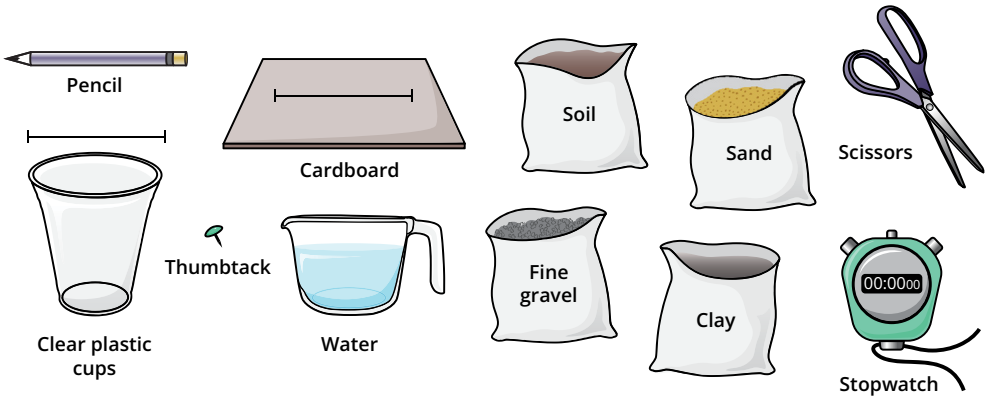
Soil Sleuth

Grades 4-12

The purpose of this experiment is to show how physical properties of soil, like grain size and how those grains cluster together, can influence how much water passes into and through it.

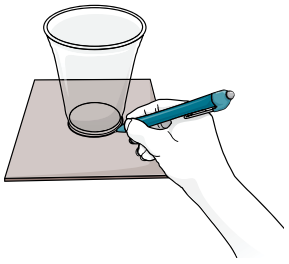
Soil is a complicated mixture of many materials, including sand, gravel and clay along with plant, animal and insect matter. Water that filters into the spaces within and between these materials is called **groundwater** (for further study, look up the water table). Groundwater is a precious natural resource important for the growth of food crops and other plants. In the U.S., groundwater supplies about 38% of the water used for agriculture.

Supplies Needed

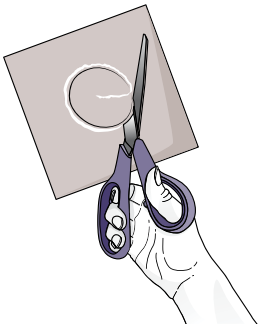


- Pencil
- Clear plastic cups
- Thumbtack
- Cardboard pieces that are larger than the opening of the cup
- Water
- 2-4 different materials such as soil, sand, clay and fine gravel
- Scissors
- Stopwatch

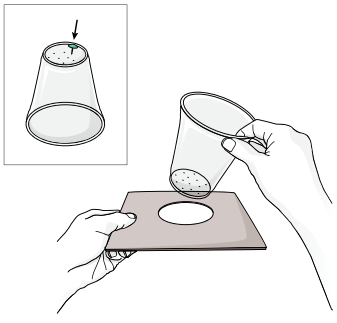
Set up the Columns



Trace the bottom of a plastic cup onto the cardboard.

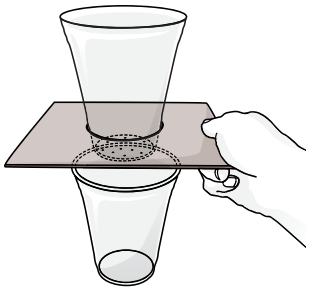


With an adult's help, cut a circle out of the cardboard that is slightly larger than the drawn circle.



With an adult's help, punch small holes into the bottom of one cup with a thumbtack.

Slide that cup through the hole in the cardboard.



Sit the cardboard/cup on top of the other cup.

Repeat these steps for every type of material you will be testing.

This educational activity is adapted from the NSF-supported Southern Sierra Critical Zone Observatory, part of the Critical Zone Observatories National Program (now the Critical Zone Network, or CZNet) at https://criticalzone.org/.
For more activities, visit:
https://czo-archive.criticalzone.org/sierra/education-outreach/k-12-education-sierra/#Educator%20Training

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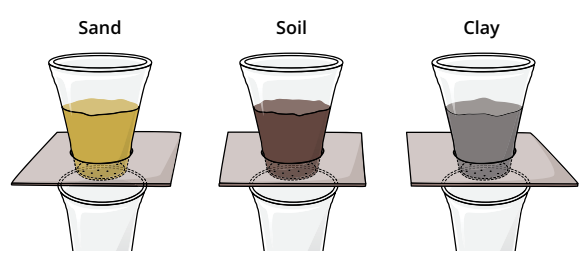
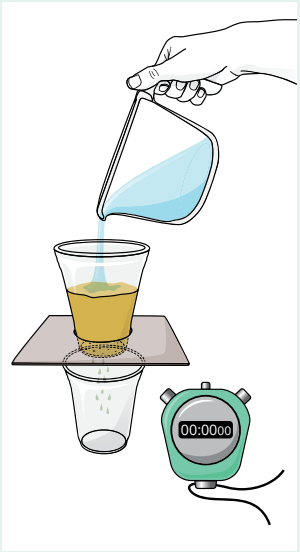
Conduct the Experiment

1. Write down your **hypothesis** stating which material you think water will travel through the fastest and why.
2. Fill each top cup halfway with a single type of material. Lightly pack the material down in each cup.



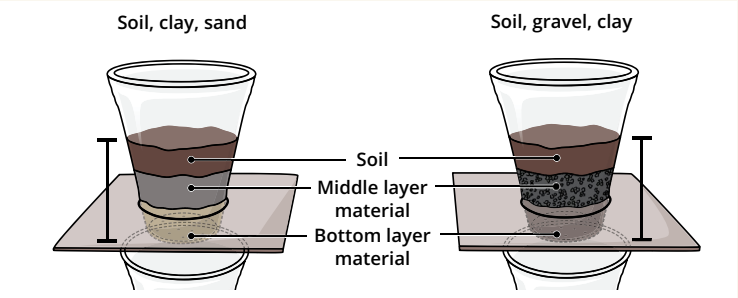
3. Add 1 cup of water to one of the top cups. Time how long it takes for water to come out of the bottom. If more than 3 minutes go by, add another half-cup of water.
4. Repeat step **3** for each column set-up, observing any differences in time for water to drain out of the bottom. Be consistent with the amount of water added to each column.
5. Did your results differ from your **hypothesis**? Why do you think so? Why do you think groundwater storage and drainage is important for crop growth?



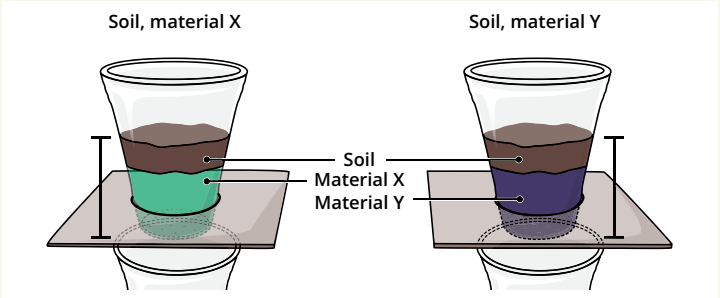
Experimental Variations

The purpose of these experiments is to observe how the amounts of each type of material that make up the soil influences how much groundwater is stored or drained.

A. Create two column set-ups with equal layers of three different materials, where soil is always the top layer (for example, soil, clay and sand versus soil, gravel and clay). Add 1 cup of water to each column, and record the time it takes for water to drain through.



B. Create two different versions of the faster-draining column set-up from variation **A**, using only two layers for each cup: soil and the middle material "X" versus soil and the bottom material "Y." Make materials "X" and "Y" twice as thick as the soil layer so that the overall thickness of the combined materials is the same as in **A**. Add 1 cup of water and time the drainage.



Follow-up Questions

- What are some of the advantages of soil that holds more groundwater?
- How might a better draining soil help encourage crop growth?
- What actions could farmers, land managers and others take to create productive soil mixtures in key agricultural areas?
- How is climate change creating more extreme precipitation events, like drought, heavy rainfall and flooding?
- How might climate change affect groundwater drainage and storage and crop growth?

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