

# Section 3: Activity work

## Safety first!

Before any kind of classwork or fieldwork, please make sure you have thought through the appropriate safety precautions, especially those laid down by your local education authority.

## (a) Classwork

### Find your own basin

Everyone lives in a river (drainage) basin – even if the land appears flat – so it is always possible to add a local flavour to river studies.

One local study would be to find out what area the local river basin actually covers. Start by using a map and tracing paper to mark out the river network. The river basin divide can then be sketched in by drawing a line half way between the headwater tributaries of ‘your’ basin, with the neighbouring basins.

If the land has significant relief, you will find that the divide corresponds to ridges and other topographic features. It also allows you to introduce or reinforce the concept of contours and mapwork.

### Make a desktop river

The most striking feature of a lowland river is a meander. It is also one of the features most readily seen on a floodplain. But although students may be able to see it, it will have much more meaning if somehow they can interact with it. Two activity suggestions are given here, one that can be done in a classroom and one that can be done in a small river under proper supervision.

Meanders occur because of the way water flows. You can demonstrate this using the board experiment in class.

You need a flat board about 1.8m (6ft) long. It is easy to get a sheet of white-faced board that is about 15cm (18 inches) wide from a hardware store.

Place the board with one end on the floor in a large bowl or bucket. The bowl will collect the river you make on the board.

Prop up the other end of the board on the seat of a chair or a box. The board now makes the (rather steep) floodplain. You will

probably need to vary the slope to get the best effect. The effect of changing the slope forms part of the demonstration.

Now, add a little deep blue water-based paint to water in a large jug or watering can. This will be the river.

Pour the water steadily from the jug onto the DRY board (see opposite). You may have to experiment quite a lot and be confident about how you pour, but a steady stream on the right slope will give a pattern of meanders. A flow lacking in confidence will probably fail. If you then get students to look carefully at the water as it is flowing, they can see the water flowing fastest around the outside of the bends. They can also see how the meanders shift down slope, especially if you increase the rate of flow during the demonstration.

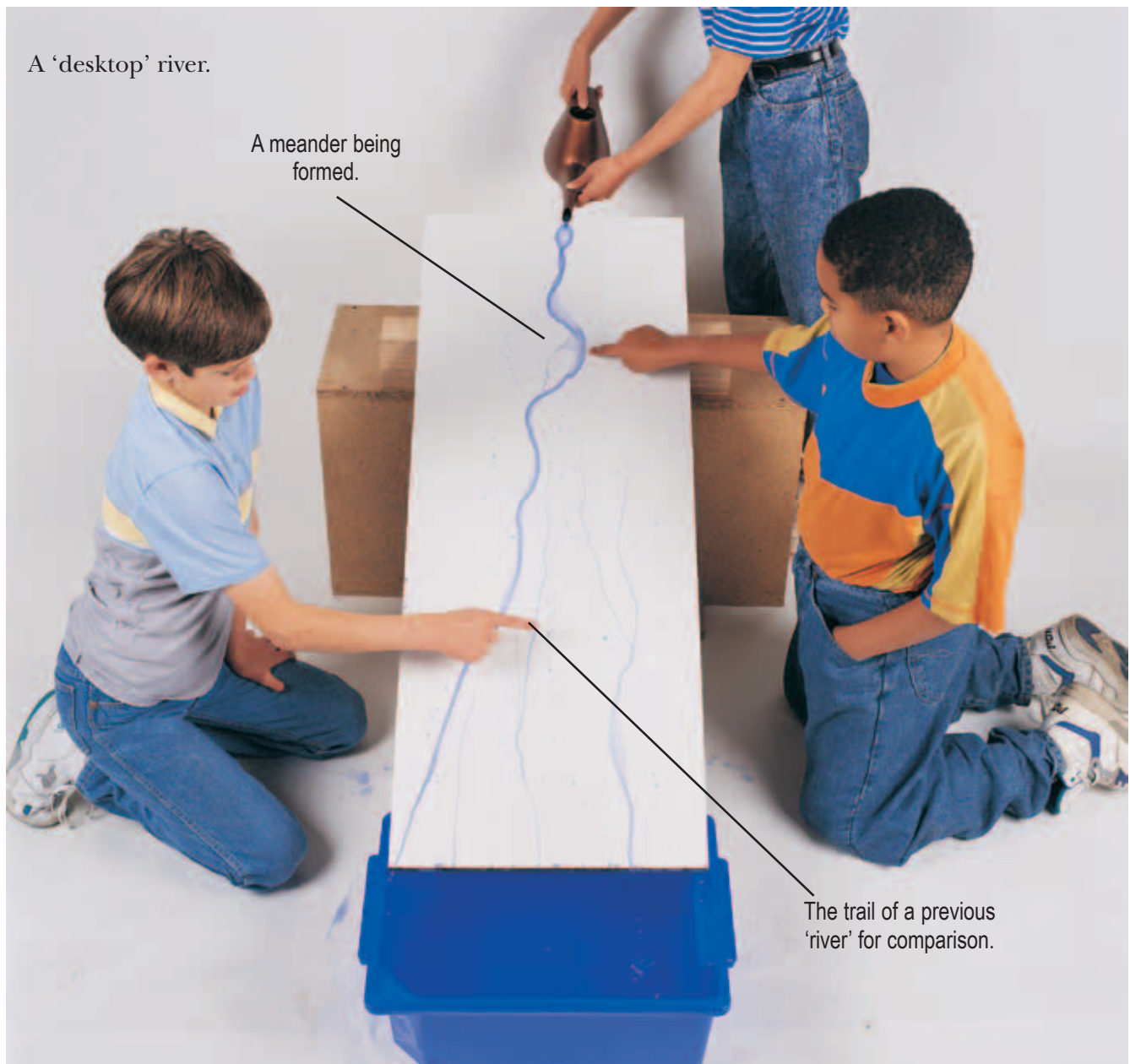
The river is held on the board by surface tension. This is how you can get a river on a board. It also shows that meandering is a property of the flowing water, and not due to local landscape effects.

While this is happening, get the students to imagine how the shifting river channel reworks the soil on a floodplain, making the floodplain flat (from side to side – it will, of course, have a downstream slope). This demonstration also shows the way that meanders migrate down a slope. It is great communal fun in a classroom, and a good scientific demonstration at the same time.

From this demonstration, you can talk about how rivers shift material about, transferring it from the outside bank of one meander to (mainly) the inside bank of the next meander. Then take the conversation further to explain how rivers shift material downriver to the sea, mainly in times of flood.

Any one particle of sediment may take hundreds or thousands of years to make its way through a floodplain. Much of its time is spent as part of the floodplain: having been deposited on the inside of a bend, it awaits the return of a meander to scour that part of the floodplain again.

To help students understand the nature of sediment transport, you can mix up soil and water and then watch it settle. The sand, and any stones, will settle almost immediately, indicating that a fast current is needed to



carry large materials, while the mud will remain in suspension for a long time. But when the mud has settled and the water cleared, has all of the soil separated from the water? The answer is no, because there will still be material dissolved from the soil. This is material that can be transported in even the gentlest of currents.

To demonstrate such things as river basin, and the way that springs form, use a thick kitchen sponge. Get one with as big a surface area as possible. Pour water onto the top of this and get students to notice that no water flows out from the bottom for a while. This lag explains the time difference between rainfall and storm runoff by the river. Making a cone shape of the sponge will concentrate water in

the centre of the cone. This 'hillside hollow' gives rise to a spring.

## (b) Fieldwork

Visiting a river can be exciting and fun, provided the obvious safety precautions are taken and that all students have well-defined tasks to achieve before they go.

It is difficult to work with large rivers. These are usually less accessible, and interesting features will be far apart. A stream or river a few to tens of metres (yards) across would be ideal. But not all such rivers have access, so it is important to find one with access from a public bank. This kind of river is also likely to fit within a single map, allowing its drainage basin to be examined in class.

A number of short, well-defined tasks are better than one long project. This is especially true for the less able and the younger student, but there is generally more satisfaction for all students in having hunted around to complete a number of tasks, rather than getting bored with one long task.

Conclusions should be clear and not subjective. Again, then students should know when they have succeeded.

## Become aware of safety through river study

Many students are unaware of the need for safety. One way to introduce the idea of safety is to play 'Pooh sticks' or 'Pooh biscuits' (an environmentally-aware version of Pooh sticks that adds a dash of colour for tracing purposes – see next column). You can also get students to read *Winnie the Pooh* by A. A. Milne, and discuss the story in the context of rivers.

The idea of safety can be emphasised through suitable questions. That is, if you set the Pooh biscuits task and get children to observe the river speed at various points, they will find out for themselves which are the more dangerous places. By dropping Pooh biscuits from a bridge, they could also find out that bridge piers create eddies and fast currents.

Of course, it is never safe to take a party to a river site when rain or snowmelt is forecast, or at times of high flow. It is not only dangerous, but with a full river you cannot see much of the bed or banks.

## Visit your basin

If you can, organise a field trip to follow part of the basin divide so that students can grasp what this really means. Is the divide clearly defined, for example? How close is it to the school? Do you cross it on your way to school? (This works even for major cities whose landscapes may at first appear to be flat – you will find that they are not!)

Another activity is to find out who in the class lives closest to the divide and who lives closest to the river. Then you can find out the distances from divide to river using the map.

Find out if any roads run along the divide, and which roads, if any, run along the side of the river. The point here is that the drainage basin is a rather abstract concept, but everyone knows the location of their

home, town centre, and local roads. They can then begin to relate the drainage basin to the features of the mental maps of their home locality.

More advanced students can find out the size of the drainage basin by placing squared paper over the map and calculating the drainage basin area.

## Pooh sticks/biscuits

Rivers are easy to look at, but it is not always clear what is happening in them. It is important, for example, to make sure that students appreciate that the water flows fastest around the outside of a bend, and it is here that the water is deepest and the energy is greatest.

One way to begin to get an appreciation of the variations in water speed in a river is to use differently-coloured floating objects thrown into the water. Dog biscuits make good floating, yet environmentally degradable, Pooh sticks. A number of different coloured biscuits can be released from a bridge by students, and the position of the river currents and eddies, etc., observed.

Pooh biscuits, of course, can be used in many ways. You can, for example, pull a surveying tape (or a rope knotted every metre) across a small stream as a way of introducing quantitative measurements. Students can stand a metre apart and drop their Pooh biscuits to make a fair test of relative current speed.



Pooh biscuits!





A series of ribbons attached to a pole will show the direction of flow in a column of water.

## Streamers

Streamers are a direct way of observing that the flow of water at depth is not the same as the flow near the surface. If students can see this, they are more inclined to believe that water flows in a corkscrew motion around a meander.

You will need a garden cane, together with a number of thin ribbons of different colours. Tie one ribbon 15cm (6 inches) from one end. Tie another 15cm (6 inches) further along, and so on until you have four or five ribbons. Waterproof package tape could also be used for fixing the ribbons.

Place the streamer in the water and the ribbons will stream out in the directions of the water currents. A teacher can wade into a river to place the streamer, and students can still see the results standing safely on a bank.

The water weed in this section of a river shows the direction of the current as it passes through the bend.



This streamer will show you how the water is moving, but you must only do it in a small, safe river where the water is no more than knee deep. You can place this 'detector' in many places in the river to find out how the water flows.

## Natural streamers

Many rivers contain natural water weed that trails out in long streamers. You can look at this from a river bank or a bridge to see the nature of the current curving around the bend. The weed forms a natural river streamer.

## Looking at sediment

Use a trowel to collect some sediment from the river bank or a part of the river bed. If river sediment isn't readily available, you can also use garden soil for this demonstration. The sediment can then be studied in class (see earlier).

Get a trowel full of sediment and put it in a large jar. Fill the jar three-quarters full of water and add a few drops of dishwashing liquid to lessen the cohesion of the particles. (Boiling the soil helps even more. Boiling the soil in some peroxide solution gives the best result, and also takes away humus staining.)

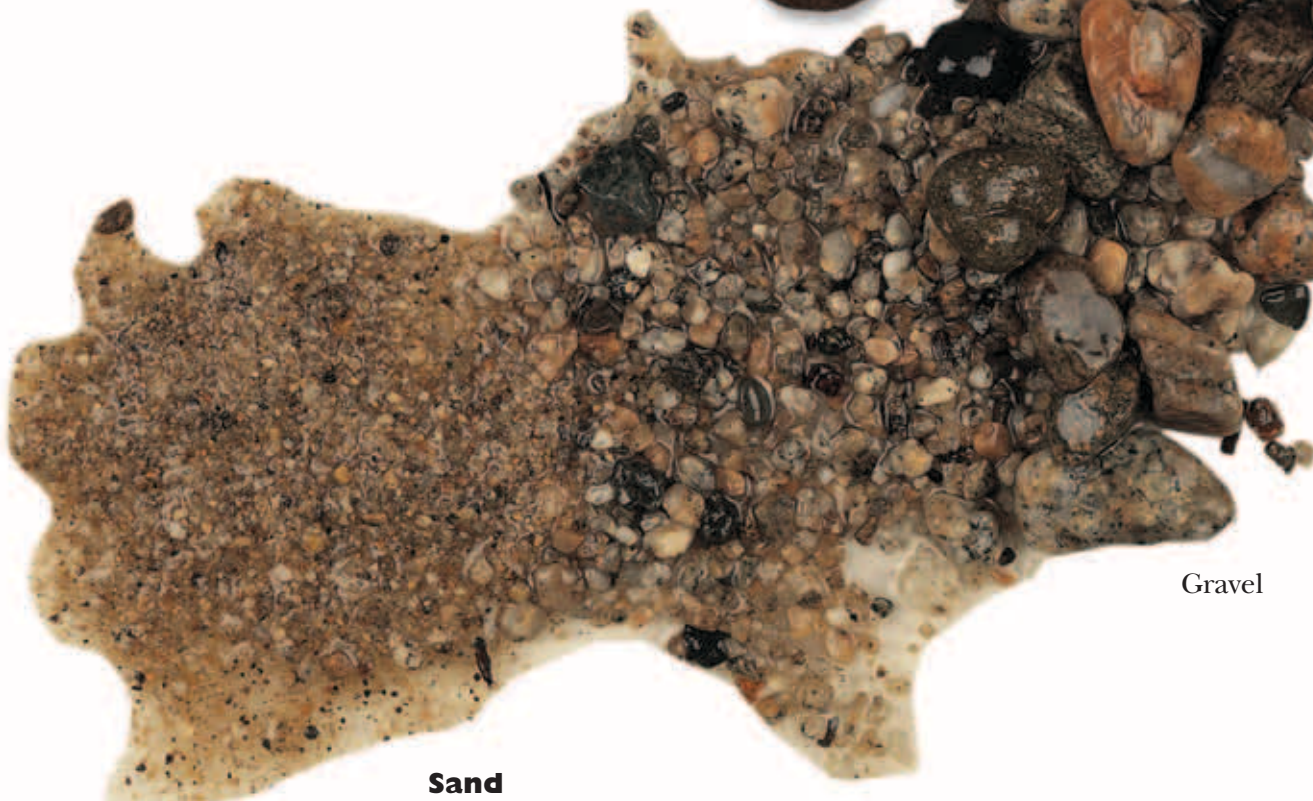
Pebbles



Gravel



Sand



Silt and clay



Shake the soil and water until it is all swirling strongly. Now place the jar where the class can see it and watch. The coarsest material will settle out first, the finest later. The result is that the jar will show all of the different grades of material as they settle. Several important points can be made:

1. The soil (like the floodplain, river bed, and river bank) is made of a mixture of materials. All are carried by strongly flowing water.
2. The heaviest material settles first, so that pebbles and gravel are carried only short distances in a flood. The clay (mud) may take days to settle in the jar, showing that it readily moves in suspension, can flow over the floodplain in times of flood and only later be deposited to form fertile soil, etc.

## Studying river beds

You can examine the bed of a small, shallow river at times of low flow. If you look at many beds, you will see that they have a surface of large pebbles. Look carefully and you should be able to see the way the larger pebbles are orientated with their flat sides angled against the river flow. They also have their shorter side against the flow. This is a good study of fluid dynamics (the watery version of aerodynamics: pebbles turn around until they face the flow and present the least resistance).

These large particles armour the bed, that is, they protect the fine material underneath. This is another reason why so little fine material flows between floods; it is buried below the armouring. However, as soon as the large pebbles begin to move in the fast waters of a flood, or near flood, all the material they have been protecting is exposed and the amount of sediment in the river increases dramatically. This is why rivers suddenly turn muddy.

## Solution in the classroom

You can show the process of solution in class by using an antacid tablet. Everyone in a class can do it for themselves, or with their parents at home. It also reinforces the link between earth science and materials science.

It is best to choose an antacid tablet that is chalk based, rather than one that dissolves away completely. Many soluble aspirins can be used in the same way, because they nearly all use a base of insoluble material to act as the



filler for the tablet. The purpose is to show that chemical weathering (chemical reaction) usually produces a precipitate of fine-grained sediment (clay, mud) as well as taking material into solution.

## Studying water in soils and rocks

Although the water cycle is an essential core topic, it can also seem very abstract. This is particularly so because most of the components of the cycle are invisible. There are two objectives to making the water cycle more comprehensible. The first is to make the various parts of the cycle visible by relating them to everyday experiences. The second is to put the parts of the cycle into a logical order.

**Evaporation:** Most children will agree that a saucer with water in it will dry as water is soaked into the air.

**Transpiration:** Can be seen by noting the way the soil in a potted plant dries out over a few days.

**Condensation:** There are two ways to show this. One is to show that steam from a kettle is a cloud in miniature; the second is to show that water comes out of the air when it is cooled by observing the condensation of water on a glass of ice-cold liquid.

**Aquifers:** Use a flat dishwashing sponge. Make it damp, wring it out, and drape it over a

sloping board. Fill a jug with water and add a few drops of food colouring to make the water easier to see. Pour the water onto the top of the sponge.

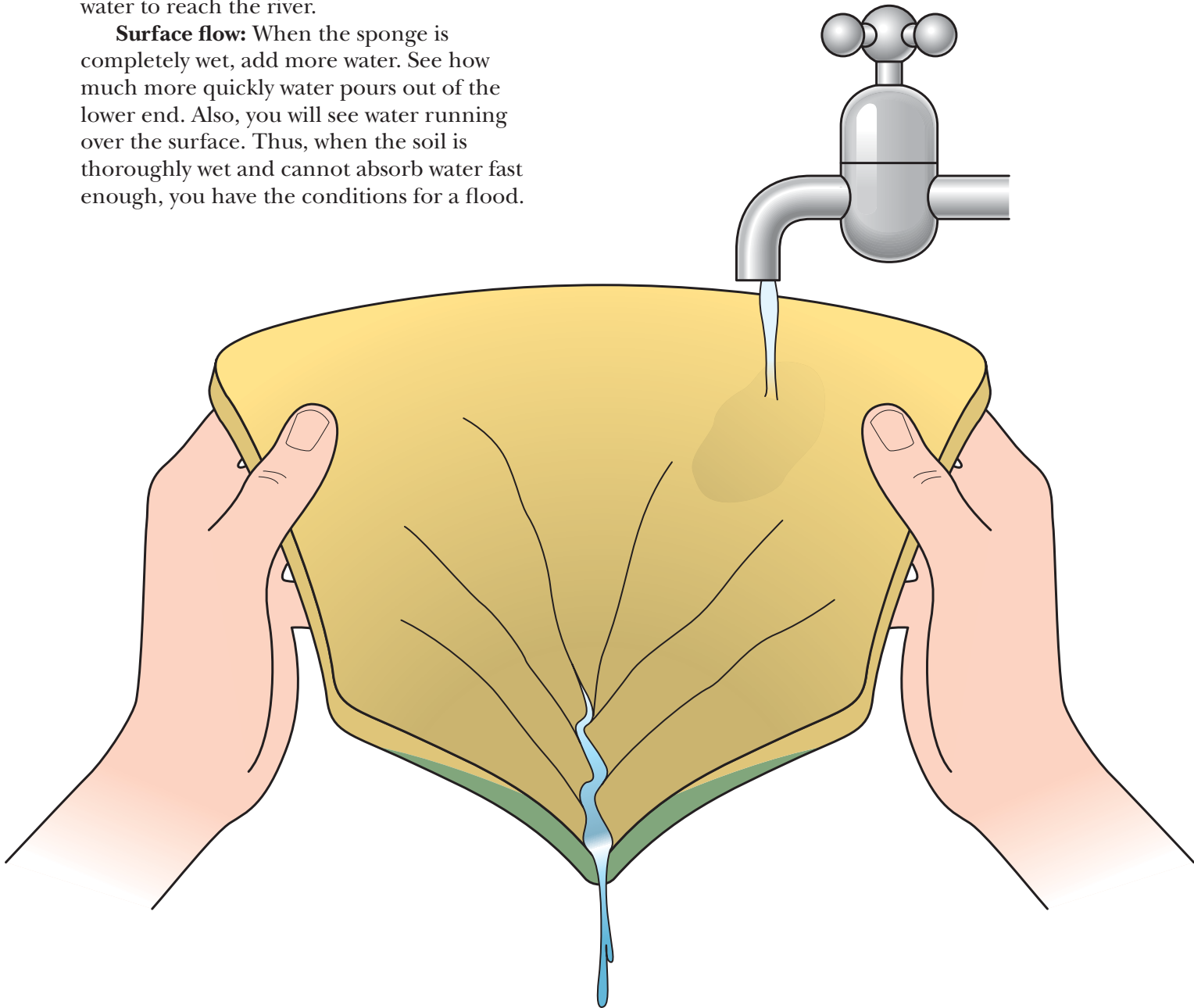
The progress of the water becomes obvious by the movement of the wet edge of the water (even without dye). Stress that it takes time for water to move through soil and rock. Students can see this for themselves simply by noting how long it takes before water drips out of the bottom of the sponge.

**Link to maths:** If the sponge was several kilometres long (a real hillside) just think (or even work out) how long it would take for water to reach the river.

**Surface flow:** When the sponge is completely wet, add more water. See how much more quickly water pours out of the lower end. Also, you will see water running over the surface. Thus, when the soil is thoroughly wet and cannot absorb water fast enough, you have the conditions for a flood.

**Drainage:** Don't forget to get students to time how long it takes for the water to stop flowing out of the bottom of the sponge after no more water is added. This explains how rivers receive water and keep flowing even after rainfall has stopped.

You can repeat the demonstration with a thick sheet of sponge, representing a thick permeable rock. Of course, water takes longer to emerge and drains for longer. Thus, the thin sponge might represent a soil on impermeable rock, the thick sponge might represent an aquifer.



## **(c) Research projects**

It is possible for students to become experts on the world's major rivers, by getting groups or individuals to use the library to find out about the Mississippi River, the Amazon, the Nile, and so on. Brief information for such a study is also available from the Curriculum Visions web site ([www.CurriculumVisions.com](http://www.CurriculumVisions.com)). Groups can give talks and presentations to one another on their chosen river. Such tasks will take several lessons or homework sessions.

Similarly, students can become experts on river features, such as oxbows and levees. These more restricted tasks can be accomplished within a lesson.