PRIMARY + STEM

Teaching Resource

ACTIVITY: Air is all around us

ACTIVITY OVERVIEW

The understanding of air and gases is important for students across all areas of science.

How do we begin to teach students about something that they cannot see or feel?

We can use this activity to prove the presence of air, then extend learning to meet the curriculum needs of the different year levels – including wind and weather, breathing, sound travelling through air, states of matter, and friction from air.

SYNOPSIS

The understanding of air and gases is important for students across all areas of science. How do we begin to teach students about something that they cannot see or feel? We can use this activity to prove the presence of air, then extend learning to meet the curriculum needs of the different year levels – including wind and weather, breathing, sound travelling through air, states of matter, and friction from air.

Foundation – Year 2

- Objects are made of materials that have observable properties (VCSSU044)
- Observable changes occur in the sky and landscape; daily and seasonal changes affect everyday life (VCSSU046)
- Light and sound are produced by a range of sources and can be sensed (VCSSU049)

Year 3 – 4

- Forces can be exerted by one object on another through direct contact or from a distance (VCSSU064)

Year 5 - 6

- Solids, liquids and gases each behave in different ways and have observable properties that help to classify them (VCSSU076)

ACTIVITY, MATERIALS AND INSTRUCTIONS

Activity – Sock in a cup

Magic meets science in this activity! Stuff a sock into the bottom of a cup.

Turn the cup upside down and dunk it in a container of water. Remove the cup from the water and touch the sock – it's dry! How did this happen? What amazing science has kept the sock dry? Students complete this activity in groups of two or three.

Materials

(For a class of 30 students, 10 groups)

- plastic cups (x 10)
- plastic jug/tub (x 5 or 10) (needs to hold water that is deeper than the height of the plastic cup)
- water
- socks (x 10) OR sheets of paper towel/tissue scrunched up

To test if you have the right sized cup for this experiment, stuff the sock into the cup. Is the sock sticking out of the top of the cup? (Yes = bad - you need a bigger cup or a smaller sock). Turn the cup upside down. Does the sock fall out? (Yes = bad - you need a bigger sock or a smaller cup).

1. Fill your large jug/container with water that is deeper than your cup height.
2. Stuff the sock/paper towel into the plastic cup.
3. Turn the cup upside down (see notes above).
4. Dunk the cup in the water (straight down and then straight up).
5. Feel the sock/paper towel – it's dry!!
6. Discuss results with students.
7. Repeat the activity, with students explaining the results to each other. (Let's practise so that we can show this to our families later. Remember to dunk straight up and down.)

It's not just a sock inside the cup - there is also air in the cup. The layer of air in the plastic cup 'protected' the sock from the water.

There was no space for the water to get into the cup, as it was full of air and sock. If there was no air, the sock would have been wet, as water would be able to fill the gap in the cup.

This activity shows us that there is definitely air around us.

Oops - did your sock get wet??

There are a few reasons that this happens.

- Sometimes, the sock drops out of the cup (maybe you squeezed it too much, or it was a bit small and just slipped out). Gravity brings the sock down towards the Earth and into the water.
- Sometimes, when you dunk the cup, it is slightly tilted, which allows some air to escape the cup and some water to take its place.

HOW TO USE THIS ACTIVITY WITH YOUR STUDENTS

Foundation – Year 2

This activity can be linked to materials and properties, wind and weather, and how sound travels. Any topic that involves air or gases can be introduced by this activity, giving the children proof of the existence of air, which they cannot see.

If you are looking at materials and properties, then use this to introduce gases – materials are not just things that we can see and hold in our hands.

If you are teaching children about weather, then wind (the movement of air) is part of what we experience daily. An understanding of air is required to help understand wind.

At these year levels, you may also find this activity useful when approaching the topic of sound. Sound that reaches our ears travels through vibrating air molecules. Once students understand that air is matter, rather than just space around us, it helps them make sense of this range of topics.

What materials are in the cup? When do we feel air moving around us? How else can we be sure that air is here? What do you predict will happen when the cup is dunked in the water? What did you observe? Let's share our observations.

You may like to show students a demonstration of convection patterns in air as part of this activity. Place a balloon over the mouth of a plastic bottle and dip bottle in between hot and cold water jugs. What's inside the bottle? Air.

When the bottle is placed in hot water, the air inside is heated and moves up into the balloon. When the bottle is placed in cold water, the air inside cools and shrinks back into the bottle. Hot air rises, cold air sinks! Moving air is wind.

Years 3/4

Students at this level are studying forces, which may include gravity, air resistance, and the forces involved in flight. Air can cause friction - a stopping force, we describe as air resistance.

Try running forward while you hold a large piece of cardboard in front of you, compared to holding a small piece. It's much harder to push the greater amount of air out of the way! These activities link together to help students understand air as matter, not just space around us.

This activity also links to the kite making, found in the Engineering topics.

What is in the cup? How else can we prove that air is around us? When do we feel air pushing on us? What do you predict will happen when the cup is dunked in the water? How could we make this activity a fair test? Do I dunk the cup the same way each time? Do you dunk at the same angle and depth as me? What happens if there is more or less air in the cup, compared to the amount of sock material?

Extend students' understanding of air resistance using a paper dropping demonstration. A piece of paper torn from a notebook will fall to the ground more slowly than the actual notebook. Students will often believe that this is due to weight, rather than air resistance. Gravity pulls on objects with an equal amount of force. It is air resistance that makes the single piece of paper flutter down to the ground, air is pushing back on the floppy

piece of paper that cannot hold its own shape. Scrunch the paper into a ball shape. When the paper ball and book are dropped together they will reach the ground at the same time. It is not the weight of objects that is important when they move through the air, it is their shape.

Years 5/6

Gases are one of the states of matter. What are gases? What are their properties? Use this activity to introduce gases to students who are looking at the broader topic of states of matter, including solids, liquids, and gases.

What materials are used in this activity? Are we using solids, liquids, or gases? How else could we prove that air is present around us?

Highlight science inquiry skills with questions to students. Is there a way that we could make this activity a fair test? What variables are present? How could we measure the success of the sock dunking? What other experiments could we use to prove the presence of air? Can we find out how gases are measured in laboratories and in the natural environment?

Link this activity to changes of state, using water as an example. We use different words like melting, boiling, freezing, and condensing, to describe these changes, which are best explained with a diagram using arrows.

When starting to learn about changes of state, water is the best example, as students are most familiar with this material. The most confusing change of state for children to understand is that between liquid and gas. We can't see gases, although children have had many years of experiencing puddles drying up, or washing on the line drying.

- **From Solid --> Liquid --> Gas**: Add heat/energy to melt and boil/ evaporate
- **From Gas --> Liquid --> Solid**: Remove heat/energy to condense and freeze

Time permitting, extend students' learning by making ice from air.

Place ice cubes and a few spoonfuls of salt in a metal cup and observe changes to the outside surface of the cup.

The cold cup absorbs energy from the water in the air and changes it from gas to liquid (this is condensation – the same process that makes clouds high up in the cold sky).

By adding salt to the ice we get a colder temperature, so even more energy is absorbed by the water on the outside of the cup, making the liquid water turn into ice. The cup will be frosty on the outside. The water has definitely not leaked from inside the cup. This is water that was in the

air, had energy taken away to change into a liquid and then had more energy taken away to change into solid ice.

DISCUSSION SECTION AND KEY THEMES

Air is matter

Something is matter if it is made up of atoms and molecules and takes up space. This makes air a matter. Air is all around us, and air is a mixture made up of different gases like nitrogen, oxygen, carbon dioxide and water.

Even though we cannot see these gases in air, we can see how they take up space. This explains how our lungs inflate when air takes up space within them, and how balloons expand when we blow air into them.

Air is a mixture of gases. What are gases?

Gases describe a state of matter, just like solids and liquids. Molecules like water, carbon dioxide, or oxygen can exist in any of these states. In the gas state, these molecules have lots of energy and can move at great speeds in all directions.

It is in the form of gases that we use oxygen and carbon dioxide for breathing. Gases are all around us and we breathe gases in and out of our bodies.

Gases spread out and fill up all the space they can find. You might have noticed this when there is a bad smell that moves from one part of your classroom and ends up spreading to the whole room (yes, we're thinking about farts here). Gases are materials and their properties include being invisible to our eyes (most gases), spreading out, with some having odours.

Wind is part of the weather that we experience. Wind is moving air.

What do we observe on a windy day? We can see the air moving things around, like leaves, branches, or even ourselves!

There is a layer of air around Earth that we call the atmosphere. We can measure how windy it is using kilometres per hour (like how fast a car travels), knots (when we are talking about the winds near the sea), or by other special scales (like the Beaufort wind scale).

The Beaufort wind scale is an old measurement, but fun to use with children. They can easily make observations (see, hear, feel) and work out the strength of the wind on this scale. Your school may also have a weather station or anemometer that can be used to measure the actual wind speed.

Sound travels through air

Sound moves as vibrations. If we are having a conversation, my voice makes the air in front of my mouth vibrate; the air molecules bump around each other.

Air molecules bump all the way from my mouth to your ear, where the air vibrates your eardrum and parts of your inner ear, which send a message to your brain to translate these vibrations into the sounds that we recognise. If there is no air, sound cannot travel. If we were in space, we could not hear each other. When sound vibrations travel through other materials (water, doors, string, spoons), changes happen to the sounds.

Air can cause friction, a stopping force

Friction is a stopping force. We see it in action when one object touches another object.

For example, when I squeeze the brakes on my bike, the brake pads rub against the tyres, causing the bike to slow down. Friction is the opposite of the push and pull forces that you may have already learnt about. Different materials will have different amounts of stopping force or friction.

If I roll a ball over a smooth floor, it will move faster than if I roll a ball over a carpet. Materials that slow objects down more effectively are those with more friction. Air is a material, and it has friction, or a stopping force, related to it. Objects moving through air rub against the air molecules. We call this air resistance.

When people design things that move fast, they try to use shapes and textures that will create less air resistance, so there is less friction from the air to slow things down. For example, a rocket has a pointy tip, so that it moves fast through the air, while a parachute spreads out to bump into as much air as possible and slow you down.

QUESTIONS AND ANSWERS (ABOUT AIR AND GASES)

What gases are in air?

The main gases that make up the air on Earth are nitrogen (78%) and oxygen (21%). (Many children will be surprised about the presence of nitrogen, as we do not talk about this gas very often.)

The remaining 1% of our air is mostly made up of argon and carbon dioxide, plus trace amounts of helium, krypton, neon, methane, and hydrogen.

Water vapour (water in gas form) is also found in the air, but the amount can change from trace amounts up to 4%.

Is there air on other planets?

The layer of air around a planet is called the atmosphere. Other planets in our solar system have atmospheres too, but they are all made up of different combinations and amounts of gases. For example, the atmosphere of Venus is made up of 96% carbon dioxide and 4% nitrogen, while Jupiter's atmosphere is 90% hydrogen and 10% helium.

What gases are in farts?

Farting is usually referred to as flatulence by doctors and is a normal part of digestion. Most of the gases in a fart don't smell, including nitrogen, oxygen, carbon dioxide, and methane. However, gases including hydrogen sulphide and ammonia are smelly and may be produced by bacteria in our guts.

Are there any animals that don't need oxygen to stay alive?

Requiring oxygen to stay alive is one of the characteristics that define animals, whether this oxygen comes from the air or the water. However, in 2020, scientists discovered a fish parasite that does not need oxygen to stay alive.

Henneguya salminicola is an 8mm long white parasite that infects the flesh of Chinook salmon. Scientists think that the parasite can get energy from its fish host, rather than having to make its own energy using oxygen.

Are there any gases that we can see?

Yes, although most gases are not visible to our eyes, there are a few that we can see. For example, iodine gas is purple, chlorine gas is greeny-yellow and nitrous dioxide is brown (you can search for images online). We do not bring these gases into the classroom to show students, as they are toxic in their gas forms.

Why are gases invisible?

Most gases are not visible to our eyes. We can only see materials that reflect light into our eyes in the visible spectrum (this is the range of colours of the rainbow that we can see). Gas molecules that we can't see are reflecting light in different parts of the electromagnetic spectrum, for example in the infrared and ultraviolet parts of the spectrum. We cannot see these with our eyes, but there are other animals that can see these types of light, so maybe they are able to see some gases that we can't. When we say that something is invisible, we mean that it is unable to be seen by our eyes.

How do birds and aeroplanes fly?

Anything that flies is affected by four forces: weight, lift, drag, and thrust. Birds and planes have curved wings that are at an angle. This design enables air to move faster over the top, creating lift, which fights against gravity. Thrust works against drag and is the push forward, made by engines, legs, or wings. The force of the weight is reduced by being made from lighter materials (bird bones are much lighter than ours), but still being rigid. The shape of birds in flight and planes is streamlined so that they can move through the air more easily.

Is there air in the oceans?

There are many different gases dissolved in seawater. Just like in the air, we find nitrogen, oxygen, and carbon dioxide in the water. The wind and waves help the movement (or exchange) of these gases between air and water. Marine animals rely on the oxygen present, while marine plants rely on carbon dioxide. Cold water can hold more gases than warm water.

Why do our bodies need air?

Our bodies need oxygen. The other gases that we breathe in and out (including the 78% nitrogen) are not needed by our bodies. Our bodies, and the bodies of all animals, need oxygen to make energy in our cells. In animals, oxygen is combined with chemicals from our food to make energy. This reaction takes place in the part of our cells called the mitochondria. Oxygen is transported to all cells of our bodies through our circulatory system (heart and blood vessels).

How high does Earth's atmosphere go?

The atmosphere contains all the air in Earth's system and is found from 1m below the surface to more than 10,000km above the surface. The atmosphere is divided into layers.

- **Troposphere (up to 12km)** – the layer we live in, where clouds form and weather happens; temperatures decrease as you go higher
- **Stratosphere (12 – 50km)** – contains the ozone layer (high energy ultraviolet light is absorbed here), planes fly in the lower stratosphere, and the temperature rises as you go higher
- **Mesosphere (50 – 85km)** – coldest part of Earth's atmosphere (about -90°C), gets colder as you go higher; the majority of meteors burn up in this layer of thin air.
- **Thermosphere (85 – 1000km)** – aurora (Southern and Northern lights) occur in this layer; high energy x-rays and ultraviolet light are absorbed here; very thin layer of air; some satellites orbit in this layer; the upper height and temperature of this layer can vary due to variations in energy from the sun; temperatures can range from 500 – 2000°C
- **Exosphere (100,000 – 190,000km)** – this layer is not counted by some scientists because it is more like space than atmosphere

OUTSIDE OR SUPPLEMENTARY READING

Bureau of Meteorology – Beaufort Wind Scale

http://www.bom.gov.au/lam/glossary/beaufort.shtml

NASA – 10 interesting things about air

https://climate.nasa.gov/news/2491/10-interesting-things-about-air/#:~:text=Air%20is%20mostly%20gas&text=It's%20a%20mixture%20of%20different,dioxide%2C%20neon%2C%20and%20hydrogen

UCAR – What's in the air?

https://scied.ucar.edu/learning-zone/air-quality/whats-in-the-air

NASA – planetary atmospheres

https://www.nasa.gov/sites/default/files/files/YOSS_Act_4.pdf

UCAR - Layers of Earth's atmosphere

https://scied.ucar.edu/learning-zone/atmosphere/layers-earths-atmosphere

TOPIC WORDS

- air
- gas
- matter
- molecules
- forces
- air resistance
- energy
- wind
- weather

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