



# Environmental Science

## A Recipe for Soil

In this activity, students will learn about soil formation using a baking analogy.

**Project Area:**  
Environmental Science

**Skill Level:** Beginner to Intermediate

**Learner Outcomes:**

- ⇒ Understand the four components that make up soil.
- ⇒ Understand the five soil forming factors.
- ⇒ Learn that different parts of the world have different soils.

**Tennessee Science Curriculum Standard GLEs:**

- S1. Embedded Inquiry 0607.Inq.5, 0707.Inq.5, 0807.Inq.5
- S2. Interdependence 0607.2.3
- S7. The Earth 0707.7.3

**Success Indicators:**

Science Skills: Observe, interpret

**Life Skills:** Observing, Reasoning

**Tags:**

soil components, soil forming factors

**Suggested prerequisite:**  
"Dig In"

**Materials:**

**Soil Brownies**

- 1 cup flour
- 1 cup unsweetened cocoa powder
- 1/2 teaspoon salt
- 1 1/2 sticks melted butter
- 3 eggs, whisked
- 2 cups sugar
- 9" x 9" or other pans
- Mixing bowl and spoons

**Introduce key concepts about soils:**

- ⇒ Soils are not just dirt — they contain all three phases of matter: solids, liquids and gasses.
- ⇒ Soil is made of four main components, which your students will label on the diagram in their handout:
  - Minerals (or quartz or clay particles, etc.)
  - Air
  - Organic matter (or leaf litter or humus)
  - Water
- ⇒ Not all soils are the same. The soil (sand) on a beach is different from the soil in a forest.



**Ask: Why are soils from different parts of the world different?**

**Demonstration: Soil Brownies**

Soils are formed through five main factors: **Parent material, activity of living organisms, climate, topography and time.** Making brownies is a good analogy to illustrate these factors. This can be done by actually baking brownies with your 4-H'ers if you only have a small number of students. For multiple clubs, consider videotaping this demonstration (or use the ones below) and asking one student from each club to bring in brownies to snack on while they watch it. Here's a great example demonstration by Julie Harstin from McNairy County: Brownies Part I (making): [http://youtu.be/l\\_jHjHYlr8E](http://youtu.be/l_jHjHYlr8E)  
Brownies Part II (tasting): <http://youtu.be/5zC35X14NFI>

**Step 1: Parent Material**

**Explain:** To make soil, first, we need **parent material**. These are the minerals found in rocks and the earth's crust that form the basic particles in soil. As mountains and rocks weather, these particles break off. In our soil brownies, we have the three different types of particles found in soil: sand (salt), silt (flour) and clay (cocoa powder).

**In a mixing bowl, combine:**

**1/2 teaspoon salt ("sand")**

**1 cup of flour ("silt")**

**1 cup unsweetened cocoa powder ("clay")**

**Step 2: Organisms or Organic Material**

**Explain:** Plants couldn't live in soil if it was just the parent materials, just like you wouldn't want to eat this flour mixture. We need something to stick it all together. Living organisms change soils through their activity. They produce products that help "glue" the parent material together. This glue holds moisture and nutrients in the soil and provides nourishment for plants and other organisms. In the same way, we add butter and eggs and sugar to help glue it all together and make it taste good!

**In a second bowl, mix together:**

**1 1/2 sticks of melted butter**

**3 eggs, whisked**

**2 cups of sugar**

**Add wet to dry ingredients and mix well.**



### Step 3: Topography

**Explain: Topography** is the surface features on the land (e.g., mountains, valleys, etc.). The soil can change depending on where it is. For example, the soil on a mountainside is different from the soil near a river. What “shape” the soil is put in will determine what it is like.

**Pour batter into a greased baking pan (one 9” x 9” or other shaped cake pans or muffin tins).**

### Steps 4 and 5: Climate and Time

**Explain:** Brownies look and taste different after they are cooked. Why? The oven changes the temperature and changes the chemistry of the brownies. With soils, precipitation, wind and temperature over time all affect the soil.

**Bake at 350 F until just set for 25 to 30 minutes; let cool. Enjoy!**

## Activity: Where in the World?

Adapted from “Dig It,” Smithsonian Institute (<http://www.forces.si.edu/soils>)

### Profile #1

**CLUE 1: What’s all the gray stuff? Ash?** Every soil has a “parent” — the original rock, sediment or organic matter that it forms from. The parent material of this soil is ash. Where did the ash come from?

**CLUE 2: Oops! Someone lost her flip-flop.** Soils that form in different climates look and behave differently. What does the flip-flop suggest about the climate?

**CLUE 3: Why are the dark layers of topsoil buried?** Each new volcanic eruption covers the dark, organic-rich surface of the existing soil, and a new surface layer begins to form.

**ANSWER: South Pacific Volcano**

### Profile #2

**CLUE 1: These long roots are “home on the range.”** Plant roots can grow very deep, up to 18 meters or nearly 60 feet. Deep roots are often found in climates and ecosystems with low rainfall and limited water.

**CLUE 2: Did a gaucho lose his spur?** “Gaucho” is a term for residents of the pampas or grasslands in parts of South America.

**CLUE 3: The topsoil is deep, dark and fertile.** The type of plants growing in a soil affects how it looks and behaves. Soils tend to have deep, dark, fertile surface layers in grasslands due to the growth of grass roots and low rainfall.

**ANSWER: South American Grassland**

### Profile #3

**CLUE 1: Brrrrr! It’s icy way down here!** Soils that form in different climates look and behave differently. What does the ice suggest about the climate?

**CLUE 2: Is that a woolly mammoth tusk?** The woolly mammoth was also called the tundra mammoth. The bones and frozen carcasses of this animal are found from northern North America and northern Eurasia.

**CLUE 3: Lots of dark brown plant compost is slowly decaying.** Soils that are waterlogged tend to accumulate a lot of partially decayed plant matter, particularly if the soils are also cold.

**ANSWER: Siberian Permafrost**

### Discuss and Apply:

If you were given a truckload of sand, what would you need to add to it to turn it into soil?

### Resources:

*Soil Education.* USDA Natural Resources Conservation Service. <http://soils.usda.gov/education>.



# Environmental Science

## Words to Explore:

- ⇒ Soil
- ⇒ Minerals
- ⇒ Organic matter
- ⇒ Relief
- ⇒ Climate

## A Recipe for Soil

Have you ever stopped to think about the soil below your feet? What is it made of?

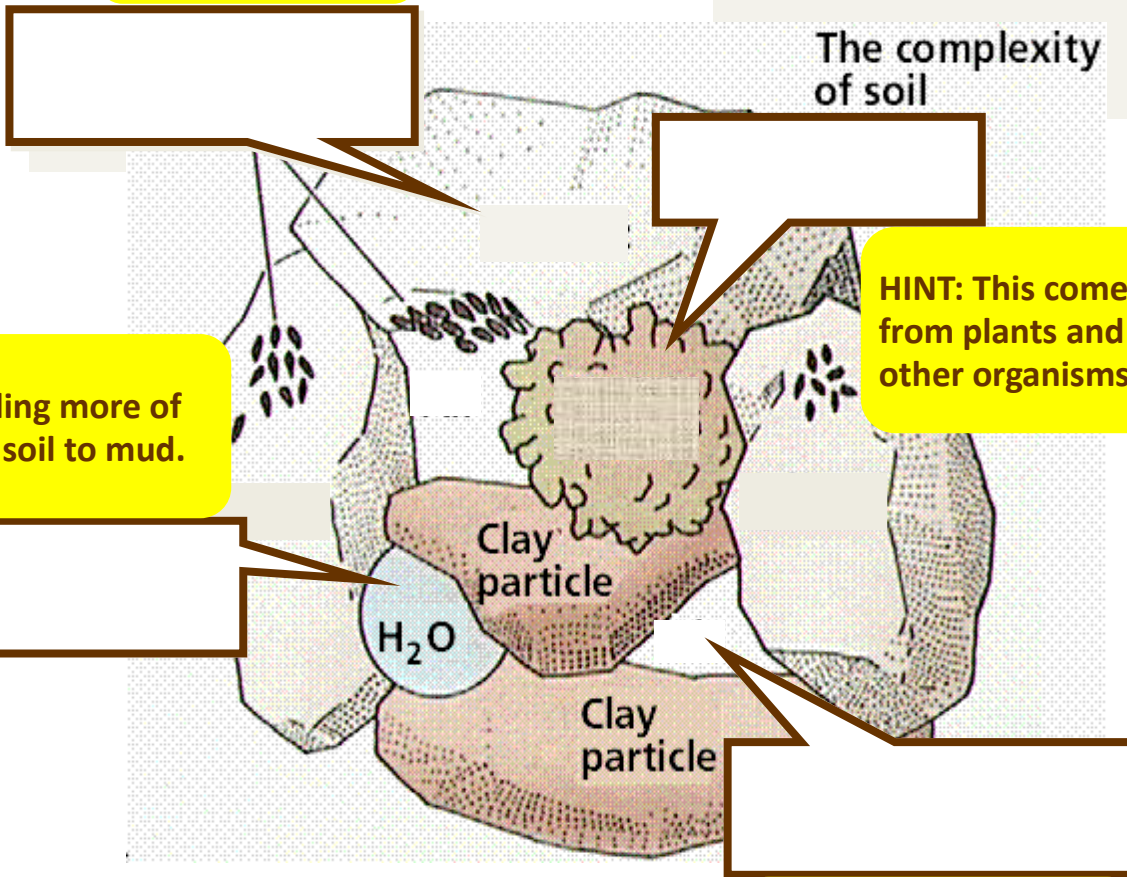
Soil is made of four main components. Label the parts of the soil particle below.



**HINT: These come from rocks.**

*Check it out!*

<http://www.iheartsoil.org>



**HINT: Adding more of this turns soil to mud.**

**Did You Know?**



The Tennessee state soil is the **Dickson series.**

**HINT: Just like us, soil organisms and plant roots need to breathe.**



# How Are Soils Made?

Not all soils are the same. Have you noticed that some soils are sandy and some are clayey? Soils also come in many, many colors — different shades of red, black, brown and gray. What causes soils to be they way they are?



## Check it out!

Watch soil chefs compete in CHEF'S CHALLENGE

[http://forces.si.edu/soils/video/chefs\\_challenge.html](http://forces.si.edu/soils/video/chefs_challenge.html)

Different materials and effects work together to make soil, just like the different ingredients you use when you make a batch of brownies. Let's see how!

### Step 1: PARENT MATERIAL

To make soil, first, we need **parent material**. These are the mineral pieces found in bedrocks and the earth's crust that form the basic particles in soil. The sand, silt and clay are like the salt, flour and cocoa powder you need for brownies.



### Step 2: ORGANIC MATERIAL

Plants couldn't live in soil if it contained only the parent materials, just like you wouldn't want to eat just a flour mixture. We need something to stick it all together. **Living organisms change soils through their activity. They break down dead plants and minerals and produce products that help "glue" the parent material together.** This glue holds moisture and nutrients in the soil and provides nourishment for plants and other organisms. In the same way, we add butter and eggs and sugar to help glue it all together and make it taste good!



### Step 3: RELIEF

**Relief, or topography,** is the surface features on the land (e.g., mountains, valleys, etc.). The soil can change depending on where it is. For example, the soil on a



mountainside is different from the soil near a river. What "shape" the soil is put in will determine what it is like, just like different shapes of pans will give you different shapes of cakes and brownies.



### Steps 4 and 5: CLIMATE and TIME

Brownies look and taste different after they are cooked. Why?

The oven changes the temperature and changes the chemistry of the brownies. With soils, **precipitation, wind and temperature over time** break down particles and change the soil's chemistry.





# WHERE IN THE WORLD?

Can you guess where in the world these soils came from?  
Match the soil profile to the correct part of the world below.

Adapted from "Dig It" Smithsonian Institute ([forces.si.edu/soils](http://forces.si.edu/soils)). Art by Matthew Frey/Wood Ronsaville Harlin, Inc. ©Smithsonian Institution

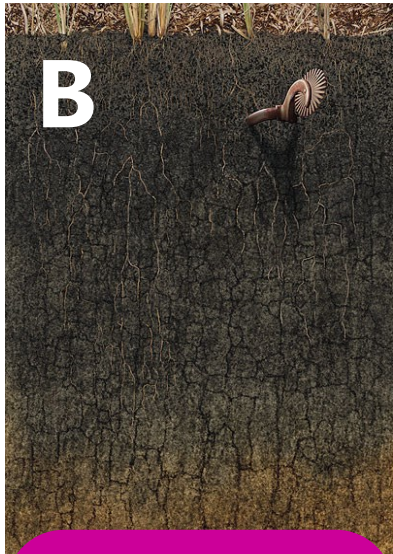


**A**

**CLUE 1:** What's all the gray stuff? Ash?

**CLUE 2:** Oops! Someone lost her flip-flop.

**CLUE 3:** Why are the dark layers of topsoil buried?



**B**

**CLUE 1:** These long roots are "home on the range."

**CLUE 2:** Did a gaucho lose his spur?

**CLUE 3:** The topsoil is deep, dark and fertile.



**C**

**CLUE 1:** Brrrr! It's icy way down here!

**CLUE 2:** Is that a woolly mammoth tusk?

**CLUE 3:** Lots of dark brown plant compost is slowly decaying.

