Easy Pressure Test

sead : stem

Subjects

Physics | Engineering | Scientific Inquiry | Chemistry

Topics

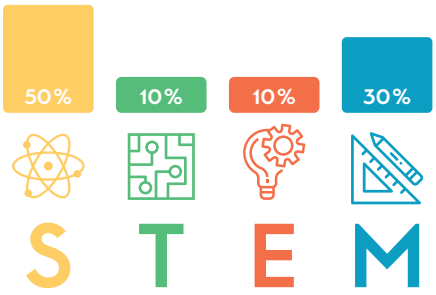
Physics | Engineering | Energy | Scientific Inquiry | Gas | Shapes | Pressure

Key Words

Air Pressure | Prototyping | Geometric Shapes

Connection to SDG

STEM Chart



Time for Activity

60–90 Minutes

Introduction

Different shapes of containers resist air or water pressure at different levels. This activity will explain why water bottles, gas or water tanks are usually in a cylindric shape. This activity will let the students build the prototype of containers. They will also test them with pressure to see the pressure resistance in a real setting.

This project allows to explore some interesting topics in physics and engineering. It's a great opportunity to learn which shape is the most pressure-resistant.

Key Objectives

1. Designing and conducting the experiment for a pressure test of containers in different shapes.
2. Explaining the shape characteristics of containers that can resist the highest pressure and of those that cannot resist the highest pressure.

Materials

per group:

1. A4 paper template in different shapes (cubic, pyramid, large cylinder, small cylinder, available for download from ▶ https://drive.google.com/drive/folders/0B1V9_gwuDfF4SExKdGk1MjhPcXc?usp=sharing)
2. 4 balloons (of more than 2 liters volume)
3. 10 ml water
4. Cylindric recipient (25 ml)
5. Timekeeper (stopwatch or mobile application)

per classroom:

1. 1–2 800 watt microwave ovens

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Safety

1. Be careful when using the microwave, keep some distance to the oven while conducting a pressure test. The experiment with microwave must be conducted under the supervision of teachers only.
2. Be careful, the water within the balloon will change its state from liquid to gas—it will be extremely hot. Let the test items cool down before you touch them!

Guiding Questions

1. Why do gas or water containers mostly come in cylindric shapes?
2. Which type of container shape can resist the highest pressure?
3. Which are the shape characteristics of containers that can resist the highest pressure?
4. Which are the shape characteristics of containers that don't resist high pressure?

Engage (5 minutes)

Introduce the challenge to students. Explain the main goal: to build a machine that can generate electricity using only the given materials.

Task

1. Ask the students to think about common containers of water or gas used in everyday life (such as cans, milk boxes, gas tanks). "Why do gas or water containers mostly come in cylindric shapes?"
2. Let the students do the air pressure test activity to identify the shape of the container that can resist the highest pressure. The teacher may use the questions to guide students through the activity.
   1. Which type of container shapes can resist the highest pressure?
   2. Which shape features can resist the highest pressure?
   3. Which container shape(s) don't resist high pressure?
3. In order to test the different shapes of containers that can resist the highest pressure, follow this procedure:
   1. Put 10 ml of water into each of the 4 balloons and tie them.
   2. Assemble paper containers in 4 shapes– cubic, pyramid, large and small cylinder– (using paper models to cut, fold and glue).

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3. Put each balloon from 3.1 into a different container and close the containers with glue. Wait until the glue has dried.
4. Provide student observe and record the characteristics of each the paper container shape in the table on the worksheet.
5. Test the pressure resistance by putting the first paper container into the microwave, set it to 800 watts and turn it on for 1 minute. Keep the time with a stopwatch until you hear the "popping" sound indicating the paper container burst. Record the time (in seconds) in the table on the worksheet. Repeat the step of testing with different paper containers and record the data.

4. Ask the students to discuss the testing results to explain the characteristics of containers that resist the high pressure and the characteristics of containers that cannot resist the high pressure by using the data from the table.
5. Ask the students to draw a picture of the water molecules in the gaseous state to show how gas molecules create pressure against container walls.
6. Ask the students to identify the areas that have high pressure in containers (on the worksheet) and discuss how these areas relate to pressure resistance according to container shapes.
7. Come to the conclusion that a cylinder has more resistance than a cubic and a pyramid-shaped container because of its characteristics in terms of edges and sides.
8. Additionally, you could link this activity to water or gas tanks in real life.

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Assessment

Evaluation Criteria	4	3	2	1
Procedures	Procedures are listed in clear steps. Each step is numbered and written down in a complete sentence.	Procedures are listed in a logical order, but steps are not numbered and/or are not written down in complete sentences.	Procedures are listed but are not in a logical order or are difficult to follow.	Procedures do not accurately list the steps of the experiment.
Experimental Design	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis but leaves some unanswered questions.	Experimental design is relevant to the hypothesis but is not a complete test.	Experimental design is not relevant to the hypothesis.
Experimental Hypothesis	Hypothesized relationship between the variables and the predicted results is clear and reasonable based on what has been studied.	Hypothesized relationship between the variables and the predicted results is reasonable based on general knowledge and observations.	Hypothesized relationship between the variables and the predicted results has been stated but appears to be based on flawed logic.	No hypothesis has been stated.
Variables	All variables are clearly described with all relevant details.	All variables are clearly described with most relevant details.	Most variables are clearly described with most relevant details.	Variables are not described OR the majority lack sufficient detail.
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the lab.	Report illustrates an accurate understanding of most scientific concepts underlying the lab.	Report illustrates a limited understanding of scientific concepts underlying the lab.	Report illustrates inaccurate understanding of scientific concepts underlying the lab.