

Introduction

What is soil? How is it made? What does rock have to do with making soil? In this lesson students will learn how rock becomes soil and what factors are involved in that process. Students will conduct two activities testing how they can speed up the process of turning rock to soil.

Objectives

- Students will understand the way that soil is formed.
- Students will understand the importance of soil.

Background

We are not talking about dirt! Dirt is the stuff that gets under your fingernails or it is the stuff that you wash off the car. Soil supports life.

Under the soil that covers Kansas is a layer of rocks. In some places, the rock is only a few inches down. In other places, it is several feet down. Imagine a bulldozer pushing all that soil off the rocks in an area the size of a football field. Then, put a big drain in it so it would not just fill up with water. Would plants grow on those rocks? No. At least not for a long time. Most plants need soil. If we just left it alone, eventually soil would start to form there. How would those rocks change into soil?

Bare rock



What is soil?

Soil is a mixture of air, water, organic matter (dead and living organisms) and minerals.



The air is absorbed from the atmosphere above the soil. Water is soaked up when it rains or snows. The organic matter is the dead and living organisms such as the plants, insects, bacteria, fungi, and other organisms. The mineral comes from the rocks as they break down.

What causes the rocks to break down?

This can happen in three ways:

- Physical weathering
 - Rocks shrink and swell as the temperature changes. This causes little pieces of the rock to break off and causes the rocks to rub against each other. This friction breaks off little pieces. Also, most rocks can soak up a little bit of water. When they water freezes, it breaks off tiny pieces.



- Chemical weathering
 - Minerals of the rock mixes with water, air and other natural chemicals that causes the rock to break down.



- Biological weathering
 - This is the breakdown of the rocks by living organisms. Roots can grow into the rock causing tiny pieces to break off. Insects and other animals may dig at the rocks looking for food or a place to hide. This allows more water to get into the rock which can cause more physical and chemical weathering.



What influences how fast soil can be formed?

CLORPT! It is not really a word; the letters represent the things that affect how fast soil is formed:

- CL = Climate
 - Temperature has a big affect on chemical reactions. More rainfall also means more reactions. Big swings in temperature means more freezing and thawing. Climate is all of these things.
- O= Organisms
 - The type of organisms that inhabit the area can affect this. The type of burrowing animals, growing plant roots, bacteria, and fungi all can have an effect.
- R = Relief
 - Relief is a way of describing the way the land lays. It may be sloped. If it is on a slope, which direction does the slope face and how steep is the slope? This effects the amount of sunlight it gets, which affects the temperature. Also, the amount of the slope determines how fast the water runs off of it.
- P = Parent Material
 - The parent material is the rock. Some rocks are harder than others and do not break easily. Some rocks are more porous. This means that it has more holes and will soak up more water.
- T = Time
 - How long the rock(s) have been exposed to the elements of nature? The longer they are exposed, the more porous they become. The more porous they become, the faster they break down.

Materials

- Creating Soil Worksheet
- Hard plastic container (pint size or larger)
- 3-5 rocks (golf ball size)
- 2 Small pots
- Tongs
- Coffee filter, napkin or paper towel
- Glass jar with lid (this experiment will cause the jar to break!)

Directions

Activity 1 – Physical weathering using freezing and thawing

We are going to re-enact the effect of Kansas weather to the extreme!

1. Gather the rocks.
2. Wash the rocks thoroughly and place in plastic container.
3. Put enough water in the container to cover the rocks then, add another cup of water.
4. Place the container in the freezer overnight.
5. Remove the container from the freezer.
6. Remove frozen water with rocks from the container. You may have to run some warm water over the container first.
7. Put the frozen water with the rocks in a pot upside down (rocks on the top).
8. Turn on low heat until the water has melted. Then, turn on high heat and wait for it to boil.

9. While you are waiting for it to boil, fill another pot halfway with water and ice and set aside.

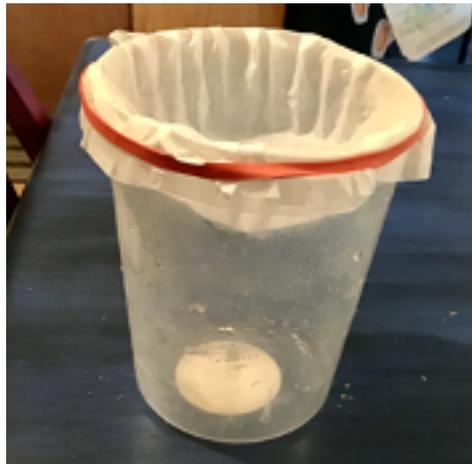


10. Allow it to boil for five minutes. Be careful to not allow it to boil over.

11. After five minutes of boiling, use the tongs to pick up the rocks one at a time. Gently swirl the rock in the hot water before removing it.

12. Carefully, lower the rocks into the pot with ice water one at a time.

13. Place a coffee filter or paper towel inside a plastic container and secure it with a rubber band.



14. Place the container in the sink or a pan to catch any spills.

15. After allowing the water to cool from pan you boiled it in, slowly pour it into the container.

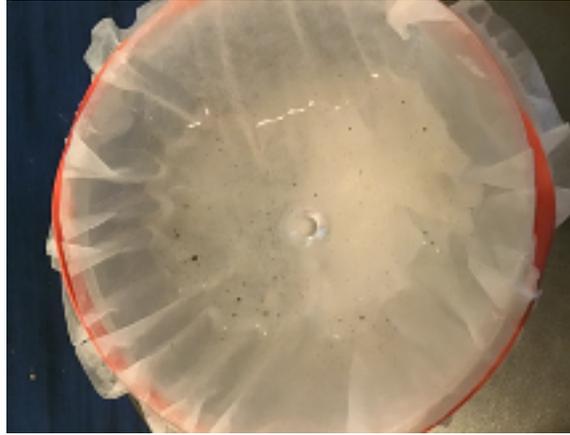
16. Occasionally swirl the water to make sure all the contents are pouring out.

17. Use the tongs to remove the ice and the rock from the other pan.

18. If you do not think that all the water will fit into the container, carefully pour some out in the sink. Then, pour the remainder into the container. Swirl occasionally.

Conclusion from activity #1:

- The small flecks of rock that are caught by the filter are the pieces that broke off due to freezing and thawing.



- You can now see how this works in nature and why it would take hundreds of years to form soil.

Activity #2 – The power of ice

Adult Supervision recommended.

1. Fill glass jar as full as possible.
2. Place lid on the jar and tighten, then jar inside a plastic bag.
3. Place bag inside the freezer overnight. It might take two nights depending on how cold the freezer gets.
4. Once it is frozen, carefully remove the bag from the freezer.



5. View the contents without opening the bag.
6. Carefully dispose of this!

Conclusion from activity #2:

- When water freezes it expands with enough force to break the glass or push the lid off the jar. Years ago, farmers would drill holes in rocks in a straight line. Then, fill the holes with water. In the winter, the ice would form and have enough force to split the rock. They would use this technique to make rock posts. You can see the marks left by the drill on this post. Today, heavy duty machinery is used to break the rock into posts.



Conclusion

To test what you have learned complete the Creating Soil Worksheet.

Remember the area where the bulldozer removed all of the soil? Even with the best CLORPT factors, it can take hundreds of years to form enough soil to grow a crop! Erosion is when wind and/or water removes soil from where it is located. It is estimated that 12 tons of soil is eroded away from Kansas farmland every year. That's a dump truck load! That is why farmer work hard to practice soil conservation. Soil supports life!

“Land is not merely soil, it is a fountain of energy flowing through a circuit of soils, plants and animals.” - Aldo Leopold



Resources

<https://www.soils.org/about-soils/basics/>

1. What four things are combined to make soil?

air, water, organic matter and minerals

2. What are the three types of weathering that breaks down rocks?

Physical, chemical and biological weathering

3. What do the letters of CLORPT stand for?

a. CL – Climate

b. O – Organisms

c. R – Relief

d. P – Parent Material

e. T – Time