# Just Passing Through (Beginner Version)

## Purpose

To develop an understanding of how water flows through different soils and how it is transformed when it flows through these soils

## Overview

Students time the flow of water through different soils and observe the amount of water held in these soils. They will also observe the filtering ability of soils by noting the clarity of the water before and after it passes through the soil.

## Student Outcomes

Students will be able to identify the physical and chemical changes that occur as water passes through soil.

### Science Concepts

*Earth and Space Science*

- Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.
- The surface of Earth changes.
- Soils consist of minerals (less than 2 mm), organic material, air and water.
- Water circulates through soil changing the properties of both the soil and the water.

### Scientific Inquiry Abilities

- Identify answerable questions.
- Design and conduct an investigation.
- Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.
- Develop descriptions and explanations, predictions and models using evidence.
- Communicate procedures and explanations.

## Time

One class period

## Level

Beginning

## Materials and Tools

*(for each team of 3-4 students)*

- Clear 2 liter bottle
- Three 500 mL beakers or similar size clear containers marked off in cm to pour and catch water
- Soil sample (Bring in 1.2 L samples of different types of soil from around the school or from home. Possibilities include top soil (A horizons), subsoils (B horizons), potting soil, sand, soils that are compacted, soils with grass growing on top, soils with clearly different textures, colors, or structures)
- Fine window screen or other fine mesh that does not absorb or react with water (1 mm or less mesh size)
- Water
- Clock or timer
- **Note:** Smaller containers may be used if desired as long as the soil container sits firmly on the water catchment container. Reduce the amounts of soil and water - but remember that it is important for all students to start with the same amount.
- *For more advanced students:*
- pH paper, pen, or meter

## Prerequisites

None

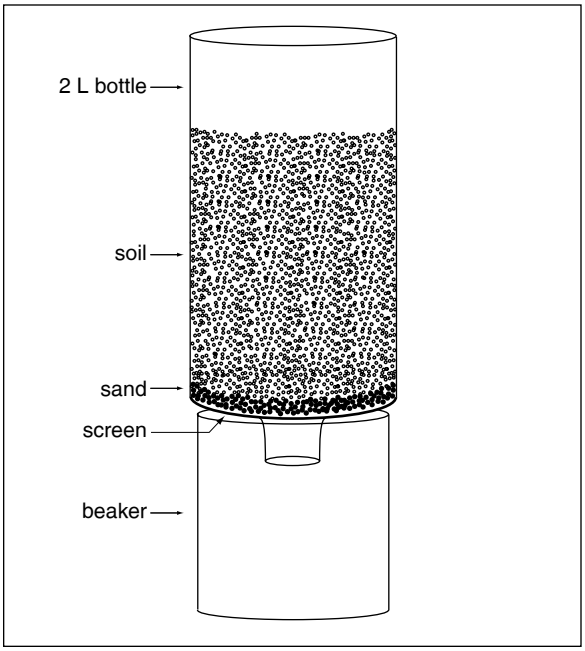
## Background

What happens to water when it passes through soil depends on many things such as the size of soil particles (texture and particle size distribution), how the particles are arranged (structure), how tightly they are packed (bulk density), and the attraction between the soil particles and the water. Some types of soil let water flow in quickly, and then hold the water inside the soil like a sponge. This might give plants a better chance of using some of that water. Other types of soil may let the water go completely through in just a few seconds. Still other soils may keep the water from getting in at all. None of these soil types is better than the other - they are simply good for different reasons. Which soil property would you look for if you wanted to plant a garden? Build a driveway or a playground? What happens if the soil is full of water and a heavy rain falls on it? How can you change the way your soil holds water? What happens to the soil when organic matter is added, when plants are growing on top of it, when it is compacted, or when it is plowed?

## Preparation

- Discuss some of the general characteristics of soils or do *Why We Study Soil* or *Soil in My Backyard Learning Activities* or the *Soil Characterization Protocols*.
- Bring in samples of different types of soil from school or from home.
- Remove the labels and lids and cut off the bottoms of the clear plastic 2 L bottles.
- Place a circle of screen inside the bottle so that it covers the cap opening.
- Pour 3-4 cm of sand onto the screen. The sand will keep the screen from becoming clogged.
- Place the bottle, mesh side down, on a beaker or clear container.
- Pour 1.2 L of soil into the bottle over the sand.
- Copy the *Work Sheets* for each student

*Figure SOIL-PB-1*




## What To Do and How To Do It

### Class Investigation

1. Choose a soil (a sandy soil works best) to use for demonstration and place 1.2 L of the soil into the 2 liter bottle.
2. Have students look closely at the soil. What do students notice: Color? Plant matter? Does it feel light or heavy? Is it granular (like cookie crumbs) or blocky (clumpy)? Record their observations about the soil on the board.
3. Pour 300 mL of water into a 500 mL beaker or other clear container for pouring. Have students notice the clarity of the water.
4. Use a black marker to draw a line showing the height of the water in the pouring container. Have students count the cm lines to reach the top of the water. Record this number on the board.
5. Ask the students "*What will happen when you pour the water onto this soil*"? Ask students to explain why they think the soil and water will behave this way when water is poured onto it. Some possible questions to ask are:

- *Will the water run out through the bottom of the bottle?*

- *Will all of it run out? How much will run out?* Make a mark on the pouring container with a red pen to show how much of the water students think will flow out.
- How fast will the water pass through the soil? *Older students may time with a clock or stopwatch. Younger students can time by marking the minutes off on a timer (like in the Work Sheets) as the teacher times.*
- What will the water look like when it comes out the bottom? Clear? Murky? Very Dirty?

6. Record the class 'hypotheses' on the board.
7. Pour the water onto the soil and begin timing. Ask students to describe what is happening as you pour the water:
- Is all the water staying on top?
- Where is it going?
- Do you see air bubbles at the top of the water?
- Does the water coming out of the soil look the same as the water going in?
- Does the soil look different where the water has gone?

8. Record the class observations on the board. Also record how long it takes for the water to pass through the soil.
9. Ask students to compare their hypotheses and the results of the experiment.
10. Once the water has stopped dripping from the bottom of the bottle, remove the soil bottle and hold up the beaker of water which has passed through the soil. Ask students:
- Is this the same amount of water that we started with? How can we tell if it is the same amount?
- *Pour the water back into the original container. Compare the amount left with the black line on the container.* How much water is missing? How could we measure how much is missing?
- *Compare the water level to the red line on the container.* Is there more or less water left than we thought there would be? How could we measure the difference? Why did you think there would be more or less?
- What happened to the water that is missing?
- Is the water more or less clear than before it passed through the soil? Why?

11. Keep the water that was poured through for comparison.
12. Using the bottle of saturated soil, ask students what will happen if you pour another 300 mL of water into the soil. Record the class hypotheses on the board.
- Will the same amount, more, or less water stay in the soil this time?
- Will it move through faster or slower or at the same speed?
- How clear will the water be? The same, more clear, or less clear than before?

13. Pour the water through the saturated soil, keep the time, observe the results, and compare with the hypotheses. Ask students:
- *Did the water flow through faster than before? How do you know?* Compare the two times.
- *Did more of it flow through than before? How can we find out?* Compare the amounts in the beakers.
- *Is the water as clear as the first time?* Compare the color of the water in the two beakers.

*Group Investigation*

**Experimenting with different soils**

**Discussion**

1. Review the properties of the various soil samples that were brought in.
2. Ask students if they think water would pass through all of the types of soils in the same amount of time and if all the soils would hold the same amount of water.
3. Discuss which soils they think might be different.
4. Provide each group of students with one of the various soils.

**Observation and Hypotheses**

1. Give each student the Look and Guess Work Sheet.
2. Ask the students to fill in the **Color** of their soil (in words or with a crayon).
3. Ask the students to circle the **Structure** which looks most like their soil.
4. Ask students to look for leaves or **Organic matter** in their soil. Circle YES if they find organic matter. Circle NO if they do not.
5. **Time:** Remind students of the observations which they made during the demonstration. Ask students to guess the amount of time it will take water to flow through their soil. Circle the time on the timer, then write the number in the blank.
6. **Amount:** Ask students to draw a RED line on the container showing the amount of water they think will flow through their soil.
7. **Clarity:** Ask students to put an X on the container which will look most like their water after it flows through their soil.

**Experiment and Report**

1. Explain that when you say 'GO' everyone will pour their water in together.
2. You will begin to time when the water is poured.
3. Have students fill in the Experiment and Report Work Sheet for their soil.

Have each group report on the results of their experiment to the class. Reports should include **Questions, Hypotheses, Observations and Conclusions** about the experiment. Students can use their Work Sheets to prepare their reports.

## *Further Investigations*

1. Using distilled water, have students measure the pH of the water.
2. Predict whether the pH will be different after the water passes through the soil.
3. Pour the water through, then test the pH again.
4. Have students draw conclusions about the effect of soil on water pH.

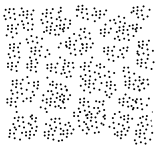
**Note:** 1. Use this procedure to experiment with conductivity by measuring the conductivity of distilled water before passing it through the soil, then using saltwater and passing it through the soil. 2. Experiment with filtering by using very murky water and passing it through clean sand.

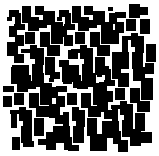
Ask students to perform the advanced version of the *Just Passing Through Learning Activity.*

# Just Passing Through – Beginners
Work Sheet

## Look and Guess

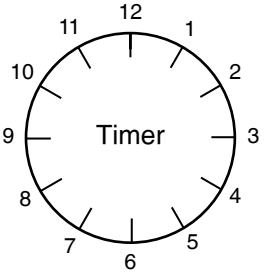
My soil is _____ color

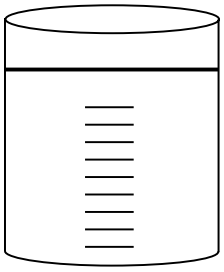




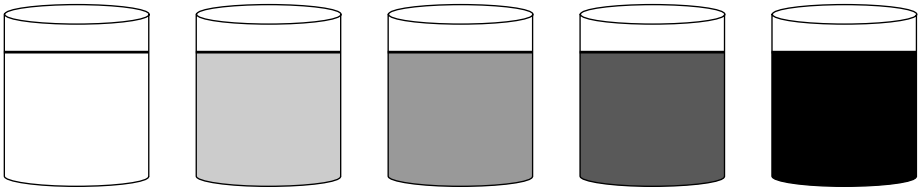
My soil looks granular blocky

My soil has  leaves. YES NO

Time _____ 

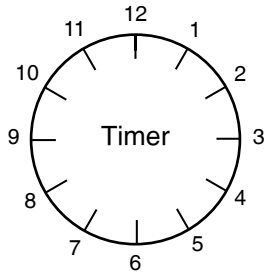

How much water will come out? Make your line RED. 

What will the water look like? (CIRCLE)

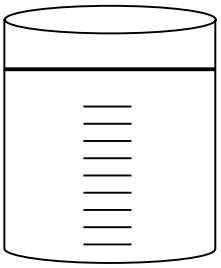


# Experiment and Report

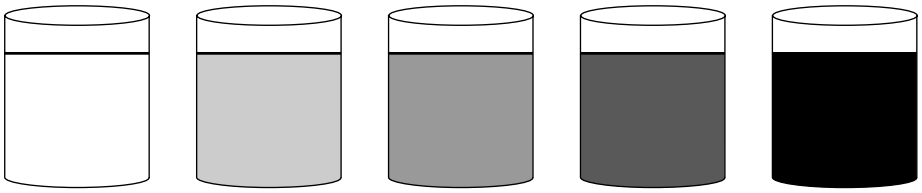
Time _____




How much water came out?



What did the water look like?



My Report