DEPARTMENT OF EDUCATION

# GRADE 10

# SCIENCE

# UNIT 5


# COMMUNICATION

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# GRADE 10

# SCIENCE

# UNIT 5

# COMMUNICATION

**IN THIS UNIT YOU WILL LEARN ABOUT:**

**TOPIC 1: METHODS OF COMMUNICATION**
**TOPIC 2: WAVE MOTION**
**TOPIC 3: SOUND WAVES**
**TOPIC 4: TELECOMMUNICATION**

**Acknowledgement**

We acknowledge the contributions of all secondary teachers who in one way or another have helped to develop this Course.

Our profound gratitude goes to the former Principal of FODE, Mr. Demas Tongogo for leading FODE team towards this great achievement.

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**DIANA TEIT AKIS**

PRINCIPAL

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## TABLE OF CONTENTS

## SECRETARY'S MESSAGE

Achieving a better future by individual students and their families, communities or the nation as a whole, depends on the kind of curriculum and the way it is delivered.

This course is part of the new Flexible, Open and Distance Education curriculum. The learning outcomes are student-centred and allows for them to be demonstrated and assessed.

It maintains the rationale, goals, aims and principles of the national curriculum and identifies the knowledge, skills, attitudes and values that students should achieve.

This is a provision by Flexible, Open and Distance Education as an alternative pathway of formal education.

The course promotes Papua New Guinea values and beliefs which are found in our Constitution and Government Policies and Reports. It is developed in line with the National Education Plan (2005 – 2014) and addresses an increase in the number of school leavers affected by the lack of access to secondary and higher educational institutions.

Flexible, Open and Distance Education curriculum is guided by the Department of Education's Mission which is fivefold:

- To facilitate and promote the integral development of every individual.
- To develop and encourage an education system that satisfies the requirements of Papua New Guinea and its people.
- To establish, preserve and improve standards of education throughout Papua New Guinea.
- To make the benefits of such education available as widely as possible to all of the people.
- To make the education accessible to the poor and physically, mentally and socially handicapped as well as to those who are educationally disadvantaged.

The college is enhanced through this course to provide alternative and comparable pathways for students and adults to complete their education through a one system, two pathways and same outcomes.

It is our vision that Papua New Guineans' harness all appropriate and affordable technologies to pursue this program.

I commend all the teachers, curriculum writers, university lecturers and many others who have contributed in developing this course.

**UKE KOMBRA, PhD**
Secretary for Education

# UNIT INTRODUCTION

Dear Student,

Welcome to Unit 5 of your Grade 10 Science Course! I hope you have enjoyed studying the earlier Units. I hope that this unit on communication will be interesting and enjoyable to study as well.

In this Unit, there are four Topics with 20 Lessons. The four topics are:

- **Methods of Communication**
- **Wave Motion**
- **Sound Waves**
- **Telecommunication**

There are four lessons in the first Topic. The lessons will introduce you to what communication is and the different methods of communication. You will also learn the process involved in communication.

The second Topic has six lessons and will discuss how waves are created and the importance of wave motion in the transmission of sound which is vital in communication. You will also learn on wave energy and energy changes that take place as waves move through a medium and the importance of waves in communication.

In the third Topic, there are five lessons that will discuss on how sound is produced and transmitted. It will also talk about sound from vibration of air and its speed and echo. You will also learn from this topic that some of the sounds are nice to hear while the others are unpleasant.

The last Topic has five lessons as well. It talks about how a radio station works and how radio waves are transmitted. You will also learn from this Topic the importance of television as another means of communication.

Remember, you have to do all the activities and carry out the Practice Exercise after each lesson. Answers to Practice Exercises are at the end of each Topic.

If you have any problems in understanding any of the lessons in this Unit, please do not hesitate to inform the Science Department at FODE Headquarters. This will help the teacher to revise the lessons for the next edition.

You may study this Unit now following the Study Guide on the next page.

All the Best!

# STUDY GUIDE

**Follow the steps given below and work through the lessons.**

Step 1 Start with Topic 1 and work through it in order.

Step 2 When you study lesson 1, do the given Activities. When you complete the Activities, check your work. The answers are given at the end of the Lesson. (Note: Short lessons may not have an Activity.)

Step 3 You will also do a Practice Exercise at the end of each lesson. After you have completed the Practice Exercise, correct your work. The answers are given at the end of each Topic.

Step 4 Then, revise and correct any mistakes.

Step 5 When you have completed all of these steps, tick the check box for Lesson 1, on the Table of Contents page, like this:

☑ Lesson 1: Introduction to Communication

Then, go on to the next Lesson. Repeat this process until you complete all the Lessons on a Topic. When this is done, revise using the Review Section.

**Remember, as you complete each lesson, tick the box for that lesson on the table of contents page. This will help you check your progress.**

**Assignments: Topic Tests and Unit Test**

When you have completed all the lessons in a Topic, do the Topic Test for that Topic, in your Assignment Book. The Unit Book tells you when to do this.

When you have completed the entire Topic Tests for the Unit, revise well and do the Unit Test. The Assignment Book tells you when to do the Unit test.

When you have completed the entire Assignment Book, check and revise well before sending it to the Provincial Centre.

If you have any questions, write them on the Student's page. You will receive a response and advice from your teacher when he/she returns your marked assignment.

**The Topic Tests and the Unit Test in each Assignment will be marked by your Distance Teacher. The marks you score in each Assignment will count towards the final result. If you score less than 50%, you will repeat that Assignment.**

Remember, if you score less than 50% in three consecutive Assignments, your enrolment will be cancelled. So, work carefully and ensure that you pass all Assignments.

# TOPIC 1

# METHODS OF COMMUNICATION

**In this topic you will learn about:**

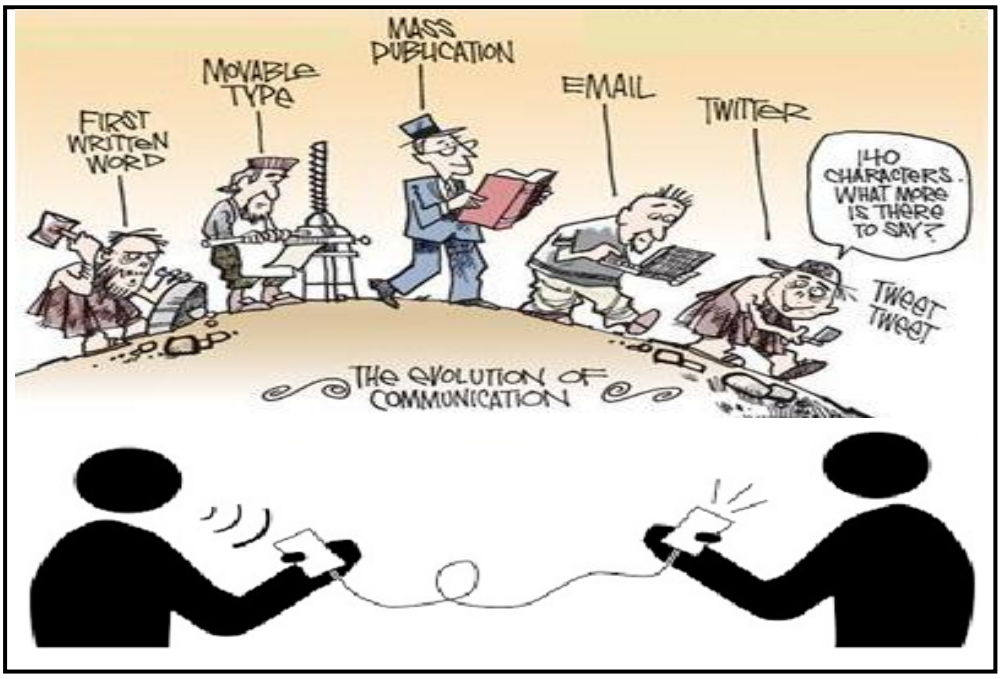
- **introduction to communication**
- **traditional communication**
- **modern communication**
- **the process of communication**

# INTRODUCTION TO TOPIC 1: METHODS OF COMMUNICATION

Communication is the sending and receiving of information between two or more people. It is the process of using words, sounds, signs, or behaviours to express or exchange information, ideas, thoughts and feelings.

The methods of communication have dramatically changed overtime. In traditional times, the beats of a garamut drum is used in coastal areas of Papua New Guinea to announce meetings. Organisations in our modern time today use emails or call members to meetings. Traditional methods of communication have been modified into advance modern communications methods with science.

Communication is a very important part of our lives. Information exchanged through communication can include facts, ideas, concepts, opinions, beliefs, attitudes, instructions and even emotions.




You should know all about communication and why it is an important part of our life. Some of the questions you may be asking yourself now are:

- What is communication?
- How is communication possible?
- Why is communication important?
- What are some traditional and modern methods of communication?
- How efficient is modern communication compared to traditional?

**In this Topic, you will find the answers to these questions and all other questions relating to methods of communication.**

# Lesson 1: Introduction to Communication

Welcome to Lesson 1. Suppose you want to send a message to someone at the back of a building, how could you do it? May be you could pass a note, send a signal using your eyes or hands or even call out. In this lesson, we will discuss what communication is and its importance.

**Your Aims:**

- define communication
- discuss the methods of communication
- discuss the importance of communication

## What is Communication?

Communication is the process of passing information and ideas from one person to another or from one place to another. It is vital in life, for example, in business, education and any other situation where people encounter each other.

Communication is part of everyday life and is essential for all people in every society. A teacher talking, charts on the wall, writing on the black board, labels, sign posts and bell ringing are examples of passing information.

Livings things, especially animals have many different ways of communicating. These include the use of smell, body movements, colour and sound.

## Methods of Communication

There are many different methods of communication. Some methods used in the past are still being used today. Others are modern methods of communication. The table below shows the different methods of communication used in the past and even today.

**Methods of communication**

| Traditional method | Modern method | Both |
|---|---|---|
| Drum | Telephone | Speech |
| Smoke | Mobile phone | Facial expression |
| Shouting and calling | Radio | Hand sign |
| Shells | Newspaper | Body gesture |
| Speech | Films | |
| Facial expression | Videos | |
| | Television | |
| | Internet | |

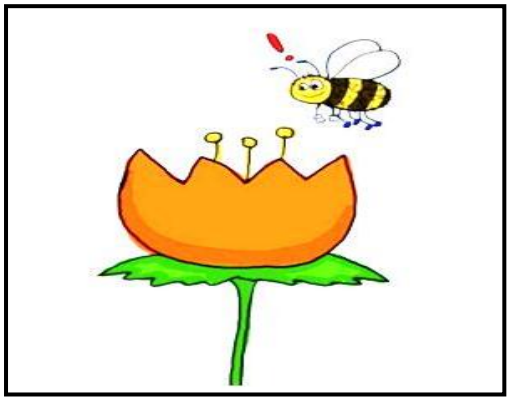
**Ways of communicating for animals**

Have you seen a bee feeding from a hibiscus flower? How does it know that there is a flower nearby? The activity of the bee coming from somewhere and feeding from the nectar explains how living things communicate. Here are some of the different ways in which living things communicate.

1. **Smell**

Smell is an important means of communication for many plants and animals. The pictures below show how some insects communicate for reproduction and food.

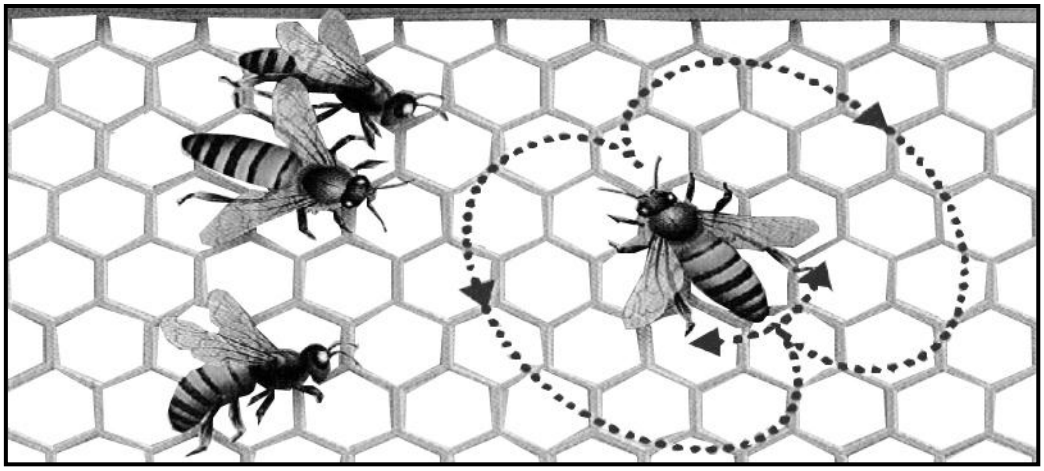
The male silk moth has big antennae to pick up the scent given out by females when they are ready to mate.



Some plants use smell to attract insects

2. **Body movements**

A bee that finds some nectar or food source comes back and dances in front of the other bees telling them where the food is. The pattern of the dance also tells the other bees where the food is located. A round dance as shown in the picture indicates that the food is nearby. Most other animals also use body movements for communicating different messages.



A bee that has found some nectar can tell the others where the food is by performing a dance

3. **Colour**

Living things use the colour of their body as a way of attracting and warning other living things. For example, some butterflies have markings that look like large eyes which stops birds from eating them.

4. **Sound**

Sound is the most important means of communication for birds and they often have many different calls. For example the great tit uses more than 50 calls. Short simple calls are used between young and parents and as alarm signals. A bird's song is a way of telling others where it's territory (own area for feeding and nesting) begins and ends so that the other birds are warned not to go there.

**Human communication**

Humans use many different kinds of communication. Humans have developed languages that can be both spoken and written. Speech is the most commonly used method of communication. Humans use signs, pictures, symbols and many different ways to communicate. Some of the signs are important parts of the road traffic system as shown below.


The octagon is used only for a **STOP** sign. This sign has a red background


The circle is used for pedestrian and hand-held **STOP** banners. This sign has a yellow background


The triangle with one point downwards is used only for a **GIVE WAY** sign. This sign has a red border.

The diamond is used for warning signs. These signs have a yellow background


The long vertical rectangle is used for all regulatory signs that do not have a shape of their own. These signs have a white background.


The horizontal rectangle is used for guide and information signs, and to provide additional messages to regulatory and warning signs. These signs usually have a green background.

Examples of some road signs

**Importance of Communication**

Communication is a very important process and it is a part of everyday life. Different communication methods and systems make people aware of many happenings around them. Plants and animals communicate in different ways to meet their survival needs such as food, shelter, mating and reproduction and also for protection from their enemies. Modern communication methods have made life easier for people because messages can now be transmitted further or to long distances using wire or even better without wires.

---

**Activity: Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

Copy and complete the following sentences using the most suitable word or words:

1. _____ means the passing of information and messages from one place to another.

2. Birds protect their area of feeding and nesting by making special _____.

3. The most commonly used method of communication by human is _____

4. Some plants produce _____ to attract insects.

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 1.**

## Summary

You have come to the end of Lesson 1. In this lesson you have learnt that:

- communication is the process of passing information and ideas from one place to another.
- the two main methods of communication are modern and traditional communication.
- living things use smell, colour, sound and body movements to communicate.
- human beings can receive messages by smell, sight, touch, taste or hearing.
- speech is the most commonly used method of communication.
- human beings have developed useful devices to make communication effective.

---

**NOW DO PRACTICE EXERCISE 1 ON THE NEXT PAGE.**

## Practice Exercise 1

**Answer the following question.**

Draw up a table and classify each word from the list below into traditional, modern or both methods of communication.

| |
|---|
| Writing & printing, Pictographs, Radio, Sound, Video, Gesture, Designs, Fax, Television, Telephone, Symbols, Newspapers, Computers, Drums, Letters, Telegraph, Mobile phones, Smoke, Magazines, conch shell, speech, |

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1.**

**Answers to Activity**

1. Communication
2. calls
3. speech
4. smell

# Lesson 2: Traditional Communication

Welcome to Lesson 2. In the last lesson, you learnt about what communication is, the methods of communication and its importance. In this lesson, you will learn about traditional communication and its efficiency and effectiveness in communication.

**Your Aims:**

- identify traditional methods of communication
- discuss the efficiency and effectiveness of traditional communication

## Traditional Methods of Communication

Communication is a process of passing information from one place to another or from people to people. Traditional method of communication does not cost anything and involves using basic local resources, such as poems, storytelling, singing, dancing and games, to convey realistic messages that people can relate to.

This method was mostly used by people in the past and was very effective in delivering messages to individuals, families or small groups of people who live in small communities and villages.

The following are some traditional methods of communication.

### Garamut

Garamut is an instrument used for communication. It is made by cutting a hollow in a tree or log. Messages are sent to a person in the form of beating the garamut. The receiver of the message responds to the sender of the message by beating their garamut as well, but the sound of responding garamut beating is different from the person sending the message. Different beats mean different things.

For example, a deep, slow beat might mean a death and a fast beat might mean a fight. There are people in villages who are taught how to communicate by beating a garamut and there are also people who are taught how to interpret the meaning of the different sounds. Beating of garamuts is mostly used in the coastal areas of PNG. People pass messages when there is death in the family, fighting, compensation, bride price payment, feasting time or just for passing ordinary messages.

Garamut

**Conch shell**
Sound is created by the blowing of the conch shell which sends out the message. Conch shell is mostly used in coastal areas of PNG. It is used for calling people together for meetings, compensation, bride price payment and feasting time.

**Kundu**
Beating the kundu produces sound and the message is sent through the sound of the kundu. It is mainly used for feasting and traditional sing sing.

A dancer blowing a conch shell and another beating a kundu for traditional singsing

**Signs**
Man-made signs were also used to communicate traditionally. Some of these signs are discussed below.

i. **Making fire**
When a fire is made, it produces smoke that signals the receiver about different messages. For example, thick and dark smoke could mean tribal fight or a feast. When people burn firewood to warm mumu stones, the smoke from the fire informs people that someone is doing mumu. Or if people cut down bushes and burn the leaves and wood, the smoke tells others that a new garden is been prepared.

ii. **Using leaves**
In many areas of Papua New Guinea, people put leaves of plants or cover objects like firewood, stones or anything useful to say no to people from stealing, cutting, damaging or removing them.

iii. **Tattoos and paints**
In PNG, people have different traditions and cultures. Some traditions practised in coastal areas are different from the highlands or the atolls. For example, the Wanigela people of the Oro Province have tattoos all over their bodies to tell others of their originality and to represent their people and culture. The Motuan women along the Papuan coastline communicate to others of their heritage.

The highlanders paint their faces in black charcoal to show that they are ready to fight a tribal warfare. The people also paint their faces in clay to indicate that they are mourning for a death or may want to join a tribal warfare with neighbouring tribe.

iv. **Cutting as a mark**

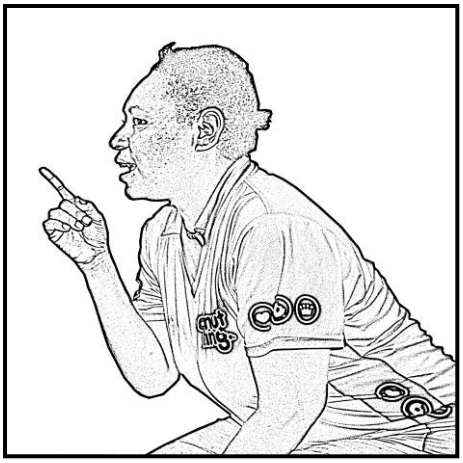
Another type of communication in the villages is where by barks of trees are cut and peeled telling others that someone has already claimed ownership of the tree where the tree dries for firewood.

Another meaning of cutting the tree could possible mean that someone is showing their frustration and anger indicating possible disturbance or arguments in the village over something.

**Using human body parts**

Apart from communicating using basic local resources, body movements were also used for communicating traditionally and even today.

For example, people use their facial expression to communicate with others. We can also use our fingers to communicate by counting from one up to five or further by folding the fingers as confirmation. We also use our pointer to hold against the mouth to say "do not talk or do not say anything" or we say "yes" by nodding our head or "no" by shaking our head.



A person using the pointer to communicate something

Our folded fingers can mean something different or it could be a show of someone's anger, disagreement or can be the opposite to say "we are united". Our eye contact also is another form of communication. Either blinking or very long stare at someone could mean "disapproval, or an agreement".

Our hands are used for clapping to show our appreciation or shaking hands to indicate the acceptance of a subject or issue.

We can also use our (5) senses for communicating, just like our fore fathers did in the past. All senses are equally important for communicating and we use our ears to hear, tongue to taste, eyes to see, our nose to smell and hands to feel or touch.

**Shouting and calling**

Shouting and calling is the most common form of communication in the past and even today. Messages are sent through shouting and calling out in loud voices over mountains and valleys. The echo of the voice sends out the messages to the receiver. The type and tone of shouts and calls signal whether there is a tribal fight, bride price payment, death, compensation payment, feasting, meetings or passing of an ordinary message.

The methods discussed may seem old and different in so many ways from the new systems introduced from abroad, but they remain what were essentially how the information needs of the traditional days were met.

**Are Traditional Methods of Communication Still Used Today?**

A number of the traditional methods of communication are still used today. Some of these are verbal or oral methods in which people use their voices and others are non-verbal. Traditional musical instruments like garamut, kundu and bamboo flute are still used today during singsing, dancing and feasts. Traditional methods of communication are still effective today although they are a slow way of passing

information over long distances. A number of modern communication methods like telephone, radio or television are the fastest and efficient methods of communication which out-weigh the effectiveness of traditional communication today.

---

## Summary

You have come to the end of Lesson 2. In this lesson you have learnt that:

- traditional methods of communication do not cost anything and involves using basic local resources.
- kundu, garamut, conch shells, smoke, calling and shouting are some traditional methods of communication.
- garamut is one of the common traditional methods of communication by the coastal people.
- apart from communicating using basic local resources, humans also communicate using body movements and sound.
- traditional methods of communication are still effective today although they are a slow way of passing information over long distances.

---

**NOW DO PRACTICE EXERCISE 2 ON THE NEXT PAGE.**

## Practice Exercise 2

**Answer the following questions on the spaces provided.**

1. What is meant by traditional communication?
   _____

2. What instrument used for traditional communication is made by cutting a hollow in a tree or log?
   _____

3. What is the message sent through the sound of the kundu mainly used for?
   _____

4. Why are traditional methods of communication not very efficient today?
   _____
   _____
   _____

5. Which form of communication is the most used in the past and even today?
   _____

6. State two ways in which we can use our body parts to say yes.

   i) _____

   ii) _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1.**

# Lesson 3: Modern Communication

Welcome to Lesson 3. In the previous lesson, we discussed about traditional communication. You have learnt that traditionally, people used smoke, drums, calls, and shells and so on to communicate with each other. Some of these traditional methods are still used today. You also learnt that communication is the process of sharing ideas, information, and messages with others. In this lesson we are going to look at modern communication.

**Your Aims:**

- describe the process of modern communication system
- discuss the importance and effectiveness of modern communication
- explain and identify different modern communication systems

Let us look at what modern communication is.

**What is Modern Communication?**

Modern communication mainly includes writing, visual communication (the use of images or pictures, such as painting, photography, video, or film), and electronic communication (telephone calls, electronic mail, cable television, or satellite broadcasts).

Many modern methods of communication have been introduced into Papua New Guinea. These methods include newspapers, films, telephones, radios, televisions, the internet and mobile or cell phones.

Using the modern communication methods, information or messages can be sent from one place to another regardless of the distance.

Today communication systems use **mass media**. Mass media refers to all of the communication media that reach a large audience. They are especially newspapers, radio and television.

Let us now carefully look at each of the modern methods of communication.

**Newspapers and magazines**

Newspaper publication is usually issued on a daily or weekly basis. The main function of it is to report news. Many newspapers also provide special information to readers, such as weather reports, television schedules, and listings of stock prices. They provide commentary on politics, economics, and arts and culture, and sometimes include entertainment features, such as comics and crossword puzzles.


A sample newspaper

**Telephone**
Do you know how telephone systems work? Let us look at how they work.

Telephone is a system for distance communication that sends electrical signals through wires. In other words, telephone messages are communicated by means of electricity.

The telephone network uses both wire line and wireless methods to deliver voice communications between people, and data communications between computers and people or other computers.

A wireless telephone

Telephone networks also use microwave relay stations to send calls from place to place on the ground. Telephone networks use satellites to transmit telephone calls across countries and oceans.

**How important is the telephone system?**
The telephone network is stable and reliable, because it uses its own wire system that is powered by low-voltage direct current from the telephone company. The telephone network has also provided the electronic network for new computer-based systems like the Internet (a worldwide interconnection of computers and computer networks), facsimile transmissions (copies sent electronically by fax machines through telephone lines).

**Cell phones**
Are you familiar with mobile phones? Mobile phones are smaller than telephones and are portable.

Let’s talk about how mobile phones exchange messages.

A cellular telephone (mobile phone) is designed to give the user maximum freedom of movement while using a telephone. A cellular telephone uses radio signals to communicate between the set and an antenna. The served area is divided into cells, something like a honeycomb, and an antenna is placed within each cell and connected by telephone lines to one exchange devoted to cellular-telephone calls.

This exchange connects cellular telephones to one another or transfers the call to a regular exchange if the call is between a cellular telephone and a non-cellular telephone. The special cellular exchange, through computer control, selects the antenna closest to the telephone when service is requested. As the telephone roams, the exchange automatically determines when to change the serving cell based on the power of the radio signal received simultaneously at adjacent sites. This change occurs without interrupting conversation. The picture on the next page shows a mobile phone tower.

**Mobile phone tower**

Mobile or Cell phone towers are part of the wireless communications network that makes cellular radio telephone calls possible. Antennae on each tower receive high-frequency radio waves from cell phones. Their range varies from distances as short as 1.5 to 2.4 km to distances as long as 48 to 56 km.

Cell phone towers are now commonly seen along roadways as cell phone communication has become increasingly popular.

A Mobile Phone Tower

**Radio**

Have you heard programs on the famous AM and FM radios? Let us see how radio messages are sent and received.

Radios transmit and receive communications at various preset frequencies. Radio waves carry the signals heard on AM (amplitude modulation) and FM (frequency modulation) radio, as well as the signals seen on a television set receiving broadcasts from an antenna.

Radio is used mostly as a public medium, sending commercial broadcasts from a transmitter to anyone with a radio receiver within its range, so it is known as a **point-to-multipoint medium**. However, radio can also be used for private point-to-point transmissions.

Two-way radios, cordless telephones, and cellular radio telephones are common examples of **transceivers**, which are devices that can both transmit and receive point-to-point messages.

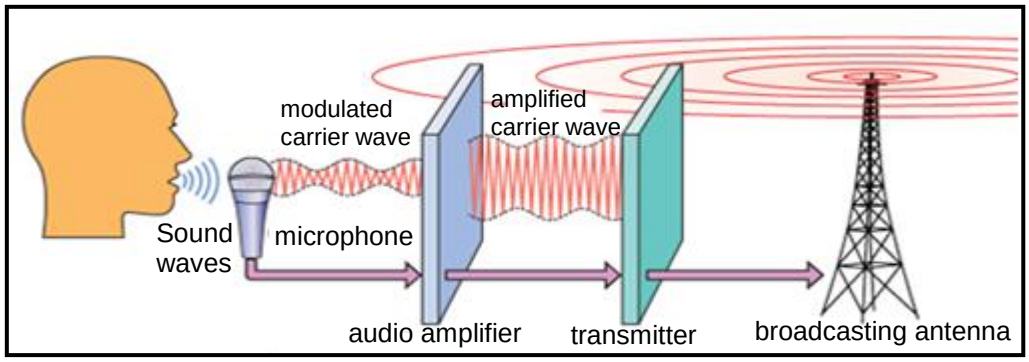
**Two-way radio**

A two-way radio allows people to talk to each other over radio waves. Police officers, firefighters, and friends use two-way radios to keep in touch.

**How does a radio work?**

A radio also works by ‘magnetic wave’. The aerial at the radio station which send the message is a long wire. A changing (vibrating) current is passed through this wire which sends out a changing magnetic field, a magnetic wave.

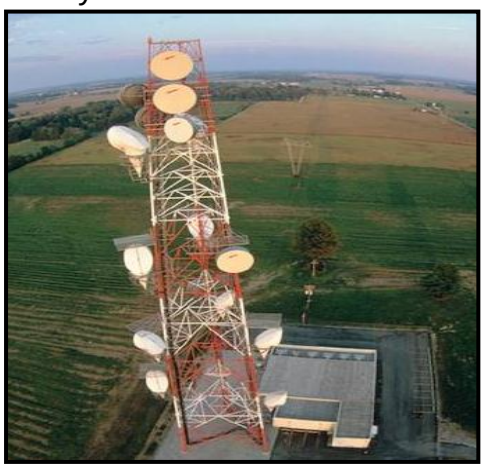
The diagram below shows how radio waves are transmitted.




How radio waves are transmitted

**Television**

Television systems send and receive pictures and sound by means of electronic signals transmitted through wires and optical fibers or by electromagnetic radiation.



A television tower

These signals are usually broadcasted from a central source, a television station, to reception devices such as television sets in homes or relay stations such as those used by cable television service providers.

Television is the most widespread form of communication in the world. Though most people will never meet the leader of a country, travel to the moon, or participate in a war, they can observe these experiences through the images on their television.

**Internet**

Internet is a computer-based global information system. The Internet is composed of many interconnected computer networks. Each network may link tens, hundreds, or even thousands of computers, enabling them to share information and processing power. The Internet has made it possible for people all over the world to communicate with one another effectively and inexpensively.

Unlike traditional broadcasting media, such as radio and television, the Internet does not have a centralized distribution system. Instead, an individual who has Internet access can communicate directly with anyone else on the Internet, post information for general consumption, retrieve information, use distant applications and services, or buy and sell products.

**What is a telecommunication?**

Telecommunication is the transmission of encoded sound, pictures or data over significant distances using radio signals or electrical or optical lines. Telecommunications messages can be sent in a variety of ways and by a wide range of devices. The messages can be sent from one sender to a single receiver (point-to-point) or from one sender to many receivers (point-to-multipoint).

Personal communications, such as a telephone conversation between two people or a facsimile (fax) message, usually involve point-to-point transmission.

**Importance of telecommunications**

Telecommunications enable people around the world to contact one another, to access information instantly, and to communicate from remote areas.

Telecommunications usually involve a sender of information and one or more recipients linked by a technology, such as a telephone system, that transmits information from one place to another.

Telecommunications enables people to send and receive personal messages across town, between countries, and to and from outer space. It also provides the key medium for delivering news, data, information, and entertainment.

**Activity: Test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. What are the modern methods of communication that were introduced in Papua New Guinea?

   _____
   _____

2. Which modern method of communication can send messages using both wireline and wireless?

   _____

3. What is mass media? Give an example of a mass media in PNG.

   _____
   _____

4. Give a reason why a mobile phone (cell phone) is small in size and designed the way it is.

   _____
   _____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 3.**

## Summary

You have come to the end of Lesson 3. In this lesson you have learnt that:

- modern communication is the efficient and fastest way of exchanging messages.
- using modern communication methods, information or messages can be sent from one place to another regardless of the distance.
- the modern communication methods are mainly mass media as they reach a large number of audience.
- telecommunications enable people around the world to contact one another, to access information instantly, and to communicate from remote areas.
- telecommunications usually involve a sender of information and one or more recipients linked by a technology, such as a telephone system, that transmits information from one place to another
- television is the most widespread form of communication in the world.
- television systems send and receive pictures by means of electronic signals transmitted through wires and optical fibers or by electromagnetic radiation.
- internet is a computer-based global information system composed of many interconnected computer networks.

---

**NOW DO PRACTICE EXERCISE 3 ON THE NEXT PAGE.**

## Practice Exercise 3

**Answer these questions on the spaces provided.**

1. What is the type of communication system that uses photography, pictures or images to convey messages?

   _____

2. Complete the sentence.

   The main purpose of a newspaper is to _____

3. If you want to send information from Port Moresby to Singapore, which type of mail would you prefer to send your message? Written letter or email.

   Circle your choice. Give a reason for your answer

   _____

4. What advantage does a mobile phone has over a home telephone?

   _____

   _____

5. What is the name of the central source where television signals are broadcasted from?

   _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1.**

**Answers to Activity**

1. Newspapers, films, telephones, radios, televisions, the internet and mobile or cell phones

2. Radio, telephone

3. Mass media refers to all of the communication media that reach a large audience. Examples: newspaper, telephones, mobile phones,

4. It gives the user maximum freedom of movement while using a telephone.

# Lesson 4: The Process of Communication

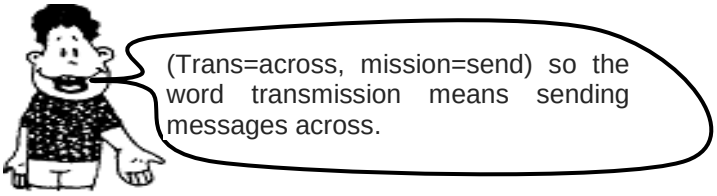
Welcome to Lesson 4. In your last lessons, you learnt about communication and the different methods of communication. People communicate for only one reason and that is to pass on information from one place to another. Information to be passed on is transmitted from one place to another. There are components involved in the communication process. This lesson will help you to identify the different processes of communication and how it is done through transmission.

**Your Aims:**

- define transmission
- describe and identify the process of communication
- explain the components of communication process
- discuss the transmission of light and sound.

## What is Transmission?

The word transmission is made up of two words**, 'trans**' which means across and **'mission'** which means send. When you put the two words together, transmission would mean send across, so transmission of messages is the sending across of messages.




**Messages travel from one place to another and this is called transmission.**

## The Process of Communication

There are three steps involved in all methods of communication and they are summarised below.

1. A person or other living thing must be the **sender** of the message. This is also known as the **source** of the message. Message is created by a source and can be in the form of verbal or written messages, radio signals, radio or television broadcasts and data.

2. The message must **travel** to another place or person. This is called the **transmission** of message. The message travels along using various ways of transmission.

3. The message must be received in a different place by the **receiver**. A person received the information at the end of the process and so the information has been passed on.

Thus, this is called the process of communication.

Now take for example a letter, which is a method of communication and see how the three steps are involved. The message is sent by writing or printing. This is the source. Next the message must travel, so in this case the paper is carried by land, air or sea and finally it must be received by the receiver which is the eye when it reads the message

Now let us look at the example of the letter in detail.

**1. The sender (source of information)**

In the first step, a person has to write the letter with necessary information. This type of person is called a sender. The sender of the information can decide on the method he wants to use to send the message. The written letter would be sent through the post office.

**2. The transmission**

The message written by the sender must now travel from one place to another for another person to receive the message. Some messages take a long time to arrive at their destination and some take shorter time. The longest time it can take for a message to be transmitted is two weeks and the shortest time can be five minutes.

For example, the message in the form of a letter, will be posted with a postage stamp, then sent to the airport in a vehicle with other letters, loaded in the plane, arrive at its destination, put on a vehicle again, unloaded at a post office and put into the box for the person to get it.

**3. The receiver**

When the message sent has reached its destination, a person is always at the other end or in a different place to receive this message. This is the third step and the person receiving the message is called the **receiver**. If it is in a letter form like in our example, the receiver will be the eye of the person reading the letter.

The three steps mentioned above are the steps involved in all other methods of communication.

**The three steps involved in all methods of communication are the sender, transmitter and receiver**

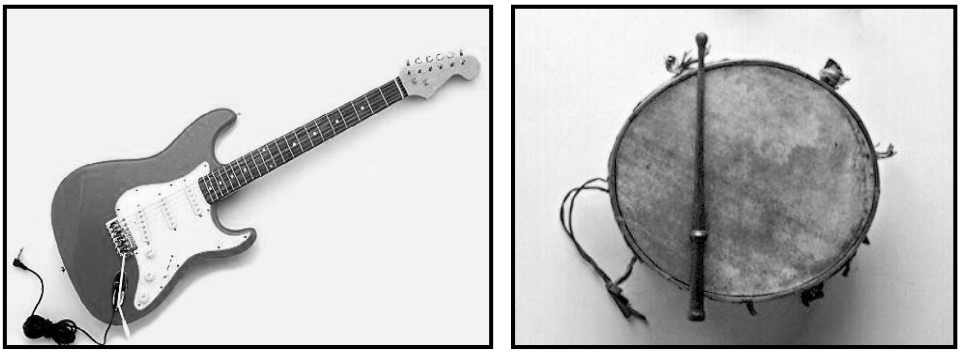
The table below shows the methods and processes of communication

| Method of communication | Sender | How message travels (transmission) | Receiver |
|---|---|---|---|
| News paper | Writing and printing | Paper carried by land, sea or air | By the eye: reading |
| Drum | Beating with stick | Sound through air/ through nothing | By the ear: hearing |
| Telephone | Voice / telephone | Wires /electricity | Ear / telephone |
| Speech | Voice /vocal cords | Sound / air | ear |
| Radio | Radio station/ aerial | Satellite, waves through nothing, | Radio /aerial |
| Film | projector | light | Screen/ eye |
| Movie | projector | light | Screen/ eye |

Communication involves:

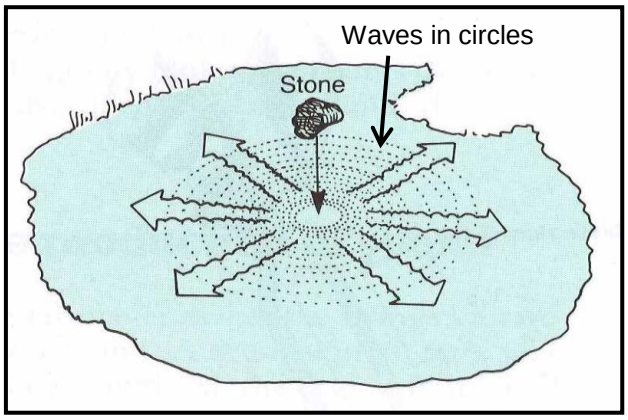

**The transmission of Sound**

Sounds are made by vibrating objects. How does it travel through the air to reach our ears?



Sounds are made by vibrating objects

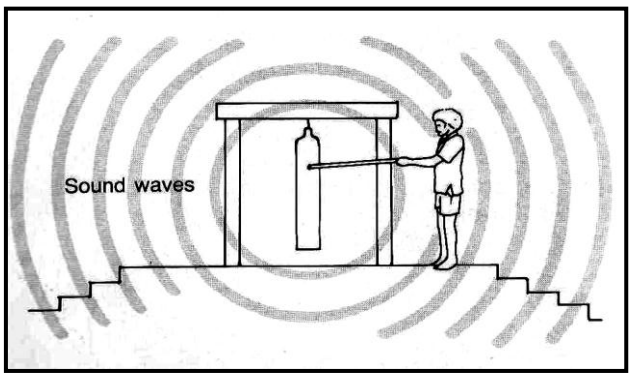
To understand this, we can look at what happens when a stone is dropped into water.




Waves spread out in circles from where the stone hit the surface of the water.

When a stone is dropped into water, waves spread out in circles from where the stone hit the surface of the water. The circles get bigger as they move as shown in the diagram above. Sound waves travel in a similar way.

Take for example a ringing bell shown in the diagram below. As the boy hits the bell, it moves in and out very fast (vibrates) and makes a sound. But how does this happen?




A ringing bell

Air is a gas made up of tiny particles. As the bell vibrates, it disturbs the air particles around it. As it moves outwards, it pushes against the air particles next to it. Then, as the bell moves inwards, the air next to it moves back again. These 'pushes' and 'pulls' travel through the air as a sound wave.

The air is continually been squashed and stretched many times every second. The sound waves travel outwards, in all directions, away from the vibrations. The 'stretches' and 'squashes' travel out through the air as waves. When they reach your ears, they make your ear drums vibrate and you hear a sound which is the bell ringing.

Sound is a fast and efficient way of transmitting messages but it is difficult to understand it because we cannot see it. However, as sound waves travel, their energy spreads out and the sound goes too soft to be heard. If we want to make sound travel further, we have to make it stronger.

In the ancestral days, people used sound to communicate messages. For example, through the beating of kundu drums in which the skin of the drum vibrates and the blowing of conch shells. Both activities produce sound waves to travel outwards in different directions so that the message transmitted with the sound can be heard from a faraway distance.

**The Transmission of Light**

Light is made up of waves. We now know that when a stone is dropped into water, waves spread out in circles from where the stone hit the surface of the water and the waves get bigger as they move.

Light travels in much the same ways but, the circles which are the 'waves' are tiny electric and magnetic vibrations. They do not need water to travel across.

Light can travel through a vacuum which is shown by the fact that sunlight travels through space to reach the earth. Light can also easily travel through substances such as air, water and glass. These substances are said to **transmit** light.

---

**Activity: Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. What is the definition of transmission?

   _____
   _____
   _____

2. Name the components involved in the process of communication and briefly describe each one.

   _____
   _____
   _____
   _____
   _____

_____
_____
_____
_____
_____

3. Briefly explain the way in which sound is transmitted.

_____
_____
_____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 4.**

## Summary

You have come to the end of Lesson 4. In this lesson you have learnt that:

- the three steps involved in the process of communication are sending, transmitting and receiving the message.
- a person or some other living thing sending out the message is called a sender. This is also known as the source of the message.
- a message travelling to another place is called transmission.
- a person in a different place receiving the message is called the receiver.
- transmission of light is when light easily travels through substances such as air, water and glass.
- sound waves are produced from vibrating objects and that they travel outwards in all directions. This is called transmission of sound.

---

**NOW DO PRACTICE EXERCISE 4 ON THE NEXT PAGE.**

## Practice Exercise 4

**Answer the following questions on the spaces provided.**

1. List the three steps involved in all methods of communication in the correct order.

   a) _____

   b) _____

   c) _____

**Refer to the information below to answer Question 2.**

A drum was beaten to send out a message for a traditional singsing.

2. a) Who was the sender?
   _____

   b) How was the message transmitted?
   _____

   c) Who was the receiver?
   _____

3. a) How are sound waves produced?
   _____

   b) How do sound waves travel from the source of the sound?
   _____

   c) Draw a diagram to explain your answer to b). Show the source of the sound as an **X**.

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 1.**

**Answers to Activity**

1. The act or process of sending messages across.

2. (i) The sender is a person who sends out the message. This is also called the source of message.
   (ii) Transmission is the process of message travelling from one place to another
   (iii) The receiver is the person who receives the message in a different pace

3. Sound waves are produced by vibrating objects and sent outwards in all directions. This is the reason why we are able to hear even though we cannot see it.

# Answers to Practice Exercises 1 – 4

## Practice Exercise 1

| Traditional method | Modern method | Both |
|---|---|---|
| Drum<br>Smoke<br>Calling/shouting (oral)<br>Shells<br>conch shell, | Telephone, Mobile phone<br>Radio, Newspaper, Films<br>Videos, Television, Internet<br>Telegraph, Magazines, Fax,<br>Pictographs, Symbols,<br>Computers, Designs, Letters,<br>Writing & printing | Speech<br>Facial expression<br>Hand sign<br>Body gesture<br>Sound, |

## Practice Exercise 2

1. Methods or ways of passing messages using traditional instruments and methods.

2. Garamut

3. It is mainly used for feasting and traditional singsing.

4. Because they are a slow way of passing information over long distances.

5. Shouting and calling

6. (i) We use the thumbs up to say yes.

   (ii) We say yes by nodding our heads.

## Practice Exercise 3

1. Visual communication

2. The main purpose of the newspaper is to report news.

3. Email or electronic mail, because it is the fastest and convenient way of sending messages over long distances.

4. It is portable and provides maximum freedom of movement while using a telephone.

5. It is called a television station.

**Practice Exercise 4**

1. a) Sender

   b) Transmitter

   c) Receiver

2. a) Beating with a stick

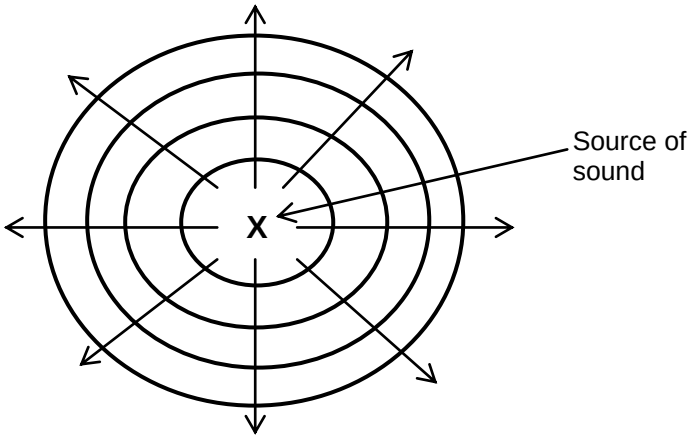
   b) Through the air

   c) Ear (by hearing)

3. a) Sound waves are produced by vibrating objects.

   b) They travel outwards from the source in all directions.

   c)




Sound travel outwards from its source in all directions to reach our ears

---

**REVISE TOPIC 1 USING THE MAIN POINTS ON THE NEXT PAGE.**

# REVIEW OF TOPIC 1: Methods of Communication

Now, revise all lessons in this Topic and then do **ASSIGNMENT 5**.
Here are the main points to help you revise.

## Lesson 1: Introduction to Communication

- Communication is the process of passing information and ideas from one place to another.
- The two main methods of communication are modern and traditional communication.
- Living things use smell, colour, sound and body movements to communicate.
- Human beings can receive messages by smell, sight, touch, taste or hearing.
- Speech is the most commonly used method of communication.
- Human beings have developed useful devices to make communication effective.

## Lesson 2: Traditional Communication

- Traditional methods of communication do not cost anything and involves using basic local resources.
- Kundu, garamut, conch shells, smoke, calling and shouting are some traditional methods of communication.
- Garamut is one of the common traditional methods of communication by the coastal people.
- Apart from communicating using basic local resources, humans also communicate using body movements and sound.
- Traditional methods of communication are still effective today although they are a slow way of passing information over long distances.

## Lesson 3: Modern Communication

- Modern communication is the efficient and fastest way of exchanging messages.
- Using modern communication methods, information or messages can be sent from one place to another regardless of the distance.
- The modern communication methods are mainly mass media as they reach a large number of audience.
- Telecommunications enable people around the world to contact one another, to access information instantly, and to communicate from remote areas.
- Telecommunications usually involve a sender of information and one or more recipients linked by a technology, such as a telephone system, that transmits information from one place to another.
- Television is the most widespread form of communication in the world.
- Television systems send and receive pictures by means of electronic signals transmitted through wires and optical fibers or by electromagnetic radiation.
- Internet is a computer-based global information system composed of many interconnected computer networks.

**Lesson 4: The Process of Communication**

- The three steps involved in the process of communication are sending, transmitting and receiving the message.
- A person or some other living thing sending out the message is called a sender. This is also known as the source of the message.
- A message travelling to another place is called transmission.
- A person in a different place receiving the message is called the receiver.
- Transmission of light is when light easily travels through substances such as air, water and glass.
- Sound waves are produced from vibrating objects and that they travel outwards in all directions. This is called transmission of sound.

---

**REVISE WELL AND THEN DO TOPIC TEST 1 IN YOUR ASSIGNMENT 5.**

# TOPIC 2

# WAVE MOTION

**In this topic you will learn about:**

- **ripples and waves**
- **wave energy**
- **transvers waves**
- **longitudinal waves**
- **wave motion and communication**
- **describing waves**

# INTRODUCTION TO TOPIC 2: WAVE MOTION

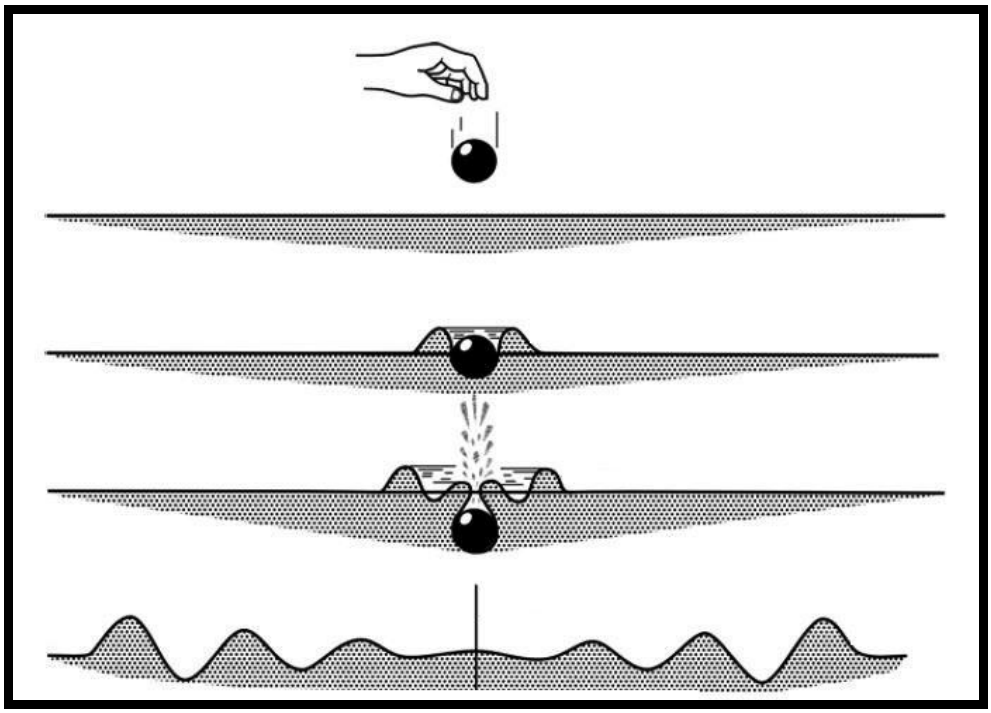
The word “wave” is mostly considered as a hand motion. However, with the prefix of the word ‘sea’, a sea wave is then associated with a crashing sound at the beach.

In science, a wave is a traveling disturbance that travels through space and matter transferring energy from one place to another. The energy from the disturbance is transferred through the particles of the medium.

When we study ‘wave motion’, it is important to remember that they transfer energy and not matter. Wave motions can be created using simple science laboratory materials like ropes, slinky springs, and ripple tanks.

Waves are categorised according to their different characteristics. Mechanical waves require a medium of transmission. Electromagnetic waves can travel through a vacuum. Mechanical and electromagnetic waves can be transverse or longitudinal.

Waves are very important in communication because they transfer energy.



A wave is a travelling disturbance

You should know all about wave motion. Some of the questions you may be asking yourself now are:

- What are waves?
- How waves are form?
- What causes a wave motion?
- What waves transfer?
- What are the types of waves and their properties?
- How are wave motions used in communication?
- How can speed, frequency and period of a wave be calculated?

**In this topic, you will find the answers to these questions and all other questions relating to wave motion.**

# Lesson 5: Ripples and Waves

Welcome to Lesson 5. In your previous lesson, you learnt about the process and components involved in communication. You also discussed the transmission of light and sound which are types of wave energy. This lesson will help you understand how waves are created and the importance of wave motion in the transmission of sound.

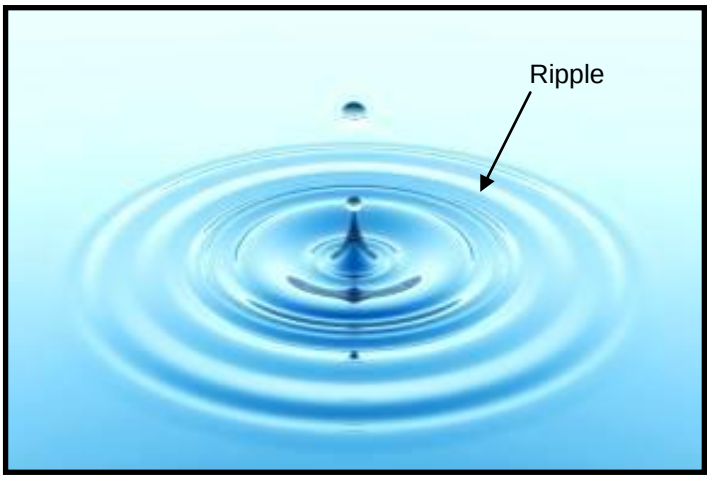
**Your Aims:**

- define ripples, waves, wave motion
- describes the wave motion in the water and a rope
- discusses relationship between wave motion and transmission of sound
- explains the importance of wave motion for communication

## Ripples

Have you ever noticed what happens when you throw a stone into a still pond? Right after the stone lands on the surface of the water, a small circle will be formed and starts to spread outward and vanishes after a while.

However, if you continuously throw several stones into the pond at the same spot, several circles will be formed and spread outward.




Ripples moving outward in all direction from the point of disturbance at the centre.

The edges or the circumferences of each circle is called a **ripple** or can sometimes be called a **hump**.

## Waves

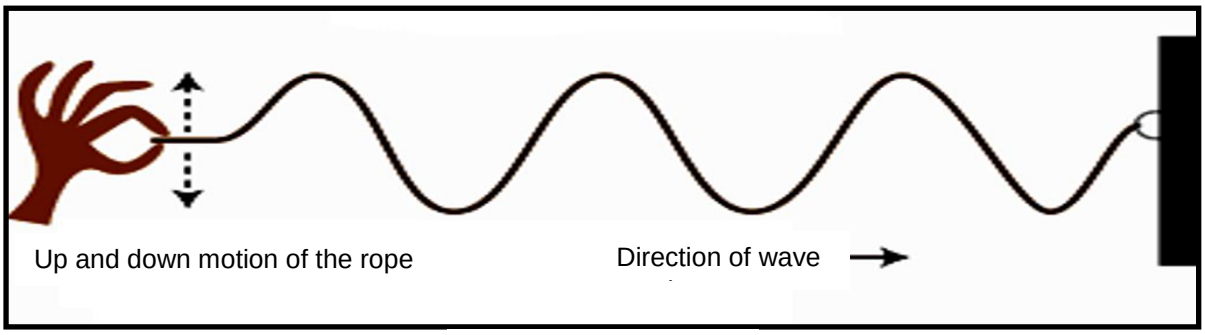
When ripples or humps are created and start to travel outward from the point of disturbance, we say that water waves are being created. So a **wave** is made up of a periodic motion repeated at regular intervals. It is caused by a disturbance in a medium such as water, rope, slinky, air and so on.

As you may have noticed, these travelling disturbances can be in the form of water waves, sound waves, light waves and so on. Waves transfer energy (disturbance)

from one place to another without the movement of the medium or particles in the medium.

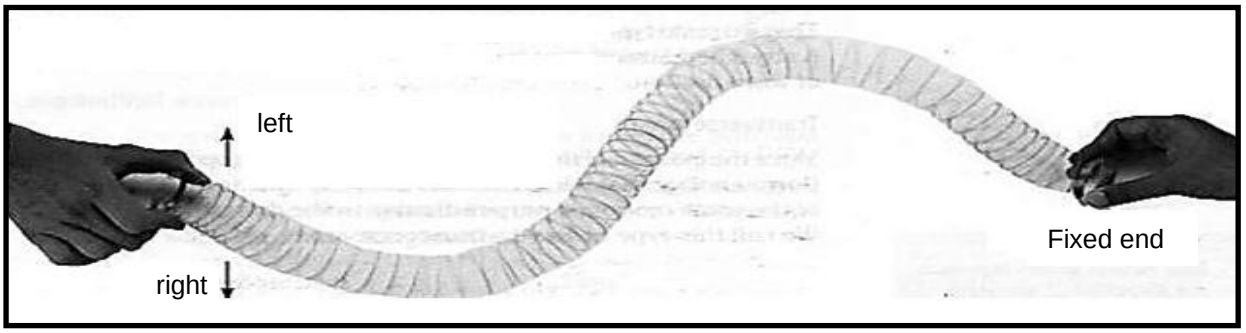
**How are waves formed?**

We can produce waves by using a rope, a slinky spring or a ripple tank. In each of these cases, we will determine how energy is transferred from one point to another with the wave motion.



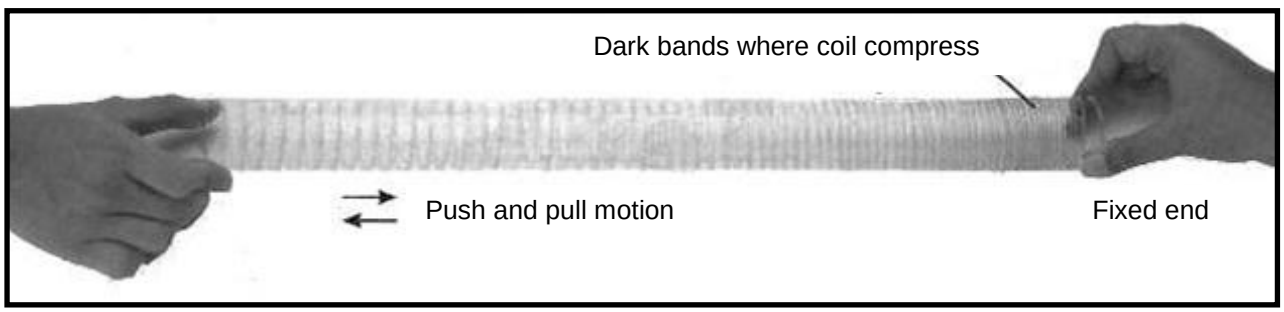

Waves from a rope

A coiled spring or slinky can also be used to create waves. This can be done by stretching out the coiled spring or slinky on the floor and fix one end of the spring. Move the free end of the slinky in a left, right motion will create waves. You will see the slinky moving left and right while humps travel to the other end as shown below. This type of wave and the ones discussed earlier in the rope and ripple are called **transverse** waves which will be discussed in our later lessons.




The left-right motion generates in a slinky (top view)

If you push and pull the spring as shown below, you will see that, the individual coils making up the whole spring will move forward and backward. You will also see that, the dark bands where the coils are compressed together will travel towards the fixed end. These types of waves are called **longitudinal** waves which will be discussed in our later lessons.




Push and pull motion also generate waves in a slinky (top view).

From our observations on waves produced by the rope, ripple tank and slinky spring, we can come-up with one very important point:

**The source of a wave is a disturbance at one point which causes a vibration or oscillation. This vibrations or oscillations generate waves which travel outward.**

---

**Activity 5.1: Now test yourself by doing this activity.**

**Part A. Multiple Choice**

Circle the correct answer.

1. The edges or the circumference of a circle produced when disturbing the surface of a still pond of water is called _____.

   A. wave B. ripple

   C. circle D. energy

2. What is a wave?

   A. When an object vibrates.

   B. A wave is a complete motion.

   C. The disturbance of water in a pond.

   D. A traveling disturbance of some kind.

3. When producing a rope wave, which of the following statements is/are correct?

   The rope

   A. provides a way through which the rope waves travel.

   B. waves travel sideways while the rope moves up and down.

   C. waves travel up and down while the rope moves sideways.

   D. moves up and down while the rope waves travel towards the wall.

---

**Refer to the short passage below to help you answer questions 4 and 5.**

A boy decides to do an experiment to investigate how waves behave by using a slinky-spring. While doing the experiment, he noticed that the spring had some regions where the coils are closer together and some regions where the coils are further apart.

4. The region where the coils are closer together is called the region of _____.

A. vibration B. compression

C. rarefaction D. wave motion

5. The region where the coils are further apart is called the region of _____.

A. vibration B. compression

C. rarefaction D. wave motion

---

**Part B. Short Answer Questions**

**Write your answers on the spaces provided.**

How can we produce waves

i. on a rope?

_____
_____

ii. on a slinky-spring ?

_____
_____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 5.**

**The Relationship between Wave Motion and the Transmission of Sound**

In our everyday life, we are exposed to different sounds such as clocks ticking, flying airplane engines, car engines, people talking, dogs barking, vibrating strings from a guitar, music from a stereo, the voice of someone over the phone and many others. Sound is a wave and needs a medium (air) to travel from one point to another.

Now, what causes these sounds to reach our ears from where they are created?

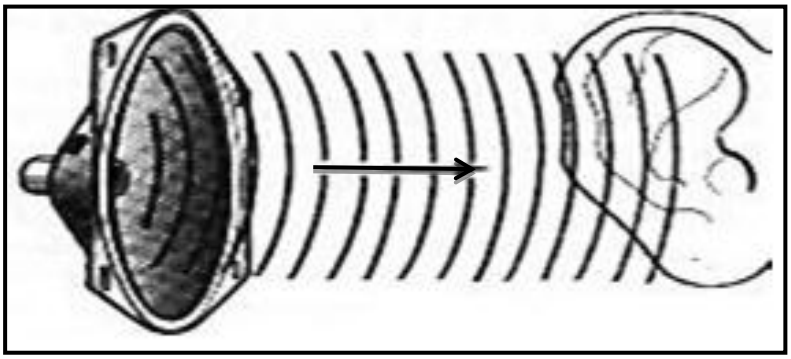
To help us answer this question, we will have to consider two situations.

What will happen if you:

- clamp one end of the ruler to a table and flick the overhanging end
- pluck a guitar string

The two situations produce the same effect. The resulting effects from the ruler and the guitar string will be vibration that produces **sound**. The produced sound reaches our ears because the vibrations cause the movement of the air particles (medium) in the form of a wave motion from the ruler or the string to reach our ears.

Sound is very important to our everyday life. Sound allows us to communicate with other people and animals. Musical sounds bring us pleasure. The sound from radios, mobile phones and televisions communicates important information and entertainment using the basic idea of vibrations and wave motion.



Sound waves from a loud speaker can be detected by the ear.

---

**Activity 5.2: Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. What does sound wave need in order to travel from its source to your ears?

   _____

2. List five examples of transmission of sound in every day communication.

   i. _____
   ii. _____
   iii. _____
   iv. _____
   v. _____

3. Explain why sound waves cannot travel through vacuum.

   _____
   _____
   _____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 5.**

## Summary

You have come to the end of Lesson 5. In this lesson you have learnt that:

- a wave is a travelling disturbance of some kind.
- a wave can be in different forms, for example, water waves, sound waves, light waves
- waves can be produced using a rope, slinky-spring and a ripple tank
- a wave motion will take place when a point in a medium is set to vibrate/oscillate thus causing a wave to be generated and starts to travel outwards.
- sound is produced from vibrating objects.
- the sound reaches our ears because of the vibrations of the air particles from the point of disturbance.
- sound waves play a major role in communications today.

---

**NOW DO PRACTICE EXERCISE 5 ON THE NEXT PAGE.**

## Practice Exercise 5

**Answer the following questions on the spaces provided.**

1. What actually happens to the particles of a medium at the point of disturbance?

_____
_____
_____
_____

2. How does a sound wave reach our ears?

_____
_____
_____
_____

3. List some ways of producing sound.

_____
_____
_____
_____
_____
_____

4. Why is the sound regarded as one of the very important factor to our everyday lives?

_____
_____
_____
_____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2.**

**Answers to Activity 5.1**

A.

1. B
2. D
3. A/D
4. B
5. C

B.

i. Waves can be produced on a rope by tying one end of the rope to a wall and moving the other up and down.

ii. On a slinky-spring, waves are created by either moving the slinky-spring from left-to-right or by pushing and pulling which create waves towards the fixed end.

**Answers to Activity 5.2**

1. Medium

2. i. clocks ticking
   ii. flying airplane engines
   iii. car engines
   iv. people talking
   v. dogs barking
   vi. vibrating strings from a guitar
   vii. music from a stereo
   viii. the voice of someone over the phone

3. Sound cannot travel through vacuum because sound needs a medium to travel.

# Lesson 6: Wave Energy

Welcome to Lesson 6. In your last lesson, you learnt about ripples, waves and wave motion. You learnt how waves can be created from water and rope by a disturbance. In this lesson, you will learn about wave energy.

**Your Aims:**

- define wave energy
- state properties of waves
- explain energy changes taking place in a wave

**What is Wave Energy?**

Waves usually are produced by a disturbance. The disturbance can be a back and forth movement on a slinky, up and down motion on a rope or a vibrating dipper in a ripple tank. It is the energy of the vibrating object that waves carry outward. This energy can spread from the vibrating object in different types of waves. Some waves, known as **mechanical waves**, can travel only through a medium. Others called **electromagnetic waves** can travel either through a medium or through vacuum (empty space).

If you take a trip to the coast and go for a swim at the beach you can observe the different behaviours of waves. Sometimes the waves are high and so strong that they almost push you over. Other times, the waves are low and just gently pass you.

Sea waves on a beach

You know about water waves because you can see and feel their movement, but there are other types of waves, also. Different types of waves carry signals to television and radios. Sound and light waves move all around us and enable us to hear and see. Waves produced by earthquakes are even responsible for many damages.

Waves transfer energy when moving through matter (medium) or space (vacuum). Waves transfer energy from one place to another. You can see how waves carry and transfer energy by the way they crash against the rocks on the sea shores. In water waves, energy is transferred by water ripples. When a wave moves, it may seem that the wave carries matter from place to place as it moves. But that is not what really

happens. When waves travel through solids, liquids, and gases, matter is not carried along with it.

When a pebble is dropped into a still pool, the energy from the pebble is transferred to the surface of the water. The energy is then passed from one ripple to the next as the wave spreads out.

**Wave energy is the energy transferred by a wave through a medium from one point to another. Waves gain their energy from an initial source.**

**Properties of Waves**

There are some basic properties of a wave. The properties which are going to be discussed below are for two types of waves and they are:

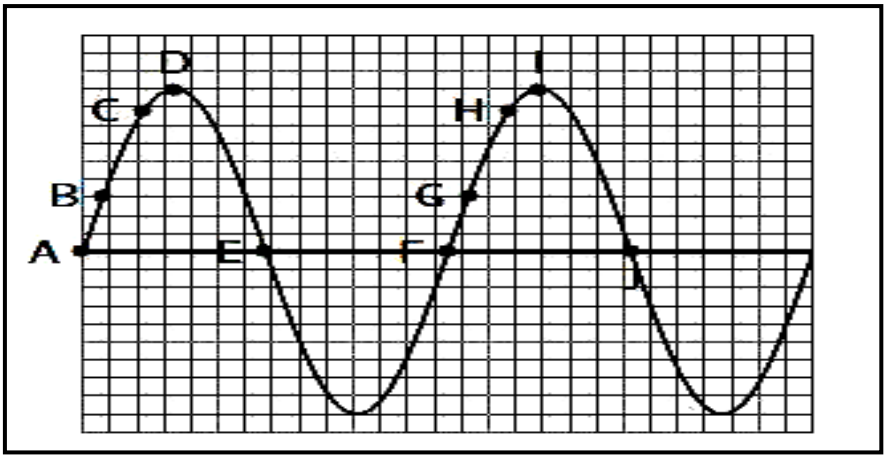
- A **transverse wave**
  This wave has the motion of the medium perpendicular to the movement of the wave pulse.

- A **longitudinal wave**
  This waves has the motion of the medium parallel to the movement of the wave pulse.

These waves will be discussed in detail later on in this topic.

**Phase**
Any two points are said to be in phase when they move in the same direction and have the same speed and the same displacement from their resting position. Any two crests or troughs are always in phase. **Displacement** refers to the distance from the resting position to that point.

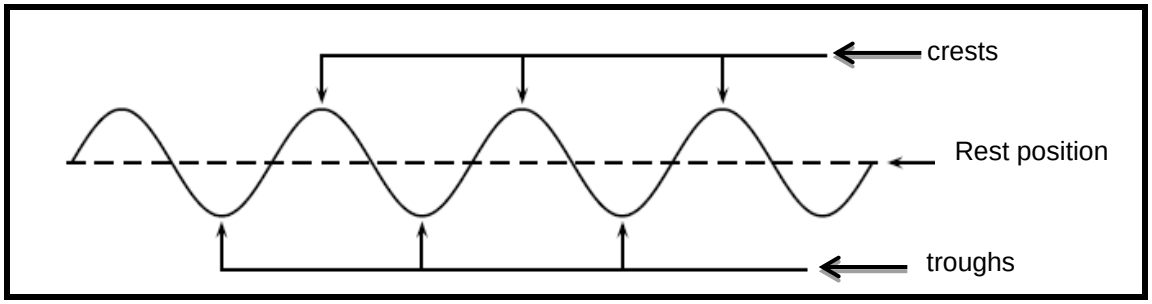
For example, if you look at the diagram below, the point which are in phase are **A** and **F**, **B** and **G**, **C** and **H** and **D** and **I**. These points are in phase because they move in the same direction, have the same speed and have the same displacement from the resting position.




Examples of points on a wave that are in phase

**Crests and troughs**

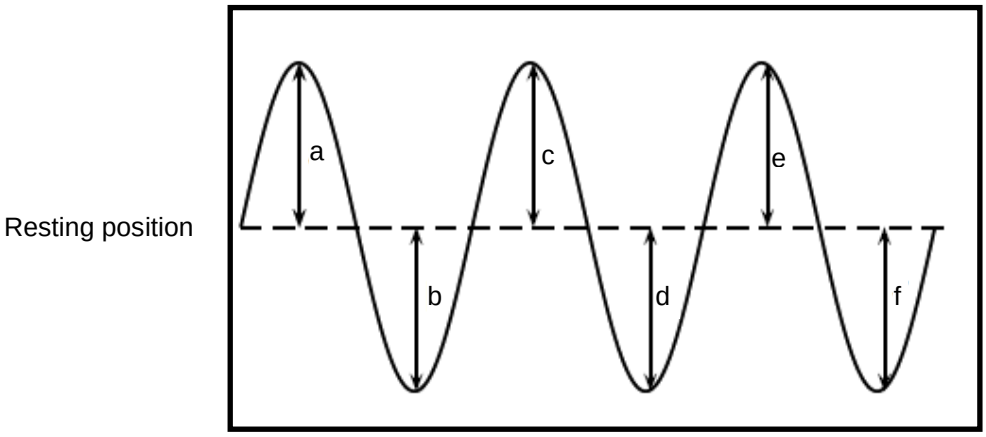
Crests are the highest points and the lowest points are called troughs in a transverse wave.




**Amplitude**

The amplitude is the maximum displacement of a particle from its rest position. It is the height of a crest or depth of a trough from rest.

**Activity 6.1: Amplitude**




**Now Do This:**

Fill in the table below by measuring the distance between the rest position and each crest and troughs in the wave above. Use your ruler to measure the distances.

| Crest/Trough | Measurement (cm) |
|---|---|
| **a** | |
| **b** | |
| **c** | |
| **d** | |
| **e** | |
| **f** | |

a. What can you say about your results?

_____

b. Are the distances between the rest position and each crest equal?

_____

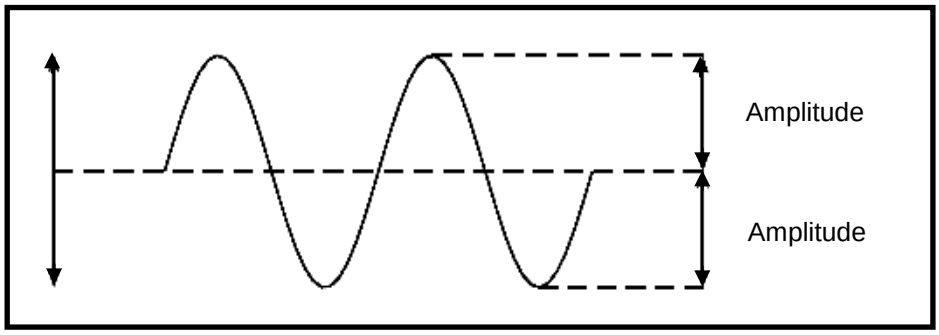
c. Are the distances between the rest position and each trough equal?

_____

d. Is the distance between the rest position and crest equal to the distance between rest position and trough?

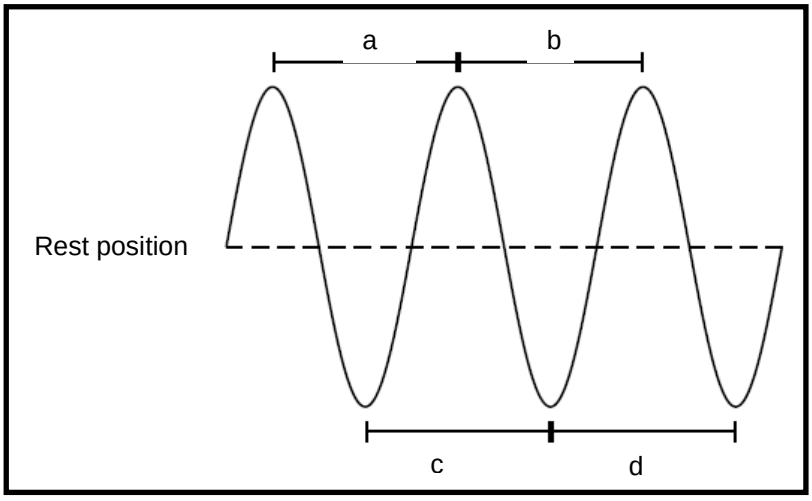
_____

As we have seen in the activity on amplitude, the distance between the crest and the resting position is equal to the distance between the trough and the resting position. This distance is known as the **amplitude** of the wave, and is the height of wave, above or below the rest position. Normally the symbol **A** is used to represent the amplitude of a wave. The SI unit of amplitude is the metre **(m).**




**Wavelength** ($\lambda$)
The wavelength is the distance between two successive crests, two successive troughs or two points which are in phase.

**Activity 6.2: Wavelength**



**Now Do This:**

Fill in the table below by measuring the distance between peaks and troughs in the wave above.

| | **Distance (cm)** |
|---|---|
| **a** | |
| **b** | |
| **c** | |
| **d** | |

a. What can you say about your results?

_____

b. Are the distances between crests equal?

_____

c. Are the distances between troughs equal?

_____

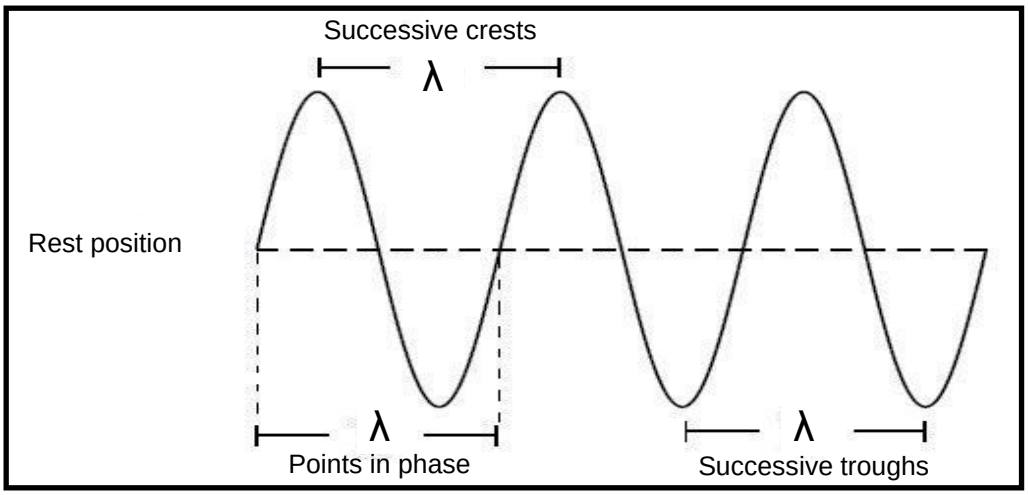
d. Is the distance between crests equal to the distance between troughs?

_____

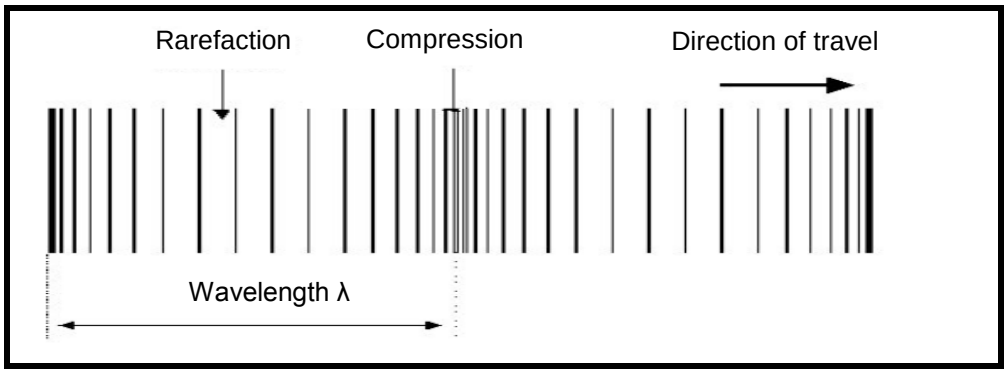
As we have seen in the activity on wavelength, the distance between two successive crests is the same no matter which two successive crests you choose. There is a fixed distance between the crests.

Similarly, we have seen that there is a fixed distance between the troughs, no matter which two troughs you look at. More importantly, the distance between two successive crests is the same as the distance between two successive troughs.

This distance is called the **wavelength** of the wave. The symbol for the wavelength is **λ** (the Greek letter lambda) and wavelength is measured in metres (m).



For longitudinal waves, the wavelength is the distance between two successive compressions or rarefactions.




**Period**

Imagine you are sitting next to a pond and you watch the waves going past you. First one crest arrives, then a trough, and then another crest. Suppose you measure the time taken between one crest arriving and then the next. This time will be the same for any two successive crests passing you. We call this time the **period**, and it is a property of the wave.

The **period (T)** is the time taken for two successive peaks (or troughs) to pass a fixed point. **Period** can also be the time for one complete wavelength (distance between two successive crests or troughs) to pass a point. It is measured in seconds (s). It is the inverse of frequency measured in seconds.

**Frequency**

Imagine the pond again. Just as a peak passes you, you start your stopwatch and count each peak going past. After 1 second, you stop the clock and stop counting. The number of peaks that you have counted in the 1 second is the **frequency** of the wave.

The **frequency** is the number of successive peaks (or troughs) passing a given point in 1 second. The unit of frequency is the **Hertz (Hz)**.

The frequency and the period are related to each other. As the period is the time taken for 1 peak to pass, then the number of peaks passing the point in 1 second is

$$\frac{1}{T}$$

But this is the frequency. So

$$f = \frac{1}{T}$$

$$\text{therefore } T = \frac{1}{f}$$

**Example**
What is the period of a wave of frequency 10Hz?

$$t = \frac{1}{f}$$
$$= \frac{1}{10}\text{ Hz or } 0.1\text{Hz}$$

The **velocity** ($v$) of the wave is the speed that a specific part of the wave passes a point.

$$\textbf{Speed} = \frac{\textbf{distance travelled}}{\textbf{time taken}}$$

$$\mathbf{v} = \frac{\boldsymbol{\lambda}}{\mathbf{T}}\mathbf{f}\boldsymbol{\lambda}$$

**Energy Changes Taking Place in a Wave**

Imagine you are finding your way towards the beach. Something that will help you know that you are reaching the beach is the sound of the waves crashing on the shores. Notice that you will hear the waves breaking before actually seeing the waves. That is because the energy transferred by the wave has changed into sound.

But where is the wave getting this energy from? To answer that question, you must first of all understand that all forms of energy come from a source. The source of the ocean wave energy is the sun. So how does the wave get it?

Energy from the sun heats up the air causing wind to blow. The wind blowing on the surface of the ocean transfers the energy onto the ocean surface creating waves. The waves then travel ashore and break onto the beach. This energy now changes to sound and others.

**Flow of Energy Change**

Sun → Air (wind) → Ocean surface (wave) → Sound (breaking waves)

## Summary

You have come to the end of Lesson 6. In this lesson you have learnt that:

- waves usually are produced by a disturbance.
- waves gain their energy from an initial source.
- waves transfer energy through a medium from one point to another.
- waves travel through matter without the matter moving.
- two points are in phase when they move in the same direction and have the same speed and the same displacement from the rest position.
- crests are the highest points of a transverse wave.
- troughs are the lowest points of a transverse wave.
- the amplitude is the maximum displacement of a wave from its rest position.
- amplitude determines the energy level of a wave .
- the wavelength is distance between two successive crests or troughs or two points which are in phase.
- the period (T) is the time taken for two successive peaks (or troughs) to pass a fixed point.
- the frequency is the number of successive peaks (or troughs) passing a given point in 1 second.
- the source of the ocean wave energy is the sun.

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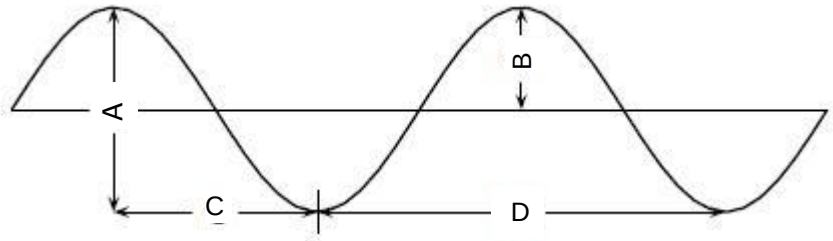
**NOW DO PRACTICE EXERCISE 6 ON THE NEXT PAGE.**

## Practice Exercise 6

**Answer the following questions on the spaces provided.**

1. Consider the diagram below and answer the questions that follow.




Which letter represents the:

a) wavelength? _____

b) amplitude? _____

2. Calculate the frequency of rotation of the second hand on a clock.

3. A transverse wave has a frequency of 15Hz. Find the period of the wave.

4. Explain what will happen to the frequency of a wave as its period increases.

_____

_____

5. A science student created transverse waves using a slinky. Where is the energy in the waves from the slinky coming from in that situation?

_____

_____

_____

_____

6. During rough weather, the waves in the sea are really high and the crashing waves sounds are louder. Explain why that is so.

_____
_____
_____
_____
_____

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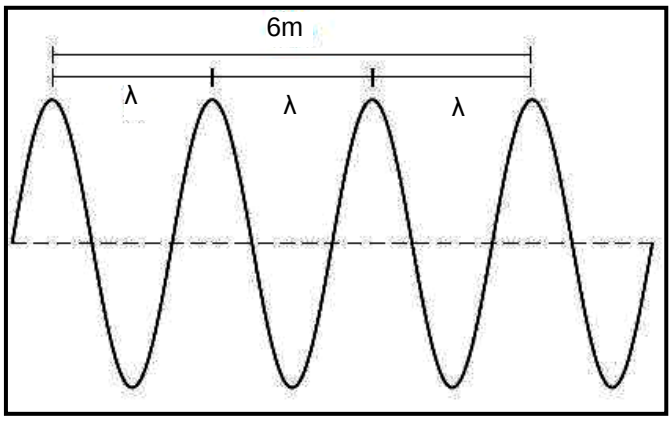
7. The total distance between 4 consecutive crests of a transverse wave is 6m.




What is the wavelength of the wave?

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2.**

**Answers to Activity 6.1**

a. The distance between the rest position and each crest are equal.
b. Yes
c. Yes
d. Yes

**Answers to Activity 6.2**

a. The distance between the peaks and the troughs are same.
b. Yes
c. Yes
d. Yes

# Lesson 7: Transverse Waves

Welcome to Lesson 7. In the last lesson you learnt about wave energy and the energy changes that take place as waves move through a medium. In this lesson, you will learn about transverse waves, its properties and some examples.

**Your Aims:**

- define transverse waves
- list examples of transverse waves

## Types of Waves

The two main types of wave motion are **transverse** and **longitudinal**. A stretched slinky that is fixed at one end can produce both types of wave motion. This lesson will form the basis of the discussion into mechanical waves. In order to understand transverse waves, we have to first understand a medium.

A **medium** is a substance or material through which waves move. In other words, the medium transfers the wave from one place to another. The medium does not create the wave and the medium is not the wave. Air is a medium for sound waves, water is a medium for water waves and rock is the medium for tremor or shock waves. Air, water and rock are therefore examples of media (media is the plural of medium)

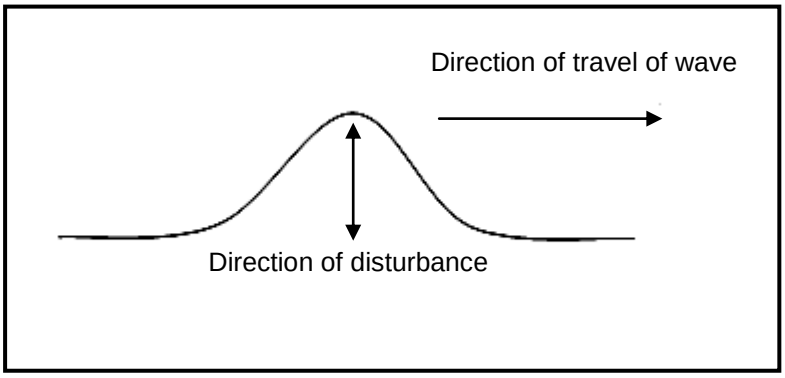
**Mechanical waves** are the waves moving in a medium. These waves are transmitted by the particles of the medium. Such waves can be seen or felt and include waves on a rope or spring, water waves and sound waves in air or in other materials. One type of mechanical wave is the transverse waves.

**A medium is the substance or material in which a wave will move.**

## Transverse Waves

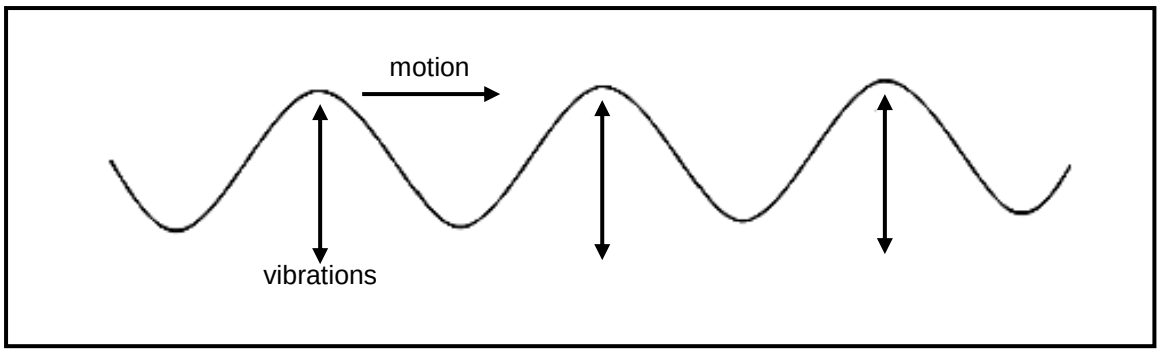
Consider a rope or slinky with one end fixed. Move the free end of a rope or slinky up and down repeatedly. You will notice that when the coil or rope moves up and down, the direction of the wave motion is **perpendicular** (at right angles or $90^0$) to the direction of the disturbance. The wave formed is called a **transverse wave.** The medium in this case is the slinky or rope.

**Transverse waves are waves that travel in a direction perpendicular to the direction of disturbance.**




Direction of wave and direction of disturbance are at right angle.

The diagram above shows one single transverse vibration (up and down motion).
If a number of transverse vibrations are linked together, then it would result in producing a number of transverse waves across the surface as the ones shown below.

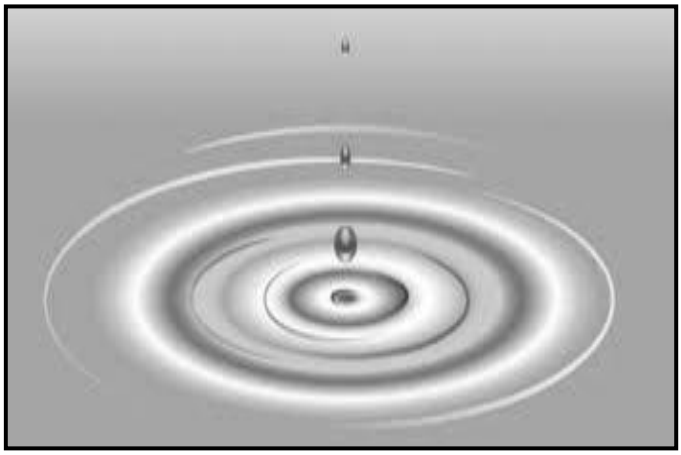



Many up and down vibrations produce waves that move across the surface.

**Examples of Transverse Waves**

There are many situations where transverse waves can be seen.

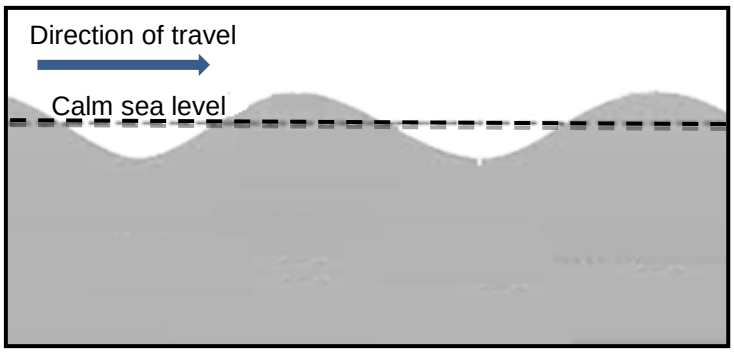
For examples, ripples on the surface of a quiet pond are transverse waves. When a stone is dropped in a pond or a pool of water, waves move out from the point where the stone is dropped. The water particles move up and down while the waves spread out from the centre.



Waves move out from the point of disturbance in a pool of water.

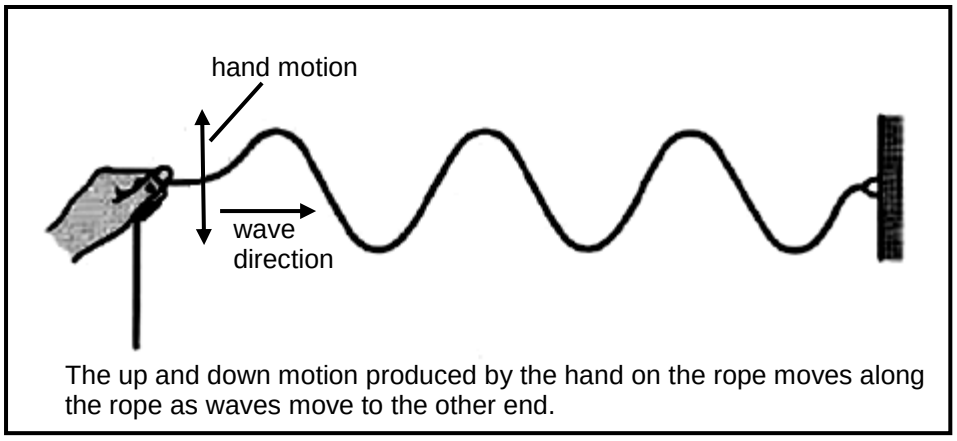
Other examples of transverse waves are electromagnetic waves, light waves, TV waves and radio waves.

Sea waves are also examples of very big ripples. The waves move on but the water particles remain in their positions and only move up and down.




Sea waves are examples of transverse waves.

Transverse waves can also be sent through a piece of rope, string or stretched spring by fixing one end and moving the other rapidly up and down. This is shown in the diagram below.

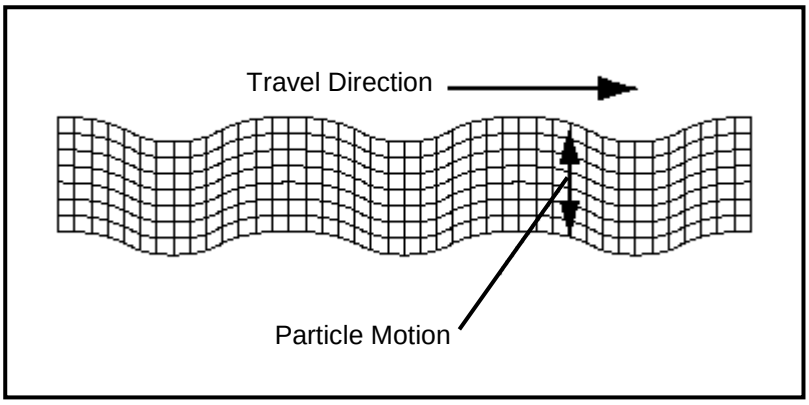



Transverse waves produced on a rope

The disturbance produced by the hand is passed on from one part of the rope to the next which performs the same motion but slightly later. This pulls the next turn, and so on. In this way, up and down movements are passed from turn to turn, and the travelling wave effect is produced.

The turns themselves do not move in the direction of travel but **vibrate** (move up and down) about the positions they would occupy if there were no movement at all. The waves are **progressive** because they are moving and **transverse** because the vibrations are at right angles to the direction of travel.

An earthquake wave called a shear or **S** wave is an example of a transverse wave. The particles of the earth and rock remain stationary and only move up and down while the wave moves forward. This is a slow wave compared to another type of earthquake wave called the P wave.




Shear or S Wave

---

**Activity: Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. What is a medium?

   _____
   _____

2. What does it mean by transverse?

   _____
   _____

3. Name two examples of specific objects which produce mechanical waves.

   (i) _____

   (ii) _____

4. (a) Draw a diagram to show the ripples produced in a pool of water as you drop a stone in the middle of the water.

   (b) On the diagram use arrows to label the direction of the movement of water particles and the direction of the moving waves.

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 7.**

## Summary

You have come to the end of Lesson 7. In this lesson you have learnt that:

- waves produced by particles that are moving to and fro are known as mechanical waves.
- progressive waves are the waves that only transmit energy from one place to another without the movement of the particles of the matter.
- transverse waves are the waves that move forward and at right angle to the direction of the vibrating matter.
- ripples on water and sea waves are examples of transverse waves.
- tremor or shock wave called the shear or **S** wave, is also a transverse wave.

---

**NOW DO PRACTICE EXERCISE 7 ON THE NEXT PAGE.**

## Practice Exercise 7

**Answer the following questions on the spaces provided.**

1. Define

   a) mechanical waves

   _____
   _____
   _____

   b) progressive waves

   _____
   _____
   _____

   c) transverse waves

   _____
   _____

2. Name the two types of progressive waves.

   a) _____

   b) _____

3. Describe the movement of the

   a) vibrating particles in a transverse wave.

   _____
   _____

   b) travelling waves in a transverse wave.

   _____
   _____

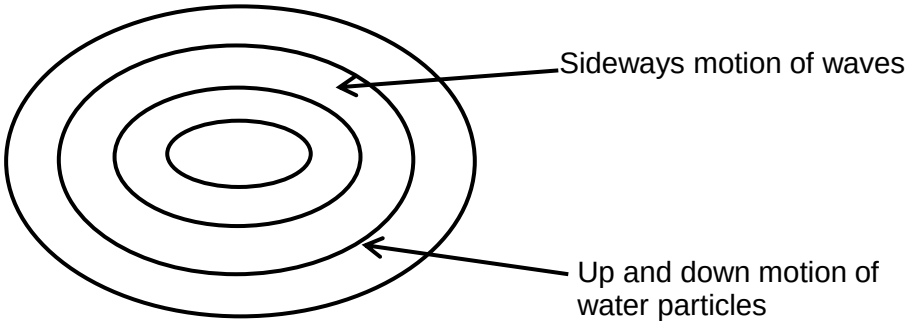
**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2.**

**Answers to Activity**

1. A medium is the substance or material in which a wave will move.

2. Cross ways or at a right angle

3. Guitar strings, drums, sea waves, ripples on water.

4. 

# Lesson 8: Longitudinal Waves

Welcome to Lesson 8. In the last lesson, you learnt about transverse waves. In this lesson, we will look at longitudinal waves. Longitudinal and transverse waves are two types of progressive wave but they are quite different from each other. We will look at ways in which longitudinal waves differentiate from transverse waves and we will also discuss some examples of longitudinal waves.

**Your Aims:**

- define longitudinal waves
- explain vibration, compression and rarefaction
- identify some sources of longitudinal waves
- discuss examples of longitudinal waves

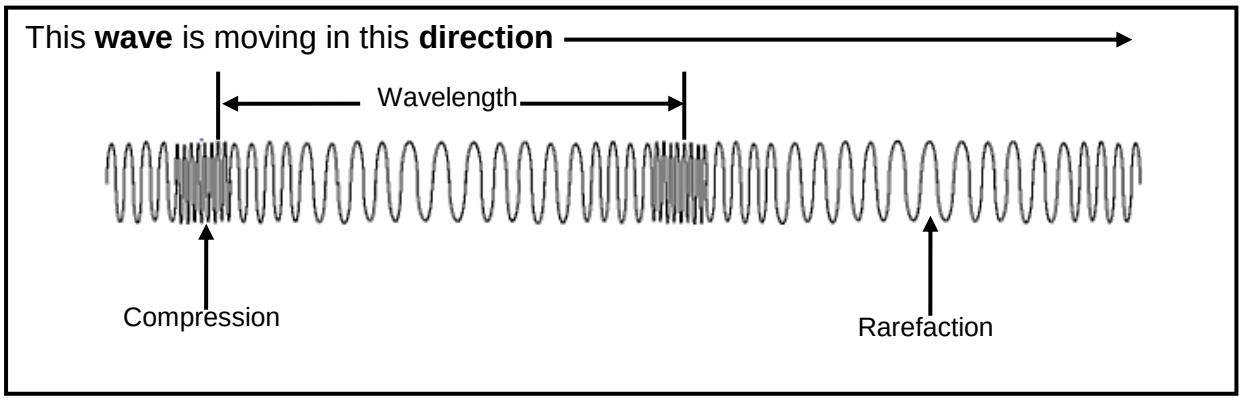
**What is a Longitudinal Wave?**

Longitudinal wave is a wave whose direction of travel is parallel or in the same direction to the vibration of the particles of the transmitting medium. That is, the particles of the transmitting medium vibrate to and fro along the same line in which the wave is travelling and not at right angles as in transverse waves.

Longitudinal waves are also called **compressional waves**, because they produce **compressions** and **rarefactions (expansion)** when travelling through a medium.

**Compression means to press together firmly so the particles are packed together while rarefaction means to expand and so the particles spread out loosely.**

Let us look at the diagram below which shows part of a spring, stretched out on a bench and fixed at one end. The vibration of the spring shows how a longitudinal wave behaves as it travels through mediums. Notice that the compressions and rarefactions are being labelled to help you identify the difference.




The springs move to and fro while the compressions and the rarefactions move along the spring as waves to the end.

You can see that the compressions are the areas where the coils are closer together and rarefactions are areas where the coils are further apart. The wavelength of a longitudinal wave can be measured from the centre of one compression to the next.

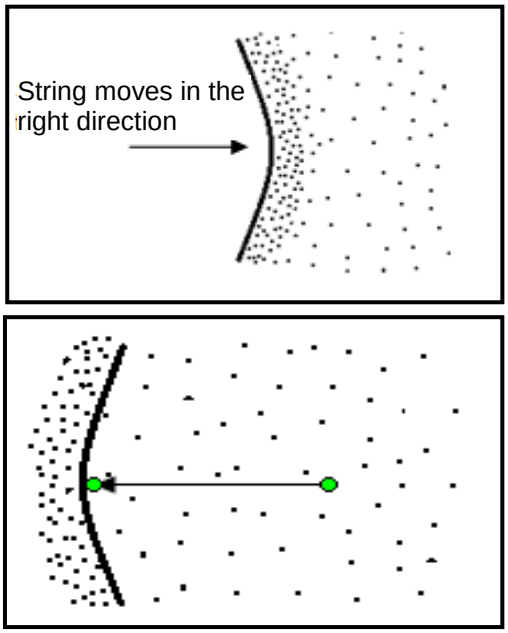
**Sound Wave**

Sound is a longitudinal wave that is created by a vibrating object. Below are examples of some vibrating objects that produce sound.

- strumming a guitar (vibration of guitar strings)
- ringing tone of a mobile phone (speaker vibration frequency)
- a crying baby (vibration of vocal cord)
- alarm bell (vibration of bell)

Sound waves in air are longitudinal waves because particles of the medium through which the sound is transmitted, vibrate in the same direction as the direction that the sound wave moves.

In a vibrating string which produces sound, the string moves in the forward **direction** (rightward). It begins to push upon surrounding air particles, moving them to the right towards their nearest neighbour. This causes the air particles to the right of the string to be compressed into a small space.

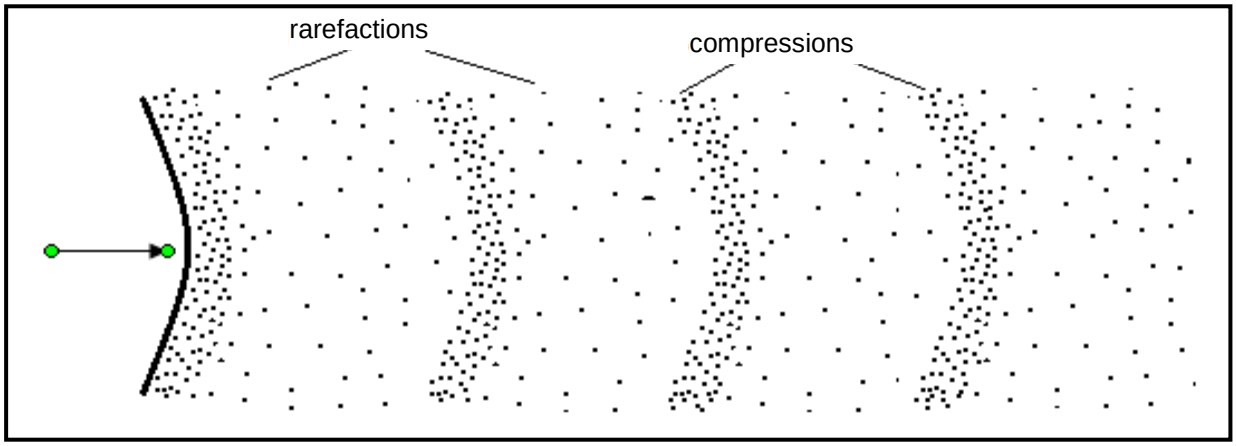



As the vibrating string moves in the **reverse direction** (leftward), it lowers the pressure of the air immediately to its right, thus causing air molecules to move back leftward. The lower pressure to the right of the string causes air particles in that area immediately to the right of the string to expand into a large region of space.

The back and forth vibration of the string causes individual air particles in the area immediately to the right of the string to continually vibrate back and forth horizontally.

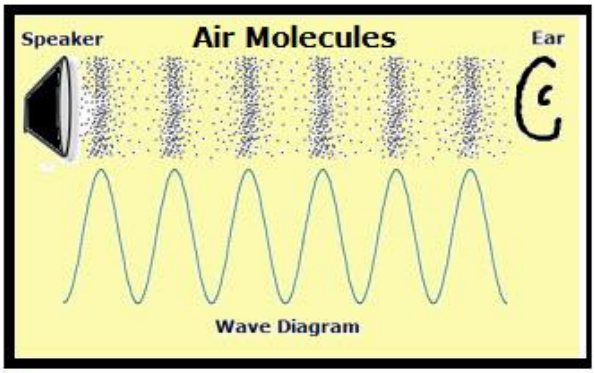
Vibrating string moves in the reverse direction

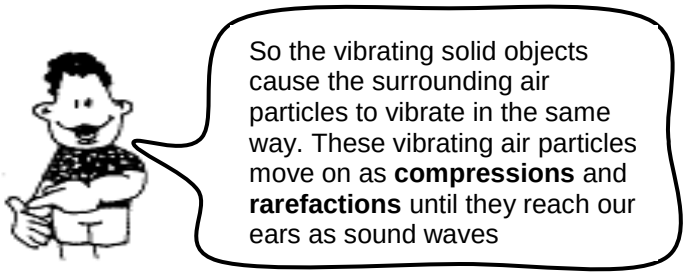
The particles move rightward as the string moves rightward and then leftward as the string moves leftward. These back and forth vibrations are passed on to nearby neighbours by particle-to-particle contact.




Other surrounding particles begin to move rightward and leftward, thus sending a wave to the right. Since air particles are moving in a direction that is parallel to the direction that the wave moves, the sound wave is referred to as a longitudinal wave. The result of such longitudinal vibrations is the creation of **compressions** and **rarefactions** within the air.

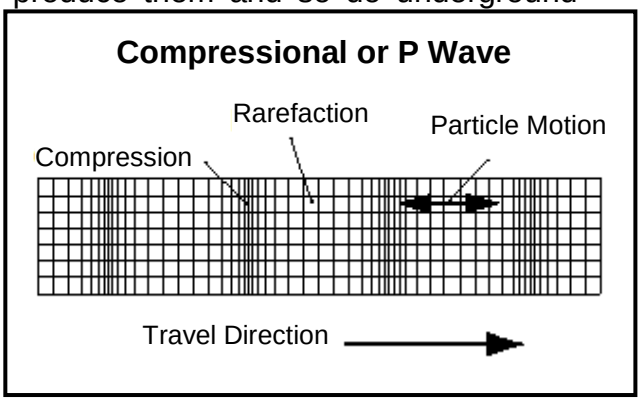
Regardless of the source of the sound wave, whether it is a vibrating string or the vibrating screen of a radio speaker, sound waves travelling through air are longitudinal waves. And the important characteristic of a longitudinal wave that distinguishes it from other types of waves is that the particles of the medium move in the same direction as the direction of the waves.




**Seismic wave (P – wave)**

Another example of a longitudinal wave is called seismic wave. Seismic waves use Earth itself as their medium. Earthquakes produce them and so do underground nuclear explosions. Seismic waves can be longitudinal or transverse. The longitudinal seismic wave is called **P (primary) wave** and it is transmitted through the earth by compressions and rarefactions just like any other longitudinal wave. As it is transmitted through, the particles of the earth's crust and rock move to and fro in the direction of the wave. These waves move on faster than the S waves which were discussed in the last lesson.




P waves producing compressions and rarefactions

**Activity: Now test yourself by doing this activity.**

**Answer the following questions**

1. Give two examples of the sources of sound.

   i. _____

   ii. _____

2. How is sound created?

   _____

   _____

3. What are the mediums of a Primary wave?

   _____

4. What is another name for longitudinal wave?

   _____

5. Why is it that a longitudinal wave is also called a compressional wave?

   _____

   _____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 8.**

## Summary

You have come to the end of Lesson 8. In this lesson you have learnt that:

- waves which are produced by particles and matter that are moving to and fro are known as mechanical waves.
- longitudinal waves are waves whose direction of vibration is the same as their direction of travel.
- longitudinal waves are also called compressional waves, because they produce compression and rarefaction when travelling through a medium.
- compressions are the areas on a spring or wave particles that are squeezed and packed together.
- rarefactions are the regions on a spring which is expanded and the particles are loosely spread out.
- the wavelength of a longitudinal wave can be measured as the distance between the centres of two compressions or any two points in phase.
- sound waves and earthquake P waves are examples of longitudinal waves.

---

**NOW DO PRACTICE EXERCISE 8 ON THE NEXT PAGE.**

## Practice Exercise 8

**Answer the following questions.**

1. What are longitudinal waves?

   _____
   _____

2. What are

   a) compressions?

      _____
      _____

   b) rarefactions?

      _____
      _____

3. How is the wavelength of a longitudinal wave measured?

   _____
   _____
   _____

4. Make a drawing showing 3 longitudinal waves sent along a spring on a table. Label compressions, rarefactions and wavelength.

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2.**

**Answers to Activity**

1. Strumming guitar, crying baby, alarm bell, ring tone of mobile phone, siren of police vehicle, radio, TV, (**Accept any of the given answers or similar**)

2. Sound is created by vibrating objects

3. Earth's crust and rocks

4. Compressional wave

5. Longitudinal wave is also called compressional wave because they produce compressions and rarefactions when travelling through a medium.

# Lesson 9: Wave Motion and Communication

Welcome to Lesson 9. In the previous two lessons, you learnt about transverse waves and longitudinal waves. In this lesson, you will learn about wave motion and communication. You will learn about the importance of longitudinal and transverse waves in communication.

**Your Aims:**

- explain transverse, longitudinal waves and communication
- state light waves and radio waves as transverse waves
- state sound waves as longitudinal waves

Let us look at the two types of waves separately and how they are useful in communication.

## Longitudinal Waves

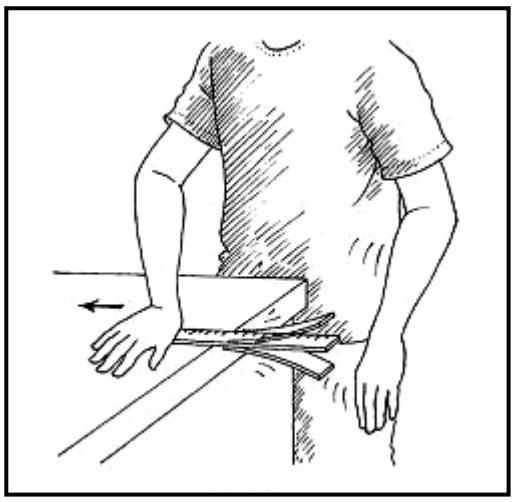
Sound waves are longitudinal waves. Sound is an important method of communication, but it is a difficult one to understand because we cannot see it. So we will begin by looking at things that make sounds, called **sources of sound**. Most of these sources of sound are visible in plain sight while others are hidden but can still be seen. For example, you can directly see a guitar string but you cannot see the engine of a car. It is hidden, but you can still see it if you remove it out from the car.

### What makes sound?

A guitar player makes the string vibrate to make a sound. A drum skin vibrates when it makes a sound. All these sounds are made by vibrating objects.

### How do vibrating objects produce sound?

A good way to study how a sound is made is to use a ruler to make a sound. If the ruler is held firmly so that it is hanging over the edge of the table and the ruler is flicked down quickly the ruler will make a sound.



A vibrating ruler produces sound

You will see that the ruler makes a sound by moving quickly up and down. This regular up-and-down movement is called a **vibration.**
If the length of the ruler over the edge of the table is short the vibrations will be very fast and you will hear a **high pitched** sound. If the length of the ruler over the edge is long the vibration will be slower and you will hear a **lower pitched** sound.

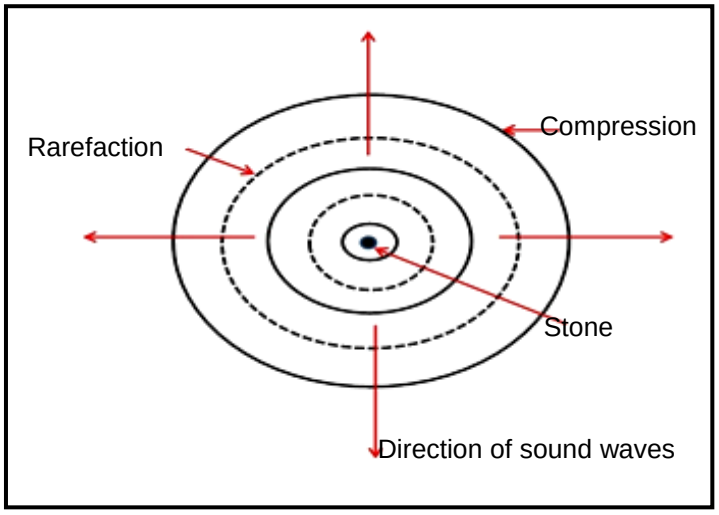
The number of vibrations made each second is called the **frequency** of the vibration. A long ruler vibrates slowly, making a low pitched sound and has a low frequency. A short ruler vibrates quickly, making a high pitched sound and has a high frequency.

Sometimes when a sound is made we cannot see any vibrations. Usually this is because the frequency of the vibrations is very high and the vibrations are too fast and small for us to see.

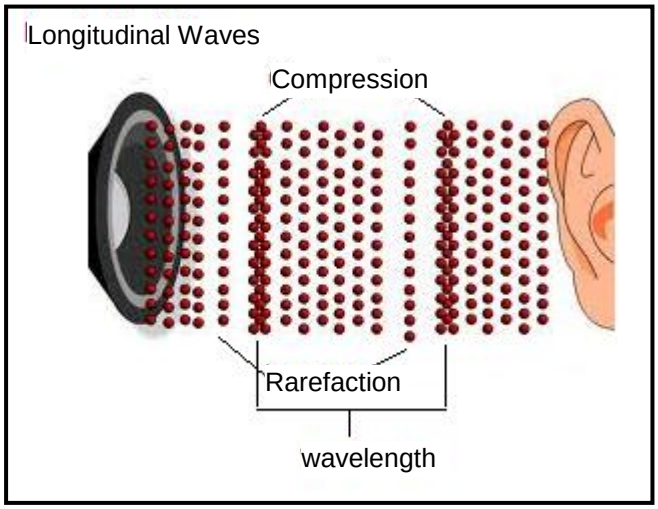
**A long ruler vibrates slowly, making a low pitched sound and has low frequency. A short ruler vibrates very fast, making high pitched sound and has high frequency. The force applied on the long and short rulers are the same.**

You now know that sounds are made by vibrating objects. But how does the sound travel through the air to reach our ear?

To understand this we can look at what happens when a stone is dropped into water. When this occurs, waves spread out in circles from where the stone hit the surface of the water. The circles get bigger as they move outwards. Sound travels in a similar way.




**Sound waves are caused by vibrations**.
When a loudspeaker cone vibrates, it alternately compresses then 'stretches' the air next to it. The backward and forward movements cause a series of compressions and rarefactions to travel out through the air. The air transmits longitudinal waves. The waves in this case are known as **sound waves**. Thus, sound waves are made up of compressions and rarefactions traveling through the air to our ears. When they enter our ears, they cause small but rapid pressure changes on a thin sheet of skin and muscle called the **ear-drum**; from this, you experience the sensation of sound.




The disturbed air particles move into the air ear as sound waves.

Sound waves are longitudinal waves. They are produced when any vibrating object compresses and stretches the material around it. A vibrating guitar string causes the air around it to compress and stretch and the disturbed air particles move out in all direction and reach our ears.

**Sound waves need a material to travel through**

Sound waves are mechanical longitudinal waves, therefore they can only move on if there is a material present to pass on vibrations. The material or substance through which sound passes is called a **medium**.

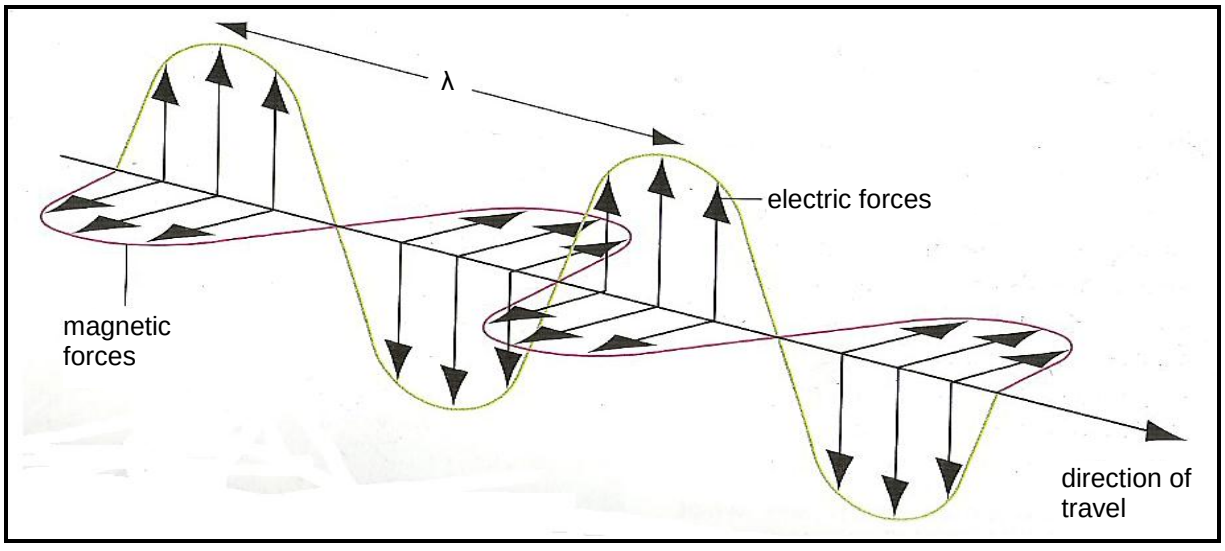
It is not possible for sound to travel through a vacuum because there is nothing to vibrate. Thus, sound will only travel through a medium and not in a vacuum. For instance, most of the sound waves reaching the ear do so by travelling through air and can also be heard swimming underwater.

**Transverse Waves**

We learnt in our previous lesson that in transverse waves, the vibrations are at right angle to the direction of travel. Transverse waves do not need to travel through a medium. They may be able to travel through a medium, but they do not have to.
Visible light, infrared rays, microwaves, and other types of electromagnetic radiation, are like this. They can travel through empty space (vacuum). Electrical or magnetic fields vibrate as the waves travel through them.

**Electromagnetic waves are transverse waves**

Electromagnetic waves can travel through a vacuum; this is how energy reaches us from the Sun. The energy is carried by changing electric and magnetic forces. These changing forces are at right angles to the direction in which the wave is travelling. So electromagnetic waves are transverse waves.




Electromagnetic waves are transverse waves

In an electromagnetic wave, energy is carried by oscillating electric and magnetic forces. These forces are at right angles to the direction in which the wave travels.

In a vacuum all electromagnetic waves travel at the same speed of 3 x $10^8$ m/s. However, electromagnetic waves travel at a slower speed when they travel in a medium. For example, light travels at a slower speed in glass.

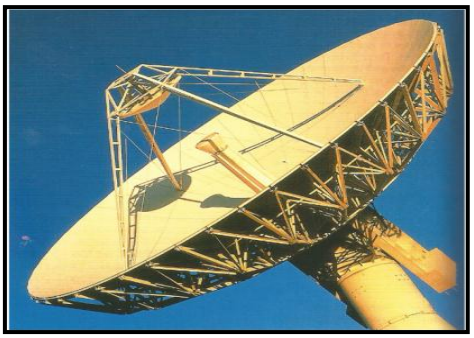
**Aerials and circular dishes are used to transmit electromagnetic waves. As these waves travel through they cause the electrical or magnetic fields around them to vibrate. These waves do not need particles to travel through. They can travel through vacuum such as the space which makes radio, television and telephone communication easier.**

### Television transmission

Television pictures are also transmitted by electromagnetic waves. The signal is transmitted and received in exactly the same way as for radio, but in this case the message includes information about the pictures as well as the sound.

### Telephone communication

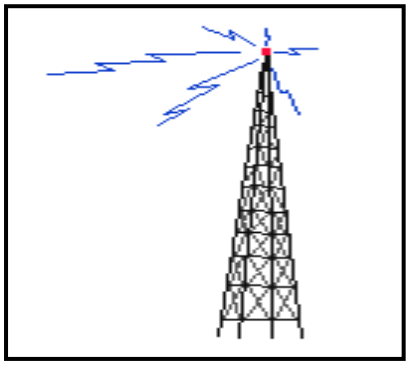
Most modern telephone systems use electromagnetic waves to transmit the signal instead of wires. The waves are transmitted from large circular dishes, which reflect them in the direction they have to travel. This is like the reflection of light waves by the circular reflector in a torch.



Electromagnetic waves are also transmitted from circular dishes.

### Radio communication

The radio can be used to communicate over long distances without any wires connecting the source and receiver. Radio does not even need any air to transmit its message. The source of a radio message is an aerial, or antenna, which is a wire through which a changing electric current is passed. As the current changes an electromagnetic wave is produced which travels out from the aerial. The electromagnetic waves are also known as **radio waves**. These radio waves are then received by the aerial of a radio receiver and make small electric currents form in the receiving aerial.



Electromagnetic waves travel from an aerial.

---

**Activity: Now test yourself by doing this activity**

**Part A: Match by drawing lines from the list in the first column to the list in the second column.**

| | |
|---|---|
| High frequency | Need no particles to travel |
| Low frequency | Travel through particles |
| Transverse waves | High pitch sound |
| Longitudinal waves | Low pitch sound |

**Part B. Fill in the blanks with the most correct words.**

A. _____ is an empty space where there is no particle. Electromagnetic waves are examples of B. _____waves and they travel at C. _____ to the direction in which the wave is travelling.
Electromagnetic waves cause D. _____ and E. _____fields around them to vibrate.

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 9.**

## Summary

You have come to the end of Lesson 9. In this lesson you have learnt that:

- a sound is a longitudinal wave therefore they can only move through where there is a particle.
- sounds are produced by vibrating objects.
- sound waves can travel through air as well as solids and liquids.
- slow vibrating objects produce low pitched sound with low frequency.
- fast vibrating objects produce high pitched sound with high frequency.
- electromagnetic waves are vibrations of electrical and magnetic fields therefore they can travel through vacuum.
- electromagnetic waves make radio and telecommunications easier.
- aerial and circular dishes are used to transmit and receive electromagnetic waves.

---

**NOW DO PRACTICE EXERCISE 9 ON THE NEXT PAGE.**

## Practice Exercise 9

**Answer the following questions.**

1. Why do two objects that are made to 'bump' together produce sound?

   _____

2. Describe the sound which is produced by a

   (i) slow vibrating object.

   _____
   _____

   (ii) fast vibrating object.

   _____
   _____

3. Briefly explain how a sound wave travels into our ear and we are able to hear the sound.

   _____
   _____
   _____

4. Explain why two people cannot talk to each other on the Moons' surface where there is no air.

   _____
   _____
   _____

5. Briefly describe electromagnetic waves.

   _____
   _____
   _____
   _____

6. What are the uses of aerials and dishes in radio and telecommunication?

   _____
   _____
   _____
   _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END TOPIC 2.**

## Answers to Activity

### Part A

| | |
|---|---|
| High frequency | Need no particles to travel |
| Low frequency | Travel through particles |
| Transverse waves | High pitch sound |
| Longitudinal waves | Low pitch sound |

### Part B.

A. Vacuum
B. transverse
C. right angle
D. electric
E. magnetic

# Lesson 10: Describing Waves

Welcome to Lesson 10. In the last lesson, you learnt about wave motion and how wave motion is used for communication.
In this lesson, you will learn of how different properties of waves can be described. You will also learn to calculate the speed and frequency of waves.

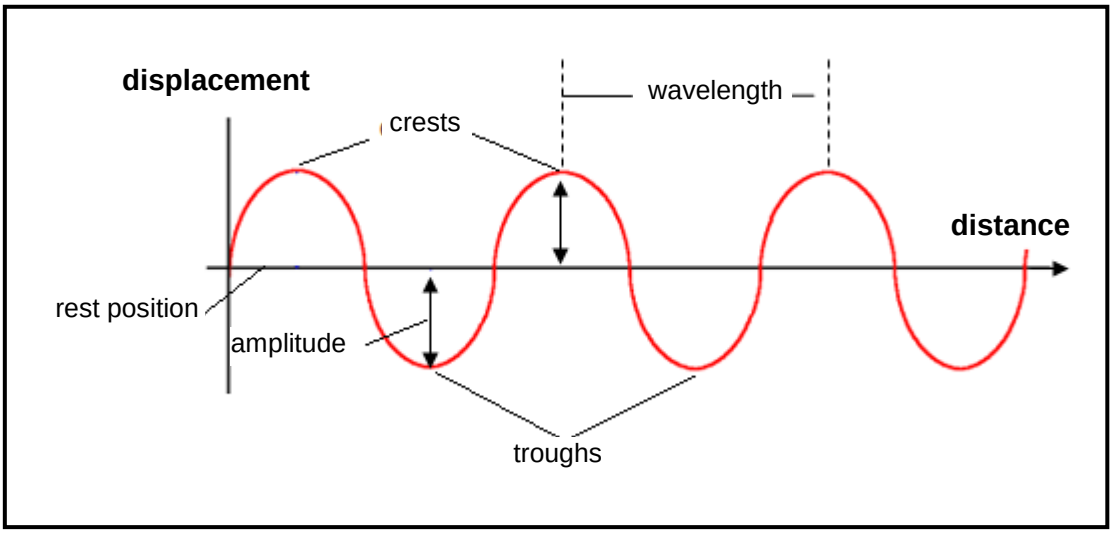
**Your Aims:**

- define and describe the properties of waves
- define speed, frequency, wavelength, amplitude.
- calculate the speed and frequency of waves

## Describing Waves

First of all we will study the terms used to describe waves, and to help us do that, we will use the **displacement-distance graph** drawn below.

The graph below shows the side view of a wave moving away from its source. Notice the different parts of the wave as it travels along its path.




The line drawn through the centre of the diagram represents the **rest position** of the string. This is the position that the wave would travel if there were no disturbances along its path. If there is a disturbance, the particles of the medium would vibrate up or down. So at any given moment in time, a particle on the medium could be above or below the rest position. This is shown in the diagram above.

## Wave Properties

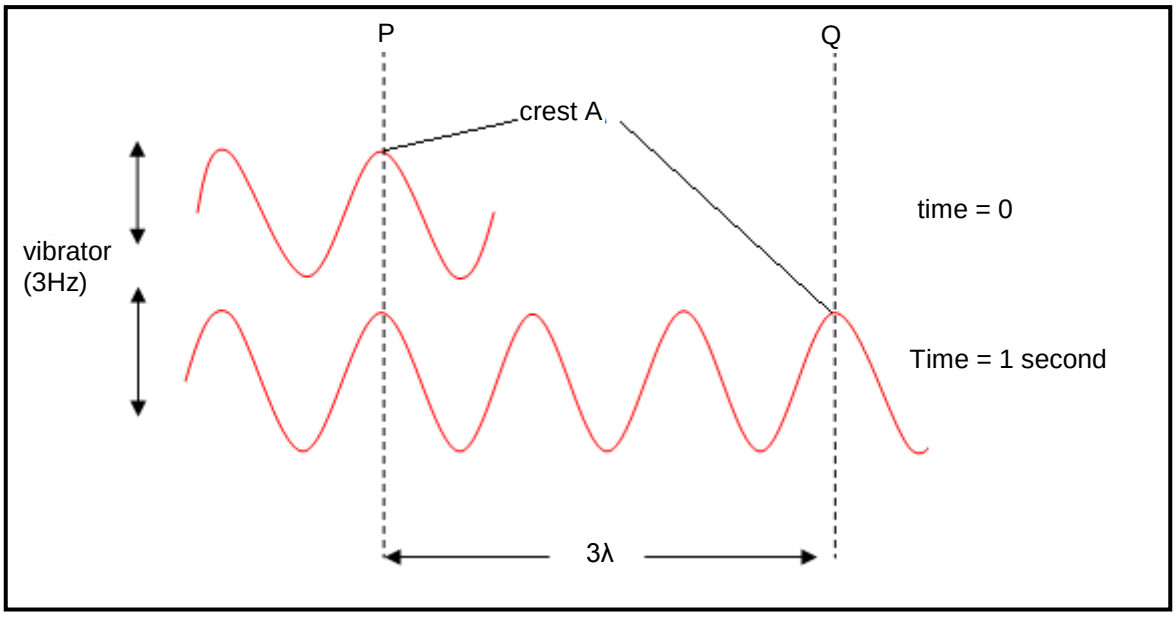
The following are general descriptions or properties of a moving wave.

- **Crest** of a wave is the highest point of the upward motion of a wave from the rest position.

- **Trough** of a wave is the highest point of the downward motion of a wave from the rest position.
- **Amplitude** is the height of a crest or depth of a trough. It is the distance from rest to crest or from rest to trough.
- **Wavelength** of a wave is simply the length of one complete wave cycle. For example the wavelength can be measured as the distance from crest to crest or from trough to trough. It is also any two points next to each other which are in phase and is represented by the Greek letter λ (lambda).
- **Frequency** (**f**) is the number of complete waves generated per second. For example, if the end of a rope is jerked up and down twice in a second, two waves are produced in this time. The frequency of the wave is 2 vibrations per second or 2 hertz. Hertz is the unit of frequency. The frequency of a wave is also the number of crests passing a chosen point per second. Frequency (f) is also given as **f = 1/T**
- **Period** (**T**) is the time required for a wave to travel one wavelength, that is one full cycle. Period is the reciprocal of frequency and is measured in seconds. **T = 1/f**
- **Speed** (**v**) of the wave is the distance moved by a crest or any point on the wave in one second.

**The Wave Equation**

There is a useful connection between frequency (**f**), wavelength (λ) and speed (**v**). Look at the diagram below. The frequency (**f**) of the vibrator (source) is 3Hz. This means that the vibrator produces three (3) waves in 1 second. Let us suppose the wavelength (λ) of the waves produced is 20cm. Now if crest **A** at position **P** travels to position **Q**, the distance covered are three (3) wavelengths (**3λ**).




What do you think would be the speed of the waves? The speed can be calculated using the wave equation. The wave equation is:

**speed = wavelength x frequency**
**v = λ x f**

Therefore, the speed of the waves is: $v = \lambda \times f$

$v = 20 \times 3$

$v = \mathbf{60cm/s}$

A wave with a small wavelength has high frequency and a wave with a large wavelength has low frequency. Similarly, if an object vibrates slowly the frequency is low and if an object vibrates fast the frequency is high.

If the vibrator in the previous page produces 5 waves in 2 seconds, then the frequency would be:

**frequency (f) = 1/T**

where 1 represents the number of waves produced and T represents time it takes for 1 wavelength to pass a given point.

Therefore, the frequency of the wave is:

$f = 1/T$

$f = 5/2$

$f = \mathbf{2.5Hz}$

The time for 1 wavelength to pass a given point would be:

$T = 1/f$

$T = 1/2.5$

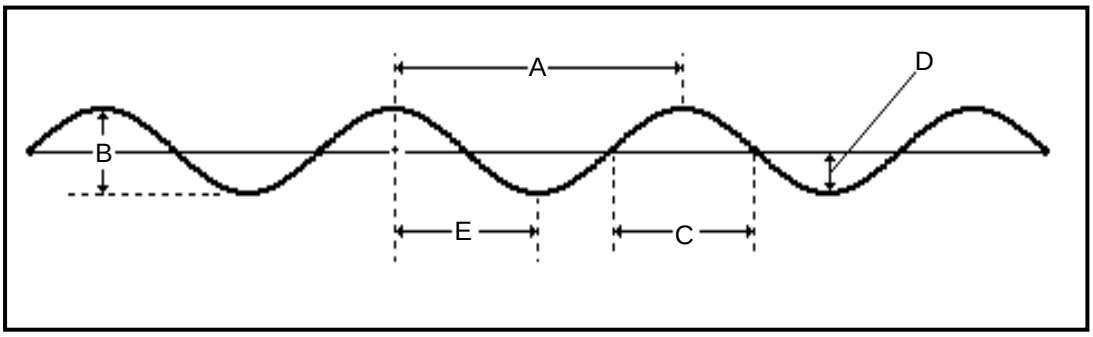
$T = \mathbf{0.4s}$

Therefore, it would take 0.4 seconds for 1 wavelength to pass a point.

---

**Activity:** **Now test yourself by doing this activity.**

**Refer to the diagram of a wave below to answer Question 1.**



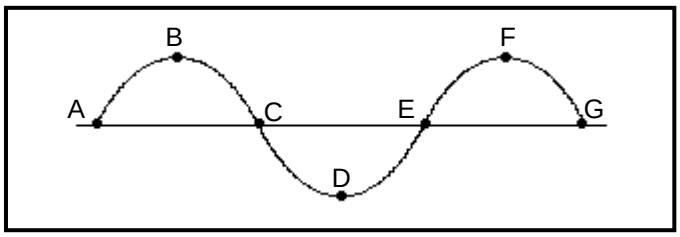

1. Which letter represents the:

   (i) wavelength of the wave? _____

   (ii) amplitude of the wave? _____

2. Indicate the interval that represents one full wavelength.

A. A to C
B. B to D
C. A to G
D. C to G




---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 10.**

## Summary

You have come to the end of Lesson 10. In this lesson you have learnt that:

- the wavelength is the length of one complete wave cycle.
- a crest is the highest point of a wave's upward motion while a trough is the highest point of a wave's downward motion.
- the amplitude is the height of a crest or the depth of a trough.
- the wavelength is simply the length of one complete wave cycle.
- the speed is the distance moved by any point on the wave in one second.
- frequency is the number of waves produced in one second.
- fast moving waves have short wavelengths, and short wavelengths means low frequency.
- the wave equation is summed as: wave speed = frequency x wavelength.

---

**NOW DO PRACTICE EXERCISE 10 ON THE NEXT PAGE.**

## Practice Exercise 10

**Answer the following questions.**

1. Define the following terms.

   a) Crest

   _____
   _____

   b) Trough

   _____
   _____

   c) Amplitude

   _____
   _____

   d) Wavelength

   _____
   _____

   e) Frequency

   _____
   _____

   f) Speed

   _____
   _____

2. Stan and Anna are conducting a slinky experiment. They are studying the possible effect of several variables upon the speed of a wave in a slinky. Their data table is shown below. Fill in the blanks in the table, analyse the data, and answer the following questions.

| Medium | Wavelength | Frequency | Speed |
|---|---|---|---|
| Zinc, 1-inch diameter coils | 1.75m | 2.0Hz | (a)_____ |
| Zinc, 1-in. dia. coils | 0.90m | 3.9Hz | (b)_____ |
| Copper, 1-in. dia. coils | 1.19m | 2.1Hz | (c)_____ |
| Copper, 1-in. dia. coils | 0.60m | 4.2Hz | (d)_____ |
| Zinc, 3-in. dia. coils | 0.95m | 2.2Hz | (e)_____ |
| Zinc, 3-in. dia. coils | 1.82m | 1.2Hz | (f)_____ |

3. As the wavelength of a wave in a uniform medium increases, what will happen to its

   a) speed?

   _____

   b) frequency?

   _____

---

4. On the surface of the sea, the wavelength of waves at one particular time was 2.5m.

   Calculate the frequencies of the waves at 3 different times when the speeds were:

   a) 1.5m/s

   _____

   b) 2.8m/s

   _____

   c) 3.2m/s

   _____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 2.**

**Answers to Activity**

1. i) A ii) D

2. D. C to G

# Answers to Practice Exercises 5 – 10

## Practice Exercise 5

1. The particles or molecules of a medium only vibrate or oscillate at a fixed position and do NOT move at the point of disturbance. What moves or travels are the waves caused by vibrating particles and molecules.

2. The sound waves reach our ears because of the vibrating or the oscillating objects. When objects oscillate, the air molecules around the objects also oscillate creating a sound wave to reach our ears.

3. Some ways of producing sound include clapping, beating of kundu drums, strumming your guitar and there are others you can name.

4. Sound is regarded as one of the very important factors of our daily lives because, it entertains us and at the same time we are able to send and receive vital information from a distance.

---

## Practice Exercise 6

1. a) D

   b) B

2. T = 60s, therefore $f = \frac{1}{T} = \frac{1}{60}\text{Hz}$

3. $T\frac{1}{f} = \frac{1}{15}\text{s}$

4. Period is the inverse of frequency, therefore if the period is increased the frequency will decrease.

   For example if the period is 5s then the frequency will be $\frac{1}{5}\text{Hz}$.

   If the period is increased to 10s, then the frequency will decrease to $\frac{1}{10}$. $\frac{1}{5}$ is less than $\frac{1}{10}$.

5. From the student

6. During rough weather the wind is so strong therefore the waves receive a lot more energy from the wind resulting in the increase in amplitude (high waves). The crashing waves sounds louder because it has a lot of energy changed.

7.

$$2 \text{ consecutive crest} = 1\lambda$$
$$3 \text{ consecutive crest} = 2\lambda$$
$$\text{therefore } 4 \text{ consecutive crest} = 3\lambda$$
$$3\lambda = 6\text{m}$$
$$\lambda = \frac{6}{3}$$
$$= 2\text{m}$$

---

**Practice Exercise 7**

1. a) Mechanical waves are a kind of waves produced by a disturbance.

   b) Progressive waves are the waves that only transmit energy from one place to another without the movement of the particles of the matter.

   c) Transverse waves are the waves that move forward and at right angle to the direction of the vibrating matter.

2. a) Transverse waves

   b) Longitudinal waves

3. a) Vibrating particles in matter move up and down.

   b) Waves move forward at right angle to movement of vibrating particle in matter.

---

**Practice Exercise 8**

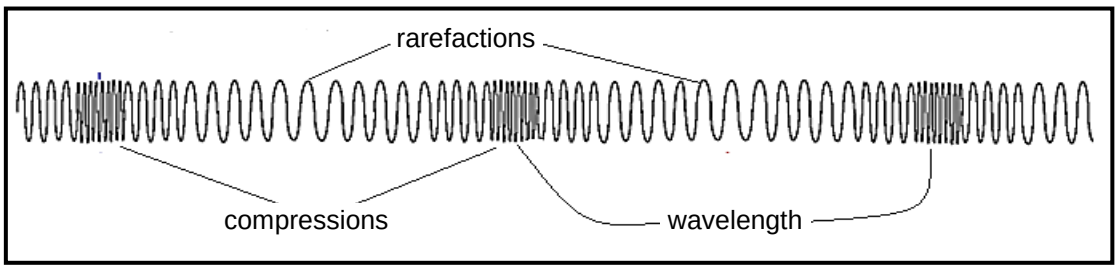
1. Waves whose direction of vibration is the same as their direction of travel.

2. a) Areas on a spring or waves particles that are squeezed and packed together.

   b) Areas on a spring which is expanded and the particles are loosely spread out.

3. The wavelength can be measured as the distance between the centres of two compressions.

4.



**Practice Exercise 9**

1. Because the collision causes the particles in them vibrate.

2. i) Low pitched sound with low frequency

   ii) High pitched sound with high frequency

3. The vibrating object which is producing the sound cause the air particles around to vibrate in the same way. This vibration moves on until it reaches our ears. This causes rapid pressure change in our ear drums and we experience the sensation of sound.

4. Because sound can only travel through particles and on the moon there is no air particles therefore they cannot hear each other talking.

5. They are vibrating electric and magnetic forces which can travel even where there is no particle.

6. Aerials and dishes are used to transmit and receive electromagnetic waves.

---

**Practice Exercise 10**

1. a) Crest is the highest point of the upward motion of a wave from the rest position.

   b) Trough is the highest point of the downward motion of a wave from the rest position.

   c) Amplitude is the height of a crest or depth of a trough.

   d) Wavelength Is the distance from crest to crest or from trough to trough.

   e) Frequency is the number of complete waves generated per second.

   f) Speed is the distance moved by a crest or any point on the wave in one second.

2.

| | | | | | | |
|---|---|---|---|---|---|---|
| Speed | a) 3.5 | b) 3.51 | c) 2.5 | d) 2.5 | e) 2.09 | f) 2.18 |

3. a) decrease

   b) increase

4. a) $f = v / \lambda$ $f = 1.5 / 2.5 = 0.6$m/s

b) $f = v / \lambda$ $f = 2.8 / 2.5 = 1.12m/s$

c) $f = v / \lambda$ $f = 3.2 / 2.5 = 1.28m/s$

---

**REVISE TOPIC 2 USING THE MAIN POINTS ON THE NEXT PAGE.**

# REVIEW OF TOPIC 2: Wave Motion

Now, revise all lessons in this Topic and then do **ASSIGNMENT 5**.
Here are the main points to help you revise.

## Lesson 5: Ripples and Waves

- A wave is a travelling disturbance of some kind.
- A wave can be in different forms, for example, water waves, sound waves, light waves
- Waves can be produced using a rope, slinky-spring and a ripple tank
- A wave motion will take place when a point in a medium is set to vibrate/oscillate thus causing a wave to be generated and starts to travel outwards.
- Sound is produced from vibrating objects.
- The sound reaches our ears because of the vibrations of the air particles from the point of disturbance.
- Sound waves play a major role in communications today.

## Lesson 6: Wave Energy

- Waves usually are produced by a disturbance.
- Waves gain their energy from an initial source.
- Waves transfer energy through a medium from one point to another.
- Waves travel through matter without the matter moving.
- Two points are in phase when they move in the same direction and have the same speed and the same displacement from the rest position.
- Crests are the highest points of a transverse wave.
- Troughs are the lowest points of a transverse wave.
- The amplitude is the maximum displacement of a wave from its rest position.
- Amplitude determines the energy level of a wave.
- The wavelength is distance between two successive crests or troughs or two points which are in phase.
- The period (T) is the time taken for two successive peaks (or troughs) to pass a fixed point.
- The frequency is the number of successive peaks (or troughs) passing a given point in 1 second.
- The source of the ocean wave energy is the sun.

## Lesson 7: Transverse Waves

- Waves produced by particles that are moving to and fro are known as mechanical waves.
- Progressive waves are the waves that only transmit energy from one place to another without the movement of the particles of the matter.
- Transverse waves are the waves that move forward and at right angle to the direction of the vibrating matter.
- Ripples on water and sea waves are examples of transverse waves.
- Tremor or shock wave called the shear or S wave is also a transverse wave.

**Lesson 8: Longitudinal Waves**

- Waves which are which are produced by particles and matter that are moving to and fro are known as mechanical waves.
- Longitudinal waves are waves whose direction of vibration is the same as their direction of travel.
- Longitudinal waves are also called compressional waves, because they produce compression and rarefaction when travelling through a medium.
- Compressions are the areas on a spring or waves particles that are squeezed and packed together.
- Rarefactions are the areas on a spring which is expanded and the particles are loosely spread out.
- The wavelength of a longitudinal wave can be measured as the distance between the centres of two compressions or any two points in phase.
- Sound waves and earthquake P waves are examples of longitudinal waves.

**Lesson 9: Wave Motion and Communication**

- A sound is a longitudinal wave therefore they can only move through where there is a particle.
- Sounds are produced by vibrating objects.
- Sound waves can travel through air as well as solids and liquids.
- Slow vibrating objects produce low pitched sound with low frequency.
- Fast vibrating objects produce high pitched sound with high frequency.
- Electromagnetic waves are vibrations of electrical and magnetic fields therefore they can travel through vacuum.
- Electromagnetic waves make radio and telecommunications easier.
- Aerial and circular dishes are used to transmit and receive electromagnetic waves.

**Lesson 10: Describing Waves**

- The wavelength is the length of one complete wave cycle.
- A crest is the highest point of a wave's upward motion while a trough is the highest point of a wave's downward motion.
- The amplitude is the height of a crest or the depth of a trough.
- The wavelength is simply the length of one complete wave cycle.
- The speed is the distance moved by any point on the wave in one second.
- Frequency is the number of waves produced in one second.
- Fast moving waves have short wavelengths, and short wavelengths means low frequency.
- The wave equation is summed as: wave speed = frequency x wavelength.

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**REVISE WELL AND THEN DO TOPIC TEST 2 IN YOUR ASSIGNMENT 5**

# TOPIC 3

# SOUND WAVES

**In this topic you will learn about:**

- **how sound is produced**
- **transmission of sounds**
- **sound from vibration of air**
- **speed of sound and echoes**
- **noise pollution**

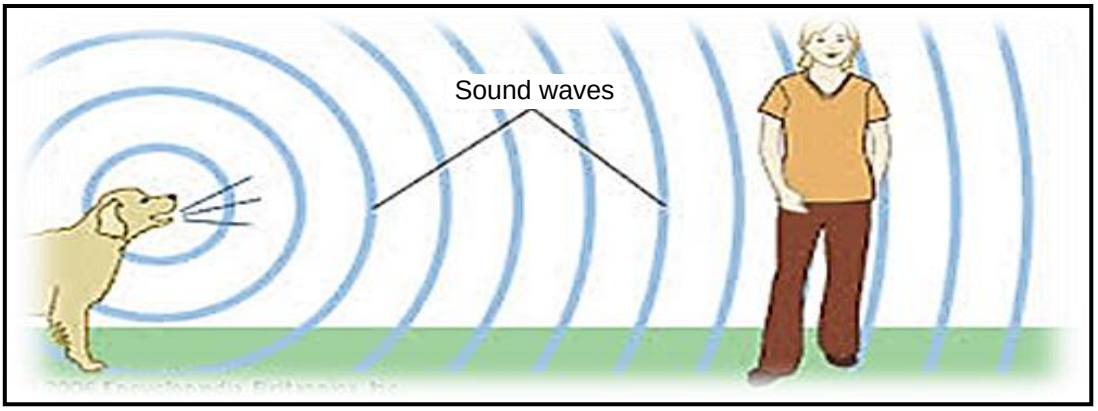
# INTRODUCTION TO TOPIC 3: SOUND WAVES

A mysterious or strange sound always captures our attention. If you hear a gun shot, would you hide or run to see what is happening? The greatest moment of your mother's life was when she heard you crying for the first time at birth. The sound of your cry removed all her labour pain. So what is sound?

We encounter sound in everyday life. We hear the sound of cars, people talking, birds singing, children playing, the ringing tone of your mobile phone or the message tone you cannot afford to miss and the argument of people at betelnut markets.

Sound is a form of wave that carries energy and information whilst travelling through mediums. They are produced by vibrating objects. Some sound are pleasant to your ears while others may seem unpleasant or noisy.

But imagine standing on the moon, would you be able to hear sound? As sound may seem a normal encounter in our daily life, imagine a world without sound. How would you feel if you are deaf at this instant? Would you miss the tone of the voice of your loved one?




When you study sound waves, you will be able to know how they are produced and transmitted. When they are transmitted, their speed will depend on the medium of transmission. You will realise that sound cannot travel in a vacuum and that sound may either be pleasant or unpleasant to your ears.

But how does sound travel to your ears?

After completing this topic you will be able to answer this question and others such as the following:

- How is sound produced?
- How is sound transmitted?
- Would you be able to hear sound on the moon?
- When does sound become a noise?
- Can sound be measured?

**In this topic, you will be able to answer these questions and appreciate sound and its importance in your daily lives.**

# Lesson 11: How Sound is Produced

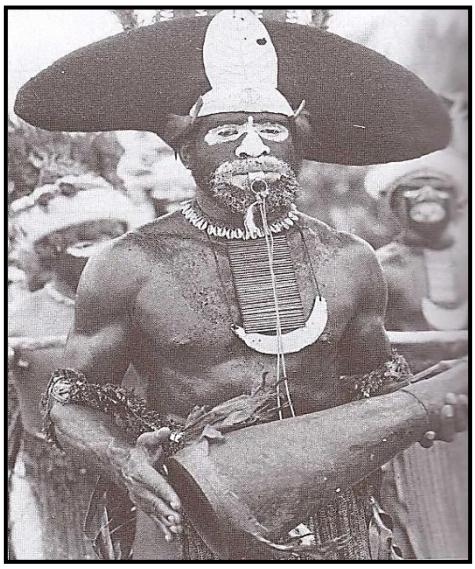
Welcome to Lesson 11. In the previous lesson, you defined speed, frequency, wavelength and amplitude of wave motions. Then you calculated the speed and frequency of waves. In this lesson, you will learn about how sound is produced.

**Your Aims:**

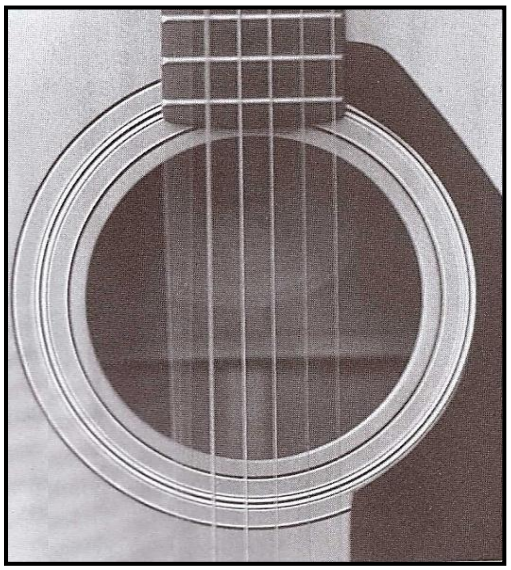
- define vibration
- describe how sound is produced
- identify different sounds around you

## The Nature of Sound

Sound is an important method of communication, but it is a difficult one to understand because you cannot see it. So it is appropriate to begin by looking at things that you can see that makes sound.



A kundu with a vibrating skin

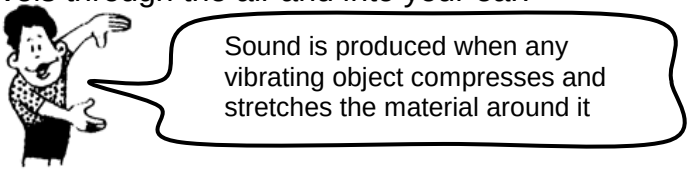


A guitar with a vibrating string

A guitar player makes the strings vibrate to make a sound. A drum skin vibrates when it makes a sound. All these sounds are made by vibrating objects. **Vibration** is the forward and backward or up and down movements of the object enabling sound to be produced.

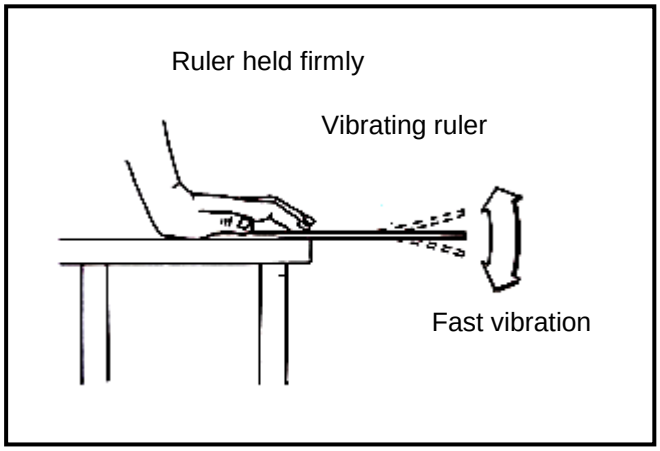
## The Production of Sound

Sound waves are caused by vibrations. When an instrument such as a guitar string or the skin of the kundu drum vibrates, it moves by compressing and then stretching the air next to it. The backwards and forwards movement causes a series of sound waves that travels through the air and into your ear.

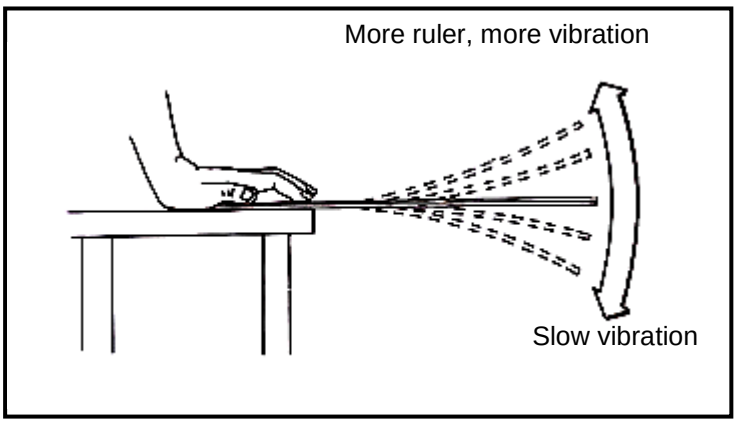


You can study how sound is made by using a ruler or a long, thin and rigid but flexible object to make a sound. If the ruler or object is held firmly so that it is hanging over the edge of the table and the ruler or object is flicked down quickly the ruler or object will make a sound. You will see that the ruler or the object makes a sound by moving quickly up and down. This regular up and down movement is called vibration.

If the length of the ruler or object over the edge of the table is short, the vibrations will be very fast and you will hear a high pitched sound. If the length of the ruler or object over the object is long, the vibration will be slower and you will hear a lower pitched sound. A pitch can also be referred to as a note.



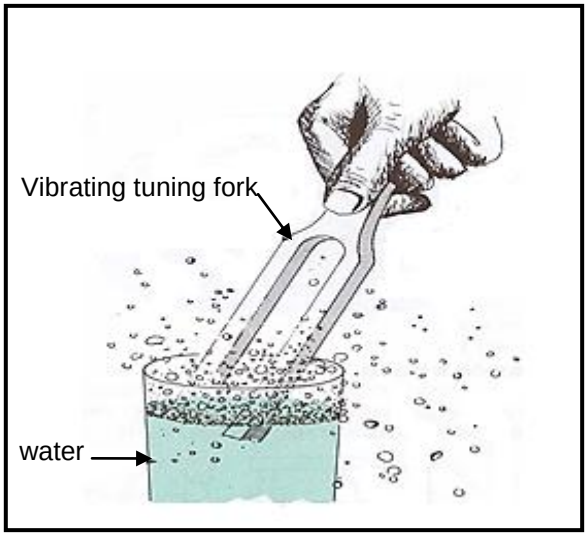

A short length of ruler produces a high note



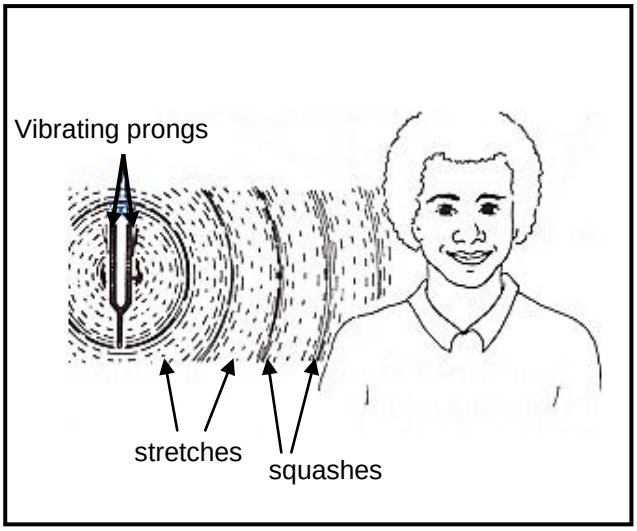

A long length of ruler produces a low note

The number of vibrations made each second is called the **frequency** of the vibration. A longer rule or object vibrates slowly, makes a low pitched sound and has a low frequency. A short ruler or object vibrates quickly, makes a high pitched sound and has a high frequency.

Sometimes, you cannot see vibrations when a sound is made. Usually this is because the frequency of the vibrations is very high and the vibrations are too fast and small for you to see. For example, when you strike a tuning fork, you hear a sound, but you cannot see the fork vibrating. But you can show that it is really vibrating by striking the tuning fork and then quickly dropping it into water. The splashes from the water show that the tuning fork is vibrating.




The splashes show the tuning fork is vibrating




The tuning fork sending out a sound wave

Another example, is when a loudspeaker cone vibrates, it moves in and out very fast. This stretches and squashes the air in front. The 'stretches' and 'squashes' travel out through the air as waves. When they reach your ears, they make your eardrums vibrate and you hear a sound.

Sound waves are longitudinal waves, where the vibrations are backwards and forwards.

**Types of Sound**

The sound produced by an instrument, an individual's speech or singing or just simply a glass breaking can only be classified as a pleasant and enjoyable sound or unpleasant to listen to by the judgment of the person hearing it.

Whether you live in a rural area or in a town or a city, there are always many sounds around you. They are made by running water, animals, people talking, radios or machines. You know that all sounds are made by vibrations.

Music is made by objects whose vibrations have a regular pattern. Their vibrations are regular and the sound produced is pleasant and sensational. A tuning folk or a guitar string produces regular vibrations. They give out musical notes.

Scientists say that noises are produced by objects whose vibrations do not have a regular pattern. Dogs barking, heavy rain dropping on an iron roof and the roar of a crowd are all examples of noises. People have different ideas about which sounds are pleasant and which sounds are unpleasant. For this reason, any unwanted sound may be described as noise by some people.

**Noise**

Most sounds you hear every day are noises. Many noises are annoying and some are dangerous. Loud noises are especially annoying. They can cause temporary or permanent damage to ears. This is the case where a person works in a factory where loud noises are present all the time. Drivers of heavy machinery have a similar problem. You must try to avoid constant loud noises. Where this is not possible, earplugs or ear muffs should be used to protect hearing.

Airport ground traffic controller wearing ear muffs to protect his ears from too much noise

**Musical sounds**

Remember that musical sounds are made by regularly vibrating objects. You can usually think of them as being made by musical instruments. Unlike many noises, they are generally not unpleasant to listen to unless they are very loud. Just as loud noise, loud music can damage hearing.

The best example of a pure musical note is the sound made by a tuning fork. Musical instruments are often tuned by using a tuning fork. There are of course many different musical notes. There are basically two things that make musical notes different. These are the pitch and the loudness of the notes.

Sound from the guitar is pleasant to hear

The sounds of music are usually made by an instrument, such as a flute, a guitar, or a drum. Each instrument has its own particular sound. Even if they all play the same note, you can tell one from another. Each instrument has its own quality of sound.

The sound produced by an instrument, an individual's speech or singing or just simply a glass breaking can only be classified as a pleasant and enjoyable sound or unpleasant to listen to by the person hearing it

**Activity: Now test yourself by doing this activity.**

**Complete this activity by answering the questions on the spaces provided and completing blanks with correct words.**

1. What is vibration by an object or instrument?
   _____
   _____

2. Define frequency of the vibrations.
   _____
   _____

3. If the length of the ruler over the edge of the table is short the vibrations will be _____and you will hear a _____ pitch sound.

4. If the length of the ruler over the edge of the table is long the vibration will be _____and you will hear _____ pitched sound.

5. _____ is an important method of communication, but it is a difficult one to understand because you cannot see it.

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 11.**

## Summary

You have come to the end of Lesson 11. In this lesson you have learnt that:

- sound is an important method of communication, but it is a difficult one to understand because you cannot see it.
- all sounds are made by vibrating objects.
- the regular up and down or backward and forwards movements by an object is called a vibration.
- fast vibrations produce high pitched sounds while slow vibrations produce low pitched sounds.
- the number of vibrations made each second is called the frequency of the vibration.
- sounds can be classed as musical notes or noises.
- a musical note has regular vibrations, while noises have irregular vibrations.
- being exposed to very loud sounds over a long period of time can damage the ear and cause partial deafness.

---

**NOW DO PRACTICE EXERCISE 11 ON THE NEXT PAGE.**

## Practice Exercise 11

**Answer the following questions on the spaces provided.**

1. Write (T) for true and (F) for false for the statements below.

   a) _____ Musical notes have quality, pitch and loudness.

   b) _____ Sound is an important method of communication, but is a difficult one to understand because you can see it.

   c) _____ Pitch depends on the frequency of vibration.

   d) _____ Fast vibrations produce low pitched sounds.

2. Answer the questions below by filling in the blank.

   What is the difference between a musical note and a noise?

   a) A musical note has _____ vibrations, while noise has _____ vibrations.

   b) Things that make sound are called the _____ of sound.

3. From the list of occupations below, select the one where a person working could get ear damage if no ear protection is worn over time.

   Doctor, Airport ground traffic officer, Teacher, Ship engineer, Plumber, Carpenter and Heavy machinery operator

   a) _____
   b) _____
   c) _____

4. Answer this question.

   List three musical instruments mentioned in the lesson.

   a) _____
   b) _____
   c) _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3.**

**Answers to Activity**

1. This is the regular up and down or forwards and backwards movement by an instrument or an object

2. The number of vibrations made each second.

3. fast, high

4. slow, lower

5. Sound

# Lesson 12: Transmission of Sounds

Welcome to Lesson 12. In the previous lesson, you defined the term vibration in reference to sound. Then you described how sound is produced. You also identified the different sounds around you and classified them whether they are pleasant, enjoyable or unpleasant to listen to. In this lesson, you will learn about the transmission of sound.

**Your Aims:**

- define decibels
- discuss how sound is transmitted.
- discuss sound waves and sound energy.

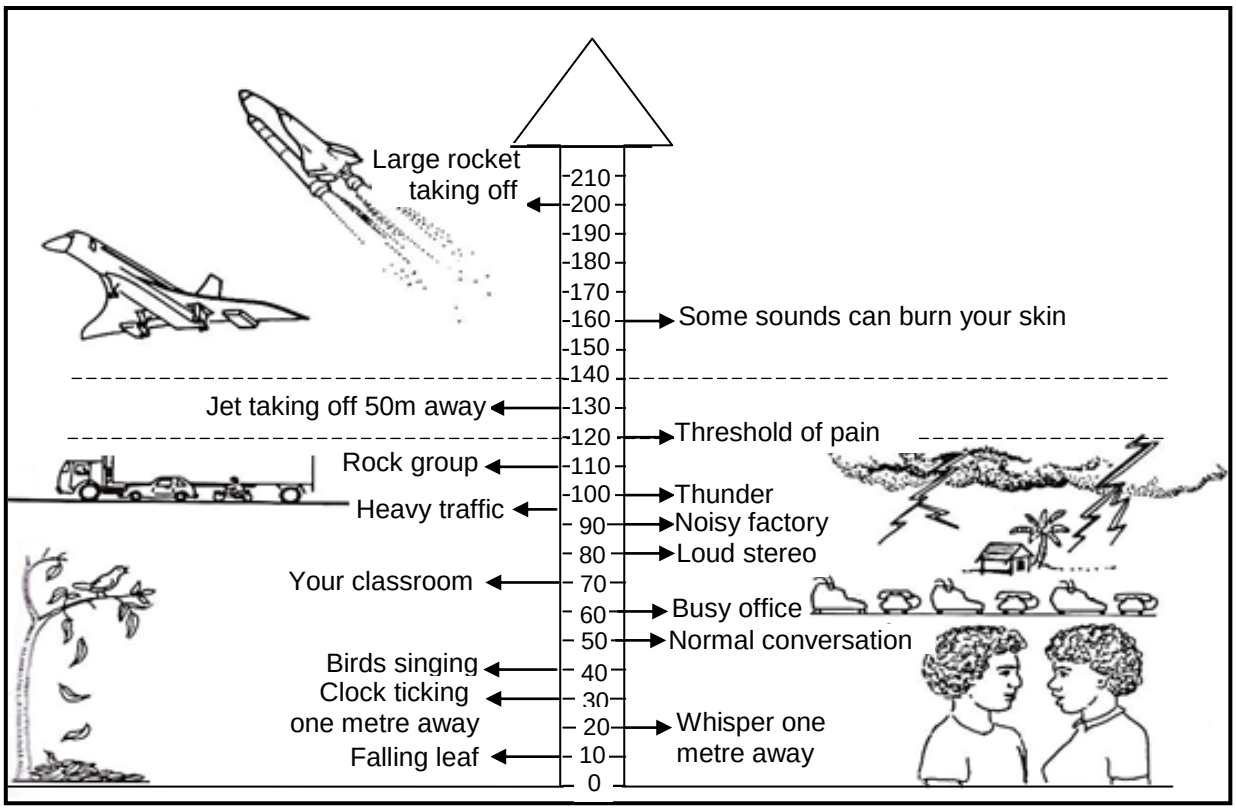
**Measuring Sound**

Sounds are measured in units called decibels. The loudness of a sound depends not only on the sound, but also on the person who hears it. Because of this, scientists do not measure loudness directly; instead, they measure sound intensity. This is measured in decibel (**dB**) using a sound level meter. The decibel levels of some everyday sounds are shown in the table below.

| Sound | Decibels |
|---|---|
| Something you can just hear | 0 |
| Your own breathing | 10 |
| Leaves rustling in the breeze | 20 |
| A suburban street at night | 40 |
| Two people talking | 60 |
| Busy traffic | 70 |
| A vacuum cleaner | 80 |
| An electric drill 20cm away | 90 |
| An underground train | 100 |
| A rock band | 90-140 |
| A machine gun 3 meters away | 130 |
| A jet plane taking off overhead | 140-150 |

Scientists do not measure loudness directly; instead, they measure sound intensity. This is measured in decibel (dB) using a sound level meter.

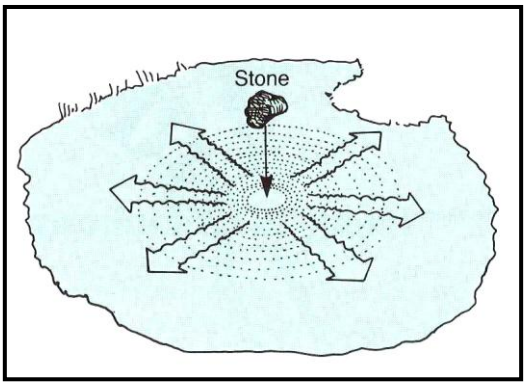
An increase in 10 dB means a sound will seem twice as loud. A vacuum cleaner (80 dB) sounds twice as loud as heavy traffic (70 dB). Exposure to sounds of 90 dB for a long period of time can damage your ears. Exposure to sounds of 110 dB for more than 2 minutes can result in permanent deafness.



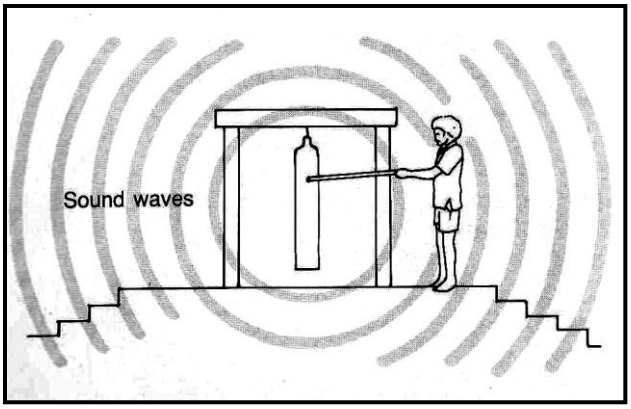

Threshold of audibility Decibels

## The Transmission of Sound

You now know that sounds are made by vibrating objects. But how does the sound travel through the air to reach your ears. To understand this you can look at what happens when a stone is dropped into water. When this occurs, waves spread out in circles from where the stone hit the surface of the water. The circles get bigger as they move outwards.

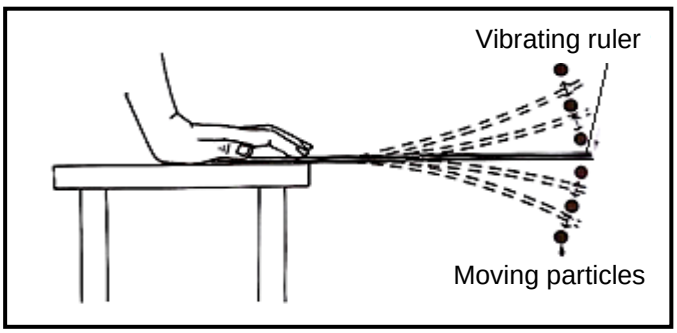



Ripples on a pond



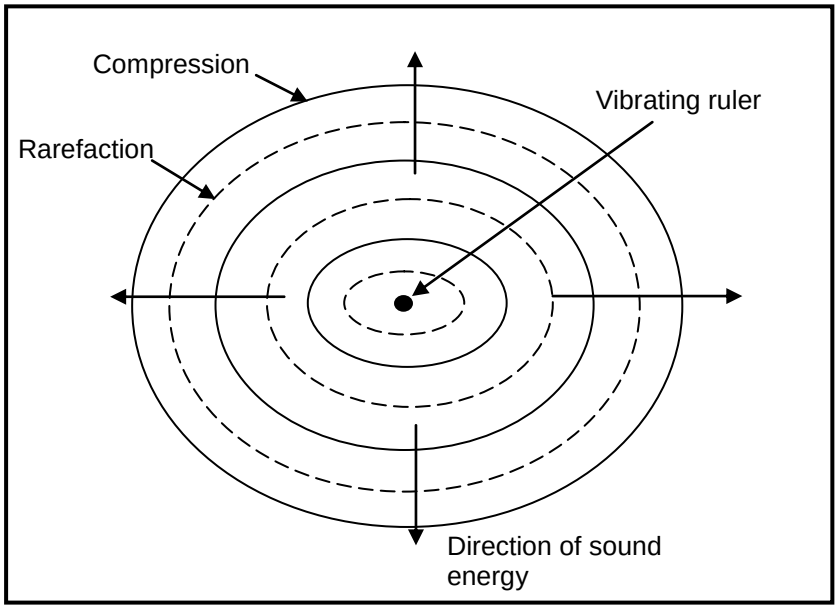

Sound travels outwards in all directions

Sound travels in a similar way. Remember the vibrating ruler or object. As the ruler moves up and down it makes the sound. But how does this happen?




A vibrating ruler makes the air particles move

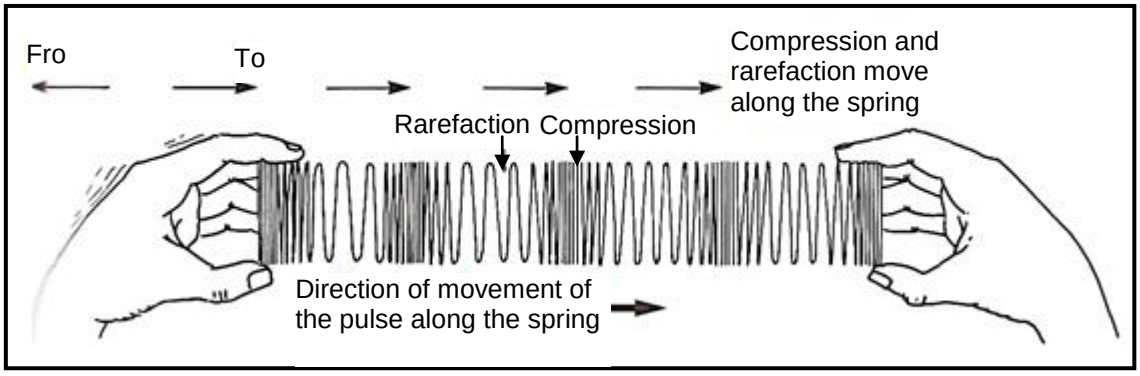
Air is a gas made up of tiny particles. As the ruler vibrates it disturbs the air around it. As it moves upwards it pushes against the air next to it. Then, as the ruler moves downwards the air next to it moves back again. These pushes and pulls travel through the air as a sound wave. The air is continually being squashed and stretched many times every second. The squashes and stretches at different places along the sound wave travel outwards in all directions away from the vibration. These squashes and stretches are also called compressions and rarefactions respectively.




Sound waves spreading out from a vibrating object, such as a vibrating ruler

**Sound Wave and Energy**

Compressions and rarefactions can be shown on a slightly stretched coil spring lying on the floor. If one end of the spring is quickly pushed together a compression is formed where the coils of the spring have been pushed closer together. This compression will move along the spring. Because some of the coils are close together to form a compression there is a small section behind the compression where the coils are further apart. This is a rarefaction and follows the compression along the spring. If the end of the spring is moved forwards and backwards in a regular way, a series of compressions and rarefactions move along the spring.



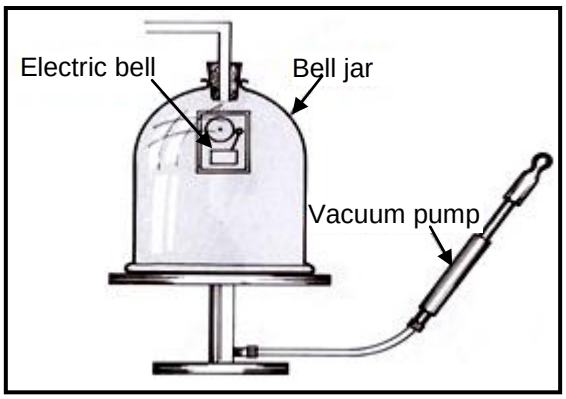

A compression and a rarefaction moving along a spring

While the compressions and rarefactions moving in a coil spring are different from those moving in the air, the idea is the same. Compressions and rarefactions move outwards in all directions from the vibrating ruler. They move out in the same way from the ruler as water waves move out from the spot where the stone landed in the water. Compressions and rarefactions moving out from the vibrating ruler are known

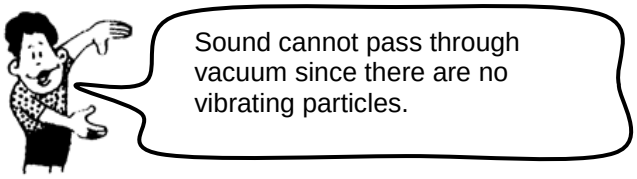
as sound waves. This is really energy moving out. Compressions and rarefactions in the air are set up as quickly or as slowly as the ruler vibrates. This is true for any object that vibrates. Therefore, sound waves have the same frequency of vibration as the vibrating object.

When the sound waves reach you, you hear the sound. They get weaker the further they travel. Eventually they fade altogether.

Sound can also pass through solids and liquids because it is made of particles that can vibrate. The substance through which sound passes is called a medium. Substances such as wood, iron, water and air are media for sound. Because there are no particles in a perfect vacuum no sound can pass through it. This can be shown if the air is pumped out of a jar containing a ringing electric bell. The sound from the bell becomes quieter and quieter until the ringing can no longer be heard.




When the air is pumped out of the jar, the sound from the bell becomes quieter and quieter

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**Activity: Now test yourself by doing this activity.**

**Part A**. Write (T) for True or (F) for false for each of the given statements

1. _____ Sounds are measured in units called decibels.

2. _____ Air is a gas made up of tiny particles that can vibrate.

3. _____ Sound waves travel outward from the source in one direction.

4. _____ The substance through which sound travels is a medium.

**Part B**. Choose the correct term from the list below to complete the following sentences.

| Solid, Ice, Vacuum, Energy, Pitch, Frequency, Compression, Decibels, Rarefactions |
|---|

1. Sound travels through solids, liquids and gases. It will not travel in a _____.

2. Sound waves transfer _____.

3. The compression and rarefaction making up sound waves have the same _____as the vibrating object.

4. When an object vibrates it squashes and stretches the surrounding air. The squashes are also called _____and the stretches are also called _____.

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 12.**

## Summary

You have come to the end of Lesson 12. In this lesson you have learnt that:

- scientists do not measure loudness directly; instead, they measure sound intensity. This is measured in decibel (dB) using a sound level meter.
- when an object vibrates it squashes and stretches the surrounding air. The squashes are also called compressions and the stretches are also called rarefactions.
- sound waves are made up of compressions and rarefactions passing through a solid, liquid or a gas.
- the compressions and rarefactions making up sound waves have the same frequency as the vibrating object.
- sound waves transfer energy.
- sound travels through solids, liquids and gases. It will not travel in a vacuum.

---

**NOW DO PRACTICE EXERCISE 12 ON THE NEXT PAGE.**

## Practice Exercise 12

**Part A: Answer the following questions on the spaces provided.**

1. What is the unit of measurement for sound?

   _____

2. What is the name of the instrument used to measure sound?

   _____

3. What is the name given to the substance through which sound passes through?

   _____

4. Sound cannot travel through a vacuum. Why is that so?

   _____

5. What is the

   (i) compression of a sound wave?

   _____

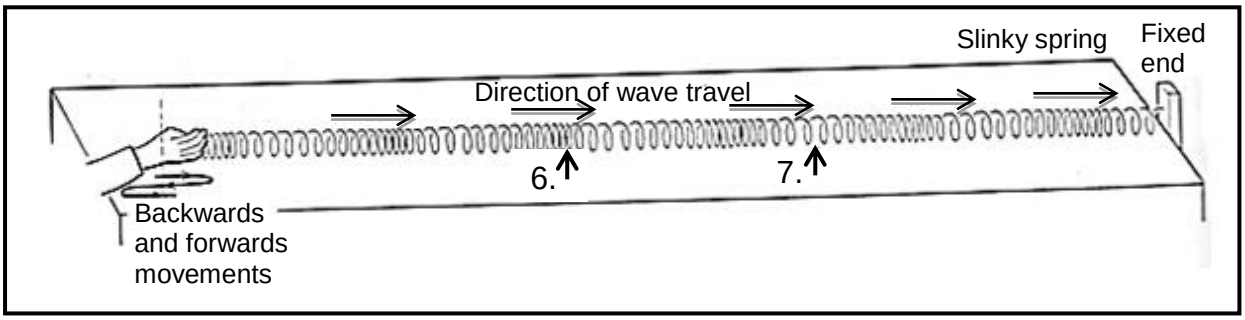
   _____

   (ii) rarefaction of a sound wave?

   _____

   _____

**Part B**: **For questions 6 and 7, label the diagram below**




6. _____ 7. _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3.**

## Answers to Activity

**Part A**.

1. T
2. T
3. F
4. T

**Part B**.

1. vacuum
2. energy
3. frequency
4. compressions, rarefactions

# Lesson 13: Sound from Vibration of Air

Welcome to Lesson 13. In the previous lesson, you defined decibels as the unit of measurement for sound. Then you discussed how sound is transmitted. You explained sound waves and sound energy. In this lesson, you will learn about sound from vibration of air.

**Your Aims:**

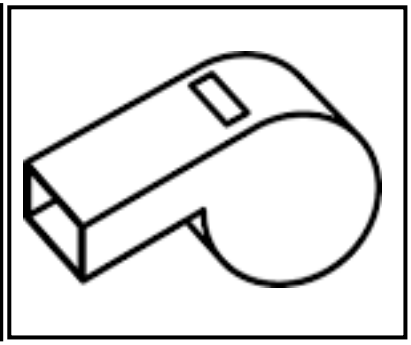
- define wind instruments
- identify instruments that produce sound by vibration of air
- identify how sound is produced by vibration of air columns

**Wind Instruments**

Have you seen toy whistles which children play with? Have you seen whistles used by football referees? Have you seen people blowing into a conch shell?

A bamboo flute

Blowing a conch shell



Referee's whistle

A whistle is a tube with an opening through which we blow. When we blow in air, the air column inside the tube vibrates and produces a sound.

It is similar to blowing a conch shell. When we blow air into it, a sound is produced. How?

The sound is produced by the vibration of air inside the shell.

Have you seen bamboo flutes, made with several pieces of bamboo? They are made by joining several bamboo tubes of different lengths. When we blow a flute of this type, we get different types of sound. Why?

The sounds are produced by the vibration of air inside each tube. The tubes are of different lengths. So, the lengths of vibrating air columns are also different. Thus, we get different sounds.

- A short tube produces a high note.
- A long tube produces a low note.
- A bamboo flute is an example of a simple wind instrument. It is an instrument which produces sound by the vibration of air inside it. In general, all musical instruments that are played by blowing air through them are called wind instruments.

The trumpet, flute and saxophone are examples of wind instruments. Notes are produced by making air inside the instrument vibrate. This is done by blowing air into the mouthpiece. The pitch (frequency) of the sound is determined by the length of the air inside the instrument. This is known as the **air column**.

The notes are changed by varying the length of the column of air that vibrates. In the tube, for example, the length of the column of air is changed by pushing valves with the fingers. With a recorder different notes are produced by blocking various combinations of holes with the fingers.

Traditional PNG man playing his traditional flute

**High and low notes**

You have learnt about producing high and low notes in drums and guitars. High notes are produced by tightening the skins of the drums and the length and thickness of the strings on the guitars.

- The more you **tighten** them, the **higher** the note produced.

How do we produce high and low notes in wind instruments? Try this activity and you will discover the answers.

An Indian man playing his traditional Indian flute

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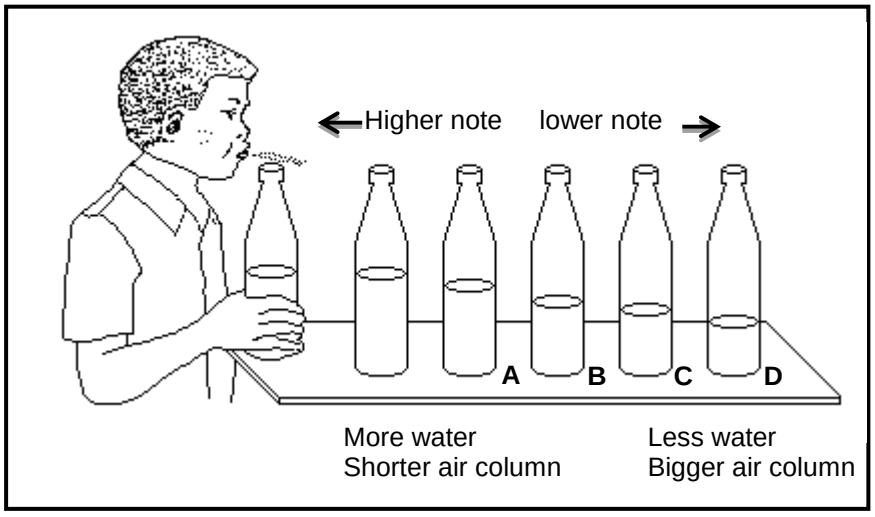
**Activity: Now test yourself by doing this activity.**

**You need**: An empty bottle, water

**Do this**: Blow over the mouth of a bottle half filled with water and listen to the sound it produces. Then pour out some water (as in **A**), blow again and listen to the sound produced.



Repeat blowing several times; each time change the level of water (as in **B**, **C** and **D**) and listen to the sound produced.

**Question**

When does it produce sound with a higher note? (When there is more or less water in the bottle?)

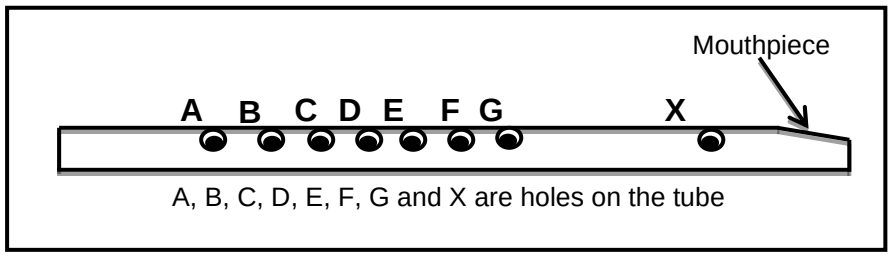
_____

As more water is poured out of the bottle, the air column inside becomes bigger and bigger. When the air column is big, the vibration of air is slow. Slow vibrations produce low notes.

**Big air columns vibrate slowly and produce low notes while short air columns vibrate faster and produce higher notes.**

**Playing wind instruments**

Wind instruments are generally tubes with holes on them. For example, a simple bamboo flute (with one tube) looks like this:




A, B, C, D, E, F, G and X are holes on the tube

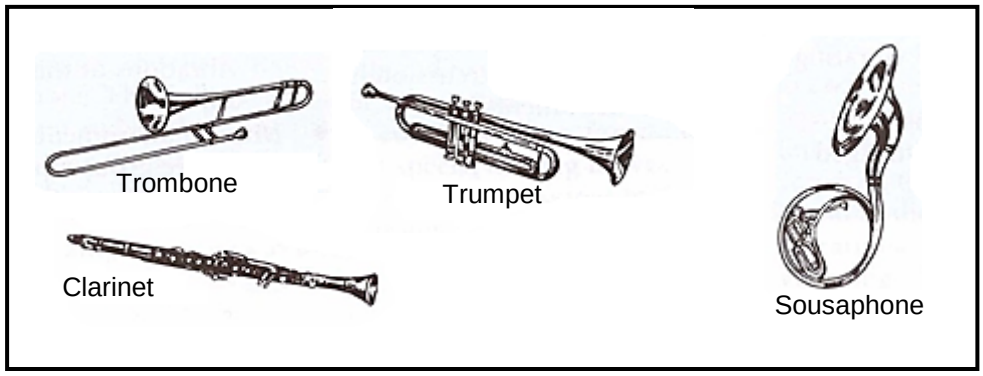
When we blow air into the mouthpiece , the flute produces a sound. In a flute, the player produces different notes by changing the length of the vibrating air column. This is what happens: (Look at the diagram)

- When hole **G** is open, the vibrating column is **GX**.
- When holes **F** and **G** are closed, and hole **E** is open, the vibrating air column is **EX**.

Air column **GX** is shorter than the air column **EX**: so, when **G** is open, the flute produces a high note. When hole **E** is open, and holes **F** and **G** are closed, it produces a low note.

**Modern wind instruments**

Here are pictures of some modern wind instruments.




Some modern wind instruments

To play a wind instrument, we blow in air and change the length of the vibrating air column. The vibrating air column is changed by repeatedly closing and opening the holes (some have valves or keys) with fingers.

**In wind instruments, high and low notes are produced by changing the length of the vibrating air column.**

---

## Summary

You have come to the end of Lesson 13. In this lesson you have learnt that:

- the trumpet, flute and saxophone are examples of wind instruments.
- sound is produced by making the air inside the instrument vibrate.
- the notes are changed by varying the length of the column of air.
- the vibration of short air columns produces high notes.
- the vibration of long air columns produces low notes.

---

**NOW DO PRACTICE EXERCISE 13 ON THE NEXT PAGE.**

## Practice Exercise 13

**Answer the following questions on the spaces provided.**

1. Complete these statements.

   a) An instrument played by blowing air through it is called a _____.

   b) High and low notes are produced by changing the length of the _____.

   c) The vibration of a short (small) air column produces a _____ note.

   d) The vibration of a long air column produces a _____ note.

   e) Fast vibrations take place in _____ air columns.

2. a) What vibrates to produce sound when we blow a conch shell, whistle or a bamboo?
   _____

   b) In your own words, explain what an air column is.
   _____
   _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3.**

**Answer to Activity**

Short air columns vibrate faster and produce higher notes.

# Lesson 14: Speed of Sound and Echoes

Welcome to Lesson 14. In the previous lesson, you defined winds instruments as instruments that produce sound by resonance of sound waves by the air column. Then you identified some examples of winds instruments. You also explained how sound is produced by vibration of air columns in the wind instruments. In this lesson, you will learn about the speed of sound and echoes.

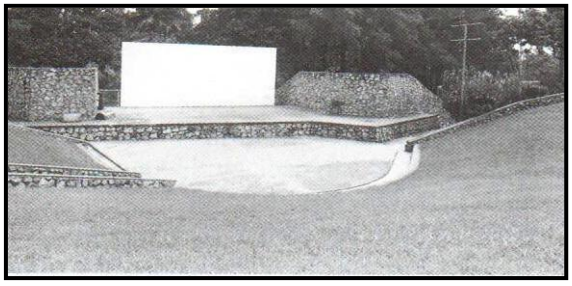
**Your Aims:**

- define echoes
- explain how echoes are produced
- discuss the speed of sounds in solid, liquids and gases
- measure speed of sound

## Reflection of Sound

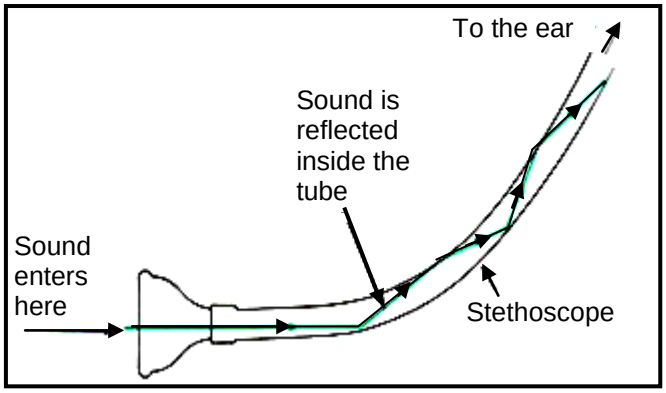
You can change the direction of light using a mirror. When light bounces off a shiny, smooth surface and goes in another direction, this is called **reflection**.

Sound waves can also be bounced off or reflected. The harder and smoother the surface, the better the sound is reflected. A brick wall will reflect sounds better than the same wall covered with a curtain. Soft materials, like curtains, absorb sounds. Open-air theatres and stethoscopes make use of the reflection of sound. Much of the sound produced in an open air theatre does not travel straight to the audience. Part of the sound travels back into the theatre, reaching the sides, the back and the roof. The theatre is designed so that this sound is reflected toward the audience.



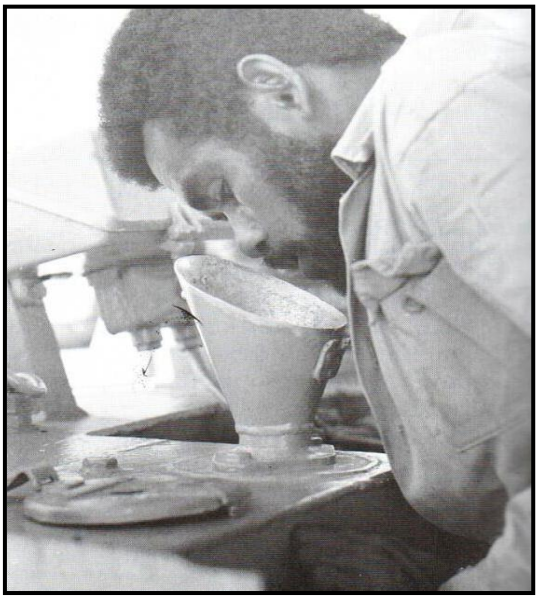
The open-air theatre at the University of Papua New Guinea.

The stethoscope makes it possible for a doctor or nurse to hear clearly a patient's heartbeat or breathing. A heartbeat reaches the doctor's ears by being reflected many times by the inside of the tubes of the stethoscope.



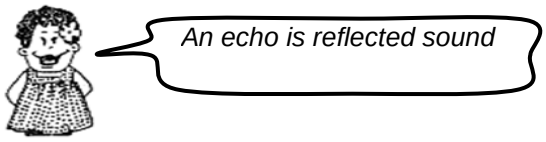

Sound travels along the inside of a stethoscope tube by being reflected many times

The speaking tube used on board some ships work in the same way.

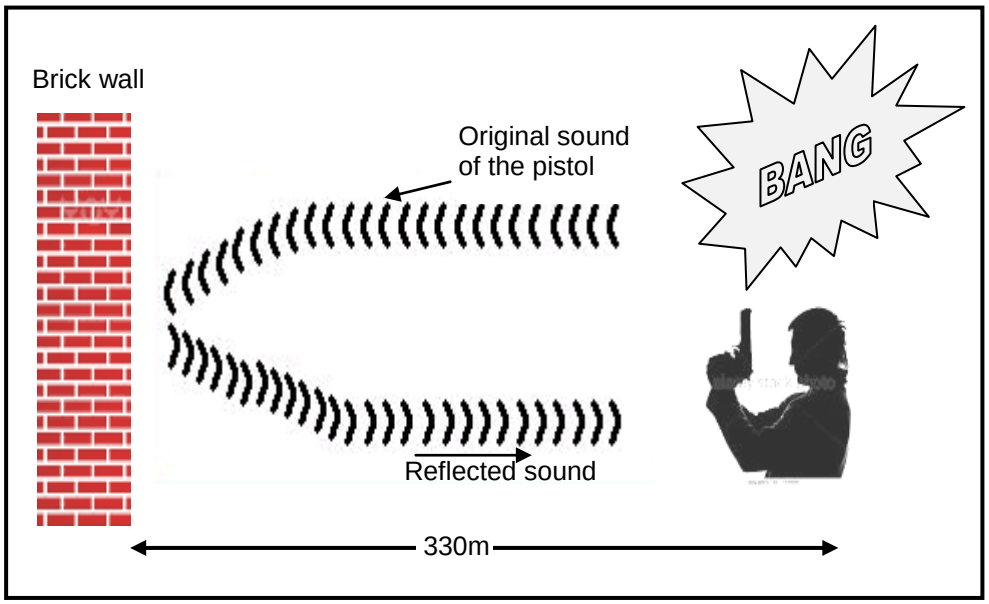


The speaking tube used on board a ship

You know that sound is reflected because in many places you hear the reflected sound. For example, if you stand near a wall and shout you will hear only one shout. If you then move further away from the wall and shout again, it is possible for you to hear your shout followed by a second shout. When you hear the second shout, you have heard an echo. An **echo** is reflected sound.



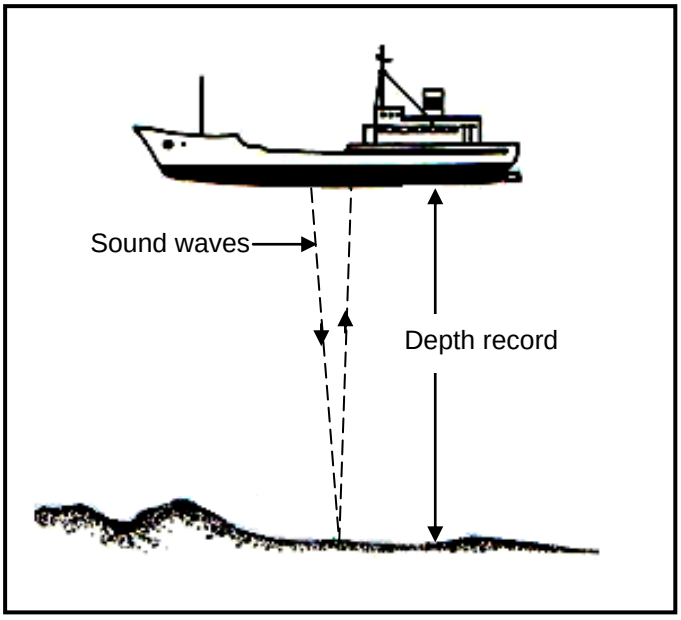

An echo is heard only if the reflected sound reaches your ear one-tenth (1/10) of a second, or more, after the original sound. If the reflected sound reaches your ears any sooner you cannot hear it. This is because your ear cannot tell the difference between the original sound and the reflected sound if the time gap is less than one-tenth (1/10) of a second.




Sound can be reflected off hard surfaces at 1/10 of a second from the time it is produced and when it reaches your ears.

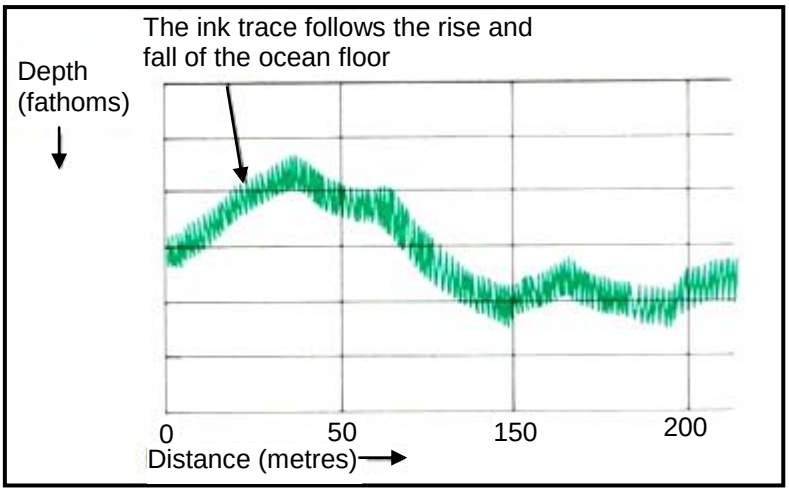
**Echo sounding**

People have learnt to use echoes. Echoes are used in navigating ships. Here, sound waves are sent from the ship, the waves hit underwater objects or the ocean floor and are reflected back to the ship. There a receiver picks up the reflected sound. Because the speed of sound is known, navigators can work out how far away the object is. They are also able to check the direction of the object.

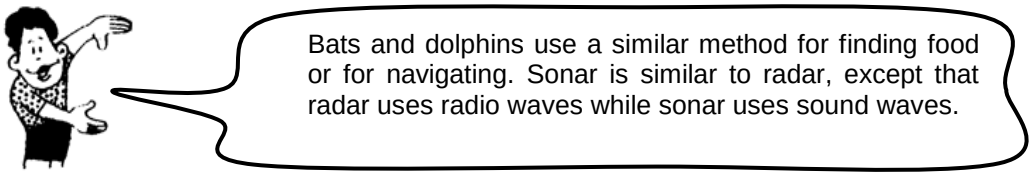



A ship using sonar to find the depth of water under its keel.

This echo system is called **sonar**, meaning Sound Ranging Navigation. In most modern ships, a continuous record of the depth of water under the ship is provided by sonar. The sonar is also used by trawlers to find schools of fish.




Part of a chart from the sonar apparatus. The ink line shows depth in fathoms. (One fathom equals 1.83 metres)



## The Speed of Sound

If someone near you talks, you can hear them at the same time as you see their mouth moving. Sound must travel fairly fast for that to happen. On the other hand, if you are watching someone cutting firewood from some distance away you see the axe hit the wood, but you do not hear the sound immediately. A short time later you hear it. This means that sound travels slower than light.

The speed of sound depends on the temperature of air. Sound waves travel faster through hot air than through cold air. This means, for example, that sound changes speed when it passes from warmer into cooler air, or vice versa. As with other types of wave, the change in speed can cause refraction, which is a change in direction of travel.

Experiments have shown that sound travels about 340 metres every second in air when the temperature is $15^0$C. This represents a speed of 1224 kilometers per hour. Light travels at 300 000 000 metres per second.

Sound travels faster in liquids and solids than it does in gases such as air. In water it travels four times as fast as in air, while in steel it travels fifteen times as fast. In air, the speed is about 330 metres per second. The exact speed depends on the temperature. Sound travels faster through water than it does through air, and even through most solids.

You now know that sounds are caused by vibrations where a series of air waves travel through the air and into your ear. In a vacuum, there is no air for the sound waves to travel through and so you cannot hear a sound. In other words, sound cannot be transmitted in a vacuum.

### Finding the speed of sound (Echoes)

Hard surfaces like walls reflect sound waves. When you hear an echo, you are hearing a reflected sound a short time after the original sound.

A girl is 80 metres from a large brick wall. She is hammering a block of wood. Every time she hits the block, she hears an echo 0.5 seconds later. This is the **echo time**.

She could use this information to calculate the speed of sound.

$$\textbf{speed} = \frac{\textbf{distance travelled}}{\textbf{time taken}}$$

So

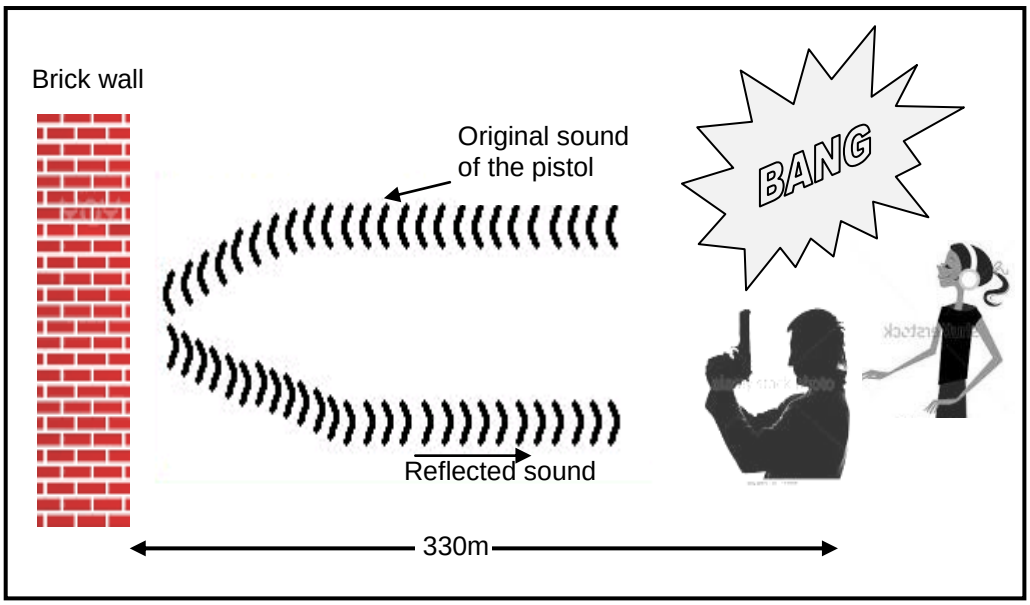
$$\text{Speed of sound} = \frac{\text{distance to wall and back}}{\text{Echo time}}$$

$$= \frac{2 \times 80}{0.5}$$

$$= \frac{160}{0.5}$$

$$= 320\text{m/s}$$

The man in the illustration below stood 330 metres from a wall. He fires a starting pistol. His friend hears the echo 2 seconds later.




Sound can be reflected off hard surfaces

The sound has travelled a distance of 2 × 330 meters.

The time taken is 2 seconds so:

$$\text{speed of sound} = \frac{\text{distance travelled}}{\text{time taken}} = \frac{2 \times 330}{2}$$

$$= 330 \text{m/s}$$

---

**Activity: Do it yourself**

If there is a large wall around, you can find the speed of sound for yourself. Just fit your own distance and time measurements into the formula below.

$$\text{speed of sound} = \frac{\text{distance travelled}}{\text{time taken}}$$

To make your measurement more accurate, measure the time for 20 echoes instead of just one. Bang the block repeatedly so that each blow is made just as an echo returns. If it takes 10 seconds to make 20 hammer blows, then the echo time is 10 ÷ 20 seconds, or 0.5 seconds.

---

**Activity: Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. Thunder and lightning occur at the same time. Why is it that people usually see the lightning before they hear the thunder?

   _____

   _____

_____
_____

2. What is an echo?

_____
_____

3. Arrange the substances below in the order of the fastest to the slowest of allowing sound to travel through it.

Water - Steel - Air

_____, _____, _____

4. What is sonar?

_____
_____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 14.**

## Summary

You have come to the end of Lesson 14. In this lesson you have learnt that:

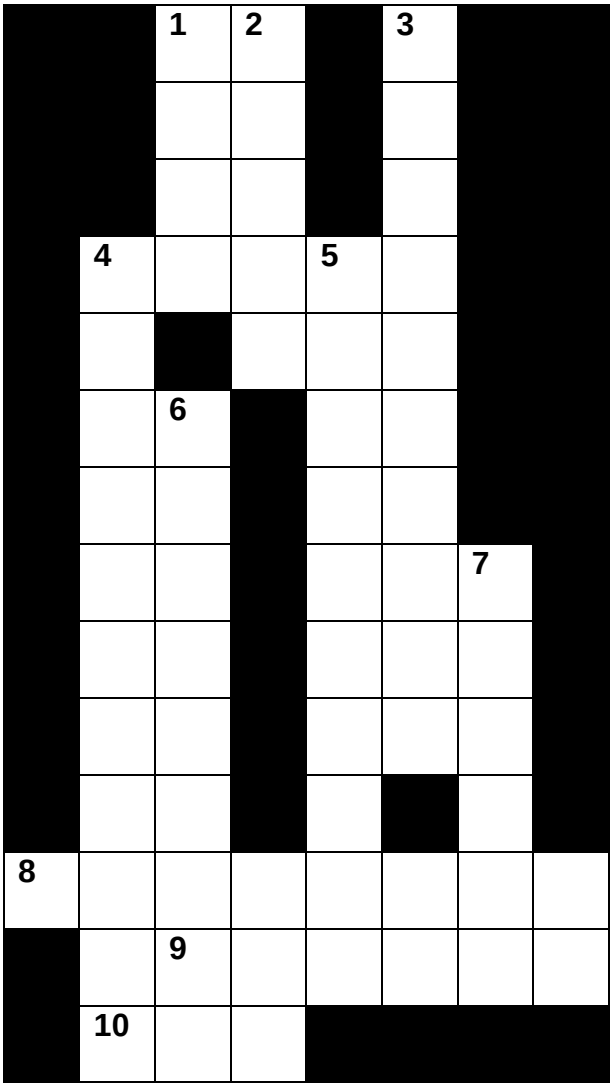
- sound waves can be bounced off or reflected.
- hard surfaces reflect sound much better than soft surfaces.
- an echo is a reflected sound.
- an echo is heard only if the reflected sound reaches the ear one tenth (1/10) of a second.
- echoes are used in navigating ships.
- sonar or Sound Ranging Navigation is the echo system used in ship navigation.
- bats and dolphins also use sonar to find food or for navigating.
- sound travels slower than light.
- sound travels about 340 metres every second in air when the temperature is 15˚C.
- sound travels faster in liquids and solids than it does in gases such as air. In water it travels four times as fast as in air, while in steel it travels fifteen times.
- speed of sound is equal to distance travelled by the sound divided by the time taken to reach the ear after an echo of the original sound.

---

**NOW DO PRACTICE EXERCISE 14 ON THE NEXT PAGE.**

## Practice Exercise 14

**Part A**: **Complete the crossword puzzle below.**



**Down**

1. Reflected sound
2. Energy created by vibrating object
3. Speeds faster than the speed of Sound.
4. Instrument used by doctors to hear the breathing and heartbeats well. It uses the echo system.
5. Bouncing off from hard surface.
6. Mammal that utilises sonar for navigation and for finding food.
7. Sound travel through this matter the fastest.

**Across**

8. Supersonic jet.
9. Sound Ranging Navigation.
10. Sounds enter through this part of your body.

**Part B**: **Calculation of sound**

1. Assuming that the speed of sound is 330m/s. Chris shouts when he is 110 metres from a wall. When will he hear his echo?

2. The finisher at the end of the 100m race track hears the starting pistol 1.5 seconds after being fired by the starter. What is the speed of the sound from the pistol?

---

3. A boat sending sound signals below 250m depth receives echo after 5 seconds. What is the speed of the sound traveling through the water?

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3.**

**Answers to Activity**

1. Because light travels faster than the sound

2. Reflected sound

3. Steel, Water, Air

4. Sound Ranging Navigation

# Lesson 15: Noise Pollution

Welcome to Lesson 15. In the last lesson you learnt about the speed of sound and echoes. We are bombarded by all sorts of sounds every day. Some of the sounds are nice to hear while the others are unpleasant. In this lesson, you will learn about noise pollution.

**Your Aims:**

- define noise pollution
- identify the effects of noise pollution
- explain supersonic speeds, sonic booms, shock waves using decibel scale

**Noise Pollution**

Whether you live in a rural area or town, there are many sounds around you .They may be made by running water, animals, people talking, radios or machines. You know that all sounds are made by vibrations. Music is made by an object whose vibration has a regular pattern. Their vibrations are regular. A tuning fork or a guitar string produces regular vibration. They give out musical notes. They have a single frequency, for example, a tuning fork has 256 hertz. Most of the sounds we hear are made up of a number of frequencies. It is the mixture of frequencies that decides whether a sound is pleasant or not.

Scientists say that noises are produced by objects whose vibrations do not have a regular pattern. Dog barking, heavy rain on the iron roof, and roar of a crowd are all examples of noises. People have different ideas about which sounds are pleasant and which sounds are unpleasant. For this reason, any unwanted sounds can be categorised as noise by some people.

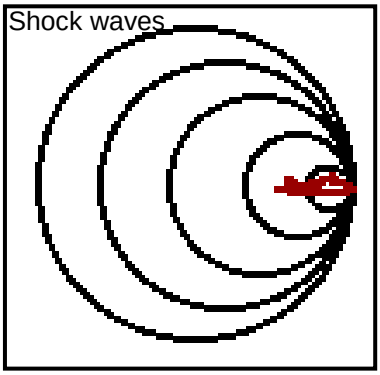
Most sounds you hear every day are noises. Many noises are annoying and displeasing and some are dangerous. Loud noises are especially annoying and can cause temporary or permanent damage to ears. This is a case where someone works in a place where loud noises are present all the time. Drivers of heavy machinery have similar problems and should avoid constant loud noises. Where this is not possible, earplugs or earmuffs should be used to protect hearing. All the types of sounds that are unpleasant can cause what scientist describe as **noise pollution**.

Earplugs or earmuffs are used to protect hearing

**Too much noise can cause ear damage. Always wear ears muffs when exposed to high level of noise**

## Shock Waves and Sonic Booms

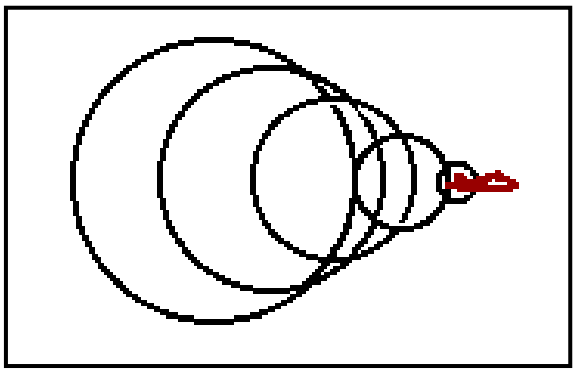
If a moving source of sound moves at the same speed as sound, then the source will always be at the leading edge of the waves that it produces. The diagram below shows how wavefronts being produced by an aircraft that is moving at the same speed as sound would look like.




Aircraft flying at the speed of sound

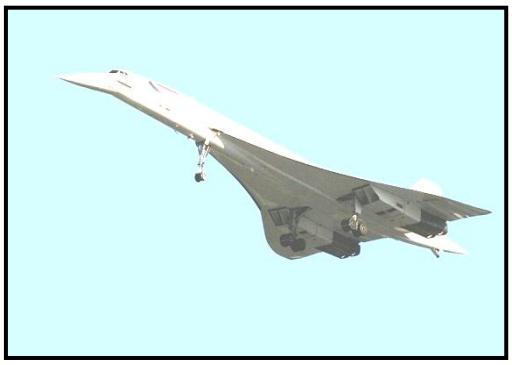
The circular lines represent compressions or 'squashes' of the sound waves. Notice that these circles are *bunched up* at the front of the aircraft. This phenomenon is known as a **shock wave**.

Shock waves are also produced if the aircraft moves faster than the speed of sound. If a moving source of sound moves faster than sound, the source will always be *ahead of* the waves that it produces. The diagram below shows how wavefronts being produced by an aircraft that is moving faster than sound would look like.
Note that the circular compressional wavefronts fall behind the faster moving aircraft (in actuality, these circles would be spheres).



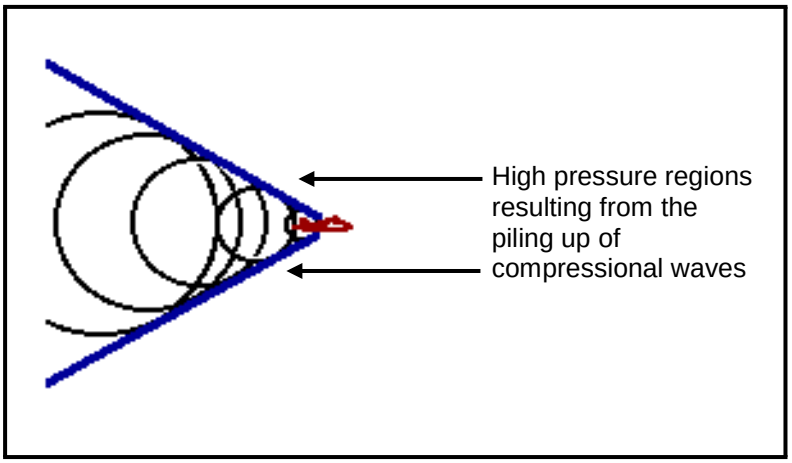
Aircraft moving faster than the speed of sound

If you are standing on the ground when a supersonic (faster than sound) aircraft passes overhead, you might hear a sonic boom. Any object that travels faster than the speed of sound is said to be at supersonic speed.



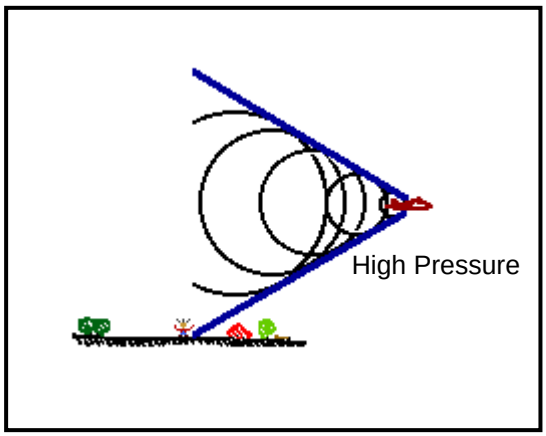
The Concorde travels at supersonic speed

A **sonic boom** occurs as the result of the piling up of compressional wavefronts along the conical edge of the wave pattern. These compressional wavefronts pile up and interfere to produce a very high-pressure zone. This is shown below.




Instead of these compressional regions (high-pressure regions) reaching you one at a time in consecutive fashion, they all reach you at once. Since every compression is followed by a rarefaction, the high-pressure zone will be immediately followed by a low-pressure zone. This creates a very loud noise.

If you are standing on the ground as the supersonic aircraft passes by, there will be a short time delay and then you will hear the **boom** - the sonic boom. This boom is merely a loud noise resulting from the high pressure sound followed by a low pressure sound. Do not be mistaken into thinking that this boom only happens the instant that the aircraft surpasses the speed of sound and that it is the signature that the aircraft just attained supersonic speed. Sonic booms are observed when any aircraft that is traveling faster than the speed of sound passes overhead. It is **not** a sign that the aircraft just overcame the sound barrier, but rather a sign that the aircraft is traveling faster than sound.




Sonic Boom

When a supersonic aircraft passes overhead, instead of the compressions and rarefactions being heard at separate times, they are heard at once. This creates a **sonic boom.**

**Any object that travels faster than the speed of sound is said to be at supersonic speed. Speeds slower than the speed of sound are called subsonic.**

---

**Activity:** **Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. What is a noise?

_____
_____
_____

2. List down 6 noises that are unpleasant.

_____
_____
_____
_____

3. A Concorde is a supersonic airliner. What do we mean by supersonic?

_____
_____
_____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 15.**

## Summary

You have come to the end of Lesson 15. In this lesson you have learnt that:

- noise is a sound that is unpleasant and annoying to hear.
- music is made by objects whose vibrations are regular.
- noise is made by objects whose vibration is irregular.
- Being exposed to very loud sounds over a long period of time can damage the ear and cause partial deafness.
- a person who has hearing problem cannot hear high frequency sounds.
- noise pollution is caused by unpleasant and loud noises.
- sonic boom is when an object moves faster than the speed of sound and sends out a shock wave.
- speed faster than the speed of sound is supersonic and speed slower than the speed of sound is subsonic.

---

**NOW DO PRACTICE EXERCISE 15 ON THE NEXT PAGE.**

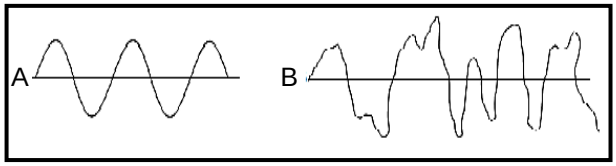
## Practice Exercise 15

**Answer the following questions.**

1. Why are earmuffs worn by many people in machinery workshops?

   _____
   _____
   _____

**Refer to this wave diagram to answer Question 2.**




Wave diagrams

2. Which of the wave diagram above belong to a

   (i) car engine? _____

   (ii) guitar string? _____

3. Describe the level of sound if you move further away from the source of sound.

   _____
   _____
   _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 3.**

**Answers to Activity**

1. Noise is a sound that has an irregular vibration.

2. Heavy traffic, aircraft taking off, dogs barking, workmen working on a construction, horn of a truck, baby crying

3. It travels faster than the speed of sound.

# Answers to Practice Exercises 11 – 15

---

## Practice Exercise 11

1. a) T
   b) F
   c) T
   d) F
2. a) regular, irregular
   b) sources
3. a) Airport ground traffic officer
   b) Ship engineer
   c) Heavy machinery operator
4. a) Tuning fork
   b) Guitar
   c) Kundu drum

---

## Practice Exercise 12

1. Decibels (dB)
2. Sound level meter
3. Medium
4. Because there are no vibrating particles present in a vacuum.
5. (i) The squashes created on a sound wave created by a vibrating object.
   (ii) The stretches created on a sound wave created by a vibrating object.
6. Compression
7. Rarefaction

**Practice Exercise 13**

1. a) wind instruments

   b) air column

   c) high

   d) low

   e) short

2. a) the air inside these instruments vibrate to produce sound.

   b) The volume of air that is vibrating in the tubes of wind instruments to produce sounds

---

**Practice Exercise 14**

**Part A**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1**E | **2**S | | **3**S | | |
| | | C | O | | U | | |
| | | H | U | | P | | |
| | **4**S | O | N | **5**R | E | | |
| | T | | D | E | R | | |
| | E | **6**D | | F | S | | |
| | T | O | | L | O | | |
| | H | L | | E | N | **7**S | |
| | O | P | | C | I | O | |
| | S | H | | T | C | L | |
| | C | I | | I | | I | |
| **8**C | O | N | C | O | R | D | E |
| | P | **9**S | O | N | A | R | |
| | **10**E | A | R | | | | |

**Part B**: Calculation of sound

1. $\text{speed of sound} = \frac{\text{distance travelled}}{\text{time taken}}$

$\text{time taken} = \frac{\text{distance travelled}}{\text{speed of sound}}$

$= \frac{110 \times 2}{330}$

$= \frac{220}{330}$

$= 0.67 \text{ seconds}$ (answer rounded off to 2 decimal places)

2. $\text{speed of sound} = \frac{\text{distance travelled}}{\text{time taken}}$

$= \frac{100\text{m} \times 2}{1.5\text{s}}$

$= \frac{200\text{m}}{1.5\text{s}}$

$= 20\text{m/s}$

3. $\text{speed of sound} = \frac{\text{distance travelled}}{\text{time taken}}$

$= \frac{250\text{m} \times 2}{5\text{s}}$

$= \frac{500\text{m}}{5\text{s}}$

$= 100\text{m/s}$

---

**Practice Exercise 15**

1. To protect their ears from being damaged by high level of sound.

2. (i) Wave diagram B belong to a car engine (noise –irregular vibration)

   (ii) A belongs to a guitar string.

3. It will become too soft to be heard. The intensity will be low.

---

**REVISE TOPIC 3 USING THE MAIN POINTS ON THE NEXT PAGE.**

# REVIEW OF TOPIC 3: Sound Waves

Now, revise all lessons in this Topic and then do **ASSIGNMENT 5**.
Here are the main points to help you revise.

## Lesson 11: How Sound is Produced

- Sound is an important method of communication, but it is a difficult one to understand because you cannot see it.
- All sounds are made by vibrating objects.
- The regular up and down or backward and forwards movements by an object is called a vibration.
- Fast vibrations produce high pitched sounds while slow vibrations produce low pitched sounds.
- The number of vibrations made each second is called the frequency of the vibration.
- Sounds can be classed as musical notes or noises.
- A musical note has regular vibrations, while noises have irregular vibrations.
- Being exposed to very loud sounds over a long period of time can damage the ear and cause partial deafness.

## Lesson 12: Transmission of Sounds

- Scientists do not measure loudness directly; instead, they measure sound intensity. This is measured in decibel (dB) using a sound level meter.
- When an object vibrates it squashes and stretches the surrounding air. The squashes are also called compressions and the stretches are also called rarefactions.
- Sound waves are made up of compressions and rarefactions passing through a solid, liquid or a gas.
- The compressions and rarefactions making up sound waves have the same frequency as the vibrating object.
- Sound waves transfer energy.
- Sound travels through solids, liquids and gases. It will not travel in a vacuum.

## Lesson 13: Sound from Vibration of Air

- The trumpet, flute and saxophone are examples of wind instruments.
- Sound is produced by making the air inside the instrument vibrate.
- The notes are changed by varying the length of the column of air.
- The vibration of short air columns produces high notes
- The vibration of long air columns produces low notes.

## Lesson 14: Speed of Sound and Echoes

- Sound waves can be bounced off or reflected.
- Hard surfaces reflect sound much better than soft surfaces.
- An echo is a reflected sound.
- An echo is heard only if the reflected sound reaches the ear one tenth (1/10) of a second.
- Echoes are used in navigating ships.
- Sonar or Sound Ranging Navigation is the echo system used in ship navigation.
- Bats and dolphins also use sonar to find food or for navigating.
- Sound travels slower than light.

- Sound travels about 340 metres every second in air when the temperature is 15°C.
- Sound travels faster in liquids and solids than it does in gases such as air. In water it travels four times as fast as in air, while in steel it travels fifteen times.
- Speed of sound is equal to distance travelled by the sound divided by the time taken to reach the ear after an echo of the original sound.

**Lesson 15: Noise Pollution**

- Noise is a sound that is unpleasant and annoying to hear.
- Music is made by objects whose vibrations are regular.
- Noise is made by objects whose vibration is irregular
- Being exposed to very loud sounds over long period of time can damage the ear and cause partial deafness.
- A person who has hearing problem cannot hear high frequency sounds.
- Noise pollution is caused by unpleasant and loud noises.
- Sonic boom is when an object moves faster than the speed of sound and sends out a shock wave.
- Speed faster than the speed of sound is supersonic and speed slower than the speed of sound is subsonic.

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**NOW DO TOPIC TEST 3 IN YOUR ASSIGNMENT 5.**

# TOPIC 4

# TELECOMMUNICATION

**In this topic you will learn about:**

- **electromagnetic waves**
- **radio broadcasting**
- **television**
- **electronic communication**
- **computers and internet**

# INTRODUCTION TO TOPIC 4: TELECOMMUNICATION

Telecommunication is the science and practice of transmitting information by utilising electromagnetic waves. A wide variety of information can be transmitted. These include animated pictures, voice and music, computer files and applications, still pictures, telegraphic and fax data.

At this time, Papua New Guinea is experiencing a fast growth in telecommunication business and infrastructure. You are no exception, if you own a phone, have a TV in your house, listen to radio or you might be on Facebook or Whatsapp. If you do, then you are part of this fast growing telecommunication era in PNG. It is making life much easier to communicate but can also be abused for selfish purposes, for example, computer hacking.

When you study telecommunication, you will realise that telecommunication has made communication much easier. You will learn that in order for you to understand this concept, you will have to know what electromagnetic waves are because these are the basis of telecommunication.

Without electromagnetic waves you would not be able to communicate with a mobile phone or talk to your friends via Facebook. You will study the different waves in the Electromagnetic Spectrum and know how they are used in various ways in Telecommunication. Examples of them being in use in practical everyday life today are TV and radio broadcasting, internet, land and sea navigation, satellite and telegraphing transfer.

But how is that sound cannot be heard on the moon and yet you can still communicate with a radio on the moon?

After completing this topic you will be able to answer this question and others such as the following
:

- How do electromagnetic waves transfer information?
- How do TV and Radio signals reach your house?
- How important are computers, telephones, fax machines and TV?
- Are there any disadvantages of using computers or radios?
- How has telecommunication affect the lives of people today?

**In this topic, you will be able to answer these questions and appreciate the importance of Telecommunication in our daily lives.**

# Lesson 16: Electromagnetic Waves

Welcome to Lesson 16. In unit four of your course, you studied light and identified light as part of the electromagnetic spectrum. In this lesson, you will study the wavelength of some of the electromagnetic waves and identify their sources.

**Your Aims:**

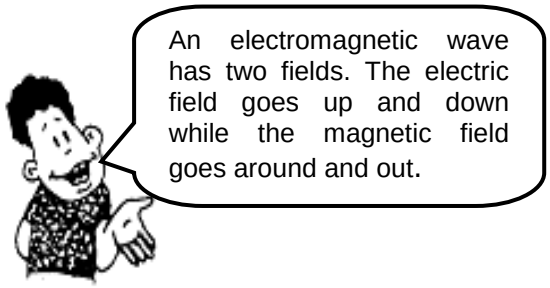
- define electromagnetic waves
- identify the properties of electromagnetic waves
- describe how electromagnetic waves work

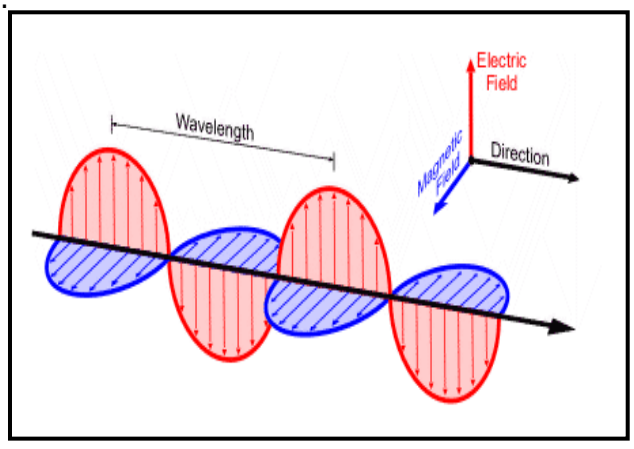
## Electromagnetic Waves

Water and sound waves travel through substances. They cause the particle in the substance to vibrate. The vibrating particles carry the energy in the wave. Electromagnetic waves can travel where there are no substances or particles. They are made of oscillating (vibrating regularly) electric and magnetic fields. The fields are at right angles to each other and to the direction of the wave.

Electromagnetic waves are transverse wave. Electromagnetic waves are formed by charges inside atoms. When the atoms gain energy they absorb it and then emit electromagnetic energy. Sometimes the energy carried by electromagnetic waves seems as if they are in packets and the packets of energy are called **photons.**

All electromagnetic waves are similar to each other. They are made of oscillating fields. They all travel at the same speed and similar to the speed of light. Light travels in empty space at a speed of 300 000 000m/s or 30 000km/s. The empty space is often referred to as vacuum. When the light travels, there are no other material or particles that will interfere with the wave .

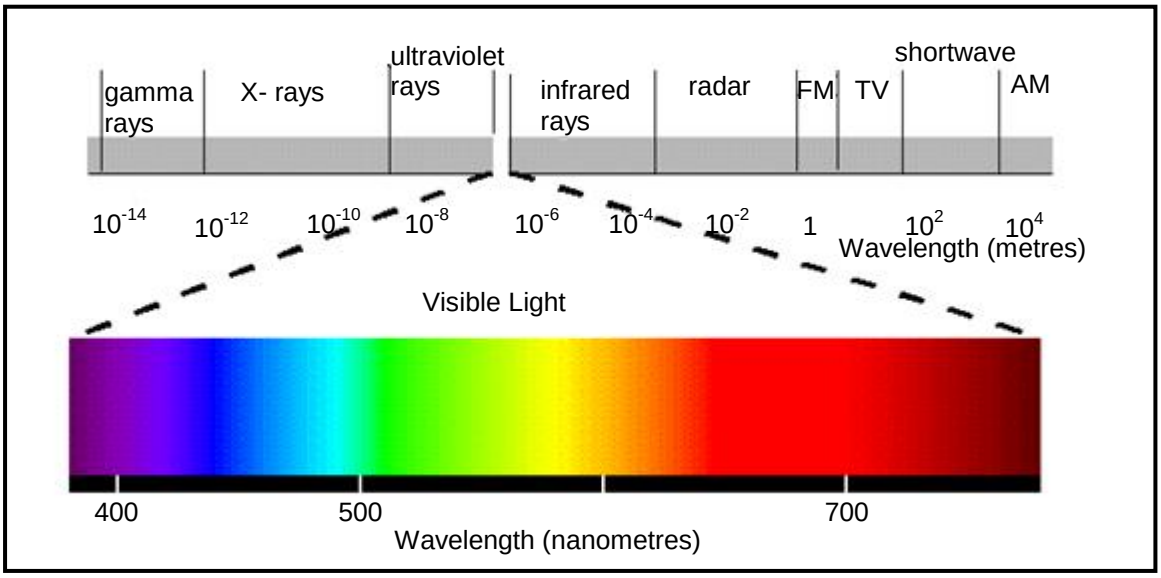



However, they may differ in their wavelength and frequency. As the wavelength gets longer, the frequency gets lower. And as the wavelength gets shorter the frequencies get higher. Remember that the wavelength is the length of one wave cycle. Frequency is the number of cycles or waves in a second. It is often measured in a unit called hertz, (**Hz**).

The frequencies of electromagnetic waves are very high. Electromagnetic waves with a very short wavelength and high frequencies are called gamma rays. If the frequencies are low and the wavelength is high then they are radio and television waves.

The range of all the different electromagnetic waves is called a **spectrum**. The diagram below shows the names of the waves in the electromagnetic spectrum.




Electromagnetic Spectrum

The other parts of the electromagnetic spectrum are the X-rays, ultraviolet rays, light rays infrared rays and microwaves.

**Gamma rays have the shortest wavelength. Short- wavelengths have high frequencies**

**Gamma Rays**
These rays have the shortest wavelength.They are produced by some radioactive atoms.Gamma rays can penetrate lead and concrete.They are very dangerous and can damage the body cells.

**X-rays**
These rays were discovered accidently,and the name X means unknown because people did not understand them. We cannot see X-rays directly, but they affect photographic film. X-rays are absorbed much more by bone than soft tissue, so bones stand out as a shadow when an X-ray is taken.

**Ultaviolet (UV)**
Ultraviolet means beyond violet. This is the part of the spectrum beyond the violet part of the light spectrum. We cannot see ultraviolet light but some insects can. Ultraviolet light is sometimes called black light and is used in checking forgeries and checking signatures. Ultraviolet light causes sunburn and skin cancer. Luckily, most ultraviolet light is absorbed by the Earth's ozone layer.

**Light**
Light is sometimes called visible light because it is the only part of the spectrum that we can see (refer to the diagram of the electromagnetic spectrum on the previous page). Our eyes have special cells that can detect this type of electromagnetic radiation. Light also affects the dyes in the photographic film and it does provide all the energy required to maintain life on earth.

**Infrared**
Light or visible light is part of the electromagnetic spectrum. We feel infrared radiation as heat. It is sometimes called heat radiation. Infrared radiation with the shortest wavelength pass through some gases and glass but the radiation with longer wavelength does not. Greenhouses work by trapping infrared radiation with long wavelengths which warms up the air inside. This is what is happening with the green house effect on the Earth.

**Microwaves**
These waves are used in telecommunication. For example, the satellite transmit microwaves. Radars in aircraft and ships use microwave. In microwave oven, the waves make the water molecules in the food vibrate, which heats and cooks the food. Microwaves are white inside because this helps to reflect microwave around the oven. Television and radio wave has the longest wavelength of all the electromagnetic spectrum. Radio waves have been grouped in to bands and each has a special set of uses. Some examples are television signals,two way radio, Fm and amateur radio.

Always remember that there is no clear distinction or boundaries where one type of radiation stops and the other begins. This means they overlap. The name given depend on the energy, the source and the use of the radiation. Some microwaves are used in radio, television and mobile phone communication and classified as radio waves. Similar waves are also used in radar and ovens and these radiation are grouped as microwave.

---

**Activity: Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. Where does the name electromagnetic wave come from?
   _____
   _____

2. How do we know if electromagnetic waves are transverse waves?
   _____
   _____
   _____

3. What is meant by wavelength and frequency?
   _____
   _____
   _____

4. What is the speed of all electromagnetic waves?

_____

_____

5. Which part of the electromagnetic spectrum is used in the following?

a) Absorbed by the ozone layer.

_____

b) Passes through thick solids.

_____

c) Is beamed to satellites.

_____

d) Is used in photosynthesis.

_____

e) Absorbed much more by bone than soft tissue

_____

f ) Is felt as heat

_____

g) Detects forgeries

_____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 16.**

## Summary

You have come to the end of Lesson 16. In this lesson you have learnt that:

- electromagnetic waves can travel where there are no particles.
- electromagnetic waves are transverse wave. They have electric and magnetic field vibrating at the same time.
- some electromagnetic waves have longer wavelength and low frequencies while others have short wavelength and high frequencies.
- all electromagnetic waves travel at the speed of light which is about 30 000km/s.
- there are eight (8) categories of electromagnetic waves.
- some of these electromagnetic waves can be beneficial in many ways while the others can be harmful.
- modern communications uses radio waves.

---

**NOW DO PRACTICE EXERCISE 16 ON THE NEXT PAGE.**

## Practice Exercise 16

**Answer the following questions on the spaces provided**.

1. Explain the sentence below:

   'Light provides all the energy needed to maintain life on Earth.'

   _____
   _____
   _____

2. What is the connection between the wavelength and frequency of electromagnetic waves?

   _____
   _____
   _____

3. Fill in the missing words.

   Electromagnetic waves can _____ where there are no _____ and no _____. They are made of oscillating _____ and _____ fields. The _____ are at _____ angles to _____ other and to the _____ of the wave. Electromagnetic waves are _____ waves. They all travel at the _____ speed of _____ metres per second.

   Gamma rays are very _____ and can go through _____ and _____. We cannot see _____ directly but they affect _____ film. Ultraviolet means '_____ _____'. Light is sometimes called _____ light because it is the _____ part of the _____ that we can _____. We feel _____ radiation as _____. Microwaves are used in _____. Television and _____ waves have the longest _____ of all of the _____ spectrum.

**CHECK YOUR WORK ANSWERS ARE AT THE END OF TOPIC 4.**

**Answers to Activity**

1. It is derived from electricity and magnetic.

2. They vibrate at right angles and travel in the direction of wave travel.

3. (a) Wavelength is the distance between crest to crest or trough to trough in a wave.

   (b) Frequency is the number of vibration in a second.

4. The speed is 30 000km/s or 300 000 000m/s.

5. a) Ultraviolet (UV)
   b) Gamma
   c) Radio waves
   d) Light,
   e) X-rays
   f) Infrared
   g) Ultraviolet

# Lesson 17: Radio Broadcasting

Welcome to Lesson 17. In your previous lesson, you learnt that radio waves are part of the electromagnetic spectrum. They have the longest wavelength of any of the electromagnetic waves in the spectrum. Radio waves are used to transmit commercial radio and television signals for radio links to weather stations and for communication in emergency services such as ambulance, fire and police. In this lesson, you will study how a radio station works and how radio waves are transmitted.

**Your Aims:**

- explain how the radio works
- identify parts of a radio
- discuss the advantages and disadvantages of a radio

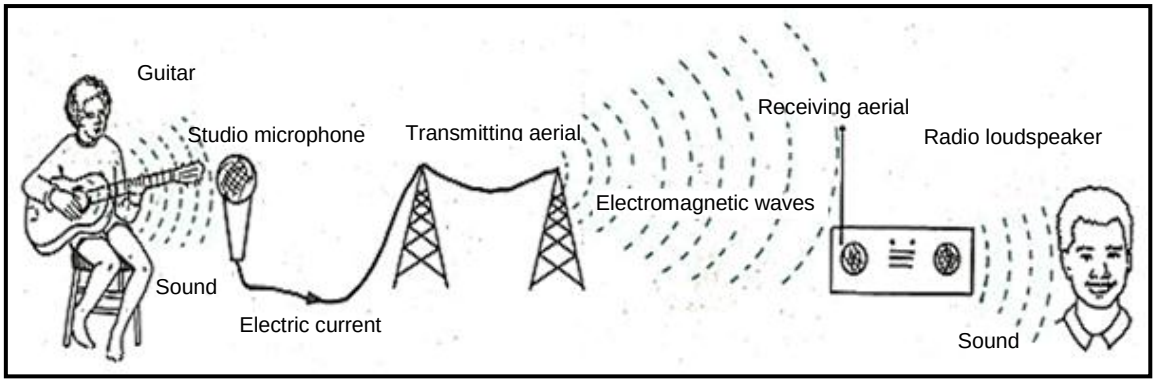
## A Radio and How It Works

You might think a radio is something for you to listen to but it can also be used to communicate over long distances. Radio means sending energy with waves. It is a method of transmitting electrical energy from one place to another without any wires connecting the source and the receiver. That is why, it is often called wireless. The radio does not even need air to transmit its message.

The source of a radio message is an **aerial** or **antenna** which is a wire through which changing electric currents are passed. As the current changes, an electromagnetic wave is produced which travels out from the aerial. These electromagnetic waves are called **radio waves**. The equipment that sends out a radio wave is known as a **transmitter**. The radio waves sent by a transmitter move quickly through the air and are then received by the aerial of a radio **receiver**, which makes small currents form in the receiving aerial.

### The way in which message is transmitted by radio

A radio station converts sound in the form of speech or music to electric current. The currents are then sent to the transmitting aerial, which converts them into radio waves. The radio receiver converts the electric currents in the receiving aerial back to sound. Thus, the sound in the radio studio is the same as the sound in the radio and the message is transmitted by electromagnetic waves




Radio messages are transmitted as electromagnetic waves

**How the aerial works**
At a radio station, electrons vibrate in a certain pattern along the transmitting aerial. This movement produces electromagnetic waves which travel through the air. If a receiving aerial is in the path of the waves, they make the electrons in the aerial vibrate in the same pattern as in the transmitting aerial. This is how your radio picks up the signal.

**Sending messages around the world**
Radio waves are used to carry messages quickly around the world. The radio waves transmitted by radio stations are reflected in different directions by a satellite. A satellite is a man-made object, orbiting in space.

Radio waves produced and transmitted from one radio station on the Earth, are reflected by the satellite to other places on the Earth. The waves reflected by the satellite are received and repeated locally by local transmitters. These repeated waves are received and changed into the original sound by receivers in radios.

**Tuning in**
When we extend the aerial on a radio receiver, it picks up some of the electromagnetic energy passing by. When we want to listen to the radio, we **tune-in** to select a station which we want to listen to. Why do we have to select and what do we select?

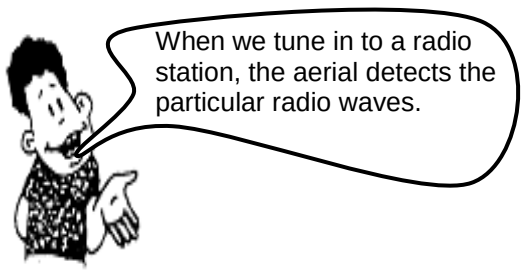
Different radio stations broadcast programs. For example, N.B.C broadcasts from Port Moresby and Provincial Radio Stations broadcasts from the provinces. A.B.C broadcasts from Sydney.

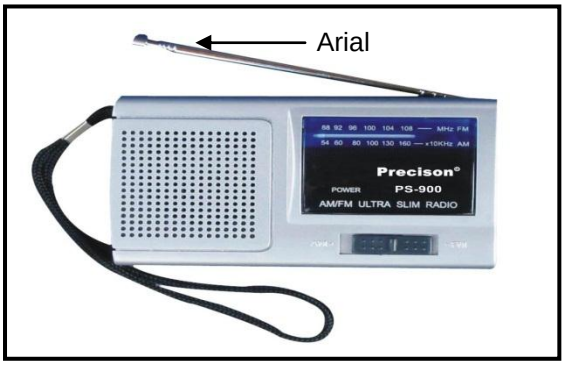
Each radio station transmits its own program on its own radio frequency. So, there are many different radio frequencies in the air at the same time. We tune - in to select the radio wave transmitted by the station we want to listen to.

If you tune the radio into a station, an electronic circuit inside the radio selects only the program you want from all those that are broadcasting.

**Reception by radio**
You know that radio stations transmit radio waves of their own programs. The original programs of news, music, advertisements and others that you hear of on the radio are in the form of sound waves. These sound waves are changed into radio waves, that is, electromagnetic waves, and transmitted using transmitters.

These radio waves are in the air around us. The radio waves travel through space and vacuum. The radio waves from distant countries are reflected by the communication satellites that are in space, moving around the Earth. So, there are radio waves from all around the world, in the air around us.



Now, what happens when we tune in our radio to a radio station we want to listen to? This is what happens when we tune in:

- The **aerial** of our radio picks up the radio frequency we select. The radio transforms (changes) the wave picked up by the aerial, into clear sound waves. When the sound is clear, we say the **reception** is clear.

**Why is the reception bad at times?**
Sometimes we do not hear the sound clearly. We say the reception is bad.

When our radio does not pick up the radio frequencies or when the aerial does not reach out high enough, the sound is not clear. Several sounds are mixed up when there are other noises and disturbances. This happens when the atmosphere is disturbed by rain and thunderstorm.

**When we tune our radio, the:**

- **aerial picks up radio frequencies we select.**
- **radio changes the radio waves into clear sound wave.**

**Analogue radio**
Radio waves carry energy as an invisible, up-and-down movement of electricity and magnetism. This carries program signals from huge transmitter antennas, which are connected to the radio station, to the smaller antenna on your radio set. A program is transmitted by adding it to a radio wave called a **carrier**. This process is called **modulation**. Sometimes a radio program is added to the carrier in such a way that the program signal causes fluctuations in the carrier's frequency. This is called frequency modulation (FM). Another way of sending a radio signal is to make the peaks of the carrier wave bigger or smaller. Since the size of a wave is called its amplitude, this process is known as amplitude modulation (AM). Frequency modulation is how FM radio is broadcast; amplitude modulation is the technique used by AM radio stations.

FM stations are broadcasted at a much higher frequency than AM stations. The higher frequency FM signal suffers less interference and the quality of the sound is much better. The lower frequency AM signals are refracted by the atmosphere so that towns behind a hill can still receive AM signals. In contrast, FM signals are unaffected by the atmosphere, so your aerial has to be in the line of sight from the transmitting tower. Reception will sometimes be poor in areas more than 100 kilometres away.

**Importance of Radio as a Means of Communication**

The radio is an important means of providing information. It provides an opportunity for people who cannot access television and cannot read to keep up to date on news, entertainment and information. It is able to function when television stations are not and is more easily accessed than the newspaper is. The information that is given over the radio is able to be broadcast to a large number of listeners and provides them with instantaneous or more timely information.

**Advantages and Disadvantages of a Radio**

There are advantages and disadvantages of using a radio and some of them are listed in the table below.

| **Advantages** | **Disadvantages** |
|---|---|
| Less expensive as it does not need more expensive equipment. | Lacks visual appeal as no picture is produced from a radio. |
| Radio programs are so much cheaper to produce on radio. | A radio signal has limited strength. |
| Has the ability to reach a large audience at the same time. | |
| Most accessible and portable. | |
| Has the ability to remain localised and at the same time cover national and international events. | |
| There is no fee for listening to radio. | |

---

**Activity: Test yourself by doing this activity.**

**Complete these statements.**

1. The radio is an important means of providing _____.

2. The source of a radio message is an _____.

3. The equipment that sends out a radio wave is known as a _____.

4. _____ waves are used to carry messages quickly around the world.

5. The radio waves transmitted by radio stations are reflected in different directions by a _____.

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 17.**

## Summary

You have come to the end of Lesson 17. In this lesson, you have learnt that:

- radio waves are part of the electromagnetic spectrum and have the longest wavelength.
- radio means sending energy with waves.
- a radio is an important means of providing information.
- a radio is often called wireless because it transmits electrical energy from one place to another without any wires connecting the source and the receiver.
- the radio does not need air to transmit its message.
- the source of a radio message is an aerial or antenna
- electromagnetic waves which travel out from the aerial are called radio waves.
- the equipment that sends out a radio wave is known as a transmitter.
- the radio waves sent by a transmitter move quickly through the air and are then received by the aerial of a radio receiver.
- radio waves carry energy as an invisible, up-and-down movement of electricity and magnetism.
- when we tune in to a radio station, the aerial detects and picks up the particular radio waves we select.
- the radio transforms (changes) the wave picked up by the aerial, into clear sound waves. When the sound is clear, we say the reception is clear.
- modulation is a process where a radio program is transmitted by adding it to a radio wave called a carrier wave.
- FM stations are broadcasted at a much higher frequency than AM stations because their signals suffer less interference and the quality of the sound is much better.

---

**NOW DO PRACTICE EXERCISE 17 ON THE NEXT PAGE.**

## Practice Exercise 17

**Answer the following questions.**

1. Why is it not possible for two radio stations to broadcast on the same frequency?

   _____
   _____

2. Why is a radio often called a 'wireless'?

   _____
   _____

3. Why are the following necessary for a radio?

   a) Transmitter

   _____

   b) Aerial/Antenna

   _____

4. What is the function of the tuner on the radio?

   _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4.**

**Answers to activity**

1. information
2. aerial
3. transmitter
4. Radio
5. satellite

# Lesson 18: Television

Welcome to Lesson 18. These days, it is very common in industrialised countries for a household to have at least one television. In fact, it is so common that it is difficult to imagine a household without TV. In Papua New Guinea, one third of the population can afford a television. This shows just how important television is. To understand how important television is, we can look at the variety of programs and valuable content it offers and the purposes it serves in daily life. Also during the discussion we will look at how encoded messages like sound, images and written words are transmitted and how it appears on the television screen.

**Your Aims:**

- explain how television transmits message
- explain the importance of television in communication
- explain CCTV

## The Invention of Television

In the period between 1900 and 1910, radio developed as a very popular form of communication. In the same period scientists and technicians suggested that if sound could be transmitted over long distances, then pictures should also be able to be transmitted as well.

An English scientist named Campbell Swinton outlined his ideas about the transmission of pictures to the Rontgen Society in London in 1911. His ideas were so brilliant and were more advanced to any electronic devices available at that time, but the way was opened for others to develop these ideas. His ideas came to fruition when John Logie Baird invented the television in 1926.

**Television** (**TV**) is a telecommunication medium for transmitting and receiving moving images that can be monochrome (black-and-white) or colored, with or without any sound. "Television" may also refer specifically to a television set, television programming, or television transmission.

Closed-circuit television (CCTV) are the most commonly used medium for broadcast television, which was modeled on the existing radio broadcasting systems developed in the 1920s, and uses high-powered radio-frequency transmitters to broadcast the television signal to individual TV receivers.

## The Importance of Television

First of all, there are many different types of programs on television. The viewer can watch a weather report to prepare for the day. Cartoons and sports provide relaxation and fun. School programs, documentaries and the news teach us about the world. Advertisements inform us about products and new ideas.

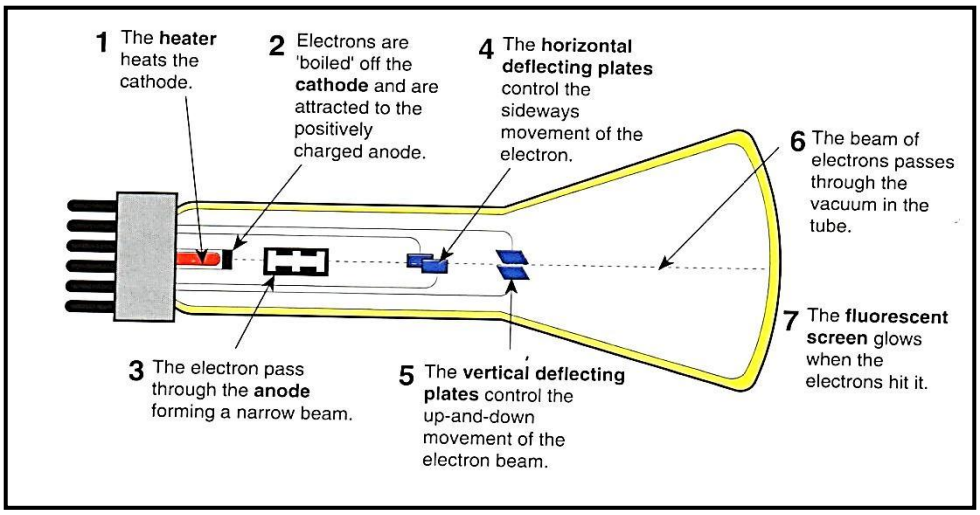
Secondly, the content is very appealing because it is realistic and up to date. As TV is a medium that combines moving colour images and sound, it resembles real life,

so the viewers can identify with what they see. Furthermore, modern technology means that the content is up to date, for example, news reports can be broadcasted live and from all over the world. This means that information is available almost anywhere at any time. TV gives us the world, other cultures, other people, languages and ideas. It introduces us to knowledge.

**How does the Television Work?**

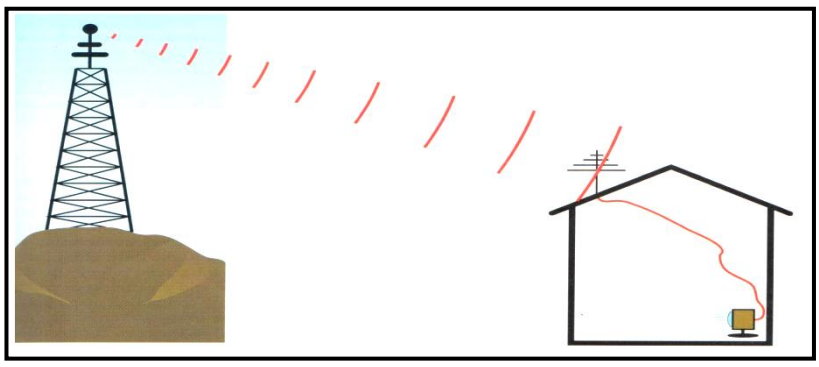
The heart of the TV set is the picture tube. This is an advance type of cathode ray tube which is also found in the oscilloscope (CRO) that you learnt of in the last lesson.

It is called the cathode ray tube because the image is formed by a beam of electrons produced by a heated negative, terminal called the cathode. The electrons are attracted to a hollow positive terminal (anode) in front of the cathode. You must note that in a battery the anode and the cathode mean the opposite. The electrons pass through the anode and form a narrow beam. Deflecting plates placed horizontally and vertically across the electron beam control the movement of the beam. The electrons strike the back of the screen, which is coated with a material that glows when struck by electrons.




The picture tube in the television is similar to the cathode ray tube

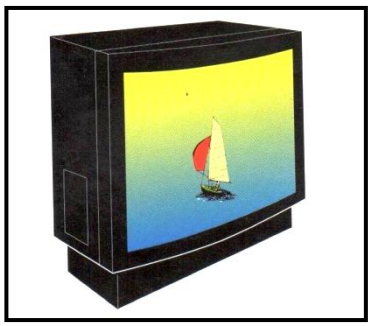
The picture tube in the television is similar to the cathode ray tube on the cathode ray oscilloscope except it has three electron beams instead of one.

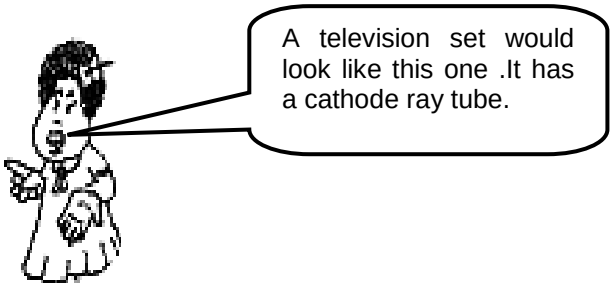


1. The TV signal is sent as an electromagnetic wave through the air by the transmitting aerial. The transmitters are usually placed on a high ground since tall buildings, hills and trees can reflect the waves giving poor reception.

2. The receiving antenna detects the waves which causes the electrons in the metal of the antenna to vibrate and produce a changing electric current (electrical signal).These electrical signals travel through the antenna cable to the TV set.

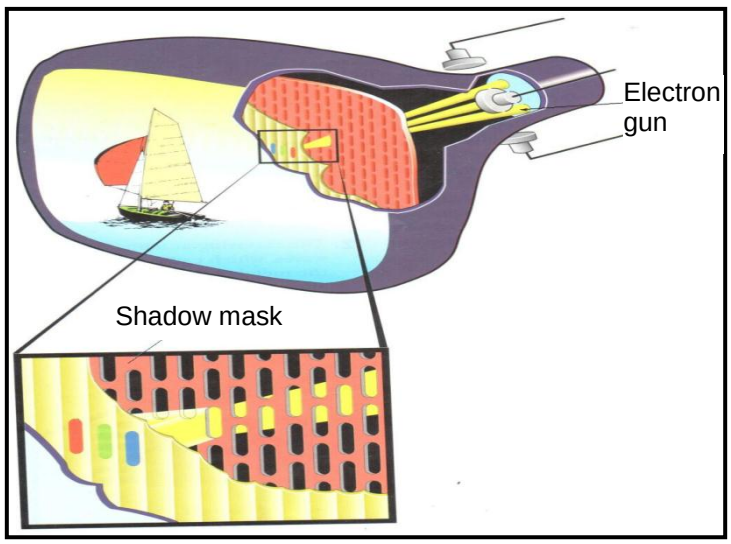
3. The electrical signals are amplified in the TV set to make signals stronger. It then passes to the three electron guns at the rear of the cathode ray tube.



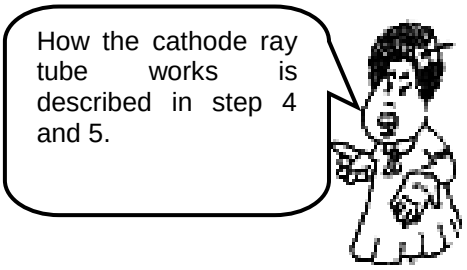



4. The electron guns fire electrons at the screen. The horizontal deflecting plates sweep the electron beams over the screen making a horizontal line. The vertical deflecting plates move the electron beams downwards after every sweep. In all, 625 horizontal lines are made on the TV screens and the whole picture is redone 25 times each second. These changes are much faster for our eyes to detect, so we see a continuous picture on the screen.

5. The inside of the screen is coated with three different substances of very small strips or dots. These substances are called phosphors. One of the phosphors glows red when struck by an electron beam, another glows blue and the third glows green. The picture on the screen is made of millions of red, blue and green patches. A shadow mask containing many holes is positioned close to the screen so that each electron beam hits the correct phosphor.



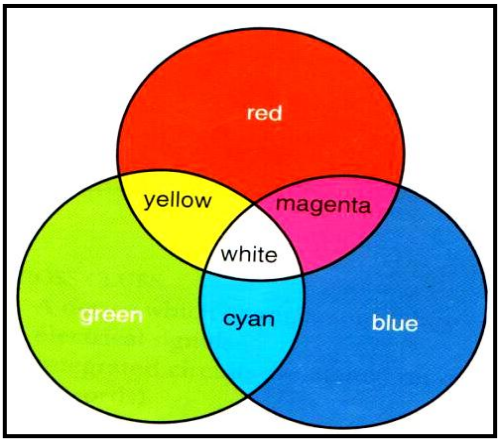

The inside of a television



Before you turn on the TV set, use a magnifying glass to look at the screen. The grey vertical lines that you observe are the phosphor strips separated by thin black lines.

Each phosphors strip is made up of the three individual phosphors that glows red, green or blue when electrons hit them. There are three electron guns in the tube because the primary colours of light are red, green and blue. When they mix they give the other colours.

You can also look at the test pattern using hand lens. If the colours are mixed you are likely to come up with the secondary colours.



Mixing coloured lights


Test pattern on TV screens when there is no signal

---

**Activity:** **Test yourself by doing this activity.**

**Read the questions below and answer accordingly.**

1. What is the function of deflecting plates in a cathode ray oscilloscope?

   _____
   _____

2. How was the cathode ray tube given its name? If you were naming it,what will you call it?

   _____
   _____
   _____

3. How does the television signal travel from the studio to your house?

   _____
   _____
   _____
   _____

4. Suppose you were able to see the colour of individual phosphors in a very small area on your TV screen. After five separate times you recorded the colours that were glowing. Your observations (0=coloured phosphors not glowing) are as follows;

| | **Colours** | | |
|---|---|---|---|
| Time 1 | Red | 0 | 0 |
| Time 2 | Red | Blue | 0 |
| Time 3 | 0 | Blue | Green |
| Time 4 | 0 | 0 | 0 |
| Time 5 | Red | Blue | Green |

What colours would you have seen at the following times?

(i) Time 1 _____

(ii) Time 2 _____

(iii) Time 3 _____

(iv) Time 4 _____

(v) Time 5 _____

5. Why do people living behind hills have to install very small TV antennaes on their rooftops?

_____
_____
_____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 18.**

## Summary

You have come to the end of Lesson 18. In this lesson you have learnt that:

- television is a telecommunication medium for transmitting and receiving moving images that can be monochrome (black-and-white) or colored, with or without any sound.
- TV gives us the world, other cultures, other people, languages and ideas. It introduces us to knowledge.
- the TV signal is sent as an electromagnetic wave through the air by the transmitting aerial.
- the receiving antenna detects the waves which causes the electrons in the metal of the antenna to vibrate and produce a changing electric current (electrical signal) which is fed to the TV screen.
- the cathode ray tube is sometimes called the electron tube.
- the inside of the screen is coated with three different substances of very small strips or dots. These substances are called phosphors.
- closed-circuit television (CCTV) are the most commonly used medium for broadcast television.

---

**NOW DO PRACTICE EXERCISE 18 ON THE NEXT PAGE.**

## Practice Exercise 18

**Answer the following questions on the spaces provided.**

1. Who invented the television and in what year?

   _____

2. Define the term CCTV.

   _____
   _____
   _____

3. List some important programs you watch on television.

   _____
   _____
   _____
   _____
   _____

4. Joshua lives to the north of the transmitting aerial of his favourite TV station. A large tree grows on the southern side of the house. The television antenna is on the roof of the house.

   a) Suggest interference for the poor reception Joshua gets on his TV set.

   _____
   _____
   _____
   _____

   b) What should Joshua do to improve the reception?

   _____
   _____
   _____
   _____

5. Which of the following pieces of equipment is responsible for the changes listed below? (Antenna, Phosphors, Speaker, Amplifier, Electron gun, Brightness control)

   a) Changes electrical signal to sound

   _____

   b) Gives off light when struck by electrons

   _____

c) Makes the received signal much stronger

_____

d) Changes electromagnetic waves into electrical waves

_____

e) Turns the electrical signal into electron beam

_____

f) Alters the number of electrons hitting the screen.

_____

_____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4.**

**Answers to Activity**

1. Horizontal plates control the sideways movement of the electrons and vertical plates control the up-down movement on the electrons.

2. Cathode means negative end (it may mean positive in battery). Since it is a negatively charged particle called electron, we can call it electron tube.

3. It travels through the air as electromagnetic waves to communication satellites and is reflected to the receiver (received by the antenna of the TV).

4.

| | | | | |
|---|---|---|---|---|
| Time 1 | Red | 0 | 0 | Red |
| Time 2 | Red | Blue | 0 | Magenta |
| Time 3 | 0 | Blue | Green | Cyan |
| Time 4 | 0 | 0 | 0 | Black |
| Time 5 | Red | Blue | Green | White |

5. The hill will reflect some of the electromagnetic waves, which will make the reception poor**.** Therefore, the antennae or aerial will make the reception clear.

# Lesson 19: Electronic Telecommunication

Welcome to Lesson 19. In the previous lesson, you identified and described the processes involved in transmitting a message using television. You also discussed the importance of television as a means of communication using a diagram and CCTV and other new television inventions. In this lesson, you will learn about electronic telecommunication.

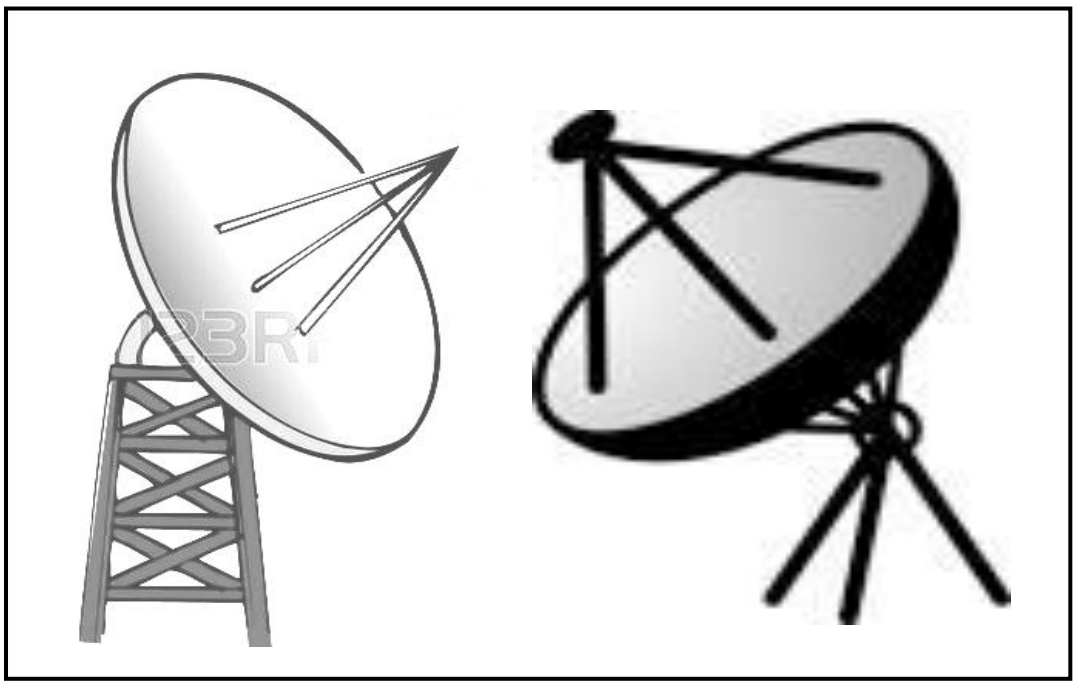
**Your Aims:**

- explain how telephones, telex and fax machines transmit messages
- discuss mobile and wireless telephones and how messages are transmitted
- explains importance of telephones, telex and fax machines for communication

**Telephone communication**

To transmit sound over long distances within a town, the sound waves are converted into an electric current for transmission. The electric current can be transmitted quickly over long distances using ordinary wires made of copper. This is how a local telephone call works. It transmits the message by sending changing electric currents along the wires.

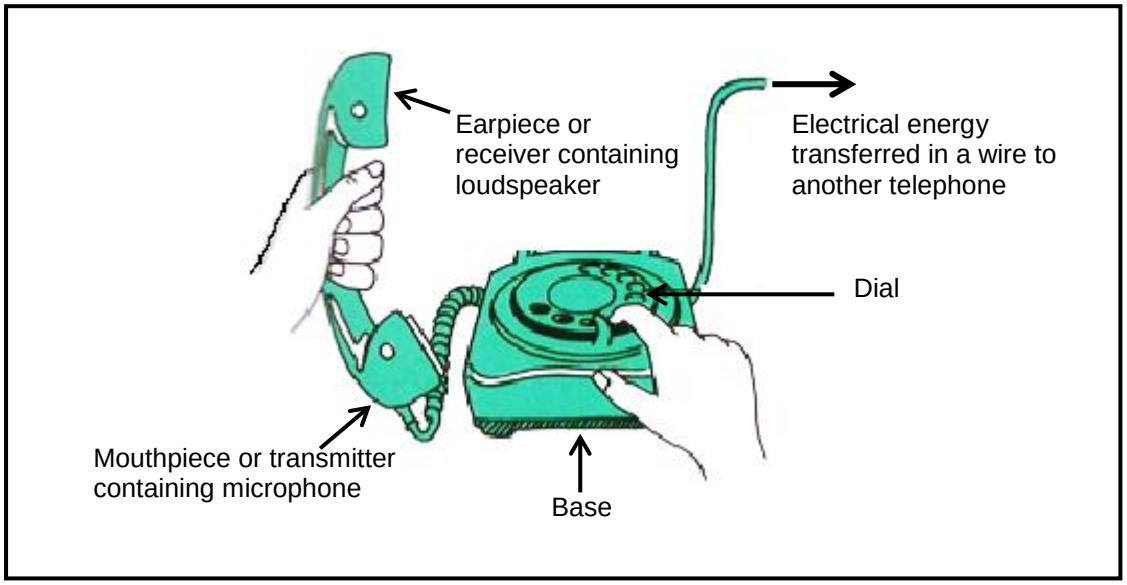
To send a telephone message from one province to another in Papua New Guinea, the microwave system is used. The sound waves are converted into electromagnetic waves for transmission. Small dishes can often be seen on top of towers in towns or on hills in the bush. These dishes help to transmit the electromagnetic waves.



Dishes help to transmit electromagnetic waves

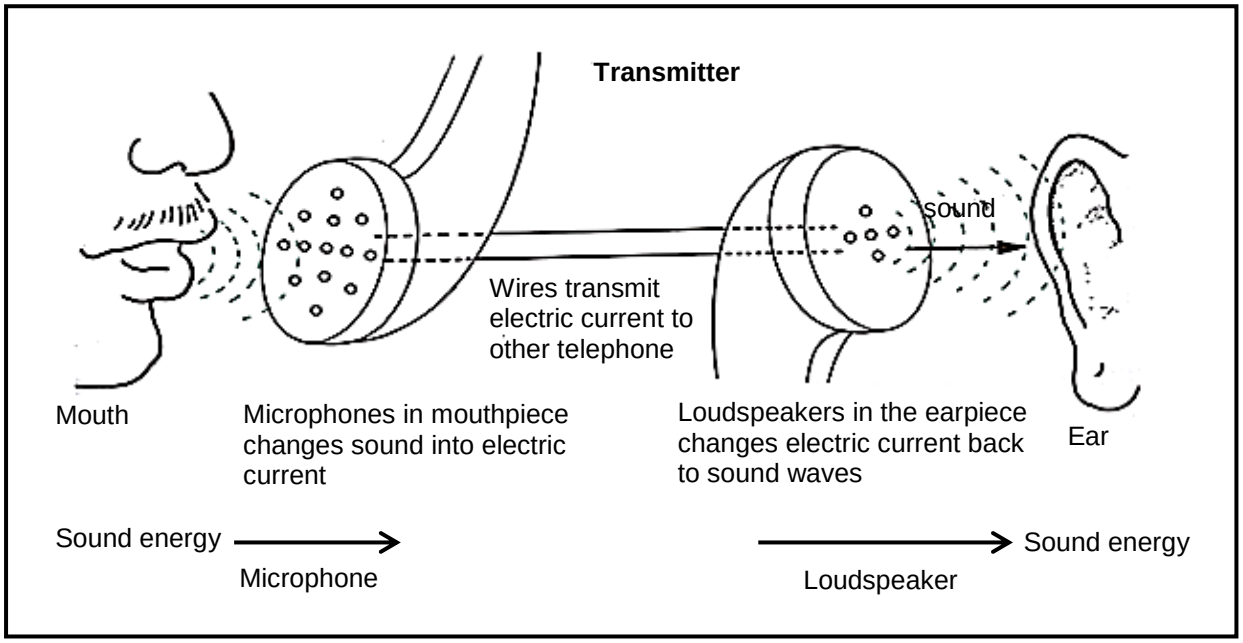
**Parts of a phone**

The telephone handset has two main parts called the mouthpiece and the earpiece. The mouthpiece is the part you speak into and it contains a microphone that changes sound waves into electric currents. These currents have exactly the same frequency as the sound wave. As the sound gets louder the electric current gets bigger. So the electric current from the microphone in the mouthpiece changes in exactly the same way as the sound from a person's voice. This changing electric current carries the electrical message along the telephone wires to the other telephone to which you have been connected by the exchange. The electrical message goes into the earpiece, which is the part with which you hear.




Telephones transfer electrical energy in a wire to the receiver

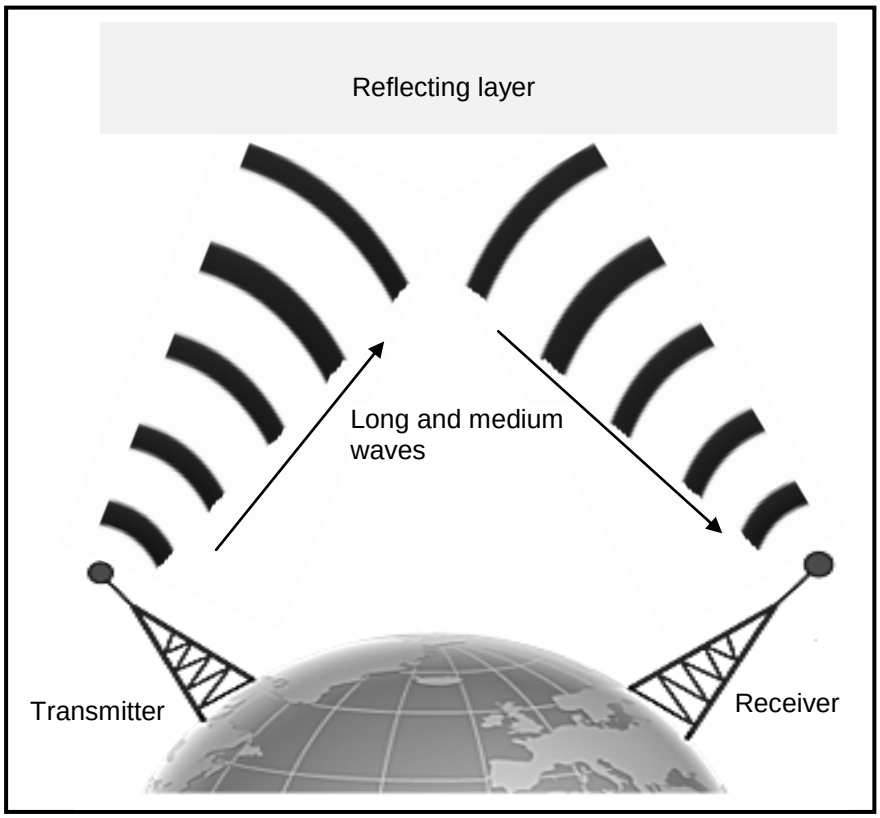
The earpiece contains a small loudspeaker. This loudspeaker converts the changing electrical current back into sound waves. These sound waves are exactly the same as the sound waves of the original person's voice. So although you hear the person's voice, the message has not transmitted as sound but was transmitted as a changing electrical current. Because an electric current can travel quickly over long distances the telephone is a good means of communication between places that are connected by electrical wires.



**Wireless Communication**

Wireless communication is the transfer of information between two or more points that are not connected by a wire (an electrical conductor).

The most common wireless technologies use electromagnetic wireless telecommunications, such as radio. With radio waves, distances can be short, such as a few metres for television remote control, or as far as thousands or even millions of kilometres for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones and cordless telephones.

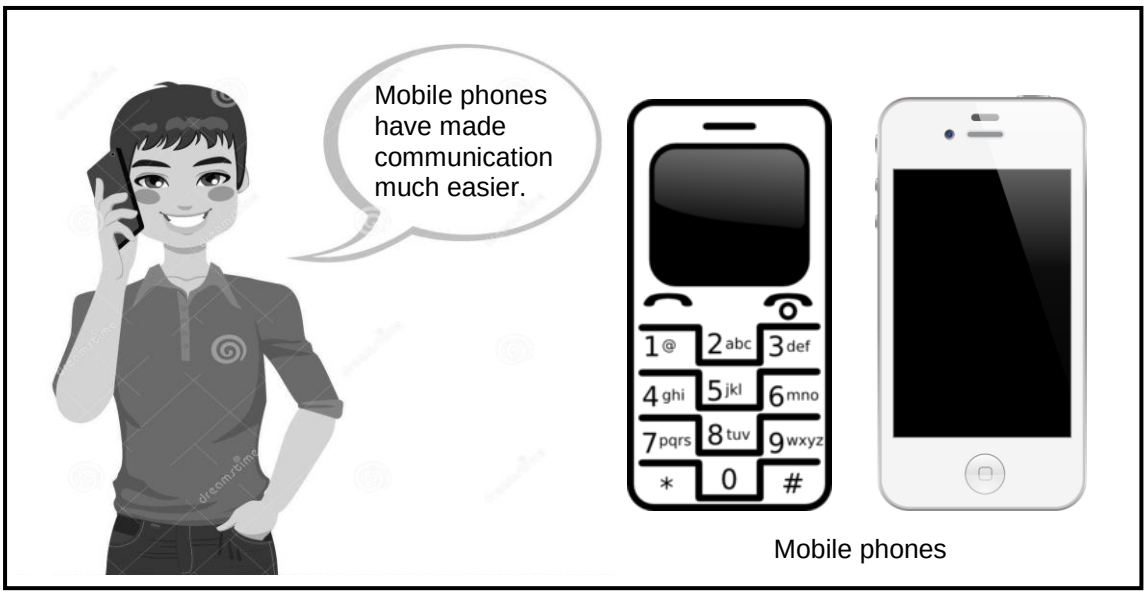



Receiver and transmitter towers reflecting radio waves

Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems. For example, radio transmitters and receivers and remote controls which use some form of energy, for example, radio waves to transfer information without the use of wires. Information is transferred in this manner over both short and long distances.

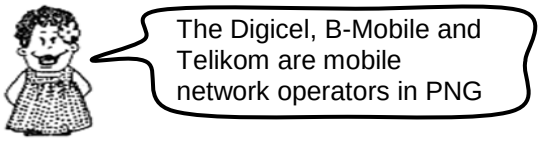
**Mobile phones**

One of the best known examples of wireless technology is the mobile phone. These wireless phones use radio waves to enable their users to make phone calls from many locations worldwide. They can be used within range of the mobile telephone site used to house the equipment required to transmit and receive the radio signals from these instruments. Mobile phones come in different models and sizes.




One of the best known examples of wireless technology is the mobile phone.

Mobile phones are also known as cellular phones, cell phones, and hand phones. They are devices that can make and receive telephone calls over a radio link while moving around a wide geographic area. It does so by connecting to a cellular network provided by a mobile phone operator, allowing access to the public telephone network.



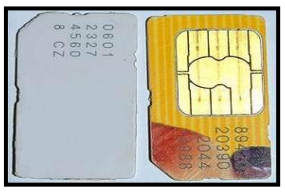

In addition to telephone, modern mobile phones also support a wide variety of other services such as text messaging, MMS, email, Internet access, short-range wireless communications (infrared, bluetooth), business applications, gaming and photography. Mobile phones that offer these and more general computing capabilities are referred to as **smartphones**.

All mobile phones have a number of features in common, but manufacturers also try to differentiate their own products by implementing additional functions to make them more attractive to consumers. This has led to great innovation in mobile phone development over the past 20 years.

The common components found on all phones are:


A samsung smartphone

- a battery, providing the power source for the phone functions.
- an input mechanism to allow the user to interact with the phone. The most common input mechanism is a keypad, but touch screens are also found in some high-end smartphones.
- basic mobile phone services to allow users to make calls and send text messages.
- all mobile phones use a SIM card to allow an account to be swapped among devices.

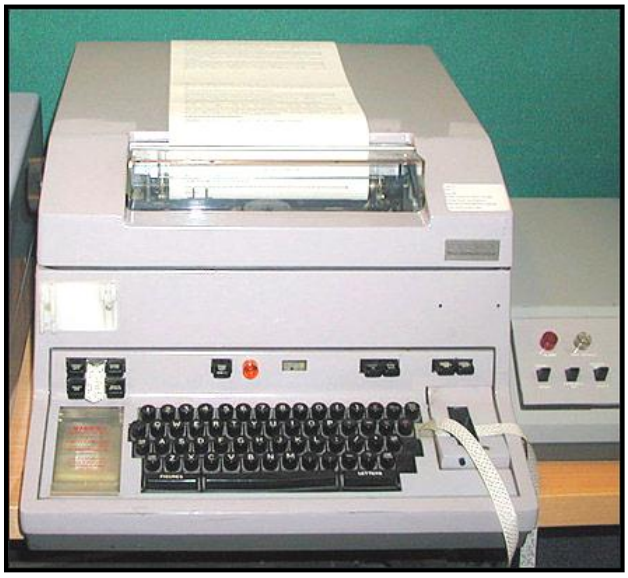


A SIM card

- individual satellite phone devices are uniquely identified by an International Mobile Equipment Identity (IMEI) number.

**Telex**

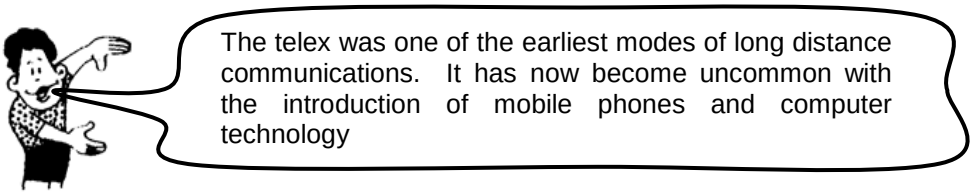
The telex network is a switched network of teleprinters similar to a telephone network, for the purposes of sending text-based messages. This network provided the first common medium for international record communications using standard signaling techniques.



A telex machine

The usual method of operation was that the message would be prepared off-line, using paper tape. All common telex machines incorporated a 5-hole paper-tape punch and reader. Once the paper tape had been prepared, the message could be transmitted in minimum time.

Telex billing was always by connected duration, so minimising the connected time saved money. However, it was also possible to connect in "real time", where the sender and the recipient could both type on the keyboard and these characters would be immediately printed on the distant machine.



**Fax**

Fax (short for facsimile), sometimes called telecopying or telefax, is the telephonic transmission of scanned printed material (both text and images), normally to a telephone number connected to a printer or other output devices. The original document is scanned with a fax machine (or a telecopier), which processes the contents (text or images) as a single fixed graphic image, converting it into electronic energy, and then transmitting it through the telephone system. The receiving fax machine reconverts the coded image, printing a paper copy.

The fax machine

---

**Activity: Now test yourself by doing this activity.**

**Answer the following questions on the spaces provided.**

1. List the three types of electronic communication methods you have learnt?

   a) _____

   b) _____

   c) _____

2. What is:

   a) a mobile phone?

   _____

   _____

   b) telex communication?

   _____

   _____

   c) a fax?

   _____

   _____

3. List the current mobile operators in PNG.

   a) _____

   b) _____

   c) _____

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 19.**

## Summary

You have come to the end of Lesson 19. In this lesson, you have learnt that:

- sound waves are converted into an electric current to transmit sound over long distances within a town.
- to send a telephone message from one province to another in Papua New Guinea, the microwave system is used where sound waves are converted into electromagnetic waves for transmission.
- the telephone handset has two main parts called the mouth piece and the earpiece.
- wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor.
- the most common wireless technologies such as radio use electromagnetic wireless telecommunications.
- mobile phones are devices that can make and receive telephone calls over a radio link while moving around a wide geographic area.
- the telex network is a switched network of teleprinters similar to a telephone network, for the purposes of sending text-based messages.
- fax short for facsimile, is the telephonic transmission of scanned printed material both text and images, normally to a telephone number connected to a printer or other output devices.

---

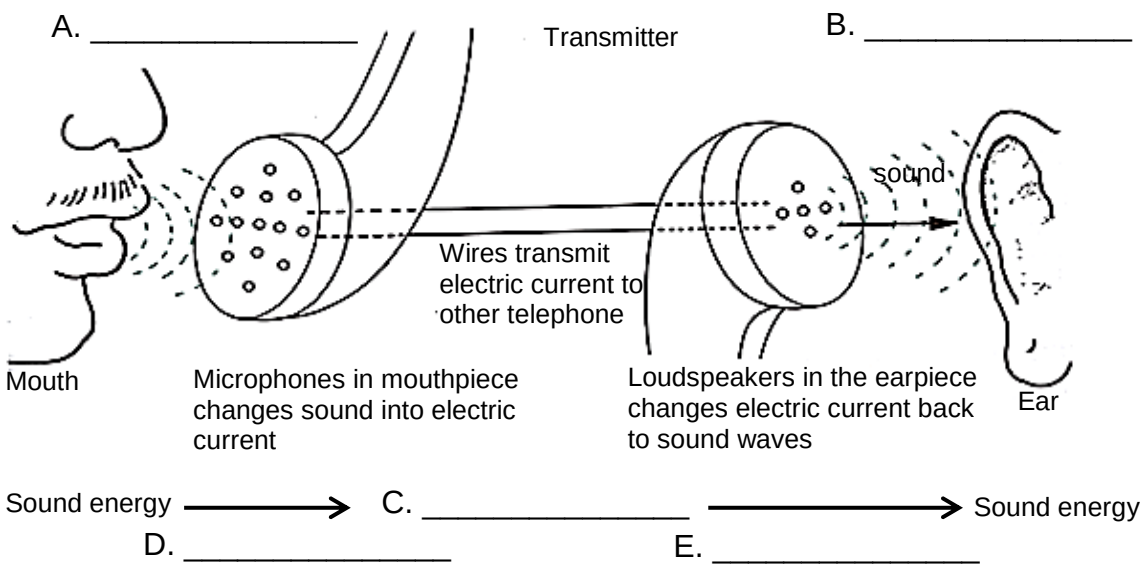
**NOW DO PRACTICE EXERCISE 19 ON THE NEXT PAGE.**

## Practice Exercise 19

**Answer the following questions.**

**Part A**: Label the parts of the diagram below with the following terms:

Receiver, Microphone, Sender, Loudspeaker, Electric current




**Part B**: Fill in the missing words from the list of words below. You may use words once in the sentences.

electromagnetic, earpiece, electric, wireless, mobile phones, mouth piece, fax, telecommunication, telex, facsimile

To transmit sound over long distances within a town, the sound waves are converted into an _____current for transmission. To send a telephone message from one province to another in Papua New Guinea the microwave system is used. The sound waves are converted into _____waves for transmission. Telephone handset has two main parts called the _____and the _____.The mouthpiece is the part you speak into and it contains a microphone that changes sound waves into electric currents.
_____communication is the transfer of information between two or more points that are not connected by a wire (an electrical conductor). The most common wireless technologies use electromagnetic wireless _____ such as radio. _____also known as cellular phones, cell phones, and hand phones are devices that can make and receive telephone calls over a radio link while moving around a wide geographic area. The _____network is a switched network of teleprinters similar to a telephone network, for the purposes of sending text-based messages. _____short for _____, sometimes called telecopying or telefax, is the telephonic transmission of scanned printed material both text and

images, normally to a telephone number connected to a printer or other output devices.

---

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4.**

**Answers to Activity**

1. a) Telephone

   b) Telex

   c) Fax

2. a) Mobile phones also known as cellular phones, cell phones, and hand phones are devices that can make and receive telephone calls over a radio link while moving around a wide geographic area.

   b) The telex network is a switched network of teleprinters similar to a telephone network, for the purposes of sending text-based messages.

   c) Fax short for facsimile, sometimes called telecopying or telefax, is the telephonic transmission of scanned printed material both text and images, normally to a telephone number connected to a printer or other output devices.

3. a) Digicel

   b) B-mobile

   c) Telikom

# Lesson 20: Computers and Internet

Welcome to Lesson 20. In the previous lesson, you described how telephones, telex and fax machines work. You also identified and explained the processes involved in transmitting a message using a telephone, telex and fax machine. You then discussed the importance of telephone, telex and fax as a means of communication. In this lesson, you will learn about the computers and internet.

**Your Aims:**

- explain how computers work
- explain the importance of the computer in communication
- explain email, Facebook and the internet

## Computers

A computer is a general purpose device that can be programmed to carry out unlimited set of arithmetic or logical operations. Since a sequence of operations can be readily changed, the computer can solve more than one kind of problem.

Generally, a computer consists of at least one processing element, typically a central processing unit (CPU) and some form of memory. The processing element carries out arithmetic and logic operations, and a sequencing and control unit that can change the order of operations based on stored information. Other external devices allow information to be retrieved from an external source such as the external drive, flash drive and SD card, and the result of operations saved and retrieved.

The first electronic digital computers were developed between 1940 and 1945 in the United Kingdom and United States. Originally they were the size of a large room, consuming as much power as several hundred modern personal computers (PCs).

Modern computers based on integrated circuits are millions to billions of times more capable than the early machines, and occupy a fraction of the space. Simple computers are small enough to fit into mobile devices, and mobile computers can be powered by small batteries. Personal computers in their various forms are icons of the Information Age and are what most people think of as “computers.” However, the embedded computers found in many devices from MP3 players to fighter aircraft and from toys to industrial robots are the most numerous.

Computers come in different models and sizes. From lap tops (L) to desk tops(R)

## The Internet

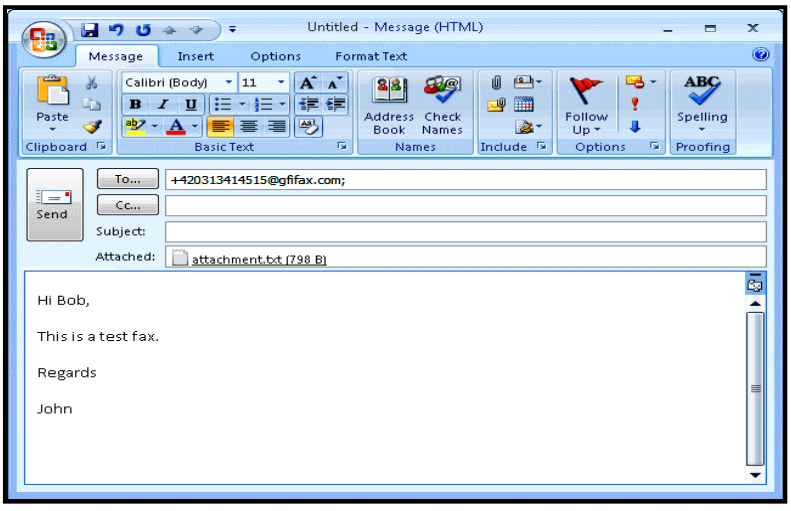
The Internet is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies. The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents of the World Wide Web (WWW) and the infrastructure to support email.

Most traditional communications media including telephone, music, film, and television are being reshaped or redefined by the Internet, giving birth to new services such as Voice over Internet Protocol (VoIP) and Internet Protocol Television (IPTV). Newspaper, book and other print publishing are adapting to Web site technology, or are reshaped into blogging and web feeds. The Internet has enabled and accelerated new forms of human interactions through instant messaging, Internet forums, and social networking. Online shopping has boomed both for major retail outlets, skilled manual workers and small traders. Business-to-business and financial services on the internet affect supply chains across entire industries.

Since the mid-1990s, the internet has had a tremendous impact on culture and commerce, including the rise of near instant communication by email, instant messaging, Voice over Internet Protocol (VoIP) "phone calls", two-way interactive video calls, and the World Wide Web with its discussion forums, blogs, social networking, and online shopping sites. Increasing amounts of data are transmitted at higher and higher speeds over fiber optic networks operating at 1-Gbit/s, 10-Gbit/s, or more. The Internet continues to grow, driven by ever greater amounts of online information and knowledge, commerce, entertainment and social networking.

## Email

Electronic mail, most commonly referred to as email or e-mail since 1993, is a method of exchanging digital messages from an author to one or more recipients. Modern email operates across the Internet or other computer networks. Some early email systems required that the author and the recipient both be online at the same time, in common with instant messaging.




The Email phase in the computer

Today's email systems are based on a store-and-forward model. Email servers accept, forward, deliver, and store messages. Neither the users nor their computers are required to be online simultaneously; they need connect only briefly, typically to an email server, for as long as it takes to send or receive messages.

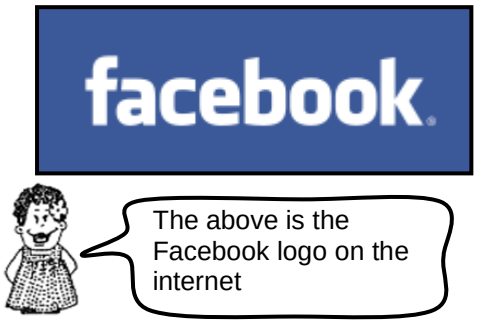
An internet email message consists of three components, the message envelope, the message header, and the message body. The message header contains control information, including, minimally, an originator's email address and one or more recipient addresses. Usually descriptive information is also added, such as a subject header field and a message submission date/time stamp.

**Facebook**

Facebook is an online social networking service, whose name comes from the general name for the book given to students at the start of the academic year by some university administrations in the United States to help students get to know each other. It was founded in February 2004 by Mark Zuckerberg with his college roommates. The website's membership was initially limited by the founders to Harvard students, but was expanded to other colleges in the Boston area, the Ivy League, and Stanford University in USA. It gradually added support for students at various other universities before opening to high school students, and eventually to anyone aged 13 and over. Facebook now allows any users who declare themselves to be at least 13 years old to become registered users of the site.

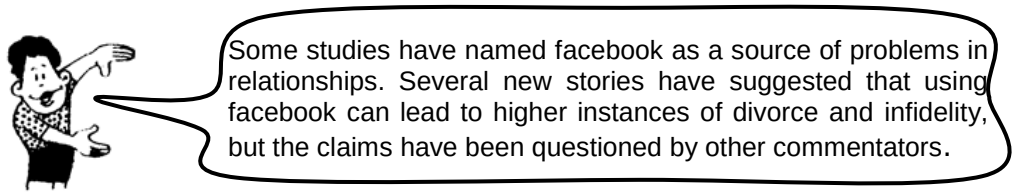
Users must register before using the site, after which they may create a personal profile, add other users as friends, and exchange messages, including automatic notifications when they update their profile. Additionally, users may join common-interest user groups, organised by workplace, school or college, or other characteristics, and categorise their friends into lists such as "People from Work" or "Close Friends". As of September 2012, Facebook has over one billion active users.


The Facebook phase in the computer




Facebook has affected the social life and activity of people in various ways. With its availability on many mobile devices, facebook allows users to continuously stay in touch with friends, relatives and other companies wherever they are in the world, as long as there is access to the internet. It can also unite people with common interests and or beliefs through groups and other pages, and has been known to reunite lost family members and friends because of the widespread reach of its network.

Some argue that facebook is beneficial to one's social life because they can continuously stay in contact with their friends and relatives, while others say that it can cause increased antisocial tendencies because people are not directly communicating with each other.




**Activity: Now test yourself by doing this activity.**

**Answer the following questions.**

1. What is

   a) a computer?

   _____
   _____

   b) the internet?

   _____
   _____

   c) Email?

   _____
   _____

   d) Facebook?

   _____
   _____

2. What does the abbreviation (**www**) stand for?

   _____
   _____

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF LESSON 20.**

## Summary

You have come to the end of Lesson 20. In this lesson you have learnt that:

- a computer is a general purpose device that can be programmed to carry out unlimited set of arithmetic or logical operations.
- generally, a computer consists of at least one processing element, typically a central processing unit (CPU) and some form of memory.
- modern computers based on integrated circuits are millions to billions of times more capable than the early machines, and occupy a fraction of the space. Simple computers are small enough to fit into mobile devices, and mobile computers can be powered by small batteries.
- the internet is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to serve billions of users worldwide.
- internet is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies.
- most traditional communications media including telephone, music, film, and television are being reshaped or redefined by the internet, giving birth to new services such as Voice over Internet Protocol (VoIP) and Internet Protocol Television (IPTV).
- the internet has enabled and accelerated new forms of human interactions through instant messaging, Internet forums, and social networking.
- electronic mail, most commonly referred to as email or e-mail since 1993, is a method of exchanging digital messages from an author to one or more recipients.
- an internet email message consists of three components, the message envelope, the message header, and the message body.
- facebook is an online social networking service.
- facebook has affected the social life and activity of people in various ways. With its availability on many mobile devices, facebook allows users to continuously stay in touch with friends, relatives and other companies wherever they are in the world, as long as there is access to the Internet.

---

**NOW DO PRACTICE EXERCISE 20 ON THE NEXT PAGE.**

## Practice Exercise 20

**Answer the following questions accordingly.**

**Part A**: Write the correct words for the following abbreviations

1. CPU _____
2. PC _____
3. www _____
4. VoIP _____
5. IPTV _____

**Part B**: Fill in the missing words from the list of words below. You may use word ones in the sentences.

central processing unit, internet, wireless, messaging, Facebook, email, electronic, computer, internet protocol suit

A _____ is a general purpose device that can be programmed to carry out unlimited set of arithmetic or logical operations.
Generally, a computer consists of at least one processing element, typically
A _____ (CPU) and some form of memory. Modern computers based on integrated circuits are millions to billions of times more capable than the early machines, and occupy a fraction of the space. Simple computers are small enough to fit into mobile devices, and mobile computers can be powered by small batteries. The _____is a global system of interconnected computer networks that use the standard _____ (TCP/IP) to serve billions of users worldwide. Internet is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, _____ and _____networking technologies. Most traditional communications media including telephone, music, film, and television are being reshaped or redefined by the Internet, giving birth to new services such as Voice over Internet Protocol (VoIP) and Internet Protocol Television (IPTV).
The Internet has enabled and accelerated new forms of human interactions through instant _____, Internet forums, and social networking. _____mail, most commonly referred to as email or e-mail since 1993, is a method of exchanging digital messages from an author to one or more recipients. An Internet _____ message consists of three components, the message envelope, the message header, and the message body. _____ is an online social networking service. Facebook has affected the social life and activity of people in various ways. With its availability on many mobile devices, Facebook allows users to continuously stay in touch with friends, relatives and other companies wherever they are in the world, as long as there is access to the Internet.

**CHECK YOUR WORK. ANSWERS ARE AT THE END OF TOPIC 4.**

**Answers to Activity**

1. a) A computer is a general purpose device that can be programmed to carry out unlimited set of arithmetic or logical operations.

   b) The internet is a global system of interconnected computer networks that use the standard Internet Protocol suite (TCP/IP) to serve billions of users worldwide.

   c) Electronic mail, most commonly referred to as email is a method of exchanging digital messages from an author to one or more recipients.

   d) Facebook is an online social networking service also known as social media.

2. World Wide Web

# Answers to Practice Exercises 16 – 20

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## Practice Exercise 16

1. Light is necessary for photosynthesis. Green plants use light energy to make food.

2. They are related and both can determine the wave speed .A higher wavelength means a low frequency and a high frequency means a short wavelength.

3. Travel, substance, particles, electric, magnetic, waves, right, each, direction, transverse, same, 300 000 000m/s, penetrative, cement, lead, X-ray, photographic, beyond violet, black, visible, only, spectrum, see, infrared, heat, telecommunications, radio, wavelength, electromagnetic.

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## Practice Exercise 17

1. If they broacast at the same frequency, there will be an inteference in their signals.

2. A radio is often called wireless because it transmits electrical energy from one place to another without any wires connecting the source and the receiver.

3. a) To transmit electromagnetic waves.

   b) To detect and pick up the electromagnetic waves.

4. It selects a station which we want to listen to.

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## Practice Exercise 18

1. The name of the inventor is John Logie Baird in 1926.

2. Closed circuit TV

3. a) Watch weather
   b) Watch sports
   c) Documentaries
   d) Advertisement
   e) News

   } Any of these answers are accepted

4. a) The tall tree is the cause of the interference by reflecting some of the electromagnetic wave that is why the reception is not good giving a poor picture.

   b) He needs to cut down the tree in order to make the reception better.

5. a) Speaker
   b) Phosphors
   c) Amplifier
   d) Antenna
   e) Electron gun
   f) Brightness control

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**Practice Exercise 19**

**Part A**:

A. Sender
B. Receiver
C. Electric current
D. Microphone
E. Loudspeaker

**Part B**:

electric, electromagnetic, mouthpiece, earpiece, Wireless,telecommunications, Mobile phones, telex, Fax, facsimile,

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**Practice Exercise 20**

**Part A**:

1. Central Processing Unit

2. Personal Computer

3. World Wide Web

4. Voice over Internet Protocol

5. Internet Protocol Television

**Part B**:

Computer, central processing unit, Internet, Internet protocol suite , wireless, optical, messaging, Electronic, email, Facebook

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**REVISE TOPIC 4 USING THE MAIN POINTS ON THE NEXT PAGE.**

# REVIEW OF TOPIC 4: Telecommunication

Now, revise all lessons in this Topic and then do **ASSIGNMENT 5**.
Here are the main points to help you revise.

**Lesson 16: Electromagnetic Waves**

- Electromagnetic waves can travel where there are no particles.
- Electromagnetic waves are transverse wave. They have electric and magnetic field vibrating at the same time.
- Some electromagnetic waves have longer wavelength and low frequencies while others have short wavelength and high frequencies.
- All electromagnetic waves travel at the speed of light which is about 30 000km/s.
- There are eight (8) categories of electromagnet waves.
- Some of these electromagnetic waves can be beneficial in many ways while the others can be harmful.
- Modern communications uses radio waves.

**Lesson 17: Radio Broadcasting**

- Radio waves are part of the electromagnetic spectrum and have the longest wavelength.
- Radio means sending energy with waves.
- A radio is an important means of providing information.
- A radio is often called wireless because it transmits electrical energy from one place to another without any wires connecting the source and the receiver.
- The radio does not need air to transmit its message.
- The source of a radio message is an aerial or antenna.
- Electromagnetic waves which travel out from the aerial are called radio waves.
- The equipment that sends out a radio wave is known as a transmitter.
- The radio waves sent by a transmitter move quickly through the air and are then received by the aerial of a radio receiver.
- Radio waves carry energy as an invisible, up-and-down movement of electricity and magnetism.
- When we tune in to a radio station, the aerial detects and picks up the particular radio waves we select.
- The radio transforms (changes) the wave picked up by the aerial, into clear sound waves. When the sound is clear, we say the reception is clear.
- Modulation is a process where a radio program is transmitted by adding it to a radio wave called a carrier wave.
- FM stations are broadcasted at a much higher frequency than AM stations because their signals suffer less interference and the quality of the sound is much better.

**Lesson 18: Television**

- Television is a telecommunication medium for transmitting and receiving moving images that can be monochrome (black-and-white) or colored, with or without any sound.
- TV gives us the world, other cultures, other people, languages and ideas. It introduces us to knowledge.
- The TV signal is sent as an electromagnetic wave through the air by the transmitting aerial.

- The receiving antenna detects the waves which causes the electrons in the metal of the antenna to vibrate and produce a changing electric current (electrical signal) which is fed to the TV screen.
- The cathode ray tube is sometimes called the electron tube.
- The inside of the screen is coated with three different substances of very small strips or dots. These substances are called phosphors.
- Closed-circuit television (CCTV) are the most commonly used medium for broadcast television.

**Lesson 19: Electronic Telecommunication**

- To transmit sound over long distances within a town, the sound waves are converted into an electric current for transmission.
- To send a telephone message from one province to another in Papua New Guinea the microwave system is used. The sound waves are converted into electromagnetic waves for transmission.
- The telephone handset has two main parts called the mouth piece and the earpiece. The mouthpiece is the part you speak into and it contains a microphone that changes sound waves into electric currents.
- Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor.
- The most common wireless technologies use electromagnetic wireless telecommunications, such as radio.
- Mobile phones also known as cellular phones, cell phones, and hand phones are devices that can make and receive telephone calls over a radio link while moving around a wide geographic area.
- The telex network is a switched network of teleprinters similar to a telephone network, for the purposes of sending text-based messages.
- Fax short for facsimile, sometimes called telecopying or telefax, is the telephonic transmission of scanned printed material both text and images, normally to a telephone number connected to a printer or other output devices.

**Lesson 20: Computers and Internet**

- A computer is a general purpose device that can be programmed to carry out unlimited set of arithmetic or logical operations.
- Generally, a computer consists of at least one processing element, typically a central processing unit (CPU) and some form of memory.
- Modern computers based on integrated circuits are millions to billions of times more capable than the early machines, and occupy a fraction of the space.
- Simple computers are small enough to fit into mobile devices, and mobile computers can be powered by small batteries.
- The internet is a global system of interconnected computer networks that use the standard internet protocol suite (TCP/IP) to serve billions of users worldwide.
- Internet is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies.
- Most traditional communications media including telephone, music, film, and television are being reshaped or redefined by the internet, giving birth to new services such as Voice over Internet Protocol (VoIP) and Internet Protocol Television (IPTV).

- The Internet has enabled and accelerated new forms of human interactions through instant messaging, Internet forums, and social networking.
- Electronic mail, most commonly referred to as email or e-mail since 1993, is a method of exchanging digital messages from an author to one or more recipients.
- An internet email message consists of three components, the message envelope, the message header, and the message body.
- Facebook is an online social networking service.
- Facebook has affected the social life and activity of people in various ways. With its availability on many mobile devices, Facebook allows users to continuously stay in touch with friends, relatives and other companies wherever they are in the world, as long as there is access to the internet.

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**NOW DO TOPIC TEST 4 IN YOUR ASSIGNMENT 5.**

**NOW YOU MUST COMPLETE ASSIGNMENT 5.**
**RETURN IT TO THE PROVINCIAL CO-ORDINATOR.**

## References

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## Other References

Some Communication notes and images were retrieved from http://www.google.pg.com/search? at different times.

# FODE PROVINCIAL CENTRES CONTACTS

| PC NO. | FODE PROVINCIAL CENTRE | ADDRESS | PHONE/FAX | CUG PHONES | CONTACT PERSON | | CUG PHONE |
|---|---|---|---|---|---|---|---|
| 1 | DARU | P. O. Box 68, Daru | 6459033 | 72228146 | The Coordinator | Senior Clerk | 72229047 |
| 2 | KEREMA | P. O. Box 86, Kerema | 6481303 | 72228124 | The Coordinator | Senior Clerk | 72229049 |
| 3 | CENTRAL | C/- FODE HQ | 3419228 | 72228110 | The Coordinator | Senior Clerk | 72229050 |
| 4 | ALOTAU | P. O. Box 822, Alotau | 6411343 / 6419195 | 72228130 | The Coordinator | Senior Clerk | 72229051 |
| 5 | POPONDETTA | P. O. Box 71, Popondetta | 6297160 / 6297678 | 72228138 | The Coordinator | Senior Clerk | 72229052 |
| 6 | MENDI | P. O. Box 237, Mendi | 5491264 / 72895095 | 72228142 | The Coordinator | Senior Clerk | 72229053 |
| 7 | GOROKA | P. O. Box 990, Goroka | 5322085 / 5322321 | 72228116 | The Coordinator | Senior Clerk | 72229054 |
| 8 | KUNDIAWA | P. O. Box 95, Kundiawa | 5351612 | 72228144 | The Coordinator | Senior Clerk | 72229056 |
| 9 | MT HAGEN | P. O. Box 418, Mt. Hagen | 5421194 / 5423332 | 72228148 | The Coordinator | Senior Clerk | 72229057 |
| 10 | VANIMO | P. O. Box 38, Vanimo | 4571175 / 4571438 | 72228140 | The Coordinator | Senior Clerk | 72229060 |
| 11 | WEWAK | P. O. Box 583, Wewak | 4562231/ 4561114 | 72228122 | The Coordinator | Senior Clerk | 72229062 |
| 12 | MADANG | P. O. Box 2071, Madang | 4222418 | 72228126 | The Coordinator | Senior Clerk | 72229063 |
| 13 | LAE | P. O. Box 4969, Lae | 4725508 / 4721162 | 72228132 | The Coordinator | Senior Clerk | 72229064 |
| 14 | KIMBE | P. O. Box 328, Kimbe | 9835110 | 72228150 | The Coordinator | Senior Clerk | 72229065 |
| 15 | RABAUL | P. O. Box 83, Kokopo | 9400314 | 72228118 | The Coordinator | Senior Clerk | 72229067 |
| 16 | KAVIENG | P. O. Box 284, Kavieng | 9842183 | 72228136 | The Coordinator | Senior Clerk | 72229069 |
| 17 | BUKA | P. O. Box 154, Buka | 9739838 | 72228108 | The Coordinator | Senior Clerk | 72229073 |
| 18 | MANUS | P. O. Box 41, Lorengau | 9709251 | 72228128 | The Coordinator | Senior Clerk | 72229080 |
| 19 | NCD | C/- FODE HQ | 3230299 Ext 26 | 72228134 | The Coordinator | Senior Clerk | 72229081 |
| 20 | WABAG | P. O. Box 259, Wabag | 5471114 | 72228120 | The Coordinator | Senior Clerk | 72229082 |
| 21 | HELA | P. O. Box 63, Tari | 73197115 | 72228141 | The Coordinator | Senior Clerk | 72229083 |
| 22 | JIWAKA | c/- FODE Hagen | | 72228143 | The Coordinator | Senior Clerk | 72229085 |

# FODE SUBJECTS AND COURSE PROGRAMMES

| GRADE LEVELS | SUBJECTS/COURSES |
|---|---|
| Grades 7 and 8 | 1. English |
| | 2. Mathematics |
| | 3. Personal Development |
| | 4. Social Science |
| | 5. Science |
| | 6. Making a Living |
| Grades 9 and 10 | 1. English |
| | 2. Mathematics |
| | 3. Personal Development |
| | 4. Science |
| | 5. Social Science |
| | 6. Business Studies |
| | 7. Design and Technology- Computing |
| Grades 11 and 12 | 1. English – Applied English/Language& Literature |
| | 2. Mathematics - Mathematics A / Mathematics B |
| | 3. Science – Biology/Chemistry/Physics |
| | 4. Social Science – History/Geography/Economics |
| | 5. Personal Development |
| | 6. Business Studies |
| | 7. Information & Communication Technology |

**REMEMBER:**

- For Grades 7 and 8, you are required to do all six (6) subjects.
- For Grades 9 and 10, you must complete five (5) subjects and one (1) optional to be certified. Business Studies and Design & Technology – Computing are optional.
- For Grades 11 and 12, you are required to complete seven (7) out of thirteen (13) subjects to be certified.

Your Provincial Coordinator or Supervisor will give you more information regarding each subject and course.

**GRADES 11 & 12 COURSE PROGRAMMES**

| No | Science | Humanities | Business |
|---|---|---|---|
| 1 | Applied English | Language & Literature | Language & Literature/Applied English |
| 2 | Mathematics A/B | Mathematics A/B | Mathematics A/B |
| 3 | Personal Development | Personal Development | Personal Development |
| 4 | Biology | Biology/Physics/Chemistry | Biology/Physics/Chemistry |
| 5 | Chemistry/ Physics | Geography | Economics/Geography/History |
| 6 | Geography/History/Economics | History / Economics | Business Studies |
| 7 | ICT | ICT | ICT |

**Notes:** You must seek advice from your Provincial Coordinator regarding the recommended courses in each stream. Options should be discussed carefully before choosing the stream when enrolling into Grade 11. FODE will certify for the successful completion of seven subjects in Grade 12.

| CERTIFICATE IN MATRICULATION STUDIES | | |
|---|---|---|
| **No** | **Compulsory Courses** | **Optional Courses** |
| 1 | English 1 | **Science Stream:** Biology, Chemistry, Physics |
| 2 | English 2 | **Social Science Stream:** Geography, Intro to Economics and Asia and the Modern World |
| 3 | Mathematics 1 | |
| 4 | Mathematics 2 | |
| 5 | History of Science & Technology | |

**REMEMBER:**

You must successfully complete 8 courses: 5 compulsory and 3 optional.