

I. Evolution

A. Define Evolution – 5.4.1

1. Evolution
 - a) the process of cumulative change in the heritable characteristics of a population.
 - (1) heritable
 - (a) change must be passed on genetically from one generation to the next
 - (b) Implies that evolution doesn't happen overnight
 - (2) cumulative
 - (a) one change isn't enough to have major impact on the species
 - (3) population
 - (a) changes do not affect just one individual

B. Evidence of Evolution – 5.4.2

- a) Evidence provided by:
 - (1) Fossil Records
 - (2) Selective breeding of Domesticated animals
 - (3) Homologous Structures
- b) Although most of the top predators today are mammals (orca whales, lions, tigers & bears oh my!), none of them existed at the time of dinosaurs or before
- c) Most living organisms today have no identical form in the fossil record.
- d) One possible conclusion drawn from observing fossils is that:
 - (1) Life on Earth is continually changing
- e) Most of the changes have been over huge timescales (hundreds of thousands or millions of years!!)
2. Selective breeding of Domesticated Animals (aka Artificial Selection)
 - a) Selective breeding gives a good record of recent changes in heritable characteristics
 - b) Selective Breeding
 - (1) Choose males and females with most desirable genetic characteristics
 - (2) Breed them to get offspring with those specific characteristics
 - c) After selective breeding from dozens to hundreds of generations, certain variations of animals have unique combinations of characteristics that didn't exist before.
 - d) This demonstrates that evolution is happening due to an accumulation of small changes over time.
 - e) Note: Artificial selection (selective breeding) is *not* the same as what happens in nature.

3. Homologous Structures

- a) **Anatomy:** Structure (Form) of the body
- b) **Physiology:** Function of the body
- c) Homologous anatomical structures similar in form and function, yet found in seemingly dissimilar species
 - (1) i.e. Whale fins, frog hands, bat wings, lizard hands and human hands are all similar in design
- d) Comparative anatomists noticed that different species have similar structures used for different functions
 - (1) e.g. the pentadactyl limb of terrestrial vertebrates
- e) These are called homologous structures
 - (1) (alike or similar in design, but may have a totally different purpose)
- f) Five-fingered (pentadactyl) limb found in animals such as humans, whales, and bats
 - (a) 'penta' = five
 - (b) 'dactyl' = fingers
 - (2) Although the shape and number of bones may vary, the general format is the same, even though the functions of the limbs may vary different
- g) Homologous structures provide evidence that such organisms have common ancestors

C. Populations tend to produce more offspring than the environment can support – 5.4.3

1. Mechanism for Evolution
 - a) Populations tend to produce more offspring than the environment can support
 - b) Natural selection as the mechanism for evolution
 - c) Natural selection accomplished by:
 - (1) Overproduction of offspring
 - (2) Presence of natural variation
2. Too Many Babies
 - a) Animals & plants produce far more offspring than could ever survive
 - (a) i.e. sea turtles and their babies
 - (2) Plants often produce thousands more seeds than necessary to propagate the species
 - (a) i.e. pine trees make more than 400 pine cones, and only around 1% actually grow into actual trees
 - (3) Fish and turtles lay thousands of eggs but only a few survive to adulthood

D. The consequence of potential overproduction of offspring is struggling for survival – 5.4.4

- a) Too many offspring, not enough resources!
- b) Supply and demand
 - (1) High demand for water, space, nutrients, sunlight, but limited supply.
 - (2) Consequence? Competition for resources to stay alive
 - (3) The Struggle for survival
 - (a) ex. Struggling to survive the IB programme

E. The members of a species show variation – 5.4.5

1. Example of No. Variation within a species:
 - a) Organisms like bacteria reproduce by making a copy of their genetic info and then splitting into two.
 - b) Result: 2nd Generation identical to the 1st
 - c) Future generation identical or show very little change
 - d) Little chance for DNA modification
2. **Variation** is closely related to how successful an organism is:
 - a) Fish with slightly different shaped mouth may feed better from coral reef than other fish unable to access
 - b) Plants producing different shaped flower may better attract insects for pollination
 - (1) Flowers colored a certain way might better attract bees, because they see in infrared
3. **Causes of Variety**
 - a) **Mutations in DNA**
 - b) **Sexual Reproduction promotes variation in species**

F. Explain how sexual reproduction promotes variation in a species – 5.4.6

- a) 2 ways genes are mixed in sexual reproduction
 - (1) **1st - Meiosis** (covered in Topic 4)
 - (2) **2nd - Fertilization** (Topic 11)

G. Explain how natural selection leads to evolution – 5.4.7

- a) Greater survival and reproductive success of individuals with favorable heritable variations (aka **Natural Selection**)
- b) can LEAD to...
- c) Change Over Time
- d) ...change in the characteristics of a population (aka **Evolution**)

H. Explain 2 examples of evolution in response to environmental change – 5.4.8

- a) On example MUST be Antibiotic Resistance to Bacteria
 - (1) (we're going to do an experiment)
- b) Other examples could include:
 - (1) The changes in size and shape of the beaks of Galapagos finches
 - (2) Pesticide resistance
 - (3) Industrial melanism
 - (a) skin cancer from acid rain
 - (4) Heavy-metal tolerance in plants
2. Antibiotic resistance in Bacteria
 - a) Biotic = Living
 - b) Antibiotics: medications that kill or inhibit the growth of bacteria
 - (1) Given to patients suffering from bacterial infections
 - c) Overuse of antibiotics can lead to the production of resistance strains of bacteria

Test

Basic Def. of evolution: need 3 parts
Homologous structures

Don't have to be the same species

Dogs have litters because many don't survive to adulthood due to sexual reproduction (dominant & recessive traits (runt))

Darwin's experience on Galapagos and the data he gained there lead him to write the Origins of species
he studied the: Mocking Bird, Finches, Tortoises¹

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