FLOWING FROM HERE TO THERE

A Design Challenge by Alie Victorine
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Description:
Students explore simple machines to transport dry, but fluid, material from one container to another.

Grade Level: 6th

Educational Outcomes:
1. Students will gain an understanding of how humans modify their environment.
2. Students explore simple machines as they design and build contraptions to transport materials.

Estimated Time: 1 class session (50 minutes)

California Science Standards Connections:

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.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 mini Design Challenge was developed as the introductory activity 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.

MATERIALS AND SET-UP
Tub for the river
Cookie sheet for the field
Beanbag material, rice, and small light gravel.
(Anything that will flow like a liquid but be easy to clean up)

Provide a variety of materials that would lead to different ideas such as:
Cardboard or tag board
Plastic caps, margarine tubs, film canisters, plastic or paper bags cardboard tubing (toilet paper, paper towel, wrapping paper)
Wheel like objects
Cans
Dowels
Rubber bands, string, straws

Tool Table:
Saws, drills, tape, miter boxes, scissors, meter sticks,
Glue guns

Research Table:
Books /posters/web sites on simple machines. A handout on simple machines might be useful. Students are not allowed to research ancient civilizations and their solutions.

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 would greatly assist the distribution.
- **Student Work Area:** Ideally students should work outside where spills can be more easily cleaned up. Inside use plastic drop cloths under work areas.

Teacher Notes:

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

A. DESIGN CHALLENGE

Scenario:
Transportation of water from rivers to fields in an easy manner was a problem for early farmers. They certainly didn't want to carry it all by hand. Using only simple machines they created methods or devices to move water.

Challenge
Create a device that will move the most water (bean bag stuffing, or rice or some dry solid that flows) from the river to the field that is 1 meter away from the river to the field.

Constraints
- "Water" may not simply be carried or moved by hand.
- The device may be hand operated. It doesn't have to work by itself, although it could.
- The "water" must stay clean, so no hand or other human body parts may enter the river.
- You may not reposition the river once the teacher has placed it.
- You have 30 minutes to design, build, and redesign your device.
- You will be given only 3 minutes to move all of the "water" from river to field.
- Remember water is precious - be very careful of spilling.
- Since we don't want to flood our field, you may not test your device until the official test.

Design Challenge Testing and Demonstration:
Students will have three minutes to move "water" from the river to field. They will be timed. Fast is good, but moving it without spilling is better. Students must identify the simple machines that their device uses.

Teacher note: Have students present what they hope their design will do before actually trying it. After testing you can allow them a moment to think of ways they might have changed it.

Teaching Points to Guide Reflection Questions:
Students should be able to discuss their approach to solving the challenge and the simple machine(s) that they chose to incorporate.

Facilitators' Questions
- Are you concentrating on moving the material quickly or carefully?
- How are you going to prevent spills?
- What simple machines are you using? How are they helping?
- Did you do any research to inform your design? How did it help you?
- If you had more time what would you add, change, or do differently?

Reflection:
After the demonstrations and clean up, students and instructor should decide which designs were successful and in what ways. Discuss which simple machines seemed to work best or were most commonly used and why. Students should be given time to reflect on how they would change their designs.

C. EVALUATION: See attached Rubric

D. HANDOUTS
Student Handout: From Here to There
Evaluation Rubric

Teacher Notes:
Decide how you are going to place the river system. You might want to use gravity to your advantage by placing the river system on a block OR let students arrive at the solution that they can place their field in such a way to harness the force of gravity. This is one of the great advantages of design challenge- it allows students to think outside the box by playing with the rules.

E. RESOURCES

Web Sites:

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

Flowing From Here to There

Scenario:
Transportation of water from rivers to fields in an easy manner was a problem for early farmers. They certainly didn't want to carry it all by hand. Using only simple machines they created methods or devices to move water.

The Challenge:
Create a device that will move water (bean bag stuffing, or rice or some dry solid that flows) at least I meter away from the river to the field in as short a time as possible.

Constraints:
- Water may not simply be carried or moved by hand
- The device may be hand operated. It doesn't have to work by itself, although it could.
- The water must stay clean, so no hands or other human body parts may enter the river.
- You may not reposition the river once the teacher has put it in place.
- You have 30 minutes to complete your device.
- Remember water is precious - be very careful of spilling.
- Since we don't want to flood our field, you may not test your device until the official test.

Testing:
You will have 3 minutes to move your "water" from the river to field. You will be timed. Fast is good, but moving it without spilling is better. You will need to identify any and all simple machines that you use in your design.

Materials:
Tub for the river
Cookie sheet for the field
You will be provided with a variety of materials to create your device

Research:
Books /posters/web sites on simple machines. You are not allowed to research ancient civilizations and their solutions.

Web Sites to Research:

http://www.brainpop.com/tech/**simple**machines/
http://library.thinkquest.org/J002079F/sub3.htm
http://www.smartown.com/sp2000/**machines**2000/
http://sln.fi.edu/qa97/spotlight3/spotlight3.html

Evaluation Rubric

Building A Device: Flowing From Here to There

Teacher name:

Student Name _____

CATEGORY	4	3	2	1
Function	Device moves all material in under 3 minutes and with little spillage	Device moves majority of material within 3 minutes and with little spillage	Device moves some material within 3 minutes. Spillage may be a problem.	Device either does not move material or spills most of it.
Scientific Knowledge	All group members can identify simple machines in their design and articulate the mechanical advantage of their construction	All group members can identify simple machines in their design and the majority can articulate the mechanical advantage of their construction.	Majority of group members can identify simple machines in their design and some can articulate the mechanical advantage of their construction. Explanations by most group members indicate basic understanding of simple machines used in the construction.	A minority of group members can identify simple machines in their design and articulate the mechanical advantage of their construction. Explanations by several members of the group do not illustrate much understanding of simple machines used in the construction.
Construction -Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.