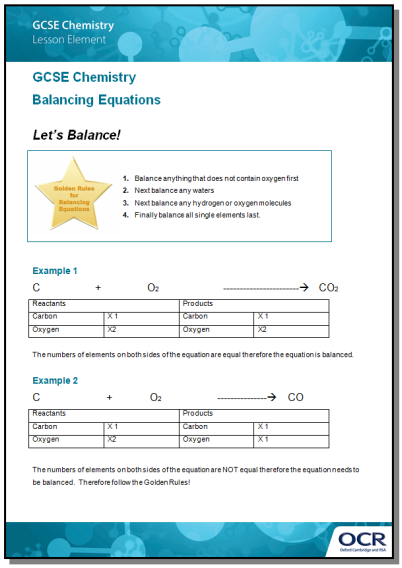
GCSE Chemistry

Balancing Equations – Let's Balance!

Instructions and answers for teachers

These instructions should accompany the OCR resource 'Balancing Equations – Let's Balance!' activity *which supports OCR GCSE Chemistry.*


GCSE Chemistry
Lesson Element

GCSE Chemistry
Balancing Equations

Let's Balance!

Golden Rules for Balancing Equations

1. Balance anything that does not contain oxygen first
2. Next balance any waters
3. Next balance any hydrogen or oxygen molecules
4. Finally balance all single elements last.

Example 1

C + O_2 ----------→ CO_2

Reactants		Products	
Carbon	X 1	Carbon	X 1
Oxygen	X2	Oxygen	X2

The numbers of elements on both sides of the equation are equal therefore the equation is balanced.

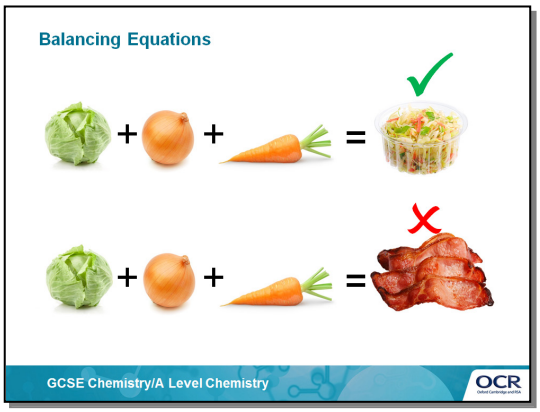
Example 2

C + O_2 ----------→ CO

Reactants		Products	
Carbon	X 1	Carbon	X 1
Oxygen	X2	Oxygen	X 1

The numbers of elements on both sides of the equation are NOT equal therefore the equation needs to be balanced. Therefore follow the Golden Rules!

OCR



The Activity:

Learning outcomes:

- To recall simple common chemical compounds and molecules
- To understand that new products can only contain elements that the reactants have
- To be able to balance symbol equations.

This activity offers an opportunity for English skills development.

This activity offers an opportunity for maths skills development.

Associated materials:

Balancing Equations - Let's Balance! Student Task Sheet, Balancing Equations PowerPoint

Introduction

This lesson element is an alternative way to introduce learners into bonding. The research shows that learners have a problem with stoichiometry often not really understanding why they are balancing equations. The balancing of equations is necessary to ensure that the reaction in question observes the rule for the conservation of mass. Learners also struggle with the concept that chemical reactions cannot produce any different substances. For example, if you begin with a magnesium compound you cannot suddenly make a compound that uses aluminium if aluminium is not present.

Learners are expected to be familiar with atoms and compounds and how to write common chemical compound using symbols; aware that reactants and products can be written in equation format and should be familiar writing these in words.

Notes for teachers

The following activities can form a lesson or be embedded into lessons. They include images to show how products are made from reactants, a modelling activity and a Student Task Sheet to practise what has been learnt.

Activity 1a: Reactions

Slide 1 contains an image which allows learners to explore the idea that although chemical reactions make new substances those substances must be made from the starting materials.

Learners should be shown the first slide and decide in small groups what the image is trying to say. This would give the teacher the opportunity to assess what the learners already know and expel /explore any misconceptions they may have. For example, leaners struggle to understand the concept of a chemical reaction often not understanding that the new substances that are being made can only contain the substances that they started off with. This is usually down to them not fully understanding the definitions of compounds, elements and mixtures that they will study at Key Stage 3. Learners who struggle with this could be asked list the elements found in products. This could help them to make the connection with this concept.

Other tasks learners could be asked to do would be to name the chemicals used to make a cake and asked what happens to these chemicals when the cake is made? They could also be given a simple word equation such as carbon + oxygen makes carbon dioxide and asked to suggest what chemicals make the product.

Activity 1b:

Learners should be shown the second slide. This is a short activity to explore the views of learners by asking them to suggest the reasons as to why the second word equation is not correct. In this activity, learners would be expected to see that water contains hydrogen and oxygen and carbon does not.

Activity 2a: Let's build!

Apparatus:

- Lego for modelling – different colours to use for different chemicals

To begin learners should be introduced to modelling the reactions with Lego using simple reactions. For example:

Hydrogen + oxygen ----------→ water
Carbon + oxygen ----------→ carbon monoxide

Learners could be asked to show how they would model the reactions using the Lego that they have been provided with and explain them to others in their class / group.

Activity 2b:

This part of the activity focusses on modelling the law of the conservation of mass.
Show the third slide containing information about chemical masses and ensure that the learners fully comprehend what the animation is showing. Learners can be shown how this can be modelled using the Lego for the above reactions eg twelve blocks all of the same size to represent the carbon atom should all be stuck together and the mass measured on a balance. The same should be done with sixteen blocks all of the same size but maybe a different colour representing oxygen. These two masses should be added together and the result noted.
Both of the models should then be stuck together and the mass should be measured to show that the mass is the same thus demonstrating the law of the conservation of mass. The learners could then be asked to comment upon why 12 blocks were used for carbon and 16 were used for oxygen.
Learners could be asked to do this for another simple compound to practise and consolidate learning.

Activity 2c:

The learners should now be able to explain why equations need balancing. They should be shown the final slide and in groups they should explain what it shows and could link this to modelling it with the Lego. This could be done as a presentation or a simple mini-whiteboard explanation.
From the slide the learners should be able to see that without balancing the equation the masses are different on both sides of the equation which does not adhere to the law of conservation of mass. Learners do not always realise that this is the reason for balancing equations in the first place.

Activity 3: Let's Balance!

This activity takes the learner through a simple method for balancing equations which develop in complexity.

Suggested answers to Student Task Sheet

Balance the following equations

(1) $CaCO_3$ + 2 HCl ----------→ $CaCl_2$ + CO_2 + H_2O

Reactants		Products	
Carbon	X 1	Carbon	X 1
Oxygen	X 2	Oxygen	X 1
Calcium	X 1	Calcium	X 1
Hydrogen	X 1	Hydrogen	X 2
Chlorine	X 1	Chlorine	X 2

(2) $Na_2S_2O_3$ + 2 HCl ----------→ 2 NaCl + S + SO_2 + H_20

Reactants		Products	
Sodium	X 2	Sodium	X 1
Oxygen	X 3	Oxygen	X 3
Sulphur	X 2	Sulphur	X 2
Hydrogen	X 1	Hydrogen	X 2
Chlorine	X 1	Chlorine	X 1

(3) NaOH + HCl ----------→ NaCl + H_2O - Already balanced

Reactants		Products	
Sodium	X 1	Sodium	X 1
Oxygen	X 1	Oxygen	X 1
Hydrogen	X 2	Hydrogen	X 2
Chlorine	X 1	Chlorine	X 1

(4) $C_6H_{12}O_6$ ----------→ 2 C_2H_5OH + 2 CO_2

Reactants		Products	
Carbon	X 6	Carbon	X 3
Hydrogen	X 12	Hydrogen	X 6
Oxygen	X 6	Oxygen	X 3

(5) $C_6H_{12}O_6$ +6 O_2 ----------→ 6 CO_2 + 6 H_2O

Reactants		Products	
Carbon	X 6	Carbon	X 1
Hydrogen	X 12	Hydrogen	X 2
Oxygen	X 8	Oxygen	X 3

Extension ideas:

At this point learners will have been introduced to formulae and their construction. So to build on this they could construct their own balanced symbol equations based upon simple word equations they have been given.

For example:

Iron Oxide + Aluminium ----------→ Aluminium Oxide + Iron

3FeO + 2Al ----------→ Al_2O_3 + 3Fe

Sodium Hydroxide + hydrochloric acid ----------→ Sodium chloride + water

NaOH + HCl ----------→ NaCl + H_2O

They would use the same process to balance the equation as was used before.

Supporting information

Before this unit of work is undertaken teachers should be familiar with the definitions of elements mixtures and compounds.

Teachers should be familiar with balancing equations such as using online resources such as the Khan academy https://www.khanacademy.org/test-prep/mcat/physical-processes/stoichiometry/v/balancing-chemical-equations

For practice examples: http://www.rsc.org/learn-chemistry/wiki/Category:Balancing_equations

A knowledge of using oxidation numbers to make determine the formulae of compounds as well as a familiarity with the periodic table for this is also necessary. Help with this can be found at the following www.youtube.com/watch?v=OU7GkayF3dc.

Teachers can also access lots of useful information on this subject at www.rsc.org in the education section. http://www.rsc.org/learn-chemistry/resource/res00001088/definitions-in-chemistry - helps with definitions. https://www.rsc.org/cpd/resource/RES00001328/quantitative-chemistry also useful for looking at aspects of quantitative chemistry (Calculating masses as well as writing equations).