

## Permeability of soils – ‘The great soil race’

### Investigating the properties of different soils by pouring water on them

Collect three samples of different local soils (or make up “artificial” soils). Aim for one clay-rich soil, one sandy soil and one soil with larger fragments like pebbles in it.

Make three test funnels, by cutting three large (2 litre) plastic water bottles in half. Make a “soil-fill” mark about 8cm from the neck of the bottle. Make a “water-fill” mark about 12cm from the neck of the bottle.

Tie a piece of cloth across the neck of each bottle, to stop the soil from falling out, and then fit the home-made funnel upside down in the body of the bottle.

Place a sample of each soil in the funnel up to the “soil-fill” mark (do not pack the soil down hard). Pour water into each funnel to saturate the soil. Once it is saturated, throw away any remaining water from the funnel and from the plastic bottle beneath. Do all this well before the lesson starts.

Fill three more separate containers with equal quantities of water. Start the clock and add water to each funnel at the same time, up to the “water-

fill” mark. Keep the water level up to the mark in each funnel by adding more as necessary.

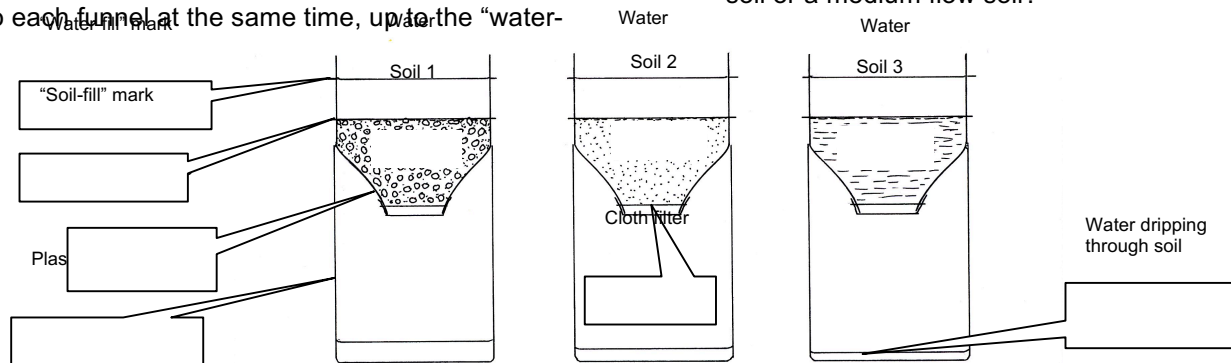
Measure the amount of water which has drained through each soil after five minutes.

Which is the most permeable soil – that lets water flow through fastest?

NB Pupils must wash their hands after handling soils, to reduce the possibility of infection.

Then ask the pupils:

- Why do you think some soils let water through faster than others?
- If you wanted to make a football field, which would be best - a soil that lets water flow through quickly or a soil that holds the water?
- What problems might there be if water ran through a soil very quickly?
- If you wanted to grow vegetables, which would be best, a quick flow soil, a slow flow soil or a medium flow soil?



Simple equipment for testing soil permeability



A permeability race!  
(Photos – P. Kennett)



Poor quality vegetables growing in waterlogged soil

## The back up

**Title:** Permeability of soils – ‘The great soil race’

**Subtitle:** Investigating the properties of different soils by pouring water on them

**Topic:** An investigation of local soils for their permeability

**Age range of pupils:** 8-18 years

**Time needed to complete activity:** 20 mins

**Pupil learning outcomes:** Pupils can:

- use simple equipment to conduct a fair test;

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- test the permeability of a range of soils, and put them in order of permeability;
- explain why some soils are permeable and others are not;
- apply their knowledge of soil permeability to local situations.

### Context:

Soils are a precious resource on which we all ultimately depend for our food supply. Understanding the structure and nature of a soil can lead to better management techniques. Many pupils will be involved in agriculture or gardening at some stage of their lives, and, in rural areas, may well depend on it for their livelihoods.

Possible answers to the questions might be:

- Why do you think some soils let water through faster than others? *Soils that have large grains with unfilled gaps are the quick-flowing ones; soils with small grains or small grains filling gaps between large grains have slow flow (since water cannot pass easily through tiny gaps).*
- If you wanted to make a football field, which would be best - a soil that lets water flow through quickly or a soil that holds the water? *Football fields need to drain quickly so they don't become waterlogged after storms.*
- What problems might there be if water ran through a soil very quickly? *In soils that drain too quickly, all the nutrients can be carried away, whilst the soils can dry out easily.*
- If you wanted to grow vegetables, which would be best, a quick-flow soil, a slow-flow soil or a medium-flow soil? *The best soil for growing vegetables is usually a nutrient-rich medium permeability soil – like a loam (with mixed sand, clay and organic material)*

### Following up the activity:

- Grow plants in the classroom under controlled conditions, using soils of varying permeability.
- Investigate the constituents of soils by shaking up a soil sample in a plastic bottle of water and letting the solid particles settle out.
- Look at local sections through soil, in stream banks, or quarry faces, to see if a 'soil profile' can be identified. This is where there are different coloured 'layers' in the soil, caused by water percolating down, carrying dissolved minerals with it. (In some climates, dissolved materials are drawn up by the sun as it evaporates surface water).

### Underlying principles:

- Soil consists of rock fragments, organic materials, living organisms, water and air.
- Fluids can pass into and through soil via the air spaces between the grains of solid material.
- Clay soils, where the particles are flaky in shape and are tightly compressed together do not readily allow the passage of fluids.
- Such soils may become waterlogged and crops do not grow well.
- In some soils, especially in the tropics, a "hard pan" of iron compounds develops below the surface, making the soil impermeable.

### Thinking skill development:

- understanding an emerging pattern (construction)
- finding that the permeability of some soils is not always predictable (cognitive conflict)
- reasoning behind the answers (metacognition)
- applying the results to local soils (bridging).

### Resource list:

- 3 plastic bottles (e.g. 2 litre bottles)
- knife for cutting up the bottles
- samples of three local soils, or artificial "soils", made up with pebbles, sand, clay
- 3 containers of uniform size to hold water for pouring onto the soils
- small pieces of cloth and string (or elastic bands) for retaining the soil
- stopwatch, watch, or clock
- water

**Useful links:** Try the Earthlearningidea activities 'Modelling for rocks: what's hidden inside - and why' published December 2007: also, 'Why does soil get washed away? Investigating why some farmers lose their soil through erosion whilst others do not', published 21<sup>st</sup> January 2008.

Try <http://www.soil-net.com/>  
[www.bbc.co.uk/schools/scienceclips/ages/7\\_8/rocks\\_soils.shtml](http://www.bbc.co.uk/schools/scienceclips/ages/7_8/rocks_soils.shtml)  
[www.globe.org.uk/activities/soil/soilt.pdf](http://www.globe.org.uk/activities/soil/soilt.pdf)  
for more information on soil.

**Source:** Earth Science Teachers' Association, (1993) *Teaching Primary Earth Science*, No:3, *Soil, forming part of Teaching Earth Sciences Vol. 18.*

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Contact the Earthlearningidea team at: [info@earthlearningidea.com](mailto:info@earthlearningidea.com)

