THE REPUBLIC OF UGANDA
Ministry of Education and Sports

# SENIOR TWO
# SELF STUDY MATERIALS
# SCIENCE PACKAGE

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

# CHEMISTRY

**Topic: Structure of the Atom**

**Learning outcomes**

**By the end of these lessons, you should be able to:**

- **a)** define an atom
- **b)** state the components of an atom
- **c)** draw a structure of an atom
- **d)** define isotopes

**Lesson 1: Structure and Components of an Atom**

***Introduction***

An atom is the smallest electrically neutral indivisible particle of an element that takes part in chemical reactions.
An atom consists of an extremely dense region called a ***Nucleus*** which is surrounded by circular paths called ***Energy levels***. The nucleus contains two sub-atomic particles called,

a) **Protons** which are positively charged.

b) **Neutrons** which have no charge.

Energy levels hold the electrons which are negatively charged.

**Activity 1**

Using the information in the introduction, draw the general structure of an atom.

**Activity 2**

Study the given table and complete it correctly

| Particle | Symbol | Charge | Mass | Position in atom |
|---|---|---|---|---|
| Proton | | | | |
| Electron | | | | |
| Neutron | | | | |

**Question**:

Why are atoms electrically charged yet both protons and electrons are electrically charged?

**Lesson 2: Atomic number and Mass number**

**Introduction**

Each element has an atomic number and a mass number. These numbers can be used to calculate the number of each of the sub-atomic particles in the atom of every element.

**Atomic number** refers to the number of protons in the nucleus of an atom. **Mass number** or **atomic mass** refers to the sum of the protons and neutrons in the nucleus of an atom, i.e *mass number=number of protons+ number of neutrons*

**Example**

Consider an atom of sodium element $^{23}_{11}Na$

The symbol of sodium atom is Na

The atomic number of sodium atom is 11

The mass number of sodium atom is 23

Sodium atom has 12 neutrons i.e 23-11=12

**Activity 1:** The given table shows mass numbers and atomic numbers of atoms P, Q and R, where the letters used are not the actual symbols of the elements. Answer the questions that follow.

| Atom | Mass number | Atomic number |
|---|---|---|
| P | 4 | 2 |
| Q | 9 | 4 |
| R | 11 | 5 |

a) How many protons are there in P?
b) How many electrons are there in Q?
c) How many neutrons are there in R?

**Activity 2:**
Atom T contains 11protons and 13neutrons

a) State the i) atomic number of T
ii) number of electrons in T
b) Determine the atomic mass of T

**Lesson 3: Electronic *configuration***

**Introduction**

Electronic configuration is the arrangement of electrons in the energy levels around the nucleus.

The first energy level takes a maximum of two (2) electrons.

The second energy level takes a maximum of eight (8) electrons.

The third energy level takes a maximum of eight (8) electrons.

**Example:**

The atomic number of Potassium is 19 and the mass number is 39. Potassium has 19 electrons, 19 protons and 20 neutrons. In the electronic configuration of Potassium atom, two electrons go into the first energy level which is then complete; eight electrons go into the second energy level which is then complete; the other eight then occupy the third energy level and the remaining electron goes to the fourth energy level.

The electronic configuration of Potassium atom is 2:8:8:1

**Activity 3:**

The table given shows the first twenty elements of the Periodic Table arranged in order of their atomic numbers. Study it well and complete it correctly.

| Element | Symbol | Atomic number | Electronic configuration |
|---|---|---|---|
| Hydrogen | | | |
| Helium | | | |
| Lithium | | | |
| Beryllium | | | |
| Boron | | | |
| Carbon | | | |
| Nitrogen | | | |
| Oxygen | | | |
| Fluorine | | | |
| Neon | | | |
| Sodium | | | |
| Magnesium | | | |
| Aluminum | | | |
| Silicon | | | |
| Phosphorus | | | |
| Sulphur | | | |
| Chlorine | | | |
| Argon | | | |
| Potassium | | | |
| Calcium | | | |

**Activity 4:**
Draw the electronic structures for each of the first twenty elements of the Periodic Table.

**ACTIVITY**: ***Making models of atoms***

- Materials needed:
- small size seeds,
- beads,
- small stones,
- glue
- large sheet of Paper e.g a newspaper

**Procedure:**

*Step1:*
pick and arrange seeds, beads and stones for the model, where seeds represent electrons; beads represent protons; and stones represent neutrons.

*Step 2*:

Draw the outline of the structure of Carbon atom on the large sheet of Paper or the newspaper.

*Step 3*:

Place the seeds, beads and stones in their right positions on the outline of the Carbon atom structure drawn in step 2.

Step *4*:

Display the completed model of the Carbon atom structure. Follow the above procedure and make models for these atoms, Lithium, Oxygen, Neon, Sulphur and Calcium.

## LESSON 4: ISOTOPES

### Introduction

Isotopes are atoms of the same element having the same number of protons but different numbers of neutrons.

An atom of any element is represented by, $^{A}X$ where A is the mass number of element X and Z is the atomic number of element X.

Examples of elements that show isotopy are; Chlorine, Hydrogen, Carbon, Potassium and Oxygen.

The Isotopes of Carbon are;

-carbon 12, $^{12}C$

-carbon 13, $^{13}C$

-carbon 14, $^{14}C$

**NOTE:**
For all the isotopes of any element, Z is constant and A varies because there are different numbers of neutrons in the different isotopes of the element.

**Activity 4**

a) Define the term Isotopy
b) mention any six (6) uses of isotopes.

**Topic: Periodic table**

**Learning outcomes**

By the end of these activities you should be able to:

1. identify groups and periods in the periodic table
2. describe the arrangement of elements in the periodic table

**Introduction:**

Visit a place where you keep utensils, how is your storage stand organized? Are plates mixed with cups and saucepans?

In a good store, materials are classified and kept according to use, shape, materials or size.

**Activity 1.1: Making a kitchen-ware storage order sheet**
**Materials needed:**

- A paper and pen
- Picture of items found in the kitchen

**Procedure**:

1. The picture below shows how kitchen items were arranged in store shelf, study the pattern in which they are organised.
2. On a sheet of paper, draw a table with boxes similar to those in the picture

3. Identify and write the name of each item in a matching box on paper.

**Observations and conclusion:**

- Which name can you give to items in each row and column?
- Why is it important to organize items at home?
  Just like you have discovered that the items above were logically organized in patterns and that this is important in your daily life.
  In the world, there are 118 chemical elements. For these elements to be easily studied, they were logically arranged into vertical sections (columns) called **groups** and horizontal sections (rows) called **periods.**
  Elements in periods and groups form the **periodic table** of chemical elements as shown below.

**Activity 1.2: Analysing the arrangement of elements in the periodic table**
**Materials needed:**

- The periodic table
- Pen and paper

**Procedure**:

1. Count and write the number of periods and groups in the periodic table.
2. Study group I and II, how is the atomic number of the elements used determine their arrangement in the groups?
3. Draw the electronic structure of lithium, sodium and potassium. How does their atomic size vary down the group?
4. Write the electronic configuration of sodium, magnesium, aluminium and chlorine. How does atomic number and atomic size vary across the period?

**Periodic table of the elements**

Alkali metals
Alkaline-earth metals
Transition metals
Other metals
Other nonmetals
Halogens
Noble gases
Rare-earth elements (21, 39, 57–71) and lanthanoid elements (57–71 only)
Actinoid elements

| period | I | II | III | IV | V | VI | VII | O |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 H | | | | | | | 2 He |
| 2 | 3 Li | 4 Be | 5 B | 6 C | 7 N | 8 O | 9 F | 10 Ne |
| 3 | 11 Na | 12 Mg | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar |
| 4 | 19 K | 20 Ca | 31 Ga | 32 Ge | 33 As | 34 Se | 35 Br | 36 Kr |
| 5 | 37 Rb | 38 Sr | 49 In | 50 Sn | 51 Sb | 52 Te | 53 I | 54 Xe |
| 6 | 55 Cs | 56 Ba | 81 Tl | 82 Pb | 83 Bi | 84 Po | 85 At | 86 Rn |
| 7 | 87 Fr | 88 Ra | 113 Nh | 114 Fl | 115 Mc | 116 Lv | 117 Ts | 118 Og |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lanthanoid series | 6 | 58 Ce | 59 Pr | 60 Nd | 61 Pm | 62 Sm | 63 Eu | 64 Gd | 65 Tb | 66 Dy | 67 Ho | 68 Er | 69 Tm | 70 Yb | 71 Lu |
| actinoid series | 7 | 90 Th | 91 Pa | 92 U | 93 Np | 94 Pu | 95 Am | 96 Cm | 97 Bk | 98 Cf | 99 Es | 100 Fm | 101 Md | 102 No | 103 Lr |