

5E Water Wheel

Christopher English, Wooster High School
Grade Level – High School

Purpose: To build a hydroelectric electricity generating device in order to give students experience engineering a renewable source of energy.

Materials: Magnets, material for the waterwheel blades (wood, metal, 30 gauge magnet wire, source of running water, led bulbs, other light bulbs, some material for the center of the water (cork?))

Standards:

All Americans will:

- Ask questions and make observations to help figure out how things work.
- Troubleshoot as a way of finding out why something does not work so that it can be fixed.
- Apply a structured approach to solving problems including: defining a problem, brainstorming, researching and generating ideas, identifying criteria and constraints, exploring possibilities, making a model or prototype, evaluating the design using specifications, and communicating results.

Nevada State Science Standards:

P.5.C.5 Students know the organization of a simple electrical circuit (i.e., battery or generator, wire, a complete loop through which the electrical current can pass).

P.8.C.6 Students know electrical circuits provide a means of transferring electrical energy to produce heat, light, sound, and chemical changes.

P.12.C.6 Students know electricity is transferred from generating sources for consumption and practical uses.

P.8.B.2 Students know electric currents can produce magnetic forces and magnets can cause electric currents.

Engagement:

Hoover dam construction video clips, Niagara falls video clips, Science 360
Hydroelectric clips

Exploration:

Procedure:

1. In a group of 2 -3 use what you know about how electricity can be generated through induction to come up with a viable design for a



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National Science Foundation
under grant number EPS-
0814372



- waterwheel that can generate enough electricity to light a light bulb.
2. Draw a labeled diagram explaining your groups' design using pencil/paper, Google sketch up, or any other suitable computer software.
 3. Construct the waterwheel.
 - a. Craft your blades
 - b. Attach blades to center of waterwheel
 - c. Attach center of waterwheel to generator (crankshaft)
 - d. Attach copper wires to your light bulb
 4. Construct a generator that can convert the motion of your waterwheel into electricity.
 5. Test the waterwheel with led bulb in the circuit.
 6. Troubleshoot the waterwheel.
 7. Measure the electricity production over a period of 5-10 minutes.
 8. Measure current produced, velocity of water, pressure of your water, area of blades.
 9. Calculate the power output of your waterwheel.

Explanation:

1. How is your waterwheel able to generate electricity?
2. How is motion able to produce electricity?
3. What is going on inside the generator?
4. How is light produced inside the LED?

Extension:

1. How could we create more electricity with a waterwheel?
2. How much electricity could we potentially produce?
3. What might limit our ability to produce electricity with water?
4. Determine the amount of electricity produced by a coal-fired power plant.
5. Calculate electricity production of a waterwheel given a certain flow-rate of water, and a certain size of generator. Compare this to the energy production of a coal-fired powerplant.
6. Analyze the cost/return on the building of a hydroelectric powerplant. Write an argument, backed up by mathematical calculations to convince a legislator that a hydroelectric powerplant would be great benefit to your area when it comes to energy production. Compare the power produced in your plant to a coal-fired powerplant.

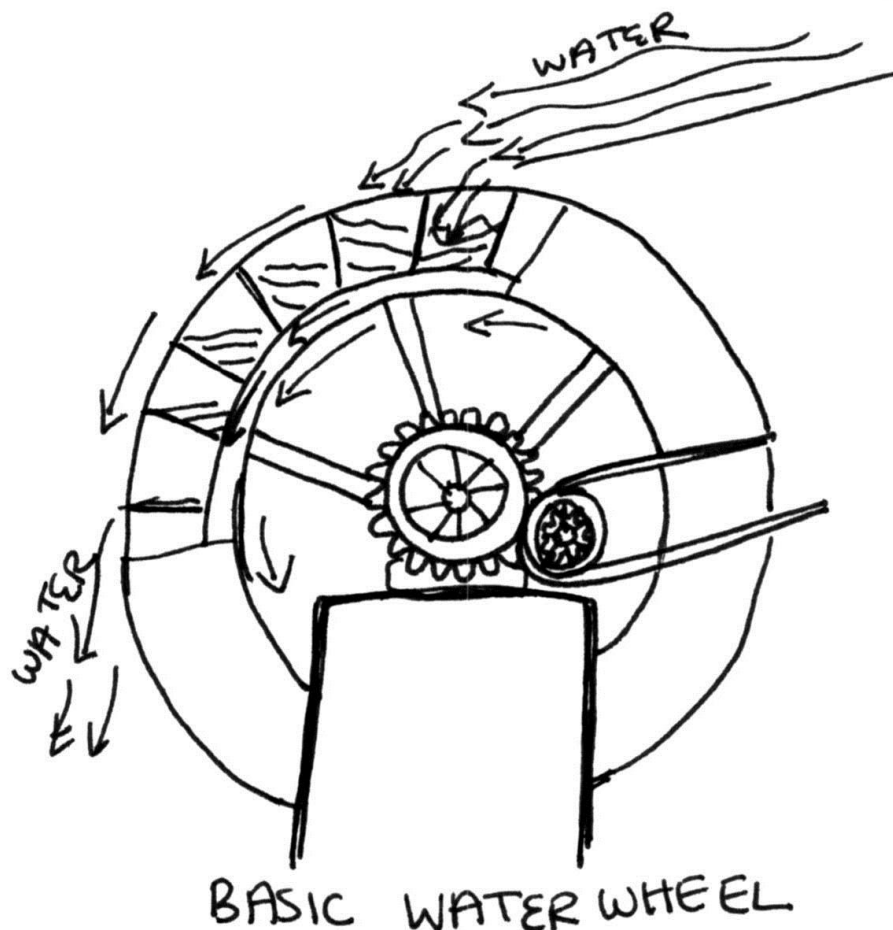


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Evaluation:

1. Discuss and compare power output results.
2. Discuss designs that would produce more electricity.
3. Grade hydroelectric powerplant analysis by rubric.
4. Practice problems involving electricity, power output/consumption, % of total energy produced by renewable sources.
5. 1 paragraph describing how a hydroelectric waterwheel can produce electricity to someone who knows nothing about the topic; Deliver to a family member or friend. Have them read it and ask you questions if confused. Teach them how hydroelectric power plants produce electricity.

Appendix: Water Wheel diagram

Inquiries and comments regarding this lesson can be directed to Chris English, Wooster High School, 1331 E Plumb Lane, Reno, NV 89502, 775-331-5100, or by e-mail: Christopher English <CEnglish@washoeschools.net>



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