Pressure

Background Information:

Air pressure is the force exerted by air particles. The air around us pushes on us and every other thing (but our bodies and objects push back with equal force so we don't notice it).

During the day the Sun heats up the surface of the Earth. Different parts of the Earth heat up at different rates (land heats and cools faster than the oceans etc). Near the Equator the surface of the Earth is facing the Sun all year and so it is warmest, the rest of the Earth is tilted away, so the climate is colder. The temperature of the Earth affects the air pressure of the atmosphere above it. If the surface of the Earth is relatively warm, air rises and the pressure at the surface falls. If the surface is relatively cool, air sinks and the pressure rises.

Air pressure can tell us a lot about weather. If we experience **high pressure** it usually means it will be clear and calm weather. However, **low pressure** brings cloudy and wet weather. In general, the lower the air pressure the worse the weather.

Air moves from a high pressure area toward a low pressure area. Meteorologists often use an instrument called a barometer to measure air pressure and the *change* in pressure, to track the movement of high and low pressure systems and the weather associated with them.

Experiences and Outcomes:

I can demonstrate an understanding of weather and climate by explaining the relationship between weather and air pressure.

SOC 4-12c

Transferable Skills:

Researching - using the Internet
Active listening
Verbal communication
Communicating
Data analysis
Working in a team

Materials:

A Balloon
Beaker or glass
Card
Matches
Plastic packing chip/ mini marshmallows
Fizz keeper pump cap
Duct tape
2 x 2 litre drinks bottle
Bubbles
A toaster & carrier bag

Suggested activities:

Explain that we are surrounded by air that pushes on us but that we don't really notice small changes in air pressure. Discuss with pupils how they feel when they experience large pressure changes: diving under water or take off and landing in a plane.

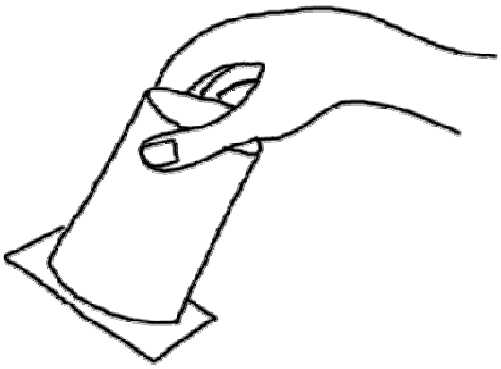
Blow some bubbles and explain that they are spherical because air exerts pressure on the bubble in all directions.

Introduce the idea that air pressure is quite strong and that we just don't notice it because air and water inside our bodies is at the same pressure.

Carry out the Magic Glass and balloon in a bottle experiments to show pupils the effect of air pressure.

The Magic Glass

You will need: a glass
a piece of card
cold water

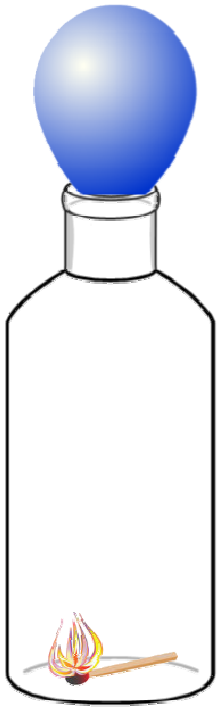


Method: Fill a glass one-third with water.
Cover the mouth with an index card and turn it over above a sink.
Remove your hand from the card.

Results: The card stays in place because the atmospheric pressure outside the glass pushing on the card is greater than the pressure from the water in the glass.

Balloon in a bottle

You will need: a glass bottle
a small balloon
a match



Method: Partially fill the balloon with air so that it is slightly bigger than the neck of the bottle.
Drop a lit match into the bottle.
Place the balloon over the bottle.

Results: The balloon is sucked into the bottle as the pressure inside the bottle lowers (this is due to the oxygen in the air being used up as the match burns).

Suggested activities: (continued)

Introduce the idea that warm air rises and cool air sinks.
Carry out the hot air balloon experiment to demonstrate this

Hot air balloons

You will need: a carrier bag
a toaster

Method: Turn on the toaster.
Hold the carrier bag upside down over the toaster.
Allow the bag to fill with warm air.
Release the bag

Results: The bag should gently float to the ceiling. This is due to the fact that hot air is lighter than cool air and so it rises. This is the same as when areas of warm air rise and cool air flows in to take its place in weather systems.

Explain that air flows from high pressure areas to low pressure areas and carry out the High Pressure bottle experiment.

High Pressure Bottle

You will need: an empty 2 litre drinks bottle
a fizz keeper cap
foam chips (or mini Marshmallows)
duct tape

Method: Punch a hole in the side of the bottle toward the bottom.
Cover the hole with the piece of tape.
Fill the bottle with Styrofoam packing peanuts (or mini marshmallows) and then put the special Fizz Keeper pump cap on the bottle.
Pump air into the bottle with the fizz keeper cap until no more can be added.
Feel the bottle – you should not be able to squeeze it easily.
Look at the foam chips and observe how they have changed.
Remove the tape from the bottle – allow pupils to feel the air escaping through the hole and observe the change to the foam chips.

Results: As the air is released the foam chips expand due to the pressure reducing inside the bottle.
The air flows rapidly from the area of high pressure inside the bottle to the area of lower pressure outside the bottle: this flow of air from high to low areas of pressure model the way wind blows horizontally from regions with different air pressures.

Extension Ideas:

Make your own barometer and keep a record of the pressure and type of weather for two weeks (http://www.rmets.org/weather/observing/make-barometer.php).
Get pupils to use their barometers to look for patterns relating a change in pressure to a change in weather.

Investigate how tornados are formed by air rising and changes in pressure.
Carry out the tornado in a bottle experiment

Tornado in a bottle

You will need: 2 x empty 2 litre drinks bottles
thick card
duct tape
glitter

Method: Fill one bottle 3/4 full with water and add a little glitter.
Cut a circle of cardboard as big around as the bottle's opening and cut a 0.5 cm hole in the centre and place it on top of your water bottle's opening.
Turn the other empty bottle onto the first bottle and wrap some tape around the bottle necks to make sure they stay together and do not leak.
Hold the bottles so that the bottle with water is upside down on top.
Hold the bottom bottle to steady it. With the other hand, begin moving the top bottle in a circle.
Watch what happens!

Results: The water swirls creating a mini tornado in the middle of the bottle.
Gravity pulls the water down into the empty bottle; but the empty one isn't really empty it is full of air. When you swirl the bottle, the water starts to move in a circle, it pushes out against the side of the bottle and leaves a low pressure open space in the middle (a vortex). The air in the lower bottle is sucked up through the open centre of the vortex into the upper bottle.
The water moving through the card shows how a tornado looks on a small scale. A real tornado causes chaos as it sweeps up objects and debris up into its vortex.

References/Resources:

Make your own Barometer: (The Royal Meteorological Society)
http://www.rmets.org/weather/observing/make-barometer.php

What to Wear: (Yorkshire and Humber grid for learning)
http://www.yhgfl.net/Resources-CPD/Weather-Resources/What-to-Wear

Make your own Weather Station: (The Franklin Institute)
http://www.fi.edu/weather/todo/todo.html

Land and sea breezes: (Exploring Earth)
http://www.classzone.com/books/earth_science/terc/content/visualizations/es1903/es1903page01.cfm?chapter_no=visualization