Investigating small-scale sedimentary processes AND modelling mighty rivers
The 'Mighty River in a small gutter' Earthlearningidea activity used at different scales

The 'Mighty river in a small gutter' can be used to investigate surface processes caused by water currents in the classroom at two different scales:

Small-scale sedimentary processes

Water flowing onto a beach

Erosion hollow

Upslope sediment being eroded and transported downslope

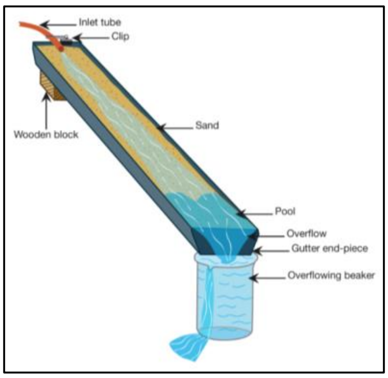
Sand grains moving by sliding and rolling (traction) and moving in a jerky motion (bouncing or saltation)

Scour upstream of small pebbles and deposition of sand downstream of them as sand shadows

Braided channels, formed by water flowing over loose sand, e.g. on a beach

Sediment builds up in braided channels until the channel is filled and abandoned and a new braided channel forms

Micro-delta building out into a pool, with a gently sloping surface and steeper delta front (left hand lobe highlighted in orange for clarity)



Modelling river processes

Flowing water from upland rainfall

Model of a waterfall plunge pool

Model of the erosion of upland areas, e.g. the Himalayas, and sediment being transported away by rivers

Model of pebbles and boulders moving by sliding and rolling (traction) and moving by bouncing or saltation

Model of scour upstream of boulders and other obstructions, and deposition of sediment downstream of them as sediment shadows

Model of a braided river, e.g. the Ganges-Brahmaputra river system

Model of sediment building up in the channels between braid bars until the channel is filled and abandoned, when a new channel forms

Model of a delta building out into a lake or the sea, e.g. the Ganges Delta – showing delta lobes to the left and right, a gently sloping delta top or delta plain (where coal swamps formed in the geological past) and a steeper delta front

Opposite – the apparatus set up *(ESEU).* Water can be fed to the gutter through an inlet tube connected to a tap, or by pouring gently from a jug, as in the large photo. (*Chris King*).

The back up

Title: Investigating small-scale sedimentary processes AND modelling mighty rivers

Subtitle: The 'Mighty River in a small gutter' Earthlearningidea activity used at different scales

Topic: Highlighting the differences in using the 'Mighty river in a small gutter' Earthlearningidea activity at different scales.

Age range of pupils: 7-18 years

Time needed to complete activity: 20 minutes

Pupil learning outcomes: Pupils can:
- describe and account for the small scale sedimentary processes seen;
- link these through modelling to sedimentary processes seen at river scale.

Context:
The small scale sedimentary processes seen include not only the traction (sliding and rolling) and saltation (bouncing) of grains, but also their transportation in suspension – shown by the muddy water in the overflow bucket (which will also contain invisible dissolved material that has been carried in solution).

During the running of this activity, many people spot the sinuous channels and believe they are meandering. These are not meandering channels but are flat-bottomed sinuous braided channels that fill and are abandoned to develop the characteristic braided pattern of flows overloaded with sediment. Such overloaded flows are found on a small scale on beaches and mine dumps, and on larger scales in rivers in mountain, glacial meltwater, and desert areas.

Meandering channels are formed by a completely different set of processes involving the erosion of the outsides of channel bends and deposition on the insides, causing meanders to grow into the characteristic sweeping curves of meandering channels. These are characteristic of lower flows impoverished in sediment, in flatter areas. Despite many attempts it has not so far been possible to replicate meandering stream formation in the lab or classroom. If you try to make your own meandering channel in the sediment, it will soon break down into a braided pattern.

Following up the activity:
The apparatus can be used to investigate water and sediment flows in different ways and at different scales. Here a small-scale obstruction has been added, producing erosion scour around one side. This is also a model of a dam, showing the effects of failure on one side of the dam.

A credit card obstruction. (*Chris King*).

The effects of varying flow rates can also be investigated, both at the scale of small-scale sedimentary processes and at model river scale.

Underlying principles:
- A range of small scale sedimentary processes can be seen, as described on page 1.
- A similar range of models of river processes can also be demonstrated.

Thinking skill development:
Investigational skills are used at both scales, involving construction and cognitive conflict. Application of both of these to the 'real world' involves bridging.

Resource list:
- 1m length of guttering (square section guttering is preferred) with two end pieces
- wooden block (about 5cm high)
- washed sand to fill the gutter to within 2cm of the top
- a cloth (to wipe up spillages)

EITHER
- a watering can or jug to pour water
- a bucket or washbowl to catch the overflow

OR
- rubber tubing to connect to a lab tap
- clip (to fix the tubing to the gutter)
- container such as a large beaker to put in the sink to catch any sediment washed over the end of the gutter – to prevent it from blocking the sink

Useful links:
Try the following Earthlearningideas:
- Mighty river in a small gutter: http://www.earthlearningidea.com/PDF/River_in_a_gutter.pdf
- Rolling, hopping, floating and invisibly moving along: http://www.earthlearningidea.com/PDF/230_Sediment_transport
- Sand ripple marks in a washbowl: http://www.earthlearningidea.com/PDF/Asymmetrical_Ripple_Marks.pdf

Source: Chris King of the Earthlearningidea Team.