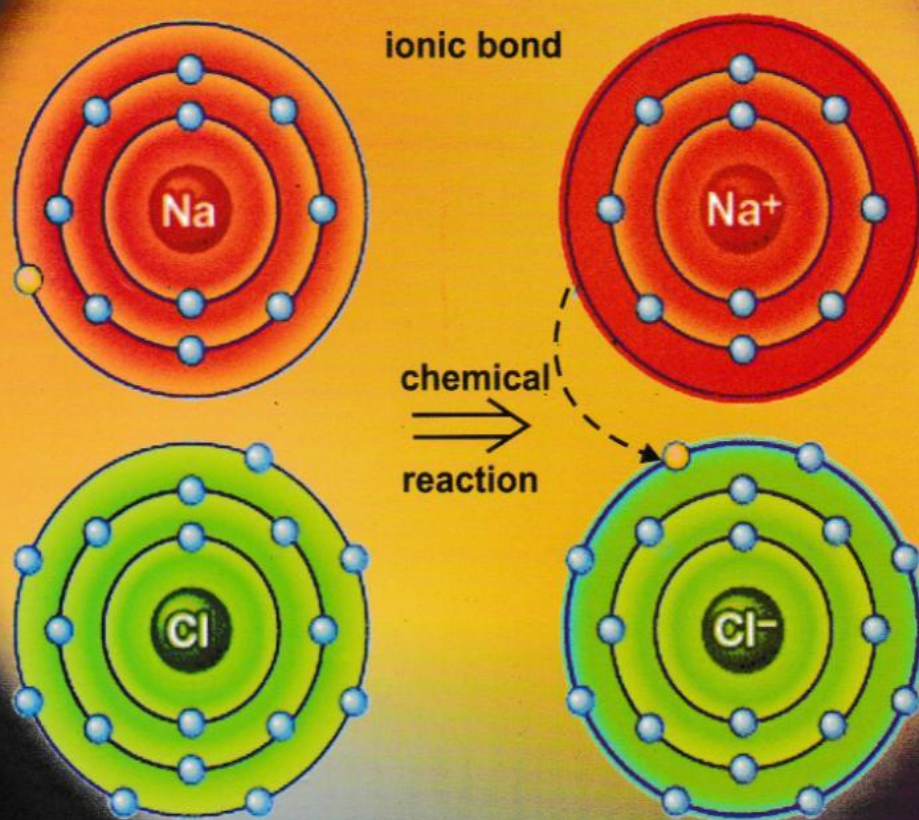


SCIENCE TEACHERS ASSOCIATION OF NIGERIA

# CHEMISTRY PANEL

SERIES 13

## CHEMICAL COMBINATION & CHEMICAL REACTION



A HANDBOOK FOR CHEMISTRY TEACHERS

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**A HANDBOOK FOR  
CHEMISTRY TEACHERS**

***Edited by:***

***Madam Peps Ibole FSTAN***

***Rev. Sr. (Dr) Margaret Ann C. Enedoh MSTAN***

***Dr. Mrs. Eunice T. Owoyemi MSTAN***

***Dr. Ekene I. Igboegwu MSTAN***



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## PAPER 3

# PLAY WAY METHOD: AN INNOVATIVE WAY FOR TEACHING CHEMICAL COMBINATIONS AND PERIODIC TABLE.

By

Theresa Udofia. Ph.D

*Department of Science Education, University of Uyo, Uyo.*

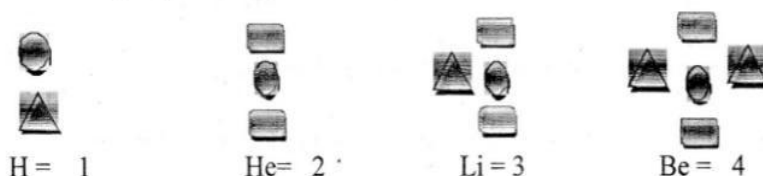
### Introduction

Chemistry is a science subject which requires the use of appropriate instructional strategies and stimulating classroom interactions for meaningful learning. Teaching methods and average retention rate after 24 hours as reported by Sousa (2001) is lecture method - 5%, reading = 10%, audio visual = 20%, Demonstration = 30% and engaged like group discussion = 50%, practice by doing = 75% and teaching others/immediate use of learning = 90%. Play way methods such as games, crossword puzzles, word scrambles, riddles and role play could be used to promote interest, participation, understanding and application of concepts in new setting. The paper explores ways of teaching the concepts of electronic configuration, chemical combination and periodic table in chemistry in a creative and playful way that can bring about meaningful learning.

### Lesson 1: Electronic Configuration of Elements

**Definition: What is configuration?** Configuration is obtain from the word configure which means to arrange, organize or build up. Electronic Configuration can be defined as the relative distribution or arrangement of electrons about the nucleus of the atom. Electronic configuration is the way electrons are arranged at different energy levels in an atom, molecule or crystals in order to attain stability.

**Strategy: Block Game (Improvised)**



### Activity 1

**Instructional materials** - balls of different sizes and colours, pen, white plain paper.

**Improvised material:** You can improvise by cutting cork and colour them as shown above in the place of coloured balls. You may use stones of different sizes.

**Previous knowledge:** Students have been taught atoms and fundamental particulate nature of matter.

Teacher asks students the following questions: What is an atom? (b) List the three subatomic particles of an atom

### Presentation:

1. Teacher groups the students into heterogeneous group of five per group.
2. Provides instructional materials (cork or balls of different sizes and colours). Each colour must differ in quantity corresponding to an element in the periodic table.
3. Tells the students to scatter the coloured corks provided
4. Guide students to arrange the corks by placing the white cork at the center of plain white sheet.
5. Arrange the corks around the nucleus starting with element 1- hydrogen as shown in steps 1, 2, 3, 4 above.

6. Mark each spot of the same coloured cork and join the points to be a line.  
Facilitate Learning and Interaction among students by asking questions and encouraging participation and Discussion. The teacher elaborates on the activity.
1. What does the white cork represent?
  2. Ask each group to explain the group arrangement.
  3. What shape is formed when the points of the colours are joined together?
  4. What can you deduce from the arrangement of the different cork based on colours?

### Discussion

1. The white cork represent nucleus.
2. Other coloured corks represent electrons of different elements.
3. The shape formed when the points of the colours are joined together is circle which the different levels or orbitals occupied by electrons

**Step2** – The teacher elaborate on the concept by draws the dot structure to explain arrangement in the various energy levels or shells of an atom. Electrons revolve round the nucleus in special regions called shells or orbits, which are positioned at fixed distances from the nucleus. The number of electrons in a shell follows the formula of  $2n^2$  where “n” represents the principal shell numbered 1,2,3,4....or K, L, M, N from the nucleus outwards.

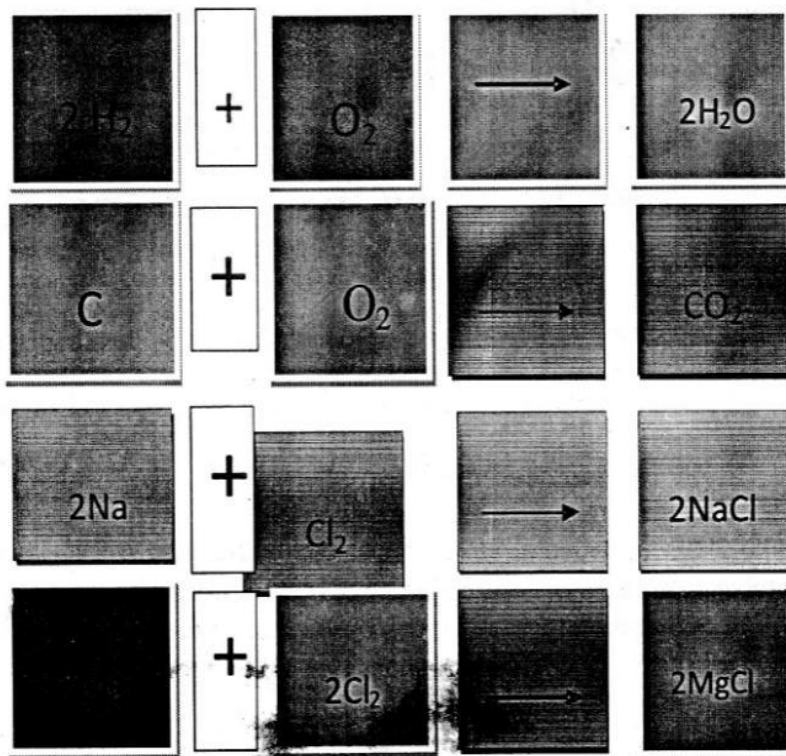
### Lesson 2: Using Card Games to Teach Valency and Chemical Combination

Valency is the combining power of an atom or radical. It is equal to the number of hydrogen atoms that the atom can combine with or displaced in a chemical reaction. Chemical combination is a chemical reaction in which two or more substances called reactants combine to form a new substance called product. The valence electrons are the electrons in the outermost shell of an atom which takes part in a chemical combination.

#### Strategy: Card Game

#### Instructional Material: cards with chemical formula.

Constructing cards with formulas or symbols can be played just like scrabble to form chemical reactants and corresponding products.



## Activity 2:

**Instructional materials:** Cardboard papers of different colours, tempo pens, scissors and ruler

1. Draw line to divide the card board paper into square as big as the size of whot' using ruler
2. Write some correct chemical formulas on each of cut white sheet of paper e.g  $\text{CO}_2$ ,  $\text{H}_2$ ,  $\text{H}_2\text{CO}_3$ ,  $2\text{Na}$ ,
3. Ensure that there is correct reactant and products among the cards make each formula up to five pieces.
4. Groups the students into heterogeneous group of five per group
5. Guide the students to play just like words are form in scrabble.
6. Reactants and products must be arranged in correct order by the last person that drops the card to score.
7. Give assignment for the students to produce more cards apart from the one used in class.  
Explain the activity emphasizing that in every chemical reaction there are participants called reactants before the formation of products.

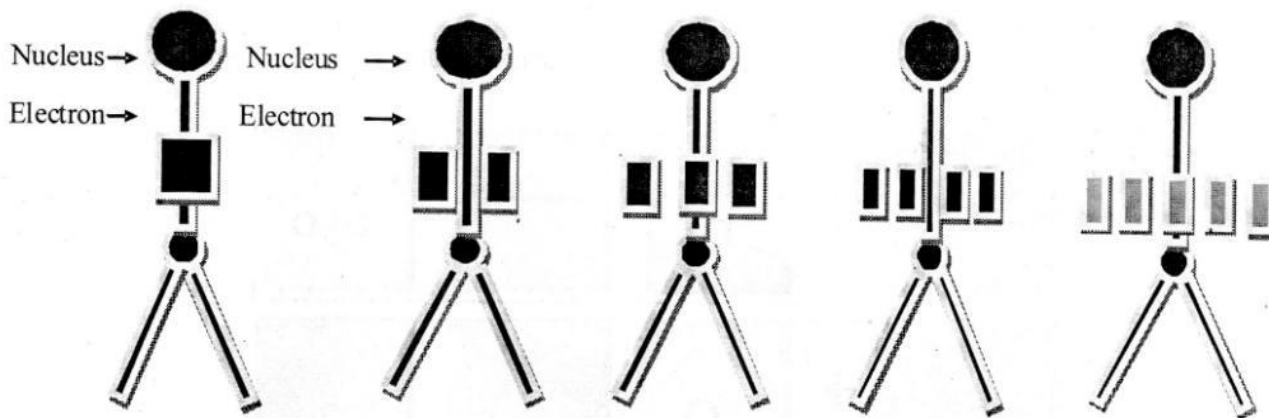
## Lesson 3:

### The Periodic Table

The discovery of electronic configuration makes it easy to understand periodic table. The Periodic Table represents is a systematic way of classifying elements and the periodic table works because elements in the period have the same electronic configuration in the outermost shell. The modern version of the periodic law is based on the atomic numbers of element.

### Strategy: Using Role Play to Teach Periodic Table.

The periodic table contains **players** just like a football team. At secondary school level, students are expected to study the first 20 elements. Thus the Periodic Table team can be said to consist of 20 players which are the first 20 elements in the periodic table.



Element 1: Hydrogen Element 2: Helium Element 3: Lithium Element 4: Beryllium Element 5: Boron

1 ELECTRON 2 ELECTRONS 3 ELECTRONS 4 ELECTRONS 5 ELECTRONS

Student 1

Student 2

Student 3

Student 4

Student 5

**Instructional materials:** Balls of different sizes and colours made into strings of various numbers corresponding to the number of electrons of each of the first elements in the periodic table.

**Improvised material:** You can use coloured corks as demonstrated above.



## Activity

1. The teacher selects the 20 players by making each student take up the name of an element.
2. Each student carries a tag name of the element with correct number of electrons.
3. Each student carries a medal with dies/beads corresponding to the number of electrons in the outermost shell.
4. Two to four to five students are called out to be the "actors" by arranging their electrons into orbital.

## Interaction

1. Students interact with peers trying to solicit for electrons to gain duplet or octet structure
2. Teacher make the students should facilitate learning by asking the actors the number of electron they are seeking.
3. Students carry out electronic configuration of what element they represent.
4. Group students into groups first and then into periods.
5. Which group has the greater number?
6. What is common among them in the different groups and periods?

7. **Step3: Discussion:** State the periodic law and explain the basic features of the periodic table and atomic properties.

The Periodic Law states the physical and chemical properties of elements are the periodic functions of their atomic numbers or when elements are arranged in order of increasing atomic number, their physical and chemical properties reoccur periodically.

Periodic Table and electronic configuration of the First Twenty Elements

Group/ Period	I	II	III	IV	V	VI	VII	0
1	1 H $1s^1$							2 He $1s^2$
2	3 Li $[\text{He}]2s^1$	4 Be $[\text{He}]2s^2$	5 B $[\text{He}]2s^22p^1$	6 C $[\text{He}]2s^22p^2$	7 N $[\text{He}]2s^22p^3$	8 O $[\text{He}]2s^22p^4$	9 F $[\text{He}]2s^22p^5$	10 Ne $[\text{He}]2s^22p^6$
3	11 Na $[\text{Ne}]3s^1$	12 Mg $[\text{Ne}]3s^2$	13 Al $[\text{Ne}]3s^23p^1$	14 Si $[\text{Ne}]3s^23p^2$	15 P $[\text{Ne}]3s^23p^3$	16 S $[\text{Ne}]3s^23p^4$	17 Cl $[\text{Ne}]3s^23p^5$	18 Ar $[\text{Ne}]3s^23p^6$
4	19 K $[\text{Ar}]4s^1$	20 Ca $[\text{Ar}]4s^2$						

The table is divided into vertical columns called groups and row called periods.

## Atomic Properties

The main cause of periodicity is the properties of elements in the Periodic Table. This is due to the repetition of similar outermost shell electronic configurations at certain intervals. The properties of the atoms exhibiting periodicity are atomic volume, ionization energy, atomic radius, electronic affinity, ionic radius and electronegativity

### 1. Atomic Volume

The atomic volume of an element is the relative mass per unit density. Generally, atomic volume decreases across the period, and increases down the group.

### 2. Atomic Radius or Atomic Size

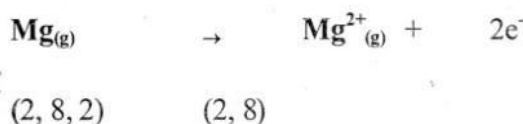
The radius of an atom is the distance between the centre of the nucleus and the outermost electronic shell.

Generally, atomic radius **increases steadily down the group**, due to increase in the number of shells and **decreases from left to right across a period**. This is due to the steady increase in nuclear charge (i.e. number of protons in the nucleus) along the period.

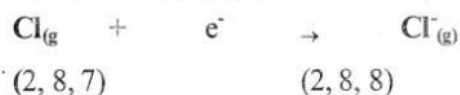
### Ionic Radius or Ionic Size

There are two types of ionic radii: radius of a **positive ion (cation)** and radius of a **negative ion (anion)**. A positive ion [cation] is formed when a neutral atom loses one or more of its valence electrons to form a stable noble gas configuration while a negative ion is formed when a neutral atom gains one or more electrons, in order to complete the outermost shell

**Radius of a Cation:** It involves the complete removal of the outermost shell. Hence, a **cation  $Mg^{2+}$**  has a smaller radius than its corresponding neutral atom  $Mg$ , and vice versa e.g.



**Radius of an Anion:** There is less attraction of the gained electrons towards the nucleus; this leads to an increase in the size of the corresponding ion. Hence, an anion,  $X$  has a larger radius than its corresponding neutral atom,  $X$ . e.g.



### Ionization Energy

Ionization energy is the energy absorbed in order to remove an electron from a gaseous atom and form a gaseous state. Ionization energy decreases steadily down the group, due to the steady increase in atomic size and increases across the period due to the decrease in atomic size, as the electron to be removed is strongly attracted to the nucleus.

**Electron affinity:** It is the energy released when a neutral gas accept electrons electron affinity decreases down the group and increases from left to right across the period. Electronegativity is the ability of an atom to attract another atom and become negatively while electropositivity is the ability to repel electrons and become positively charged. Electronegativity increased across the period and decreases down the group while electro positivity decreases down the period and increases across the group.

### Conclusion

Chemistry is fun and interesting and easy to learn when innovative strategies are used during instructional delivery. This can be achieved through role-play methods as students naturally like playing games. This calls for chemistry teachers to be creative and resourceful to make teaching of chemistry delightful and interactive for students to learn with understanding.

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