

Mysteries of the Deep

Activity 2: Grades 5-8

Leaky Seal

Although archeologists and scientists have been examining the recovered wreckage of the Hunley for several years, no one has the definitive answer for its sinking. A variety of theories exist. In this show, you were introduced to a possible reason for the sub's demise based upon a leaky rubber seal in the hatchway. When the hatch was shut, the rubber gasket was not compressed equally along its length. This permitted water to slip by the seal and flood the inner hull. Eventually, the weight of the extra water would have offset the buoyancy of the ship, causing it to sink.

This activity page will offer:

- An exploration of one theory for the Hunley sinking
- Operational definition of a sealing gasket
- Hands-on exploration

MATERIALS

- Two metal jar lids
- Four thick rubber bands
- Discarded rubber glove (or swatch of rubber material)
- Scissors
- Drawing compass
- Sink or tub filled with water
- Two fishing weights

Waterproofing a Seal

In this activity, you'll explore the mechanics of waterproofing a seal. Instead of a submarine hatchway, two metal lids will be "sealed" together using rubber bands. You'll compare and contrast the effectiveness of a metal-to-metal seal versus one that uses a rubber gasket.

PROCEDURE

1. Clean and dry four identical metal lids. Then, position two of the lids so that the rims align against each other. When the rims are face to face they will be creating an enclosed hollow space.
2. Secure the positions of these two lids with two thick rubber bands. The bands should be placed at a 90 degree angle to each other to insure a uniform seal.
3. Obtain a discarded rubber glove or a swatch of thin rubber material. Place one of the unused lids over the material and trace the outline of the rim onto the rubber.
4. Use a compass to draw two additional circles using the center of this traced outline. One circle should have a diameter about 1 inch (2.5 cm) less than the traced image. The other circle should have a diameter about 1 inch more than the traced circle.
5. Use scissors to cut out the ring of rubber material that lies between the outermost and innermost circle. This ring will become the sealing gasket for the two lids.
6. Repeat steps 1 and 2. (You may be better off just repeating these steps using the unused lids) This time, however, insert the rubber seal between the two rims. Be sure that the gasket remains in place when the lids are secured together with the rubber bands.
7. Place both lid systems in a sink or tub filled with water. To prevent the lids from floating, you may need to place a fishing weight over each lid system. Let stand for several minutes.
8. Carefully remove the lids and dry off any water from the outside of each set-up. Separate the lids and observe the appearance of the inside of each system. Did water enter either system? Explain your observations.

Questions

1. What was the role of the ring of rubber material?
2. Although the lids were metal, both setups were very buoyant. Explain.
3. What was the role of the fishing sinkers?
4. Predict the buoyancy of each lid system over time.

EXTENSIONS

Visualizing the Concept

A rubber gasket produces a waterproof seal by filling in the tiny pits of unmatched surfaces. Its expansion into these surface irregularities prevents water from flowing through minute metal-to-metal gaps. Can you envision the action of such a gasket? If so, illustrate it in two drawings that show a magnified view of metal surfaces in close contact. One view should illustrate the bare interface of bare metal. The other view should show the exact same surfaces (with identical pitting and surface irregularities), but aligned against a common rubber gasket

Space Shuttle

The space shuttle Challenger was another vessel that met her demise due to faulty seals. The seals that failed on the Challenger, however, were o-rings inserted between adjoining segments of the solid rocket boosters. Research this disaster and compare and contrast the failing of the seals in both losses.

Leaky Hulls

Did you know that water entering the hull of a ship is a common occurrence. That is why most ships have bilge pumps. These devices pump any water that has entered the hull out into the surrounding sea. Contact a local boat supplier or do a web search to learn more about bilge pumps. Could such a pump have saved the Hunley? How would it operate? How would it differ from the ballast pumps? Explain.

WEB CONNECTION

[Friends of the Hunley - Inside the Hunley](http://www.hunley.org/main_index.asp?CONTENT=INSIDE)

http://www.hunley.org/main_index.asp?CONTENT=INSIDE
An interactive panorama of the inside of the submarine hull

[Friends of the Hunley - Recovery](http://www.hunley.org/main_index.asp?CONTENT=RECOVERYDAY)

http://www.hunley.org/main_index.asp?CONTENT=RECOVERYDAY
Information about the recovery of the submarine

[Archeology in the Hunley](http://home.att.net/~JVNautilus/Hunley/Hunleyarchaeology.html)

<http://home.att.net/~JVNautilus/Hunley/Hunleyarchaeology.html>
Site that illustrates the hatchways and locking systems employed to keep the hull watertight.

The activities in this guide were contributed by Michael DiSpezio, a Massachusetts-based science writer and author of "Critical Thinking Puzzles" and "Awesome Experiments in Light & Sound" (Sterling Publishing Co., NY).

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Questions

1. What was the role of the ring of rubber material?
(It acted as a gasket to produce a waterproof seal between the adjoining metal surfaces)
2. Although the lids were metal, both setups were very buoyant. Explain.
(The paired lids trapped a volume of air that produced sufficient buoyancy to float each system)
3. What was the role of the fishing sinkers?
(Their added weight was needed to keep the lids at the bottom of the water-filled tank)
4. Predict the buoyancy of each lid system over time.
(The system that lacked the gasket would be first to fill with water. Therefore, it would sink first. Although the gasket fitted system would resist water, eventually, the rubber bands or gasket itself would fail, allowing water to spill inside the system resulting in a loss of buoyancy.)

CURRICULUM LINKS

Physical Science

Buoyancy
Properties of Matter
Models
Elasticity
Technology

NATIONAL SCIENCE STANDARDS (Grades 5-8)

Science as Inquiry- Content Standard A

Student will observe a model in order to develop a cause/ effect relationship.

Physical Science - Content Standard B

Students will identify different properties in matter.

Science in Personal and Social Perspectives - Content Standard F

Students will understand that science and technology can not solve all problems for society.