

What causes us to feel hot and cold?

## HEAT AND TEMPERATURE

Ana and her friend are eating at a restaurant.

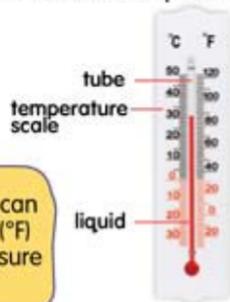


Heat is a **form of energy that is transferred due to the difference in temperature**. A material will become hotter when gaining heat. A material will become colder when losing heat.

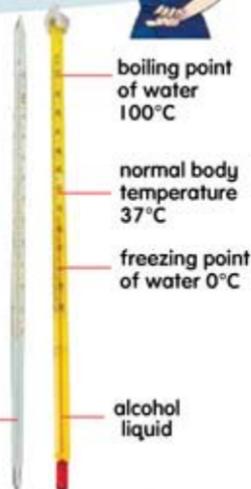
How do we measure the temperature of a material?



Temperature is the **degree of hotness or coldness of a material**. Temperature can be measured using a thermometer. The standard unit for measuring temperature is degree Celsius. The symbol for degree Celsius is  $^{\circ}\text{C}$ . Let us look at the pictures of thermometers.



room thermometer



laboratory thermometer

### SCIENCE INFO

Besides degree Celsius, we can also use degree Fahrenheit ( $^{\circ}\text{F}$ ) on the thermometer to measure temperature.

## THERMOMETER

The liquid in the thermometer will expand or contract when exposed to different surrounding temperatures.



When the temperature decreases, the liquid level in the thermometer falls as the liquid contracts.



When the temperature increases, the liquid level in the thermometer rises as the liquid expands.



How to use the thermometer correctly?

Let us observe how to use the thermometer with the correct technique.



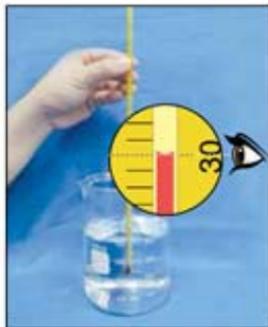
1. Place a beaker filled with water on a flat surface.



2. Hold the upper part of the thermometer upright.



3. Immerse the thermometer into the beaker. Ensure that the bulb of the thermometer does not touch the bottom surface of the beaker.



4. When the liquid level in the thermometer remains constant, adjust the position of the eye to the meniscus of the thermometer to obtain the temperature reading.



What is the meniscus level in a thermometer?

Meniscus level is the curved level of the liquid in the glass tube of a thermometer.



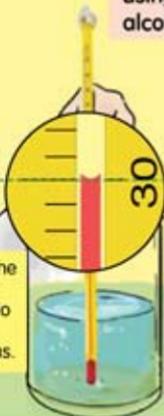
How do we determine the meniscus correctly?



Way to obtain the temperature reading using a laboratory thermometer with alcohol liquid.



Position of the eyes must be levelled to the level of the meniscus.



Position of the eye is too high



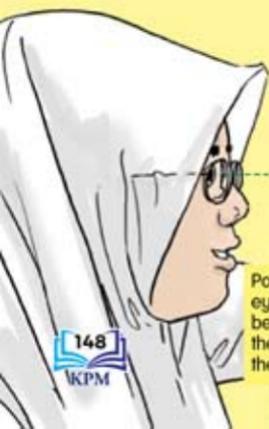
Position of the eye is correct



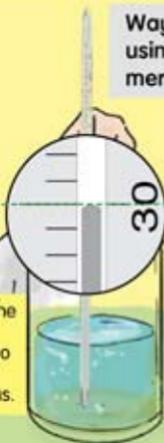
Position of the eye is too low



Way to obtain the temperature reading using a laboratory thermometer with mercury liquid.



Position of the eyes must be levelled to the level of the meniscus.



The correct position of the eye



What do heat and temperature mean?





## LET'S TEST

# THERMOMETER



### AIM

Using the thermometer with the correct technique to measure the temperature of water.

### APPARATUS AND MATERIALS

Beaker, thermometer, tap water, hot water, and cold water.

### STEPS



- Place the beaker on the table and pour 250 ml of tap water into the beaker.
- Immerse the thermometer into the beaker. Ensure that the bulb of the thermometer does not touch the bottom surface of the beaker.
- Wait until the liquid level in the thermometer becomes constant. Measure the temperature of the tap water at the correct meniscus level.
- Repeat steps 1 to 3 using hot water and cold water.
- Record the observations in the table as shown below.
- Construct a bar chart using the data in the table.

Types of water	tap water	hot water	cold water
Temperature (°C)	/	/	/

**!** Thermometers cannot be used for stirring.

- Report the results of your group's activity.



- Explain the correct ways to measure the temperature using a thermometer.
- Compare your bar chart with other groups.
- Predict the temperature of the tap water if it is mixed with ice.



Identify the thermometers as shown in the pictures and state their functions. (a)



(b)

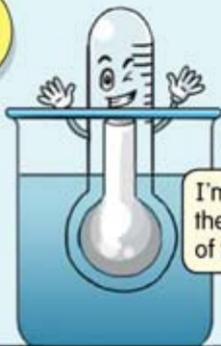
## CHANGES IN THE WATER TEMPERATURE

The temperature of our surrounding is constantly changing. The temperature of water also changes according to the temperature of its surrounding. Let us follow the story of Mr Thermometer to understand changes in the temperature of water.

It's cold. The temperature at  $0^{\circ}\text{C}$  has reached the freezing point.

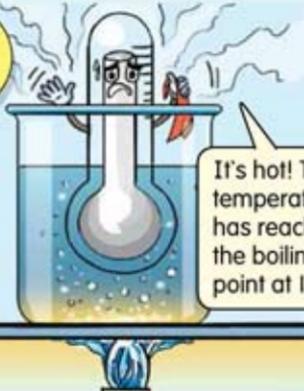


after  
40  
minutes



I'm comfortable at the temperature of  $26^{\circ}\text{C}$ .

after  
15  
minutes



It's hot! The temperature has reached the boiling point at  $100^{\circ}\text{C}$ .



Based on the story above, ice changes to water when the temperature increases. When heating duration of water increases, its temperature also increases.

Let us carry out an experiment to determine the relationship between space and time by observing the changes in the temperature of water when heated.



## LET'S TEST

# FREEZING POINT AND BOILING POINT



### AIM

To observe the changes in temperature when ice is heated and to determine the freezing point and boiling point of water.

### APPARATUS AND MATERIALS

Retort stand, tripod stand, wire gauze, Bunsen burner, beaker, thermometer, stopwatch, lighter, and ice cubes.

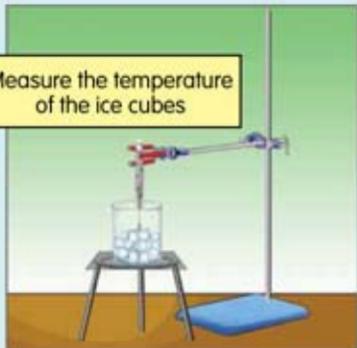
### STEPS

1. Prepare the apparatus as shown in the picture.
2. Start the stopwatch and measure the temperature of the ice cubes using the thermometer.
3. Turn on the Bunsen burner.
4. Record the temperature of the water every five minutes until the water boils.
5. Stop heating the water when it boils.
6. Record the observation in the table as shown below.

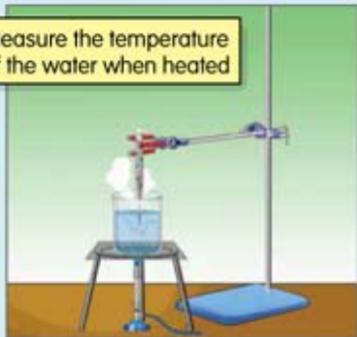
Time (minutes)	0	5
Temperature ( $^{\circ}\text{C}$ )		
When water is heated		

7. Construct a bar chart based on the data collected.
8. Discuss your group's observations with other groups.

Measure the temperature of the ice cubes



Measure the temperature of the water when heated



Be careful when handling the hot water and the Bunsen burner.



- (a) State the freezing point and the boiling point of water.
- (b) What is the trend of change of the temperature when the water is heated?
- (c) State the relationship between the heating duration and the water temperature.

## WATER AT ROOM TEMPERATURE

How does the temperature of water change when hot water cools to room temperature?



How does hot water become cool?

The heat in the hot tea flows to the metal spoon. The metal spoon becomes hot because it gains heat energy from the hot tea.

The heat in the metal spoon flows to our hand when we touch it. Our hand feels warm because it gains heat from the metal spoon.

The heat from hot water flows to the surrounding from a hot to cold area. This causes the hot water to lose heat and the temperature of the water decreases. The temperature of the water will decrease until it is equal to the temperature of the surrounding or the room temperature.

### SCIENCE INFO

People who live in an extremely cold climate make bonfire to warm themselves. The heat energy from the bonfire flows to the surrounding.





## AIM

To describe the changes in the temperature of hot water when it is cooled to room temperature.

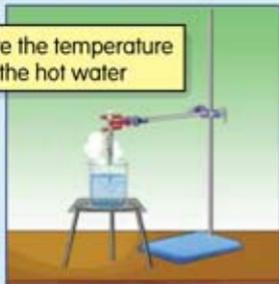
## APPARATUS AND MATERIALS

Retort stand, tripod stand, wire gauze, beaker, thermometer, stopwatch, and hot water.

## STEPS

1. Prepare the apparatus as shown in the picture.
2. Pour 200 ml of hot water into the beaker.
3. Measure the temperature of the hot water every five minutes until its temperature becomes constant.
4. Record the observations in the table as shown below.

Measure the temperature of the hot water



Time (minutes)	Temperature ( $^{\circ}\text{C}$ )
0	/
5	/

5. Construct a bar chart based on the data collected.
6. Then, upload the bar chart on Google Classroom.
7. Discuss your group's observations with other groups.



Be careful when handling the hot water.



- (a) What can you observe in the trend of change in the temperature?
- (b) At what minute does the temperature of the water become constant?
- (c) Describe the change in the water temperature when the hot water cools to room temperature.

## EXPANSION AND CONTRACTION OF MATERIALS

Materials will expand when gaining heat and contract when losing heat. Let us observe the situations below.

Melia poured hot water into a drinking bottle and then she screwed the cap. A few minutes later, she observed the situation that happened below.



What causes the bottle cap to pop off?

The air in the drinking bottle expanded when it gained heat from the hot water. This causes the bottle cap to pop off.

Melia noticed that two glasses are overlapping and are difficult to be separated. She did the following steps below to solve her problem.



How can the overlapping glasses be separated?

When the ice cubes are put into the glasses, the glasses will contract because they lose heat. Thus, the overlapping glasses can be separated.

What are the effects when a material gains or loses heat? Let's carry out an experiment to observe the effects of heat on materials.



# EXPANSION AND CONTRACTION OF MATERIALS



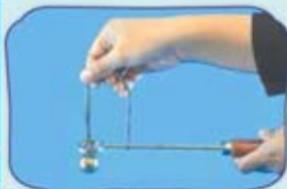
## ACTIVITY 1

**AIM** To observe the effect of heat on a metal ball.

**APPARATUS AND MATERIALS**

Metal ball and metal ring set, Bunsen burner, lighter, glass container, test tube holder, and water.

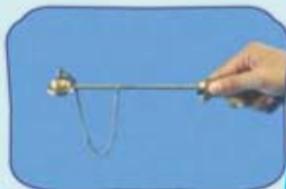
**STEPS**



1. Insert the metal ball through the ring and observe it.



2. Light the Bunsen burner and heat the metal ball for three minutes.



3. Insert the metal ball through the ring again and observe it.



4. Put the metal ball into the glass container filled with water.



5. Insert the metal ball through the ring again and observe it.

Step	Observation	Inference
Step 1	/	/
Step 3	/	/
Step 5	/	/

6. Record the observations and inferences in the table as shown above.
7. Discuss your group's observation in front of the class.



1. Be careful when handling the Bunsen burner.  
2. Use the test tube holder when handling the hot metal ball.



What can you conclude when the metal ball is heated and cooled?

## ACTIVITY 2



**AIM** To observe the effect of heat on liquid.

### APPARATUS AND MATERIALS

Conical flask, glass tube, one-holed cork stopper, coloured water, a glass container filled with hot water, and a glass container filled with ice.

### STEPS



1. Pour coloured water into the conical flask until it is full.



2. Attach the glass tube to the one-holed cork stopper. Then, close the conical flask with the cork stopper.



3. Put the conical flask into the glass container filled with hot water and observe the level of water in the glass tube.
5. Sketch and record your observations in the table as shown below. State your inference for each observation.

Step	Observation	Inference
Step 3	/	/
Step 4	/	/



4. Put the conical flask into the glass container filled with ice and observe the level of water in the glass tube.
6. Discuss your group's observation in front of the class.

**!** Be careful when handling the hot water.



What can you conclude about the level of water in the conical flask when the conical flask is immersed in a glass container filled with:  
(a) hot water?      (b) ice?

### ACTIVITY 3



**AIM** To observe the effect of heat on air.

#### APPARATUS AND MATERIALS

Plastic bottle, balloon, a glass container filled with hot water, and a glass container filled with ice.

#### STEPS



1. Insert the nozzle of the balloon over the mouth of the plastic bottle.



2. Immerse the plastic bottle into the glass container filled with hot water and make an observation.



3. Immerse the plastic bottle into the glass container filled with ice and make an observation.

5. Discuss your group's observation in front of the class.

4. Sketch and record your observations in the table as shown above. State your inference for each observation.

Step	Observation	Inference
Step 2	/	/
Step 3	/	/



What can you conclude about the size of the balloon when the plastic bottle is immersed in the glass container filled with:  
(a) hot water?      (b) ice?

What is your conclusion based on the results of Activity 1, 2 and 3?



Be careful when handling the hot water.



## THE IMPORTANCE OF EXPANSION AND CONTRACTION PRINCIPLE OF MATERIALS

The effect of heat on a material can cause the material to undergo expansion and contraction. The situations in the pictures below show the process of expansion and contraction of materials in daily life.

### Gaps between connectors on a metal bridge



The gaps between metal connectors on the bridge allow the bridge to expand when the temperature of the surrounding increases.



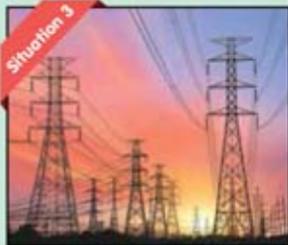
### Gaps between connectors on the railway tracks



The gaps between the connectors on a railway track allow the track to expand when the temperature of the surrounding increases.



### Electric cables are hung loosely



The electric cables are hung loosely between the electric poles to allow the wires to contract when the temperature decreases.



Why are the applications of expansion and contraction principle of materials very important in our daily life?





## FUN ACTIVITY

# THE IMPORTANCE OF CONTRACTION AND EXPANSION PRINCIPLE OF MATERIALS

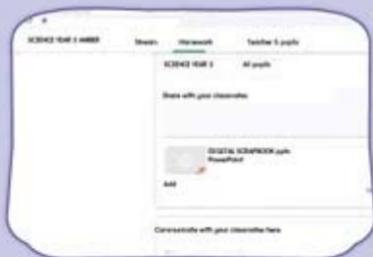
### APPARATUS AND MATERIALS

Computer and internet access.



### STEPS

1. Surf the internet to find information and pictures about the expansion and contraction principle of materials in our daily life.
2. Download the information and pictures.



3. Make a digital scrapbook about the importance of expansion and contraction principle of materials in our daily life.
4. Upload the digital scrapbook on Google Classroom.



- (a) State daily activities that involve the expansion and contraction principle of materials.
- (b) Why does the expansion and contraction principle of materials as identified in the activity very important in our daily life?



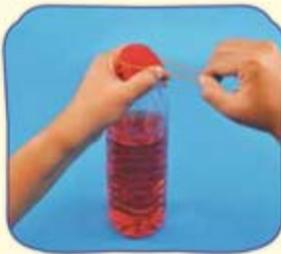
Produce a handmade thermometer using a plastic bottle, rubber band, transparent drinking straw, coloured water, balloon, a glass container filled with hot water, and a glass container filled with ice.



My thermometer

**STEPS**

1. Pour coloured water into the plastic bottle.



2. Tie the balloon at the neck of the bottle using a rubber band.



3. Make a hole at the centre of the balloon to insert the drinking straw.



4. Put the plastic bottle into the glass container filled with hot water and observe it.



5. Put the plastic bottle into the glass container filled with ice and observe it.



Be careful when handling the hot water.



## MIND REFLECTION

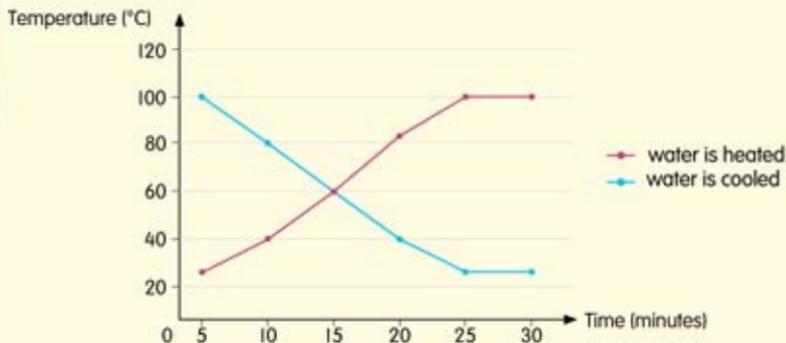
1. Heat is a form of energy that is transferred due to the difference in temperature.
2. A material becomes hotter when it gains heat and becomes colder when it loses heat.
3. Temperature is the degree of hotness or coldness of a material.
4. Thermometer is used to measure the temperature. The standard unit for temperature is degree Celcius ( $^{\circ}\text{C}$ ).
5. When the temperature of a material decreases, the level of liquid in the thermometer falls as the liquid contracts.
6. When the temperature of a material increases, the level of liquid in the thermometer rises as the liquid expands.
7. The meniscus level is the curved level of the liquid in the glass tube of a thermometer.
8. Freezing point of water is  $0^{\circ}\text{C}$ .
9. Boiling point of water is  $100^{\circ}\text{C}$ .
10. When hot water is left unattended, the temperature of the water will decrease until it is equal to the temperature of the surrounding and remains constant.
11. The expansion of a material occurs when materials such as solids, liquids, and gases gain heat from the surrounding.
12. The contraction of a material occurs when materials such as solids, liquids, and gases lose heat to the surrounding.
13. The application of the expansion or contraction of materials is important in daily life. For example:
  - the gaps between the metal connectors on the bridge allow the bridge to expand when the surrounding temperature increases. This prevents damages to the surface of the bridge when it gains heat.
  - the gaps between the connectors on the railway track allow the track to expand when the surrounding temperature increases. This prevents the track from bending when it gains heat.
  - the electric cables are hung loosely between the electric poles to enable them to contract when the surrounding temperature decreases. This prevents the electric cables from snapping when they lose heat.



## MIND TEST

Answer all questions in Science exercise book.

1. State the meaning of the following:  
(a) heat. (b) temperature.
2. What is the temperature of water at the:  
(a) freezing point? (b) boiling point?
3. Read the situations below and answer the following questions:  
(a) Ravi left the key for his bicycle lock at the school field. He was surprised because the key was too hot and cannot be held. Based on this situation, what caused the key to become too hot?  
(b) Ana put a bottle of hot milk for her little brother in a container filled with tap water before giving it to him. Based on this situation, why did Ana put the hot milk bottle in the container filled with tap water?
4. The graph below shows the changes in water temperature when the water is heated and cooled.



- (a) What is the trend of change of the temperature as the water is cooled?
- (b) What is the trend of change of the temperature as the water is heated?
- (c) What is the boiling point of the water in the graph above?
- (d) At what minute does the temperature of the water reach the boiling point in this activity?
- (e) At what minute does the temperature of the heated water and the cooled water become the same?
- (f) What hypothesis can you make from the trend of change of the water temperature?