Evolution
Evolution – the gradual change over time
  Organic evolution – the process of continual change that occurs in a species over time
  Controlled organic evolution -
  Geologic evolution – the process of continual change that the earth undergoes

Evolution includes the change in characteristics of populations through generations

Evolution theory – states that existing life forms have evolved from earlier life forms
  Includes the change in characteristics of populations through generations

  Provides an explanation for differences in structure, function, and behavior among life forms

Supporting evidence of the theory of evolution
  Geologic record – the earth is about 4.6 billion years old – radioactive dating of rocks
  The upper layer are the newest and lowest level is the oldest

Fossils – the direct or indirect remains of organisms preserved by natural processes
  Provide the strongest evidence of organic evolution

Formation of fossils
  Amber and ice provide anaerobic conditions or severe cold. Decay of soft tissue does not occur. Entire organisms have been preserved – amber is the yellow transparent resin from trees – traps insects like in jurassic park

Fossil bones – hard mineral parts of animals – shells bones and teeth. These can be preserved for millions of years. You can use a fossil field guide to identify the organism

Petrification – the process in which remains are turned to stone. The original remains are turned to stone dissolve and are replaced by minerals which turn to stone

Sedimentation – The process by which remains are carried by streams and deposited. Then they are covered by fine particles of rock (sediments) the layers harden and the remains are preserved – sedimentary rock – shale

Fossil sequences:
  Sedimentary rock – acquires a layer structure
  The oldest fossils can be found in the lowest layer
  The newest are found in the upper layer
Evolution comparisons

Comparative anatomy – similarities between organism
Homologous structures – parts of organisms that are structurally similar but perform different functions – bat’s wing, whale’s flipper, humans arm, frog leg
Analogous structure – parts of organisms that have similar functions – but different internal structures – bird’s wing and a fly’s wing.

Vestigial structure – nonfunctional structures in an organism that are remnants of the structures that were functional to an ancestor – human coccyx and the pelvic girdle of snakes

Comparative embryology – similarities in embryonic (fetal) development
Closely related species show similar patterns of development
The more closely related two species are the longer they continue to resemble each other during development

Comparative cytology – comparing the cell make-up
All living things are composed of cells
Organelles are structurally and functionally similar in most organisms

Comparative biochemistry
Nucleic acids (DNA, RNA) are similar in related organisms
The closer the relationship the more similar the DNA
Many organism have similar proteins and enzymes
Amino acid sequences are almost identical in similar species – human and gorilla

Theories of evolution – attempts to explain the diversity among species
Jean Baptiste Lamarck
Theory of use and disuse – new organs arise according to needs of the organism
The size of the organ is determined by the degree of use

Theory of transmission of acquired characteristics
Useful characteristics acquired by an individual during its lifetime can be passed on to the offspring – tails in mice
Weisman – helped to disprove Lamarck’s theory. Showed acquired characteristics were not inherited – he cut of mouse tails over several generations
Charles Darwin – considered the father of evolution
Origin of species – a book written by Darwin - Based on:
Variation – the characteristics in individuals that differ from the typical characteristics of other individuals of the same species

Natural selection – the process whereby organisms w/ favorable variations survive and produce more offspring than less well adapted organisms

Six main concepts in the Origin of Species:
1) Overproduction – Species produce far more offspring than are needed to maintain a population.
2) Only a small # live to reproduce
3) Competition – space and food are limited. Offspring compete w/each other and other species for the necessities – the best adapted find food and shelter
4) Speciation – over generations favorable traits (adaptations) accumulate in species and unfavorable traits disappear.
5) A species is defined as a group of organisms structurally similar that pass Their traits on to the next generation
6) Reproduction – individuals w/ favorable traits tend to live long enough to Reproduce- the favorable traits are passed on to the next generation

Survival of the fittest – those individuals of a population that have adaptations that are advantageous normally survive and reproduce

Natural Selection – organisms w/ favorable variations survive and produce more offspring than those species that are less well adapted.

Artificial selection – when man selects certain traits to be passed on to future generations

Darwin’s theory did not explain how variations initially arise in a species
Alfred Wallace – similar idea to Darwin – except he did not include man leaving the option open for some sort of deity
Modern Evolution
The modern theory of evolution includes Darwin’s ideas of variation and natural selection and also a genetic basis of variations.

Variations – different characteristics
are the result of mutations, migrations of individuals between populations
Mutations – the appearance of a different gene form on a chromosome which produces a variation. Most mutations result in the death of the individual
Sexual reproduction – recombining different genes during sexual reproduction
Genetic recombination – new combinations of alleles

Natural selection
The environment decides which traits are favorable and which are not
Adaptable traits tend to survive and accumulate in future generations because those that have them reproduce
Non-adaptable traits tend to decrease with the next generation – parents are not as successful

Environmental conditions – determine what is favorable and changes w/in the environment can change the outcome of species

Isolation – any process which prevents two groups from interbreeding

Geographic isolation – changes in gene frequency that lead to the development of a new species occurs when a population is divided by natural barrier – mountains, desert, ocean etc..

Reproductive isolation – the loss of the ability to interbreed by two isolated groups
Also – when an isolated population becomes so different from the main population they can no longer interbreed – 2 distinct species

Founder effect – the gene frequencies in the main group is different from the gene frequencies in the isolated group

The time frame for the process of evolution
Scientists agree on the factors involved in evolutionary change but they disagree on the time frame

Theory of gradualism – (Darwin)
New species develop slowly building up small variations – eventually reproductive isolation occurs with an new species
Theory of Punctuated equilibrium
Species go a long time w/ no change and then major occur quickly leading to new species

Both of these are somewhat supported

Origin of Life:
Early theories
Spontaneous generation – AKA abiogenesis
The idea that living things regularly arise from non-living matter – maggots from meat
Louis Pasteur – disproved this theory
He proved that the presence of air alone could not produce microorganisms
Swan neck flask

Heterotroph hypothesis – the most widely accepted hypothesis for the origins of life
Proposed by a small group of scientists in the 1920 – 30’s
It states that the first organic compounds were formed by natural chemical processes on earth
The first lifelike structures could not synthesize their own organic nutrients
From inorganic compounds

Primitive earth – much different conditions than today rocks, hot thin ocean, primitive atmosphere
Raw materials – H2, H2O, NH3, CH4 – now it is O2, N2, CO2
Increased energy levels – oceans with temp. just below boiling - primordial Soup
Atmosphere – the gases alone did not block UV light – increased radiation
No ozone

Energy Sources – energy used for breakdown and formation of chemical bonds
Heat given off from the earth
Radiation from decaying radioactive elements
Electrical energy from lightning
Ultraviolet and visible light
X-rays from the sun

Formation of the oceans
Hot thin soup just below the boiling point – very shallow
Chemical reactions were likely to occur more rapidly and created conditions favorable for chemical reactions to occur
Synthesis of organic materials

Simple compounds in the atmosphere and oceans could have reacted to form more complex organic compounds.

There were sufficient elements and raw inorganic materials along with increased energy supplies.

Complex molecules became amino acids, nucleotides and sugars.

This is supported by experiments.

Aggregates – parts brought together by chance

Complex molecules formed aggregates.

Probably incorporated molecules from the seas as food. Carrying on heterotrophic nutrition.

In time they became complex organized and able to reproduce.

Aggregates considered alive when they were able to reproduce.

Heterotroph to autotroph

Heterotrophs produced energy similar to anaerobic fermentation.

Fermentation adds CO2 to the environment.

Some heterotrophs began using CO2 to make organic foods (CO2 + H2O → C6H12O6)

This was the start of autotrophs and aerobic respiration.

Anaerobe – don’t need O2 to produce energy.

Aerobe – needs O2 to produce energy.

Autotrophy added O2 to the environment – some organisms found ways to use it becoming aerobic.