purple PLOW

SAVE THE SOIL

Student Guide

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Challenge Rationale

Students can help conserve natural resources locally and protect local ecosystems by addressing current and historical problems associated with the erosion of topsoil that limits the ability to grow food. After thoughtful research to evaluate how these challenges exist globally and locally, students will design, test, and demonstrate a solution that reduces topsoil erosion for their unique location or situation to help conserve productive soil. The final product will be a model which demonstrates a measurable reduction in soil erosion.

Establishing The Challenge

The Challenge

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.

Establishing The Challenge

Challenge Question

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 SOLUTION 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

STEP ONE

1 | IDENTIFY

Purpose of Step

Define the need and how it affects life globally, nationally, and locally. Research and consider how others have approached solving the need including how people have addressed this need historically. Describe why this challenge needs a solution and 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

Students will present a description of the challenge to the facilitator. The description should include how this challenge 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.).

Important discoveries during this step:

- Define the problem as it relates to you locally

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

STEP ONE: REFLECTION

1 | IDENTIFY

Important Discoveries During this Step:

Define the Problem as it Relates to You Locally:

Plans for the Next Step (E.G. Knowledge to Gain, Questions to Answer, Preparations to Make, Etc.):

STEP TWO

2 | IMAGINE

Purpose of Step

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

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 the identified challenge to the facilitator.

STEP TWO: REFLECTION
2 | IMAGINE

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.):

STEP THREE

3 | DESIGN

Purpose of Step

Develop a possible solution and identify the materials needed to provide evidence for why the solution is creative, unique, and sustainable. Write out the steps to take and 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 description of the solution as well as a written plan of how it could be carried out. Include the following in the plan: a materials list with budget (if building a physical model or conducting lab research), detailed directions, and expected outcomes.

STEP THREE: REFLECTION
3 | DESIGN

Important Discoveries During this Step:

Justify Your 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.):

STEPFOUR
4 | CREATE

Purpose of Step

Follow the design plan and construct the solution.

Student Prompts and Guiding Questions:

- Use all research, knowledge gained, and the design plan to create the solution.

- 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

You will construct the solution and share with the facilitator.

STEPFOUR: REFLECTION
4 | CREATE

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.):

STEP FIVE

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 affect the movement of soil particles?

- Does size or weight of soil affect 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

The students will keep records of all test trials and share data with the facilitator. Entries should include both qualitative and quantitative data. The students will also share recordings of any improvements made to the solution and the effect they had on the outcome.

STEPFIVE: REFLECTION

5 | TEST & IMPROVE

Important Discoveries During this Step:

Impacts to the Global, National, and Local Community:

Plans for the Next Step (E.G. Knowledge to Gain, Questions to Answer, Preparations to Make, Etc.):

STEP SIX
6 | SHARE

Purpose of Step

Communicate what was learned throughout the challenge. Share the design process, data, and conclusions on how the solution answers the challenge question.

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, including sharing how the solution addresses the problem, key aspects of design, data from test trials, and end results.