NATURAL SELECTION AND ARTIFICIAL SELECTION

Learning Targets

1. I can explain how diversity of species occurs through gradual processes over many generations.
2. I can define reproduction and explain its effect on the continuation of species.
3. I can explain that the characteristics of an organism are a result of inherited traits received from parent(s).
4. I can explain that all traits are determined by genes and environmental factors to varying degrees.
Vocabulary within this set of notes

1. Evolution:
2. Natural Selection:
3. Artificial Selection:

- Recall that adaptations provide some form of advantage for a species, allowing them to survive better.
- But the question is how do these adaptations show up in a population of organisms?
- Also, how did so many different species arrive on the planet over time?
- Why is there so much biodiversity?
**Evolution**- Change over time

- Based on the fossil record and the geological record, we know the environment of the Earth has changed, the continents have changed, and the organisms have changed.
- The term evolution simply means change over time, so the environment, the continents, and the organisms have evolved over time.

But how can organisms change over time?

- A **population** refers to all of the individuals of a species that live an area at the same time.
- A **species** is a group of closely related organisms that can mate to produce fertile offspring.

Charles Darwin first developed a hypothesis that then became a theory by observing fossils and finches in the Galapagos Islands.
Darwin’s Observations

- Darwin observed the birds across the islands and realized that although they had very different traits, such as different sizes and beaks, they were all finches. The environment offered a variety of foods and it appeared as though the finches adapted to their specific environment across the various islands. Darwin suggested that all of the finches branched off of a single ancestor.

Darwin reasoned the birds’ diets were related to the beak and size differences in the birds.
So why did Darwin suggest that the biodiversity of finches arose from a single finch species due to pressures of the environment? What influenced him?

1. Organisms pass traits on to offspring
2. Organisms acquire traits
3. Earth changes over time
4. A struggle for survival exists

1. Organisms pass traits on to offspring

- Farmers and breeders have picked certain traits they desire to be passed on from one generation to the next. We know these as inherited traits.
- The practice by which humans select plants or animals for breeding based on desired traits is called artificial selection.
- Basically, humans pick and choose the traits they want passed on from one generation to the next. This has created new breeds and in some cases, new species of organisms that otherwise would not have been found in nature.
- This is evidence that traits in a species can change over time.
- This is also evidence that traits can be spread through a population.
Artificial Selection- Corn Example

- Remember, humans have been selecting for certain traits in plants and animals
- Ancient corn used to look like tall grass.
- The larger size corn trait was selected for by breeding the plants that had the largest ears together generation after generation.

2. Organisms acquire traits

- Some traits help an organism to survive, while others may lessen its ability to survive
- Some traits are gained over time and are not related to the organism’s DNA, these are known as **acquired traits**.
- Some traits begin as being influenced by DNA and are inherited, but then the environment can impact them over time. These are known as **environmentally-influenced traits**.
- Darwin understood that traits could be influenced by the environment and can change over time.
3. Earth changes over time

- It was suggested that the Earth changed by small amounts over a vast period of time by looking at the geologic record.
- Darwin reasoned if the Earth was so old and if the land and environment had changed greatly in that amount of time, then perhaps small changes in life forms could add up to very large changes across vast amounts of time as well.

4. A struggle for survival exists

- The environment puts pressure on organisms to survive, and can influence which individuals live and which ones perish.
- All populations are affected by population growth such as:
  - Disease
  - Predation
  - Competition for food
  - Living space

Darwin reasoned that the survivors in a population likely had traits that helped them survive and that some of these traits could have been passed on to their offspring.
Darwin’s proposition- Most evolution happens through the **natural selection** of advantageous traits.

- **Natural Selection** is the process by which organisms that inherit advantageous traits tend to reproduce more successfully than other organisms do.
- Basically, traits that give an advantage in a specific environment are passed from one generation to the next.
- Over long period of time, this can cause the whole population to change or perhaps even create new species.

- The different foods available across the islands applied pressure on the original finch population.
- Birds with larger beaks would have had an advantage on islands that offered nuts.
- Birds with smaller, more pointed beaks would have had an advantage on islands that offered insects or flowers.
- The physical separation and length of time allowed for these advantageous traits to be passed from one generation to the next, forming new populations.
There are 4 Parts to Natural Selection

1. **Overproduction of offspring** - when a plant or animal reproduces, it usually makes more offspring than the environment can support. Ex. Finding Nemo- Hundreds of fish eggs are fertilized but only a small number will survive.

2. **Genetic Variation** - There are naturally occurring variations, or differences in traits. Inherited traits can be affected by natural genetic mutations. The greater the variation, the greater the biodiversity. This increases the chances that some traits will provide an advantage over others!

   Example - A population of rabbits can have black fur or white fur. If the environment has a lot of snow, which type of rabbit has the advantageous trait?

   Over time, the black rabbits would be spotted by predators, would be killed, and would be unable to pass their traits to the next generation. Eventually, the population would mostly be white!
There are 4 Parts to Natural Selection

3. Selection- The environment provides pressures, such as lack of food, predators, disease, etc. that ends up selecting for a particular set of traits.

Example- A population of rabbits can have black fur or white fur. If the environment has a lot of snow, which type of rabbit has the advantageous trait?

Over time, the black rabbits would be spotted by predators, would be killed, and would be unable to pass their traits to the next generation. Eventually, the population would mostly be white!

There are 4 Parts to Natural Selection

4. Adaptation- The inherited trait that provided the advantage for that environment becomes an adaptation. Over time, the population becomes better adapted to survive in that environment.

Example- A population of rabbits can have black fur or white fur. If the environment has a lot of snow, which type of rabbit has the advantageous trait?

Over time, the black rabbits would be spotted by predators, would be killed, and would be unable to pass their traits to the next generation. Eventually, the population would mostly be white!
Natural Selection Example Diagram

Some final points regarding Evolution by Natural Selection

- Adaptations are inherited traits that help an organism survive and reproduce.
- Small genetic differences can add up to large changes over time.
- Changes in the environment can affect the survival of organisms with particular traits.
  - For example, what happens to the white rabbits who lived in the snow environment if all of a sudden there was less snowfall?
- If the environment changes, two things can happen
  - If some individuals have traits that offer advantages, new adaptations may form to the new environment.
  - If there are no traits in the existing population, then the species might go extinct.

Hellmund saying on Natural Selection “Those that survive get to reproduce and pass on their inherited traits to the next generation. Kinda hard to reproduce to pass on weak traits if they are dead.”