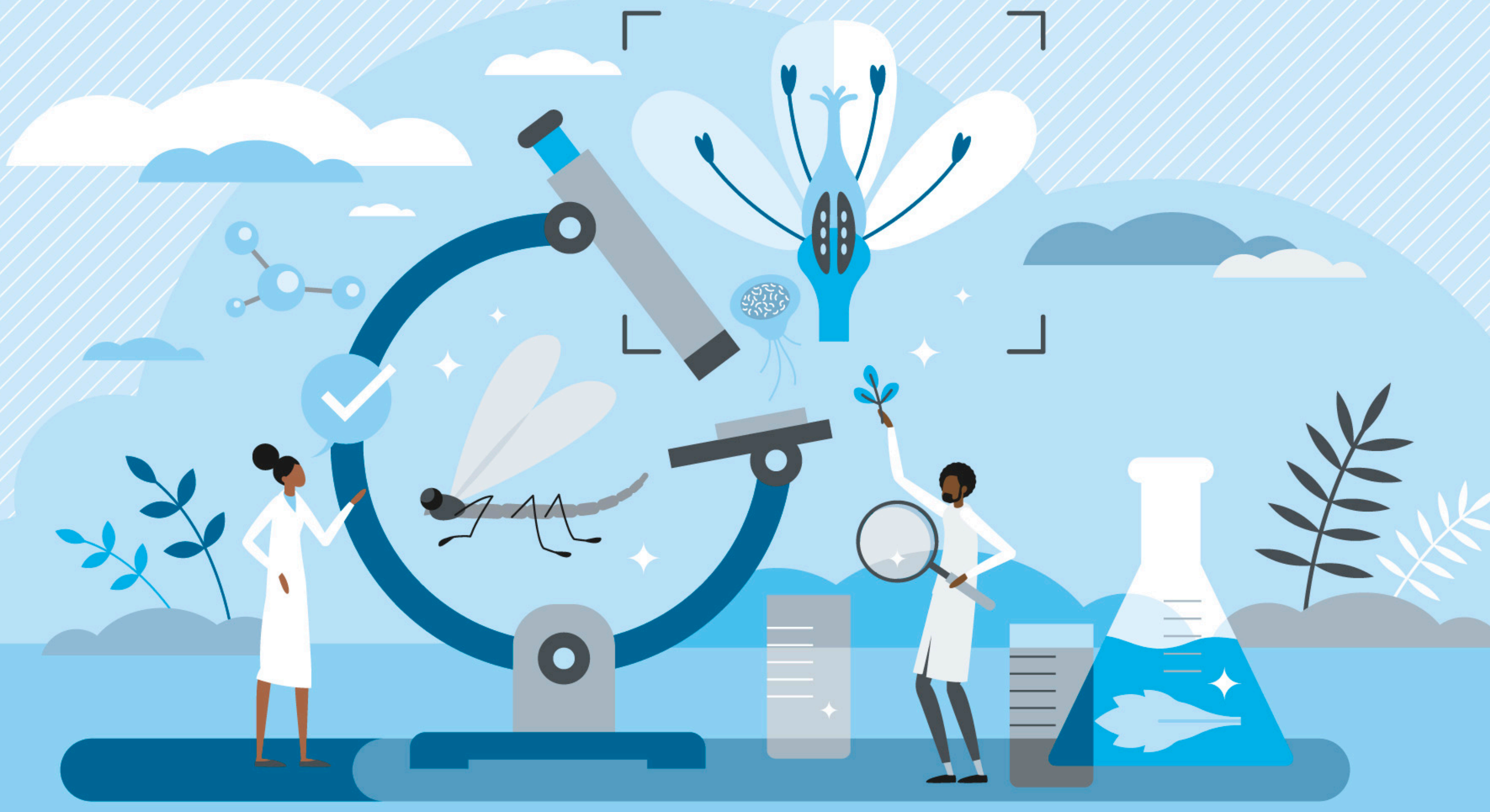
PARTICIPANT'S HANDOUT

2017 TERM 2 TRAINING WORKSHOP

NATURAL SCIENCES



GRADES 8-9

PIL

IMPROVING LEARNER PERFORMANCE

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Just-in-Time Training Workshop Term 2 2017

Participant's Manual

Grade 8 & 9

Natural Sciences

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what I do matters

Endorsed by:

SADTU

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TEACH WITH DIGNITY

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Unit 1: Atoms

Purpose: - unpacking the concept of atoms - identify unknown elements based on subatomic particles	**Duration**	20 min
Resources: participant's manual, calculator, Periodic Table of Elements	**Method**	Group work

1.1 Background

Vocabulary

Atoms: *the smallest building block of matter; makes up elements*

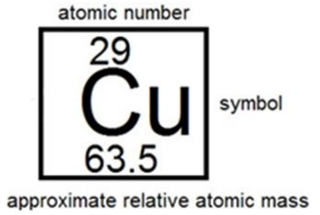
Particles: *the basic building block of a certain substance*

1.2. Atoms – building blocks of matter

- All matter is made up of tiny particles called atoms
- An element is made up of atoms of the same kind. For example all the atoms of an element, such as copper, are identical
- Atoms of one element differ from the atoms of all other elements
- All known elements are listed on the Periodic Table of the elements

1.3. Sub atomic particles

- Atoms are made up of smaller sub-atomic particles (protons, neutrons and electrons).
- The central region of the atom is called the nucleus.
- The nucleus is made up of positively charged particles called protons and neutral particles called neutrons.
- Negatively charged particles called electrons move around the nucleus.
- Atoms are neutral because the number of negatively charged particles (electrons) is equal to the number of positively charged particles (protons). For example, Oxygen atom has 8 protons, 8 neutrons and 8 electrons.
- The number of protons determines the atomic number. The number of protons plus neutrons is called a mass number (A). The notation below shows the representation of atomic number (Z) and mass number (A) for mystery element X.

$^{atomic\ number(Z)}_{mass\ number(A)}X$	

Atomic number vs mass

Atomic number (Z): number of proton within the atom

Mass number (A): number of protons and neutrons

$$\text{Mass number } (A) = \text{number of protons}(Z) + \text{number of neutrons}$$

$$\Rightarrow \text{number of neutrons} = A - Z$$

Vocabulary

protons: *positively charged particles found in the nucleus of an atom.*

neutrons: *neutral particles found in the nucleus of an atom*

electrons: *negatively charged particles that move around the nucleus*

Alkali metals: *elements in group I(1)*

Alkaline earth metal: *elements in group II (2)*

Halogens: *elements in group VII (19)*

Noble gases: *Elements in group VIII (18)*

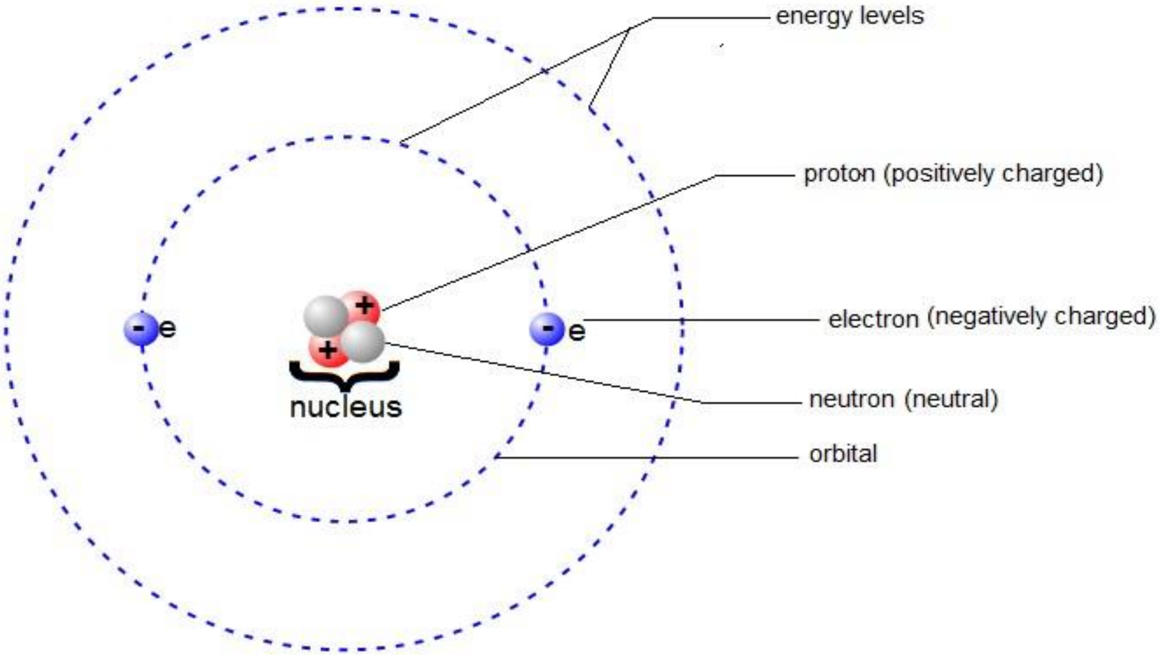


Figure 1: the structure of an atom

Unit 2: The Periodic Table

Purpose: ☐ Familiarizing participants with the Periodic Table of elements ☐ Interactive reading strategy-friendly question	**Duration**	20 min
Resources: CAPS document, participant's manual, calculator, Periodic Table	**Method**	Group work

2.1 Facts about Periodic Table of elements

- The elements can be classified into **metals, non-metals and semi metals**.
- The elements found in **groups** (vertical columns): have **similar chemical properties**.
- Each element on the Periodic Table (in its own block) has an **atomic number** (smaller number), **mass number** (larger number), **name** and **symbol**.
- A **formula** is a ratio of the elements and number of atoms in a compound.

2.2 Activity

Build your skills at reading the Periodic Table by finding the missing information in the samples below.

1 H	1.a. atomic number ____________ b. atomic mass ____________	3 Lithium	3.a. element symbol ____________ b. atomic number ____________
9 F	9. a. element name ____________ b. number of neutrons ____________	10 Ne	10.a. number of protons ____________ b. number of electrons ____________ c. element name ____________
11 Na	11. a. number of protons ____________ b. element name ____________	14 Silicon	a. atomic mass ____________ b. number of neutrons ____________ c. element symbol
4 Be	a. atomic number ____________ b. element name ____________	19 Potassium	a. atomic number ____________ b. number of protons ____________ c. element symbol ____________

Unit 3: Pure substances

Purpose: unpacking the concept pure substances naming elements and compound writing chemical formulae	**Duration**	10min
Resources: CAPS document, participant's manual, calculator, models	**Method**	Group work

3.1 Background

Elements and compounds are **pure substances**. An **element** is a material that consist of atoms of only one kind, e.g. oxygen is an element. A **compound** is a pure substance that consists of two or more different elements that are chemically bounded together in a fixed ratio, e.g. water is a compound that consists of two hydrogen atoms and one oxygen atom.

3.2 Elements

- An element is a material that consists of atoms of only one kind, such as hydrogen (H), oxygen (O), carbon (C), sodium (Na) and chlorine (Cl).
- All known elements are listed in the Periodic Table of Elements. They are limited in number and are the building blocks of millions of compounds.
- Some elements in the Periodic Table form **diatomic molecules** for example hydrogen (H_2), nitrogen (N_2), oxygen (O_2), chlorine (Cl_2). These are called molecules of elements
- Sometimes atoms react together chemically to form molecules of compounds (such as H_2O, CO_2).

3.3 Compounds

- A **compound** is a material that consists of atoms of two or more different elements chemically bonded together, such as water (H_2O), carbon dioxide (CO_2), salt (NaCl)
- A **chemical bond** is the force that holds atoms together in compounds [such as water (H_2O), carbon dioxide (CO_2), and salt (NaCl)] by chemical reactions. Compounds can be broken down in a decomposition reaction into other compounds or their original elements by heating or electrolysis. For example, electrolysis decomposes water (H_2O) to form hydrogen (H_2) and oxygen (O_2).
- Many compounds are named according to their elements, such as sodium chloride (table salt) which is made of the elements sodium and chlorine. But others have common names such as water and ammonia.
- Some compounds have names such as carbon monoxide CO, carbon dioxide CO_2, sulfur trioxide SO_3. In these compounds: ***mono***xide- tells us that ***one*** oxygen atom has combined with the carbon atom ***di***oxide- tells us that ***two*** oxygen atoms have

combined with the carbon atom ***tri***oxide- tells us that ***three*** oxygen atoms have combined with the sulfur atom.

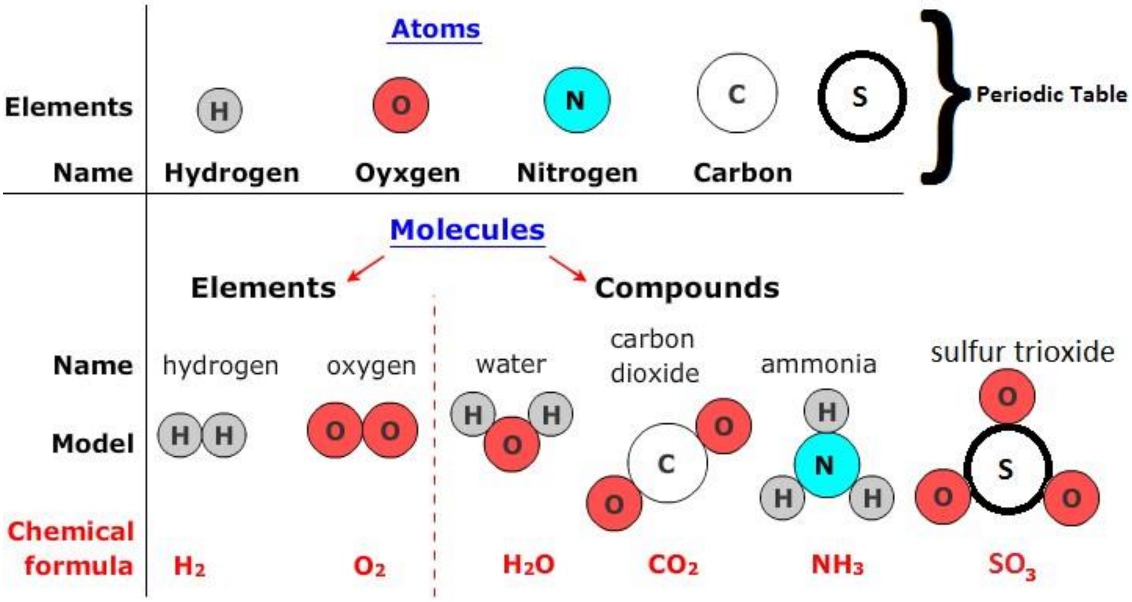
3.4. Chemical formulae

There are many different types of chemical formulae. Chemical formula are commonly used as a shorthand way to show:

- the **number** and **type** atoms in a **compound** and,
- the **number** of atoms in a **molecular element.**

Elements & Molecular elements		Compounds	
Hydrogen	H_2	Water	H_2O
Oxygen	O_2	Carbon dioxide	CO_2
Ozone	O_3	Glucose	$C_6H_{12}O_6$

- In a **chemical formula** the chemical symbol of each element is shown with subscript numbers which tell us the numbers or ratio of atoms in the compound or molecular element. For example the **compound** water has the chemical formula H_2O.
- This tells us water is made up of two elements, hydrogen and oxygen. The subscript 2 in H_2O tells us there are two parts hydrogen to one part oxygen. Note: The subscript 1 is never but taken for granted. That is why water has the formula H_2O and not H_2O_1. Some elements also exist as molecules.
- **Molecules** are groups of atoms joined together by chemical bonds. **Molecular elements** like compounds also have a chemical formula. Examples of molecular elements include hydrogen, H_2 and oxygen O_2. These are also referred to as diatomic molecules. The following image shows the relationship between atoms and molecules.



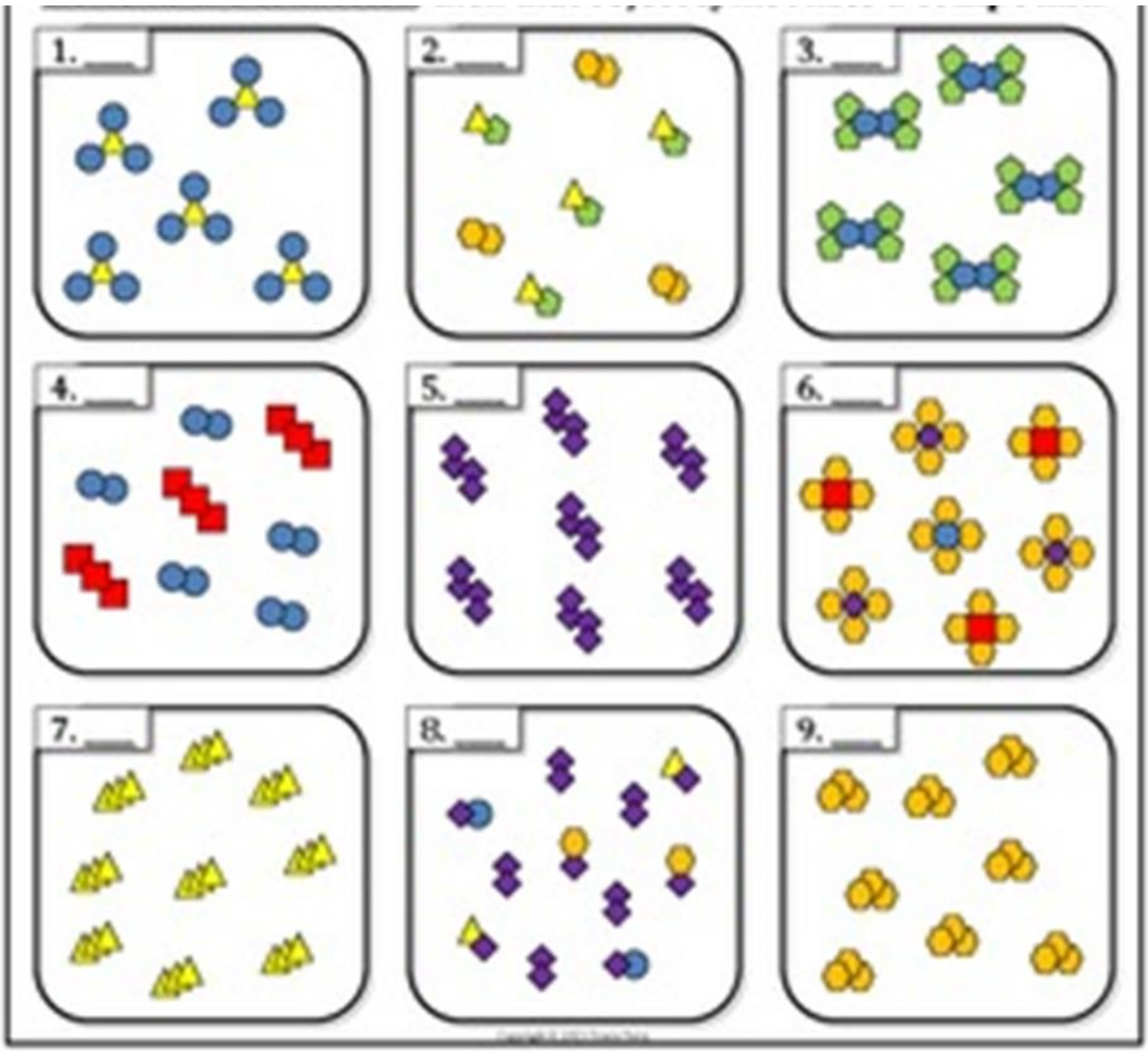
Relationship between atoms, molecules and compounds

Adapted from www.chemicalformula.org

3.5 Activity 1: Elements, compounds and mixtures

Each picture below is one of the following:

Element, Compound, Mixture of elements, mixture of compounds, mixture of elements and compounds. Correctly label each picture for what it is representing. **Remember** each shape symbolizes an element. If two different elements are connected, then that object symbolizes a **compound**.



3.6 Activity 2: Molecules

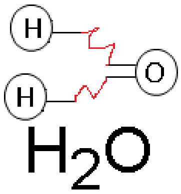
	Build and draw 3D structures for the following molecules. Materials: improvise
a)	O_2
b)	H_2
c)	H_2O

d)	CO_2	
e)	CO	

Unit 4 Chemical reactions

Activity 1: Writing chemical formulas using "arms and link" method

The 'arms and link' method is a quick and easy way for learners to learn how to write the chemical formula of compounds. Using this method the chemical formula water molecule can easily be determined as shown by the illustration below.



Hydrogen (H) has a combining power of 1.It has 1 arm. Oxygen has a combining power of 2. It has 2 arms. To link all the arms of **O** two H's must be used. The chemical formula for this compound is therefore H_2O.

Refer to the Periodic Table and complete the table below:

Elements	**"Arm and link' illustration**	**Chemical formula**	**Name of a compound**
H and N			
Na and Cl			
Al and O			
S and O			
C and O			
Mg and Cl			
Ca and O			

4.1. Chemical reactions (Lecture, Questions & ANS-CAPS p.45 &64)

By working through this sub-unit, you should be able to:

- Write both words and symbolic equations for combustion, photosynthesis, respiration and the reactions of metal with oxygen, reaction of non-metal with oxygen, reaction of acid with a base (neutralisation), reaction of acid with metal oxide and reaction of acids with metal carbonates.
- Give description of what happens during chemical reactions mentioned above.
- Link reactions to your everyday experience.

CAPS pp. 64-69 and Tracker Term 2 (week 3-7) chemical reactions of metals, non-metals, acids and bases and allocates four weeks for all reactions.

The relationship between different reactions are not always clear and the order in which content and concept are dealt with might be confusing. The diagram below might be useful as it seeks to show the link between the different chemical reactions.

Activity 2: Understanding simple chemical reactions

a) Suppose you mix some chemicals in a beaker. How will you know if a **chemical reaction** has taken place? Describe each of the signals that would indicate that a chemical reaction has taken place and what each signal tells you about that reaction.

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....

b) Write your own definition of what a **reactant** is in a chemical reaction.

....

....

....

c) Write your own definition of what a **product** is in a chemical reaction.

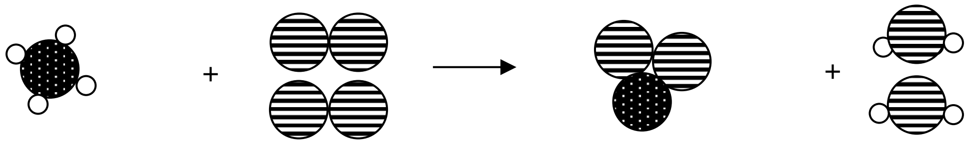
....

....

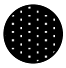
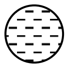
....

d) Explain what happens to the **chemical bonds** between atoms in the reactants and products in a chemical reaction.

e) Methane gas is a natural fuel gas that burns in oxygen gas to produce carbon dioxide and water. The reaction can be represented by the following diagram:



Key:

Atoms	Carbon atom	Oxygen atom	Hydrogen atom	Nitrogen atom
Code				

Use the above diagram and the 'key' provided to write the **chemical formula** of each of the substances in the reaction.

Name of compound	Methane	Oxygen	Carbon dioxide	Water
Chemical formula				

f) What are the reactants and products of the above reaction?

Reactants:

Products:

g) Ammonia (NH_3) is produced from hydrogen gas and nitrogen gas.

i) Write a balanced chemical equation for the reaction of hydrogen and oxygen gases to form ammonia.

ii) Use the key supplied in (f) above and draw a symbolic representation of a balanced chemical equation between hydrogen and oxygen gases to form ammonia.

4.2. Balancing chemical reactions (CAPS-p.64)

Being able to balance equations is important because it allows you to predict how a chemical reaction will occur, including what products will be formed, how much will be produced and how far a reaction will proceed if you know the amount of reactants. Follow the steps below in order to balance chemical reactions effectively.

Step 1: Apply the Law of conservation of Mass to get the same number of atoms of every element on each side of the equation.

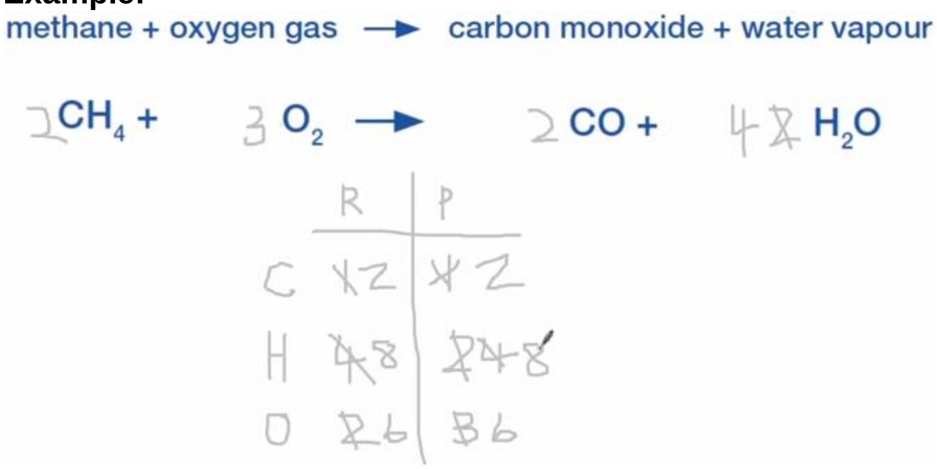
Step 2: Determine and list the number of elements or atoms on the left (reactants) and the right hand side (products)

Step 3: Balance metals, followed by non-metal first

Step 4: Balance chemical formulas by placing coefficients in front of them. Do not add subscripts, because this will change the formulas.

Step 5: balance oxygen and hydrogen last.

Example:



Activity 3: Balancing chemical reactions

Use the above mentioned guidelines or any other techniques to balance the following chemical reactions.

1. $\_\_\_ H_2(g) + \_\_\_ O_2(g) \rightarrow \_\_\_ H_2O(g)$
2. $\_\_\_ Ca(s) + \_\_\_ Cl_2(g) \rightarrow \_\_\_ CaCl_2(s)$
3. $\_\_\_ CH_4(g) + \_\_\_ O_2(g) \rightarrow \_\_\_ CO_2(g) + \_\_\_ H_2O(g)$
4. $\_\_\_ Mg(s) + \_\_\_ O_2(g) \rightarrow \_\_\_ MgO(s)$
5. $\_\_\_ Fe(s) + \_\_\_ O_2(g) \rightarrow \_\_\_ Fe_2O_3(s)$
6. $\_\_\_ N_2(g) + \_\_\_ H_2(g) \rightarrow \_\_\_ NH_3(g)$

Experiment 1: The eggshell – an example of a chemical reaction (CAPS p45 – Gr8)

Things you will need

- 1 egg (hard boiled is less messy if you accidentally break but it, but you can use a raw one)
- 1 cup white vinegar
- clear jar or glass beaker
- clear lime water

Procedure

1. Carefully place the egg in a jar or glass beaker. Be careful not to crack the shell.
2. Cover the egg with vinegar. Wait a few minutes.
3. Look closely at the egg (but do not disturb it!), can you see anything happening on the eggshell?
4. What is this observation a sign of?
5. Leave the egg in vinegar for 24 hours.
6. Carefully remove the egg from the vinegar.
7. Touch the surface of the egg.
8. Write your observations.

Note: Brown eggs are desirable since the contrast is more noticeable, but you may still use white eggs. Observations become more evident if the egg is left to stand in vinegar for at least 4 – 5 days.

Answer the following questions based on the above eggshell experiment:

a) What signs did you see that told you a chemical reaction had taken place?

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b) Briefly explain what happened to the eggshell?

In this chemical reaction, the **chemical equation** can be written as follows:

$$\text{eggshell} + \text{vinegar} \rightarrow \text{calcium acetate} + \text{carbon dioxide} + \text{water}$$

i) Write the chemical names for the eggshell and vinegar.

---

c) What test can be done to prove that the gas formed in the above reaction is carbon dioxide?

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d) Refer to CAPS document, pp. 10–11 to answer the questions below:

i) Identify at least five cognitive and practical process skills that learners will develop from the above experiment.

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ii) What specific aim(s) does the eggshell experiment addresses?

Experiment 2: The decomposition of copper chloride – another example of a chemical reaction (CAPS p41)

When atoms separate from each other and recombine into different combinations of atoms, we say a chemical reaction has occurred. A chemical reaction in which a compound is broken down into simpler compounds and even elements is called a **decomposition reaction**.

Aim: To determine whether it is possible to decompose copper chloride using electrical energy.

Things you will need:

Beaker two graphite electrodes 9 volt battery Old touch cells	2 bits of wire copper chloride solution cardboard disk large enough to cover the top of the beaker

NB: Make the following observations before starting:

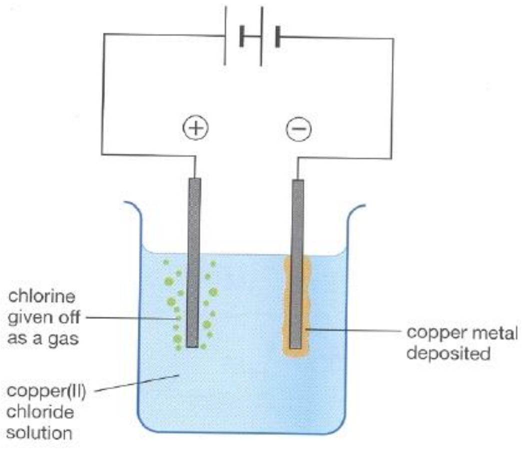
1. What colour is the copper chloride solution?

---

2. What colour are the graphite electrodes?

Procedure

1. Pour the copper chloride solution into the beaker.
2. Make two small holes in the cardboard disk and push the electrodes.
3. Place the disk over the beaker, so that the greater part of each electrode is under the surface of the solution.
4. Connect the tops of the electrodes to the ends of the battery using the wire lengths.
5. Allow the reaction to proceed for a few minutes and observe what happens.
6. When the reaction has proceeded for approximately 10 minutes, the wires can be disconnected and the set-up disassembled.



Observations:

1. After the reaction had proceeded for a few minutes, what do you observe on the surface of the two electrodes?

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2. At the end of the experiment, what colour was the copper chloride?

Analysis and discussion:

1. What gave the copper chloride solution its intense blue colour?

---

2. Do you think that some of the copper chloride may have changed into something else during the reaction? Explain why you think so?

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3. How would you explain the bubbles on the surface of the first electrode? Do you have any idea what they might have been? Hint: what did the electrode smell like afterwards?

---

4. Do you know what the reddish-brown coating on the second electrode is? Hint: Which metal has that same characteristic reddish-brown colour?

5. How do we know that a chemical reaction has occurred?

6. What process skills will learners develop from this experiment?

Experiment 3: Reaction metals with oxygen CAPS p.65

Materials	
aluminium pan	steel wool
Balance	Magnesium
uncoated extra-course steel wool	Bunsen burner
Tongs	

Procedure

1. Weigh the empty pie pan and record the mass.
2. Place a pad of the steel wool (approximately 3 in x 3 in) in the pan and record the mass of the pan and pad.
3. Light the burner and adjust it to obtain a blue (hot) flame
4. Hold the steel wool with the tongs and place it in the flame for several minutes.
5. Rotate the pad so that all parts are exposed to the flame. After all of the pad has a dull grey appearance, turn off the burner. Place the steel wool in the pan, sweeping any "popped" pieces of the steel wool into the pie pan as well.
6. Weigh the pan and steel wool and record the mass.

Data and Observations

1. Mass of the empty pan ___________g
2. Mass of the pan and steel wool before heating ___________g
3. Initial mass of the steel wool ___________g
4. Mass of the pan and steel wool after heating___________g
5. Mass of the steel wool after heating ___________g
6. Difference between the mass of the steel wool before and after heating -----------g

Questions

1. What kind of change took place?

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2. Why did the mass of the steel wool change as a result of heating? Can you explain the differences in the masses? "Steel" wool is composed of elemental iron (Fe).

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3. Write a balanced chemical equation for the burning of steel.

Extension activity

Burn magnesium metal using the same procedure outlined above. *CAUTION*: When magnesium burns, it gives off a very bright light. Do not look directly at the light! Permanent eye damage can occur!

1. Write a balanced chemical equation for the burning of the metal.

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2. How are the equations for the burning of steel wool and magnesium similar?

----

3. How can the *oxidation* of a metal (sometimes called *corrosion*) be prevented?

References

1. www.chemicalformula.org
2. Siyavula ‘curious learners book A’ Grade 8 & 9
3. Natural Science solutions for all, Learner book, Grade 8 & 9
4. Natural Science Tracker, Term 2, Grade 8 & 9
5. Natural Science CAPS document (Grade 7-9)

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY

29	Atomic number
Cu	Symbol
63,55	Relative atomic mass

I	II											III	IV	V	VI	VII	0
1 H 1,008																	2 He 4,003
3 Li 6,941	4 Be 9,012											5 B 10,81	6 C 12,01	7 N 14,01	8 O 16,00	9 F 19,00	10 Ne 20,18
11 Na 22,99	12 Mg 24,31											13 Al 26,98	14 Si 28,09	15 P 30,97	16 S 32,07	17 Cl 35,45	18 Ar 39,95
19 K 39,10	20 Ca 40,08	21 Sc 44,96	22 Ti 47,88	23 V 50,94	24 Cr 52,00	25 Mn 54,94	26 Fe 55,85	27 Co 58,93	28 Ni 58,69	29 Cu 63,55	30 Zn 65,39	31 Ga 69,72	32 Ge 72,59	33 As 74,92	34 Se 78,96	35 Br 79,90	36 Kr 83,80
37 Rb 85,47	38 Sr 87,62	39 Y 88,91	40 Zr 91,22	41 Nb 92,21	42 Mo 95,94	43 Tc	44 Ru 101,1	45 Rh 102,9	46 Pd 106,4	47 Ag 107,9	48 Cd 112,4	49 In 114,8	50 Sn 118,7	51 Sb 121,8	52 Te 127,6	53 I 126,9	54 Xe 131,3
55 Cs 132,9	56 Ba 137,3	57 La 138,9	72 Hf 178,5	73 Ta 180,9	74 W 183,9	75 Re 186,2	76 Os 190,2	77 Ir 192,2	78 Pt 195,1	79 Au 197,0	80 Hg 200,6	81 Tl 204,4	82 Pb 207,2	83 Bi 209,0	84 Po	85 At	86 Rn
87 Fr	88 Ra 226,1	89 Ac															

58 Ce 140,1	59 Pr 140,9	60 Nd 144,2	61 Pm	62 Sm 150,4	63 Eu 152,0	64 Gd 157,3	65 Tb 158,9	66 Dy 162,5	67 Ho 164,9	68 Er 167,3	69 Tm 168,9	70 Yb 173.0	71 Lu 175,0
90 Th 232,0	91 Pa	92 U 238,0	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr