# Trace fossils – burrows or borings
## What evidence do living organisms leave behind in rocks?

Living creatures often leave behind evidence of their activity in rocks, even if their actual remains are not found as body fossils. Clues may be obtained from living examples, which we can study in their modern habitats.

This activity is best used immediately after pupils have worked though the Earthlearningidea activity titled *Sea shell survival - How are common sea shells adapted to their habitats?* Photographs 1 and 2 are taken from that activity. Remind pupils that marine bivalves which live on the sea bed without burrowing into it usually have strong shells and two muscle scars, e.g. bivalves S and T below. Bivalves which burrow into soft sediment usually have thinner shells and have a bulge in the pallial line, marking where they can 'store' their feeding tubes when not in use, e.g. bivalve R. Bivalves which bore holes in solid rock are similar, except that they have a jagged serrated edge at the front of the shells, in order to rasp away at the rock, e.g. bivalve U.

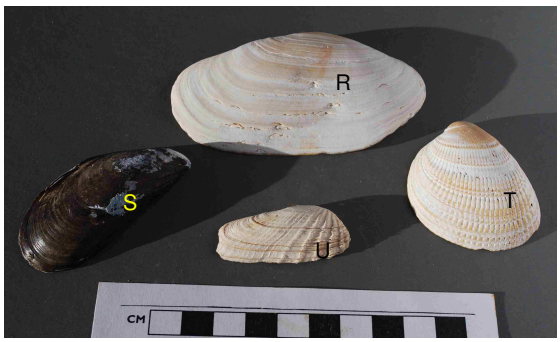


Photo 1: The exteriors of four bivalve sea shells

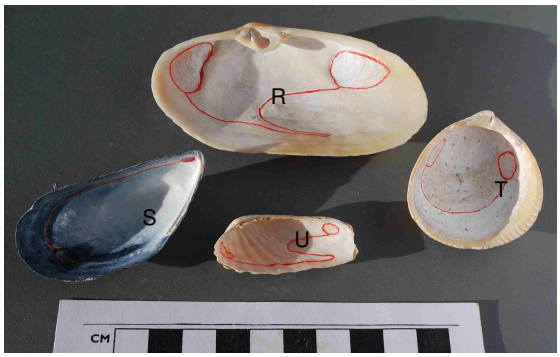


Photo 2: The interiors of the same four bivalve sea shells

Now show the class Photographs 3 and 4, showing rocks with evidence of the previous existence of bivalves. Ask them to match one of the types of shell in Photograph 2 to Photograph 3 and another to Photograph 4. (*Shell type U matches Photo 3. The holes were bored into the rock by the animal twisting its shells this way and that as it grew. Shell type R matches Photo 4. The disturbed layers in the sandstone were made when the sand was still loose on the sea bed, when the animal moved up to leave its burrow).*


Photo 3: Red sandstone with holes, from the rocky shore at Exmouth, Devon.
(The white objects are worm tubes)

Evidence like this is vital for helping us to understand ancient sedimentary rock sequences and life environments. If the rock contains burrows, it must have been soft sediment when animals were living in it, but if the rock has been bored, the rock must have been hard, and may be very much older than the boring animals. In Photo 3, the red sandstones are more than 200 million years old, but the borings are all modern.


Photo 4: Sandstone from rocks of Carboniferous age, Sheffield.

## The back up

**Title:** Trace fossils – burrows or borings

**Subtitle:** What evidence do living organisms leave behind in rocks?

**Topic:** Pupils are invited to apply previously learned observations about the features of modern bivalve shells to the fossil record.

**Age range of pupils:** 11 – 18 years

**Time needed to complete activity**: 10 minutes or less

**Pupil learning outcomes:** Pupils can:
- recognise some of the distinguishing features of bivalve shells;
- revise their skills in relating the shell features to the mode of life of the animal;
- interpret the evidence left behind in sedimentary rocks as trace fossils.

**Context:** Adaptations to different habitats are reflected in the shell structure of bivalves. This understanding is applied to working out what ancient environments were like from the trace fossils left behind by similar organisms.

Burrows can be distinguished from borings, since borings cut straight through bedding and lamination, but burrows disturb the layers that were soft sediment at the time – the layers usually bend down into the burrows, as in Photo 4.

**Following up the activity:** Ask pupils to study Photographs 5 and 6 and their titles and then to say all they can about the environment at the time when the animals lived. They need to be told that modern oysters live on a hard sea bed, usually fixed to it by shelly material secreted by the oyster. (*Oysters are marine creatures, so the area must have been under the sea. They like a hard sea bed to live on, so the sediment must have already hardened and had not remained as soft limey sand. The holes and tubes show where animals bored into the solid rock, again showing that there must have been time for the loose limey grains to become hardened into rock and also to be very near to the shore. We are not sure what organisms made the borings, but the above interpretation remains valid).*


Photo 5: Side view of a hard limestone with tubes running through it. Lincolnshire Limestone, Jurassic, Ketton, England

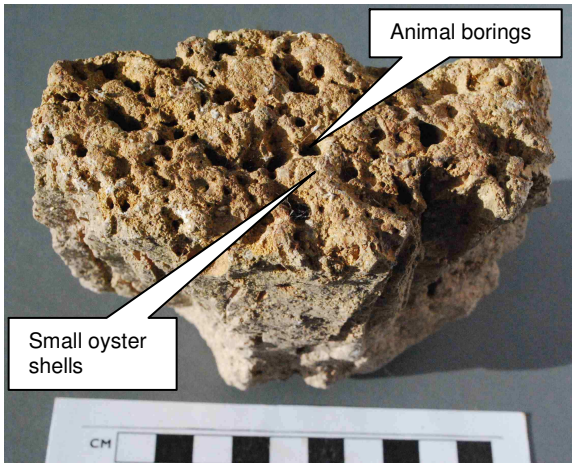


Photo 6: Top view of the same specimen, showing holes and small oyster fossils (All photos: *Peter Kennett*)

**Underlying principles:**
- The shells of marine bivalves provide evidence of the arrangement of the soft parts, even when these have decayed away.
- Fossil bivalves usually display the same characteristics.
- The sea bed itself may retain evidence of the bivalve, even though the shell has gone;
- If an animal burrows in soft sediment, the burrow usually becomes filled in by loose material as soon as the animal leaves the burrow or dies (seen where the bedding is disturbed, as in Photograph 4);
- A sample such as the one shown in Photographs 5 and 6 is referred to as “hard ground”;
- “Hard ground” represents a time when deposition had ceased for long enough for the sediment to become cemented into a sedimentary rock – hard enough for animals to bore their way into it and leave tubes;
- “Hard ground” may sometimes be used to work out where ancient shorelines stood, in

comparison to areas of continuous deposition – this may be important in choosing the best areas to search for oil and gas deposits.

**Thinking skill development:** Revising the relationship between bivalve shell structure and habitat involves construction; metacognition may be involved as pupils discuss their conclusions, and bridging skills are needed to relate the examples given here to the real world.

**Resource list:**

- Copies of the photographs above
- Optional – shells of various types: any real trace fossils, or plaster replicas of them

**Source:** Written by Peter Kennett of the Earthlearningidea team.