



Evolution – genetic change over time

*Theory = explanation based on much evidence (do not confuse with "hypothesis")
*Not goal-oriented (can change and change back in response to environment)

I. Charles Darwin (1809-1882)

A. Darwin's Travels

- 1. Sailed on the HMS Beagle for 5 years starting in 1831.
- 2. Visited many places around world and carefully observed living things.



4. Galapagos Islands

- Darwin's most important visit.
- A group of small islands west of South America, each with unique environments and living things.







H.M.S. BEAGLE Revel

B. Darwin's Observations & Ideas 1. Organisms on each island fit their environments.







a. Adaptation - physical or behavioral traits that enable an organism to survive the selective pressures in its environment.



How do these catfish videos illustrate the concepts of **SELECTIVE PRESSURES & ADAPTATIONS**?

Video 1: Selective Pressures: _____ Adaptations: _____ Video 2: Selective Pressures:______ Adaptations:_____

b. Darwin's Finches – small birds on each island

which looked similar but had changed beak shapes

(adaptation)

according to different food types

(selective pressure)



 Geospiza fortis
 Certhidea olini Finches from Galapagos Archipelago





- 2. Darwin's theory explained the **variation** of individuals in a population and the **overproduction** of offspring.
 - Gives nature a variety of traits to choose from
 - An "insurance policy" that some will survive



- 3. Origin of Species
 - 1. Darwin's book published in 1856.
 - 2. Described his theory that all living organisms are

constantly changing in response to their environment.



II. Evidence for Evolution

A. **Fossils** - when comparing fossils of different organisms,

shared characteristics may show a common link.



*Fossils that connect different groups of organisms are called **"Transitional Fossils"** (*aka: "Missing Links"*)

Example: Archaeopteryx (~150mya)



Example: Tiktaalic (~375mya)



B. <u>Homologous Structures</u> – similar structures in different

groups of organisms.

Ex) bones in human arm & bat wing & whale flipper

C. <u>Similarities in Chemical Compounds</u> (12:00-15:35)

1. All organisms share same basic body chemicals:

*DNA, carbon, hydrogen, oxygen, amino acids

2. Comparing these chemicals may show how closely - related different animals may be to each other.







D. Similarities in Embryonic Development

- 1. Embryo organism in very early stages of development
- 2. Embryos of most species are almost identical in their

early development. (tail, gill slits, etc.)



- E. <u>Vestigial Organs</u> parts that were once functional but are now unused.
 - Ex) human appendix, python leg stubs, whale pelvis





III. Selective MECHANISMS of Genetic Change

A. The most **FIT** genes are selected by 3 **MECHANISMS**:

1. Mechanism #1: Natural Selection

- A process of selection in which the organisms best suited to their physical environment survive to pass along their genes.
- Often summarized as "Survival of the Fittest".

**Fitness*, in this case, refers to an organism's ability to survive in its environment and pass along its genes to the next generation.

- Organisms that survive <u>selective pressures</u> (disease, predators, etc.) will pass along their genes to the next generation.
- Different environments have different selective pressures, so new species evolve over time.
- Genetic <u>variation</u> in nature provides a range of traits to choose from during natural selection.

- 2. Mechanism #2: <u>Sexual Selection</u> (4:26)
 - A process of selection based on traits that give an organism an advantage in finding a mate and passing on its genes.
 - Traits good for sexual selection may be bad for natural selection. Called the "Handicap Principle".

Ex) flashy colors, large clumsy feathers,

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bird songs, sagging, etc.
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*May show a potential mate that "I am so healthy that I can survive even with this clumsy decoration, so you should want your baby to have my genes!"

• Males are usually the ones who display unusual traits to attract females.

Ex) peacock's feathers, lion's mane, etc.

- 3. Mechanism #3: Artificial Selection
 - Process of selection in which humans choose which traits are passed to offspring.
 - Used in crops, livestock, pets.
 - Because of the variation of a trait within a species, we can choose the variation we want to increase.

Ex) Cross the biggest tomatoes in a garden to

produce a next crop of bigger average size.

IV. Other Influences on Evolution

A. Geographic Isolation (video1, video2)

- If a species is separated by mountains, water, etc., and the selective pressures are different, then each population may change into its own unique species.
- Examples: Darwin's finches Post-Pangea continental drift







B. Behavioral Isolation (video1)

- Two populations of a specie may begin to behave differently or mate at different times, causing them to develop into two new species.
- Examples: Slightly different bird calls Frogs that mate a week apart

C. Mutations

- Nature's way of "experimenting" with different traits.
- Random changes: good ones are kept and passed to the next generation, bad ones die off.



D. Genetic Drift

- Some individuals survive in greater numbers because of random chance, making their genes more common in the next generation.
- The larger the population, the more likely they will survive to pass along their genes and "drift" will have a lesser effect.



V. Types of Evolution

A. **Divergent Evolution** (aka: Adaptive Radiation)

1. A single species which has evolved into several

different species living in different ways.

Ex) Darwin's Finches



B. Convergent Evolution

- 1. Unrelated organisms evolve to look similar to each other because of similar selective pressures.
- 2. Ex) "flippers" in sharks, dolphins, penguins, seals



C. Coevolution

- 1. Two species living closely together evolve together.
- 2. One is a selective pressure on the other.
- 3. Ex) clown fish & anemone

Ex) predator & prey ("Evolutionary Arms Race")







