Evidence for evolution

4.6.3.4 · Inheritance, variation and evolution · revision notes

Why the theory of evolution by natural selection is now widely accepted: we know that characteristics are passed on in genes, and there is evidence from the fossil record and from bacteria becoming resistant to antibiotics. Usually short 'give the evidence' or 'explain how this supports evolution' questions.

Key facts

- Evolution by natural selection is now widely accepted
- Evidence: the fossil record shows how organisms changed over time
- Bacteria reproduce quickly, so evolution can be seen in years, not millions of years
- Evidence: characteristics are passed on to offspring in genes
- Evidence: the evolution of antibiotic resistance in bacteria

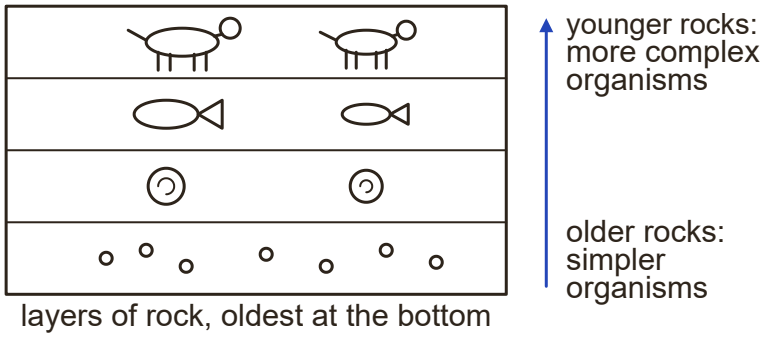
Notes

Why the theory is accepted now

- The theory of evolution by natural selection is now **widely accepted**.
- Evidence for Darwin's theory is now available, because it has been shown that characteristics are passed on to offspring in **genes**. This explains how variation is inherited, which was unknown when Darwin published.
- There is further evidence in the **fossil record** and from how **resistance to antibiotics** evolves in bacteria.

Evidence from fossils

- Fossils are the remains of organisms from millions of years ago, found in rocks.
- Comparing fossils from rocks of different ages shows how much or how little organisms have changed as life developed on Earth.
- Older rocks generally contain simpler organisms, and more complex organisms appear in younger rocks.
- Some groups have a series of fossils showing gradual changes over millions of years, such as changes in the size of the body or the shape of the limbs.



Fossils in rock layers show how organisms have changed over time.

Evidence from resistant bacteria

- Bacteria reproduce very quickly, so natural selection can be seen happening over a short time.
- A mutation can make a bacterium resistant to an antibiotic. When the antibiotic is used, non-resistant bacteria are killed, but resistant bacteria survive and reproduce.
- The population of the resistant strain rises. This is evolution by natural selection that we can actually observe.

How to answer each type of question

Give evidence for evolution 1 to 2 marks **Grade 4**

1. Name the fossil record and antibiotic resistance in bacteria.
2. You can also say that characteristics have been shown to be passed on in genes.

Example. Give two types of evidence that support the theory of evolution by natural selection. [2 marks]

Model answer.

The fossil record (1). The evolution of antibiotic resistance in bacteria (1).

Also allow: characteristics are passed on to offspring in genes.

Explain how fossils support evolution 2 marks **Grade 5**

1. Fossils show what organisms that lived long ago were like.
2. Fossils from rocks of different ages show how organisms have changed gradually over time.

Example. Explain how fossils provide evidence for evolution. [2 marks]

Model answer. Fossils show what organisms that lived millions of years ago were like (1). Fossils from rocks of different ages show how organisms have gradually changed over time / simpler organisms are found in older rocks (1).

Explain how resistant bacteria are evidence for evolution 3 marks **Grade 5**

1. A mutation makes some bacteria resistant.
2. The antibiotic kills non-resistant bacteria; resistant ones survive and reproduce.
3. Bacteria reproduce quickly, so this natural selection can be seen in a short time.

Example. Explain how the development of antibiotic resistance in bacteria provides evidence for evolution by natural selection. [3 marks]

Model answer. A mutation makes some bacteria resistant to the antibiotic (1). When the antibiotic is used, the non-resistant bacteria are killed, but the resistant bacteria survive and reproduce, so the resistant strain becomes more common (1). Bacteria reproduce so quickly that this natural selection can be observed over a short time (1).

Don’t lose marks

- Saying bacteria become resistant because they 'get used to' the antibiotic. Resistance comes from a random mutation, which is then selected.
- Saying the antibiotic causes the mutation. The mutation happens by chance; the antibiotic kills the bacteria that are not resistant.
- Saying fossils show every stage of evolution. The fossil record is incomplete.

More tips

Memory tricks

- Evidence for evolution: bones, bugs and genes (fossils, resistant bacteria, inheritance in genes).
- Bacteria are evolution you can watch: many generations in a few days.

Exam technique

- In 'explain' questions, go through natural selection step by step: mutation → survive → reproduce → resistant population rises.
- Say why bacteria are useful evidence: they reproduce quickly, so change can be seen in a short time.
- Describe the theory as 'widely accepted' or 'supported by evidence', not 'proved'.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

State that evolution is widely accepted

The theory of evolution by natural selection is now widely accepted.

Grade 4

Name two types of evidence for evolution

The fossil record and the evolution of antibiotic resistance in bacteria.

Grade 5

Explain why genes support Darwin's theory

It has been shown that characteristics are passed on to offspring in genes, which explains how they are inherited.

Grade 5

Explain how fossils support evolution

Fossils from rocks of different ages show how organisms have changed over millions of years.

Grade 5

Explain how resistant bacteria show evolution

Bacteria reproduce so quickly that natural selection of resistant strains can be seen over a short time.

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