



Kansas Corn: Soil Erosion



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Kansas Corn: Soil Erosion

Grade Level: Middle School

Overview

Soil erosion is the movement and transportation of soil by various natural processes. Erosion is responsible for the loss of an average of 12 tons per acre of agricultural soils per year. The soil that is most affected by erosion is the topsoil layer. Soil erosion is accelerated by a sloped landscape, the removal of vegetation to create land space, soil tillage for agriculture, and drought. Wind and water play a monumental role in soil erosion.

On agricultural land, erosion causes loss of nutrient rich topsoil, which results in an increased need for fertilizer being added back to soils. This can lead to further problems as fertilizer runoff leads to water contamination, which affects the habitats of area livestock and wildlife.

Water erosion is the focus of our lab today. Erosion from water removes topsoil from agricultural land and can cause runoff of nutrients to nearby water supplies, jeopardizing surrounding wildlife habitats.

Kansas College and Career Ready Standards

- **MS-ESS3-1.** Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- **MS-ESS2-2.** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- **HS-ESS2-5.** Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

English

- **W.7.1.** Write arguments to support claims with clear reasons and relevant evidence.
- **W.7.10.** Demonstrate command of the conventions of standard English grammar and usage when writing.
- **W.8.1.** Write arguments to support claims with clear reasons and relevant evidence.

Learning Objectives

- Students will construct an explanation based on scientific evidence for how the uneven distributions of groundwater resources are the result of past and current geoscience processes.
- Students will analyze and interpret data to provide evidence of the effects of soil erosion.
- Students will plan and conduct an investigation of the properties of water and its effects on Earth's materials and surface processes.

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Materials

- Soil Erosion PowerPoint (available at www.kansascornstem.com)
- 2-3 empty 2 L bottles
- 2-3 plastic cups or beakers (1,000 mL)
- Stanley box knife (or any box knife to cut the bottles)
- Garden soil
- Wheat stubble (you can obtain this from a local farmer)
- Wheat seed (optional)
- Water

Procedures for Instruction

Length of Time for Preparation: 1 day for preparation

- Have the 2-L bottles cut and ready for soil and other materials.
- If you are using wheat grown from seed, you will need to allow plenty of time for root growth to begin. The germination time for wheat is about a week. You will need to allow about two weeks for a good root system to develop.

Length of Time for Classroom Teaching: 1-2 days of classroom work

- Day 1: Students perform lab through observations, record data and comparisons. You can use this as a 1-day lab, or you could extend it out over a period of days to measure the erosion rate over the period of time.
- Day 2: Review of lab.

Background Information

Soil is an important part of the Kansas economy. Nearly 50 percent of the state is covered in crops, while 34 percent is covered in range and pasture lands, according to the Natural Resources Conservation Service. This land provides nearly \$8.7 billion in annual income through our number one industry, agriculture.

Although Kansas is blessed with abundant soil, each year, 190 million tons of Kansas topsoil is degraded through human activities. It took hundreds of years to create the Harney silt loam soil in Kansas, and it's not easily renewed.

To help preserve the soil, farmers use sustainable techniques, such as cover cropping and no-till. Each of these allow soil to build nutrients and improve soil structure. No-till crop ground allows soil nutrients to stay below the surface, reduces the erosion of soil nutrients and is often used in conjunction with cover cropping. The use of cover crops helps reduce water runoff that not only carries water away from the plants, but often takes nutrients needed for crop growth along with it. In this lab, we are going to test the protective capabilities of a cover crop

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against soil erosion from water.

Classroom Discussion

Pre-lab Questions

Introduce the topic and assess students for prior understanding. Let students discuss their ideas, and guide the discussion without telling them if they are right or wrong.

- Our job is to investigate the causes of soil erosion.
 - What is soil erosion?
 - What role does soil erosion play in Kansas agriculture?
 - Can erosion be slowed down or stopped with the use of cover crops?

Procedure for Lab

Bottle Setup

1. Cut out an area approximately 3" x 10" along the side of 2 bottles. Label the bottles 1 and 2.
2. Fill each bottle with 3 cups of garden soil.
3. Add a layer of wheat stubble to the top of bottle 2.

Perform the lab

1. Position the bottles so there is enough overhang so you can get a 1,000-mL beaker underneath them. (I use the sink and the neck of the bottle drains into the beaker sitting in the sink.)
2. The bottles need to be angled slightly with the neck of the bottle pointing downward. (You can use a textbook under the end to elevate the bottle. I used a 1" to 1/2" 3-ring binder to sit my bottles on so they were angled downward.)
3. Starting in the back end of the bottle (farthest away from the neck), pour 800 mL of water into bottle 1.
4. Let the water drain out the neck into the "collection buckets."
5. Repeat for bottle 2.
6. (Optional): You can repeat the above steps for multiple days if you choose to see how much erosion would take place over a certain time period.

Lab Analysis

Post-lab Questions

- Which bottle had the most erosion present?
- Which bottle had the least amount of erosion present?
- Why are cover crops important to farmers?

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Take it Further

You can have your students take the collection cups and measure the mass of the amount of soil and sediment that drained out of the bottles. If you do this as a multiple day lab, they can graph the amount of soil that was eroded away each day.

Extended Learning

There is an option to add two additional bottles to this lab to show how vegetation can help with soil erosion. This would involve growing wheat grass in the 3rd and 4th bottles, and in the 4th bottle, you would add wheat stubble (prior year cover crop). Adding two additional bottles would allow the students to compare:

- Bottle 1 - soil without vegetation.
- Bottle 2 - soil without vegetation but with stubble from prior year cover crop.
- Bottle 3 - soil with vegetation.
- Bottle 4 - soil with vegetation but with stubble from prior year cover crop.

This would add about 2 weeks to the lab prep in order to grow the wheat seed in the two bottles. The rest of the procedures remain the same for the lab.

Teacher Resources

Visit www.kansascornstem.com for videos to assist with this lab.

Reflection and Conclusion

Have students reflect on the observations they made in the lab.

1. How do the collection bottles compare:
 - The amount of sediment that is present in each bottle?
 - The colors and clarity of the water in the collection buckets?
2. What do these results tell us about:
 - The power of water?
 - The use of cover crops on a field?
3. Why is protecting the soil important to a farmer?
4. Is there evidence of erosion present around your school? Investigate your school grounds and identify erosion processes that are occurring. Using your knowledge of erosion, what are some ways that you can slow or stop the erosion that is occurring?

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Science and Agriculture Careers

- Agricultural inspector
- Agricultural specialist
- Soil and plant scientist
- Crop production specialist

To learn more about agriculture careers, visit www.agexplorer.com. You can also find career profiles at www.kansascornstem.com.

Any educator electing to perform demonstrations is expected to follow *NSTA Minimum Safety Practices and Regulations for Demonstrations, Experiments, and Workshops*, which are available at <http://static.nsta.org/pdfs/MinimumSafetyPracticesAndRegulations.pdf>, as well as all school policies and rules and all state and federal laws, regulations, codes and professional standards. Educators are under a duty of care to make laboratories and demonstrations in and out of the classroom as safe as possible. If in doubt, do not perform the demonstrations.