

Unit 1 What's the Temperature?

Thermometers tell us when it is hot or cold. They tell us the exact temperature. We use them in our daily lives.

How do they work?

Can we make our own thermometer?

Let's make a thermometer with everyday materials.

Step 1. Pour water into a small bottle and add a few drops of food coloring.

Step 2. Poke a small hole in the lid.

Step 3. Close the lid. Put the straw through the hole so it touches the water. Seal it with clay.

Step 4. Draw horizontal lines on a piece of paper and put it on the straw.

What did we see?

When the temperature was warm, the water went up inside the straw.

When the temperature was cold, the water went down into the bottle.

How does it work? Liquids increase when they meet something warm.

The water moves up the straw. Water decreases when it meets something cold. So, it moves down the straw.

The thermometer showed us the change in temperature.

Unit 2 James Feels Hot

James coughs. He feels sick.

“Mom, my forehead is too hot!” he says.

Mom takes a thermometer out of a drawer.

She checks his temperature. It’s normal.

“You seem okay,” she says.

James looks at the thermometer. “Mom, what’s the red stuff inside?”

Mom says, “It’s alcohol. Alcohol changes its volume, so it goes up and down quickly.

For this reason, alcohol is used in thermometers.”

“There are many kinds of thermometers. This one measures your body temperature. I also use one in the kitchen for cooking. There are thermometers in botanical gardens and hospitals as well!”

“Wow. Do we have any more thermometers at home?”

“Let’s go and see!”

Unit 3 Melting Points

It was very cold. Mandy and Mark went to the movie theater. When the movie finished, they went out.

“The ice on the street didn’t melt!” said Mandy.

When they got home, Mark put some ice in a glass of water. It melted in five minutes!

Does ice melt at a different speed in different liquids? Let’s see!

Step 1. Pour cola, milk, and water into different bowls. Put an ice cube in each bowl at the same time.

Step 2. See how long it takes for the ice to melt in each bowl.

The ice melts in this order: first in water, then in cola, and then in milk.

Ice melts fastest in pure water. But ice melts slowest in milk.

The melting point is the temperature when a solid changes to a liquid.

The melting point of water is higher than the other liquids

Water is a pure substance. Mixtures have lower melting points than pure substances.

That is why ice melts the fastest in water.

Unit 4 The Case of the Disappearing Snowman

Emma woke up early on Christmas morning.

Snow was everywhere!

“Dad, let’s make a snowman!” she said. So they did.

Then she went to her grandparents’ for a tasty meal. That evening, they came home.

“Dad, the snowman ran away! Where is it?”

“It was warm today,” said her dad. “The snow melted.

“Last night, the temperature was below zero degrees Celsius. The water vapor in the air froze. It turned to snow and fell from the clouds.

“Today, the temperature was warm. It was more than zero degrees Celsius. So the snow melted. Zero degrees Celsius is the melting point of water.

“Look, can you see the water where your snowman was?”

“I see it! Can we make a snowman next time it snows?”

“Of course! Now, who wants some ice cream?”

Unit 5 Wet and Dry

Do you know what high humidity is? It's when there is a lot of water vapor in the air.

When it's hot and humid, you sweat a lot. The sweat stays on your body. You feel hotter.

When it's cold and humid, your clothes get wet.

When cold wind blows on them, you feel colder.

Let's see how humidity works.

Let's make a hygrometer.

Step 1. Make an arrow out of a straw. Make a hole in the arrow. It should be slightly larger than the size of a pin.

Step 2. Put a pin through the hole, and pin it to the bottom of a thick piece of cardboard.

Step 3. Take a long hair. Stick one end to the top of the cardboard. Stick the other end to the arrow.

Step 4. Take a hairdryer and blow hot air on the hair.

Step 5. Now, put the hygrometer in a bag with a wet sponge. Close the bag and wait.

When we used the hairdryer on the hair, it got shorter, and the arrow moved.

When we put the hygrometer in the bag, the hair got longer, and the arrow moved the other way.

Why did this happen? The hairdryer dried out the air around the hair. It made the hair shrink. In contrast, hair expands when it's wet or humid. Humidity can even make your hair curly!

Unit 6 Hot and Humid

It rained all day yesterday, but today it's sunny.

Mia goes to the park with her mom. It's really hot and sticky.

Mom says, "The weather today is really hot and humid."

"Humid? What's that?" Mia asks.

"Humidity is how much water vapor there is in the air. High humidity means there is a lot of water vapor in the air. Low humidity means there is little water vapor in the air.

"When the humidity is too high, like today, you feel hotter.

You sweat more. And food goes bad quickly!"

"So high humidity is harmful?" asks Mia.

"Not at all. When the humidity is too low, the air is dry. It dries your skin and eyes. It can be hard to breathe."

"Well, it's too humid today. Let's go home," says Mia.

Unit 7 Heat Transfer

Leave a spoon in a hot pot of soup. When you touch it later, the spoon is hot!

But the spoon handle wasn't inside the soup.

Why did it get hot?

Heat moved up the spoon.

When you heat part of a solid material, that part gets hotter. Then the heat moves to the rest of the object.

The whole object gets hot over time. Heat moves through solid materials. This is called "conduction."

Let's watch it happen. This experiment involves fire, so be careful.

Step 1. Prepare three different copper sheets.

Step 2. Attach thermochromic adhesive labels to the three different copper sheets.

Step 3. Heat a corner of each copper sheet and observe the color change on the labels.

Step 4. Draw the direction the color changes when heating the copper sheets.

The first part of the sheet to change color is the part near the fire. Then the rest of it changes.

Heat transfers from a high temperature to a low temperature.

Unit 8 Insulating Ice

Danny saw a picture of an igloo in a magazine.

“Wow, Mom, look! A house made of ice! But isn’t it cold in there?”

“No, not at all. The house is made of cold ice. But it isn’t cold inside because of insulation!”

“What’s insulation?”

“Insulation stops heat escaping from an object or a place.

“Put a lid on a hot cup of tea. The tea stays hotter for longer. Wear a jacket in winter. Hot air stays near your body.”

“Oh, that’s why you tell me to close the windows in winter! To keep the hot air in the house.”

“That’s right.”

“I’m glad that even people at the North Pole can stay warm.”

Unit 9 Dissolving Substances

Put sugar in your tea. Put salt in your soup.

They mix with the liquid. They seem to disappear.

You can't see them, but the sugar and the salt are still there. Drink the tea. It tastes sweet.

Try the soup. It tastes salty. The sugar and the salt mixed with the liquids.

When a substance mixes with another substance, we call this "dissolution."

Step 1. Pour water in a beaker. Put the beaker on an electronic scale.

Step 2. Put a sugar cube on the scale, too. Weigh them together.

Step 3. Now, put the sugar cube in the beaker, and dissolve it completely in the water.

Step 4. Weigh the beaker again.

The weight of the beaker doesn't change. It is the same before and after dissolving the sugar cube in it.

The sugar cube is still in the water. It dissolved in the water. It mixed with the water.

Unit 10 Solvents and Solutes

Today, some friends of Lisa's mom came to visit her at home. They ate cookies and drank coffee.

Lisa's mom put sugar cubes in her bitter coffee.

The sugar completely disappeared!

Lisa wanted to ask what happened, but her mom was busy talking. So Lisa looked online.

"Oh, the sugar didn't disappear. It just dissolved. It got very small, and it mixed into the coffee. Now mom's coffee is much sweeter!"

Lisa saw that substances that dissolve in other substances are called "solute."

Sugar and salt are solutes.

The substance they dissolve in is called a "solvent." Water and coffee are solvents.

That's why you can taste salt when you pour it on your food. But you can't see it.

Then Lisa mixed some substances together. Sugar dissolved in milk. But not everything worked. Water didn't dissolve in oil!

Unit 11 All the Stars in the Sky

There are various stars in the night sky. People group the bright stars together into recognizable shapes called constellations. Some of them look like people or animals.

Let's make a light box and see the constellations at home.

Step 1. Look at a map of the stars. Make holes in the lid of a box to match one constellation.

Step 2. Make a large hole in the bottom of the box. Put a flashlight in the hole.

Step 3. Show your friends the constellation light box that you made. Go to a dark room, shine the flashlight at the ceiling or the walls, and enjoy the constellation show.

Constellations are different in summer and winter.

This is because Earth moves around the sun. As Earth moves in space, we can see different stars.

Unit 12 Orion and the Big Dipper

Ryan went camping with his dad. They sat around the campfire at night.

Ryan looked up at the night sky. Wow! There were so many stars in the sky. Ryan couldn't see that many in the city.

In the city, fog, lights, and tall buildings hid the stars.

Dad pointed to the sky. "Look! There's Orion!"

"Orion? What's that?"

"Orion is a man, but not a real man. It's a constellation. That's a group of stars that looks like something. It's easy to spot Orion in the winter sky here. Just look for three stars that look like a belt."

"I see them!" says Ryan. "I can see Orion. Are there any more?"

"Many more. Look over there. That one looks like a ladle. It's called the Big Dipper."

Unit 13 Water in the Air

Go outside early in the morning. Can you see drops of water on the grass or leaves?

These drops are called dew.

There are low and thick clouds close to the ground, making it difficult to see. That's called fog.

Fog and dew are different. But both are made by water in the air.

Dew forms when water vapor meets cold leaves or branches. Then, the air cools down, and the water vapor in the air condenses.

Let's watch it happen.

Step 1. Fill 2/3 of a jar with water and ice cubes.

Step 2. Wipe the surface of the jar with a dry towel. Then, observe the changes on the surface of the jar.

The vapor outside the jar condenses. It forms water drops on the surface of the cold jar.

Fog forms from water vapor as well.

Step 1. Fill up the jar with warm water to warm it up. Then pour out the water.

Step 2. Put a lit incense stick into the jar for a minute. Then, take it out.

Step 3. Place a dish with ice cubes on top of the jar. See what happens.

The ice cools the warm water vapor. The water vapor condenses, and it makes fog inside the jar.

Unit 14 Steaming Hot Soup

Kevin is very hungry. Dad made carrot soup for dinner. Mmm!

Dad puts the hot bowls on the table and starts to eat.

Kevin starts laughing.

“What’s funny?” asks his dad.

“Your glasses are foggy! You look like Grandfather!”

Kevin’s dad laughs.

“That’s because of the steam,” he says. “Hot water vapor comes out from the soup, and it hits my cold glasses. The vapor cools down quickly and turns to liquid.”

Kevin thinks about his morning shower.

“That’s why the mirror steams up when I have a shower!”

“Yes! That’s right,” says Dad. “Now eat your soup before it cools down.”

Look for steam around you when you get home today.

Unit 15 Aerospace Engineers

Do you know about the Wright brothers?

The Wright brothers invented the first airplane in 1903. It only flew for 12 seconds! It flew just 36 meters.

Now, planes can fly from Asia to America. They can fly for 21 hours non-stop. Planes can fly over 15,000km!

Who made planes better? Aerospace engineers did. They keep designing better planes.

They make planes faster, quieter, and safer. They make planes from better materials.

They think of better shapes. They make planes better for the environment.

Aerospace engineers don't just design planes. They design drones and helicopters.

They even design things that can travel in space, like satellites and space rockets.

Would you like to design a rocket to visit the rest of the universe?

Become an aerospace engineer!

Unit 16 3D Printing

We can print photos. We can print books.

Can we print a pen? Or a cup? Or even a pizza?

Yes, we can! 3D printers can print anything we can imagine. Special 3D printers can even print food!

Install special software on your computer. Design anything you want.

Your computer delivers the design to the 3D printer. The printer moves in all directions. It makes your design real.

Mechanical engineers designed the first 3D printers forty years ago. The printers used to be very big and very expensive. They couldn't print many things. Now they are smaller, and they are cheaper. They can print more and more things.

Doctors can make artificial 3D-printed hearts. Artists can 3D-print their art. You can print your own toys.

We can print anything we like thanks to 3D printers!