Unit 1 Air Pressure Creates Wind

Air is all around us.

It's made of tiny particles. These particles don't stay still. They are always moving.

But why does it move? And how does it move?

Let's look for ourselves.

Step 1. Blow up a balloon to three-quarters of the size and tie the end with a binder clip.

Step 2. Put the end of the balloon onto a thick tube.

Step 3. Blow up another balloon halfway and tie the end using a binder clip. Put the balloon on the other end of the tube.

What do you think will happen? Will the air move? Will it stay in the same place?

Step 4. Remove the clips from both balloons. Watch the air move inside the balloons.

Which balloon will get bigger and which will get smaller? Why did the big balloon get bigger and expand all the way while the small one got smaller?

It's because air moves from areas of higher pressure to areas of lower pressure.

The air inside the small balloon is in a smaller space. So the air molecules are closer together, causing high pressure. The air molecules in the larger balloon are spread out, causing lower pressure. The air moves from the small balloon to the big balloon. Air moves like this in nature as well. We call it "wind."

Unit 2 The Weather Forecast

Lulu and her mom are watching TV together. The weather forecast is on.

“Be careful, as there will be a lot of low pressure today.”

“Is low pressure bad, mom?” asks Lulu.

“It’s bad for the weather. High pressure brings sunshine and clear skies. Low pressure brings rain and clouds. There could be wind or even snow if it’s cold.”

“Then I should take my umbrella today,” says Lulu.

“Good idea!” says Mom.

The weather forecast continues.

“Heavy rain and wind are expected in the southern region. Check before you travel.”

“Dad is on a business trip in the south, isn’t he? He planned to fly home today.”

Mom says, “I just got a call from your dad. His flight was canceled. He will come home tomorrow.”

“It’s lucky we know the weather in advance! This way, we can watch out for low pressure.”

Unit 3 How Does Heat Move Liquids?

Have you ever boiled water using a kettle?

The bottom of the kettle gets hot. It heats the water inside from the bottom to the top.

How does all the water in the kettle get hot and finally boil? Let's see.

Step 1. Prepare a large water tub, four cups to support the tub, blue food coloring, a dropper, and a small paper cup.

Step 2. Put the water tub on top of the four cups. Put water in it.

Step 3. Drop the blue food coloring into the bottom of the tub using the dropper. Make sure you put the food coloring in slowly.

Step 4. Fill the small paper cup with hot water. Put the paper cup under the food coloring in the tub. See what happens to the blue food coloring.

What happened? The hot water under the tub heated the food coloring.

After a while, the heated food coloring started moving. It flowed from the bottom to the top of the tub.

The heated blue water went up. The cold water went down.

We call this process a "convection current."

In a kettle, the hot water at the bottom moves up. The cold water moves down.

Then that water gets hot, and it moves up again.

This keeps happening until all the water is hot. The kettle boils!

Would you like some tea?

Unit 4 Water Moves Around the World

It was a very cold winter day. Tim went to the sea with his dad. He put his foot in the water.

“Dad, the water is very cold! The water at the North Pole is much colder, right?”

Dad answered, “That’s right. The water near the North Pole is cold. But the water near the equator is warm. This causes something amazing to happen.”

“What is that?” Tim asked.

“It’s the circulation of the seawater. Cold water is heavier than warm water. When the seawater near the poles gets colder, it sinks down. The cold water flows to warm areas near the equator. The warm water moves to where the cold water was. It’s a huge convection current.”

“Wow, it works just like our kettle at home! How fast does the water move?”

“It’s very slow. It flows about 1 cm per hour. It takes more than one thousand years to circulate around the whole world!”

Unit 5 Growing Mushrooms

Animals and plants are two different types of living things. There's another type of living thing. It's called a fungus. Mold and mushrooms are types of fungi.

They grow well in warm and humid environments.

We can often see mold and mushrooms growing in the summertime.

They don't get their food from sunlight like plants.

They can grow in the dark. They get nutrients from other living things, dead or alive.

Let's watch a mushroom grow and see for ourselves!

Step 1. Get a mushroom growing kit. Follow the instructions on the kit.

Step 2. Your kit will include a substrate (mushroom food) and mycelium (mushroom spawn). It will take a few days for the mushrooms to grow.

Did your mushrooms grow? Aren't they amazing? All they need to grow are the spawn and the substrate. They don't need sunlight to grow. You didn't use seeds to grow the mushrooms.

Mushrooms don't make seeds. They make spores. Wild mushrooms release the spores. They get carried away by the wind. If a spore lands somewhere dark, humid, and with good food, it releases the spawn, and a new mushroom can grow.

Mushrooms are easy to find in the woods. It's dark and humid, and the soil has lots of nutrients. But not all mushrooms can be eaten, so don't pick them.

Unit 6 I Am Not a Plant!

It's very nice to meet you. I'm a mushroom. I have a wide cap and a stalk.

I don't move, and I grow upward, so people think I am a plant. But I'm not a plant! I'm not an animal either.

Then what am I? I'm a fungus. Mold is a member of my family!

Fungi like me grow well in a warm and humid environment. You can see a lot of us in the summer.

Plants make their own food through photosynthesis.

I can't do this, so I get nutrients from dead and living things around me.

How do I reproduce?

I reproduce by spores. Spores are powders in the gills under my cap.

Spores are light, so they float in the air. They float away and land on the earth. There, they grow into new mushrooms.

Unit 7 Water Drops

We know that water has three states: liquid, solid, and gas. We know water can move between these states.

There's also something else to know about water. It's called "surface tension."

What is surface tension? Let's do an experiment and see.

Step 1. Place a penny on a flat surface. Fill a pipette with water.

Step 2. Pour drops of water on the penny, one at a time. Count the drops.

Step 3. Keep adding drops. How many drops does it take until the water spills off the penny?

Step 4. Try again. How many drops can you add this time before it spills?

How did the water stay on the penny? Why didn't it spill over straight away?

It's because of surface tension. Surface tension keeps the water molecules together tightly. On the surface of the water, they hold together even tighter.

They're like a skin on the water. This is surface tension.

Surface tension held a few water drops together. When we added more and more drops of water, eventually we broke the surface tension. The water spilled.

Where else can we see surface tension in action?

Unit 8 A Water Strider

I'm a water strider. You can find me at ponds and reservoirs.

My body looks like a thin stick. I have three pairs of legs. My front two legs are short. My back four legs are very long. Some people say my four long legs make me look like a drone.

Drones float in the air, and I float on the water! I can walk on water, too. Is it because I'm light? I am light, but there is a more scientific reason. It's because I use surface tension.

There are thousands of fine hairs covering my whole body. The hairs shut in air while my legs push on the surface of the water and spread my weight out. The water pushes my legs up. That's how I float on the water.

Look for me in the water!

Unit 9 Speed Racers

How can we compare the speed of objects? There are two ways to do it.

We can compare their speed over the same distance.

For example, five people run a 100-meter race. The person who finishes first is the fastest.

We can also compare how far objects can travel at different speeds over the same amount of time.

A bicycle travels 60 km in 3 hours. A car travels 240 km, and a train travels 300 km in the same time.

Which is the fastest? It's the train. It travels the farthest in the same amount of time.

Let's compare the speed of objects over the same amount of time.

Step 1. Draw a starting line on the floor. Place a tape measure so it is vertical to the line.

Step 2. Prepare three paper cars. Place one car at the starting line and set a time for the race, for example 1 minute.

Step 3. Move the paper car using a fan. Mark where the car stopped and measure how far it moved.

Step 4. Now do it for the other two cars. Which car moved the farthest?

The first car went 72 cm, the second car went 52 cm, and the third car went 40 cm.

The first car went the farthest in the same amount of time, so it is the fastest.

Which car was the fastest for you?

Unit 10 A Race to Grandfather's House

It's Sally's grandfather's birthday. Sally and her uncle both arrive at Grandfather's home at 10 a.m.

"Hi, Uncle Pete!" says Sally. "When did you leave home?"

"We left home at 8 a.m., so it took us 2 hours to get here," Uncle answers. "When did you leave?"

"We left at 7 a.m., so it took us 3 hours. Hmm... Whose car was faster? How can we find it out?"

"We need to work out the velocity," says Uncle Pete.

"Your home is 240 kilometers away from Grandfather's. It took you 3 hours, so divide 240 km by 3 hours. That's 80 km/h. My home is 140 kilometers away from here, and I took 2 hours to get here. Divide 140 by 2 to make 70 km/h."

Sally asks, "So our car was 10 km/h faster than your car, right?"

"Right, Sally. You won!" says Uncle.

Unit 11 The Changing Volumes of Gases

You want to play table tennis. The ball rolls off the table and you step on it by mistake.

Oh, no! Now the ball is crushed! How can you play?

Can you fix the crushed ball?

Step 1. Put a balloon over the mouth of a triangular flask.

Step 2. Put the flask in a beaker filled with hot water.

Step 3. Now, put the flask in a beaker filled with ice water.

The volume of gases gets bigger when they get hotter. The hot gases made the balloon bigger. The volume of gases gets smaller when the gases get colder. The cold gases made the balloon smaller.

So, how can we fix the crushed ball? Can you work it out?

That's right.

Put the ball in hot water. The volume of the gases in the ball will get bigger.

The crushed ball will return to its original shape!

With your knowledge of the volume of gases, you can play table tennis!

Where else can you use this knowledge?

Unit 12 Cold Air, Hot Air

“Brian, look at this stew!” says Erica. “It looks weird! Mom said to eat it for dinner, but I’m not sure whether it’s okay to eat.”

“What’s wrong?” says her brother.

“Look at the plastic wrap on top. It’s curved downward. Does that mean it’s rotten?” Erica says.

“Don’t worry, Erica!” laughs Brian. “It’s just because the stew was in the fridge. It got cold. The air between the plastic wrap and the stew got cold, too. The volume of the air got smaller, so the plastic wrap curved downward.”

“What happens when you microwave the stew? Will the volume of air get bigger?”

“That’s right. The plastic wrap will curve upward!”

“Wow! And then we can eat the stew?”

“Yes, once we take off the plastic wrap!”

Unit 13 Stems Carry Water

Plants are made of roots, a stem, and flowers, among other parts. Roots spread out under the ground. They support the plants and absorb water. The stem brings the water from the roots to the flowers.

How can we see the water move up a plant?

Prepare some red food coloring and the stem of a lily.

Step 1. Add the red food coloring to the water. Put the lily stem in the red water for 4 hours.

Step 2. After 4 hours, take the stem out and cut it horizontally. Make sure not to cut yourself. What do you see?

Step 3. Now, cut it vertically and see what it looks like.

You can see red dots when you cut it horizontally.

You can see red lines when you cut it vertically.

The red parts show us how the water moved up the stem.

There are many thin tubes inside a plant's stem. These tubes carry water from the roots to the flower.

The appearance of stems varies. Some are thick and straight. Some are long and thin. Some wind around other objects.

All of them bring water from the roots to the flowers. Aren't they clever?

Unit 14 Grandmother's Garden

Brian visits his grandmother for the weekend. He loves helping her in her garden.

Today, Brian is digging up some sweet potatoes. He stops digging when he sees something interesting.

"Grandma, those tomato plants have upright stems. But these sweet potato stems crawl along the ground."

"That's right," says Grandmother. "A crawling stem, like that of these sweet potatoes, is called a stolon. Sweet potatoes and strawberries have stems like this."

"Plants are so interesting. What other plants have different stems?" asks Brian.

"Well, morning glory stems wrap around other objects."

"Wow! That's cool."

"Yes, there are many different types of stems. They look different, but they all do the same thing. They all support the plant. They all carry water and nutrients."

Brian keeps digging sweet potatoes. Learning about plant stems is good, but Grandmother's sweet potato pie is better!

Unit 15 What's the Weather Like Today?

In the morning, you check the weather forecast before you go out. But who makes the weather forecast? And how do they do it?

Meteorologists predict the weather. They know what the weather will be like in the next few days.

They do this in many different ways. They send weather balloons high up in the sky to record atmospheric pressure. They use satellites to see if there is wind or rain on the way. They also know what the weather is usually like in an area or at this time of year.

All of this information goes into computers. The computers analyze the information to predict the weather.

We can see weather reports on our phone. We can watch weather forecasters on TV. Sometimes they get things wrong. But it's still a good idea to check the weather forecast!

Unit 16 Hydro Helpers

71 percent of Earth's surface is covered with water. It's all around us. But only 3.5 percent of Earth's water is fresh water. The rest is salty seawater.

Humans can only drink fresh water. We need it to live.

Therefore, it's important to protect fresh water. We must keep it clean and safe from pollution. We must make sure everyone on Earth has safe water to drink.

Hydrologists help with this. "Hydro" means water. These scientists study the water. They help protect it.

They sort out the problems with contaminated water. They look for water to drink.

Groundwater is water that is held underground. Hydrologists look for groundwater that can become drinking water for people. They make sure it is clean and safe to drink. They save lives!

Hydrologists are very important. Think of them when you have a cold glass of water today.