THE REPUBLIC OF UGANDA

Ministry of Education and Sports

O' LEVEL

SELF STUDY MATERIALS

SENIOR ONE

SCIENCE PACKAGE

NCDC
NATIONAL CURRICULUM
DEVELOPMENT CENTRE

UGANDA NATIONAL EXAMINATIONS BOARD

CHEMISTRY

TOPIC ONE: CHEMISTRY AND SOCIETY

Learning Outcomes

After going through the activities in this topic you should be able to;

i)know the appropriate activities to explain the distinct nature of Chemistry.
ii) understand why chemistry is studied and how it overlaps with other subjects such as Biology, Physics, Mathematics and Geography.
iii) understand the importance of chemistry and relate knowledge of chemistry to relevant careers.
iv) know the contribution of chemistry to the Ugandan economy.

***Lesson One*: The Nature of Chemistry**

INTRODUCTION

In primary seven you learnt about integrated science. I hope you remember what integrated science is.

Here in secondary school, we have science separated into mainly three(3) branches and those are:

- **Biology**: deals with living things.
- **Physics**: deals with relationship between energy and matter.
- **Chemistry**: *(you will find out about this in a while)*

In this lesson, we shall find out what Chemistry deals with and also the common things we use in everyday life that are made with the knowledge of Chemistry, by carrying out the given activities.

ACTIVITY 1.1

Identify the common things we use in everyday life that you think are made of chemicals. Write your findings in your chemistry note book.

ACTIVITY 1.2

INSTRUCTIONS

- Look for the following products/items and assemble them in one place.
  - Bar soap, Vim, Toilet paper, Jik, Soda, Tooth paste, Pens, Detergent (e.g Omo,sunlight,Nomi),mineral water bottle,a cloth,a comb,shoe polish,a book,Tomato sauce,Blueband
- Observe the products/items critically and answer the given questions, answers should be written in your chemistry note book.

a) Give at least one use of each of the products/items.
b) Are these products a result of the knowledge of Chemistry?
c) Name any other products produced using the knowledge of Chemistry.

CONCLUSION

Chemistry is all around us. The common chemicals in pharmaceuticals, cosmetics, plastics, foods&beverages, soaps&detergents, water treatment, alcohol preparation at home, are all related to Chemistry.

Question

What careers require the study and knowledge of Chemistry? Write the solutions in your chemistry note book.

***Lesson Two*: The Meaning of Chemistry**

Introduction

Chemistry deals with the study of materials that make up our world. Carry out the following activities to explore the meaning of chemistry further.

Activity 2.1.

Steps

1.Burn a piece of paper using a lighted match stick. Observe and write the changes that happen to the paper during the burning.
2.Now consider the following processes that take place in everyday life;
i)the rusting of a panga
ii)the boiling of water
iii)the rotting of fruits
a)What changes take place in each of the given processes above(i-iii)?
b)What are the necessary conditions for each of the above changes to take place?
3.Name any other processes in which materials change from one form to another?

Conclusion

The changes you have just observed and many others show what the study of chemistry is about.
Therefore, *Chemistry is the study of matter and the changes that occur to substances under different conditions*.

***Lesson Three*: Why Is Chemistry Studied And How It Overlaps With Other Subjects?**

Chemistry helps us to;

- Understand what different materials/substances are made of and their properties, some are poisonous, corrosive, toxic, etc
- Know the effects of chemicals to the environment hence we learn how to conserve and protect our environment.
- Get knowledge to advance in science and technology for better and quality human life.
- Acquire knowledge relevant in making new materials which are relevant and useful in our everyday life e.g making of food supplements, distillation of crude oil, making of plastics, making of cosmetics, making of dental creams, manufacture of soap&detergents, making of insecticides&herbicides, etc
- Get knowledge and skills of how to extract and use materials from the earth e.g Gold, Copper,etc

ACTIVITY 3.1

Using relevant Chemistry text books and the internet, research about more reasons why Chemistry should be studied and how Chemistry relates with other subjects. Write your findings in your Chemistry note book.

***Lesson Four*: Importance of Chemistry in Everyday Life.**

There are many examples of chemistry in everyday life which show how prevalent and important chemistry is.

Activity 4.1

Complete the following statements by filling in the blank spaces

- Digestion relies on chemical reactions between ……. and enzymes to breakdown large substances into …… that the body can …….
- Soaps and ……. are chemical substances that "dissolve"……when we wash our clothes, ……. and ……
- Drugs work because of chemistry and its chemistry knowledge helps us know which drugs are ……. or harmful to us as humans.
- Cooking is a chemical change that alters food to make it ……..,kills dangerous …… and makes food more ……

ACTIVITY 4.1

Summarise the mentioned examples in your chemistry note book. Use the internet and research for more ways how chemistry is important in everyday life, write your findings in your chemistry note book.

***Lesson Five*: Contribution of Chemistry to The Economy of Uganda.**

ACTIVITY 5.1

Using the knowledge of common industrial products in our country and their uses, ask older people around you, use books/magazines/newspapers and also the internet, to research about how chemistry contributes to the economy of Uganda. Base your research in the fields of medicine, industries, transport and Agriculture. Write a short report in your chemistry note book, showing the areas in chemistry which contribute to the economy of Uganda.

***Lesson six*: Laboratory rules and risk assessment**

Introduction:

At home there is a place where you prepare meals from. Although this place is worthy visiting, it can expose you to danger. The breakable equipment in this place further make it necessary to have guidelines in regard to its access.

Just like there are guidelines followed in almost all the places at home, similarly a science laboratory has guidelines set up to ensure safety.

It is important for you to make safety evaluation of the environment we live in. The evaluation of likely dangers in our environment is called **risk assessment.** Have you realised that when the floor is wet you reduce speed? Why?

By the end of this lesson, you should able to;
a) Know laboratory rules and regulations
b) Understand the importance of risk assessment in order to work safely

Activity 6.1: **Understanding laboratory rules and risk assessment**

Materials you need:

- Chart/paper or note book and marker/pen
- Picture of learners in a laboratory

Procedure:

Step 1: Study the picture below that show's unsafe behaviour of learners in a chemistry laboratory.

a) Identify and write the risks likely to happen in this laboratory.

b) If any of the dangers identified in a) above happened, write down what you would do.

c) If you were in charge of this laboratory, write down 5 rules you would setup.

Summary

- In this exercise, you have assessed risks in the picture. Do you realise it is important for you make risk assessment in order to work safely?
- When risks assessment is done and corrective action taken, then the likely danger(s) is/are avoided.

Follow-up activity:

a) Visit a kitchen or a general store or garden at home. Observe and identify areas which can be of risk.

b) Write 3 dangers that are likely to happen if you accessed the place without taking precaution.

c) As a responsible person, which measures or rules can you put in place to safe guard other family members at home?

***Lesson seven*: Scientific method of investigation**

Introduction:

The scientific method of investigation enables you increase on your skills in the field of chemistry research. It involves a systematic method of investigation to study and understand events in a natural world. This systematic approach to investigation ensures relevance of risk assessment to yourself and others. Mixtures are common substances we handle in life, separating them is an easy task when we use a scientific method of investigation.

By the end of this lesson, you should able to understand the scientific method to carryout investigations

Materials you need:

A detergent e.g *Omo, Nomi,* etc.

- Tea spoon
- 3 equal glasses
- Hot water
- Water at room
- temperature.
- Warm water

Investigation question: Does temperature affect formation of bubbles by detergents?

Prediction: The higher the temperature of water the more bubbles formed.

Procedure:

1. Measure equal amount of water at different temperature into 3 separate glass glasses,
2. To each glass, add a spoonful of detergent and agitate gently for 15 seconds,
3. Measure and record the height (in millimetres) of bubbles formed in each glass.

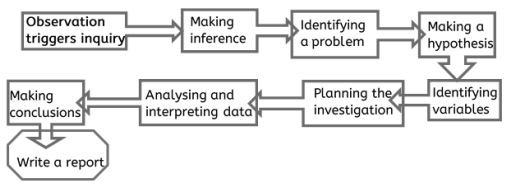
Observations and conclusion:

Table

Glass	Glass with hot water	Glass with warm water	Glass with water at room temperature
Height of bubbles recorded(mm)			

4. Plot a bar graph to represent information in table above.
5. Draw a conclusion to summarise the relationship between amount of bubbles formed and temperature of water.
6. Prepare a report on this investigation and how it can help you at home?

Summary:



Follow –up activity:

a) Using the scientific method of investigation, investigate why rainwater or boiled water readily forms bubbles with soap than any other locally available water.

b) What are the possible risks in your investigation

c) How is the knowledge of risk important to you and others?

Lesson Eight: States and Changes of States of Matter

By the end of this lesson, you should be able to:

a. appreciate that matter is anything which occupies space and has mass and can exist in a solid, liquid, gas and plasma form

b. understand that solids, liquids and gases have different properties including shape, pouring and compressing

Materials you will need

- ice
- water
- saucepan or tea kettle
- source of heat
- notebook

Introduction

You probably know already that a substance may be in the form of **a solid**, **a liquid** or **a gas**. These are the **three states of matter**. With your prior knowledge of states of matter, predict in what state a flame is? Everyone knows that water has a solid state, which is ice, a liquid state, which is water, and a gaseous stage, which is water vapour. In this lesson you will learn about what happens to the different states of matter when subjected to certain conditions.

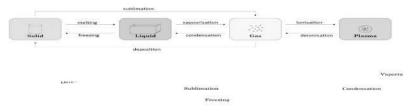
Procedure

In this activity you will differentiate between a gas, a solid and a liquid

Activity 8.1. Identifying the different states of matter

Step 1: Sketch the arrangement of molecules in solids, liquids and gases i.e. draw three rectangles and label them solid, liquid and gas respectively. Draw circles within each of the rectangles to represent the arrangement of molecules). (Compare your sketches with those in a textbook you can access).

Step 2: Look at the diagram below and give responses to the questions that follow.



a) How many states of matter can you identify? Name the states.

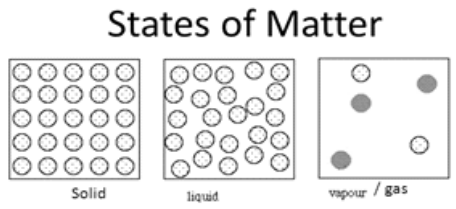
b) Which of the states do you think occur naturally on Earth and which one(s) does not?

c) Give at least three examples of the states of matter which occur naturally on Earth and two which does not occur naturally.

Activity 8.2. Finding out how states of matter can undergo a change

Step 1: What do you think causes matter to change from one state to another? A change in state of matter means a change in structure and properties of matter. You will use water in this activity.

Step 2: Obtain ice cubes and liquid water.



Solids – shape and volume don't change (definite or fixed)
Liquids – volume doesn't change but takes shape of container
Gas – takes volume and shape of container; compressible (can press particles closer together)

i) Place some ice cubes in a glass. What have

you noticed about the space they occupy

and their shape relative to the glass in which

they are placed? You might have observed

that the shape of the ice did not change with

the container it is placed in. Why? *This is*

because it is a solid and has a definite

volume and definite shape.

ii) Measure half a glass of water. Pour the same

amount of water in different size of containers. What did you observe? You might have observed that liquid water has a definite volume but not a definite shape.

iii) the water vapour is all around us, but is invisible! You might have observed that water in its gas state has no definite volume and no definite shape.

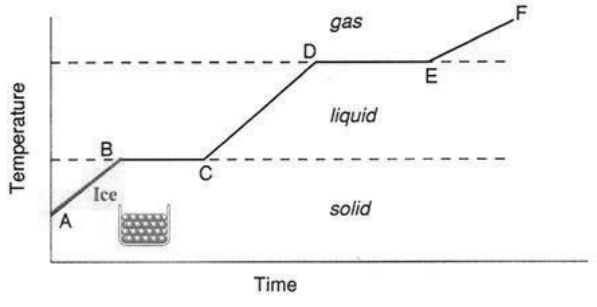
Step 3: Is it possible for matter to change from one state of matter to another? If so, when does matter change from one state to another? Matter can change states through heating or cooling, and it is sure to change states when it reaches its boiling point or freezing point. The change can be represented on a graph called heating and cooling curve for water at a constant rate.

Look at the graph of temperature against time, and describe how these states can change.

Heating and cooling curve for water heated at a constant rates.

A-B = Solid ice, temperature is increasing.

Particles gain kinetic energy, vibration of particles increases.



i) A – B shows solid ice. Predict what is happening to the temperature, energy of particles and movement of the particles?

ii) What happens between B-C?

iii) What happens between C-D?

iv) D-E shows liquid water. Predict what is happening at this stage.

v) What is happening between E-F?

Step 4: How to explain the particle arrangement in states of matter.

The kinetic theory of matter helps us to explain why matter exists in different states (i.e. solid, liquid and gas), and how matter can change from one state to the next. The kinetic theory of matter also helps us to understand other properties of matter.

Therefore, it helps to explain particle arrangement, inter-particle forces, movement of particles and the properties of solids, liquids and gases.

Follow-up activity

1. In which state of matter are molecules moving slowest?
2. What causes a solid to change to a liquid?
3. What point has water reached when it turns from a liquid to a solid?
4. What occurs when liquid turns into a gas?
5. In which state of matter are molecules moving the fastest?
6. What effect does the speed of molecules have on matter?
7. What happens when water reaches its boiling point?

PHYSICS

Chapter 1:
Lesson1: INTRODUCTION TO PHYSICS
Competences:
By the end of this lesson, you will be able to:

- explain the meaning of Physics.
- describe the relationship between Physics and other subjects like Biology /Chemistry.

Introduction
In primary school level, you studied science as a single subject. However, at secondary school level, Science is split into independent subjects like Physics and Biology. Can you name other cience subjects?
Look at the pictures in Figure 1 below:

Figure 1
What is happening in each picture?

To answer these questions and many more, you need knowledge of a new subject known as Physics. Did you know that Physics is all around us? All things surrounding us are either in form of matter or energy. This is what the study of Physics is all about.

Activity

- Are there some things that you have always wondered how they work, or how they happen?
- Make a list of all those things and ask your parents or brothers/sisters for explanations where possible.
- Are these things related to Physics?

Lesson 2: Branches and applications of Physics.
Competences:
By the end of this lesson, you will be able to:

- identify the branches of physics.
- explain the application of physics inside and outside the classroom.

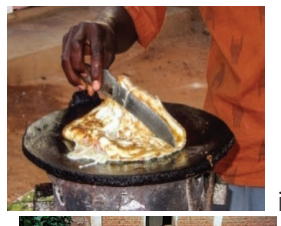
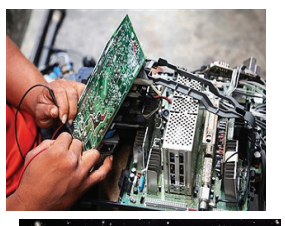
Materials you need:

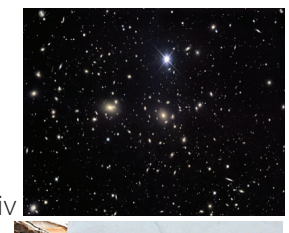
- A bulb (or a torch)
- Water in a saucepan
- A bar of soap
- Pieces of Firewood
- Flat iron with wooden handle
- Poles to construct a house
- Phone (even a spoilt one)
- mineral water bottle with holes
- A television
- A stove (either charcoal or kerosene)
- A radio (even a spoilt one)

Introduction
In your home environment, there aremany things and machines which do exist because of knowledge of Physics. The knowledge of Physics has helped many people to invent many things/ machines and apply them in different fields. These fields are the branches of Physics.

Activity 1
What to do:
Look at the pictures in Figure 1 and answer the following questions:

i) explain what is happening in each picture.
ii) which branches of primary Science are related to the activities in each of the pictures?

i  ii 

iii  iv 

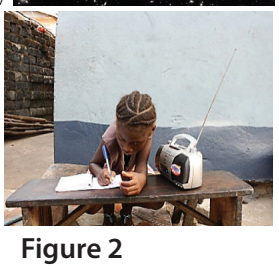
v  vi 

Figure 2

From this activity, you find that there are different branches of Science. The branches of Science indicated in Figure 2 are some of the branches in Physics. Can you now name some of the branches of Physics?

Activity 2

(i) Now that you know what physics is and what it involves, are there domestic equipment in the home that were made using the knowledge of Physics?

(ii) Think of ways in which Physics is important to you, your family or the community

Lesson 3: The Laboratory and its safety rules
Competences:
By the end of this lesson you will be able to:

- explain what a laboratory is
- state the rules and regulations of the laboratory**.**
- explain the importance of laboratory rules and regulations.

Materials:

- Saucepan,
- Small lamp or candle
- Match box
- Charcoal stove/ Firewood
- Plastic cup
- Water
- Variety of kitchen equipment
- Small jerrycan (5 *l*)
- stirring rode
- sugar
- Manila paper and Marker/pen
- Room (Kitchen)

Activity 1: Make a visit to the Kitchen at your home
What to do:

(a) Make a tour of the kitchen at home and try to establish various equipment and how they are used.

(b) How can you take care of the kitchen equipment?

(c) Suggest rules to follow while you are in the kitchen

From Activity 1, you have found out that there is equipment in the kitchen for different purposes. A school laboratory is much similar to the kitchen. Most of the practical works in Science, for example, experiments, tests, observations or investigations are conducted in a laboratory.

A laboratory is a building, part of a building or other place specifically designed for scientific work. It contains many pieces of apparatus and materials for practical use.

Apparatus is equipment or tools needed for a particular scientific activity or purpose. We use apparatus when we are carrying out an experiment. Laboratory apparatus is similar to the kitchen equipment.

Experiment is a scientific step-by-step process undertaken to make a discovery, test a proposed law or theory, or demonstrate a known fact.

Activity 2:
Now that you have seen that a laboratory is similar to a kitchen, answer the following questions:

1. Suggest some rules which you must follow while working in the laboratory
2. Why is is important to follow laboratory rules and regulations
3. Give the name and importance of the apparatus shown below.

Why is it important to always wash your hands after working from a laboratory?
The tests for the different diseases such as covid-19 are done in the laboratory

Chapter 2:
MEASUREMENTSIN PHYSICS

Lesson 1: Estimation and measurement
Competence:
By the end of this lesson, you will be able to:

- Explain the meaning of measuring and estimating
- Identify the major physical quantities that are measured

Materials you need

- A ruler
- A watch/clock

Introduction
When you go to a butchery, you buy meat in kilograms. When you go to a tailor, your cloth is cut according to your size. What is the general term used to describe the above cases?

Give examples of everyday life situations where the above process is applied, and explain what is done in each case.

Note: In the above process, you assign a numerical value and a unit to a physical quantity.

When you are carrying out the above process, you use an instrument such as the ones in Figure 3 below. Can you identify these instruments?

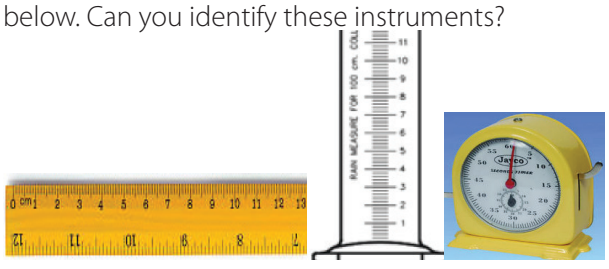


Figure 3

Is it possible to obtain a value of a quantity by simply looking at an object without an instrument? If you do so, then you are estimating.

For your knowledge
There are different physical quantities that are measured. Some are shown in the table below, with their units and instruments used to measure them

Physical Quantity	Name of Unit	Abbreviation	Instrument
Mass	Kilogram	kg	Beam balance
Length	Metre	m	Metre rule
Time	Second	s	Clock
Temperature	Kelvin	K	Thermometer
Weight	Newton	N	Spring balance
Volume	Cubic metre	m^3	Measuring cylinder

Are there otherphysical quantities not indicated in the table? Identify them
Can you differentiate between measuring and estimating?

Lesson 2: Measuring length
Competence:
By the end of this lesson,you will be able to;

- Make an instrument for measuring length
- Measure length and express it in different units

Materials you need

- A ruler
- Stick almost your height

Introduction
In lesson one, you saw that length is one of the quantities measured in physics. Its a distance between two points or objects. In this lesson you will measure length conveniently and express it appropriately.
Activity 1

Procedure
Using your set ruler, measure and record the length of;

(a) Your book

(b) One side of your house

You may have discovered that measuring the length of one side of your house was quite hard. But to simplify this, you need a different instrument.
Activity 2
Procedure

- Using the ruler, make divisions on the stick several times until you have formed a metre rule.
- Record the length of the formed metre rule
- Estimate the following
  (a) the length of one side of your house
  (b) your height
  (c) the height from the ground to the window of your house
  (d) the height of your house
- Now using this metre rule, measure the above distances and compare with your estimates as shown in figure 4.

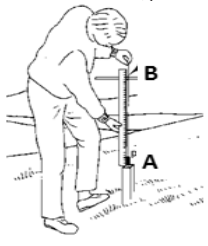


Figure 4: Measuring vertical distance
Please do not forget to indicate your answer in cm

For your knowledge: 1 m= 100 cm

Now you can alsoexpress the **above** estimate and measurements in metres as well.

Figure 5: Estimating measurement using stride/ pace

You should try to measure different lengths on the ground using your pace as shown in Figure 5.

Lesson 3: Measuring mass
Competence:
By the end of this lesson, you will be able to;
- Define mass and state its units
- Describe how to measure masses

Materials you need
- A small bottle of mineral water
- Water
- Bucket
- Basin

Introduction
Ask yourself about this: What is the amount of matter in a block of wood, a lump of sand, a heap of stones or a bottle of water?

Activity
- Fill up a small bottle of mineral water with water.
- Pour this water into a big container such as a bucket or basin
- Do this until you have poured water ten times into the bucket or basin

What is the amount of matter in the water you have poured into the bucket or container?
The amount of matter in the water in the container is called **mass. It is measured in grams.**

The mass of a small bottle of water filled with water is about 500 g. So what is the mass of water in the big container?
Using this activity, try to estimate the mass of water in a jerrycan.

Do you know your mass?
For your knowledge: Mass is measured in laboratories using a beam balance

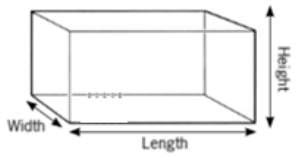
Lesson 4: Volume
Competence:
By the end of this lesson, you will be able to;
- Define volume and state its units
- Describe how to measure volume

Materials you need
- A small bottle of mineral water
- Some water
- A ruler
- A rectangular object such as a brick or bible

Introduction
What happens when you pour water or sand in a container? How do you record the amount of water or sand? What you record is the amount of space occupied by the water or sand, or the **volume of water/sand**.

Acivity 1
Measuring the volume of a regular object such as a rectangular object
What you need
- Ruler

What to do
1. Estimate the length and width and height of the rectangular object such as the bible or brick and find their product to estimate the volume of the object
2. Now measure the length, width and height of the bible or brick with a ruler (Figure 6) and calculate the real volume of the book or brick



volume = length x width x height

Figure 6: Illustration of measuring volume of a rectangular object

How close was your estimate to the measured value?

Note: If you measure the sides of the rectangular block in *centimetres* (cm), the volume will be in *cubic centimetres* (cm^3). If you measure the sides of block in *metres* (m), the volume will be in *cubic metres* (m^3). However, the SI unit of volume is *cubic meters* (m^3).

Try this one out: How many cm^3 are in $1m^3$?
What to do
- Convert 1m to cm.
- Multiply 1m by 1m by 1m to $1m^3$.
- Multiply also 100cm by 100cm by 100cm. What do you get?
- Compare the volume in m^3 to the volume in cm^3.

Did you know? $1000cm^3$= 1 litre
Lesson 5: Finding the volume of a liquid
Competence:
By the end of this lesson you will measure volume of liquids

What you need
- Small bottle of mineral water (its volume is 500 cm^3 or 0.5 litres)
- Some water in a cup

Procedure
1. Estimate the volume of the water in the cup in litres
2. Pour the water into the mineral water bottle.
3. Try to estimate the volume of the water using the mineral water bottle. Remember to read the bottom of the meniscus

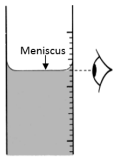


Figure 7: Position of eye while measuring volume of a liquid
Can you make a measuring cylinder out of a plastic bottle? How accurate can it be?

Lesson 6: Finding the volume of an irregular object
Competence:
By the end of this lesson, you should be able to measure volume of an irregular object

Introduction

A regular solid is one with straight sides, for example a book. An irregular solid does not have straight sides, for example a stone. You can measure the volume of irregular shaped solids by putting them in water in a marked container and finding out how far the water rises. We can only do this for objects which sink in water.

Activity
You need;
- Marked water bottle
- Water
- stone (small enough to go into the water bottle)

What to do
1. Estimate the volume of the stone.
2. Put some water in the marked water bottle and read the volume (*x cm^3*) .
3. Put the stone in the water in the marked water bottle and read the new volume (*y cm^3*).
4. The difference between the two volumes is the volume of the stone.

Lesson 7: Measuring time
By the end of this lesson, you should be able tomeasure time using different methods

Materials you need
- A watch/clock
- A small polyethene bag containing sand

Introduction
Our great grandfathers used different ways to measure time. These included observing the shadow, flowing sand, heartbeat and cockcrow. Some of these are indicated in Figure 8 below.

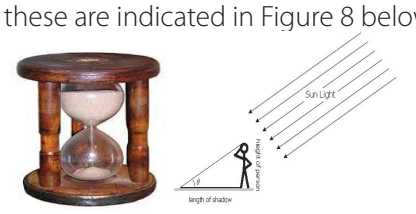


Figure 8: Ancient ways of measuring time

However, many of these methods were inaccurate or unreliable. Nowadays, engineers have developed more accurate clocks and watches for measuring time (Figure 9)

Figure 9: Modern ways of measuring time

How good are you at estimating time? Can you count so that you say one number each second? Try it.

A good way of measuring a second is to make a pendulum by tying a stone to a piece of string. If the string is 1 m long, the stone moves from one side to the other in 1 second. The SI unit of time is second. Other units of time are minutes, hours, days and weeks. Can you think of other units of time?
Follow up activity
State the most appropriate units in which you can express the following times
a) Your age
b) The time it takes to drink a cup of tea

c) The time the school assembly takes
d) The gestation period of a goat

Lesson 8: The scientific method
Competence:
By the end of this lesson you will be able to explain the steps followed in the scientific method

Introduction
In the previous lessons, you may have seen that Physics relies upon the practice of making observations and carrying out experiments. In Physics, you observe, raise questions, experiment, make conclusions. You may also make discoveries. That is called **'the scientific method'.**

Figure 10: The steps followed in a scientific method

1. Make an observation, for example:A torch does not light.
2. Ask a question, for example:Why doesn't the torch light?
3. Form a theory, or an explanation that you can test, for example: may be the torch doesn't light because the bulb is blown.
4. Predict what will happen based on the theory, for example: A new bulb will make torch light.
5. Test the prediction through experimentation, for example:Remove the top and replace the bulb with a new one.
6. Use the results to conclude or make new theories, for example:
   The torch did not light because the bulb was blown, or failure to light is not due to a blown bulb.
   In the second case look for another theory to answer your question and test it. Repeat until you get the correct theory.

The scientific method follows these steps:

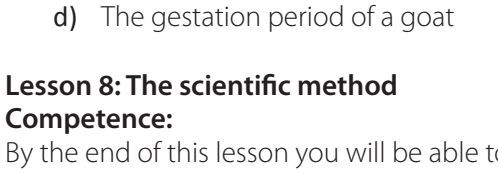


Figure 10:

Did you know?

When we **observe** in science, we normally use four of our senses to notice things.

- We look at things when we use our sense of *sight*.
- We feel things when we use our sense of *touch*.
- We listen to things when we use our sense of *hearing*.
- We smell things when we use our sense of *smell*.

(We do not usually use our sense of taste as that could be dangerous.)

Activity: Solving a problem using the scientific Method

What you need
- A radio which does not work but with old dry cells inside.
- A pair of new dry cells.

What to do
1. Copy the table below in your book.
2. Use the guideline provided in steps 1 – 6 above to carry out an investigation to identify the problem with the torch and record your results in Table 1 below.

Table 1

Observation	
Question	
Theory	
Prediction	
Experiment	
Conclusion	

Lesson 9: Density
Competence:
By the end of this lesson, you will will be able to;
- Define density and state its units
- Solve numerical problems related to density

Materials you need
- A pumpkin or any other large fruit available
- A small bottle of mineral water
- A block of wood or brick
- A container such as jug

Introduction
How do you compare two objects to see which one is bigger than the other? The task may be difficult, because even if the size of a body is larger, it does not necessarily mean that the particles in the body are closely packed. It may not even be heavier.
In this section, you will learn a more convenient way of comparing objects and why it is important to compare objects using the concept of density.

Now do this activity.
Look at the objects in Figure 11

Figure 11

(a) Which of the objects is the biggest? How do you know?
(b) Which object has the greatest mass?Which object has the most matter in it?

Some objects in **Figure11** have a small mass but with a large volume. The plastic bottle is one of these. The brick, however, has a large mass but with a small volume.We say that the brick has a large **density** but the plastic bottle has a small density. Therefore what is density?

The **density** of a substance is the mass of 1 cm^3 of the substance or **mass per unit volume**.

To find the density of a substance we divide its mass by its volume:

$$density = \frac{mass}{volume}$$

Think back to what you did earlier in this chapter to remind yourself about how you measure mass and volume.

Now that you know the method of obtaining density of an object, can you obtain the units of density?

Try out these problems:

1. The density of a metal is 8.9 g cm^{-3}. What does it mean? What is the importance of this value?
2. A rectangular piece of glass has a mass of 145.8 g and measures 2 cm by 9 cm by 3 cm. Find its density and express your answer in kg m^{-3}.

Lesson 10: Comparing densities of substances using water
Competence
By the end of this lesson, you will be able to compare densities of different materials using water

Activity
Materials you need
Some different solids such as:
- Pieces of metal
- Piece of plastic
- Piece of wood
- A small stone
- Some water in a container

What to do
1. Take different solids and put them in water
2. Observe whether they float or sink

Those substances with a density of less than that of water (1 g cm^{-3})willfloat in water. What can you say about the densities of the objects that sink?
Look at Table 1 below.

Table 1: Densties of commn substances

Substance	Density (g cm^{-3})	Substance	Density (g cm^{-3})
Aluminium	2.7	Methylated spirits	0.8
Brass	8.5	Paraffin	0.8
Copper	8.9	Petrol	0.7
Cork	0.3	Polyethene	0.9
Glass	2.5	Sand	2.6
Gold	19.3	Tin	7.3
Steel	7.9	Wood	0.6
Lubricating oil	0.9	Water	1.0
Mercury	13.6		

Which of the substances in Table 1 float in water?

Did you know that the floating of ships is a result of density of the ship material and its contents? (Figure 1). The material has more density than water but it floats because it contains air and occupies a large volume. Hence its density becomes less than that of water.

BIOLOGY

Revision activity 1:

Cells are the tiny building blocks of life that make up living organisms. Most cells are too tiny to be seen by unaided eye. You can only observe cells using a microscope. A microscope is an instrument used to observe things that are too small to be seen by an unaided eye. It makes them appear much larger and clearer. The egg of a bird is actually a cell and can be seen without the use of a microscope.

Things you will need:

i) Picture of an animal cell as seen under a microscope
ii) Raw chicken egg in a clear plate/saucer
iii) notebook
iv) pen /pencil

Activity set-up

Get a raw chicken egg and carefully crack it from the side of the airspace, hold the egg at the edge of a flat clear plate/saucer and gently pour out the contents onto the plate.

Procedure:

Step 1: Observe the raw egg on the plate/saucer. Look at the different layers.

i) How many layers are you able to see?
ii) Describe the size (big or small or thin) and position (outer, central, inner) of the layers
iii) Record the information from (i) and (ii) above in the table below. You will use it later in this activity.

Step 2: Study the picture of an animal cell as seen under a microscope

Step 3: Now compare the observation of the picture of an animal cell with that of the raw egg.

	Raw egg	**Animal cell**
Number of layers		
Size of layers		
Position of layers		

The central part of the animal cell is called the nucleus.

The fluid part surrounding the nucleus is called the cytoplasm.

The outer boundary surrounding the cytoplasm is the cell membrane.

Step 4: Draw and label the parts of the animal cell

Follow-up activity

1. Complete the following statements by filling in the blank spaces

_____ is a thin, outer layer surrounding the contents of the cell. It allows some substances to go in and some to come out of the cell.

_____ is a mucus-like liquid in the cell. This is where some of the life processes take place.

_____ is the "brain" of the cell. It controls all the chemical activities that take place in a cell. For example, _____, _____ and _____

2. The coronavirus is a microscopic organism, how different or similar is it to the animal cell?

Revision activity 2

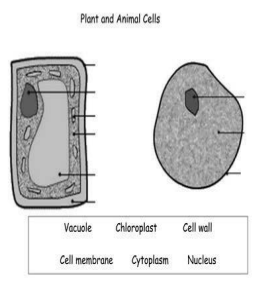
Introduction: The plant cell has parts that are the same as those found in an animal cell. It also has parts that are unique to it. The structure of the plant cell is also different from that of the animal cell.

Things you will need:

i) Picture of a plant cell as seen under a microscope
ii) notebook
iii) pen /pencil

Procedure:

Step 1: Study the picture of a plant cell as seen under a microscope



The thick outer polygon-shaped layer is called the cell wall. The small green oval-shaped structures scattered in the cytoplasm are called chloroplasts. The vacuole is the large centrally located area of the cell found within the cytoplasm.

Step 2: Draw the plant cell and label its parts.

Follow-up activity - Complete the following statements by filling in the bank spaces

The cell wall is made up of a tough material called cellulose hence it provides _____ to the plant cell. The chloroplasts are numerous round structures that are green in colour because they contain chlorophyll which is used to trap _____ energy needed in the process of _____. The vacuole stores waste materials and useful substances such as _____, _____ and _____.

Revision activity 3

Cells are grouped together or organised at various levels in order to carry out specific functions and key life processes in the body. This ensures efficient functioning of the body for the survival of the organism. In this lesson, you will find out the different levels of cell organisation and what they do.

Things you will need:

i) notebook
ii) pen /pencil

Procedure:

People in a group can perform more complex tasks than one person alone. Consider what happens when there is a social gathering at your home and three families are supposed to prepare a meal for the function.

Step 1: List the categories of foods that form the meal going to be prepared.

Step 2: For each of the categories you have identified, sort them out according to the number of people that would be required to prepare that category of food i.e.

- 1 person
- 2 to 3 people
- 4 to 8 people (one family)
- more than 9 people (2 or more families)

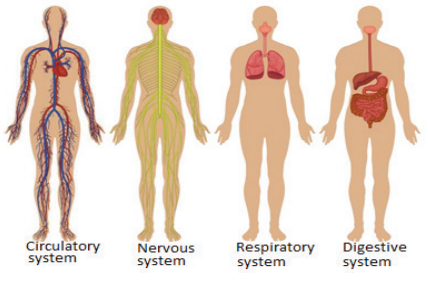
Write what you have done in a notebook

Step 3: Like people, similar cells in our bodies are organised into groups to make them work more effectively.

- *A group of **similar cells** performing a particular function is a **tissue** e.g. muscle tissue*
- *A group of **different tissues** form an **organ** to perform a particular function e.g. heart*
- *A group of **different organs** form an **organ system** to perform a particular function e.g. circulatory system*
- *A group of **different organ systems** form an **organism** e.g. a human*

Compare what you wrote down in step 2 with the information given in step 3. Write down what would be the equivalent of a cell, tissue, organ, organ system and organism.

Step 4: Study the figure below



Identify;

i) The four systems shown in the figure
ii) The organs that make up each of the systems shown

State the function of each of the systems you have identified.

MATHEMATICS

Topic: Working with Integers

This topic is to guide you to work with positive and negative integers.

LESSON ONE

In this lesson you will be able to identify, read and write natural numbers as numerals and words in million, billion and trillion.

Materials Required

A pen and book.

Review

In your day-to-day life, you use numbers to count items, to keep information, to transact business and many others. Since you use numbers in your day-to-today situations, knowledge of integers will be helpful to you.

In lower primary, you learnt counting items using numbers one, two, three and so on. In mathematics these numbers are called counting or natural numbers.

Activity 1

Look around your homestead.

i. How many cows or hens or goats or ducks or banana plantains or cups do you have:
ii. Write each of the numbers in words.

Brain teaser:

When do you start counting? Is it at 0 (Zero) or 1 (one)?

TIPS FOR LEARNING.

When zero is included in the set of natural numbers/ counting numbers, they become whole numbers.

N is a set of Natural numbers $\{1,2,3,4,5,------\}$

W is a set of Whole numbers $\{0,1,2,3,4,5.------\}$

Activity 2

Match the following correctly

One million and three	1000003
One million three	1030000
One zero zero zero zero three	One billion three hundred fifty million sixty-four thousand five hundred seventy-six thousand.
1,350,064,576	One billion three fifty thousand sixty-four thousand five hundred seventy-six
	One billion three hundred fifty million six hundred forty thousand five hundred seventy-six

Exercise

Write the following in words:

1. 8,008,008
2. 606,520,060
3. 9,000,909,800
4. 1,629,284,729,000

Write the following in figures:

1. Six hundred five million three thousand and eight
2. Seven billion eighty-nine million four thousand seven
3. Five trillion two hundred fifty billion eight hundred seventy-five million three hundred sixty thousand

LESSON 2:

By the end of this lesson you will be able to relate natural numbers and integers

Activity 1: Relating natural numbers and integers

The average normal body temperature of a human being is 37^0C. In one of the markets, temperatures of 5 people were taken and recorded as follows. Use the results to answer the questions that follow.

PERSON	TEMPERATURE RECORDINGS
A	36^0C
B	37.5^0C
C	38^0C
D	38.5^0C
E	34^0C

Questions

1. Which of the persons had a normal temperature?
2. Which person has a low body temperature? How does it compare with the normal person's body temperature?
3. Which person has the highest body temperature? How does it relate with the normal person's body temperature?
4. If a patient has his/her temperature measured at 34.5^0C, explain the difference from the normal body temperature of 37^0C
    b. What special name is given to the difference you obtained in (4) above?
5. If a patient has his/her temperature measured at 39.5^0C, explain the difference from the normal body temperature of 37^0C
6. What special name is given to the difference you obtained in (5) above?

Which of the following is a true statement?

a. The natural numbers include fractions
b. The natural numbers can be positive or negative
c. The natural numbers are the counting numbers
d. The natural numbers go up to 100

Sort out the natural numbers from the following list

20, 1555, 63.99, 5/2, 60, −78, 0, −2, −3/2

Write an integer to represent each situation:

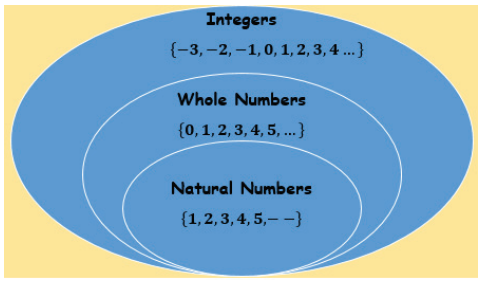
STATEMENT	INTEGER
3 degrees above 0	
A loss of UGX.20,000	
A gain of 7 points	
5 steps backward	

Brain teaser

Are the following statements **TRUE** or **FALSE**? Give reasons.

1. Addition of natural numbers gives a natural number
2. Subtraction of natural numbers is equal to an integer.
3. Multiplication of integers is always equal to a natural number.
4. Subtraction of natural numbers is equal to a natural number
5. Division of integers is equal to a natural number.

Tips for Learning



The relationship between integers, whole numbers and natural numbers

Lesson 3:

By the end of the lesson you will be able to use Directed Numbers (Limited to Integers) in Real-life Situations

Activity 1

Read the story below and answer the questions.

Once upon a time, there lived an old woman. She had hot and cold stones and a big pot of water. If she put one hot stone in the water, the temperature of the water would rise by 1 degree. If she took the hot stone out of the water again, the temperature would go down by 1 degree.

Question 1

If the temperature of the water is 24 degrees and the old woman adds 5 hot stones, what is the new temperature of the water?

Now imagine that the temperature of the water is at

29 degrees. The old woman takes a spoon and takes out 3 of the hot stones from the pot.

Question 2

What is the temperature of the water when the old woman removes 3 hot stones? Explain your answer.

The old woman also had cold stones. If she adds 1 cold stone to the water, the temperature goes down by 1 degree. The temperature of the water was 26 degrees. Then the old woman added 4 cold stones.

Question 3

What is the temperature of the water after the old woman added 4 cold stones? Give a reason for your answer.

Just like the old woman could remove the hot stones and the temperature would decrease she could also remove the cold stones.

Question 4

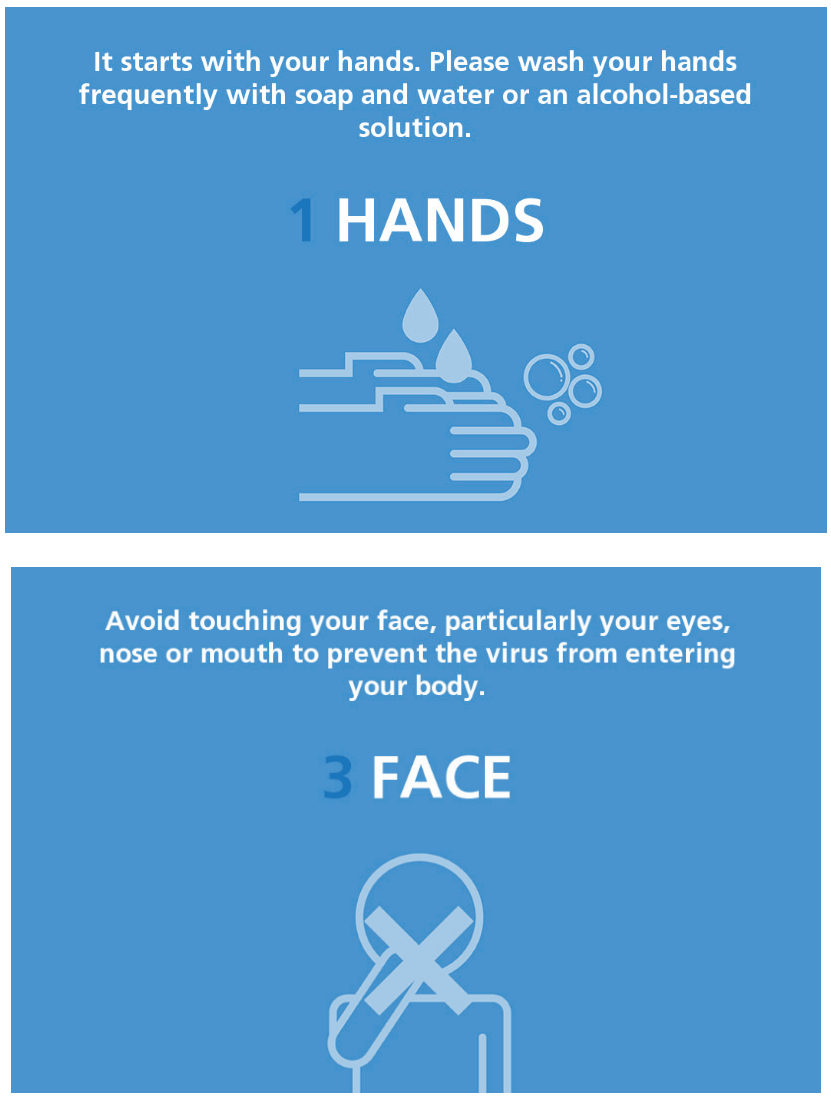
Imagine that the temperature of the water was 22 degrees and the old woman removes 3 cold stones. What happens to the temperature of the water?

What is the new temperature of the water? Explain your answer.

Activity 2

Get a cup of hot water and dip your finger. Note the time at which you have dipped the finger and how you felt. Give an interval of 30 minutes, and dip the finger again in the cup of water. What do you feel? Explain the effects using the knowledge of integers.

Five steps to kicking out coronavirus



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