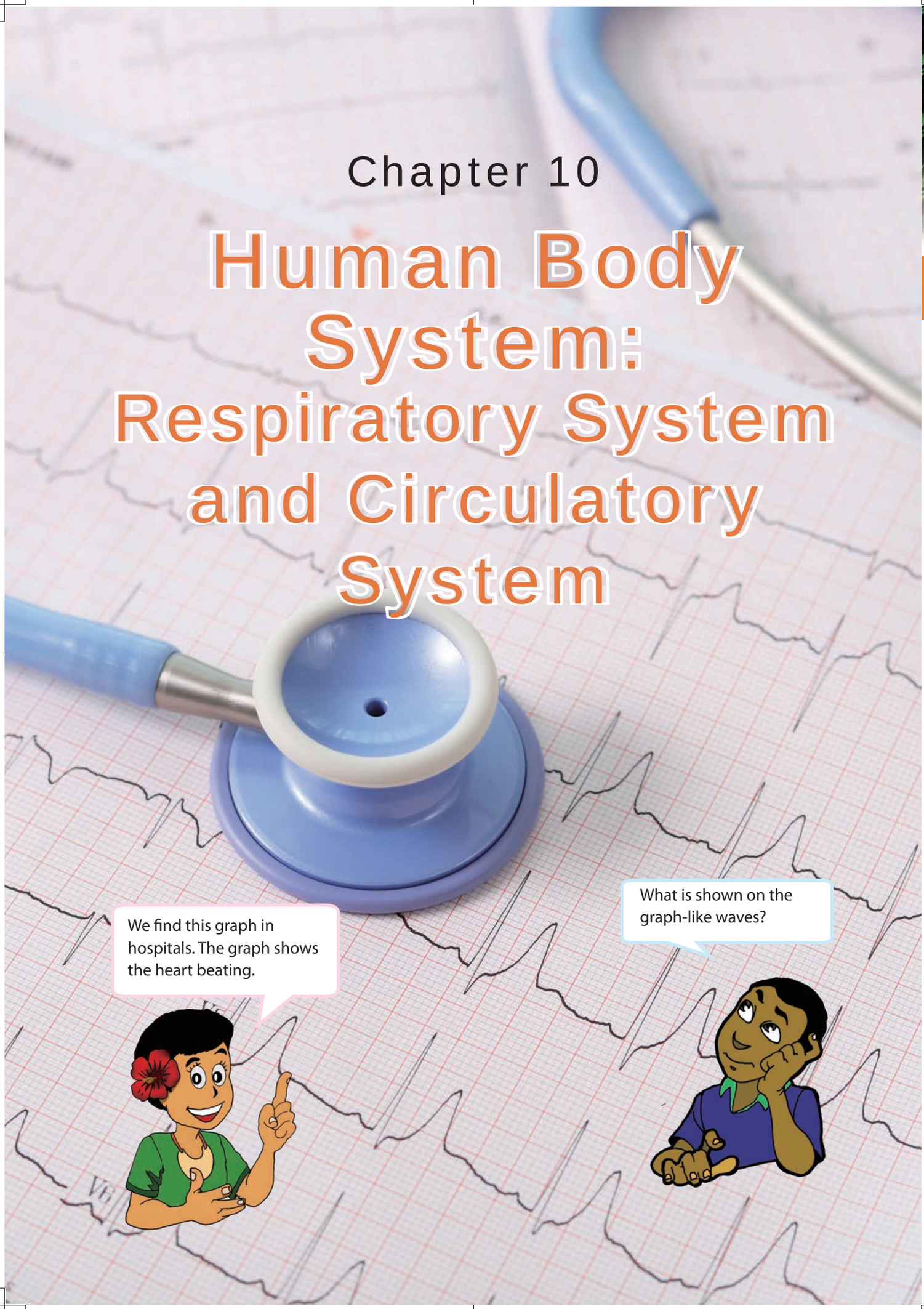
Chapter 10

Human Body System: Respiratory System and Circulatory System



10.1 Respiratory System

Lesson 1 Breathing

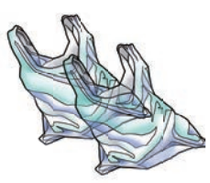
We cannot live without air. When we breathe, we take in and give out air.

How does air move in and out of our body?

Activity : What is contained in exhaled air?

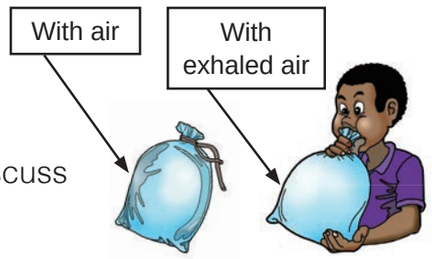
What We Need:

- limewater, two clear plastic bags



What to Do:

1. Fill a plastic bag with air around you. Pour the limewater into it and tie the mouth of the plastic bag tightly. Shake it well and observe what happens to the limewater. Record your observations.
2. Blow up another plastic bag with your exhaled air. Pour limewater into it and tie the mouth of the plastic bag tightly. Shake it well and observe what happens to the limewater. Record your observations.
3. Share your findings with your classmates. Discuss what is contained in the exhaled air.



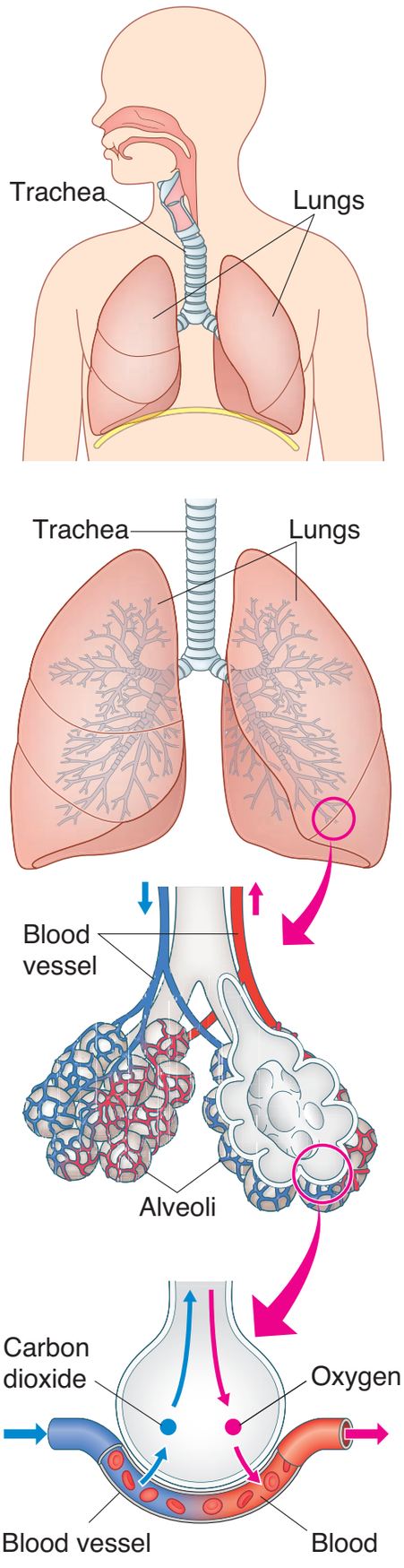
Result

We found out that limewater with air did not change its colour. On the other hand, the limewater with the exhaled air turned cloudy. From this result, exhaled air contained more carbon dioxide than the air.

Summary

Breathing is the process of moving air in and out of the body. When we breathe, we take in oxygen and give out carbon dioxide.

The group of organs in our body that enables us to breathe is called the **respiratory system**. An **organ** is a special part of the body that has a specific form and function. Eyes, ears, brain and heart are examples of organs. The major organs of the respiratory system are nose, trachea, alveoli and lungs. When we breathe in, we take air into our body through our nose. The air moves into our **trachea**, which connects the throat to the **lungs**. In the chest, the trachea is divided into two tubes and each of these tubes leads to one of the two lungs. Each tube is divided into smaller tubes that end in millions of tiny balloon-like air sacs which are called **alveoli**. In the alveoli, oxygen is transferred to the blood. Blood carries oxygen to all parts of our body. At the same time, carbon dioxide is transferred from the blood to the alveoli. When we breathe out, our body gets rid of carbon dioxide.



Mechanism of Lungs

Lesson 2 Lungs

Lungs are the main organs of the respiratory system. How do the lungs work? What structures do lungs have?

What are the functions and structure of lungs?

Activity : Making a lung model

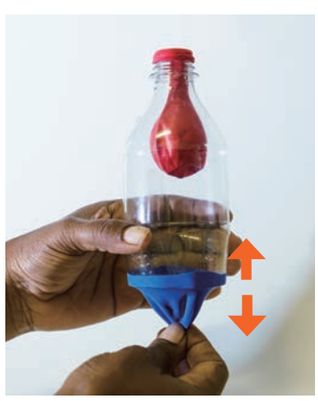
What We Need:

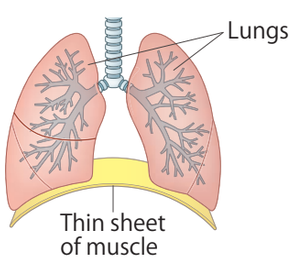
- a plastic bottle with the end cut-off, a balloon, a balloon with the half cut-off

What to Do:

1. Push the balloon into the neck of the bottle and fold its end around the neck of the bottle.
2. Place the half cut-off over the open end of the bottle.
3. Pull on the middle of the half-cut balloon and let go. Observe what happens.
4. Gently push in the half-cut balloon as shown on the right. Observe and record what happens.
5. Think about the question below based on your observations.

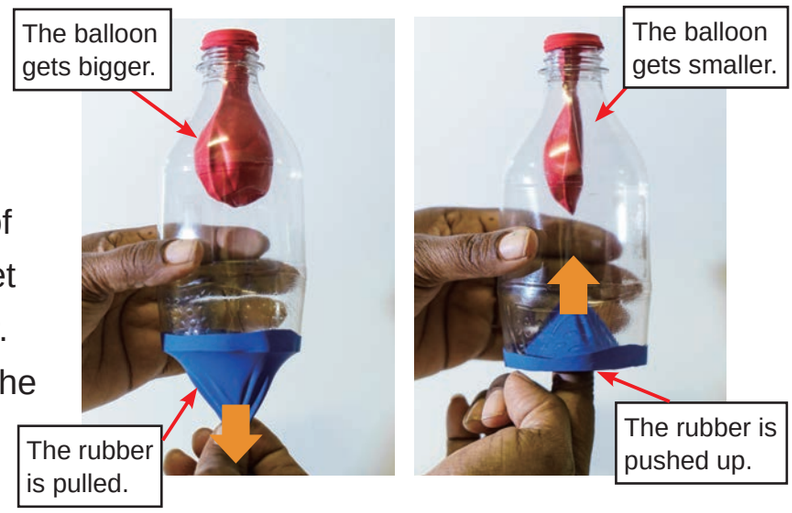
   The figure below shows the structure of the lungs. Which parts of the lung are represent in lung model?
6. Share your findings with your classmates. Describe how the lungs work when breathing.





Result

We found out that when we pulled on the middle of the half-cut balloon and let go, the balloon got bigger. When we gently pushed the half-cut balloon up, the balloon got smaller.

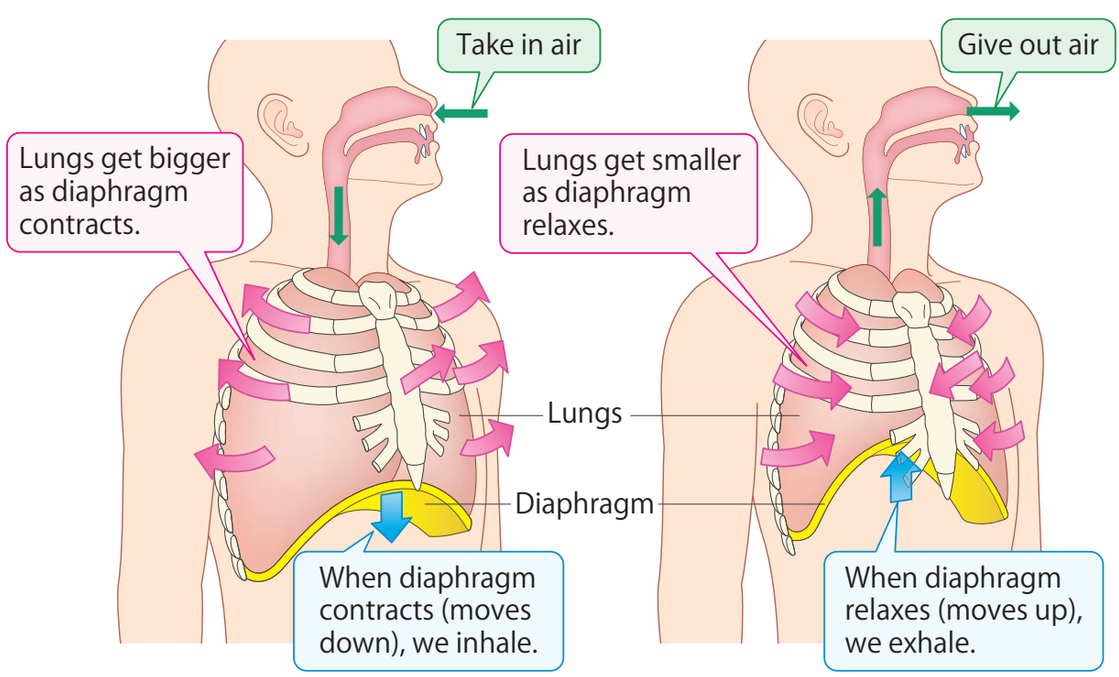


Summary

As we breathe, we have a special muscle that helps our lungs move. The muscle is called the **diaphragm**. It makes our lungs larger and smaller as we breathe in and out.

When we inhale, the diaphragm contracts and moves down in our chest. This causes our lungs to become bigger and allows air to come into our lungs.

As we exhale, the diaphragm relaxes and moves up towards the lungs, this causes our lungs to become smaller and air is forced out of our lungs.



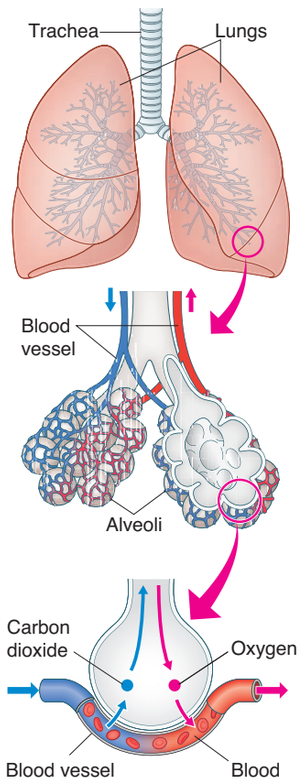
Mechanism of breathing

Summary and Exercise

Summary 10.1 Respiratory System

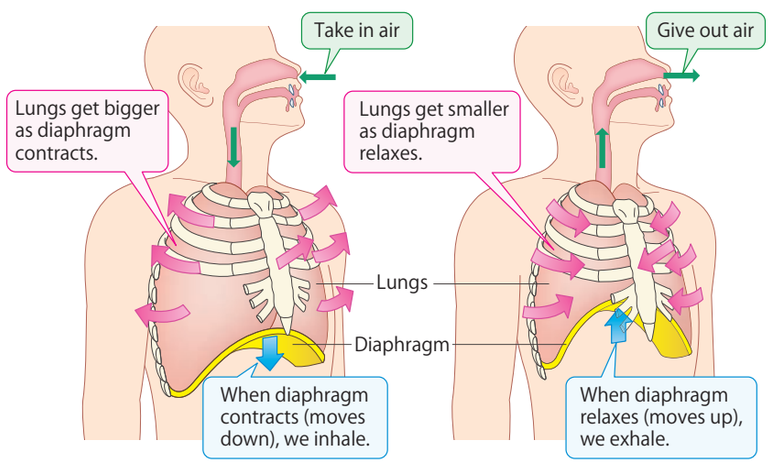
Breathing

- The group of organs in our body that enables us to breathe is called the respiratory system.
- The major organs of the respiratory system are nose, trachea or windpipe, alveoli and lungs.
- When we breathe, we take in oxygen and give out carbon dioxide.
- The air moves into our trachea, which connects the throat to the lungs.
- In the alveoli, oxygen is transferred to the blood which is carried to all parts of our body.



Lungs

- Diaphragm is the muscle that makes our lungs larger and smaller for the action of breathing.
  1. Lungs get bigger as the diaphragm contracts and the air comes in our lungs when we inhale.
  2. Lungs get smaller as the diaphragm relaxes and the air is forced out of our lungs when we exhale.



Summary and Exercise

Exercise 10.1 Respiratory System

Q1. Complete each sentence with the correct word.

(1) The process of moving air in and out of the body is called _____.

(2) An _____ is a special part of a body that has a specific form and function.

(3) The group of organs in our body that enable us to breathe is called the_____ system.

(4) The muscle that makes our lungs larger and smaller during breathing is called the _____.

Q2. Choose the letter with the correct answer.

(1) What are the major organs of the respiratory system?

A. Eyes, ears and mouth

B. Nose, trachea and heart

C. Trachea, lungs and oxygen

D. Nose, trachea and lungs

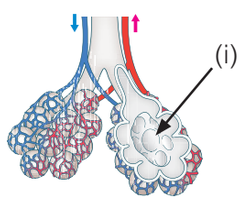
(2) What is the correct name of the organ labeled (i) shown in the diagram on the right?

A. Heart

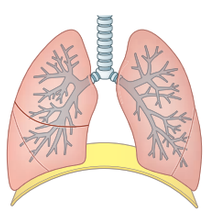
B. Trachea

C. Alveoli

D. Diaphragm



Q3. How does the diaphragm help the lungs to move when breathing?



Q4. Name the gas that we breathe in and how it moves through the main organs of the respiratory system.

10.2 Circulatory System

Lesson 1 The Heart

After a heavy exercise, we can feel the beat of our heart on our chest.

What does the heart do?

Activity : Measuring your pulse rate

What to Do:

1. Draw a table like the one shown below.

	Pulse	
	Beats in 15 seconds	Beats in 1 minute
At rest		
After exercise		

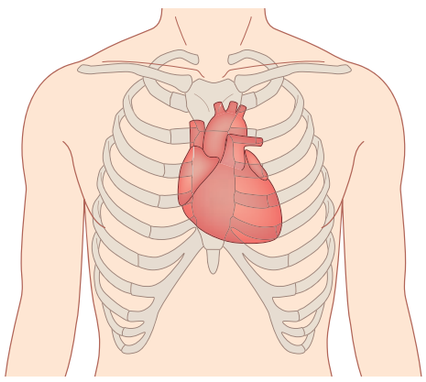
2. Take your pulse for 15 seconds and count the number of beats while at rest. Record your pulse rate in the table.
3. Jump at the same spot for one minute, then take your pulse for 15 seconds. Record your pulse rate in the table.
4. Calculate your pulse rate for one minute using the formula;

The number of beats in 15 seconds	X 4 =	The number of beats in 1 minute

5. Record your pulse rate for one minute in the table.
6. Share your findings with your classmates. Discuss:
   (1) How your pulse rate changed before and after the exercise.
   (2) Why your pulse rate increased after the exercise.
   (3) How your breathing rate was like before and after the exercise.

Summary

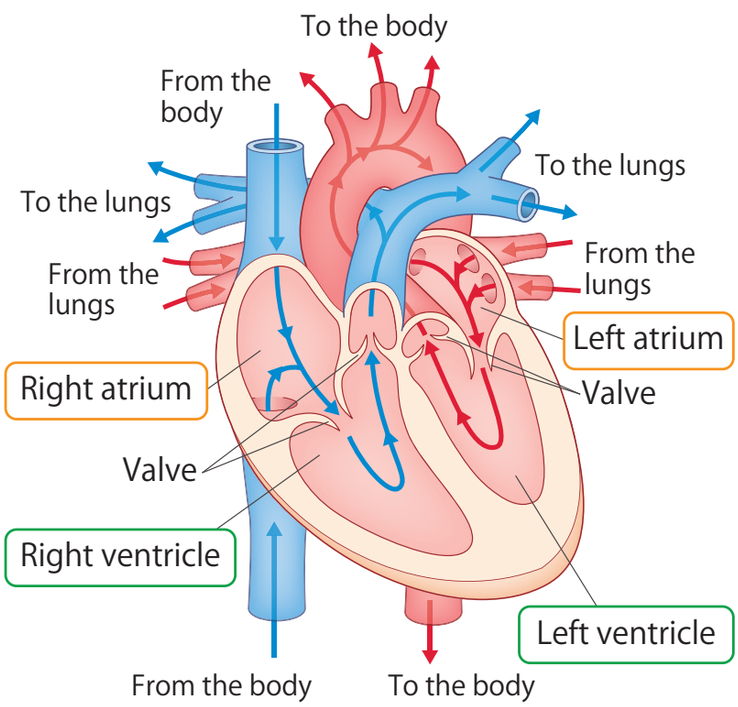
The **heart** is an important organ in the human body. It is about the size of our fist and is located within our rib cage to the left of the centre of the chest. The heart is made of a muscle called the heart muscle. We can control our arm and leg muscles, but we cannot control the heart muscle. This muscle in our heart works all the time even while we are sleeping.



The heart is located to the left of the centre of the chest.

The heart pumps thousands of litres of blood to all parts of our body every day. The heart has four spaces which are called **chambers**. These are called the left and right **atriums** and the left and right **ventricles**.

The atrium is a chamber that receives blood from the body and the lungs, and the ventricle is a chamber that pumps blood to the lungs and the body. Between the chambers there are valves. The valves open and close to control the movement and direction of blood flow.



When ventricles contract, blood is forced out of the heart. We can feel this contraction as a pulse. During physical exercise, more oxygen is needed in the muscles so the blood must carry oxygen to the muscles faster than when the body is at rest. To meet these demands the pulse rate increases.

Lesson 2 Circulation of Blood

The heart pumps blood to all parts of our body everyday.

How does blood flow through the body?

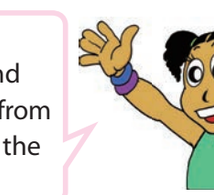
Activity : Observing the blood flow

What We Need:

- small live fish, small ziplock bag, microscope

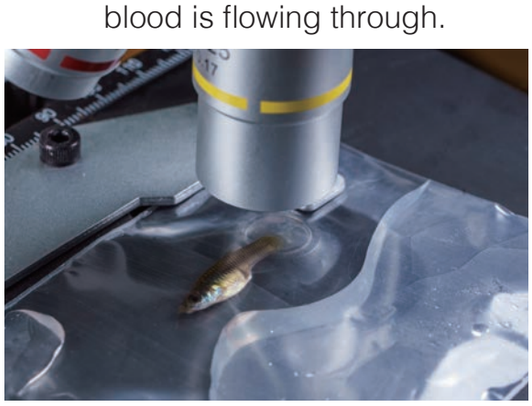
What to Do:

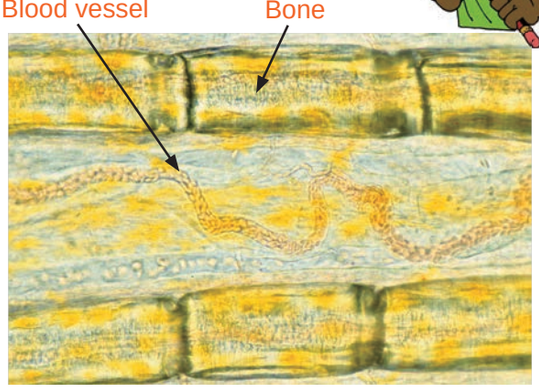
1. Put the live fish into a ziplock bag with water.
2. Put the ziplock bag with fish on the stage of the microscope and observe the flow of blood in the tail fin through the microscope.
3. Sketch the flow of blood and record your observations in your exercise book.
4. Share your findings with your classmates. Discuss about:
   (1) What you found in the tail fin.
   (2) The direction of the blood flow.
   (3) The thickness of the tubes that the blood is flowing through.



Don't touch the fish with your hand directly. The heat from your hand makes the fish die easily!

After observation, let's release the fish!





Microscopic view showing blood vessel in a fish.

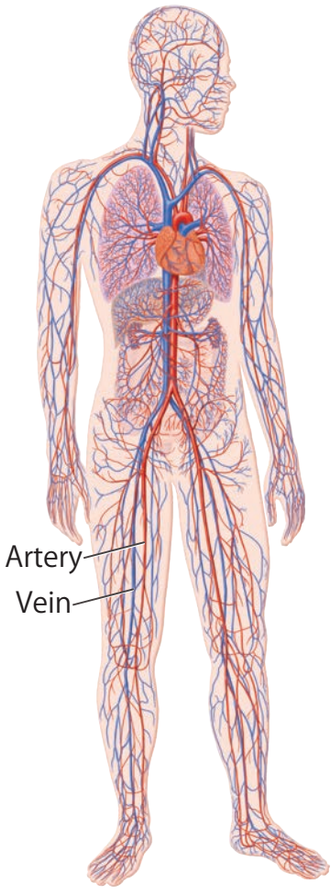
Summary

Blood flows through tubes to get to the different parts of our body. These tubes are called **blood vessels**. There are two types of blood vessels; an artery and a vein. **Artery** is the blood vessel that carries blood away from the heart. **Vein** is the blood vessel that carries blood back to the heart. The heart pumps blood to the lungs through the arteries, and the blood picks up oxygen from the lungs. The blood rich in oxygen flows into the heart through the veins and is pumped to all parts of the body through the arteries.

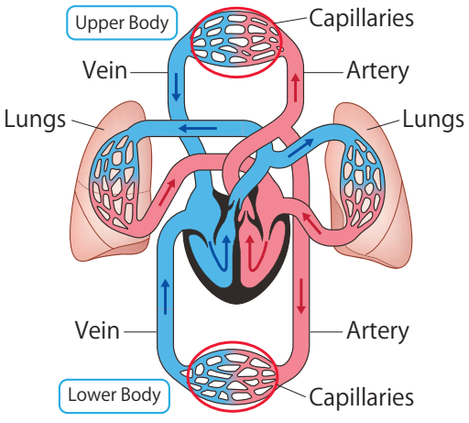
The arteries are divided into smaller tubes and end in tiny blood vessels which are called **capillaries**. The capillaries connect the arteries and veins.

The blood in the capillaries passes the oxygen to and picks up carbon dioxide from the cells. A **cell** is the basic unit that makes up all living things. After passing capillaries, blood flows through the veins. The blood in the veins have little oxygen. It enters the heart and goes to the lungs again to pass carbon dioxide to and picks up oxygen from the lungs.

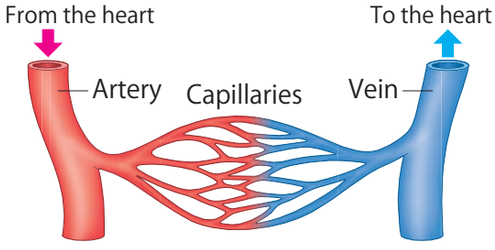
A network of organs such as the heart, blood and blood vessels that transport oxygen and nutrients to and carbon dioxide from the cells is called a **circulatory system**.



Blood vessels in body



A model of blood circulation



Structure of capillaries, artery and vein

Lesson 3 Blood

The blood passes oxygen to the cells and picks up carbon dioxide from the cells.

How does blood carry oxygen and carbon dioxide?

Activity : Components of blood

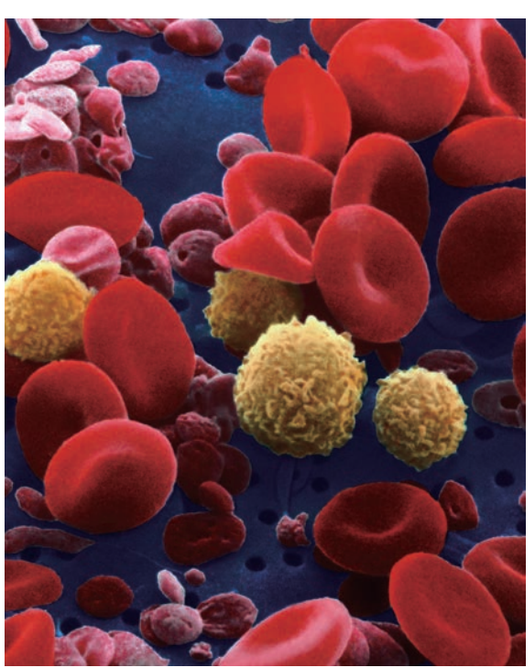
What to Do:

1. Draw a table like the one shown below.

Sketch	Its characteristics

2. Study the close-up photograph of blood below taken by an electronic microscope and identify the different types of particles.
3. Sketch them and record the characteristics of each type of particle in the table.
4. Share your ideas with your classmates. Discuss about:
   (1) The number of each type of particles you find.
   (2) The characteristics of each type of particles.

Is blood a solid or a liquid? Can you guess what blood consists of?



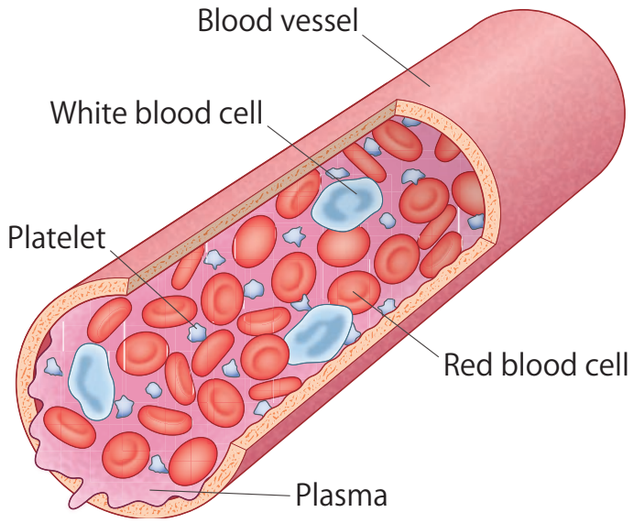
Summary

Blood carries oxygen, carbon dioxide, nutrients and wastes in our body. Blood is made up of solid and liquid parts. The solid parts of the blood are suspended in liquid.

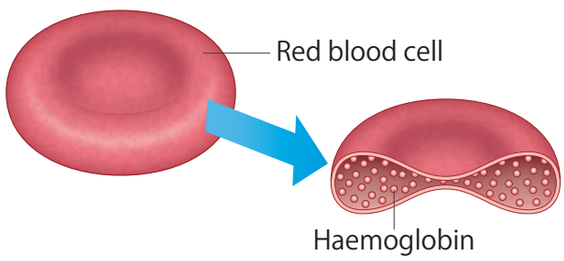
The solid parts of the blood include **red cells**, **white cells** and **platelets**. The liquid part of the blood is called **plasma**.

The red blood cells are disc shaped and they contain **haemoglobin**. Red blood cells use the haemoglobin to carry oxygen from the lungs through all parts of the body.

White blood cells are an important part of the body's immune system. They defend the body against bacteria, viruses and other infectious diseases.



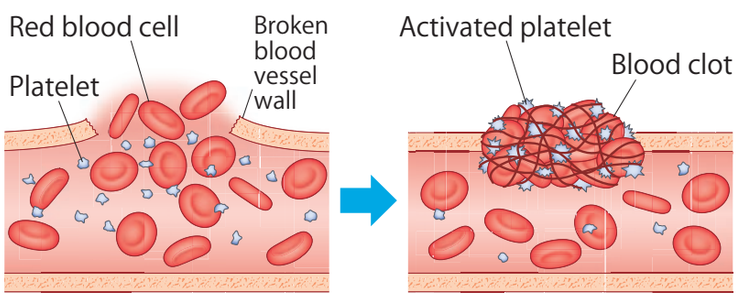
Components of blood



Cross section of red blood cell

White blood cell is attacking bacteria.

Platelets help blood clot in order to stop bleeding, to heal cuts and other injuries. Plasma is the main component of blood and mostly consists of water. Plasma carries nutrients and water to the cells and carries away wastes such as carbon dioxide from the cells.



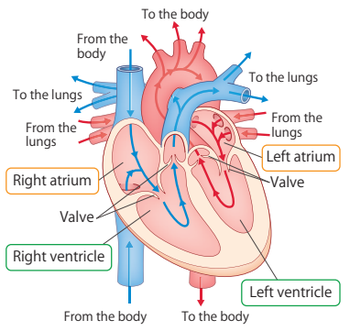
The way red blood cells and platelets form blood clot.

Summary and Exercise

Summary 10.2 Circulatory System

The Heart

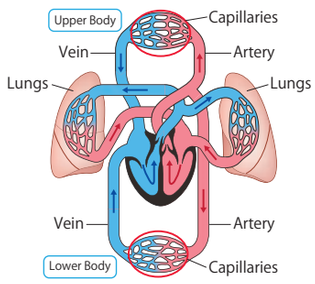
- The heart is an important organ that pumps thousands of litres of blood to all parts of the body.
- The heart is about the size of our fist and is located within the rib cage to the left of the centre of the chest.
- The heart is made up of four chambers called left and right atriums and left and right ventricles.
- The atriums receive blood from the body and the lungs and the ventricles pump blood to the lungs and the body.
- The valves open and close and help contol the movement and direction of the blood flow.



The model of heart

Circulation of the Blood

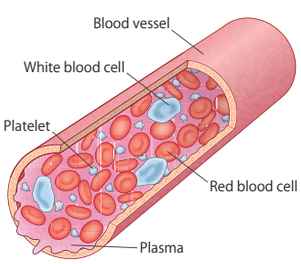
- Circulatory system is a network of organs such as the heart, blood and blood vessels that transport oxygen, and nutrients to and carbon dioxide from the cells.
- Blood flows through many tubes called blood vessels to get to different parts of our body.
  1. The artery is the blood vessel that carries blood away from the heart.
  2. The vein is the blood vessel that carries blood back to the heart.
- Capillaries are tiny blood vessels that connect the artery to the vein.
- The blood in the capillaries passes the oxygen to the cells and picks up carbon dioxide from the cells.



The model of blood circulation

Blood

- Blood is made up of solid and liquid parts:
  1. The solid parts of the blood include red cells, white cells and platelets.
  2. The liquid part of the blood is called plasma.
- Blood carries oxygen, carbon dioxide, nutrients and wastes in our body.



The model of blood

Summary and Exercise

Exercise 10.2 Circulatory System

Q1. Complete each sentence with the correct word.

(1) The _____ is an organ that pumps blood to all parts of the body.

(2) The heart is made up of four _____.

(3) The tubes that blood flows through to different parts of the body are called _____ _____.

(4) Red blood cells contain _____ that is used to carry oxygen.

Q2. Choose the letter with the correct answer.

(1) What is the name of the particle in the blood shown below?

A. White blood cell

B. Plasma

C. Red blood cell

D. Platelet

(2) Which type of blood vessel does the blood rich in oxygen flow through?

A. Vein

B. Artery

C. Capillaries

D. Cell

Q3. Answer the following questions.

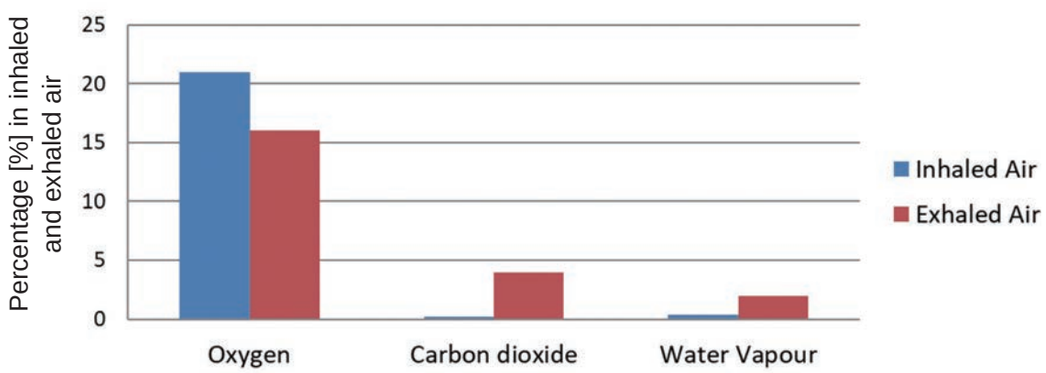
(1) Sam had a bad fall. He hurt his knee and was bleeding. Soon his wound stopped bleeding, leaving a red lump on the wound. What kind of cell in the blood helped to stop the bleeding?

(2) Describe the characteristics of the circulatory system.

Q4. Lora ran very fast to catch a ride on a bus. After she sat down she was breathing heavily. Explain the reason for her breathing using the word 'oxygen' in your explanation.

What does the air we inhaled and exhaled contain?

Lungs take in oxygen from the air and release carbon dioxide as waste product. There are other gases that are also inhaled and exhaled. Atmospheric air, which we breathe, is composed of the following gases: nitrogen, oxygen, carbon dioxide, water vapour and other small amounts of gases. Inhaled air by volume contains nitrogen about 78%, oxygen 21%, carbon dioxide 0.04% and watar vapour 0.4%. How does the percentage change in exhailed air? Exhaled air by volume contains nitrogen about 78%, oxygen 16%, carbon dioxide 4% and watar vapour 2%.



Percentage of oxygen, carbon dioxide and water vapour in inhaled and exhaled air.

Exhaled air contains less oxygen and more carbon dioxide.Oxygen in the inhaled air is transferred to the blood in the lungs and the blood carries oxygen to cells in all parts of our body. The cells recieve oxygen to produce its energy and release carbon dioxide as its waste into the blood. When the blood come back to the lungs, carbon dioxide is transferred from the blood to exhaled air. Therefore, exhaled air contains less oxygen and more carbon dioxide than inhaled air.

In addition, there is more water vapour in exhaled air than inhaled air because of the moisture in the airways.

Chapter Test

10. Human Body System

Q1

Complete each sentence with the correct word.

(1) After exercise, we feel the beat of our _____ on our chest.

(2) Blood flows through blood _____ to get to the different parts of our body.

(3) Blood is made up of _____ _____, white cells, platelets and plasma.

(4) When we breathe, we take in _____ and get rid of _____ _____.

Q2

Choose the letter with the correct answer.

(1) What is the name of the muscle that helps the lungs for breathing to occur?

A. Diaphragm

B. Nose

C. Alveoli

D. Trachea

(2) Which muscle in our body works all the time even when we are asleep?

A. Bicep muscle

B. Calf muscle

C. Heart muscle

D. Cheek muscle

(3) Why is the white blood cell an important part of the body's immune system?

A. They allow any bacteria to enter the body.

B. They defend against bacteria, viruses and other infectious diseases.

C. They transport oxygen to the heart.

D. They remove waste from the system.

(4) What caused the lime water to turn cloudy?

A. Oxygen present in the inhaled air.

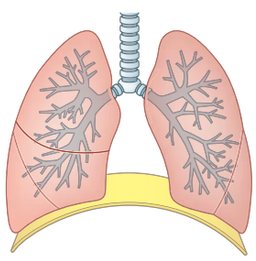
B. Carbon dioxide present in the exhaled air.

C. Heat present in exhaled and inhaled air.

D. Oxygen present in exhaled air.

Q3

Study the picture and explain how the diaphragm and the lung work as air is taken in and taken out.



(1) What happens to the diaphragm and the lungs when we breathe in?

_____

_____

_____

_____

_____

(2) What happens to the diaphragm and the lungs when we breathe out?

_____

_____

_____

Q4

(1) There are two types of blood vessels; an artery and a vein. What are the functions of the artery and the vein?

_____

_____

_____

(2) How does your pulse rate change before and after an exercise? Explain why.

_____

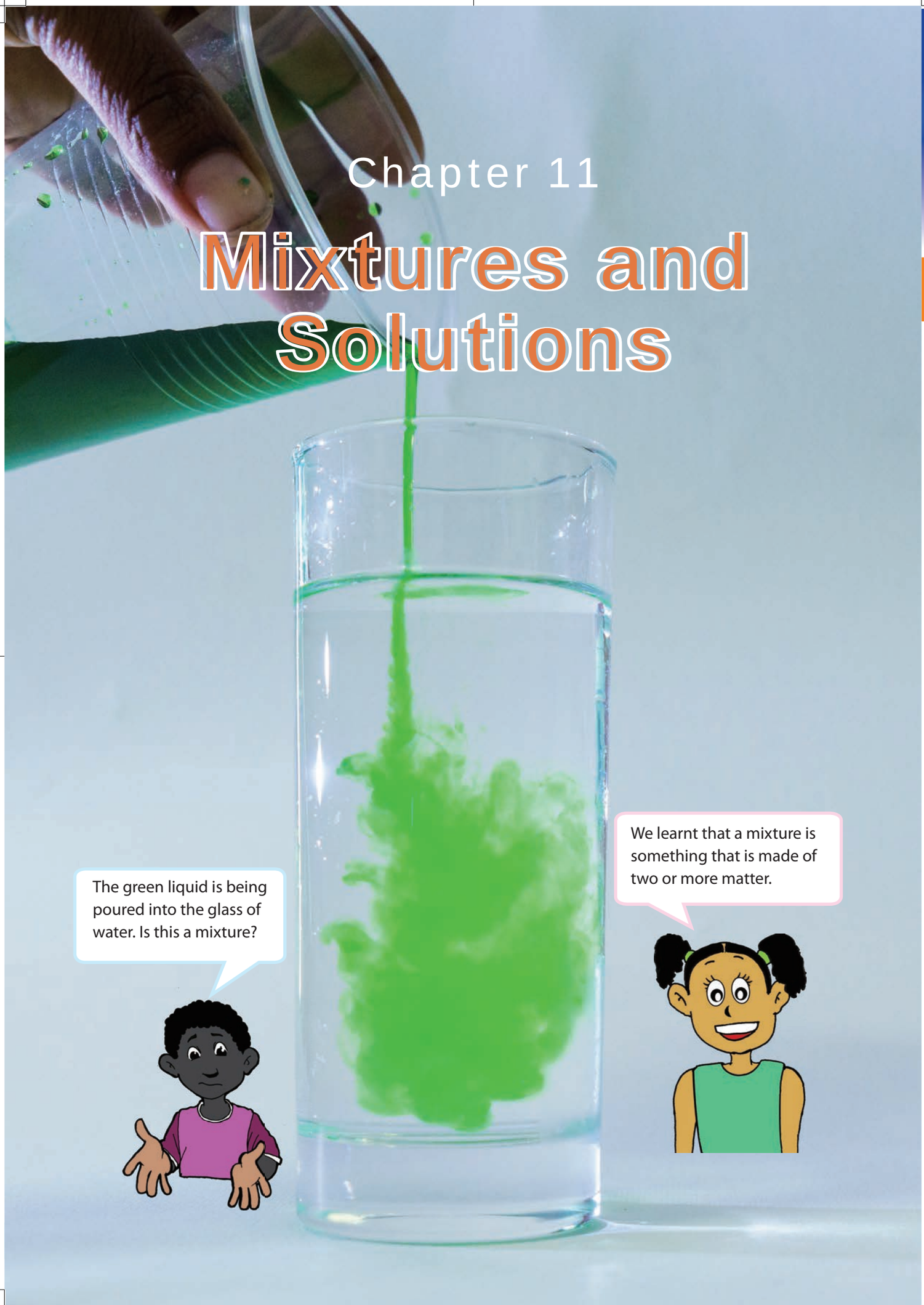
_____

_____

_____

Chapter 11

Mixtures and Solutions



11.1 Mixtures

Lesson 1 Mixtures and Substances

A mixture is something made of two or more kinds of matter but do you know what a mixture is? How are mixtures made? What properties do mixtures have?

What is a mixture?

Activity : How are mixtures made?

What to Do:

1. Draw a table like the one shown below.

Mixtures	Ingredients or materials

2. Study the picture below. Find the mixtures in the picture and write their names in the table.
3. Write the ingredients or materials that make up each of the mixtures in the table.
4. Share your ideas with your classmates. Discuss how mixtures are made.

Summary

Matter can be classified as solid, liquid or gas. Matter can also be classified as a substance or a mixture.

A **substance** is one kind of matter with certain properties. A substance is made of only one kind of matter. The colour, texture, smell and taste of all the particles in a substance is the same. For example, salt is a substance. Salt is made of one kind of matter. It does not contain any other kinds of matter. When we taste salt, it always tastes salty. Every part of the salt is the same colour. Water, oxygen, salt and gold are examples of substances.

Water

Salt

Gold

Examples of substances

A **mixture** is a matter that is made up of two or more substances that are combined physically. Sea water, soil and blood are examples of mixtures. Making a mixture results in a physical change. For example, sand, clay and pebbles are combined to make a soil mixture, but sand is still sand and clay is still clay. The physical properties of each substance in the soil mixture do not change.

Pebbles (substance)

Sand (substance)

Clay (substance)

Soil (mixture)

Sand, pebbles and clay in a soil do not change their properties.

Lesson 2 Types of Mixtures

Mixtures are everywhere. A salad is a mixture. An ocean is also a mixture. Are salad and ocean the same mixtures? How can we classify these mixtures?

What types of mixtures are there?

Activity : Different types of mixtures

What We Need:

- water, salt, sand, cooking oil

What to Do:

1. Draw a table like the one shown below.

Two substances	Their states

2. Choose two substances from the above to make a mixture.
3. Record the types of substances you chose and their states in the table.
4. Mix the two substances.

5. Think about the following questions based on your results:
   (1) Which two substances did you choose to make the mixture and what were their states?
   (2) How many combinations can you make with the four substances to make a mixture?
6. Share your findings with your classmates. Discuss what types of mixtures are there.

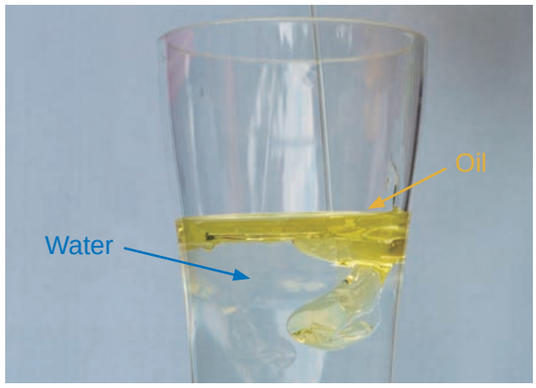
Summary

Substances are matter. They can be in the states of a solid, liquid and gas. Mixtures are combinations of three states of substances. There are many different types of mixtures: Solid-Solid mixture, Liquid-Liquid mixture, Solid-Liquid mixture, Gas-Gas mixture and Gas-Liquid mixture. The following are some examples of the different types of mixtures.

Rock is a mixture of minerals.

Solid-Solid Mixtures

This type of mixture consists of two or more different solid substances such as rocks. The rock is made of several different kinds of minerals. They are all solids.



Mixture of oil and water

Liquid-Liquid Mixtures

This type of mixture consists of two or more different liquid substances such as a mixture of vinegar and water and a mixture of oil and water. Vinegar, water and oil are all liquids.

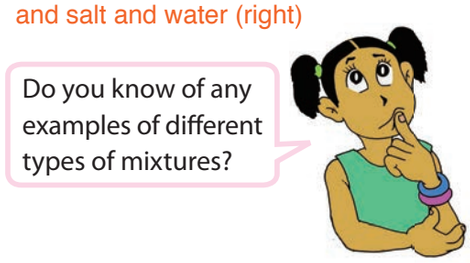
Mixture of sand and water (left) and salt and water (right)

Solid-Liquid Mixtures

This type of mixture consists of solid and liquid substances such as a mixture of sand and water and salt and water. Sand and salt are solids but water is liquid.

Gas-Gas Mixtures

This type of mixture consists of different gases. For example air. Air is mostly made of gases such as nitrogen, carbon dioxide, oxygen and water vapour.



Lesson 3 Separating a Mixture 1

A mixture of rice and kidney beans in a bowl can be separated easily by picking them out by hand. How about a mixture of water and sand? Can you separate them by picking them out?

How can we separate sand from water in a mixture?

Activity : Separating a mixture of water and sand

What We Need:

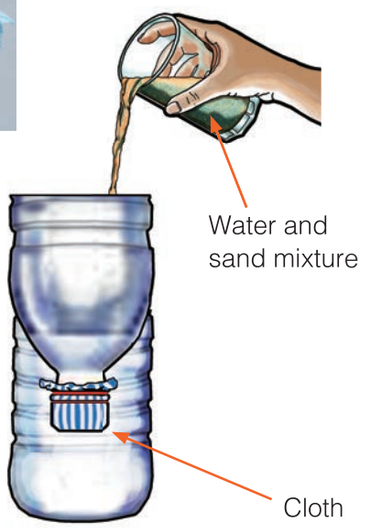
- glass, a mixture of sand and water, plastic bottle, cutter knife, cloth, rubber band




What to Do:

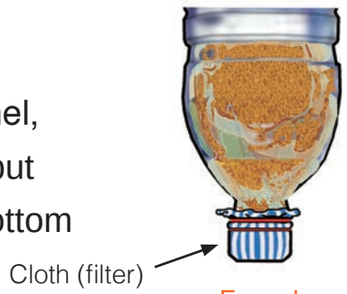
1. Cut off the top part of the plastic bottle where it is marked with the cutter knife to make a funnel.
2. Cover the mouth of the bottle with the cloth and tie it with the rubber band.
3. Place the funnel on the open-end of the cut plastic bottle.
4. Pour the mixture of water and sand into the funnel.
5. Observe what remains on the cloth and in the cut plastic bottle. Record your observations in your exercise book.

Funnel



Result

We found out that in the funnel, sand remained on the cloth but water was collected at the bottom of the plastic bottle.



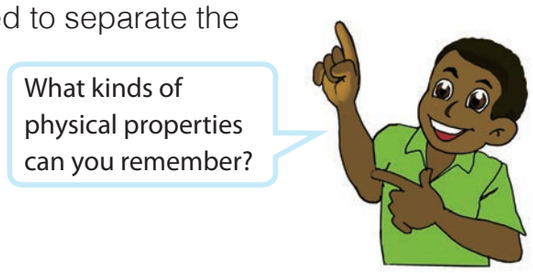
Funnel

Bottom part of the plastic bottle

Discussion

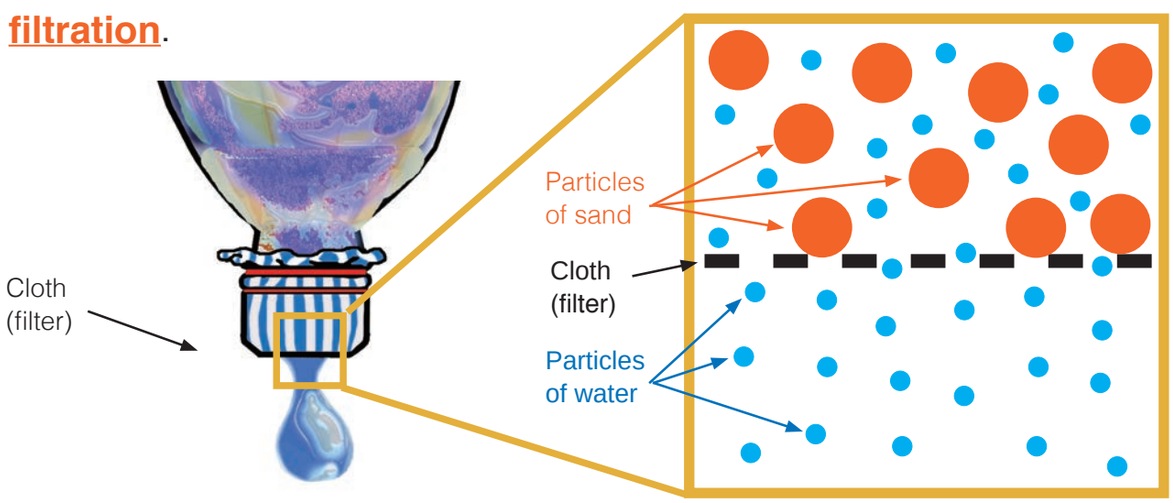
Think about the following questions based on your result.

1. Why did the water in the mixture drop to the bottom of the plastic bottle?
2. What kind of physical property was applied to separate the mixture of water and sand?



Summary

Mixtures can be separated according to the different physical properties of substances. The property to separate water and sand is ‘size’. The particles of water are so small that they can pass through the cloth. But the particles of sand are too large to pass through the cloth and remain in the cloth. The method for separating a solid from a liquid by using a filter is called **filtration**.



Particles of water can pass through the cloth but particles of sand cannot.

Lesson 4 Separating a Mixture 2

A mixture of water and sand can be separated by filtration. How about a mixture of water and salt? Can it also be separated by filtration?

How can we separate salt from water in a mixture?

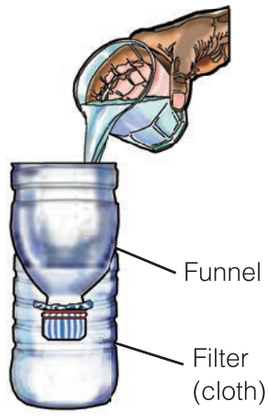
Activity : Separating a mixture of water and salt

What We Need:

- funnel with filter (cloth) from Lesson 3, a mixture of salt and water, burner, empty tin-can

What to Do:

1. Separate the mixture of water and salt using the funnel and filter. Record your result in your exercise book.
2. Pour the mixture of water and salt into the tin-can. Place the can on the burner. Heat it until all the liquid in the can evaporates.
3. Observe the inside of the tin-can and record your observations in your exercise book.
4. Share your observations with your classmates.



Burner with a mixture of salt and water

Be careful when handling hot objects.

Result

We found out that when the mixture of water and salt was poured into the funnel, salt did not remain on the cloth. But when the mixture of water and salt was heated, all the liquid in the tin-can evaporated and a white substance remained.

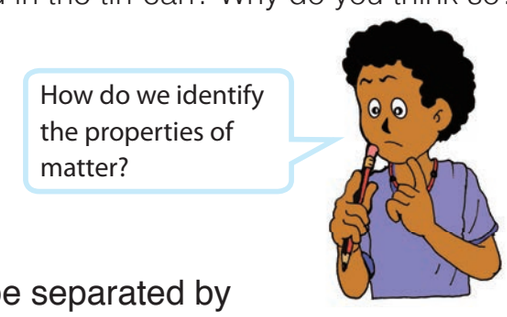
Filtered salt water

Heated salt water

Discussion

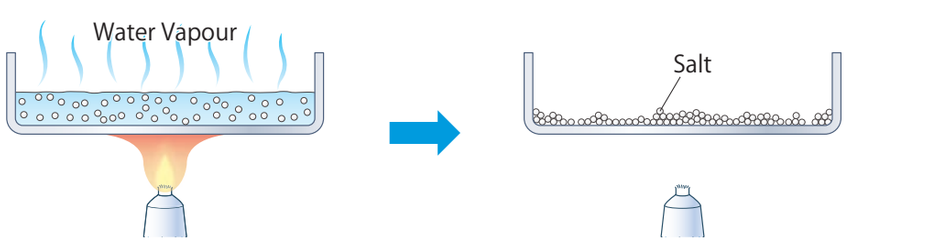
Think about the following questions based on your result.

1. What was the white substance that remained in the tin-can? Why do you think so?
2. Why didn't the salt remain on the cloth?



Summary

Salt in a mixture of water and salt cannot be separated by filtration. This is because the particles of salt in water are too small and can pass through the filter (cloth). Salt in water can be separated by boiling salt water until all the water has evaporated. A method for separating a solid in a mixture from a liquid is called **evaporation**. For example, when the mixture of water and salt in the tin-can was heated for some time, all the water evaporated as water vapour and salt was left behind.



When salt water is heated, water evaporates.

Salt remains after all had the water evaporated.

Summary and Exercise

Summary 11.1 Mixtures

Mixtures and Substances

- Matter can be classified as a substance or a mixture.
- A substance is made up of only one kind of matter.
- A mixture is a kind of matter that is made up of two or more substances.

Examples of substances			Examples of mixtures		
					
Water	Salt	Gold	Rock	Soil	Salt water

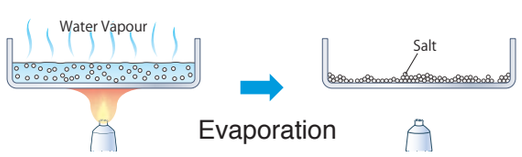
Types of Mixtures

- Mixtures are combinations of three states of substances; solid, liquid and gas.

Solid-solid mixture	Liquid-liquid mixture	Solid-liquid mixture	Gas-gas mixture
This type of mixture consists of two or more different solid substances. E.g. Rock	This type of mixture consists of two or more different liquid substances. E.g. Mixture of oil and water	This type of mixture consists of solid and liquid substance. E.g. Mixture of salt and water	This type of mixture consists of different gases. E.g. The air we breathe is made up of different gases.

Separating a Mixture 1 and 2

- Mixtures can be separated according to the different physical properties of substances that they are made up of.
- Filtration is a method for separating solid from liquid by using a filter.
- Evaporation is a method for separating solid from a liquid by evaporating all the liquid from the mixture.



- Salt in water cannot be separated by filtration. This is because the particles of salt in water are too small and can pass through the filter. Salt in water can be separated by evaporation.

Summary and Exercise

Exercise 11.1 Mixtures

Q1. Complete each sentence with the correct word.

(1) A _____ is made up of two or more substances that are physically combined.

(2) Liquid-liquid mixture consists of two or more different _____ substances.

(3) The method for separating solid from a liquid by evaporating all the liquid from the mixture is _____.

Q2. Choose the letter with the correct answer.

(1) Which of the following is an example of a solid-liquid mixture?

A. Rock

B. Sugar water

C. Water

D. Air

(2) What happens when salt dissolves in water?

A. The particles can be clearly seen.

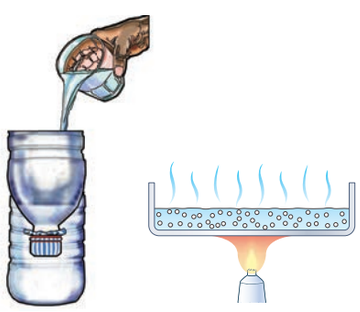
B. Salt particles are inactive or weak.

C. The particles cannot be seen.

D. It becomes a liquid.

Q3. Answer the following question.

Study figures (i) and (ii) shown on the right. Shirley dissolved two teaspoons of sugar in water. Which method (i) or (ii) will she use to separate the sugar from the water?



(i) (ii)

Q4. Samuel tried to separate mud from water by filtration, but the liquid after passing through the filter is still brown in colour. Explain why the mud water cannot be separated by filtration.

11.2 Solutions

Lesson 1 Mixtures and Solutions

In the last topic we studied about mixtures. We are now going to look at special types of mixtures, called **solutions**.

What is a solution?

Activity : Comparing mixtures

What We Need:

- two glasses, water, salt, sand, spoon

What to Do:

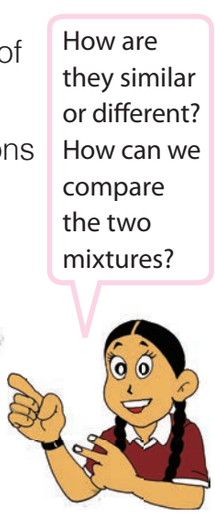
1. Draw a table like the one shown below.

	Your observation
A mixture of water and sand	
A mixture of water and salt	

2. Pour the same amount of water into two glasses.
3. Add a half spoonful of sand in one glass and a half spoonful of salt in the other glass. Stir the contents of the two glasses.
4. Observe the two types of mixtures and record your observations in the table. Share your findings with your classmates.

Sand and water mixture

Salt and water mixture



Result

We found out that sand particles could be seen the in the mixture of sand and water, but salt particles could not be seen in the salt and water mixture.


Sand and water mixture


Salt and water mixture

Discussion

Think about the following questions based on your result.

1. What happened to the mixtures in each glass?
2. When we mixed salt and water, it disappeared. Where has the salt in the mixture gone to?

Summary

A **solution** is a mixture where one or more substances are dissolved evenly into another substance. Solutions have the same properties throughout the mixture. To **dissolve** means to mix completely by separating into particles that cannot be seen. For example, salt-water is a solution. When we mix salt and water, we can make a mixture of salt and water.

The salt particles in salt-water cannot be seen because the particles of salt become so small and they spread evenly in the water. But when we mix sand and water the sand settles at the bottom. The sand does not dissolve into the water. The mixture of sand and water is not a solution. Soda, air and gasoline are examples of solutions.

Soda is a solution where carbon dioxide is dissolved in water.

Lesson 2 Weight of Solution

When salt is mixed with water, the salt in the salt-water seems to disappear. How about the weight of the salt? Does the weight of salt also disappear?

What happens to the weight of a substance in a solution?

Activity : Measuring the weight of salt in salt-water

What We Need:

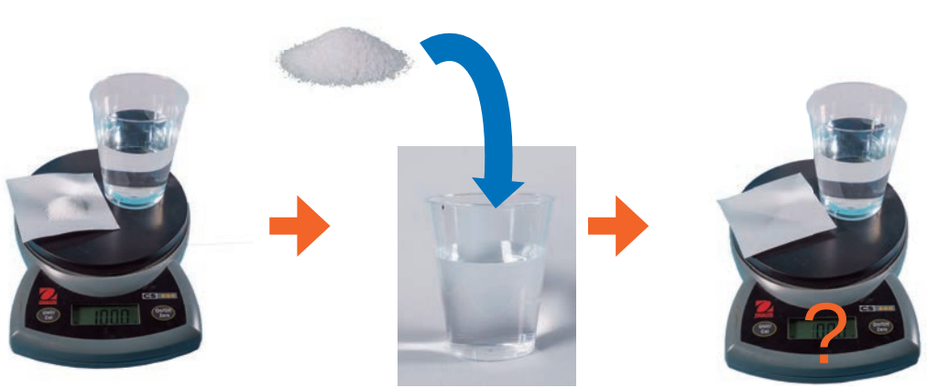
- glass, water, salt, paper, scale

What to Do:

1. Draw a table like the one shown below.

	Total amount of weight
Before dissolving salt in water	
After dissolving salt in water	

2. Pour water into the glass. Place the glass of water and the paper with salt on the scale.
3. Measure the total amount of weight and record it in the table.
4. Remove salt from the scale. Pour the salt into the glass and stir until the salt is completely dissolved.
5. Place the glass and paper on the scale again and measure the total weight. Record the weight in the table. Share your findings with your classmates.



Result

We found out that the total amount of weight before and after dissolving salt in water did not change.

Sample of the result

Before dissolving salt in water

After dissolving salt in water

Discussion

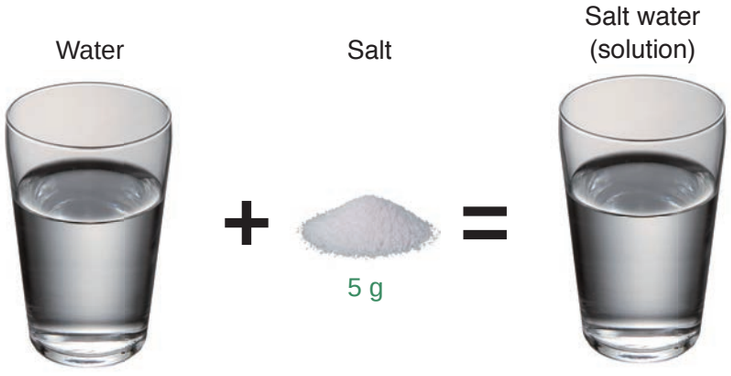
Think about the following questions based on your result.

1. What was the total amount of weight before dissolving salt in water?
2. What was the total amount of weight after dissolving salt in water?
3. What happened to the weight of salt before and after it is dissolved in water?

Summary

When a substance is dissolved in water its weight does not change.

The weight of a solution is equal to the sum of the weight of water and a substance to be dissolved. A substance dissolved in water cannot be seen but it actually exists in the solution.



The weight of salt water is equal to the sum of the weight of water and salt.

Lesson 3 Amount of Substance Dissolved in Water 1

Salt can be dissolved in water, but what will happen if we keep adding more salt? Will the salt continue to dissolve?

How much of a substance can dissolve in water?

Activity : Amount of salt to be dissolved in water

What We Need:

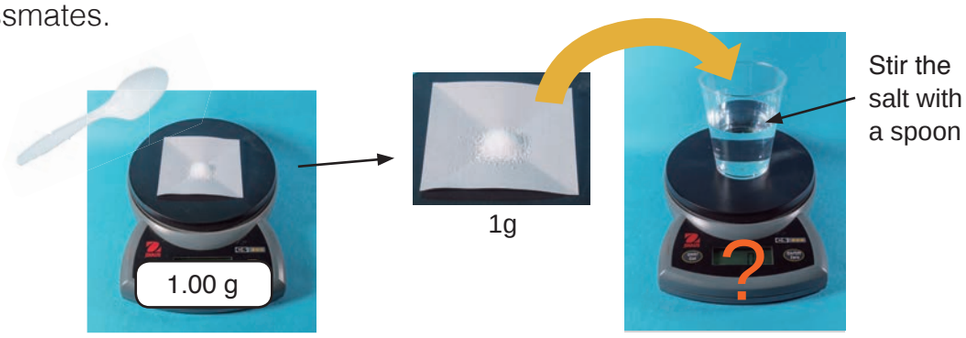
- glass, water, spoon, salt, paper, scale

What to Do:

1. Draw a table like the one shown below.

	The amount of salt dissolved
50 mL water	
100 mL water	

2. Pour 50 mL of water into the glass. Add 10 g of salt into the glass of water and stir it well with a spoon.
3. Measure 1 g of salt on the scale. Add 1 g of salt into the water and stir it well. Repeat this step until the salt no longer dissolves in the water. Record the amount of salt dissolved in 50 mL of water in the table.
4. Repeat Steps 2 and 3 using 100 mL of water. Record your results in the table.
5. Summarise your results in a graph and share your findings with your classmates.



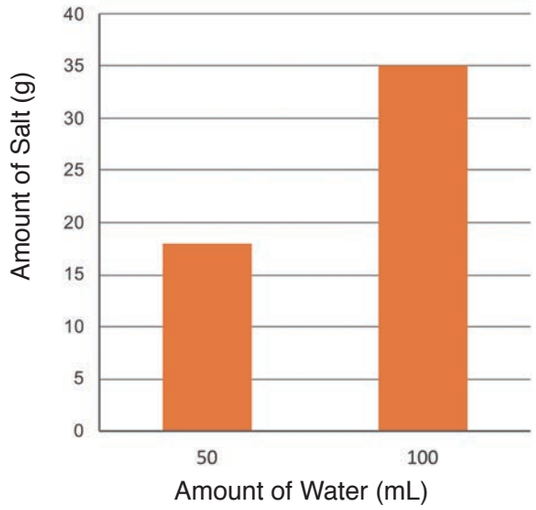
Result

We found out that salt dissolves in water as shown in the table and graph.

Sample of the results

	The amount of salt dissolved
50 mL water	18 g
100 mL water	35 g

Can you find any relationships between the amount of water and the salt dissolved in water?



Discussion

Think about the following questions based on your result.

1. Do you think salt can continue to dissolve in water? Why do you think so?
2. What happened to the amount of salt that dissolved in water when the amount of water increased?
3. Can you infer the relationship between the amount of water and the salt that dissolved in water?

Summary

If we keep adding salt to the salt-water solution, the salt will no longer dissolve but will settle to the bottom of the container. This is because the amount of salt that can be dissolved in a certain amount of water has been reached. The amount is different from substance to substance. More substances will dissolve in water when the amount of water increases. If the amount of water decreases the amount of substance to be dissolved in water will also decrease.

Lesson 4 Amount of Substance Dissolved in Water 2

More salt will dissolve in water when the amount of water increases.

How can we dissolve more substance without changing the amount of water?

Activity : Dissolving more sugar in water

What We Need:

- glass, water (room temperature), hot water, spoon, thermometer, sugar, scale

What to Do:

1. Draw a table like the one shown below.

	Temperature (°C)	The weight of the glass with water (g)	The weight of the glass, water and sugar dissolved in water (g)
Water			
Hot water			

2. Pour 50 mL of water into the glass. Measure the weight of the glass with the scale and the temperature of the water with the thermometer. Record the measurement of the weight and the temperature in the table.
3. Add sugar into the glass and stir well. Repeat this step until the sugar no longer dissolves in the water. Then measure the weight of the glass and record it in your exercise book.
4. Repeat Steps 2 and 3 using 40˚C and 60˚C hot water.
5. Share your results with your classmates.

Result

We found out that more sugar can be dissolved in the same amount of water at different temperatures shown in the table and the graph.

Example of the results

	Temperature	The weight of the glass with water	The weight of the glass, water and sugar dissolved in water
Water (50 mL)	20°C	180 g	282 g
Hot water (50 mL)	40°C	180 g	300 g
Hot water (50 mL)	60°C	180 g	323 g

Amount of sugar and salt dissolved in 100 g water

Discussion

Think about the following questions based on the results above.

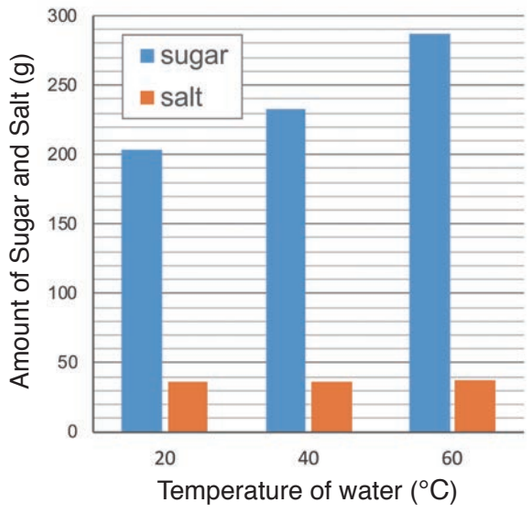
1. Calculate how much sugar is dissolved in 50 mL of water at 20°C, 40°C and 60°C.
2. What happened to the amount of sugar dissolved in water when the temperature of water increased?
3. Can you infer the relationship between the temperature of water and the amount of sugar dissolved in water?

Summary

Temperature of water	Amount of sugar dissolved in water	Amount of salt dissolved in water
20°C	203.9 g	35.9 g
40°C	233.1 g	36.4 g
60°C	287.3 g	37.0 g

Amount of sugar and salt dissolved in 100 g water

When the temperature of water increases more sugar can be dissolved, but the amount of salt to be dissolved does not change much. The amount of a substance that can be dissolved in water depends on the kind of substance even when the temperature of water increases.



Amount of sugar and salt dissolved in 100 g of water

Summary and Exercise

Summary 11.2 Solutions

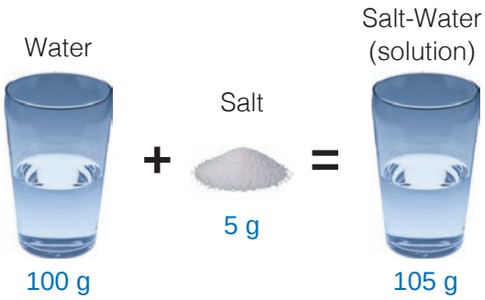
Mixtures and Solutions


Salt-water

- A solution is a mixture where one or more substances are evenly dissolved into another substance.
- Dissolve means to mix completely by separating into particles that cannot be seen.
- A solution has the same property throughout a mixture.
- Salt-water is a solution. When salt is mixed with water its particles spread evenly in the mixture where salt particles cannot be seen.

Weight of Solutions

- The weight of a solution is equal to the sum of water and the substance to be dissolved.
- The weight of a substance does not change when the substance is dissolved in water.
- A substance that dissolves in water cannot be seen but it exists in the solution.



Amount of Substance Dissolved in Water

- The amount of substance that dissolves in water depends on the amount of water and the temperature of water.
  1. More substances dissolve in water when the amount of water increases.
  2. More substances dissolve in water when the temperature of water increases.
- The amount of substances that dissolve in water depend on the type of the substances.

Summary and Exercise

Exercise 11.2 Solutions

Q1. Complete each sentence with the correct word.

(1) A kind of mixture where one or more substances are evenly dissolved into another substance is called a _____.

(2) Solution have the same _____ throughout a mixture.

(3) A substance in a solution is hard to see because it is _____.

(4) The weight of a solution is equal to the _____ of the weight of water and the substance to be dissolved.

Q2. Choose the letter with the correct answer.

(1) Which of the following is <u>not</u> a solution?

A. Mixture of salt and water.

B. Mixture of oil and water.

C. Mixture of sugar and water.

D. Soda water.

(2) What happens to the amount of sugar dissolved in water if the temperature of water is increased?

A. Less sugar will dissolve in water.

B. More sugar will dissolve in water.

C. The amount of dissolved sugar does not change.

D. The volume of water will decrease.

Q3. Answer the following questions.

Study and compare the picture shown on the right.

(1) What can you say about the particles of sand and salt in the mixture?

(2) What are the two factors that cause the change in the amount of salt dissolved in water?

A mixture of sand and water

A mixture of salt and water

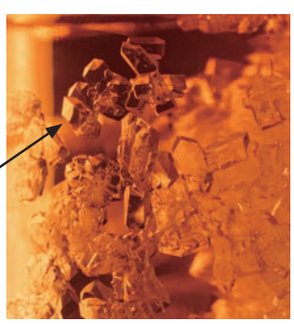
Q4. Celine added 50 g of sugar into 200 g of hot water. She stirred the sugar to dissolve completely in the hot water and recorded the weight. Explain the relationship between the weight before and after dissolving?

Chapter 11
•Science Extras•

Solutions are types of mixtures. A mixture of sugar and water is an example of a solution. We learnt that when the temperature of water increases more sugar can be dissolved. What happens when more sugar is dissolved in hot water and it is cooled?

Let's make sugar crystal from sugar solution

1. Wet the end of the skewer in a glass of water. Coat it with sugar grains and gently tap to remove excess sugar and leave to dry.
2. Pour 200 ml of water into a medium sized pot. Dissolve 250 g of sugar in the pot for a start. Heat the sugar mixture.
3. Keep stirring the sugar mixture until it gets hot. Add another 250 g of sugar little by little into the pot and stir until all sugar completely dissolve.
4. Pour the thick sugar solution into the glass cup.
5. Place the skewer coated with sugar grains slowly into the glass cup.
6. Carefully move the glass cup to a place where they won't be disturbed.
7. Make sure not to touch the glass cup. Leave about one day for crystal to form and slowly build up.
6. Observe the crystal of sugar formed around the skewer.



Chapter Test

11. Mixtures and Solutions

Q1

Complete each sentence with the correct word.

(1) Air is a mixture of _____ such as nitrogen, carbon dioxide.

(2) A _____ has the same properties throughout the mixture.

(3) To _____ means to mix matter completely into the liquid by separating into its particles that cannot be seen.

(4) A _____ is a combination of two or more substances.

(5) Mixtures can be _____ using their physical properties.

Q2

Choose the letter with the correct answer.

(1) Which of the following is the correct explanation about filtration?

A. Let the water evaporate from the mixture.

B. Use filter paper to trap the solid from the mixture.

C. Use tweezers to pick out the solid from the mixture.

D. Use a magnet to attract the solid from the mixture.

(2) Sugar dissolved in water is an example of which type of mixture?

A. Liquid-solid mixture.

B. Gas-liquid mixture.

C. Liquid-liquid mixture.

D. Solid-liquid mixture.

(3) What happens to the weight of a substance in a solution? The weight of the solution

A. does not change.

B. increases.

C. disappears.

D. decreases.

(4) What is the correct method used to separate salt from water?

A. By evaporation

B. By condensation

C. By expansion

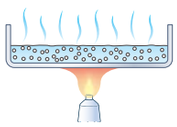
D. By filtration

Q3

(1) Josie wants to separate salt from water. Which method would she use A, B or C?

_____

A.



Heat gently
(Evaporate)

B.

By handpicking

C.

Filtration

(2) Explain two ways to increase the amount of salt dissolved in water.

a. _____

b. _____

(3) Angie added five teaspoons of salt in a glass of water and stirred it for a minute. After stirring, the salt disappeared. What had happened to the salt?

_____

Q4

(1) Helen used a screen to separate a mixture of gravel, sand and water. Why did the sand go through the screen but not the gravel?

_____

_____

_____

(2) Bonita added 10 g of salt into 100 mL of water and stirred it with a spoon. After the salt dissolved, she did not find any salt particles in the solution. Suggest what would happen to the weight of the salt dissolved in water.

_____

_____