

UNIT 6

FORCE

Adam and his friends are on duty in the school library.
Observe their activities.



Based on the situation above, how are the books in the school library moved and arranged?

Force

We apply force to perform various activities. Force is a pull or push that acts upon an object.



What is the force applied in each activity below?

closing a door



opening a door



pressing a clipboard



opening a laptop lid



pulling the zipper of a pencil case



pressing the keyboard keys



Pull is an action that moves an object closer towards us.
Push is an action that moves an object away from us.





LET'S TEST >>> Push and Pull

Aim: To state the meaning of force by carrying out an activity

Apparatus and materials: pencil case, spring, ping-pong ball, bar magnet, paper clips

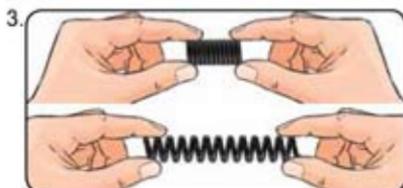
Steps: Carry out the activities below and record your observations.



Push the pencil case.



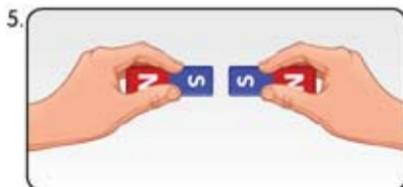
Pull the pencil case.



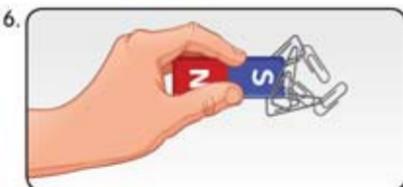
Compress the spring and release it. Then, stretch the spring and release it.



Throw the ball up and observe its movement.



Bring two magnet bars of the same pole together.



Bring a magnet bar towards some paper clips.

Questions:

1. What is the meaning of force?
2. What is the force applied in each activity above?
3. Which activity involves a force applied without the need for contact with the object? What is that force?



What type of force is Earth's gravity? Explain.

Effects of Force

The force applied by an object on another object cannot be seen. However, the effects of the force can be observed and felt.

When Adam is shaking hands with Chua, his hand is applying a force on Chua's hand.



The applied force cannot be seen but we can feel it.



Observe these pictures to understand the effects of force.

Force changes the shape of an object



The shape of a toothpaste tube changes when it is squeezed.



Clay can be pressed and shaped to make various shapes of flowerpots.

Force changes the direction of movement of an object



The player hits the shuttlecock to his opponent.



The player dribbles the ball to control its direction.

Force changes the speed of an object



The cyclist increases his speed by applying more force on the pedals.



The force from the waves can increase or decrease the speed of the kayak.

Force moves a stationary object



The worker pulls the trolley to move the boxes.



The bowling pins fall after the bowling ball hits them.

Force stops a moving object



Force can stop a moving toy car.



The ball is stopped from entering the goal post.

SCIENCE INFO

A plastic comb that is rubbed with a cloth can attract tiny pieces of paper through electrostatic force.





FUN ACTIVITY

Identifying and Explaining the Effects of Force

Apparatus and materials: camera, computer, Internet access, Google Slides, Google Classroom



Google Slides app



Steps:

1. Identify and carry out three activities that show the effects of force.
2. Take pictures or record a video while carrying out those activities.
3. Scan the QR code to use the Google Slides app.
4. Prepare your presentation using Google Slides.
5. Share your presentation slides using the Google Classroom app.

Questions:

1. State the force applied in the activities that you have carried out.
2. What are the effects of the observed force?



- Examples of activities that the pupils can do are kicking a ball, pulling a rubber band, changing the shape of modelling clay, and others.
- Teachers can modify the activities accordingly.
- Besides using Google Slides app, the pupils can also use Microsoft PowerPoint to prepare the presentation slides.

Frictional Force



Frictional force is the force produced when two surfaces are in contact with one another.



Frictional force is always applied in the opposite direction of the movement of the object.



**LET'S TEST****Frictional Force**

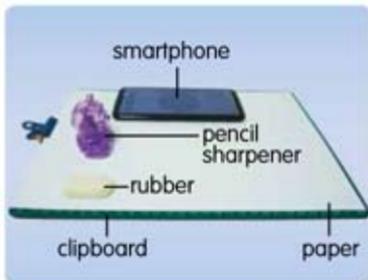
Aim: To state the meaning of frictional force

Apparatus and materials: smartphone, clipboard, paper, pencil sharpener, rubber

Steps:

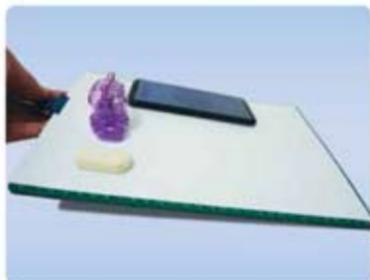
1. Download an inclinometer app in a smartphone. Open the app.
2. Clip a few sheets of paper on the clipboard.

3.



Arrange the apparatus and materials as shown in the picture.

4.



Tilt the clipboard slowly. Stop when the pencil sharpener or the rubber starts to slide down.

5. Take the inclinometer reading and record it in a table.

Object	Inclinometer reading
pencil sharpener	/
rubber	/

6. Repeat steps 4 and 5 for objects that have not been tested.

Questions:

1. Which object records the highest inclinometer reading? State your inference.
2. What do you understand about frictional force?



- The inclinometer app can measure slopes. It can be downloaded from Google Play Store and Apple App Store. The app is also known as clinometer or bubble level.
- Smartphones can be replaced with a protractor or a ruler to measure inclination of the clipboard.

Effects of Frictional Force



Miss Ena, how does a match light up?

A match can light up when heat is produced as a result of the frictional force between two surfaces that are in contact. The heat causes the end part of the match that is coated with flammable material to burn.



There are advantages and disadvantages of frictional force in our daily activities.

Advantages of frictional force



Rubbers can erase writings on paper.



Brake pads can slow down bicycles and stop their movement.



Sandpaper can smoothen the rough surface of wood.



Tread patterns on vehicle tyres can increase the grip on the soil.

Disadvantages of frictional force

1.



Frictional force can wear out shoe soles. The worn out shoe soles can cause us to slip easily.

2.



Loud noise is produced when drilling. It causes sound pollution.

3.



The friction in car engines can damage the engines over time.

4.



Rusty screws can increase friction and make them harder to loosen.

What are other effects of frictional force that you can observe?



FUN ACTIVITY

Effects of Frictional Force Around Me

Apparatus and materials: marker pen, manila card, sticky notes

Steps:

1. Identify the effects of frictional force around you.
2. In turns, write the effects of frictional force on sticky notes.
3. Sort the advantages and disadvantages of frictional force written on the sticky notes.
4. Paste the sticky notes on a manila card.
5. Discuss your observations in your group.



Question:

Based on your observation, describe the effects of frictional force in our daily lives.

Factors Affecting Frictional Force

Frictional force is affected by several factors. Let us carry out the experiments to test these factors.

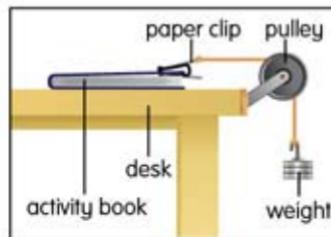


EXPERIMENT

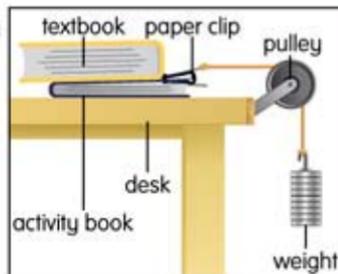
Mass of an Object



- Aim:** _____
- Problem statement:** How does the mass of an object affect frictional force?
- Hypothesis:** _____
- Variables:**
 - manipulated: _____
 - responding: _____
 - constant: _____
- Apparatus and materials:** pulley, paper clip, 10 units of 50 g weight, exercise book, textbook, thread
- Steps:**
 - Prepare the apparatus and materials as shown in picture A.
 - Add a 50 g weight until the exercise book begins to move on the desk.
 - Record your observation in a table.
 - Repeat steps 6(b) and 6(c) by adding a textbook on top of the activity book as shown in picture B.
- Data:** _____
- Interpreting Data:**
 - Based on the experiment, compare the weights that are used to move the books. Give your inference.
 - What is the factor that affects frictional force?
 - What is the operational definition of frictional force?
- Conclusion:** _____



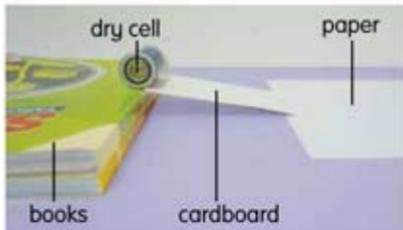
picture A



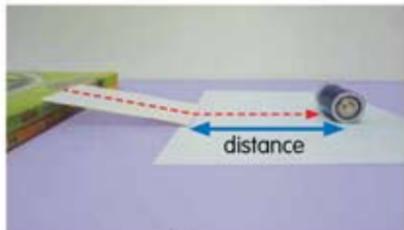
picture B



- Aim:** _____
- Problem statement:** How does the surface of an object affect frictional force?
- Hypothesis:** _____
- Variables:**
 - manipulated: _____
 - responding: _____
 - constant: _____
- Apparatus and materials:** ruler, two books, cardboard, dry cell, paper, cloth, sandpaper, small carpet
- Steps:**



picture A



picture B

- Arrange the apparatus and materials as shown in picture A.
 - Push the dry cell from the top of the books and let it roll down the cardboard.
 - Observe the movement of the dry cell and mark the location of where it stops.
 - Measure the distance travelled by the dry cell as shown in picture B.
 - Record the observation in a table.
 - Repeat steps 6(a) to 6(e) by replacing the paper with a piece of cloth, sandpaper, and a small carpet.
- Data:** _____
 - Interpreting Data:**
 - Based on the experiment, compare the distance travelled by the dry cell on the different surfaces. Give your inference.
 - What is the factor that affects frictional force?
 - What is the operational definition of frictional force?
 - Conclusion:** _____

Frictional Force in Daily Lives

Frictional force always exists in our daily lives. There are times when the frictional force needs to be reduced or increased so that an activity can be done effectively.

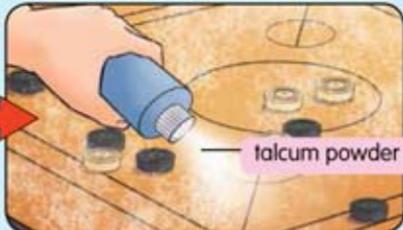
Ways to reduce frictional force

Father, the bicycle chain is tight and is making a noise. The bicycle is hard to paddle.

Let me help you.



The surface of the carrom board is not smooth enough.



It's so difficult to move this box!



SCIENCE INFO

Maglev is a magnetic train that uses electromagnetic attraction or repulsion to overcome frictional force as it travels.



Ways to increase frictional force



Explain ways to reduce and increase frictional force in each situation above.



FUN ACTIVITY >>> No Frictional Problems

Apparatus and materials: printer, Internet access, scissors, glue, marker pen, manila card



Be careful when using scissors.

Steps:

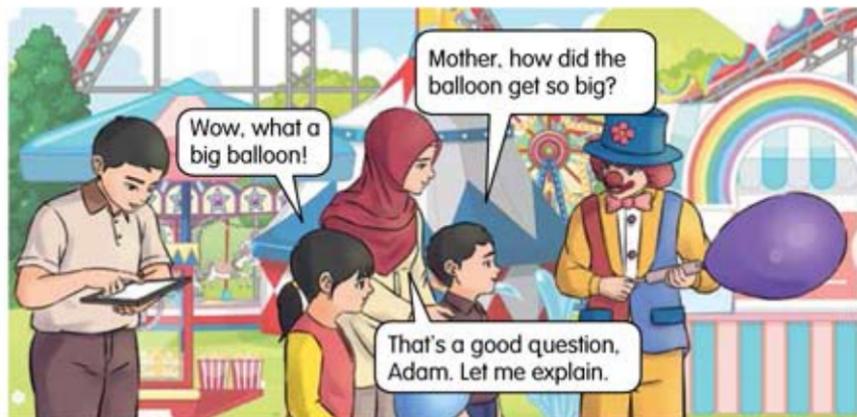
1. Find pictures that show problems related to frictional force in our daily lives.
2. Print the pictures and paste them on a manila card.
3. Identify ways to overcome problems related to frictional force. Write them on the manila card.
4. Discuss the answers with your partner.

Questions:

1. Based on the pictures observed, state the problems related to frictional force.
2. What are the ways to overcome these problems?

Air Pressure

Air exists around us. Air cannot be seen but air pressure is applied to all objects around us. How is air pressure created?



There are many air particles that move randomly inside the balloon.



The air particles inside the balloon collide with one another and with the surface of the balloon.



When air particles collide with the surface of the balloon, a force is applied on the surface. This generates air pressure.



movement of air particles

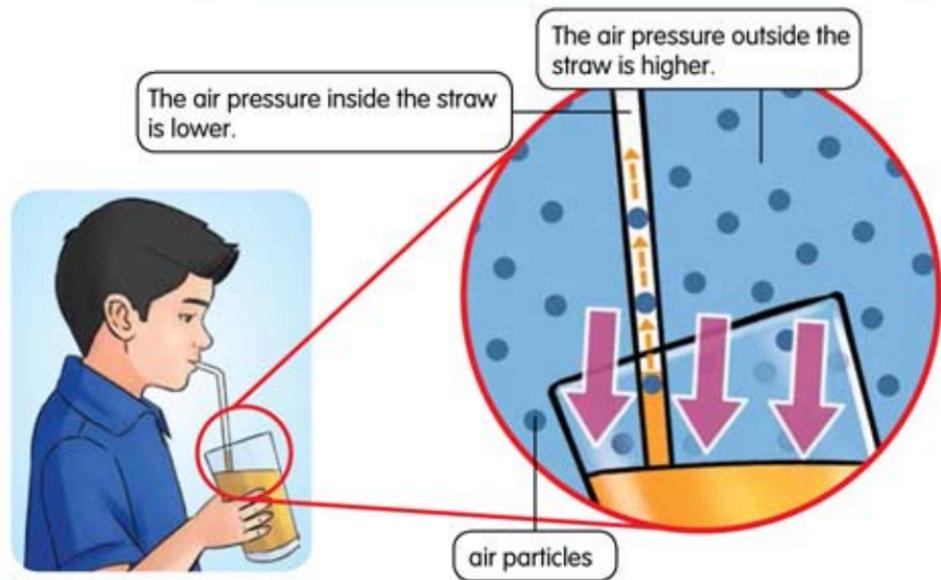
The balloon expands because there is increasing air pressure inside it.

Air pressure results from the force applied on the surface of an object due to the collisions of air particles.



How do we sip the water from the glass?

This situation involves air pressure. When we sip water using a straw, the number of air particles inside the straw decreases.



When the number of air particles inside the straw decreases, the frequency of collisions between the air particles and the inner surface of the straw also decreases. Thus, the air pressure inside the straw is lower.

Therefore, the air pressure which is higher outside the straw will push the water into the straw and straight into our mouth.

What are other examples around us that involve air pressure?



**LET'S TEST****The Presence of Air Pressure**

Aim: To investigate the presence of air pressure

Activity 1

Apparatus and materials: glass mug, thick card, water

Steps:

1. Conduct this activity at a sink.



Fill a glass mug with water until it is full.



Cover the glass mug with a thick card. Hold the thick card so the glass mug is always covered.



Invert the glass mug along with the thick card. Then, slowly remove your hand away from the thick card.

5. Sketch your observation.

**Questions:**

1. What is your observation? Why?
2. Draw arrows to indicate the direction of air pressure in the activity above.
3. What is your conclusion for this activity?

Activity 2

Apparatus and materials: drawing pins, plastic bottle, water

Steps:

1. Conduct this activity at a sink.
2. Fill a plastic bottle with water until it is full. Then, close the lid tightly.
3. Make three holes at the bottom part of the bottle using drawing pins A, B and C. Make another hole at the upper part of the bottle using drawing pin D.
4. Remove drawing pins A, B and C. Make an observation.
5. Finally, remove drawing pin D. Make an observation.



Be careful when using drawing pins.

**Questions:**

1. What is your observation? Why?
2. Draw arrows to indicate the direction of air pressure in the activity above.
3. What is your conclusion for this activity?

Activity 3

Apparatus and materials: glass mug, paper cups, tray, candle, kitchen tissues, water

 Be careful when using candles.



Steps:



Wet a kitchen tissue and place it on a tray.



Put a candle on the kitchen tissue and light it up.



Invert a glass mug to cover the candle.



Wait until the candle burns out. Then, press the glass mug immediately.



Wait for a while. Then, lift the glass mug and make an observation.



Put two paper cups filled with water beside the glass mug. Then, lift the glass mug and make an observation.

Questions:

1. What is your observation? Why?
2. Draw arrows to indicate the direction of air pressure in the activity above.
3. What is your conclusion for this activity?

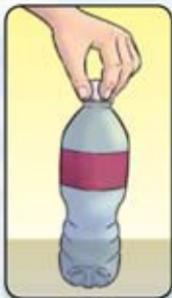
Relationship Between Air Pressure and Height

I have finally reached the peak of Mount Kinabalu. Why is it hard for me to breathe?

You cannot breathe easily because the amount of air here is lesser than at the base of the mountain. The air pressure here is also lower.

What is the relationship between air pressure and elevation level? In the pictures below, observe the tightly-closed empty plastic bottle brought from the peak of a mountain until it arrives at the base of the mountain.

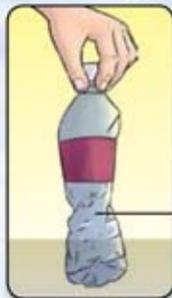
At the peak of the mountain, the air pressure in the bottle is the same as the air pressure around it.



At the peak of the mountain



When going down the mountain



When arriving at the base of the mountain

the bottle is crushed

The crushed bottle proves that the air pressure at the base of the mountain is higher than the air pressure at the peak of the mountain.



Why does the air pressure differ at different elevation level?

The number of air particles is **lower** at the peak of the mountain.

lower air pressure

elevation level

base of the mountain

higher air pressure

The number of air particles is **higher** at sea level.

Earth is surrounded by a layer of air called the atmosphere. As the elevation level above the sea level increases, the number of air particles decreases. Thus, the collision between the air particles also decreases. This causes the decrease of air pressure.



LET'S TEST

Simulation on the Changes in Air Pressure

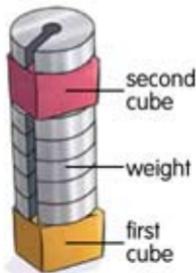


Aim: To study the relationship between air pressure and elevation level

Apparatus and materials: six units of 100 g weights, two sponges

Steps:

1. Make two cubes using sponges. The cubes represent the elevation level.
2. Place five units of weight on the first cube. The weights represent the number of air particles.
3. Put the second cube and a weight on top of it.
4. Observe both cubes.



Questions:

1. What happened to both cubes?
2. Which cube experienced lower pressure? Why?
3. What is the relationship between air pressure and elevation level based on the simulation?

Application of Air Pressure

The application of air pressure is important to solve problems in our daily lives.



Observe the situation in the following pictures. How are the applications of air pressure used in daily lives?

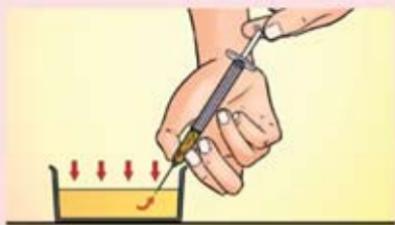
Siphon

When the siphon tube is at a different height, the water will flow out to the lower level of the siphon. A lower pressure is produced in the siphon tube. The higher pressure outside the tube will push the water into the siphon tube.



Syringe

When the piston is pulled, a lower pressure is produced inside the syringe. The higher air pressure outside the syringe will push the liquid into the syringe.



Plunger

When the plunger is pressed down, a lower air pressure is produced inside it. When the plunger is pulled back up, the higher pressure in the sinkhole pushes the clogged waste.



If there is no air pressure, could the problem in each of the situation be solved? What is the importance of air pressure?



LET'S TEST

Application of Air Pressure

Aim: To explain the application of air pressure through an example

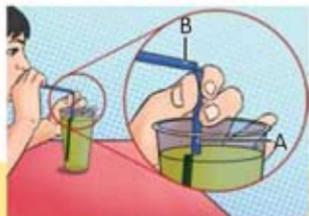
Apparatus and materials: scissors, straw, water

Steps:

1. Fill a glass with water.
2. Cut a straw into two parts of the same length. Label them as A and B.
3. Insert straw A into the water.
4. Bring straw B closer to straw A as in the picture. Blow straw B as hard as you can.
5. Make an observation.



Be careful when using scissors.



Questions:

1. Explain your observation.
2. Name a tool that uses the application of air pressure as in this activity.
3. Design a model using the knowledge that you have learned about air pressure.



Make a straw rocket using a pair of scissors, plastic bottle, modelling clay, adhesive tape, big-sized straw, small-sized straw, and cardboard.

Steps:

Be careful when using scissors.



Insert half of a small-sized straw into a plastic bottle.



Ensure the small-sized straw is placed upright in the plastic bottle using modelling clay.



Close one end of the big-sized straw using adhesive tape.



Cut a piece of cardboard into triangular shapes.



Paste the triangular shapes onto the big-sized straw as shown in the picture.



Insert the small-sized straw inside the big-sized straw. Launch your straw rocket by pressing the plastic bottle.



MIND REFLECTION

1. Force is a pull or push applied on an object.
2. The effects of force are as follows:
 - (a) changes the shape of an object
 - (b) changes the direction of movement of an object
 - (c) changes the speed of an object
 - (d) moves a stationary object
 - (e) stops a moving object
3. Frictional force is the force produced when two surfaces are in contact with one another.
4. The direction of the frictional force always opposes the direction of movement of the object.
5. The advantages and disadvantages of frictional force in our daily activities are as follows:

Advantage	Disadvantage
<ul style="list-style-type: none">• Rubbers can erase writings on paper.• Brake pads can slow down bicycles and stop their movement.• Sandpaper can smoothen rough surfaces of objects.• Tread patterns on vehicle tyres can increase the grip of tyres on the soil.	<ul style="list-style-type: none">• Worn out shoe soles can cause us to slip easily.• Loud noises are produced when drilling.• The friction in car engines can damage the engines over time.• Rusty screws can increase friction and make them harder to loosen.

6. Factors affecting frictional force are as follows:
 - (a) mass of an object
 - (b) type of surface
7. Daily activities can be done effectively by reducing or increasing frictional force as follows:

Ways to decrease frictional force	Ways to increase frictional force
<ul style="list-style-type: none">• Using lubrication oil to smoothen a bicycle chain.• Using flour or talcum powder to smoothen a carrom board.• Using a trolley to move a heavy box.	<ul style="list-style-type: none">• Using a cloth to open the lid of a bottle.• Using a brush to clean a stain on the floor.• Using a racquet's grip on the handle to increase the grip on the racquet.

8. Air pressure exists around us.

9. Air pressure is caused by the collisions of air particles on the surface of an object.
10. Air pressure at the peak of a mountain is lower than air pressure at the base of a mountain.
11. Examples of the application of air pressure in our daily lives are as follows:
 - making two holes on a can
 - siphon
 - syringe
 - plunger



MIND TEST

Answer all questions in the Science exercise book.

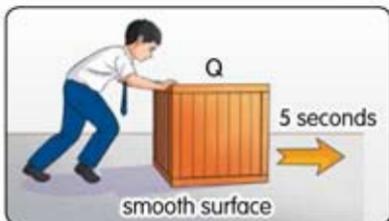
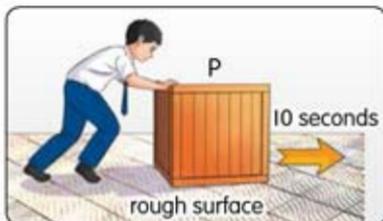
1. State the force used to carry out the following activities.



2. Explain the effects of force for the activities shown in the pictures below.



3. The pictures below show the time taken to move box P and Q for the same distance. Box P and Q also have the same mass.



- (a) Why does it take a longer time to move box P compared to box Q?
 (b) What is the factor that affects the movement of both boxes?
 (c) Predict the time taken to move box P and box Q if the mass of the boxes is increased. Give your reasons.

4. State the effect of frictional force in each picture below.



5. The pictures below show problems involving frictional force. State the ways to overcome the problems.



6. Tick (✓) the correct statements.

- (a) Air pressure is produced due to the collisions of air particles on the surface of an object.
- (b) Air pressure at the peak of a mountain is higher than the air pressure at the base of a mountain.
- (c) Air pressure will increase when the number of air particles increases.



7. Answer the questions below based on the following statement.

Many climbers require oxygen tanks to reach the peak of Mount Everest safely.

- (a) Why do climbers use oxygen tanks when they are at the peak of Mount Everest?
 (b) How do you describe the air pressure at the peak of the mountain based on your answer in 7(a)?
 (c) State the relationship between elevation level of the mountain and air pressure.