TWO RIVERS RAN THROUGH IT

A Design Challenge by Alie Victorine
Windmill Springs Elementary School, San Jose, CA

Description:
Farmers in Ancient Mesopotamia faced many challenges. As a result they developed new technologies to control the rivers that ran through their land. In this challenge students will discover the problems that early farmers faced while developing agriculture in "the land between two rivers" and design a working model that solves those unique challenges.

Grade Level: 6th

Educational Outcomes:
1. Students will identify the 3 major obstacles to farming along the Tigris or Euphrates River: drought during growing season, flood during harvest season damaging crops and homes, and transportation of water to the fields during times of low water.
2. Students will design and build a working model that attempts to solve all three of these problems. Models will include a working river system, model farm and town.
3. Students will gain an understanding of how humans modify their environment.
4. Students will show their understanding of the problems faced by ancient farmers by writing a short expository essay that describes the problems and proposes possible solutions.

Estimated Time: 3 class sessions (50 minutes)

California Science Standards Connections: Grade 6 Earth Science
2. Topography is reshaped by weathering of rock and soil and by the transportation and deposition of sediment.
2a Water running downhill is the dominant process in shaping the landscape.
2b Rivers and streams are dynamic systems that erode and transport sediment, change course, and flood their banks in natural and recurring patterns.
2d earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.
All Grades: Investigation and Experimentation: Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.

California History-Social Science Connections: Grade 6 Ancient Civilizations
6.1.c. The climatic changes and human modifications of the physical environment that give rise to the domestication of plants and animals.
6.2 Students analyze the geographic, political, economic, religious, and social structures of the early civilizations of Mesopotamia, Egypt and Kush.
6.2.a. Locate and describe the river systems and physical setting that supported permanent settlement and early civilizations.
6.2.b. Research the development of agricultural techniques that permitted the production of economic surplus and the emergence of cities as centers of culture and power.

Teacher Notes:
This Design Challenge was developed as the culmination project for a longer unit of study called, "Farmers in Ancient Mesopotamia". It has been presented as a 'stand-alone' Design Challenge to offer teachers the option of working it into their own unit of study.

Please download "Farmers in Ancient Mesopotamia" for a more complete student experience.

California Language Arts Connections: Grade 6 Reading and Writing
Reading Comprehension (Focus on Information Materials):
2.0 Students read and understand grade-level appropriate material. They describe and connect essential ideas, arguments, and perspectives of text, and they relate text structure, organization, and purpose.
2.3 connect and clarify main ideas, identifying their relationship to other sources and topics.
Writing Applications (Genres and Their Characteristics)
2.0 Students write narrative, expository, persuasive, and descriptive text.
2.2 Write expository compositions (e.g., description, explanation, comparison/contrast, and/or problem solution) that state the thesis or purpose, explain the situation, follow and organizational pattern appropriate to the type of composition, offer persuasive evidence for the validity of the description, proposed solutions.

MATERIALS AND SET-UP
Each group will need a container to build their river model in. The container will need san outlet for water to escape. Any elongated plastic or metal container that you can cut a hole in for the outlet will work. A single aluminum-roasting pan works fine, although splicing two together to create a longer streambed would create a better effect. Stream tables work very well, but they are expensive. Plastic tubs or dishpans also work and have the benefit of being more stable. Bussing trays available from restaurant supply stores also work very well. Groups do not need to have the same type of platform. This can be part of their decision of what materials to use. The longer the tray the better.

Other materials to have for the creation of their models:
- Sand, kitty litter, potting soil, pebbles, gravel, small rocks, wet diatomaceous earth
- Popsicle sticks, small pieces of scrap lumber, toothpicks
- Clay
- Plastic wrap (for lining stream beds)
- Cardboard
- Legos or building blocks
- String
- Water jugs, buckets and containers to collect the water.
- Plastic drop cloths for their work areas.
- Plastic tubing available from pet stores that sell aquariums will be needed for the water drainage, although shouldn't be allowed in the actual model.

Students are allowed to bring other materials from home, although the simplicity and availability of materials to Ancient Mesopotamians should be stressed.

Tools: scissors, glue guns, small saws, awls, vises, miter boxes

Set Up:
Students should be organized into groups of no more than 4
Materials and Organization:
- **Tool Table:** include a sawing area and a gluing area
- **Resource/ Supplies Table:** All materials should be set out on a table that is easily accessible. Special consideration should be given to the sand or kitty litter and how it will be distributed to each group. Pre-bagging it in gallon plastic bags greatly assists the distribution.

Student Work Area: Ideally students should work outside, where spills can be more easily cleaned up. When working inside use plastic drop cloths under work areas.

Teacher Notes:

Diatomaceous earth should be bought from a swimming pool supply, not a garden center (There are two different kinds of diatomaceous earth) Only adults should handle the dry earth and should always wear a dust mask. Students should only be exposed to moistened earth.

Language Arts Connection: During this challenge I read my students the beautifully written and illustrated trilogy of books by Ludmilla Zeman retelling the epic story of Gilgamesh.

Please note: A very powerful activity to do before this Design Challenge is a Stream Table Exploration. Please see the longer unit of study, called " Farmers in Ancient Mesopotamia" for a complete description of this activity.

A. INTRODUCTORY CHALLENGE

Students read the information provided on the geography and climate of the Fertile Crescent (See student handout). They identify and clarify new vocabulary, connect what they are reading to the river experience (if they did the stream table exploration) and identify the problems that ancient farmers faced. They are presented with the challenge and discuss constraints and materials. Working in teams students begin to brainstorm possible solutions to each of the problems that they discover in the reading.

Taking on the role of an ancient civil engineer, students compose an essay that identifies problems and proposes solutions. Included with this is a sketch or diagram of their proposed solution. These are delivered to the King of the City-State (teacher) for approval. (This can be individual or group work.)

B. TWO RIVERS RAN THROUGH IT

Scenario:

You are an ancient Mesopotamian farmer working with other farmers to develop agricultural lands in the southern lowlands. You must identify the problems and challenges that your community might face in developing this farmland along the mighty river (should this be rivers? Tigris? Euprhates?). You also must be able to explain your ideas of how to overcome these problems to your community so that work can proceed smoothly.

Challenge

Create a working model of the river, fields, and town that shows how you overcame all of the challenges identified in your proposal.

Constraints

- The model must feature the river, fields and town and solve all of the challenges.
- No research may be done on how the Mesopotamians (or any other civilization) conquered the problems. After all, they were developing these ideas for the first time - surely you can too*.
- True to this time period only simple machines may be used (the wheel has only recently been developed)l. You may research simple machines to give yourself ideas of how they could be used.
- Use of wood should be limited**. Wood is in scarce supply and is very expensive and must be imported from great distances. **
- Each group member must participate in the design, construction, and presentation of the models (participation will be evaluated with a rubric—see Handouts section).
- You will be allowed to test your model as you work***.

Design Challenge Testing and Demonstration:

Students must explain to the class the basic design features of their model and how they solved the challenges. Starting with the planting/drought season, students should demonstrate how they store and transport water to the fields. They can add small amounts of water to demonstrate this. Next, the Rain God/desks (teacher) bring forth the yearly flood. Hopefully the Gods will be kind.

Teacher note: Use your judgment of how much water to pour. While it would be fair to always add the same amount of water to each model – different materials and platforms will only be able to hold or withstand so much water. The flood will need to be a flood for that particular model. You can use anything that will give you a good steady flow, but that won't take a huge amount of time to add the water. A large water bottle or watering can with a long narrow spout would work best. You can discuss the polytheistic religious beliefs of early civilizations at this point. Remember the Gods can be cruel, but teachers should be kind.

Teacher Notes:

The three basic problems facing the farmers were drought during planting season, flood during harvest, and transportation of the water to the fields. As a result, farmers developed dams, dykes and floodwalls to protect from flooding. They developed systems of storage ponds, and irrigation techniques using canals and gates. In addition they developed simple machines to help transport water to the fields. While this seems obvious to us, I have found that students growing up in the city really struggle with these concepts. By allowing them a chance to develop these ideas on their own in a creative, dynamic way using the design challenge model, students develop a much clearer understanding of agricultural technology and how revolutionary it was.

It is imperative that students not be allowed to look at pictures of farming in Mesopotamia or do research of any kind. After they develop their models and solutions you can discuss how their solutions compared to those of the ancient Mesopotamians.

* Allowing research negates the design challenge process of using technology to solve a problem in as many varied ways as possible. Research turns this into a model building exercise, which, although useful, is not as exciting or stimulating as Design Challenge.

**You could give students a limited amount of precious materials (such as wood) but allow them the option of trading or bartering with other groups for materials.

***Students are allowed to test their designs and revise based on their results. They should be encouraged to test their designs with varying levels of flooding (not to just carefully pour or drip water in) The Rain God/dess can be cruel!

Reflection:
After the demonstrations and clean up, students and instructor should decide which designs were successful and in what ways. Students should be given time to reflect on how they would change their designs.

Teaching Points to Guide Reflection Questions:
Students should be able to discuss the challenge facing the Ancient Mesopotamian farmers and how their solutions attempted to solve those challenges. They should take into account how a river behaves based on their explorations with the stream table.

Facilitators' Questions

- What are the three major challenges you have to find solutions for?
- Explain how you are solving the challenges of flood, drought, and transportation).
- What will happen if the flood has more water than what you are testing?
- In the river exploration we did first, there was a lot of sediment carried to the bottom of the river. Do you think that will cause a problem in any way? (Should this question still be here?)
- What needs to be protected during a flood?
- How are you planning to transport water from the river to the field? What are some limitations of your plan?

C. EXPANSION OF DESIGN CHALLENGE CONCEPTS

Comparison of student models to Ancient Mesopotamian methods and modern farming methods

- Using available textbooks or trade books on Mesopotamia, students and teachers read and compare pictures of farming techniques with the student models.

Teaching Points for Activity or Demonstration

- Students create a Venn diagram comparing their model to pictures or texts of Mesopotamian farming techniques, as well as to modern farming techniques.
- Vocabulary development should include dykes, floodwalls, and irrigation,
- Concept development should include the idea that modern farmers still use many of these same ideas to help control and modify their environment.

Facilitators' Questions

- How does your model compare with the pictures of Mesopotamian farming techniques?
- How did ancient farmers solve the problem of flooding, drought, and transportation?
- What do you think of the ingenuity of the ancient Mesopotamians?

D. EVALUATION: See attached Evaluation Rubric

Please note: I would not necessarily show the rubric to students before hand, because I would not want to influence their design process. A successful design is one that attempts to solve a number of the challenges and all the group members know why they created the different features of their model.

E. HANDOUTS

Student Handout #1: The Tigris and Euphrates Rivers
Student Handout #2: Two Rivers Ran Through It
Evaluation Rubric

F. INSTRUCTOR RESOURCES

Banks, James et al. Ancient World: Adventures in Time and Place. McGraw-Hill School Division. New York; 2000. Chapter 5, Lesson 1.

Bayley, Rosalind. Mesopotamia. Librairie du Liban. Beirut, Lebanon; 1991

Hubbard Scientific: Stream Table Instruction Guide PO BOX 760 Chippewa Falls, WI 54729

"Mesopotamia". Kids Discover Magazine PO Box 54206 Boulder, Colorado 80323

Zeman, Ludmilla. Gilgamesh, Revenge of Ishtar andThe Last Quest of Gilgamesh. Tundra Books, 1993.

Gems Teacher Guides. River Cutters. Lawrence Hall of Science, 1999 revised. (510) 642-7771

http://www.lhs.berkeley.edu/gems

Brainpop: Simple Machines
http://www.brainpop.com/tech/**simple**machines/

Thinkquest: Simple Machines
http://library.thinkquest.org/J002079F/sub3.htm

Townsville Primary School: Simple Machines
http://www.smartown.com/sp2000/**machines**2000/

"InQuiry Almanack": Simple Machines
http://sln.fi.edu/qa97/spotlight3/spotlight3.html

Student handout # 1

The Tigris and Euphrates Rivers

The Tigris and Euphrates Rivers run through the region of land that became known as Mesopotamia. Mesopotamia actually means "land between two rivers" in Greek. The rivers begin in the Taurus Mountains in the north and flow down canyons to a vast rocky flatland or plateau. The rivers continue south across lowlands to the Persian Gulf. The rivers provide the southern lowlands with water and rich, fertile silt making them perfect for farming. Well, almost.

Due to the climate of the region the rivers receive little rainfall during most of the year. This means that farmers have to deal with drought conditions. The other part of the year the heavy rains produce huge floods that cause great damage to homes and crops, and loss of life.

To make matters worse, the drought condition happens in the early planting season when seedlings need extra water. The yearly floods occur during harvest time, when extra water can ruin the crops. Farmers have had to create new technologies to protect their fields from both drought and flood.

In ancient times, as farms produced surplus food, cities grew along the banks of the rivers. Larger farms were needed to provide food for the cities. Better methods of transporting water to the fields had to be developed.

Student handout # 2

Two Rivers Ran Through It

Scenario:

You are an ancient Mesopotamian farmer working with other farmers to develop agricultural lands in the southern lowlands. You must identify the problems and challenges that your community might face in developing this farmland along the one of the mighty rivers. You also must be able to explain your ideas of how to overcome these problems to your community so that work can proceed smoothly.

Pre Challenge:

Write a proposal that identifies the three major challenges and propose solutions. You may include drawings or diagrams in this written proposal.

The Challenge:

Create a working model of the river, fields, and town that shows how you can overcome all of the challenges identified in your proposal.

Constraints:

- The model must feature the river, fields and town and solve all of the challenges.
- No research may be done on how the Mesopotamians (or any other civilization) conquered the problems. After all, they were developing these ideas for the first time - surely you can too*.
- True to this time period only simple machines may be used (the wheel has only recently been developed). You may research simple machines to give yourself ideas of how they could be used.
- Use of wood should be limited**. Wood is in scarce supply and is very expensive and must be imported from great distances.
- Each group member must participate in the design, construction, and presentation of the models (participation will be evaluated with a rubric—see Handouts section).
- You will be allowed to test your model as you work.

Materials:

You will be provided one platform to build your working model. A variety of materials will be provided for you to build and create your model. Some materials such as wood will be limited, although you can trade with other groups. You may bring in materials from home, but they must be approved before you use them. You may use plastic to simulate clay or bricks, since we don't have time to make hand-made bricks.

Evaluation Rubric

Building A Structure: Two Rivers Ran Through It

Teacher name:

Student Name _____

CATEGORY	4	3	2	1
Construction - Care Taken	Creates a working river system that shows a river with head and mouth, city and farm. All placed in reasonable places.	Creates a working river system that shows a river with head and mouth, city and farm. May not be placed in reasonable places.	Creates a river but may not have an outlet. City and farm are included but may not be in reasonable places.	Creates a river with only a city or a farm not both.
Plan	Attempts to solve all three problems: drought, flood, and transportation of water to fields. Protects both city and field from flooding.	Attempts to solve at least two of the problems: drought, flood, and transportation of water to fields. Protects both city and field from flooding.	Attempts to solve at least one of the problems: drought, flood, and transportation of water to fields. Does not protect both city and field from flooding.	Plan does not attempt to solve any of the problems. No protection from flooding.
Function	Structure functions extraordinarily well, holding up under atypical stresses.	Structure functions well, holding up under typical stresses.	Structure functions pretty well, but deteriorates under typical stresses.	Fatal flaws in function with complete failure under typical stresses.
Modification/Testing	Clear evidence of troubleshooting, testing, and refinements.	Some evidence of troubleshooting, testing and refinements.	Little evidence of troubleshooting, testing and refinements.	No evidence of troubleshooting, testing or refinement.
Scientific Knowledge	Explanations by all group members indicate a clear and accurate understanding of problems faced by early farmers underlying the construction and modifications.	Explanations by all group members indicate a relatively accurate understanding of problems faced by early farmers underlying the construction and modifications.	Explanations by most group members indicate relatively accurate understanding of problems faced by early farmers underlying the construction and modifications.	Explanations by several members of the group do not illustrate much understanding of problems faced by early farmers underlying the construction and modifications.