NOTES

6. How does your model compare with what you know of large-scale hydroelectric generators?

   The model does not actually produce electricity. There is no generator to convert the mechanical energy into electrical energy. However, the model does demonstrate that the power of falling water can be harnessed. Large-scale hydroelectric generators such as those at commercial dams take advantage of the weight of huge quantities of water to drive the power output of spinning turbines. The model is more like a small-scale hydroelectric generator powered by a stream or river.

7. What are the advantages and disadvantages of using water power?

   Water power is a renewable energy source, because nothing is consumed during the production of electricity from the movement of water. However, dams, associated with hydroelectric power, can affect the migration of fishes that swim upstream, such as salmon. In addition, dams can alter the chemistry of lakes and rivers and contribute to silting of water beds. Diverting waterways alters the landscape and causes changes to plant and animal habitats.

Differentiated Instruction

- Allow students to present their design activity findings by means that best fit their learning style. See the Presentations section for creative ideas.
- Provide instructions for how to use the funnel attached to the tubing and pipet to make a concentrated stream of water. See the image in the Procedure section for the Day 1 Design Activity.
- Demonstrate how to fix a straw to the tank to serve as an axle. Students can then investigate the best blade design without spending too much time on other aspects of the model.

Extension Activities

Science Extension

1. Have students use the hand generator to power other electronic devices, like a buzzer or a miniature fan.

Technology Extension

2. Have students make video recordings of their trials and analyze the footage for any flaws in their design.

Engineering Extensions

3. Have students design a water wheel with whatever materials they can find. This will probably lead to materials and constructs that are more elaborate.
4. Have students test their design with a constant stream of water using tubing and a fish tank pump in a bucket of water. This scenario more closely resembles the flow from a river or stream.

Math Extension

5. Have students hook the hand generator to a multimeter, and then graph the relationship between spins per minute and volts produced.

Grading Rubric

Below is a rubric for assessing students' projects. You may wish to adjust how each topic is weighted depending on the focus of the activity, your objectives, and students' needs.

Topic	4. Exemplary	3. Proficient	2. Fair	1. Needs Improvement
Idea Generation	Group develops creative ideas that pertain to the objectives.	Group develops adequate ideas that pertain to the objectives.	Group develops ideas that partially pertain to the objectives.	Group does not develop ideas that pertain to the objectives.
Design	Group presents clear, complete descriptions and/or schematics of the model sufficient for replication.	Group presents clear, complete descriptions and/or schematics of the model.	Group presents complete but unclear descriptions and/or schematics of the model.	Group presents incomplete descriptions and/or schematics of the model.
Data Collection and Analysis	Group collects a complete data set and accurately completes the necessary calculations and graphs.	Group collects a data set and attempts to complete the necessary calculations and graphs.	Group collects an incomplete data set or presents flawed calculations and graphs.	Group collects an incomplete data set and does not complete the necessary calculations and graphs.
Implementation	Group demonstrates a working model that exceeds the objectives.	Group demonstrates a working model that meets the objectives.	Group demonstrates a working model that partially meets the objectives.	Group demonstrates a model that does not meet the objectives.
Results and Reflection	Group presents clear and accurate results and creative ideas for improvement.	Group presents clear results and ideas for improvement.	Group presents clear results but no ideas for improvement.	Group presents unclear or incomplete results and no ideas for improvement.