

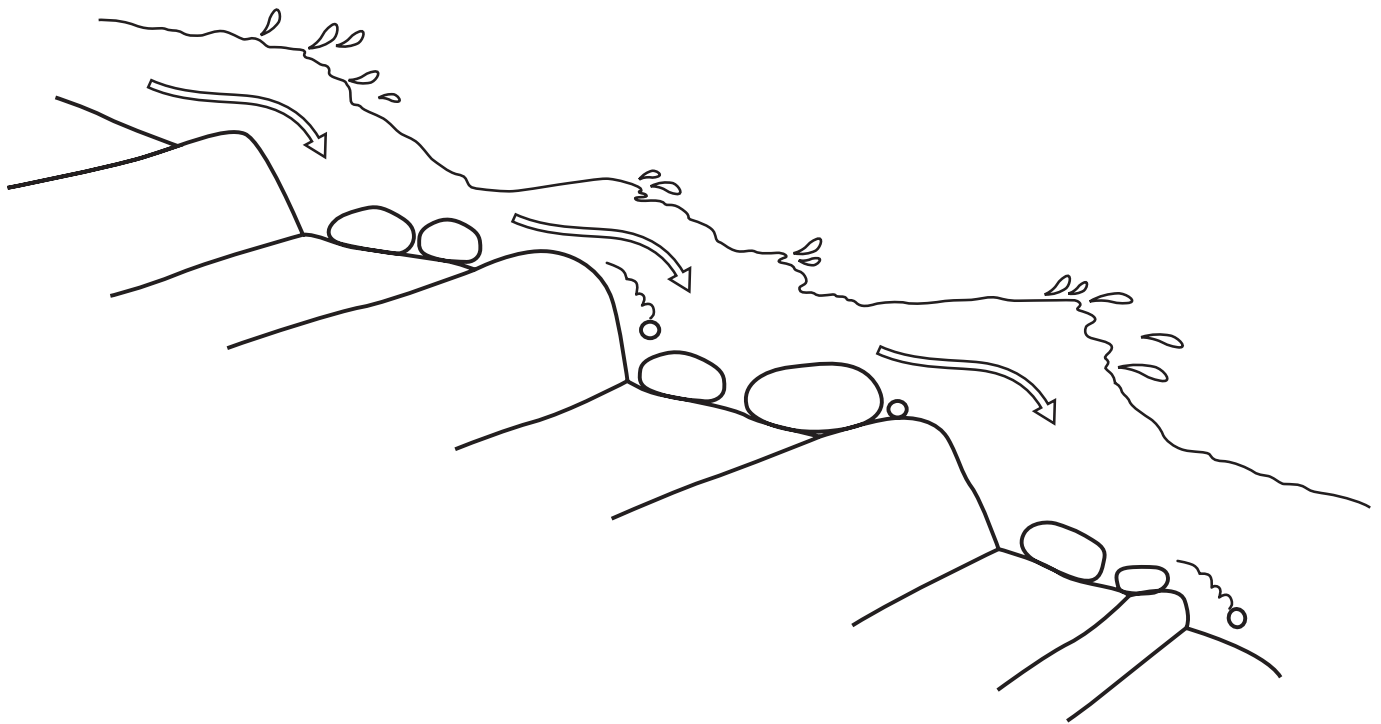
How rivers wear away rocky beds

Rivers use many tools to wear away their beds. One method is simply to dissolve the rock away, and another is to use pebbles, gravel, and sand that are carried by the water as a kind of liquid sandpaper.

Q1. Write the single word that means 'wear away'.

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Q2. This picture shows a side-on view of part of a river bed. Not all the rock is the same hardness. If rivers can wear away softer rocks more easily than hard rocks, mark where you think the soft rock is.



Q3. Describe how the water moves the pebbles along.



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Answers

Q1. Erode/erosion

Q2. The soft rock corresponds to the places where the pebbles have eroded the bed most, that is the 'treads' on the rocky staircase.

Q3. The answer to this is found in the caption to the picture ② on page 10 of The River Book: "The plunging and swirling water lifts the pebbles, then lets them fall back to the bed. Sometimes very big pebbles are just rolled along."

Background support

The processes of erosion all follow from the observations on how water moves. The key to this is to spot that white water is a sign that water is moving fast enough to trap air bubbles. White water can therefore be associated with 'a lot of energy' in the context of moving sediment (pebbles, gravel, sand, silt, and clay).

The pictures have been chosen for the way they show water swirling between large rocks, and tumbling over rocky ledges. The key idea is that water flowing around and over obstacles is very turbulent and will have fast-flowing threads of water in it which can move large sizes of material.

For now, once the idea of turbulence has been established, it is also useful to discuss the fact that rocks vary in their resistance to erosion. This can be simplified, if necessary, by referring to greater resistance under the simple term 'hard rock', and less resistance to erosion through the term 'soft rock'. In this context, the diagram shows sloping bands of hard and soft rock. In effect, the diagram shows rapids (and this can be returned to later to make a comparison with waterfalls).

Another useful way of talking about the differences that are produced by alternating bands of hard and soft rock is to compare the cross section (referred to in the book under the expression 'side view') to a staircase, with treads and risers, or steps and ledges, or whatever terms seem most appropriate to you.

Clearly, the risers in the rapids are made from hard rocks, while the treads tend to be soft rocks.

Scouring action can often produce wide treads, over which water flows with less energy than when it is cascading down a riser. In this way energy is concentrated on the risers, which are then eroded. As risers erode, water again flows faster on the treads, again leading to erosion of the soft rocks. In practice, a kind of equilibrium sets in that maintains the shape of the staircase.

The rocks on the treads represent material

carried by the river in times of flood (and therefore times of highest energy), and left behind on the places with the least energy as the flood subsides.

Erosion

Erosion actually occurs in two stages: weathering (the breaking of the rock *in situ*), and transport to somewhere else. In a river these two stages happen together, but on a hillside they may be separated by hundreds of years (for example, a rock is frost shattered (i.e., cracked and loosened) by frost, but doesn't fall away until many years later).

River erosion processes are solution, corrosion, and attrition. Solution is a chemical process whereby water and the substances it has in solution react with the materials of the bed and bank, creating new products, which are usually clay (which is insoluble) and some invisible soluble products. Clay is always the result of a chemical process; it cannot be produced by mechanical action. Solution is a slow process. But overall it is at least as important as mechanical effects (and in hot humid climates, very much more important).

Corrosion is a mechanical effect produced by the abrasion of rocks by gravel and sand as they are carried by the water. Pebbles may have some effect as they are rolled and bounced along river beds in times of flood. Many people call this process by the general name of 'scouring'. The effect is to abrade the bed and bank materials. Corrosion sounds a little like corrosion and you may think it is better to use the term 'abrasion'.

Attrition is the mechanical effect of transportable sediment (boulders, pebbles, gravel, sand) becoming smaller, either because they are involved in corrosion or because they collide with each other during transport. Attrition can reduce boulders to sand and silt; however, it cannot reduce material to clay size; that is a chemical process.

Across the curriculum

Using this material you can link:

- ▶ Rocks and minerals, discussing a selection of actual rocks and minerals, and experimenting to find out which will wear others away, linking through to measures of hardness;
- ▶ Ideas of (kinetic) energy;
- ▶ The difference between mechanical and chemical weathering, and the formation of soils.