Sadiq Public School

Do the right, fear no man

Subject: Biology **Class: H2** **Day: Saturday, 16th November 2024**

Lesson

This lesson is about the different types of natural selection (stabilizing, directional, and disruptive) and explain the processes of each type of natural selection on a population.

A: Inquiry

- 1. In a stable environment, why might natural selection favor the intermediate phenotype?
- 2. Illustrate how natural selection leads to changes in allele frequencies over generations.
- 3. Can you think of an example where stabilizing selection is at work in nature? Explain how this benefits the population.

B: Information

Natural Selection: Types of Selection

- Environmental factors that affect the chance of survival of an organism are **selection pressures**
  - For example, there could be high competition for food between lions if there is not plentiful prey available; this environmental factor 'selects' for faster, more powerful lions that are better hunters
- These selection pressures can have different effects on the **allele frequencies** of a population through **natural selection**
- There are three types of selection:
  - **Stabilising**
  - **Disruptive**
  - **Directional**

Stabilising selection

- **Stabilising** selection is natural selection that keeps allele frequencies relatively **constant** over generations
  - This means that allele frequencies stay as they are unless there is a change in the environment
- A classic example of stabilising selection can be seen in human birth weights
  - Very low and very high birth weights are selected against leading to the **maintenance of intermediate** birth weights
    - It is disadvantageous to have a very low birth weight because it increases the risk of health complications for the baby
    - It is disadvantageous to have a very high birth weight as this increases the risk of birth complications

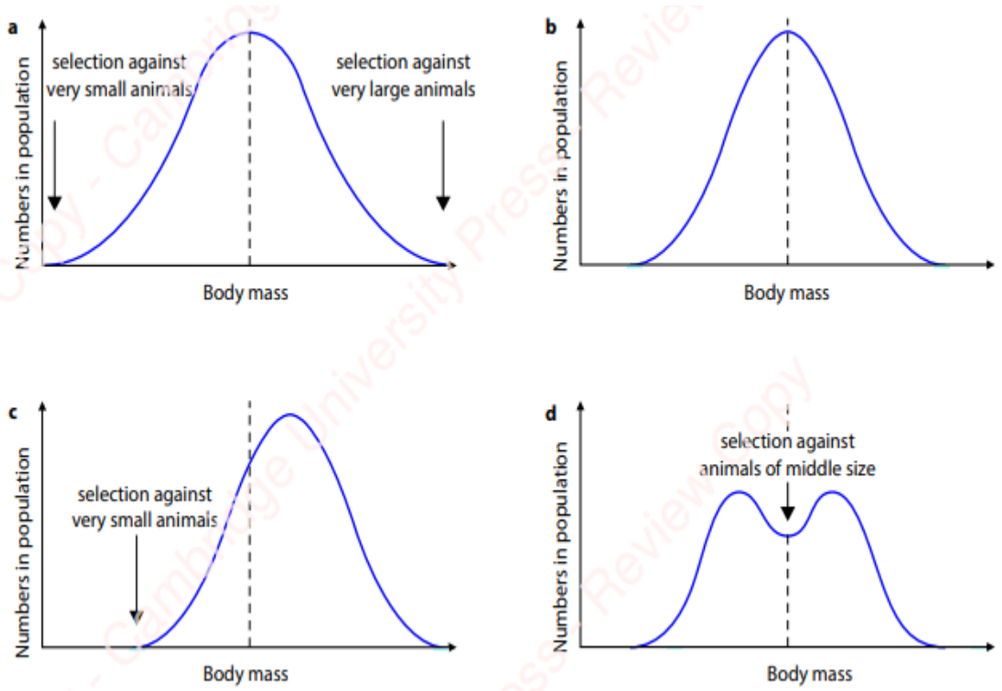
Directional selection

- **Directional** selection is natural selection that produces a **gradual change** in allele frequencies over several generations
- This usually happens when there is a **change in the environment** or a new selection pressures which leads to a certain allele becoming advantageous
- For example, a recent finding has shown that climate change is having an effect on fish size in certain habitats; the increase in temperature is **selecting for a smaller body size** and against a larger body size
  - Warmer seas cause fish metabolism to speed up and so increases their need for **oxygen**; oxygen levels are lower in warmer seas
  - Larger fish have greater **metabolic** needs than smaller fish, and so they feel the effect of increased temperatures more strongly

- Organisms are **sensitive** to changes in **temperature** primarily because of the effect that temperature can have on **enzyme** activity
- **Fish** with a **smaller** body size are therefore fitter and **better adapted** to living in seas experiencing increased temperatures
- Fish body size is determined by both genetic and environmental factors
- Fish of a smaller size are **more likely** to reproduce and pass on their alleles to offspring
- Over **generations,** this leads to an **increase** in the **frequency** of **alleles** that code for a small body size and a decrease in the frequency of alleles that code for a larger body size

Disruptive selection

- **Disruptive** selection is natural selection that **maintains high frequencies of two different sets of alleles**
  - In other words, individuals with intermediate phenotypes or alleles are selected against
- Disruptive selection maintains **polymorphism**; the continued existence of **two or more distinct phenotypes** in species
- This can occur in an environment that shows **variation**
- For example, birds that live on the Galapagos Islands use their beaks to forage for different sized seeds
  - Different sizes of seed are more efficiently foraged by a shorter or longer beak than by a medium-sized beak
  - The size of the bird's beaks are either small or large with the intermediate, medium-sized beak selected agains

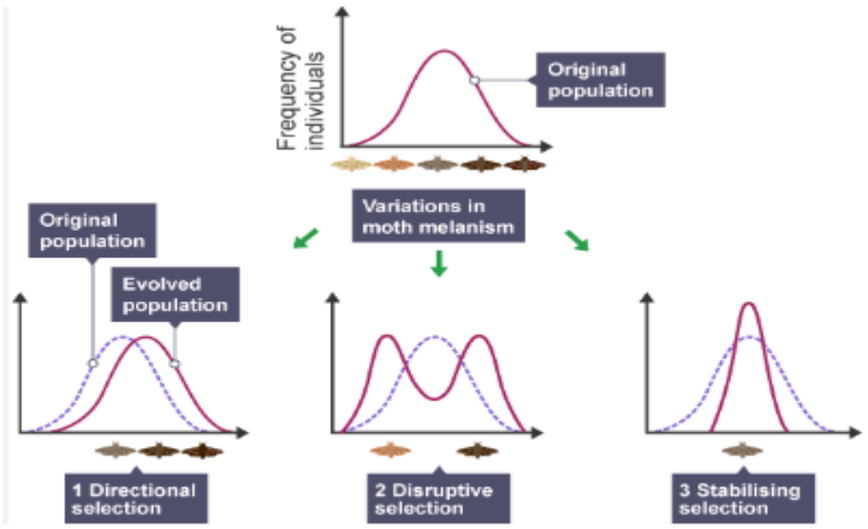


If a characteristic in a population, such as body mass, shows wide variation, selection pressures often act against the two extremes **(graph a).**

Very small or very large individuals are less likely to survive and reproduce than those whose size lies nearer the centre of the range. This results in a population with a narrower range of body size **(graph b).** This type of selection, which tends to keep the variation in a characteristic centred around the same mean value, is called stabilising selection.

Graph c shows what would happen if selection acted against smaller individuals but not larger ones. In this case, the range of variation shifts towards larger size. This type of selection, which results in a change in a characteristic in a particular direction, is called directional selection.

Graph d shows the result of selection that favours both large and small individuals but acts against those whose size is in the middle of the range. This is disruptive selection.



Summary

Stabilising selection: natural selection that tends to keep allele frequencies relatively constant over many generations.

Directional selection: natural selection that causes a gradual change in allele frequency over many generations.

Disruptive selection: natural selection that maintains relatively high frequencies of two different sets of alleles; individuals with intermediate features and allele sets are not selected.

Polymorphism: the continued existence of two or more different phenotypes in a species

Review Questions

C: Synthesis/absorbing the information

1. How does stabilizing selection affect the genetic diversity of a population?
2. What might happen to a population experiencing directional selection if the environment changes again?
3. In a population of birds with varying beak sizes, why might both small and large beaks be favored over medium-sized beaks in certain environments?

D: Practising activity: (on notebooks)

1. Write down briefly on all types of selection by giving at least one example in each type.
2. Can you think of an example where disruptive selection might occur, and what could be the long-term consequences for the population?