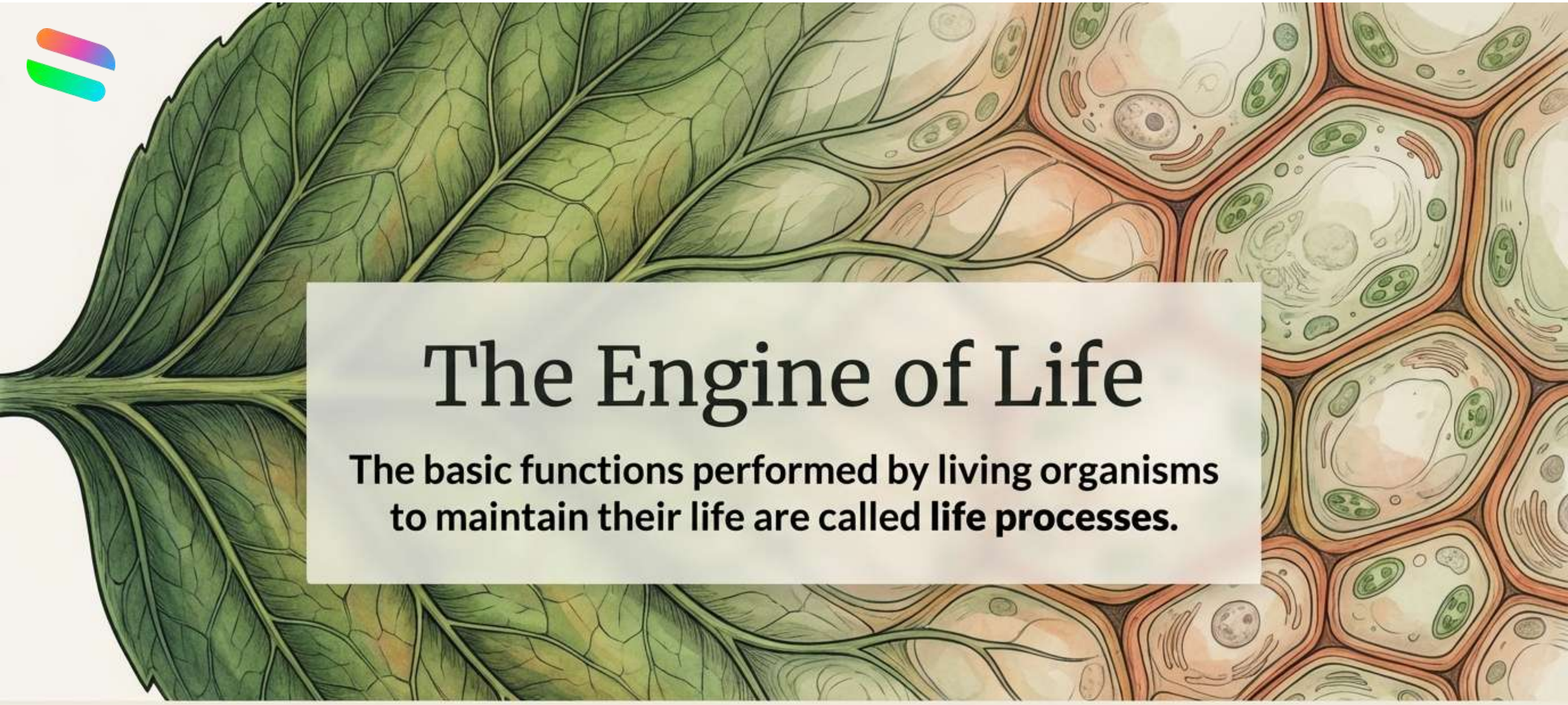


The Engine of Life

The basic functions performed by living organisms to maintain their life are called life processes.

Movement

Nutrition

Growth

Control & Co-ordination

Respiration

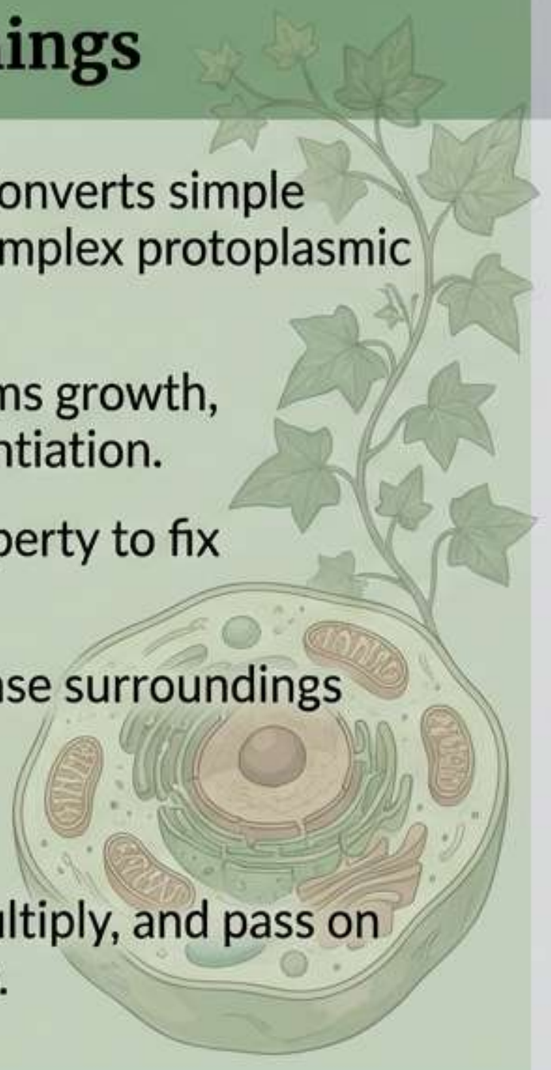
Excretion

Reproduction

The Architecture of Life

Living Things

- **Self-built organization:** Converts simple outside molecules into complex protoplasmic constituents.
- **Dynamic Growth:** Performs growth, development, and differentiation.
- **Self-Repair:** Inherent property to fix damaged tissues.
- **Responsive:** Ability to sense surroundings and protect themselves.
- **Finite** life span.
- **Evolution:** Reproduce, multiply, and pass on genes to evolve over time.



Non-Living Things

- **Imposed organization:** Organization is limited and static.
- **No cellular activity:** Cannot convert outside molecules.
- **Outside Repair:** Requires outside agencies to fix damage.
- **Unresponsive:** Protection must be externally imposed.
- **Indefinite** life span.
- **No Evolution:** Cannot reproduce, multiply, or pass on genes.

The Quest for Energy: Modes of Nutrition

NUTRITION

Autotrophic
Manufactures organic food from inorganic raw materials.

Photosynthesis:
Energy from sunlight
(e.g., Most plants)

Chemosynthesis:
Energy from special chemical processes
(e.g., Certain bacteria)

Heterotrophic
Obtains organic substances from other organisms.

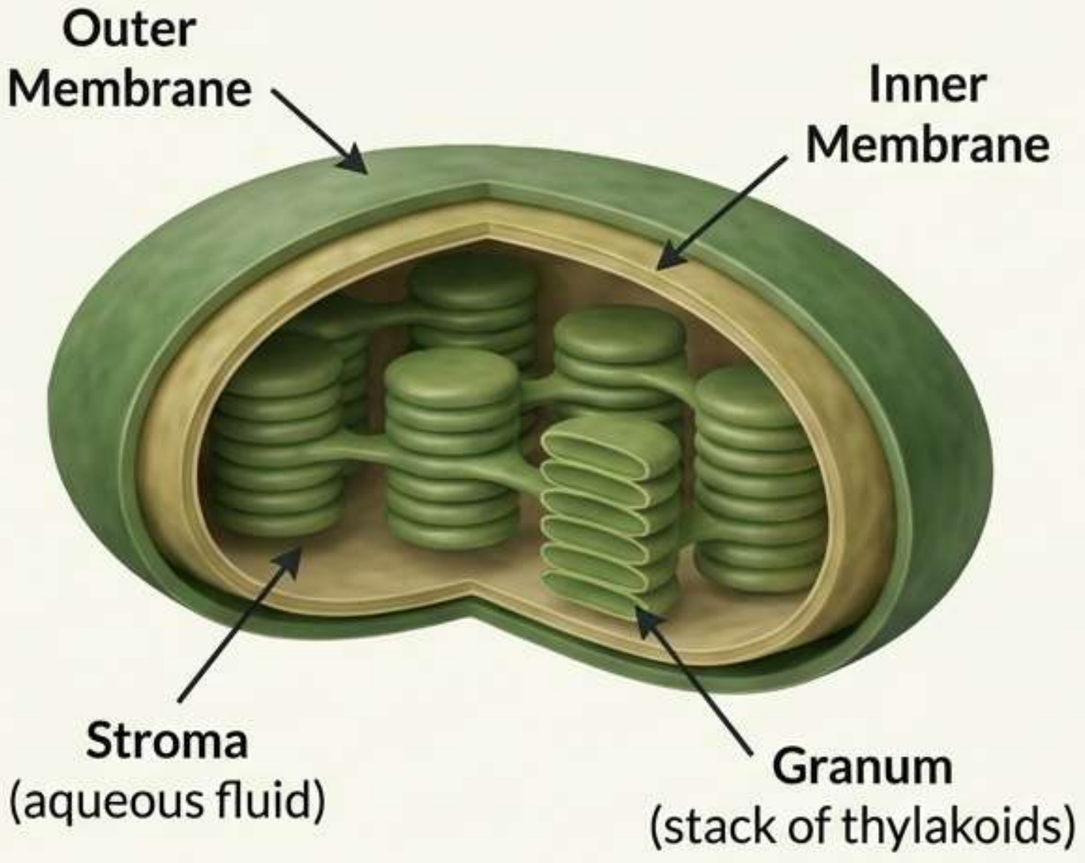
Holozoic:
Eating organisms usually as a whole
(e.g., Most animals and fungi)

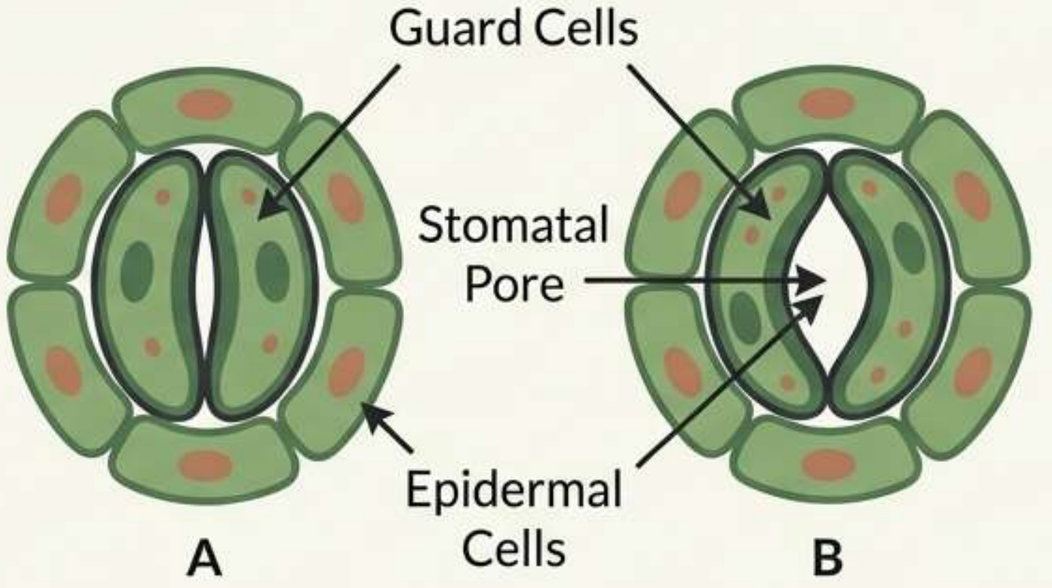
Saprotrophic:
Feeding on dead organic matter; secretes enzymes outside the body
(e.g., Fungi, certain bacteria)

Parasitic:
Derives food from the body of a living host without killing it
(e.g., *Cuscuta*, *Plasmodium*)

The Blueprint of Photosynthesis

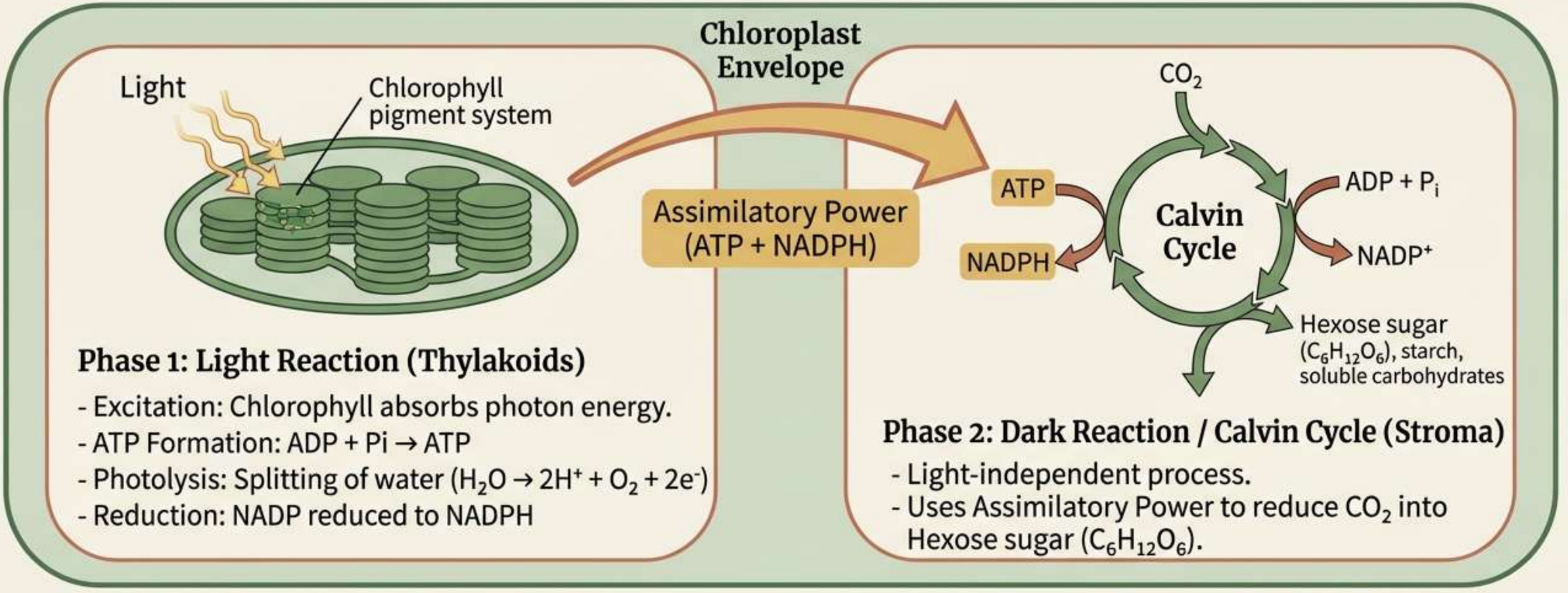
$$6CO_2 + 6H_2O \xrightarrow{\text{Sunlight, Chlorophyll}} C_6H_{12}O_6 + 6O_2$$





Turgid guard cells expand to open the pore. Flaccid cells **shrink to close** it, controlling CO2 entry and water transpiration.

The Photosynthetic Engine



Phase 1: Light Reaction (Thylakoids)

- Excitation: Chlorophyll absorbs photon energy.
- ATP Formation: ADP + Pi → ATP
- Photolysis: Splitting of water ($H_2O \rightarrow 2H^+ + O_2 + 2e^-$)
- Reduction: NADP reduced to NADPH

Phase 2: Dark Reaction / Calvin Cycle (Stroma)

- Light-independent process.
- Uses Assimilatory Power to reduce CO_2 into Hexose sugar ($C_6H_{12}O_6$).

Desert Plant Note: Desert plants absorb CO_2 at night, preparing malic acid to be acted upon by daytime solar energy while keeping stomata closed to conserve water.

Consuming the World: Heterotrophic Strategies

Holozoic

Food is taken into a specialized tube (alimentary canal) for digestion and absorption.

- **Herbivores:** Plants only (e.g., cow, elephant)
- **Carnivores:** Flesh only (e.g., lion, tiger)
- **Omnivores:** Both plants and flesh (e.g., humans, pigs)

Saprotrophic

Organisms that live on dead organic matter (like milk, bread, dead bodies). They secrete enzymes outside their bodies to digest food before absorbing it.

- **Examples:** Fungi and many prokaryotes.

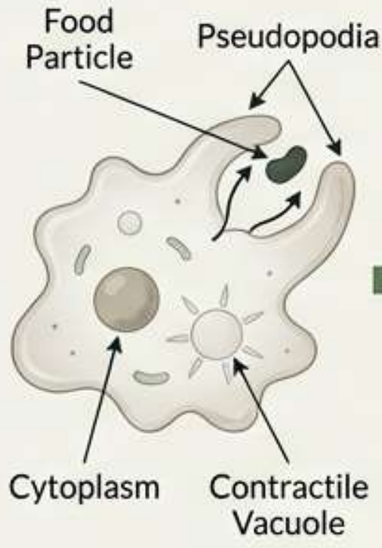
Parasitic

Organisms that derive food directly from the body of another living organism (the host) without killing it.

- **Examples:** Plasmodium, roundworms, Cuscuta (amarbel)

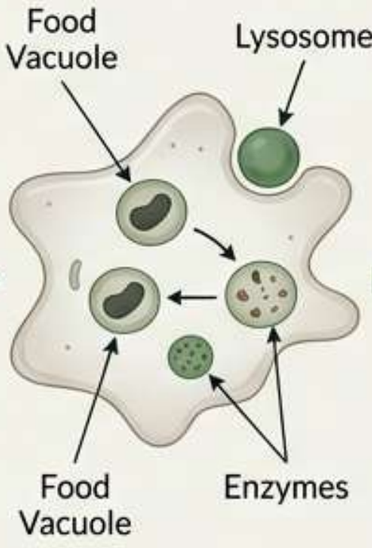
Micro-Digestion: Nutrition in Amoeba

1. Ingestion



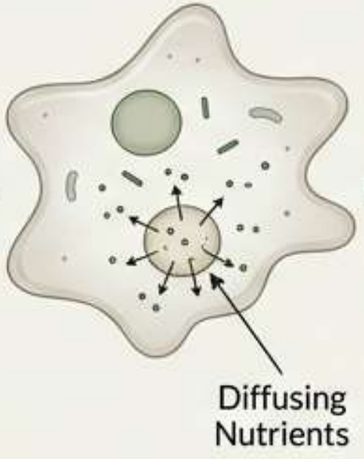
Phagocytosis via pseudopodia to engulf a food particle into a food vacuole.

2. Digestion



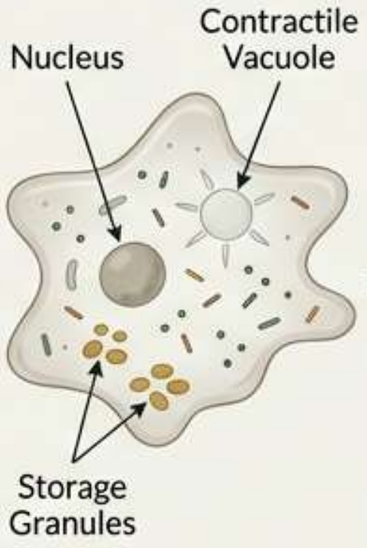
Intracellular breakdown. A lysosome full of enzymes fuses with the vacuole.

3. Absorption



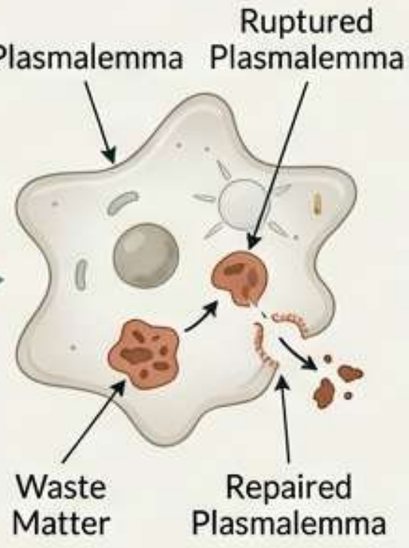
Soluble food diffuses from the vacuole into the surrounding cytoplasm.

4. Assimilation



Absorbed food is synthesized into protoplasm or stored as glycogen/fats.

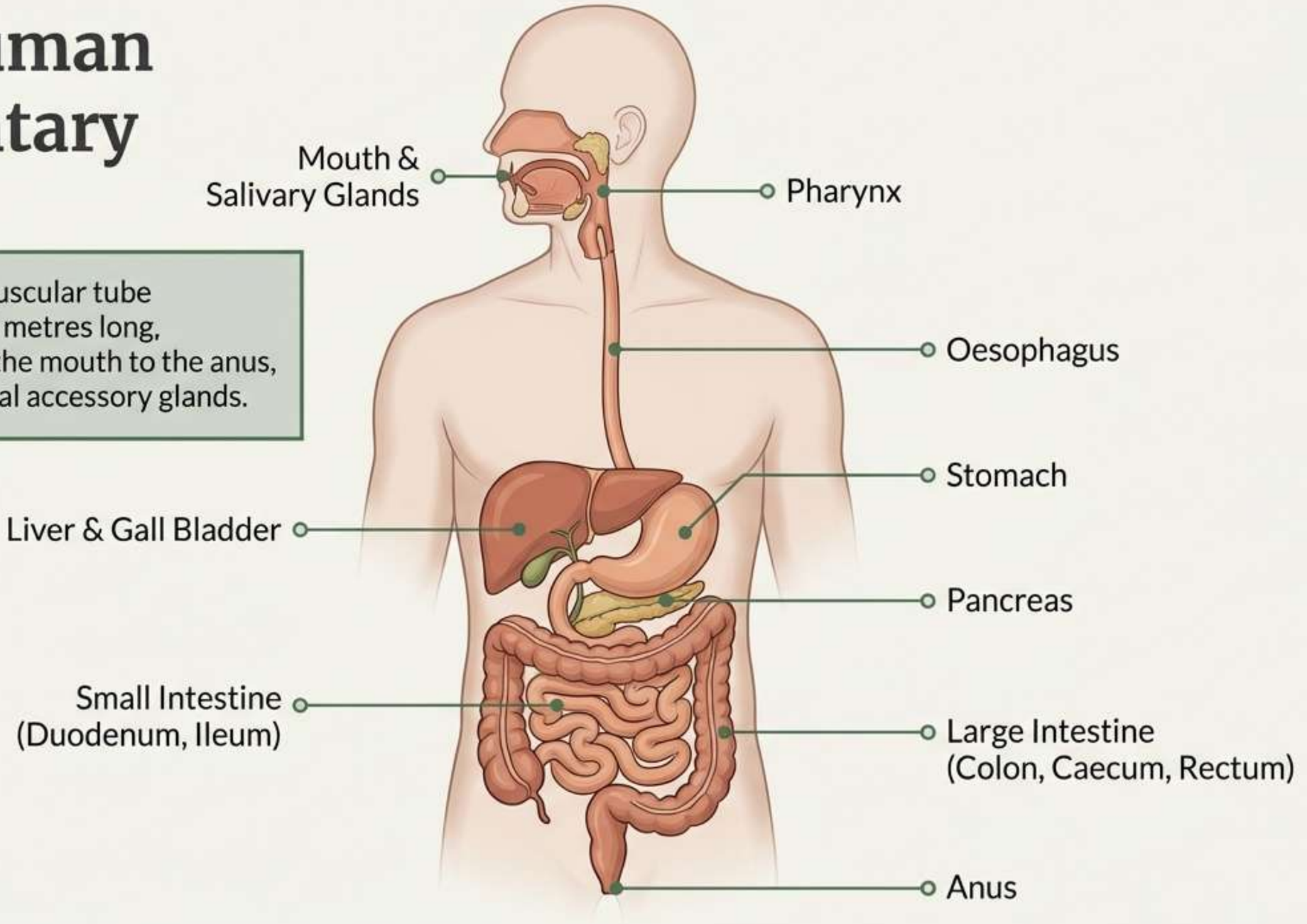
5. Egestion



Undigested, dense matter moves to the edge; the plasmalemma ruptures to expel waste, then instantly repairs itself.

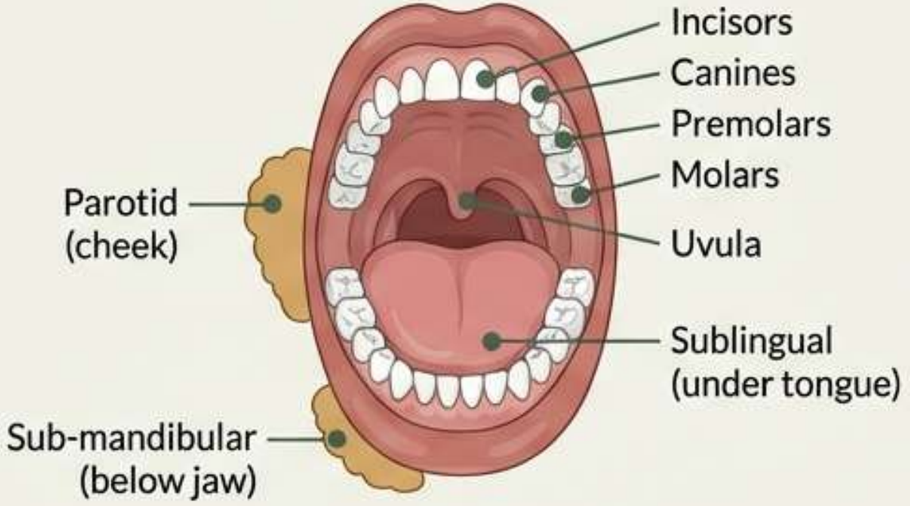
The Human Alimentary Canal

A specialized, muscular tube approximately 9 metres long, extending from the mouth to the anus, supported by vital accessory glands.



Phase 1: Mechanical & Chemical Initiation

The Mouth



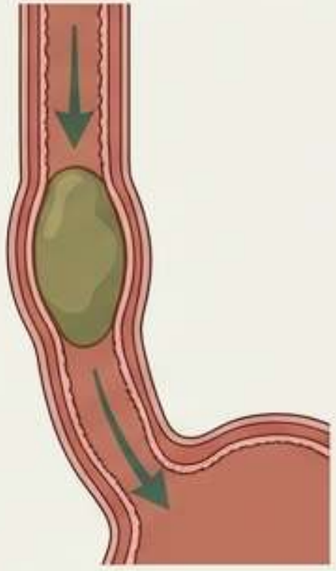
Mechanical

Heterodont teeth (Incisors, Canines, Premolars, Molars).
Adult dental formula: 2123/2123.

Chemical

Three pairs of salivary glands (Parotid, Sub-mandibular, Sublingual).
Saliva contains **Lysozyme** (antiseptic) and **Salivary Amylase/Ptyalin** (breaks starch into maltose).

The Oesophagus

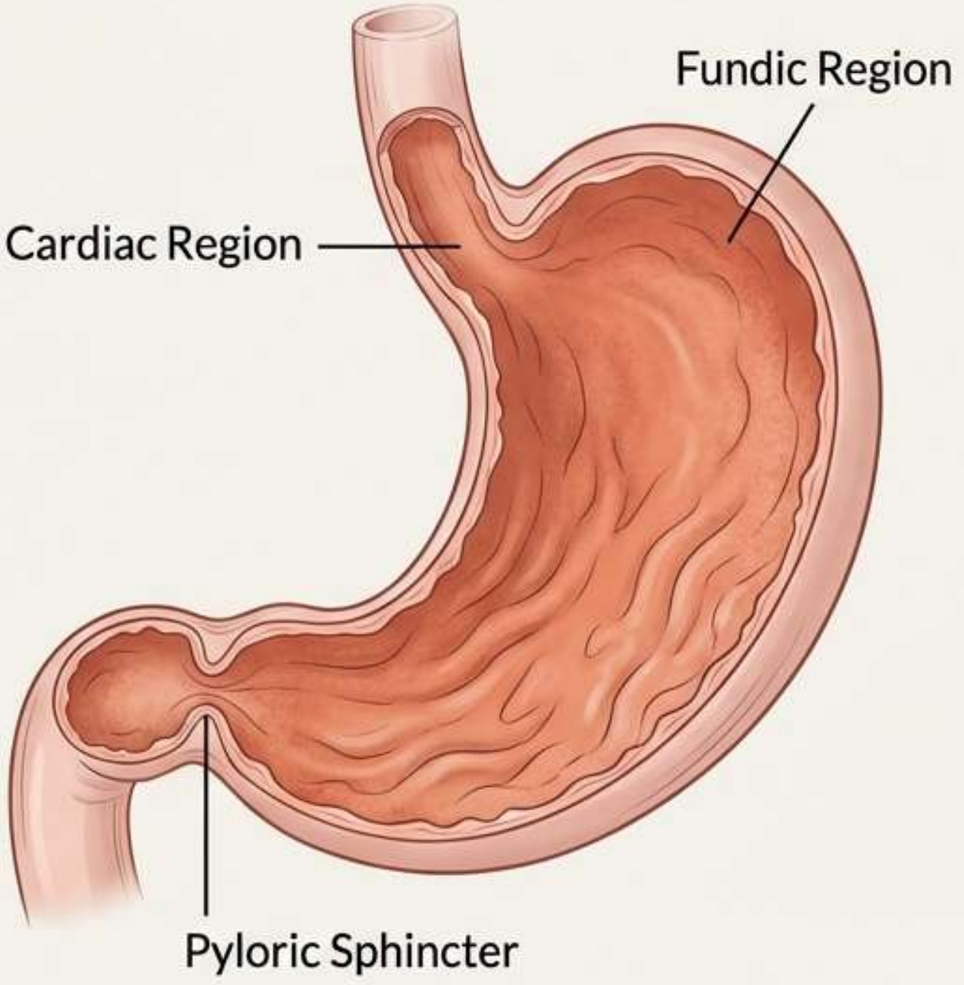


A 25cm tube connecting the pharynx to the stomach.

Peristalsis: The food bolus is pushed down by the rhythmic contraction and relaxation of muscles.

Gated by the **oesophageal sphincter** to prevent regurgitation of acidic contents.

Phase 2: The Acidic Crucible



Gastric Secretions

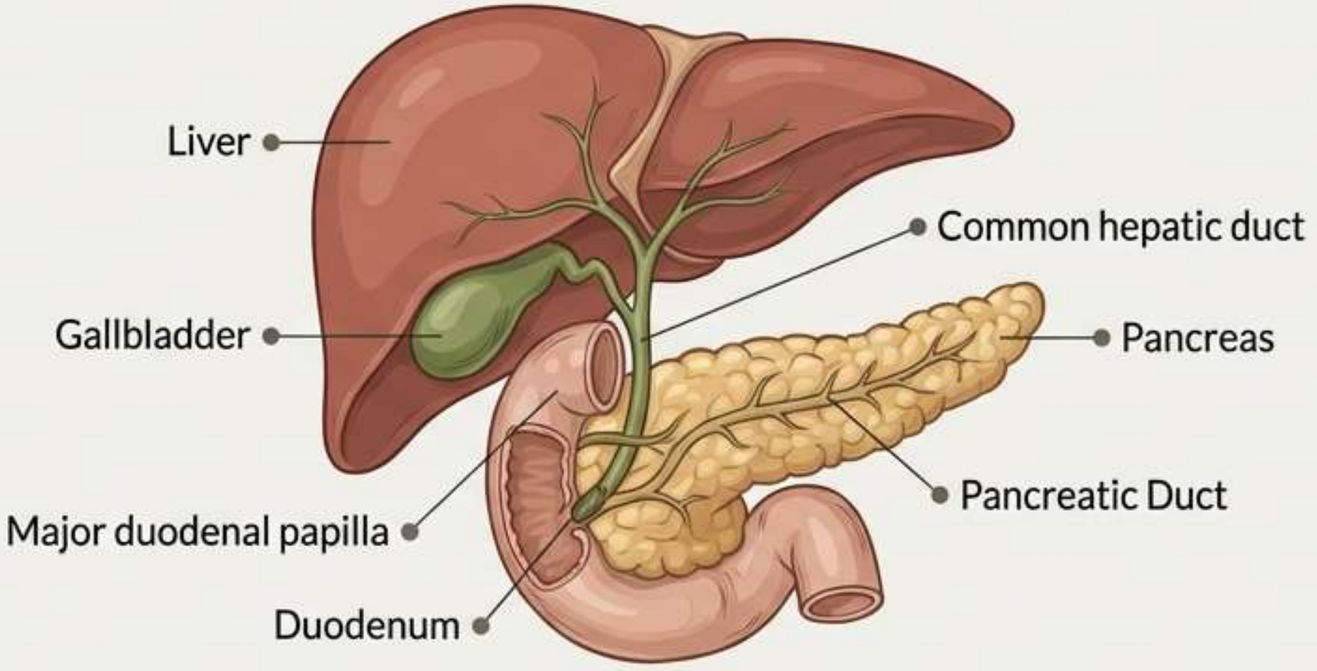
Parietal Cells
Secrete Hydrochloric Acid (HCl), providing an acidic medium and killing germs.

Chief Cells
Secrete inactive pepsinogen, which HCl activates into Pepsin to digest proteins. (Also secretes Rennin in infants to digest milk casein).

Mucus Cells
Secrete mucus to protect the stomach lining from its own acid.

Warning: Peptic Ulcers occur when an imbalance in acidic gastric juice erodes the mucosal layer.

The Accessory Factories: Liver & Pancreas



The Liver (1.5 kg)

The body's largest gland.

- **Digestion**
  Secretes Bile juice to emulsify fats (break into small globules) and creates an alkaline medium for pancreatic enzymes.
- **Regulation**
  Retains excess glucose, storing it as glycogen. Removes excess amino acids via deamination.

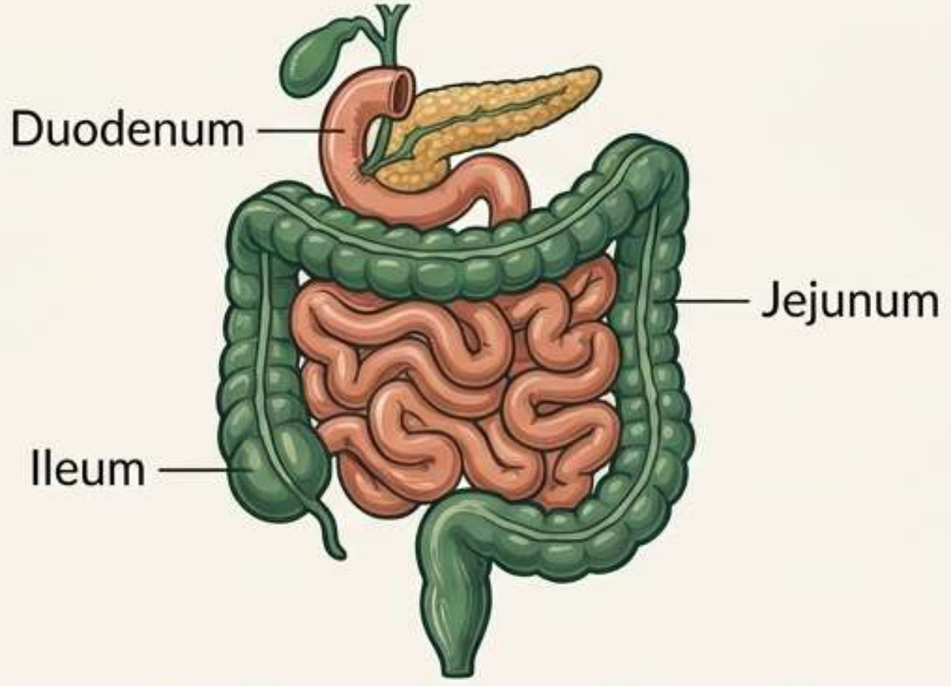
The Pancreas

An exocrine gland sitting below the stomach.

Pancreatic Juice
Secretes into the small intestine containing:

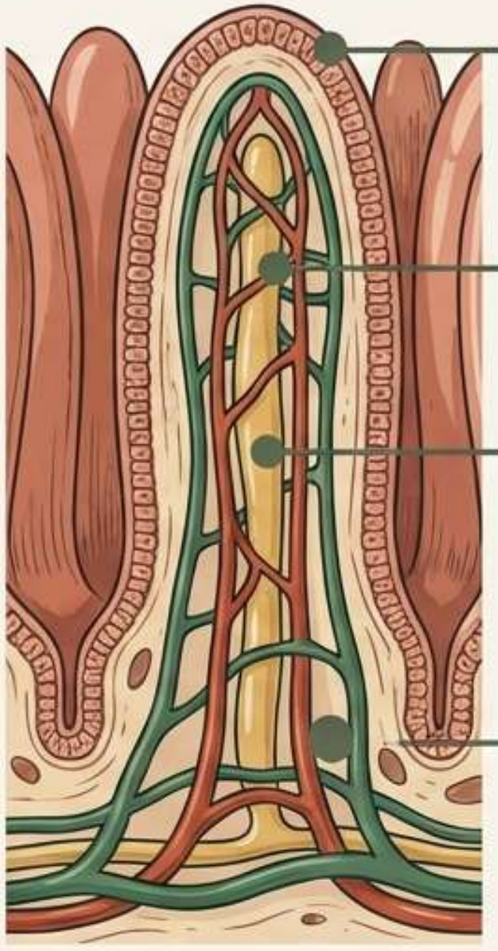
- Amylase (digests carbohydrates)
- Trypsin (digests proteins)
- Lipase (digests fats)

Phase 3: Complete Digestion & Absorption



The 7-Metre Pathway

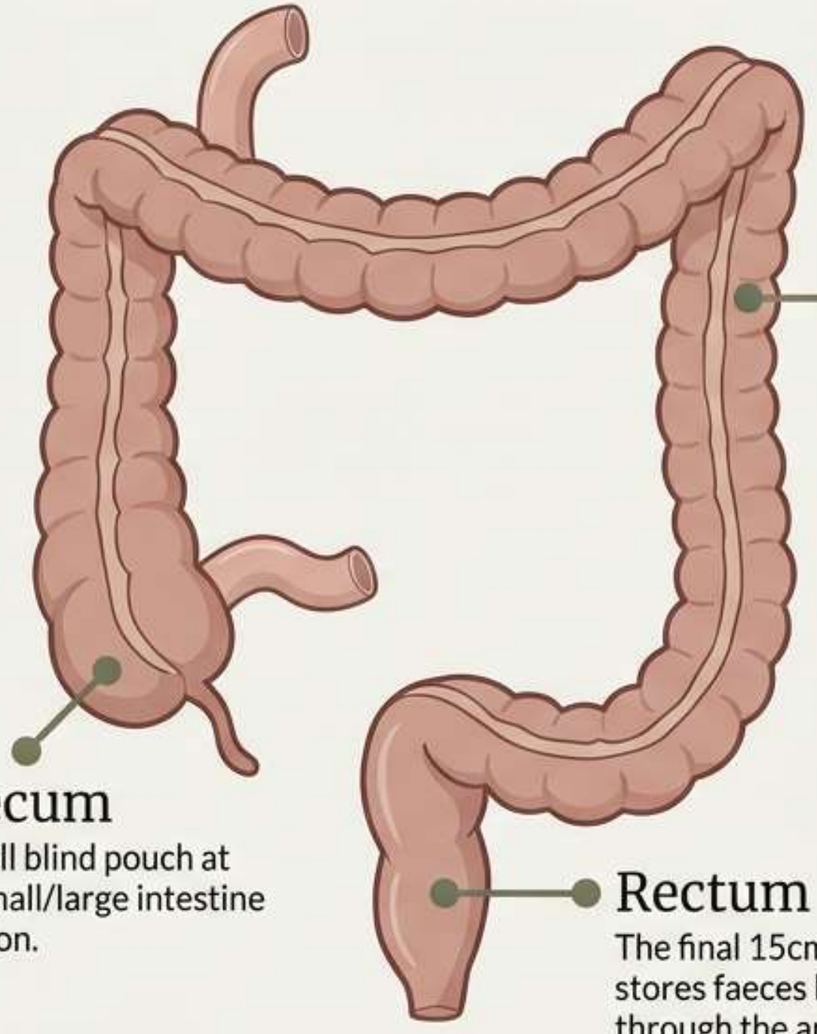
- **Duodenum:** C-shaped, receives bile and pancreatic juices.
- **Jejunum:** Middle section, ~2m long.
- **Ileum:** ~4m long, secretes succus entericus (intestinal juice).



The Power of Villi

- Finger-like projections that increase the surface area by nearly 8 times.
- This is where the final products (glucose, fatty acids, acids, amino acids) are absorbed directly into the blood stream and lymph capillaries.

Phase 4: Reclamation & Elimination



Colon
A 1.0m long, broad tube where primary water absorption takes place.

Caecum
A small blind pouch at the small/large intestine junction.

Rectum
The final 15cm section that stores faeces before egestion through the anus.

Core Function

No nutrient digestion occurs here. The **primary function** is **absorbing water and electrolytes**, and **secreting mucus.**

The Three Stages

Caecum
A small blind pouch at the small/large intestine junction.

Colon
A 1.0m long, broad tube where primary water absorption takes place.

Rectum
The final 15cm section that stores faeces before egestion through the anus.

The Chemical Workforce: Digestive Enzymes

Location/Source	Enzyme	Substrate	Products
Mouth (Salivary Gland) 	Salivary Amylase	Starch	Maltose
Stomach (Gastric Glands) 	Pepsin & Rennin (via HCl)	Proteins / Milk Casein	Peptones / Paracasein
Liver 	Bile (No enzymes)	Fats	Fat Droplets (Emulsified)
Pancreas (Pancreatic Juice) 	Amylase, Trypsin, Lipase	Starch, Proteins, Fats	Maltose, Peptides, Fatty Acids
Small Intestine (Intestinal Gland) 	Maltase, Sucrase, Lactase, Peptidases	Carbohydrates, Peptides	Glucose, Fructose, Amino Acids

Essential Nutrients & Deficiencies

Key Vitamins

Vitamin A (Retinol) → Night-blindness, Xerophthalmia 

Vitamin B-Complex

B1 (Thiamine) → Beri beri 

B2 (Riboflavin) → Cheilosis 

B3 (Niacin) → Pellagra 

B12 / Folic Acid → Anaemia 

Vitamin C (Ascorbic Acid) → Scurvy 

Vitamin D (Calciferol) → Rickets (children), Osteomalacia (adults) 

Vitamin K → Bleeding disease 

Minerals & Macros

Iron → Anaemia 

Iodine → Goitre 

Proteins / Calories → Kwashiorkor, Marasmus