Water Wheel Challenge

Lesson Focus

Students explore potential and kinetic energy while working in a team to design and build an interactive water wheel that lifts the most weight.

Lesson Summary

Students will learn about the history of water wheels while exploring potential and kinetic energy. Working in a team they will design then build their own interactive water wheel.

Grade Level

Middle School

Objectives

- Explore the conversion of potential to kinetic energy.
- Design and build an interactive water wheel that will lift weight.
- Students will follow the engineering design process to solve the design challenge.

Design Challenge

Design and build a small water wheel that provides enough energy to lift the most weight.

Lesson Activities

Students will begin lesson by reading about the history of water wheels. Next, students will work in teams to brainstorm, design, and build a water wheel that will lift the most weight. Students will examine the science behind the water wheel, making improvements in efficiency.

Materials (For water wheel construction)

Paper Plates
3"x5" Index Cards
One 12" Wooden Dowel
5 ounce Dixie Cups
Masking Tape
String
Paper Clips
Drinking Straws
Plastic Spoons
Scissors
Metal Washers

Materials (For testing water wheels)

- White Rice (Used in place of water
- Tarp (spread under testing area)
- Plastic Wash Basins (placed under wheel in testing area to catch rice)
- Scale (to measure weight)

Next Generation Science Standards
Engineering Design Middle School

ETS1-1 Define the crote5roa and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Lesson Variations

- Attach a cost to each of the materials. Students must purchase their items (Math)
- Have students design the most inexpensive water wheel that lifts the most weight. (Math)
- Have students design a water wheel for under a set amount (e.g., <$40) that lifts the most weight (Math).
- Give all teams the same materials; allow students to buy or trade/barter materials from/with other teams (Social Studies/Math).
- Give some teams bags with missing materials, other teams receive bags with extra materials. Teams must trade or purchase materials from other teams in order to build a water wheel (Social Studies/Math)

Plastic Spoons
Scissors
Metal Washers

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The Engineering Design Process Worksheet

Directions: Use this worksheet to ensure you complete every step in the Design Process. Use the spaces provided to show your work. If you need more room, you may attach additional pieces of paper. You must have the check and sign each completed step before you begin the next one.

Name_____**Class**_____**Date**_____

Step	Write your responses in these blocks.
1. ASK What is the problem?	
1. ASK What are the requirements?	
1. ASK What are the constraints?	

Teacher Approval	

Step	
2. IMAGINE Brainstorm ideas.	Write a short description of each of the ideas you came up with in this box.
2. IMAGINE Choose the best one.	Select the two best designs from your ideas above. Write each one in the appropriate space and then fill in the chart.

Option 1-	
List the things that are good about this design.	List the things that are not so good about this design.

<table>
<tr><td>2. IMAGINE
Choose the best one.</td><td>
<table>
<tr><td colspan="2">Option 2-</td></tr>
<tr><td>List the things that are good about this design.</td><td>List the things that are not so good about this design.</td></tr>
</table>
***Additional Charts are available if you have more than 2 options to choose between.
</td></tr>
<tr><td>2. IMAGINE
Choose the best one.</td><td>Based on the information you have provided in the charts, decide which option is most likely to be successful. Which one did you choose? What factor was the most important in helping you decide?</td></tr>
</table>

Teacher Approval	

3. PLAN Draw your design.	Draw a neat and detailed sketch of your design. (You can attach a separate sheet if needed.)
3. PLAN Gather necessary materials.	List the materials and supplies you will need for your design. I will give you your materials when you show me this step is completed.

Teacher Approval	

4. CREATE Follow your plan.	In this box, write any problems you have and any changes you made to your design and why.
4. CREATE Test it out.	How did it work?

Teacher Approval	

5. IMPROVE Does is meet requirements?	Compare your design to the requirements you listed in Step 1. Does it meet all of the requirements? If not, what didn't it meet and why not?
5. IMPROVE Does it meet constraints?	Compare your design to the constraints you listed in Step 2. Does it meet all of the constraints? If not, what didn't it meet and why not?
5. IMPROVE Start again to improve your design.	What changes can you make to improve your design?

Teacher Approval	

Step 2- Choose the Best Option

Additional Comparison Charts

Option -	
List the things that are good about this design.	List the things that are not so good about this design.

Option -	
List the things that are good about this design.	List the things that are not so good about this design.

Option -	
List the things that are good about this design.	List the things that are not so good about this design.

Option -	
List the things that are good about this design.	List the things that are not so good about this design.