

4. Have student connect a second bulb to the hand generator.
 - a. Loosen the connecting nuts on the binding post.
 - b. Slip the spade connectors into place and retighten the nuts.
 - c. Screw the loose bulb into the bulb holder.
5. Have students experiment with various combinations of connections with the goal of illuminating the second bulb.
6. Unscrew the bulb on the hand generator. Students should observe that the light from the external bulb brightens.
7. Have students answer Question 1 and Question 2.

Design Activity

1. Organize students into eight groups of four. If your class size differs, adjust the size of the eight groups accordingly.
2. Explain the objectives of the activity and the materials that are available to students. Point out the location of the string and any other shared materials (e.g., glue, staplers).
 - a. All groups should have access to the same supplies. If students are unfamiliar with any materials, introduce the new items.
 - b. Explain that students are to build a device that uses the energy of falling water to turn an axle. To avoid safety issues associated with experimentation using water and electricity, the work done by the water is quantified in this exercise by the lifting of a paperclip instead of generating electricity.
 - c. Students should observe similarities between the turning of the axle and the turning of the hand generator.
3. Assist students as they brainstorm possible designs.
4. If necessary, guide students' design proposals by providing them with one or more of the following prompts:
 - Will the height that the water falls from change the speed of the water wheel?
 - Will the concentration of the water stream change the speed of the water wheel?
 - Will the weight of the water wheel affect its speed as the water collides with it?
5. During this planning stage, encourage students to manipulate their materials without making any permanent changes.
6. Instruct students to complete and turn in their design plan.

Teacher Hints

- Water wheels constructed from a foam cup may work well. In one possible prototype, the hub is made from the bottom of the cup and the

Notebooking Tips

- Have students record their thoughts during the Brainstorming portion of the activity on a discrete page in their notebooks. Information developed using the Design Guide, along with descriptions and finalized drawings, should appear on the page that follows the design brainstorm page.
- Have students dedicate one or two pages of their notebook to preparing their proposal based on the questions in the Design Guide. Before they proceed, have them submit these pages for your approval. Review each design and offer assistance as appropriate.