Your notes

GCSE Biology: revision notes

Variation, evolution and natural selection

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Variation

- **Variation** is the differences in the characteristics of individuals in a population.
- It can be caused by the genes they inherited (genetic causes), the conditions they developed in (environmental causes), or a combination of both.
- There is usually a lot of genetic **variation** in a population. All variants arise from **mutations**.
- Most **mutations** have no effect on the phenotype; some influence it; very few determine it. If a new phenotype suits a change in the environment, the **species** can change quickly.

Natural selection

- **Evolution** is a change in the inherited characteristics of a population over time through **natural selection**, which may result in the formation of a new **species**.
- Individuals in a population vary. Those with characteristics best suited to the environment are more likely to survive and breed.
- They pass on their alleles to their offspring, so over many generations these characteristics become more common.
- All **species** of living things have evolved from simple life forms that first developed more than three billion years ago.

Speciation

- If two populations of one **species** become so different in phenotype that they can no longer interbreed to produce fertile offspring, they have formed two new **species**.

- (Separate sciences) This often happens when populations are separated, for example by a mountain range or sea, and **natural selection** acts differently on each.

Developing the theory (separate sciences)

- **Charles Darwin** proposed the theory of **evolution** by **natural selection** after studying species on his round-the-world voyage, and published On the Origin of Species in 1859.
- The theory was only gradually accepted: it challenged the idea that God made all living things, there was not enough evidence at the time, and the mechanism of inheritance was not known.
- Alfred Russel Wallace independently proposed **natural selection**, especially using evidence from warning colouration.
- **Gregor Mendel**'s breeding experiments with pea plants showed that characteristics are passed on in 'units' (now called genes) that are dominant or recessive. His work was not recognised until after his death.
- Jean-Baptiste Lamarck wrongly thought changes that happen during an organism's life are passed on.

Evidence for evolution

- Fossils show how organisms have changed over time.
- Antibiotic-resistant bacteria show **evolution** happening now: resistant strains survive and spread quickly because bacteria reproduce so fast.

Human evolution (Edexcel)

- Ardi (Ardipithecus ramidus), from about 4.4 million years ago, had a big toe for grasping branches and long arms for climbing, but also walked upright.
- Lucy (Australopithecus afarensis), from about 3.2 million years ago, had feet better suited to walking than climbing, and a slightly larger brain than Ardi.
- Richard Leakey's team found fossils from about 1.6 million years ago, including Turkana Boy (Homo erectus): taller, with shorter arms and a larger brain, more like a modern human.
- Stone tools became more complex over time, from simple pebble tools to shaped hand axes and then fine flint tools. Tools can be dated from the layer of rock they are found in: deeper layers are usually older.
- The pentadactyl limb (a limb with five digits) is found in mammals, birds, reptiles and amphibians. The same bone pattern, used for different jobs, suggests they share a common ancestor.

Key terms

Variation	Differences in the characteristics of individuals in a population.

Your notes

Evolution	A change in the inherited characteristics of a population over time through natural selection.
Natural selection	The process in which individuals best suited to their environment survive and breed more.
Mutation	A change in DNA that can create a new variant.
Species	A group of organisms that can interbreed to produce fertile offspring.
Speciation	The formation of a new species.
Adaptation	A characteristic that helps an organism survive in its environment.
Charles Darwin	The scientist who proposed the theory of evolution by natural selection.
Gregor Mendel	The monk whose pea plant experiments showed how characteristics are inherited.

Your notes

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What causes variation?
2. Where do all genetic variants come from?
3. What is evolution?
4. In natural selection, which individuals are most likely to breed?
5. When have two populations become different species?
6. Who proposed the theory of evolution by natural selection?
7. What did Mendel experiment with? (Separate sciences)
8. Why was Darwin's theory slow to be accepted? (Separate sciences)

Answers

1. Genes, the environment, or both
2. Mutations
3. A change in inherited characteristics of a population over time
4. Those best suited to the environment
5. When they can no longer interbreed to produce fertile offspring
6. Charles Darwin
7. Pea plants
8. It challenged religious beliefs and there was little evidence then

What to do next

Practise 14 questions on this topic

Try 8 exam questions, with mark schemes

Read the lesson, one step at a time

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