-Easy to use, but can be challenging because of the significant variation that can exist within a species
-Individuals of the same species can exhibit variability in shape, size (males larger than females), eye color, and features (reproductive organs, male lions have manes and female lions don't)

**Phylogenetic Species Concept:**
Biologists can define "species" based on evolutionary relatedness between the among species (characteristics to group organisms)

**Using Phylogeny:**
-Modern biological classification systems are starting to rely more on evolutionary relatedness rather than morphology and reproduction
-DNA technology can now be used to identify species
-The closer the DNA= the more closely related organisms are

**Evidence used to determine relatedness:**
-Anatomical characteristics (anatomy)
Ex) features that have a common evolutionary origin, comparing embryos
-DNA
Ex) 93% of human gene match with the macaque monkey, 98% match with chimpanzees

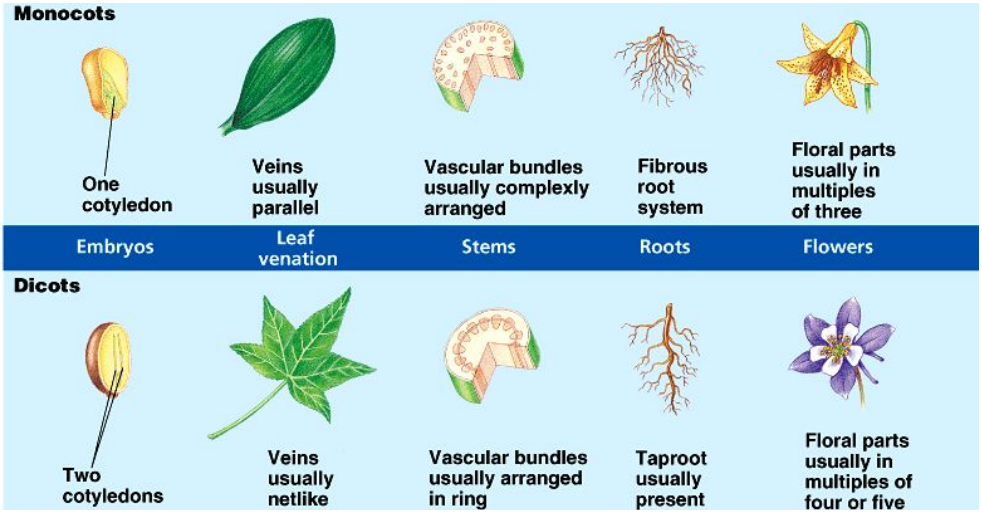


**Why do we not always use the Phylogenetic Concept?**
-Evolutionary histories are not known for all species
-Difficult to obtain DNA samples from extinct organisms

**Phylogenetic tree:**
-A branching diagram depicting evolutionary relatedness between different species or groups
-The base of the tree represents the oldest ancestral species, and upper ends represent more recent descendants
-A fork or node represents the points where an ancestral species split into two new species
-This point represents the most recent common ancestor of all descendants after it

**Comparing Prokaryotic and Eukaryotic Cells:**

| | **PROKARYOTE** | **EUKARYOTE** |
|---|---|---|
| **Meaning of name** | Pro=before Karyon=nucleus | Eu=true Karyon=nucleus |
| **Evolution of First** | Appeared 3.5 billion years ago | Appeared 1.5 billion years |




**Photosynthesis:**

Carbon Dioxide + Water + Light Energy → Glucose + Oxygen

-Occurs in the chloroplasts

-Converts solar energy into chemical potential energy

*Glucose must go through cellular respiration to be used

**Cellular respiration:**

Glucose + Oxygen → Carbon dioxide + Water + usable energy (ATP)

-Turns chemical potential energy into usable energy

-Occurs in the mitochondria



**Leaves:**

| Part | Structure | Function |
|---|---|---|
| Blade | -Thin, flat, and broad<br>-Attaches to stem by petiole<br>-Can be simple of compound | -Maximizes SA for light absorption<br>-Increases SA for gas exchanges<br>-Allows for materials to travel in and out of stem |
| Veins | -Contains vascular tissue<br>-Found in spongy mesophyll | -Transport sugar nutrients and water<br>-Maximizes distribution to all leaf cells |
| Epidermis | -Covered by waxy cuticle<br>-Do not contain chloroplasts<br>-Transparent | -Prevent water loss while performing gas exchange<br>-Since its transparent, allows light to pass through<br>-Protection against invaders |
| Mesophyll | -Palisade mesophyll is elongated<br>-Cells have many | -Tightly packed so maximizes light collection for photosynthesis |

| | | |
|---|---|---|
| | barrier (Casparian strip) | |

**Mycorrhizae:**
-Fungi and plant roots
-Plant provides sugar for fungi
-Fungi increase surface area for more nutrients available for plants to absorb and release enzymes the plant can absorb

**Solutions to adapt life on land:**

| **Solutions to adapt life on land** | **What it's for** |
|---|---|
| Waxy cuticle | -Waterproof coating<br>-Blocks evaporation (prevents water loss from inside the plant)<br>-Found in all land plants |
| Roots | -Obtain water for photosynthesis<br>-Anchors the plant<br>-Obtain nutrients the plant builds it's body from |
| Stomata | -Gas exchange<br>-Prevents water loss<br>-Found in all land plants |
| Leaves | -Large SA to volume ratio<br>-Sunlight absorption<br>-Obtains carbon dioxide from the atmosphere through the stomata |
| Xylem and phloem | -Transport tissues<br>-Xylem transport water<br>-Phloem transport nutrients and sugar |
| Stems | -Contain xylem and phloem<br>-Provides structural support<br>-Resists gravity so the plant can grow<br>-Herbaceous and woody stem |
| Seed | -Responsible for reproduction<br>-Protects embryo from drying up<br>-Gives embryo food until it can survive on its own |
| Flowers and fruits | -Found in angiosperms<br>-Flowers: contain reproductive parts: pollen (male sex cell) and ovule<br>-Fruits: protects the seed, allow it to be dispersed<br>-Both increase survival success and reproduction (colors and nectar attract |

- Rock layers contain fossils of many species that do not occur in layers above or below.

**Charles Lyell (1797-1875):**
-He developed the theory of uniformitarianism, which is that:
- The same processes in the past that are occurring now have changed Earth.
- Geological change is slow and gradual rather than fast and catastrophic.
- Natural laws that influence these changes are constant and eternal, and they operated in the past with the same intensity as they do today.

**About Darwin:**
-Age 22
-Studied religion in school
-Sails from England in 1831
-Ship name: HMS Beagle
-Traveled for 5 years

**Brazil:**
-Job was to collect and log species (Naturalist)
-Relates nature and religion
-Thinks everything in nature has been made by a creator
-Thinks all species are immutable
-Views species as parts of a divine plan



**South America- Uruguay:**
-Looks for both fossils and living animals
-All species found in South America are only found in South America and questions where new species came from
-Discovers the bones of huge creatures
-Found enormous creatures fossils that resembles an Armadillo and a sloth
-Glyptdon: Ancestor of Armadillo
-Megatherium: Ancestor of Sloth
-Darwin noticed a relationship because these large fossils were the same structure of modern day animals (sloth and armadillo) and are found in the same area
-Discovered a relationship between past and present species: One species changes overtime into another species
-Also says extinction is possible

**Argentina (Patagonia):**
-Treks cross-country with Gauchos (The local men)
-Stubbles across a small Reha
-Looks very similar to an ostrich and cant fly
-He is about to eat Reha and realizes he is eating something different than one he saw before

-The mix of partially digested food, water, and gastric juices entering the small intestine

**Physical digestion:** 3 layers of muscle contractions
**Chemical digestion:** gastric juices denature proteins; pepsin breaks down proteins into smaller parts

**The pancreas:**
-Chyme from stomach is very acidic and can easily destroy small intestine
-To prevent this, the pancreas produces sodium bicarbonate (a base), which raises the pH of chyme from about 2.5-9

**Digestive enzymes secreted from pancreas:**

1) Lipase: breaks down triglycerides into glycerol and fatty acids which can enter the blood stream
2) Pancreatic amylase (same as Amylase): breaks down starch into maltose
3) Trypsin (same as pepsin): breaks down protein into smaller chains

**The liver:**
-Produces bile (emulsifier), which is stored in the gall bladder
-Bile salts mechanically act like detergents by breaking down fats into smaller clusters
-Bile separates large globules of fat into smaller ones to increase their surface area
-Now lipases break them down faster into their component glycerol and fatty acids



**The small intestine:**
Divided into three regions:

1) **Duodenum:** the first region after the stomach. It is the shortest region (25 cm) and the widest. The pancreatic and bile ducts secrete here
2) **Jejenum:** the middle region is approx. 2.5 m in length. Contains the highest density of villi and intestinal glands. Where remaining proteins and carbs are broken down
3) **Ileum:** the region before the large intestine contains fewer and smaller villi. Absorbs nutrients and remaining go to the large intestine. 3 m

-The small intestine is the main site for chemical digestion and absorption of nutrients
-Two important features are:
1) Enzymes
2) Large surface area for absorption

**Secretions of the small intestine:**
Maltase: breaks down maltose into glucose
Peptidase: breaks down small protein chains into amino acids

**Absorption:**

-Once food is broken down to its final product (monomers) it must now be absorbed through the blood stream
-To maximize SA on the small intestine, it is a very long winding system of tubes covered in millions of tiny finger-like projections called villi
-Each individual cell has projections called microvilli
-There are small intestinal glands that occupy the spaces between the villi and secrete intestinal juices
-Within each villus there are two different vessel networks (one for blood and one for lymph)
-The blood vessels are the smallest and thinnest of all the vessels known as capillaries
-The water-soluble products of digestion are transferred here to be transported through the body
-The lymph vessels are called lacteals and take in materials like fats to be transported around the body

**Digestion of fats:**
Fats are difficult to digest because they don't dissolve in water; they tend to stay in clumps

**Vitamins and minerals:**
-Along with the 3 main macromolecules our bodies need micronutrients in the form of vitamins and minerals
-These dissolve in water or fat (fat soluble vitamins include A, D, E, K) and are absorbed along with them



**The large intestine:**
-Some parts of food are indigestible and make it to the large intestine
-They are bundled together with others wastes to form the feces
-Cellulose is the main component of feces
-The main function of the large intestine is to absorb water and dissolve minerals from any undigested foods
-This is also the region where intestinal bacteria produce vitamins B12 and K and some amino acids
-Also a site for the reabsorption of water
-The rectum is the region at the end of the colon where feces is held until it is passed through the final opening, the anus

**The two sphincters on the large intestine:**
1) External anal sphincter: where feces is held until it is egested
2) Internal anal sphincter: where feces is released

**Three main parts of the large intestine:**
1) Ascending colon
2) Transverse colon
3) Descending colon

-Your tissues require macronutrients
-These macronutrients are broken down and absorbed into the blood in the digestive system
-These allow cells to grow, function, and derive energy
-Deriving energy requires one other essential ingredient; oxygen
-Every cell in your body needs to receive oxygen and glucose and must remove carbon dioxide

**Arteries and veins (both organs):**
Arteries-carry blood away from the heart (oxygenated)
Veins-carry blood to the heart (deoxygenated)

**Differences between veins and arteries:**
**Artery:** smaller diameter, thicker wall, elastic layer (keeps blood flowing in one direction) and this result in high-pressure environment
**Vein:** thinner wall, large diameter, valves (keeps blood flowing in one direction) results in low-pressure environment

**Two systems in the circulatory system:**
1) Pulmonary circuit (heart→lungs→hearts)
2) Systematic circuit (heart→body→heart)



**The passage of blood through the heart:**
-Blood oxygenated in the lungs
-Heart pumps blood (high in O2 concentration) to the body though the arteries
-Gas exchange occurs. O2 delivered to the cells. CO2 back to the blood
-Deoxygenated blood returns to the heart through the veins
-Heart pumps blood back to lungs for gas exchange

**About the heart:**
-The heart a muscle that relaxes to fill with blood and contract to pump the blood
-Your heartbeat is a double pump
-"LUBB-DUBB" sound is noise of valves closing
-First, both atria relax, allowing them to fill with blood
-This relaxation is called diastole
-The first pump pushes blood from the atria into the ventricles (filling the ventricles)
-Valves between the atria and ventricles prevent backflow of the blood (AV valves)
-The second, stronger (thicker) pump pushes blood from the ventricles to the lungs and body
-This contraction of the heart is known as systole (emptying the heart)
-A valve in the pulmonary artery and one in the aorta prevent the blood from flowing back into the ventricles when the heart relaxes after each pump
-"LUBB": AV valves closing
-"DUBB"-semilunar valves closing
-**SA Node** "pacemaker of the heart", causes the atria walls to contract