General Botany (Bot 102)

علم النبات العام

(102 نبت)

Part (2)

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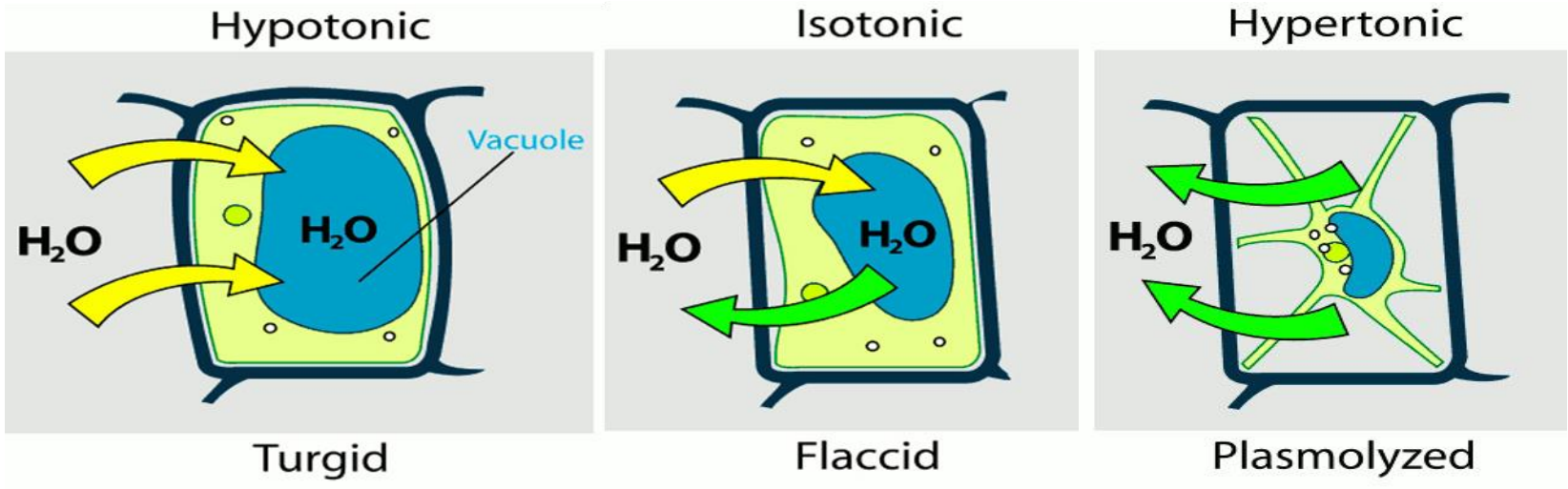
Plant Physiology

Levels of Tissue Organization

- **cell** - unit of structure of all live organisms
- **tissue** - composed of groups of similar cells
- **organs** - composed of groups of tissues functioning together
- **organ systems** - composed of groups of organs functioning together

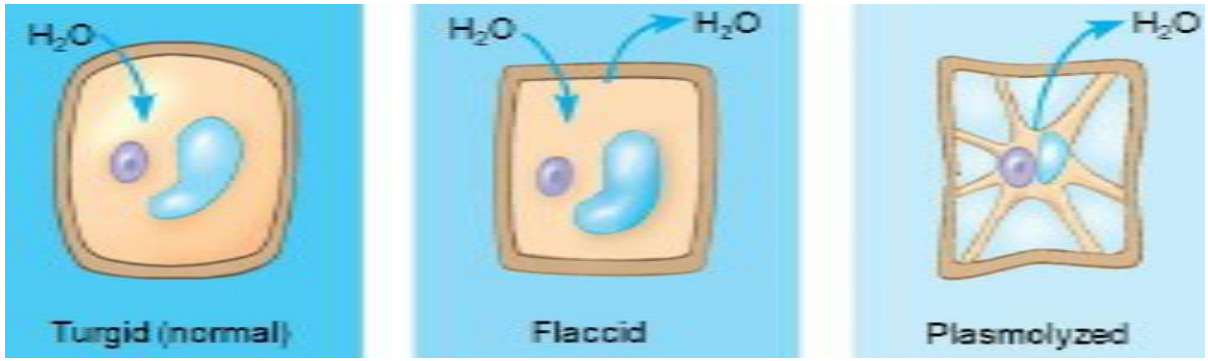
Cell wall and Turgor



- When comparing two solutions there are three possible relationships, We Identify the relationships by determining what would happen if a cell were placed in the solution.
- **Hypotonic**- A solution that causes a cell to **swell** because of osmosis meaning water rushes into the cell.
- **Isotonic**- A solution that causes **no change** in cell size. Meaning there is no movement of water.
- **Hypertonic**- A solution that causes a cell to **shrink** because of osmosis. Meaning water leaves the cell.

Cell wall and Turgor

- Cell walls is made of neutral and charged polysaccharides ⟶ absorbs H_2O because it has a **hypotonic** environment.
- Increased H_2O in the cell ⟶ Turgor Pressure
- If a plant cell is turgid, It is very firm, a **healthy state** in most plants
- If a plant cell is flaccid, It is in an **isotonic** or **hypertonic** environment



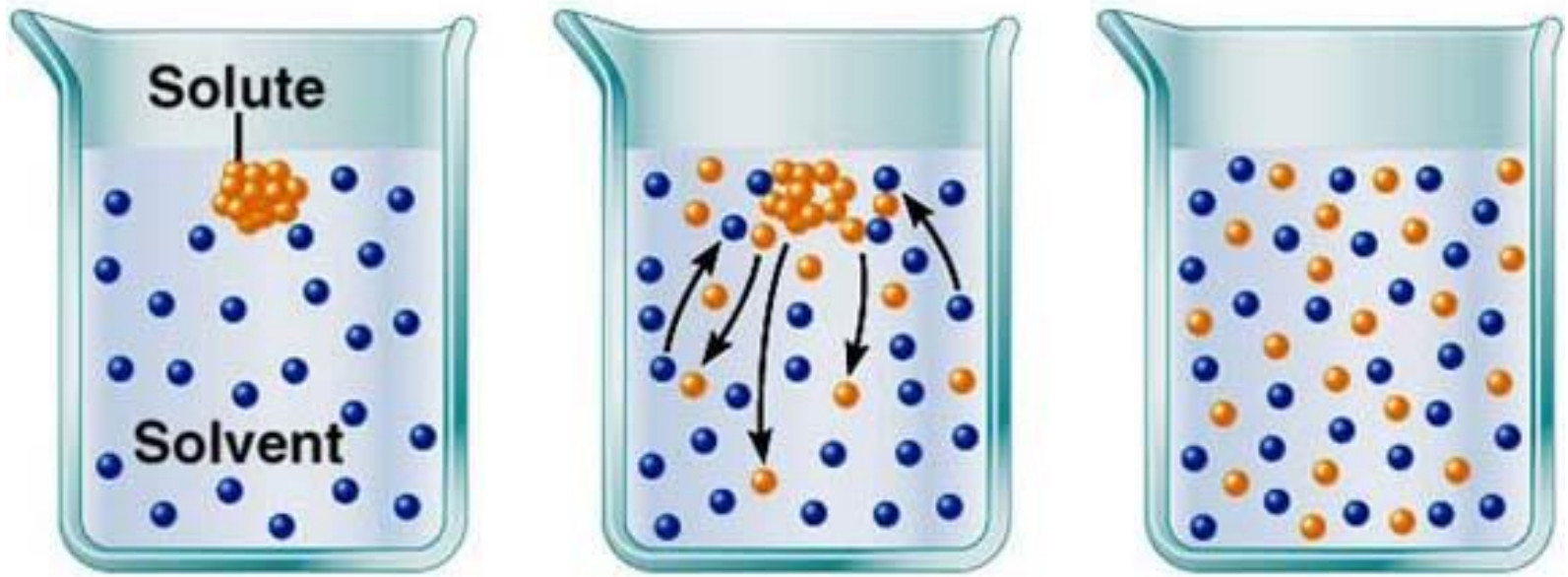
PROCESSES OF THE PLASMA MEMBRANE

- There are two types of **passive transport**: Diffusion and Osmosis
- The goal of both diffusion and osmosis is to reach **EQUILIBRIUM** within the cell
- **Equilibrium** is a condition in which the **movement in one direction is equal to the movement in another direction**

Diffusion

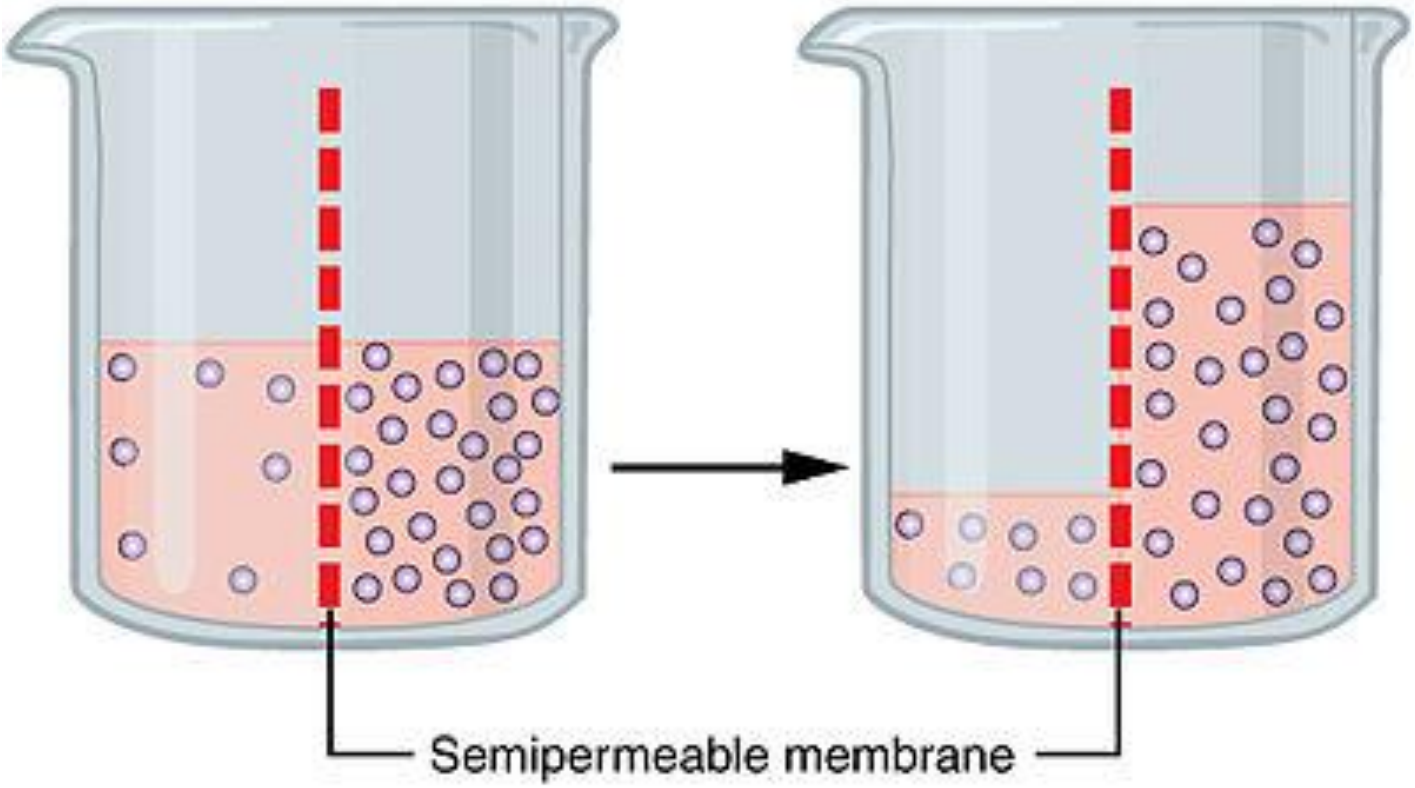
- The tendency of molecules to move from an area of higher concentration to an area of lower concentration
- A difference in concentration between two adjacent regions is called a concentration gradient.

Diffusion



Osmosis

- movement of water through a membrane from a region of higher to lower concentration
- **Solute** - substance being dissolved in a liquid (e.g. salt)
- **Solvent** - substance doing the dissolving (e.g. water)
- **Permeability** - the extent to which a membrane will allow particular sized molecules to pass
- **Semi-permeable membrane** (selectively permeable)- allows some molecules to pass but not others


Semipermeable membrane

Types of transport in Cells

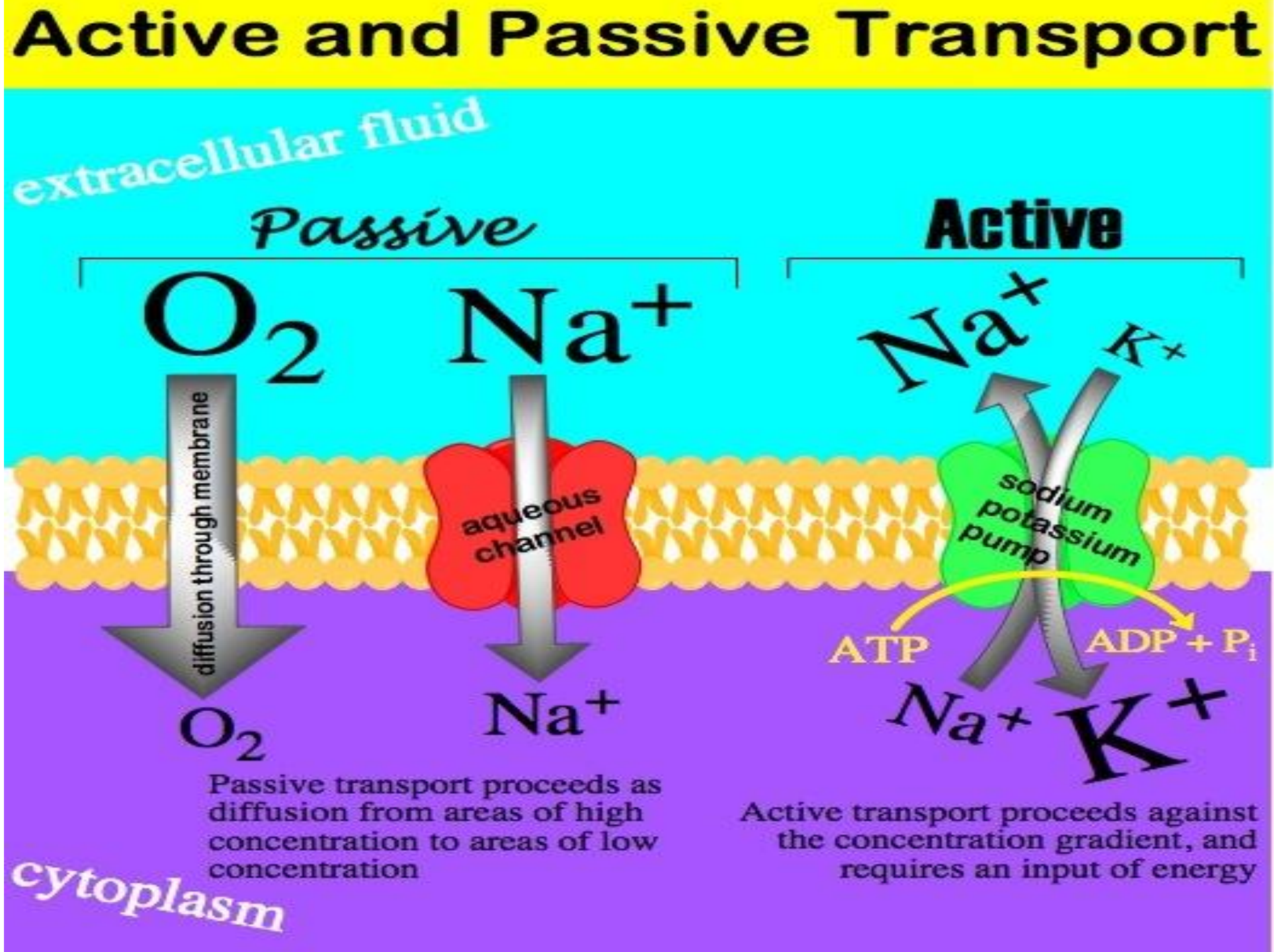
- **Passive transport** - movement of substances through a membrane from a region of high to a region of low concentration - no energy needed (ATP) - diffusion and osmosis are examples of this
- **Active transport** - movement of substances through a membrane from a region of low concentration to a region of high concentration - requires cellular energy (ATP)

- Whether passive or active transport is needed depends on the CONCENTRATION GRADIENT
- The concentration gradient is the difference in the concentration of a substance in two different spaces
- Concentration - the amount of a particular substance in a contained area compared with the amount of the same substance in another area

Active Transport

- The movement of a substance against the concentration gradient. (uphill)
- Active transport requires cell to **USE ENERGY**
- **Sodium pump** - transports three sodium ions out of the cell and two potassium ions into the cell
- Both are against the concentration gradient
- The energy needed to perform this activity is supplied by ATP (adenosine tri-phosphate)
- ATP is a unit of energy made by the cell

Active and Passive Transport



Photosynthesis

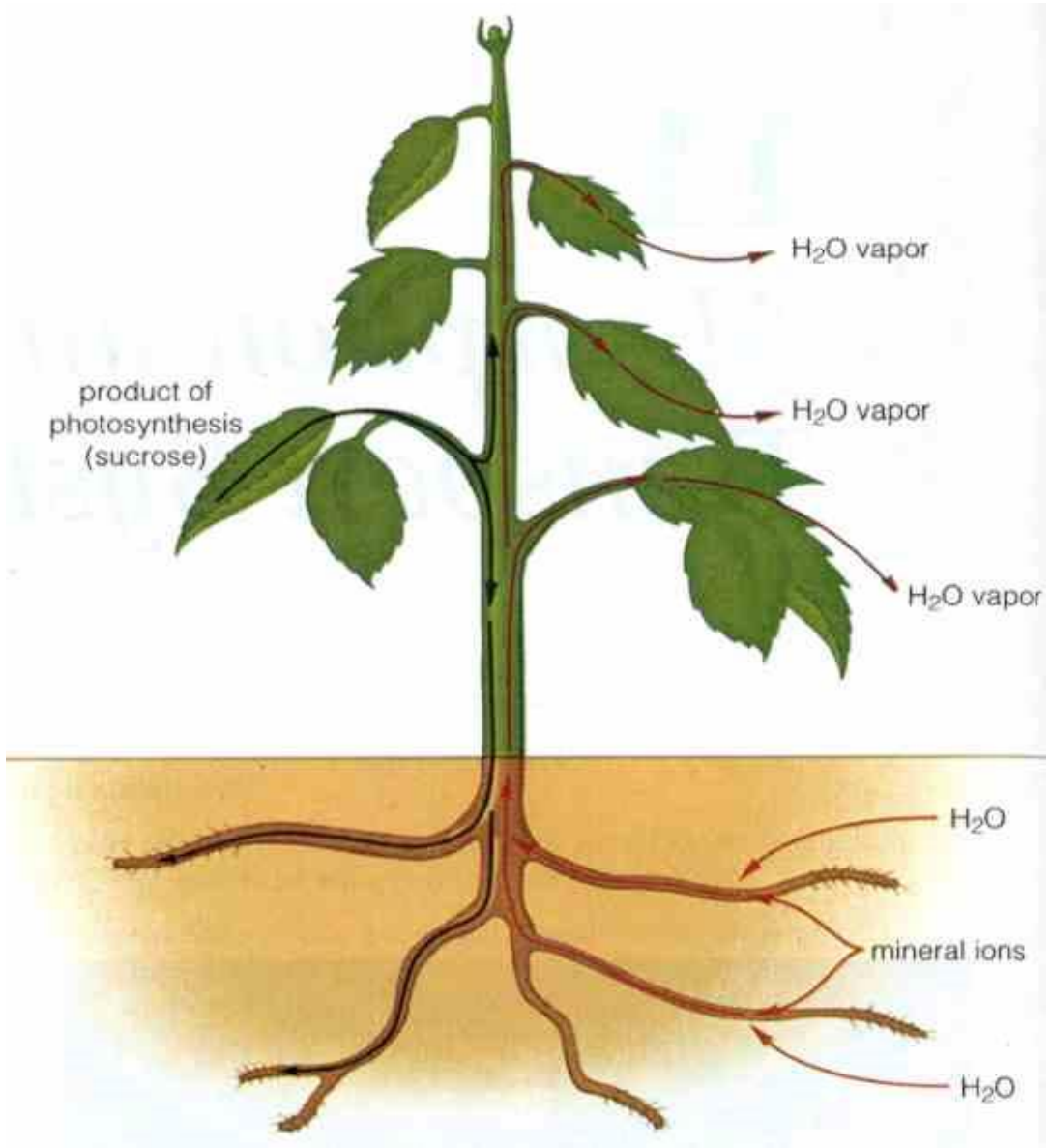
- the conversion of light energy to chemical energy by chlorophyll in chloroplasts

- Overall Net equation for photosynthesis:
  - 6 Water + 6 Carbon dioxide yields glucose + 6 oxygen (when catalyzed by chlorophyll in the presence of sunlight)

$$6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2$$

Respiration

$$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + Energy$$

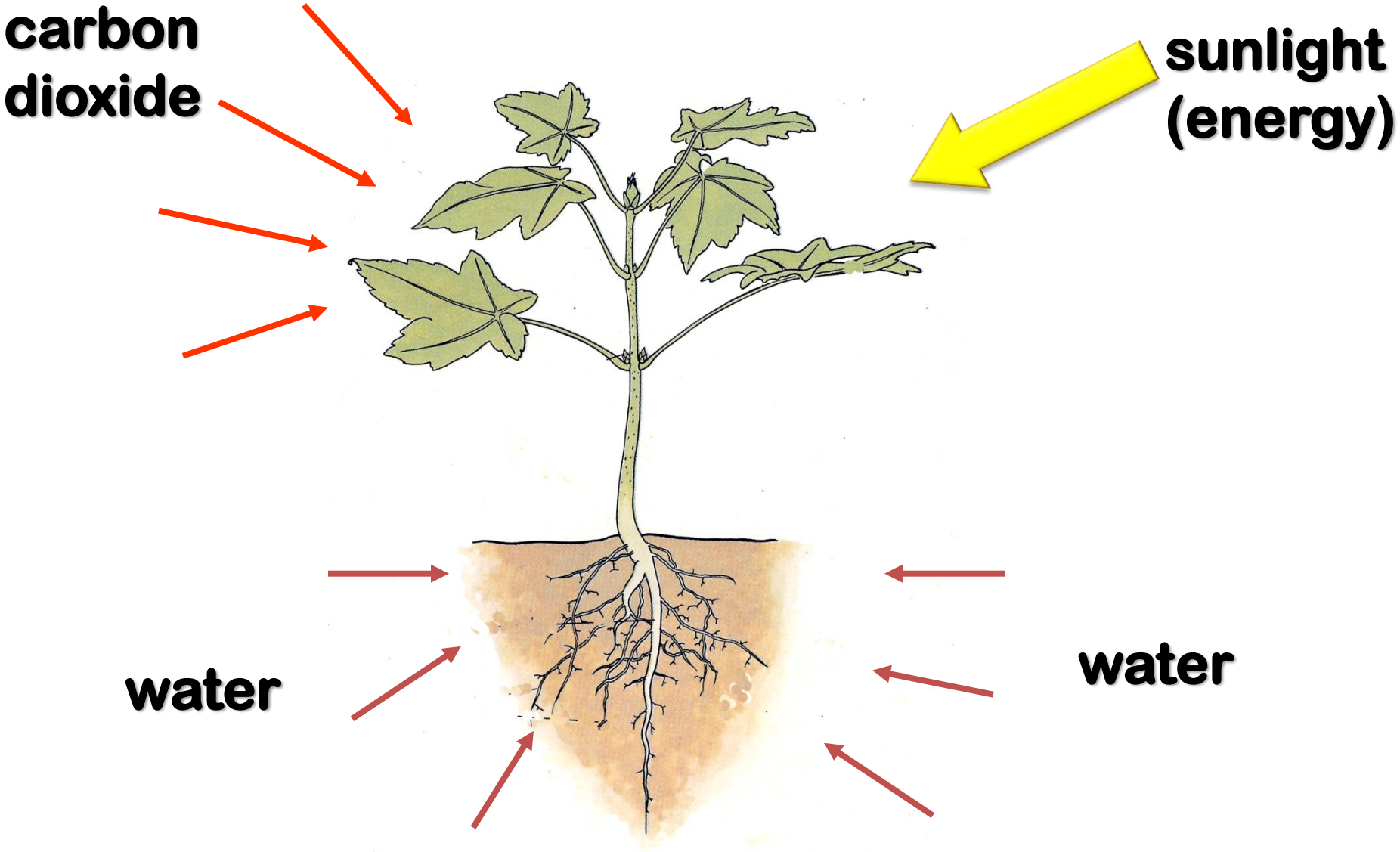


Plant Water Relations

Why is water important to (plant) cells?

- Water constitutes about 70% by weight of annual plants
- Water has multiple roles in plant cells
  1. Thermal property: a liquid!
     - High heat potential: can absorb energy changes without large temperature changes (slows heating and cooling)
  2. "Universal" solvent required for mineral uptake and transport
  3. It is a requirement for biochemical reactions to proceed
     - Most enzymes are water soluble

How plants get their food ?



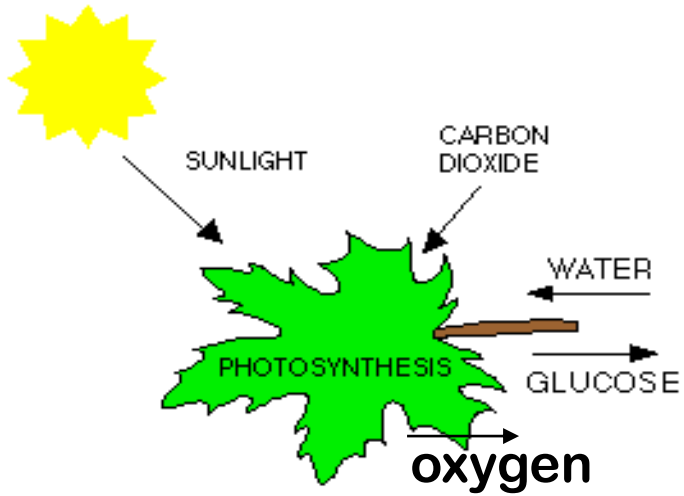
Photosynthesis:

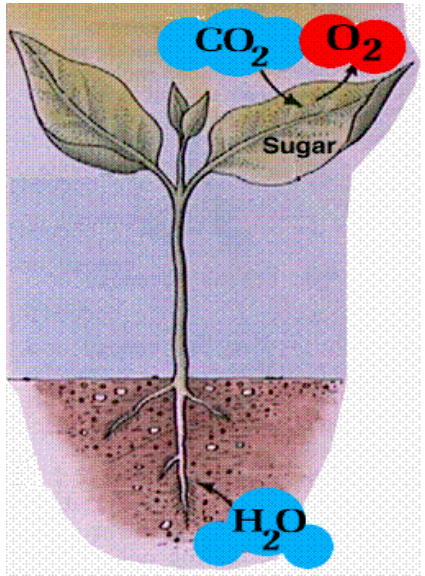
Green plants take in carbon dioxide (CO_2) from the air

They take up water (H_2O) from the soil

The plants combine the CO_2 with the H_2O to make the sugar (Glucose ($C_6H_{12}O_6$))

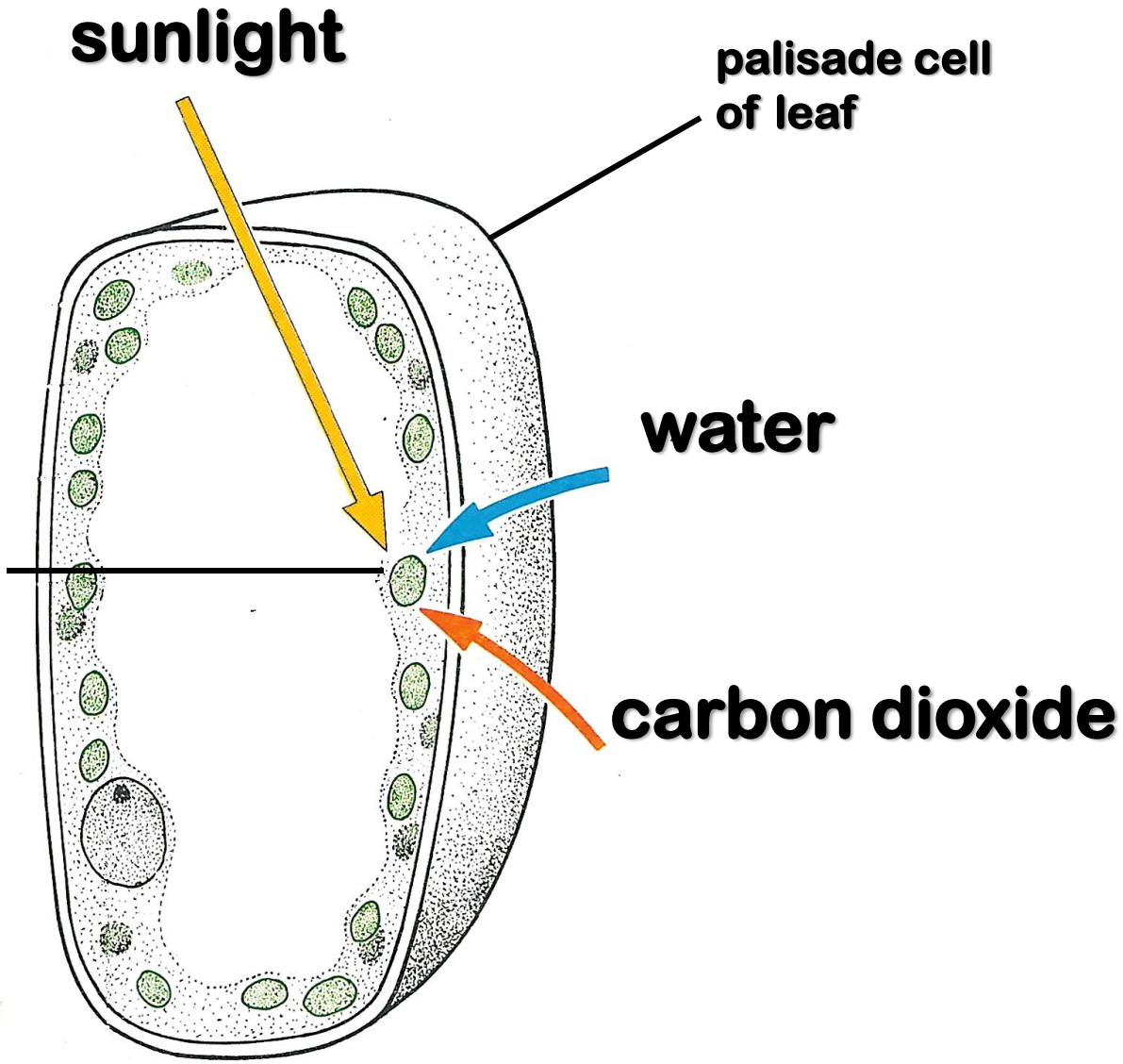
- **Photosynthesis** is a chemical process that energy from light is harvested to provide carbohydrates.
- It is the major path through which carbon re-enters the biosphere (from CO_2).
- **Photosynthesis** is also the major source of oxygen (O_2) in the earth's atmosphere

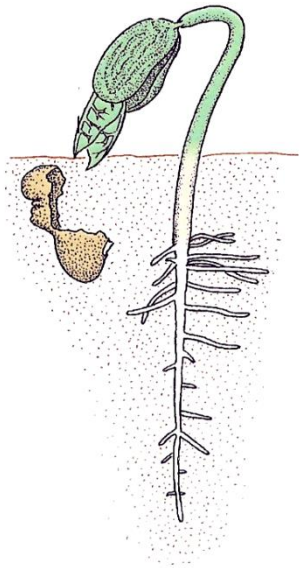




All the reactions to combine CO_2 and H_2O take place in the chloroplast

in the chloroplast, carbon dioxide and water combine to make sugar





e.g. seed germination

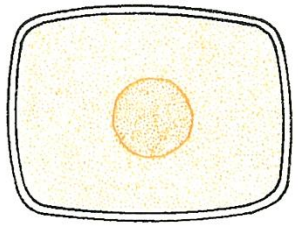
energy

other sugars

fruits

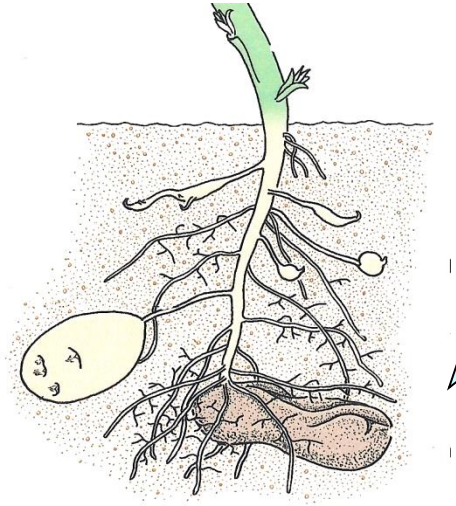
GLUCOSE

protein



cytoplasm

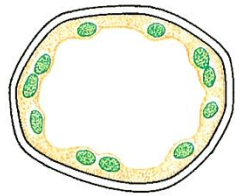
starch



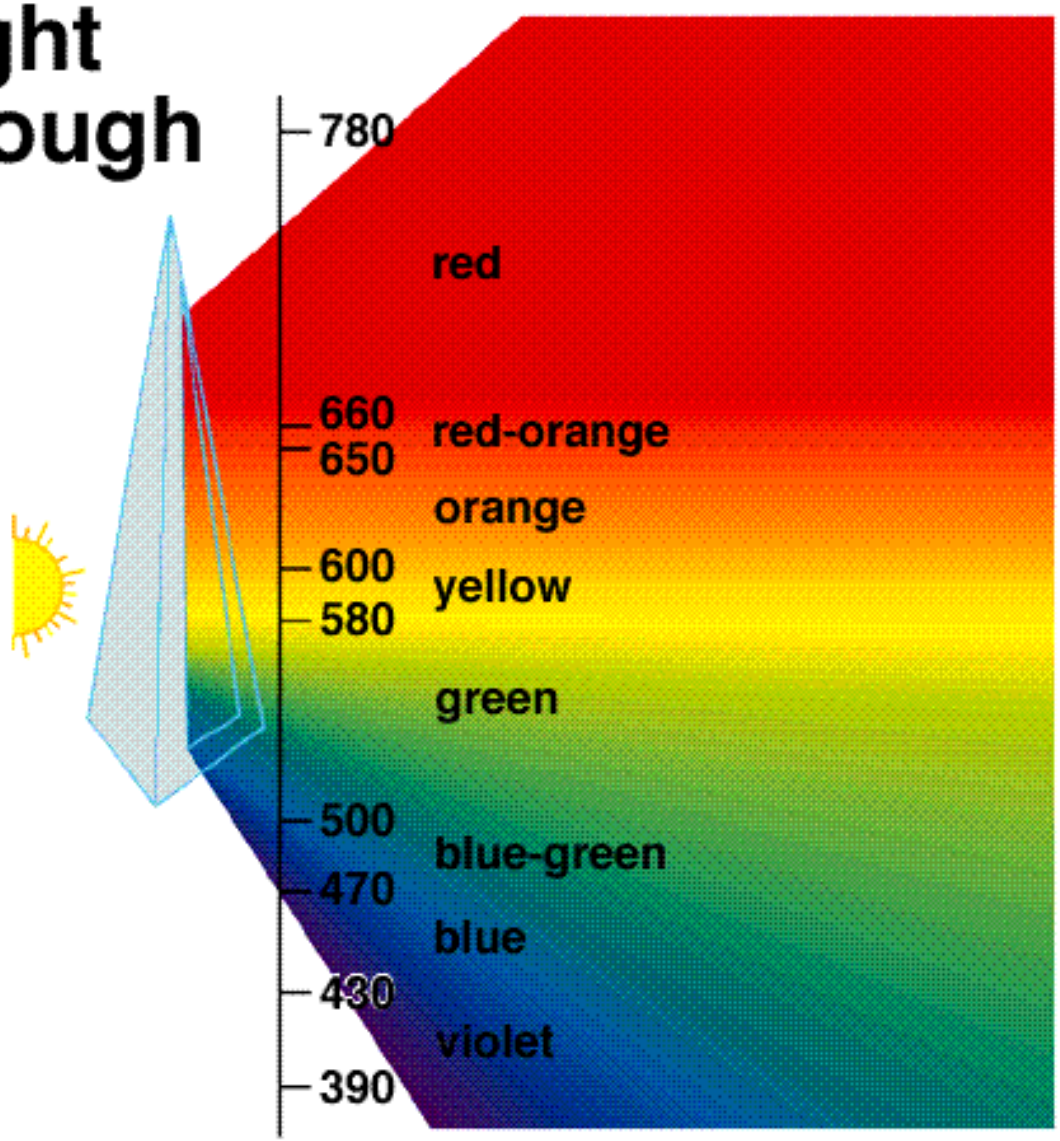
storage e.g. starch in potato

cellulose

cell walls



Visible Light Passing Through a Prism



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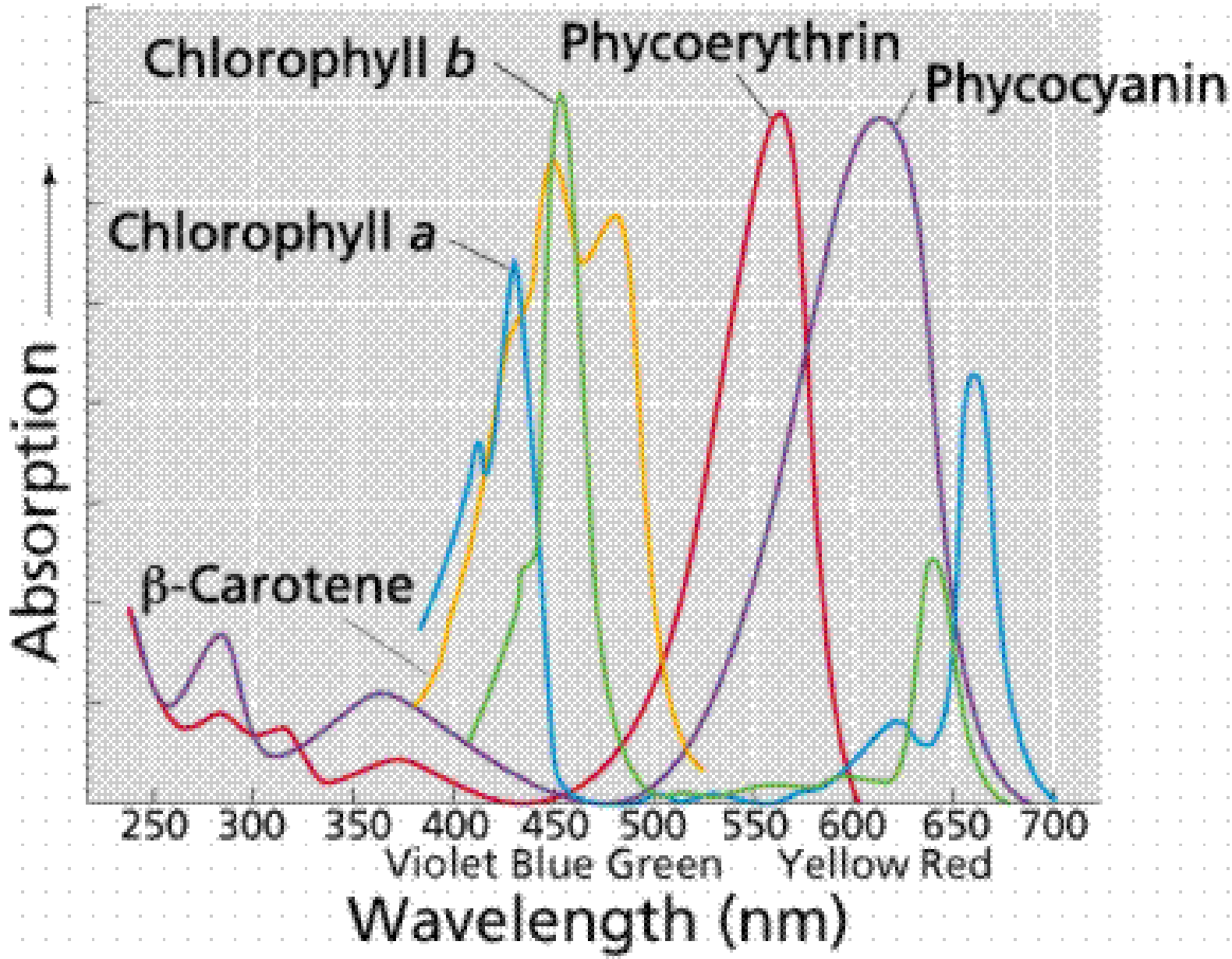
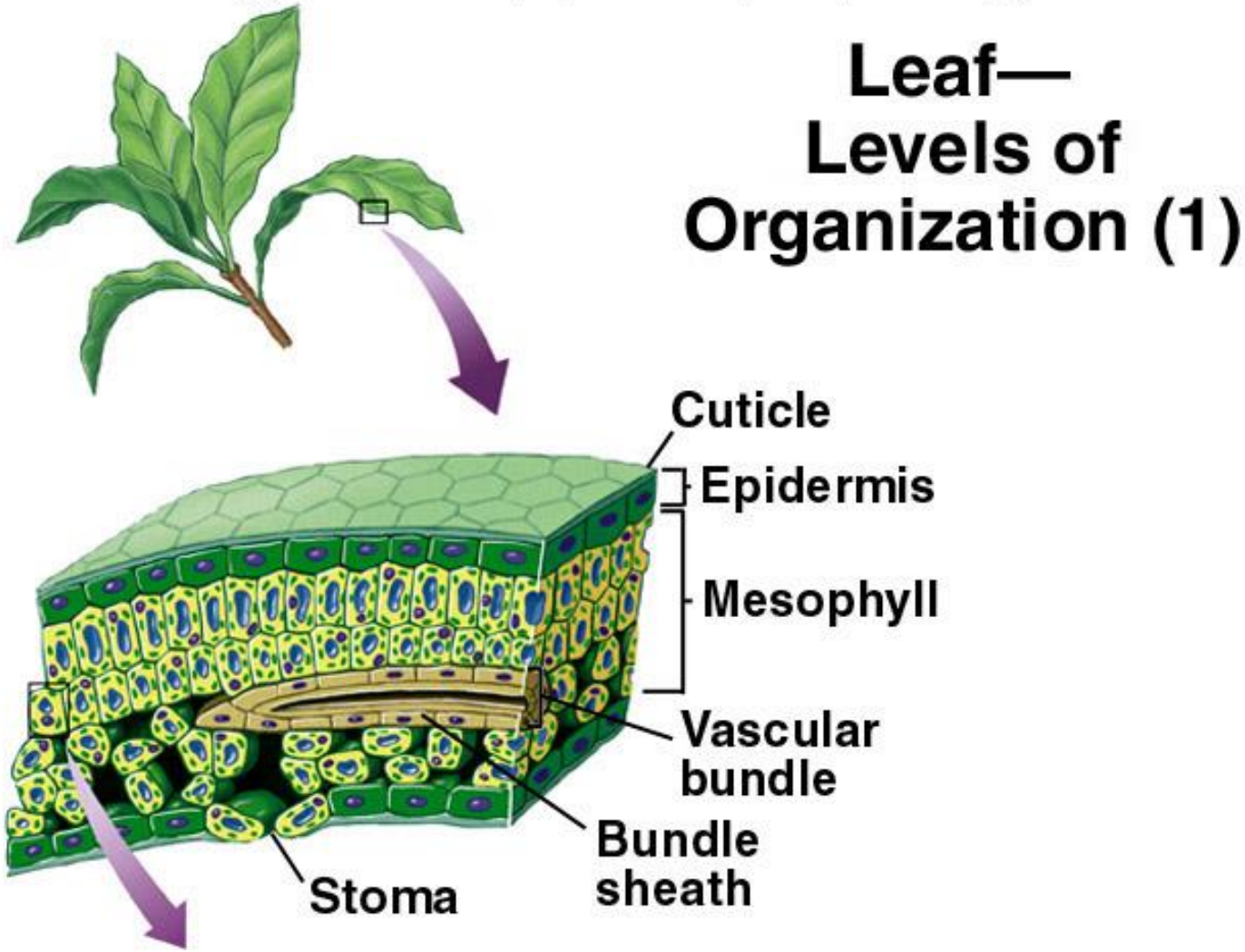

Chlorophyll b
Phycoerythrin
Phycocyanin
Chlorophyll a
β-Carotene
Absorption
250 300 350 400 450 500 550 600 650 700
Violet Blue Green Yellow Red
Wavelength (nm)

Capturing Energy
أقتناص الطاقة



Types of photosynthesis

- **C3**
  - The majority of plants In the case of C3 photosynthesis, the first organic product of carbon fixation is a three-carbon compound (3-phosphoglycerate), which is the reason these plants are termed the C3 plants.
- **C4**
  - CO_2 temporarily stored as 4-C organic acids resulting in more efficient C exchange rate
  - Advantage in high light, high temperature, low CO_2
  - Many grasses and crops (e.g., corn, sorghum, millet, sugar cane)
- **CAM**
  - Stomata open during night
  - Advantage in arid climates
  - Many succulents (e.g. cacti, euphorbs, bromeliades, agaves)

TO SUM UP .....

Plants combine carbon dioxide from the air, and water from the soil to make glucose.

The energy needed for this process comes from sunlight

The sunlight is absorbed by chlorophyll contained in the chloroplasts of the leaf.

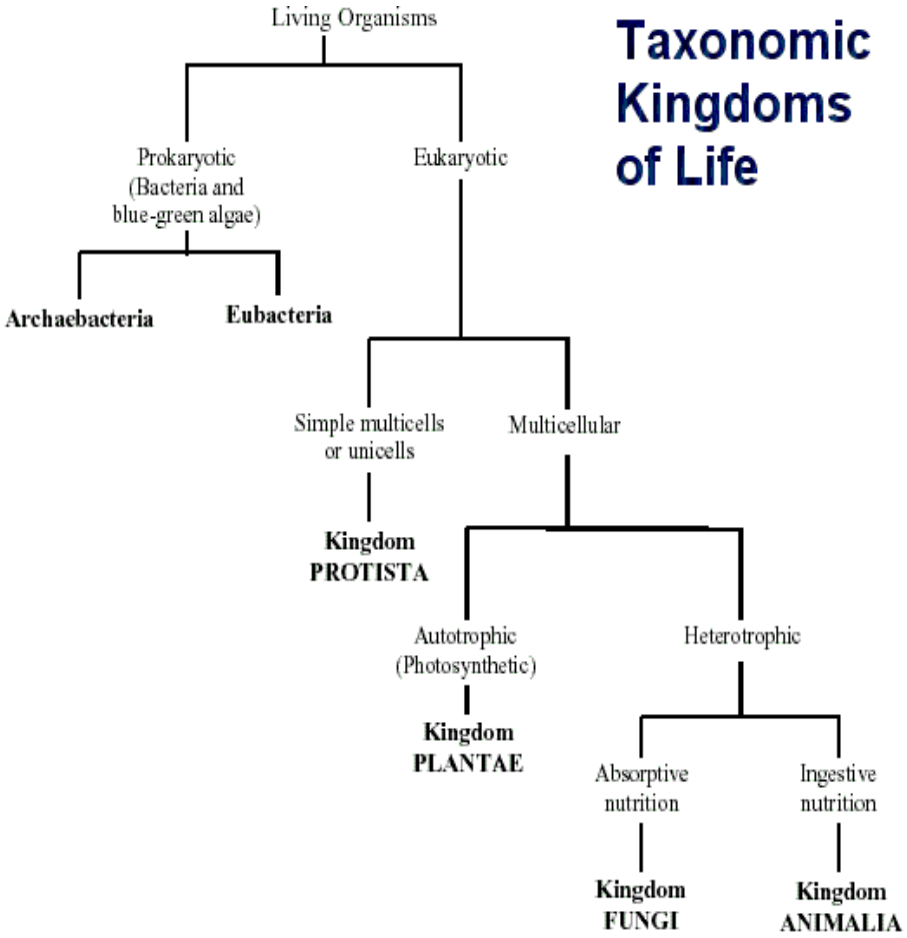
The glucose can be used for energy or to make other substances.

To make other substances, the glucose must be combined with other chemical elements such as nitrogen and potassium.

These chemical elements are present as ions in the soil and are taken up in solution by the roots.

Classification of Organisms

Classification of Organisms



Taxonomic Kingdoms of Life

- **The most basic category of organisms is called a *kingdom*.**
- **Most scientists divide organisms into five major kingdoms.**

Systematics

1. **Species**: Organisms sharing a set of biological traits and reproducing only their exact kind. (Species is the fundamental unit in taxonomy)
   a. **strains**: organisms within the species varying in a given quality
   b. **types**: organisms within the species varying immunologically.
2. **Genus**: closely related species
3. **Family** : closely related genera
4. **Order** : closely related families
5. **Class** : closely related order
6. **Division** : related classes

Survey of Microorganisms

1. Viruses
2. Bacteria
3. Cyanobacteria
4. Algae
5. Fungi
6. protozoa

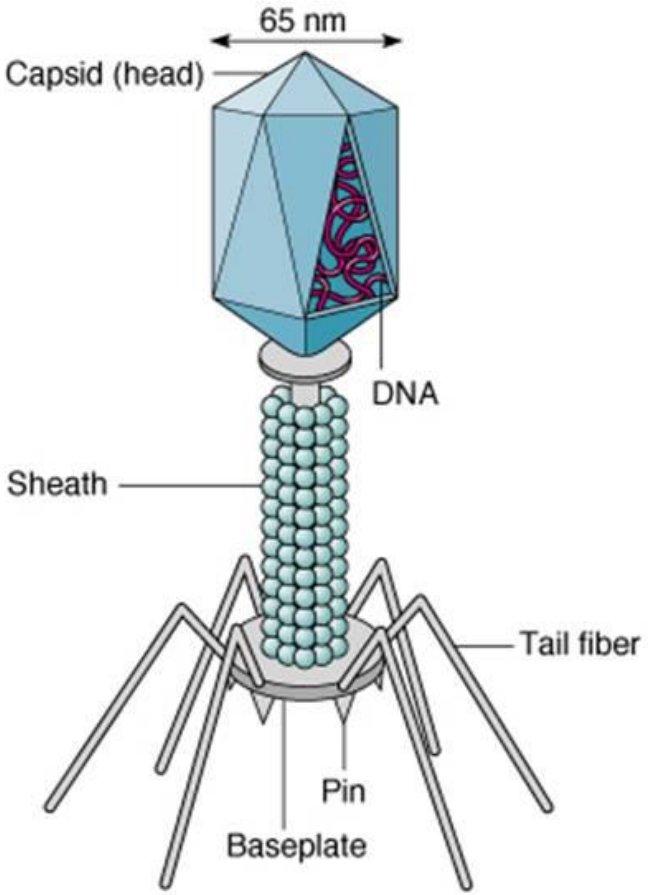
VIRUSES

- Obligated intracellular parasite.
- host specific:
  - bacteriophage
  - animal virus
  - plant virus
- according to its genetic material
  - DNA virus
  - RNA virus
- Shape:

  Most common shape is icosahedral , some are helical shape
- Structure:

  Protein capsid and genetic material some animal virus have envelope with glycoprotein spikes
- Life cycle: lytic infection lysogenic infection
- Some animal viruses are closely associated with certain cancers

Virus structure



(a) A T-even bacteriophage

Biological Kingdoms

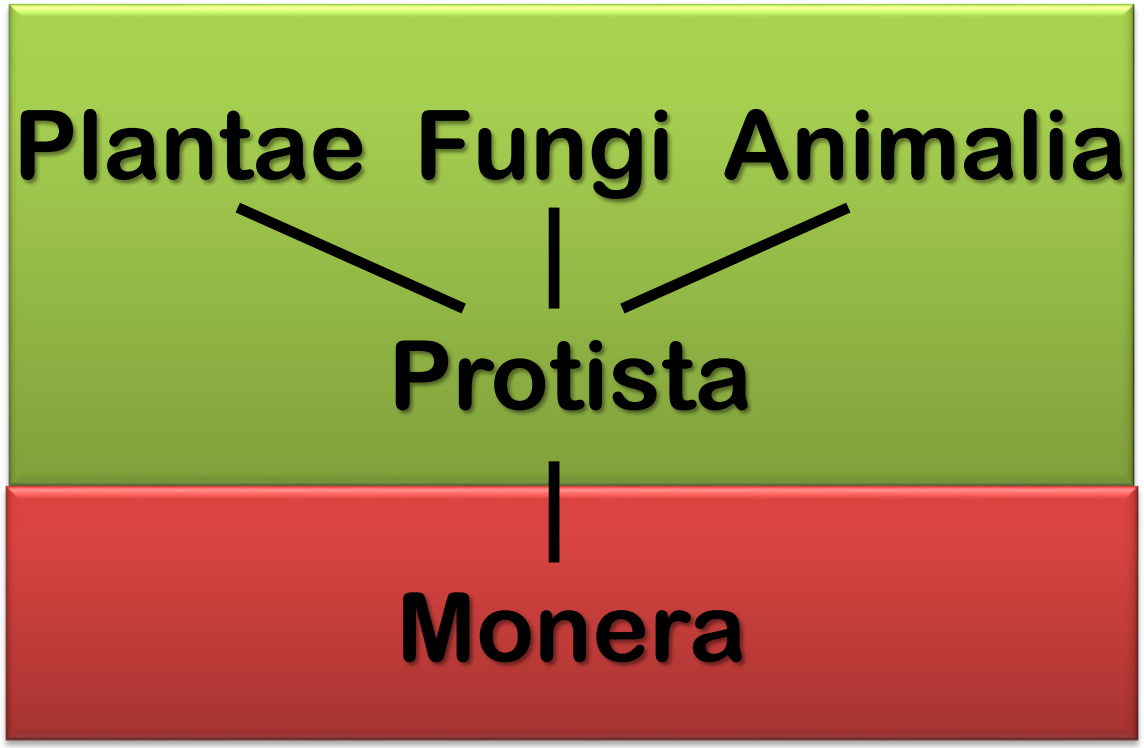
- 2 Kingdoms

  Traditional view

Biological Kingdoms

- 5 Kingdoms

Whittaker, 1969



Biological Kingdoms

Five kingdom system:

Six kingdom system:

Three domain system:

Eight kingdom system:

Six-Kingdom System

Kingdom Archaebacteria

Kingdom Eubacteria

Kingdom Fungi

Kingdom Protista

Kingdom Plantae

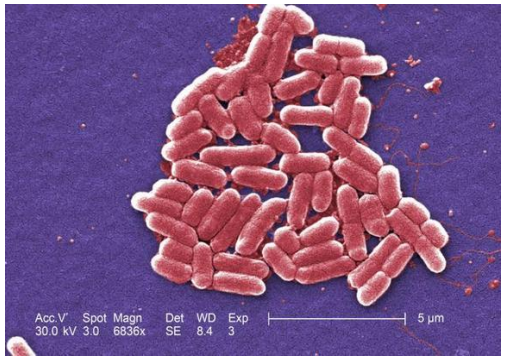
Kingdom Animalia

KINGDOM:ARCHAEBACTERIA

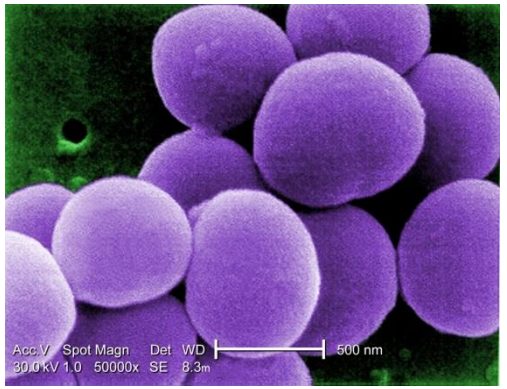
- They Are UNICELLULAR PROKARYOTES with distinctive Cell Membranes as well as Biochemical and Genetic Properties that differ from ALL other kinds of life.
- Some are autotrophic, producing food by chemosynthesis. Includes Chemosynthetic Bacteria
- Most are heterotrophic.
- Many Archaebacteria live in harsh environments such as Sulfurous Hot Springs, very salty lakes, and in anaerobic environments, such as the intestines of mammals.

KINGDOM EUBACTERIA

- They are UNICELLULAR PROKARYOTES.
- Most of the Bacteria (Germs) that affect your life are members of the Kingdom Eubacteria.
- Eubacteria are both autotrophic and heterotrophic.
- Includes the disease-causing bacteria such as tooth decay or food poisoning.
- The Combined Kingdoms, Archaebacteria and Eubacteria include the greatest number of living things on Earth.
- All of the prokaryotes are in these two kingdoms (Archaebacteria and Eubacteria).
- Both reproduce by binary fission, but they do have some ways to recombine genes, allowing evolution to occur.



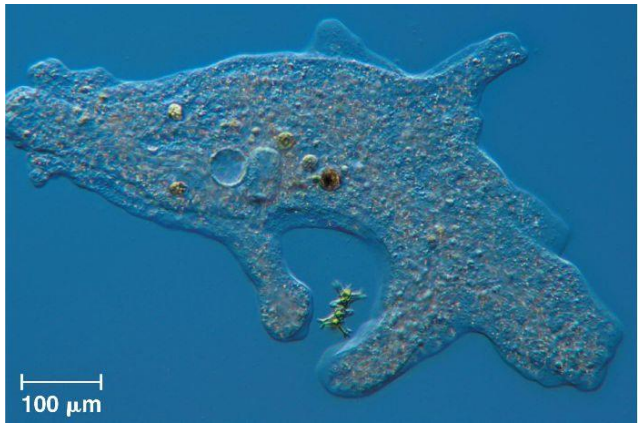
Escherichia coli



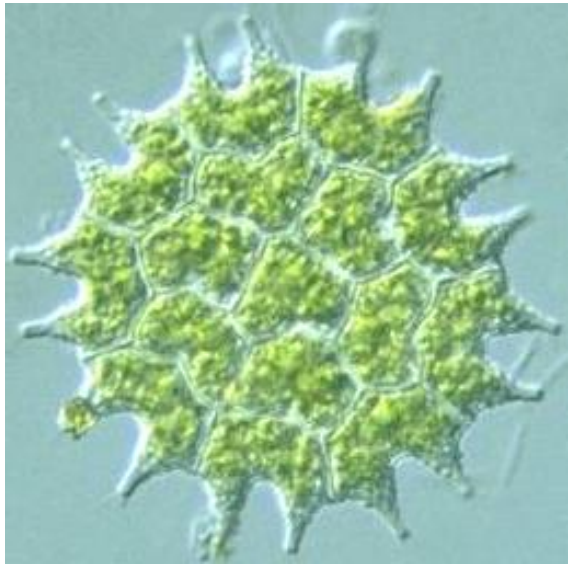
Staphylococcus

KINGDOM PROTISTA

- Kingdom Protista contains all eukaryotes that are NOT Plants, Animal, or Fungi, more than 50,000 species in all.
- Kingdom Protista includes unicellular and a few simple multicellular EUKARYOTES.
- The cells of multicellular protists are not specialized to perform specific functions in the organisms.



Amoeba



Pediastrum

KINGDOM FUNGI

- Fungi are eukaryotes, and most are multicellular.
- The cells of fungi have cell walls that contain a material called chitin.
- These organisms are heterotrophic and obtain their nutrients by releasing digestive enzymes into a food source.
- Fungi act either as decomposers or as parasites in nature.

mushroom

KINGDOM PLANTAE

- Plants are eukaryotic, multicellular and carry out photosynthesis. They are autotrophs.
- The cells of plants have cell walls, that contain the polysaccharide cellulose.
- Plant cells are specialized for different functions.
- Kingdom Plantae includes mosses, ferns, cone-bearing plants (gymnosperms), and flowering plants (angiosperms).

fern

Flowering plant

KINGDOM ANIMALIA

- Animals are multicellular, eukaryotic, and heterotrophic.
- Animal cells have NO CELL WALLS.
- Most members of the Animal Kingdom can move from place to place.
- Fish, Birds, Reptiles, Amphibians, and mammals-including humans belong to the Kingdom Animalia.
- This Kingdom also includes sponges, jellyfish, worms, sea stars, and insects.

jellyfish

elephant

Six-Kingdom System

TABLE 18-2 *Six Kingdoms of Life*

Kingdom	Cell type	Number of cells	Nutrition
Archaebacteria	prokaryotic	unicellular	autotrophy and heterotrophy
Eubacteria	prokaryotic	unicellular	autotrophy and heterotrophy
Protista	eukaryotic	unicellular and multicellular	autotrophy and heterotrophy
Fungi	eukaryotic	unicellular and multicellular	heterotrophy
Plantae	eukaryotic	multicellular	autotrophy and (rarely) heterotrophy
Animalia	eukaryotic	multicellular	heterotrophy

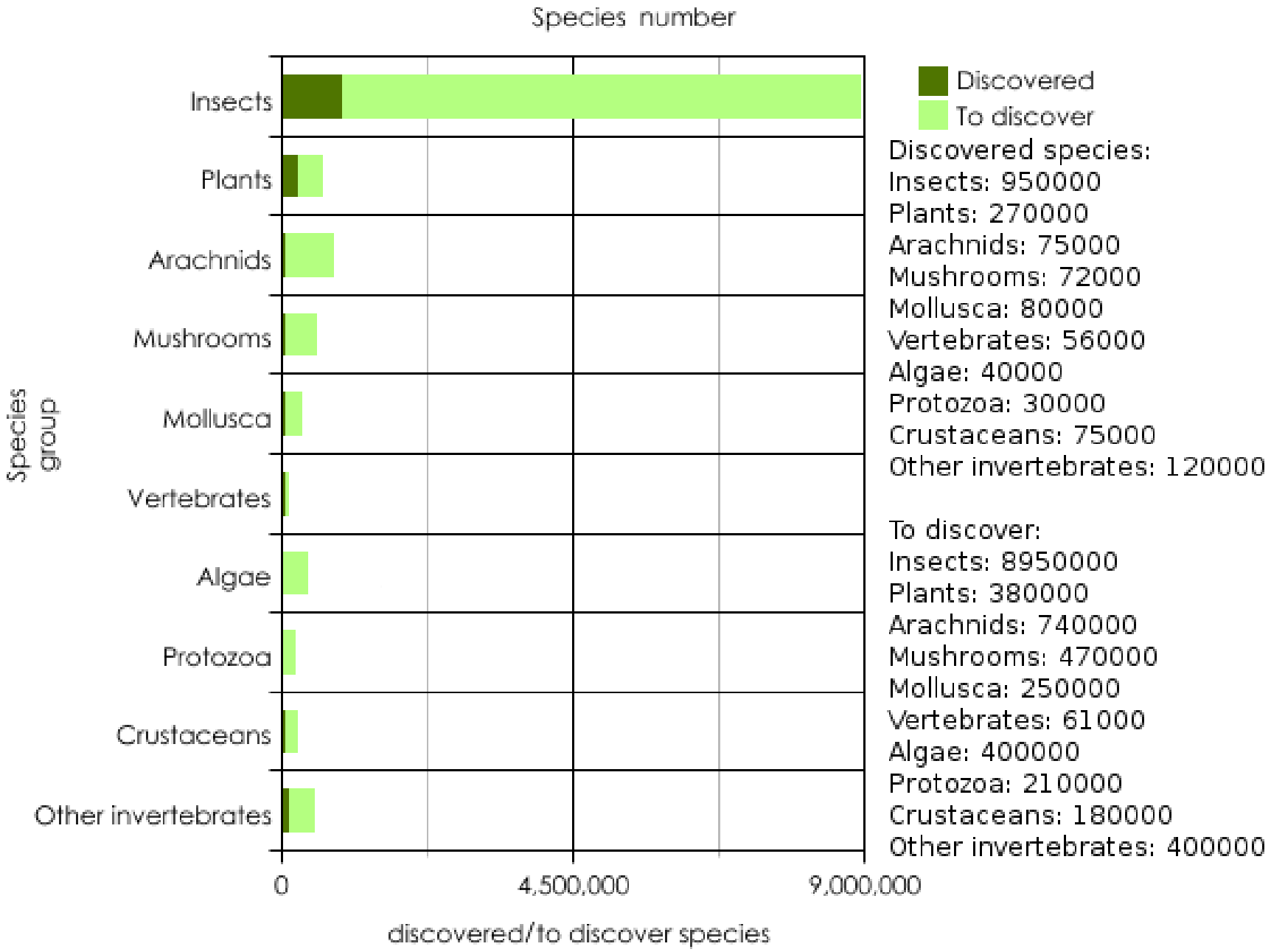
prokaryotic
eukaryotic

unicellular
multicellular

autotrophic
heterotrophic

Group	عدد الانواع
بكتيريا	5,000
طحالب	40,000
احياء وحيدة الخلية	40,000
لا فقاريات (دون الحشرات)	303,000
لافقاريات (حشرات)	840,000
فقاريات	46,500
فطريات	70,000
نباتات متطورة	256,000
المجموع	1,600,500

Category	Species	Totals
Vertebrate Animals		
Mammals	5,513	
Birds	10,425	
Reptiles	10,038	
Amphibians	7,302	
Fishes	32,900	
Total Vertebrates		**66,178**
Invertebrate Animals		
Insects	1,000,000	
Spiders and scorpions	102,248	
Molluscs	85,000	
Crustaceans	47,000	
Corals	2,175	
Others	68,827	
Total Invertebrates		**1,305,250**
Plants		
Flowering plants (angiosperms)	268,000	
Conifers (gymnosperms)	1,052	
Ferns and horsetails	12,000	
Mosses	16,236	
Red and green algae	10,386	
Total Plants		**307,674**
Others		
Lichens	17,000	
Mushrooms	31,496	
Brown algae	3,127	
Total Others		**51,623**
TOTAL SPECIES		**1,730,725**


Species number
Insects
Plants
Arachnids
Mushrooms
Mollusca
Vertebrates
Algae
Protozoa
Crustaceans
Other invertebrates
Species group
0
4,500,000
9,000,000
discovered/to discover species
Discovered
To discover
Discovered species:
Insects: 950000
Plants: 270000
Arachnids: 75000
Mushrooms: 72000
Mollusca: 80000
Vertebrates: 56000
Algae: 40000
Protozoa: 30000
Crustaceans: 75000
Other invertebrates: 120000
To discover:
Insects: 8950000
Plants: 380000
Arachnids: 740000
Mushrooms: 470000
Mollusca: 250000
Vertebrates: 61000
Algae: 400000
Protozoa: 210000
Crustaceans: 180000
Other invertebrates: 400000

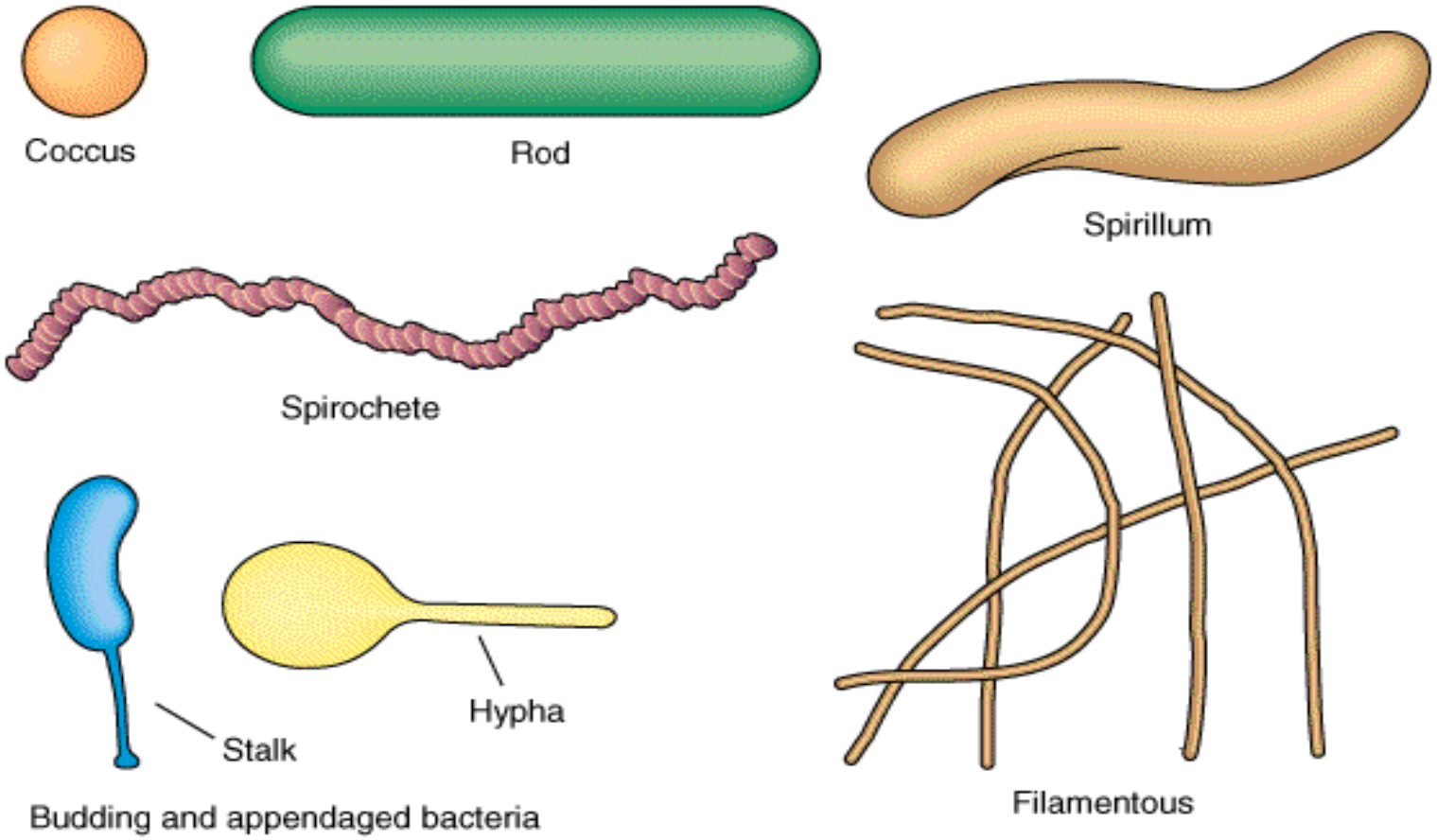
BACTERIA

- Typical prokaryotes.
  - Three shapes: cocci, bacilli and spiral
  - Can be autotroph or heterotroph

    Autotroph: photoautotroph or chemoautotroph
- Heterotroph: parasite or saprophyte
  - Type of reproduction: binary fission
  - Some genetic material transfer:

    transformation, transduction and conjugation

Bacterial morphology



Algae

1. Euglenoids
   eg. Euglena
   food storage - lipoid polysaccharide - paramylum
2. Green algae
   eg. Chlamydomonas
   food storage - starch
3. Golden Brown algae
   eg. Diatoms
   food storage – oil and leucosin (a polysaccharide)
   have fucoxanthin, a brownish pigment
4. Brown Algae
   Mainly marine water algae
   food storage – laminarin, a polysaccharide and mannitol, a sugar alcohol
5. Fire Algae
   Dinoflagellate
   eg. Peridinium
   food storage – starch, fat, oils

Fungi

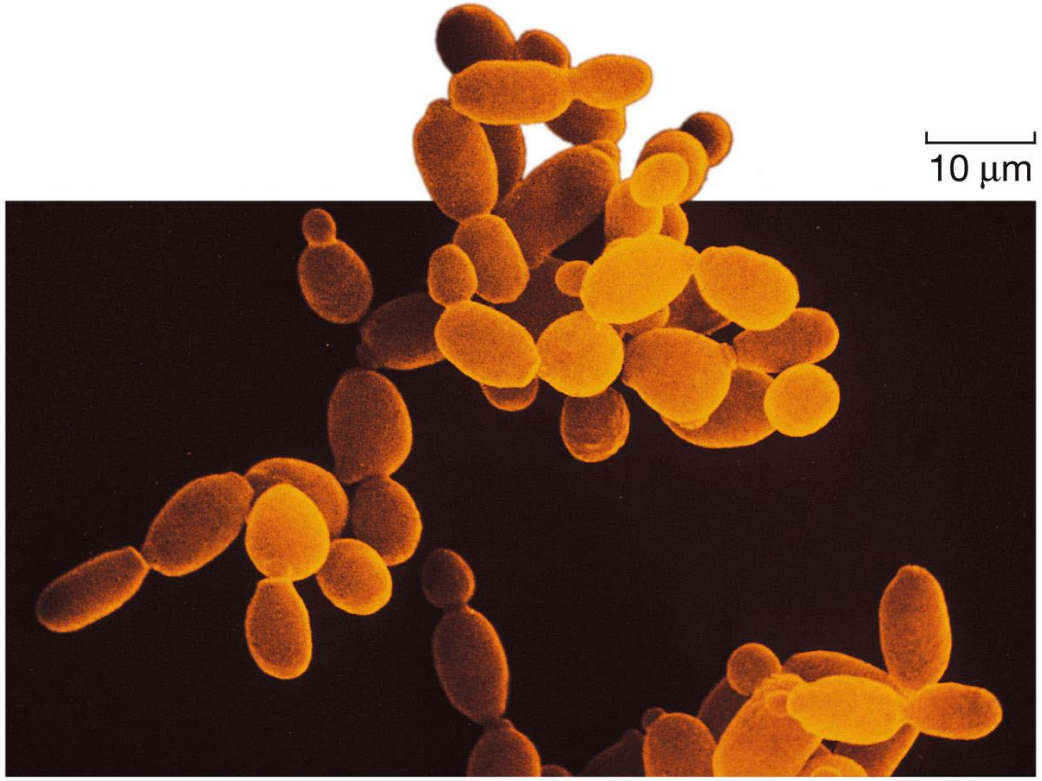
The fungi are **not true plants** ...!! you see they do not contain chlorophyll! Indeed many scientists today place fungi as more closely related to animals than plants (**chitin** – which also forms the arthropod exoskeleton - is the main component of fungal cell wall).

Fungi and animals are descended from a common ancestor: A unicellular eukaryote with a flagellum.

Unicellular

Unicellular members of the zygomycetes, ascomycetes, and basidiomycetes.

e.g. , Yeasts:
Budding: mitosis followed by asymmetrical cell division.



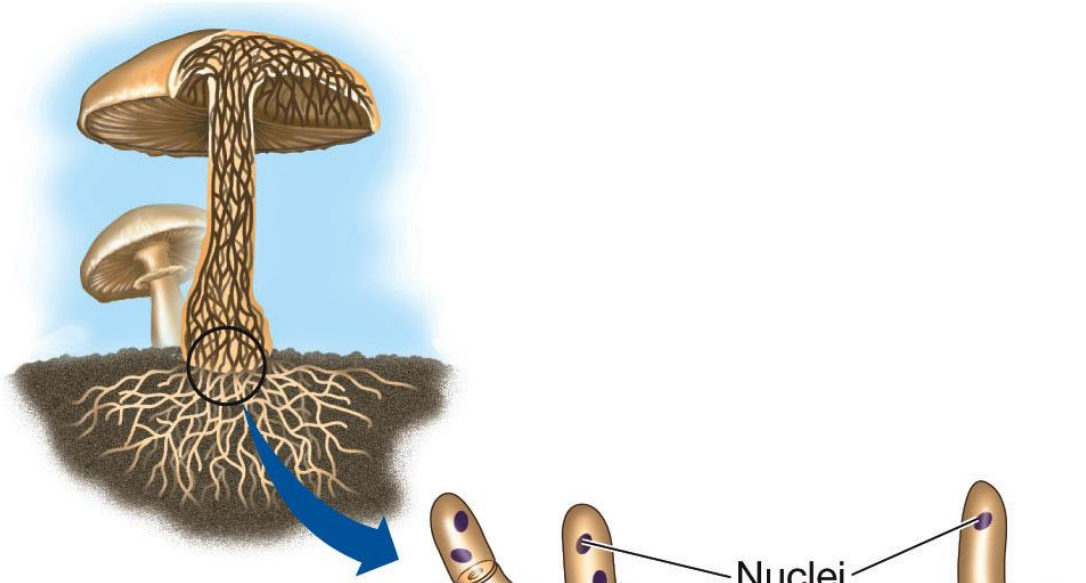
Saccharomyces sp.

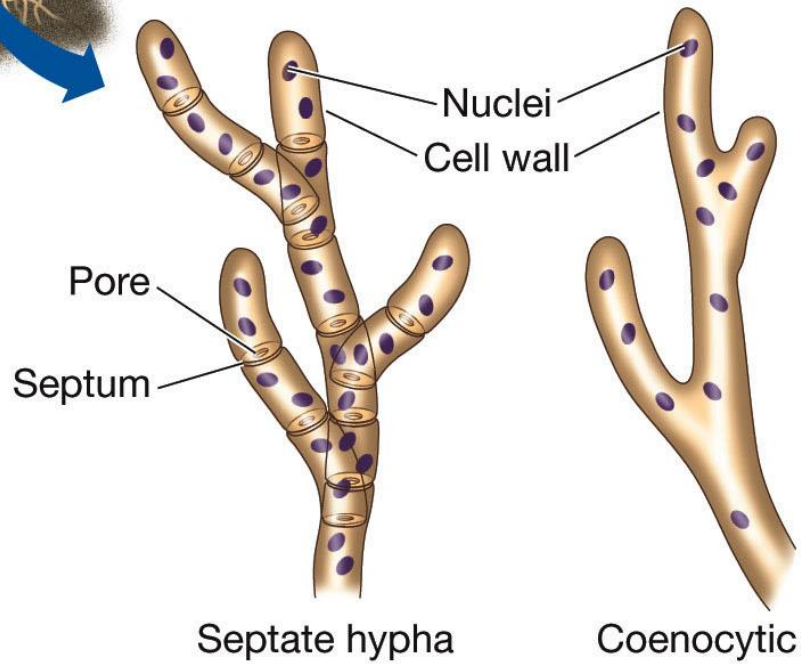
Multicellular

Multicellular fungi:

- Body is a **mycelium**—composed of tubular filaments called **hyphae.** (singular hypha)
- Hyphae cell walls have **chitin**.
- Some hyphae have incomplete cross walls or **septa**, and are called **septate.**
- Hyphae without septa are called **coenocytic.**

Most Hyphae Are Incompletely Divided into Separate Cells



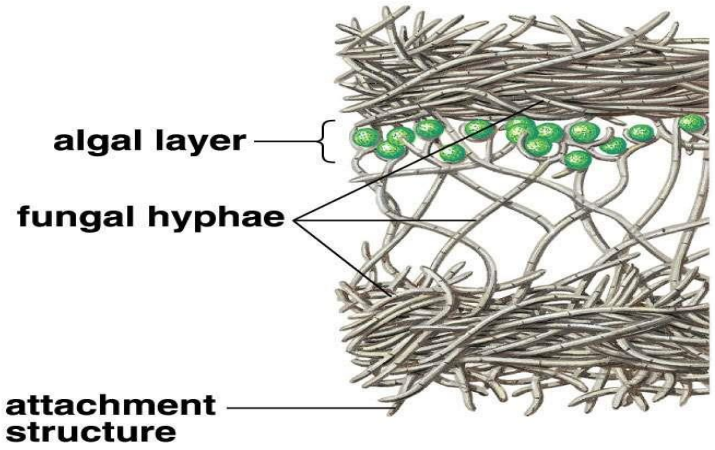


LIFE 8e, Figure 30.4

Lichens: Nature's perfect marriage

Lichens: fungus + photosynthetic organism

- Fungi—mostly ascomycetes
- Photosynthetic partner—cyanobacterium or alga, or both.
- Species are named for fungal component.
- Can survive the harshest environments on Earth.
- Very sensitive to toxic compounds—good indicators of air pollution.
- Lichens are great ecological markers
- Early medicinal remedy



Plant systematics

WHAT'S THE PLANT ?

- Plants are members of the kingdom plantae. Plants are photosynthetic multicellular eukaryotes **PHOTOAUTOTROPHS**.
- Cell walls are made of **CELLULOSE** - the material that bacteria and protists in our small intestine digest for us. Cellulose is a kind of complex sugar or polysaccharide.
- Although cellulose plays an important role in structural support in the cell walls of plants, cellulose is found in other forms - such as cotton.
- The green of plants comes from their photosynthetic pigments (chlorophyll a & b)

What are characteristics of plants?

- Sessile
- Multicellular & cell specialization
- Eukaryotic
- cellulose cell walls
- autotrophic (photosynthetic)
- Chlorophylls *a* and *b* in thylakoid membranes
- Store reserve food as amylose (starch)
- Alternation of Generations
  - Sporophyte
  - gametophyte

What do plants need to survive?

- **Sunlight** - energy of sun captured by chlorophyll and used to join CO_2 and H_2O to form glucose ($C_6H_{12}O_6$); plants need broad leaves to maximize light absorption
- **Water and minerals** - roots to absorb these
- **Gas Exchange** – stomata in leaves
- **Protective structures** - were required to protect the developing embryos.
- **Movement of water and nutrients**
  - Most plants have tubes – phloem (nutrients down) and xylem (water up)
  - Some small plants use diffusion

Plant Adaptations to Land

Problems:

- Need minerals
- Gravity
- Increase in Height for Light
- Adaptations for Drier environment
- Reproduction

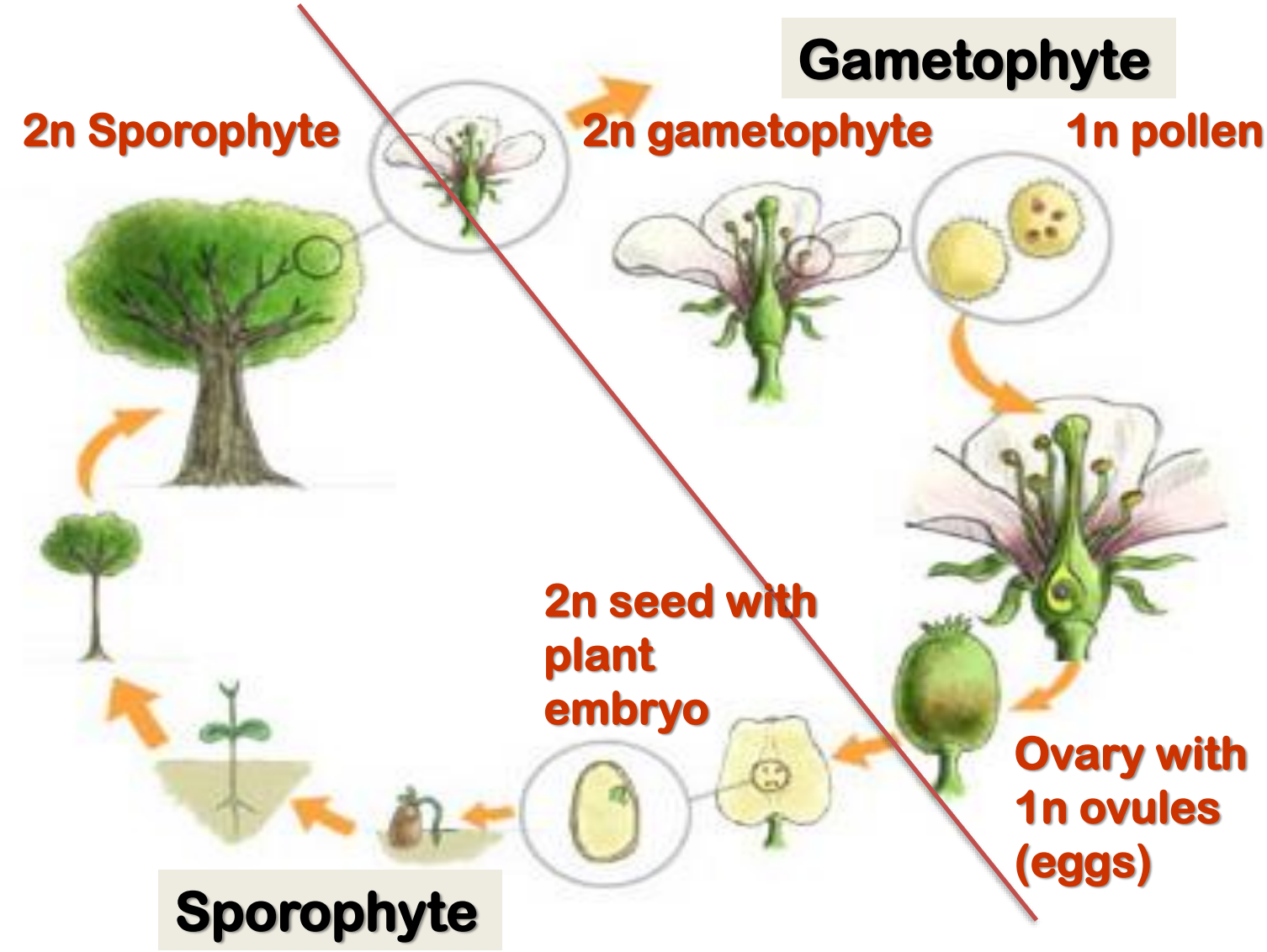
Solutions:

- Roots absorb H_2O & minerals
- Lignin & cellulose in cell walls
- Vascular Transport System
- Waxy cuticle & stomata with guard cells
- Pollen containing sperm

GENERAL LIFE CYCLE OF PLANTS

- The life cycle of plants has two different phases. This is called; ALTERATION OF GENERATIONS. In this alteration of generations, the plant takes turns undergoing mitosis and meiosis to produce haploid (n) gametes and diploid (2n) phase.
- The diploid (2n) phase is called the sporophyte - or spore producing plant. The haploid (n) phase is called the gametophyte - or gamete producing plant.
- The spores are haploid (n) and produced through meiosis in the sporophyte plant - each spore can grow into a new plant; the gametophyte!
- A gamete is a reproductive cell produced by mitosis and fuses during fertilization with another gamete to produce a new individual - the diploid sporophyte.

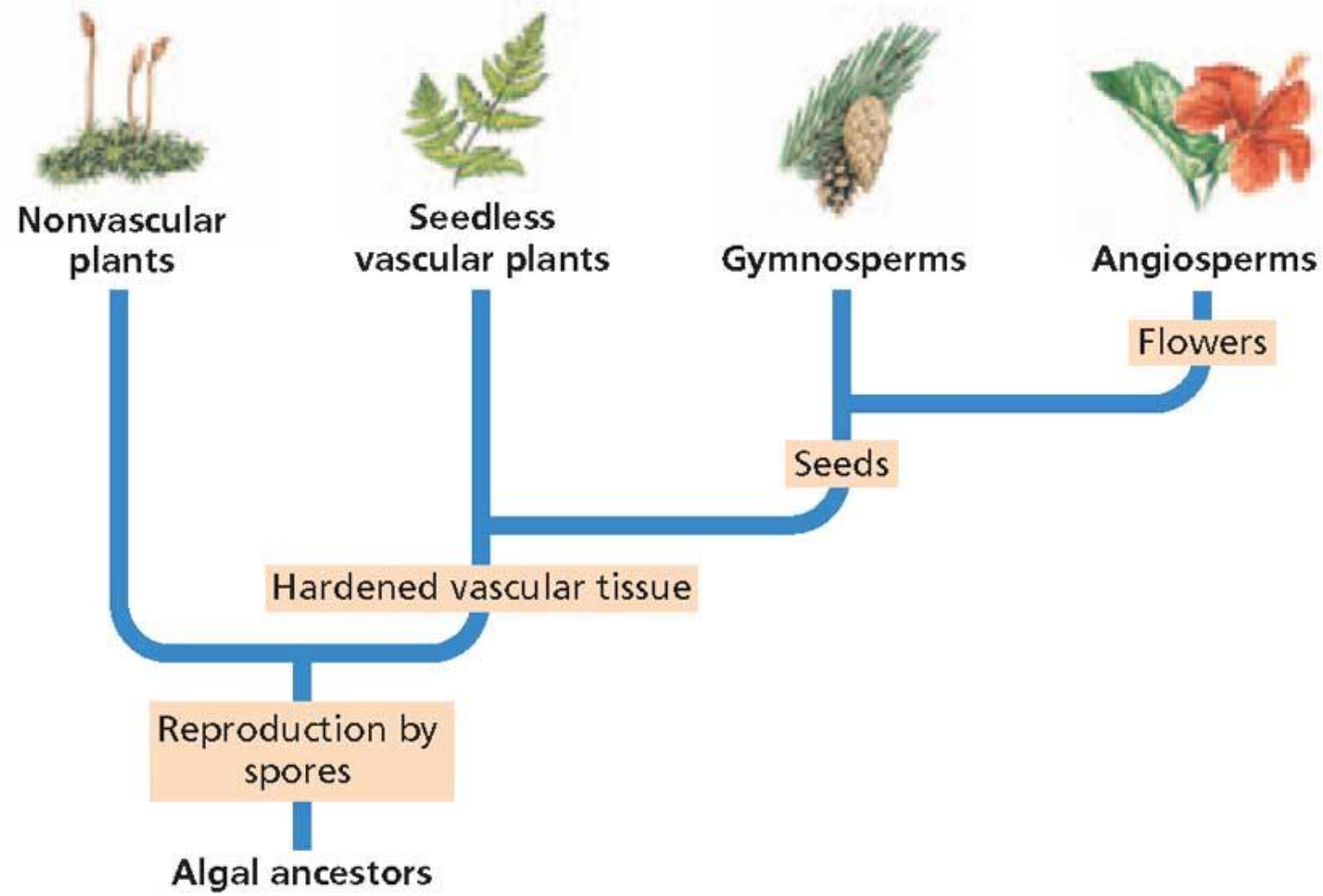
Alternation of Generations



- **Alternation of generations:**
  - **Sporophyte – 2n – Diploid – produce haploid spores by meiosis**
  - **Gametophyte - (1n) – haploid undergoes mitosis to produce eggs and sperm – the eggs and sperm (gametes)**
  - **Zygote - merge to grow into a 2n sporophyte (cycle continues)**

Plant Cladogram

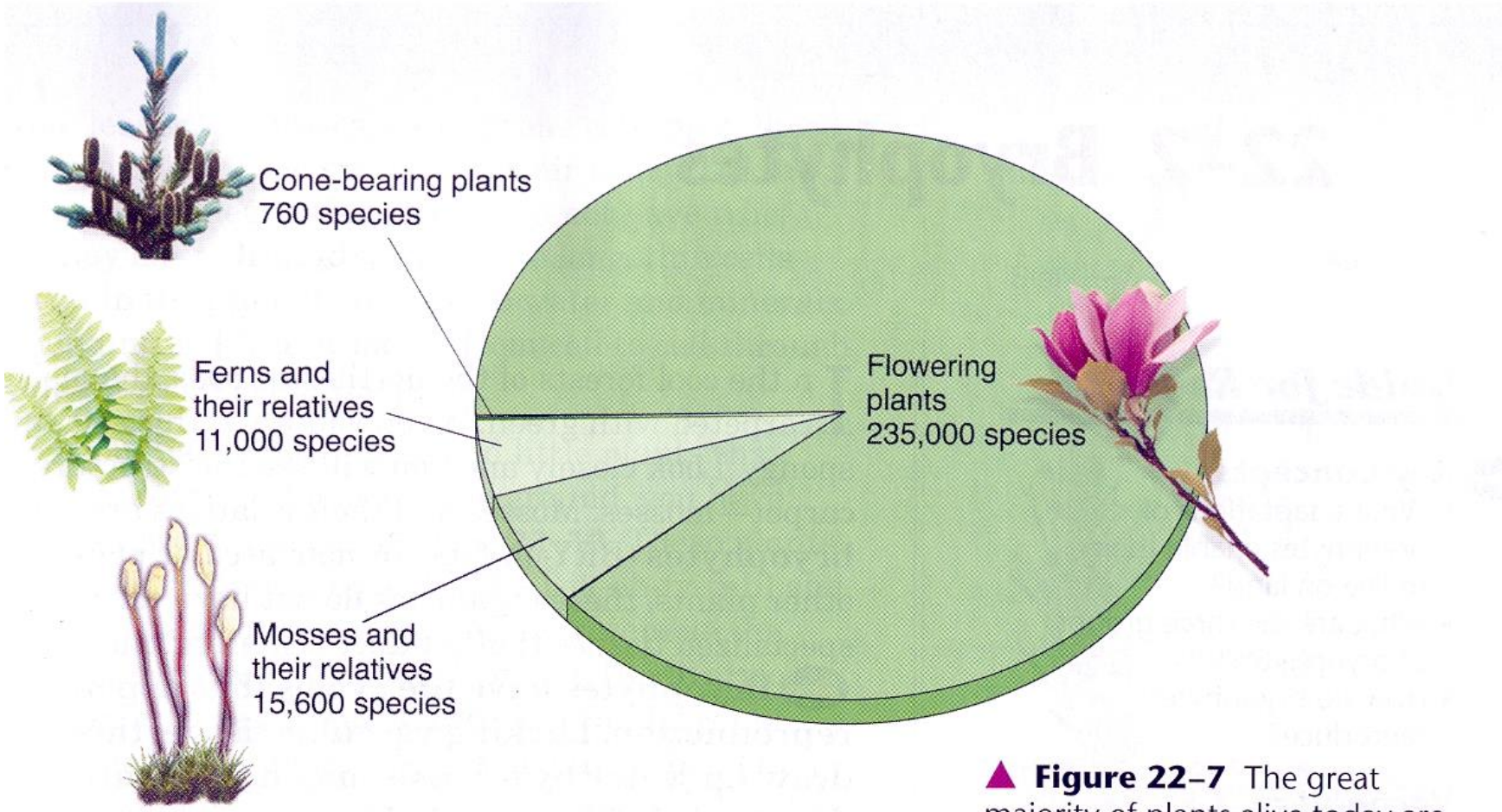
Relationships among the various groups of plants



The four main groups of plants:

- **Mosses** (nonvascular plants)– Bryophytes (15,600 species)
- **Ferns** (vascular & seedless plants)– Pterophytes (11,000 species)
- **Gymnosperms** (vascular & naked seeds)- Cone-bearing Plants (760 species)
- **Angiosperms** (vascular & covered seeds)- Flowering Plants (235,000 species)

Diversity of plants today



▲ **Figure 22–7** The great majority of plants alive today are angiosperms, which are also known as flowering plants. **Interpreting Graphics** *What is the second largest group of plants?*

Plant kingdom

(Land Plants)

Hepatophyta (Liverworts)

Anthocerotophyta (Hornworts)

Bryophyta Mosses

Nonvascular plants

Lycophytes (spike mosses)

Sphenophyta (horsetails)

Psilotophyta (whisk ferns)

Pterophyta (Ferns)

Seedless plants

Vascular plants

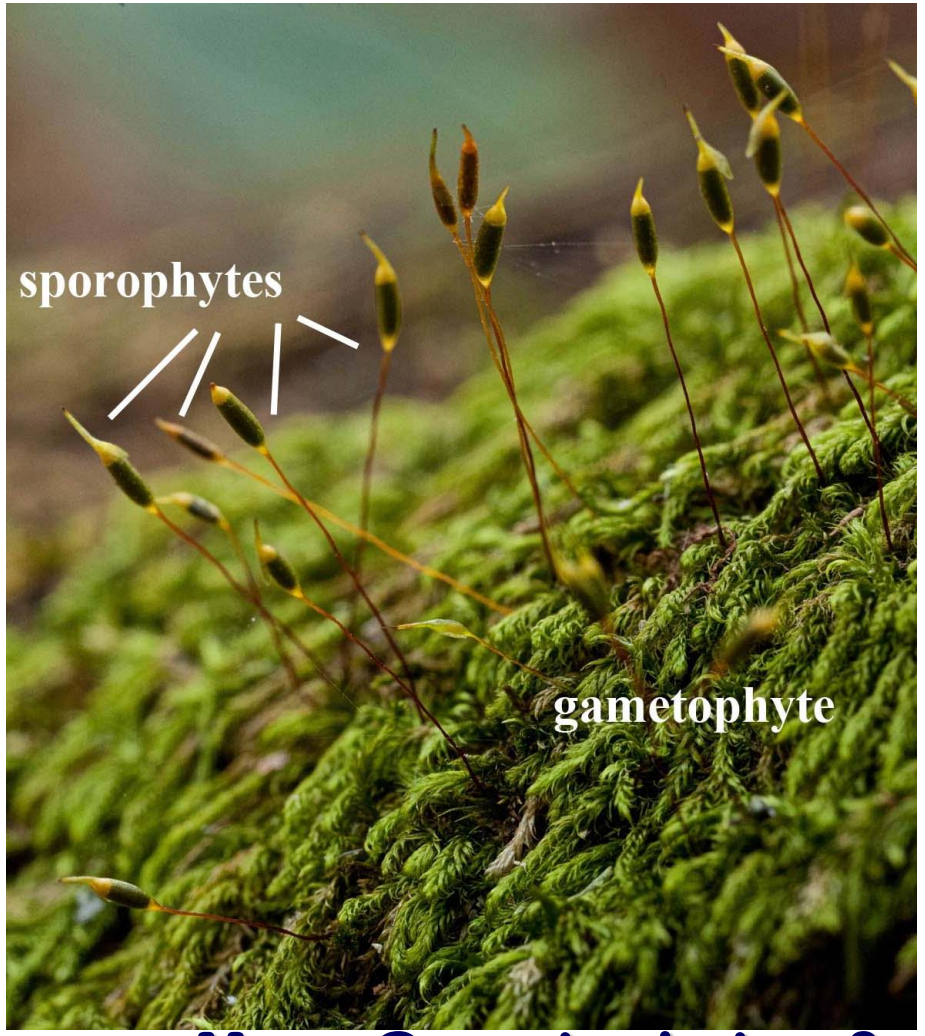
Gymnosperms

Angiosperms

Seed plants

Nonvascular Plants

- Do not have vascular tissue for support or conduction of materials
- Require a constantly moist environment
- Plants can't grow as tall



Moss Gametophytes & Sporophytes

Nonvascular Plants (contd.)

- Cells must be in direct contact with moisture
- Materials move by diffusion cell-to-cell
- Sperm must swim to egg through water droplets

Vascular Plants

Vascular System:

- **Xylem** tissue carries **water** and **minerals** upward from the roots
- **Phloem** tissue carries **sugars** made by photosynthesis from the leaves to where they will be stored or used
- **Sap** is the fluid carried inside the xylem or phloem

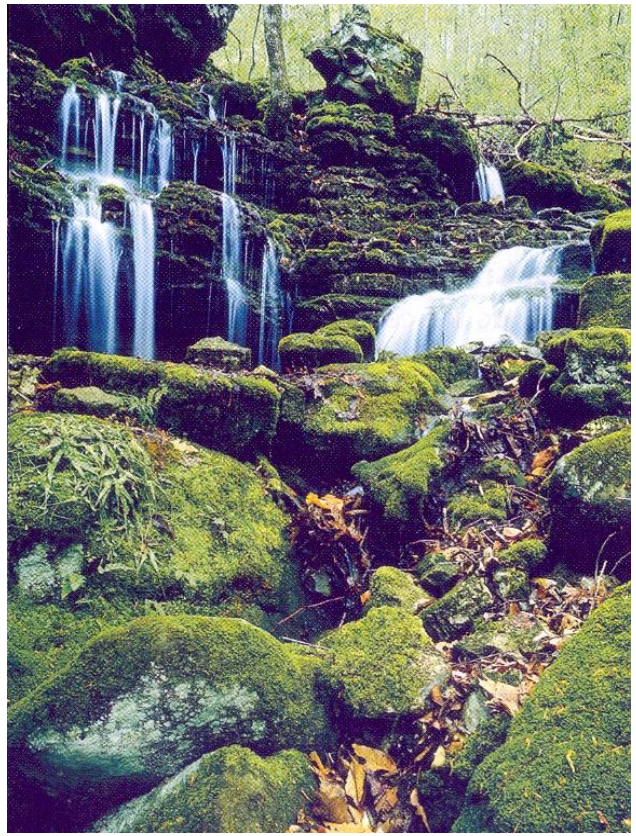
Seed producing plants

- **Major adaptations**
  - Pollen (male gametophyte)
  - Seeds (embryonic plant)

  (male and female gametophyte are greatly reduced in size)
- **Two types**
  - Gymnosperms (lack flowers, naked seeds)
  - Angiosperms (flowering plants, seeds enclosed in fruits)

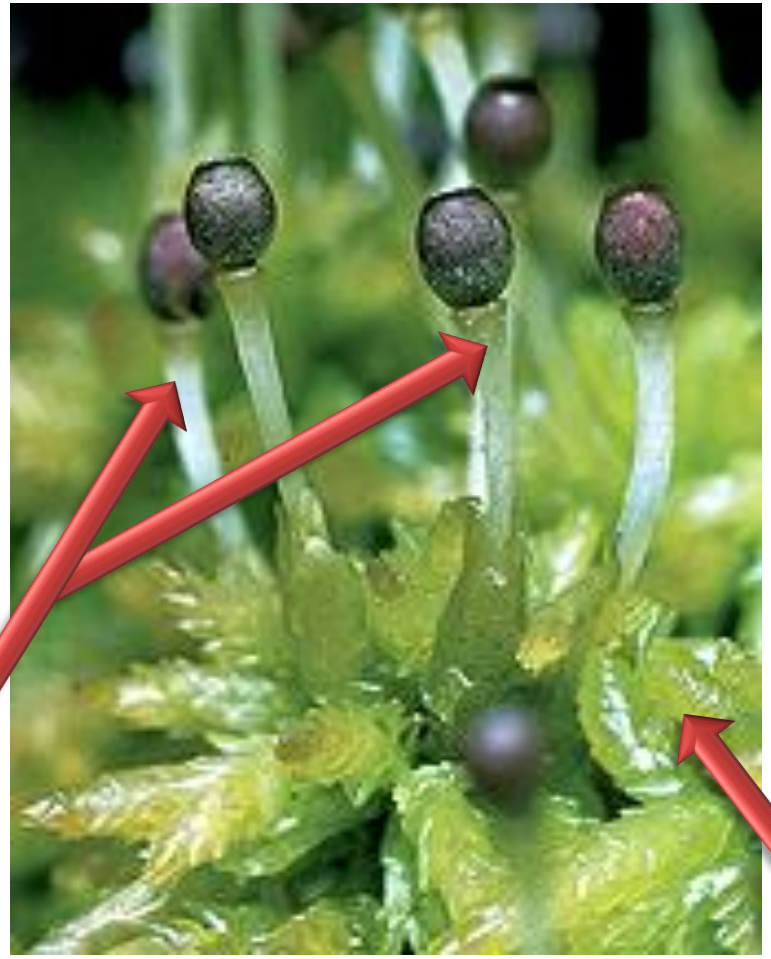
Types of Nonvascular Plants

(1) Bryophyta
(2) Hepatophyta (liverwort)
(3) Anthocerophyta (Hornworts)



Types of Nonvascular Plants

(1) BRYOPHYTA

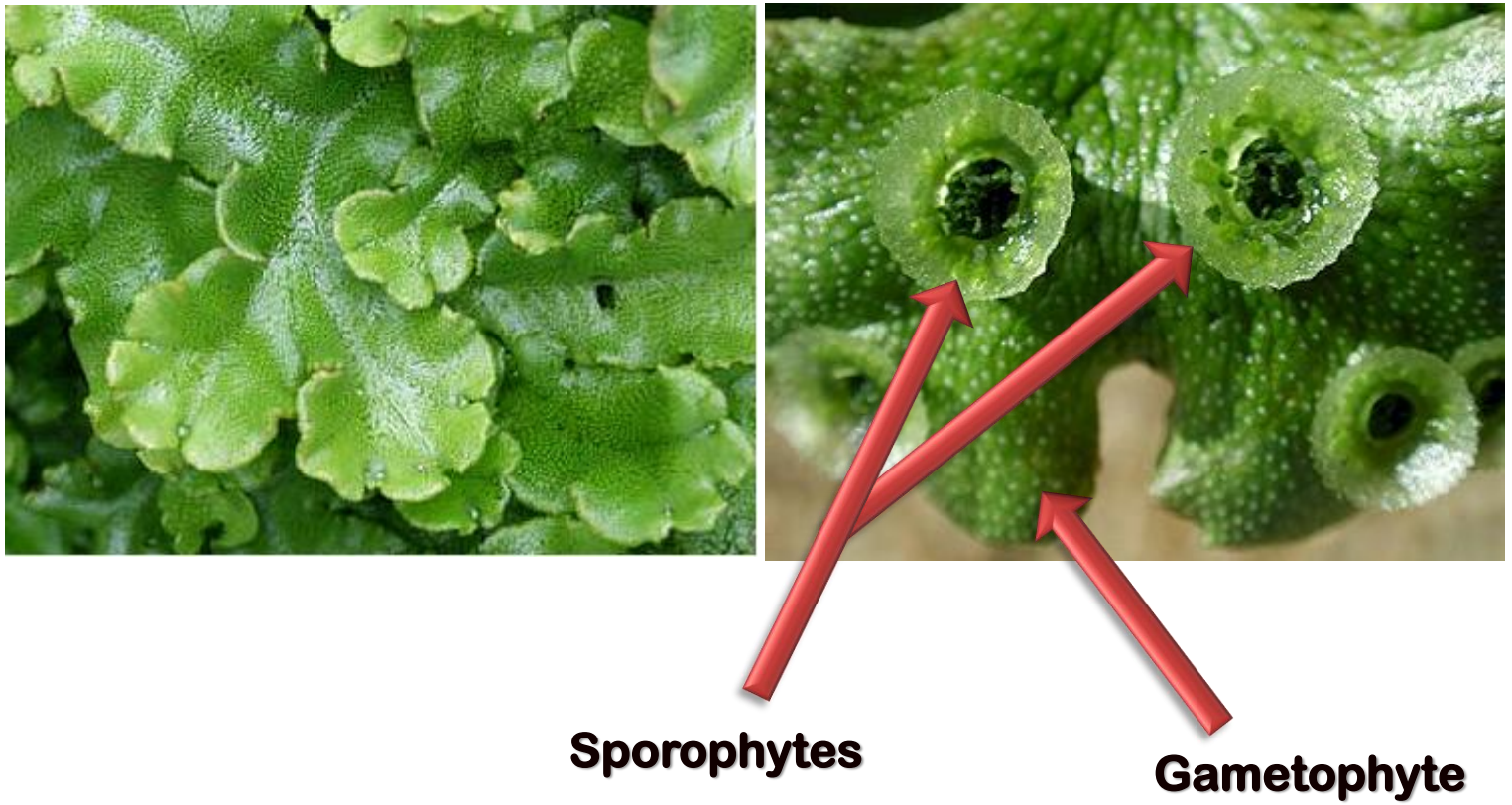


Sporophytes

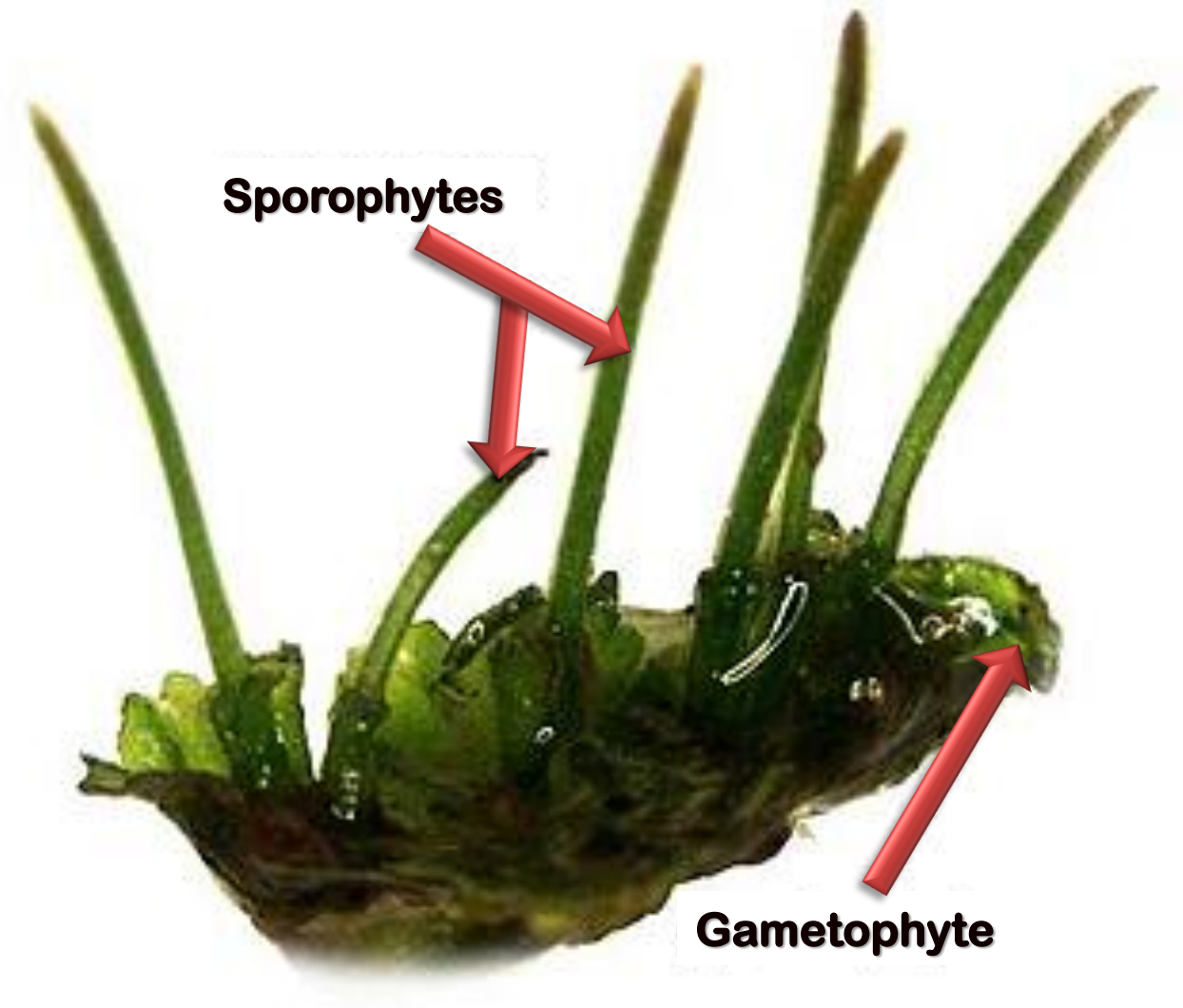
Sphagnum

Gametophyte

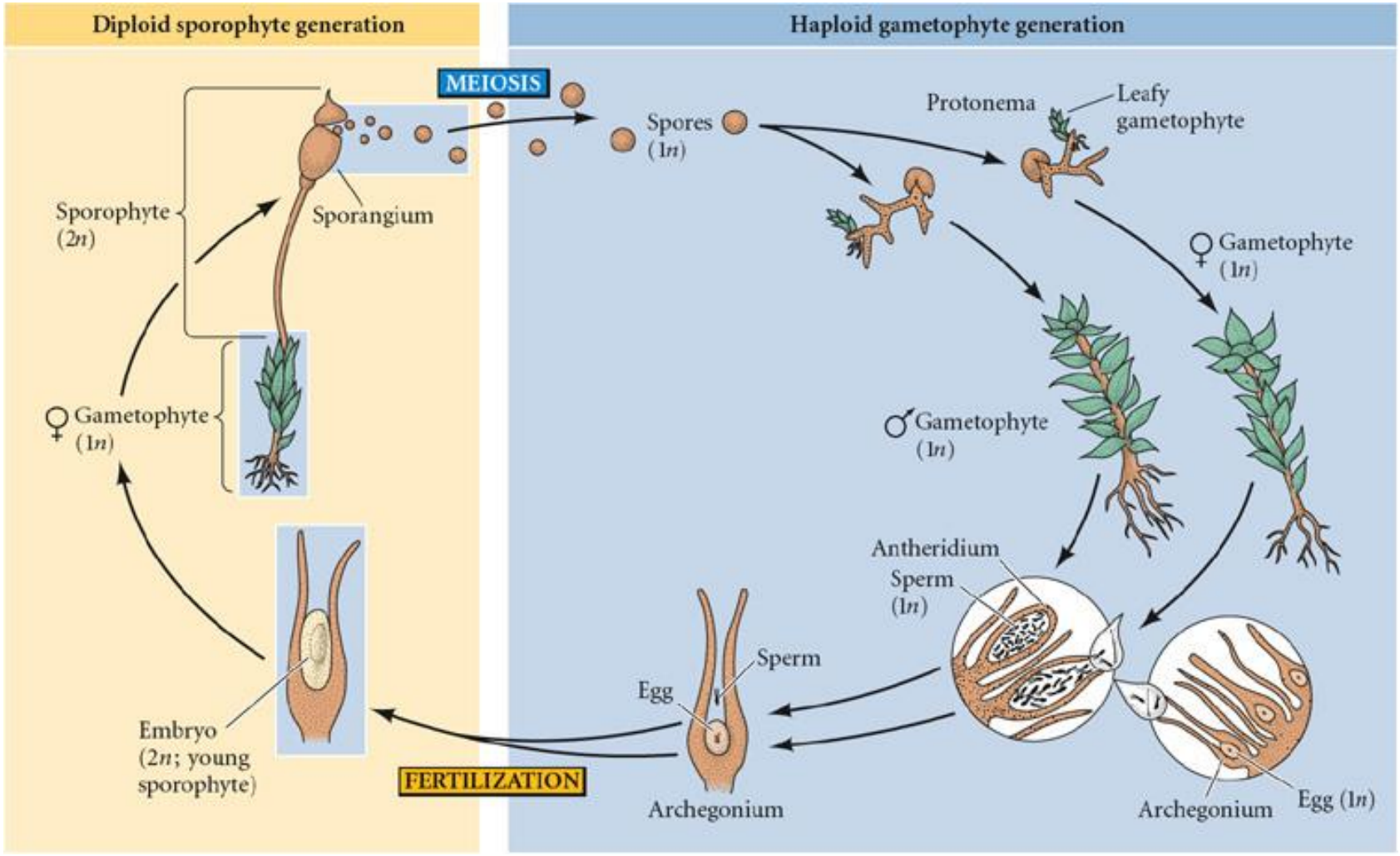
(2) Hepatophyta (liverwort)



(3) Anthocerophyta (Hornworts)



Simplified Lifecycle of a Bryophyte



Types of Seedless Vascular Plants

(1) Psilophyta (Whisk Ferns)

(2) Lycophyta (Spike Mosses)

(3) Sphenophyta (Horsetails)

(4) Pterophyta (True Ferns)

Types of Seedless Vascular Plants

(1) PSILOPHYTA (whisk ferns)

- Epiphytes
- Rootless and leafless

(2) LYCOPHYTA (spike mosses)

- Produces a sporangia bearing strobilus.

(3) SPHENOPHYTA (Horsetails)

- Genus: *Equisetum*
- Large deposits of silica in their leaves.
- Jointed stems with whorled leaf arrangement.

(4) PTEROPHYTA
(True ferns)

PTEROPHYTA (True ferns)

- Broad leaves called fronds
- Leaflets called pinnae
- Sporangium (sorus *pl* sori) are formed on the underside of the fronds.
- Unfolding fronds are called fiddleheads.
- Spores are dispersed by the wind.

Seedless Vascular Plants (reproduce via spores)

TABLE 30-2 *Seedless Vascular Plants*

Example plant	Phylum	Features	Size	Location
Whisk ferns	Psilotophyta	• produce reproductive structures on the ends of forked branches • no roots or leaves	• about 30 cm (1 ft) tall	• tropical and temperate regions, as far north as South Carolina
Club mosses	Lycophyta	• evergreens that produce spores in cones • have roots	• about 5 cm (2 in.) tall	• tropical and temperate regions, on forest floors, in swamps, or as epiphytes
Horsetails	Sphenophyta	• jointed stems • outer cells of stems contain silica, the major component of sand	• about 60–90 cm (2–3 ft) tall	• tropical and temperate regions, usually in moist soil
Ferns	Pterophyta	• leaves • most have an underground stem • most produce spores on the underside of their leaves	• range from less than 1 cm (0.4 in.) to 25 m (82 ft) tall	• all climates, on forest floors, as epiphytes, some in full sun, some aquatic

Types of Gymnosperms

Plant kingdom

(Land Plants)

Hepatophyta (Liverworts)

Anthocerotophyta (Hornworts)

Bryophyta Mosses

Nonvascular plants

Lycophytes (spike mosses)

Sphenophyta (horsetails)

Psilotophyta (whisk ferns)

Pterophyta (Ferns)

Seedless plants

Vascular plants

Gymnosperms

Angiosperms

Seed plants

(1) CYCADOPHYTA (Cycads)

- Large fernlike leaves
- Plants are either males or females
- Plants produce gametes in large strobilus

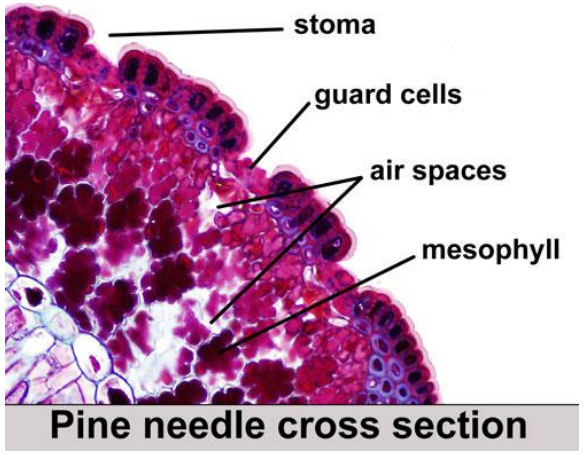
(2) GINKGOPHYTA (*Ginkgo biloba)*

(2) GINKGOPHYTA (*Ginkgo biloba)*

- Only one species in present day
- Bear male and female cones on separate plants.
- Male produces pollen in strobilus-like cones.
- Female bears seed which develop a fleshy outer covering
- Plants are resistant to air pollution

(3) CONIFEROPHYTA
(Cone-bearing trees)

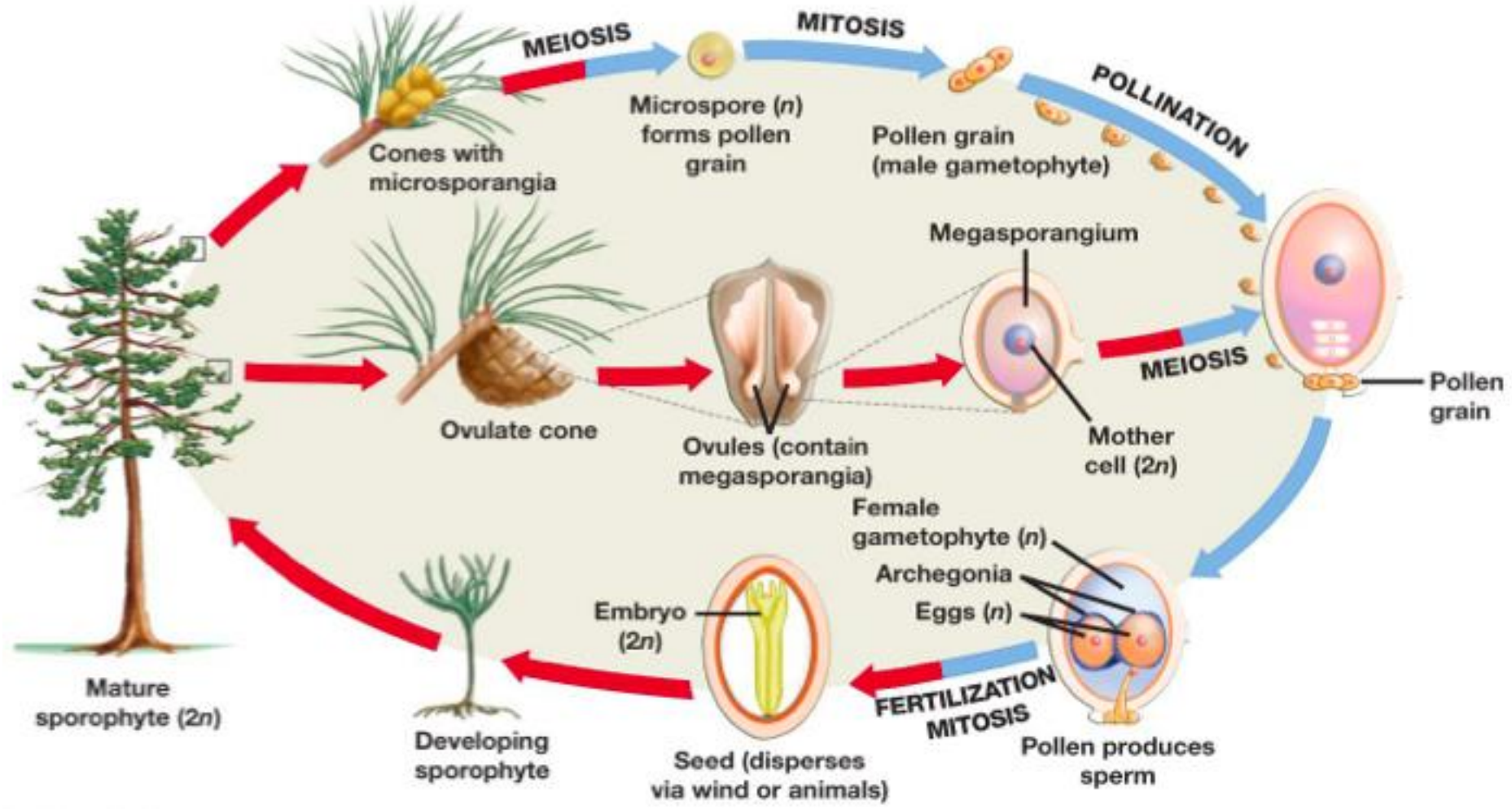
- Cone bearing
- needles with thick waxy covering
- Stomata in cavities below surface
- Seeds are carried on the surfaces of cones
- Evergreen and adapted to cold and dry habitats



Pine needle cross section

Male & female cones

What is alternation of generations in gymnosperms?

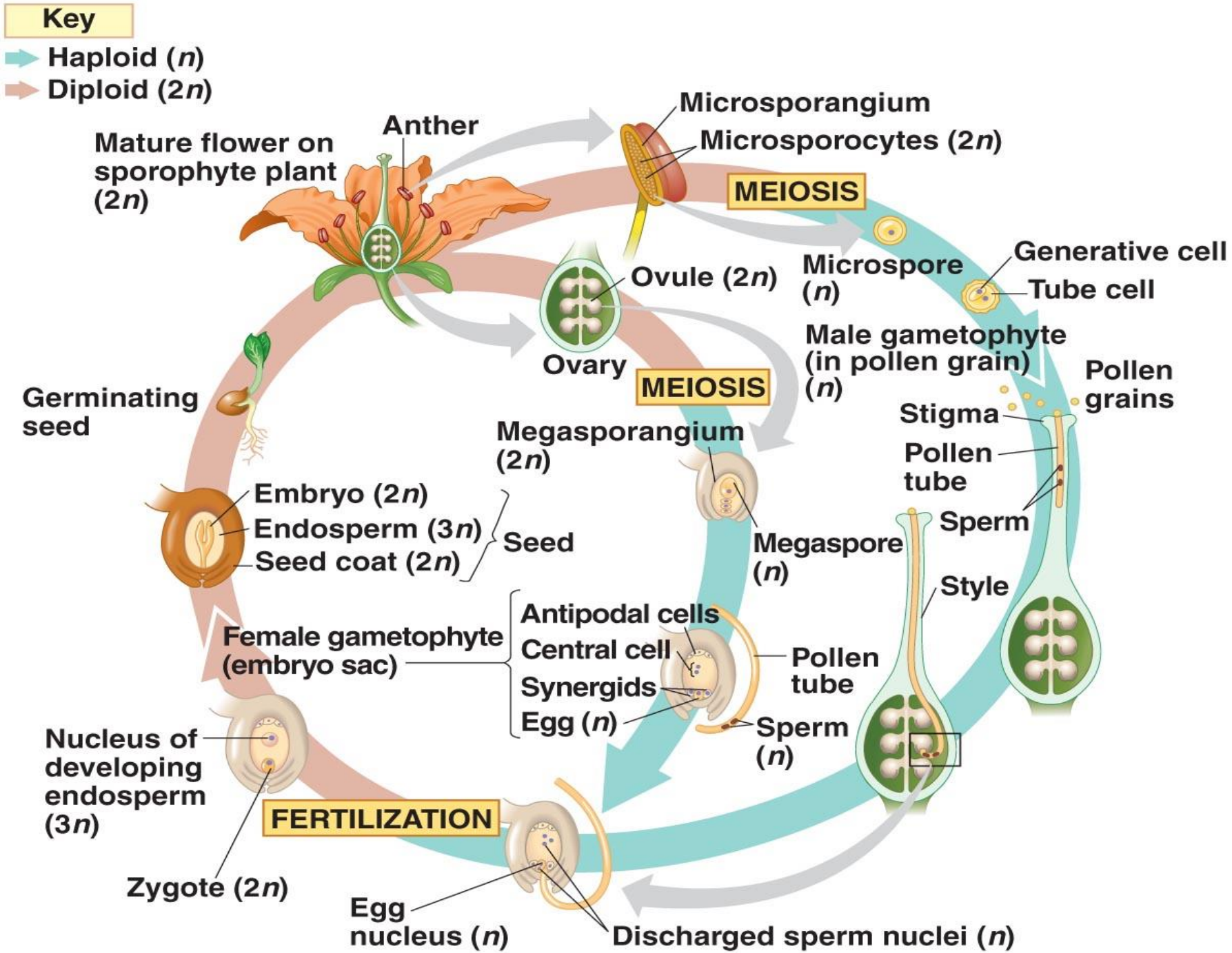


(4) GNETOPHYTA

There are three genera:

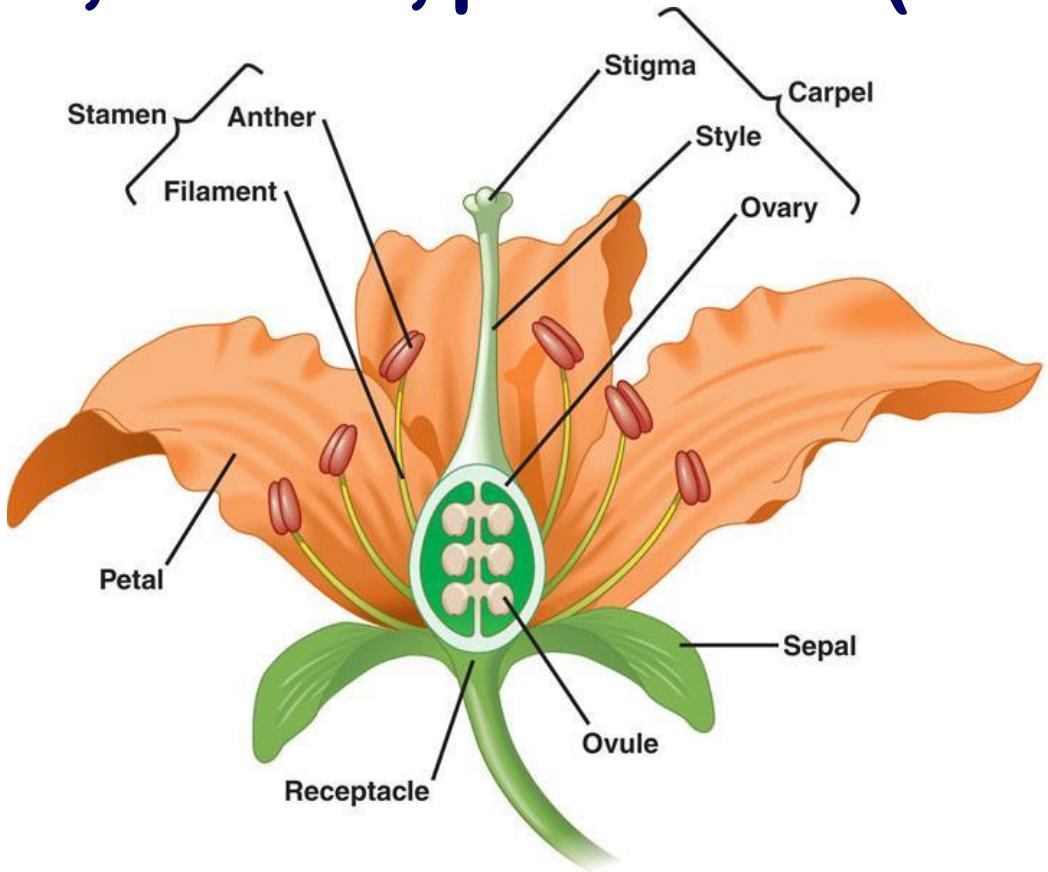
1. *Gnetum* : A tropical climbing plant
2. *Ephedra* (Shrub-like plants)
3. *Welwitschia* (Desert dweller with large tuberous root). Has only two leaves and may live 1000 yr.

Angiospermae
(Anthophyta – flowering plants)



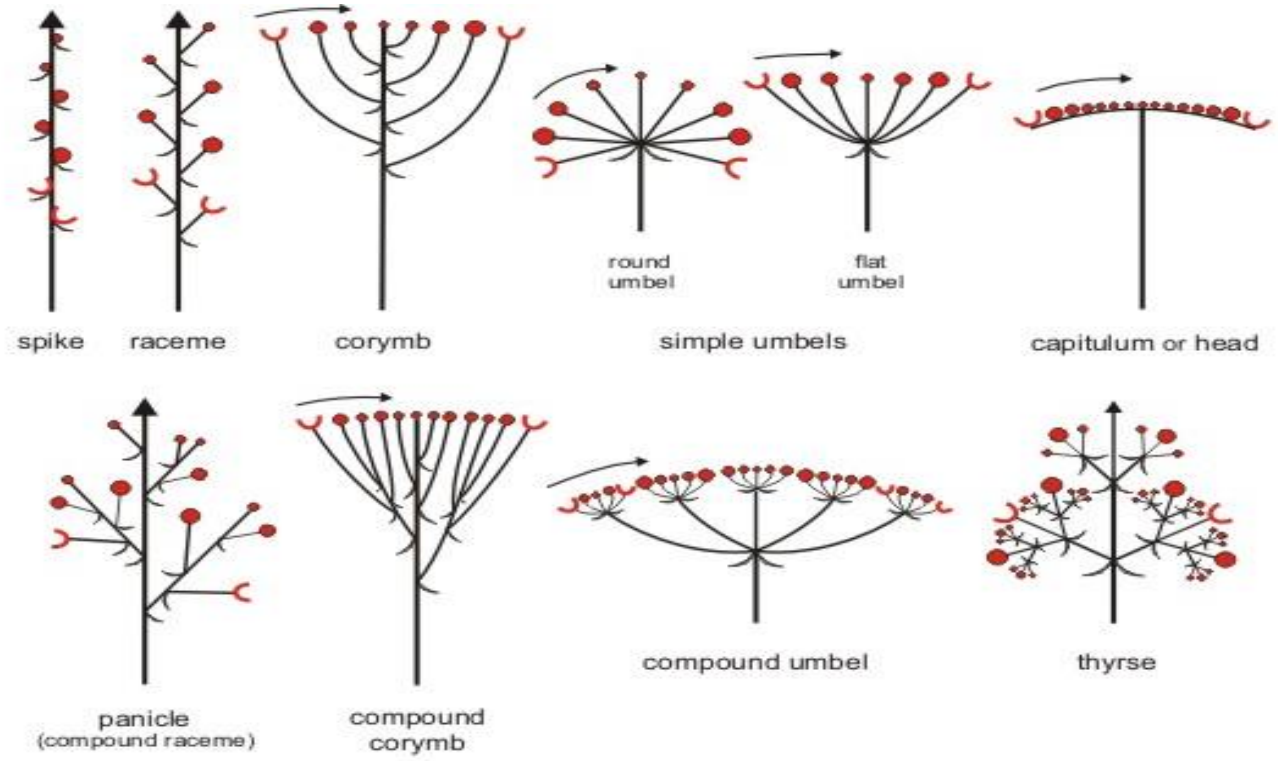
What are the ANTHOPHYTA?

- Flowering
- Seeds are within a layer of protective tissue
- Flowers, ovaries, pollinators (insects, etc.)



Inflorescence types

- An inflorescence is an arrangement of one or more flowers on a floral axis



Inflorescence types

- Inflorescence type determined by:
  - Number of flowers
  - Positional relationships
  - Degree of the development of their pedicels
  - Nature of their branching pattern

Simple Inflorescences

- **Terminal: flower at the tip of a stem**

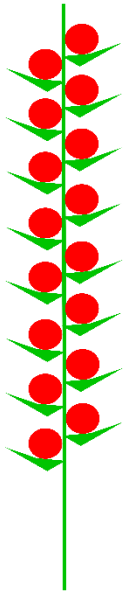
Scarlet rose-mallow (*Hibiscus coccineus*)

Compound Inflorescences

- Two or more flowers per inflorescence

Compound Inflorescences

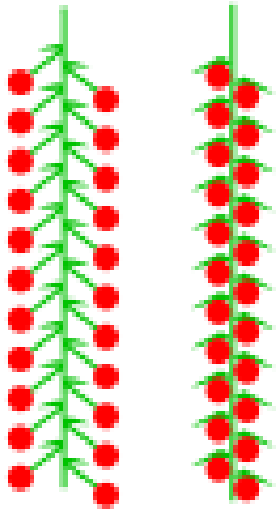
- **Spike**: elongate inflorescence; flowers are sessile, dense, or remote from one another



Spiked blazing star (*Liatris spicata*)

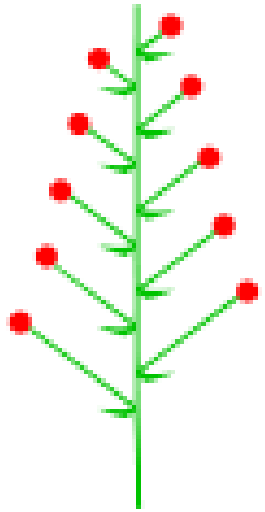
Compound Inflorescences

- **Catkin**: A spikelike inflorescence of unisexual flowers; found only in woody plants.



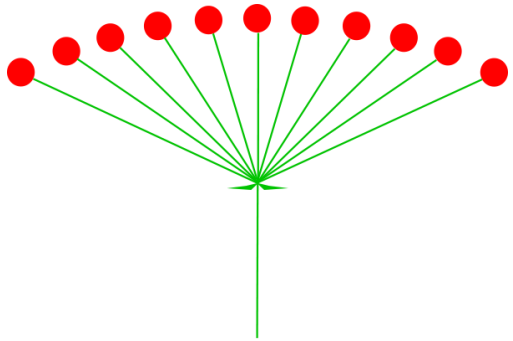
Compound Inflorescences

- **Raceme**: an elongate inflorescence of pedicellate flowers on an unbranched rachis



Compound Inflorescences

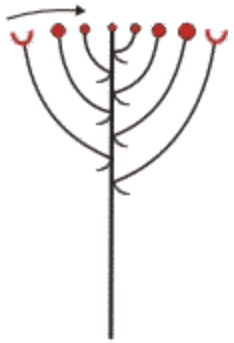
- **Umbel**: a flat-topped or somewhat rounded inflorescence in which all of the pedicels arise from a common point at the tip of the peduncle



Butterfly weed (*Asclepias* sp.)

Compound Inflorescences

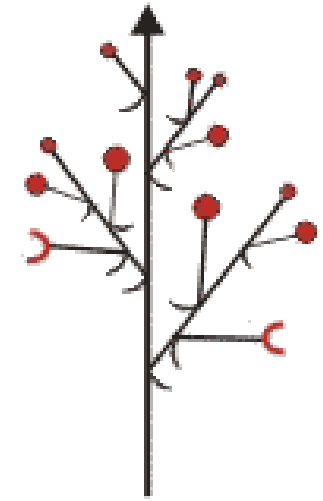
- **Corymb**: a flat-topped or somewhat rounded inflorescence in which the pedicels of varying length are inserted along the rachis



corymb

Compound Inflorescences

- **Panicle**: a much-branched inflorescence with a central rachis which bears branches which are themselves branched



panicle
(compound raceme)

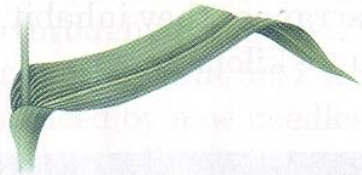
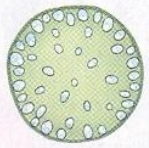
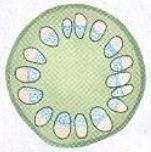
Compound Inflorescences

- **Head, (Capitulum) :** is a short dense spike in which the flowers are borne directly on a broad, flat peduncle, giving the inflorescence the appearance of a single flower.

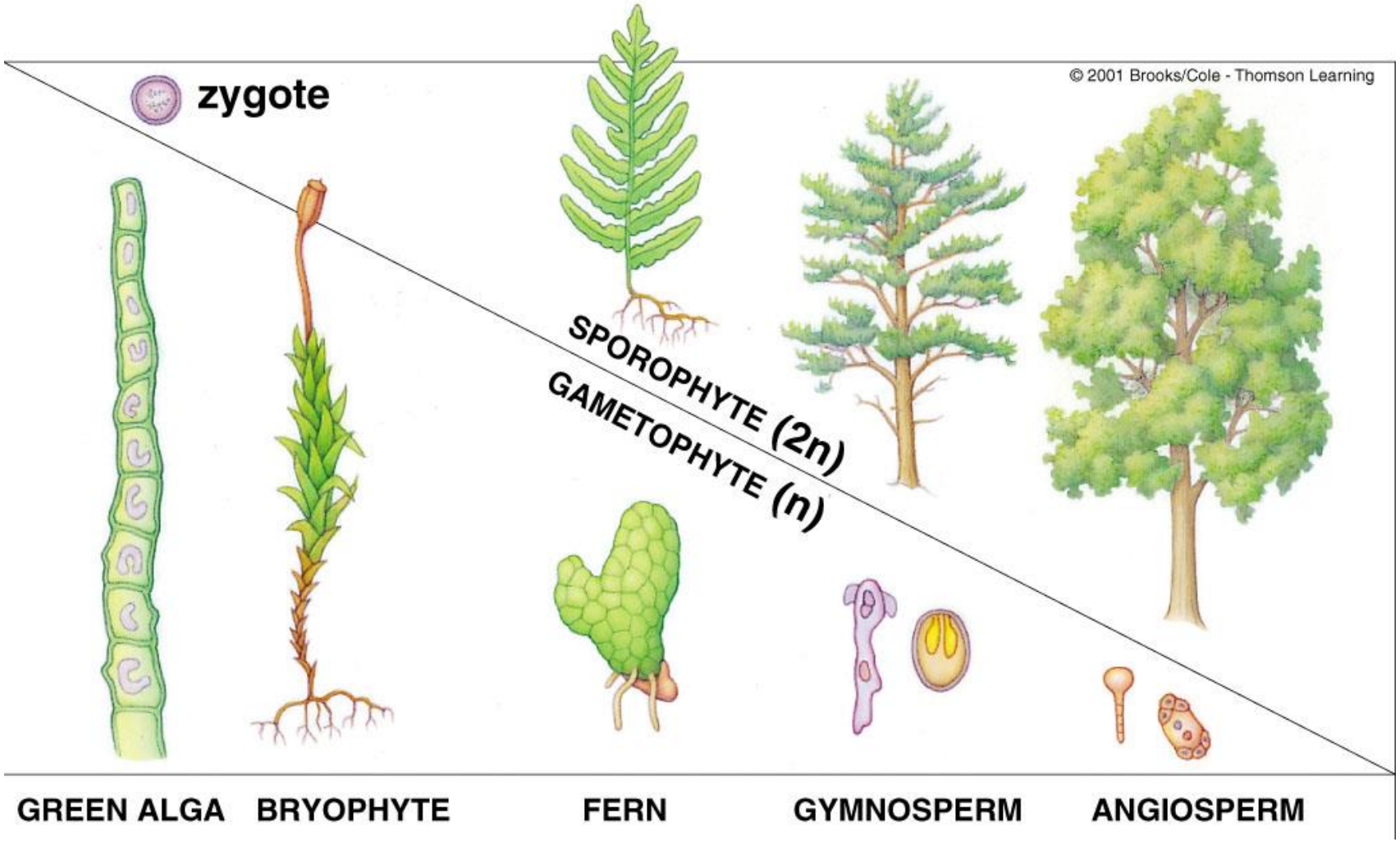
capitulum or head

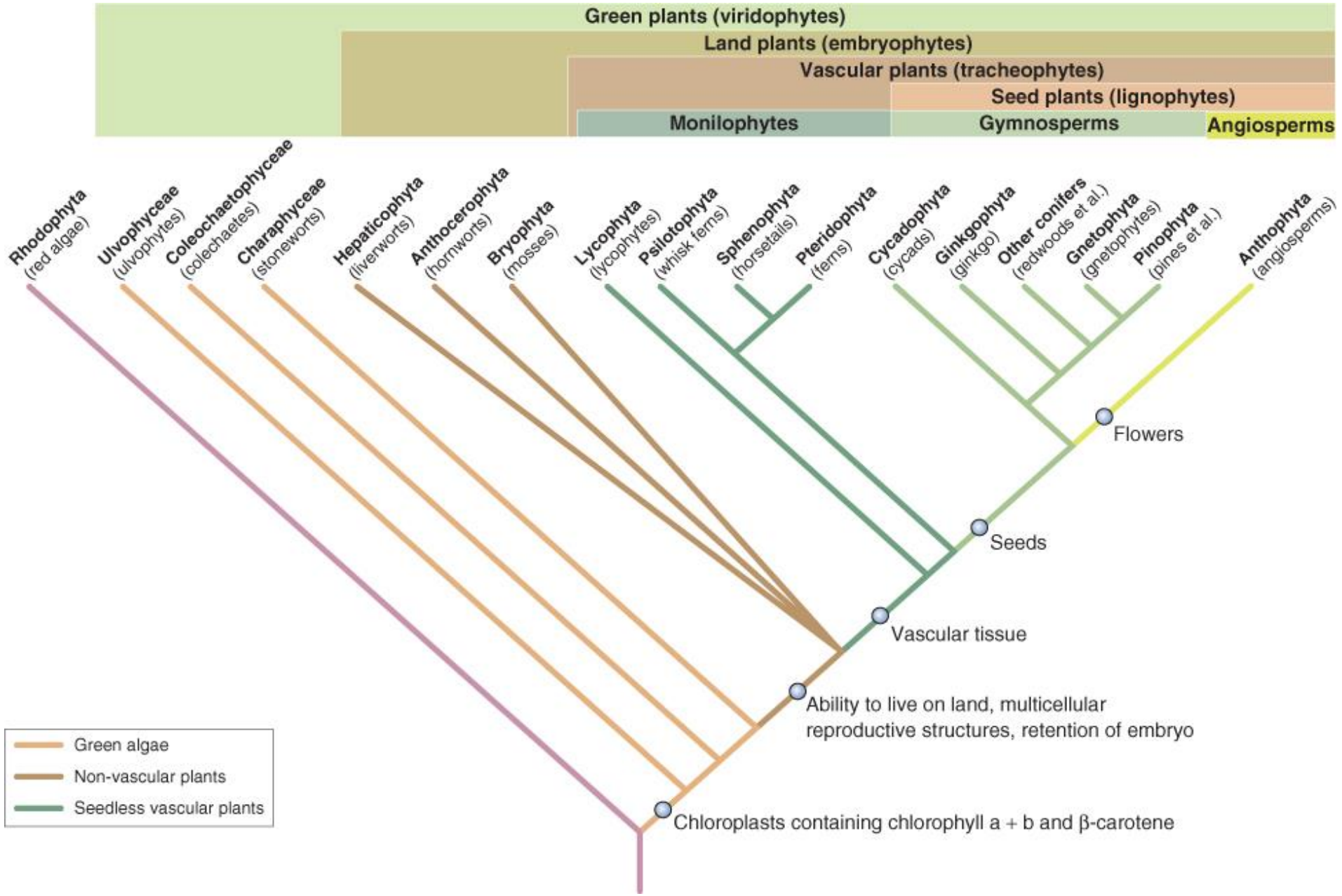
Dicots v Monocots – other differences

Characteristics of Monocots and Dicots

	Monocots	Dicots
Seeds	Single cotyledon 	Two cotyledons 
Leaves	Parallel veins 	Branched veins 
Flowers	Floral parts often in multiples of 3 	Floral parts often in multiples of 4 or 5 
Stems	Vascular bundles scattered throughout stem 	Vascular bundles arranged in a ring 
Roots	Fibrous roots 	Taproot 

Switch to Sporophyte Dominance




Green plants (viridophytes)
Land plants (embryophytes)
Vascular plants (tracheophytes)
Seed plants (lignophytes)
Monilophytes
Gymnosperms
Angiosperms
Rhodophyta (red algae)
Ulvophyceae (ulvophytes)
Coleochaetophyceae (colechaetes)
Charaphyceae (stoneworts)
Hepaticophyta (liverworts)
Anthocerophyta (hornworts)
Bryophyta (mosses)
Lycophyta (lycophytes)
Psilotophyta (whisk ferns)
Sphenophyta (horsetails)
Pteridophyta (ferns)
Cycadophyta (cycads)
Ginkgophyta (ginkgo)
Other conifers (redwoods et al.)
Gnetophyta (gnetophytes)
Pinophyta (pines et al.)
Anthophyta (angiosperms)
Flowers
Seeds
Vascular tissue
Ability to live on land, multicellular reproductive structures, retention of embryo
Chloroplasts containing chlorophyll a + b and β-carotene
Green algae
Non-vascular plants
Seedless vascular plants

Plant Ecology

Ecology

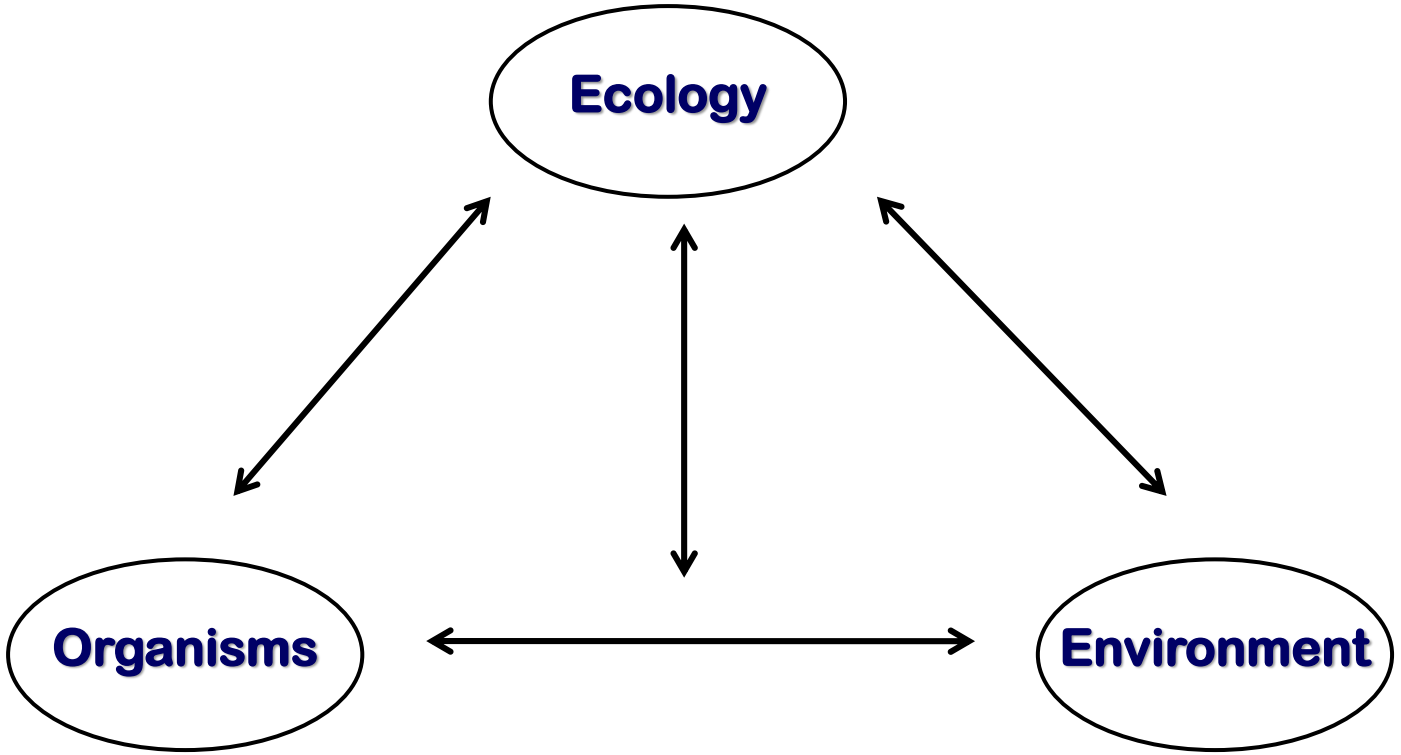
The word first coined by E. Haeckel (1869) and H. Reiter (1885) from the Greek words ***OIKOS*** (habitat or home) and ***LOGOS*** (the study or knowledge).

Ecology is the study of living organisms in relation to their habits and habitats.

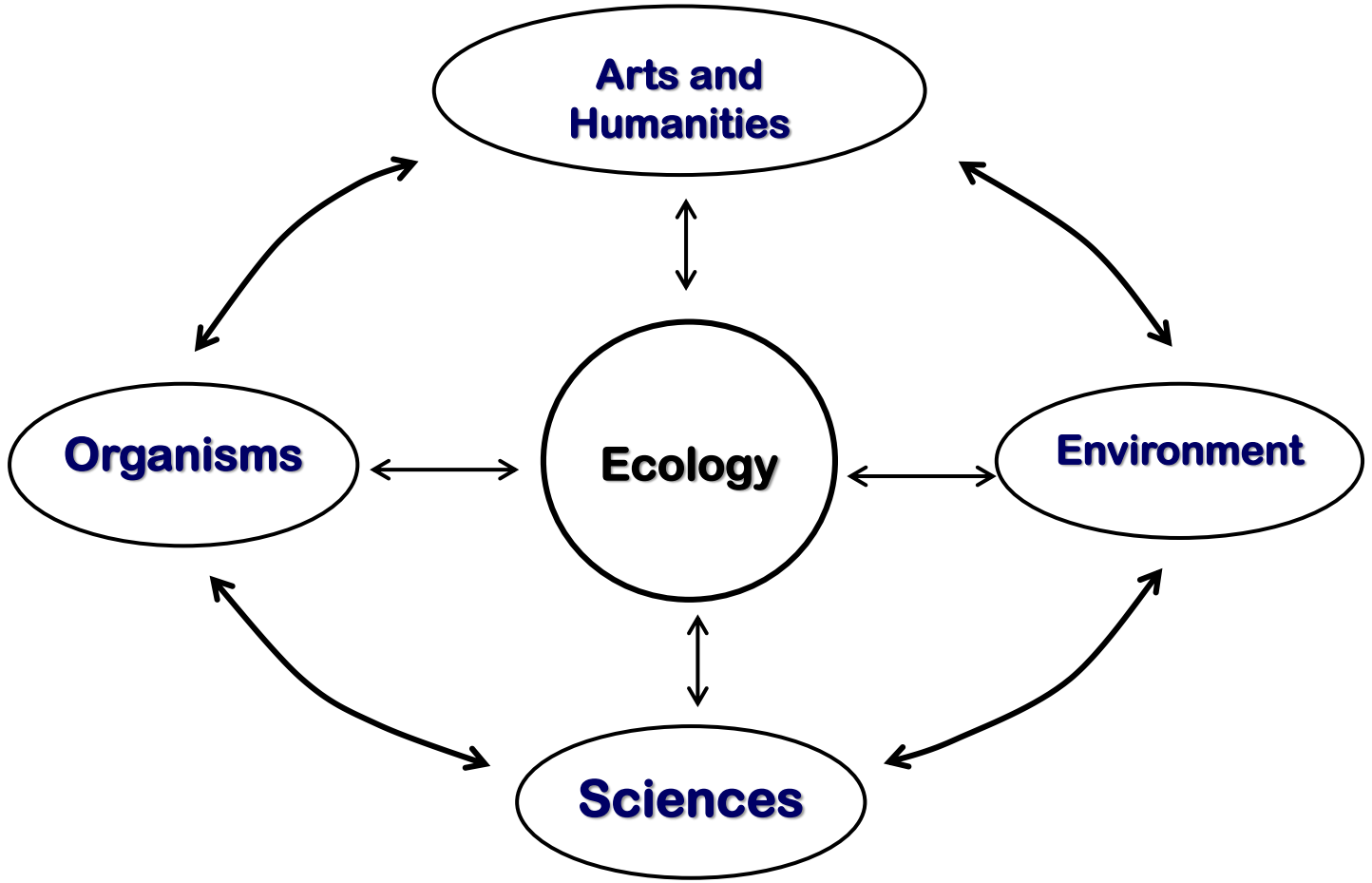
It seeks to explain how many different kinds of organisms can live together in the same place for many generations (share habitats).

It deals with the reciprocal relationships between organisms and their environment.

The reciprocal relationships between organisms and their environment



Odum (1971) and Clark (1973) have defined ecology as a science of ecosystems, i.e. study of the structure and function of nature.



The interplay of organisms and environment combines between objectivity of science and subjectivity of art.

The three fundamental ecological questions

- What is there?
- How much is there?
- Why is it there?

Environment

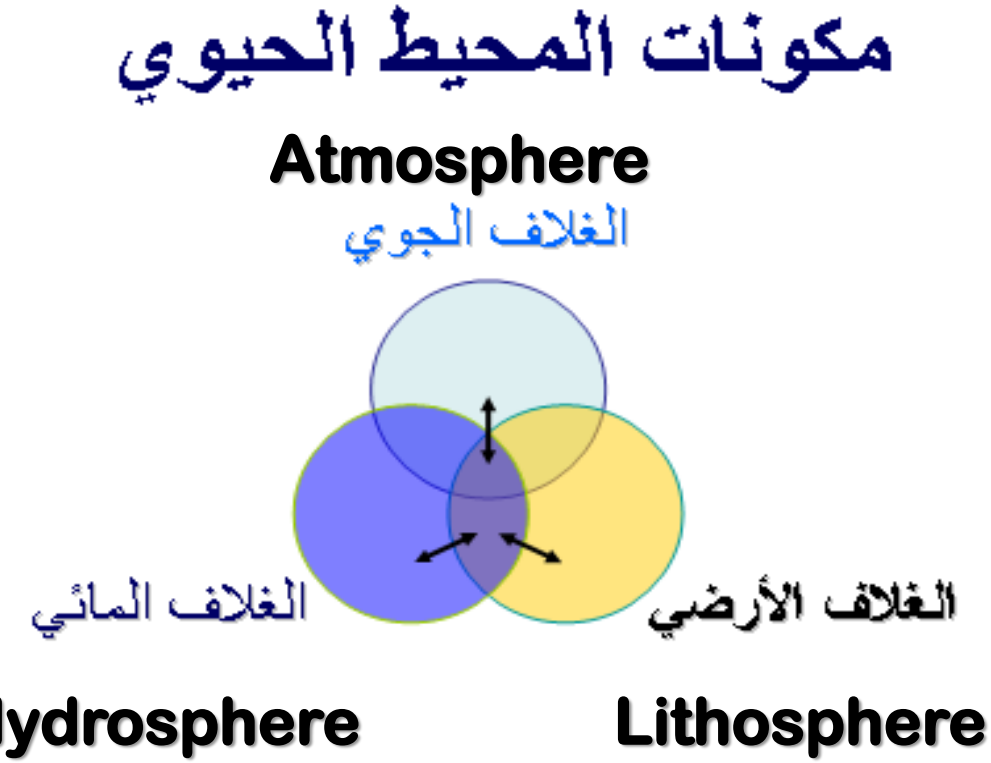
Summation of all biotic (living) and abiotic (non-living) components that surround or potentially influence the organisms and their habitats.

It is a complex of factors acting, reacting and interacting with the organism complex, i.e., organisms and their environment are wedded together in state of constant flux.

- Macro-environment (prevailing regional climate)
- Micro-environment (close to an organism to be influenced by it)

Biosphere (sphere of life)

Total portion of lithosphere, hydrosphere and atmosphere that supports the life of organisms.



Levels of organization

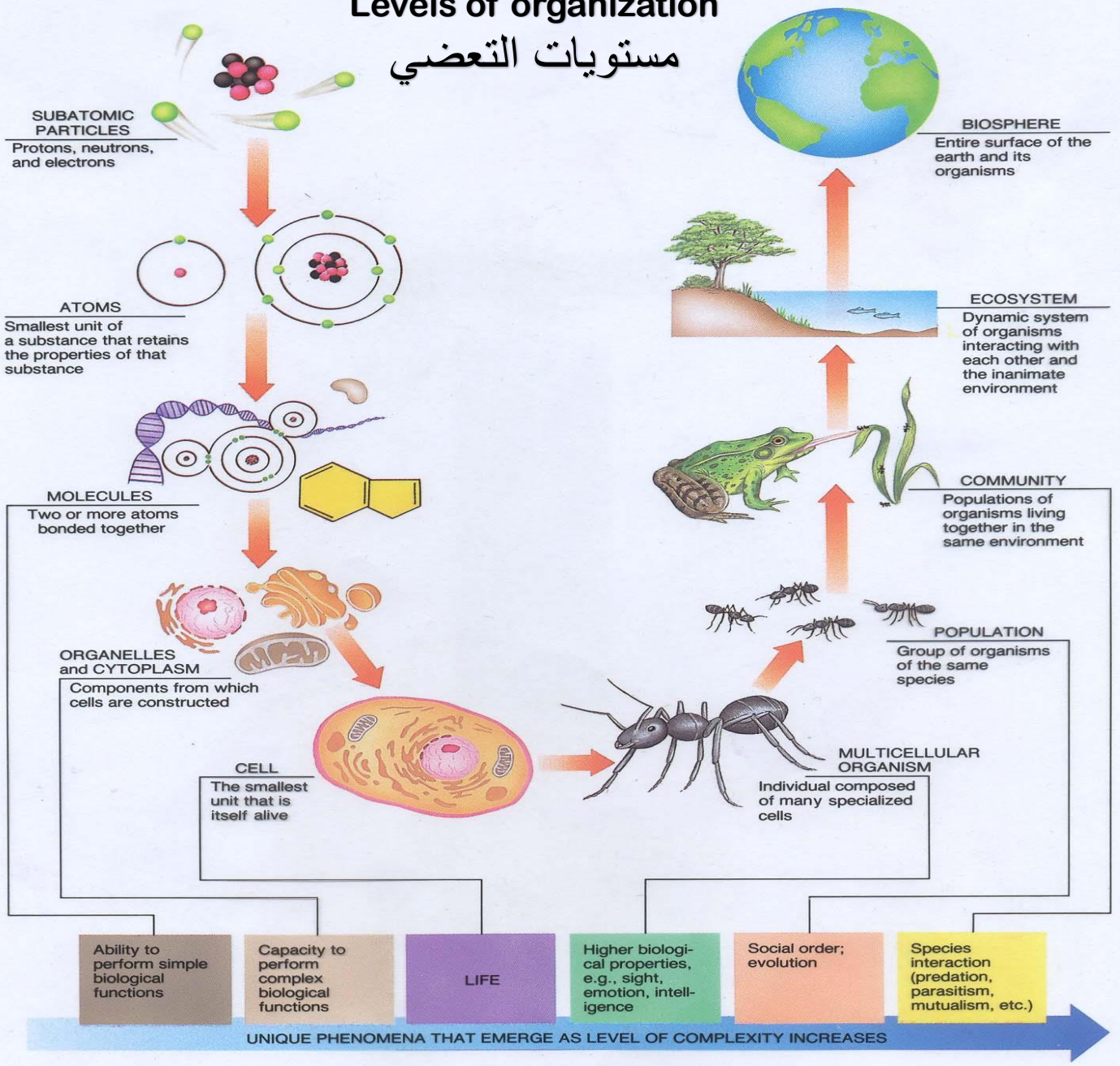
The biological portion of an interactive organism-environment system.

In ecology, the levels of organization include:

- **Individuals - the fundamental functional units.**
- **Populations - members of the same species co-occurring in space and time and sharing the same resources.**
- **Guilds - group of populations of different species exploit the same resources.**
- **Communities - populations of organisms living together in the same environment.**
- **Ecosystems – Dynamic systems of organisms interacting with each other and their environment.**
- **Biomes - regional ecosystem types with similar communities.**

Levels of organization

مستويات التعضي



Ecosystem

All organisms and their physical environment in a single location.

Self-sustaining and self-regulating communities of organisms interacting with one another and with their environment.

The matter that cycles into and out of the ecosystem is small compared with the quantities that are internally recycled in a continuous exchange of the essentials of life.

Various ecosystems make up the largest life unit called biosphere.

Ecosystem structure

1. Abiotic components

- Energy - solar energy
- Physical factors - temperature, light, wind, etc.
- Chemicals - inorganic substances (oxygen, carbon, etc.) and organic substances (carbohydrates, proteins, etc.)

2. Biotic components

- Producers - green plants (autotrophs)
- Consumers - animals (heterotrophs)

-Herbivores (primary consumers)

-Carnivores (primary, secondary, tertiary, etc. consumers)

-Omnivores (generalists)-can feed on both plants and animals.

-Scavengers (top carnivores)-utilize the dead remains of animals

3. Decomposers (saprotrophs)

bacteria and fungi

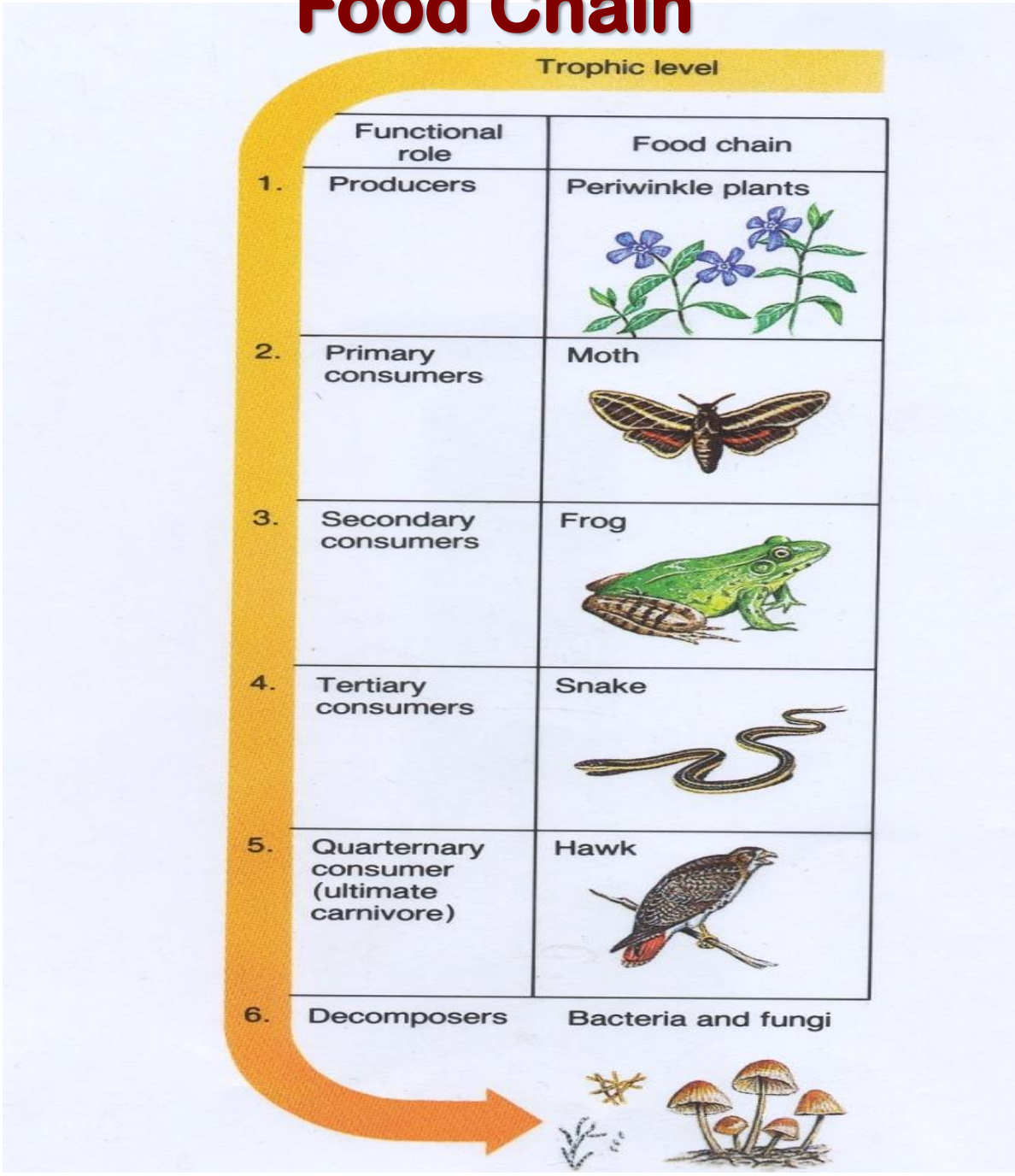
Food chain

A linear energy and chemical flow through organisms

i.e. food from one trophic (feeding) level reaches to the other trophic level (who eats whom?).

In the classical food chain, plants are eaten only by primary consumers, primary consumers are eaten by secondary consumers, secondary consumers are eaten by tertiary consumers, and so forth.

Food Chain


Trophic level
Functional role
Food chain
1. Producers
Periwinkle plants
2. Primary consumers
Moth
3. Secondary consumers
Frog
4. Tertiary consumers
Snake
5. Quarternary consumer (ultimate carnivore)
Hawk
6. Decomposers
Bacteria and fungi

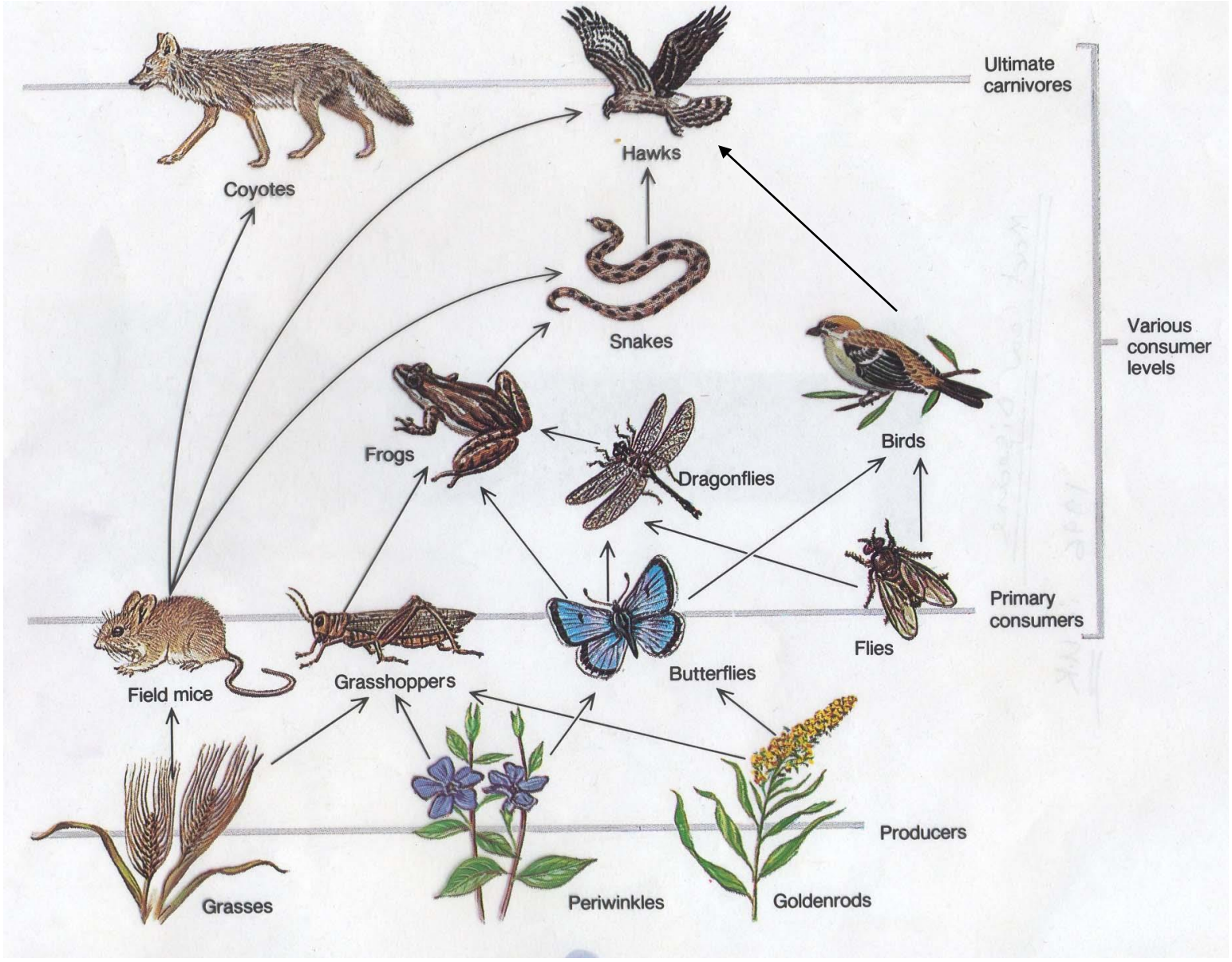
Food web

The actual pattern of food consumption in a natural ecosystem.

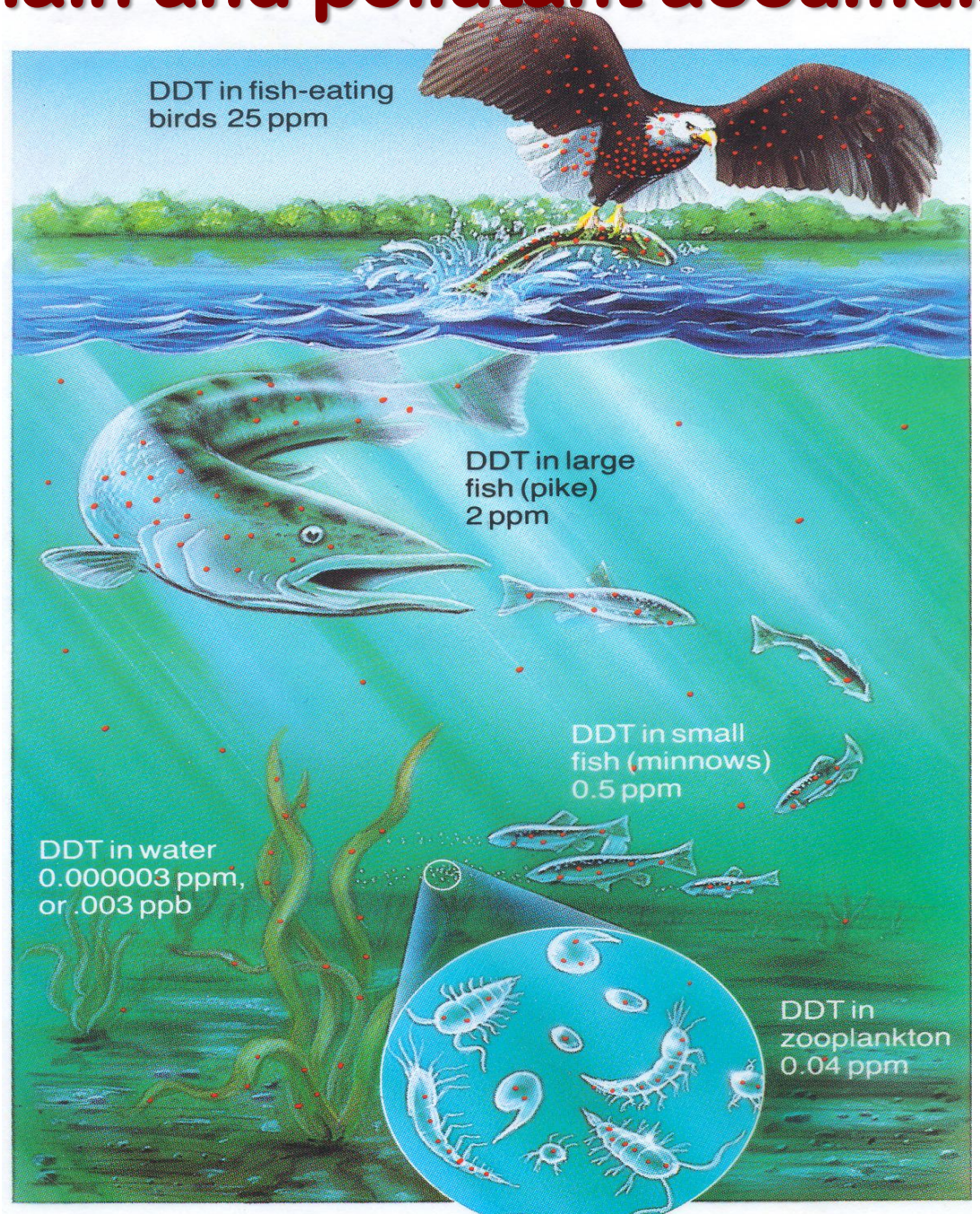
A given organism may obtain nourishment from many different trophic levels and thus gives rise to a complex, interwoven (interconnected) series of energy transfers.

The more complex the food web, the more stable the ecosystem.

Food web


Ultimate carnivores
Hawks
Coyotes
Snakes
Various consumer levels
Birds
Frogs
Dragonflies
Flies
Primary consumers
Butterflies
Grasshoppers
Field mice
Producers
Grasses
Periwinkles
Goldenrods

Food chain and pollutant accumulation



Types of Systems

(1) Closed system: Energy but not matter is exchanged between the system and environment, e.g., earth.

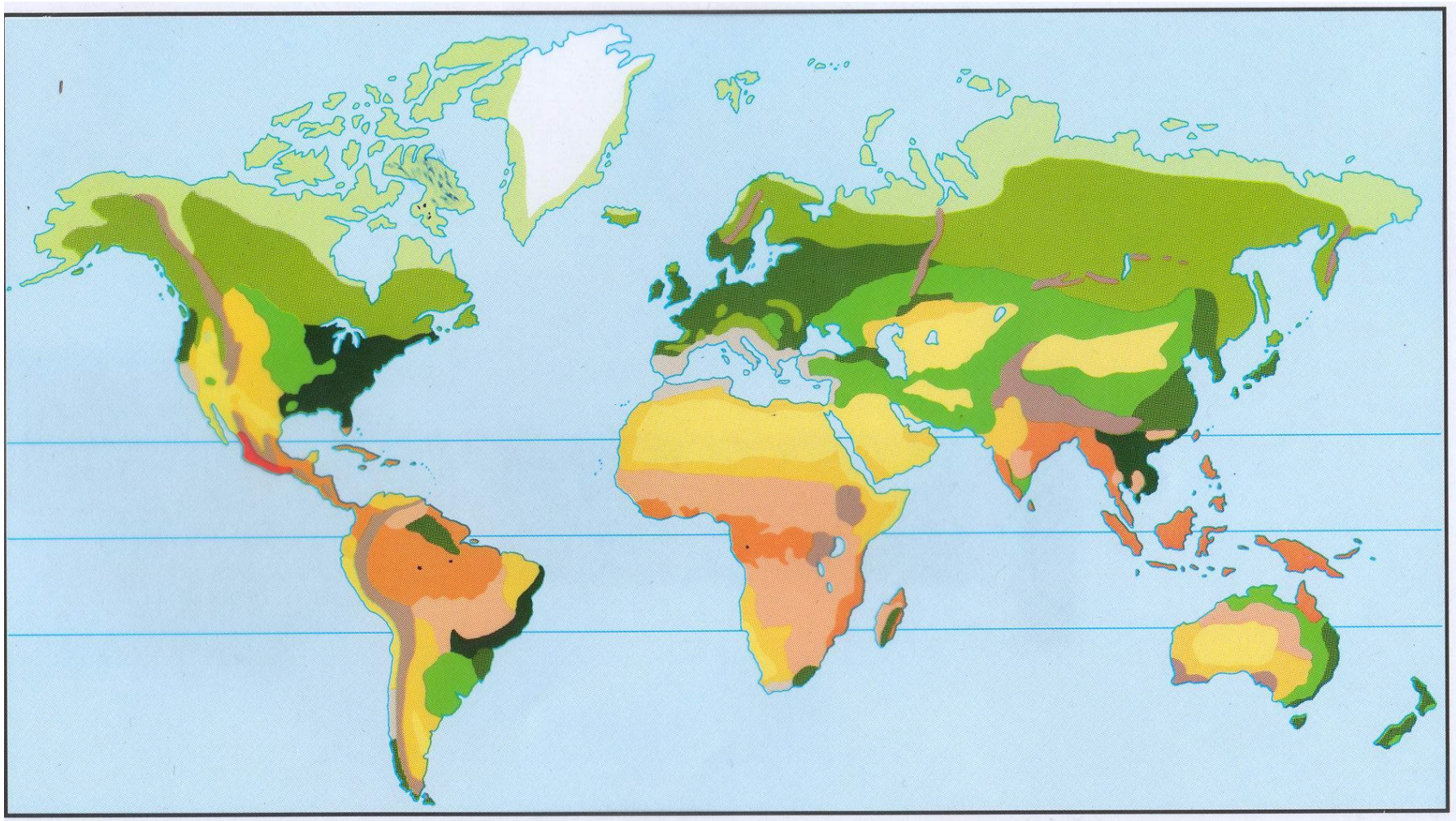
(2) Open system: Both energy and matter are exchanged between the system and environment, e.g., lakes or living organisms.

(3) Isolated system: Neither energy nor matter are exchanged between the system and environment, e.g., (examples and comments given as student assignment).

Zonobiomes (Biomes)

1. Equatorial diurnal climate	المناطق المدارية اليومية
2. Tropical	المناطق الاستوائية
3. Subtropical (Desert)	المناطق تحت الاستوائية (الصحراء)
4. Mediterranean	مناطق البحر المتوسط
5. Warm temperate	المناطق المعتدلة الدافئة
6. Temperate	المناطق المعتدلة
7. Arid temperate (Continental)	المناطق المعتدلة الجافة (المناخ القاري)
8. Cold temperate	المناطق المعتدلة الباردة
9. Arctic (Tundra)	المناطق القطبية (التندرا)

Zonobiomes


Tundra
Coniferous forests (Montane and Taiga)
Deciduous forests
Grasslands
Shrublands (chaparral, mediterranean, and tropical)
Deserts
Tropical rain forests
Semidesert (including tropical thornwoods) arid grasslands
Mountains with mixed biomes
Tropical savannas

Allelopathy

- **Allelopathy** is a **chemical interaction** between two or more populations that suppresses one population while the another remains stable through the release of metabolic by-products (**allelochemicals**) into the environment.

- The allelochemicals are selectively toxic, affecting some species but not the others.

- Many allelopathic species release **autotoxic** compounds which affect their own growth and development negatively (**Autopathy**).

- To gain a selective advantage, there must be a trade-offs between allelopathy and autopathy through which the source (donor) species inhibits the target (receptor) species more than its self-inhibition.

- **Amensalism**: An interaction between two populations in which one **is not** affected and the other is **negatively** affected.

- **Commensalism**: An interaction between two populations in which one **is not** affected and the other is **positively** affected.

- **Predation**: An interaction in which one living organism serves as a food source for another organism; one **positively** (predator) affected and the other is **negatively** (prey) affected.

- **Parasitism**: An interaction in which an organism serves as a food source (host) for other organisms (parasites) that commonly are much smaller in size, ultimately results in the death of, or detriment to, the host organism.

- **Symbiosis**: An interaction in which both species are positively influenced as a result of their co-occurrence (happy and strong together).

- **Mutualism**: An interaction in which each member derives a positive benefit and also provides a portion of the cost of the interaction.

THE END ...