

## Understandings:

### 1. State that natural selection can only vary when there is a variation of members in same species.

- Logically, if there was no variation, there will be no natural selection since nature has nothing to choose from! No individual will be favoured.

So natural selection only happens when there is a variation in species.

### 2. State the factors that cause variation.

- These factors are well understood and proven that these cause variation.

1. Mutation. Random mutations may change characteristics of species to favourable, not favourable, or neutral.

2. Meiosis. Sex cells are produced in this way that has random combinations of alleles and genes.

3. Sexual reproduction. It enables the fusion of male genes and female genes.

### 3. Explain adaptation.

- Adaptation is the result of natural selection. When species migrate to new places, the variations might lead to that some has characteristics that are better adapted to the environment, hence survive more and reproduce more. This is evolution again.

### 4. Explain overproduction, and its reason.

- This phenomenon where a species tends to produce more offspring than what the environment can support is because nature wants to select only the best. Since there is variation in species, nature wants to be sure to pick out the best. So the more you have, the higher chance there is an organism that is fit enough to survive.

We humans, the males actually, produce many sperms, but the fastest/most robust sperm finds the egg first. Yes, we are the winners of natural selection. But of course, another kind of natural selection takes place in the society...unfortunately, where intelligence is the factor.

### Extra notes

- Understand that overproduction is not a direct evidence for evolution. Overproduction is merely a phenomenon that may lead to evolution and phenomenon that is difficult to justify without evolution. The three main evidences for evolution are explained previously in 5.1. Those are fossils, domestic selective breeding and homologous structures.

### 5. State that individuals with better adapted traits tend to survive and its effect.

- Yes, we have stated this over and over again. The effect is that better adapted traits have a higher chance to reproduce more, and therefore pass on their genes.

**6. State that the characteristics are passed onto next generation.**

- The characteristics in the gene are passed on. The acquired things, such as a skill, short hair or even a broken leg are not passed on.

**7. Explain progressive change.**

- Progressive change is the gradual change in frequency/number of the species with well adapted traits. Eventually, the other organisms with less adapted traits may get extinct.

This might take millions and millions years, of course.

**Applications and skills:**

**1. Explain changes in beaks of finches on Daphne Major (island).**

- Darwin noticed that the finches lived in different areas where they all had different diet, as well as their beaks. Researchers studied at different periods, such as drought, El Niño, monsoon, and found that this lead to fluxes in reproduction of the different species with the different beaks. *G.fortis* can feed on both smaller and larger seeds, while *G.fuliginosa* can only feed on small seeds. When there was drought, there was lack of small seeds, and then *G.fuliginosa's* reproduction rate decreased greatly.

**2. Explain the evolution in antibiotic resistant bacteria.**

- We can directly observe evolution by looking at bacteria. When we use antibiotics, we filter out the bacteria that are resistant, which in turn reproduce very rapidly, in matter of hours, a new generation. We have just made bacteria resistant to that antibiotic we just used. The more we use, the more we speed up the evolution of bacteria. The problem is that we cannot keep up with the pace of bacteria reproducing and our research into finding new antibiotics bacteria are not resistant to. Even if we find, there will be some group of bacteria that will be randomly resistant.

**TOK:**

**1. Natural Selection is a theory. How much evidence is required to support a theory and what sort of counter evidence is required to refute it?**