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Master 3-2

Protocol for the Propeller Test

1. Set the pushpins into the wood block as shown in figure 3-2.1.

   Be sure the pushpins are as far down into the wood block as they can be. If they are not, they can fly into the air when you attach a rubber band to them later.

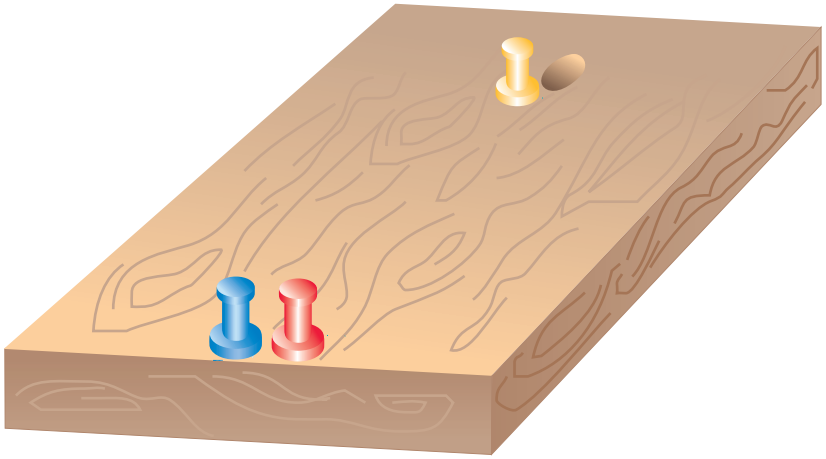

Figure 3-2.1: Place the pushpins into the wood block as shown. The two pushpins are as close to the edge of the block as they can be. They are also very close to each other. Squeeze them together if you need to. The single pushpin is about 15 centimeters (6 inches) from the two pushpins. All the pushpins are centered along the short side of the block.

2. Begin making the propeller by following Steps 2a–d. These steps will help you make the base for the propeller. Follow each step in figure 3-2.2.
   - **a.** Unbend a paper clip. Notice that one end is smaller than the other.
   - **b.** Bend the paper clip up at the small end. The small end of the clip should form a right angle to the large end of the clip.
   - **c.** Unbend the hook at the small end. Slip the bead onto this end of the paper clip until it stops at the kink.
   - **d.** Bend the small end back into a hook.

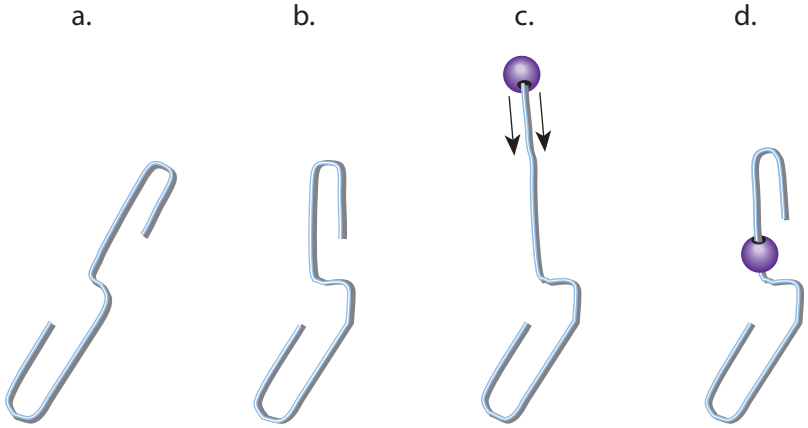

Figure 3-2.2: How to start the propeller. Follow Steps 2a–d to begin making the propeller. The letters *a–d* in this figure show you what Steps 2a–d describe.

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3. Hook a rubber band onto the small end of the paper clip. Squeeze the small end of the paper clip together to keep the rubber band from coming off.
4. Put on your safety goggles. Attach the paper clip and bead to the block, as shown in figure 3-2.3.

   Caution: Safety goggles will protect your eyes if anything flies into the air. Wear them for the rest of the protocol.

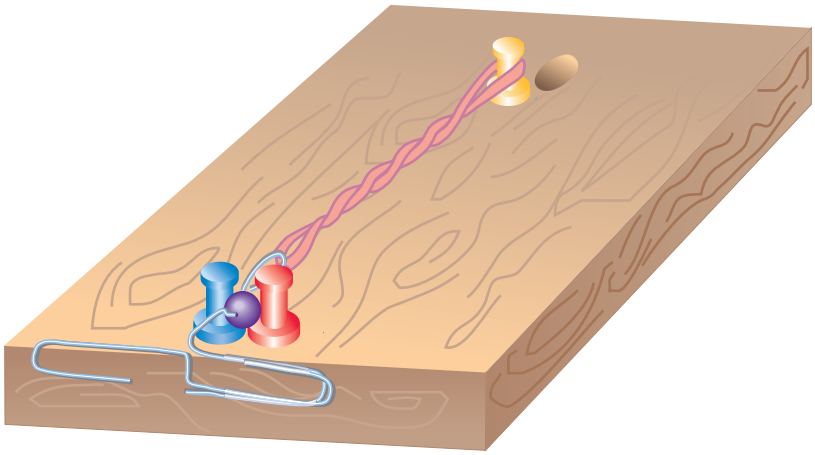

Figure 3-2.3: Attach the paper clip to the block as shown. The rubber band should be hooked over the single pushpin. Then stretch the rubber band with the paper clip attached across the wood block toward the two pushpins. The bead should sit on the side of the pushpins that is further away from the single pushpin.

5. Twist the rubber band by winding the large end of the paper clip 30–35 times. Continue to hold the paper clip so that the rubber band stays twisted.
6. Release the paper clip to see if it spins like a propeller. If it spins, continue to the next step. If it does not spin, adjust the pin, bead, or rubber band until it does spin.
7. Unbend another paper clip as you did in Step 2a. Do not follow Steps 2b–d.
8. Use electrical tape to tape the new paper clip to the large end of the old paper clip. This is shown in figure 3-2.4.

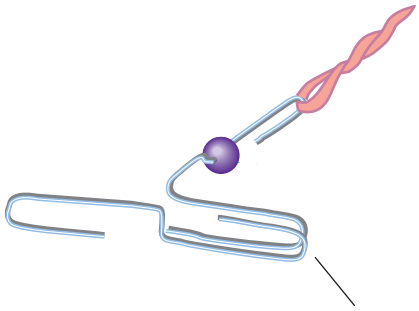

Figure 3-2.4: Tape the new, unbent paper clip to the old one. Use electrical tape to hold the two paper clips together. Try not to use too much tape.

9. Trace a paper propeller onto an aluminum-foil pie plate or baking pan. Cut out the propeller.

   Caution: Propellers cut from aluminum-foil pans might have sharp edges. Be careful not to cut yourself.
10. Tape the aluminum-foil propeller to the paper clip as shown in figure 3-2.5. Use electrical tape. Bend the aluminum-foil propeller to get the best fit on the paper clip.

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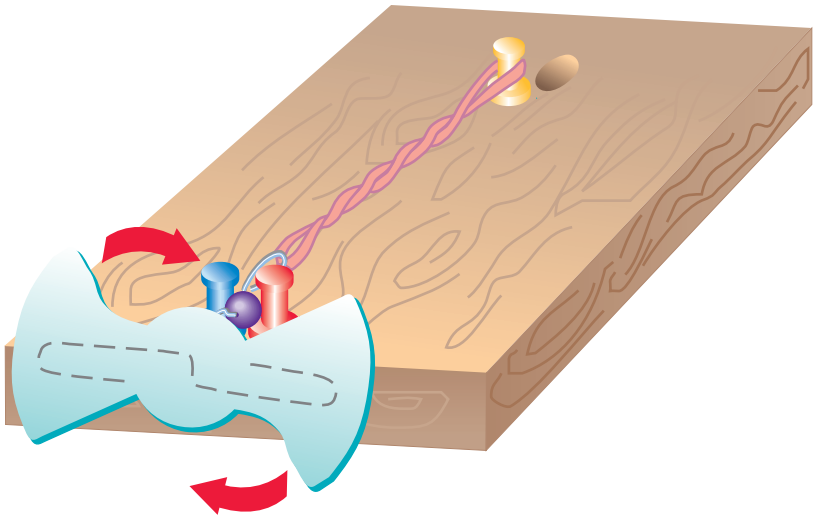

Figure 3-2.5: Attach the aluminum-foil propeller to the paper clip. You may have to bend the propeller so it fits on the paper clip.

11. Take the boat to the tub or sink of water. Wind the propeller 30–35 times. Release it after you place the boat in the water.
12. With your team, decide what you will change in your next tests.

    You might change how many times you wind the propeller, the angle of the two sides of the propeller, or the angle of the blades of the propeller. Twist and bend the propeller to see which angles work best.

13. Create a data table in your technology notebook. You will need to record the results of the tests. You will also need space for recording what you changed for these tests.

    Remember what your class decided on for the criterion that describes the purpose of the boat. Make sure your data table is set up to record results related to that criterion.

14. Run the additional tests. Be sure to record the data each time you try a new test.
15. Using a different color, put a star beside the conditions that worked best for the boat.
16. Return the materials to where they belong.