# Understandings:

**1. Define evolution.**

- A species evolves when the heritable characteristics of a species change. So evolution only considers the heritable characteristics. Things like particular skills or muscles are not heritable! Those are acquired.

**2. Explain the evidence from fossils.**

- How come the theory of evolution emerged from the first half of the 19th century? It is due to the fossils. Scientists studied the different layers of rock sediments and assigned the visible layers with different names and eras.

On the layers of rocks, there were also sequences of fossils. By analysing them, they found that:

1. As we move higher up on the sediment, the animals seem to become more complex. This matched with their hypothesis that animals evolved over time.

2. The sequence of emergence seemed to fit the ecology of the groups. Plants come first, then insect pollinators, land animals, etc. It is just like a food chain.

3. The sequences of fossils can be used as links to connect existing species with extinct species. This gives us a picture of how they have changed.

**3. Explain the evidence from selective breeding.**

- By having selective breeding, we can see that evolution itself is possible, but we do not know if natural selection is possible. Selectively breeding cattle and dogs can result in evolution in a relatively short time span, enough for us human to notice changes.

**4. Explain the evidence from homologous structures.**

- Homologous structures have the same origin/common ancestor but may have different function. Ex, pentadactyl limbs. Scientists view this as adaptive radiation, where they "radiate away" from each other.

Analogous structures are the opposite. They have different structures but the same function. Whales and fish is an example. Scientists call this convergent evolution.

The problem is, this does not reveal anything about whether animals have evolved or not and the mechanism of evolution. However, it is difficult to explain without evolution; hence this is accepted as a theory so far. In addition, things called vestigial organs, or organs that do not serve any function, is also explained easily by evolution.

**5. Explain how populations can diverge into separate species by evolution.**
- When two species separate and live in different circumstances for a long time, species with different characteristics are favoured in the different areas, thus evolution takes place. Eventually, the two populations might not be able to interbreed, hence separate species. This is called speciation.

**6. Explain the evidence from patterns of variation.**
- If the speciation process is true, then we should find the process to be ongoing even today, since this process is constant. In fact, the cases where scientists are not sure about whether two organisms are the same species or separate species, is an ongoing process. Darwin gave an example of the finches in Galapagos Archipelago.

## Applications and skills:

**1. Be able to take melanistic insect as an example of evolution.**
- When the surrounding area changes, especially the colours of its habitat, insects with a particular colour might have higher chance to survive, hence reproduce. This will lead to only their genes being passed on. This is evolution by natural selection.

**2. Compare the pentadactyl limbs of vertebrates with different function/locomotion.**
- Difference can be in lengths and thickness.

## TOK:

**1. Evolutionary history is an especially challenging area of science because experiments cannot be performed to establish past events or their causes. There are nonetheless scientific methods of establishing beyond reasonable doubt what happened in some cases. How do these methods compare to those used by historians to reconstruct the past?**