## Curricular Activity Template

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| Activity Title: Preventing Erosion with the Engineering Design Process. |
| Grade Level (s): 5th Grade | Approx. Time: 10 hours |
| Subject Areas: Technology/Engineering, Science |
| Standards: (Please list by number using the following abbreviations: Earth and Space Science (ESS), Life Science (LS), Physical Science (PS), Technology/Engineering (TE), Mathematics (M)). Massachusetts frameworks: ESS 5, ESS 12, TE 1, TE 2 |

### Description of Activity (please limit to 250 words): In this activity, the students co-learn the Engineering design process and the erosion process. The activity begins with a demonstration of pouring water through a small tube into a pan filled with soil. The water runs out of the pan and washes some soil with it. A discussion follows and the students are asked for ideas of how to stop the erosion and why this might be important. The students eventually arrive at the conclusion (with any necessary leading from the teacher) that the erosion could be stopped with a fence that allows water to pass but holds soil back and that it could be important for homes on the coast, near a river, or in an area that has heavy rain. The students follow the 8-step engineering design process in small groups and create a detailed design of such a fence that could be built with the available craft materials in the class. After the design in approved by the teacher, the group submits a materials list and builds their prototype. The fence is inserted in the end of the pan and the water is poured in again. The students compare the erosion amount to the original with no fence and assess their fence’s performance. The fences are redesigned, rebuilt, and retested to see if improvements can be made. All the data is recorded in engineering books and the students conclude their project with an overall assessment of their fences. |

### Implementation (classroom organization, presentation, other implementation comments): Follow the attached lesson plan as you see fit. This lesson is made to allow for lots of improvisation and customization by the classroom teacher. |

### Materials (include vendor information if appropriate):

- Five 2 – 4 inch deep aluminum pans (could also use plastic or any waterproof container approximately 2-4” X 12-24” X 6-12”)
- Enough soil or dirt to fill the pans
- 2 liter bottle of water
- Fence Materials (These could be anything that children could use to construct a retaining fence. Some suggestions are: popsicle sticks, wire, glue, pipe cleaners, string, chopsticks, cardboard, nails, or any other craft supplies that can be obtained inexpensively or free. A good idea is for the teacher to first search through the materials he/she already has and decide which of them would make could retaining wall materials.)
- Scissors
- Masking Tape

Please attach any worksheets or handouts in electronic format that accompany this activity.
Title of Lesson: Erosion Laboratory
Unit Title: Erosion
Discipline: Engineering, Earth Science
Grade: 5

Discipline: Science and Technology/Engineering
Strand 1: Technology/Engineering
Standard 1: Engineering Design

Discipline: Science
Strand 2: Earth and Space Science
Standard 2: Soil

Student Outcomes: The students will design an erosion detainment system that will allow water to pass through but hold soil back. The system will be drawn out with a written description first. Next, a prototype will be built and tested. Finally a detailed report will be drafted outlining the analysis of the prototype. After the lesson, students should feel confident about their knowledge of erosion. They should be able to identify how erosion works and where it is a problem. They should also be able to identify solutions to erosion problems and rate the solutions based on a variety of variables. The students should gain a further understanding of the engineering design process and how it applies to real-world applications.

Length of Lesson: 3 hours.
Lesson:

Note: Feel free to alter the following lesson as you see fit based on your resources, student needs, and student capabilities.

- Setup:
  1. Cut the short side off of each of the pans.
  2. Fill the pans with packed dirt.
  3. Fill the bottle with water.

Please attach any worksheets or handouts in electronic format that accompany this activity.
4. Carefully poke or drill a hole in the cover of the water bottle. If a spigot that is made for a two liter bottle is available, use this instead.
5. Set up pans in an area that can safely have water spilled on it. This should either be outside or into a larger container.

- This lesson is to be presented as the culminating point of the Erosion unit, so students should be very familiar with the concept of erosion at this point.
- Quickly review the key terms and concepts that have been taught in the erosion unit.
- Explain to the students what you are about to do and ask for suggestions concerning the expected outcome of the situation.
- Prop one of the dirt-filled pans up on a textbook so that it has a slight declination.
- Squirt the water from the two liter bottle into the pan on the high end and have the students watch as the dirt erodes out of the container.
- Ask the students what they observed and relate the experiment to a real-life erosion problem such as a residence near the ocean, a road near a river, or a wildlife habitat.
- Ask the students what could be done to remedy the problem. Look for the answer, "A structure could be built to hold back the dirt but allow the water to flow through."

Explain why this is the correct answer.

Explain the assignment:
Students in groups of two or three are to design a retaining fence following the engineering design process. First they must discuss and decide on the materials to use. They must provide a description of why they chose those materials. They should base this decision on multiple variables such as price, ease of installation, aesthetics, availability, environmental concerns, and performance. Next the students will design their fence on paper with a diagram outlining how the fence will be put together. If you prefer to use a worksheet for the design portion of this assignment, a sample worksheet is attached in Appendix A, or you can construct your own.

During the next class period, the students will build a model of their retaining wall out of the supplies allotted in the classroom, or their own from home. Provide a time limit of about half the class period for this exercise. At the end of the time limit, all fences will be collected.

The fences will then be inserted between the cut out edge of the pan and the open air (where the water flows from the pan to the container or ground). Two liters of water will be squirted into each pan and the students will be told to observe and take notes as to what happens.

For homework the students will be assigned to fill out the worksheet in Appendix B, or another follow-up worksheet of your choice.

**Instructional Mode:**
This lesson begins with a demonstration portion. Next is a discussion with the whole class. Students then work in small groups. Finally, the homework portion of the lesson is an individual assignment.

**Multiple Intelligence:**
Logical-Mathematical
Intrapersonal

**Essential Questions:**
How does the erosion process work?
When could erosion be a problem?
What are some potential solutions to the erosion problem?
What are the best materials to create retaining walls?

**Material / Resources Needed:**
Please attach any worksheets or handouts in electronic format that accompany this activity.
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2 liter bottle of water
Fence Materials (These could be anything that children could use to construct a retaining fence. Some suggestions are: popsicle sticks, wire, glue, pipe cleaners, string, chopsticks, cardboard, nails, or any other craft supplies that can be obtained inexpensively or free. A good idea is for the teacher to first search through the materials he/she already has and decide which of them would make could retaining wall materials.)
Scissors

**Instructional Strategies Activity or Procedure:**
- Be sure students understand that the design that holds back the most dirt is not necessarily the best. It is important for them to consider letting water through, price, ease of installation, aesthetics, availability and environmental concerns in addition to performance.
- Make sure the students understand that this project follows the engineering design process of design, build a prototype, test and redesign.

**Assessment:**
After completion of the assignment and collection of the follow-up worksheet, teachers should answer the following questions:

1. Do the students have a better understanding of the erosion process? How do you know?
2. Do the students have a better understanding of the engineering design process? How do you know?

**Evidence that Student Learning Occurred:**

**Technology Skills Required or Developed:**

**Worcester Public Schools:**

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**Liaison:** Michele Sullivan

**Date:** 7/23/03

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Please attach any worksheets or handouts in electronic format that accompany this activity.
Appendix A: Design Worksheet

Name:__________________
Partner(s):_______________
Date:___________________

List the materials you would use to build your retaining wall. For each material listed, explain why you chose that material. You must give at least three reasons for each material.

Diagram your fence here. Show the approximate dimensions and what each section is made of.

Please attach any worksheets or handouts in electronic format that accompany this activity.
Appendix B: Follow-up worksheet

Name: ____________________
Partner(s): ______________
Date: ____________________

Did the construction of your model fence go as planned? Why or why not?

How well did your model fence do the job of letting water pass through?

How well did your model fence do the job of stopping dirt from passing through?

If you had a chance to redesign your model fence, what would you change from the original? Include drawings.