Science@School | Book 3D

Rocks and soils

Teacher's Guide

Support material for the pupil book
can be found at the dedicated web site:

www.science-at-school.com

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Peter Riley

Teacher's sheet: comprehension

See **pages 4 and 5** of *Rocks and soils*

Answers

1. **(a) A layer below the ground matching that in the pupil book should be drawn.**
   (b) A rock face of horizontal and vertical lines.
2. **Tiny pieces, mostly rock.**
3. **(b).**
4. **Rock.**
5. **Natural material.**
6. **Soil is a loose material made from tiny pieces of rock while a rock is a large solid piece.**

Complementary work

(a) The children could use secondary sources to find out how people used stone in the Stone Age.

(b) The children could use secondary sources to find out about meteorites and asteroids.

Teaching notes

As the children investigate the rocks on the surface of the planet and see in the picture that the planet is in fact made of rock, they may ask where the rock came from. Some children may know about asteroids and meteorites and you could build on this knowledge to say that the rocks formed in space. About four and a half billion years ago the gas and dust circling the developing Sun formed the planets. The particles of dust crashed into each other and formed larger fragments which in turn crashed into other fragments to form the rocky planets and the cores of the gas giants. Asteroids and meteorites are rocky lumps that did not make it this far.

Teacher's sheet: activity

Based on **pages 4 and 5** of *Rocks and soils*

Introducing the activity

(a) Show the children some different kinds of rock (see note (i)). It may help if the pieces are large, to reinforce the idea that we live on a rocky world. Tell the children that you do not need large pieces of rock for identification and that they are going to use small pieces and a magnifying glass to perform their tasks.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 to 3 (see note (ii)).

(c) Let the children try tasks 1 to 3.

(d) Check the children's work and if it is correct let them try task 4 (see note (iii)).

Completing the activity

(e) Ask the children to report on their rock survey.

Conclusion

Rocks can be identified by their appearance.

Teaching notes

(i) Small rockery rocks from a garden centre may be useful.

(ii) Make sure the children know how to use a magnifying glass. Check that they can find a magnified image by moving the glass to different distances above the surface of the rock and moving their eye different distances from the lens.

(iii) Make up a collection of small rocks (10 or 12). Most should be either sandstone or limestone, with a few granite rocks. You may want to have perhaps four or five different types so that the children can produce bar graphs of their results.

Teacher's sheet: comprehension

See **pages 6 and 7** of *Rocks and soils*

Answers

1. **The central pipe should be drawn in connecting the chamber to the top of the volcano. A side pipe may also be drawn in.**
2. **This should be running down the side of the volcano.**
3. **(a) Red; (b) Black.**
4. **Lava flows out of it, gas and ash is produced.**
5. **Granite.**
6. **It is white or grey with specks.**

Complementary work

(a) The children could be introduced to crystals by looking at salt and sugar crystals with a magnifying glass or microscope to see their flat sides meeting at sharp angles.

(b) You may demonstrate how to grow a crystal of alum from a kit available from educational suppliers.

Teaching notes

The children may be surprised that when you go deep into the Earth the rocks should be molten. This is due to the high temperatures and pressures inside the Earth. The pressure is due to the weight of the rocks and the heat is due to radioactive materials which release energy. Some of this energy is in the form of heat, which heats up the rocks. The centre of the Earth is at a temperature of 4,500°C, which is 45 times hotter than a boiling kettle.

Most of the rock in the Earth moves slowly, rather like the toothpaste you squeeze from a tube. But nearer the surface, where there is less pressure, the rock is thinner and may run like a liquid if it gets a chance to escape onto the surface. All volcanic rock is made from crystals. If the rock cools quickly (e.g. lava) the crystals are small and difficult to see, but if the rock cools slowly (e.g. granite) the crystals are larger and easier to see. Lava cools quickly above ground because it loses heat quickly to the air. Granite cools slowly underground because it loses heat slowly to the surrounding rock. The pink crystals in granite are feldspar and the black crystals are mica. They are embedded in a glass-like crystalline material called quartz.

2

Teacher's sheet: activity

Based on **pages 6 and 7** of *Rocks and soils*

Introducing the activity

(a) Ask the children to imagine that they are standing near a volcano as it erupts and see the ash thrown into the air and the lava flowing. Show them a piece of pumice as an example of a frothy lava and show them black treacle, which you can make behave like lava.

(b) Tell the children that they are going to investigate each one in turn.

Using the sheet

(c) Give out the sheet, pieces of pumice and pebbles, let the children fill in their names and form, then go through task 1 (see note (i)).

(d) Let the children try task 1 (see note (ii)).

(e) When the children have completed their written account go through tasks 2 and 3.

(f) Let the children make their plan (see note (iii)).

(g) Let the children try their plan when you have checked it.

(h) Let the children try task 4.

Completing the activity

(i) The children can compare their results.

Conclusion

Cold treacle (lava) flows more slowly than warm treacle (lava).

Teaching notes

(i) Tell the children that they have to find out how the pumice stone is different from a pebble. Say that they can use a magnifying glass, scales and a dish of water.

(ii) They should readily observe the two rocks with the magnifying glass and may feel the difference in weight which they can then check with the balance. The difference in weight is due to the fact that pumice contains trapped air bubbles. If the children do not think about testing in water, suggest this to them, and they will discover that the pumice stone floats while the pebble sinks.

(iii) They can draw a diagram of how they would set out their equipment. The plan should include putting each drop of treacle at the same distance from the edge of the tray, having the tray on the same slant for both tests, timing from the moment the treacle reaches the tray from the spoon until it has flowed to the bottom edge of the tray.
The table should have two columns – the left one headed 'Treacle (or lava)' and the right one headed 'Time to flow (secs)' (see example below). In the boxes in the left column should be written 'Cold treacle' and 'Warm treacle'. You may warm up some treacle by putting a cup of it in a bowl of warm water. Depending on the ability of your class it may be better if you put the treacle on the tray when the children are ready for it.

Treacle (lava)	Time to flow (secs)
Cold treacle	
Warm treacle	

Teacher's sheet: comprehension

See **pages 8 and 9** of *Rocks and soils*

Answers

1. **A on left hand rock, B on right hand rock.**
2. **Small pieces are being rubbed off the softer rock.**
3. **Mudstone or shale.**
4. **Natural cement.**
5. **Sea shells.**
6. **A kind of limestone that is baked underground.**

Complementary work

(a) The children can use secondary sources to find out about the different ways that rocks are made.

Teaching notes

Although the children do not have to know about the rock cycle at this level, they do investigate certain aspects of it in the course of studying the pupil book. It may be helpful here just to give an outline of the cycle to show how the different rocks are related to each other. All the original rock on the Earth's surface was volcanic but over the course of time most of it has been weathered (broken down). The fragments of weathered rock have been transported by rivers and deposited in oceans where they have been compacted and cemented together to form sedimentary rocks such as mudstone and sandstone.

Many sea creatures can extract calcium from sea water and use it to make shells. When the creatures die, their shells collect on the sea bed and also form a sedimentary rock.

The movement of the molten rock inside the Earth moves huge plates of rock across its surface. At places where the plates meet, layers of sedimentary rock may be folded up, squashed and brought nearer to the hot rocks below for a while. The increase in heat bakes these rocks and they change form. These rocks are known as metamorphic rocks.

Limestone and marble are featured in the unit, and slate is a metamorphic rock formed from baked mudstone. Over time, the surface of the Earth has become covered with sedimentary, metamorphic and with volcanic rock that is still moving up from below the Earth's crust today.

Teacher's sheet: activity

Based on **pages 8 and 9** of *Rocks and soils*

Introducing the activity

(a) You may begin by saying how people associate rock with hardness and even use the phrase 'rock hard'. The children are going to test the rocks to see if they are all very hard.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 and 2.

(c) Let the children try tasks 1 and 2 (see note (i)).

(d) Review the test with the children then let them try task 3 (see note (ii)).

(e) Let the children try task 4. The order should be granite, sandstone, mudstone and chalk.

Completing the activity

(f) Introduce another stone such as marble (very hard) or limestone (soft). Ask the children to feel it and predict where it may come on their scale, then let them try and place it (see note (iii)).

Conclusion

Rocks do not all have the same degree of hardness and some may be quite soft.

Teaching notes

(i) Let the children use granite and natural chalk or a pebble and chalkboard chalk if these other materials are not to hand. Natural chalk is a rock made from broken up shells of microscopic sea creatures.

(ii) The other stones for the test should be sandstone and mudstone/shale.

(iii) The children could be reminded of the scratch test used for testing materials, if they have previously studied ***3C Properties of materials*** in this series. You can demonstrate this by saying that if a fingernail makes a mark the rock is very soft, if a coin makes a mark the rock is soft, but if a nail makes a mark the rock is hard.

Teacher's sheet: comprehension

See **pages 10 and 11** of *Rocks and soils*

Answers

1. **The rocks with the vertical cliff faces should be shaded in.**
2. **The rock below the hard rock.**
3. **A river or a sea, or even rain.**
4. **A mesa or tableland.**
5. **Hills.**
6. **The pillar of rock made by the lava in the pipe at its centre.**

Complementary work

(a) The children could look at photographs of the local landscape and identify areas where there are hard and soft rocks.

(b) The children could study photographs of landscapes from around the world and identify regions where hard and soft rock may be found below ground.

(c) The children can use secondary sources to find out about minerals and mining.

Teaching notes

This unit builds on the fact that rocks vary in hardness, and links this to the landscape and its role in people's lives. It will help to sustain the idea that we live on a rocky planet. Factors affecting the development of a landscape are complex and here just two are considered – the different hardnesses of the rock and the erosion of the rocks by water. Glacial erosion is also important in many landscapes but it need not be developed here.

In previous units, the children have been introduced to a layered pattern in the diagram of the volcano and have seen that rock fragments become cemented together. Here, the hard and soft rocks are shown in layers, and you may like to explain that when rocks are broken down into fragments, the fragments settle out to form layers. If the children try the accompanying activity they will see how sand moves from one part of the landscape and settles in another.

It is mentioned in the unit that the flatter surface of the softer rock allows the build up of soil, which in turn provides a suitable environment for growing crops. By contrast, the steep slopes of the hills produced by the hard rocks have only a thin soil. This is covered in grass which provides a suitable food for sheep. A more direct link to livelihood and rocks can be made by looking at mining. To appreciate this the children need to know that rocks are made from a mixture of minerals, and that sometimes molten rock that squeezes into cracks between other rocks cools to form structures called veins which are especially rich in certain minerals. Miners extract the minerals. Rocks which have a high mineral content are known as ores.

Teacher's sheet: activity

Based on **pages 10 and 11** of *Rocks and soils*

Introducing the activity

(a) Remind the children that the landscape is made from the materials that lie beneath it, and say that they are going to test this idea by making a model landscape and then wearing it down with water.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 to 4 (see note (i)).

(c) Let the children try tasks 1 to 4.

(d) Go through tasks 5 and 6 then let the children try them (see note (ii)).

(e) Let the children try out tasks 7 to 11 (see note (iii)).

Completing the activity

(f) Let the children compare their results and assess the predictions made by each other.

Conclusion

Hard materials stick up in the landscape when the softer materials have been worn away.

Teaching notes

(i) You may like to demonstrate these tasks by making a small mound of soil over a rock and covering it with sand.

(ii) The water should cut valleys in the sand and carry it away to the edges of the landscape. Some of the soil may go, too.

(iii) The sand may be washed off the pebble and some of the sand and soil may be washed away from around the pebble. A different pattern of valleys may form.

(Note that 'valleys' only form if a sufficiently long slope is available.)

Teacher's sheet: comprehension

See **pages 12 and 13** of *Rocks and soils*

Answers

1. **It will flow across the surface and over the edge.**
2. **Chalk and sandstone.**
3. **They have holes in them.**
4. **They crumble.**
5. **Acid.**
6. **Limestone, sandstone, chalk.**

Complementary work

(a) The children can use secondary sources to find out about caves and how they form. They can find out about stalactites and stalagmites.

(b) You could set up a demonstration of how stalactites and stalagmites form by dissolving a large amount of washing soda in some water and pouring it into two jars. Place the jars about 12 centimetres apart. Dip both ends of a piece of woollen yarn into each jar and let the middle of the yarn hang down a little between them. Put a dish under the lowest point of the yarn. The washing soda solution will soak into the yarn and begin to drip into the dish. In a few days, it may form a stalactite and a stalagmite.

Teaching notes

When water enters the gaps in a piece of rock and the rock is frozen, the water expands as it turns into a solid. This expansion of the water causes parts of the rock to snap. When the rock is thawed out, and the ice contracts and turns back to liquid, the broken parts inside the rock cause it to crumble. This is a form of weathering that is sometimes called frost shattering, and the rocks are called frost shattered rocks.

Today the term acid rain refers to the rain produced when the fumes from power stations are dissolved in raindrops. These fumes contain sulphur dioxide, which forms sulphurous acid in rainwater. Rain was slightly acid before the development of power stations. The acid is formed when carbon dioxide dissolves in water. This acid is called carbonic acid.

When rain falls on limestone it reacts with (dissolves) the limestone and widens cracks in the rock. As the water soaks through the limestone it removes more of the rock and may create caves. Eventually, the water will reach a rock which is not permeable and it will run along its surface, dissolving limestone as it goes, until it reaches the surface again lower down the hill or mountain. The place where the water returns to the surface is called a spring.

Inside a limestone cave, water covers the roof and some evaporation occurs. This leads to some of the limestone reforming as spikes (stalactites). Water drips from the stalactites and as each drop leaves the stalactites more limestone is left behind to increase the size of the stalactites. On the cave floor where the drops fall, a stalagmite builds upwards.

Teacher's sheet: activity

Based on **pages 12 and 13** of *Rocks and soils*

Introducing the activity

(a) Tell the children that they are going to test some rock samples to see if they soak up water. They are not being told the identity of the rocks and must label them using the code (see note (i)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 (see note (ii)).

(c) Let the children perform task 1.

(d) Go through tasks 2 to 4, then let the children try them.

(e) Check that the children have filled in their table correctly then let them try tasks 5 and 6 (see note (iii)).

(f) Check that the children have filled in their table correctly then let them try task 7.

Completing the activity

(g) Let the children compare their work and ask them if they can identify any of the rocks.

Conclusion

Granite, marble and slate do not soak up water. Sandstone, chalk and some soft limestones (but not hard mountain limestone) soak up water.

Teaching notes

(i) You may like to put the rocks in separate boxes. For example A = limestone, B = granite, C = slate, D = chalk, E = marble, F = sandstone. Try to use samples of rocks that the children have not seen previously. If possible, they should be a different shape from previously seen specimens.

(ii) The children must put each piece of rock on a separate piece of paper and label the paper.

(iii) Depending on the ability and attitude of the children, you may prefer to use teaspoons instead of droppers. The children need to make a fair test, which includes adding the same number of drops to each rock and, if the rocks are flat, leaving the water on the different rocks for the same amount of time.

Teacher's sheet: comprehension

See **pages 14 and 15** of *Rocks and soils*

Answers

1. **The roof.**
2. **It is waterproof. It breaks into thin sheets.**
3. **The statue (and/or the walls).**
4. **To make it look attractive.**
5. **The road surface.**
6. **It is hard.**

Complementary work

(a) If you have introduced the children to minerals and gemstones, they could find how they are used in jewellery by looking at the pages of a mail order catalogue.

(b) The children could use secondary sources to find out how rocks are extracted from a quarry and prepared to make building stone.

Teaching notes

Rock was one of the first materials to be used by humans. Flint and the volcanic rock obsidian became widely used for making cutting instruments, from axes to arrowheads and even sickles. These are brittle rocks which can be chipped to make sharp cutting edges. Other rocks, such as sandstone, have been used to make grinding stones for grinding corn and are still used for this purpose in some countries today.

Polished granite is often used to decorate the front of prestigious buildings because its crystals make its surface look attractive. Polished stones may also be used as ornaments and are found both inside and outside buildings. Turquoise and opal are two rocks commonly used in jewellery.

If the children have been made aware of minerals in Unit 4, you may wish to extend this by considering the use of minerals as gemstones in jewellery. The most widely used gemstones are diamond, sapphire, amethyst, ruby, emerald topaz, garnet, jade and onyx (which is a form of agate).

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Rocks and soils*

Introducing the activity

(a) Begin by asking the children if they can find anything that is made of stone in the school or its surroundings (see note (i)).

(b) Explain that the children are going to look for the use of stone in their surroundings (see note (ii)).

Using the sheet

(c) Give out the sheet, let the children fill in their names and form, then go through tasks 1 to 3 (see note (iii)).

(d) Let the children try tasks 1 to 3.

(e) Check the tables have been filled in correctly then let the children try task 4.

Completing the activity

(f) If the children have done this as a homework exercise they could compare their results in class. If they have made a school neighbourhood survey you may like to produce a simple map on which they could write the locations of the various stone objects (see note (iv)).

Conclusion

The type of rock used will depend to some extent on the local rock. In a limestone area many of the features will be made of limestone. The fronts of prestigious buildings such as libraries and town halls may be made of granite or marble in any area. Although slate is the best roofing material, sometimes slabs of other kinds of rock may be used.

Teaching notes

(i) The school itself may be made of stone or it may have stone steps or a stone wall in the playground.

(ii) You may wish to take the children on a walk around the school neighbourhood, or you may like to set the work for homework and have them look in the immediate neighbourhood to their homes. They may give an approximate location for the rocks they see, such as Market Street or Green Park.

(iii) If you are setting this as a homework exercise, you may wish to blank out some of the items in the table (e.g. grave stones). Either way you decide to have the children perform the activity, there are some extra spaces in the table for the children to fill in if they find any other uses of rock.

(iv) You may wish to take photographs of the siteps of the various stone objects and let the children place them on a map.

Teacher's sheet: comprehension

See **pages 16 and 17** of *Rocks and soils*

Answers

1. **(a) The two small buildings should be marked with an A. (b) The two large buildings should be marked with a B.**
2. **The pedestrian area.**
3. **Cement.**
4. **Stone, sand, cement (and water).**
5. **The stones.**
6. **By wetting clay and shaping it into a brick shape, then letting it dry and baking it.**

Complementary work

(a) The children can use secondary sources to find out how bricks were made in Ancient Egypt, how they are made today and how adobe bricks are made and where they are used.

(b) If walls with different brick patterns can be found they can be shown to the children.

Teaching notes

The clay for brick-making is extracted from a clay pit. The clay is screened to remove small stones, then may be ground up to make all the particles the same size so they can pack together more closely. Water may also be added to the clay so that it can be extruded easily into a slab, then cut into blocks with wire. Clay that is too thick to be extruded is pressed into a mould. Moulded bricks have a depression in the top called a frog. The bricks are dried before firing to let the water evaporate, then heated in a kiln at 800 to 1,100°C for four to ten days. Chemical changes take place in the kiln which bind the clay particles together.

Mortar is used to bind the bricks together. The simplest mortar is made from sand and cement. Lime is used in many mortars because it makes a more weather-resistant bond. Bricks can be made with special properties. For example, facing bricks may have a surface coated in sand or small stones. These make the brick more weather-resistant as facing bricks are used for building outside walls.

The arrangement of bricks in a wall confers strength on the wall. The arrangements are known as bonds. The alternate arrangement shown in the photograph is called stretcher bond, and the bricks that are laid along the wall with their side showing are called stretchers. In walls that are two bricks thick, some bricks may be laid so that their ends face out of the wall instead of their sides. These bricks are called headers. In English bond there are alternate rows of stretchers and headers. In Flemish bond the stretchers and headers are arranged alternately in each row. Note that in modern houses brick walls are cavity walls and are only one brick thick. The inner wall is made from concrete blocks.

Cement is made by heating a mixture of limestone and concrete, then grinding it to a powder.

7 Teacher's sheet: activity

Based on **pages 16 and 17** of *Rocks and soils*

Introducing the activity

(a) You may begin by saying that we live in a habitat made by artificial rocks. Walls are made of brick and concrete blocks, floors are made of concrete, and some roofs are covered with baked clay tiles (see note (i)).

(b) Tell the children that they are going to find out how the properties of artificial rock compare with real rocks.

Using the sheet

(c) Give out the sheet, let the children fill in their names and form, then let them try task 1 (see note (ii)).

(d) When you have checked their test let them try it and also let them perform tasks 2 and 3 (see note (iii)).

(e) Let the children try task 4 (see note (iv)).

(f) When you have checked their test let them try it and also let them complete task 5 (see note (v)).

Completing the activity

(g) The children can compare their results.

(h) Challenge the children to think of a way to stop water rising through a brick wall. If they have already studied ***3C Properties of materials*** in this series they may suggest putting a waterproof material between the bricks. You could then set up a brick in a bowl of water with a piece of waterproof material (e.g. plastic sheet) on top, then another brick above this. The children would see the water rise through the first brick but not the second. You could take them outside and show them a damp-proof course in a wall.

Conclusion

Artificial rocks have similar properties to real rocks but they are lighter and cheaper.

Teaching notes

(i) Show children examples of brick, concrete block and roof tile, if possible.

(ii) The children should use the test on page 9 of the pupil book. They may use drawings in their plan.

(iii) Depending on the rock used, they may find that the brick is softer than some of the rock and that the sand and cement part of the concrete is easily worn away.

(iv) The children should use the test on page 12 of the pupil book. They may use drawings in their plan.

(v) The brick and concrete will take up water.

Teacher's sheet: comprehension

See **pages 18 and 19** of *Rocks and soils*

Answers

1. **Spiral arrows drawn in each pot hole.**
2. **They crash into each other and pieces get broken off.**
3. **Pebble chips.**
4. **It is made from smaller pieces.**
5. **(c) The lower part.**
6. **Pebbles, sand, silt and mud.**

Complementary work

(a) If there are examples of pebble dashing used as a protective coating on buildings in your area, you may be able to show them to the children.

(b) You may be able to arrange a visit by a person who makes jewellery from polished stones, to demonstrate how pebbles are made smooth. (Note that you should check if electrical equipment brought into school needs professional checking before use.)

Teaching notes

When water is moving fast it can trap air bubbles inside it. These scatter light in all directions and make the water seem white. White water in a river in flood has enough energy to raise and move the loose, rocky components of a river bed.

The pebbles shown in picture 2A of the pupil book are trapped in potholes. These are hollows which have been worn into the solid rock of the river bed and should not be confused with pot holes, which are caverns in limestone country. A pothole in a river is formed when circular currents or eddies swirl pebbles over an area of softer rock. This rock is worn away to make a shallow depression which in turn affects the way the water flows over it. The depression produces more circular currents, and pebbles trapped in the pothole move round and deepen it.

Along the length of a river, the bed changes. Generally, rivers flow over solid rock beds near their headwaters, while lower down the beds are dominated by pebbles, and towards the river's mouth the bed is dominated by the smallest particles of silt and clay. Material is also moved in suspension.

The particles are not moving down the river all the time. When the river is low, the water is clear and particles are not transported, but when the river is in flood transportation occurs. The activity helps the children to think about how rocky fragments of different sizes are transported by a river in flood. See also ***The River Book*** in the Curriculum Visions series.

8 Teacher's sheet: activity

Based on **pages 18 and 19** of *Rocks and soils*

Introducing the activity

(a) Tell the children they are going to make a model of how water and rocky material behave when a river floods.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 and let the children set up the equipment.

(c) Go through tasks 2 to 4 and make sure the children know how to perform each task (see note (i)).

(d) Let the children perform tasks 2 to 4 then check their work.

(e) Let the children try task 5 and check their work.

(f) Let the children try tasks 6 and 7 (see note (ii)).

Completing the activity

(g) Let the children compare their results (see note (iii)).

(h) Some children may wonder if you would get the same pattern if they made the slope of the gutter a little steeper. You may like them to demonstrate this to the whole class and discover that although the gravel and sand may travel further down the gutter, the arrangement of the parts of the mixture stays the same.

(i) You may like to ask the children the reason for the distribution of rocky particles. Look for an answer that the heavier particles travel the least and the lightest particles travel the furthest (see note (iv)).

Conclusion

When a mixture of rocky particles is carried along by a current of water, the heaviest ones settle out first and the lightest ones settle out last.

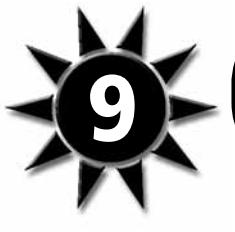
Teaching notes

(i) Make sure the children stir up the mixture well, to simulate the water rushing over a river bed and churning it up. This will help the different components settle out at different lengths along the gutter.

(ii) The children should find that the gravel settles at the top of the gutter, the sand settles in the middle and some of the silt and clay may settle in the lower part of the gutter, while the rest may go into the bowl with the water. They should not find that there is any difference in this arrangement over three tests.

(iii) You may like to ask the children if they can see a pattern in the results and talk about how scientists look for patterns in results. You may like to refer them to some other work they have done where a pattern is shown through measuring (e.g. plant growth).

(iv) The clay particles form a suspension in the water and only slowly settle. The other particles settle much faster and form a sediment. The children may come across these terms when they study the separation of solids and liquids.



Teacher's sheet: comprehension

See **pages 20 and 21** of *Rocks and soils*

Answers

1. **A is the topsoil, B is the subsoil.**
2. **Rock.**
3. **A.**
4. **Rainwater.**
5. **Clay, mud, silt, sand, stones.**
6. **Plant and animal remains.**

Complementary work

(a) The children can use secondary sources to find out about the type of soil found in a desert, a mountainside and a rainforest.

(b) The children could use secondary sources to find out about animals that make burrows in the soil.

Teaching notes

The particles in soils are categorised according to their diameter as coarse sand (2.0 to 0.2mm), fine sand (0.2 to 0.02mm), silt (0.02 to 0.002mm) and clay (below 0.002mm). A sandy soil has over 70% sand and less than 20% clay. A loam has between 40% to 70% sand and 20% to 40% clay. A clay soil has under 40% sand and over 40% clay. In the unit, a simple formation of the soil is described.

The brown colour of soil is due to a chemical containing iron, in the same way that the brown colour of rust is caused by a chemical containing iron.

The part of the soil made from plant and animal remains is called humus. It is dealt with in more detail in *3B Helping plants to grow* in this series.

Teacher's sheet: activity

Based on **pages 20 and 21** of *Rocks and soils*

Introducing the activity

(a) Begin by asking the children if they think that all soils are the same. From their response, ask the children how they could compare soils and steer them towards the tasks in the activity.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 to 4 (see note (i)).

(c) Let the children perform tasks 1 to 4 (see note (ii)).

(d) Go through task 5 then let the children perform it (see note (iii)).

(e) Go through tasks 6 to 8 with the children, then let the children perform them.

(f) Let the children perform task 9.

(g) Go through tasks 10 and 11 with the children (see note (iv)).

(h) Let the children try tasks 10 and 11 (see note (v))

Completing the activity

(i) Let the children display their work and compare the way they have arranged the soils in order (see note (vi)).

Conclusion

There are different types of soil. They differ in the composition of the fragments, colour and texture.

Teaching notes

(i) The containers could be everyday items such as tin lids and paper plates.

(ii) You may like to make up your own compositions of soil from sand, clay, aquarium gravel and loam, or use soils from the school surroundings. Any soil used must not come from areas where there is broken glass or dog faeces.

If you make your own soils, make up three different soils, with different amounts of sand, clay, gravel and loam in each. If you use soils from the area, make sure you use three different types of soil. A garden centre can often supply a variety of soils.

(iii) The children may use scales, a school balance or their own balance, if they have made one from an elastic band or a spring. The children should compare soils of the same weight.

(iv) Children may be unsure how they compare things so it may be useful to remind them to look at a particular feature of a soil, for example, the amount of large fragments in it, and look at this feature in all the soils.

(v) The children may arrange them in order of colour, or lightness and darkness, if these are obvious features. They may arrange them in order of texture, such as 'grittiness'. The soils may be arranged in order of amount of a particular size of fragment, starting with the one, for example, with the greatest amount of large fragments. They may also compare the weight of the samples before and after sieving.

(vi) Look for the way they have expressed themselves in giving a reason for their arrangement of soil and perhaps pick out good examples to discuss with the class.

Teacher's sheet: comprehension

See **pages 22 and 23** of *Rocks and soils*

Answers

1. **(i) Use same amount of sand, clay and loam. (ii) Pour same amount of water onto each soil. (iii) Let water pass through each soil for the same amount of time.**
2. **Sand would have the most water in the beaker and clay would have the least.**
3. **Sand.**
4. **Clay.**
5. **A soil which cannot let water seep through it fast enough to drain.**

Complementary work

(a) The children could put 12 large counters or coins on a piece of graph paper (millimetre squares are best) and push them into a group so that their edges touch and they can see the squares of paper in the gaps. The children should then do the same with small counters or coins and note that they see fewer squares because the gaps are smaller.

(b) The children can use secondary sources to find out more about waterlogged soils such as those in paddy fields and swamps. They could also find out about the use of water meadows in the past.

In this they should note that waterlogging can arise from position in the landscape as well as from low permeability. Thus, meadows are wet primarily because they are close to a river and paddy fields are waterlogged only because of the constant application of water.

Teaching notes

The ability of a soil to drain water is simply a matter of grain size, which in turn affects the pore size. When the soil is not full of water the empty gaps hold air. A sandy soil has lots of air spaces. A clay soil, by comparison, has smaller gaps and holds less air.

The relationship between soil and plant growth is studied in appropriate detail for this level in *3B Helping plants to grow*.

(The correct term for the movement of water through a soil is permeability. This is not the same as porosity. Soils with many small pores, such as clays, are poorly permeable.)

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Teacher's sheet: activity

Based on **pages 22 and 23** of *Rocks and soils*

Introducing the activity

(a) Show the children two samples of soil (see note (i)) and say that they have to find out which one holds more water than the other. Ask the children for ideas on how they could do it (see note (ii)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then let them try tasks 1 and 2 (see note (iii)).

(c) If necessary, go through a plan with them again as a class, then let them try task 3 (see note (iv)).

(d) Ask the children to think about how they will record their result. If they wish to use a table they should make one now (see note (v)).

(e) Let the children try tasks 4 and 5.

Completing the lesson

(f) Let the children compare their results. Those who have not used a table should see that a table allows the results to be presented more clearly.

Conclusion

The sandy loam drains better than the clay loam. The clay loam holds onto more water.

Teaching notes

(i) These should be a sandy loam and a clay loam.

(ii) Depending on the ability of the class you may like to write some of their ideas on the board so that they can use them in their plan. The spelling and list of equipment is particularly useful here.

(iii) The equipment could include a balance, a soil container with drainage holes, a funnel, a clamp and stand or other support, a beaker, a measuring cylinder, a watch or stop clock.

(iv) The plan should include: using the same weight or amount of dry soil, pouring the same volume of water onto each soil, letting each soil drain for the same amount of time.

(v) The children should make a table. It could have two columns – 'Soil' and 'Amount of water drained' (cm^3), as shown below.

Soil	Amount of water drained (cm^3)