SAVE THE SOIL

student guide

Purple Plow
Uncovering STEM Solutions

Save the Soil Challenge

Identify a Problem

According to the United States Department of Agriculture's Natural Resource and Conservation Service, soil erosion "will remain an important global issue for the 21st century because of its adverse impact on agronomic productivity, the environment, and its effect on food security and the quality of life." It is estimated that only 11% of our Earth's land surface has the topsoil considered suitable for producing food. In the United States, we are losing at least 3 billion tons of topsoil a year to erosion! Without topsoil, our land becomes a desert and is not capable of producing food. What can we do to start solving this global problem? To address the necessity of food production, we need to start at the soil level.

Response to Problem

With the challenge of losing over 3 billion tons of fertile topsoil each year, your team has been selected to design a prototype and construct a system that will reduce topsoil erosion.

This system must address the following needs:

- Address local erosion concerns.
- Reduce topsoil erosion.

Success will be determined by

- Design, create, and test a topsoil erosion simulation model which demonstrates a measurable reduction of topsoil erosion.
- Produce a presentation which shows the topsoil reduction model in use and communicates results.

1. Identify

PURPOSE OF STEP

Define the problem and how it is affecting life globally, nationally, and locally. Research and consider how others have approached solving the program. Describe why this problem needs a solution. Determine constraints (e.g., time, space, resources, etc.).

STUDENT PROMPTS AND GUIDING QUESTIONS

- What is erosion?
- What are the various causes of erosion?
- Why is topsoil erosion a problem?
- How does soil erosion affect global agricultural practices?
- How does soil erosion affect local agricultural practices?
- Why is soil erosion a problem for agriculture, and more broadly, our society?
- What form of topsoil erosion presents a problem in your area (e.g., water, wind, ice, etc.)?
- How has erosion changed our world throughout history?
- How has soil erosion affected agriculture locally and globally throughout history?

SIGNS OF STEP COMPLETION

Present a description of the problem to the facilitator. Be sure to include how this problem affects communities globally, nationally, and locally. The description should also include ways in which others have addressed finding a solution and constraints to be considered (e.g., time, space, resources, etc.).

1. Identify reflection

Important discoveries during this step:

Impact to the global, national, and local community:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

2: Imagine

PURPOSE OF STEP

Brainstorm solutions to the problem. List all of your ideas – don't hold back! Discuss and select the best possible solution.

STUDENT PROMPTS AND GUIDING QUESTIONS

- What is the desired result?
- What are current global solutions to the soil erosion problem?
- What solutions to soil erosion are being used in the United States?
- What erosion solutions are being used in your community or region?

SIGNS OF STEP COMPLETION

Present a list of possible solutions to your identified problem to the facilitator.

2: Imagine Reflection

Important discoveries during this step:

List your possible solutions:

Identify the solution that you think will be achievable:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

3: Design

PURPOSE OF STEP

Diagram the model. Identify the materials needed to build the model. Write out the steps to take. Describe the expected outcomes.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Design a model that meets the demands set forth in the challenge and simulates erosion.
- Determine what specific materials will be used to make your model landscape and erosion simulation.
- How could you simulate topsoil erosion?
- In what unique ways could you design a system that reduces topsoil erosion?
- How will you provide evidence of topsoil erosion reduction with your system?
- Justify why particular design choices have been made.
- Identify, obtain, and track costs of materials for your topsoil erosion model.

SIGNS OF STEP COMPLETION

Present a detailed diagram of the prototype as well as a written plan of how it will be built. Be sure to include a materials list with budget, detailed directions, and expected outcomes.

3: Design Reflection

Important discoveries during this step:

Justify your topsoil erosion model design and the materials you will need:

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

4: Create

PURPOSE OF STEP

Follow the design plan and build the prototype.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Use all research, knowledge gained, and the design plan to create the model.
- Repeat any of the previous steps should issues arise during the building process
- Consider the parameters of the challenge and what needs to be accomplished for a successful challenge.

SIGNS OF STEP COMPLETION

Build the prototype and share with the facilitator.

4: Create Reflection

Important discoveries during this step:

Describe any barriers you overcame in creating your model.

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

5: Test + Improve

PURPOSE OF STEP

Test the design and collect qualitative and quantitative data. Discuss results and compare with the expected outcome. Seek areas of improvement and make changes where needed.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Create data tables, graphs, photographs showcasing data, etc.
- How does wind and/or water effect the movement of soil particles?
- Does size or weight of soil effect the movement of the soil particles?
- Calculate rate of erosion.
- How do plants affect the rate of erosion?
- What other factors are affecting the system and what observations can be collected?
- How will you collect and measure sediment within your model?
- What will need to be observed (qualitative data)?
- What information can be put into a chart or graph (quantitative data)?

SIGNS OF STEP COMPLETION

Keep records of all test trials and share data with the facilitator. Entries should include both qualitative and quantitative data. Record any improvements made to your model and the effect they had on the outcome.

5: Test & Improve Reflection

Important discoveries during this step:

Summarize the improvements you made to your model and the effect each had on outcomes.

Plans for the next step (e.g., knowledge to gain, questions to answer, preparations to make, etc.):

6: Share

PURPOSE OF STEP

Communicate what was learned. Share the design, data, and conclusions. Present results.

STUDENT PROMPTS AND GUIDING QUESTIONS

- Take pictures of your model.
- Film your topsoil erosion simulation in action.
- Develop a presentation including knowledge gained, design plans, and materials used to create the model, testing completed during challenge, and data analysis.

SIGNS OF STEP COMPLETION

Present what was learned through the design process. Share how the prototype addresses the problem, key aspects of design, data from test trials, and end results.

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