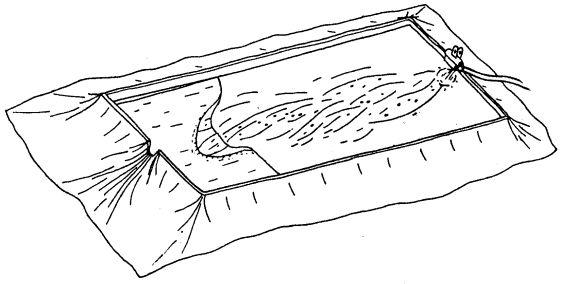
Mighty river in a small gutter
Sediments on the move

Set up a sloping "stream table" using a piece of square section gutter or even a box covered in a plastic sheet. Half fill it with washed sand and add some small pebbles or gravel. Make a straight channel through the sand with your finger.

Ask the pupils:
- What do you think will happen if we pour water slowly on to the sand at the top end of the gutter?
- Which will move first – the sand or the pebbles? Explain your answer.
- As more water is poured onto the surface, will the channel become deeper, or will it get filled up?
- What will happen if we pour the water more quickly?
- Where do you think the sand and pebbles will settle down after they have been moved?



A simple stream table made from a box and plastic sheeting [from Association of Teachers of Geology (1988), Science of the Earth, Unit 4: *Building sedimentary structures – in the lab and millions of years ago.* Sheffield: Geo Supplies]

With the pupils watching carefully, pour water onto the sand, either from a container, or from a hose pipe if running water is available. Ask the pupils to see if their predictions were correct. Also, ask if they can spot how the sand grains and pebbles are moving – are they sliding, bouncing or rolling over the bed of sand?

Continue to watch as channels fill with sediment and switch over, forming a braided pattern – and, if a pool forms at the bottom, how a micro-delta can build out.

It is often possible to see that more dense particles in the sediment accumulate where the flow of water is slow. This is how placer deposits of dense minerals, like gold, form. Dense materials, such as iron filings, or crushed pyrite, could be added to the sand to see where they settle out.

Trainee teachers studying sediment movement in a gutter with flowing water.
(Photo: P. Kennett)

The back up

Title: Mighty river in a small gutter

Subtitle: Sediments on the move

Topic: Investigating the effects of flowing water on loose sediment to see how it is eroded, transported and deposited

Age range of pupils: 7 – 18 years

Time needed to complete activity: 20 mins

Pupil learning outcomes: Pupils can:
- describe how moving water can both erode, transport and deposit loose sediment of various sizes;
- explain that, in general, it takes more energy to move larger particles than smaller ones;
- describe how small channels fill with sediment and switch and how alluvial fans/microdeltas develop;
- explain why the most dense minerals accumulate whenever the speed of the water slows;
- relate the small-scale investigation to real rivers, such as the Ganges, and understand how a large river might behave when in flood.

Context: The activity could form part of a lesson looking at the mechanism of sediment movement, but could also lead to an understanding of the behaviour of real rivers and how this affects people's lives on a large scale. It can be used to explain the deposition of economically valuable minerals, e,g, gold, diamonds, tin.

- What do you think will happen if we pour water slowly on to the sand at the top end of the gutter?
  If the sand is dry, the water will all soak in and will only flow over the surface when the sediment is saturated. When heavy rain falls on dry ground, it may have little effect at first, but may be followed by flooding if the rainfall persists.
- Which will move first – the sand or the pebbles? Explain your answer. *Generally, the sand will move first, since it has less inertia than the pebbles.*

- As more water is poured on to the surface, will the channel become deeper, or will it get filled up? *Much depends upon the flow rate of the water and exactly where it is poured on to the surface. Generally, we might expect the channel to be deepened as sand is eroded away from the sides and bed, but slumping of wet sand into the channel may subsequently block it. More water then has to cut a new channel in order to flow away down the slope, so developing a braided pattern. In the lower reaches of the channel, sediment will become deposited as the flow rate slackens.*
- What will happen if we pour the water more quickly? *Erosion of sediment will take place more quickly, and larger particles may start to move, usually when sand grains are carried away from beneath them.*
- Where do you think the sand and pebbles will settle down after they have been moved? *Some may settle in the upper parts of the channel, but most will be carried lower down. If the water is allowed to flow right off the gutter or sand tray, the sand will either be carried off with it, or may pile up as an alluvial fan. If the gutter has an end stop, water will accumulate in its lower end and the sediment may build out into the pool to form a microdelta, as in the graphics above.*
- How do the sand grains and pebbles move? *Sand grains move by sliding over the bed, or by rolling. They also move by "jumping" and dislodging another grain when they land, but this is very difficult to spot on this scale. If the flow rate is fast, some sand may be carried in suspension, up in the water, for a short distance. Larger particles such as pebbles are mostly moved by being undermined by the removal of sand in the current until they become unstable and roll. Once moving, their higher momentum may enable them to keep rolling for a short distance.*

Following up the activity:

- Prop up the gutter at a steeper angle and then investigate any differences from the first run.
- Investigate reports of flooding or loss of land by river erosion. These may come from local knowledge or from the media or web. When the Ganges-Brahmaputra is in flood, it has been known to sweep away a 500m or so width of its banks, obliging villagers to move their entire settlement to safer ground.
- Try other Earthlearningidea activities dealing with related themes, e.g. 'Why does soil get washed away?'; 'Sand ripples in a washbowl'; 'Sand ripple marks in a tank'.

Underlying principles:

- Different energy levels affect erosion, transportation and deposition.
- An increased volume of water will cause larger particles to be eroded and transported than before. A 10% increase of volume increases the total energy by 10%.
- An increased gradient on the gutter increases the velocity of the water and larger particles will be eroded and transported than before. If the velocity is increased by 10%, there will be 21% increase in total energy.
- If the volume and/or velocity of the water is decreased, then deposition will occur.
- This activity produces small scale braided channels naturally – but also models a large scale braided river system.

Thinking skill development:
Investigating sediment flow is a constructional activity. Cognitive conflict arises when trying to predict how the pebbles will move. Applying the principles to a real river involves bridging.

Resource list:

- anything from which a waterproof channel can be made, e.g. a gutter; a shallow plastic box; or even a cardboard box covered with a plastic sheet
- washed sand, to half-fill the channel
- a small quantity of gravel or small pebbles
- water, either from a running source, or poured from a container
- if being carried out indoors, a container to catch the overflow and to prevent sand blocking a sink

Useful links: See the Earth Science Education Unit's 'The dynamic rock cycle' workshop booklet at:
http://www.earthscienceeducation.com/workshops/worksheets/dynamic_rock_cycle.

Source: This activity is based on one published by the Earth Science Teachers' Association (1996), *Teaching Primary Earth Science, No: 16, Rivers, forming part of Teaching Earth Sciences, Vol. 21.*