

SOS (SAVING OUR SOIL)

GRADES 6-12

OBJECTIVE

Help students visualize how cover crops can reduce erosion and sediment pollution using a miniature rainfall simulator.

MATERIALS

Soil
Cereal rye or oat seed
2L plastic soda bottles (cut in half length-wise)
Spray bottles (filled with water)
Empty glass cups/beakers

BACKGROUND

Iowa leads the nation in production of several important agricultural commodities including corn, soybeans, eggs, and hogs. However, in addition to being one of the world's top producers of food, Iowa also has another noteworthy distinction: Iowa leads the nation in soil erosion.

Soil erosion is the process by which soil is lost, as a result of unprotected soil being moved by wind or water. Soil erosion is an important issue because soil is, for most intents and purposes, a non-renewable resource. Soil formation requires a great deal of time. It is estimated that it takes anywhere from 500-1000 years to form just one inch of topsoil. Soil losses far outpace the rate at which it renews. Research results show that Iowa loses, on average, over 5 tons of topsoil per acre each year.

This staggering amount of soil loss does not only affect farmers. Sediment pollution caused by farmland erosion is the top water quality issue in Iowa. Moreover, the problems associated with sediment pollution don't end at Iowa's borders. Sediment from agricultural runoff is a major factor in the annual formation of the Gulf of Mexico hypoxia zone (i.e. Dead Zone), and has negatively affected the Gulf aquatic ecosystem for the past several decades.

Adding cover crops is one of the best practices to help reduce erosion, improve water quality, and attenuate the severity of the Gulf hypoxia zone. Cover crops provide protection to soil during the time when there are no other crops growing: in Iowa this is typically from mid-October to mid-April. Cover crops act as a shield to reduce the force of raindrops that could move soil and cause erosion. Furthermore, living cover crops have extensive root systems that help hold soil in place, providing additional protection against erosion.

Cover crops protect soil from erosion, help with nutrient cycling in the soil, and in turn also protect water quality. Winter-hardy cover crops, like cereal rye shown below, provide growth in the fall and the spring.



DEFINITIONS

Cover Crop- A crop seeded with the purpose of protecting or improving soil health; cover crops are grown outside of the regular crop growing season

Hypoxia- A low-oxygen condition that occurs in water as a result of nutrient pollution; can be detrimental to fish and other aquatic organisms

Non-renewable resource- A resource that takes much longer than a human lifespan to re-form

Nutrient- A mineral that is needed for an organism to live; nitrogen, phosphorus, and potassium are examples of nutrients

Runoff- The volume of water running over the soil surface and potentially carrying soil and nutrients with it

Soil erosion- The process by which soil is moved by wind or water

Sediment- Soil deposits that have been moved by wind or water

TEACHER PREPARATION

Teachers should prepare the miniature rainfall simulators prior to classroom demonstration. There will be two simulators; one with a living cover crop and the other with only bare soil.

For the simulator that has a living cover crop, there are two options for preparation. Teachers can either seed their own cover crop, or established sod can be used in lieu of seeding. If the seeding option is chosen, take care to allow at least 3 weeks for the cover crop to gain adequate growth.

INSTRUCTIONS

1. Cut plastic bottles lengthwise as evenly as possible. One half-bottle will contain bare soil; the other half-bottle will contain soil covered with rooted, actively growing plants. The half-bottle with the living plants should have enough growth to cover most of the soil surface.
2. There should be 2 half-bottles per group of students: one with only bare soil, and one with living cover. Each half-bottle should be placed on a 20° slope (approximate) with the spout being the lowest point to allow for runoff. Place a glass cup or beaker underneath the bottle spout to catch runoff.
3. Student groups will use spray bottles to mimic rainfall at each half-bottle simulator until there is sustained runoff. Students should begin spraying each simulator at the same time to ensure that both simulators are being treated as equally as possible.
4. Students will then make observations about the appearance of the runoff at each of the two simulators. Observations should include which was the first to have runoff and which has the dirtiest runoff.

DISCUSSION QUESTIONS

Prompt students to answer the following questions after the conclusion of the experiment:

- Which simulator was the first to have runoff?
- Which simulator had the most polluted water?
- How did the living plant material affect the amount of soil being washed away? Is this a realistic representation of what happens on a landscape scale? Why or why not?

CHALLENGE QUESTIONS

The two nutrients that have the biggest impact on water quality are nitrogen and phosphorus. Nitrogen is invisible and phosphorus attaches strongly to soil. Which simulator do you think has less nutrient pollution? Explain your response.

What types of tests might you perform to determine how much nutrient pollution is in the water? Please be as specific as possible.

ADDITIONAL RESOURCES

For Teachers:

<http://extension.agron.iastate.edu/soybean/documents/SoilErosion.pdf> (Soil Erosion-What will the Future Bring?)

<https://connect.extension.iastate.edu/p7sqo5f1v71/?launcher=false&fcsContent=true&pbMode=normal> (Webinar- Soil Erosion in Iowa)

<http://science.howstuffworks.com/environmental/earth/oceanography/dead-zone.htm> (Gulf of Mexico Dead Zone-Should We Be Worried?)

<http://www.swcs.org/documents/filelibrary/CCCW2.pdf> (Cover Crop Effects on Wind & Water Erosion)

<http://video.pbs.org/video/2247092322/> (Uncovering the Dust Bowl)

<http://thegazette.com/2013/05/04/cover-crops-control-soil-erosion/> (Cover Crops for Erosion Control)

For Students:

<http://wepp.mesonet.agron.iastate.edu/> (Iowa Daily Erosion Project)

<http://www.ewg.org/losingground/> (Losing Ground Video and Report)

<http://oceanservice.noaa.gov/facts/deadzone.html> (NOAA-Dead Zone Facts)

<http://video.pbs.org/video/2247092322/> (Uncovering the Dust Bowl)