
IMH TEP'S

LEGACY ACADEMY

Water Power (H₂O Pressure Fountain and Making a Siphon)

Grade 7 Activity Plan

Reviews and Updates

7.6 Water Power

Objectives:

1. To show how the pressure of a liquid increases with depth
2. To demonstrate how hydraulic systems use liquids to transmit force
3. To show that water moves from areas of high pressure to areas of low pressure
4. To show how air pressure can work against gravity to move water

Keywords/concepts: hydraulics, piston, siphon, pressure, potential energy, viscosity

Segment	Details
African Proverb and Cultural Relevance (5 min.)	"Where two rivers meet, the waters are never calm." Uganda
Background (20 min.)	Students are first each given a glass of water and asked to dip their finger in it. Students are then asked to explain what they feel. They are then asked to imagine placing their hand under running tap water or a hose. What are some of the differences between the ways the running water feels on their finger than when it was in the glass? As about examples of water pressure at work in nature (geysers, deep sea diving). Activities are done in hopes of demonstrating to the students the power that water has... "potential energy" Discuss the behaviour of fluid particles.
Activity 1 (5 min.)	Observe how pressure influences water flow out of a bottle at different depths.
Activity 2 (10 min.)	Experiment on the ability to transmit pressure from one object to another through a liquid using two syringes, one that is full of oil and the other half full. Discuss applications of hydraulic (liquid) systems (e.g. car breaks).
Activity 3 (20 min.)	Demonstrate using three different jars how changes in pressure can create a water fountain.
Activity 4 (10 min.)	Using two bottles at different elevations and a tube show how a siphon causes water to move from higher to lower elevation.
Follow-up (10 min.)	Recap important points from background information so students will be better able to undergo evaluation. Students are asked questions to test memory of information.
Post-test (5 min.)	Students will be given a maze "Water Wheel". With an incentive for the person who finishes fastest.

Suggested interpretation of proverb: When two people with different ideas or different ways of life meet, they often clash. It takes time for them to work out their differences and work together. The waters are never calm where two rivers meet because each exerts a force on the other. In today's activity, you will discover how powerful water pressure can be.

BACKGROUND INFORMATION

Pressure is an effect which occurs when a force is applied on a surface. Pressure is the amount of force acting on a unit area; $\text{Pressure} = \text{Force} / \text{Area}$. The SI unit for pressure is the pascal (Pa), equal to one newton per square meter (N/m^2 or $\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$). A non-SI measure is pounds per square inch (psi).

Old Faithful geyser in America's Yellowstone National Park is probably the best natural example of water under pressure. The Yellowstone website states Old Faithful explodes up to 8,000 gallons of water to an average height of 150 feet into the air, every one to five minutes, due to, among other factors, "changes in water pressure."

Scuba divers know that as you go down to greater depths, the water pressure increases. In fact, the increase in pressure is 14.7 psi for every 34 feet of additional depth. A diver that descends to a depth of 100 feet must withstand a pressure of $\dots (100 \text{ ft} / 34) \times 14.7 = 43.24$ psi. This happens because as the person dives deeper, they have more water above pushing down on them: each additional foot adds about half a pound per square inch. This means that every square inch of their body feels like just under half a pound has been placed on top of it. However, this pressure is also pressing inwards, the diver experiences it from the top, bottom and sides simultaneously. Imagine the diver brings an empty bottle of water down with him. When it was initially brought underwater, it had been full of air and sealed tightly. The deeper it went, the more the water pressure pushed against it, until finally the pressure of the water was too much for the pressure in the bottle to counteract--it started to buckle. The point is that as you descend deeper into a fluid the pressure increases. And if you go upward toward the surface, the pressure becomes less.

Activity 1: Water Pressure (with worksheet)

Purpose: To show how water pressure increases with depth

Item	Quantity (10 students)
1 L plastic bottle	10
Nail (~3")	5
Dish (Large enough to hold bottle)	10
Roll of Tape	1

Procedure:

1. In the plastic bottle, make small holes with a nail at different levels.
2. Place bottle in a dish and put small piece of tape over each hole.
3. Fill the bottle with water, and remove the tape from all the holes.

Activity 2: Hydraulic Power

Purpose: To demonstrate how hydraulic systems use liquids to transmit force

Item	Quantity (10 students)
Icing Syringe	20
Plastic Tubing (transparent)	~1 ½ ft.
Cooking oil	5 cups
Electrical tape	1 roll

Procedure:

1. Fill a syringe with air, cover hole with finger and press down on plunger. Can the gases be compressed?
2. Fill a syringe with water, cover hole with finger and press down on plunger. Can the liquid be compressed?
3. Fill one syringe with oil and insert nozzle into plastic tubing. Tape to secure.
4. Half fill the second syringe with oil and fix it to the other end of the tube. Tape to secure.
5. Make sure there are no air bubbles inside the tube or syringes
6. Press on one plunger and you will see the other plunger move out – the force has been transmitted.

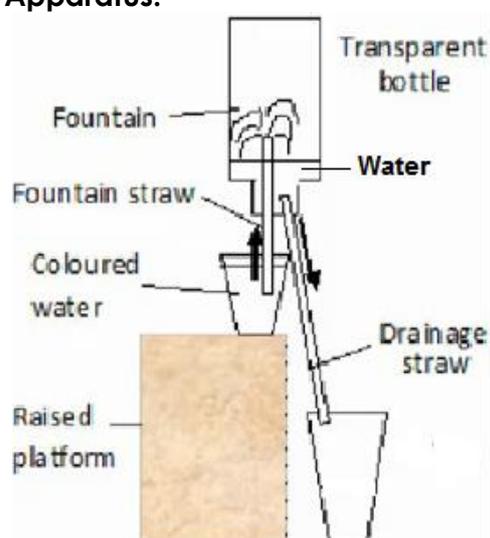
Activity 3: Pressure Fountain

Purpose: To show that water moves from areas of high pressure to areas of low pressure

Suggested format: Students will work in groups of two

Item	Quantity (10 students)
Food colouring	4 bottles
Plastic Jar with lid (medium)	5
Plastic Cups	10
Drinking straw	10
Electric Drill	1
Hot glue gun	1
Glue sticks (for glue gun)	4

Apparatus:



Procedure:

1. **Stack** books or other objects to make a raised platform.
2. **Fill one cup with coloured water** and place it on the raised platform.
3. **Drill 2 holes** into the lid of the jar and push the **straws** into these holes. One should stick out further from the top. **Seal holes** with a hot glue gun.
4. **Fill the jar** about half full of water and screw the lid on.
5. Place an **empty cup** beside the platform.
6. Block the end of the longer straw with your finger, and **invert jar**. Position it over the cups so that the shorter straw dips into the blue water, and the longer straw extends into the empty cup.

Additional resources:

http://www.youtube.com/watch?v=93V_BvU-HhQ&NR=1

<http://www.youtube.com/watch?v=uDuyKgGxbU>

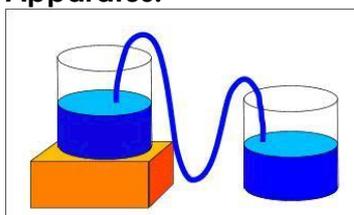
Activity 4: Making a Siphon

Purpose: To show how air pressure can work against gravity to move water

Suggested format: Students will work in groups of two

Item	Quantity (10 students)
Glass jar (medium)	10
Plastic tubing (transparent)	~ 10ft.

Apparatus:



Procedure:

1. **Place** two jars on a level surface.
2. **Fill jars** 1/3 full of water
3. Take ~2ft. of **plastic tubing** and fill it with water.
4. **Clamp your thumbs** over the end of the tube on both sides to prevent the water flowing out.
5. Place the ends of the tubes in the jars and **release thumbs** once underwater.
6. **Raise** one of the beakers so its water level is higher than the second beaker's water level and watch what happens. Now, switch the levels of the beakers so the second beaker is higher than the first. Watch what happens. Then put both beakers at the same level on the table and watch what happens to the water levels in the beakers.

Additional resources:

Refer to links "student page" and "siphon" for more information on how siphons work and where they are used.

<http://www.nbmj.unr.edu/ScienceEducation/ScienceOfTheComstock/Physics-Siphons.html>

Activity 1 Worksheet – Water pressure

Before

From which hole do you think the water will squirt farthest from?

TOP

MIDDLE

BOTTOM

After

Which hole did the water squirt farthest from?

TOP

MIDDLE

BOTTOM

Post-test

Water Wheel

