# LESSON NOTE 1

**ENERGY TRANSFORMATION IN NATURE**

Energy transformation refers to the **conversion of energy from one form to another**. In nature, energy flows through ecosystems starting from the **sun**, passing through **plants** and then through **animals** via feeding relationships.

However, this flow is **not 100% efficient**—energy is **lost at each stage**, mostly as **heat**, which affects the structure and stability of ecosystems.

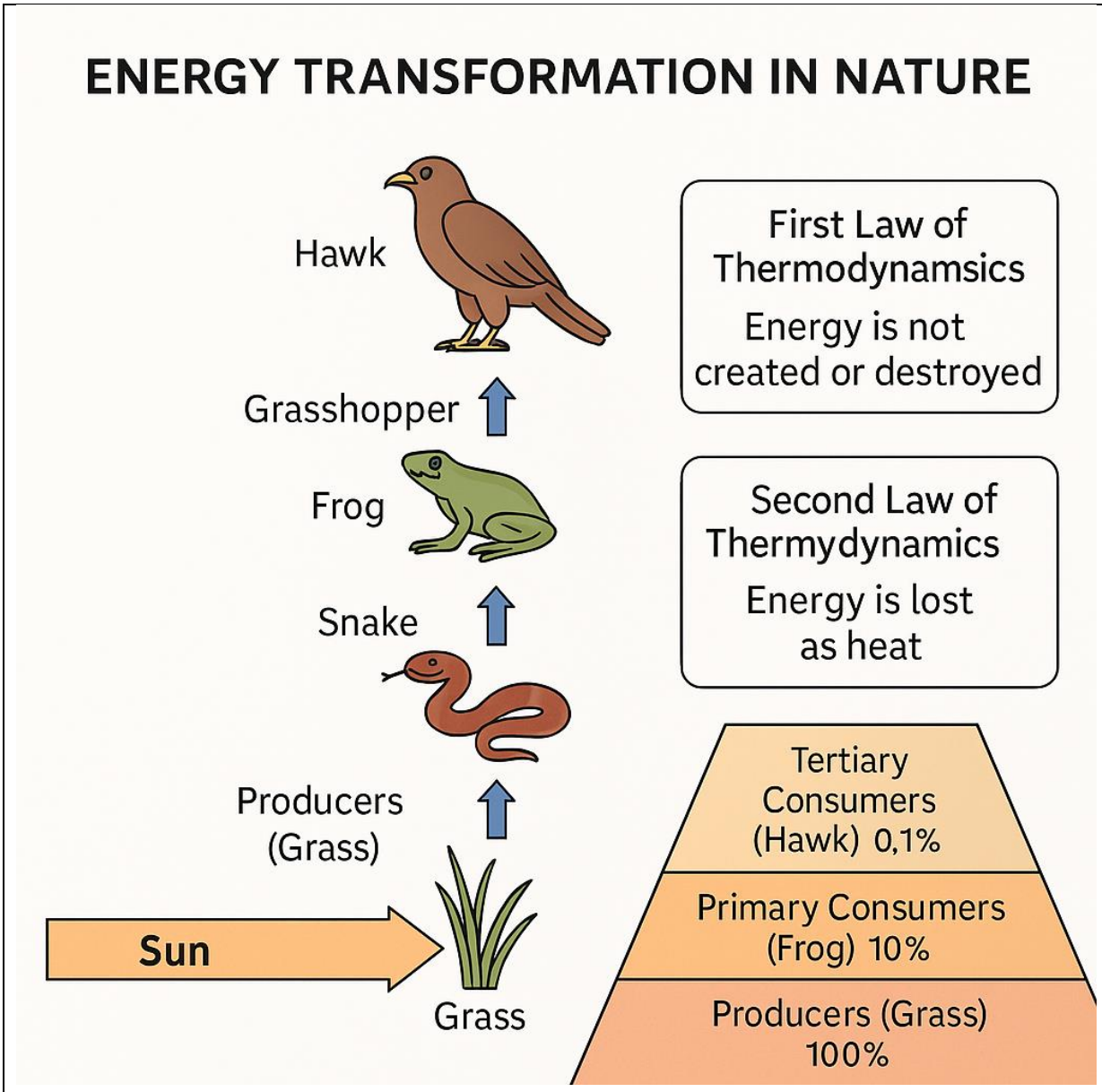
## Energy Loss in Ecosystems

Energy loss explains why:

- There are **fewer organisms** at the top of the food chain.
- **Food chains are short** (usually 3–5 levels).
- **Top predators** (e.g., lions, hawks) need large territories to survive.

This is modeled in the **pyramid of energy**, which always tapers toward the top.

## Laws of Thermodynamics and Their Ecological Applications




First Law of Thermodynamics

**"Energy cannot be created or destroyed, only transformed."**

*Application in Ecology:*

- Plants **convert sunlight (radiant energy)** into **chemical energy** through photosynthesis.
- When herbivores eat plants, they **transform chemical energy** into mechanical and heat energy.
- Energy flows **but is not lost** from the system—just **changes form**.

Second Law of Thermodynamics

**"In every energy transfer, some energy becomes unavailable for work—usually lost as heat."**

*Application in Ecology:*

- When energy is passed from one trophic level to another, **a significant portion is lost as heat**.
- This explains:
    - Why **only 10%** of energy is passed to the next level.
    - Why **top predators are few**—not enough energy reaches them.
    - Why **ecosystems require a large base of producers** to support a few consumers.

# LESSON NOTE 8

**AQUATIC HABITAT**

An aquatic habitat is any type of environment where water is the primary medium in which organisms live. This includes all environments in rivers, lakes, oceans, seas, and estuaries.

Organisms living in aquatic habitats have special adaptations that help them survive under water conditions like pressure, salinity, light availability, and temperature variations.

## Types of Aquatic Habitats

Aquatic habitats are broadly classified into three types:


freshwater

1. **Freshwater Habitats**
    - Water bodies with little or no salt content.
    - Examples: Rivers, lakes, ponds, streams.

2. **Marine Habitats**

   - Large water bodies with high salt content (seas and oceans).
   - Examples: Atlantic Ocean, Pacific Ocean, Indian Ocean.

3. **Estuarine Habitats**


- Found where freshwater rivers meet saltwater seas.
- The water here is called **brackish water** (a mix of fresh and saltwater).
- Examples: River mouths, mangrove swamps.

# Characteristics of Aquatic Habitats

- **Presence of Water:** Water is constantly or seasonally available.
- **Variation in Salinity:** Salt levels vary (freshwater is low in salt, marine water is high in salt).
- **Oxygen Availability:** Oxygen is dissolved in water; its amount depends on temperature and water movement.
- **Temperature Changes:** Surface water is warmer; deep waters are colder.
- **Light Penetration:** Light decreases with depth; photosynthesis only occurs in upper layers.
- **Pressure:** Increases with depth, affecting the structure of deep-sea organisms.
- **Buoyancy:** Water supports body weight, allowing many organisms to float or swim easily.

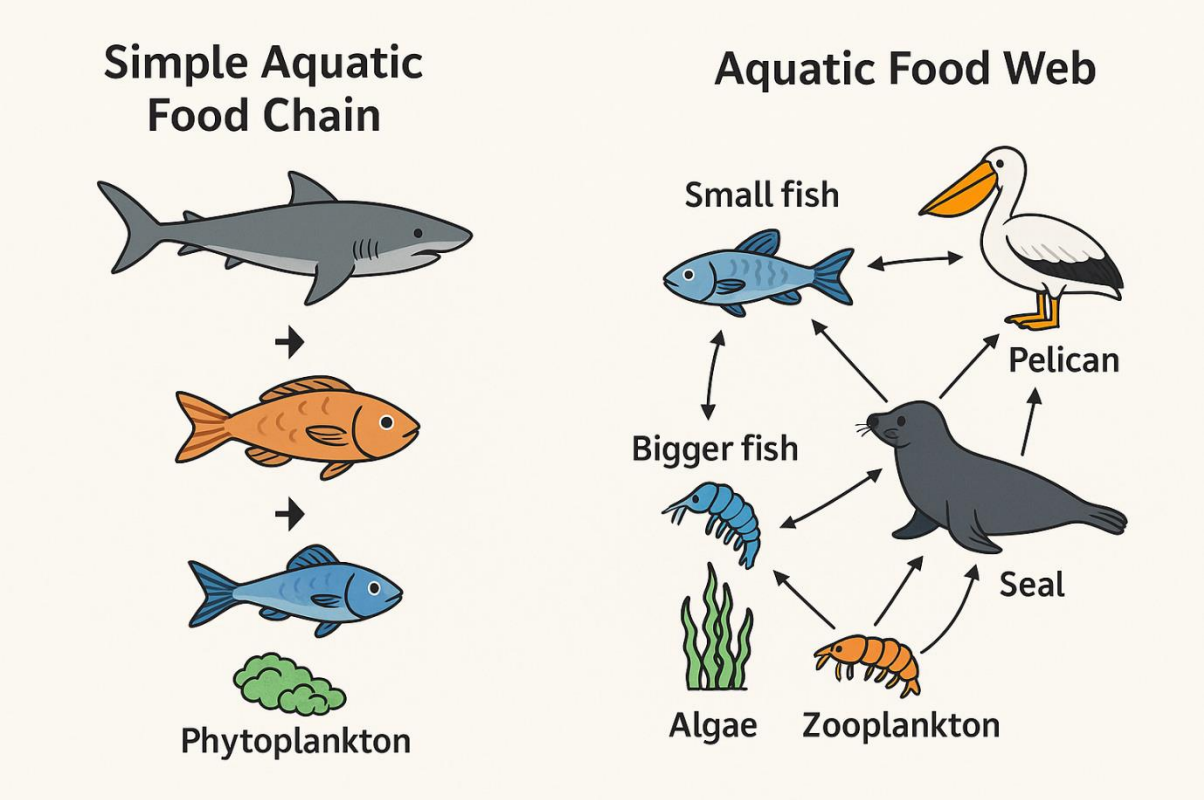
Examples of organisms in Aquatic Habitats

Freshwater: Catfish, Frogs, Waterlilies

Marin: Sharks, Starfish, Whales

Estuarine: Crabs, Mangroves, Mudskippers

# Food Chain in Aquatic Habitat




**Simple Aquatic Food Chain Example:**

**Phytoplankton → Small Fish → Bigger Fish → Shark**

- **Producers:** Algae and phytoplankton (make their own food through photosynthesis).
- **Primary Consumers:** Small fish and zooplankton (feed on producers).
- **Secondary Consumers:** Larger fish (eat small fish).
- **Tertiary Consumers:** Top predators like sharks (eat larger fish).

# Food Web in Aquatic Habitat

A **food web** is a complex network of interconnected food chains showing multiple feeding relationships among aquatic organisms.

**Example of an Aquatic Food Web:**

- Algae → Zooplankton → Small fish → Big fish → Seal
- Algae → Zooplankton → Small fish → Pelican

In a food web, organisms can have multiple feeding options, making the ecosystem more stable and less likely to collapse if one food source is lost.

# LESSON NOTE 9

**TERRESTRIAL HABITAT**


A **terrestrial habitat** is any land-based environment where plants, animals, and other organisms live. Terrestrial habitats differ widely in temperature, water availability, soil type, and sunlight, leading to a variety of ecosystems.

# Types of Terrestrial Habitats

1. **Forest**
    - A habitat dominated by dense trees and undergrowth.
    - Examples: Tropical rainforests, temperate forests.
    - Organisms: Monkeys, parrots, snakes, and orchids.
2. **Desert**

    - Dry regions receiving very little rainfall.
    - Can be hot (Sahara) or cold (Gobi Desert).
    - Organisms: Camels, cacti, lizards, desert foxes.

3. **Grassland**

- Large open areas dominated by grasses.
- Examples: Savannah (Africa), Prairies (North America).
- Organisms: Lions, zebras, antelopes, grasshoppers.

4. **Mountain**

- High elevation areas with rugged terrains.
- Temperatures are colder with increasing altitude.
- Organisms: Mountain goats, snow leopards, eagles.

5. **Tundra**


- Very cold, treeless regions near the polar areas.
- Soil is often frozen (permafrost).
- Organisms: Polar bears, arctic foxes, mosses.

# Characteristics of Terrestrial Habitats

- **Presence of Soil:** Plants grow in soil, which provides nutrients and anchorage.
- **Air Availability:** Oxygen and carbon dioxide are freely available.
- **Sunlight:** Essential for photosynthesis; varies with location and season.
- **Temperature Variation:** Wide range from very cold to very hot.
- **Water Availability:** Abundant in forests, scarce in deserts.
- **Adaptation Needs:** Organisms must survive harsh conditions like drought, heat, or cold.

Examples of Organisms in Terrestrial Habitats

Forest: monkeys, snakes, parrots, orchids

Desert: camels, cacti, lizards

Grassland: lions, zebras, antelopes

Mountain: mountain goats, snow leopards

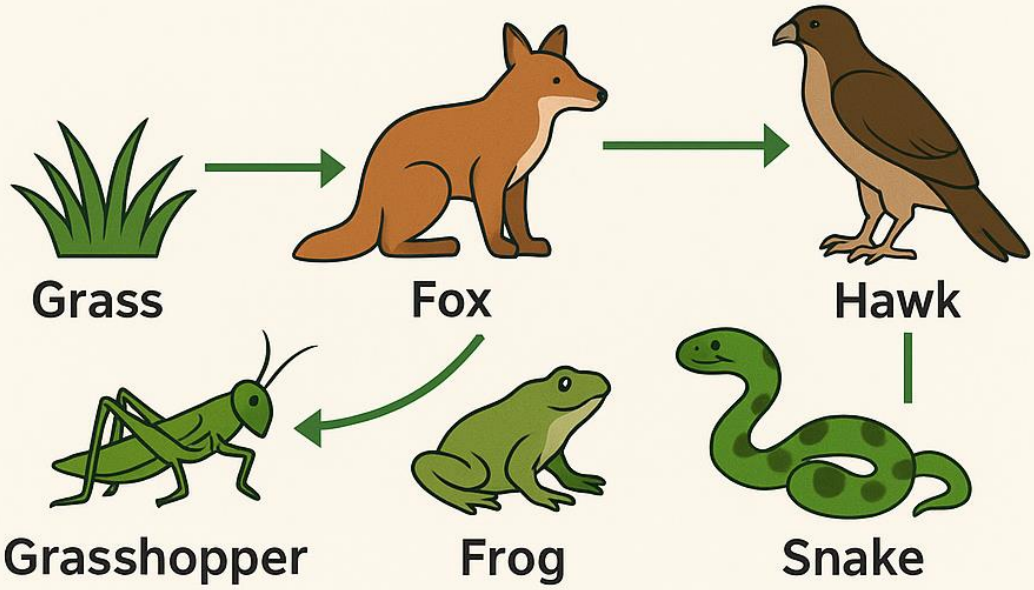
Tundra: polar, bears, mosses, artic foxes

# Adaptive Features of Terrestrial Organisms

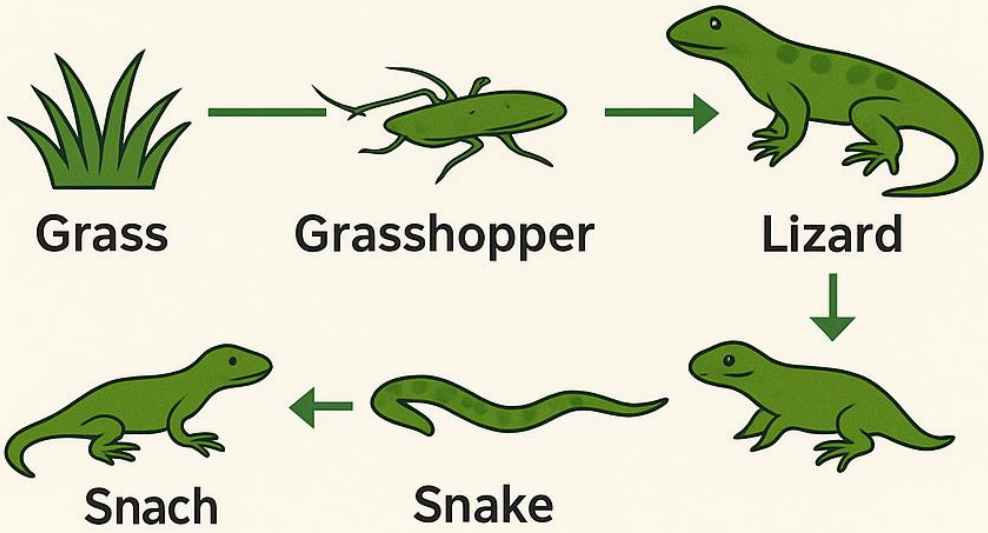
- **Thick Fur/Feathers:** Keeps animals warm in cold climates (e.g., polar bears, arctic foxes).
- **Water Storage:** Camels store fat (energy) in their humps and can survive long without water.
- **Deep Roots:** Desert plants like cacti have long roots to reach underground water.
- **Speed and Agility:** Grassland animals like cheetahs and antelopes have long legs for fast running.
- **Camouflage:** Many animals blend into their environment to escape predators (e.g., chameleons, arctic hares).

# Food Chain in Terrestrial Habitat

# FOOD WEB IN TERRESTRIAL HABITAT




# FOOD CHAIN IN TERRESTRIAL HABITAT



A **food chain** shows the flow of energy from one organism to another.

**Simple Example:**

**Grass → Grasshopper → Lizard → Snake → Eagle**

- **Producers:** Plants that produce their own food (grass, trees).
- **Primary Consumers:** Herbivores that eat plants (grasshopper, rabbit).
- **Secondary Consumers:** Carnivores that eat herbivores (lizard, snake).
- **Tertiary Consumers:** Top predators (eagle, hawk).

# Food Web in Terrestrial Habitat

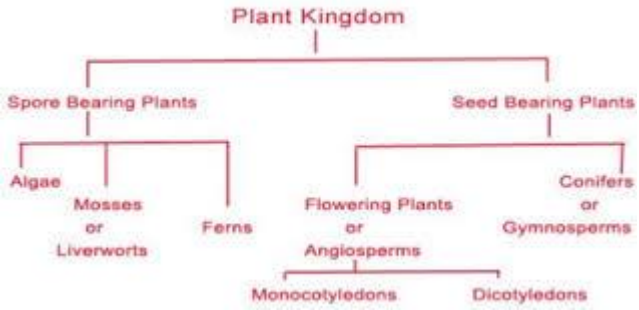
In a food web, an organism may eat or be eaten by multiple other organisms, making the system more stable.

**Example of a Terrestrial Food Web:**

- Grass → Rabbit → Fox
- Grass → Grasshopper → Frog → Snake → Hawk
- Fruits → Birds → Hawk

## LESSON NOTE 10

**CLASSIFICATION OF PLANTS**




Plant classification is the process of grouping plants into categories based on their similar characteristics. These characteristics can include the presence or absence of seeds, flowers, vascular tissues, and method of reproduction.

Plants are broadly divided into two groups:

- **Non-seed-bearing plants**
- **Seed-bearing plants**

## Non-seed-bearing Plants (Spore-producing Plants)


These are plants that do not produce seeds. They reproduce through **spores**, which are tiny reproductive cells capable of developing into a new organism.

*Characteristics:*

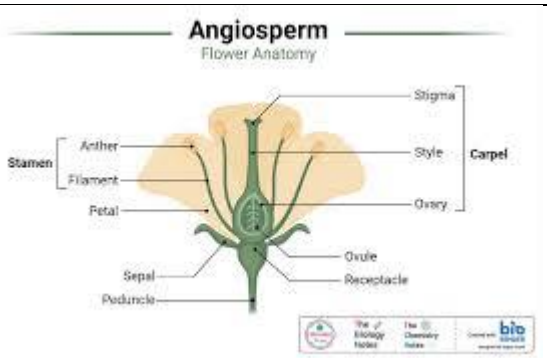
- Usually found in moist environments
- May not have true roots, stems, or leaves
- May or may not have vascular tissues

Examples include; algae, bryophytes (mosses), pteridophytes (ferns)

## Seed-bearing Plants


These are plants that reproduce by producing **seeds**. Seeds contain the embryo of a new plant and are often enclosed in fruits or cones.

Seed-bearing plants are further divided into:


- **Gymnosperms** – plants with naked seeds (not enclosed in fruit)
- **Angiosperms** – flowering plants with seeds enclosed in fruits

*Characteristics:*

- Have vascular tissues (xylem and phloem)
- Gymnosperms have cones, not flowers
- Angiosperms have flowers and fruits
- Usually larger and more advanced than non-seed plants

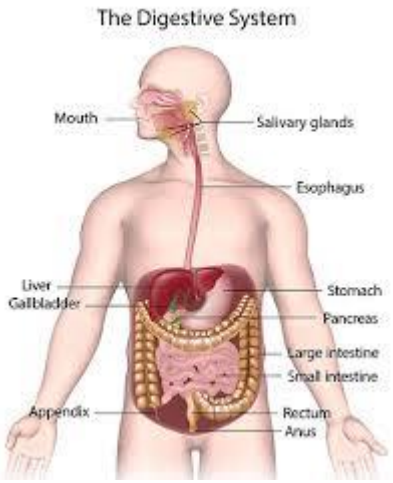
Examples are gymnosperm (pine, cycads) and angiosperms (maize, hibiscus, mango tree etc.)

## Differences Between Seed-bearing and Non-seed-bearing Plants

| Feature | Non-seed-bearing Plants | Seed-bearing Plants |
|---|---|---|
| Reproduction | Spores | Seeds |
| Examples | Algae, moss, fern | Maize, pine, hibiscus |
| Vascular Tissues | May be absent or present | Always present |
| Presence of Flowers | Absent | Present in angiosperms |
| Presence of Fruits | Absent | Present in angiosperms |
| Habitat | Mostly damp environments | Various environments |

# LESSON NOTE 11

**DIGESTIVE SYSTEM**




**Digestion** is the process by which large, complex food substances are broken down into smaller, simpler forms that can be absorbed and used by the body. The **digestive system** is the group of organs that work together to perform digestion. It includes the **alimentary canal** (a long tube from the mouth to the anus) and **accessory organs** (like the liver and pancreas) that help in digestion.

PARTS OF THE HUMAN DIGESTIVE SYSTEM AND THEIR FUNCTIONS

1. Mouth: chews food (mechanical digestion); saliva begins digestion of starch
2. Oesophagus: transports food from mouth to stomach using muscular movement (peristalsis)
3. Stomach: mixes food with gastric juices, begins protein digestion
4. Small intestine: completes digestion; absorbs nutrients into the bloodstream
5. Large intestine: absorbs water; forms and stores faeces
6. Rectum/anus: stores and expels undigested food as faeces
7. Liver: produces bile for fat digestion
8. Pancreas: produces enzymes that digest proteins, fats and carbohydrates
9. Gall bladder: stores and releases bile produced by the liver

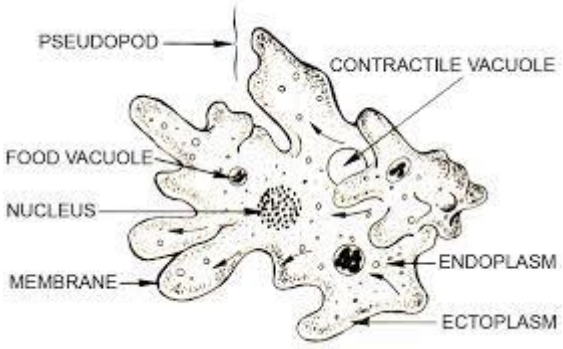
# Stages of Digestion

1. **Ingestion** – taking food into the mouth
2. **Digestion** – breaking down food mechanically and chemically
3. **Absorption** – taking nutrients into the blood (mostly in the small intestine)
4. **Assimilation** – using the absorbed nutrients for growth and energy
5. **Egestion** – removal of undigested food as feces

## Mechanical vs. Chemical Digestion

| Mechanical Digestion | Chemical Digestion |
|---|---|
| Physical breakdown of food | Breakdown by enzymes |
| Occurs in mouth and stomach | Occurs throughout the digestive tract |
| Example: chewing | Example: enzyme action in saliva |

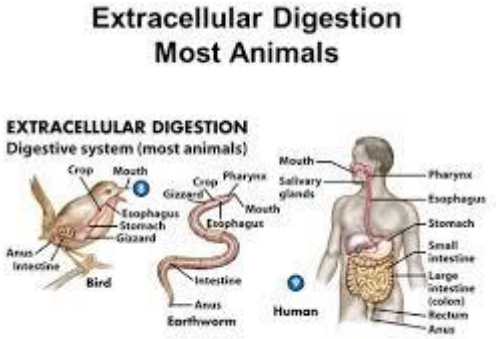
## Types of Digestion




*Intracellular Digestion*

- Occurs **inside a cell**.
- Food is engulfed and digested in **food vacuoles** using enzymes.
- Found in **unicellular organisms** such as **Amoeba** and **Paramecium**.
- There is **no digestive tract** involved.

*Extracellular Digestion*



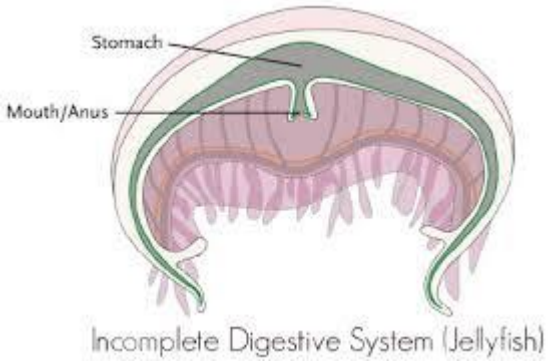

- Occurs **outside cells**, often in a **digestive cavity or system**.
- Enzymes are secreted into this cavity, and digested nutrients are later absorbed into cells.
- Seen in **humans**, **birds**, **earthworms**, and **many other multicellular animals**.

Some simple multicellular animals, like **Hydra** and **Planaria**, use both:

- **Extracellular digestion** occurs in the gut cavity.
- **Intracellular digestion** follows inside cells lining the cavity.

# Types of Digestive Systems

1. Incomplete Digestive System




- Only one opening (e.g., mouth serves as both entry and exit)
- Found in simple organisms like hydra and flatworms
- Digestion is partly extracellular and partly intracellular

Note: amoeba does not have a digestive system. It digests food entirely within its cell using no openings or tract.

2. Complete Digestive System


- Two openings (mouth and anus for ingestion and egestion)
- Food moves in one direction allowing for organized digestion and absorption
- Found in complex organisms like humans, birds, and ruminants

# Digestive Systems of Other Organisms

| Organism | Digestive System | No. of openings | Digestive type | Description |
|---|---|---|---|---|
| Amoeba | None | Not applicable | Intracellular only | Engulfs food using pseudopodia; digested food in vacuoles |
| Hydra/Planaria | Incomplete | One | Extra + Intracellular | Digestion occurs in a gut cavity, the inside cells; only one opening |
| Birds | Complete | Two | Extracellular | Use crop (storage) and gizzard (grinding); |

| | | | | |
|---|---|---|---|---|
| | | | | digestion is external to cells |
| Ruminant (cow) | Complete | two | Extracellular | Four chambered stomach; microbial digestion of cellulose; cud chewing. |