Air pressure: How it is measured? How can we use it?

Respective blueprint	The "philosopher's stone" of Heron
Description	In this pedagogical sequence students will learn about air pressure
Learning Objectives	Students will: - develop a basic understanding of air pressure - be able to measure air pressure - create a model of the "philosopher's stone" of Heron
Related curricular subject(s)	Physics, Technology

Prerequisites / preparatory actions for teachers	Teachers should gather the materials for the blueprint
Prerequisites / preparatory actions for students	Be able to build objects with simple tools like screw drivers, rulers, bottles etc.
Age of students	13-17
Duration	2-3 hours
Level of difficulty	Difficult

Step by step description of the tasks

Step 1: Air and air pressure

Air and its particles are crashing into us all the time. What we call air pressure is the force of these particles hitting a surface. Air pressure is the weight of air molecules pressing down on the Earth. The pressure of the air molecules changes as you move upward from sea level into the atmosphere. The highest pressure is at sea level where the density of the air molecules is the greatest.

At sea level, we feel the most pressure from the air. Scientists use the term "one atmosphere" to describe how much pressure there is at sea level. When you're at sea level, the pressure is 14.7 psi (pounds per square inch). Barometers show that the normal pressure at sea level is 29.9213 inches (760 mm) on them. Why are we able to move our hands back and forth? Because the pressure is the same on all parts of our hands, we can. Our bodies aren't crushed by the weight of the pressure because there is equal pressure inside and outside of our bodies, too, so we don't feel it.

Air pressure goes down as we go up. As you drive or ride a train up and down hills in the mountains, your ears will often pop. When your ears pop, your ears are getting used to the pressure in your eardrums. This evens out the pressure in your ears, so they won't burst when the pressure changes.

Activity 1: Fig. 1 shows the same bottle in different altitudes. The left bottle was sealed in a high altitude, e.g. in a mountain. Then, when it was moved to a lower altitude, e.g. at sea level. The bottle will be crushed as in the second bottle of the image. Why is that? Discuss it in the classroom.

Fig. 1 The same bottle in different altitudes

Activity 2: Use this service https://www.mide.com/air-pressure-at-altitude-calculator to calculate the pressure of the air at various altitudes. Experiment with different temperatures as well.

Activity 3: Watch this video https://www.youtube.com/watch?v=thSeYzcPrqs and discuss it with your classmates.

Step 2: The automatics of Heron

Heron of Alexandria was a very competent and resourceful person. He was an engineer, an inventor, a mathematician, a methodical scientist, and a miracle worker, all at the same time.

Activity 4: Visit the https://kotsanas.com/gb/cat.php?category=03 to learn about the inventions of Heron.

Activity 5: Develop the "philosopher's stone" of Heron and use it with various colored liquids.

Assessment activities

Assessment activity 1. Ask the students to search for information on air pressure in daily life

Assessment activity 2. Ask the students to search information on the Web for the “Air Pressure Bottle Experiment” and ask them to implement this project.

Assessment activity 3: Answer the following questions

1. What happens to air pressure as you ascend into the atmosphere?
2. A barometer is a device used to measure atmospheric pressure. True or False?
3. The air pressure is higher at the mountain's top or at its base? Please explain your answer.
4. When you ride in an elevator, your ears 'pop' because the air pressure changes. Does it decrease or does it increase? Justify your answer.