4.1 Adoption, Variation, and Natural Selection

- In this section, you will:
- **Describe** how sexual reproduction and changes in genetic information result in variation within populations
- **Design** an investigation to measure variation in a population
- **Describe** how some mutations may improve an individual organism’s change for survival and reproduction
- **Define** natural selection

- Why is it that not all members of a species are exactly alike?
  - Look around this class, you are not exactly like your neighbor!

- **Variations** in populations of the same biological species. These are visible (ex. color) and invisible (ex. biochemical) differences — passed on from one generation to the next.

- If the variations are passed on and are advantageous to the population they are called **adaptations**.
Adaptations

- **Change** or process of change
  - Better suited for environment.
- Best adapted will be most likely to **survive**
- **Structural, behavioral, or physiological**

**Structural Adaptations**

- Physical features of an organism like the bill on a bird or the fur on a bear

**Behavioural Adaptations**

- Behavioral response to stimulus (what does a cat do when threatened)

**Physiological Adaptations**

- A response of an individual to a specific external stimulus in order to maintain homeostasis
The Source of Adaptations

- Due to the gradual change in characteristics of population over time
- Not all variations are beneficial

Variation Within Species

- **Variation** - visible or invisible difference
- Result of genetic changes and recombinations/mutations in DNA
- The recombination of genes can occur during sexual reproduction

What causes variations to arise?

- **Mutations** - changes in the genetic material of an organism.
  - Happen continuously in the DNA
  - Causes: 1) **Spontaneous**
  - 2) **Mutagens** (UV radiation, environmental agents)

Results: 1) Exhibition of new characteristics (ex. Sickle cell RBCs)
- 2) Cell Death
- 3) Malfunctioning Cells
- 4) Multiplying more (could result in a tumor)
• Location: 1) **Somatic cells** (body cells) – disappear upon death
  2) **Reproductive (germ) cells** (gametes) – passed on to the next generation – lead to variations – lead to selective advantage

**Mutations and Variation**

• All **variation** is due to **mutations**
• Changes in genetic code result in different genes
• DNA mutations can occur from **errors** in **copying, damage** from radiation, or mutagens

**The Effect of Mutations**

• **Genes** (amino acids) code for **proteins**
• A change in code can alter sequence of amino acids that form a protein
• Change in the shape of the protein will change its action

**Mutations and Selective Advantage**

• Produce change in an individual that may be beneficial
• These mutations increase chance of survival – Passed on to the next generation
Case Study: Venom-Resistant Squirrels

- In California, some ground squirrels have developed a mutation that makes them more resistant to rattlesnake venom
- Therefore, the ground squirrels with the mutation have a greater chance of survival and therefore will pass on their traits to the next generation
- Ultimately, the majority of the squirrel population will have this beneficial adaptation because they are more likely to survive to reproduce

Case Study: Pesticide Resistance

- In 1955, the World Health Organization initiated a widespread program to kill malaria-carrying mosquitoes using DDT
- This program was initially very successful in decreasing mosquito populations, but they quickly reappeared

Case Study: Pesticide Resistance

- Why did DDT lose its effectiveness?

Case Study: “Superbugs”

- In 1928, Sir Alexander Fleming discovered that penicillin could be used to kill bacteria
- Penicillin was first used as a medicine in 1941
- By 1945, there were already reports of penicillin-resistant strains of bacteria
- There are now bacterial strains that are resistant to all known antibiotics
Case Study: “Superbugs”

• What factors contributed to the development of antibiotic-resistant bacteria?

Natural Selection

• **Beneficial adaptations** passed on to their offspring
• For **natural selection** to occur, there must be variation within the species
• The environment will exert a selective pressure on a population
• [https://www.youtube.com/watch?v=aTftyFboC_M](https://www.youtube.com/watch?v=aTftyFboC_M)

Example: Selective Pressure

• In a population of grasses, some of the grasses are better adapted to survive drought conditions
• If a drought occurs, it exerts a **selective pressure** that favors those plants that are drought-resistant
• This causes a change in the makeup of the population
Natural Selection & the Environment

- Natural selection does not anticipate changes in the environment
- Instead, random changes occur and produce traits that may be beneficial in the future

![Image](image_url)

- Variations that are not beneficial in a certain environment may not be harmful, they may simply be useless
- If a variation is detrimental, it is unlikely that it will be passed on until the environment changes to select for that variation

Crash Course

- Evolutionary Development