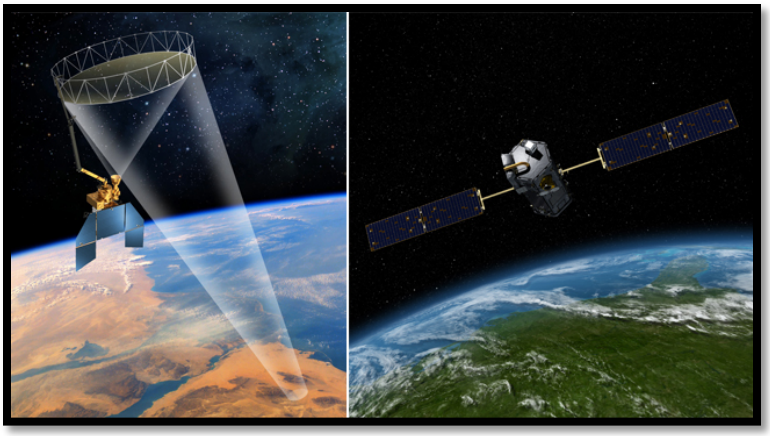
From Space to Soils

Take a moment to think about what we can learn about our world by studying Earth from space.



Satellites moving around Earth collect valuable information about the Earth's surface including data on its soils and plants. Some satellites even monitor soil moisture, ocean salinity, soil salinity, and forest cover.

What else can we learn by studying soils from so far away? How do farmers manage their soils and crops across hundreds of acres of farmland?

Farmers and scientists alike are using photographs and data collected from satellites orbiting Earth to better understand the soils that grow our food and sustain life. Farmers use satellite images to study the landscape, identifying farm areas that may need more fertilizer or a different irrigation plan. What can you identify in the image? Soils? Crops? Have you seen satellite images like this one before? Discuss with your mentor.

Soil is not d*rt: An Introduction

“Like our own skin, we cannot live without soil.”

Have you ever thought about how important soil is in your life? Soil grows the food you eat, filters the water you drink, and provides stable foundations for your home and school! In fact, soil is one of the most valuable yet underappreciated natural resources in the world!

Soil is the living, breathing top layer of the Earth’s crust. Soil is made up of air, water, and minerals. Soils also contain thousands of tiny bugs, known as arthropods, most of which you cannot even see with your bare eyes!

People often think that all desert soils are dry, unable to support crops, and may even resemble the cracked soils of Death Valley seen to the right. Yet, Native Americans have been farming in the southwest for thousands of years! The Tohono O’odham people are growing traditional crops, such as O’odham squash (hal), O’odham corn (huñ), and tepary beans (bawĭ), in the soils of southern Arizona. The Tohono O’odham community even harvest from a traditional “ak-chin” farm irrigated only with rainwater diverted from desert washes after powerful rainstorms.

If soil is so valuable in our lives, even those living in the desert, what must we do to save our soils? First, we must love, study, and preserve our soils! Second, we must stop referring to soil as dirt!

Careers in Soil Science:

- Crop scientist
- Soil microbiologist
- Farmer
- Soil mapping and interpretation scientist
- Wetland specialist
- Soil conservationist
- Soil research scientist
- Landscaper
- Marketing manager for an agricultural firm
- State soil and water quality scientist
- Environmental scientist
- Pest management specialist

Education After High School:

Associate's Degree in Science: Pima Community College in Tucson (2 years after high school). Option to take Introduction to Agribusiness, Introduction to Agriculture Science, and Introduction to Plants, Soils and Crops as elective courses.

THE UNIVERSITY OF ARIZONA®
Soil, Water and Environmental Science
COLLEGE OF AGRICULTURE AND LIFE SCIENCES

Bachelor's Degree in Soil, Water and Environmental Science, University of Arizona in Tucson; in Global Institute of Sustainability, Arizona State University in Phoenix; in Environmental Science, Northern Arizona University in Flagstaff (4-5 years after high school).

Master of Science in Soil, Water and Environmental Science, University of Arizona, Tucson; in Sustainability, Arizona State University, Phoenix; in Environmental Sciences and Policy, Northern Arizona University in Flagstaff (6-7 years after high school).

PhD in Soil, Water and Environmental Science, University of Arizona; in Environmental Life Sciences, Arizona State University, Phoenix; in Earth Sciences and Environmental Sustainability, Northern Arizona University in Flagstaff (8-10 years after high school).

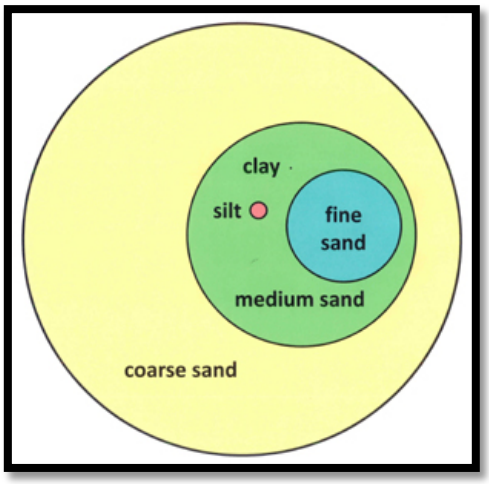
Possible Employers

- Federal government agencies
- State government conservation agencies
- Private industry (consulting agencies)
- Universities
- Government regulatory bodies

Activity 1: Soil Texturing!

Introduction: Soil scientists, farmers, gardeners, and students study soil texture and other soil properties every day! Soil texture is one of the most important characteristics of a soil because it determines how air and water will move through the soil.

What is soil texture? Soil texture is defined as the size of the particles that make up a soil. The particle sizes of a soil include sand, silt, and clay. The amount of each determines how easily plants will be able to access water in the soil. For humans, soil texture help determine how well our food will grow and how stable the foundations of our buildings will be.



Now that you have learned about how important soils are you in your daily life, it is time to learn how to texture soils by feel! Let's take a closer look.

Activity 1 (Continued)

What You Will Need:

- Butcher paper
- Plastic spoon
- Soils (different textures)
- Water (in squeeze bottle)
- Soil texturing flowchart (attached)
- Ruler
- Paper towels
- Soil waste bucket

Activity Directions:

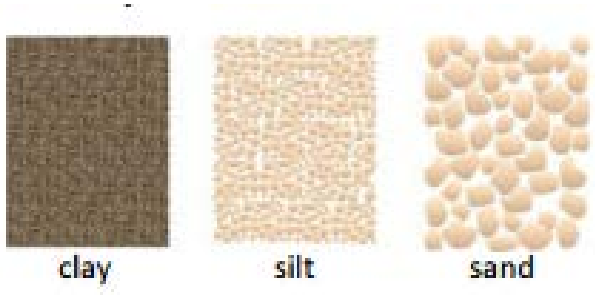
1. Spread butcher table over the table you plan to work at.
2. Set your plastic spoon, soils, and squeeze water bottle onto the butcher paper.
3. Use the plastic spoon to scoop 1-2 spoonfuls of soil into the palm of your hand.
4. Squirt a small amount of water onto the soil in your hand. Squeeze your hand together and start to form a ball with the soil.
5. Add small squirts of water to the soil if it feels too dry to form a ball. Be careful not to add too much water too quickly.
6. If you do add too much water, mix in small pinches of dry soil.
7. Keep adding water (or additional soil) until you form a ball of soil that feels like moist silly putty.

Activity 1 (Continued)

8. Gently hold the ball of soil between your thumb and forefinger (as in the picture above). Start to form a ribbon of soil. Continue pushing the ribbon through your fingers until the ribbon breaks under its own weight.
9. Measure the length of the ribbon with the ruler.
10. Now place a small pinch of your soil ribbon (about the size of a penny) into the center of your palm. Use the water bottle to excessively wet the pinch of soil. Rub your forefinger in the center of your palm. Does the soil feel gritty to you? Smooth?
11. Look at your "Soil Texturing By Feel" guide on the next page. Based on the characteristics of your soil that you just measured (Does it form a ball? How long is the soil ribbon?), what is the texture of your soil?
12. Practice your new soil texturing skill by analyzing at least 2 or 3 more soils! How do the textures compare to one another?
13. Congratulations! You have just mastered a skill that soil scientists, gardeners, and students use all over the world to study soils!

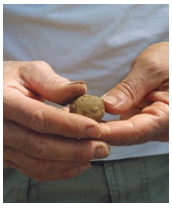
JOURNAL IT!

- Record your scientific findings in your science journal. What was the texture of your soil? About how much clay is in your soil?
- In the image below, what soil texture will water move through the fastest? The slowest? Discuss with your mentor and write down your thoughts in your journal.



- Talk with your mentor about the different types of soils you have seen around your yard, neighborhood, school, or around Tucson. Have you noticed soils of different textures?

Soil Textype By the "Feel Method"



START

Place approximately one tablespoon of soil in palm. Add water a drop at a time and knead the soil to break down all aggregates. Soil is at the proper consistency when plastic and mobile, like moist putty.

Add dry soil to soak up water.

Does soil remain in a ball when squeezed?

NO → Is soil too dry? NO → Is soil too wet? NO → SAND 1/ 0-10%

YES → Is soil too dry?

YES → Is soil too wet?

YES → Place ball of soil between thumb and forefinger gently pushing the soil with the thumb, working it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over the forefinger, breaking from its own weight.

Does soil form a ribbon?

NO → LOAMY SAND 0-15%

YES → Does soil make a weak ribbon less than 1" long before breaking?

NO → Does soil make a medium ribbon 1" to 2" long before breaking?

NO → Does soil make a strong ribbon 2" or longer before breaking?

YES → Excessively wet a small pinch of soil in palm of hand and rub with forefinger.

YES → Excessively wet a small pinch of soil in palm of hand and rub with forefinger.

YES → Excessively wet a small pinch of soil in palm of hand and rub with forefinger.

Does soil feel very gritty?

YES → SANDY LOAM 0-20%

NO → Does soil feel very smooth?

YES → SILT or SILT LOAM 0-27%

NO → Neither grittiness nor smoothness predominates.

YES → LOAM 7-27%

Does soil feel very gritty?

YES → SANDY CLAY LOAM 20-35%

NO → Does soil feel very smooth?

YES → SILTY CLAY LOAM 27-40%

NO → Neither grittiness nor smoothness predominates.

YES → CLAY LOAM 27-40%

Does soil feel very gritty?

YES → SANDY CLAY 35-55%

NO → Does soil feel very smooth?

YES → SILTY CLAY 40-60%

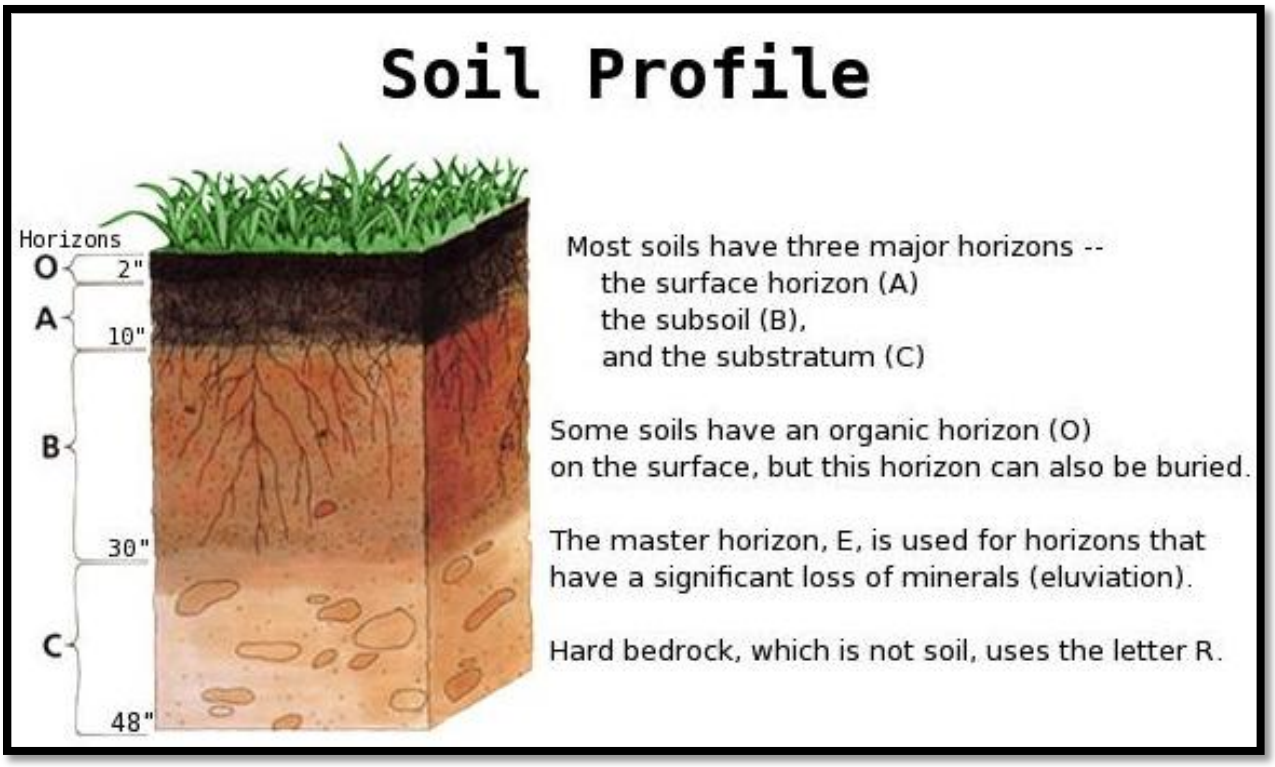
NO → Neither grittiness nor smoothness predominates.

YES → CLAY 40-100%

1/ Clay percentage range

Activity 2: Make Edible Soil!

Introduction: Many soils form on top of geologic rock over thousands of years. As soils thicken, different soil horizon layers are formed. Soil horizons have different soil colors, soil textures, and other properties that can be seen with just your eyes! Can you pick out the soil horizons in the picture?



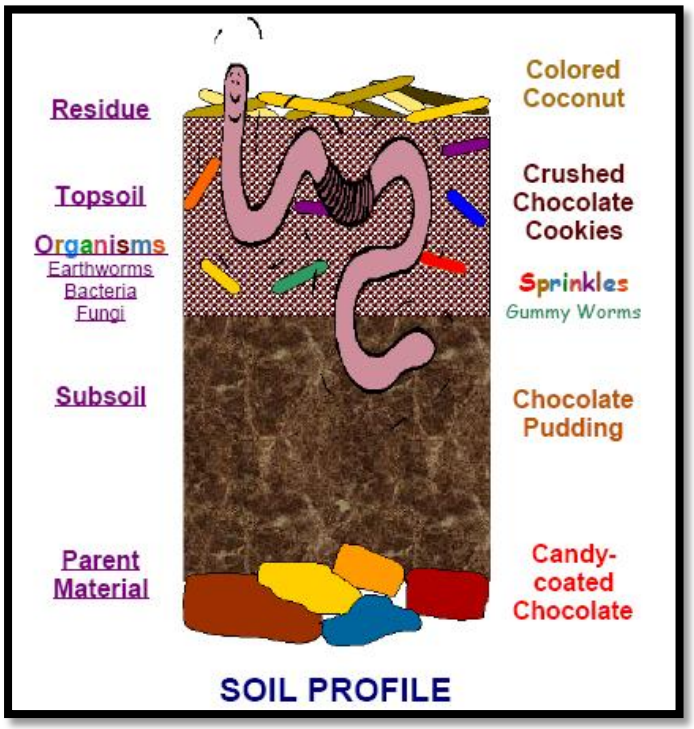
The O horizon is made up of decaying plant material or leaves that have fallen from the trees or other plants. The A horizon contains plant roots, earthworms, and other living things in the soil. The B horizon is the subsoil that accumulates clays and nutrients from the A and O horizons from above. The C horizon is bedrock that has been broken down over time. The R horizon is hard bedrock and is not considered soil.

You are now going to use your knowledge of soil horizons to build your own edible soil profile!

(Activity 2 Continued)

What You Will Need:

- Clear plastic cups
- Paper plates
- Plastic spoons
- Candy coated chocolate
- Crushed chocolate cookies
- Chocolate pudding
- Shredded coconut
- Food coloring (Green, brown, and yellow)
- Gummy worms
- Digital camera



Activity Directions:

1. Look over the edible soil supplies and the labels for each part of the soil profile.
2. Based on what you just learned about soil horizons, how will you order your soil horizons as you build your edible soil profile?
3. Record your answer in your science journal.
4. Choose the parent material (candy-coated chocolate pieces), organisms (sprinkles, gummy worms), topsoil (crushed cookies), and organic residues (green, brown, or yellow coconut) that you wish to use to construct your soil profile.
5. Add the parent material (chocolate pieces) to the bottom of your plastic cup.
6. Carefully add the subsoil (chocolate pudding). Next, sprinkle the topsoil (crushed cookies), organisms (gummy worms and sprinkles) on top of your subsoil layer.
7. Finally, use a plastic spoon to add the organic residue (coconut) of your choice to the top of your soil!
8. Photograph your finished edible soil model with the digital camera.
9. Your soil profile is finished! Enjoy your edible soil!

Activity 3: Soil Painting

Introduction: Navajo Sandpainting

Sandpainting has been used by Native Americans in healing ceremonies for centuries. The Navajo People (The Diné) call their sand paintings *'iikáàh*, which means a “place where the gods come and go.” During a healing ceremony, a Navajo Medicine Man (*Hatałii*) uses a combination of ground rock, pollen, powdered roots, and crushed flowers to symbolize sacred stories. The paintings created in the ceremony are not permanent “art objects.” Sandpainting is one part of a dynamic spiritual ceremony focused on connecting the patient to healing spirits that help to restore wellness and harmony. Following a healing ceremony, the sands are swept away and returned to the desert.

Activity 3: Soil Painting

What You Will Need:

- Cardstock paper
- Pencils
- Ink pens (black, different tip sizes)
- Cardboard backing
- Paint brushes (different types and sizes)
- Elmer’s glue
- Paper cups
- Stir sticks
- Water (in squeeze bottle)
- Ground soil (different colors)
- Sponges and rags
- Masking tape

Activity 3 (Continued)

Activity Directions

1. Sketch your art work on cardstock paper with a pencil. Use ink pens to draw in permanent lines.
2. Tape the edges of the cardstock paper to the cardboard backing with masking tape to make sure that your art work dries flat after you finish painting.
3. Pour small amounts of Elmer's glue into the small paper cups. Add small pinches of soil and stir. Experiment with color and consistency. Mix the different soils to form new colors or use soils individually.
4. Select the kinds of paint brushes, sponges, and rags that you want to paint with. Paint with the soils and have fun!
5. As your soil painting masterpiece begins to dry, you can try applying additional layers of soil paint.
6. Allow the soil paintings to dry until next week. Use a black ink pen to add any finishing touches to your soil art.
7. Enjoy!

JOURNAL IT!

- Write down the colors of the soils you chose to paint with. Why did you select these soils?
- Using the figure at the right, think about where in the soil profile the soils you painted with came from. Match the colors of your soils to the soil horizons (O, A, B, or C).
- Brainstorm with your mentor about what processes in nature could cause the different colors in the soil you used today. Fire? Decomposing plant leaves?