STEAM Subject: Engineering
Lab: Waterwheel

Grades: 5th-8th

Learning objective: Students will build a model of a *waterwheel* to explore the use of renewable energy sources.

ENGAGE:
Ask students the following questions**:**

- What are some natural sources of energy? *Sun, wind, water*
- How can we get energy from water?
- Have you ever heard of renewable energy?
- What engineers can build to help our communities capture energy from water?

EXPLORE:

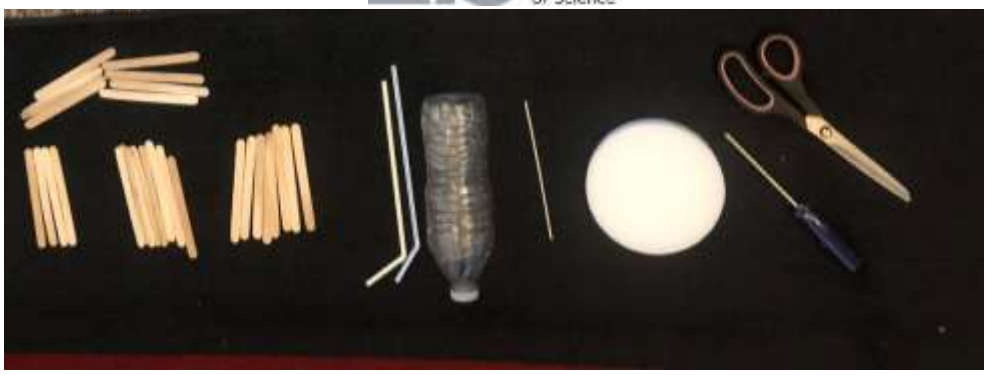
Building a Waterwheel Activity
Students will build their own homemade water wheel (image from Wiki).

Materials needed per student:

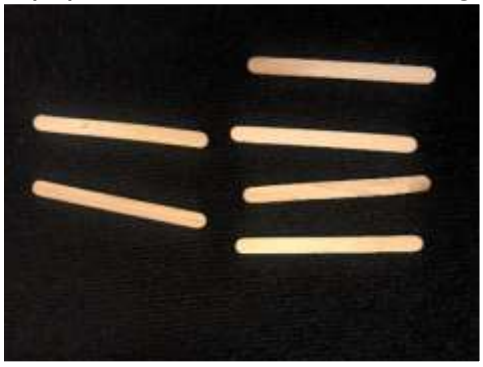
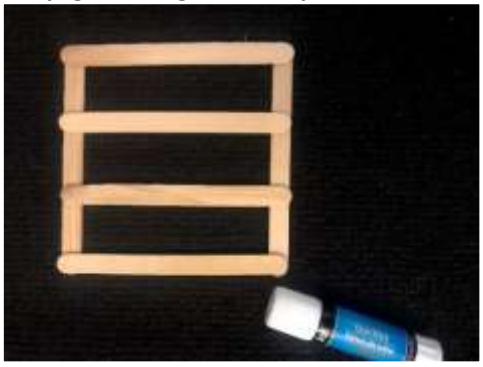
- 40 popsicle sticks
- Glue (super glue preferred)
- Gloves
- Styrofoam disk (no smaller than 1 ½ inches across)
- Plastic water bottle
- 2 straws (bendable at the top)
- Container (no smaller than 6 inches wide x 6 inches long)
- 1 standard screwdriver (adult supervision required)
- Scissors (adult supervision required)
- Skewer or wooden dowel (no more than 1/4 inches in diameter)
- Measuring tape

Directions:

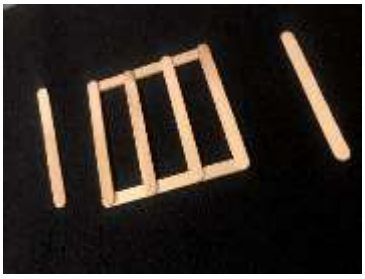
1. Lay out necessary materials. See example below.



2. Set aside 6 popsicle sticks (left image below)
3. Arrange popsicle sticks as shown with glue (right image below)

4. Repeat steps 2 and 3. Total number of these should be two (2).
5. Grab two additional popsicle sticks. Arrange popsicle sticks (as shown on the right) with glue along the edges.

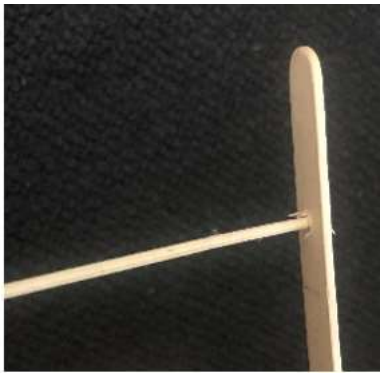



6. <u>Base of Waterwheel Device</u>
Grab four additional popsicle sticks and arrange vertically and glue at the base of the vertical sticks.


7. Add two additional popsicle sticks on both sides of base of waterwheel as shown below and glue in place.

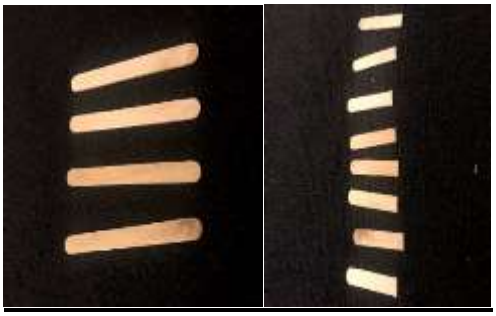
8. Waterwheel Axle Support Part A. Grab two more popsicle sticks. Mark on each popsicle stick with pencil or pen 1 inch from edge of sticks. Create a small hole to fit a skewer or wooden rod (no larger than 1/4 inches thickness) through it.



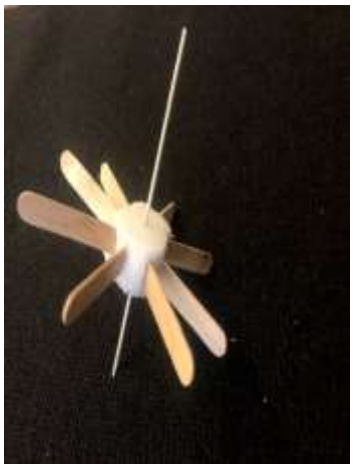


9. Waterwheel Axle Support Part B. Add additional popsicle supports to hold up water wheel in the next steps.

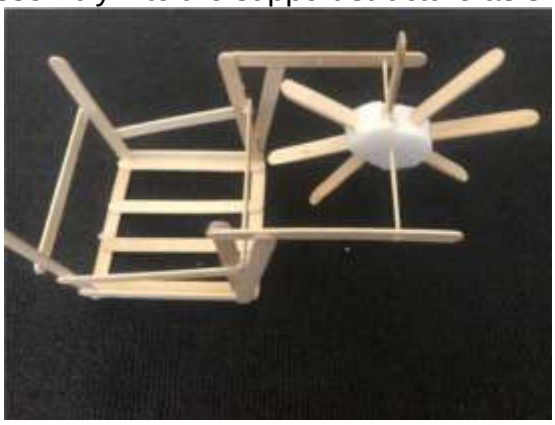
10. Water Wheel Assembly. Grab 4 popsicle sticks and cut each stick in half for a total of eight (8) pieces.



11. Grab a Styrofoam disc (no smaller than 1 ½ inches across) or cut out a circular shape out of Styrofoam no smaller than 1 ½ inches across. Insert the 8 popsicle sticks gently into the Styrofoam in a circular pattern. Last place the wooden rod or skewer through center of Styrofoam.

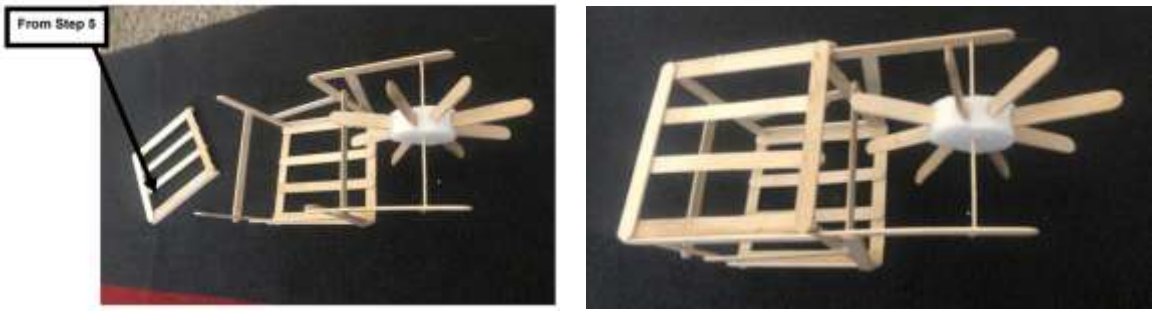


12. Insert water wheel assembly into the support structure as shown below.



13. Support for Water Storage

Grab the last remaining piece from step 5 and add to top of structure to support water storage in the next steps.



14. Water Storage and Pipe. Grab an empty plastic water bottle and mark a point approximately 2 inches above the bottom of the bottle. This will be used to insert a small straw to let water out and onto the water wheel.

Marked point for pipe (2 inches above bottom of bottle)

15. Grab a bendable straw and cut a small piece before the bend (between 1 and 2 inches from end of straw). The small piece will be used as the pipe for water to flow out of plastic bottle.

16. Cut out small hole marked (from Step 14) and insert the small piece of straw (from Step 15) through the hole.

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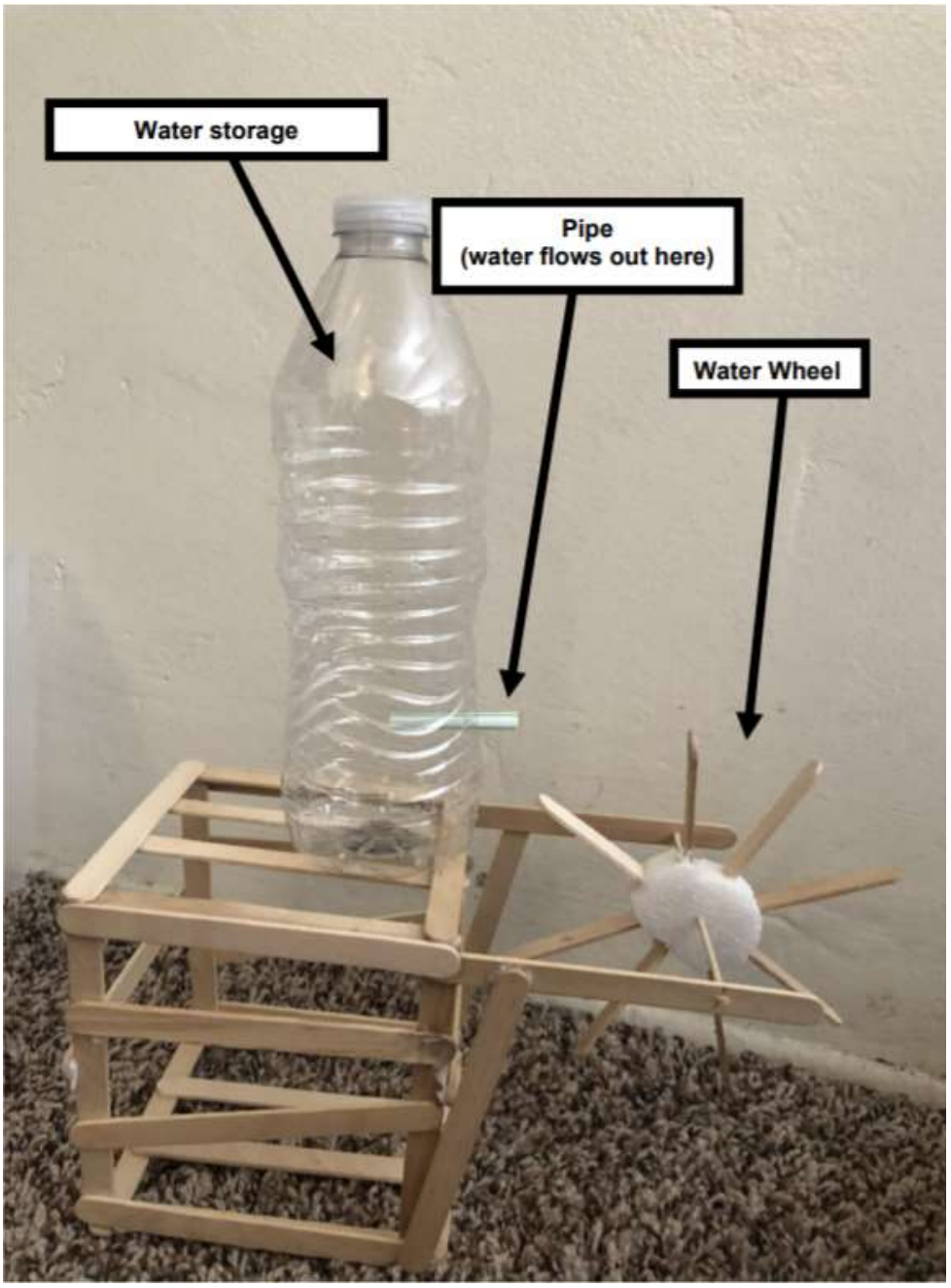

17. Testing your design. Grab a small container (no smaller than 6 inches wide x 6 inches long) and the water storage bottle, and fill up storage bottle at least halfway.
18. Pinch open end of straw pipe to stop flow of water.

19. Position the water storage bottle on top of the structure with straw pipe directly over water wheel. Allow water to be released from the straw pipe. Allow water to collect in container below and re-use for further testing.

EXPLAIN:
Students will observe how the wheel turns when water flows out of the bottle.
Have students determine if the change in height of the water dropping onto the wheel causes any change to the speed of the wheel turning. How can we improve our design?

Review STEAM Vocabulary

- What is renewable energy? *Usable energy from replenishable (natural) sources.*
- What is a water wheel? *A machine for converting the energy of flowing or falling water into useful forms of power.*
- What is hydropower? *The use of flowing water to power machinery or to generate electricity.*

Students can examine the pros and cons of hydroelectric power using the following resources

- What is the relationship between hydropower and climate change?
- What are the environmental issues related to dams?
- How is hydropower a clean energy source?

- USGS Hydroelectric Power How it Works: https://www.usgs.gov/special-topic/water-science-school/science/hydroelectric-power-how-it-works?qt-science_center_objects=0#qt-science_center_objects
- https://www.nationalgeographic.org/encyclopedia/hydroelectric-energy/
- "The Role of Hydropower in Climate Change Mitigation and Adaptation" https://www.sciencedirect.com/science/article/pii/S209580991631164X
- Scientific American magazine "The Downside of Dams: Is the Environmental Price of Hydroelectric Power Too High?": https://www.scientificamerican.com/article/how-do-dams-hurt-rivers/
- "How a hydroelectric project can affect a river": https://fwee.org/environment/how-a-hydroelectric-project-can-affect-a-river/pulling-the-pieces-together/

EVALUATE:

Have students discuss uses of hydro(water) power.
How we can best use hydro(power). Examples? Think about dams. Dams can be used to generate electricity from flowing water. What are the benefits and environmental impacts? What would you do to improve their design?
Have students discuss the importance of water in our everyday lives.
What are the advantages of using renewable energy sources?