Chapter 14: Genetics and evolution

Knowledge organiser

Theory of evolution

Evolution is the gradual change in the inherited characteristics of a population over time.

Evolution occurs through the process of **natural selection** and may result in the formation of new species

Process of natural selection

The theory of evolution by natural selection states that

- organisms within species show a wide range of variation in phenotype
- individuals with characteristics most suited to the environment are more likely to survive and breed successfully
- these characteristics are then passed on to their offspring.

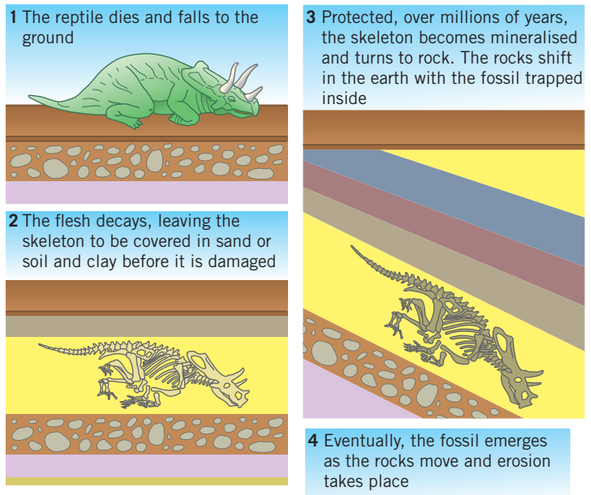
Evidence for evolution

The theory of evolution by natural selection is now widely accepted because there are lots of data to support it, such as

- it has been shown that characteristics are passed on to offspring in in genes
- evidence from the fossil record
- the evolution of antibiotic resistance in bacteria.

Fossils

Benefits of the fossil record	Problems with the fossil record
• can tell scientists how individual species have changed over time • fossils allow us to understand how life developed over Earth's history • fossils can be used to track the movement of a species or its ancestors across the world	• many early organisms were soft-bodied, so most decayed before producing fossils • there are gaps in the fossil record as not all fossils have been found and others have been destroyed by geological or human activity – this means scientists cannot be certain about how life began on Earth



Extinction

Extinction is when there are no remaining individuals of a species still alive.

Factors that may contribute to a species' extinction include

- new predators
- new diseases or pathogens
- increased competition for resources or mates
- catastrophic events (e.g., asteroid impacts, volcanic eruptions, earthquakes)
- changes to the environment (climate change, destruction of habitats).

Key terms

Make sure you can write a definition for these key terms.

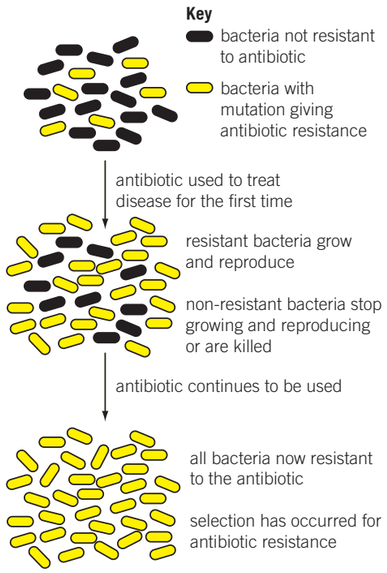
extinction *fossil record* *antibiotic-resistance* *natural selection* *evolution*

Emergence of antibiotic resistance

The development of new antibiotics is expensive and slow, so is unlikely to keep up with the emergence of new antibiotic-resistant bacteria strains.

To reduce the rise of antibiotic-resistant strains

- doctors should only prescribe antibiotics for serious bacterial infections
- patients should complete their courses of antibiotics so all bacteria are killed and none survive to form resistant strains
- the use of antibiotics in farming and agriculture should be restricted.



Classification of living organisms

Carl Linnaeus developed a system to classify living things into groups, based on their structure and characteristics.

New models of classification were proposed as understanding of biochemical processes developed and improvements in microscopes led to discoveries of internal structures.

There is now a **three-domain system** developed by Carl Woese, dividing organisms into

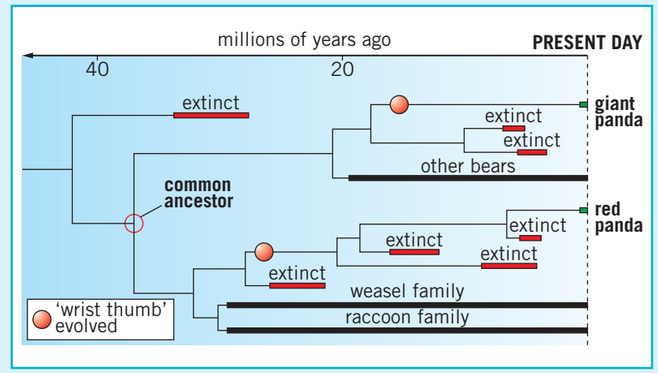
- Archaea (primitive bacteria usually living in extreme environments)
- Bacteria (true bacteria)
- Eukaryota (including protists, fungi, plants, and animals).

kingdom
↓
phylum
↓
class
↓
order
↓
family
↓
genus
↓
species

organisms are named by the **binomial system** of genus and species

Evolutionary trees

Evolutionary trees use current classification data for living organisms and fossil data for extinct organisms to show how scientists believe organisms are related.



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Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	B14 questions	Answers
1	What are fossils?	remains of organisms from millions of years ago, found in rocks
2	How might fossils be formed?	• parts of an organism do not decay because the conditions needed for decay are absent • traces of organisms are preserved • parts of an organism are replaced by minerals
3	What are the benefits of the fossil record?	can learn how species changed and life developed on Earth, and can track the movement of species across the world
4	What are the problems with the fossil record?	• many early organisms were soft-bodied so left few fossils • gaps in the fossil record as not all fossils have been found and some have been destroyed
5	What is extinction?	no individuals of a species are still alive
6	What is the binomial system?	naming of organisms by their genus and species
7	What classification system did Carl Woese introduce?	three-domain system of Archaea, Bacteria, and Eukaryota
8	Why can bacteria evolve rapidly?	they reproduce at a fast rate
9	How do antibiotic-resistant strains of bacteria develop?	mutations that allow the strain to survive and reproduce

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