



Lesson Plan: Conditions at Sea Introductory Activity, Making Waves

Summary

Forecasting the conditions at sea is an important tool for sailors, fishers, maritime transportation, anyone on the water. In Conditions at Sea, a three-part series, students first learn about the concepts of wave formation and forecasting, conduct an in-class wave-making activity, and access near real-time and real-time data from ocean observing buoys to investigate the relationship between wind and wave height, and predict the actual conditions out at sea using the Beaufort scale.

Subject Area

Physical Science/ Earth science

Grade Level

6-12

Key Concepts

- Ocean wave formation is primarily caused by wind.
- Wave characteristics can be forecasted from wind data.
- Forecasting is an important tool for mariners

Objective

- Explain the process of wave formation and the forces that cause waves.

Materials

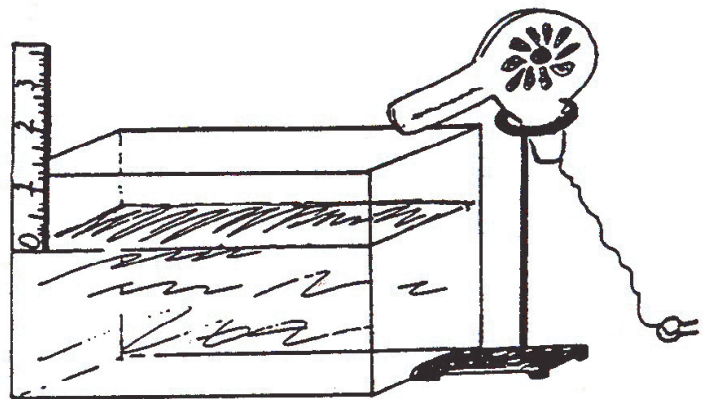
- hair dryer
- aquarium, clear glass or plastic rectangular container
- ring stand or doll stand (to hold and position hair dryer)

- erasable markers
- ruler
- water
- tape
- clock or watch


Safety note: do not let any part of the dryer touch the water!!!

Procedure


1. Place the aquarium or glass/plastic container on a firm surface.
2. Fill the container about three fourths full of water.
3. Allow the water to settle into a smooth surface
4. Tape a ruler on the outside of the container with the zero mark at the waterline. See illustration.



5. Set the ring stand or doll stand at one end of the container. Attach the hair dryer, so that it is a few inches from the edge of the container and a few inches above the water. (See sample of a data table at the end of this procedure.)
6. With an erasable marker, mark the water level of the still surface, which is at the zero mark on the ruler.
7. With the dryer on low level, note the time you turned the dryer on, and let it blow for three minutes. Describe the waves in your data table. (See a sample of a data table at the end of this procedure.)
8. After three minutes, mark the height of the waves on the outside of the container (label this mark, A). In your data table, record the height of these waves and the distance above the still water level and describe the shape of the waves.

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9. Continue to let the dryer blow on the water for 5 minutes, mark the height of the waves on the outside of the container (label this mark, B). Record their height and description in your data table.
 10. Describe what happens to the waves as they hit the end and sides of the container. Place this information in your data table.
 11. Turn the dryer off and let the water settle.
 12. Turn the dryer on medium speed. Describe these waves.
 13. After 3 minutes, mark the height of the waves on the outside of the container (label this mark, C). Record the waves' height and description in your data table.
 14. After 5 minutes, mark the height of these waves on the outside of the container (label this mark, D). Record the description and height of these waves in your data table.
 15. Describe what happens to these waves as they hit the end and sides of the container.
 16. Turn the dryer off again and let the water settle.
 17. Turn the dryer on high power and observe the waves.
 18. Describe these waves.
 19. After 3 minutes, mark the height of the waves on the outside of the container (label this mark, E). Record the waves' height and description in your data table.
 20. After 5 minutes, mark the height of these waves on the outside of the container (label this mark, F). Record the waves' height and description in your data table.
 21. Describe what happens to these waves as they hit the end and sides of the container.
 22. Turn dryer off!

Note: Some hair dryers have only low and high speeds. If this is the case, omit steps #12 – 16 in the above procedure. You will also need to modify the Sample Data Table.




Sample Data Table:

Dryer speed	Low	Medium (if available)	High
Description of original waves			
Description of waves after 3 minutes			
Height of waves after 3 minutes			
Description of waves after 5 minutes			
Height of waves after 5 minutes			
Description of what happens to the waves as they strike the end and sides of container			

Have Students use the information in their data table to do the following and answer questions such as:

- Describe how the force or strength of the wind affects the height of the waves.
- How is the wave height affected by the length of time the wind blows?
- Does the strength of the waves have any effect on the movement of the waves?
Explain your answer.
- What happens to the waves when they hit the end and sides of the container?
- Compare the behavior of the waves that reach the end of the container with those that reach the sides.

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- If your container was twice as long, what effect do you think this extra length would have on the behavior of the waves? (If a larger container is available - try it and see!)

Assessment

Have students write a few paragraphs and draw a diagram to explain how this investigation demonstrates the factors that affect wind waves and how these factors affect wave size.

Resources


- National Geographic wave simulator. Students can adjust wave height, wave period and/or wave length to see how each affects wave formation:
<http://www.nationalgeographic.com/volvooceanrace/interactives/waves/>
- Background information on waves. Windows to the Universe:
http://www.windows.ucar.edu/tour/link=/earth/Water/ocean_waves.html&edu=mid&back=/search/search_navigation.html
- Office of Naval Research:
<http://www.onr.navy.mil/Focus/ocean/motion/waves1.htm>

Standards

NSES (National Science Education Standards)

Oregon Science Standards

Washington State **EALRs** (Essential Academic Learning Requirements) and **GLEs** (Grade Level Expectations)



Content Standard or Essential Principle	LEARNING GOALS
A: Abilities necessary to do science <i>NSES</i>	<input type="checkbox"/> Use appropriate tools and techniques to gather, analyze, and interpret data. (6-8) <input type="checkbox"/> Develop descriptions, explanations, predications, and models using evidence. (6-8) <input type="checkbox"/> Think critically and logically to make the relationships between evidence and explanations. (6-8)
B. Motion and Forces <i>NSES</i>	<input type="checkbox"/> The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph. (6-8)
B. Interactions of Energy and Matter <i>NSES</i>	<input type="checkbox"/> Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter. (9-12)
Scientific Inquiry <i>OR</i>	<input type="checkbox"/> Collecting and Presenting Data: Conduct procedures to collect, organize, and display scientific data.
Scientific Inquiry <i>OR</i>	<input type="checkbox"/> Summarize and analyze data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.
EALR 2: Inquiry Core Content: Questioning and Investigating <i>WA</i>	<input type="checkbox"/> Collecting, analyzing, and displaying data are essential aspects of all <i>investigations</i> .
EALR 2: Inquiry Core Content: Questioning and Investigating <i>WA</i>	<input type="checkbox"/> <i>Models</i> are used to represent objects, events, <i>systems</i> , and processes. <i>Models</i> can be used to test <i>hypotheses</i> and better understand <i>phenomena</i> , but they have limitations.
EALR 4: Physical Science Core Content: Interactions of Energy and Matter <i>WA</i>	<input type="checkbox"/> Energy can be <i>transferred</i> from one place to another through <i>waves</i> . <i>Waves</i> include vibrations in materials. Sound and earthquake <i>waves</i> are examples. These and other <i>waves</i> move at different speeds in different materials.