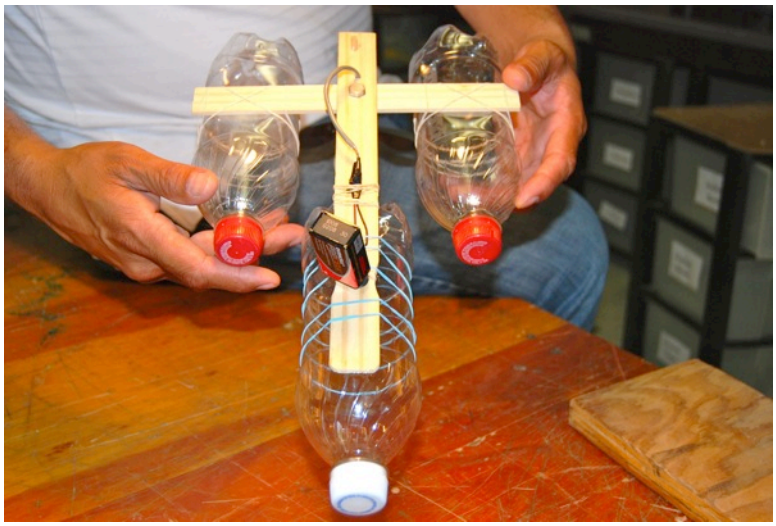
Speed Boat

Category: Physics: Force & Motion
Electricity & Magnetism

Type: Make & Take



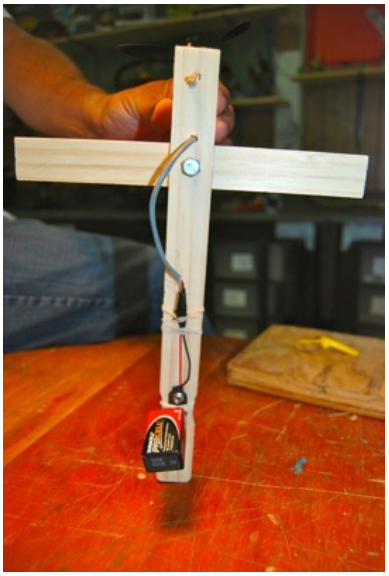
Rough Parts List:

2	Paint paddles
3	Plastic bottles
2	Electrical wires
1	9V battery
1	9V battery snap
1	Screw & bolt
1	Motor
1	Propeller
6”	Wood dowel
1” x 2”	Wood block
6	Rubber bands
1	Airtight container, i.e. film canister

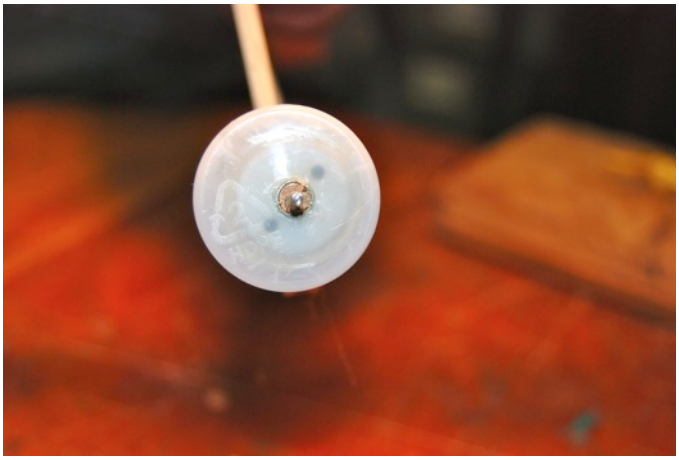
Tools:

Drill, ¼” bit
Hot glue gun

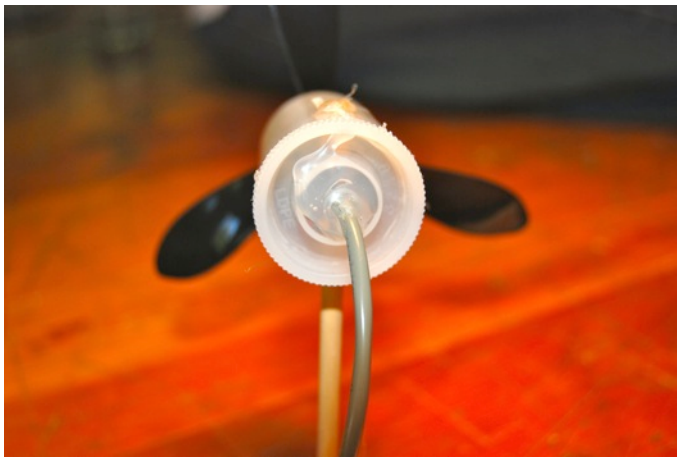
How To:



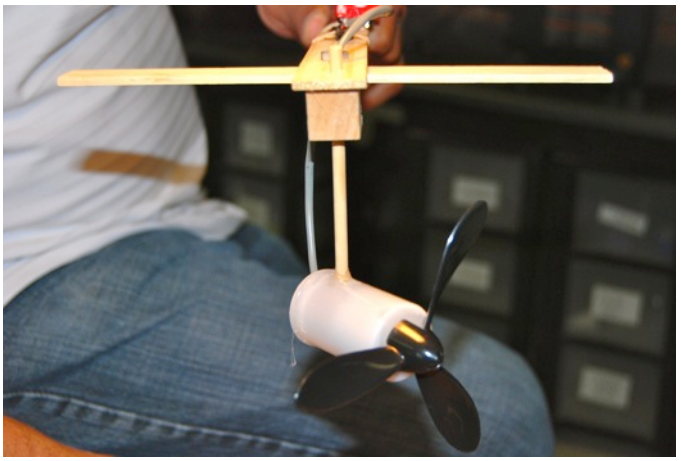
Screw the paint paddles together in the shape of a cross. Use rubber bands to attach a 9V battery and 2 electrical wires to the frame.



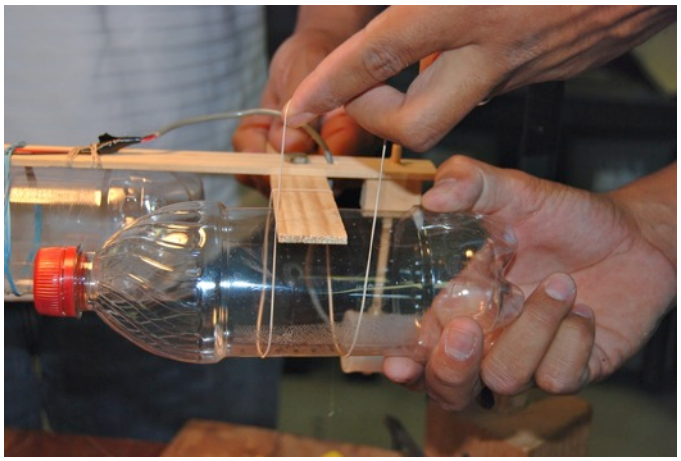
Drill a ¼” hole through the bottom of the film canister. Place a motor inside the canister and have the motor stick out through the hole. Attach a propeller to the motor.



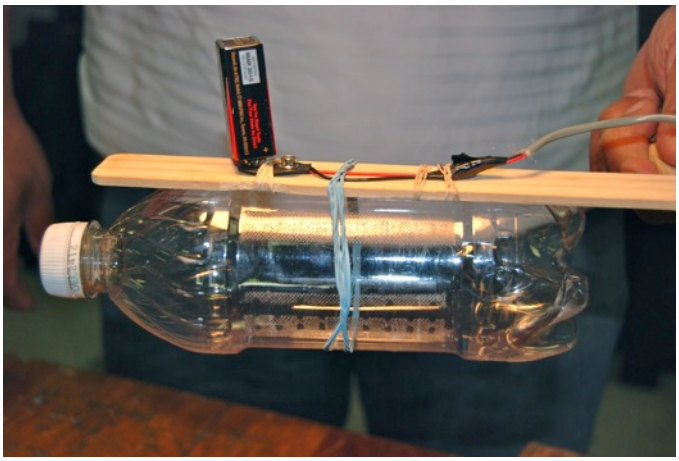
Drill holes through the lid and on one side of the canister. Stick a dowel through the side hole. Push the electrical wires through the lid and connect them to the motor. Use a glue gun to seal the holes.



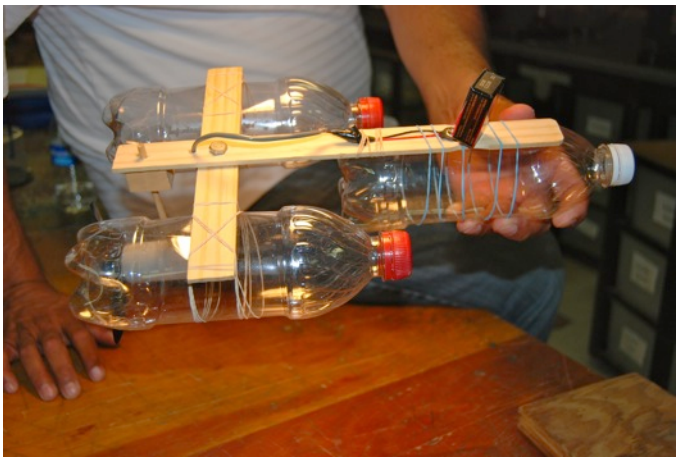
Attach a 1”x 2” wood block to one end of the boat frame. Drill a hole through both the block and paint paddle. Push the dowel through both pieces so that it sticks out above the frame.



Use rubber bands to attach a plastic bottle onto the under side of the frame.



Place the plastic bottles so that they all face in the same direction.



Place the boat in water, plug it in, and watch it speed away!

Fine Points:

→ The dowel should be able to turn around; it acts as the rudder for this boat.
→ Because the motor sits under water, the canister that holds it must be watertight. Use a hot glue gun to seal any gaps in the canister.

Concepts Involved:

- Newton's Third Law: for every action there is an equal and opposite reaction.

Focus Questions:

1. How can you make this boat go faster?
2. What happens if you put a larger or smaller propeller on this boat?
3. What would happen if you built this boat with 2-Liter bottles instead of the smaller water bottles?

Elaboration:

Have you ever thought about why so many large cities are near bodies of water? Water is useful, and not just for drinking. You can haul stuff easier through the water because friction is low at low speeds. It is always relatively level, so you don't have to deal much with going up and down hills. If it is hard going up a river, you make up for it coming back down. You don't need wheels, though you can make use of them in the form of paddle wheels.

Think of all the ways to make something move in water: rowing, paddling, kicking, flipping a whale tale, and of course spinning a propeller. This boat uses a propeller, and it is small compared to the propellers used by model airplanes. This is an example of Newton's third law: for every action there is an equal and opposite reaction. If the propeller is properly slanted, it will push the water in one direction and the boat will move in the opposite direction.

Things float according to their density. This model is made of lightweight materials and it would be tough to make it any lighter. To make it sink, place high-density objects like nails, rocks or coins onto the boat. If you put enough high-density things on the boat, it will sink to the bottom. Then you have a submarine.

Links to k-12 CA Content Standards:

<u>Grades k-8 Standard Set Investigation and Experimentation</u>
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

<u>Grades k-12 Mathematical Reasoning:</u>
1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
2.1 Use estimation to verify the reasonableness of calculated results.
2.2 Apply strategies and results from simpler problems to more complex problems.
2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to

a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 2 Standard Set 1. Physical Sciences:
The motion of objects can be observed and measured.
1.a Students know the position of an object can be described by locating it in relation to another object or to the background.
1.b Students know an object's motion can be described by recording the change in position of the object over time.
1.c Students know the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.
1.d Students know tools and machines are used to apply pushes and pulls (forces) to make things move.

Grade 3 Standard Set 1. Physical Sciences (Energy & Matter):
1.c Students know machines and living things convert stored energy to motion and heat.
1.d Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.

Grade 8 Standard Set 2. Forces:
Unbalanced forces cause changes in velocity.
2.a Students know a force has both direction and magnitude.
2.c Students know when the forces on an object are balanced, the motion of the object does not change.
2.e Students know that when the forces on an object are unbalanced, the object will change its velocity (that is, it will speed up, slow down, or change direction).
2.f Students know the greater the mass of an object, the more force is needed to achieve the same rate of change in motion.

Grade 8 Standard Set 8. Density & Buoyancy
All objects experience a buoyant force when immersed in a fluid.
8.c Students know the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced.
8.d Students know how to predict whether an object will float or sink.

Grade 9-12 Physics Standard Set 1. Motion & Forces
Newton's laws predict the motion of most objects.
1.b Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's First Law).
1.d Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's Third Law)
1.f Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed.