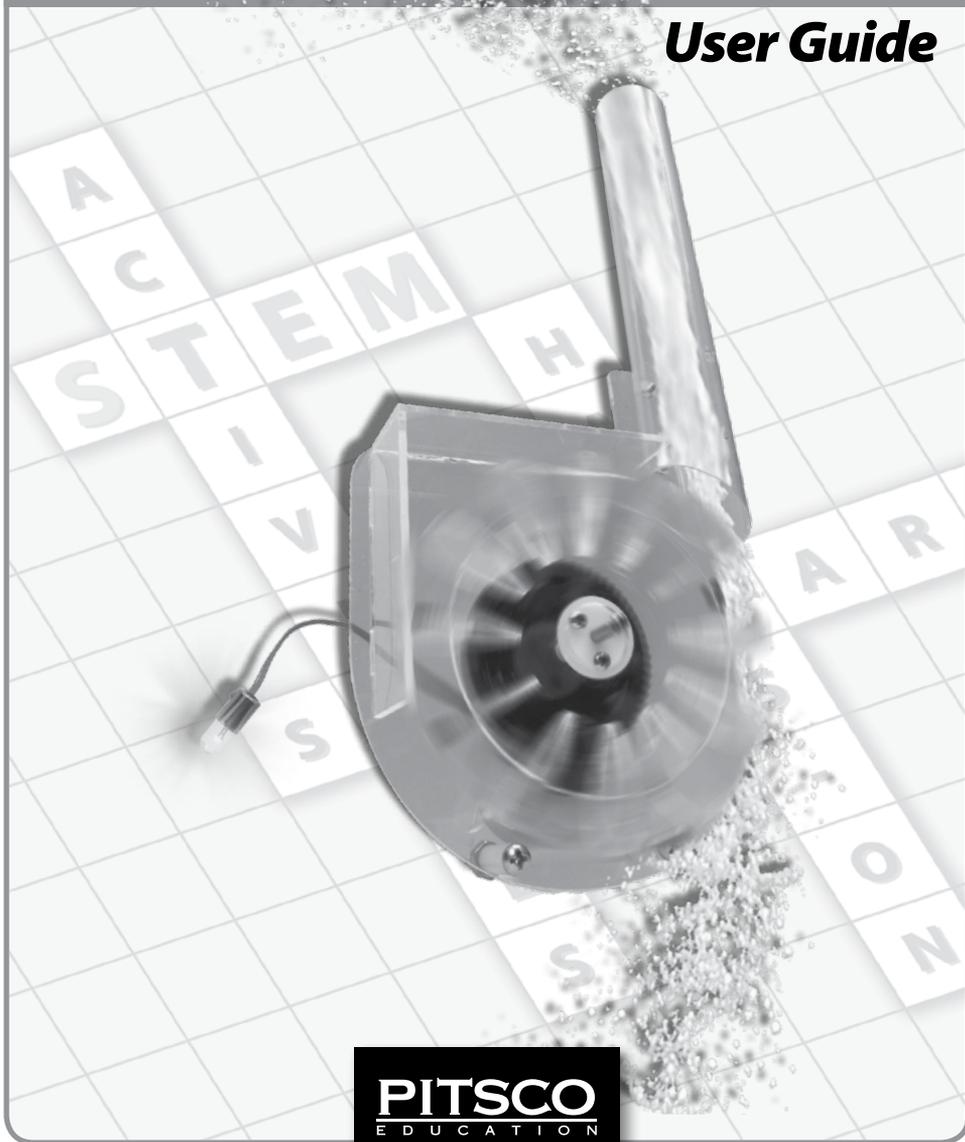


H₂O Turbine Kit

User Guide



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59873 V0311

Materials Included

- 17 acrylic parts, laser cut
- 10-tooth gear (pinion gear)
- Clear tube
- 2 large O-rings
- 2 small O-rings
- 1-1/4" stainless steel axle
- 2 – 1/2" nylon spacers
- 2 – 1/16" nylon spacers with 1/4" outside diameter (the width of the spacer)
- 1/16" nylon spacer with 5/16" outside diameter
- 4 axle hubs with nylon bushings and screws (not all will be used)
- Motor with presoldered wires and bulb
- 60-tooth gear (drive gear)
- 2 – 1/4" screws
- 2 – 7/8" screws
- 2 nuts
- 2 flat head screws

Items Required (not included)

- Small Phillips screwdriver
- Medium Phillips screwdriver
- Small flat head screwdriver
- Transparent tape
- Flowing water source (an outdoor hose is good; an indoor faucet with a strong water flow might work)
- Ruler
- Large straight pin

Brief History of Hydropower

Hydropower has been used for more than 2,000 years – both the ancient Chinese and Romans utilized waterwheels to convert the motion of water into mechanical energy. The Chinese used the horizontal waterwheel, which has blades that are spun horizontally by a jet of water.

The Romans used a vertical waterwheel – like the one pictured on page 3 – which is a more powerful design. There are two kinds of vertical waterwheels. The first is undershot, which means the wheel is set in the moving water and the water pushes the blades. Overshot waterwheels are designed so that water falls down on the wheel (usually from a trough or channel constructed to guide the water to the wheel). The gravity pulling the water down creates more power to push the blades.

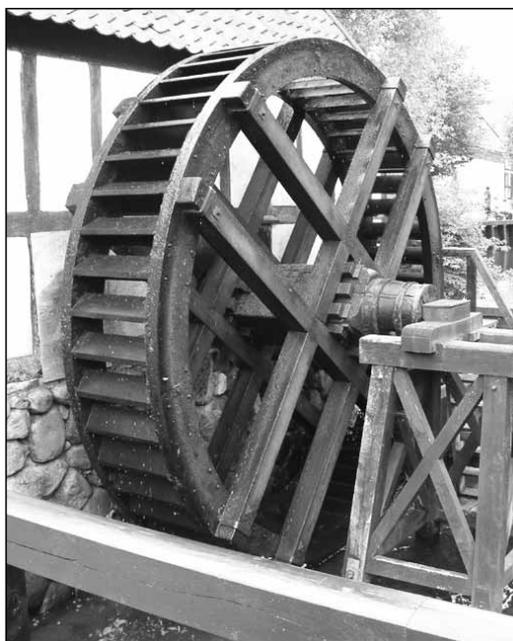
These were used for operating the billows of iron casting operations and for grinding grain. Large-scale operations were built as early as the fourth century A.D., when the Romans built a flour mill with 16 waterwheels in southern France.

During the Middle Ages, the use of waterwheels increased. They were used for sawing wood, milling, olive crushing, pumping water from mines, rice husking, papermaking, and more.

In the late nineteenth century, hydropower could be converted into hydroelectric power. In 1882, paper manufacturer H.F. Rogers built the first hydroelectric plant in Appleton, Wisconsin. In a hydroelectric plant (often created with a dam), water is directed down a sluice into a turbine. The water turns the turbine, which causes electromagnets to spin in the generator. This is what creates the electric power.

A few years later when Nikola Tesla patented his alternating-current (AC) motor, this technology made it possible to move very large amounts of energy. George Westinghouse used this to tap into the energy of Niagara Falls. Today, about seven percent of the United States' power comes from hydroelectric plants.

The H₂O Turbine is a small version of the overshot vertical waterwheel.



A vertical waterwheel

Photo courtesy of MorgueFile.com

Sources:

(as of January 2010)

"Waterwheels" by Roger D. Hansen
at www.waterhistory.org/histories/waterwheels/

"Water Science for Schools" from the U.S. Geological Survey at <http://ga.water.usgs.gov/edu/wuhy.html>

"The Facts about Water Energy" by World of Energy at http://www.worldofenergy.com.au/factsheet_water/07_fact_water_rivers.html

Building the Turbine

1. Peel off the paper backing the acrylic parts. There will be 12 small, identical pieces that will be the turbine blades. There will be five other pieces of varying shape etched with the labels A-E.
2. Take Part B and push the post of the motor through the middle hole of the part. This hole is oblong – make sure that the motor post is at the bottom of the hole when the narrow end of Part B is pointing up (Figure 1a). Find the two flat head screws and place a 1/16" nylon spacer with 1/4" outside diameter over each one. Fasten the motor in place with the screws (Figure 1b).
3. Press the pinion gear onto the end of the motor post, making sure the post end is flush at the other side of the gear (Figure 2).
4. At the top of Part B, push a nylon axle bushing into the small hole. Do this so the flat side of the bushing is on the same side as the pinion gear (Figure 3 on the next page). Set aside the motor assembly.

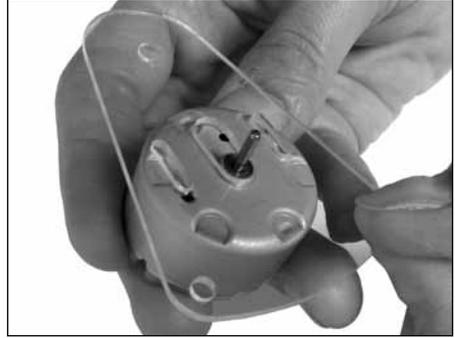


Figure 1a

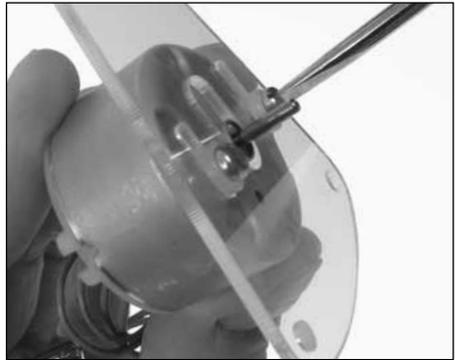


Figure 1b

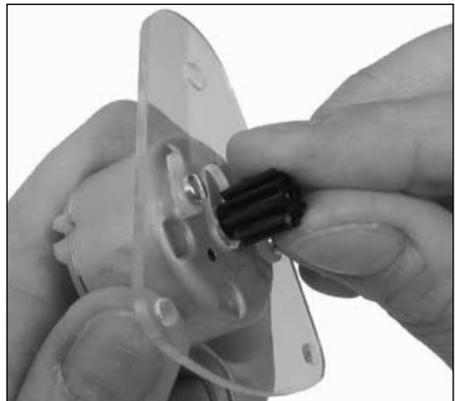


Figure 2

5. Find Part E and hold it facing you so the etched arrow on the part is pointing clockwise. From the other side of Part E, line up the flat side of the axle hub to the hole in the center. The hub will overlap the part with an inside ridge holding it in place.

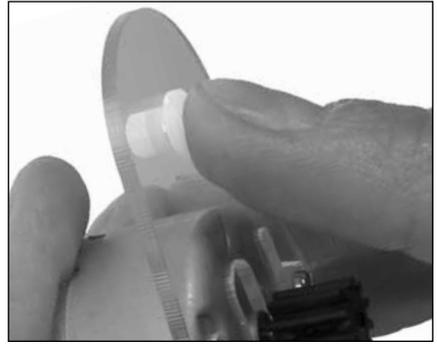


Figure 3

6. Holding these together, start all three screws (that come with the hub) in the holes at the hub's edge. With a small Phillips screwdriver, fasten all three screws completely down (Figure 4).

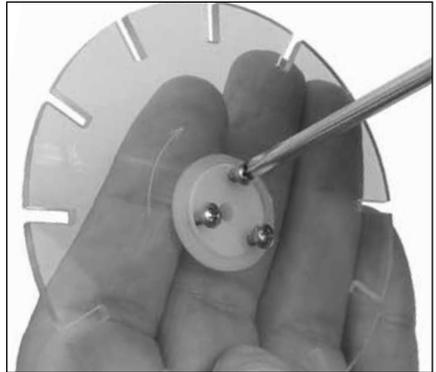


Figure 4

7. Find the 12 blades and two large O-rings. Insert the blades into the notches of Part E. An easy way to do this is to insert four blades evenly around the part (if it were a clock, the blades would be at 3, 6, 9, and 12 o'clock) (Figure 5a) and stretch one O-ring to catch the hooks on the four blades (do this only on one side of Part E). Then insert the rest of the blades one at a time, pulling the O-ring over the hook as you go (Figure 5b).

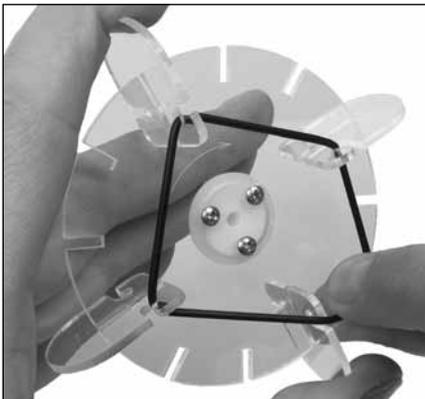


Figure 5a

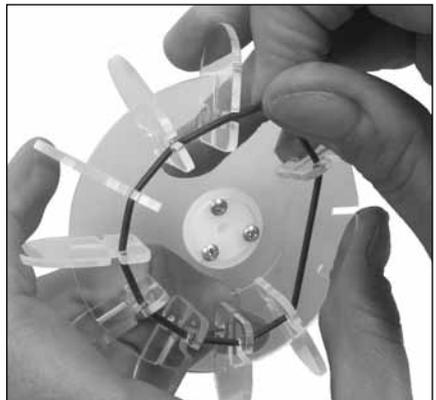


Figure 5b

8. Stretch the other O-ring on the other side of Part E, hooking it over the blades' second set of hooks (Figure 6). This is the turbine wheel.
9. Insert the stainless steel axle into the drive gear so about 3/4" of the axle extends from one side (Figure 7).
10. Take Part A and hold it so the rounded side is at the bottom and the notch coming from the top is on the right side (holding it in front of you). Push a nylon bushing into this part's center hole with the flat side of the bushing toward you (Figure 8).
11. Continuing to hold Part A so the notch is pointing up and on the right side, push the 3/4" end of the axle on the gear through the bushing from the back of the part (Figure 9 on the next page). Slide a 5/16" nylon spacer over the axle on the side near you.

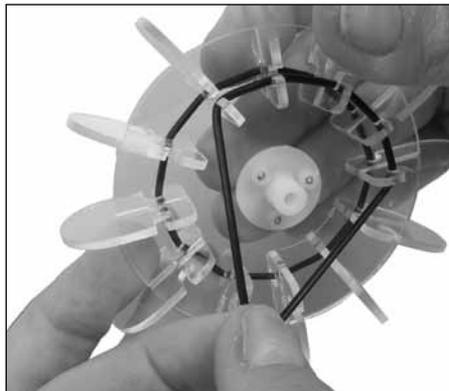


Figure 6

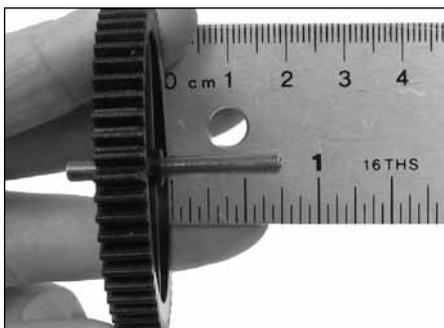


Figure 7

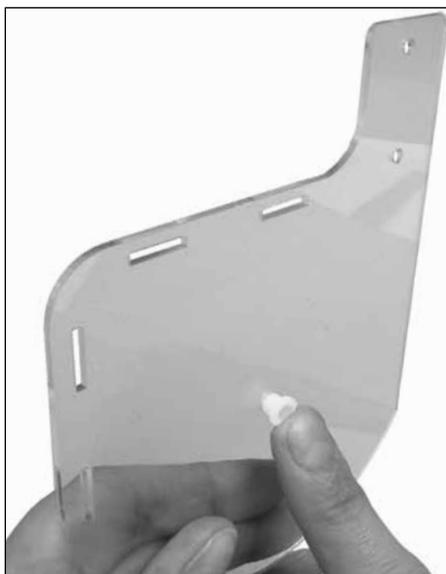


Figure 8

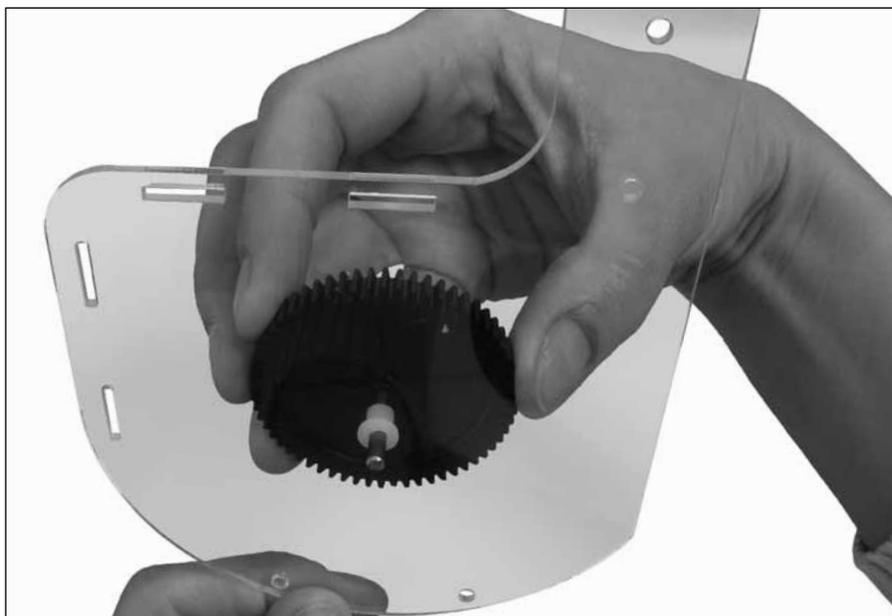


Figure 9

12. Carefully push the turbine wheel – with the arrow pointing clockwise – on the end of the axle near you just until the axle end is flush with the outside of the hub. Make sure the turbine wheel spins freely.

13. Take the motor assembly (from Steps 2-4) and drop the two 7/8" screws into the holes at the bottom of the assembly on the same side as the motor. Turn over the assembly and place a 1/2" nylon spacer over each screw end (Figure 10).

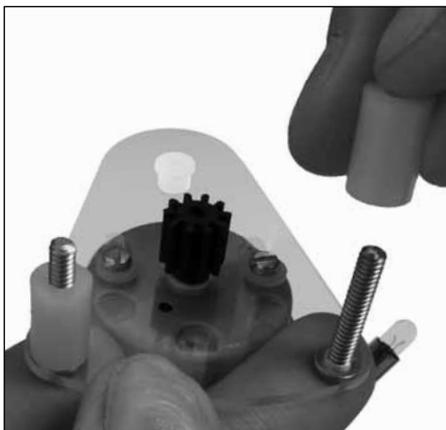


Figure 10

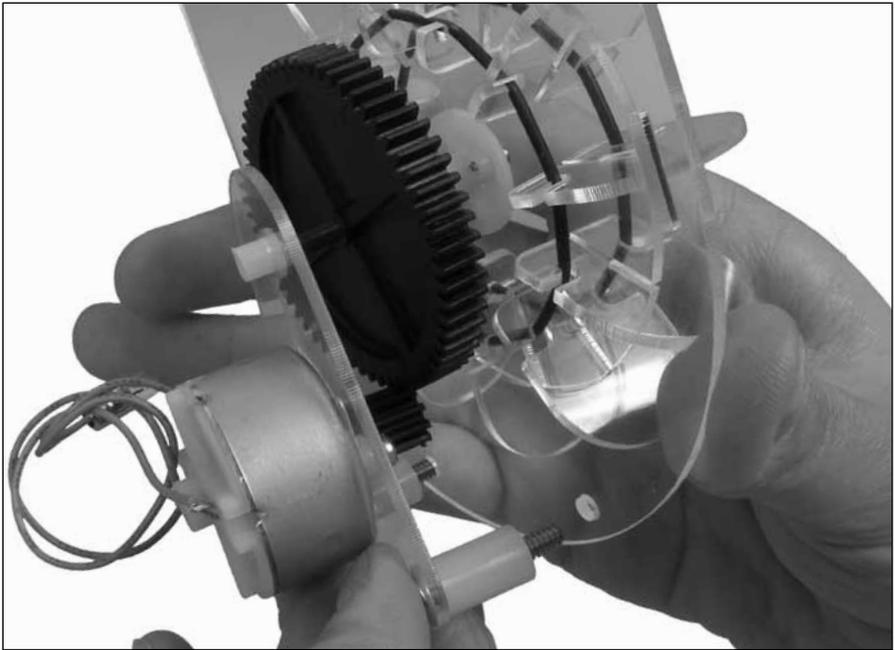


Figure 11

14. Align the two screw ends to the bottom of Part A with the turbine wheel – the axle will also need to go through the bushing at the top of the motor assembly (Figure 11).
15. With the two nuts, secure the two screws (Figure 12).

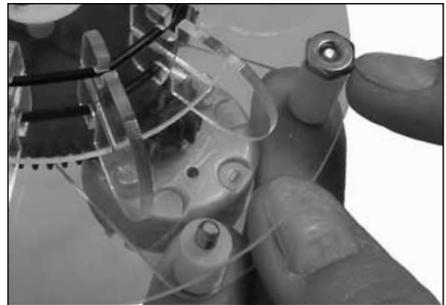


Figure 12

Adding the Splash Guards

1. Find the two rectangular acrylic parts labeled C and D. Part D hooks into Part A on the left side (when holding it so the motor is at the bottom and the notch is on the top right side) (Figure 13a on the next page). Make sure the narrow end with the notch is facing up. On the back where the small hooks come through, stretch a small O-ring over the two hooks to fasten Part D to Part A (Figure 13b on the next page).

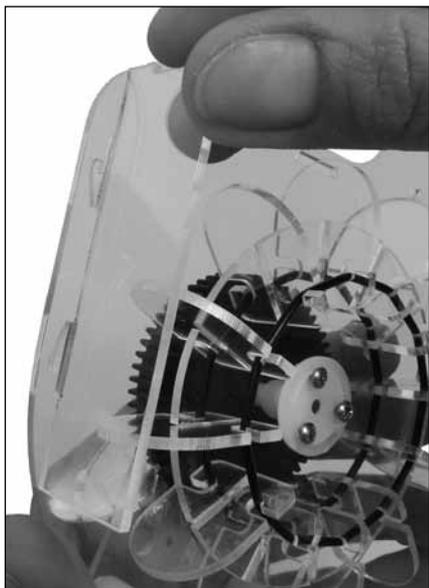


Figure 13a

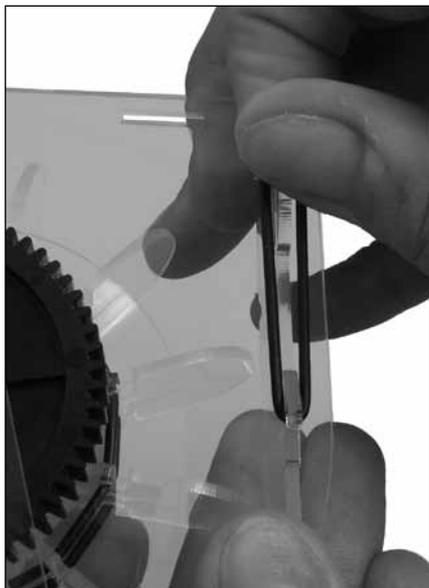


Figure 13b

2. Insert Part C at the top of Part A so its notched narrow end joins with Part D (Figure 14). Stretch the other small O-ring over the hooks on the back.
3. Take a piece of transparent tape and place it over the corner of these two pieces.



Figure 14

4. Take the clear tube and line it up with the two holes on the notch extending from the turbine. Do this so the angled end is pointing toward the turbine blades as shown (Figure 15). You want the tube as close to the blades as possible without being in the blades' path when the turbine spins.

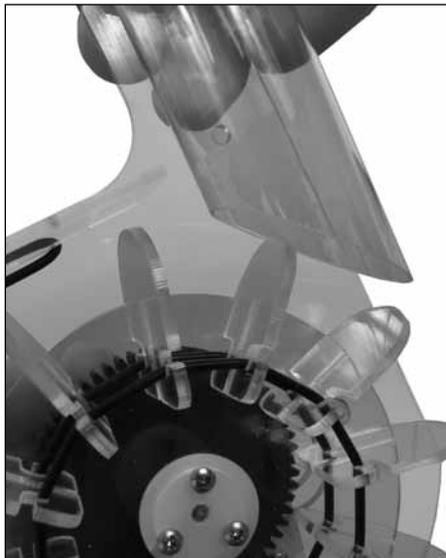


Figure 15

5. When you have the correct tube position, take the large pin and use it to create starter holes in the tube where it should line up with the turbine body (Figure 16). Use the holes in Part A to guide you.

Tip: Laying the assembly down on a table or desktop will help keep everything in place as you do this step.



Figure 16

6. Using the two 1/4" screws, fasten the tube to the turbine through the starter holes. Your H₂O Turbine is now ready to go.

Using the H₂O Turbine

Locate a running water source such as an outdoor hose or a strong indoor faucet. Place the end of the tube under the water so it runs down the tube and into the turbine (Figure 17). You may need to angle the turbine a bit for the blades to catch the water and start spinning. **Caution:** Be careful of the direction the turbine faces or the operator might get splashed with water.



Figure 17

As the turbine spins, notice the bulb attached to the motor – it will light up as the water turning the turbine creates energy that is tapped by the motor. **Tip:** If the bulb doesn't light up, try increasing the flow of water.

Concepts to Research

- Hydroelectricity
- Overshot versus undershot waterwheel designs
- Environmental pros and cons of using hydropower
- Indirect solar energy
- Energy conversion and rotational energy

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