

The Forces of Wind: Sailing Activity Sheet

Name: Teacher Guide

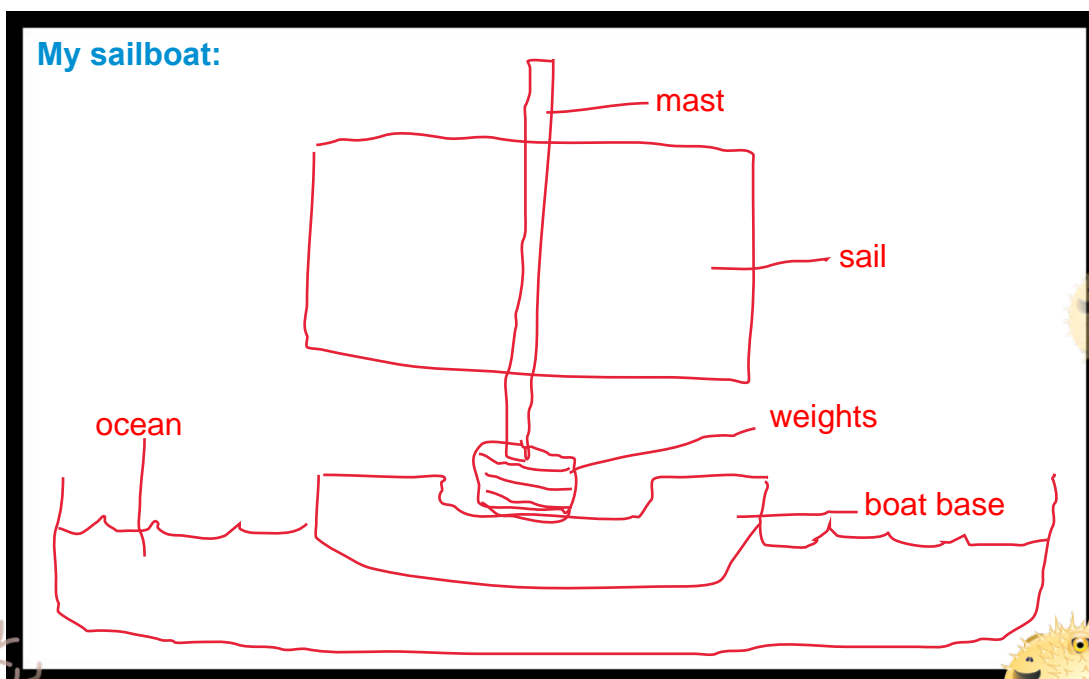
Date: _____

Build your sailboat!

1. Gather your materials to build a sailboat and model the winds!
 - a. **Boat building suggestions:** Boat base (e.g. egg carton, cardboard, plastic container, foil, heavy paper), mast (e.g. wooden skewer, chopsticks, popsicle sticks, craft sticks, small tree branches), sail (e.g. construction paper, rigid cloth, foil, glue, string, tape)
Optional: Pennies to add weight to the boats.
 - b. **Testing the wind:** large tray or bucket to hold water, fan, hairdryer
Optional: Straw (metal or silicone to limit the use of single use plastics)

Note: the procedure may vary depending on what materials you use. Below are suggested guidelines.

2. Create a boat base from your chosen material (i.e. folded tinfoil, cardboard box, plastic container).
3. Cut a rectangle from construction paper to make your sail. Decorate it!
4. Poke two small holes in line at the top and bottom of the sail. Get help from your teacher as needed!
5. Attach the sail to the mast (chopstick, skewer, stick, or similar material) by guiding the stick through the holes. Add tape or glue as necessary to secure it.
6. Create an 'ocean' (tray of water) and place your sailboat on the surface of the water.
7. Optional: add pennies or other items to the boat to create weight.
8. Draw a picture of what your boat looks like. Label the parts.



Test the Winds:

1. Before testing the effect of wind on your sailboat, think about your hypotheses and record them on your data table:
 - a. How will the force of wind affect the motion of my sailboat? (i.e. Will there be a difference in your boat's movement when the wind is weaker compared to when the wind is stronger?) **This question is designed to have students think about the cause and effect of wind strength. Look for students relate stronger wind with faster motion; the boat will move faster when the wind is stronger and slower when the wind is weaker.**
 - b. How will the direction of wind affect the motion of my sailboat? (i.e. Will your boat move sideways, straight ahead, backwards, etc.?)
This question is designed to have students think about the cause and effect of wind direction. If wind blows from the side, the force against the sail will have a different effect than if the wind blows from straight behind the sail.
2. Conduct your trials:

Trial #1: Direct Winds:

- a. Blow gently on your sailboat using your breath. You may also blow through straw to help direct your 'wind.' (Please use a metal, cardboard, or other type of non-plastic straw!)
- b. Record your observations on the data table.

Trial #2: Indirect Winds

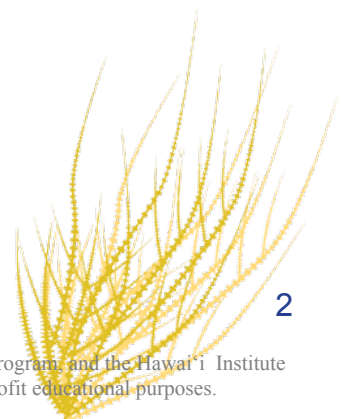
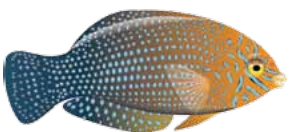
- a. Use a fan to blow wind toward your sailboat. Place the fan pointing in the general direction of the sailboat. Turn the fan onto the lowest setting.
- b. Record your observations on the data table

Trial #3: Strong Winds

- a. Use a hairdryer to blow from different directions on your sailboat.
- b. Switch between high and low settings.
- c. Record your observations on the data table.

Trial #4: Equal Winds

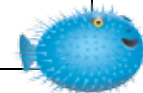
- a. Using either hairdryers or your breath, blow on one side of your sailboat while your partner blows with the same force on the opposite side.
- b. Record your observations on the data table.



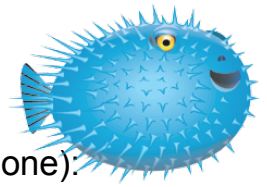
Force of the Winds Data Table



TEST: <i>What will I do?</i>	PREDICTION: <i>What will happen?</i>	OBSERVATION DATA: <i>What do I observe?</i> (Note: use words and/or a labeled drawing)
Trial #1: Blow <i>directly</i> on the sailboat	The boat will move slowly away from me.	<p>In general, the boat should move slowly when the students blow gently, and it should move in the opposite direction of the wind force.</p> <p>In some cases, the boat may not move because the force of the wind is not enough to overcome, or unbalance, the force of gravity.</p>
Trial #2: Blow <i>indirectly</i> towards the sailboat	The boat will move sideways.	<p>In general, there should be a difference in the direction the boat moves when the wind comes indirect (at an angle). The boat should still move away from the wind, but it will probably not move in the opposite direction of the student. Rather, the boat will move both forward and away or backward and away.</p>
Trial #3: Blow <i>strongly</i> on the sailboat	The boat will move fast.	<p>The increased strength of wind should result in faster movement of the boat.</p>
Trial #4: Blow at the same time as your partner (facing each other) on the sailboat	The boat will stay still.	<p>If the students blow in equal but opposite directions, the sailboat will remain still. If one student blows harder, or if the blowing is offset in direction, the forces will be unbalanced, and the boat will move.</p>



Activity Questions



1. When a sailboat is floating but not moving, the forces acting on it are (circle one):

a. Balanced

b. Unbalanced

2. When a sailboat is moving, the forces acting on it are (circle one):

a. Balanced

b. Unbalanced

3. When your boat is not moving, there are forces acting on it to keep it floating on the water. However the boat does not move because those forces are balanced.

These questions are designed to help students think about balanced and unbalanced forces.

a. What balanced forces are acting on the floating sailboat?

The force of gravity acts on the boat to pull it toward the center of the earth, which is why the boat does not fly away into space. The pressure of water, buoyant force, acts on the boat to push it up, which is why it floats. Balanced wind forces might also be acting on the boat.

b. What additional forces could you apply to cause the boat to move?

The force of wind could be applied to move the boat. A paddle might also be used to create wave forces that move the boat. A swimmer or marine animal could apply a force to push or pull the boat (note that with fins, a swimmer can move a small sailboat surprisingly well!).

4. What happened when you blew gently on the sailboat?

Answers will vary. In general, the boat should move slowly when the students blow gently. In some cases, the boat may not move because the force of the wind is not enough to overcome, or unbalance, the force of gravity.

5. What happened when you blew harder?

In general, the boat should move faster and farther with a stronger wind force. However, students may also experience the boat tipping over and/or going in different directions.

6. What changed when your partner blew at the same time as you? Were the forces balanced or unbalanced?

This part of the activity is designed to help students think about the interaction of wind on sails. If the students blow in equal but opposite directions, the sailboat will remain still. If one student blows harder, or if the blowing is offset in direction, the forces will be unbalanced, and the boat will move.

7. When you push a ball and it rolls on the floor, is this a balanced or unbalanced force?

This is an example of an unbalanced force, which is seen in the movement of the ball.

8. You have been testing wind as an unbalanced force that moves sailboats. Give an example of another unbalanced force that can cause an object to move.

Answers will vary. Encourage students to think of as many examples as they can: motors, paddles, waves (including tides, tsunamis, and wind waves), gravity, etc.

9. How might sailors use the knowledge of winds to plan for voyages?

Answers will vary. Encourage students to think about wind direction and pattern, like the Easterly trades, and think about trying to sail to Hawaii from California and then the reverse. How might they plan to sail to Tahiti? Sailing in a straight line might not be possible; sailors use the force