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## Application of Mnemonics in Science Education

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### Abstract

*Learning strategies are used to help students understand information and in problem solving. Students who do not know or use good learning strategies often learn passively and ultimately fail in school. Learning strategy instruction focuses on making students active learners which will develop vital skills and knowledge and a positive attitude towards learning. A mnemonic is an instructional and learning strategy designed to help students improve their memory retention capacity. This technique connects new learning to prior knowledge through the use of visual and / or acoustic cues. This paper is replete with examples of types of mnemonics such as key words, rhymes, connection, acronyms, outline notes card, music, model/image, short memory phrases, poems, note organization, imagery, and spelling that can aid*

The goals of education in Nigeria include the acquisition of scientific skills. The realization of this goal can be impeded by the non-adoption of innovative pedagogic strategies. Science education is very important to the development of any nation that is why every nation must address this with all amount of seriousness. Many of the developed nations are able to achieve so much in science and technology because they promote science education. Despite all the great things science education can accomplish in the development of a nation there are still many problems militating against it especially in Nigeria. Using the right methodology to teach science enables learners to access a wealth of knowledge and information. Teaching science using the appropriate teaching strategies inspires learners and attracts their interest. Students who excel in science lessons are likely to develop a strong ability to think critically which can be translated in the solving of functional problems.

Mnemonic device is a learning technique that aids information retention. Mnemonics aim at translating information into a form that the brain can retain better than it would have naturally. Even the process of merely learning conversions might already aid in the transfer of information to long-term memory. Mnemonics are easy - to - remember memory devices that help learners memorize concepts that are difficult to learn. The basic types of mnemonic strategies rely on the use of key words, rhymes, connection, acronyms, outlined note card, music, model, short memory phrases, poem, note organization, imagery, and spellings ( Congos, 2006 ) Their use is based on the observation that the human mind more easily remembers spatial, kinesthetic personal, surprising, physical, humorous, or otherwise 'relatable' information, rather than abstract or impersonal forms of information. Mnemonics are memory strategies that help learners recall larger pieces of information, especially in the form of listing, steps, stages, parts, phases, etc.

The word mnemonic is derived from the Ancient Greek word mnēmonikos, meaning "of memory, or relating to memory" and is related to Mnemosyne ("remembrance"), the name of the goddess of memory in Greek mythology. Mnemonics in antiquity were most often considered in the context of what is today known as the art of memory. Ancient Greeks and Romans distinguished between two types of memory: the 'natural' memory and the 'artificial' memory. The former is inborn, and is the one that everyone uses automatically and without thinking. The artificial memory in contrast has to be trained and developed through the learning and practicing of a variety of mnemonic techniques. Mnemonic systems are special techniques or strategies consciously used to improve memory. Memory needs every method of nurturing Its Capacity. The general name of mnemonics, or memoria

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technica, was the name applied to devices for aiding the memory, enabling the mind to reproduce a relatively unfamiliar idea.

#### **Some Common Examples of First Letter, Name, List and Spelling Mnemonics.**

##### **BIOLOGY**

First letter mnemonics:

To remember the order of biological classification: "King Phillip Came Over For Great Soup"; "King Phillip Cut Open Five Green Snakes"; "Kings Play Chess On Fine Green Sand" or "King Prawn Curry Or Fat Greasy Sausages" - where each of the initial letters matches the name of the classification level (kingdom, phylum, class, order, family, genus, species).

##### **Letter mnemonics for spelling:**

##### **DIARRHOEA**

1. **D**ashing **I**n **A** **R**ush, **R**unning **H**arder **O**r **E**lse **A**ccident.
2. **D**inning **I**n **A** **R**ough **R**estaurant: **H**urry, **O**therwise **E**xpect **A**ccident ( Evans, 2007 )

##### **Model / image mnemonics:**

In a Model Mnemonic, some type of representation is constructed to help with understanding and recalling important information. Examples include a circular sequence model, a pyramid model of stages, a pie chart, and a 5-box sequence. Models should be used in addition to words and lists because they make recall during a test much easier. With a large model such as the Krebs Cycle, it is easier to learn and remember if it is divided into quarters and learned one quarter at a time; hence, the cross hairs.

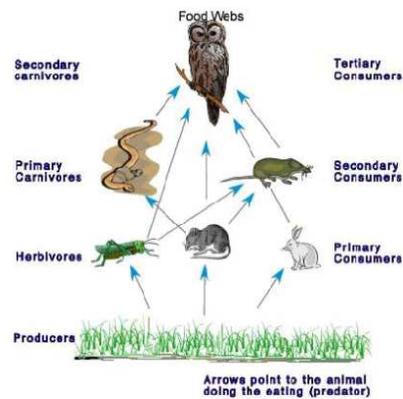
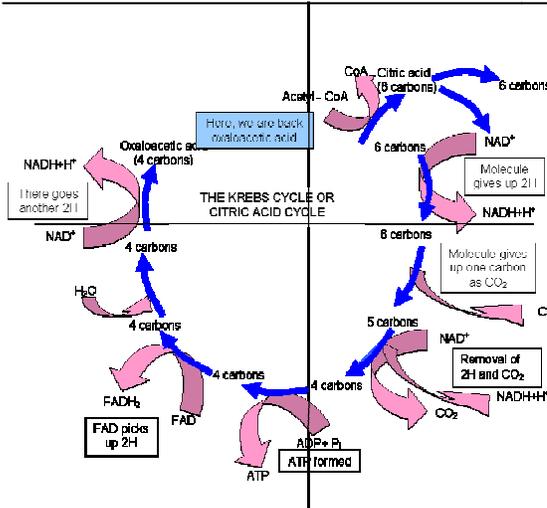
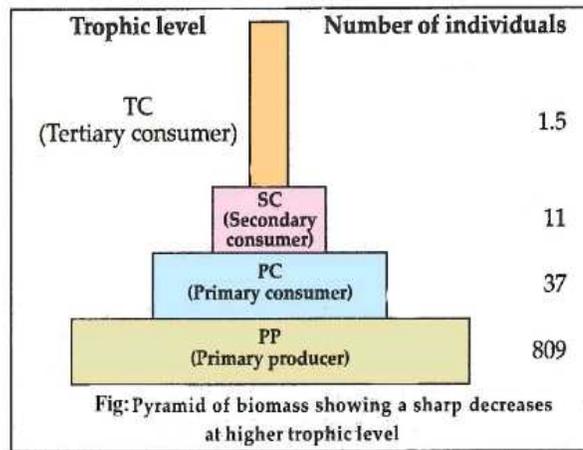


Fig: Diagrammatic representation of energy flow through different levels



### Connection mnemonic

### Ode or Rhyme Mnemonics:

Ode or rhyme mnemonic puts information in the form of a poem. Examples:

You'd probably want your students to know the difference between cyanate and cyanide: Cyanate "I ate" and Cyanide "I died." Cyanide is a little fatal.

Here is an easy way to remember the nerves: Olfactory, Optic, Oculomotor, Trochlear, Trigeminal, Abducens, Facial, Acoustic, Glassopharyngeal, Yagus, Spinal Accessory

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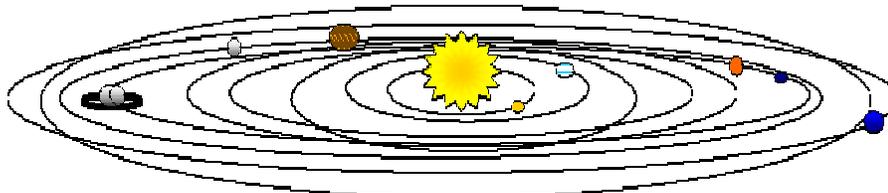
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and Hypoglossal. O n O ld O lympos' Towering Tops, A Finn And German Viewed Some Hops.

#### Planetary mnemonic

To memorize the names of the **planets**, use the planetary mnemonic: "My Very Educated Mother Just Served Us Nuts. Each of the initial letters matches the name of the planets in our solar system (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune).

#### Image Mnemonics



The information in an Image Mnemonic is constructed in the form of a picture that promotes recall of information when you need it. The sillier the Image Mnemonic is, the easier it is to recall the related information. These images may be mental or sketched into text and lecture notes. Don't worry about your artistic ability. As long as you know what your sketch means, Image Mnemonics will help you learn and remember. Examples: You can use an Image Mnemonic to remember BAT (the depressant drugs mentioned above is Barbiturates, Alcohol, and Tranquilizers). Visualize or sketch in your notes a limp, depressed bat that took B arbiturates, A lcohol, and T ranquilizers. Picture meeting someone new at a party named John Horsley. Use an Image Mnemonic to help you remember his name. Visualize a horse sitting on a john: not pretty but effective in recall. No example provided on this one. What is a numismatist? Visualize a new mist rolling onto a beach from the ocean and beach is made of coins. Silly of course, but sillyography makes it is easier to remember that a numismatist is a coin collector. How about using a bad joke to help you remember? Picture two numismatists having a drink for old time's sake. funny? Yes, but syllyography often makes things easier to remember.

Teachers should develop mnemonic strategy or have the students come up with their own. Teachers are encouraged to use mnemonics as teaching strategies to establish long term memory retention. Mnemonics are effective for groups of people who have the challenge of weak.

#### **First letter mnemonic**

Almost every anatomy class has to remember the eight small bones in the wrist: N avicular, L unate, T riquetrum, P isiform, Multongular (Greater), M ultongular (Lesser), C apitate, Hamate.

N ever L ick T illy's P opsicle, Mother M ight C ome Home.

## **PHYSICS**

### **Categorized list of physics mnemonics**

#### **Mechanics**

Work: formula

Lots of work makes me mad

Work = Mad:

$W = ma \times s$

M = Mass

a = acceleration

s = distance

#### **Thermodynamics**

Ideal gas law

Pure Veronica Never Really Towed

$PV = nRT$

#### **Gibb's free energy formula**

Good Honey Taste Sweet (delta)  $G = H - T (\text{delta}) S$

#### **Electrodynamics**

Ohm's Law

Virgins Are Rare

Volts = Amps x Resistance

**$V = I \times R$**

#### **Electromagnetic spectrum**

In the order of increasing frequency or decreasing wave length of electromagnetic waves

Radio waves, Microwaves, Infrared, Visible light, Ultraviolet, X – Rays, Gama Rays

Roman Men Invented Very Unusual X – Ray Guns

In order of increasing wave length

Good Xylophone Uses Very Interesting Musical Rhythms

(Watts, Jedrosz, Loxley, 2006)

To memorize color codes as they are used in electronics: the phrase "Bill Brown

Realized Only Yesterday Good Boys Value Good Work" represents in order, the 10 colors and their numerical order (black (0), brown (1), red (2), orange (3), yellow (4), green (5), blue (6), violet or purple (7), gray (8), white (9). (Andrew, 2014)

Metric Units of Weight:

Kilogram, Hectogram, Dekagram, Gram , Decigram, Centigram , Milligram

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King Hector Died Gaily Drinking Chocolate Milk

Metric System Prefixes:

- Atto 10<sup>-18</sup>
- Femto 10<sup>-15</sup>
- Pico 10<sup>-12</sup>
- Nano 10<sup>-9</sup>
- Micro 10<sup>-6</sup>
- Milli 10<sup>-3</sup>
- Centi 10<sup>-2</sup>
- Mega 10<sup>6</sup>
- Giga 10<sup>9</sup>
- Tera 10<sup>12</sup>

After Florence Played Note You Must Come Keep My Giant Tortoise (Butler, n.d. )

**CHEMISTRY**

**The periodic table for the first 20 elements**

The first twenty elements of the periodic table poses a great challenge for students as they are expected to know these elements and their arrangement in a short-row periodic table. The use of mnemonic will help them to remember and arrange them in the abridge version of the periodic table.

**First letter mnemonic**

H He  
He Has  
Li Be B C N O F Ne  
Light Brain But Could Not Offer Full Needs

Na Mg Al Si P S Cl Ar  
Subjects Many Arts Students Put Some Charges Against  
K Ca  
Police Case

**Periodic table:**

Group 1

H Li Na K Rb Cs Fr  
Hydrogen Lithium Sodium potassium Rubidium Caesium Francium  
Happy Listens Naturally keenly Rubbing Cans Frankly

Group 2

Be Mg Ca Sr Ba Ra  
Beryllium Magnesium Calcium Strontium Barium Radium

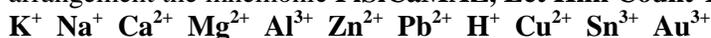
Being Magnanimous Can Severe Black Race

Period 1

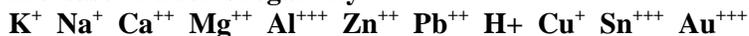
H                      He  
Hydrogen          Helium  
Hi Hello  
Period 2  
Li      Be      B      C      N      O      F      Ne  
Lithium    Beryllium    Boron    Carbon    Nitrogen    Fluorine    Neon  
Little Betty Became Charles Number One Friend and Neighbor  
Period 3  
Na    Mg      Al      Si      P      S      Cl    Ar  
Sodium    Magnesium    Aluminum    silicon    Phosphorus    Sulphur    Chlorine    Argon  
Naughty Maggi Always Sought Perfect Songs Clearly Armed

### **The Electrochemical series (ECS)**

The electrochemical series is another challenge for chemistry students. They find it difficult to know which of the ion is discharged in preference to the other when they are competing for discharge at the electrodes. The electrochemical series is an orderly arrangement of these ions. The ion at the top is discharged in preference to the one below it. It can also displace such a metal in a compound of such a metal. To learn this arrangement the mnemonic **PiSiCaMAZ, Let Him Count Tin Gold** can be used



—————→  
**Increase in electronegativity**



**Pi Si Ci M A Z Let Him Count Tin Gold**

### **Electronegativity:**

#### **First letter mnemonic**

Electrochemical series

Fluorine > Oxygen > Nitrogen > Chlorine > Bromine > Iodine > Sulfur > carbon. >  
Hydrogen > Phosphorus: Florence Oxen Needs Cloth, Brighter It's Sight Cup Hop Pop  
Potassium > Calcium > Sodium > Magnesium > Aluminium > zinc > Iron > Tin > Lead  
> Hydrogen > Copper > Silver > Gold  
Paddy Could See Mary A Zulu In The Lovely Hut Causing Many Strange Gazes

### **Acronym Mnemonics:**

To memorize chemical reactions, such as redox reactions, where it is common to mix up oxidation and reduction, the short phrase "LEO (Loose Electron Oxidation) the lion says GER (Gain Electron Reduction)" or "Oil Rig" can be used, which is an acronym for "Oxidation is losing, Reduction is gaining".

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### Expression or Word Mnemonic:

Examples: For physical laws dealing with gasses.

**Charles' Law:** For a constant volume, pressure is directly proportional to temperature. The simple way to remember this is : Chuck said if the tank is too hot, you're blown into muck.

**Henry's Law:** The solubility of a gas increases with pressure. Good old Hank, remembered the bubbles in the shaken Coke he drank.

**Boyles' Law:** At constant temperature, pressure is inversely proportional to volume. Boyle's law is best of all because it presses gasses awfully small.

Chemistry  
Physics  
Electronics  
Technology  
History of  
Science  
and  
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About  
Gallery

Name of gas	Image / Symbol	Formula	Prepared in the laboratory by:
methane		CH <sub>4</sub>	Heating a compound called sodium ethanoate with another compound soda-lime (sodium hydroxide). The methane gas is collected over water.
			<b>SAFETY FIRST</b> This preparation must be carried out in a fume cupboard and only by a teacher.
oxygen		O <sub>2</sub>	Adding hydrogen peroxide solution to manganese IV oxide powder. The oxygen gas is collected over water.
			<b>SAFETY FIRST</b> You can use this apparatus but you must wear safety glasses.
carbon dioxide		CO <sub>2</sub>	Adding dilute hydrochloric acid to calcium carbonate powder or chips. The carbon dioxide gas is collected by downward delivery.
			<b>SAFETY FIRST</b> You can use this apparatus but you must wear safety glasses.
chlorine		Cl <sub>2</sub>	Heating concentrated hydrochloric acid with manganese IV oxide. The chlorine gas is collected by downward delivery.
			<b>SAFETY FIRST</b> This preparation must be carried out in a fume cupboard and only by a teacher.

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Chemistry  
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Chemistry  
Laboratory  
Work  
Questions  
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Physical  
Science  
Listings,  
Recognitions  
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hydrogen		H <sub>2</sub>	Adding dilute acid to zinc granules. The hydrogen gas is collected over water.
			<b>SAFETY FIRST</b> You can use this apparatus but you must wear safety glasses.
hydrogen sulphide		H <sub>2</sub> S	Adding dilute acid to iron II sulphide. The hydrogen sulphide gas is collected over water.
			<b>SAFETY FIRST</b> This preparation must be carried out in a fume cupboard and only by a teacher.
hydrogen chloride		HCl	Adding concentrated sulphuric acid to sodium chloride. The hydrogen chloride gas is collected by downward delivery.
			<b>SAFETY FIRST</b> This preparation must be carried out in a fume cupboard and only by a teacher.
nitrogen		N <sub>2</sub>	Taking out the other gases from a sample of air. The nitrogen gas is collected over water.
			<b>SAFETY FIRST</b> This preparation must be carried out in a fume cupboard and only by a teacher.

### Image Mnemonic

Activity series:

K > Na > Ca > Mg > Al > Zn > Cr > Fe > Pb > H > Cu > Au

### **First letter mnemonics**

Cations vs Anions : POSITIVE vs NEGATIVE

Carboxylic acids:

### **Common homogeneous aliphatic carboxylic acids**

Formic, Acetic, Propionic, Butyric, Valeric, Caproic

Frogs are Polite, Being Very Courteous

### **Acids:**

Acid to water; All is well. Water to acid; what an accident

### **The Oxidation Reduction Electrodes**

Another challenge students find difficulty in is which of the electrodes oxidation electron occurs in electrode processes. Oxidation occurs at the Anode and Reduction at the Cathode. Simply put is **OaRc** and the mnemonic for easy remembrance is **Odd Arrangement Reduces Copper**

### **The Noble Gases**

The noble gases in the first row periodic Table are Helium, Neon, Argon, Krypton, Radium. The mnemonic to remember them is **HeNeArKryRa**

### **The Electrode Processes**

At the electrodes, ions (positive and negative) migrate to gain or lose electrons to be discharged. Students find it difficult to know which ones migrate to which electrodes. Cations (positive ions) migrate to the Cathode (negative electrodes) and Anions (negative ions) migrate to the Anode (positive electrodes). To remember this, the mnemonic **Cat-Cat Ani-Ano** is used to facilitate retention.

### **Music mnemonics**

#### **Using science songs to enhance learning**

#### **Biology**

To remember the lifecycle of cells (Interphase, Prophase, Metaphase, Anaphase, Telophase, Cytokineses)

I Pee More After Tea Consumption

Idiotic Penguins Make Antartica Too Cold

To remember the roles of the reproductive organs of plants

Stamen are male; Stigma (as in mother)

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**Chemistry**

To remember the common functional groups

(Hydroxyl, Carbonyl, Carboxyl, Amine, Sulfhydryl, Phosphate, Methyl)

Hair Care Can Always Save People Money

To remember the series of Alkanes:

Methane, Ethane, Propane, Butane, Pentane, Hexane

My Enormous Penguin Bounces Pretty High

How to remember the products of fractional distillation of crude oil

(Refinery gases, gasoline, naphtha, kerosene, diesel oil, fuel oil, lubricating fraction and bitumen)

Really Great Great Kings Don't Forget Ladies Birthdays

**Exercises**

1. Body's excretory organs - Liver, kidneys, skin, lungs, intestines

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2. 6 types of machines - lever, inclined plane, axle, wheel jack, screw, pulley, & gear.

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3. 6 ways to purify water - settling, filtration, coagulation, chlorination, aeration, boiling.

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4. Factors that affect water evaporation - temperature, area exposed, wind, and humidity.

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5. How soil fertility is restored – rotating crops, adding fertilizer, resting the soil, sweetening the soil, draining and irrigating, undoing damaged or polluted soil.

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6. Four types of chemical reactions - synthesis, decomposition, single- replacement, and double-replacement.

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7. General properties of matter - mass, weight, volume, and density.

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8. Five parts of a deciduous forest – upper stratum, lower tree stratum, shrub layer, ground layer, soil layer.

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9. Four Ocean zones: intertidal, near-shore, edge of continental shelf, perpetual darkness

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10. Components of a cell: microtubules, microfibrils, pinocytotic vesicle, golgi complex, vacuole, lysosome, granule, nuclear membrane, ribosome, reticulum, cytoplasmic matrix, mitochondrion, plasma membrane, nucleus, nucleolus

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### **Conclusion**

Mnemonics vary in effectiveness for several groups ranging from young children to the elderly. Mnemonic learning strategies require time and resources by educators to develop creative and effective devices. The most simple and creative mnemonic devices usually are the most effective for teaching. In the classroom, mnemonic devices must be used at the appropriate time in the instructional sequence to achieve their maximum effectiveness.

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