

# Know Soil Know Life Activity | Soil is a Filter

Adapted by permission of Clay "Dr. Dirt" Robinson, PhD

NGSS:  
3-5-PS1.B: Chemical Reactions  
MS-PS1.B: Chemical Reactions  
MS-ESS3.A: Natural Resources  
3-5.ESS3.C: Human Impacts on Earth Systems

## Materials and Preparation:

- 3 oz and 5 oz paper cups (Put 3-5 holes in bottom of 5 oz cup. A toothpick works well). The 5 oz cup fits inside 3 oz cup, then put the toothpick inside, between the cups.
- play sand
- natural soil
- grape Kool-aid
- toothpicks
- other colors, e.g., green, red, orange, yellow food coloring (optional)
- "floaties"

*The results are more dramatic if the play sand has been sieved to remove the smaller particles. If you do not have soil sieves, you can use a colander or a spaghetti strainer if the holes are small. Another material that makes a good sieve is screening. A fine screen attached to a small frame makes an excellent sieve.*



## Objectives:

- Students will discover that soils physically and chemically filter impurities out of water.
- Students will discover the role of soil in having good drinking water.

## Introduction:

*Asking questions is a good way to find answers (and to learn something).*

- What is a filter? (Show a coffee filter or a tea bag to aid discussion.)
- Can soil be a filter?
- Do all soils work the same?

## Hypothesis:

*Briefly explain experiment.*

- Have students make hypotheses and complete table.
- What will happen to the dirty water "floaties"?
- What color will come out the bottom?

		Dirty water	Kool-aid
Sand	Hypothesis		
	Observations		
Soil	Hypothesis		
	Observations		

**Methods:**

We will use two soils- a sand by itself, and a sand with natural soil on top (the sand keeps the natural soil in the cup). Sand has large, rough particles. Natural soil is a mixture of particle sizes.

**Sand**

1. Take a 5 oz cup with holes in the bottom and fill it half full of sand.
2. Put it inside the 3 oz cup. Put a toothpick between the cups so that air can escape from the bottom cup.
3. Pour some of the dirty water into the top cup

Observe:	What happens to the things floating in the water?
Record:	Write your observations in the table.

1. Pour out the water in the bottom cup.
2. Pour some of the grape Kool-aid into the top cup.

Observe:	What color is the Kool-aid that goes into the cup? What color is the water that collects in the bottom cup?
Record:	Write your observations in the table.

**Topsoil**

1. Put a layer of sand the width of your pointer finger in the bottom of the 5 oz cup. (It has holes in it.)
2. Add topsoil until the cup is half full.
3. Put the 5 oz cup into the 3 oz cup.
4. Pour some of the grape Kool-aid into the top cup.

Observe:	What color is the Kool-aid that goes into the cup? What color is the water that collects in the bottom cup?
Record:	Write your observations in the table.
Compare:	Is the water in the bottom cup the same color for both soils?
Record:	Write your observations in the table.

- The photo shows the results of a filtering exercise.
- The upside-down cup on the left shows the holes in the bottom.
- To the right of that is a cup with soil inside the smaller cup. The toothpick is barely visible between the cups on the right side.
- The next four cups across the top contain the leachate (the water that ran through the soil) for the soils in the containers below them.
- The soils vary in color from gray to red to brown to the light brown sand on the right.
- The color of the water in the bottom cup ranges from purple (about the same color as the grape drink began), to bright pink, to almost colorless, to a murky red.
- Discussion points: Remember that blue and red make purple. The smallest soil particles (clays) have a negative charge. Opposite charges attract and like charges repel. In all cases the red dye passes through the soil, so it must have a like charge as the soil (negative). The blue dye is retained in three of the soils, so it must have an opposite charge (positive). In this case, the soil with the purple leachate had very good structure, and the Kool-aid probably went through the pores and did not mix much with the soil.



### ***So what? (Application)***

- Soil naturally filters water that falls as rain and goes into rivers.
- Soil filters many chemicals out of water just like it did the grape Kool-aid.
- These same techniques are used to purify wastewater that comes from houses, cities, industry, and large animal feeding operations.

A healthy soil is important for good drinking water!