that the animal bellows (calls) very frequently and with strange sound. The animals will become paralysed and die.

Rabies in the horse and camel

The horse will show the furious (mad) type of the disease. It will kick and bite and show signs similar to colic. The animal will die after paralysis of the back legs.

In the camel the signs of rabies are similar to those shown by an animal in the rut.

What to do with a biting dog

Remember that not every dog which bites has rabies. If the dog belongs to somebody ask the owner about its normal behaviour. If the dog is showing signs of rabies you must inform your veterinary officer immediately. The dog must be shot and if it has bitten anybody, they must be taken to a hospital immediately for vaccination.

Control of rabies

Dogs in your community can be vaccinated against rabies. You should ask your veterinary service about vaccination against rabies. If there is an outbreak of rabies, the livestock in your community can be vaccinated too.

Treatment (ethnovet practices) :

Leaves of chirchra (Achyranthes aspera) 100gm and onion 50 gm are ground well and smeared over the bitten place. The extract of these ingredients is administered orally twice in a day.

4. Blue tongue

Bluetongue, a disease which is transmitted by midges, infects domestic and wild ruminants and also camelids, however sheep are particularly badly affected. Cattle, although infected more frequently than sheep, do not always show signs of disease. Virus spreads between animals occurs via the midges of Cullicoides species.

The likelihood of mechanical transmission between herds and flocks, or indeed within a herd or flock, by unhygienic practices (the use of contaminated surgical equipment or hypodermic needles) may be a possibility.

Clinical signs

Sheep : eye and nasal discharges, drooling, high body temperature, swelling in mouth, head and neck, lameness and wasting of muscles in hind legs, haemorrages into or under skin, inflammation of the coronary band, respiratory problems, fever, lethargy.

In cattle: nasal discharge, swelling of head and neck, conjunctivitis, swelling inside and ulceration of the mouth, swollen teats, tiredness, saliva drooling, fever.

Note: a blue tongue is rarely a clinical sign of infection

Control

Inspect stock closely, particularly focusing on the lining of the mouth and nose and the coronary band (where the hoof stops and the skin starts). If an animal is suspected as having bluetongue, it must be reported as quickly as possible. Telephone your local animal health office immediately.Buy vitamins and supplements

Preventive measures and treatment (ethovet):

Since the animal is not taking any feed the starvation may lead to death. So the animal has to be administered orally the following food. Banana fruits (one) smeared with sesame oil (50 ml) for 2 to 3 times. By this animal will recover little. However, this will not control the disease fully. Next the leaf pulp of “sothukathalai”(Aloe vera) has to be administered daily.

Administering of Aloe vera has to be continued for more days till the animal fully recovers from this disease. By this treatment the infected animal will recover from the disease. The disease will not spread to other animals if all animals are administered with Aloe vera as a preventive treatment. Administering aloe vera also increases the body weight of animals as it is against all intestinal parasite.

5. Pox

Epidemiology : sheep-pox is a highly contagious disease. It causes a mortality of 20 to 50 per cent in animals below the age of 6 months, and causes damage to the wool and skin in adults. Of the pock diseases, sheep-pox ranks only second to human small-pox in virulence. The disease is transmissible to in-contact goats but not to other species of animals. It, however, spreads slowly.

Symptoms : The disease in characterized by high fever, and symptoms of pneumonia and acute enteritis. Skin lesions appear particularly in parts free from wool, notably around the eyes, inner side of the thigh, udder and under surface of the tail. The internal organs such as trachea, lungs, kidneys and intestines are also affected. The disease results in emaciation and, as already mentioned, frequent deaths of affected animals.

Treatment, prevention and control

The diseased animal should be treated with palliatives. In the young ones nursing is more important than medication. The infected litter should be burnt and the bedding changed every day. Affected animals should be kept on soft diet. The ulcers on the skin should be washed with potassium permanganate lotion and dusted with boric acid; strict hygienic measures should be adopted.

Preventive measures and treatment (ethnovet)

External application of paste prepared by grinding neem leaves, tulsi leaves each 100 gm and turmeric powder- 50gm sprinkled with sufficient water. Continue for 3 to 5 days. Administer orally the same mixture by diluting with water.

6. Tetanus

This is an infectious, non-febrile disease of animals and man, and is characterized by spasmodic tetany and hyperaesthesia. This disease is prevalent all over the world.

Transmission

Infection takes place by contamination of wounds. Deep punctured wounds provide favourable conditions for the spores to germinate, multiply and produce toxin which is subsequently absorbed in the animal body. The micro-organism is present in soil and in animal faeces, and is carried into the wound by a penetrating object. The organism is present in the intestine of normal animals, and under some undetermined conditions multiplies rapidly and produces toxin in sufficient quantities to be absorbed and cause the disease.

Symptoms

The incubation period is generally 1-2 weeks but it may be as short as 3 days. Tetanus affects many species of domesticated animals but occurs particularly in horses and lambs; less frequently in adult sheep, goats, cattle, pigs, dog and cats; and rarely in poultry. The initial symptoms are mild stiffness and an unwillingness to move all the animals. More severe symptoms develop after 12-24 hours which are stiffness of limbs, neck, head, tail and twitching of muscles. The spasms develop in response to noise. In terminal stages ears are erect, nostrils dilated, nictitating membrane protruded. Mastication becomes very difficult because mouth cannot be opened, hence the name lockjaw.

Treatment

The treatment is carried out by first injecting antitoxin then treating the wound. Penicillin parenterally is beneficial. Muscular relaxation is achieved by injection of relaxants. The animal should be kept in a dark room and fed with the help of stomach tube.

Control

Proper hygiene and cleanliness at castration and other surgical procedures should be observed. Sheep should be given 2 injections based 3 weeks apart to develop a solid immunity.

7. Johne`s disease

Johne`s disease is a specific chronic contagious enteritis of cattle, sheep, goat, buffaloes and occasionally of pigs. The disease is characterized by progressive emaciation and in cattle and buffaloes by chronic diarrhea and thickening of the intestine.

Transmission

Under natural conditions the disease spread by ingestion of feed and water contaminated by the faeces of infected animals. The infection occurs mostly in the early month of life. The incubation period extends from 12 months to several years. The animal aged 3 to 6 years mostly suffer from the disease. Affected animals may not show clinical symptoms continue to discharge organisms in faeces.

The organisms persist in pastures for about 1 year. The organisms are susceptible to sunlight, drying and high ph of soil; continuous contact of urine with faeces reduces the life of bacteria. In cattle clinical signs appear mainly during 2-6 years of age. The infected animals which are apparently healthy, often show clinical signs after parturition.

Treatment

the organisms is more resistant to chemotherapeutic agents invitro than mycotuberculosis. Because of this the practical utility of treatment in clinical cases is poor.

Control

The affected animal should be segregated and their faeces properly disposed off. Alive vaccine has been developed. It reduces the incidence of clinical disease. It consists of a non-pathogenic strain of jhone`s bacillus with an adjuvant. The calves soon after birth are inoculated with vaccine subcontaneously. The vaccinated animals become reactors of jhonin. Vaccination is generally done in heavily infected herds.

8. Footrot

Foot rot is a common cause of lameness in cattle and occurs most frequently when cattle on pasture are forced to walk through mud to obtain water and feed. However, it may occur among cattle in paddocks as well, under apparently excellent conditions.

Foot rot is caused when a cut or scratch in the skin allows infection to penetrate between the claws or around the top of the hoof. Individual cases should be kept in a dry place and treated promptly with medication as directed by a veterinarian.

If the disease becomes a herd problem a foot bath containing a 5% solution of copper sulphate placed where cattle are forced to walk though it once or twice a day will help to reduce the number of new infections. In addition, drain mud holes and cement areas around the water troughs where cattle are likely to pick up the infection. Keep pens and areas where cattle gather as clean as possible. Proper nutrition regarding protein, minerals and vitamins will maximize hoof health.

9. Bovine rhinotracheitis

Infectious bovine rhinotracheitis (ibr) is a highly contagious, infectious respiratory disease that is caused by bovine herpesvirus-1 (bhv-1). It can affect young and older cattle. In addition to causing respiratory disease, this virus can cause

conjunctivitis, abortions, encephalitis, and generalised systemic infections. Ibr is characterized by acute inflammation of the upper respiratory tract.

Treatment

There is no direct treatment for viral diseases. Infected animals should be isolated from the rest of the herd and treated with anti-inflammatory drugs and antibiotics for secondary infections if necessary. Carrier cattle should be identified and removed from the herd.

Prevention

Control of the disease is based on the use of vaccines.

10. Ringworm

This is the most common infectious skin disease affecting beef cattle. It is caused by a fungus, and is transmissible to man. Typically, the disease appears as crusty grey patches usually in the region of the head and neck and particularly around the eyes.

As a first step in controlling the disease, it is recommended that, whenever possible, affected animals should be segregated and their pens or stalls cleaned and disinfected. Clean cattle which have been in contact with the disease should be watched closely for the appearance of lesions and treated promptly.

Proper nutrition, particularly high levels of vitamin a, copper and zinc while not a cure, will help to raise the resistance of the animal and in so doing offer some measure of control. Contact your vet and or feed store for products to treat this disease. Using a wormer like ivomec will kill lice and help prevent cattle from scratching causing skin damage and a place for the fungus to enter.[27]

Vocabulary Exercise 1: Match the Word with its Meaning

Match the vocabulary word on the left with its correct meaning on the right.

Word	Meaning
1. Husbandry	a. Time between infection and appearance of symptoms
2. Susceptible	b. An organism that lives on or in another and benefits at their expense
3. Antibiotics	c. A disease regularly found in a particular area
4. Contaminated	d. Severe and sudden in onset
5. Endemic	e. Medicines used to treat bacterial infections
6. Incubation period	f. Caring for and managing animals on a farm
7. Spore	g. Easily affected or harmed by something
8. Acute	h. Infected or made impure by germs or toxins
9. Vaccination	i. A dormant form of a bacterium that can survive harsh conditions
10. Parasite	j. The process of injecting a vaccine to provide immunity

[27] https://support.centreforelites.com/en/the-10-most-common-animal-diseases/

Vocabulary Exercise 2: Fill in the Blanks

Complete the sentences using the correct word from the box below:

*antibiotics, vaccination, symptoms, parasite, contamination, incubation, susceptible, acute, vaccine, symptoms, antibiotic, quarantine, parasite, incubation, treatment, bacteria, infection, hygiene *

1. The _____ period is the time between infection and when symptoms first appear.
2. Farmers give animals _____ to help protect them from common diseases.
3. _____ diseases develop quickly and are often severe.
4. Bacteria can form _____ to survive in harsh conditions like soil.
5. Animals living in crowded farms are more _____ to infections.
6. Skin infections can occur due to _____ like lice or mites.
7. Eating food with _____ can cause sickness in animals.
8. Fever and loss of appetite are common _____ of many animal diseases.
9. Good _____ and feeding help prevent animal diseases.
10. A _____ is used to protect animals from specific diseases.
11. The _____ period is the time between infection and when signs appear.
12. Farmers should keep sick animals in _____ to stop diseases from spreading.
13. _____ are tiny organisms that can cause illness.
14. _____ are signs like fever, trembling, or swelling that show the animal is sick.
15. _____ is a medication used to treat bacterial infections.
16. _____ means the presence of harmful organisms in the body.
17. Animals can suffer from _____, which live on or inside them and cause problems.
18. Early _____ of diseases helps prevent serious loss.

Vocabulary Exercise 3: True or False

Write **True** or **False** based on the information in the text.

1. Good husbandry and hygiene can help prevent animal diseases.
2. Antibiotics are effective against viral infections like foot-and-mouth disease.
3. Anthrax spores can be inhaled or swallowed to cause infection.
4. Rabies germs live in the saliva of infected animals.
5. Vaccination is a preventive measure that must be repeated with booster shots.
6. Footrot is caused by a parasite living under the skin.
7. Ringworm is a fungal disease that can be transmitted to humans.
8. All animal diseases can be treated with antibiotics.
9. Anthrax is caused by a virus.
10. Rabies can be transmitted by the saliva of an infected animal.
11. Black quarter affects only old cattle.

12. Blue tongue is spread by midges.
13. Tetanus is caused by contamination of wounds.
14. Footrot is often caused by walking through mud.
15. Vaccines can cure a viral disease after symptoms appear.
16. Ringworm is a fungal disease that can affect humans.
17. Johne's disease is easy to treat with antibiotics.
18. Good hygiene helps prevent animal diseases.

Vocabulary Exercise 4: Multiple Choice

Choose the correct answer.

1. What does "susceptible" mean?
   a) Resistant to infection
   b) Likely to be harmed or infected
   c) Free from disease
   d) Vaccinated regularly
2. How is anthrax commonly transmitted to hoofed animals?
   a) Through the air only
   b) By drinking contaminated water only
   c) By swallowing or inhaling spores from contaminated pasture
   d) Through direct contact with other animals
3. Which of the following is NOT a symptom of black quarter?
   a) Fever
   b) Lameness
   c) Excessive drinking
   d) Difficult breathing
4. What is the best immediate action if an animal shows symptoms of rabies?
   a) Wait for symptoms to disappear
   b) Consult a veterinarian immediately
   c) Treat with antibiotics at home
   d) Vaccinate the animal once symptoms appear
5. What is the main cause of anthrax?
   a) Virus
   b) Bacterium
   c) Parasite
   d) Fungus
6. Rabies primarily affects which animals?
   a) Cattle and sheep
   b) Dogs, foxes, and bats
   c) Salmon
   d) Horses and camels
7. Which disease is characterized by fever, pneumonia, and skin lesions in sheep?
   a) Footrot
   b) Blue tongue
   c) Pox
   d) Rabies

8. How is tetanus infection usually transmitted?
a) Contact with saliva
b) Contaminated wounds
c) Parasite bites
d) Airborne droplets
9. Which disease causes lameness due to cuts between claws?
a) Johne's disease
b) Black quarter
c) Footrot
d) Ringworm

Vocabulary Exercise 5: Word Formation

Use the word in parentheses to complete the sentence with the correct form.

1. Good _____ (hygiene) on the farm helps prevent disease.
2. Farmers must follow strict _____ (regulate) when moving animals between farms.
3. The veterinarian gave the animal an _____ (inject) to protect it from rabies.
4. Footrot causes _____ (pain) in the animal's hoof and can cause lameness.
5. The _____ (infect) period for rabies can last up to 10 weeks.

Cooperative learning and Case study section.

Cooperative Learning Exercises

1 Jigsaw: The Top 10 Diseases

Objective: Build a complete shared understanding of the 10 diseases.

Instructions:

Divide the class into 10 groups; each group takes **one disease** from the list.

Each group prepares:

Causal agent (bacteria, virus, fungus, etc.)
Main animal species affected
Key symptoms
Transmission route
Treatment & control measures

After preparing, one representative from each group joins new mixed groups and teaches their disease to others.

Each mixed group makes a summary table or poster covering all 10 diseases.

2 Gallery Walk: Prevention & Control

Objective: Identify and compare prevention and control strategies.

Instructions:

Form small teams. Each team picks 2–3 diseases from the list.

Create large posters showing:

* What farmers can do to prevent these diseases
* What to do when disease appears
* Special notes (e.g., vaccination, hygiene, quarantine)

Place posters around the room.
Teams walk around, study each poster, and add sticky notes with questions or ideas.

3 Debate: Antibiotics vs. Vaccines
Objective: Discuss responsible disease prevention and treatment.
Instructions:
* Split into two teams:
  Team A: Argues that vaccines are more important
  Team B: Argues that antibiotics are more important
* Use real examples from the 10 diseases:
  Which are controlled best with vaccination?
  Which need antibiotics, and why misuse is risky.
End with class reflection: what is the right balance between prevention and treatment?

4 Role Play: Farmer–Vet Dialogue
Objective: Practice farmer education and diagnosis discussion.
Instructions:
* Form pairs: one student as the farmer, one as the vet.
* Farmer describes signs (e.g., swelling and lameness in young cattle; drooling in sheep).
* Vet must:
  * Ask questions to narrow down the disease
  * Explain likely disease, how it spreads, and next steps
  * Advise on treatment and prevention
* Rotate roles to practice different scenarios.

5 Concept Map: From Risk Factors to Disease
Objective: Connect feeding, hygiene, parasites and other risk factors to diseases.
Instructions:
In groups, draw a concept map starting with:
Husbandry / Hygiene / Feeding / Parasites
Show how these contribute to:
Bacterial infections, viral diseases, fungal infections, parasitic diseases.
Include the 10 diseases in appropriate places.

Case Study Exercises
Case Study 1: Anthrax on Pasture
A cow dies suddenly after being apparently healthy. Farmer reports bloody discharge from mouth.
Tasks:
1. Identify likely disease and explain why it’s so fatal.
2. What should the farmer do immediately? Why shouldn’t the carcass be opened?
3. How can vaccination help prevent new cases?

Case Study 2: Black Quarter in Young Bull
A 1-year-old bull shows swelling over the hip and high fever; it dies within 24 hours.
Tasks:
1. What disease fits this description?
2. When and why should cattle be vaccinated against it?
3. Why are well-fed young cattle more often affected?

Case Study 3: Dog Bite and Rabies Risk
A child is bitten by a strange dog in the village. The dog drools, can't move well, and dies after 8 days.
Tasks:
1. What is the risk to the child?
2. What must be done immediately?
3. How can rabies be prevented in communities?

Case Study 4: Bluetongue Outbreak
Several sheep show drooling, swelling of head and neck, high fever.
Tasks:
1. Identify likely disease and vector.
2. Why don’t cattle usually die from this disease?
3. What local measures can reduce spread?

Case Study 5: Sheep-Pox
Young lambs show fever and skin lesions around eyes and under tail.
Tasks:
1. What disease is this?
2. Why is hygiene so important for control?
3. Suggest ethno-veterinary and conventional treatments.

Case Study 6: Tetanus in a Horse
Horse becomes stiff and unable to chew after stepping on rusty nail.
Tasks:
1. Identify disease and explain how bacteria enter.
2. Outline treatment steps (antitoxin, relaxants).
3. How can it be prevented during castration or wounds?

Case Study 7: Chronic Diarrhea
Older cow has progressive weight loss, chronic diarrhea.
Tasks:
1. Identify disease.
2. Why is treatment difficult?
3. What control measures protect other animals?

Case Study 8: Footrot After Rain
Many cows become lame after rainy season; hoof area smells bad.
Tasks:

1. What disease is likely?
2. What farm management can reduce it?
3. Role of foot bath and drainage.

Case Study 9: Bovine Rhinotracheitis
Several cows have nasal discharge, fever, some abortions.
Tasks:
1. Identify the disease and virus type.
2. Why are antibiotics not the main solution?
3. How can vaccines help?

Case Study 10: Ringworm Outbreak
Grey, crusty skin lesions appear around eyes and neck of several cows.
Tasks:
1. Cause of disease and zoonotic risk.
2. Why hygiene and nutrition help reduce spread.
3. Example of treatment and environmental control.

QUIZ 1: Multiple Choice
1. Which disease often causes sudden death in cattle and is linked to grazing on contaminated pasture?
A. Rabies
B. Anthrax
C. Ringworm
D. Bluetongue
2. What is the main method of transmission of bluetongue?
A. Direct contact with saliva
B. Midges (Culicoides spp.)
C. Contaminated water
D. Soil-borne bacteria
3. Which disease is caused by a fungus and can spread to humans?
A. Sheep-pox
B. Black quarter
C. Ringworm
D. Johne’s disease
4. Rabies virus travels in the body mainly via:
A. Bloodstream
B. Lymphatic system
C. Nerves
D. Digestive tract
5. What is a common sign of black quarter in cattle?
A. Diarrhea
B. Paralysis of back legs
C. Hot, painful swelling and lameness
D. Saliva drooling from mouth
6. Tetanus is most often linked to:

A. Airborne transmission
B. Wounds and punctures
C. Contaminated feed
D. Insect bites
7. Which of the following is mainly a viral respiratory disease in cattle?
A. Infectious bovine rhinotracheitis (IBR)
B. Footrot
C. Anthrax
D. Black quarter
8. The main prevention for rabies in dogs and livestock is:
A. Antibiotics
B. Deworming
C. Vaccination
D. Isolation
9. Chronic diarrhea and weight loss in adult cattle may suggest:
A. Footrot
B. Johne's disease
C. Anthrax
D. Ringworm
10. Which disease can be partially prevented by using foot baths with copper sulphate?
A. Footrot
B. Tetanus
C. Ringworm
D. Rabies

Answers (Quiz 1):
1. B
2. B
3. C
4. C
5. C
6. B
7. A
8. C
9. B
10. A

QUIZ 2: True or False
1. ___ Rabies can only be spread if the animal shows obvious signs of illness.
2. ___ Anthrax spores can survive in soil for many years.
3. ___ Ringworm is caused by bacteria.
4. ___ Black quarter mainly affects very old animals.
5. ___ Vaccination can help prevent tetanus in livestock.
6. ___ Bluetongue is spread mainly by midges, not by direct contact.
7. ___ Sheep-pox can cause skin lesions, fever, and pneumonia.

8. ___ Footrot is always fatal.
9. ___ Antibiotics can cure viral diseases directly.
10. ___ Proper hygiene at surgery helps prevent tetanus.

Answers (Quiz 2):
1. False
2. True
3. False (it's fungal)
4. False (young cattle 6–24 months)
5. True
6. True
7. True
8. False
9. False
10. True

QUIZ 3: Short Answer / Fill in the blanks
1. Name two typical signs of anthrax in cattle.
→_____,
_____
2. What type of organism causes black quarter?
→ _____
3. Which animal disease often shows as grey, crusty patches on skin?
→ _____
4. What is the common name for infectious bovine rhinotracheitis?
→ _____
5. How does the rabies virus usually enter the body?
→ _____
6. What wound-related disease causes muscle stiffness and "lockjaw"?
→ _____
7. Name a chronic wasting disease in cattle that leads to thickened intestines.
→ _____
8. Which disease in sheep is spread by biting insects and rarely shows a truly blue tongue?
→ _____
9. What farm practice can help reduce footrot besides medication?
→ _____
10. Why shouldn't you open the carcass of an animal suspected to have died of anthrax?
→ _____

Suggested answers (Quiz 3):
1. Sudden death, bloody discharge, trembling, high fever
2. Bacterium (Clostridium chauvoei)
3. Ringworm
4. IBR

5. Through bites (via saliva)
6. Tetanus
7. Johne's disease
8. Bluetongue
9. Keep areas dry, use foot baths, drainage
10. Risk of releasing and spreading spores

Parasitology

The Most Common Parasites in Animals

Parasites in animals are not uncommon. While it's not always possible to avoid parasites in the first place, being able to reduce the risk of infection, identify types of parasites – such as animal worms – and treat the infection can help ensure an animal's continued health and safety.

The effect parasites have on animals (hosts) can vary depending on the parasite's life cycle and the animal's general health. It is always best to treat parasites as early as possible to reduce the severity of the disease and the potential for complications, as well as limit the risk of contamination of the environment and allow animals to recover as quickly as possible.

Roundworms

Animal worms are one of the most common and commonly known types of parasites in animals. Infection is not limited to wild or working animals, as domestic animals, such as cats and dogs, can also suffer from worms at any stage in their life.

Roundworms in horses, also known as ascarids, are common parasites that live inside a host's intestines, feeding on partially digested food. Although you may not see notable symptoms in an infected animal, some roundworm symptoms include:

Weakness
Diarrhoea
Weight loss
Malnutrition

Roundworms can produce tens of thousands of eggs a day and can easily spread between animals. Young animals can get roundworms from their mothers when they are born or drink their milk. However, most of the time, animals become infected because of contaminated pasture.

Preventing and treating roundworms

As roundworms can enter an animal's body in many ways, it is vital to control environments as much as possible – including removing manure from fields and pastures, limiting the number of animals kept together to reduce contamination and avoiding overgrazing.

Animal worms can typically be treated, so if you have an animal that is infected with roundworms, contact a vet for appropriate treatment methods.

Pinworms

These tiny, narrow intestinal worms affect only a few types of animals, such as equines, rabbits and hamsters. However, unlike some other parasites, pinworms cannot be transmitted between different types of animals.

Animals infected with pinworms usually have quite mild symptoms, and some may not exhibit any whatsoever in some cases. However, the most apparent

indication that an animal may have pinworms is itching and irritation around the anal area, as this is where female pinworms deposit eggs. Animals with pinworms may also exhibit weight loss and sleeplessness.

How to treat pinworms

There are two things to consider when treating pinworms in infected animals: the pinworm within the animal's intestine and the eggs. Anal areas should be cleaned regularly to remove any remaining eggs. At the same time, vets can prescribe oral medication to kill existing adult pinworms, as well as those that have just hatched.

Sarcoptic mange

Sarcoptic mange (scabies) is the medical name for the skin disease caused by infection from a highly contagious skin parasite named Sarcoptes scabiei mite. Compared to infections caused by other parasites, scabies is an infestation of mites that burrow their way into the host's skin, causing severe itching. This, in turn, can result in scabs and hair loss in animals.

Treatment for sarcoptic mange (scabies)

Although rare, scabies is zoonotic – meaning it's transmissible between animals and people, so treating it as soon as possible is critical. Symptoms of sarcoptic mange are most seen on the abdomen, elbows and chests of animals, so it can be difficult to diagnose.

Always consult a veterinarian if you suspect an animal may be suffering from an infestation. They will be able to recommend effective therapies for treatment.

Ticks

Ticks are tiny spider-like creatures that suck blood from other animals, dropping off when they have had enough. They typically live in woodland areas or places with long grass and climb or drop on animals when they brush past. Ticks also carry parasites such as babesia – a blood parasite that infects red blood cells causing health issues such as anaemia, jaundice and fever – which they transmit between animals.

How often ticks can affect animals depends on the region/country, the time of year and whether an animal has been treated with any tick control products.

How to remove ticks from animals

Although tick bites rarely cause more than irritation, it's essential to be vigilant and check animals for ticks regularly. This is because they can pass on infections such as anaplasmosis, Trypanosoma or babesia, and in rare cases, diseases such as Lyme disease. Extra care should be taken with tick removal due to the risk of bacterial infections, as there is a chance that incorrect removal could result in a remnant of the tick being left behind, which may cause infection. For example, it is important to avoid squeezing the tick's body or leaving the head in the animal that the tick has infected. It's equally important to avoid harsher methods such as burning them off.

If you are unsure about the best way to remove ticks, speak to a vet who can show you the appropriate method, which involves twisting.

Bots

Bots are flies capable of causing both irritation and physical damage to animals. They lay sticky white or yellow eggs in the hairs of equines, which the animals can then ingest.

Problems caused by bots

Ingested larvae can:

Impede digestion

Create loss of appetite

Cause intermittent diarrhoea or constipation

Result in stomach ulcers

Cause perforation of the stomach, in severe cases

Controlling and treating bots

There are special tools designed to facilitate the removal of bot eggs. Washing or wiping off animals can also help remove eggs before they get licked off and ingested by animals grooming themselves or each other. However, removing all the eggs may not always be possible as some can be hidden beneath the animals' hair.

Vets will also be able to inform you of an appropriate dewormer and how it should be administered, as this can help kill maturing larvae.

Threadworms

Although natural immunity to threadworms usually develops in equines at about six months, infected foals are typically left weak and susceptible to diarrhoea and anaemia. Once adult, threadworms often remain dormant but can be passed to newborns that are suckling.

How to combat threadworms

Treating animal worms such as threadworms before they cause severe problems is crucial for a growing foal's health. Foals should be wormed against threadworms as early as possible. Worming the mare during pregnancy can also help reduce the chances of transferring threadworms while the animal is nursing. Always consult a vet when considering worming treatments.[28]

Vocabulary Exercise 1: Multiple Choice

Choose the correct meaning of the bolded word from the text.

1. **Parasites** in animals are not uncommon.
   a) animals that live independently
   b) organisms that live on or inside another organism
   c) animals that hunt others for food
   d) plants that grow near animals
2. Roundworms produce tens of thousands of **eggs** a day.
   a) young animals
   b) small offspring
   c) reproductive cells
   d) parasites
3. Pinworms cause **itching** and irritation around the anal area.
   a) pain
   b) redness
   c) a sensation that makes you want to scratch
   d) swelling

[28] https://spana.org/working-animals/working-animal-health/the-most-common-parasites-in-animals/

4. Sarcoptic mange is a **contagious** skin disease.
   a) painful
   b) easy to catch and spread
   c) rare
   d) harmless
5. Ticks are **tiny spider-like creatures** that suck blood from other animals.
   a) very big insects
   b) small animals resembling spiders
   c) plants
   d) worms

Vocabulary Exercise 2: Match the Word with its Definition

Draw lines or write the correct letter next to each word.

Word	Definition
1. Host	a) the presence of harmful organisms in the body
2. Infection	b) signs or effects of a disease
3. Symptoms	c) to treat a disease or condition
4. Diagnose	d) the process of identifying a disease or condition
5. Treatment	e) an animal or person that a parasite lives on or in

Vocabulary Exercise 3: Fill in the Blanks

Use the correct word from the box to complete each sentence.

parasites, contaminated, larvae, diagnose, immunity, infestation, transmission

1. Roundworms can spread easily because of **_____** pastures.
2. A **_____** is when many parasites live on or in an animal at the same time.
3. **_____** is the passing of disease or parasites from one animal to another.
4. Vets can help **_____** parasites in animals through examination.
5. Young animals sometimes get infected by **_____** from their mothers.
6. Some animals develop **_____** to certain parasites as they grow older.
7. The young form of some parasites, like bots, are called **_____**.

Vocabulary Exercise 4: True or False

Write **True** or **False** next to each statement.

1. Pinworms can be transmitted between different types of animals.
2. Sarcoptic mange mites burrow into the skin causing itching and hair loss.
3. Ticks only live on animals and never in the environment.
4. Bots lay eggs that animals can accidentally ingest during grooming.

5. Treating parasites early can reduce disease severity and complications.

Vocabulary Exercise 5: Definition Writing

Write a short definition or explanation for each of the following words based on the text.

1. Parasite
2. Roundworm
3. Sarcoptic mange
4. Tick
5. Bot

Cooperative learning and Case study section.

Cooperative Learning Activities

1 Jigsaw: "Meet the Parasites"

Purpose: Learn details about each parasite by teaching each other.

Steps:

Divide the class into 6–7 groups. Assign each group one parasite or parasite group:

* Roundworms
* Pinworms
* Sarcoptic mange
* Ticks
* Bots
* Threadworms

Each group:

Reads the text section carefully.

Creates a poster or slide summarizing:

* Parasite name & type
* How infection happens
* Main symptoms
* Prevention & treatment

Groups then form new "mixed" teams where each student becomes the expert teaching about their parasite.

2 Think–Pair–Share: "The Hidden Dangers"

Prompt:

"Why might mild parasite infections still be important to diagnose and treat early, even if the animal doesn't look very sick?"

Steps:

* Think individually → Pair up → Share answers with the whole class.

* List risks (e.g., environmental contamination, zoonotic risk, long-term health effects).

3 Role Play: Vet and Owner

Scenario: An owner brings in an animal showing signs of scratching, weight loss, or diarrhea.

Steps:

* In pairs: one student plays the veterinarian, the other the owner.
* The “owner” describes symptoms from the text.
* The “vet” asks questions, explains what the likely parasite could be, and suggests diagnostic & treatment options.
* Switch roles & repeat with a new case.

4 Parasite Life Cycle Flowchart

Task: In small groups, choose one parasite and draw a life cycle chart, labeling:

* Stage in animal
* Stage in environment
* How transmission happens
* Where prevention is possible

Then share and explain to class.

5 Debate: Environmental Control vs. Medication

Motion:

“It is more important to improve hygiene and management than to rely on medication to control parasites.”

Steps:

* Divide into two teams.
* Prepare arguments using evidence from the text.
* Hold a short debate and reflect as a group.

Case Study Exercises

Case Study 1: The Itchy Pony

A 3-year-old pony is constantly scratching its tail area and is restless at night. The owner notices hair loss and irritation near the anus.

Questions:

* Which parasite do you suspect? Why?
* What would you do to confirm the diagnosis?
* What treatment and prevention steps would you recommend to the owner?

Case Study 2: The Thin Foal

A 2-month-old foal shows diarrhea and poor weight gain. The mare looks healthy.

Questions:

* Which parasite could be involved?
* How could the infection have been transmitted?
* What would you do to help both the foal and prevent reinfection?

Case Study 3: The Scratching Dog & Family Risk

A dog has scabs and hair loss on the chest and elbows, and itches constantly. The owner is also complaining about itchy skin.

Questions:

* What is the likely parasite?

* Why is this case more urgent?
* What measures should the vet recommend for the dog, owner, and home?

Case Study 4: The Pasture Problem

A herd of horses grazes in the same field. Several young horses show mild diarrhea and weight loss. Manure hasn't been removed regularly.

Questions:

* Which parasite is most likely?
* Why does the environment play a big role here?
* What management changes should be suggested?

Case Study 5: The Tick Check

A farm animal has been found with several ticks, and the area is known for long grass.

Questions:

* Why should the owner be concerned beyond irritation?
* What's the safe way to remove ticks?
* How can future infestations be prevented?

PART 4

Veterinary toxicology

What Is Veterinary Toxicology?

Toxicology explores the effects of harmful chemicals and substances on animals, humans, and the environment. Although the work of veterinary toxicologists leans more toward animals, they also explore the effects that such chemicals can have on human health. They're well versed in the traits of different toxicants, how they're absorbed into the body, the impact of different doses, side effects, and treatment options.

Depending on where a veterinary toxicologist chooses to work, they may:

Identify the cause of poisoning in animals and animal populations.

Train the next generation of veterinary toxicologists.

Assess the safety and efficacy of new drugs and chemicals.

Treat poisoned animals.

Identify potential health risks to animals and more.

Veterinary toxicologists aim to prevent poisoning in animals but are prepared to diagnose and treat cases if they occur. They develop new ways to mitigate the effects of toxicants on different species to improve the safety and well-being of companion animals, food animals, exotic animals, and more. This includes building awareness of common household items pet owners may not immediately identify as dangers.

Companion animals are in the unique position of being exposed to items, foods, and substances they wouldn't encounter in the wild. Veterinary toxicologists can educate pet owners on potential dangers hiding in plain sight, such as:

Cocoa mulch

Grapes and raisins

Over-the counter drugs and prescription medications

Insecticides and pesticides

Macadamia nuts
Mouse bait
Play dough
Plant materials
Why Is Veterinary Toxicology Important?
Although veterinary toxicologists' primary goal is to protect the safety and well-being of animals, their work also impacts environmental and public health. Those working for regulatory agencies like the U.S. Food and Drug Administration often evaluate the safety of new medications and additives in animal feed. This involves reviewing food ingredients prior to the product being available for consumption, animal food labels, and any claims being made about the food.
They can identify animal food contaminants, create emergency responses in case contaminated feed is being sold, and assist with food recalls. They may also identify the risks drug residue in food animals may pose to humans once consumed. This information can be used to create new programs and policies that can prevent or reduce the chances of negative outcomes.
Environmental contaminants, like pesticides or toxins produced by certain plants, can also pose a risk to both animal and public health. Animals living in mining areas, where the soil or air is rich in mercury, may be at risk of disease, reproductive issues, population decline, and other adverse effects. Veterinary toxicologists can identify which poisons animals may encounter simply due to their environment and help inform policy changes to mitigate these risks.
The impacts of these changes can simultaneously help improve animal, environmental, and public health. [29]

Exercise 1: Match the Words with Their Definitions
Instructions: Match the vocabulary words with their correct definitions.

Vocabulary Word	Definitions
A. Toxicant	1. A branch of science that deals with poisons and their effects.
B. Veterinary	2. A specialist in identifying and treating animals exposed to toxic substances.
C. Toxicology	3. A harmful or poisonous substance.
D. Mitigate	4. Related to the medical treatment of animals.
E. Veterinary toxicologist	5. To make something less severe or harmful.

Exercise 2: Fill in the Blanks
Instructions: Complete the sentences using the correct word from the box.
Word Bank:
contaminants, identify, companion, pesticides, residue, public, additives, exposure
1. Veterinary toxicologists help _____ the causes of poisoning in animal populations.

[29] https://veterinary.rossu.edu/about/blog/what-does-a-veterinary-toxicologist-do

2. Grapes, chocolate, and some medications can be dangerous to _____ animals like dogs and cats.
3. Food _____ must be evaluated before being included in commercial animal products.
4. Drug _____ in meat products can affect _____ health when consumed by humans.
5. _____ such as mouse bait or play dough are often overlooked dangers for pets.
6. _____ to environmental toxins can lead to reproductive problems in wild animals.

Exercise 3: True or False
Instructions: Read the statements and write **True** or **False**.
1. Veterinary toxicologists only work with pets.
2. One of the goals of veterinary toxicology is to prevent poisoning before it happens.
3. Insecticides and pesticides are always safe for all animals.
4. Veterinary toxicologists can influence public health policies.
5. Cocoa mulch is harmless to animals.
6. Toxicologists never work with the environment.

Exercise 4: Vocabulary in Context (Multiple Choice)
Instructions: Choose the best meaning for the underlined word based on how it is used in the sentence.
1. *Veterinary toxicologists aim to **mitigate** the effects of toxicants on different species.*
   A. Eliminate completely
   B. Study
   C. Reduce or lessen
   D. Ignore
2. *They may identify animal food **contaminants**, create emergency responses, and assist with food recalls.*
   A. Healthy ingredients
   B. Harmful substances
   C. Vitamins
   D. Supplements
3. *Animals living in mining areas may be at risk of disease and other **adverse** effects.*
   A. Positive
   B. Natural
   C. Harmful
   D. Rare

Cooperative learning and Case study section.
Cooperative Learning Exercises
1. Jigsaw Activity: Roles of Veterinary Toxicologists

Divide students into small groups, assigning each group one role of veterinary toxicologists mentioned in the text (e.g., diagnosing poisoning, training, assessing drug safety, treating poisoned animals, identifying health risks).
* Each group researches their assigned role in detail and prepares a short presentation or poster explaining:
  * What the role involves
  * Why it's important
  * Examples of situations they might encounter
* After the presentations, regroup so that each new group has one member from each original role group. They teach each other about their assigned roles.
Goal: Everyone understands the diverse responsibilities of veterinary toxicologists.

2. Jigsaw Activity: Roles of Veterinary Toxicologists
* How do the different roles of veterinary toxicologists complement each other in ensuring animal and public health?
* Which role do you think is the most challenging, and why?
* How might the work of veterinary toxicologists differ between companion animals and food animals?
* In what ways can veterinary toxicologists influence policies and regulations?

3. Group Discussion: The Importance of Veterinary Toxicology in Public and Environmental Health

* How do veterinary toxicologists contribute to both animal and human health simultaneously?
* What might be some consequences if veterinary toxicology was ignored in food safety regulation?
* How can environmental contamination affect entire ecosystems, including humans?
* What responsibilities do governments have in supporting veterinary toxicology research and intervention?

4. Think-Pair-Share: Common Toxicants in Companion Animals' Environments
Think: Individually, students list any common household items or foods that could be toxic to pets (using the text or their own knowledge).
Pair: Students pair up and compare their lists, discussing why these items might be dangerous to animals.
Share: Each pair shares their findings with the class, and the teacher compiles a master list on the board.
Follow-up: Discuss how pet owners can be educated about these dangers.

5. Group Discussion: The Importance of Veterinary Toxicology in Public and Environmental Health
* Divide the class into groups and assign each group one of the broader impacts of veterinary toxicology:
  * Protecting animal health
  * Ensuring food safety and drug residue monitoring

  * Environmental contamination and policy influence
* Groups discuss and write down:
  * Why their assigned area is important
  * Examples from the text
  * Potential consequences if veterinary toxicology was absent in this area
* Groups share with the whole class.

Case Study Exercises

Case Study 1: Poisoning in a Household Dog

Scenario: A family brings their dog to the vet after it ate cocoa mulch from their garden. The dog is vomiting and appears lethargic.

Questions:

1. What toxic substance is likely responsible for the dog's symptoms?
2. What effects does this toxicant have on dogs?
3. What immediate steps should a veterinary toxicologist take to treat the dog?
4. How can this poisoning be prevented in the future?

Case Study 2: Contaminated Animal Feed Recall

Scenario: A batch of cattle feed is suspected to be contaminated with a pesticide. Several animals have shown signs of poisoning, and there's concern about drug residue entering the human food chain.

Questions:

1. What role would a veterinary toxicologist play in this situation?
2. What are the risks to animal health and human health?
3. How should the contamination be handled and communicated to the public?
4. What policies or preventive measures could reduce the risk of similar contamination in the future?

Case Study 3: Environmental Toxicity in Wildlife

Scenario: A mining area has elevated mercury levels in the soil and water. Local wildlife, including birds and mammals, are experiencing reproductive problems and population decline.

Questions:

1. How might veterinary toxicologists investigate the effects of mercury in this environment?
2. What are the potential consequences of mercury contamination for animals and humans?
3. What recommendations might toxicologists make to policymakers?
4. How could these recommendations improve public and environmental health?

Veterinary hygiene

Hygienic working practices

The range of zoonotic pathogens capable of causing human disease found in Finland has grown in recent years. Animals brought into the country from abroad can carry infectious diseases that are not found in native species. Some of these diseases, including Canine Distemper, remain well-controlled thanks to high vaccination coverage. Due to the increasing volume of animal imports into Finland, Rabies, the

most serious of the animalto-human transmitted pathogens that pose a health risk to humans should again be viewed as a workplace health and safety issue. The numbers of multi-resistant bacteria have also grown in recent years and this development is associated with an increase in broad-spectrum antibiotic prescribing. Staff treating animal patients must remain aware of the risks associated with this activity and ensure that they appropriately protect themselves against infection. By taking the necessary precautions, you are also protecting your patients. The Finnish Occupational Safety and Health Act (738/2002) places a duty on all employers to ensure the occupational health and safety of their workforce and on employees to protect themselves against serious diseases. The employer must provide the appropriate personal protective equipment and train staff to use them correctly. Employers can use this guidance to provide training on safe working practices. Employees are responsible for using the personal protective equipment provided to them by their employer and for maintaining such order and cleanliness as well as exercising such care and caution as is necessary for the purposes of ensuring workplace health and safety. You should treat all patients as potential carriers of infectious diseases or problematic microbes. Infection control measures on hygiene are designed to prevent animal-to-animal, animalto-human and human-to-animal disease transmission. These precautions must be followed by all staff providing care to animal patients. A healthcare-associated infection (HAI) is an infection that was not present on admission. Surgical site infections are the most common type of healthcare-associated infection. Other types of HAI include post-surgical pneumonia, in-patient and post-discharge UTIs and canine infectious tracheobronchitis or kennel cough, which can be contracted by dogs sharing a ward with infected animals. The correct use of aseptic technique and maintaining a high standard of hygiene help to prevent healthcare-associated infections. All HAIs must be carefully monitored to ensure high standards of care are maintained. Patients with post-surgical infections should always be kept under active review. If you suspect a surgical-site infection, take a sample for microbiological analysis. It is essential that all HAIs and related bacterial findings are carefully documented so that any outbreaks can be identified. Poor record keeping can result in unnecessary delays.[30]

Exercise 1: Matching (Definitions)

Match the words with their correct definitions.

Words	Definitions
1. Zoonotic	a. A disease-causing microorganism
2. Pathogen	b. Practices intended to maintain cleanliness and prevent the spread of disease
3. Aseptic	c. Not responding to multiple antibiotics
4. Multi-resistant	d. Transmissible from animals to humans
5. Hygiene	e. Free from contamination by harmful bacteria or viruses

[30] Katariina Thomson and Hanna Aaltonen Veterinary hygiene – a guideline for veterinary Practices Ministry of Agriculture and Forestry, Helsinki 2019 54 p.

Exercise 2: Fill in the Blanks
Use the words in the box to complete the sentences.
(protective, zoonotic, antibiotics, hygiene, outbreak, aseptic, infection, vaccinated)
1. Canine distemper is controlled because animals are regularly _____.
2. Staff must wear personal _____ equipment to avoid infection.
3. Rabies is a dangerous _____ disease.
4. Good _____ practices prevent healthcare-associated infections.
5. The use of broad-spectrum _____ has led to resistant bacteria.
6. An _____ of infection can be prevented by proper documentation.
7. _____ technique is important during surgical procedures.
8. A surgical site _____ must be reported and monitored.

Exercise 3: Word Formation
Use the correct form of the word in brackets to complete the sentence.
1. The _____ (import) of animals has increased the risk of disease transmission.
2. Employers must ensure proper _____ (train) in hygiene practices.
3. The law places a _____ (responsible) on workers to protect themselves.
4. _____ (infect) control is vital in veterinary clinics.
5. Poor _____ (document) may delay outbreak detection.

Exercise 4: True or False (Vocabulary Understanding)
Read each statement and write **True** or **False**.
1. "Multi-resistant bacteria" refers to bacteria that respond well to many antibiotics.
2. "Aseptic" means clean and free from bacteria.
3. "HAI" is a disease present before the patient is admitted.
4. The term "zoonotic" relates to diseases only found in humans.
5. "Personal protective equipment" is used to help staff stay safe from infections.

Cooperative learning and Case study section.
Cooperative Learning Exercises
1. Jigsaw Activity: Roles in Veterinary Hygiene
Step 1: Divide the class into 4 groups.
Step 2: Assign each group one of the following topics to become "experts" on:
* Group 1: Zoonotic pathogens and animal import risks
* Group 2: Occupational health and safety responsibilities (employers & employees)
* Group 3: Infection control measures and personal protective equipment (PPE)
* Group 4: Healthcare-associated infections (HAIs) and aseptic technique
Step 3: Each group studies their topic and prepares a 5-minute presentation.
Step 4: Form new mixed groups with one "expert" from each original group. Each expert teaches their topic to the others.
Goal: Ensure every student understands all aspects of veterinary hygiene from different perspectives.

2. Think-Pair-Share: Workplace Safety & Infection Control
Think: Individually, students list 3 risks related to veterinary hygiene from the text and write down precautionary measures to mitigate them.
Pair: Students pair up and discuss their lists, comparing and refining their ideas.
Share: Pairs share their final lists with the whole class for group discussion and instructor feedback.

3. Role-Play: Employer and Employee Responsibilities
* Divide students into pairs. One acts as an employer, the other as an employee in a veterinary clinic.
* Role-play a conversation about occupational health and safety responsibilities:
  * Employer explains PPE provision and training duties.
  * Employee explains their responsibilities to maintain hygiene and proper PPE use.
* Switch roles and repeat.
* Afterwards, discuss challenges and solutions in workplace hygiene.

Case Study Exercises
Case Study 1: Managing Imported Animals
Scenario: A veterinary clinic in Finland has recently received several dogs imported from abroad. One dog shows symptoms suspicious for Rabies. The clinic staff are unsure how to proceed.
Questions:
* What workplace health and safety issues arise in this situation?
* What infection control measures should staff implement immediately?
* How should the employer and employees fulfill their responsibilities under the Finnish Occupational Safety and Health Act?
* What personal protective equipment (PPE) would be necessary?
* How should the clinic document and monitor this situation?

Case Study 2: Surgical Site Infection Outbreak
Scenario: Over the past month, multiple post-surgical patients at a veterinary hospital have developed infections at their surgical sites. These infections are delaying recovery and raising concerns about aseptic technique.
Questions:
* What steps should be taken to identify and control the outbreak?
* How important is microbiological analysis in this case, and how should it be used?
* What infection control protocols could help prevent healthcare-associated infections?
* What role does record keeping play in managing this situation?
* How should staff be trained or retrained based on this case?

Case Study 3: Multidrug-Resistant Bacteria Concerns
Scenario: There has been an increase in broad-spectrum antibiotic prescribing at a veterinary clinic, which has correlated with a rise in multi-resistant bacteria infections in patients.
Questions:

* How does antibiotic prescribing relate to multi-resistant bacteria?
* What practices can staff follow to minimize the spread of these resistant bacteria?
* What are the risks to both staff and patients?
* How can hygiene practices and occupational safety measures be improved to address this issue?
* What is the importance of treating all patients as potential carriers of infection?

Staff uniforms

Uniforms must always be worn by staff taking part in direct patient care activities / direct clinical care. The uniforms must be machine washable and able to withstand high temperatures and disinfectant detergent. The uniform should consist of trousers and a short-sleeved tunic or coat with sleeves that can be rolled up above the elbow when seeing patients. Shoes must be robust safe to wear and offer good support to your foot. You should also ensure that they can be cleaned and disinfected when required. Uniforms should be changed regularly and whenever they become soiled. Long-sleeved tops, including traditional "white coats", prevent effective hand hygiene, as they stop you from washing your wrists and forearms properly. Long sleeves are also liable to become contaminated in the course of clinical activities and can help transmit infectious agents. Long hair should be worn tied up.

In the veterinary setting, a significant percentage of infections are transmitted through hand contact. Hand hygiene means taking care of your skin, using alcohol-based hand rub and, where indicated, washing your hands with soap and water. For all direct patient care activities, follow the "nothing below the elbows" principle to support effective hand hygiene. Rings, watches, bracelets and fitness and activity trackers should not be worn. You should look after your skin by regularly cleaning your hands and forearms with plenty of alcohol hand rub and by regularly applying moisturiser to these areas. If your skin is dry and cracked, it's a good idea to apply a generous layer of moisturiser and wear a pair of cotton gloves overnight to help absorption. You should always keep your nails short. As a rule of thumb, you should not be able to see any nail with your palm turned up. False nails, gel nails, nail extensions and nail varnish must not be worn as they prevent you from exercising effective hand hygiene and can harbour micro-organisms when cracked.[31]

Exercise 1: Matching (Definitions)

Match each word with its correct meaning.

Word	Definition
1. Tunic	a. Germs or microorganisms that cause disease
2. Disinfectant	| b. An upper body garment, often part of a uniform
3. Soiled	c. A substance used to kill germs on surfaces
4. Contaminated	d. Dirty or unclean
5. Infectious agents	e. Made impure by contact with harmful substances

[31] Katariina Thomson and Hanna Aaltonen Veterinary hygiene – a guideline for veterinary Practices Ministry of Agriculture and Forestry, Helsinki 2019 54 p.

Exercise 2: Fill in the Blanks
Choose the correct word from the box to complete each sentence.
(robust, short-sleeved, hand hygiene, moisturiser, nail varnish, elbows, alcohol-based, cracked)
1. All uniforms must include a _____ tunic or coat.
2. Good _____ is essential in preventing infections.
3. Staff must follow the "nothing below the _____" principle.
4. Shoes must be _____ and provide good support.
5. Avoid wearing _____, as it can hide harmful bacteria.
6. Use _____ hand rub regularly to clean your hands.
7. Apply _____ to dry skin to prevent damage.
8. If your hands are _____, use cotton gloves overnight.

Exercise 3: Word Formation
Complete the sentences using the correct form of the word in brackets.
1. Staff uniforms should be _____ (wash) in a machine at high temperatures.
2. Long sleeves can lead to _____ (contaminate) during clinical care.
3. Alcohol hand rub helps reduce the spread of _____ (infect).
4. Wearing accessories is not _____ (permit) during direct patient care.
5. Regular use of hand rub and moisturiser supports skin _____ (protect).

Exercise 4: Multiple Choice
Choose the best answer for each question.
1. What type of coat or tunic should staff wear?
   * A) Long-sleeved lab coat
   * B) Short-sleeved tunic or coat
   * C) Jacket with pockets
   * D) Waterproof raincoat
2. Why are long sleeves not allowed during patient care?
   * A) They look untidy
   * B) They are too warm
   * C) They interfere with hand washing and carry bacteria
   * D) They're uncomfortable
3. What should you use to clean your hands if soap and water aren't available?
   * A) Hand cream
   * B) Cold water
   * C) Alcohol-based hand rub
   * D) Antibacterial wipes
4. Which of the following is **NOT** allowed during clinical care?
   * A) Tied-back hair
   * B) Short fingernails
   * C) Gel nails
   * D) Moisturiser

Cooperative learning and Case study section.

Cooperative Learning Exercises

1. Jigsaw Activity: Components of Proper Uniform and Hygiene

Step 1: Divide students into 4 groups, each assigned one topic:

* Group 1: Uniform requirements and materials (machine washable, short sleeves, shoes)
* Group 2: Importance of sleeve length and hand hygiene principles ("nothing below the elbows")
* Group 3: Personal grooming (hair tied up, nails, jewelry restrictions)
* Group 4: Skin care practices for hand hygiene (use of alcohol rub, moisturizers, cotton gloves)

Step 2: Groups read, discuss, and summarize their topic in their own words.

Step 3: Form mixed groups with one member from each original group. Each member teaches their topic to the others.

Goal: Ensure all students understand the full scope of uniform and hand hygiene standards.

2. Think-Pair-Share: Hand Hygiene Barriers and Solutions

Think: Students write down common barriers to effective hand hygiene in a veterinary clinical setting (e.g., long sleeves, jewelry, false nails).

Pair: Discuss these barriers with a partner and suggest practical solutions to overcome each barrier.

Share: Pairs share solutions with the class, and the instructor compiles a best-practices list.

3. Role-Play: Educating New Staff on Uniform and Hygiene Policy

* Split students into pairs or small groups. One acts as a senior staff member, the others as new hires.
* The senior staff member explains the uniform and hand hygiene policies, focusing on reasons behind each rule and demonstrating good practices.
* The new hires ask questions or raise concerns, and the senior member provides clarifications.
* Rotate roles so everyone practices teaching and questioning.

Case Study Exercises

Case Study 1: Hand Hygiene Non-Compliance

Scenario: A veterinary assistant frequently wears long-sleeved coats and multiple bracelets during patient care. Despite reminders, they have been found to have poor hand hygiene practices, and there has been an increase in minor infections reported in the clinic.

Questions:

* What are the potential risks caused by the assistant’s uniform choices and accessories?
* How does wearing long sleeves and jewelry interfere with hand hygiene?
* What advice and corrective actions should be given to the assistant?

* How can management support improved compliance with uniform and hygiene policies?

Case Study 2: Skin Irritation Due to Frequent Handwashing
Scenario: A veterinary technician complains of dry, cracked skin on their hands and forearms from frequent use of alcohol-based hand rubs and hand washing. This is causing discomfort and concern about possible infection risks.
Questions:
* What skin care recommendations from the text apply to this situation?
* How can the technician prevent skin damage while maintaining proper hand hygiene?
* What role do moisturizers and cotton gloves play in skin care?
* How might this situation impact overall infection control if not addressed?

Case Study 3: Uniform Contamination Incident
Scenario: After a busy day of clinical care, a veterinary nurse notices that their uniform trousers are visibly soiled with animal fluids, but they have not changed into clean uniforms by the end of their shift.
Questions:
* Why is it important to change uniforms when they become soiled?
* What risks does continuing to wear contaminated uniforms pose to staff, patients, and the clinic environment?
* What should be the protocol for handling and laundering uniforms?
* How can the clinic encourage staff to follow uniform hygiene practices consistently?

Disinfection
Disinfection using an alcohol hand gel is quicker, more effective and kinder to skin than using soap and water. Alcohol-based hand rub is an important part of all direct patient care activities and an effective way to prevent the spread of infections. Alcohol-based hand rub eliminates transient flora picked up from patients and any contaminated environment but does not affect resident flora or lead to resistance. Many of the products sold in Finland contain humectants like glycerine that do not evaporate with the alcohol. With glycerine to soothe and hydrate the skin, it is possible to use alcohol-based hand rub frequently without the skin drying out. Hand disinfection must be carried out using the correct technique. Dispense two doses of alcohol-based hand rub into dry hands. This equates to approximately 3–5 ml of product. Start with the fingertips and then scrub all hand surfaces; fingers, between the fingers, palms, backs of the hands and wrists. Finally, run the back of your fingers against your palms. Rub hands together for 20–30 seconds or until completely dry. Do not dry your hands while using the alcohol hand rub as this will reduce its efficacy. To ensure effective hand disinfection, ensure that sufficient numbers of alcohol hand rub dispensers are available for staff. Make sure they are positioned in a way that means they are convenient to use, and staff disinfect their hands before every episode of patient contact. In the clinical environment, dispensers should be sited no more than (2) metres apart. A number of different designs are available, and

it is a good idea to consider which types are best suited to your premises. In addition to wall-mounted dispensers, pump bottles should be made available on all available countertops, shelves, desks and clinical trollies. Brackets for alcohol-based hand rub can also be added to kennel doors.[32]

Vocabulary Matching Exercise

Match the word (Column A) with its correct definition (Column B):

Column A	Column B
1. Disinfection	a. Temporary microorganisms picked up from the environment
2. Alcohol-based	b. A substance added to keep moisture in the skin
3. Transient flora	c. Containing alcohol as a main ingredient
4. Resident flora	d. device used to release small amounts of liquid
5. Humectant	e. The ability to produce the intended result
6. Dispenser	f. Cleaning to eliminate harmful microorganisms
7. Efficacy	g. Bacteria normally present on the skin
8. Convenient	h. Found or placed in a suitable or convenient location

Fill in the Blanks

Complete the sentences using the words from the box below:

disinfection | alcohol-based | glycerine | dispensers | technique | flora | convenient | efficacy`

1. Using an _____ hand rub is quicker and more effective than using soap and water.
2. Proper hand _____ ensures all parts of the hands are cleaned thoroughly.
3. _____ is a humectant that hydrates the skin.
4. The alcohol-based hand rub eliminates transient _____.
5. Hand _____ is essential to prevent the spread of infections.
6. Alcohol hand rub _____ should be placed no more than two metres apart.
7. Make sure the dispensers are in _____ locations so staff can use them easily.
8. Rubbing your hands for 20–30 seconds improves the _____ of the product.

[32] Katariina Thomson and Hanna Aaltonen Veterinary hygiene – a guideline for veterinary Practices Ministry of Agriculture and Forestry, Helsinki 2019 54 p.

Word Formation Exercise
Complete the chart with the correct form of the word.

Verb	Noun	Adjective
disinfect		
evaporate		
hydrate		
position		

True or False Vocabulary Statements
Write **True or **False** based on the meaning in the text.**
1. Transient flora refers to bacteria that permanently live on the skin.
2. Glycerine helps to keep skin moisturized during frequent hand disinfection.
3. Dispensers should only be placed in clinical storage rooms.
4. Alcohol-based hand rub can lead to bacterial resistance.
5. A humectant is used to make the alcohol dry faster.

Cooperative learning and Case study section.
Cooperative Learning Exercises
1. Jigsaw Activity: Hand Disinfection Process
Step 1: Divide learners into 5 groups.
Step 2: Assign each group one part of the hand disinfection process:
* Group 1: Benefits of alcohol hand gel over soap and water.
* Group 2: Ingredients in alcohol-based hand rubs and their role (e.g., glycerine).
* Group 3: Correct hand disinfection technique step-by-step.
* Group 4: Placement and accessibility of hand rub dispensers.
* Group 5: Importance of hand disinfection in preventing infection.
Step 3: Each group studies their part and prepares a short presentation.
Step 4: Groups come together to share and teach their part to peers.
Goal: After sharing, everyone should understand the whole process and importance of hand disinfection.

2. Think-Pair-Share: Hand Rub Efficacy
Step 1: Individually, learners write down why alcohol hand rub is more effective and kinder to the skin compared to soap and water.
Step 2: Pair up and discuss their thoughts.
Step 3: Share findings with the whole group and clarify any misconceptions.

3. Role-Play: Hand Disinfection Compliance
* Learners form small groups where some play healthcare workers, others play infection control officers.
* The healthcare workers explain how they currently use hand rubs.
* Infection control officers suggest improvements based on dispenser placement and hand hygiene technique.
* After role-play, groups discuss barriers and solutions to compliance.

Case Study Exercises

Case Study 1: Outbreak in a Clinic

Scenario:

A small clinic reports an increase in patient infections traced back to poor hand hygiene. Observation reveals that alcohol-based hand rub dispensers are located mostly at the entrance and not near patient care areas. Staff frequently skip hand disinfection between patient contacts.

Questions:

1. Based on the text, what are the likely reasons for the poor hand hygiene compliance?
2. How could the clinic rearrange the dispensers to improve usage?
3. What steps would you recommend to educate staff on correct hand disinfection technique?
4. Why is it important to use two doses of hand rub and not dry hands while rubbing?

Case Study 2: Skin Irritation Complaints

Scenario:

Several healthcare workers complain about dry and irritated skin after frequent use of alcohol-based hand rubs.

Questions:

1. According to the text, what ingredient helps prevent skin dryness in alcohol hand gels?
2. How does this ingredient work?
3. What advice would you give the healthcare workers to reduce skin irritation while maintaining proper hand hygiene?

Bioethics

The discipline known as bioethics is the modern manifestation of the venerable field of medical ethics. Bioethics includes the categories traditionally known as medical ethics – the proper way to treat patients, ethical principles around death and dying, abortion, euthanasia, confidentiality, and so on. One characteristic that distinguishes bioethics from its forbearers, however, is the attention it pays to biotechnological solutions for health problems. From genetic medicine, stem cells, and biologics to brain imaging, artificial hearts, and other biomechanical treatments, bioethics grapples with the impact of our extraordinary technological virtuosity on the human body.

The field of bioethics is intrinsically interdisciplinary. Philosophers, social scientists, theologians, historians, and other disciplinary academics interact with lawyers, physicians, biologists, chemists, and other clinicians and scientists to try to understand the implications of biotechnological advances and to establish ethical guidelines that will inform treatment. Given the diversity of values in our pluralistic society, the ethical complexity of the issues, and the very different religious approaches to medicine and the body that are represented in Western Society, it is not surprising that there are many bioethical challenges where there is sharp disagreement over the proper ethical course.

The degree of disagreement should not be overestimated, however. Despite media and professional attention to the disputes – that is where the action is, after all – there

is overall consensus on a surprisingly large number of ethical principles. The right of individuals to have autonomy over their bodies except under specific circumstances, such as incompetence or gross self-mutilation, the importance of informed consent, the fiduciary responsibility of clinicians to their patients, the corrupting effects of monetary inducements on clinicians to promote particular treatments, the nature of individual and institutional conflicts of interest, pursuit of equity and justice in access to treatment, and many other principles have been agreed upon, and their specifics have generally been worked out, even if they are not always actualized in practice.

Of course, the use of drugs in treating illness has long been an activity with ethical implications. Even the earliest medical codes of ethics discussed the dispensing drugs as a primary topic for ethical guidance: in the Hippocratic Oath, for example, the clinician vows never to give a person a deadly drug, even if requested, and not to give a woman an abortive remedy. On the other hand, the way drugs were tested and administered before the twentieth century seems almost casual to our eyes today. Prior to the Pure Food and Drug Act of 1906, for example, there were no consumer regulations about drug development, few research subject protections, and no review bodies such as the Food and Drug Administration (FDA) or institutional review boards. The latter half of the twentieth century, in contrast, has been a time of rapid development of regulations and regulatory bodies to ensure that both clinical research and clinical care conform to ethical and safety standards. Some aspects of that development are surprisingly late: for example, the Common Rule, the set of regulations that covers ethical standards for using human beings as research subjects in all federally funded research, was not finally codified until 1991.[33]

Exercise 1: Match the Words with Their Definitions

Match the term in **Column A** with its correct definition in **Column B**.

Column A	Column B
1. Bioethics	a. Agreement or general acceptance among a group
2. Autonomy	b. A conflict between personal interest and professional duty
3. Informed consent	c. The study of ethical issues in medical and biological research
4. Pluralistic	d. The ability to make one's own choices, especially regarding one's body
5. Conflict of interest	e. When a person voluntarily agrees to a procedure after being fully informed
6. Regulatory body	f. Describes a society with diverse cultures, values, and beliefs
7. Consensus	g. An organization responsible for enforcing rules and standards
8. Fiduciary	h. Involving trust, especially in a relationship between professional and client

[33] https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/bioethics

Exercise 2: Fill in the Blanks
Use the words below to complete the sentences.
Words: autonomy, bioethics, fiduciary, pluralistic, consensus, regulatory, euthanasia, informed
1. In a _____ society, different moral and religious beliefs often shape bioethical debates.
2. _____ responsibility requires clinicians to act in the best interests of their patients.
3. The concept of _____ is central to medical ethics, ensuring patients understand and agree to treatments.
4. One major issue in _____ is the ethical debate surrounding abortion and _____.
5. Medical ethics has evolved with the establishment of _____ bodies like the FDA.
6. Despite complex ethical disagreements, there is a surprising amount of _____ on key principles.
7. Respecting patient _____ means allowing them to make decisions about their own care.

Exercise 3: Word Family Chart
Complete the chart by filling in the missing forms of the word.

Noun	Verb	Adjective
regulation	regulate	
ethics		
autonomy		
consent		
discipline		

Exercise 4: True or False
Write **True** or **False** based on the vocabulary meaning in the context of the text.
1. **Bioethics** only concerns itself with traditional medical ethics, such as patient treatment.
2. **Fiduciary** duty implies a legal obligation of care and loyalty.
3. The **Common Rule** was created in the 19th century.
4. A **conflict of interest** occurs when a doctor prescribes treatment solely based on patient needs.
5. **Autonomy** refers to when a doctor decides what's best for the patient without their input.

Exercise 5: Use in Context
Choose the correct word from the list to complete the sentence.
Words: interdisciplinary, codified, inducements, biotechnological, theologians
1. Bioethics is an _____ field involving experts from many areas like philosophy, medicine, and law.

2. The ethical rules for human subject research were officially _____ in 1991 under the Common Rule.
3. Financial _____ can lead clinicians to act against patients' best interests.
4. _____ advances, such as artificial hearts and genetic editing, have created new ethical challenges.
5. _____ often contribute to bioethical discussions around end-of-life issues and dignity.

Cooperative learning and Case study section.
Cooperative Learning Exercises
1. Expert Group Jigsaw: Components of Bioethics
Step 1: Divide learners into five groups, each assigned one focus area from the text:
* Group 1: Traditional medical ethics topics (death, dying, abortion, confidentiality).
* Group 2: Biotechnological advances and their bioethical implications.
* Group 3: Interdisciplinary nature of bioethics and its societal challenges.
* Group 4: Areas of ethical consensus (autonomy, informed consent, conflicts of interest).
* Group 5: History and development of drug ethics and regulation.
Step 2: Each group studies their assigned topic and prepares a summary and discussion points.
Step 3: Groups re-form so each new group has one member from each expert group.
Step 4: Members teach their topics to their new group peers, completing the whole picture of bioethics.

2. Think-Pair-Share: Ethical Disagreements and Consensus
Step 1: Individually, learners list two bioethical issues where there is likely to be disagreement and two where consensus exists.
Step 2: Pair up to compare and discuss their lists.
Step 3: Share with the class and collectively explore why consensus exists on some principles and disagreement on others.

3. Role-Play: Interdisciplinary Bioethics Committee
* Form small groups representing different disciplines: philosophers, lawyers, physicians, theologians, and scientists.
* Present a bioethical dilemma involving a new biotechnological treatment (e.g., genetic editing or artificial hearts).
* Each group presents their perspective based on their disciplinary values.
* Groups must then negotiate and try to reach a consensus on ethical guidelines for the treatment.

Case Study Exercises
Case Study 1: Genetic Editing Ethics
Scenario:

A biotech company has developed a new genetic editing therapy that could potentially cure a hereditary disease but carries unknown long-term risks. The therapy is expensive and not accessible to all patients.
Questions:
1. What bioethical principles apply to the decision to use or regulate this therapy?
2. How should issues of equity and justice in access be addressed?
3. What role does informed consent play, especially given the unknown long-term risks?
4. How might different disciplines (e.g., lawyers, physicians, philosophers) view this therapy differently?

Case Study 2: Drug Testing and Regulation
Scenario:
A clinical trial for a new drug is underway. Some participants express concerns that they were not fully informed about potential risks. There are also rumors that the sponsoring pharmaceutical company is influencing clinicians to recruit more patients.
Questions:
1. What ethical standards should guide the conduct of clinical trials?
2. How do regulatory bodies like the FDA and institutional review boards help ensure these standards?
3. What conflicts of interest might arise, and how should they be managed?
4. Reflect on the historical context of drug regulation mentioned in the text—how has regulation improved patient safety?

GRAMMAR PART

Запитання в англійській мові

Специфіка формування питань в англійській мові є не дуже складною, головне зрозуміти та запам'ятати, що тут є **СТАЛИЙ ПОРЯДОК СЛІВ У ПИТАННІ.** Тобто, ми не можемо переставляти слова місцями, як ми це робимо в українській мові, наприклад:

Do I go to school? (слова не можемо переставляти в межах питання)

Чи я йду до школи? (тут ми можемо переставляти слова місцями, наприклад: Йду я до школи? До школи йду я? Я йду до школи?)

Це перше і найголовніше правило

Тепер перейдемо до **формування питань**

Загальні питання – тобто ті, які починаються з допоміжних дієслів робити легко, складність полягає тільки у Present і Past Simple де ми мусимо добавити допоміжне дієслово Do, does та Did в минулому. У всіх решта часах ми виносимо на перед допоміжне дієслово (Друге слово в реченні). Наприклад

She reads books – Does she read books? – ми поставили does на початок речення

He went to school – did he go to school? – так само, лише минулий час перенесли з дієслова went (go) на Did

Це складніші варіанти. Простіші будуть формуватися так:

I have gone to school?
Have I gone to school?
She will have been reading books
Will she have been reading books?
We are going to the cinema
Are we going to the cinema?

Зверніть увагу, ми тільки міняємо місцями перше та друге слово в реченні.

Коли є модальні дієслова, то тут ми робимо так само, виносимо їх наперед

I must go to school
Must I go to school?
She can read book
Can she read books?
We may go to cinema

May we go to cinema?

Це стосовно загальних питань

Спеціальні питання, або питання Wh формуються також просто
Тут нам потрібно поставити питальне слово перед допоміжним дієсловом у загальному питанні, наприклад:

I go to school – Do I go to school? – Where do I go?

School ми забрали, щоб питання було логічним, а не давати відразу відповідь на питання у самому питанні. Таким самим чином ми формуємо усі питання. Бажано попрактикуватися декілька разів. Придумайте одне речення і постарайтеся поставити максимум питань до нього.

ПРОТЕ є виняток. Він стосується питального слова who – хто.
І тут все залежить від того, до чого ви ставите питання, до суб'єкта або підмета (Перше слово в реченні в англ. мові) чи до інших членів речення. Формування є простим, наприклад:

Ivan goes with Peter to pub

Якщо ми ставимо питання до Івана, тобто хто йде з Петром у паб – ми Іван замінюємо на who

Who goes with Peter to pub? – просто

Якщо ми ставимо питання до Петра, наприклад З ким Іван йде до пабу? Тобі буде

Who does Ivan go to pub with? – також просто

Useful references:
https://www.youtube.com/watch?v=t4yWEt0OSpg&t=140s
https://www.youtube.com/watch?v=a1uTdQ-F5J0
https://www.youtube.com/watch?v=xyahL8GT9NU
https://grammarway.com/ua/types-of-questions
https://cambridge.ua/uk/blog/voprosy-v-anglijskom-yazyke-tipy-pravila-primery/

Present Simple and Present Continuous

Це два теперішні часи, які мають дуже невелику різницю
Розглянемо перший – це **Present Simple**

Утворюється
S+V(es)
Do/does + S+ V?
S + do/does + not + V

S – підмет або головна дійова штука в реченні
V – дієслово
Ми додаємо закінчення es до дієслова коли ми маємо в якості підмета He, She, It, або імена людей, тварини, речі ітд. Наприклад

He goes to school / Peter goes to school – Peter=He

Цей час вживається:

1) Для позначення регулярних дій в теперішньому часі
   He goes to school
   Він ходить до школи – кожного дня
2) Для позначення законів природи
   Water boils at 100 C
   Вода закипає при 100 C
3) Для позначення розкладу – тут увага, будь який розклад, мається на увазі розклад руху, відкриття магазинів, телепередач ітд. Але є нюанс, ми кажемо: Потяг приїде в 8 годині вечора (а зараз 4 дня) – тобто це фактично майбутній час, але тут вживатиметься Present Simple
   Train arrives at 8 pm.

   Цей час вживається з такими обставинами часу:
   Always, every_____, usually, often, seldom, rarely, never

Present Continuous
S + am/is/are + Ving
Am/is/are + S + Ving?
S+am/is/are + not + Ving

Вживається

1) Для позначення дії, яка відбувається зараз
2) Для позначення тимчасової дії – мається на увазі тимчасова дія, наприклад: I am using my dads car these days. – these days означає цими днями, тобто тимчасово. В цьому випадку буде часто використовуватися these + days, weeks ітд.
3) Для позначення запланованої майбутньої дії – але вживайте недалеке майбутнє, тобто сьогодні ввечері, але не завтра.
   I am meeting my friend this evening.
   Я зустріну свого друга цього вечора
4) Для ситуацій, яка змінюється. Наприклад:
   More and more people are using cars
   Все більше і більше людей використовують авто

Тут є одна підказка – тут використовується вищий ступінь порівняння прикметників – more and more, bigger and bigger, newer and newer ітд.

Обставини часу, які вживаються з цим часом: now, at the moment, these____, at present.

Useful references:
https://www.youtube.com/watch?v=-8gObuZuYts
https://www.youtube.com/watch?v=VP8MRGAjgAs

Causative form **Have smth done**

Ця форма є трохи незвичною для нашої мови, оскільки вона не звучатиме в перекладі нормально та логічно
Перекладається вона як **хтось комусь щось робить**
Наприклад:
Мені малюють будинок – I have my house painted
Тут виникає проблема, бо в дослівному перекладі це означатиме **Я маю свій будинок мальований**
Якщо комусь буде легше, то створюйте цю форму за таким українським прикладом **Я маю щось зроблене**
Для кращого розуміння – попрактикуйтеся і напишіть декілька речень
Різниця між **Get** і **Have** як написано в підручнику майже немає, тому можете використовувати в будь-якому випадку
Декілька прикладів:
Їй прибирають кімнату – She has her room cleaned
Їм ремонтують машину – They have their car repaired
Нам замовляють столик – We have table booked
Обов'язково дотримуйтеся формули: **хтось має щось зроблено**
Обов'язково має бути **Have** дальше **щось** або **предмет** і тоді **дієслово в 3 формі або з закінченням ed**

Порівняння прикметників
Існує дві форми порівняння прикметників, як і в українській мові:
Вищий – коли ми добавляємо суфікс – великий – більший, високий – вищий, зелений – зеленіший. Більший, вищий і зеленіший це прикметники вищого ступеня порівняння. В англ. мові все так само, тільки простіше. До прикметників ми добавляємо закінчення er – якщо вони короткі big – bigger, tall – taller, smart – smarter
Якщо прикметники довгі – то ми перед ними ставимо слово more, наприклад: intelligent – more intelligent, casual – more casual, interesting – more interesting
Найвищий – це коли ми в укр. мові добавляємо префікс **най** перед прикметником, наприклад – зелений – найзеленіший, великий – найбільший, могутній – наймогутніший. В англ. мові все так само, ми добавляємо закінчення

est в кінці прикметника якщо він короткий – наприклад: big – biggest, smart – smartest, tall – tallest.
Якщо прикметники довгі – то ми перед ними ставимо слово most, наприклад: intelligent – most intelligent, casual – most casual, interesting – most interesting

Одна важлива річ: Завжди перед НАЙВИЩИМ ПРИКМЕТНИКОМ ставимо артикль the – the biggest, the tallest, the most interesting

Інші види порівнянь
As…as – такий…як ------- для заперечень використовуємо not as …. as
Він такий зелений як трава She is as green as grass

The more/…er, the more/…er – чим ……, тим ……

The more you study, the better you will know

Less… than – менш….. ніж
Він менш говіркий ніж вона – He is less talkative than she
The least of/in – найменш …. у/в
Він найменш говіркий у класі – He is the least talkative in the class

Для того, щоб краще зрозуміти цю тему, напишіть по 5 речень до кожного з порівнянь

Useful references:
https://www.youtube.com/watch?v=plSLAePQ458
https://www.youtube.com/watch?v=UfmGIHdX1_I

Past Simple

Утворення
S + V2/ed
Did + S + V2/ed?
S + did + not + V2/ed

S – це підмет або головна дійова штука в реченні
V – це дієслово. Даний час використовує дієслово зі закінченням ed якщо воно правильне. Якщо не правильне, тоді з 2 колонки.
Приклад:
I went to school
Did I go to school?
I did not go to school

Вживання
Цей час позначає звичайну минулу дію.

Обставини часу: ago, when, then, in1980, last…, yesterday

Present perfect

Утворення
S+have/has +V3/ed
Have/has + S + V3ed?
S + have/has+not+V3/ed

S – це підмет або головна дійова штука в реченні
V – це дієслово. Даний час використовує дієслово зі закінченням ed якщо воно правильне. Якщо не правильне, тоді з 3 колонки.

Приклад:
I have gone to school
Have I gone to school?
I have not gone to school

Вживання:
Вживається для позначення дії, яка почалася у минулому та або нещодавно закінчилася або ще триває. Тут ключове слово є щойно. Загалом, це час, який позначає минулу дію, яка нещодавно відбулася. Проте є проблема у розумінні цього часу укр. студентами. Детальніше ми його розглянемо в порівнянні з минулим.

Обставини часу: just, ever, never, already (тільки в стверджувальних реченнях), yet (тільки в запитаннях і запереченнях), still, so far.

Ці два часи є дуже важкими для укр. студентів. Чому? В укр. мові ми маємо один минулий час, а ці два часи в перекладі звучатимуть як минулий час. В анг. мові вони мають кардинальну різницю, тому старайтеся їх зрозуміти, проте не завдяки перекладу. Кожний з них має свою специфіку і дію, яку вони позначають. Загалом в українській мові є один час, який використовується для минулих дій, в англійській мові ми маємо шість часів, і це без future in the past.

Відмінності між двома часами

Past Simple	**Present Perfect**
Дія відбулася в чітко зазначений час у минулому. Тобто має бути обов'язково сказано коли відбулася дія, наприклад last year, yesterday, 2 years ago ітд Я помив машину вчора (чітко зазначений час - вчора) I washed my car yesterday	Дія відбулася у минулому, але без чітко вказаного часу, наприклад Я помив машину (коли? Не вказано часу) I have washed my car
Минула дія, звичка або стан Я ходив до школи I went to school	Дія, яка нещодавно закінчилася Я щойно закінчив школу I have just finished school

Минула дія, яка відбувалася одна за одною Я витягнув ключі, відкрив двері і зайшов до кімнати I took out keys, opened the door and went into the room	Дія, яка почалася у минулому і продовжується до тепер Вона жила в цьому будинку 2 роки (і все ще живе) present perfect She has lived in house for 2 years Вона жила в цьому будинку 2 роки (вже не живе) past simple She lived in house for 2 years
Дія, в якої не зазначено час і вона не пов'язана з теперішнім Я зустрів Елвіса Преслі (Елвіс помер і я його вже не зустріну) I met Elvis Presley	Дія, в якої не зазначено час і вона пов'язана з теперішнім Я зустрів Мадонну (Вона ще жива і я її можу ще зустріти) I have met Madonna

Useful references:
https://www.youtube.com/watch?v=eIllAP4ZJg0
https://www.youtube.com/watch?v=rechDnQr8zM
https://www.youtube.com/watch?v=oDzO_Scb89U
https://www.youtube.com/watch?v=1i8EpsDzVwE

Article

Артикль в англійській мові вживається перед злічуваними іменниками (які можна порахувати).

В англійській мові є два типи артиклів

- Неозначені – це артиклі я **a/an.** Вони вживаються перед іменниками, в однині, які не є означеними, тобто:
  A car is standing at parking
  Ми вживаємо артикль **A**, оскільки ми не знаємо, яка машина стоїть на парковці, тобто **A car** – будь-яка машина

a – вживається перед приголосними
an – вживається перед голосними

- означений **the –** вживаються перед іменниками, в однині та множині, які є означувальними, тобто
  The car is standing at parking
  Ми вживаємо артикль **The**, оскільки ми знаємо точно, яка машина стоїть на парковці, тобто **The car** – конкретна машина

Існує ще багато випадків вживання артиклів, найважливіші з них:

1) **a/an** вживається перед злічуваними іменниками в однині, коли ми говоримо про речі загалом.
   An airplane is faster than a train
   An airplane – будь-який літак
   A train – будь-який потяг
2) ми вживаємо **a/an** часто після дієслів **to be/to have**

3) **a/an** не вживаються перед іменниками в множині або незлічуваними. Замість них ми вживаємо some
   I would like some biscuits (biscuits – печеня - незлічуваний)
4) **the** ми вживаємо перед іменниками в множині або однині, злічуваними та незлічуваними, коли ми говоримо про щось конкретне або коли ми говоримо про річ вдруге
   The boy who has just left is my cousin the boy – конкретно – бо він мій кузин, або той, хто щойно вийшов
   There is a cat on the sofa. The cat is sleeping – the cat – вживається вдруге. The sofa – конкретно, на якій кіт.
5) Ми використовуємо **the** перед словами **cinema, theatre, radio, country(side), seaside, beach.**

We go to the beach every Sunday.

Useful references:
https://www.youtube.com/watch?v=9T0KGhMgVU8
https://www.youtube.com/watch?v=lTzVazO3U2k
https://www.youtube.com/watch?v=BzM-h93g9AU
https://www.youtube.com/watch?v=uU-RbEEolw0

Reported speech

В будь-якій мові існує пряма і непряма мова.
Пряма мова – Він сказав: "я йду до школи"
Не пряма мова – Він сказав, що він пішов до школи

В англійській мові для прямої мови ми використовуємо слова tell –told say – said

He said: "I go to school"
He said that he went to school

1. Щоб зробити непряму мову, ми використовуємо дієслово (say, tell, advice, explain, promise) після чого йде слово that – що/щоб
2. Займенники та присвійні прикметники змінюються на reflexive
   She said: "I can repair it myself"
   She said that she could repair it by herself
3. Деякі слова змінюються в непрямій мові

Direct	Indirect
This	That
These	Those
Here	there
Can	Could
Must	Have to
May	Might
Last night/month/year	Previous night/month/year
Present simple	Past simple

Present perfect	Past perfect
Present continuous	Pas continuous
Pas simple	Past perfect
Future will	Would

He said: "I am writing the letter" – He said that he was writing the letter
She said: "I will go to the cinema" – She said that she would go to the cinema
We told: "We have cleaned the car" – We told that we had leaned the car
They said: "We must listen" - They said that they have to listen

4. Деякі модальні дієслова не змінюються в непрямій мові, ми їх залишаємо без змін, це: should, would, might, could, ought to
   He said: "I should close the window" – He said that he should close the window

5. Для того, щоб зробити непряму мову в командах, ми використовуємо дієслова (order, ask, tell, advise, offer, warn, beg, suggest) та добавляємо після них інфінітив to
   He said: "Don't touch it" – He warned me not to touch it – ми тут say змінили на warn оскільки це звучить як попередження, або
   He said: "don't touch it" – He advised me not to touch it – тут вже звучить як порада
   Тобто ми можемо самі вибирати дієслово, відповідно до того контексту, який нам потрібен
   В цьому випадку головне знати переклад дієслів в зеленому полі

6. Питання зробити в непрямій мові дуже просто. Для цього ми використовуємо слово ask – питати
   - **Якщо** питання починається на допоміжне дієслово, то ми використовуємо слово Чи – whether/If

   He asked: "Do you know the time?" – He asked me whether/if I knew time.
   She asked: "Have you read the book?" – She asked me whether/if I had read book
   - **Якщо** питання починається на питальне слово, то ми його так і переробляємо, залишаючи це питальне слово

   He asked: "When do you come?" – He asked me when did I come.
   She asked: "What do you read?" – She asked me what did I read.

Useful references:
https://www.perfect-english-grammar.com/indirect-questions.html
https://www.youtube.com/watch?v=5jrWkUuAgB8&feature=emb_logo
https://cambridge.ua/uk/blog/pryamaya-i-kosvennaya-rech-v-anglijskom-yazyke-pravila-obyasneniya-primery/
https://grade.ua/uk/blog/direct-indirect-speech/

Modal verbs

Модальні дієслова в англійській мові позначаються декілька варіантів дій, тобто фізичну здатність (могти), примус (мусіти), критику (варто) і т д. Розбирати ми їх будемо в залежності від застосування. НАЙГОЛОВНІШЕ, що слід запам'ятати, це те, що після модальних дієслів вживається дієслово в інфінітиві (оригінальний варіант).

Запитання і заперечення за допомогою модальних ставляться дуже просто. В запитанні модальне виносите наперед, а в запитанні добавляєте not

I can swim

Can I swim?

I can not swim

Здатність

Здатність ми виражаємо такими модальними дієсловами

Can – могти (теп і майб час)

I can read now

Could – міг (мин час)

I could read when I was 5

be able to – (могти. Ве відміняється am is are) ця форма має варіанти у всіх часах, просто ставите дієслово be у потрібний час

I am able to read / She is able to read / They are able to read

I was able to read / They were able to read

They will be able to read.

Можливість

Для вираження можливості (Я можливо піду до школи) ми використовуємо:

Can/could/may/might – можливо. Вони використовуються без різниці значень.

She can/could/may/might go to Spain.

Must – мусить. Використовується, коли ви точно знаєте, що дія відбувається.

She must be at home on Sunday – в неділю ніхто не працює

Can't – не може бути.

She can't go to work on Sunday.

Можливість відбуття дії відповідно до відсотків:

Must – 100%

Can't – 80%

Can/may/could/might – 60%

Дозвіл

Для запитання про дозвіл та давання/не давання дозволу ми використовуємо:

Can/could/may/might – чи можна? – використовуються без різниці значень

Can/Could/may/might I borrow your book?

І відповідь даєте

Yes, you can/may/could/might

No, You can/could/may/might not

Ще ми використовуємо **must not –** проте це дуже жорсткий варіант, тобто ви його вживаєте, коли ви забороняєте щось робити комусь.

Примус

Для примусу ми використовуємо:

Must – (теп/майб час) мусиш зробити, це обов'язково (100%)

ought to – (теп/майб час) мусиш зробити, це обов'язково (100%)

have to – (будь-який час) – маєш щось зробити, але це не обов'язково (70%)

You must do your homework

You ought to do your homework

You have to/had to/ will have to do your homework

Відсутність необхідності

Must not – не мусиш, заборонено щось робити

Don’t have to/didn’t have to/ will not have to або **don’t need to/didn’t need to/will not need to** – не потрібно щось робити.

Needn't – не потрібно щось робити (але ви це зробили)

You needn’t have bought bread, we have it in the house.

You must not to drive carelessly.

You don’t have to work on Saturday

Прохання/пропозиція

Ці модальні дієслова вживаєте, коли хочете щось запропонувати або попросити

Can/could – чи ти щось зробиш

Can/could you help me to clean my room?

Would you like – чи хотів би ти (ввічлива форма)

Would you like a cup of coffee?

Shall I/we або **lets/how about + Ving –** давайте

Shall we go to the cinema?

Lets go to the cinema

How about going to the cinema?

Will you/he/she/it/they – давайте

Will you help me with homework?

Порада

Варто щось зробити

Should – вартує

You should have read this book – тобі вартує прочитати цю книжку

Had better – краще б

You had better read this book – тобі краще було б прочитати цю книжку

Для кращого розуміння модальних дієслів, вивчіть їх переклад та напишіть декілька речень з кожним з них

Suggestions

Ми утворюємо пропозиції в англ. мові за допомогою декількох слів.

Let's
Let's go dancing
Shall
Shall we go dancing
How about + Ving
How about going dancing?
Why don't…..
Why don't we go dancing?
Suggest + Ving
I suggest going dancing

Просто ставите ці слова в потрібному місці в реченні і готово

Для кращого розуміння – попрактикуйтеся написавши декілька варіантів з кожним із словосполучень

Useful references:
https://www.youtube.com/watch?v=ZC710CZYv6k
https://www.youtube.com/watch?v=2oumWdjA9hM
https://www.youtube.com/watch?v=Nk9nQwoCFig
https://www.youtube.com/watch?v=4GMU08J98MQ
https://www.youtube.com/watch?v=-ZI2N0OcTVA
https://www.youtube.com/watch?v=HUFb5pkF0fY
https://www.youtube.com/watch?v=Sse2FKrC_DE
https://www.youtube.com/watch?v=2zyca6fGo4A
https://www.youtube.com/watch?v=hRvVmO5Vc4E
https://www.youtube.com/watch?v=iXi8pIMM6gM

Passive Voice

Пасивний стан в англійській мові часто використовується:

1) Коли ми не знаємо хто виконує дію
   The picture is painted
2) Дія важливіша ніж об'єкт
   The car is broken.
3) Щоб наголосити суб'єкт
   This picture was painted by Picasso

Пасивний стан утворюється за допомогою формули **be+Ved/3**, де be ми ставимо у потрібний час та форму, наприклад

The car is repaired
The car was repaired
The car is being repaired
The car will be repaired
The car have been repaired
The car must be repaired

Перетворювати активний стан у пасивний не складно, ми лише міняємо суб'єкт і об'єкт місцями і застосовуємо формулу пасиву, наприклад

I repaired the car – The car was repaired by me
She will paint window – window will be painted by her

Ми вживаємо by – коли дія виконується особою, тобто ким
The book was read **by** her – Книжка була прочитана **(ким)** нею
Ми вживаємо with коли дія виконувалася іншим об'єктом або складається з чогось

The book is compiled **with** words – Книжка складається **зі** слів

Useful references:
https://www.youtube.com/watch?v=oXbgIWBYYxE
https://www.youtube.com/watch?v=pxbQ2U3Uuv0
https://www.youtube.com/watch?v=nkAyggAM1q4
https://www.youtube.com/watch?v=nRGLDD0BBdc

Countable and Uncountable nouns

Злічувані та незлічувані іменники

Злічувані – це ті, які ми можемо порахувати: ручка, олівець, зошит ітд

Не злічувані – це ті, які ми не можемо порахувати: сніг, вода, молоко ітд

Деякі не злічувані нам можуть здаватися злічуваними, наприклад: гроші, час, новини, меблі, хліб, дерево (матеріал) ітд

Незлічувані іменники не мають множини!!!

Позначення кількості

Злічувані	**Не злічувані**
Many багато	Much багато
A lot of – багато	
Few мало	Little мало

Для того, щоб не злічувані іменники зробити злічуваними, ми їх поміщаємо в якусь ємкість, наприклад: *вода – два стакани води*

Useful references:
https://www.youtube.com/watch?v=EEtDJKRTTUo
https://www.youtube.com/watch?v=LfHuXPSWJK4
https://www.youtube.com/watch?v=1SbJ1B1MTQg

Relative clauses

Підрядні речення

Ця тема дуже легка в англійській мові, оскільки підрядні речення утворюються так само як і в українській мові. Основне тут знати запитальні слова і переклад до них. тобто when – коли, what – що, who – хто, that – що, який ітд

Проте є декілька нюансів

Who – вживається завжди з людьми
What – з неживими об'єктами
Which – вживається зі всіма

Підрядні речення складаються з двох менших речень, які з'єднані між собою тими питальними словами. Наприклад

Я не знаю де він живе
I don't know where he lives
Вона піде до дому, коли зробить домашнє завдання
She will go home when she does her homework
Машина, яку я купив вчора, не працює
The car that I bought yesterday, doesn't work

Useful references:
https://www.youtube.com/watch?v=RFKWdOuNJrA
https://www.youtube.com/watch?v=Ht_Lb2djZ4o
https://www.khanacademy.org/humanities/grammar/syntax-sentences-and-clauses/phrases-and-clauses/v/relative-clauses-syntax-khan-academy

Conditionals

Conditionals в анлійській мові це речення зі словом **якщо**

Якщо я піду до дому, то ти будеш плакати

Речення з **якщо** в обидвох мовах складаються з двох менших речень - Якщо я піду до дому – перше речення, то ти будеш плакати – друге речення

В українській мові ми маємо два типи речень з **якщо**

1) **Дійсний спосіб** - просте речення, реальна дія, тобто
   Якщо я буду вчитися, то я буду знати
2) **Умовний спосіб –** речення, до якого ми добавляємо частки **б** або **би**
   Якщо б я вчився, то я б знав

Все ніби просто. Зверніть увагу, що в українській мові речення з умовним способом використовуються в минулому часі.

Тепер перейдемо до англійської ☺ є два важливих моменти:

1. В англ. мові частки **б** та **би** які позначають нашу умовність, перекладаються як **would**
2. В укр мові ми вживаємо для умовного способу минулий час і в англійській також
3. В англійській мові є два умовних стани, теперішній та минулий. І тут для нас є дуже велика проблема, оскільки ми цього не маємо в нашій мові.

Проте не все так просто з англійською. В них є чотири або дехто каже 3 форми утворення речень з **якщо**

Дійсний спосіб	Дія реальна, в теперішньому часі Якщо зима, то вода холодна	**If + present simple, present simple** If it is winter, water is cold
	Дія реальна, але з відсилкою на майбутній час Якщо буде зима, то вода буде холодна	**If + Present tense (**будь-який з 4**)*, Present Simple, will, can, may** If it is winter, water will/may/can be cold
Умовний спосіб	Дія умовна теперішня Якщо б зима була морозна (зараз), то вода була б холодна (зараз)	**If + past simple/past continuous, would + V** If winter was icy, water would be cold
	Дія умовна минула Якщо б зима була морозна (вчора), то вода була б холодна (вчора)	**If + past perfect/past perfect cont., would + have + V3/ed** If winter had been icy, water would have been cold

***після if will не вживається**

Для кращого розуміння, напишіть одне речення і провідміняйте його у всіх Conditionals. Зробіть так декілька разів для кращого розуміння.

Useful references
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