Diversity of Life – based on Kim Brown PowerPoint's

Viruses: The Non-living Parasite

- Viruses are not alive! They do not meet the criteria of life.
- Have no metabolism – they don't consume (eat) or use energy
- Don't grow
- Don't develop as they age.
- Are completely parasitic: must enter a host cell to replicate

How Viruses are Named

- The disease they cause (polio virus, HIV virus)
- The part of the body they infect (adenovirus affects adenoid tissue in back of throat)

Bacteriophage

A bacteriophage is a virus that attacks bacteria

Structure of Viruses

- Nucleic acids surrounded by capsid (protein coat)
- Large viruses: surrounded by an envelope.
- Nucleic acids contain instructions for making more copies of the virus

How Viruses Work:

- The virus finds and attaches to a specific host cell.
- The attachment process resembles a spaceship docking procedure.
- Each virus can only attach to one kind of cell due to a lock and key type of fit.

Entry into the Cell:

- There are two ways the virus can enter the cell:
  - Virus injects nucleic acids into the cell and leaves capsid outside.
  - Endocytosis: The entire virus enters the cell wrapped in cell membrane. Once inside the cell, the viral DNA replicates and produces more virus.
- There are two viral cycles:
  - The Lytic Cycle -- The Lysogenic Cycle

The Lytic Cycle

- The virus uses the cell's materials and energy to replicate.
- New viruses burst from the cell
- Cell is killed
- New viruses are released into the body to infect and kill more cells.
- How the lhe lytic cycle works:
  - The virus injects its DNA into the cell
  - The viral DNA is replicated using parts and metabolism of the host cell
  - The new viruses burst from the cell, killing the host. The viruses released into the system infect other cells.

The Lysogenic Cycle

- Viral DNA is mixed into the host DNA (is now a *provirus).*
- The provirus DNA is copied every time the cell replicates
- Viruses remain dormant until a trigger activates them.
- All viruses enter a lytic cycle similtaneously
- All the host cells are killed at once.
- How the lysogenic Cycle Works
  - The virus attaches to the host cell
  - The virus injects its nucleic acid into the cell
  - A provirus forms (temporary virus that is incorporates itself into the DNA of the host).
  - Eventually, some trigger causes the viruses to enter a lytic phase, releasing them and killing the host cell.

Examples of Lysogenic Viruses

- Reoccurring cold sores
- Genital herpes
- Chicken pox (which heals, but stays in the system and recurs occasionally as shingles.
- Hepatitis B
- HIV

HIV and AIDS

- HIV (lysogenic provirus) affects white blood cells.
- Viruses enter and are replicated by cells.
- Eventually, all the white blood cells are infected.
- When triggered, proviruses will kill all the white blood cells at once (AIDS).
- Person loses resistance to infection and dies.

The Prokaryotes: Archaebacteria and Eubacteria

- All bacteria are prokaryotes: What is a prokaryote?
  - Have cell walls, ribosomes, circular DNA
  - No nucleus or organelles
  - Use flagella to move.
  - Single cells
  - Use pili for reproduction

The Two domains of bacteria:

- Archaebacteria: the extremists
- Eubacteria: the heterotrophs and autotrophs

Domain Archae

- Archae: the extremists
- More similar to eukaryotes than to eubacteria
- Produce methane gas.
- Live in extreme, oxygen-free environments
  - Marshes
  - Lake sediment
  - Digestive system of ruminants
  - Found in deep ocean vents where they use the vent energy to live
  - They live in high salt environments, like the Great Salt Lake and the Dead Sea.
  - Some live in hot sulfur springs where they convert sulfur to energy
  - Others live in sewage disposal plants, breaking down sewage

Domain Bacteria

- One kingdom: Eubacteria
- Single-celled organisms lacking nucleus and organelles
- Two feeding methods:
  - Heterotrophs:
    - Heterotrophs
    - Parasites
    - Saprophytes (break down and feed on dead matter)
  - Autotrophs: make their own energy
    - Photosynthetic Bacteria
      - Use sunlight to make food.
      - Includes cyanobacteria, which live in ponds, streams and moist land.
    - Chemosynthetic Bacteria
      - Use chemicals to make food.
      - Nitrogen-fixing bacteria: convert N2 from air to a form that plants and animals can use to live.

Identifying Bacteria

- Bacteria can be identified and classified in three ways:
  - Gram staining
  - Shape/arrangement
  - Feeding methods

Gram Staining

- Bacteria are categorized by how they react to gram stain.
- Structural differences in the cell wall cause two types of color changes
  - Gram positive bacteria turn purple.
  - Gram negative bacteria turn pink.
- Each category of bacteria are killed by different antibiotics, so identification of bacteria in an infection is very important to the treatment

Shapes and arrangements

- Bacteria are also Identified by shape. There are several basic bacteria shapes:
  - Coccus = spherical
  - Bacillus = rod-shaped
  - Spirillum = coiled
- Bacteria is also identified by the arrangement of these shapes:
  - Diplo- = double (diplococcus) – the shapes are attached in pairs
  - Staphylo- = looks like bunch of grapes (staphylococcus)
  - Strepto- = twisted (streptococcus) strands of a shape

Feeding Methods

- Bacteria are also identified by how they eat
  - Autotrophic – make their own energy
    - Photoautotrophs: use sunlight, CO_2, and water to make glucose
    - Chemoautotrophs: make glucose from chemicals in the environment
  - Heterotrophic – get energy from food sources (plants and animals)

Types of Reproduction in Bacteria

- Binary fission: the bacteria makes a copy of its DNA, and then splits in half with one complete copy of DNA in each of the new bacteria
- Conjugation: bacteria share DNA along pili (pili are like little bridges that form between two bacteria)

Things Bacteria Do

- Good bacteria:
  - Nitrogen fixing bacteria: make inorganic nitrogen molecules available for plants and animals to use
  - Decomposing bacteria: break down dead and decaying matter in the environment so that it can become available for plants and other organisms
  - Used to make food (cheese, pickles, yogurt)
  - Used to make antibiotics to kill bad bacteria
  - Used to help digestion (cows, termites use bacteria to digest cellulose in wood)
- Bad bacteria cause disease
  - Strep throat
  - Tuberculosis
  - Lyme disease
  - Tetanus
  - Cavities

Protista
The catch-all kingdom

- Protists are very diverse
  - May be unicellular or multicellular
  - Can be autotrophs or heterotrophs
  - Can be plant-like, animal-like or fungus-like
  - Can be microscopic or large
  - Can move through cilia, flagella, by changing shape, or not at all!
  - Found on land, in fresh water, or in the ocean.
- How they are alike: They are all eukaryotes which do not fit in any other kingdom.

Three main groups of Protists:

- Protozoa (Animal-like protists): like animals, but are unicellular
- Algae (Plant-like protists): like plants, but have no organs (roots, stems, leaves)
- Slime Molds/mildew (Fungus-like protists): like fungi, but can move around at some time in their life.

Protozoans: Animal-like protists.

Amoeba: the shapeless protozoans

- Constantly changing form
- Have the ability to surround & digest food, and constantly pump water out of their body.
- Attacking Prey
  - When the amoeba encounters prey, it moves by changing shape & oozing to the food
  - Surrounds the food, then captures and digests it
- Protozoa and Termites
  - Flagellated protozoans live inside the gut of termites and digest the wood, making nutrients available to the termite.

Cilia

- Thousands of cilia on the outside of protozoa help them to move.
- Paramecium have cilia

Protozoans & Spores

- Some protozoans (like Malaria) produce spores to reproduce

Malaria

More than 2 million people per year die from Malaria. Malaria affects red blood cells.

- Spread by mosquitoes in tropical places

Algae: Plant-like Protists

- Use photosynthesis to make food & energy
- Six types of algae: 3 unicellular & 3 multicellular
- Unlike plants, algae have no roots, stems or leaves

Euglena

- Lives in water, makes food *&* eats food
- Move with flagella

Diatoms

- Marine algae
- Diatoms make food for fish which is stored as oil. This oil gives fish their oily taste.

Fungus-like Protists: Slime Molds, Water Molds & Downy Mildew

- Like fungus, the fungus-like protista decompose organic materials.
- Unlike fungus, they move around during much of their life cycle.

Slime Molds

- Live in shady, damp places and grow on rotting leaves/trees/logs.
- It eats while creeping over the surface of decaying matter (logs/leaves).

Water Molds & Downy Mildew

- Fuzzy decomposers that live in water and moist places.
- Downy Mildew is a plant parasite

Kingdom Fungi

- Found everywhere (forests, water, air, basements, between toes).
- Decomposers: eat dead or decaying organic matter

Characteristics:

Like plants, most anchor in soil

- Most (except yeast) are multicellular
- Most reproduce sexually
- Heterotrophic

Structure of Fungi

- Fungi have thread-like filaments that develop from spores
- The filaments spread out into huge networks of fibers

Feeding Relationships

- Fungus feed in three ways:
- Saphrophytic: decomposers
- Parasitic: take nutrients from a host
- Mutualistic: work with another organism: both benefit.

Saprophytic: decomposer

- The saprophytic fungus breaks down and consumes decaying or rotting organic matter

Parasitic Fungus

- Penetrate host and steal nutrients

How are fungi harmful to humans?

1. Can cause disease (directly or indirectly)

Household Molds

•Long term water damage can lead to fungus (mold) that releases mycotoxins (toxic spores)
•This can cause flu-like symptoms, lung damage, or even death

Fungal Infections of the Skin

•Jock itch: intense burning/itching in groin area due to warm/moist conditions
•Athlete's feet: moist/warm feet leading to dry, flaky, itching, and burning between toes
•Ringworm: fungal infection that spreads out from initial infection, producing ring on the skin. Produces itching, redness.

2. Cause disease in plants or animals that we rely on for food

•Chestnut blight – a fungal infection that has virtually eliminated the American Chestnut Tree
•Fungal infections in crops (wheat, barley, tobacco, bananas…) significantly reduce yields

3. Cause rot or contamination of food

- Bread mold occurs when a mold spore lands on bread and grows into mycelium
- White mold in strawberries
- Blue or blue-green mold in tree-borne fruit
- Caused by spores in air landing on and growing on fruit

4. Destroy almost all types of manufactured goods (except plastics and pesticides)

Beneficial Fungi

1. Fungi recycle important elements back into ecosystem (nitrogen, carbon)

- As decomposers, fungi break down matter in the soil & make it available for plants to use

2. Edible Fungi: Some are found in the wild, others are cultivated

- Morels: used in french dishes
- Truffles:
  - Allegedly an aphrodisiac
  - Distinctive, alluring smell
- White Button Mushrooms: the most popular and well-known edible mushroom
- Shiitake Mushrooms
  - Healing properties
  - Used by Chinese to boost immune system
  - Antioxidant that lowers cholesterol
- Portabello Mushrooms: Large mushrooms used as a meat substitute by many vegetarians

3. Fungi are used to make foods & drinks

- Fermentation of fungi (particularly yeast) is used in making food & drinks:

•Blue Cheese •Vinegar •Soy sauce
•Brie cheese •Wine/beer

4. Fungi are used as antibiotics & medicine

•Antibiotics (treats bacterial infection)
  - Penicillin
  - Cephalosporin

•Cyclosporin (immune suppressant)
  - Used after transplants to prevent rejection

•Statins
  - Remove harmful cholesterol from arteries
  - Reduces risk of heart disease/stroke

- Magic Mushrooms (Shrooms)
  - Originally used by Native Americans over 1000 years ago
  - Have a psychoactive affect (out of body feelings, color/spatial distortion, visual and auditory hallucinations)
  - Like LSD, but shorter duration

5. Mutualistic fungi: associations with other species that benefit both, like the lichens and mycorrhizae

The Plant Kingdom

What is a Plant?

A plant is a multicellular eukaryote that can produce its own food in the form of glucose through the process of photosynthesis.

- Multicellular
- Eukaryote
- Autotroph (self-feeding)
- Uses photosynthesis to produce glucose
- Thick cell walls made of cellulose.
- Cuticle: waxy, waterproof covering on stems and leaves

Green Algae: Predecessor to the plant – Why?

- cellulose in cell walls
- chlorophyll
- photosynthesis.
- Store food as starch. All other organisms store food as glycogen.

The first actual plant was the liverwort. All other plants came from this one.

Plant Adaptations for Land

- Gametes = have protective covering.
- Cuticle on leaves prevent water loss
- Leaves trap light energy for photosynthesis.
- Roots: water/mineral absorption, anchors the plant in the ground, some store starch.
- Stem: support, transport of food and water.

Overview of the Plant Kingdom

- The 12 divisions are broken into two main groups:
  - vascular plants
  - non-vascular plants

Two main categories of Plants

1. Non-vascular Plants = **Bryophytes**. No vessels for moving food or water through plant
2. Vascular Plants = **Tracheophytes**. Have vessels for moving food and water.

Non-vascular PlantsThe Bryophytes

- No vascular tissue.
- Move water and food through osmosis and diffusion.
- Very slow and impractical method.
- Must be in moist environment
- Must remain small.

Three divisions: liverworts, hornworts, mosses

Liverworts

- Thought to be the first plant.
- May be the ancestor of all plants
- Shaped like the lobes of the liver

Hornworts

- Sporophytes resemble the horns of an animal.
- Grow in damp/shady habitats or in water

Moss

- Small plants with leafy stems.
- Leaves usually one cell thick.
- Have rhizoids which anchor the plant in soil.
- Peat Moss
- Grows in acidic environment
- Usually grow in dense carpets.
- Above: moss rhizoids
- Below: moist habitat for moss
- Harvested for use as fuel and garden fertilizer.

Vascular Plants The Tracheophytes

- Have vascular tissue: tubelike, elongated cells through which water/materials flow. (XYLEM carries water; PHLOEM carries glucose)
- Can survive in drier habitats & grow larger.
- Vascular plants are divided into seed plants and non-seed plants.

Non-seed Plants

- Reproduce by making spores
- Need watery environment to survive.
- Includes all non-vascular plants, plus the ferns, whisk ferns, horsetails and club mosses

Spores

- A single haploid cell with hard outer wall.
- Each spore will grow into a new plant

Kinds of Non-seed Plants

- All of the bryophytes (non-vascular plants): liverworts, hornworts and mosses.
- Four of the Tracheophytes (vascular plants):
  --Whisk Ferns --Club Mosses --Horsetails --Ferns

Whisk Ferns

1. Thin, green, leafless stems.
2. Vascular, but have no roots or leaves.
3. Have small scales covering stem.
4. Most are tropical.

Club Moss

- Vascular plants adapted to moist environments.
- Have stems, roots, small leaves.
- Often called ground pine because they look like tiny pine trees.

Horsetails

- Vascular plants
- Hollow, jointed stems covered with whorls of scale-like leaves.
- Some have silica scales covering the stem.
- Called scouring rushes because people used to use the rough stems to scour pots and pans.

Ferns

- Most diverse of the non-seed plants.
- Have been around for 400 million years
- Abundant in Plaeozoic and Mesozoic forests.

Fern Leaves

- Leaves, called **fronds**, are large and complex.
- Fronds are divided into leaflets called **pinnae**.
- Fern Spores

Spores are on the underside of the leaf in clusters called sori.
Fiddleheads
- Young ferns uncurl as they grow.
- They are called fiddleheads because their shape resembles the neck of a violin.

Seed Plants
- Produce seeds.
- Seeds protect the zygote from drying out and help disperse it.
- Seed plants are more evolved.

What are Seeds?
- A seed is an embryo and food source covered by a protective coat.
- Seeds protect the zygote from drying out and help disperse it.

Seeds can be surrounded by fruit or carried naked on the scales of a cone

The seed plants are divided into two categories:
- **gymnosperms (naked seeds in cones)**
- **angiosperms (flowering plants with fruited seeds).**

Gymnosperms
- Seeds are exposed rather than being hidden in a fruit.
- Most are in cones called **strobili**.
- Four Divisions of Gymnosperms **(from primitive to complex)**
  - Cycads
  - Gnetophytes
  - Ginkgoes
  - Conifers

- **Cycads**
- Palm-like trees with scaly trunks.
- Cycads produce male and female cones on separate trees.
- Common in Mesozoic era.
- **Gnetophytes**

Three distinct groups, each with different characteristics (*ephedra)*
- **Ginkgo**
- Only one species in this division: ginkgo biloba
- Ginkgos have fan-shaped leaves.
- Like cycads, have male and female trees.

--Male trees have pollen in strobilus (cone). --Female has seeds in fleshy, orange seed coat.
- **Conifers**
- Cone-bearing trees/shrubs with needle or scale-like leaves.
- Include pine, fir, cypress and redwood trees.

Cones
- Both male and female cones produced on a single tree.
- Male cones are much smaller than female cones.

Leaves
- Needle-like or scaly leaves
- Evergreen
- Adaptations to minimize water loss
  - thick epidermal wall with heavy cuticle
  - recessed stomata
  - shape reduces surface area
  - Needles bunches minimize weather damage

Angiosperms
- Flowering plants (flowers are reproductive organs)
- The fruit is the ripened ovary of a flower.
- Seeds enclosed in fruits.
- One division of Angiosperm:

Flowering Plants
- Large and very diverse division.
- Produce seeds and flowers.
- Have stems, roots, leaves.

Fruits
- Fruit texture and shape help with dispersal
- Many have shapes which the wind can carry
- Some are tasty to dispersers (animals).

Flowers and Pollination: Insects, birds and bats pollinate flowers

Two Groups of Angiosperms: Named for number of seed leaves (cotyledons) within the seed.

1. Monocotyledons– one seed leaf
2. Dicotyledons– two seed leaves

Monocots
- One seed leaf in cotyledon.
- Flower parts in multiples of three.
- Usually have leaves with parallel veins
- Grasses, lilies.

Dicots
- Two seed leaves in the cotyledon.
- Flower parts of four or five.
- Usually have leaves with branched veins
- More advanced than monocots

Life Span of Flowering Plants

Annuals – live for one year or less
- Most are herbaceous (green stems and no woody tissue).
- Most food plants and garden weeds.

Biennials – live for two years

Most have large storage roots (turnips, carrots).

Perennial – live for more than two years
- Lives many years.
- Survive by dropping leaves in harsh/cold weather.
- Produce leaves/seeds yearly.