STEM Curriculum Planning Guide

This instructional design guide serves as the template for the design and development of STEM units of instruction at the Dayton Regional STEM Center in Dayton, Ohio. The guide is anchored to the *STEM Education Quality Framework* also developed at the Dayton Regional STEM Center.

STEM Unit Title	**What's All the Commotion About Erosion?**
Economic Cluster	Environmental Engineering
Targeted Grades	4
STEM Disciplines	Science, Technology, Engineering, Math
Non-STEM Disciplines	Social Studies, Language Arts

Section I: STEM Unit Overview

Unit Overview

River erosion is the gradual removal of rock material from the banks and bed of a river. In this unit, students will use a physical model of a river bed to determine the causes of erosion and will brainstorm ways to prevent it within their model. Concepts of environmental engineering will be applied to help students understand the implications of, both the causes of, and partial solutions to, erosion issues as they relate to a river model.

Essential Question

How do natural earth processes affect landforms such as riverbeds? How do these environmental transformations affect human interaction with the environment?

Enduring Understanding

Throughout this lesson, students will apply science, technology, engineering, and math knowledge as they design multiple erosion-reduction methods. Students will use scientific and geographic skills to collect, organize and evaluate where, why and how erosion occurs. Students will use mathematical number sense as they apply their measurement skills to determine distances as they create a useful method to help prevent erosion.

Engineering Design Challenge

Students will design and test solutions that reduce river bank erosion on a model river. Students will engage the engineering design process by first defining the problem. They will use a physical model of a river and conduct research in the causes of erosion as well as devise methods for measuring it. Once they understand the nature and magnitude of this destructive process, they will brainstorm methods to reduce erosion. Students will design at least two erosion-reduction methods and will test them on the physical model. After testing, they will discuss the efficiency of their designs and determine what design changes are required to produce an effective method to prevent riverbed erosion.

Time and Activity Overview

Day	Time Allotment	Actvities
1	50 minutes	Pre-Test Hook- Lego Steve Stream Table YouTube video Erosion Picture Observation Activity
2	50 minutes	Introduce/Define the problem of erosion Introduce Erosion Research Newspaper Assignment Begin Research
3	50 minutes	Create Erosion Newspaper
4	50 minutes	Complete Erosion Newspaper Assignment
5	50 minutes	River Tray Model (Teacher Demonstration) Introduce Engineering Design Challenge

6	50 minutes	Design, Test, and Collect Data
7	50 minutes	Design, Test, and Collect Data
8	50 minutes	Design Final Erosion Prevention Design
9	50 minutes	Present and test Final Design Post-test

Pre-requisite Knowledge & Skill

The students should use the river simulation to:
• Run tests of “normal” river flow, and use the data collected to determine typical erosion rates they can test their designs against.
• Provide a “subjective” description of the erosion patterns that complements their objective, analyzed data (e.g. “erosion was heaviest at the start of the bend, the erosion at the bend was twice as bad as the erosion at the end of the bend”).
Students should be prepared to discuss different mechanisms that cause river erosion. For example, erosion can be caused by water, sediment in the water, or both.

Students should also be aware of the “downstream” effects of water erosion. In other words, if the river banks in a given location are eroding, where is that missing material going? This material can be deposited in a variety of locations such as river deltas, and they can contribute to increased erosion at other locations down river.

While they may have an intuitive sense of why material is removed as the result of river erosion, students should understand some of the basic physical processes that are occurring when they are using their river model. The water in the river exerts a force on the area along the river bank – force applied over an area is defined as pressure. Increasing or decreasing pressure can change natural erosion patterns.

Academic Content Standards

Add Standard	Mathematics	Ohio
Grade/Conceptual Category	4.MD.1	
Domain	Measurement and Data	
Cluster	Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.	
Standards	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec.	

Add Standard	Mathematics	Ohio
Grade		
Standard		
Benchmark		
Indicator		

Add Standard	English Language Arts	Ohio
Grade	W.4.2	
Strand	Writing	
Group	Texts Types and Purposes	
Standard	2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	

Add Standard	English Language Arts	Ohio
Grade	W.4.4	
Strand	Writing	
Group	Production and Distribution of Writing	
Standard	4. Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.	

Add Standard	English Language Arts	Ohio
Grade	W.4.7	
Strand	Writing	
Group	Research to Build and Present Knowledge	
Standard	7. Conduct short research projects that build knowledge through investigation of different aspects of a topic.	

Add Standard	English Language Arts	Ohio
Grade	SL.4.1	
Strand	Speaking and Listening	
Group	Comprehension and Collaboration	
Standard	1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.	

Add Standard	English Language Arts	
Grade		
Standard		
Benchmark		
Indicator		

Add Standard	Social Studies	
Grade	4	
Theme	Ohio in the United States	
Strand (pk-8 only)	Geography	
Topic	Human Systems	
Content Standard	People have modified the environment since prehistoric times. There are both positive and negative consequences for modifying the environment in Ohio and the United states.	

Add Standard	Social Studies	
Grade	4	
Standard	Geography	
Benchmark	Explain how environmental processes (i.e. glaciation and weathering) and characteristics (landforms, bodies of water, climate, vegetation) influence human settlement and activity in Ohio.	
Indicator	Identify ways that people have affected the physical environment of Ohio including: e. Building Dams	

Add Standard	**Social Studies**	
Grade	4	
Standard	Social Studies Skills and Methods	
Benchmark	10. Use a problem-solving/decision –making process which includes:	
Indicator	a. identifying a problem b. gathering information c. listing and considering options d. considering advantages and disadvantages of options e. choosing and implementing a solution f. developing criteria for judging effectiveness	

Add Standard	**Science**	Ohio
Grade		
Theme		
Topic		
Content Standard		

Add Standard	**Science**	Ohio
Strand	4	
Course Content	Earth and Space Science	
Content Elaboration	8. Describe how wind, water and ice shape and reshape Earth's land surface by eroding rock and soil in some areas and depositing them in other areas producing characteristic landforms (e.g., dunes, deltas and glacial moraines).	

Add Standard	Science	Ohio
Strand	4	
Course Content	Earth and Space Science	
Content Elaboration	10. Describe evidence of changes on Earth's surface in terms of slow processes (e.g., erosion, weathering, mountain building and deposition) and rapid processes (e.g. volcanic eruptions, earthquakes and landslides).	

Add Standard	Science	Ohio
Grade		
Standard		
Benchmark		
Indicator		

Add Standard	Fine Arts	Ohio
Grade		
Subject		
Standard		
Benchmark		
Indicator		

Add Standard	**Technology**	
Grade	4	
Standard	Design Standard: Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.	
Benchmark	Describe and apply a design process to solve a problem.	
Indicator	1. Apply the design process to purposefully solve a problem (e.g. how to improve recycling at school and home)	

Add Standard	**Technology**	
Grade	4	
Standard	Design Standard: Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.	
Benchmark	Describe and apply a design process to solve a problem.	
Indicator	2. Recognize when changes to a solution are needed to meet the requirements.	

Add Standard	**Technology**	
Grade	4	
Standard	Design Standard: Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.	
Benchmark	Understand the role of troubleshooting in problem-solving.	
Indicator	1. Apply the process of experimentation to solve a technological problem (e.g., test which glue works best for a given material).	

Assessment Plan

What evidence will show that students have acquired the enduring understandings for this STEM unit?

Performance Task, Projects	Erosion-reduction designs Erosion Newspaper Project
Quizzes, Tests, Academic Prompts	Pre/Post Test Lab Sheet
Other Evidence (e.g. observations, work samples, student artifacts, etc.)	Science Notebook
Student Self- Assessment	Lab Sheet Small team discussions Review Discussion

Technology Integration

ADISC Technology Integration Model*

	Type of Integration	Application(s) in this STEM Unit
A	Technology tools and resources that support students and teachers in ***adjusting, adapting, or augmenting*** teaching and learning to meet the needs of individual learners or groups of learners.	www.internalrivers.org/dams -and-geology http://www.youtube.com/watch?v=5bqJo5ze3Bkwww.library. thinkquest.org
D	Technology tools and resources that support students and teachers in ***dealing effectively with data***, including data management, manipulation, and display.	Computer Publishing Software Printer
I	Technology tools and resources that support students and teachers in conducting ***inquiry***, including the effective use of Internet research methods.	Internet Rulers (cm) Metric capacity measurement
S	Technology tools and resources that support students and teachers in ***simulating*** real world phenomena including the modeling of physical, social, economic, and mathematical relationships.	
C	Technology tools and resources that support students and teachers in ***communicating and collaborating*** including the effective use of multimedia tools and online collaboration.	Computer Publishing Software
	**The ADISC Model was developed by James Rowley PhD, Executive Director of the Institute for Technology-Enhanced Learning at the University of Dayton*	

Career Connections

Career Description

Civil engineer: Civil engineers design things. These things might be roads, buildings, airports, tunnels, dams, bridges, or water supply and sewage systems. They must consider many factors in their designs, from the costs to making sure the structure will stay intact during bad weather. This is one of the oldest types of engineering. (http://www.bls.gov/k12/build05.htm).

Environmental engineer: Environmental engineers, or ecological engineers, study problems posed by a growing population such as intensifying land-use pressures, rapidly evolving technology, and increasing government regulations. The environmental engineer must develop technically sound solutions while maintaining or improving environmental quality. The engineer works on problems such as design and evaluation of erosion control systems. (http://www.bae.ncsu.edu/academic/environmental_work.php).

Geologists: Geologists study the materials and structure of the solid earth. They study the quantity, quality, and ability to recover natural resources. They study erosion patterns and try to predict future problems. (http://www.aipg.org/Education/pdf/Geology_Geologists_1h.pdf).

Hydrologists: Hydrologists apply scientific knowledge and mathematical principles to solve water-related problems in society: problems of quantity, quality and availability. They may be concerned with finding water supplies for cities or irrigated farms, or controlling river flooding or soil erosion. (http://ga.water.usgs.gov/edu/hydrology.html).

Soil and water conservationists: Soil and water conservationists plan and develop ways to control soil erosion, conserve soil and water, and study land use. (http://occupations.careers.org/19-1031.01/soil-and-water-conservationists).

Section II: STEM Lesson Plan

Title of Lesson	**Day 1- Introduction to Erosion**
Time Required	50 minutes
Materials	Pre-test (Appendix A)- one per student Pre-test Answer Key (Appendix B) Ten sheets of legal size paper or larger Science Notebook- one per student will be made in this lesson Guided Observation Sheet (Appendix D) - one per student
Objectives	Students will take pre-test (Appendix A). Students will watch the Lego Steve video of a stream table. Students will search for pictures of water erosion and record observations.
Instructional Process	1. Administer the Pre-Test (Appendix A). 2. Have students create Burrito Book to use as a science notebook for the unit. See directions (http://new.thesolutionsite.com/solutionsite/data/858/burrito.htm). Use at least ten pieces of paper for each book. Students should write the title of the unit and their name on the cover. 2. Watch the Lego Steve stream table video. While the students watch the video have them record both observations and questions in a T-chart in their science notebook. http://www.youtube.com/watch?v=5bqJo5ze3Bk 3. Following the video discuss student observations as a class. Record student questions on chart paper and hang in the classroom. Students could also write these questions in their science notebook. As the lesson progresses, revisit the questions and discuss the discovered answers. 4. After the class discussion have the students look online for example pictures of water erosion. Each student should print one example picture. Partner students and have them respond the the questions on Appendix D about their two pictures. Students should glue their picture and their observations in their science notebook.
Differentiation	1. Help students cut and assemble science notebooks as needed. 2. Have example pictures prepared for students if printing is not an option or if some students need assistance.

Assessments	Pre-Test (Appendix A) Written observations in science notebook

Section II: STEM Lesson Plan

Title of Lesson	**Day 2- Research and Introduce Newspaper Project**
Time Required	50 minutes
Materials	Erosion Research & Newspaper Assignment/Rubric (Appendix E)- one per student Computers with Publishing Software and an internet connection - one per student pair Science Notebooks for note taking during research (one per student) Butcher paper (Differentiation)
Objectives	Students will research and answer specific questions about soil/riverbank erosion.
Instructional Process	1. Hand out Erosion Research & Newspaper Assignment/Rubric (Appendix E) to every student. Review the required research questions at the top of the page. Explain to students that they need to answer the questions in their science notebook. They will use the information to write an erosion newspaper tomorrow. 2. Allow students to work in pairs (same or different pairs from Day 1) on computers to answer the assigned questions in their science notebooks. 3. Allow 10-15 minutes at the end of class for class discussion about the information they discovered. Revisit the chart paper of questions from Day 1. Have any questions been answered through their research? 4. Students missing necessary research may add it to their notes during the discussion. They can also write down where they can find the information and finish the research for homework.
Differentiation	1. Provide a list of specific websites where students can find the required information. 2. Provide students the guided research handout with websites included. Check websites and update handout if needed.
Assessments	Answers to research questions in science notebook.

Section II: STEM Lesson Plan

Title of Lesson	**Day 3 and 4 - Create a Newspaper**
Time Required	50 minutes
Materials	Erosion Research & Newspaper Assignment/Rubric (Appendix E) Computers with Publisher software and internet connection Science Notebooks
Objectives	Students will use their research to complete an erosion newspaper project.
Instructional Process	1. Review the Erosion Research and Newspaper Assignment handout (Appendix E) from Day 2. Review the project requirements with the students. Students will work with their research partner from Day 2 on the newspaper project. 2. Inform students that they have the option of a handwritten or computer published newspaper. 3. Review the rubric with the students and answer any questions about the assignment. Inform the students that the assignment must be completed by the end of class tomorrow. 4. Each student should write one of the two newspaper articles and complete one of the two required newspaper elements. Partnerships will combine their individual work into the final newspaper project. 5. Collect completed newspaper assignments at the end of Day 4.
Differentiation	Provide a pre-made computer template for students to use.
Assessments	Erosion Research & Newspaper Assignment/Rubric (Appendix E)

Section II: STEM Lesson Plan

Title of Lesson **Day 5 - River Model (Teacher Demonstration)**

Time Required 50 minutes

Materials

1 cup of water
2 kg aquarium gravel
2.5 kg fine sand
Aluminum 8"X10" pan/tray
2 liter bottle of water
Bucket or additional aluminum tray
Lab Sheet-Demonstration (Appendix H)
Medicine cups
River Tray Model Instructions (Appendix G)
Small ball of clay
Testing materials:
- Clay
- Craft sticks
- Foam pieces
- Large rocks
- Bottle caps
- Corks
- Index cards
- Tape
- Styrafoam peanuts
- Other teacher approved materials that are suggested by the students

Engineering Design Challenge (Appendix I) - one per student

Objectives

Teacher will demonstrate water erosion using a physical model.
Teacher will introduce Engineering Design Challenge to begin on Day 6.

Instructional Process

1. Prior to lesson, set up River Tray Model (Appendix G) for demonstration.
2. Review concept of erosion with students. Explain that you will be pouring water into the river to simulate water flow. They will observe erosion as the water flows through the riverbed. Students should write three observations from the demonstration in their science notebook while they observe. Before the demonstration ask students what they think will happen when the water is poured into the model.

3. Demonstrate erosion using the model. Using a full 2 liter bottle of water, steadily pour all contents at the rate of approximately 2 liters per 22 seconds. This can be accomplished by setting the opening of the bottle on the edge of the pan at the pour site and tipping the bottom of the bottle up at a 45 degree angle. When the demonstration is complete students should record the new measurements on Appendix H and glue this page in their science notebook.
4. When the demonstration is complete ask the questions, "What effect does the flow of the water have on the land? Where is the greatest amount of erosion taking place?" Have the students answer these questions in their science notebooks.
5. Discuss student observations. Ask the questions, "Did you see erosion? Where?" Help students conclude that the greatest amount of erosion is taking place at the bend.
6. Ask the question, "How can we reduce or eliminate erosion?" At this point put the students into design teams of three to four students. Hand out the Engineering Design Challenge (Appendix I).
7. Explain to students that they will be testing different materials to see if they are able to reduce or eliminate erosion on their own models. Show materials students will be testing: clay, craft sticks, foam pieces, large rocks, bottle caps, corks, index cards, tape, Styrafoam peanuts, or other materials teams suggest and the teacher approves. Discuss the best location for placing materials to be tested (at the bend).
8. Explain that teams will begin on the following day with a model just like the one they see now. Point out the way the model has been set up and designed. Explain that conducting tests in the real world require changing one variable at a time, thus the models must be created to be identical so as to conduct a valid test.
8. If time permits, work with students to start creating each team's first model for tomorrow's activity.

Differentiation

Have discussion questions posted in the classroom.

Assessments

Student answers to the discussion questions.

Section II: STEM Lesson Plan

Title of Lesson	**Day 6 and 7 - Engineering Design Challenge**
Time Required	50 minutes each day
Materials	Engineering Design Process (Appendix C) - one per student Engineering Design Challenge (Appendix I) - one per student Team Data Sheet (Appendix J) - one per student Erosion Project Rubric (Appendix L) - one per student 2 kg aquarium gravel 2.5 kg fine sand (one per team) 2 liter bottle of water (one per team) Bucket or additional aluminum tray (one per team) Large aluminum oven tray (29 cm X 45 cm) Rulers Testing Items (one choice per team): bottle caps clay corks craft sticks foam pieces index cards large rocks tape other materials suggested by teams and teacher approved Water
Objectives	Students will be able to characterize and describe the nature and magnitude of the erosion that occurs using the physical model. Students will take measurements of erosion caused by water flow and discuss possible solutions to reduce the erosion they detected.
Instructional Process	1. Distribute copies of the EDP (Appendix C) to students. Have students glue this in their science notebook. Explain the Engineering Design Process to students. Explain to students that they will be working in teams, utilizing the EDP, to see if they can engineer a design to eliminate or reduce erosion. 2. Review the Engineering Design Project steps (Appendix I). 3. If needed, set up stream tables for the first trial. Follow the directions for setting up the teacher model for setting up student models.

	4. Students should choose and test their first material. They will record their data in the data table. Students should follow the steps on Appendix I. 5. After the first trial is complete, students teams need to reset their stream tables and test their second material. They should repeat these steps until they have tested three different materials. It is important to remind the students that each time they reset their stream table the measurements needs to be the same. All data should be recorded in the data table. 6. Each team needs to turn in a copy of their data sheet. At the end of this day copy each team's data for every other team. The teams will use the shared data to build their final design on Day 8.
Differentiation	Have stream tables prepared and ready for students to use for second trials. This will help students with building the model and could help save time between trials.
Assessments	Team Data Sheet (Appendix J) Erosion Project Rubric (See Appendix L)

Section II: STEM Lesson Plan

Title of Lesson **Day 8 - Final Erosion Prevention Design**

Time Required 50 minutes

Materials

Engineering Design Challenge (See Appendix I) - one per student
Team Data Sheet (See Appendix J) - one per student
Erosion Project Rubric (See Appendix L) - one per student
2 kg aquarium gravel
2.5 kg fine sand (one per team)
2 liter bottle of water (one per team)
Bucket or additional aluminum tray (one per team)
Large aluminum oven tray (29 cm X 45 cm)
Rulers
Testing Items (one choice per team):
- bottle caps
- clay
- corks
- craft sticks
- foam pieces
- index cards
- large rocks
- tape
- other materials suggested by teams and teacher approved

Water

Objectives

Teams will use the data collected on days 6 and 7 to create their final erosion prevention design.

Instructional Process

1. Have students sit with their engineering teams. As a class, discuss what materials helped prevent erosion well and what materials were not as successful. Pass out the data sheets so each team has a copy of each team's data.
2. After the class discussion inform teams they will create one final design. They can use any of the materials they tested or that classmates tested in their final design.
3. Tell the teams that they will share their final design when all the designs are tested tomorrow and the designs will be evaluated using rubric (Appendix L).
4. When teams finish their final design they will need to individually write a paragraph explaining the materials they used and why they used those materials. Each student should write their own paragraph in their science notebook.

5. At the end of Day 8 students should turn in their science notebook.

Differentiation

Assessments

Final Design
Final Design Summary

Section II: STEM Lesson Plan

Title of Lesson	**Day 9 - Test Final Designs**
Time Required	50 minutes
Materials	Final Designs Post-Test (Appendix A) - one for each student Post-Test Answer Key (Appendix B)
Objectives	Teams will share their final designs and complete the lesson post-test.
Instructional Process	1. Have each team briefly share what materials they used for their final design and why they chose the materials before they performed the final test. 2. Administer Post-Test.
Differentiation	Testing accommodations as needed.
Assessments	Post-test (Appendix A)

Section III: Unit Resources

Materials and Resource Master List

Materials (one set per team):
2 kg aquarium gravel
2.5 kg fine sand
Aluminum 8”x10” pan/tray - 2
2 liter bottle
Bucket or small aluminum tray for water collection
Small ball of clay
Medicine cups
1 cup of water
Water

Teacher Demonstration:
2.2 kg aquarium gravel
2.5 kg fine sand
Aluminum 8”x10” pan/tray
2 liter bottle
Bucket or small aluminum tray
Small ball of clay
Medicine cups
Water (food coloring optional)

Other Materials Needed:
Computer Lab with Publisher Software and internet connection
Document Camera (if available)
Digital Camera
Hook video (YouTube)
Paper (at least legal size) -10 sheets per student
Rulers with metric units
Testing Items (one choice per team):
- bottle caps
- clay
- corks
- craft sticks
- foam pieces
- index cards
- large rocks
- tape
- other items suggested by teams and approved by teacher

Key Vocabulary

Baseline-A specific value or values that can serve as a comparison

Brainstorm-The activities performed by a team to gather information, stimulate creative thinking, and develop new ideas

Conversion-A change in units

Delta-A flat area at the mouth of some rivers where the mainstream splits into several tributaries

Design-An outline or plan used to build a machine or other system

Dune-A sand hill or ridge formed by the wind

Engineering-The art and science of the practical application of the pure sciences; using knowledge to solve real world problems

Erosion-The process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc.

Glaciation-To become frozen or covered with ice or glaciers

Glacier-A large mass of ice formed from snow falling and accumulating over the years and moving very slowly

Inference-The process of arriving at a conclusion by considering available information

Landform-A feature on the surface of the earth such as plains, plateaus, mountains, hills and valleys

Model-A representation of an object of a system used for testing and analysis. Models can be physical (either larger or smaller than the real system), or they can be computer models (virtual representations of real objects)

Moraine-A deposit of material left by the passage of a glacier

Observation-The act of noticing or perceiving; attentively watching

Sediment-The solid matter that settles in, or is deposited by, a liquid
Structure-The arrangement and interrelationship of parts in a construction

Transformation-A change or alteration of an object

Weathering-Mechanical and chemical processes that cause rock to decompose

Technical Brief

Erosion is a difficult problem that requires extensive efforts by a variety of STEM professionals such as geologists, environmental engineers, civil engineers, etc. It is important that students be aware that definition of, and solutions to, erosion problems will not always yield clean, definitive answers they could expect in other science and engineering fields. Also, solutions these scientists and engineers have found may not completely solve erosion problems, but help to reduce them.

Teachers should stress that erosion can be either a manmade or a natural process. Erosion has been occurring for millions of years naturally, but human land use can change natural erosion patterns. For example, a manufacturing facility that introduces water into a river would be increasing total water flow and would change the rates at which the river erodes.

Lastly, teachers may want to discuss (in terms students can understand) the ethical consequences of their designs. As stated earlier, erosion is a natural process; erosion control designs must consider the effects on the environment.

Safety and Disposal

The river models will contain aquarium gravel and sand. Students will be reminded to be cautious not to disturb the aluminum trays – it will be quite messy if the materials in them are spilled.

Students should be reminded to be careful when transporting supplies in the classroom, particularly water. Spills should be brought to the attention of the teacher and cleaned up immediately.

There are no hazardous materials used during this lesson. Students are encouraged to recycle those materials that can be reused.

It is encouraged to keep small vacuum nearby for sand spills.

References

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Section IV: Appendices

Printable Resources: What's All the Commotion About Erosion?

Appendix A: Pre-Test/Post-Test
Appendix B: Pre-Test/Post-Test Answer Key
Appendix C: Engineering Design Process
Appendix D: Guided Observation Sheet
Appendix E: Erosion Research and Newspaper Assignment/Rubric
Appendix F: Websites for Guided Research
Appendix G: River Tray Model Teacher Instructions
Appendix H: Lab Sheet - Demonstration
Appendix I: Engineering Design Challenge
Appendix J: Team Data Sheet
Appendix K: Final Results
Appendix L: Erosion Project Rubric