

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	1	<b>TOPIC</b>	Classification of Matter Time: : 60 minutes	<b>Lesson</b>	1
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>
<b>LESSON OBJECTIVES</b>	At the end of this lesson learners should be able to:	
	<ul style="list-style-type: none"> <li>Define matter and explain what is it made up of?</li> <li>What are materials and are able to list some common examples of materials?</li> <li>The different phases of which matter is made up of.</li> <li>The physical properties of the different phases of matter.</li> </ul>	
	The following results will be the outcome of this lesson:	
	<ul style="list-style-type: none"> <li>The learners being able to identify matter in terms of it being a solid; a liquid or a gas.</li> <li>The learners being able to classify matter in terms of its physical properties.</li> <li>The learners being able to explain some of the physical properties of matter.</li> </ul>	

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	
Scientific ; Investigative ; observation ; Question and Answer; Narrative	
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	
<ul style="list-style-type: none"> <li>Introduce the lesson with an exciting practical / demonstration/ experiment OR explain an example where the lesson is applied to life in general. e.g. : reaction of brown copper powder(solid) with concentrated nitric acid (clear liquid) to produce a reddish brown gas; a blue solution and water.</li> <li>Learners observe/ record/ listen to what teacher is doing.</li> </ul>	
<b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)	
A basic understanding of :	
<ul style="list-style-type: none"> <li>The different phases of matter eg: solid; liquid and gas. (grade 9 work)</li> <li>Some observable characteristics (properties) of solids; liquids and gases.</li> <li>Some common examples of matter in their daily lives</li> <li>Elements; compounds and the periodic table</li> </ul>	
<b>EDUCATOR tests pre-knowledge</b> by using the question and answer method as indicated in the baseline assessment.	

**BASELINE ASSESSMENT**

## QUESTIONS/ ACTIVITY

- What is matter? What are the components of matter?
- What is a material? List some examples of materials in your life.
- What is meant by the physical property of a substance? What kinds of physical properties do substances have? List a few.

**2.2 Main Body (Lesson presentation)**

- Educator starts lesson off with an exciting demonstration about mixtures. [10 min.]

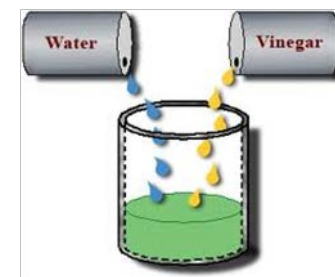
Educator demonstrates the reaction between concentrated nitric acid and copper powder or a similar type of reaction where a gas is given off that can be seen or has a characteristic smell. Educator explains the observations: that as the brown copper metal (a pure substance and a solid) reacts with the clear concentrated nitric acid (a liquid and a mixture), a reddish brown gas is given off and a blue liquid is formed, the gas mixes in the atmosphere to form a mixture of gases with the air particles, in this reaction matter is present in the 3 different phases. We can also identify some of the physical properties of matter, namely the way it feels (hard; soft; rough; smooth); colour; the phase and the smell. Educator writes observations and the word equation on the board. (PRECAUTION: learners warned not to touch concentrated nitric acid because it is corrosive- burns/ corrodes/ eats away the skin)

Copper metal + conc. Nitric acid → reddish brown nitrogen dioxide gas (sharp detergent smell) + copper sulphate + water

- Educator uses the question and answers method to engage learners in the baseline assessment as well as discusses the answers to the questions given. [10 min.]

Matter is found in everything around us, it has mass and occupies space. Matter is composed of materials which are present in the liquid; solid and gaseous phases. Materials are the substances (eg: wood; plastic; metal; glass; stone; clay etc.) of which objects are made out of. The physical property of a substance is what makes it useful to man eg: some metals (iron; aluminium; steel) are good conductors of heat and therefore they are used to make cooking utensils. Some of the other examples of physical properties are: the strength (how easily it breaks); electrical conductivity; magnetic properties; water absorption/ resistance; malleability; ductility

- This entire lesson is based on learners answering questions relating to the physical properties of matter in the practical activity they will be involved in. [20 min.]
  - IDENTIFY/ LABEL/ NAME the materials in front of you. Educator to give learners a sample of at least +10 materials eg: some salt/ sugar crystals; Epsom salts powder added to some water and bubbles produced ; some sulphur powder; some liquorice sweets; a piece of a plastic ruler; a small piece of wood/ stick; iron filings/ a small piece of zinc; few pieces of different types of materials that clothes are made up of eg: cotton; wool; leather etc.; some sand(rough); some soap (solid and liquid); toothpaste; cooking oil; hand lotion etc. (educator can make up his own list or use the one above



❑ Learners to group them in terms of solids; liquids or gases.

❑ Learners to answer the following questions about the materials in front of them as well as the demonstration/s they observed:

- What are some of the characteristics (properties) of solids? Eg: How do they feel, hard/ soft, smooth/ rough? Are they strong/ weak? Do they break easily? Do they have a shape? Can they be separated easily? Do they have specific colours? Can they be broken down into smaller particles? Are they man made (synthetic) or natural?
- What are some of the characteristics (properties) of liquids? How do they feel, hard/ soft, smooth/ rough? Do they have a shape? Are they strong/ weak? Can they break easily? Can they be separated easily? Do they have specific colours? Can they be broken down into smaller particles? Are they man made (synthetic) or natural?
- What are some of the characteristics (properties) of gases? Can they be seen easily? Can we feel them? Can we smell them? Do they have specific colours? Can they be broken down into smaller particles? Are they man made (synthetic) or natural? Do they have a shape?
- Educator explains main concepts of the lesson and summarises points on chalkboard. [10 min]
- that all matter is made up of solids; liquids and gases
- that solids have a shape; are generally hard to the touch; are stronger than liquids and gases and cannot be separated easily; there are many examples of natural solids and there are many examples of man made solid materials; they can be broken down into smaller particles
- that liquids are soft to the touch; they do not have a specific shape; they can be separated easily;
- that gases are very difficult to see but most of them have a characteristic smell; they can be easily separated, most of them occur naturally and there are a few that are made by mans' daily activities and they are dangerous to the environment eg: fumes from the burning of waste materials like plastic and rubber and exhaust fumes.

### 3. Conclusion

**Activity to Re-enforce lesson** (Educator to direct relevant questions to learners to see if they understood the main aspects of the lesson OR learners can write answers in their notebooks). [10 min.]

i.e. What is matter? What is it made up of? Give examples of the different phases of matter in your life/ in the class etc. What properties do solids, liquids and gases have? Is it possible to mix solids and liquids; liquids and gases; solids and gases? Give examples from your daily life of all the different mixtures that are possible.

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [20 min]

eg: Read the chapter in your textbook and give the meaning of the following terms( as well as examples from your life of each term) in your own words: mixture; pure substances; impure substances; elements; compounds; homogeneous/ heterogeneous mixture.

**RESOURCES USED:**

Relevant apparatus and chemicals for practical demonstration; worksheet/ transparency for baseline assessment; relevant textbook/ notes eg (chapter 7 from textbook PHYSICAL SCIENCES 10 (mind action series) S.CROSSMAN)

**Reflection/Notes:**

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	1	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	2
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	At the end of this lesson learners should be able to:		
	<ul style="list-style-type: none"> <li>Explain the meaning of a pure substance and list examples of pure substances.</li> <li>List and explain some of the physical properties of pure substances, and mixtures.</li> <li>Explain the meaning of a mixture and give examples of mixtures.</li> <li>List and explain some of the physical properties of mixtures.</li> </ul>		
	The following results will be the outcome of this lesson:		
	<ul style="list-style-type: none"> <li>The learners being able to classify matter in terms of it being a pure substance or a mixture.</li> <li>The learners being able to list and explain some of the physical properties of pure substances and mixtures.</li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Investigative ; observation ; Question and Answer; Narrative
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	<ul style="list-style-type: none"> <li>Introduce the lesson with an exciting practical / demonstration/ experiment OR explain an example where the lesson is applied to life in general. Eg: educator to burn a piece of a wet/ green stick to create smoke to show a mixture of gases.</li> <li>Learners observe/ record/ listen to what teacher is doing.</li> </ul>
<b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)	A basic understanding of :
	<ul style="list-style-type: none"> <li>The different parts of matter eg: solid; liquid and gas. (grade 9 work)</li> <li>Some observable characteristics (properties) of solids; liquids and gases.</li> <li>Some common examples of matter in their daily lives</li> <li>The physical properties of matter, namely that of solids ; liquids and gases.</li> </ul>

**BASELINE ASSESSMENT / EDUCATOR** tests pre-knowledge by using the QUESTION and ANSWER method of the content taught in the previous lesson.

- eg: What is matter? What are the different phases of matter, give relevant examples? List some physical properties of solids; liquids and gases. Explain some of the physical properties of matter eg: shape; colour; feel; strength etc.

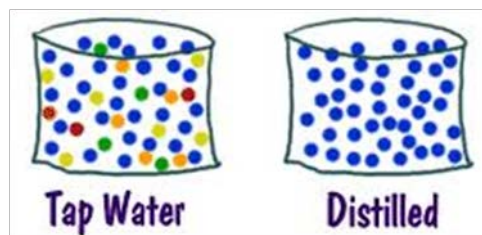
## 2.2 Main Body (Lesson presentation)

- Educator starts lesson off with an exciting demonstration about mixtures. [10 min.]
  - Educator burns a piece of a stick/ tree branch that is still green and then shows the learners examples of pure substances eg: a teaspoon of sugar crystals; a piece of copper metal and a bottle of distilled water. Educator explains that the smoke particles given off when the green piece of stick is burning has a distinct colour (greyish white) and smell as compared to the air particles. The smoke mixes with the air particles to form a mixture of gases, the smoke and the air particles can be distinguished from each other by its colour and its smell, smoke. That in a **mixture** the different components of the mixture can be identified by their different physical properties (properties that can be observed). That a **pure substance** (eg: the sugar crystals; the copper metal and the bottle of distilled water) consists of the same type of particles and they are all the same.
- Educator uses the question and answer method to engage learners in the baseline assessment as mentioned above. [5 min.]  
Educator discusses answers to the baseline assessment which are given in lesson 1.
- This entire lesson is based on learners answering questions relating to the observations they make during the practical activity they will be engaged in, as explained below. [20 min.]
  - Learners to be divided into groups depending on the amount of materials that are available, a sample of at least 10 different substances/ materials to be given to each group eg: water; oil; pure orange juice ; toothpaste; chalk; iron filings; salt/ sugar crystals added to water; orange juice/ ink in some water; cold drink eg: a can of coke etc.; Epsom salts powder added to some water and bubbles produced ; some sand(rough) in water; some soap (solid and liquid) added to water; some cooking oil added to water and some added to methylated spirits; hand lotion; some mayonnaise in water etc. (educator can make up his own list or use the one above).
  - Educator instructs learners to mix some of the substances listed above: eg: water and oil; sand and water; orange juice and water; salt and sugar; salt and water; sugar and oil etc.

### EXAMPLES of PURE SUBSTANCES (ELEMENTS and COMPOUNDS) and MIXTURES

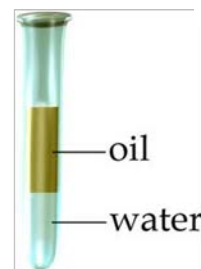


PURE SUBSTANCES (ELEMENTS)

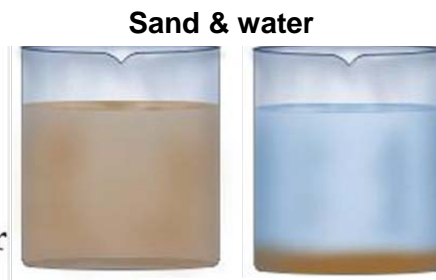


MIXTURE  
(water and metal ions)

PURE SUBSTANCE (compound)  
(only water particles)



MIXTURE  
(2 compounds)



MIXTURE  
(2 compounds)

- ❑ Learners to group the substances in terms of pure substances and mixtures according to the observations they make with regards the physical properties of the substances they have in front of them.
- ❑ Learners to answer the following questions about the observations they have made:

- What is a pure substance? Give some household examples (3) of pure substances.
- What is a mixture? Give some household examples (3) of mixtures.
- What is a homogeneous mixture? Give 3 household examples of homogeneous mixtures.
- What are some of the characteristics (physical properties) of pure substances and mixtures.
- Educator explains main concepts of the lesson and summarises points on chalkboard. [15 min]

A pure substance:

- cannot be separated into 2 or more substances by physical or mechanical means, is homogeneous, i.e., has uniform composition throughout the whole sample, its properties are constant throughout the whole sample, its properties do not depend on how it is prepared or purified, has a constant chemical composition eg: elements and compounds (carbon, copper, distilled water, oil, salt; sugar)

A mixture:

- can be separated into 2 or more substances by physical or mechanical means, displays the properties of the pure substances making it up, its composition can be varied by changing the proportion of pure substances making it up, ones with non-uniform composition throughout the sample are always mixtures eg: sand and water; rice crispies and milk; salt and water

**Homogeneous Mixture:** substances that look the same throughout. Homogeneous substances have one phase and uniform composition. eg: tea and water, salt and water; a can of cold drink while still in the can and closed

**Heterogeneous Mixture:** substances in which you can see more than one colour or type of matter. Heterogeneous substances have more than one phase and a non-uniform composition. eg: spaghetti in sauce; masala and oil; pap and curry.

**Physical properties of pure substances:** particles are identical in size, shape and colour, they melt and boil at the same temperature, they have the same density and mass, always combine in a fixed ratio eg: water  $H_2O$  (2 atoms of hydrogen to 1 atom of oxygen).

Physical properties of mixtures: particles are not identical in size, shape and colour, they melt and boil at different temperatures, they may not have the same mass and density, they can be mixed in any ratio (2 teaspoons of sugar can be added to water to make sugar water or 10 tablespoons can also be added to the same glass of water to make sugar water).

### 3. Conclusion

**Activity to Re-enforce lesson** (Educator directs questions to learners to see if they understood the main aspects of the lesson). [10 min.]

- Educator explains main concepts of the lesson by the question and answer method: the meaning of a pure substance and a mixture, some of the physical properties of a mixture and a pure substance and how to differentiate between a mixture and a pure substance by looking at their physical properties. The educator summarises the main aspects of the lesson on the chalkboard.

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [15 min]

eg: 1. What is a pure substance? Give 5 examples of pure substances you have at home 2. What is a mixture? Give 5 examples of mixtures you use at home 3. What is the difference between a pure substance and a mixture? 4. What is meant by 'physical properties'? List 5 examples of physical properties. 5. What are some of the physical properties of a pure substance? 6. What are some of the physical properties of a mixture?

#### RESOURCES USED:

Relevant apparatus and chemicals for practical demonstration; worksheet/ transparency for baseline assessment; relevant textbook/ notes eg (chapter 7 from textbook PHYSICAL SCIENCES 10 (mind action series) S.CROSSMAN; module 4 grade 10 PHYSICAL SCIENCES A OLIVIER)



Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	1	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	3
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Explain the meaning of poly-atomic ion and how to write the formula and charge of some common poly-atomic ions.</li> <li>• Give chemical names and common names of the household chemicals found in the school laboratory and in their houses.</li> </ul> <p>The following results will be the outcome of this lesson:</p> <ul style="list-style-type: none"> <li>• The learners being able to give the common name and the corresponding chemical name of a few household chemicals.</li> <li>• The learners being able to write the formulae of the chemical names and common names of the household chemicals being used.</li> </ul>		

TEACHING and LEARNING ACTIVITIES		
COMMON NAME	CHEMICAL NAME	FORMULA
<p><b>1. TEACHING METHOD/S USED IN THIS LESSON:</b></p> <p>Scientific ; Question and Answer; Narrative</p>		
<p><b>2. LESSON DEVELOPMENT</b></p> <p><b>2.1 Introduction</b></p> <ul style="list-style-type: none"> <li>❑ Educator introduces the lesson by giving some of the COMMON NAMES of chemicals found in the house and in the laboratory and checking if learners can identify their chemical names. e.g.: baking soda; washing soda; bleach; caustic soda; 'handy-andy;' vinegar; plaster of paris; Epsom salts; citric acid; battery acid; blue vitriol; chloroform; liquid petroleum gas; cigarette lighter fluid; alcohol; glycerine; table salt etc. (educator can make own list)</li> <li>❑ The educator points out to learners the monatomic and polyatomic ions found in these various compounds. Learners to listen and make notes of the names and formulae of chemicals explained by the educator.</li> </ul>		
<p><b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)</p> <ul style="list-style-type: none"> <li>• Learners should know the meaning of an element and that of a compound.</li> <li>• Learners should know the names and formulae of some of the household examples of elements and compounds</li> <li>• Learners should be able to use the table of ions (POLYATOMIC IONS) to work out the formula of compounds.</li> <li>•Learners should know the position (group number) of the element on the periodic table and their respective charge (monatomic ions) they form when they bond to form a compound.</li> </ul>		
<p><b>BASELINE ASSESSMENT (BL 6)</b></p> <p>EDUCATOR tests pre-knowledge by using the QUESTION and ANSWER method of the content taught in the previous lesson.</p> <p>1. What are ELEMENTS? 2. Give the formula and name of 10 elements their ionic state? 3. What are COMPOUNDS? 4. Give the formula and common name of some household compounds (magnesium sulphate; sodium carbonate; sodium hydrogen carbonate; ethanoic acid; sodium hypochlorite; magnesium hydroxide; sulphuric acid; hydrochloric acid).</p>		

1. acetylene	ethyne	
2. Baking soda	Sodium hydrogen carbonate	
3. Battery acid	Sulphuric acid	
4. Bleach	Sodium hypochlorite	
5. Blue vitriol	Copper sulphate	
6. calomel	mercury i chloride	
7. Caustic soda	Sodium hydroxide	
8. Chilli-saltpetre	Sodium nitrate	
9. Chloroform	Trichloromethane	
10. Dry ice	Solid carbon dioxide	
11. Epsom salts	Magnesium sulphate	$Mg^{+2} + SO_4^{-2} \longrightarrow MgSO_4$
12. Fools gold	Iron ii sulphide	
13. formalin	Methanol	
14. Formic acid	Methanoic acid	
15. Glauber salts	Sodium sulphate	
16. Glycerine/ glycerol	Propantriol	
17. Marble/ chalk	Calcium carbonate	
18. Milk of magnesia	Magnesium hydroxide	
19. Plaster of paris (gypsum)	Calcium sulphate	
20. Caustic Potash	Potassium hydroxide	
21. Quick lime/ unslaked lime	Calcium oxide	
22. Saltpetre	Potassium nitrate	
23. Slaked lime	Calcium hydroxide	
24. Smelling salts	Ammonium carbonate	
25. Spirits of salts	Hydrochloric acid	
26. Table salt	Sodium chloride	
27. Vinegar/ acetic acid	Ethanoic acid	
28. Washing soda	Sodium carbonate	

## 2.2 Main Body (Lesson presentation)

- ❑ Educator starts lesson off by showing learners how to write the names and formulae of some of the common elements and compounds found in the school laboratory as mentioned in the introduction. [10 min.]
- ❑ Educator tests baseline assessment by question and answer method and writes answers on the chalkboard.[10 min.]
- ❑ Educator uses the table of ions (monatomic and poly-atomic) while learners have their copy in front of them and then explains that MONATOMIC IONS are ions that have a single element in their formula and that they usually have a FIXED CHARGE depending on their position on the periodic table, that POLYATOMIC IONS have MORE THAN

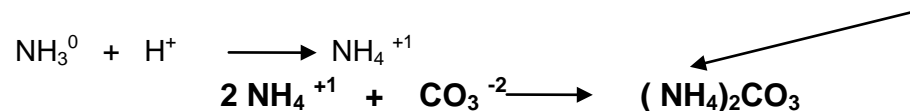
ONE ELEMENT in their formula and have charges as shown in the table below. The educator then explains how elements get to be charged and form single ions known as monatomic ions and discusses some of the common poly-atomic ions and uses them to write the formulae of compounds as shown below.

- Educator uses the table of common names and chemical names to discuss some of the chemical names of the common chemicals found in the house and the school laboratory. E.g. sodium carbonate is a weak base used in acid-base reactions in the laboratory but it is also known as washing soda, the main component of washing powder. Educator also explains how to write the formula for some of these common chemicals used at home as shown on the table of common names and chemical names given to the learners. [30 min.]

e.g. 1. What is the formula for ammonium carbonate (commonly called smelling salts)?

The carbonate ion has the formula  $\text{CO}_3^{-2}$ , **OXYGEN** retains its - 2 charge in most compounds and therefore the total charge of the 3 oxygen ions in the formula = - 6 and therefore carbon has to have a +4 charge for the charge of the ion to be - 2

therefore the formula for ammonium carbonate will be worked out as follows: since the ammonium ion is formed from ammonia and a hydrogen ion and it has a charge of +1 charge in a bond, therefore two ammonium ions are needed to balance the two negative charges of the carbonate ion as shown below:



#### TABLE OF COMMON NAMES and CHEMICAL NAMES of compounds

### 3. CONCLUSION

**Activity to Re-enforce lesson** (Educator gives learners a list of compounds and learners try to write the correct formula of these compounds using the ion table and the periodic table). E.g: Write the correct chemical formula for: magnesium carbonate; sodium hydroxide; sodium sulphate; potassium chlorate; calcium carbonate; calcium hydroxide; potassium dichromate? Educator checks answers on the chalkboard with learners. [10 min.]

**4. HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) Learners to answer questions 1 to 15 from the table of common names and chemical names. [15 min]

### 5. RESOURCES USED:

Relevant apparatus and chemicals for practical demonstration; worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. Worksheets given to learners; the table of ions and the table of common names and chemical names.

Reflection/Notes:

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Name of Teacher:		HOD:	
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<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	1	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	4
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>
<b>LESSON OBJECTIVES</b>	At the end of this lesson learners should be able to:	
	<ul style="list-style-type: none"> <li>Define a chemical element and give examples of elements found on the periodic table?</li> <li>Define a compound and give examples of some common compounds?</li> <li>Explain the arrangement of the elements on the periodic table in terms of metals; non metals and metalloids.</li> <li>Explain the arrangement of the elements on the periodic table in terms of groups and periods.</li> </ul>	
	The following results will be the outcome of this lesson:	
	<ul style="list-style-type: none"> <li>The learners being able to identify the components of a pure substance, a homogeneous or a heterogeneous mixture in terms of elements and compounds.</li> <li>The learners being able to identify elements on the periodic table in terms of metals; metalloids and non metals.</li> </ul>	

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Investigative ; observation ; Question and Answer; Narrative
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	<ul style="list-style-type: none"> <li>Introduce the lesson with EXAMPLES of some of the COMMON ELEMENTS and COMPOUNDS found in the school laboratory. e.g. sulphur powder; aluminium metal powder; cobalt chloride crystals, iodine granules; red/ yellow phosphorous sticks, potassium metal; nitric acid; copper carbonate etc. (educator to compose own selection of chemicals )</li> <li>Learners to observe some of the physical properties (colour; size of particles; phase; texture etc.) of the elements and compounds.</li> </ul>
<b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)	
The meaning of	<ul style="list-style-type: none"> <li>pure substances and listing household examples of pure substances</li> <li>a mixture and listing household examples of mixtures</li> <li>homogeneous and heterogeneous mixtures as well as listing household examples of these types of mixtures</li> <li>The physical properties of pure substances and mixtures</li> </ul>

**BASELINE ASSESSMENT / EDUCATOR** tests pre-knowledge by using the QUESTION and ANSWER method of the content taught in the previous lesson.

- e.g.: What are pure substances? Give some household examples of pure substances? List 3 physical properties of pure substances. What is a mixture? Give 3 household examples of mixtures. What is a homogeneous mixture? Give 3 household examples of homogeneous mixtures. What is a heterogeneous mixture? Give 3 household examples of heterogeneous mixtures. Make a list of the physical properties of pure substances and mixtures.

## 2.2 Main Body (Lesson presentation)

Educator starts lesson off with an exciting demonstration about elements and compounds. [15 min.]

- Educator to put together a selection of elements and compounds that have different physical properties and allow the learners to get a close up inspection of the chemicals and the educator can explain some of the uses and applications of these chemicals in our lives e.g.: sulphur powder is a good fungicide, it burns in oxygen with a blue flame to form sulphur dioxide which is a poisonous gas but it is also used in tomato sauce as a preservative; nitric acid is used to make fertilisers and is also used to make nitro-glycerine which a chemical used in most explosives, potassium is a soft metal that reacts explosively with water and burns with a purple flame in oxygen the same metal used in fireworks that give off purple sparks, it is also a very important ion in the human body used to transmit messages from the brain to the rest of the body and that when you get dehydrated it is one of the ions together with sodium that needs to be replaced in your body for you to be normal again.
- Educator uses the question and answer method to engage learners in the baseline assessment as mentioned above. [10 min.]
- This entire lesson is based on learners using the periodic table as a resource, educator engages learners on a discussion of the components of the periodic table. [25 min.]
  - An **element** is composed of a single kind of atom. An **atom** is the smallest particle of an element that still has all the properties of the element. The atoms in an element all have the same number of protons. Elements are the building blocks of matter. And they're arranged on the periodic table according to their atomic number.
  - Learners to be given a copy of the periodic table and are instructed to make the relevant notes about the periodic table in their notebooks.
  - Educator to explain the following and simultaneously draw up the relevant chalkboard summary on the chalkboard:  
the VERTICAL COLUMNS are called **groups** and the HORIZONTAL ROWS are referred to as **periods**; group 1 elements are called the **alkali metals**; group 2 elements are called **alkali earth metals**; group 7 (17/ VII A) are called **halogens**; group 8 (18/ 0) are called the **noble gases**; that the majority of the elements are metals found in the solid phase at room temperature and Mercury; Caesium and Francium are the only metals in the liquid phase, the metalloids or semi-metals are found in group 4 of the periodic table except for Boron in group 3, the elements are arranged in terms of their atomic numbers (number of protons/ positive charges) found in the nucleus of the atom, elements in the same group have similar chemical and physical properties; elements react with each other to form compounds, elements **lose negative charges** (electrons) to form **positive ions (cation)** and **gain negative charges** to form **negative ions (anion)**.

**VERTICAL COLUMNS (GROUPS)**

H  
O  
R  
I  
Z  
O  
N  
T  
A  
L  
  
R  
O  
W  
S  
  
P  
E  
R  
I  
O  
D  
S

		VERTICAL COLUMNS (GROUPS)																			
1	1	1	2											13	14	15	16	17	18		
1	1	H																			2
	3	Li	Be											B	C	N	O	F	Ne		
2	4	Li	Be											B	C	N	O	F	Ne		
3	11	Na	Mg	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
	19	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
4	39.10	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
	22.99	Na	Mg	44.96	47.88	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.61	74.92	78.96	79.90	83.80		
	6.941	Li	Be											10.81	12.01	14.01	16.00	19.00	20.18		
	1.008	H												26.98	28.09	30.97	32.07	35.45	39.95		
	12.01	C												26.98	28.09	30.97	32.07	35.45	39.95		
	12.01	C												69.72	72.61	74.92	78.96	79.90	83.80		

Atomic number  
Symbol  
Atomic weight

Metal  
Semimetal  
Nonmetal

		VERTICAL COLUMNS (GROUPS)																			
1	1	1	2											13	14	15	16	17	18		
1	1	H																			2
	3	Li	Be											B	C	N	O	F	Ne		
2	4	Li	Be											B	C	N	O	F	Ne		
3	11	Na	Mg	III B	IV B	V B	VI B	VII B	VIII B	VII	IB	IB	13	14	15	16	17	18			
	19	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
4	39.10	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
	22.99	Na	Mg	44.96	47.88	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.61	74.92	78.96	79.90	83.80		
	6.941	Li	Be											10.81	12.01	14.01	16.00	19.00	20.18		
	1.008	H												26.98	28.09	30.97	32.07	35.45	39.95		
	12.01	C												26.98	28.09	30.97	32.07	35.45	39.95		
	12.01	C												69.72	72.61	74.92	78.96	79.90	83.80		

IA IIA IIIA IVA VA VIA VIIA VIIIA 0

IA IIA III B IV B V B VI B VII B VIII B VII IB IB

H - gas Li - solid Br - liquid Tc - synthetic

Non-Metals Transition Metals Rare Earth Metals Halogens

Alkali Metals Alkali Earth Metals Other Metals Inert Elements

- A **compound** is composed of two or more elements in a specific ratio. For example, water is a compound made up of two elements, hydrogen (H) and oxygen (O). These elements are combined in a very specific way — in a ratio of two hydrogen atoms to one oxygen atom, known as:  $H_2O$ . The compound water has physical and chemical properties different from both hydrogen and oxygen — water's properties are a unique combination of the two elements.

### 3. Conclusion

**Activity to Re-enforce lesson** (Educator directs questions to learners to see if they understood the main aspects of the lesson). [10 min.]

Educator explains main concepts of the lesson by the question and answer method: What is an element? What is a mixture? What are some of the physical properties of a mixture and a pure substance? How do you differentiate between a mixture and a pure substance by looking at their physical properties? The educator summarises the main aspects of the lesson on the chalkboard.



**4. HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [15 min]

eg: 1. What is an element? Give the names and symbols of 5 examples of metal; non metals and metalloids. 2. What is a compound? Give the names of 10 examples of compounds you use at home 3. What is the difference between an element and a compound? 4. What is the difference between an anion and a cation? Give 3 examples of each type.

**5. RESOURCES USED:**

Relevant apparatus and chemicals for practical demonstration; worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. (chapter 7 from textbook PHYSICAL SCIENCES 10 (mind action series) S.CROSSMAN)

**Reflection/Notes:**

<b>Name of Teacher:</b>		<b>HOD:</b>	
<b>Sign:</b>		<b>Sign:</b>	
<b>Date:</b>		<b>Date:</b>	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	2	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	1
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>
<b>LESSON OBJECTIVES</b>	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>Explain the meaning of monatomic ion and how to write the formula and charge of some common monatomic ions.</li> <li>Use monatomic ions to write the formulae of some common compounds.</li> </ul> <p>The following results will be the outcome of this lesson:</p> <ul style="list-style-type: none"> <li>The learners being able to name and write the formulae of monatomic ions.</li> <li>The learners being able to use monatomic ions to write the formulae of compounds.</li> </ul>	



<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Question and Answer; Narrative
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	<ul style="list-style-type: none"> <li>Educator introduces the lesson by naming some of some of the COMMON ELEMENTS and COMPOUNDS found in the school laboratory. The educator explains on the chalkboard how to write the names and formulae of the different chemicals found in the school laboratory. e.g.: sulphur powder (S); aluminium metal powder (Al); iodine granules (I<sub>2</sub>) DIATOMIC found as two atoms together; sodium chloride; calcium oxide; copper chloride; sodium bromide, hydrochloric acid etc. (educator can use his own list)</li> <li>Learners to listen and make notes of the names and formulae of chemicals explained by the educator.</li> </ul>
<b>PRE-KNOWLEDGE</b>	learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)
	<ul style="list-style-type: none"> <li>Learners should know the meaning of an element and that of a compound.</li> <li>Learners should know the names and formulae of some of the household examples of elements and compounds</li> <li>Learners should know the position (group number) of the element on the periodic table.</li> </ul>
<b>BASELINE ASSESSMENT / EDUCATOR</b>	tests pre-knowledge by using the QUESTION and ANSWER method of the content taught in the previous lesson. [10 min.]
	<ul style="list-style-type: none"> <li>e.g.: What are ELEMENTS? Give the formula and name of some household examples of elements? What are COMPOUNDS? Give the formula and name of some household examples of compounds?</li> </ul>
<b>2.2 Main Body (Lesson presentation)</b>	

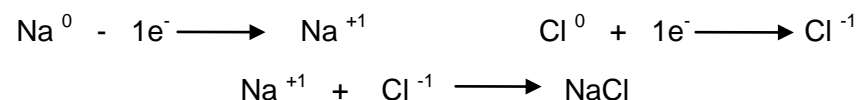
Educator starts lesson off by showing learners how to write the names and formulae of some of the common elements and compounds found in the school laboratory.

[15 min.]

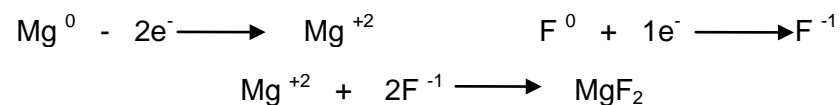
Educator uses the periodic table while learners have their copy in front of them and then explains how elements get to be charged and form single ions known as monatomic ions.

[25 min.]

- Educator explains that all elements on the periodic table are neutral, they have the same number of positive (protons) and negative (electrons) charges in their atoms and that they become positively or negatively charged when they take part in a bond with another element or poly-atomic ion, e.g. the element sodium  has an atomic number of 11 (11 protons- positive charges in its nucleus and it also has 11 electrons- negative charges in its outer orbital) ie.  $+11 + -11 = 0$  and the element chlorine  has an atomic number of 17 (17 protons- positive charges in its nucleus and it also has 17 electrons- negative charges in its outer orbital) ie.  $+17 + -17 = 0$  and that when sodium (a group 1 metal) takes part in a bond with chlorine (a group 7 non-metal) then sodium tends to give off 1 electron to form a positive (+1) charge  $+11 + -10 = +1$  while chlorine tends to take in 1 electron to form a negative (-1) charge  $+17 + -18 = -1$ . Since they are now oppositely charged ions there is a force of attraction between them and they take part in a chemical bond to form NaCl (sodium chloride) commonly called 'table salt'



- Educator explains how magnesium fluoride is formed, when ions/ charges bond to form a compound the TOTAL CHARGE of the compound formed is ZERO ie. Magnesium in group 2 forms a +2 charge in a bond therefore when fluorine bonds with the magnesium ion there must be two fluorine ions with a total charge of -2 to balance the +2 charge of the magnesium ion as shown below. Therefore the formula for magnesium fluoride is  $\text{MgF}_2$  and the 2 is written at the bottom of the FLOURINE atom because it must only apply to the fluorine atom.



- Educator then explains the relationship between the group numbers and the charge that the elements form in a bond, that metals tend to form positive charges and that

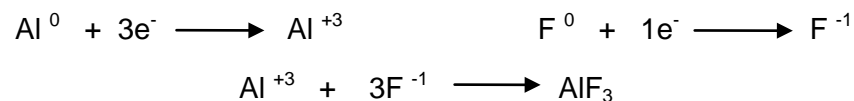
non metals tend to form negative charges. Metals form positive charges that correspond to their group numbers and non-metals form negative charges using the following method: the group number of the non-metal minus the total of the groups, group 8 e.g. if the element is in group 5 then it will have a charge as follows

$$5 - 8 = -3$$

CHARGES		VERTICAL COLUMNS (GROUPS)																		
		+1	+2											+3	-3	-2	-1	0		
1	IA	1 H																	2 He	
2		3 Li	4 Be																	
3		11 Na	12 Mg	III B	IV B	V B	VI B	VII B	VII			IB	IB	5 B	6 C	7 N	8 O	9 F	10 Ne	
4		19 K	20 Ca	21 Sc	22 Ti	23 Y	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	

### 3. CONCLUSION

**Activity to Re-enforce lesson** (Educator explains another example or two of the writing of formulae using monatomic ions to see if learners understood the main aspects of the lesson). E.g: What will be the formula for aluminium fluoride? [10 min.]



### 4. HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook)

Write the formula for the ionic states of Lithium; Potassium; Calcium; Aluminium; Fluorine and Bromine. Write the formula of the following compounds: sodium fluoride; potassium chloride; lithium bromide; magnesium chloride; aluminium bromide. [15 min]

**5. RESOURCES USED:**

Relevant apparatus and chemicals for practical demonstration; worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. (chapter 7 from textbook PHYSICAL SCIENCES 10 (mind action series) S.CROSSMAN)

**Reflection/Notes:**

<b>Name of Teacher:</b>		<b>HOD:</b>	
<b>Sign:</b>		<b>Sign:</b>	
<b>Date:</b>		<b>Date:</b>	

GRADE	10	SUBJECT	Physical Sciences	WEEK	2	TOPIC	Classification of Matter Time: 60 minutes	Lesson	2
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LESSON SUMMARY FOR: DATE STARTED:	DATE COMPLETED:
LESSON OBJECTIVES	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>Explain the meaning of poly-atomic ion and how to write the formula and charge of some common poly-atomic ions.</li> <li>Use poly-atomic ions to write the formulae of some common compounds.</li> </ul> <p>The following results will be the outcome of this lesson:</p> <ul style="list-style-type: none"> <li>The learners being able to name and write the formulae of poly-atomic ions.</li> <li>The learners being able to use poly-atomic ions to write the formulae of compounds.</li> </ul>

### TEACHING and LEARNING ACTIVITIES

#### 1. TEACHING METHOD/S USED IN THIS LESSON:

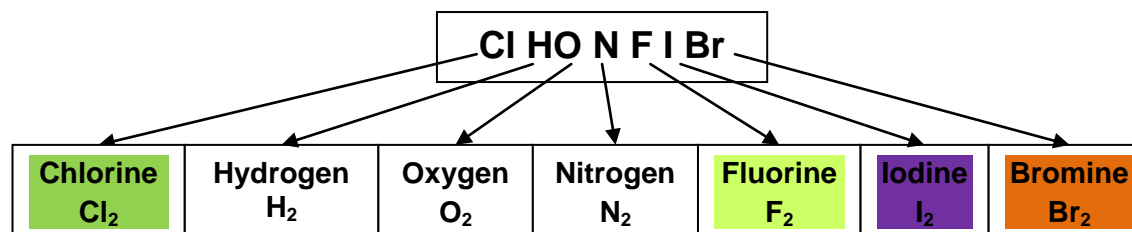
Scientific ; Question and Answer; Narrative

#### 2. LESSON DEVELOPMENT

##### 2.1 Introduction

- Educator introduces the lesson by naming some of some of the COMMON ELEMENTS and COMPOUNDS found in the school laboratory. The educator explains on the chalkboard how to write the names and formulae of the different chemicals found in the school laboratory.

e.g.: sulphur powder (S); aluminium metal powder (Al); iodine granules (I<sub>2</sub>) **DIATOMIC found as two atoms together** – below is a list of the other diatomic gases;



sodium chloride (NaCl); calcium oxide (CaO); copper chloride (CuCl<sub>2</sub>); sodium bromide (NaBr), hydrochloric acid (HCl); copper sulphate (CuSO<sub>4</sub>); copper carbonate (CuCO<sub>3</sub>); potassium permanganate (KMnO<sub>4</sub>); magnesium hydroxide (Mg(OH)<sub>2</sub>) etc. (educator can use his own list)

- The educator points out to learners the monatomic and polyatomic ions found in these various compounds.

- ❑ Learners to listen and make notes of the names and formulae of chemicals explained by the educator.

**PRE-KNOWLEDGE** learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)

- Learners should know the meaning of an element and that of a compound.
- Learners should know the names and formulae of some of the household examples of elements and compounds
- Learners should know the position (group number) of the element on the periodic table and their respective charge (monatomic ions) they form when they bond to form a compound.

**BASELINE ASSESSMENT / EDUCATOR tests pre-knowledge** by using the QUESTION and ANSWER method of the content taught in the previous lesson.

- ❑ e.g.: What are ELEMENTS? Give the formula and name of elements when they form ions? What are COMPOUNDS? Give the formula and name of some household compounds (EPSOM SALTS-magnesium sulphate; WASHING SODA- sodium carbonate; BAKING SODA- sodium hydrogen carbonate; VINEGAR- ethanoic acid; JIK- sodium hypochlorite; MILK OF MAGNESIA- magnesium hydroxide; BATTERY ACID- sulphuric acid; SPIRITS OF SALTS- hydrochloric acid).

## 2.2 Main Body (Lesson presentation)

- ❑ Educator starts lesson off by showing learners how to write the names and formulae of some of the common elements and compounds found in the school laboratory as mentioned in the introduction. [10 min.]
- ❑ Educator tests baseline assessment by question and answer method and writes answers on the chalkboard.[10 min.]
- ❑ Educator uses the table of ions (monatomic and poly-atomic) while learners have their copy in front of them and then explains that MONATOMIC IONS are ions that have a single element in their formula and that they usually have a FIXED CHARGE depending on their position on the periodic table, that POLYATOMIC IONS have MORE THAN ONE ELEMENT in their formula and have charges as shown in the table below. The educator then explains how elements get to be charged and form single ions known as monatomic ions and discusses some of the common poly-atomic ions and uses them to write the formulae of compounds as shown below. [30 min.]

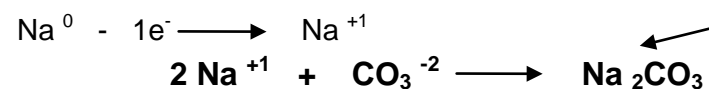
## PHYSICAL SCIENCES GRADE 10 THE PERIODIC TABLE (Monoatomic and Polyatomic ions)

+1		+2		+3		-1		-2		-3	
formula	name	formula	name	formula	name	formula	name	formula	name	formula	name
Li <sup>+1</sup>	Lithium ion	Mg <sup>+2</sup>	Magnesium ion	Al <sup>+3</sup>	Aluminium ion	F <sup>-1</sup>	Flouride ion	O <sup>-2</sup>	Oxide	N <sup>-3</sup>	nitride
Na <sup>+1</sup>	Sodium ion	Ca <sup>+2</sup>	Calcium ion			Cl <sup>-1</sup>	Chloride ion	S <sup>-2</sup>	sulphide	P <sup>-3</sup>	phosphide
K <sup>+1</sup>	Potassium ion					Br <sup>-1</sup>	Bromide ion	CO <sub>3</sub> <sup>-2</sup>	carbonate		
NH <sub>4</sub> <sup>+1</sup>	Ammonium ion					I <sup>-1</sup>	Iodide ion	SO <sub>4</sub> <sup>-2</sup>	sulphate	PO <sub>4</sub> <sup>-3</sup>	phosphate
						OH <sup>-1</sup>	Hydroxide ion	Cr <sub>2</sub> O <sub>7</sub> <sup>-2</sup>	dichromate		
						NO <sub>3</sub> <sup>-1</sup>	Nitrate ion	SO <sub>3</sub> <sup>-2</sup>	sulphite		
						NO <sub>2</sub> <sup>-1</sup>	Nitrite ion	C <sub>2</sub> O <sub>4</sub> <sup>-2</sup>	oxalate		
						CH <sub>3</sub> COO <sup>-1</sup>	Ethanoate ion	S <sub>2</sub> O <sub>3</sub> <sup>-2</sup>	thiosulphate		
						CNS <sup>-1</sup>	Cyanate ion				
						CN <sup>-1</sup>	Cyanide ion				
						ClO <sub>3</sub> <sup>-1</sup>	Chlorate ion				

e.g. 1. What is the formula for sodium carbonate?

The carbonate ion has the formula CO<sub>3</sub><sup>-2</sup>, **OXYGEN** retains its - 2 charge in most compounds and therefore the total charge of the 3 oxygen ions in the formula = - 6 and therefore carbon has to have a +4 charge for the charge of the ion to be - 2

therefore the formula for sodium carbonate will be worked out as follows: since sodium forms a +1 charge in a bond, therefore two sodium ions are needed to balance the two

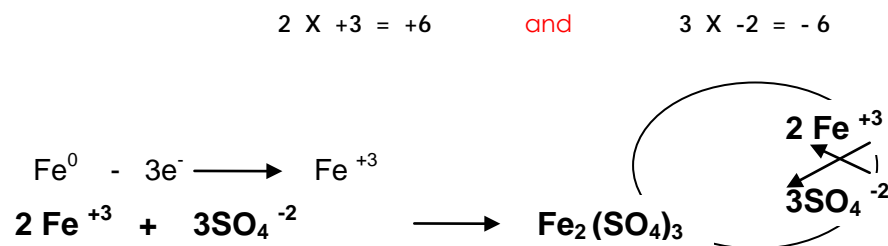


negative charges of the carbonate ion as shown below:

e.g. 2. What is the formula for Iron III Sulphate? The sulphate ion has the formula SO<sub>4</sub><sup>-2</sup>, **OXYGEN** retains its - 2 charge in most compounds and therefore the total charge of the 4 oxygen ions in the formula = - 8 and therefore sulphur has to have a +6 charge for the charge of the ion to be - 2



therefore the formula for iron iii sulphate will be worked out as follows: the ROMAN NUMERAL iii gives us the charge (ALWAYS POSITIVE) on the transition element (IRON), since the TOTAL CHARGE in a compound must be ZERO, therefore the NUMBER of each CHARGE (3 & 2) must be swapped around to give the number of ions needed to balance the charges so that the TOTAL of the CHARGES = ZERO



- ROMAN NUMERALS in the names of compounds is usually referred to as 'STOCK NOTATION' and the NUMBER indicates the CHARGE of the POSITIVE ION in the compound OR the FIRST ION written in the chemical formula. Roman numerals are used for ions that can have more than ONE CHARGE e.g. Iron ii ( $\text{Fe}^{+2}$ ) and Iron iii ( $\text{Fe}^{+3}$ ) ; Copper i ( $\text{Cu}^{+1}$ ) and Copper ii ( $\text{Cu}^{+2}$ ) etc., the TRANSITION ELEMENTS (the word transition means a state of change) usually have more than one charge depending on the other monatomic/ polyatomic ion they are bonded to AND some non-metals like SULPHUR; NITROGEN; CHLORINE also have more than one charge when they bonded to the oxygen ion in a polyatomic ion, instead of their NORMAL NEGATIVE CHARGE since they are non-metals they now have a POSITIVE CHARGE e.g. sulphite ion  $\text{SO}_3^{-2}$  here the SULPHUR has a charge of +6 instead of its normal -2 belonging to group 6 in the periodic table.

### 3. CONCLUSION

**Activity to Re-enforce lesson** (Educator gives learners a list of compounds and learners try to write the correct formula of these compounds using the ion table and the periodic table ). E.g: Write the correct chemical formula for : magnesium carbonate; sodium hydroxide; sodium sulphate; potassium chlorate; calcium carbonate; calcium hydroxide; potassium dichromate? Educator checks answers on the chalkboard with learners. [10 min.]

**4. HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) Learners to answer THINK TANK 6 & 7 (chapter 7 from textbook PHYSICAL SCIENCES 10 (mind action series) S.CROSSMAN) [15 min]

### 5. RESOURCES USED:

Relevant apparatus and chemicals for practical demonstration; worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. (chapter 7 from textbook PHYSICAL SCIENCES 10 (mind action series) S.CROSSMAN)

Reflection/Notes:

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<b>Name of Teacher:</b>		<b>HOD:</b>	
<b>Sign:</b>		<b>Sign:</b>	
<b>Date:</b>		<b>Date:</b>	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	2	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	3
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>To write chemical formulas without using the ion worksheets and the periodic table</li> <li>Give chemical names and common names of the household chemicals found in the school laboratory and in their houses.</li> </ul> <p>The following results will be the outcome of this lesson:</p> <ul style="list-style-type: none"> <li>The learners being able to give the common name and the corresponding chemical name of a few household chemicals.</li> <li>The learners being able to write the formulae of the chemical names of compounds without the ion worksheets.</li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Question and Answer; Narrative
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	<ul style="list-style-type: none"> <li>□ Educator introduces the lesson by showing learners on the chalkboard how to write the chemical formula of a compound by using their knowledge of the periodic table and the ions.</li> <li>□ The educator points out to learners the monatomic and polyatomic ions found in these various compounds. Learners to listen and make notes of the way chemical formulae are written from their names.</li> </ul>
<b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)	
	<ul style="list-style-type: none"> <li>Learners should know the names and formulae of some of the household examples of elements and compounds</li> <li>Learners should have a good knowledge of the table of ions (POLYATOMIC IONS) to work out the formula of compounds.</li> <li>Learners should know the position (group number) of the element on the periodic table and their respective charge (monatomic ions) they form when they bond to form a compound.</li> </ul>
<b>BASELINE ASSESSMENT (BL 7)</b>	

EDUCATOR tests pre-knowledge by using the QUESTION and ANSWER method of the content taught in the previous lesson.

1. Name the following ions:  $\text{NO}_3^{-1}$ ;  $\text{NO}_2^{-1}$ ;  $\text{CH}_3\text{COO}^{-1}$ ;  $\text{O}^{-2}$ ;  $\text{S}^{-2}$ ;  $\text{CO}_3^{-2}$ ;  $\text{SO}_4^{-2}$ ;  $\text{Cr}_2\text{O}_7^{-2}$ ;  $\text{SO}_3^{-2}$

2. Give the formula and the charge of the following ions: nitride; phosphide; phosphate; Cyanate; Cyanide; Chlorate; chlorite; hypochlorite; peroxide

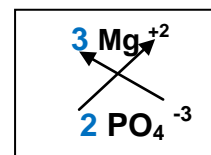
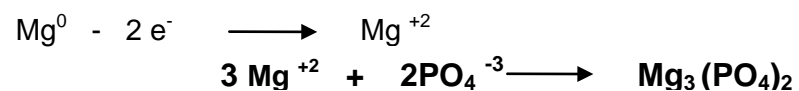
## 2.2 Main Body (Lesson presentation)

- ❑ Educator starts lesson off by showing learners how to write the names and formulae of some of the common elements and compounds found in the school laboratory as mentioned in the introduction. [10 min.]
- ❑ Educator tests baseline assessment by question and answer method and writes answers on the chalkboard. [15 min.]
- ❑ Educator explains to learners that the table of ions (polyatomic) must be memorised by the learners in order for them to do well in chemistry. Educator must emphasize that whenever any chemical is used in any question the learners must practise writing the formulae and naming the ions in order to get familiar with chemicals and their symbols; formulae and their names. [15 min.]

e.g. 1. What is the formula for magnesium phosphate?

The phosphate ion has the formula  $\text{PO}_4^{-3}$ , **OXYGEN** retains its - 2 charge in most compounds and therefore the total charge of the **4 oxygen ions** in the formula = - 8 and since phosphorous is bonded to an oxygen ion it now has a **positive charge** different from its **normal charge of -3** being in **group 5**, this happens because of the higher electro-negativity of oxygen, the **charge of the phosphorous** is +5 to give the **-3 charge** of the **phosphate ion**

therefore the formula for magnesium phosphate will be worked out as follows: since magnesium is a **metal element** found in **group 2** it will form a **+2 charge** in a bond, in order to balance the charges when the compound is formed the **NUMBER** of the charges can be swapped as shown below:



## 3. CONCLUSION

**Activity to Re-enforce lesson** (Educator gives learners a list of compounds and learners try to write the correct formula of these compounds using the ion table and the periodic

table). E.g: Write the correct chemical formula for: magnesium sulphate; sodium hypochlorite; potassium chlorate; iron iii oxide; copper i oxide; copper ii oxide; phosphoric acid; hydrogen peroxide? Educator checks answers on the chalkboard with learners. [10 min.]

**4. HOMEWORK QUESTIONS (HW 7)** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook)

Write the chemical formula for the following compounds (write the ionic equations): [15 min]

1. sodium chloride
2. Calcium sulphide
3. Copper sulphite
4. Potassium fluoride
5. Magnesium oxide
6. Aluminium hydroxide
7. Ammonium nitrate
8. Iron iii carbonate
9. Copper iodide
10. Magnesium phosphate

**5. RESOURCES USED:**

Relevant apparatus and chemicals for practical demonstration; worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. Worksheets given to learners; the table of ions and the table of common names and chemical names.

Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	3	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	1 and 2
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Explain the meaning of the different physical properties of substances.</li> <li>• List physical properties of metals and be able to explain them.</li> <li>• List some of the uses of metals in our daily lives.</li> <li>• The following results will be the outcome of this lesson: <ul style="list-style-type: none"> <li>• The learners being able to explain the different physical properties of substances.</li> <li>• The learners being able to list and explain some of the physical properties and uses of metals.</li> </ul> </li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Investigative ; observation ; Question and Answer; Narrative
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	<ul style="list-style-type: none"> <li>❑ Educator introduces the lesson by showing the learners some examples of metals found in the school laboratory and in the house e.g.: copper , iron, zinc, brass( alloy of copper and zinc), aluminium, tin, steel (alloy -small amount of carbon and iron mixed), silver, gold, cast iron(alloy-carbon and silicon mixed with iron) (educator can make own list)</li> <li>❑ The educator points out to learners to observe some of the physical properties of the metals in terms of colour; phase; lustre, hardness etc.</li> </ul>
<b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)	<ul style="list-style-type: none"> <li>• Learners should know the meaning of an element and that of a compound.</li> <li>• Learners should know the general meaning of physical property of a substance.</li> </ul>
<b>BASELINE ASSESSMENT (BL 9)</b>	
<b>EDUCATOR</b> tests pre-knowledge by using the QUESTION and ANSWER method of the content taught in the previous lesson.	
1. What is meant by the physical property of an element or a compound?	
2. List some of the physical properties of elements and compounds.	

**2.2 Main Body (Lesson presentation)**

- ❑ Educator tests baseline assessment by question and answer method and writes answers on the chalkboard. [10 min.]

The physical property of a substance relates to its physical characteristics i.e. its size; shape; colour; its hardness/ softness; how heavy/ light it is; its strength etc.

ELEMENTS and compounds have the following physical properties: different colours; different shapes and sizes as they are found in nature; different densities (heavy/ light); hard/ soft to the touch; good / poor heat conductors ; good electrical conductors and also good insulators of electricity; some can be bent into shapes without breaking; some can be hammered into thinner layers and others can be drawn out into thin wires.

- ❑ Educator starts lesson by showing learners some of the common metals found in the home and in the laboratory and learners have to observe some of the physical properties of these metals.

- ❑ Educator explains the meaning of the different physical properties of substances using relevant examples from the practical activity done in the previous lesson: [30 min.]

**MELTING POINT** of a substance is the temperature at which the solid particles are changed to liquid particles (during the change in phase the temperature of the substance remains constant)

**BOILING POINT** of a substance is the temperature at which the particles of a liquid (even the ones at the bottom of the container ) are changed into the gas phase. (during the change in phase the temperature of the substance remains constant)

**EVAPORATION** is the process where the surface particles of a liquid gain enough kinetic energy to escape into the gas phase (only the surface particles are affected and not the rest of the liquid unlike the boiling process).

**DENSITY** is the closeness of the particles in a substance, the more closer the particles are (generally strong bonds) the higher the density, metals have higher densities than liquids and gases.

**LUSTRE** is the degree of shine a substance has, the ability of a substance to reflect light off its surface will affect how much it shines, metals generally have a high lustre while non metals are dull and do not reflect light so well.

**MALLEABILITY** is the ability of substances to be hammered into different shapes without breaking, most metals are highly malleable whilst most non metals break when hammered.

**BRITTLINESS** is the tendency for substances to break when they are bent, most non metals break when they are bent. E.g. graphite (pencil lead).

**DUCTILITY** is the ability of a substance to be drawn out into long, thin pieces of wire, most metals are highly ductile and non metals have very poor ductility.

**TENSILE STRENGTH** is the ability of a substance to bend without breaking, most metals have a high tensile strength while non metals break even at the slightest bend.

**THERMAL CONDUCTIVITY** is the ability of a substance to absorb heat and give it off without burning or undergoing any permanent change (physical- melting/ changing colour, chemical – change in its properties) in its structure. Metals are very good conductors of heat while non metals conduct heat very poorly and usually undergo physical and chemical changes when heated.

**ELECTRICAL CONDUCTIVITY** is the ability of a substance to allow an electric current to flow in it without losing a great deal of electrical energy in the process. Metals are very good electrical conductors because of the presence of electrons that free to move in it, while non metals do not have these free electrons and are therefore used as insulators in electrical components and appliances.

PHYSICAL Property	Cu	Zn	Mg	Fe	Al	Ag	Brass	Steel	Cast iron	Sn
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Appearance (LUSTRE) ✓	shiny	shiny	dull-shines if oxide is removed	dull-shines if oxide is removed	dull-shines if oxide is removed	shiny	shiny	shiny	dull	shiny
Colour ✓	red-brown	silver-grey	dark grey	dark grey	light grey	light grey	yellow-gold	light grey	dark grey	light grey
Density ✓	not very high	low	low	high	low	middle range	high	high	high	low
Physical State (25°C, 101.3kPa) ✓	solid	solid	solid	solid	solid	solid	solid	solid	solid	solid
Melting and Boiling Point	relatively high	middle range	middle range	high	high	high	high	high	high	low
Heat (thermal) Conductivity ✓	good	good	good	good	good	good	good	good	good	good
Electrical Conductivity ✓	good	good	good	good	good	very good	good	good	middle range	good
Tensile Strength ✓	low	medium	very low	medium	low	medium	high	high	brittle	low
Malleability ✓	high	high	high	high	low	medium	high	medium	very low	high
Ductility ✓	high	medium	medium	high	medium	high	high	high	very low	high

### 3. CONCLUSION

**Activity to Re-enforce lesson** (Learners have to write the definitions of the following (tensile strength; malleability; ductility; lustre; thermal conductivity; boiling point; melting point; freezing point; evaporation; sublimation). Educator checks answers with learners using the notes in the main part of the lesson. [10 min.]

**Educator should add the following definitions to the list:**

**FREEZING POINT** the temperature at which the particles of a liquid start changing to a solid (during this change in phase there is no change in the temperature of the substance).

**TEMPERATURE** is a measure of the average kinetic energy of the particles of a substance.

**KINETIC ENERGY** is the energy particles of a substance have when they are in motion. Kinetic energy of a substance increases by the same factor as its temperature increases and decreases by the same factor as its temperature decreases (directly proportional relationship).

**4. HOMEWORK QUESTIONS (HW 9)** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) Learners to answer the following questions as homework: 1. What is temperature? 2. What is kinetic energy? 3. Explain why the temperature of a substance



does not change during a change in phase. 4. Name at least two other substances in your daily lives that undergo the sublimation process. 5. What is potential energy? How is the potential energy of a substance affected when it undergoes a change in phase? 6. How is the potential energy of a substance affected when it undergoes a change in phase?

7. Oil is used in the oil heaters that some of us have at homes, is oil a good or a poor conductor of heat? Explain.

**5. RESOURCES USED:**

Relevant worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. Table for learners to record their observations, the relevant metals as mentioned in the introduction, Bunsen / spirit burner to test thermal conductivity, light-bulb, batteries, conducting wires to test electrical conductivity.

**Reflection/Notes:**

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	3	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	3
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>Define groups in which the metal elements are found on the periodic table.</li> <li>List physical properties of metals and be able to explain them.</li> <li>List some of the uses of metals in our daily lives.</li> <li>The following results will be the outcome of this lesson: <ul style="list-style-type: none"> <li>The learners being able to identify the groups in which the metals are found on the periodic table.</li> <li>The learners being able to list and explain some of the physical properties and uses of metals.</li> </ul> </li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Investigative ; observation ; Question and Answer; Narrative
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	<ul style="list-style-type: none"> <li>Educator introduces the lesson by showing the learners some examples of metals found in the school laboratory and in the house e.g.: copper , iron, zinc, brass( alloy of copper and zinc), aluminium, tin, steel (alloy -small amount of carbon and iron mixed), silver, gold, cast iron(alloy-carbon and silicon mixed with iron) (educator can make own list)</li> <li>The educator points out to learners to observe some of the physical properties of the metals in terms of colour; phase; lustre, hardness etc.</li> </ul>
<b>PRE-KNOWLEDGE</b>	<ul style="list-style-type: none"> <li>Learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)</li> <li>Learners should know the meaning of an element and that of a compound.</li> <li>Learners should know the position (group number) of the metals on the periodic table and their respective charge (monatomic ions) they form when they bond to form a compound.</li> </ul>
<b>BASELINE ASSESSMENT (BL 8)</b>	
<b>EDUCATOR tests pre-knowledge by using the QUESTION and ANSWER method of the content taught in the previous lesson.</b>	
<b>1. What is meant by the physical property of an element or a compound?</b>	
<b>2. List and explain some of the physical properties of elements and compounds.</b>	

**2.2 Main Body (Lesson presentation)**

- ❑ Educator tests baseline assessment by question and answer method and writes answers on the chalkboard. [10 min.]
- ❑ Educator starts lesson by showing learners some of the common metals found in the home and in the laboratory and learners have to observe some of the physical properties of these metals and record them in their tables as shown below. [10 min.]
- ❑ Educator uses the periodic table to show learners the position of the metals on the table.
- ❑ Educator divides learners into groups and then provides each group with samples of the metals and the relevant apparatus (apparatus to test thermal conductivity and apparatus to test electrical conductivity), so that they can make observations with regards the physical properties (ONLY the ones with a TICK ✓) and record them in the table as shown below: [30 min.]
- ❑ Educator discusses the properties of boiling point; melting point and the chemical properties of the metals with the learners.  
i.e. metals generally have high boiling points and melting (besides mercury the only liquid metal at room temperature) because of the strong bonds and high density; metals also form basic oxides and form positive ions in a bond with the non-metals, they react with non-metals to form salts e.g. table salt (sodium chloride)
- ❑ Educator explains some of the important uses of metals in our daily lives i.e. copper is used as an electrical conductor and for water pipes; iron is used in most metal/ steel structures; iron and zinc in corrugated iron for the roofing of most informal settlement houses and industries; aluminium for the frames of glass sliding/ shower doors and window frames; tin for soft drink cans; tungsten for filament light bulbs and heating elements for stoves/ kettles/ heaters; titanium for spectacle frames and jet engines, platinum for jewellery and as a catalyst for many chemical industrial processes etc. And what about all the metals used in our foods as minerals e.g. potassium; sodium; magnesium for transporting nerve impulses in the body and preventing dehydration; calcium for tooth enamel and bones; iron for blood clotting in injuries etc.

## Periodic Table of the Elements

1A																	8A
1 <b>H</b> 1.00794 Hydrogen																	2 <b>He</b> 4.002602 Helium
3 <b>Li</b> 6.941 Lithium	4 <b>Be</b> 9.012182 Beryllium											5 <b>B</b> 10.811 Boron	6 <b>C</b> 12.0107 Carbon	7 <b>N</b> 14.0067 Nitrogen	8 <b>O</b> 15.9994 Oxygen	9 <b>F</b> 18.9984032 Fluorine	10 <b>Ne</b> 20.1797 Neon
11 <b>Na</b> 22.989769 Sodium	12 <b>Mg</b> 24.3050 Magnesium											13 <b>Al</b> 26.9815386 Aluminum	14 <b>Si</b> 28.0855 Silicon	15 <b>P</b> 30.973762 Phosphorus	16 <b>S</b> 32.065 Sulfur	17 <b>Cl</b> 35.453 Chlorine	18 <b>Ar</b> 39.948 Argon
19 <b>K</b> 39.0983 Potassium	20 <b>Ca</b> 40.078 Calcium	21 <b>Sc</b> 44.955912 Scandium	22 <b>Ti</b> 47.867 Titanium	23 <b>V</b> 50.9415 Vanadium	24 <b>Cr</b> 51.9961 Chromium	25 <b>Mn</b> 54.938045 Manganese	26 <b>Fe</b> 55.845 Iron	27 <b>Co</b> 58.933195 Cobalt	28 <b>Ni</b> 58.6934 Nickel	29 <b>Cu</b> 63.546 Copper	30 <b>Zn</b> 65.38 Zinc	31 <b>Ga</b> 69.723 Gallium	32 <b>Ge</b> 72.64 Germanium	33 <b>As</b> 74.92160 Arsenic	34 <b>Se</b> 78.96 Selenium	35 <b>Br</b> 79.904 Bromine	36 <b>Kr</b> 83.798 Krypton
37 <b>Rb</b> 85.4678 Rubidium	38 <b>Sr</b> 87.62 Strontium	39 <b>Y</b> 88.90585 Yttrium	40 <b>Zr</b> 91.224 Zirconium	41 <b>Nb</b> 92.90638 Niobium	42 <b>Mo</b> 95.96 Molybdenum	43 <b>Tc</b> [98] Technetium	44 <b>Ru</b> 101.07 Ruthenium	45 <b>Rh</b> 102.90550 Rhodium	46 <b>Pd</b> 106.42 Palladium	47 <b>Ag</b> 107.8682 Silver	48 <b>Cd</b> 112.411 Cadmium	49 <b>In</b> 114.818 Indium	50 <b>Sn</b> 118.710 Tin	51 <b>Sb</b> 121.760 Antimony	52 <b>Te</b> 127.60 Tellurium	53 <b>I</b> 126.90447 Iodine	54 <b>Xe</b> 131.293 Xenon
55 <b>Cs</b> 132.9054519 Cesium	56 <b>Ba</b> 137.327 Barium	57-71 Lanthanides	72 <b>Hf</b> 178.49 Hafnium	73 <b>Ta</b> 180.94788 Tantalum	74 <b>W</b> 183.84 Tungsten	75 <b>Re</b> 186.207 Rhenium	76 <b>Os</b> 190.23 Osmium	77 <b>Ir</b> 192.217 Iridium	78 <b>Pt</b> 195.084 Platinum	79 <b>Au</b> 196.966569 Gold	80 <b>Hg</b> 200.59 Mercury	81 <b>Tl</b> 204.3833 Thallium	82 <b>Pb</b> 207.2 Lead	83 <b>Bi</b> 208.98040 Bismuth	84 <b>Po</b> [209] Polonium	85 <b>At</b> [210] Astatine	86 <b>Rn</b> [222] Radon
87 <b>Fr</b> [223] Francium	88 <b>Ra</b> [226] Radium	89-103 Actinides	104 <b>Rf</b> [267] Rutherfordium	105 <b>Db</b> [268] Dubnium	106 <b>Sg</b> [271] Seaborgium	107 <b>Bh</b> [272] Bohrium	108 <b>Hs</b> [279] Hassium	109 <b>Mt</b> [276] Meitnerium	110 <b>Ds</b> [281] Darmstadtium	111 <b>Rg</b> [280] Roentgenium	112 <b>Cn</b> [285] Copernicium	113 <b>Uut</b> [284] Ununtrium	114 <b>Uuq</b> [289] Ununquadium	115 <b>Uup</b> [288] Ununpentium	116 <b>Uuh</b> [293] Ununhexium	117 <b>Uus</b> [294] Ununseptium	118 <b>Uuo</b> [294] Ununoctium
Lanthanides		57 <b>La</b> 138.90547 Lanthanum	58 <b>Ce</b> 140.116 Cerium	59 <b>Pr</b> 140.90765 Praseodymium	60 <b>Nd</b> 144.242 Neodymium	61 <b>Pm</b> [145] Promethium	62 <b>Sm</b> 150.36 Samarium	63 <b>Eu</b> 151.964 Europium	64 <b>Gd</b> 157.25 Gadolinium	65 <b>Tb</b> 158.92535 Terbium	66 <b>Dy</b> 162.500 Dysprosium	67 <b>Ho</b> 164.93032 Holmium	68 <b>Er</b> 167.259 Erbium	69 <b>Tm</b> 168.93421 Thulium	70 <b>Yb</b> 173.054 Ytterbium	71 <b>Lu</b> 174.9668 Lutetium	
Actinides		89 <b>Ac</b> [227] Actinium	90 <b>Th</b> 232.03806 Thorium	91 <b>Pa</b> 231.03588 Protactinium	92 <b>U</b> 238.02891 Uranium	93 <b>Np</b> [237] Neptunium	94 <b>Pu</b> [244] Plutonium	95 <b>Am</b> [243] Americium	96 <b>Cm</b> [247] Curium	97 <b>Bk</b> [247] Berkelium	98 <b>Cf</b> [251] Californium	99 <b>Es</b> [252] Einsteinium	100 <b>Fm</b> [257] Fermium	101 <b>Md</b> [258] Mendelevium	102 <b>No</b> [259] Nobelium	103 <b>Lr</b> [262] Lawrencium	
Alkali Metals		Alkaline Earth		Basic Metal		Halogen		Noble Gas		Non Metal		Rare Earth		Semi Metal		Transition Metal	

PHYSICAL Property	Cu	Zn	Mg	Fe	Al	Ag	Brass	Steel	Cast iron	Sn
Appearance (LUSTRE/ SHINE) ✓	shiny	shiny	dull-shines if oxide is removed	dull-shines if oxide is removed	dull-shines if oxide is removed	shiny	shiny	shiny	dull	shiny
Colour ✓	red-brown	silver-grey	dark grey	dark grey	light grey	light grey	yellow-gold	light grey	dark grey	light grey
Density (HEAVY/ LIGHT) ✓	not very high	low	low	high	low	middle range	high	high	high	low
Physical State (25°C, 101.3kPa) ✓	solid	solid	solid	solid	solid	solid	solid	solid	solid	solid
Melting and Boiling Point	relatively high	middle range	middle range	high	high	high	high	high	high	low
Heat (thermal) Conductivity ✓	good	good	good	good	good	good	good	good	good	good
Electrical Conductivity ✓	good	good	good	good	good	very good	good	good	middle range	good
Tensile Strength (resistance to bending) ✓	low	medium	very low	medium	low	medium	high	high	brittle breaks	low
Malleability (roll into sheets/ hammered into shapes) ✓	high	high	high	high	low	medium	high	medium	very low	high
Ductility (draw into wire) ✓	high	medium	medium	high	medium	high	high	high	very low	high
<b>CHEMICAL PROPERTY</b>										
Charge on Ions (in general)	positive	positive	positive	positive	positive	positive				positive
Bonding in oxides and chlorides	good	good	good	good	good	good				good
pH of oxides	weak base	neutral	strong base	weak base	weak base	neutral	neutral	neutral	neutral	weak base

## 3. CONCLUSION

**Activity to Re-enforce lesson** (Learners have to complete the yellow part (tensile strength; malleability; ductility and charge on ions) of the table on their own. Educator checks learners' observations with regards the properties of metals on the table). [10 min.]

#### 4. HOMEWORK QUESTIONS (HW 8)

(educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook)

1. List 10 more uses of metals besides the ones discussed during the lesson. 2 List two more chemical properties of metals besides the ones mentioned in the lesson. [15 min]

#### 5. RESOURCES USED:

Relevant worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. Table for learners to record their observations, the relevant metals as mentioned in the introduction, Bunsen / spirit burner to test thermal conductivity, light-bulb, batteries, conducting wires to test electrical conductivity.

Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	3	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	4
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of this lesson learners should know the following:</p> <ul style="list-style-type: none"> <li>• Explain the meaning of thermal conductivity and thermal insulator.</li> <li>• List and explain the factors that affect thermal conductivity.</li> <li>• List the applications and uses of materials that are good/ poor conductors of heat.</li> <li>• The following results will be the outcome of this lesson: <ul style="list-style-type: none"> <li>• The learners being able to explain the meaning of thermal conductivity and thermal insulator.</li> <li>• The learners being able to list examples of good thermal conductors and thermal insulators.</li> <li>• The learners being able to explain the use of thermal conductivity in our lives.</li> </ul> </li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>
<p><b>1. TEACHING METHOD/S USED IN THIS LESSON:</b> Scientific ; Investigative ; observation ; Question and Answer; Narrative</p> <p><b>2. LESSON DEVELOPMENT</b></p> <p><b>2.1 Introduction</b></p> <p>□ Educator introduces the lesson by heating a piece of copper rod and a plastic ruler. Learners make their observations while educator explains what he is doing.</p> <p><b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)</p> <ul style="list-style-type: none"> <li>• Learners should be able explain what is meant by the physical property of a substance.</li> <li>• Learners should know the physical properties of metals and non-metals.</li> <li>• Learners should know the position (group number) of the metals and non-metals on the periodic table.</li> </ul> <p><b>BASELINE ASSESSMENT (BL 12)</b></p> <p><b>EDUCATOR tests pre-knowledge</b> by using the QUESTION and ANSWER method of the content taught in the previous lesson.</p> <ol style="list-style-type: none"> <li>1. What is meant by the physical property of a substance?</li> <li>2. List and explain some of the physical properties of metals and non metals?</li> </ol>

## 2.2 Main Body (Lesson presentation)

- Educator tests baseline assessment by question and answer method and writes answers on the chalkboard. [5 min.]

Educator starts lesson by heating a piece of a copper rod and a piece of a plastic ruler, learners observe the physical changes that take place with regards the two substances when they are heated. [10 min.]

- Educator discusses explains the reason for the learner's observations with regards the practical that was done before. [5 min.]
- The copper rod is a good conductor of heat, it absorbs the heat very quickly and is able to give it off just as quick. The plastic ruler is a poor conductor of heat because it absorbs the heat quickly but it takes very long to transfer it to its surroundings, the extra heat breaks the bonds between the plastic molecules and it changes from a solid to a liquid and starts to melt.
- Educator divides class into groups and provides learners with samples of the following substances: glass; wood; graphite; zinc; aluminium; silver if possible; bees wax; cooking oil (educator can make up his own list). Learners then heat the substances directly (glass; wood; graphite; aluminium; silver) for 5 minutes and the bees wax or candle wax ; water and cooking oil are heated indirectly in glass beakers. After heating for a few minutes learners to note the physical changes that take place with regards the substances as well as note the change in temperature of the substance over a time period of 15 minutes once the heat has been removed. Learners record their observations in the table shown below: [30 min.]

substance heated	glass	wood	graphite	aluminium	silver	bees wax/ candle wax	cooking oil	tap water
initial temp.								
final temp. After heating for 5 minutes								
temp. At 10 minutes								
temp. At 15 minutes								
physical changes (colour; size; shape; phase; volume)								



### 3. CONCLUSION

**Activity to Re-enforce lesson** (Educator reinforces lesson content by discussing and explaining the concepts related to thermal conductivity and also uses the table below to show the learners a comparison of the measured thermal conductivities of a few household substances). [10 min.]

THERMAL CONDUCTIVITY non-metals

Material/Substance	CONDUCTIVITY at 25°C
Cork board	0.04
Wool felt	0.04
Rock wool	0.04
Polystyrene (styrofoam)	0.033
Polyurethane	0.02
Wood	0.12-0.04
Air at 0° C	0.024

THERMAL CONDUCTIVITY metals

Material/Substance	CONDUCTIVITY at 25°C
Silver	429
Copper	401
Gold	310
Aluminium	250
Magnesium	156
Zinc Zn	116
Brass	109
Sodium	84
Iron	80
Platinum	70
Cobalt	69
Tin Sn	67
Iron, cast	55
Lead Pb	35
Antimony	18.5
Stainless Steel	16
Mercury	8

- **THERMAL CONDUCTIVITY** is the ability of a substance to conduct heat. Materials with a high thermal conductivity allow heat to be transferred at a faster rate (very quickly) through the substance while those with a low thermal conductivity retain the heat and transfer it very slowly.  
Heat passes through some materials easily and these materials are called thermal conductors.  
Metals usually feel cold to the touch. Metals are good thermal conductors, because heat passes through them quickly.

Thermal conductivity (4 highest elements listed):

1. (highest) Silver: 4.29 W /cm K
2. Copper: 4.01
3. Gold: 3.17
4. Aluminum: 2.37

- ❑ **THERMAL INSULATORS** Heat does not pass through some material or it passes through them very slowly such as plastic, oven glove, thermal underwear, cork board and wood. These materials are called thermal insulators. These thermal insulators are good for keeping heat out as well as in. Some examples of good insulators are - a thermos flask, it keeps hot things hot and keeps cold things cold, cooler - keeps the heat out and keeps the inside cool, and a polystyrene cup keeps the heat in and keeps it hot. Remember that a good insulator is a poor conductor. Insulators often contain pockets of trapped air like feathers on a bird and fur on animals to keep them warm. Heat loves to travel and will travel from a warmer material to a colder material. The heat will only travel from hot things to colder things and never the other way around. Some materials allow heat to travel through easily and some don't. If you boil a tea pot on the stove, the pot becomes too hot to touch whereas the tea pot handle does not get hot.
- ❑ Wood and plastic are good heat insulators and are used for saucepan handles. Whereas the saucepan is made of metal due to metals being good heat conductors and allow the heat to pass from the cooker into the food.

#### 4. HOMEWORK QUESTIONS (HW 12)

(educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) Consider the table of thermal conductivity given above: 1. Which substance is the best heat conductor? 2. Which substance is the worst heat conductor? 3. What property of a substance affects its ability to conduct heat well? 4. Why are metals better conductors of heat as compared to non-metals? Explain. 5. Which of liquids; solids or gases are better conductors of heat? Explain [20 min]

#### 5. RESOURCES USED:

Relevant worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. instruction sheet for practical activity; materials for practical (glass; wood; zinc; copper; graphite; aluminium; silver; bees wax/ candle wax; cooking oil; tap water; Bunsen burner/ spirit burner; tongs; retort stand; 3 glass beakers (50/100 ml)

Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

GRADE	10	SUBJECT	Physical Sciences	WEEK	4	TOPIC	Classification of Matter Time: 60 minutes	Lesson	1
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LESSON SUMMARY FOR: DATE STARTED:	DATE COMPLETED:	TIME: 60 minutes
LESSON OBJECTIVES	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Explain the meaning of electrical conductivity.</li> <li>• List and explain the factors that affect electrical conductivity.</li> <li>• List the applications and uses of materials that are good/ poor conductors of electricity.</li> <li>• The following results will be the outcome of this lesson:</li> <li>• The learners being able to explain the meaning of electrical conductivity.</li> <li>• The learners being able to list examples of good electrical conductors and electrical insulators.</li> <li>• The learners being able to explain the use of electrical conductivity in our lives.</li> </ul>	

### TEACHING and LEARNING ACTIVITIES

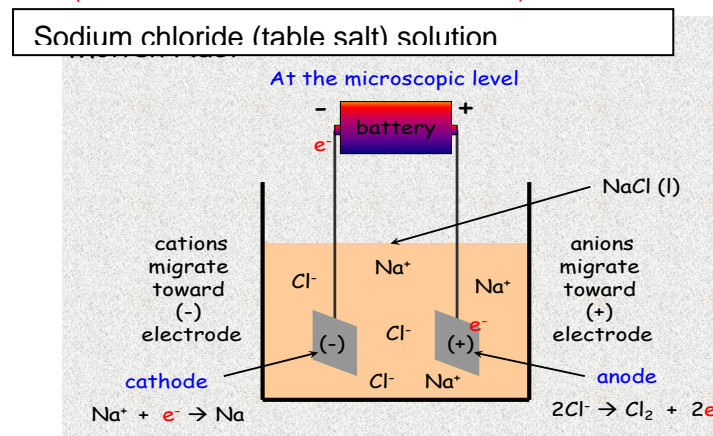
#### 1. TEACHING METHOD/S USED IN THIS LESSON:

Scientific ; Investigative ; observation ; Question and Answer; Narrative

#### 2. LESSON DEVELOPMENT

##### 2.1 Introduction: Educator introduces lesson by setting up the following electrochemical cell: (sodium chloride solution with a battery and carbon electrodes)

Educator explains to learners that table salt solution allows an electric current to pass through it because it has ions that are free to move, the electric current breaks up the salt into sodium ions and chloride ions. The chloride ions form chlorine gas which is the sharp irritating BLEACH smell they get after a few minutes after the electric current is connected to the solution using the carbon electrodes. The bleach smell is only present when the wires from the electrodes are connected to the battery to complete the circuit. The electric current helps to separate this solution into the two ions. The educator explains that this substance is a conductor of electricity because it is the presence of the free mobile ions in the solution (the sodium and chloride ions) that allow the current to be transferred in the solution from one part of the solution to the next.



**PRE-KNOWLEDGE** learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)

- Learners should know that a compound is made up of positive (cations) and negative (anions) ions.
- Learners should know the formula of sodium chloride and the ions that make up this compound.
- Learners should be able to write the ionic equation for this compound.

**BASELINE ASSESSMENT (BL 13)**

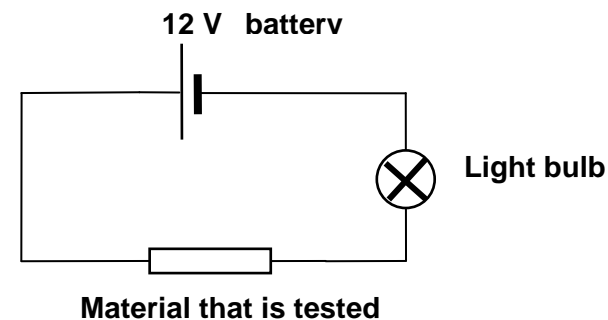
**EDUCATOR** tests pre-knowledge by using the QUESTION and ANSWER method for the content taught in the previous lesson.

1. What is the formula for sodium chloride?
2. Write the formula and name the ions that make up sodium chloride.
3. What is the common name for sodium chloride?

**2.2 Main Body (Lesson presentation)**

- ❑ Educator tests baseline assessment by question and answer method and writes answers on the chalkboard. [5 min.]
- ❑ Educator starts lesson by demonstrating the electrical conductivity of a sodium chloride solution. [15 min.]
- ❑ Educator divides class into groups and provides learners with samples of the following substances: glass; wood; graphite; bicarbonate of soda; aluminium; silver if possible; bees wax; tap water and distilled water (educator can make up his own list).
- ❑ Learners then connect the substances to a circuit including conducting wires; a battery and a light bulb as shown below: Learners record their observations in the table shown below with regards the light coming on or staying off when the different substances are connected in the circuit: [20 min.]

material/ substance	glass	wood	graphite	aluminium	silver	bees wax/ candle wax	distilled water	tap water
conductor (allows current to pass through)								
insulator (does not allow current to pass through)								



- ❑ Learner's record their observations in the table shown above with regards the light coming on or staying off when the different substances are connected in the circuit: [20 min.]
- ❑ **ELECTRICAL CONDUCTIVITY** is the ability of a substance to allow electric al charges to pass through it, the presence of 'free ions' that are able to move makes a substance a conductor of electricity.  
Electrical conductivity (4 highest elememts listed)
  1. Silver (highest) 630,000 /Ohm cm
  2. Copper 596,000 /Ohm cm
  3. Gold 452,000

## 4. Aluminum 377,000

- Materials that allow **electrical charges to pass through them easily** are regarded as **electrical conductors**. E.g. metals and some semi-metals (silicon and germanium) and the non-metal carbon in the form of graphite.
- Materials with a **low or zero electrical conductivity** (non-metals) do not have free ions that are mobile and therefore they do not allow charges to be transferred through the substance are regarded as **electrical insulators**. E.g. rubber; plastic; glass; ceramic; wood and most non-metals besides carbon in the form of graphite.  
This is the reason why electrical wiring is covered with rubber; plastic and other non-metal materials because they are good insulators of electricity.

## 3. CONCLUSION

**Activity to Re-enforce lesson** (Educator reinforces lesson content by discussing and explaining the concepts related to electrical conductivity and also uses the table below to show the learners a comparison of the measured electrical conductivities of the metals, non metals and metalloids). [20 min.]

## ELECTRICAL CONDUCTIVITY METALS; SEMI-METALS and NON- METALS

DECREASING CONDUCTIVITY

METALS Name	Sym
Silver	Ag
Copper	Cu
Gold	Au
Aluminium	Al
Magnesium	Mg
Tungsten	W
Zinc	Zn
Iron	Fe
Platinum	Pt
Tin	Sn
Titanium	Ti
Mercury	Hg

SEMI-METALS Name	Sym
Boron	B
Antimony	Sb
Arsenic	As
Tellurium	Te
Germanium	Ge
Silicon	Si

NON-METALS Name	Sym
Carbon	C
Selenium	Se
Iodine	I
Phosphorus	P
Sulfur	S
oxygen	O
nitrogen	N
hydrogen	H

The electrical conducting properties of the semi-metals decrease from Boron to Silicon. Silicon and Germanium are chemically changed (doped) to make them better conductors of electricity, their **conductivity increases** as the **temperature increases** unlike the metals. This is why they are used so widely in most electronic appliances.

**ALMOST ZERO CONDUCTIVITY** for all the non metals except for **CARBON** in the form of graphite. Carbon electrodes are used in most electrochemical cells as an electrical conductor

## 4. HOMEWORK QUESTIONS (HW 13)

(educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook)

Consider the tables given above showing the electrical conductivity of the metals: 1. Which substance is the best electrical conductor? 2. Why is it not used in electrical wiring? 3. Why do we use copper instead of the metal mentioned in question 1? 4. Which METAL is the worst electrical conductor? 5. What is the scientific term for substances that do not conduct electricity? 6. What property of a substance affects its ability to conduct electricity? 7. Why are metals better conductors of electricity as compared to non-metals? Explain.

8. Tap water conducts an electrical current but distilled water does not? Explain. [10 min]

**5. RESOURCES USED:**

Relevant worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. instruction sheet for practical activity; materials for practical (glass; wood; zinc; copper; graphite; aluminium; silver; bees wax/ candle wax; bicarbonate of soda (baking soda); carbon electrodes; distilled water; tap water; battery (4 x 1.5 V) or a 9 V; conducting wires)

**Reflection/Notes:**

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	4	<b>TOPIC</b>	Classification of Matter Time: 60 minutes	<b>Lesson</b>	2
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of this lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>Classify substances as magnetic and non-magnetic.</li> <li>List the applications and uses of materials that are magnetic.</li> <li>The following results will be the outcome of this lesson: <ul style="list-style-type: none"> <li>The learners being able to list examples of magnetic substances in their daily lives.</li> <li>The learners being able to explain the use and importance of magnetism in their daily lives.</li> </ul> </li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Investigative ; observation ; Question and Answer; Narrative
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction:</b>	Educator introduces lesson by showing learners the different examples of magnets that are used in different situations: e.g. Alnico magnets used in car speakers; ceramic magnets used on fridge doors; Samarium cobalt magnets used in the motors of video machines; Neodymium-iron-boron magnets used in computers and toys (Educator to determine how many samples of magnets he is able to gather to use in his demonstration).
<b>PRE-KNOWLEDGE</b> learners need for this topic: (a list of concepts/ definitions/ theory needed for understanding the lesson to be taught)	<ul style="list-style-type: none"> <li>Learners should know that not all substances are magnetic.</li> <li>Learners should know the metals on the periodic table that have magnetic properties.</li> </ul>
<b>BASELINE ASSESSMENT (BL 14)</b>	
<b>EDUCATOR tests pre-knowledge</b> by using the QUESTION and ANSWER method for the content taught in the previous lesson.	
	<ol style="list-style-type: none"> <li>Name and give the formula of the metals that have magnetic properties?</li> <li>Why does a metal object made out of steel have magnetic properties? Explain.</li> </ol>
<b>2.2 Main Body (Lesson presentation)</b>	



- ❑ Educator tests baseline assessment by question and answer method and writes answers on the chalkboard. [5 min.]
- ❑ Educator starts lesson by demonstrating the magnetic properties of the different magnets he has in front of him. Learners to make their observations in terms of the substance that has the strongest magnetic property. [15 min.]
- ❑ Educator divides class into groups and provides learners with samples of the following substances: glass; wood; graphite; copper; aluminium; zinc; iron nail; steel nail; brass screws and paper clips and ceramic magnets or any other magnet that is available (educator can make up his own list).
- ❑ Learners then touch the different substances with the magnet and see if there is any force of attraction or repulsion between the magnet and the substance: Learners record their observations in the table shown below: [15 min.]

material/ substance	glass	wood	graphite	aluminium	copper	silver	steel nail	brass screws	paper clips
magnetic (sticks to a magnet)									
non-magnetic (does not stick to a magnet)									

- ❑ Educator discusses the important concepts with regards magnetism. [15 min.]
- ❑ **MAGNETIC MATERIALS** are materials that are attracted to a magnet. Substances that are strongly attracted to magnets are referred to as being **FERROMAGNETIC**. The three elements (metals) on the periodic table that have magnetic properties are IRON; NICKEL and COBALT, they are affected by the earth's magnetic field.
- ❑ The **earth has a magnetic field** that protects us from harmful solar particles and other bodies that are moving through the atmosphere at very high speeds, the earth's magnetic field help to deflect these particles away from the earth so that they do not collide with the earth and destroy it. The earth's magnetic field has a north pole and a south pole and all magnets have these two poles no matter how small a magnet is. Opposite poles attract each other and like poles repel each other.
- ❑ A magnetic compass has a piece of metal (needle) that has magnetic properties and is attracted by the north pole of the earth's magnetic field.
- ❑ Materials that are not attracted to a magnet are referred to as being DIAMAGNETIC or **NON-MAGNETIC**. E.g. all non metals and all other metals (aluminium; zinc; copper; silver; gold etc.) that do not have any iron or nickel or cobalt in their composition. Steel is magnetic because it is an alloy that has some iron in it.
- ❑ Magnetism is an extremely important property of materials, we use a magnetic field (the space around a magnet where another magnet will experience a force) to produce electrical current, we use magnetism to make an electrical motor spin, we use magnetism to pick up heavy metal objects (electromagnets); we use magnetism in electrical and electronic communication e.g. all bank / medical aid/ gym cards etc. have a magnetic strip that has a message which is picked up by electronic scanners.

### 3. CONCLUSION

**Activity to Re-enforce lesson** (Educator reinforces lesson content by discussing and explaining the answers to the investigation the learners performed on identifying the magnetic and non-magnetic substances from their list). [10 min.]

#### 4. HOMEWORK QUESTIONS (14)

(educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook)

1. What is an alloy? 2. Why is steel magnetic while brass is not? 3. Why is magnetism such an important property in our lives? Give three applications of magnetism in your life

4. What is a magnetic field? 5. What will happen if the earth's magnetic field is destroyed? Explain. 6. Explain how a magnetic compass works? [15 min]

#### 5. RESOURCES USED

Relevant worksheet/ transparency for baseline assessment; relevant textbook/ notes e.g. glass; wood; graphite; copper; aluminium; zinc; iron nail; steel nail; brass screws and paper clips and ceramic magnets or any other magnet

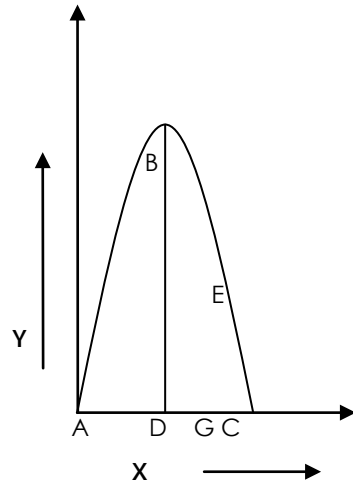
Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
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<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	5	<b>TOPIC</b>	Pulses on a spring & string Time: 60 minutes	<b>Lesson</b>	1
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> <li>• Define a pulse</li> <li>• Define a transverse pulse</li> <li>• Describe a pulse and sketch a pulse graph</li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Scientific ; Investigative ; observation ; Question and Answer
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	<ul style="list-style-type: none"> <li>• Introduce the lesson with an exciting practical / demonstration/ experiment OR explain an application of lesson in daily life.</li> <li>• Learners observe/ record/ listen to what teacher's illustrations.</li> </ul>
<b>a) PRE-KNOWLEDGE</b>	learners need understanding of the following:
(a)	displacement
(b)	rest position
(c)	velocity
(d)	drawing a graph on Cartesian plane
<b>b) BASELINE ASSESSMENT</b>	(educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge)
	<b>QUESTIONS for the BASELINE ASSESSMENT [5 min]</b>
i.	Define displacement (ii) Describe a rest position and draw a sketch of a pulse to explain further (iii) Illustrate the meaning of medium in physical sciences (iv) List three applications of waves in our daily lives
<b>2.2 Main Body (Lesson presentation) [30 min]</b>	
	<ul style="list-style-type: none"> <li>• Stretch a long slinky spring on the table and fix one end so that the spring does not move. Describe this position as the rest position.</li> <li>• Tie short pieces of coloured ribbons to some of the turns of the spring</li> <li>• Push the spring once and observe it back again</li> <li>• When you move your hand in this way, it cause a single disturbance. Define a pulse as the single disturbance in a medium</li> </ul>



Describe a pulse from the diagram and explain ;

**Pulse length (A –C)** is the distance from the beginning to the end of a pulse

**Displacement (G –E)** is how far and in which direction a point on the spring has moved from the rest position

**Amplitude (D – B)** is the maximum displacement of the point from the rest position

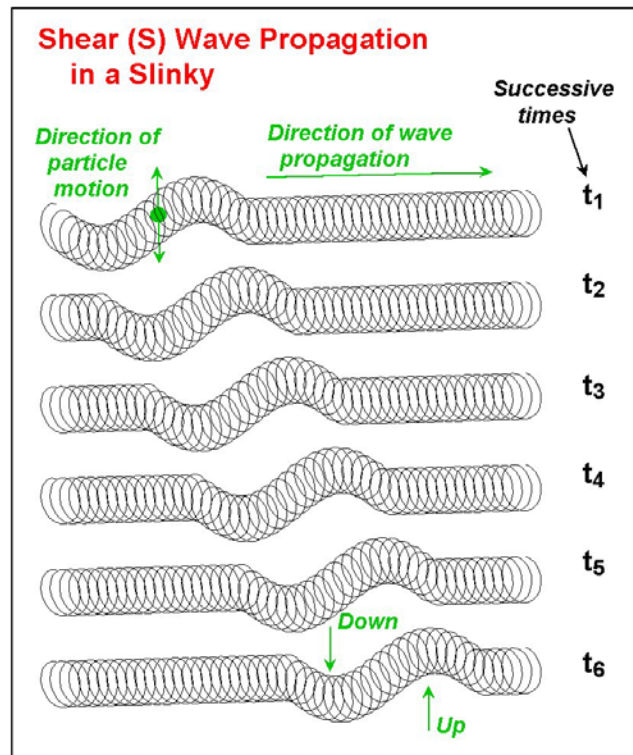
**Pulse speed** – is the speed at which the pulse travels

**Crest (B)** is the highest point of the pulse

Your hand moves the end turn of the spring sideways when the turn moves, it moves the next turn. The sideways movement goes on from turn to turn.

The pulse travels down the spring, but the turns of the spring do not move in the same direction (they move at right –angles to the direction in which the pulse is moving. ( This kind of the pulse is called the transverse pulse)

In the transverse pulse, the particles of a medium move at right angles to the direction of propagation of the pulse through the medium. The direction of propagation of the pulse is the direction that the pulse is moving through the medium



## 2.2 Learners Activities [15 min]

[ Educators need to add more questions such as one word and multiple choice questions which could not be included because of space ]

2.2.1 Define a pulse

2.2.2 Describe how to produce a transverse pulse using a slinky spring

2.2.3 Explain how a pulse moves from turn to turn along a slinky

2.2.4 Draw a graph to show the progression of a transverse pulse in a slinky. Label the axes, pulse length, pulse speed, amplitude, rest position and crest

## 3. Conclusion

**Activity to Re-enforce lesson** (Educator may summarise the main aspects of the lesson) [5 min.]

ie. The meaning of a pulse. Drawing the structure of a pulse and labelling different components of a pulse. Explaining the movement of particles and the direction of propagation. Explain how a pulse moves from a turn to a turn.

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the

prescribed textbook) [30 min]

**RESOURCES USED:**

*Slinky spring*  
 colourful ribbons  
 table surface  
 worksheet/ transparency for baseline assessment  
 relevant textbook

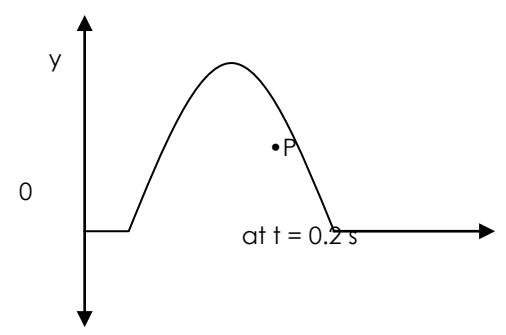
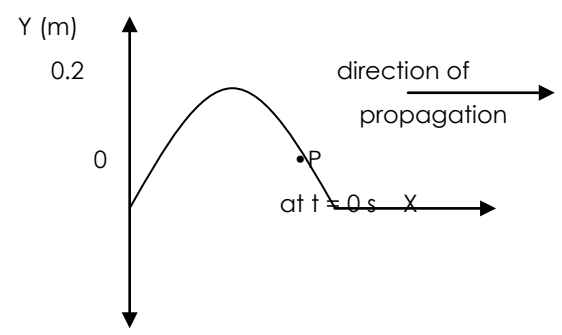
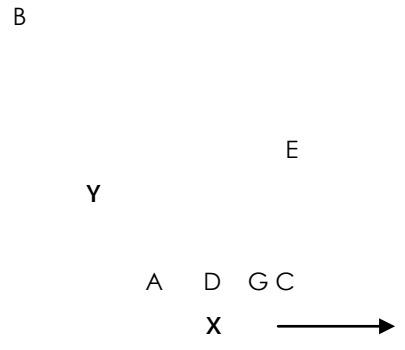
**Reflection/Notes:**

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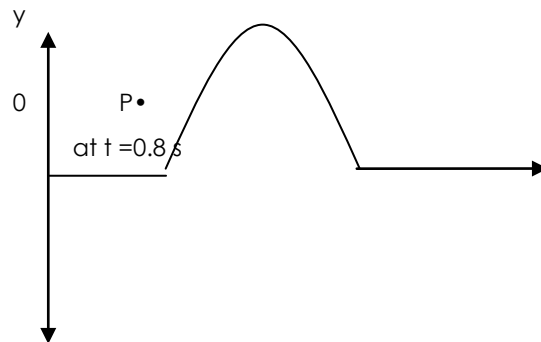
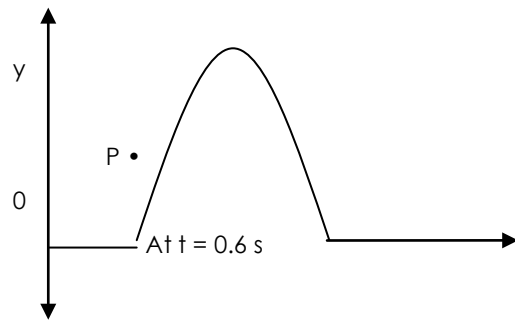
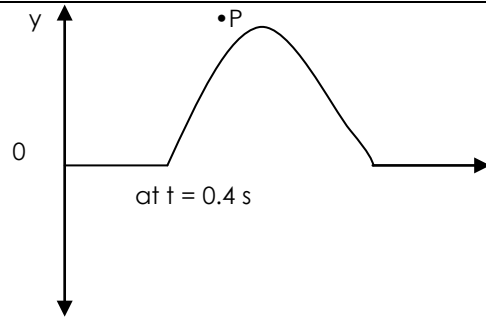
GRADE	10	SUBJECT	Physical Sciences	WEEK	5	TOPIC	Pulse and particles graph Time: 60 minutes	Lesson	2
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LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Draw particle motion graphs</li> <li>• Define motion of the particles in a form of graph</li> <li>• Explain components of the pulse using particles and their positions on the graph</li> </ul>		

TEACHING and LEARNING ACTIVITIES	
1. TEACHING METHOD/S USED IN THIS LESSON:	Scientific ; observation ; Question and Answer
2. LESSON DEVELOPMENT	
2.1 Introduction	<ul style="list-style-type: none"> <li>• Introduce the lesson with an explanation of the components of the pulse from the previous lesson</li> </ul>
a) PRE-KNOWLEDGE	learners need understanding of the following:
(a)	Pulse
(b)	Transverse pulse
(c)	Components of a transverse pulse and defining each component
b) BASELINE ASSESSMENT	(educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge)
	QUESTIONS for the BASELINE ASSESSMENT [5 min]
i.	Define crest, amplitude, pulse length, displacement and pulse speed (ii) Describe how to produce a transverse pulse using a slinky spring (iii) compare the movement of particles to the direction of propagation on a slinky spring
c)	Do corrections and clarify misconceptions
2.2 Main Body (Lesson presentation)	[30 min]
	<ul style="list-style-type: none"> <li>• From the pulse diagram drawn before, explain the movement of pulse on a string or a rope. (If no slinky spring available, use skipping ropes available stores. One end is fixed and you cause a single disturbance from one end on the rope)</li> </ul>







The diagrams above show the position of a transverse pulse at 0.2 s interval.  $P$  is the single particle of the medium. The particle moves perpendicular to the direction of propagation

- The position of the pulse is on the x-axis and the displacement is on the y a-axis
- Describe the movement of the particles as compared to the direction of propagation. Direction of movement of particle's is always perpendicular to the direction of movement of pulse on the medium. From the diagrams above, the particles are moving along the y-axis, and the pulse is moving along the x- axis

### 2.2. Learners Activities [10 min]

[ Educators need to add more questions like one word and multiple choice questions which could not be included because of space ]

2.2.1 Compare the directions of motion of a transverse pulse with the motion of particles of the medium

2.2.2 What is the maximum displacement of particle P?

2.2.3 Define the amplitude of the pulse?

2.2.4 Draw the following graphs to show the motion of the particle along a rope from the time the rope was disturbed from its rest position until it returns to rest position again

- i) Position – time graph (ii) Velocity - time graph (iii) Acceleration –time graph

### 2.3 Do corrections

with the learners, provide clarity and you may refer to possible answers for more explanations [5 min].

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson). [5 min.]

ie. Drawing graphs of motion for the particle moving through the medium and show the displacement of particle at specific time. Explaining the movement of particles and the direction of propagation. Analyse and explain both the position time graph and the velocity time graph.

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

### RESOURCES USED:

Rope  
worksheet/ transparency for baseline assessment  
relevant textbook

Reflection/Notes:

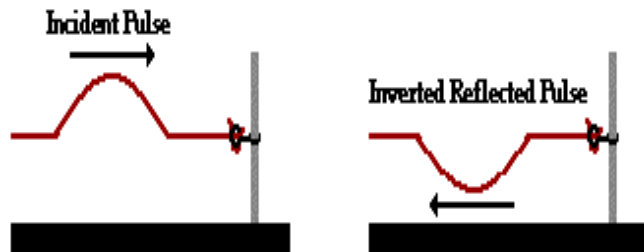
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GRADE	10	SUBJECT	Physical Sciences	WEEK	5	TOPIC	Reflection of pulse Time: 60 minutes	Lesson	3
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LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>Describe reflection of a pulse using a diagram</li> <li>Define incident, reflected and transmitted pulse</li> <li>Explain the effects of medium change on the pulse</li> </ul>		

TEACHING and LEARNING ACTIVITIES	
1. TEACHING METHOD/S USED IN THIS LESSON:	Scientific ; observation ; Question and Answer
2. LESSON DEVELOPMENT	
2.1 Introduction	<ul style="list-style-type: none"> <li>Introduce the lesson with an explanation of the components of the pulse from the previous lesson</li> </ul>
a) PRE-KNOWLEDGE learners need understanding of the following:	<ul style="list-style-type: none"> <li>(i) Amplitudes in phase and out of phase</li> <li>(ii) Pulse reflection</li> <li>(iii) Definition of a medium</li> </ul>
b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge)	
QUESTIONS for the BASELINE ASSESSMENT [5 min]	
i. What happens to the pulse as it reaches a boundary (ii) explain what is meant by pulse reflection (iii) Draw the sketch to show two pulses in phase	
c) Do corrections and clarify misconceptions	
2.2 Main Body (Lesson presentation) [30 min]	<ul style="list-style-type: none"> <li>Slinky spring demonstration. (If no slinky spring available, use ripple tank as recommended in the guideline)</li> <li>Start a lesson reviewing the meaning of the medium as the learners understand it. Then define the medium :</li> <li>A medium is a substance or material that carries the wave.</li> <li>Fix one end of the slinky spring and send a pulse along</li> <li>Observe what happens to the pulse as it reaches the boundary ( It travels backwards but the displacement is on the other side of the spring. The pulse is inverted)</li> </ul>

### Fixed End Reflection



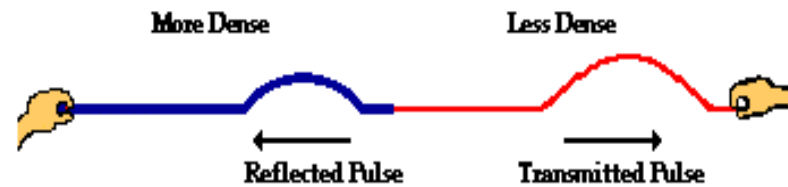
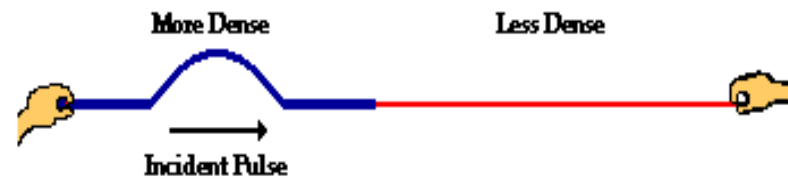
- Define reflection of a pulse as
- Explain to the learners that reflected pulse has equal pulse length and amplitude to the incident pulse, and pulse direction to differentiate reflected pulse from incident pulse ( A guitar string may be used as an example
- Hold the slinky so that it hangs down. Send a pulse down it. Learners observe.

### Free End Reflection



- Notice that the pulse reflects from the free end with the displacement of the pulse on the same side of the spring. It is **not inverted** ( this usually is observed from wind instruments like trumpet)
- Join two slinky spring of different diameter, one heavier and one lighter. The free end of the lighter slinky should be fastened to a fixed point
- Send a pulse from the heavier slinky and ask learners to record their observations. [ At the boundary some pulse is transmitted and some is reflected. Neither the transmitted nor reflected pulse gets inverted.

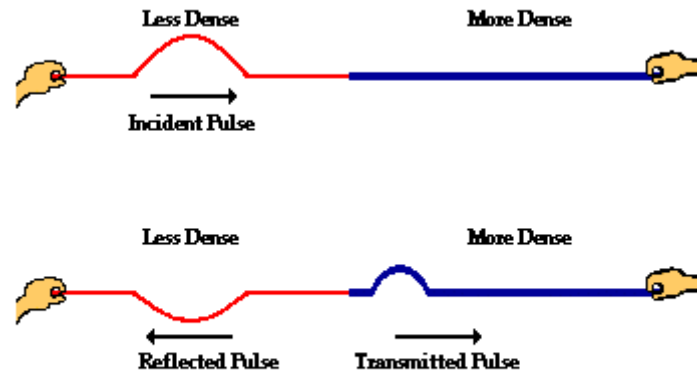
**A wave traveling from a more dense to a less dense medium ...**



**...will be reflected off the boundary and transmitted across the boundary into the new medium. There is no inversion.**

- From a less dense to heavier medium, some pulse is reflected and some pulse is transmitted. But the reflected pulse gets inverted

**A wave traveling from a less dense to a more dense medium ...**



**...will be reflected off the boundary and transmitted across the boundary into the new medium. The reflected pulse is inverted.**

**2.2 Learners Activities [10 min]**

[ Educators need to add more questions like one word and multiple choice questions which could not be included because of space ]

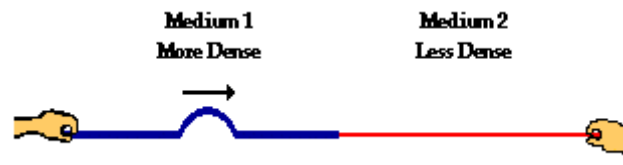
2.2.1 Explain "pulse reflection"

2.2.2 Describe what happens when the slinky spring reflects from the fixed end

2.2.3 Draw a diagram and explain the effects caused by change in medium as the pulse moves from the lighter medium to heavier medium

2.2.4 A pulse is moving from a heavier medium to a lighter medium. Draw a diagram to show how the pulse will either be transmitted, reflected or even both.

2.2.5 A pulse in a more dense medium is traveling towards the boundary with a less dense medium.



2.2.5.1. The reflected pulse in medium 1 \_\_\_\_\_ (will, will not) be inverted because \_\_\_\_\_.

2.2.5.2. The speed of the transmitted pulse will be \_\_\_\_\_ (greater than, less than, the same as) the speed of the incident pulse.

2.2.5.3. The speed of the reflected pulse will be \_\_\_\_\_ (greater than, less than, the same as) the speed of the incident pulse.

2.2.5.4. The wavelength of the transmitted pulse will be \_\_\_\_\_ (greater than, less than, the same as) the wavelength of the incident pulse.

2.2.5.5. The frequency of the transmitted pulse will be \_\_\_\_\_ (greater than, less than, the same as) the frequency of the incident pulse.

#### Solutions for 2.2.5

1. will not... because the reflection occurs for a wave in a more dense medium heading towards a less dense medium.

2. faster

3. the same as

4. greater than

5. the same as

#### 2.3 Do corrections

with the learners, provide clarity and you may refer to possible answers for more explanations [5 min].

#### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

i.e. Explain the terms transmission and reflection. Use diagrams to illustrate reflection and transmission from both fixed end and free end .

Also explain the effect brought by the change in medium as the pulse meets the boundary.

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

#### RESOURCES USED:

Rope

worksheet/ transparency for baseline assessment

relevant textbook



Reflection/Notes:

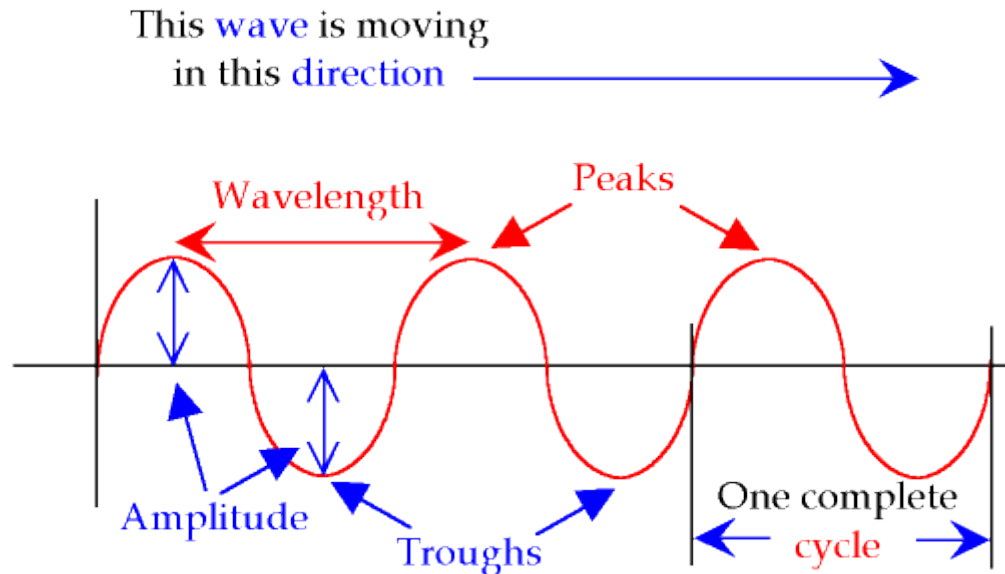
Name of Teacher:		HOD:	
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GRADE	10	SUBJECT	Physical Sciences	WEEK	5	TOPIC	Transverse wave(s) Time: 60 minutes	Lesson	4
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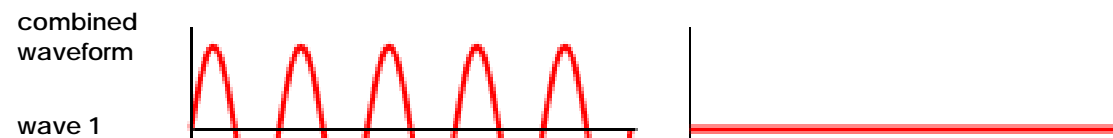
LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Define a transverse wave</li> <li>• Define wavelength, frequency, period crest and trough of a transverse wave</li> <li>• Draw particle motion graphs</li> <li>• Explain the wave concepts: in phase and out of phase</li> <li>• Identify the wavelength, amplitude, crest, troughs, points in phase and points out of phase on a wave diagram</li> </ul>	

TEACHING and LEARNING ACTIVITIES	
1.	<p><b>TEACHING METHOD/S USED IN THIS LESSON:</b> Demonstration ; observation ; Question and Answer</p>
2.	<p><b>LESSON DEVELOPMENT</b></p> <p><b>2.1 Introduction</b></p> <p>Introduce the lesson by asking questions based on the transverse pulse to check their understanding of :</p> <p>a) <b>PRE-KNOWLEDGE</b> learners need understanding of the following:</p> <p>(a) Pulse (b) Transverse pulse (c) Components of a transverse pulse and defining each component</p> <p>b) <b>BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge)</p> <p>QUESTIONS for the <b>BASELINE ASSESSMENT</b> [5 min]</p> <p>i. Define crest, amplitude, pulse length, displacement and pulse speed (ii) Describe the movement of the particles as compared to direction of propagation on a transverse pulse. (iii) Draw a pulse diagram and indicate the crest, amplitude, pulse length, and displacement. What happens to the amplitudes of two pulses that are in phase as they come together?</p> <p>c) <b>Do corrections and clarify misconceptions</b></p> <p><b>2.2 Main Body (Lesson presentation) [30 min]</b></p> <p>Depending on the teacher's preference (stone dropped into the pond, slinky or pendulum), introduce the new concept with a demonstration</p> <ul style="list-style-type: none"> <li>• If a pond filled with water is available, drop a stone into the pond , learners will observe and record the results</li> <li>• Ask the question “ <b>What happens to if a stone is thrown into the pool into the pond filled with water ?”</b></li> </ul>

- From learners answers, explain that each ripple formed is a pulse, and the pulses together form a wave.
- **A transverse wave** can therefore be defined as : regular and repetitive succession of pulses. Remind the learners that the particles of a transverse wave will move up and down, and the direction of propagation is perpendicular to the direction of the particles, i.e. forward. NB Explain that water waves are transverse waves at the beach, but deep in the ocean it is longitudinal wave
- Ask learners to draw this wave diagram in their own before you show the diagram to the learners. Self exploration might be more effective than lecture (telling )method .



- Learners should define the following:
- **Displacement** - is the straight line distance (**perpendicular to direction of propagation**) travelled by the particle of a medium from **rest position**
- wave length** - is the distance between two successive points that are in phase e.g. between two successive crests
- trough** - is the lowest point reached by a particle from rest position on a wave or pulse



**crest** - is the highest point reached by a particle from rest position on a wave or pulse

**amplitude** - is the maximum displacement of the point from the rest position to the crest, perpendicular to the direction of propagation

**wave 2**

Two waves in phase, resulting wave is bigger

Two waves 180° out of phase, resulting wave amplitude decreases

- Draw diagrams to show transverse waves in phase and transverse waves out of phase and explain the results

Define **the principle of superposition**

**superposition will occur** when waves cross, and their combined displacement is equal to the sum of their displacements .

If two waves interact, a new wave is temporarily formed, after which the two waves carry on with exactly the same properties as before, as if nothing had happened. The waves are **superposed**.

Superposition can only be applied to waves of the **same kind**. Light and sound waves cannot superpose; light and X-rays can. Let us look at two waves of different wavelengths crossing and superposing:

**Interference (in one dimension only)** - is the wave behaviour where two waves come together and their sum of amplitude changes as they travel in the same medium

**Destructive interference** - occurs when two waves meet out of phase and their combined (sum of) amplitude decreases

**and constructive interference** occurs when two waves meet in phase and their combined (sum of) amplitude increases

## 2.2. Learners Activities [10 min]

[ Educators need to add more questions like one word and multiple choice questions which could not be included because of space ]

2.2.1.1 Maximum destructive inference between two waves occurs when the waves are out of the phase by

- A. 180 degrees
- B. 45 degrees
- C. 90 degrees
- D. 360 degrees

2.2.1.2 When the particles of a medium are vibrating at right angles to the direction of energy transport, then the wave is a \_\_\_\_ wave.

- a. longitudinal
- b. sound
- c. standing
- d. transverse

2.2.1.3 Many wave properties are dependent upon other wave properties. Yet, one wave property is independent of all other wave properties. Which one of the following properties of a wave is independent of all the others?

a. wavelength

b. frequency

c. period

d. velocity

2.2.2 Provide a term or scientific phrase for each of the following

- (i) Wave behaviour that occurs when two waves come together in phase and the amplitude increases
- (ii) When waves cross, their combined displacement is equal to the sum of their displacements

2.2.3 Define a transverse wave

2.2.4 Draw a transverse wave and show: rest position, displacement, wavelength, amplitude, trough and crest

2.2.5 State the principle of superposition of waves

**2.3 Do corrections** with the learners, provide clarity and you may refer to possible answers for more explanations **[5 min]**.

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

In conclusion, indicate the importance/application of interference on daily lives. Some applications may include :

- o Noise cancelling headphones in the media industry
- o Holographic images

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

#### RESOURCES USED:

Water pond, slinky, worksheets

Reflection/Notes:

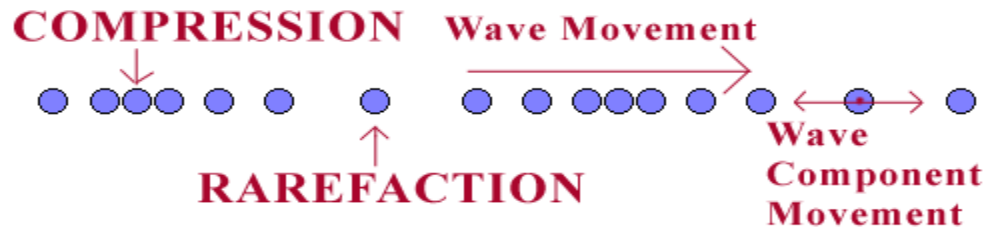
Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	6	<b>TOPIC</b>	Longitudinal wave on a spring Time: 60 minutes	<b>Lesson</b>	1
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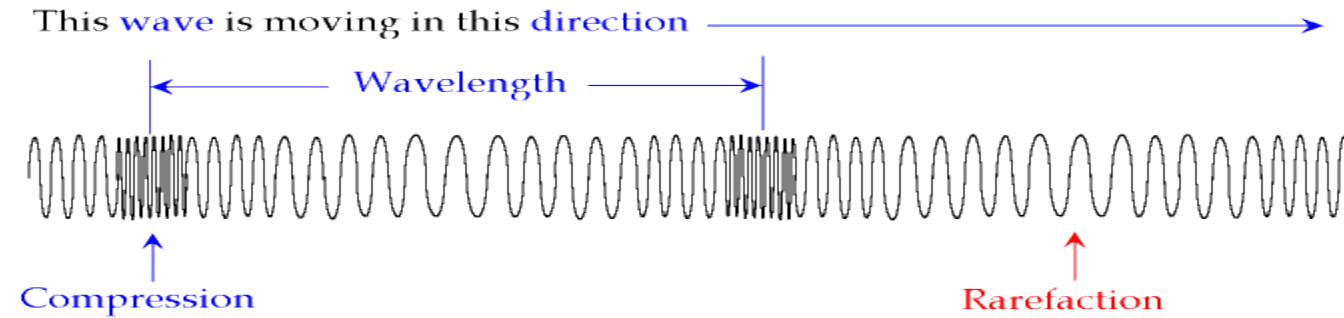
<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>
<b>LESSON OBJECTIVES</b>	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Describe how a longitudinal wave may be generated from a slinky spring</li> <li>• Draw a longitudinal wave diagram and label it</li> <li>• Identify the motion of a wave and the direction in which the particles move</li> </ul>	

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b> Demonstration ; observation ; Question and Answer	
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	
Introduce the lesson by asking questions based on the transverse wave to check their understanding of :	
<b>a) PRE-KNOWLEDGE</b> learners need understanding of the following:	
(a) Transverse wave diagram	
(b) Definition of a transverse wave	
(c) Direction of particles and direction of propagation of a transverse wave	
<b>b) BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]	
QUESTIONS for the <b>BASELINE ASSESSMENT</b>	
i) Describe how a transverse wave may be generated from a slinky spring	
ii) List the differences between transverse wave and a longitudinal wave	
iii) Draw and label the diagram of a longitudinal wave	
<b>c) Do corrections and clarify misconceptions</b>	
<b>2.2 Main Body (Lesson presentation) [30 min]</b>	
• Hold a slinky so that it hangs down and send five disturbances.	
• Learners will observe and record the movement of the particles and the direction of propagation – particles of the medium move in the same direction as the wave movement (direction of propagation).	

- Define the **longitudinal wave**- regular and repetitive to and fro motion. Indicate that the direction of particles movement is the same as the wave movement.
- Longitudinal waves, as known as "l-waves", are waves that have the same direction of vibration as their direction of travel, which means that the movement of the medium is in the same direction as or the opposite direction to the motion of the wave. Mechanical longitudinal waves have been also referred to as **compression waves**.

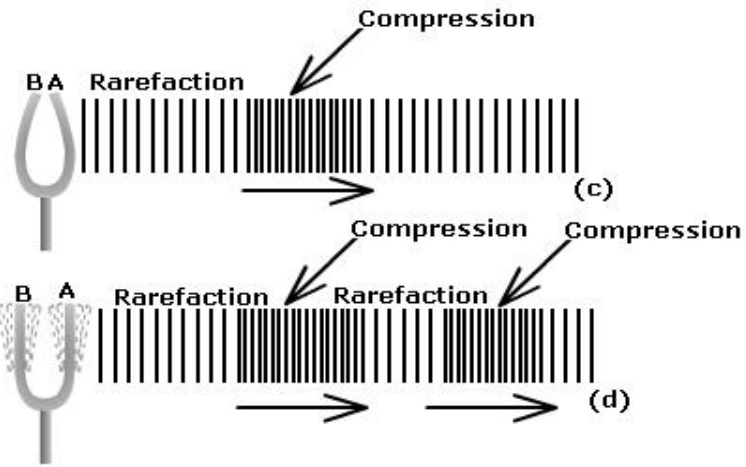


On a slinky spring



And the tuning fork





• Examples of longitudinal waves are

1. Sound.
2. P waves from earthquakes , waves in a slink, tsunami waves, vibrations in gases, oscillations in springs, internal-water waves and ultra sounds

**Learners activities 10 min**

2.2.1 Each compression in the waveform of the longitudinal wave corresponds to what feature of the transverse wave below it?

- a) wavelength
- b) crests
- c) troughs
- d) amplitude

2.2.2 A wave will

- a) Transmit substance without transmitting matter
- b) Transmit energy without transmitting matter
- c) Make things get hot
- d) Make things go up and down

2.2.3 In a longitudinal wave the particles

- a) Move at right angles to the direction of the wave's travel
- b) Move backwards and forwards along the direction of the wave's travel
- c) Stay still

d) Have a negative charge

2.2.4 What is the difference between a mechanical and a non-mechanical wave? Give one example of each?

2.2.5 Draw a longitudinal wave diagram and show the wavelength, compression, rarefaction.

2.2.6 Compare a longitudinal wave with a transverse wave and indicate similarities

**Corrections [7 min]**

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

#### RESOURCES USED:

Worksheets

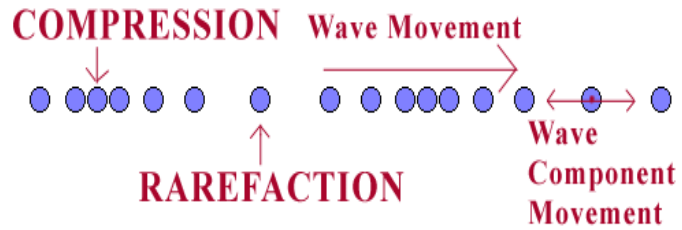
**Reflection/Notes:**

<b>Name of Teacher:</b>		<b>HOD:</b>	
<b>Sign:</b>		<b>Sign:</b>	
<b>Date:</b>		<b>Date:</b>	

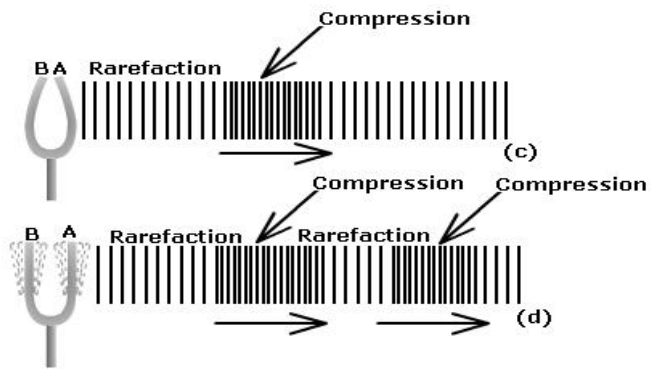
<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	6	<b>TOPIC</b>	Wavelength, frequency and amplitude Time: 60 minutes	<b>Lesson</b>	2
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> <li>• Define wavelength and amplitude of a longitudinal wave</li> <li>• Define compression and rarefaction</li> </ul>		

TEACHING and LEARNING ACTIVITIES	
<p><b>1. TEACHING METHOD/S USED IN THIS LESSON:</b> Demonstration ; observation ; Question and Answer</p> <p><b>2. LESSON DEVELOPMENT</b></p> <p><b>2.1 Introduction</b> Introduce the lesson by asking questions based on the transverse pulse to check their understanding of :</p> <p><b>a) PRE-KNOWLEDGE</b> learners need understanding of the following:</p> <p>(a) Longitudinal wave diagram (b) Similarities and differences between longitudinal and transverse wave (c) Direction of particles and direction of propagation of a longitudinal wave</p> <p><b>b) BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]</p> <p>QUESTIONS for the <b>BASELINE ASSESSMENT</b></p> <p>i) Describe how a longitudinal wave may be generated from a slinky spring ii) List the differences between transverse wave and a longitudinal wave iii) Draw and label the diagram of a longitudinal wave</p> <p><b>c) Do corrections and clarify misconceptions</b></p> <p><b>2.2 Main Body (Lesson presentation) [30 min]</b></p> <ul style="list-style-type: none"> <li>• Define the longitudinal wave- regular and repetitive to and fro motion. Indicate that the direction of particles movement is the same as the wave movement. Longitudinal waves, as known as "l-waves", are waves that have the same direction of vibration as their direction of travel, which means that the movement of the medium is in the same direction as or the opposite direction to the motion of the wave. Mechanical longitudinal waves have been also referred to as <b>compression waves</b>.</li> </ul>	



Use the diagrams below to show the rarefaction and compression on longitudinal wave



Define a **rarefaction** as the region where the coils of the spring are pulled apart/ or the region of lower pressure

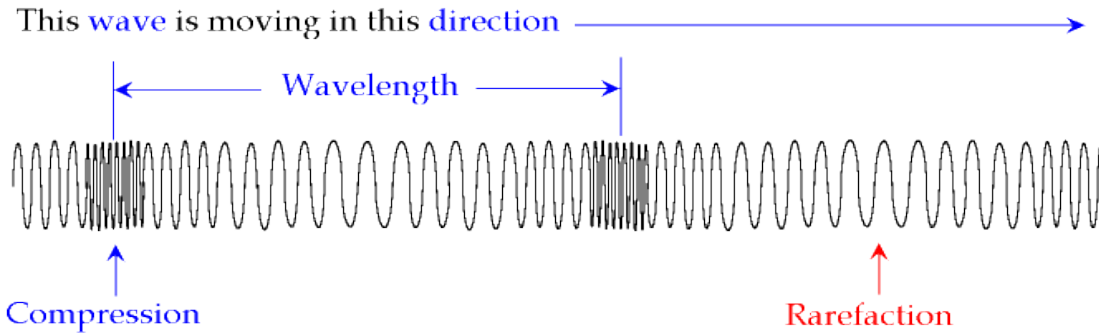
Or A **rarefaction** is a region in a longitudinal wave where the particles are furthest apart

**compression** as the name given to the region where the coils of the spring are pushed together or the region of higher pressure

Or A **compression** is a region in a longitudinal wave where the particles are closest together.

The **wavelength** can be measured as the distance between the centre of two compressions.

The distance between two adjacent compressions or rarefactions is the **wavelength**.



The amplitude is the distance from the equilibrium position of the medium to a compression or a rarefaction.

#### Learners activities 10 min

2.2.1 Define a wavelength of a longitudinal wave

2.2.2 What is meant by an amplitude of a longitudinal wave?

2.2.3. Distinguish a longitudinal wave from the transverse wave. Draw a longitudinal wave diagram to show how it differs from transverse wave.

2.2.4. From the transverse wave, which parts relate to rarefaction and compression? Explain

#### Corrections [7 min]

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

#### RESOURCES USED:

Worksheets

Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

GRADE	10	SUBJECT	Physical Sciences	WEEK	6	TOPIC	Longitudinal Wave speed Time: 60 minutes	Lesson	3
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LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>Identify the relationship between frequency and speed</li> <li>Define wave speed in terms of wave length and frequency</li> <li>Calculate quantities from the speed equation <math>v = f \lambda</math></li> </ul>		

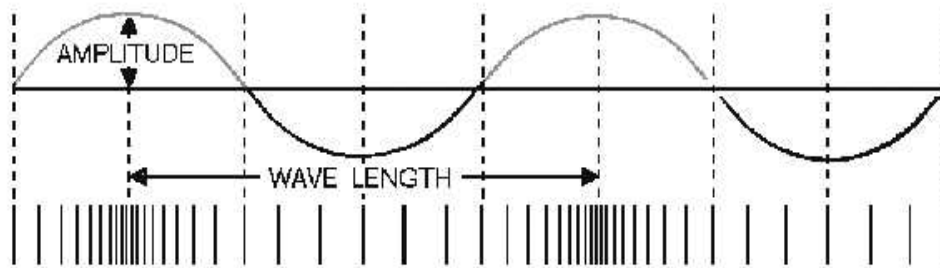
TEACHING and LEARNING ACTIVITIES	
1.	<p><b>TEACHING METHOD/S USED IN THIS LESSON:</b> Demonstration ; observation ; Question and Answer</p>
2.	<p><b>LESSON DEVELOPMENT</b></p> <p><b>2.1 Introduction</b> Introduce the lesson by asking questions based on the transverse pulse to check their understanding of :</p> <p><b>a) PRE-KNOWLEDGE</b> learners need understanding of the following:</p> <ol style="list-style-type: none"> <li>Longitudinal wave diagram</li> <li>Definition of a longitudinal wave</li> <li>Transverse wave speed calculation</li> </ol> <p><b>b) BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]</p> <p><b>QUESTIONS for the BASELINE ASSESSMENT</b></p> <ol style="list-style-type: none"> <li>Define a wave speed</li> <li>What is meant by frequency?</li> <li>Describe the relationship between frequency and period</li> </ol> <p><b>c) Do corrections and clarify misconceptions</b></p>
	<p><b>2.2 Main Body (Lesson presentation) [30 min]</b></p> <ul style="list-style-type: none"> <li>From the definition of longitudinal wave, use the expression '<b>regular succession</b>' to define frequency</li> <li>Frequency (f) is therefore defined as the number of vibrations/oscillations per unit time. It is measured in Hertz (Hz)</li> <li>Define <b>period (T)</b> as the time taken to complete an oscillation, one cycle or a wave.</li> </ul>

time (T) of one vibration =

$$\frac{1}{\text{frequency (f)}}$$

or

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



The diagram above shows the relationship between transverse wave and longitudinal wave

**Define the speed of a wave:** the product of frequency and wavelength of a wave and write it as an equation  $\text{Speed} = \text{Frequency} \times \text{wavelength}$  ( $v = f \times$

$v = f \lambda$  where 'v' is the speed of wave(s) in  $\text{m}\cdot\text{s}^{-1}$

f is the frequency in Hz

$\lambda$  is the wavelength in m

**Similarly** Another equation,

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

If guitar strings are available ; Stretch a light and a heavier guitar strings with the same force and compare the speed of the waves on the two strings. **Conclusion is that the less dense (less mass) medium has higher wave speed**

Send a pulse down the slinky spring. Then stretch it to increase the tension and send another pulse. : **The greater the tension in the medium the faster is the pulse/wave speed**





2.2.3 One end of a hose-pipe is tied around a pole. The other end is being shaken by the young boy who generates a wave of frequency 0,3 Hz and a speed of 2,4 m's<sup>-1</sup>.

Calculate the wave length of the wave

2.2.4. What is the frequency of a wave that has a speed of 0.4 m/s and a wavelength of 0.020 meter?

2.2.5 If the frequency of a wave is doubled and if the speed remains constant, its wavelength is \_\_\_\_.

a. quartered.

b. halved.

c. unchanged.

d. doubled.

**Corrections [7 min]**

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

In conclusion, indicate the importance/application of wave speed on daily lives. Some applications may include :

- o Pictures and sound on a movie
- o Printers , telegraphic machines

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

#### RESOURCES USED:

Worksheets

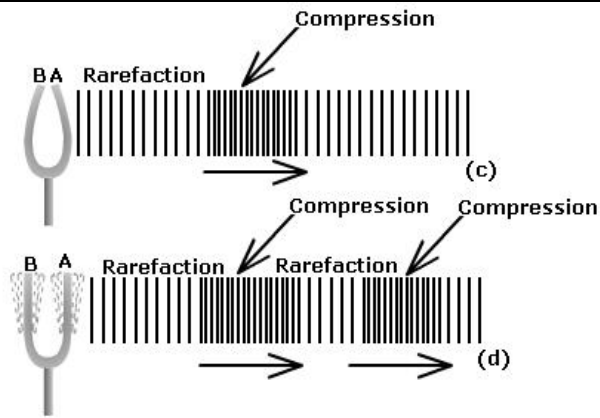
#### Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	6	<b>TOPIC</b>	Pitch, loudness and quality Time: 60 minutes	<b>Lesson</b>	4
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Define pitch, loudness and quality (tone) of sound</li> <li>• State the relationship between frequency and pitch of sound</li> <li>• Describe the relationship between loudness and amplitude of sound</li> <li>• Identify frequencies sensitive to human ear</li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Demonstration ; observation
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	
<b>a) PRE-KNOWLEDGE</b> learners need understanding of the following:	
i) Frequency	
ii) Amplitude	
iii) Music	
<b>b) BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]	
<b>QUESTIONS for the BASELINE ASSESSMENT</b>	
i) Define a longitudinal wave	
ii) What is meant by frequency of a longitudinal wave	
iii) Draw and label the diagram of a longitudinal wave	
iv) Describe how pressure relates to a compression on a longitudinal wave	
<b>c) Do corrections and clarify misconceptions</b>	
<b>2.2 Main Body (Lesson presentation) [30 min]</b>	
<b>Educator need to choose relevant resources and adjust this lesson according to available resources</b>	
<b>Demonstration</b>	
• Select tuning forks of different frequencies (e.g. 128 Hz, 256 Hz and 512 Hz) without telling learners about frequencies	
• Slightly hit the table with a tip of a tuning fork and allow it to vibrate on an A4 paper to observe the sound produced	



- Repeat the same with each of the tuning forks and allow learners to observe the sound each time
- Learners should try to explain the difference in sound produced. Should the explanations be correct, illustrate further the:

#### Pitch

**Pitch** depends on the frequency of a sound wave. **Frequency** is the number of wavelengths unit time. Remember that a wavelength is equal to one compression and one rarefaction.

**High frequency** will produce high pitch sound

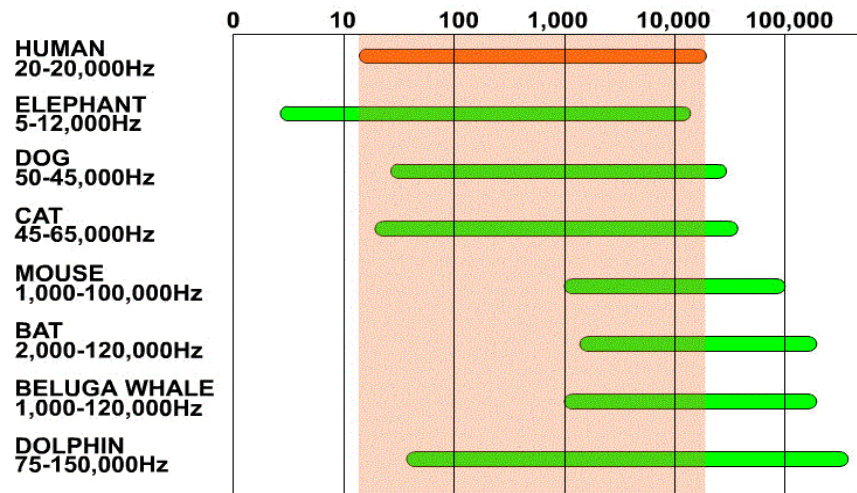
Standard Pitch or Concert Pitch is a universal frequency or note that all musical instruments are tuned to. Today's standard pitch is A440 or C523.3 and this enables musicians to play instruments together in harmony, without clashing pitches.

#### Amplitude

**Amplitude** is the objective measurement of the degree of change (positive or negative) in atmospheric pressure (the compression and rarefaction of air molecules) caused by sound waves. Sounds with greater amplitude will produce greater changes in atmospheric pressure from high pressure to low pressure.

**High amplitude** will relate to **loud sound** and **low amplitude** relates to **soft sound**

Amplitude may be compared to the loudness of sound. Listening to very loud music can start to permanently damage hearing. There is a Hazard in using earphones if the volume is cranked up too high. Since the earphones are directly against the ears, there is not buffering and high intensity sound waves blast directly on the eardrum



- If sound produced has frequency less than or greater than human threshold frequency, it won't be cause recognized vibrations on the human ear. Either it won't be heard or it will cause damage to the ear
- The frequency range of a young person is about 20 to 20,000 hertz, but changes with age

Learners activities 10 min

### 2.2.1. The pitch of a sound depends on

- How near it is
- How far away it is
- Its amplitude
- Its frequency

2.2.2 Describe how the amplitude determines the loudness of sound

2.2.3 What will a person hear if the frequency of a sound is higher than the human threshold frequency? Explain

2.2.4 What are the effects of being exposed to louder sound and how does it affect a person hearing with age

Corrections [7 min]

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

In conclusion, indicate the importance/application of sound waves on daily lives. Some applications may include :

- o Music and concert
- o Hearing aids

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

**RESOURCES USED:**

Worksheets, tuning forks, vuvuzela, flute

**Reflection/Notes:**

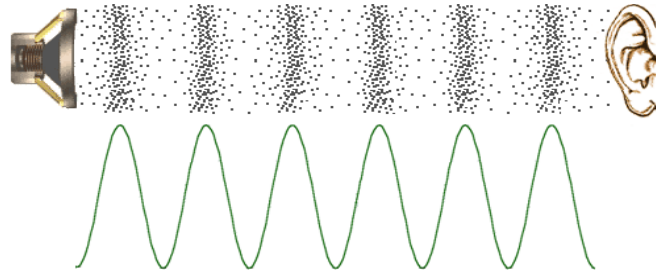
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GRADE	10	SUBJECT	Physical Sciences	WEEK	7	TOPIC	Longitudinal Wave speed Time: 60 minutes	Lesson	1
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LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Explain how sound waves are generated</li> <li>• Describe the sound as a longitudinal wave</li> <li>• Identify the relationship between wave speed and properties of medium in which sound wave travels</li> </ul>		

TEACHING and LEARNING ACTIVITIES	
1. TEACHING METHOD/S USED IN THIS LESSON:	Demonstration ; observation ; Question and Answer
2. LESSON DEVELOPMENT	
2.1 Introduction	
a) PRE-KNOWLEDGE	learners need understanding of the following:
(i)	Components of longitudinal wave
(ii)	Definition of wavelength of a longitudinal wave
(iii)	Speed of a wave
b) BASELINE ASSESSMENT	(educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]
	QUESTIONS for the BASELINE ASSESSMENT
i)	Define a wavelength of a longitudinal wave
ii)	Explain how sound is produced from vibrations
iii)	Describe the relationship between frequency and period
c)	Do corrections and clarify misconceptions
2.2 Main Body (Lesson presentation) [30 min]	
	<ul style="list-style-type: none"> <li>• As part of introduction of sound waves to the class, you may a learner to blow air into the 'Vuvuzela' column, sound is produced.</li> <li>• Explain how sound waves work:</li> </ul> <p>Sound waves exist as variations of pressure in a medium such as air. They are created by the vibration of an object, which causes the air surrounding it to vibrate. The vibrating air then causes the human eardrum to vibrate, which the brain interprets as sound.</p>

In the diagram below, the black dots represent air molecules. As the loudspeaker vibrates, it causes the surrounding molecules to vibrate in a particular pattern represented by the waveform. The vibrating air then causes the listener's eardrum to vibrate in the same pattern. Viola — Sound!



**Variations in Air Pressure and Corresponding Waveform**

- Explain to learners that air molecules do not actually travel from the loudspeaker to the ear (that would be wind). Each individual molecule only moves a small distance as it vibrates, but it causes the adjacent molecules to vibrate in a rippling effect all the way to the ear.

Sound is a **longitudinal** wave.

- Remember that longitudinal waves are made up of areas where the wave is compressed together, and other areas where it is expanded.
- This would agree with the way that humans themselves make sounds. We force air, sometimes harder, sometimes softer, through our vocal cords.
- In the process the air is either squished or allowed to move freely... making the air into a longitudinal wave! three fundamental characteristics of sound: **speed, frequency,** and **loudness**. The **speed of sound** in air actually depends on the temperature of the air.
- As a standard, we will say that the **speed of sound** is **340m/s** at 15°C. If you are not told anything different in a question, use this value.

Sound travels at different speeds depending on what it is travelling through. Of the three mediums (gas, liquid, and solid) sound waves travel the slowest through gases, faster through liquids, and fastest through solids. By exciting adjacent molecules.

Since water molecules are closer together than in air, the vibrations transfer from one to the other faster.



$$v = \sqrt{\frac{\text{elastic property}}{\text{inertial property}}} = \sqrt{\frac{B}{\rho}} = \text{where } B = \text{bulk modulus}$$

$$\rho = \text{density}$$

This relationship works fairly well for water with tabulated values:

$$B_{\text{steel}} = 160 \times 10^9 \frac{\text{N}}{\text{m}^2}$$

and that for water is

$$B_{\text{water}} = 2.2 \times 10^9 \frac{\text{N}}{\text{m}^2}$$

$$v = \sqrt{\frac{2.2 \times 10^9 \text{ N/m}^2}{1000 \text{ kg/m}^3}} = 1483 \text{ m/s}$$

This agrees well with the measured speed of sound in water, 1482  $\text{m}\cdot\text{s}^{-1}$  at 20°C. The situation with solids is considerably more complicated, with different wave speeds in different directions, in different kinds of geometries, and differences between transverse and longitudinal waves.

For example, a general tabulated value for the bulk modulus of steel gives a sound speed for structural steel of

$$v = \sqrt{\frac{160 \times 10^9 \text{ N/m}^2}{7860 \text{ kg/m}^3}} = 4512 \text{ m/s}$$

At normal atmospheric pressure, the temperature dependence of the speed of a sound wave through dry air is approximated by the following equation:

$$v = 331 \text{ m}\cdot\text{s}^{-1} + (0.6 \text{ m}\cdot\text{s}^{-1} \text{ C}^{-1}) \cdot T$$

where T is the temperature of the air in degrees Celsius. Using this equation to determine the speed of a sound wave in air at a temperature of 20 degrees Celsius yields the following solution.

$$v = 331 \text{ m}\cdot\text{s}^{-1} + (0.6 \text{ m}\cdot\text{s}^{-1} \text{ C}^{-1}) \cdot T$$

$$v = 331 + (0.6) \cdot (20)$$

$$v = 331 + 12$$

$$v = 343 \text{ m}\cdot\text{s}^{-1}$$

#### Learners activities 10 min

2.2.1. Which of the following is the region of a sound wave in which the density and pressure are greater than normal?

- rarefaction
- compression
- amplitude
- wavelength

2.2.2 Of the following materials, sound waves travel fastest through . Explain

- a. helium at 0°C.
- b. air at 0°C.
- c. copper at 0°C.
- d. air at 100°C.

2.2.3 Sound waves do not travel through

- a. solids
- b. liquids
- c. gases
- d. vacuum

2.2.4 Does sound travel faster or slower as temperature increases? Explain

2.2.5 What are the characteristics of sound waves?

**Corrections [7 min]**

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

In conclusion, indicate the importance/application of wave speed on daily lives. Some applications may include :

- o Pictures and sound on a movie
- o Printers , telegraphic machines

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

#### RESOURCES USED:

Worksheets, tuning forks, vuvuzela, flute

#### Reflection/Notes:

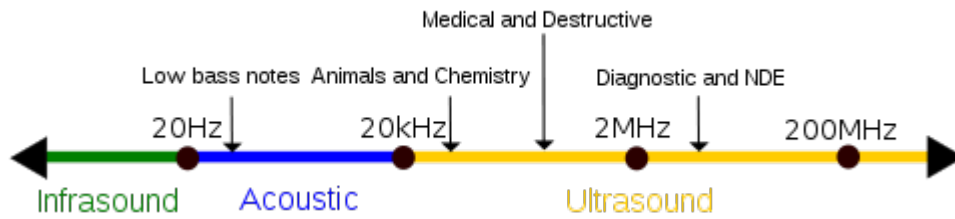
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<b>Sign:</b>		<b>Sign:</b>	
<b>Date:</b>		<b>Date:</b>	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	7	<b>TOPIC</b>	Ultra sound TIME: 60 minutes	<b>Lesson</b>	2
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Describe sound with frequency greater than 20 kHz as ultrasound</li> <li>• Explain how an image can be created using ultrasound</li> <li>• Describe the medical benefits of ultrasound</li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Demonstration ; Question and answer method
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	
<b>a) PRE-KNOWLEDGE</b>	learners need understanding of the following:
(i)	Amplitude and sound wave
(ii)	Frequency of a sound wave
(iii)	Waves and their reflection
<b>b) BASELINE ASSESSMENT</b>	(educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]
	<b>QUESTIONS for the BASELINE ASSESSMENT</b>
i)	What is meant by wave reflection ?
ii)	What is the frequency range that can be heard by an average young person?
iii)	Explain how loudness of sound is related to an amplitude of sound waves
<b>c) Do corrections and clarify misconceptions</b>	
<b>2.2 Main Body (Lesson presentation) [30 min]</b>	
	<b>Revise the frequency range that can be recognised by an average young person</b>
	<ul style="list-style-type: none"> <li>• From the explanation of the frequency range above, describe the ultrasound as the sound with frequency higher than 20 kHz. Meaning the frequency greater than a young person could hear.</li> <li>• Explain that the ultra sound ranges between 20 kHz and 100 kHz</li> </ul>



Ultrasound involves the use of high-frequency sound waves to create images of organs and systems within the body

**Medical sonography (ultrasonography)** is an ultrasound-based diagnostic medical imaging technique used to visualize muscles, tendons, and many internal organs, to capture their size, structure and any pathological lesions with real time tomographic images.

#### How the Test is Performed

*An ultrasound machine creates images that allow various organs in the body to be examined. The machine sends out high-frequency sound waves, which reflect off body structures as part of the wave is absorbed and other part is transmitted. A computer receives these reflected waves and uses them to create a picture. Unlike with an x-ray or CT scan, there is no ionizing radiation exposure with this test.*

The test is done in the ultrasound or radiology department. You will be lying down for the procedure. A clear, water-based conducting gel is applied to the skin over the area being examined to help with the transmission of the sound waves. A handheld probe called a transducer is moved over the area being examined. You may be asked to change position so that other areas can be examined.

Ultrasound examinations can help to diagnose a variety of conditions and to assess organ damage following illness.

Ultrasound is used to help physicians evaluate symptoms such as:

- **Pain, swelling, infection, and hematuria (blood in urine)**

Ultrasound is a useful way of examining many of the body's internal organs, including but not limited to the:

- heart and blood vessels, including the abdominal aorta and its major branches
- liver, gallbladder, spleen, pancreas, kidneys, bladder, uterus, ovaries, and unborn child (fetus) in pregnant patients
- Eyes, thyroid and parathyroid glands, scrotum (testicles), brain in infants and hips in infants

Doppler ultrasound images can help the physician to see and evaluate:

- blockages to blood flow (such as clots).
- narrowing of vessels (which may be caused by plaque).
- tumors and congenital malformation.

With knowledge about the speed and volume of blood flow gained from a Doppler ultrasound image, the physician can often determine whether a patient is a good candidate for a procedure like angioplasty

### Learners activity 10 min

2.2.1. By definition, ultrasound is sound having a frequency greater than \_\_\_\_ cycles per second, that is, sound above the audible range.

- A. 10,000                      B. 20,000                      C. 30,000                      D. 40,000

1. 2.2.2 Explain how an image is created using the ultrasound
2. 2.2.3 Describe the medical benefits of ultrasound
3. 2.2.4 How is an ultrasound performed on pregnant woman? Explain.
4. 2.2.5 What can the Doppler images help the physician with? Give three examples

### 5. Corrections [5 min]

### 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

In conclusion, indicate the importance/application of sound waves on daily lives. Some applications may include :

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]. **Spend about 5 minutes explaining quick summary of information on annexure A and B.**

**RESOURCES USED:** Worksheets

Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

## Annexure A Additional reading

## Definition of Ultrasound

ultrasound is sound with frequency greater than 20,000 cycles per second or 20kHz. Audible sound sensed by the human ear are in the range of 20Hz to 20kHz.

## Advantages

Ultrasound can be directed as a beam.  
Ultrasound obeys the laws of reflection and refraction.  
Ultrasound is reflected by objects of small size.

## Producing a sound wave

## Disadvantages

Ultrasound propagates poorly through a gaseous medium.  
The amount of ultrasound reflected depends on the acoustic mismatch.

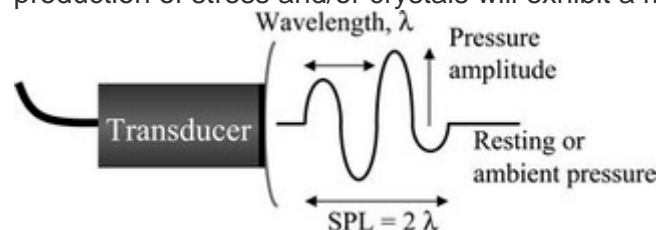
Creating an ultrasound image is done in three steps - producing a sound wave, receiving echoes, and interpreting those echoes.

- Ultrasound waves are produced by a transducer. A transducer is a device that takes power from one source and converts the energy into another form eg electricity into sound waves. The sound waves begin with the mechanical movement (oscillations) of a crystal that has been excited by electrical pulses, this is called the piezoelectric effect.



The sound waves are emitted from the crystal similar to sound waves being emitted from a loud speaker. The frequencies emitted are in the range of (2- 15MHz) and are unable to be heard by the human ear. Several crystals are arranged together to form a transducer. It is from the transducer that sound waves propagate through tissue to be reflected and returned as echoes back to the transducer.

- Sound is produced using Piezoelectricity which is the ability of some materials (notably crystals and certain ceramics) to generate an electric charge in response to applied mechanical stress, the reverse applies when
- The word is derived from the piezoelectric effect is reversible in that materials exhibiting the *direct piezoelectric effect* converse *piezoelectric effect* (the production of stress and/or crystals will exhibit a maximum shape change of about 0.1% of the original dimension).



Precise electrical pulses from the ultrasound machine make the transducer create sound waves at the desired frequency. The sound is focused either by the shape of the transducer (Curved, Linear, Sector) or a set of control pulses from the ultrasound machine. This focusing produces the desired shaped sound wave from the face of the transducer. The wave travels into the body and comes into focus at a desired depth.



- On the face of the transducer a rubber material enables the sound to be transmitted efficiently into the body. This rubber coating is required for impedance matching and allows good energy transfer from transducer to patient a vice versa. To help with the transmission of sound waves a water based gel is placed between the patient's skin and the probe. The gel establishes good acoustic contact with the body, since air is a very good acoustic reflector.

### Receiving the echoes

- The image is formed by the reverse of the process used to create the sound waves. The returning echoes to the transducer are converted by the crystals into electrical signals and are then processed to form the image.

### Forming the image

- To form the image ultrasound machine needs to determine the direction of the echo, how strong the echo was and how long it took the echo to be received from when the sound was transmitted. Once the ultrasound scanner determines these three things, it can locate which pixel in the image to light up and to what intensity.

### Sound in the body

- When a sound wave encounters a material with a different density (acoustic impedance), part of the sound wave is reflected back to the transducer and is detected as an echo. The time it takes for the echo to travel back to the transducer is measured and used to calculate the depth of the tissue interface causing the echo. The greater the difference between acoustic impedances, the larger the echo is.
- Highly reflective interfaces give rise to a strong echo which is represented on the screen as a bright spot, whilst the opposite is true of weak reflective interfaces. Areas without acoustic interfaces such as the lumen of vessels and other cavities containing liquid (blood, bile, ascites or urine) give no reflection and no spot on the screen ie a black space on the monitor. If the waves hits gases or solids the density difference is so great that most of the acoustic energy is reflected and it becomes impossible to see deeper.
- The speed of sound is different in different materials, and is dependent on the acoustical impedance of the material. However, the ultrasound scanner assumes that the acoustic velocity is constant at 1540 m/s. An effect of this assumption is that in a real body with non-uniform tissues, the beam becomes de-focused and image resolution is reduced.
- The formula for the velocity of sound is (velocity = frequency x wavelength). The frequencies used for medical imaging are generally in the range of 2 to 15 MHz. Higher frequencies have a smaller wavelength (as can be seen from the formula for velocity of sound), and can be used to make images with smaller details. However, the attenuation of the sound wave is increased at higher frequencies, so in order to have better penetration of deeper tissues, a lower frequency 3-5 MHz is used. Seeing deep structures in the body with ultrasound is very difficult as some acoustic energy is lost every time an echo is formed, but most of it is lost from acoustic absorption.

### **Annexure B**    **Ultrasound and animals**

#### **Bats**

Bats use ultrasounds to navigate in the darkness.

Bats use a variety of ultrasonic ranging (echolocation) techniques to detect their prey. They can detect frequencies beyond 100 kHz, possibly up to 200 kHz.

### Insects

Many insects have good ultrasonic hearing and most of these are nocturnal insects listening for echolocating bats. This includes many groups of moths, beetles, praying mantids and lacewings. Upon hearing a bat the insects will make evasive manoeuvres to escape being caught by the bat. Ultrasonic frequencies trigger a reflex action in the noctuid moth that cause it to drop a few inches in its flight to evade attack.

### Dogs

Dogs can hear sound at higher frequencies than humans can. A dog whistle exploits this by emitting a high frequency sound to call to a dog. Many dog whistles emit sound in the upper audible range of humans, but some, such as the **silent whistle**, emit ultrasound at a frequency in the range 18–22 kHz.

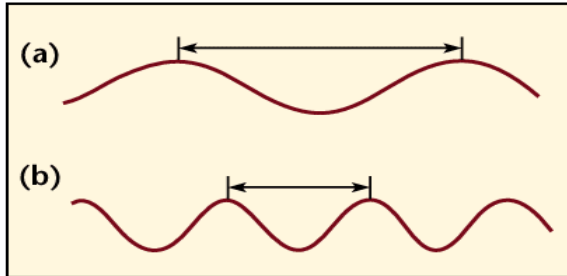
### Dolphins and whales

It is well known that toothed whales (Odontocetes), including dolphins can hear ultrasound and use ultrasonic sounds in their navigational system (biosonar) to orient and capture prey. **Porpoises** have the highest known upper hearing limit, at around 160 kHz.

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	7	<b>TOPIC</b>	Dual Nature of electromagnetic radiation TIME: 60 minutes	<b>Lesson</b>	3
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> <li>• Describe the source of electromagnetic radiation</li> <li>• Draw the diagram to explain how the an electromagnetic wave propagates</li> <li>• State the mutual dependence of the two fields</li> </ul>		

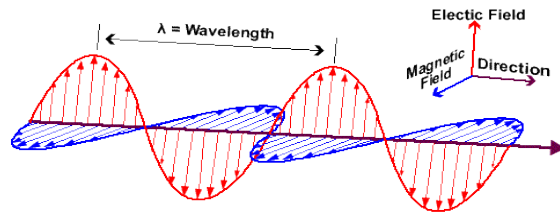
<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Demonstration ; Question and answer method
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	
<b>a) PRE-KNOWLEDGE</b>	learners need understanding of the following:
(i)	Electromagnetic radiation
(ii)	accelerating particles
(iii)	Speed of light
<b>b) BASELINE ASSESSMENT</b>	(educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]
	<b>QUESTIONS for the BASELINE ASSESSMENT</b>
i)	Define an electromagnetic wave
ii)	Which two fields in an electromagnetic wave are mutually dependent on each other ?
iii)	Give two examples of electromagnetic waves and their uses on daily lives?
<b>c) Do corrections and clarify misconceptions</b>	
<b>2.2 Main Body (Lesson presentation) [30 min]</b>	
	Catch the learners attention by asking the question:
	• Do you listen to the <b>radio</b> , <b>watch TV</b> , <b>twit a friend on a cellphone</b> or <b>use a microwave oven</b> ? All these devices make use of electromagnetic waves. Radio waves, microwaves, visible light, and x rays are all examples of electromagnetic waves that differ from each other in wavelength.
	Electromagnetic radiation has a dual nature. It has a wave nature and a particle nature.
	• i) Some aspects of behaviour of electromagnetic radiation can be explained <b>using the wave model</b> . That will include amongst others, diffraction, interference, reflection and refraction.



### Describe the source of EM waves

- Electromagnetic waves are produced by the motion of electrically charged particles. These waves are also called "electromagnetic radiation" because they radiate from the electrically charged particles. They travel through empty space as well as through air and other substances.
- They consist of mutually inducing, changing electric and magnetic fields which are perpendicular to each other

Electromagnetic radiation is a combination of oscillating electric and magnetic fields propagating perpendicular to each other through space and carrying energy from one place to another



- They transfer energy from one point to another

### Explain each of the properties of Electromagnetic radiation below :

- The waves originate from accelerating charges
- There is nothing in an electromagnetic wave that oscillates, the crests and trough are where the fields are strongest
- This type of wave is a non-mechanical wave, it does not need a medium ( can travel in a vacuum)
- They travel in a vacuum at a speed of light ( $c$ ) =  $3 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
- The complete range of frequencies and wavelength is referred to as electromagnetic spectrum

### ii) Electromagnetic wave as a particle

- Some aspects can be explained using a **particle model** . Photoelectric effect

A wave has particles carrying energy (photons). Describe a photon : Is a discrete bundle (or quantum) of electromagnetic (or light) energy that are always in motion

### Basic Properties of Photons

According to the photon theory of light, photons . . .

- move at a constant velocity,  $c = 3.0 \times 10^8 \text{ m/s}$  (i.e. "the speed of light"), in free space
- have zero mass and rest energy.

- carry energy and momentum, which are also related to the frequency ( $f$ ) and wavelength  $\lambda$  of the electromagnetic wave by  $E = hf$
- can be destroyed/created when radiation is absorbed/emitted.

## 2.2 Learners activity 10 min

2.2.1 Describe the source of electromagnetic waves

2.2.2 Explain how an electromagnetic wave propagates

2.2.3 List three properties of electromagnetic radiation

2.2.4 Draw a diagram to show the mutual dependence of magnetic field and electric field of an electromagnetic wave

**Do corrections with the learners [5 min]**

## 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

Educator should summarise the important aspects of the lesson, reinforcing what needs to be remembered and recalled

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

**RESOURCES USED:** Worksheets

## Reflection/Notes:

Name of Teacher:		HOD:	
Sign:		Sign:	
Date:		Date:	

<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	7	<b>TOPIC</b>	Particle nature of Electromagnetic radiation Time: 60 minutes	<b>Lesson</b>	4
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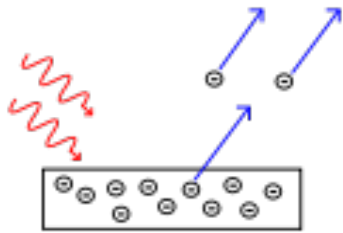
<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	At the end of the lesson learners should be able to: <ul style="list-style-type: none"> <li>• Define a photon</li> <li>• Calculate the energy of a photon</li> <li>• Explain how electrons will be ejected from a metal surface</li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<p><b>1. TEACHING METHOD/S USED IN THIS LESSON:</b> Demonstration ; Question and answer method</p> <p><b>2. LESSON DEVELOPMENT</b></p> <p><b>2.1 Introduction</b></p> <p><b>a) PRE-KNOWLEDGE</b> learners need understanding of the following:</p> <p>(i) Frequency and energy of a wave (ii) Radiation spectrum</p> <p><b>b) BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]</p> <p><b>QUESTIONS for the BASELINE ASSESSMENT</b></p> <p>i) Briefly explain gamma ray and x-ray radiation and indicate hazards of each radiation if there are any</p> <p>ii) What is the relationship between frequency and energy of any radiation</p> <p>iii) Write down the wave equation to calculate the speed of a wave, illustrate meaning of each symbol and provide a unit of measurement for each symbol.</p> <p><b>c) Do corrections and clarify misconceptions</b></p> <p><b>2.2 Main Body (Lesson presentation) [30 min]</b></p> <p>From dual nature of electromagnetic radiation, this section will focus on light as a particle</p> <p>Describe a photon : Is a discrete bundle (or quantum) of electromagnetic (or light) energy that are always in motion</p> <p><b>Basic Properties of Photons</b></p> <p>According to the photon theory of light, photons . . .</p>	

- move at a constant velocity,  $c = 3.0 \times 10^8$  m/s (i.e. "the speed of light"), in free space
- have zero mass and rest energy.
- carry energy and momentum, which are also related to the frequency ( $f$ ) and wavelength  $\lambda$  of the electromagnetic wave by  $E = hf$
- can be destroyed/created when radiation is absorbed/emitted.
- can have particle-like interactions (i.e. collisions) with electrons and other particles, such as in the Compton effect.

### Photoelectric effect

• The photoelectric effect is the observation that when light is shone onto a piece of metal, a small current flows through the metal. The light is giving its energy to electrons in the atoms of the metal and allowing them to move around, producing the current. However, not all colours of light affect metals in this way. No matter how bright a red light you have, it will not produce a current in a metal, but even a very dim blue light will result in a current flowing.



- The minimum frequency that light should have in order to eject electrons is called **threshold frequency**. If frequency of the light shone on the metal is :
  - Less than threshold frequency, no electrons are emitted from the metal
  - Equal to the threshold frequency, electrons will be just emitted ( no kinetic energy)
  - Greater than threshold frequency, electrons are emitted with kinetic energy

And if brighter light is shone/ more intensity, more electrons will be emitted with same kinetic energy

Light consists of particles (photons), and the energy of such a particle is proportional to the frequency of the light. There is a certain minimum amount of energy (dependent on the material) which is necessary to remove an electron from the surface of a zinc plate or another solid body (work function). If the energy of a photon is bigger than this value, the electron can be emitted. From this explanation the following equation results:

$$E_{\text{kin}} = hf - W$$

$E_{\text{kin}}$  ... maximal kinetic energy of an emitted electron  
 $h$  ..... Planck constant ( $6.626 \times 10^{-34}$  Js/  $4.14 \times 10^{-15}$  eV s)  
 $f$  ..... frequency  
 $W$  ..... work function

$$E = hf = \frac{hc}{\lambda}$$

$$W = hf_0 = \frac{hc}{\lambda_0}$$

Example : The work function of caesium metal is  $3,04 \times 10^{-19}$  J

- Calculate the threshold frequency
- Calculate the wavelength of the wave

#### Solution

a)  $E = hf$   
 $3,04 \times 10^{-19} = 6,63 \times 10^{-34} \times f$   
 $f = 4,59 \times 10^{14}$  Hz

b)  $c = f \times \lambda$   
 $3 \times 10^8 = 4,59 \times 10^{14} \times \lambda$   
 $\lambda = 6,54 \times 10^{-7}$  m

#### Learners activity

2.2.1 Define a photon

2.2.2 List five basic properties of a photon

2.2.3 A photon has a frequency of  $8,0 \times 10^{14}$  Hz.

a) Calculate the energy of the photon

b) calculate the wavelength of electromagnetic radiation

c) What type of electromagnetic radiation is this? Give a reason for your answer

2.2.4 The infra red beam emitted by a TV remote has a wave length of  $1,2 \mu\text{m}$ .

2.2.4.1 What is the energy of a photon of this infra red radiation?

2.2.4.2 If this infrared beam was shone onto a piece of caesium metal, which has a threshold frequency of  $4,59 \times 10^{14}$  Hz, would electrons be emitted? Justify your answer with calculations















## 2.2.4.5 What is meant by threshold frequency?

Corrections [7 min]

## 3. Conclusion

**Activity to Reinforce lesson and electromagnetic radiation**(Educator may summarise the main aspects of the lesson).[5 min.]

Phenomenon	Can be explained in terms of waves.	Can be explained in terms of particles.
Reflection	 ✓	 ✓
Refraction	 ✓	 ✓
Interference	 ✓	 ✗
Diffraction	 ✓	 ✗
Polarization	 ✓	 ✗
Photoelectric effect	 ✗	 ✓

Most commonly observed phenomena with light can be explained by waves. But the photoelectric effect suggested a particle nature for light. Then electrons too were found to exhibit dual natures

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

**RESOURCES USED:** Worksheets**Reflection/Notes:**

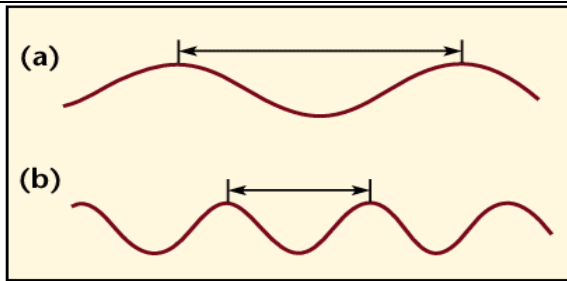
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<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	8	<b>TOPIC</b>	Electromagnetic radiation(Source) Time: 60 minutes	<b>Lesson</b>	1
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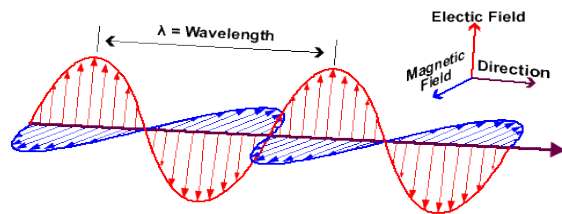
<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>	
<b>LESSON OBJECTIVES</b>	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Describe the source of electromagnetic radiation</li> <li>• Draw the diagram to explain how the an electromagnetic wave propagates</li> <li>• State the mutual dependence of the two fields</li> </ul>		

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Demonstration ; Question and answer method
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	
<b>a) PRE-KNOWLEDGE</b>	learners need understanding of the following:
(i)	Electromagnetic radiation
(ii)	accelerating particles
(iii)	Speed of light
<b>b) BASELINE ASSESSMENT</b>	(educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]
	<b>QUESTIONS for the BASELINE ASSESSMENT</b>
i)	Define an electromagnetic wave
ii)	Which two fields in an electromagnetic wave are mutually dependent on each other ?
iii)	Give two examples of electromagnetic waves and their uses on daily lives?
<b>c)</b>	<b>Do corrections and clarify misconceptions</b>
<b>2.2 Main Body (Lesson presentation) [30 min]</b>	
	Catch the learners attention by asking the question:
	<ul style="list-style-type: none"> <li>• Do you listen to the <a href="#">radio</a>, <a href="#">watch TV</a>, <a href="#">twit a friend on a cellphone</a> or <a href="#">use a microwave oven</a>? All these devices make use of electromagnetic waves. Radio waves, microwaves, visible light, and x rays are all examples of electromagnetic waves that differ from each other in wavelength.</li> </ul>



### Describe the source of EM waves

- Electromagnetic waves are produced by the motion of electrically charged particles. These waves are also called "electromagnetic radiation" because they radiate from the electrically charged particles. They travel through empty space as well as through air and other substances.
- They consist of mutually inducing, changing electric and magnetic fields which are perpendicular to each other



- They transfer energy from one point to another

### Explain each of the properties of Electromagnetic radiation below :

- The waves originate from accelerating charges
- There is nothing in an electromagnetic wave that oscillates, the crests and trough are where the fields are strongest
- This type of wave is a non-mechanical wave, it does not need a medium ( can travel in a vacuum)
- They travel in a vacuum at a speed of light ( $c$ ) =  $3 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
- The complete range of frequencies and wavelength is referred to as electromagnetic spectrum

## 2.2 Learners activity 10 min

2.2.1 Describe the source of electromagnetic waves

2.2.2 Explain how an electromagnetic wave propagates

2.2.3 List three properties of electromagnetic radiation

2.2.4 Draw a diagram to show the mutual dependence of magnetic field and electric field of an electromagnetic wave

**Do corrections with the learners [5 min]**

## 3. Conclusion

**Activity to Re-enforce lesson**(Educator may summarise the main aspects of the lesson).[5 min.]

Educator should summarise the important aspects of the lesson, reinforcing what needs to be remembered and recalled

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

Resources : Worksheets

RESOURCES USED:  
Worksheets

**Reflection/Notes:**

Name of Teacher:		HOD:	
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GRADE	10	SUBJECT	Physical Sciences	WEEK	8	TOPIC	Electromagnetic spectrum Time: 60 minutes	Lesson	2
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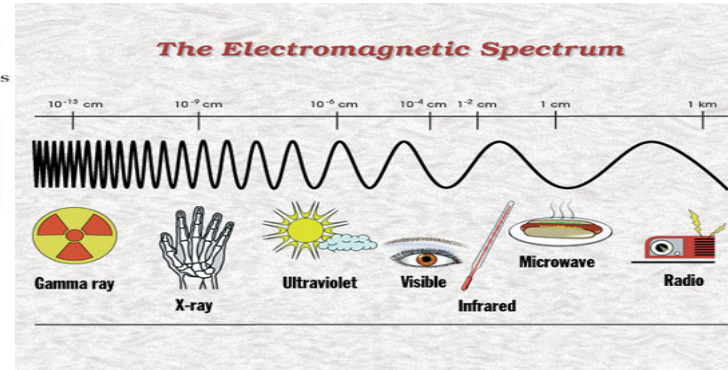
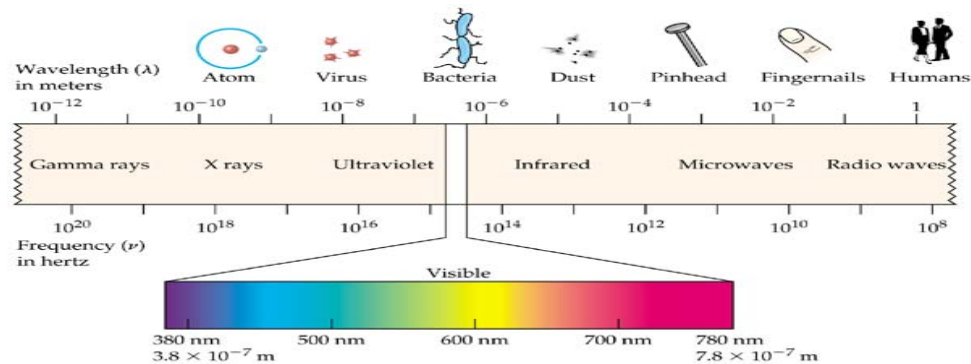
LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:
LESSON OBJECTIVES	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>List different types of electromagnetic radiations</li> <li>Arrange the electromagnetic radiation according to their frequency and wavelength</li> <li>Calculate the speed of wave (c) from <math>c = f \times \lambda</math></li> <li>Describe the dangers of some electromagnetic radiation</li> <li>Discuss radiation from cell-phones</li> </ul>	

### TEACHING and LEARNING ACTIVITIES

<p><b>1. TEACHING METHOD/S USED IN THIS LESSON:</b> Demonstration ; Question and answer method</p> <p><b>2. LESSON DEVELOPMENT</b></p> <p><b>2.1 Introduction</b></p> <p><b>a) PRE-KNOWLEDGE</b> learners need understanding of the following:</p> <p>(i) Electromagnetic radiation (ii) wave speed equation (iii) Frequency and energy</p> <p><b>b) BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]</p> <p><b>QUESTIONS for the BASELINE ASSESSMENT</b></p> <p>i) Define electromagnetic radiation ii) Give three examples of electromagnetic wave iii) Describe how the two fields dependent on each other propagates the electromagnetic wave</p> <p><b>c) Do corrections and clarify misconceptions</b></p> <p><b>2.2 Main Body (Lesson presentation) [35 min]</b></p> <ul style="list-style-type: none"> <li>Revise introduction from week 8 lesson 1 and list the appliances using electromagnetic radiation: <b>radio, TV, a cell-phone or a microwave oven.</b> All these devices make use of electromagnetic waves.</li> <li>Radio waves, microwaves, visible light, and x rays are all examples of electromagnetic waves that differ from each other in wavelength or frequency.</li> </ul>
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## Electromagnetic spectrum

Explain each of the radiation in the spectrum. You may use the examples of the EM spectrum below. From the diagrams below, it should be clear that spectra with higher frequencies (short wavelength) are more penetrative and they are dangerous. e.g. Gamma and X-rays.



## Uses of Electromagnetic Waves

Wave	Wavelength	Use
Long Wave Radio	1500 m	Broadcasting
Medium Wave Radio	300 m	Broadcasting
Short Wave Radio	25 m	Broadcasting
FM Radio (Frequency modulation)	3 m	Broadcasting and communication
UHF Radio ( ultra high frequency)	30 cm	TV transmissions
Microwaves	3 cm	Communication Radar Heating up food
Infra red	3 mm	Communication in optical fibres Remote Controllers Heating
Light	200 - 600 nm	Seeing Communicating
Ultra violet	100 nm	Sterilising Sun tanning
X-ray	5 nm	Shadow pictures of bones
Gamma rays	<0.01 nm	Scientific research/ nuclear reaction

- Dangers of electromagnetic radiation

- **Gamma rays** Gamma rays bombard our bodies constantly. They come from the naturally radioactive materials in rocks and the soil. We take some of these materials into our bodies from the air we breathe and the water we drink. Gamma rays passing through our body produce ionization in tissue. High levels of gamma rays can produce dangerous ionization of the tissue and can cause skin cancer.

- **X-rays** : A danger associated with X-rays is the extremely high voltage that occurs. In human beings an overdose exposure of X-rays may produce cancer, skin burns, and a reduction of the blood supply or other serious conditions.

#### Radiation from cell phone

- Cell phones emit radiofrequency energy, a form of non-ionizing electromagnetic radiation, which can be absorbed by tissues closest to where the phone is held.
- The amount of radiofrequency energy a cell phone user is exposed to depends on the technology of the phone, the distance between the phone's antenna and the user, the extent and type of use, and the user's distance from cell phone towers.
- Studies thus far have not shown a consistent link between cell phone use and cancers of the brain, nerves, or other tissues of the head or neck. More research is needed because cell phone technology and how people use cell phones have been changing rapidly

#### Learners activity [10 min]

2.2.1 How are the wave energy and the wavelength in the electromagnetic spectrum related?

- As wavelength gets shorter, the waves have more energy.
- As wavelength gets longer, the waves have more energy.
- As wavelength gets shorter, the waves have less energy.
- As wavelength gets shorter, the waves have the same energy

2.2.2 Provide a word or a phrase for the following

2.2.2.1 Electromagnetic radiation which is used in curing the cancer

2.2.2.2 Complete range of frequencies and wavelengths of electromagnetic radiation

2.2.3 What is electromagnetic radiation?

2.2.4 Arrange the following forms of light in order of increasing frequency (lowest frequency first): ultraviolet, infrared, gamma rays, visible, radio, X-rays. Put them in order of increasing wavelength (shortest wavelength first). Put them in order of increasing energy (lowest energy first).

2.2.5 Briefly explain each EM radiation and indicate hazards of that radiation if there are any.

2.2.6 Calculate the speed of a Gamma ray with a frequency of  $1.0 \times 10^{24}$  Hz and wavelength of  $1.0 \times 10^{-15}$  nm.

#### Corrections [7 min]

### 3. Conclusion 3 min

Emphasise the important aspect learners seem to have misconceptions on according to their answers on learners activity

**HOMEWORK QUESTIONS/ ACTIVITY** (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

#### RESOURCES USED:

Worksheets, remote control, cell phone etc



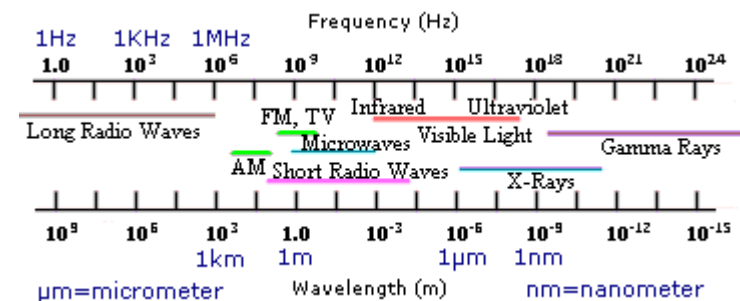
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## The Electromagnetic Spectrum

The electromagnetic spectrum is the range of wavelengths and frequencies that electromagnetic radiation can assume. This is a very broad range, and these waves exhibit a variety of properties associated with wavelength and frequency.

**Long radio waves** have the lowest frequency and wavelength - they sometimes have frequencies less than 1 Hertz and wavelengths in excess of 1 kilometer. They are generally used for long-range radio transmissions. **Short radio waves** have higher frequencies and correspondingly shorter wavelength; they are used mostly in very short-range radio transmissions. AM (amplitude modulation) radio waves have frequencies between these two wave types. In varying AM waves, the strength or height (maximum displacement from equilibrium) is changed. By contrast, FM (frequency modulation) radio waves usually have higher frequencies closer to those of TV transmissions. In varying FM waves, the frequency of the wave is changed. Exposure to radio waves causes no major health problems and is not regulated.



**Microwaves** are higher-frequency waves lying roughly between radio and infrared waves. They have a number of common applications, the most familiar of which is the microwave or microwave oven used for cooking. In these kitchen devices, microwaves are used to excite the water molecules in food, thus generating heat. Microwaves can easily penetrate nonmetal containers but generally cannot penetrate metal. For this reason, food to be microwaved cannot be heated in metal containers. High densities of microwave radiation (such as what is found in masers, or "microwave lasers") are known to cause health problems such as burns, cataracts, nervous-system damage, and sterility. Exposure to microwave radiation is usually regulated; the U.S. government limits exposure to 10 milliwatts per square centimeter or less.

**Infrared radiation** is the portion of the electromagnetic spectrum just below red light in terms of frequency. Infrared radiation, along with visible light and ultraviolet rays, are produced by the transitions of outer electrons. Infrared radiation has many applications in the field of astronomy because earth's atmosphere does not scatter it as much as visible light. Thus, special filters that block all but infrared rays can be used to obtain precise astronomical images without the scattering associated with visible light. Infrared radiation can also be used in detecting the positions of objects or people in the absence of visible light. This property has been put to good use in modern military technology. A more mundane use of infrared light can be found in the admissions booths of many theme parks, where visitors' hands are stamped with special ink visible only under infrared lights to prove that admission fees have been paid. A special infrared light, often referred to as a **black light**, is used to detect the ink. Infrared radiation itself is also often called "black light." Few if any dangerous side effects result from low-level exposure to infrared radiation.

**Visible light** is what is generally referred to by the term "light." This is the only type of electromagnetic radiation detectable by human eyesight. White light can be broken up into six distinct colours, each corresponding to a separate frequency and wavelength. These colours are, in order of increasing frequency, red, orange, yellow, green, blue, violet. (Indigo is often considered the seventh colour of the spectrum, but is no longer recognized as a distinct spectral colour.) This spectrum can be obtained by passing white light through a prism; when it occurs naturally as a result of light reflection in water droplets, it is called a **rainbow**. The colours seen in everyday life are due to the disproportionate absorption of certain wavelengths by everyday objects. For example, if an object is green, it tends to absorb red, orange, yellow, blue, and violet light, but reflects green light back to the observer. If an object is a colour "in between" two spectral colours - i.e., teal - then it reflects these two colours while absorbing the others. In the case of teal, red, orange, yellow, and violet light is absorbed, while green and blue light is reflected. Aside from its ordinary applications, visible light spectra can be used to detect such things as changes in the configurations of molecules.

**Ultraviolet light** is just beyond violet light in terms of frequency. Its main natural source is the sun and other stars; artificially, it is produced by electric-arc lamps for scientific purposes. Ultraviolet rays are often harmful to plants and animals, including humans. Their danger is generally proportional to their wavelength. They are divided into three categories: **UV-A**, **UV-B**, and **UV-C**. UV-A has the longest wavelength and is least dangerous; UV-B is of intermediate wavelength and is the type of sun emission that causes sunburn and, over long periods of exposure, skin cancer; UV-C has a very short wavelength and kills bacteria and viruses so well that it is often used to sterilize surfaces. The earth's atmosphere, especially the ozone layer, provides some protection from harmful UV rays from the sun; however, the depletion of the ozone layer in recent years has led to an increase in the amount of ultraviolet radiation to which the average human is exposed. Also, ultraviolet radiation is not entirely harmful because vitamin D is produced when it hits a human's or animal's skin. Another interesting property of ultraviolet light is the fact that it causes some objects to glow, or become **fluorescent**, upon contact. Molecules in the object gain energy on contact with ultraviolet light, then release the energy in the form of visible light. In astronomy, satellite-based ultraviolet ray detectors provide excellent data on distant stars.

**X rays**, also known as Roentgen rays in honor of their discoverer, are divided into two categories: soft and hard X rays. Soft X rays have longer wavelengths and are closer to the ultraviolet band of the spectrum. Hard X rays are closer to the gamma-ray band of the spectrum and have much shorter wavelengths. X rays are produced when high-velocity electrons are hit by material objects. Each element has a certain spectrum of **characteristic X rays** associated with it that identify it absolutely. This is extremely useful when studying the elemental makeup of distant objects. X rays are highly penetrating of ordinary objects, and their penetration power depends on the density and atomic weight of the object. They find their best-known use in medicine, where they easily penetrate flesh and are more effectively absorbed by bone. The result is that bone appears white on a photographic plate, while soft tissues appear gray. Another related, familiar application of X rays is luggage scanning at airports and other such facilities. Again, the empty portions of luggage or light objects like clothing are easily penetrated by X rays, while other, harder objects made of metal or hard plastic absorb the radiation more effectively. X rays are also associated with ionization and research into quantum mechanics; more information on these topics is available in Theoretical Cosmology.

**Gamma rays** are the shortest-wavelength, highest-frequency type of electromagnetic radiation. They are essentially identical to X rays in their effect, but are produced by excited nuclei instead of inner electrons. They are the most penetrating of all electromagnetic radiation. They are often produced as a result of **gamma decay** of radioactive elements; this is the most dangerous and the most penetrating of all radioactive decay.

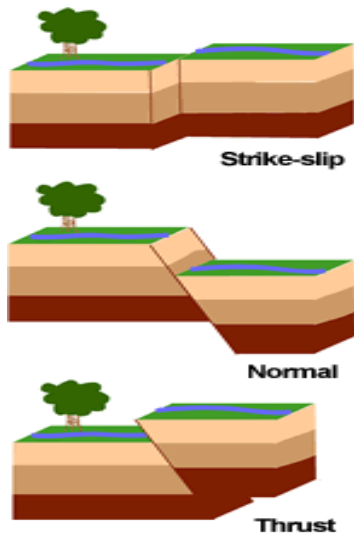
<b>GRADE</b>	10	<b>SUBJECT</b>	Physical Sciences	<b>WEEK</b>	8	<b>TOPIC</b>	Natural disasters and waves Time: 60 minutes	<b>Lesson</b>	3
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<b>LESSON SUMMARY FOR: DATE STARTED:</b>		<b>DATE COMPLETED:</b>
<b>LESSON OBJECTIVES</b>	<p>At the end of the lesson learners should be able to:</p> <ul style="list-style-type: none"> <li>• Discuss qualitatively animal behaviour related to Natural disasters</li> <li>• Discuss earthquakes, tsunami and floods</li> <li>• Explain how animals respond to waves related to natural disasters</li> </ul>	

<b>TEACHING and LEARNING ACTIVITIES</b>	
<b>1. TEACHING METHOD/S USED IN THIS LESSON:</b>	Discussion Method, Question and answer method
<b>2. LESSON DEVELOPMENT</b>	
<b>2.1 Introduction</b>	
<b>a) PRE-KNOWLEDGE</b> learners need understanding of the following:	
(i) Waves	
(ii) Sound waves and the ear	
<b>b) BASELINE ASSESSMENT</b> (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]	
<b>QUESTIONS for the BASELINE ASSESSMENT</b>	
i) What is the frequency range that an average human being can hear	
ii) How does Tsunami occur?	
iii) Give the difference between Tsunami and Floods	
<b>c) Do corrections and clarify misconceptions</b>	
<b>2.2 Main Body (Lesson presentation) [30 min]</b>	
<b>Describe Tsunami</b>	
<b>Tsunami</b> : is a series of water waves caused by the displacement of a large volume of a body of water, usually an ocean, though it can occur in large lakes. Owing to the immense volumes of water and the high energy involved, tsunamis can devastate coastal regions. Give an example of the recent incident in Japan	

### History of tsunami

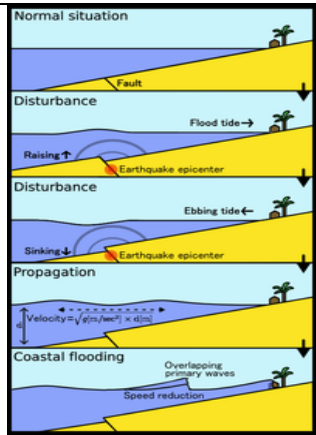
As early as 426 B.C. the Greek historian Thucydides inquired in his book *History of the Peloponnesian War* about the causes of tsunami, and was the first to argue that ocean earthquakes must be the cause. The cause of this phenomenon must be sought in the earthquake. At the point where its shock has been the most violent the sea is driven back, and suddenly recoiling with redoubled force, causes the inundation. Without an earthquake it does not seem like such an accident could happen.



When the earth shakes due to the movements of plates below the earth's crust it is known as Earthquake. Earthquakes are natural disasters, which kill thousands of people in an instant and can destroy cities and countries- human habitation across miles. The vibration during an earthquake has the potential to wreak havoc and destruction, which is beyond imagination. The destruction is the maximum near the epicenter, the place from where the vibrations arise and spread. Of late there have been many such natural disasters, which can be associated with earthquakes like the Tsunami that hit the shores of India, Thailand and razed down buildings and annihilated many lives.

The Roman historian Ammianus Marcellinus (Res Gestae 26.10.15-19) described the typical sequence of a tsunami, including an incipient earthquake, the sudden retreat of the sea and a following gigantic wave, after the 365 A.D. tsunami devastated Alexandria. While Japan may have the longest recorded history of tsunamis, the sheer destruction caused by the 2004 Indian Ocean earthquake and tsunami event mark it as the most devastating of its kind in modern times, killing around 230,000 people. The Sumatran region is not unused to tsunamis either, with earthquakes of varying magnitudes regularly occurring off the coast of the island.

The principal generation mechanism (or cause) of a tsunami is the displacement of a substantial volume of water or perturbation of the sea. This displacement of water is usually attributed to either earthquakes, landslides, volcanic eruptions, glacier calving or more rarely by meteorites and nuclear tests. The waves formed in this way are then sustained by gravity. Tides do not play any part in the generation of tsunamis



Schematic representation of a Tsunami

### Causes of Tsunami

A tsunami can be generated by any disturbance that rapidly moves a large mass of water, such as an earthquake, volcanic eruption, landslide or meteorite impact. However, the most common cause is an undersea earthquake. An earthquake which is too small to create a tsunami by itself may trigger an undersea landslide quite capable of generating a tsunami.

Tsunami can be generated when the sea floor abruptly deforms and vertically displaces the overlying water. Such large vertical movements of the earth's crust can occur at plate boundaries. Subduction earthquakes are particularly effective in generating tsunamis, and occur where denser oceanic plates slip under continental plates in a process known as subduction.

### Causes

Sub-marine landslides (which are sometimes triggered by large earthquakes) as well as collapses of volcanic edifices may also disturb the overlying water column as sediment and rocks slide downslope and are redistributed across the sea floor. Similarly, a violent submarine volcanic eruption can uplift the water column and form a tsunami.

Waves are formed as the displaced water mass moves under the influence of gravity to regain its equilibrium and radiates across the ocean like ripples on a pond.

In the 1950s it was discovered that larger tsunamis than previously believed possible could be caused by landslides, explosive volcanic action and impact events. These phenomena rapidly displace large volumes of water, as energy from falling debris or expansion is transferred to the water into which the debris falls. Tsunamis caused by these mechanisms, unlike the ocean-wide tsunamis caused by some earthquakes, generally dissipate quickly and rarely affect coastlines distant from the source due to the small area of sea affected. These events can give rise to much larger local shock waves (solitons), such as the landslide at the head of Lituya Bay which produced a water wave estimated at 50 150 m and reached 524 m up local mountains. However, an extremely large landslide could generate a megatsunami that might have ocean-wide impacts.

### Characteristics

Often referred to as "tidal waves", a tsunami does not look like the popular impression of "a normal wave only much bigger". Instead it looks rather like an endlessly onrushing tide which forces its way around and through any obstacle. Most of the damage is caused by the huge mass of water behind the initial wave front, as the height of the sea keeps rising fast and floods powerfully into the coastal area. The sheer weight of water is enough to pulverise objects in its path, often reducing buildings to their foundations and scouring exposed ground to the bedrock. Large objects such as ships and boulders can be carried several miles inland before the tsunami subsides.

Tsunamis act very differently from typical surf swells; they are phenomena which move the entire depth of the ocean (often several kilometres deep) rather than just the surface, so they contain immense energy, propagate at high speeds and can travel great trans-oceanic distances with little overall energy loss. A tsunami can cause damage thousands of kilometres from its origin, so there may be several hours between its creation and its impact on a coast, arriving long after the seismic wave generated by the originating event arrives. Although the total or overall loss of energy is small, the total energy is spread over a larger and larger circumference as the wave travels. The energy per linear meter in the wave is proportional to the inverse of the distance from the source.[citation needed] (In other words, it decreases linearly with distance.) This is the two-dimensional equivalent of the inverse square law, which is followed by waves which propagate in three dimensions (in a sphere instead of a circle).

A single tsunami event may involve a series of waves of varying heights; the set of waves is called a train. In open water, tsunamis have extremely long periods (the time for the next wave top to pass a point after the previous one), from minutes to hours, and long wavelengths of up to several hundred kilometres. This is very different from typical wind-generated swells on the ocean, which might have a period of about 10 seconds and a wavelength of 150 metres.

The actual height of a tsunami wave in open water is often less than one metre. This is often practically unnoticeable to people on ships. The energy of a tsunami passes through the entire water column to the sea bed, unlike surface waves, which typically reach only down to a depth of 10 m or so.

The wave travels across open ocean at an average speed of 500 mph. As the wave approaches land, the sea shallows and the wave no longer travels as quickly, so it begins to 'pile-up'; the wave-front becomes steeper and taller, and there is less distance between crests. While a person at the surface of deep water would probably not even notice the tsunami, the wave can increase to a height of six stores or more as it approaches the coastline and compresses. The steepening process is analogous to the cracking of a tapered whip. As a wave goes down the whip from handle to tip, the same energy is deposited in less and less material, which then moves more violently as it receives this energy.

A wave becomes a 'shallow-water wave' when the ratio between the water depth and its wavelength gets very small, and since a tsunami has an extremely large wavelength (hundreds of kilometres), tsunamis act as a shallow-water wave even in deep oceanic water. Shallow-water waves move at a speed that is equal to the square root of the product of the acceleration of gravity ( $9.8 \text{ m/s}^2$ ) and the water depth.

Tsunamis propagate outward from their source, so coasts in the "shadow" of affected land masses are usually fairly safe. However, tsunami waves can diffract around land masses). It's also not necessary that they are symmetrical; tsunami waves may be much stronger in one direction than another, depending on the nature of the source and the surrounding geography.

### Research Task : Earthquake

Read the article below and discuss qualitatively animal behaviour related to the earthquake across two different cultural groups and within scientific studies under the following sub-headings:

1. Definition
2. Causes of earthquake
3. Can animals really sense earthquakes? What technology do animals use to be safe? ( refer to frequency heard by certain animals).
4. Legends and people behaviour in the areas usually hit by earthquakes ( How rigid are their houses? what precautions do they take to minimize earthquake damages to their houses?)

The length of your task should not exceed **five** written pages. You are allowed to use pictures, but avoid to overcast your work with pictures

**Earthquake**

It seemed like Mother Nature was avenging herself on us who have used all her endowments to the fullest extent without caring to rejuvenate them. Here we would try to find out the causes of earthquakes so that we can all contribute to the prevention of such things in our own small ways. Individual awareness would definitely lead to mass awareness.

**RESOURCES USED:** Worksheets

**Reflection/Notes:**

<b>Name of Teacher:</b>		<b>HOD:</b>	
<b>Sign:</b>		<b>Sign:</b>	
<b>Date:</b>		<b>Date:</b>	