

Properties of Life

| | |
|-----------------------------|--|
| Order | distinction, precise internal order |
| Evolutionary | changes that occurs over generations |
| Adaption | |
| Response to the environment | living organisms can respond to non-living |
| Homeostasis | range of values the body monitors, adjusts, and re-evaluates. Ex: temperature, blood pressure, blood sugar, cholesterol levels |
| Energy Usage | being able to take in things (non-living & living) and use energy |
| Growth & Development | |
| Reproduction | |

To Study Biology

Reductionism- start with a large problem and reduce it to several small things that can be studied easily. Ex: understanding DNA: looked at bacteria --> lower plants & animals --> higher animals & plants --> humans (human genome project)

Systems Biology

attempt to understand how the parts of systems interact with one another. Deals with large and complex questions

Ex: muscle tissue - calcium is required for muscle contraction. What if you had too much calcium in your body? How would it effect all the proteins necessary for muscle contraction?

Studying Systems Biology

| | |
|----------------------------|--|
| High throughput technology | computing capability. Ex: human genome project |
| Analyzing information | bioinformatics: power of a computer, modeling capability, statistical analysis |

Studying Systems Biology (cont)

| | |
|---|---|
| Interdisciplinary team (vary on question) | Answering one question the team might need an engineer, biologist, chemist, medical specialist, mathematician, computer specialists, etc. |
|---|---|

Order (hierarchy;simple to complex)

| | |
|---------------------|---|
| Emergent Properties | At all levels of hierarchy; comparing with each level. Unique and unpredictable at each level |
| Atoms | unit of matter that cannot be broken down by ordinary chemistry means(no nuclear activity) |

Biological molecules carbohydrates, lipids, proteins

Organelles tiny organ like mitochondria, cytoplasm

Cells smallest unit that has all characteristics of life

Tissue many cells that have the same function and work together. Ex: blood

Organ have many tissues that are operating for a common function

Organ System many tissues & organs that function together

Organism many systems together

Population many members of a species in a single location

Community many populations in a single location

Ecosystem many communities interacting with the environment

Planetary View Everything

Theme 2: Cells

| | |
|--------------------------------|---|
| Prokaryotic Cells | have one organelle (ribosome). No membrane bound nucleus. Primitive cells (has DNA). Pro=come before karyon= kernel "nucleus" |
| Eukaryotic Cells | Higher order cells. Lots of organelles. Eu= true karyon= kernel 'nucleus" |
| 1665- Robert Hooke:England | 30X magnification lens. Cork Cells (dead cells). gives the word "cell" |
| Antone Von Leuweenhoeck: Dutch | 300-400X magnification lens. Blood (large cells), Fish Sperm (large cells), Pus (white blood cells) |
| 1838- Schleiden | Plants- botanist. "All plants are composed of cells" |
| 1839 - Schwann | Animals- zoologist. " All animals are composed of cells" |
| Virchow:Russian | Cell Theory - All plants and animals are composed of cells and all of the functions of plants and animals take place inside cells and all hereditary molecules are contained within cells |

Theme 3: Continuity (sameness over time) of Life

- There is a presence of order
- Depends on inheritable material (DNA- all life uses the same DNA) for inherited instructions

Theme 4: Structure and Function (Always related)

Structure **what form that organism takes**
"Anatomy"

Function **what the organism does**
"Physiology"

- Bone Formation
 - Fish Bone: solid, sturdy, strong
 - Terrestrial Bone: hollow space inside (morrow cavity)
 - Bird Bone: hollow, spaces filled with air.
- Maximum protection, minimum weight

Theme 5: Organism Interacting with Environment

Both the organism and it's environment is changed

Ex: Tree. A tree is living and takes in water and materials, which are both non-living. Then using sunlight (non-living) and taking in CO2 using the chlorophyll organelle it goes through a process of photosynthesis.

Theme 6: Regulatory Mechanisms

Homeostasis "range of values"

Ex: blood pressure, blood sugar, temperature, hormone regulations

Theme 7: Unity and Diversity of Organisms

Unity Things that all organisms have in common. Ex: properties of life

Diversity variation of life forms that exists of Organism

Domain Largest. Three categories: Domain bacteria (all modern bacteria), Domain archaea (bacteria with ancient lineage, descendants of 1st life), Domain eukarya (everything else)

Kingdoms prokaryotic vs. eukaryotic/
heterotrophic vs. autotrophic/
multicellular vs. unicellular. Four categories: protista, fungi, plantae, animalia

Protista unicellular, eukaryotic, heterotrophic or autotrophic, plant-like (algae), animal-like (protozoa)

Theme 7: Unity and Diversity of Organisms (cont)

Fungi molds, mildews, mushrooms, parasites on plants and animals. first multicellular kingdom, eukaryotic, neither autotrophic nor heterotrophic they are absorptive feeders

Plantae multicellular, eukaryotic, autotrophic (all higher plants)

Animalia multicellular, eukaryotic, heterotrophic (all higher animals)

Phylum Many phyla in a kingdom. 30 major phyla in animal kingdom. 30 minor phyla in animal kingdom (estimate).

Class many classes within a phyla

Order many orders within a class

Family many families in an order

Genus many genese in a family

Species many species in a genus. True biological entity.

Genus scientific name

+
species

Theme 8: Evolution - Darwin

Evolution implies the presence of an ancestral form for a related organism
ex: mammals- fur (hair)

Charles Darwin: England

- published in 1859 "Origin of Species by Natural Selection"
- Natural Selection - mechanism of evolution taking place
- HMS Beagle, Ship's naturalist <-- ship Darwin got on

Theme 8: Evolution - Darwin (cont)

- traveled for 5yrs around South American and came across the island Galapagos. He focused on Finches: the islands towards the equator (warmest) had finches with long narrow beaks for nectar sipping. In the middle islands (temperate climate) had "normal" sized beaks for opening regular seeds. In the islands toward the arctic (coldest) had large, sturdy beaks for opening very heavy seed coats.

- It took Darwin 25 yrs to write the Theory of Evolution

Fact 1: All species have great reproductive potential

Fact 2: Most population remain the same size over time

Inference 1: production of more individual than the environment can support leads to a struggle for existence

only a fraction of each generation actual survives

Fact 3: Individuals in a population vary

Fact 4: variations that you can see are inherited

Inference 2: survival is not a random **survival of the fittest**

Inference 3: Differential reproductive success (unequal ability to survive) leads to gradual (gradualism) changes in a population over time (geologist)

environment determines who survives

Theme 9: Scientific Method & Reproducible Results

Scientific Method varies as the scientists who use it. Observation -> Hypothesis -> Experimentation. **You can never prove the hypothesis to be true, it can only be proven false.** Science is open-ended (leaves space in science for new information also is self correcting). To write and formulate a hypothesis (If..then statement) requires inductive reasoning (specific to general)

Theme 9: Scientific Method & Reproducible Results (cont)

Reproducible Results the experiment needs to be able to be repeated with the same equipment.

Fission Reaction split the atom, releasing a good amount of energy

Fusion reactions reactions that takes place on surface of the sun and release a huge amount of energy.

Theme 10: Science and Society

Cloning, Diseases, Viruses, Genetics, Climate Change

Inorganic Chemistry

Atom

- protons (positive, in the nucleus, weight)
- neutron (neutral, in the nucleus, weight)

total weight is found in the nucleus

- electron (negative, outside the nucleus, no weight)

--Atomic # : number of protons

--Atomic weight: (total number of protons and neutrons)

* Atoms that are not chemically combined with other atoms they have electrical neutrality
protons = electrons

* atoms all seek stability by having the maximum number of electrons in their outermost shell

* atoms will always do the easiest thing

*Charged particles are called IONS

*Ionic bonds are the characteristic bond of inorganic chemistry (Strong Bonds)

- forms when the electrons are given off and received by another atoms

If an atom has 1,2,or 3 electrons in the outermost shell it will give them up in order to become stable. If an atom has 5,6,or 7 electrons in the outermost shell then it will take on electrons in order to reach a stable state.

Inorganic Chemistry (cont)

No atom will give up its last electron, but it will share --> Covalent Bond

Ex: H₂O

- polar molecules are when there are a positively and negatively charged ends

Hydrogen bonds: tiny bonds, easily formed and easily broken (it gets strength in numbers, but when by itself it is weak)

Properties of Water

Surface Tension skin on the surface of water. Ex: insect that can walk on water: the strength of the hydrogen bonds exceeds the weight of the bug

Capillary Action water moving into fibers or into a straw. Adhesion: clinging of unlike molecules to each other (water to fiber). Cohesion: to cling like molecule to each other (water to water)

- Inhibition water moving into wood (solid)

Specific Heat very high for water, amount of heat it takes to raise the temp. of water. As you increase the temperature, you increase the rate of the molecular motion.

-Heat the measure of the movement of molecules

Heat of Vaporization for water is very high, amount of heat it takes to cause a change in the state (liquid, solid, gas) of water. Ability to break hydrogen bonds by adding heat to water so individual hydrogen molecules can go off the surface of the water (steam carries heat away).

Freezing individual water molecule