**NOTE: This is an official document by Indexademics. Unless otherwise stated, this document may not be accredited to individuals or groups other than the club IDX, nor should this document be distributed, sold, or modified for personal use in any way.**

**IDX G9 Biology S STUDY GUIDE ISSUE 5**

**By Amy and Mya**

**16.1 Darwin’s Voyage of Discovery**

* In 1831, Charles Darwin set on a voyage for five years on the*Beagle*, he mainly explored the Galápagos Islands. He developed a scientific theory of biological evolution that explains how modern organisms evolved over long periods of time through descent from common ancestors.

**Species Vary Globally**

* Darwin noticed that different, yet ecologically similar, animals species inhabited separated, but ecologically similar, habitats around the globe.
  + Ex: Emu (Australia), Rheas (South America), Ostriches (Africa)

**Species Vary Locally**

* Darwin noticed that different, yet related, animal species often occupied different habitats within a local area.
  + Ex: Isabella Island Tortoise, Hood Island Tortoise (both Galapagos Islands)

**Species Vary Overtime**

* Darwin noticed that some fossils of extinct animals were similar to living species
  + If u don’t know what a fossil is go back to kindergarten

**16.2 Ideas That Shaped Darwin’s Thinking**

**James Hutton and Geological Change**

* Hutton proposed that forces beneath Earth’s surface can push rock layers upward, tilting or twisting them in the process
* Slowwwwww takes long periods of time 🡪 conclude for these processes to produce present day Earth, it must be much older than just thousands of years old

**Charles Lyell’s Principles of Geology**

* Laws of nature are constant over time and scientists must explain past events in terms of processes they can observe in the present (uniformitarianism)
* Geological processes we see in action today must be same ones that shaped Earth
* Also argued that Earth is very very old through his findings

**Lamarck’s Evolutionary Hypothesis (The Inheritance of Acquired Characteristics)**

* Jean-Baptiste Lamark suggested that organisms could change during their lifetimes by selectively using or not using various parts of their bodies.
  + Individuals could pass these acquired traits on to their offspring, enabling species to change overtime.
* Acquired characteristics: Traits altered by an individual organism during its life
* Why he was wrong:
  + Evolution doesn’t mean that overtime species become *better*
  + Acquired traits cannot pass to offspring
* Why he was right:
  + Suggest species changed as one of first naturalists
  + Among first to try to explain evolution scientifically with natural processes
  + Recognized link between organism’s environment and its body structures

**Thomas Malthus’s Principle of Populations**

* If population grew without limiting factors, there would not be enough living space and food for everyone.
  + Limiting factors include war, famine, disease
  + Helped Darwin in the finding of natural selection

**Artificial Selection**: When nature provides variations and humans select the useful ones

**16.3 Darwin Presents His Case**

Darwin outlined ideas of evolution in the book "On the Origin of Species": natural selection with three principles

1. **The struggle for existence**

If more individuals are produced than can survive, members of a population must compete to obtain food, living space, and other limited necessties of life.

Eg: Bear, 50% suirvive past 1 year

1. **Variation and Adaptation**

Individuals in a population vary in heritable characteristics

Adaptation = High fitness : any hertitable characteristic that increases an ogranism's ability to survive and reproduce in its environment

* Camouflage Eg: Stick mantid in Africa, Grasshopper
* Mimicry: Harmless species mimics a hramful one
* Behavior

1. **Survival of the fittest**

Fitness : how well an organism can survive and reproduce in its environment

Survival of the fittest : the different in rate of survival and reproduction

The environment (not a farmer/ animal breeder) infuences fitness.

Common descent : all species (living and extinct) are descended from ancient common ancestors.

Descent with modification : living species are descended, with modofication, from common ancestors.

Fosisil recoeds provide for evidence of descent with modification over long periods of time.

**16.4 Evidence of Evolution**

Biogeography: the study of where organisms live now and where they and their ancestors live in the past.

Patterns in the distribution of living and fossil species tell us how modern organism evolved from their ancestors.

1. **Closely Related but different = (Adaptive radiation)**

* One species evolved into several different forms that live in different ways
* Adapt to different environment
* Share a common ancestor

Eg: Human, cats, bats, and birds have common ancestor: first vertebrate

1. **Distantly Related But Similar = (Convergent evolution)**

* Unrelated organisms live in similar environment and come to resemble on another
* Adapt to similar organism
* Do not share a recent common ancestor

Eg: Dolphin (mammals) & Fish

**Evidence 1: Fossils**

* Earth is 4.5 billion years old
* Intermediate fossil forms show evolution of moderm species from extinct ancestors
* Fossils are preserved or mineralized remains or imprint of an organism that lived long ago
* Due to geological processes, marine fossils can be found on mountain tops

**Evidence 2: Comparing Anatomy**

1. **Homologous Structures**

* Different species have structures adapted for different functions, but these structures show many similarities
* Evidnece of common ancestors

Eg: the forlimbs (five digits) in tetrapods (amphibians, reptiles, birds, and mammals)

1. **Vertigial Structures**

* Structures that inherited from ancestors, but have lost much of their original function due to different selection pressures on the decendant
* Evidnece of common ancestors

Eg: hind limbs of whales and dolphins

1. **Analogous Structures**

* Body parts that share a common function, but not common structure
* Do not provide evidence of common ancestor

Eg: Wing of a bee and the wing of a bird

**Evidence 3: Comparative Embryology**

* Similar patterns of embryo development
* Evidence of common ancestor

Eg: At some time in their development, all vertebrate embryos exhibit common structures: a tail, a notochord, and pharyngeal pouhes

**Evidence 4: Genetics and Molecular Biology**

* All living organisms use the same universal genetic code
* Similarities in DNA/RNA/protein sequnces provider the most powerful evidence of common ancestors
* **Homologous genes**

Eg: Hox genes, help to determine the head to tail axis in embryoinc development. Homologous Hox genes are found in almost all multicellular animals

* **Homologous proteins**

Eg: Cytochrome c, functions in cellular respiration. Similar versions of cytochrome c are found in almost all living cells

**Testing Natural Selection**

* Observe natural selection in action—observations of animals living in their natural environment—the Galapagos finches
* The Grants data also confirm factors that drive natural selection
  + - compitition/overproduction
    - environmental change
    - sexual reproduction