Fossils

4.6.3.2 · Biology · revision notes

What fossils are, the three ways they form, why the fossil record is incomplete, and what fossils tell us about how life developed. Questions include 'describe how fossils form', 'explain why scientists cannot be certain how life began' and interpreting evolutionary trees.

Key facts

- Fossil = the remains of an organism from millions of years ago, found in rock
- Traces: footprints, burrows, rootlet traces
- Record incomplete: early life was soft-bodied; geological activity destroyed traces
- Fossils show how much or how little organisms have changed
- Formed by: no decay (conditions for decay absent); replacement by minerals; preserved traces
- Decay needs warmth, moisture and oxygen; remove one and remains may be preserved
- So scientists cannot be certain how life began

Notes

How fossils form

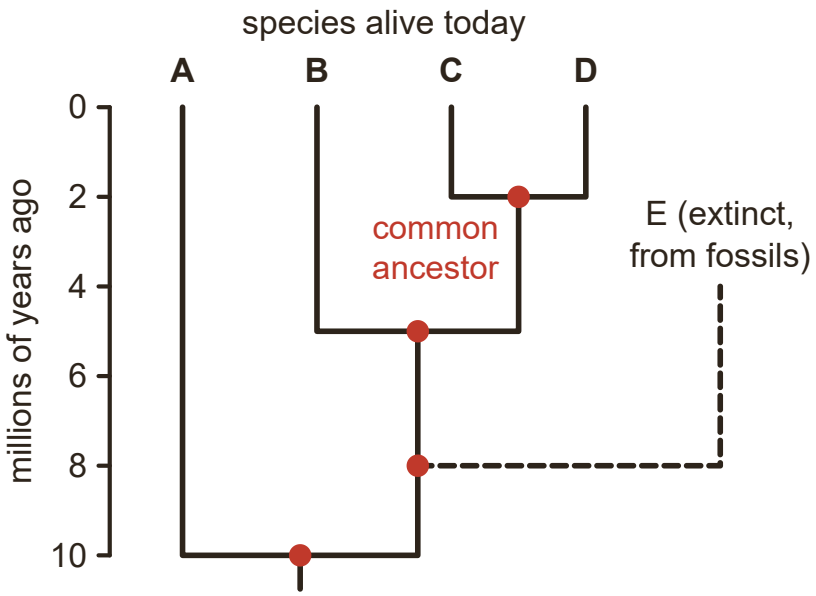
- **Fossils** are the 'remains' of organisms from millions of years ago, which are found in rocks.
- They may form from parts of organisms that **have not decayed**, because one or more of the **conditions needed for decay are absent**, e.g. too cold, too little oxygen or too little water. Examples: animals frozen in ice, or insects trapped in amber.
- They may form when parts of the organism are **replaced by minerals** as they decay. Hard parts such as bones, teeth and shells are often preserved this way.
- Typical sequence: the organism dies and is buried in **sediment** (mud, sand or silt); the soft parts decay; the hard parts are slowly replaced by minerals; the sediment hardens into rock.
- They may be **preserved traces** of organisms, such as **footprints**, **burrows** and **rootlet traces**.

Why the fossil record is incomplete

- Many early forms of life were **soft-bodied**, so they have left few traces behind.
- What traces there were have been mainly destroyed by **geological activity** (for example rocks being worn away, folded or melted).
- This is why scientists **cannot be certain how life began on Earth**.
- Also, most dead organisms decay completely, so only a tiny fraction ever become fossils, and many fossils have not yet been found.

What fossils tell us

- We can learn from fossils **how much or how little** different organisms have **changed** as life developed on Earth.
- Fossil data for extinct organisms is used with data from living organisms to build **evolutionary trees**.
- On an evolutionary tree, each branch point is a common ancestor. Organisms that share a more recent common ancestor are more closely related.



Evolutionary tree: the more recent the common ancestor, the more closely related the species.

How to answer each type of question

Describe how fossils form

2 to 3 marks | **Grade 4**

1. Give the three ways: no decay, replacement by minerals, preserved traces.
2. For 'no decay', say which condition was missing (e.g. oxygen).

Example. Describe three ways in which fossils can be formed. [3 marks]

Model answer. Parts of an organism do not decay because one or more of the conditions needed for decay are absent, e.g. no oxygen (1). Parts of the organism are replaced by minerals as they decay (1). Traces of the organism, such as footprints or burrows, are preserved (1).

Explain why a specimen did not decay

2 marks | Grade 5

1. Name the missing condition: warmth, moisture or oxygen.
2. Link it to the decomposers: microorganisms could not grow or break down the tissue.

Example. A woolly mammoth was found frozen in ice. Its skin and hair were preserved. Explain why the mammoth had not decayed. [2 marks]

Model answer. The temperature was too low (1), so decomposers / microorganisms could not grow and break down the tissue (1).

Explain why scientists cannot be certain how life began

2 to 3 marks | Grade 6

1. Early life forms were soft-bodied, so they left few traces.
2. Most of the traces that did form were destroyed by geological activity.
3. So there is very little evidence.

Example. Explain why the fossil record cannot tell scientists how life began on Earth. [3 marks]

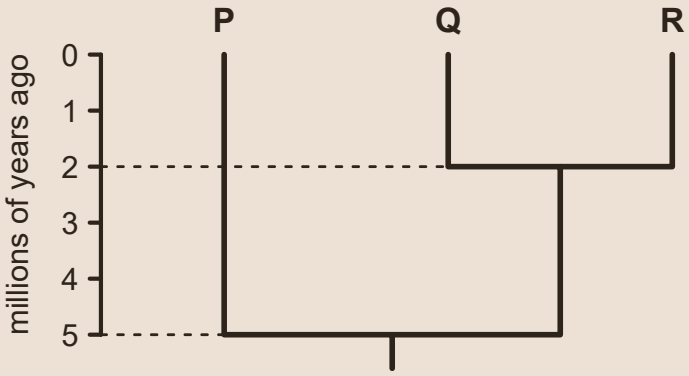
Model answer. Early forms of life were soft-bodied (1), so they left few traces / did not form fossils easily (1). Most of the traces there were have been destroyed by geological activity (1).

Interpret an evolutionary tree

2 marks | Grade 4

1. Find the branch point where each pair of organisms joins (their common ancestor).
2. The more recent the common ancestor, the more closely related they are.
3. Quote times from the tree if it has a time scale.

Example. The evolutionary tree shows that species P and Q share a common ancestor that lived 5 million years ago, and species Q and R share a common ancestor that lived 2 million years ago.



Which two species are the most closely related? Give a reason. [2 marks]

Model answer. Q and R (1). They share the most recent common ancestor, 2 million years ago rather than 5 million years ago (1).

Don’t lose marks

- Saying fossils are only bones. Footprints, burrows and rootlet traces are fossils too.
- Saying the conditions for decay were 'bad'. Name the missing condition (oxygen, warmth or moisture).
- Saying early life left few fossils because it was 'too small'. The reason is that it was soft-bodied, and traces were destroyed by geological activity.
- Saying the dead organism was 'buried in rock'. It is buried in sediment, which later hardens into rock.

More tips

Memory tricks

- Three ways to make a fossil: decay stopped, tissue swapped for minerals, trace stamped into rock (footprints).
- Decay needs warmth, moisture and oxygen; take one away and remains can last.
- Most recent common ancestor = most closely related.

Exam technique

- In 'describe how fossils form', give three different methods, not three examples of the same method.
- For evolutionary trees, read branch points against the time axis and use the numbers in your answer.
- Link fossils to evidence for evolution: they show how organisms have changed over time.

What each grade needs

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

Grade 3 — **Define a fossil**
The remains of organisms from millions of years ago, which are found in rocks.

Grade 4 — **Describe three ways fossils form**
Parts that have not decayed, parts replaced by minerals, and preserved traces such as footprints.

Grade 4 — **Interpret an evolutionary tree**
Organisms sharing the most recent common ancestor are the most closely related.

Grade 5 — **Explain why some remains do not decay**
One or more of the conditions needed for decay (such as oxygen, warmth or moisture) are absent.

Grade 5 — **Explain why the fossil record is incomplete**
Early soft-bodied organisms left few traces, and most traces were destroyed by geological activity.

Grade 6 — **Explain uncertainty about how life began**
So few traces of early life remain that scientists cannot be certain how life began.

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