

S3 Chemistry

Unit 2 Nature's Chemistry

Name	
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Week 1 - FUELLING THE FUTURE

-  I can state what the words fuel, combustion and exothermic mean
-  I can describe the test for oxygen and state the composition of air

What are fuels?

A fuel is any substance that can be burned to give energy.

OXYGEN



FUEL

HEAT

We have talked about the fire triangle shown above before. If you need a reminder watch this

<https://www.youtube.com/watch?v=kGGUNM9D78A&t=294s>

Now fill in the following sentence.

Fuels are chemicals that _____ in oxygen to _____ energy.

Another word for burning is _____.

Exploding Can

Watch the following video clip.

<https://www.youtube.com/watch?v=GSexzkJBM9k>

The 'fuel' used is methane.

Combustion gives out heat - we call this an

_____ reaction. The heat energy is used for heating, cooling, transport and generating electricity.

Remember there is a particular word we use to describe a chemical reaction which gives out energy. However not all chemical reactions give out energy.

Remind yourself about exothermic and endothermic reactions

<https://www.youtube.com/watch?v=pYpZWodUTVk&t=4s>

Air is made up of a mixture of gases - can you find out what air is made of using the internet ? Complete the following sentence.

The air is made up of approximately ___% oxygen and 80% _____, with very small amounts of argon (1%), carbon dioxide (0.04%) and other gases.

Project

Remember anything that burns can be used as a fuel. Find out what fuels are used in these 3 situations 1) Rockets 2) Racing cars and 3) jet aircraft.

You may find some of these helpful.

<https://www.youtube.com/watch?v=zWgLsOErVOY>

<https://www.youtube.com/watch?v=t-XKUVNI1Vs>

https://www.youtube.com/watch?v=EYFF_1HSgDU

Using gas tests to identify oxygen, carbon dioxide and hydrogen

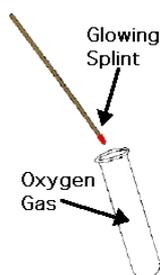
Below you can see three different gas tests.
Complete the sentence on the next page about gas tests when you have watched the clips below.

We have done all of these gas tests in S1. However you might need a reminder.

<https://www.youtube.com/watch?v=eVPNtO1ojk8>

<https://www.youtube.com/watch?v=0VonvhSzhR4>

<https://www.youtube.com/watch?v=kHzbkri29so>



Glowing splint



Lit Splint



Lime water

Results

The test for oxygen is that it _____ a _____ splint.

Air will not give a positive result for oxygen as it has only _____ oxygen.

The test for carbon dioxide is that it turns _____ cloudy.

Fuels: We use fuels for heating, generating electricity, to power factories, cooking

Match each fuel with its correct use.

Charcoal	Patio heaters, cooking
Coal	Electricity generation, open fires
Gas	Barbeques, hand warmers
Diesel	Heating, electricity generation, cooking
Calor gas	Tractors, lorries, cars, boats, factories

Week 2 - What are Fossil Fuels?



I can name the fossil fuels and describe how they were formed



I can explain what finite means and explain what a fuel crisis is

Coal, oil, gas and peat are fossil fuels. Fossil fuels are fuels that have been formed in the earth's crust over millions of years by the action of heat and pressure on decomposing life forms. Fossil fuels contain energy from the sun trapped by the process of photosynthesis. The energy is stored as chemical energy in carbon based compounds.

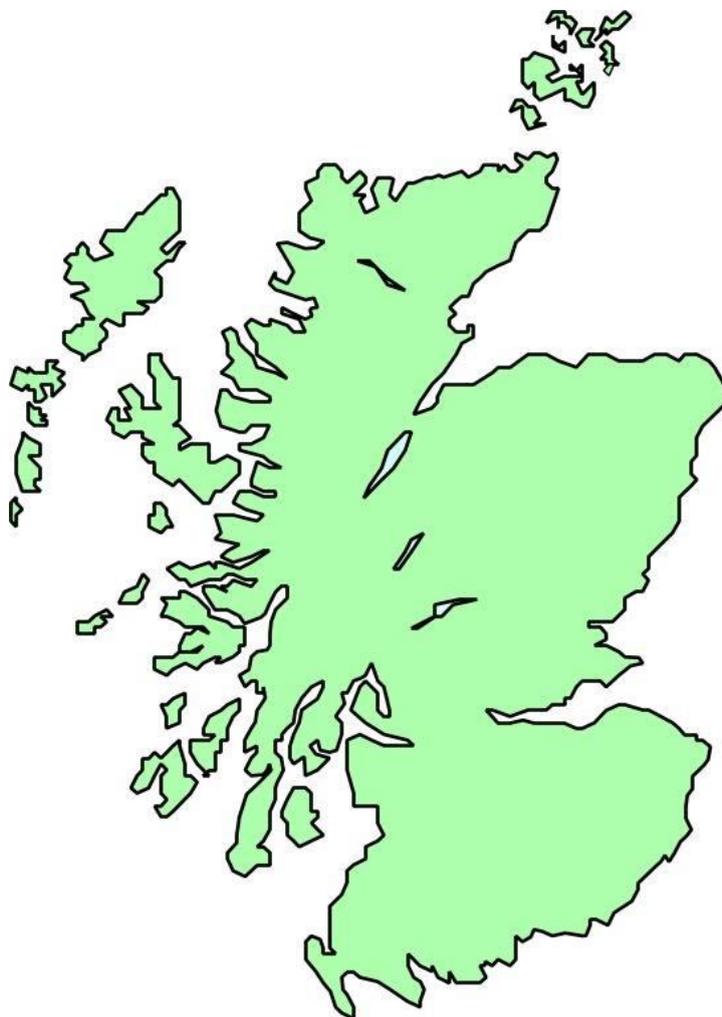
Scotland has a long history of coal, oil and gas production. These fossil fuels are part of our natural resources. Peat is also used as a fossil fuel in more remote parts of Scotland.

The oil industry is of huge economic importance to Scotland.

Use the internet to identify:

- 3 places where coal used to be mined
- two of the north sea oil production fields
- Scottish oil refinery.

Draw these onto the map below:



Project on fossil fuels

Using the information which you have found from the internet make a PowerPoint or poster to describe oil and coal are formed.

Week 3 - Useful Substance from Crude oil

-  I can describe the composition of crude oil and name the elements that are contained in oil and gas
-  I can describe the process used to refine crude oil and the physical property it relies on
-  I can explain what a crude oil fraction is and give example of their uses
-  I can explain the terms evaporation, viscosity and flammability and describe how they vary for the fractions of crude oil

The price of a barrel of oil is a constant feature in the news because it affects so many areas of the economy from heating, transport and industry to air fares, the price of goods and wage demands. Oil is not only a source of fuels; it is a 'raw material' for many products such as plastics, detergents and pharmaceuticals.

Word Bank

structures

carbon

hydrogen

fractional distillation

What is Crude oil?

Crude oil is a mixture of compounds called hydrocarbons. Hydrocarbons contain the elements _____ and _____ only. The compounds have different _____ because they are different sizes and contain different numbers of carbon and hydrogen atoms.

The oil is separated into groups of molecules called "fractions" by a process called _____.

<u>Word Bank</u>	fractions	fractional distillation	boiling
	Fractionating tower		

Fractional Distillation

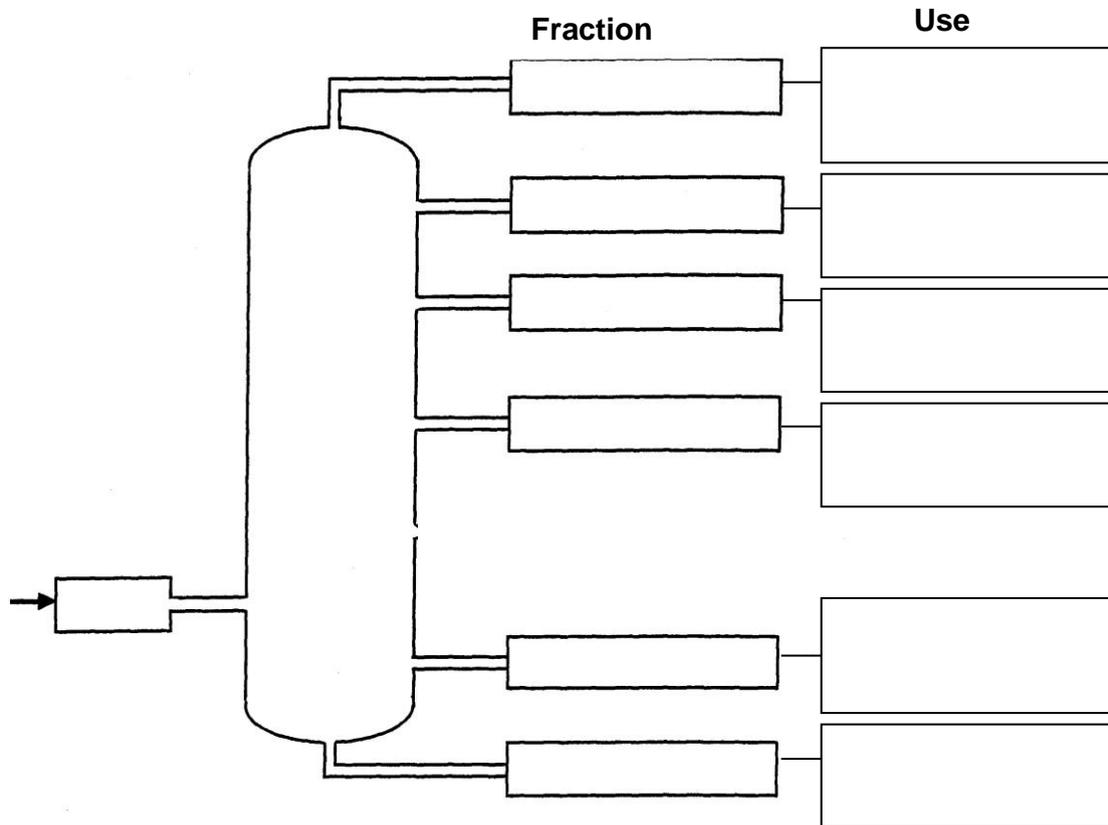
In its raw state crude oil is no use. It has to be treated in an oil refinery to produce the useful fuels and other chemicals.

The first stage in the refining process involves separating the oil into groups of compounds with similar _____ points. These groups of compounds are called _____.

The process by which oil is separated into fractions is called _____ . Distillation does not produce any new substances as it is a physical separation process which involves evaporation followed by condensation. Crude oil is distilled in a tall tower called a _____.

Pupil Activity

Complete the following diagram and text that follows using a suitable resource.



<u>Word Bank</u>	turn	temperature	liquid
higher			

The oil is heated until the fractions evaporate and then the oil vapours are pumped into the bottom of the tower. As the _____ at the bottom of the column is much _____ than at the top, the fractions can be removed from the column when they reach the points at which it is cool enough for them to _____ into a _____ (condense).

Fractions are often compared using physical properties.

These include:

Flammability, which means:

Viscosity, which means:

Ease of Evaporation, which means:

Fraction	Boiling Range	No. of C atoms	Ease of evaporation	Flammability	Viscosity	Colour
Refinery Gas						
Gasoline						
Naphtha						
Kerosene						
Gas oil						
Residue						

Week 4 - Alkanes

-  I can name the elements present in alkanes
-  I can name the first 8 alkanes and identify an alkane from its name
-  I can work out the names of alkanes from molecular, structural and general formula

The alkanes are the simplest family of organic compounds.

mnemonic	NAME	FORMULA	FULL STRUCTURAL FORMULA
	methane	CH ₄	$ \begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{H} \\ \\ \text{H} \end{array} $
	ethane	C ₂ H ₆	
		C ₃ H ₈	
		C ₄ H ₁₀	
	pentane		
		C ₆ H ₁₄	
	heptane		

Alkanes fit the general formula _____ and can be used as fuels.

Week 5 - Alkenes

I can name the elements present in an alkene



I can name the first 7 alkenes and identify an alkene from its name, molecular, structural and general formula

The alkenes have a **carbon to carbon double bond**.

Name	Structural Formula	Molecular formula
ethene		C_2H_4
propene	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}=\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $	
butene		
pentene		
hexene		
heptene		
octene		

The general formula for the alkenes is _____ and they are used to make polymers such as _____. Alkenes are quite reactive (See next lesson)

Week 6 - Alkene Reactions

-  I know the meaning of the word saturated and unsaturated (and give examples of these hydrocarbons)
-  I can describe the test used to identify between a saturated and unsaturated hydrocarbon
-  I can explain what an addition reaction is and give examples.

Pupil Experiment - Bromine Water

Aim: To distinguish between a saturated and an unsaturated hydrocarbon

Method: Collect two test tubes and place 2ml of an alkane (saturated) in one test tube and 2ml of an alkene (unsaturated) in the other. Add bromine water and shake vigorously. Record your findings below.

Results:

Test Tube	Alkane or Alkene	Result on adding bromine
1		
2		

Conclusion:

From this experiment I found out that _____ decolourise bromine water quickly.

Alkenes decolourise bromine.

propene + bromine → dibromopropane

Word Equation

→

**Equation using
structural
formulae**

Molecules with **carbon to carbon double bonds** are said to be **unsaturated**. Molecules with **carbon to carbon single bonds** are said to be **saturated**.

Test for Unsaturation

Unsaturated molecules _____ bromine solution quickly while saturated molecules (carbon to carbon single bonds) react very slowly react with bromine solution.

Alkenes undergo addition reactions with other small molecules too

butene + hydrogen → _____ *word equation*

+ →

*equation using
structural formulae*

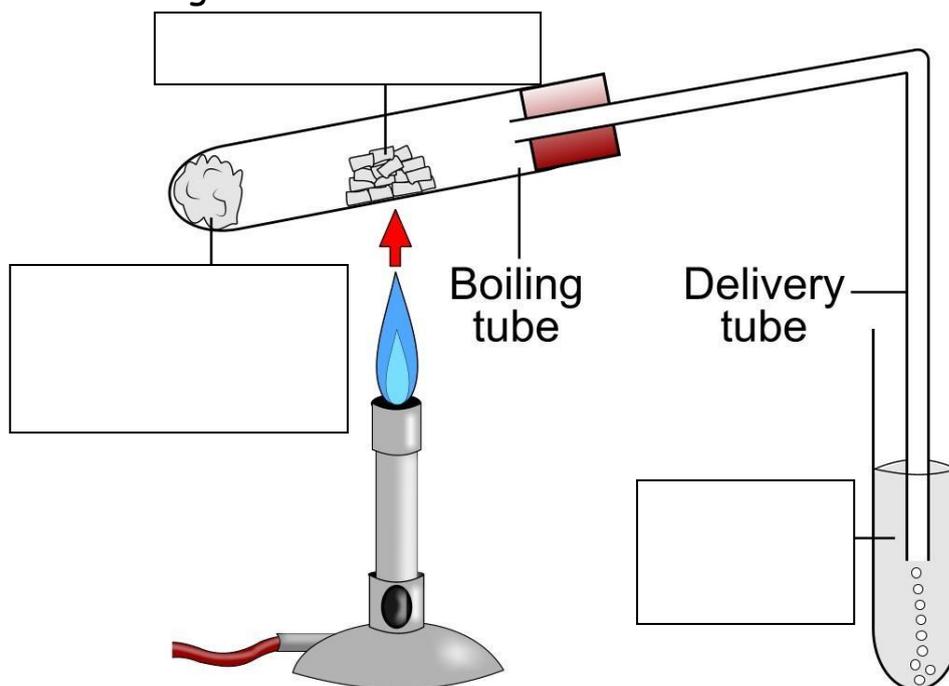
Week 7 - Catalytic Cracking

- i I can describe the process of cracking hydrocarbons and explain why cracking is a worthwhile process
- i I can describe what happens to the size of hydrocarbon molecules during cracking

The distillation of crude oil produces a high percentage of longer, less useful molecules giving insufficient petrol to meet market demand. Chemists have developed a process called Cracking to solve this problem: long chain molecules are broken down into shorter more useful molecules.

Pupil Experiment - Cracking

Label the diagram below.



When the paraffin is heated, it changes into a gas. As the paraffin gas passes over the Aluminium Oxide it reacts on the surface. **The Aluminium Oxide acts as a catalyst for the reaction.** The catalyst allows the reaction to take place at a _____ temperature.

Cracking produces molecules that are s_____ and molecules which are u_____ - both of which are more useful and valuable than larger ones.

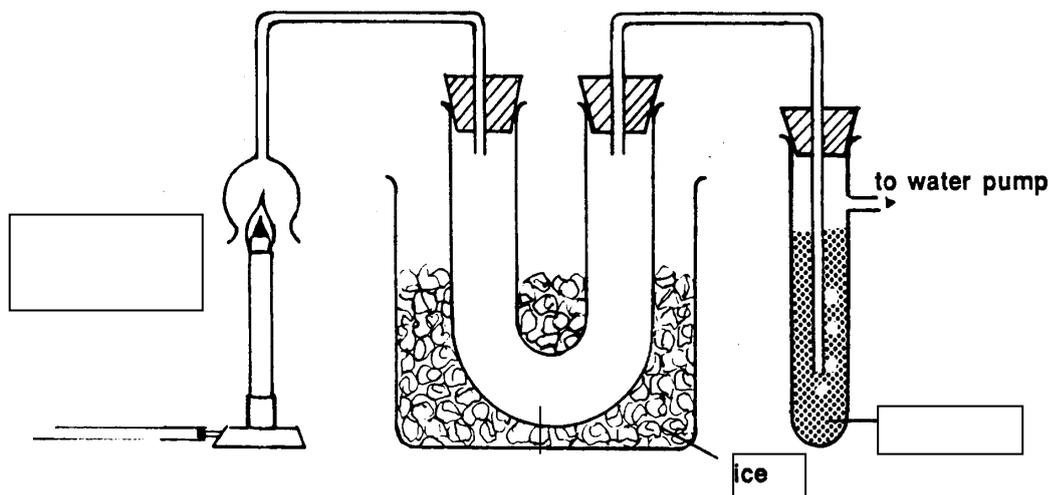
Week 8 - Pollution Problems

-  I can state the tests for carbon dioxide and water
-  I can balance an equation for the combustion of an alkane

Combustion of Hydrocarbons

1. What do you think will be formed when hydrocarbons are burned in Oxygen?
-

Label the diagram below



2. What is produced when a hydrocarbon burns?
-

3. How did you test the products?
-

Write a word equation for the combustion (burning in oxygen) of the hydrocarbon methane.

Word equation

Balancing equations

In any chemical reaction the same number of atoms that go into a reaction (reactants) at the start must come out at the end (products). Chemists show this using a balanced chemical equation (same number of atoms on reactant and product sides).

Can you now write a balanced equation for the combustion of methane?

Balanced Chemical equation

Complete combustion

The burning of coal, oil or gas in a plentiful supply of oxygen always produces _____ and _____.

Carbon dioxide is one of the main causes of global warming. A lot of _____ energy is also produced. This is what makes fossil fuels such good fuels. This is called **complete combustion**.

Week 9 - Other pollutant gases

-  I can name the pollutants produced in a car engine and state how they can be reduced, by altering air to fuel ratio or using a catalytic converter
-  I can describe incomplete combustion including the cause and the products produced.

Incomplete Combustion

When a Bunsen burner's air hole is open, the good air supply allows complete combustion.

Your teacher may allow you to investigate the products of incomplete combustion - where air hole is closed.

Write a brief account of any findings

Use suitable resources to make notes on the **poisonous gas** produced in **incomplete combustion**. Be sure to include

- the name of the gas
- how is this gas formed,
- an explanation of how this can lead to death

Car Engines - Oxides of Nitrogen

A mixture of petrol (hydrocarbon) and air (contains mainly _____ at ___% and 20% _____), is ignited by a spark from a spark plug in a car engine. The high temperature of the spark can make the _____ and _____ in the air react to form a variety of nitrogen oxide compounds. These compounds are poisonous and can cause acid rain.

Sulfur Dioxide

All fossil fuels contain small amounts of sulfur. One of the reasons why Scottish coal stopped being used was due to the amount of sulfur present in our natural coal resources, which was higher than in other countries. When the fuels burn, the sulfur reacts with the _____ in air to form _____ which is poisonous and also contributes to acid rain.

Write equations for the reaction of sulfur with oxygen:

Word equation _____ + _____ → _____

Formula equation + →

Week 10 - Alternative fuels

-  I can state that biodiesel is a renewable energy source and through practical investigation I can compare the benefits and disadvantages of using it
-  I can name some renewable energy sources and compare their advantages and disadvantages, with those from fossil fuels

If we continue using fossil fuels at today's rate, they may run out in less than 200 years. We have to find renewable energy sources - one of these alternative fuels is biodiesel.

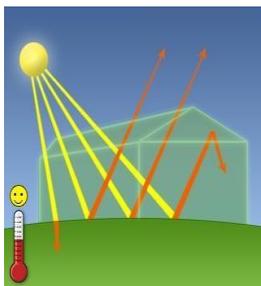
Use suitable sources to fill in the following table on oil and gas, and alternative fuels

Fuel	Advantages	Disadvantages	Example of where used
Oil/Gas			
Biodiesel			

Hydrogen			
Biomass			

Week 11 - Greenhouse effect & Global Warming

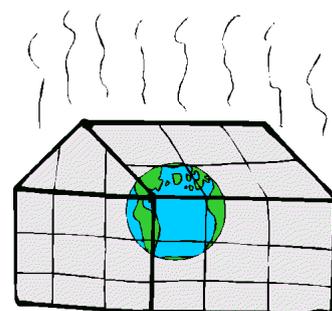
-  Through practical investigation, I can discuss the greenhouse effect and the possible impact on global warming
-  Through discussion and presentation of my work, I can express an opinion on the risks and benefits of using fossil fuels.



Can you describe the greenhouse effect?

Greenhouses trap heat from the sun. The glass panels let in light but keep heat from escaping. This causes the greenhouse to heat up.

The gases in the atmosphere act like a blanket around our planet. They trap in heat making the temperature rise. This is called the greenhouse effect and is a natural process that keeps our planet warm. Without greenhouse gases, heat would escape back into space and the average temperature on earth would be -18°C , not warm enough for humans to survive!



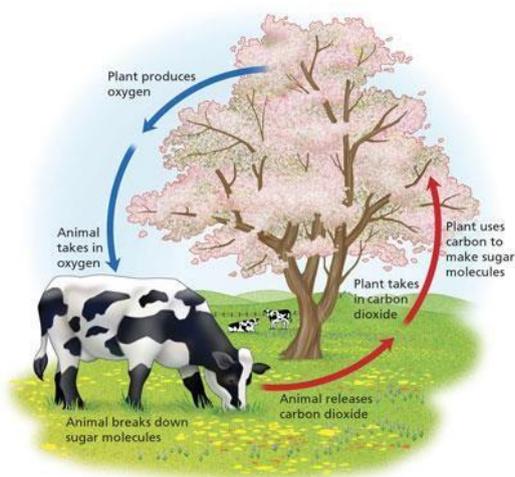
Increasing amounts of greenhouse gases have been released into the atmosphere, which has caused the planet to trap more heat, making the planet warmer. Carbon dioxide is one gas thought to be involved in the warming of earth by the greenhouse effect. Other greenhouse gases include methane, water vapour, ozone, nitrogen oxides, sulfur dioxide.

Teacher Demo: Greenhouse gases

Your teacher may show you a demonstration of the greenhouse effect.

Write a brief account including a diagram

Your teacher may now choose to show the video 'an inconvenient truth' at this point or BBC frozen planet 'climate change'. Write down some facts as you listen to this video.



In the earth's atmosphere there should be a consistent level of 0.04% carbon dioxide due to the **balance** of two natural processes of **photosynthesis** and **respiration**. Plants take in CO_2 and animals produce CO_2 . Deforestation - cutting down trees, together with the burning of fossil fuels has led to increased amounts of CO_2 ,

and an increase in global warming.

In this topic on fossil fuels you have identified some of the **facts** about global warming. There is always a debate around 'global warming' and there are social and political issues surrounding **what we should do** to reduce the impact of global warming.

Do you believe that global warming is really happening?

Your teacher may lead a class discussion about the main global warming issues.

Learning Outcomes - Fossil Fuels

Lesson No.	Learning Outcome	Tick ✓
1	I can state what the words fuel, combustion and exothermic mean.	
1	I can describe how to test for oxygen.	
1	I can state the composition of air.	
2	I can name the fossil fuels and describe how they were formed.	
2	I can explain what 'finite' means and explain what a fuel crisis is.	
3	I can describe the composition of crude oil and name the type of elements in gas and oil.	
3	I can describe the process used to refine crude oil and the physical property it relies on.	
3	Explain what a crude oil fraction is and give examples of their uses.	
3	I can explain the terms evaporation, viscosity and flammability and describe how they vary for the fractions of crude oil.	
4	I can name the elements present in alkanes.	
4	I can name the first 8 alkanes and identify an alkane from it's name	
4	I can work out the names of alkanes from molecular, structural and general formula	
5	I can name the elements present in an alkene	
5	I can name the first 7 alkenes and identify an alkene from it's name, molecular, structural and general formula	
6	I know the meanings of the word saturated and unsaturated and can give examples of saturated and unsaturated hydrocarbons	
6	I can describe the test used to test between a saturated and an unsaturated hydrocarbon	

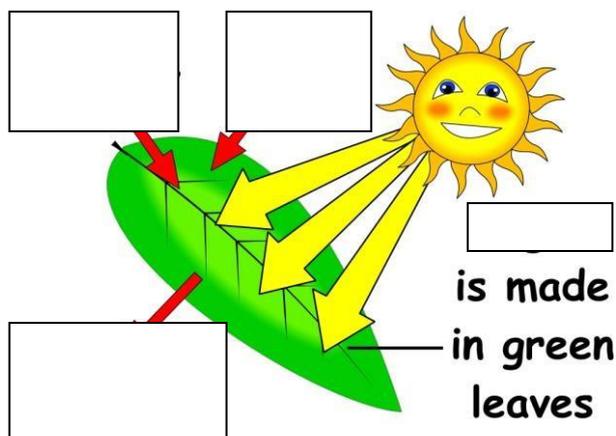
Learning Outcomes - Fossil Fuels

Lesson No.	Learning Outcome	Tick √
6	I can explain what an addition reaction is and give examples	
7	I can describe the process of cracking hydrocarbons and explain why cracking hydrocarbons is a worthwhile process	
7	I can describe what happens to the size of hydrocarbon molecules during cracking	
8	I can balance a chemical equation for the combustion of an alkane.	
8	I can state the tests for carbon dioxide and water	
8	I can describe incomplete combustion including the cause and the products produced.	
9	I can describe the effect of burning sulfur compounds in fossil fuels.	
9	I can name the pollutants produced in a car engine and state how they can be reduced	
10	I can state that biodiesel is a renewable energy source	
10	Through practical investigation, I can compare the benefits and disadvantages of using Biodiesel	
10	I can name some forms of renewable energy sources and compare the advantages and disadvantages of fossil fuels with these renewable energy sources.	
11	Through practical investigation, I can discuss the greenhouse effect and the possible impact on global warming.	
11	Through discussion and presentation of my work, I can express an opinion on the risks and benefits of using fossil fuels.	

Lesson 12 - Carbohydrates

i I can explain photosynthesis including reactants, products and other requirements

i I can state the elements present in carbohydrates



Green plants make their own food by Photosynthesis (photo = light, synthesis = to make). Plants need water, _____, light and a special substance called _____ to do this. The products from photosynthesis are the gas _____ and a compound called a **carbohydrate**.

Write the word equation for photosynthesis below:

Word equation

Can you guess the elements present in the name?

Carbo Hydr ate

Element = _____

Your teacher may demonstrate the reaction of sugar and concentrated sulfuric acid



When concentrated sulfuric acid is added to a carbohydrate called sucrose the products are _____ and _____.

This proves that **carbohydrates** contain the elements _____, _____, and _____.

Lesson 13 - Using Carbohydrates

-  I can explain respiration including reactants and products
-  I can describe the importance of carbohydrates, giving examples

Carbohydrates are one of the three main food types we have in our diet. The other two are _____(for growth and repair) and _____(for insulation and energy).

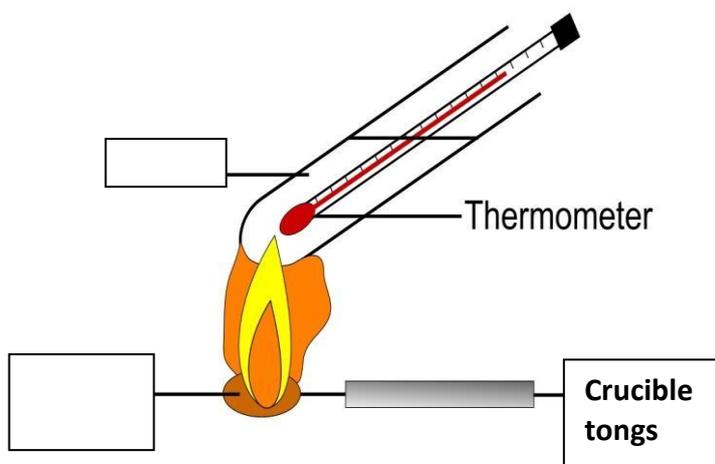
Pupil Experiment - Burning carbohydrates

Aim: To help find out why carbohydrates are important.

Method: Follow instructions given by your teacher.

Results:

From our experiment we were able to identify that _____ and _____ both showed a large increase in temperature compared to _____.



Conclusion

This experiment shows us that carbohydrates are a source of e_____

Teacher demo: Carbohydrates

Your teacher may show you a 'screaming jelly baby' experiment just to prove how much energy can be released!

Respiration



Respiration is the process we use to release energy from carbohydrates. It is the opposite of photosynthesis.

In respiration the products are _____, _____.

Write a summary word equation for respiration below:



Lesson 14 - Testing Carbohydrates



I can name chemical tests and results for starch, glucose and sucrose

Carbohydrates are one of the three main food types we have. There are different types and sizes of carbohydrates. Some are known as sugars and others as starch but they all burn to give carbon dioxide and water and provide us with energy.

Pupil Experiment: Testing different Carbohydrates

Aim: To investigate the differences between different carbohydrates.

Method: Follow the instructions from your teacher.

Results:

Carbohydrate	Solubility	Iodine test	Benedict's Test
Glucose			
Sucrose			
Starch			

1. What is the best test for glucose?

2. Which test would you use for starch?

3. Why is sucrose known as the 'double negative' carbohydrate?

4. Name one difference between starch and glucose. What does this suggest about the size of starch?

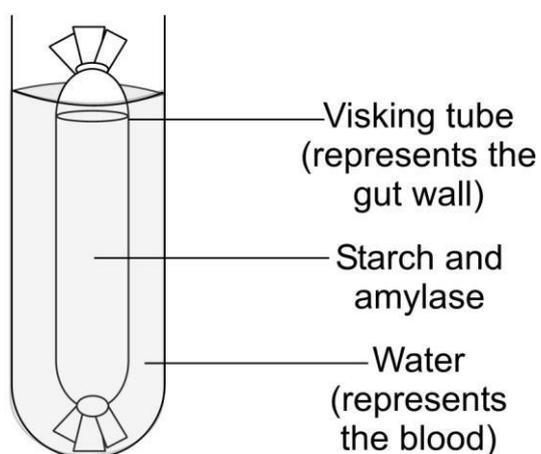
Lesson 15 - Digestion

-  I can explain how starch is made from glucose
-  I can describe what happens during starch digestion

Digestion begins in our _____ where we chew our food. Saliva which contain _____ (biological catalysts) are also added to the food.

Pupil Experiment: Digestion

Aim: To see how and if enzymes in saliva (amylase) help with the digestion of food.



Method:

Starch solution (carbohydrate) and amylase (enzyme) are mixed and added to visking tubing.

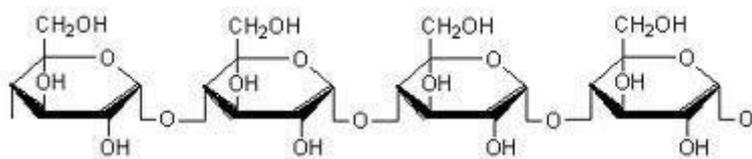
A temperature of 37°C is used to help make the enzyme work at it's best.

The water will be tested for starch and glucose at the end of the experiment

Results from this experiment show us that:

- Starch can be broken down into _____ using an enzyme and the process is known as _____.
- Starch must be a long chain (or polymer) of _____.

Here is a long chain molecule of starch.



Glucose has a formula of $C_6H_{12}O_6$. Can you show where to cut the starch molecule up to get four glucose 'units'?

Lesson 16 - Fermentation

-  I can examples of raw materials used to make alcoholic drinks and explain the role of yeast in this process
-  I can explain fermentation including reactants, products and other requirements

Alcohol (or ethanol) is produced from starch and sugars. Different alcoholic drinks can be made depending on the type of fruit or vegetable used.

Using a suitable resource, complete the table below:

Alcoholic Drink	Fruit or Veg Used	% Alcohol
Beer / Lager		
	Apples	
Wine		
Whisky		
	Potatoes	
Rum		
	Rice	
Gin		

These drinks are all made by a process called **fermentation**

Teacher Demonstration: Fermentation

Your teacher will show you a mixture of yeast in sugary water

Results (how did you know a chemical reaction had taken place?):

Conclusion:

In fermentation **glucose** is converted into _____ by an _____ (biological catalyst). Carbon dioxide gas is also produced. Complete the word equation:



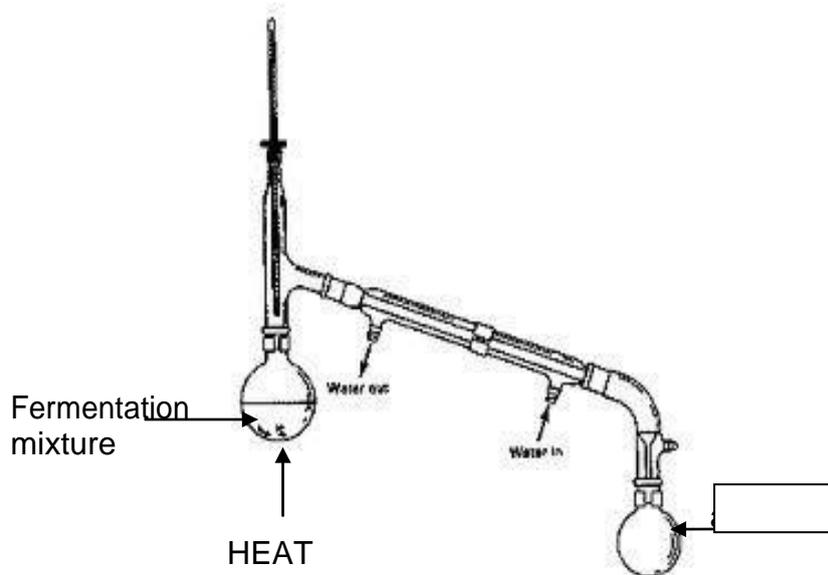
Lesson 17 - Distillation

- i** I can explain how alcoholic drinks can be made more concentrated
- i** I can explain why water and alcohol can be separated by distillation

Alcohol (or ethanol) is produced from starch and sugars using an enzyme. One problem with using an enzyme is that the ethanol produced poisons the yeast and it is difficult to get alcoholic drinks over 15% alcohol content.

Teacher demo: Distillation

Your teacher will carry out an experiment to show how we can increase alcohol content for production of drinks such as whisky:



Ethanol and water are present as a mixture in the fermentation liquid.

They can be separated by _____ as they have different _____ points.

Answer the following questions on the distillation technique:

1. What is the % alcohol in whisky, does this suggest whisky is made by distillation?

2. Is distillation an example of a chemical reaction (think of signs of a chemical reaction) or is it a physical process?

Lesson 18 - Units of alcohol



I can state the number of units of alcohol in alcoholic drinks



I can describe some of the long term effects of alcohol in alcoholic drinks

The effect of alcohol on the human body depends on the amount of alcohol in the blood. This varies depending on how quickly the alcohol is drunk and how quickly it is broken down in the person's body. Alcohol consumption is measured in 'units'. 1 unit is 10ml of pure alcohol. Recommended units per week are 14 for women and 21 for men. The liver breaks down alcohol at the rate of about 1 unit per hour.

Using the table below answer the questions that follow:

Drink	Alcohol Units
Small glass of wine	1 unit
Large glass of wine	2 units
Pint beer / lager / cider	2 unit
A pub measure of whisky / vodka/ gin	1 unit

- Mr Green regularly drinks a large glass of wine every day after work. He then drinks 4 pints on a Saturday night. Does he drink more or less than the recommended number of units per week?

- Mrs Brown regularly has a gin and tonic at night, and also enjoys 4 large glasses of wine at a weekend. How many units does she drink?

- At 11a.m, a person has six units of alcohol in their body. At about what time would all of this alcohol have been broken down?

- Name two parts of the body that can be damaged by long term affects of drinking.

Lesson 19 - Drugs and Medicines



I can explain the difference between a drug and a medicine



I can name some plants used in making medicines

A drug is a substance that alters the way the body works. Alcohol is a drug - if taken in excess, alcohol can have harmful effects on the body. Drugs which have a beneficial effect on health are called_____.

Herbal medicines were made from plants and used to treat disease for hundreds of years before they were made by chemists in industrial plants. About 30% of medicines used today come from plants. Here are a few of the medicines which have been made from plants:

Medicine	Plant	Treatment
Aspirin	Willow bark	Pain relief
Morphine	Opium poppy	Strong pain killer
Quinine	Chinchona	Malaria
Digoxin	foxglove	Heart disease

Presentation

Your teacher may allow you to carry out your own research into one of the above medicines. Make sure you answer the following:



- Where are the plants found and grown?
- Identify the main 'active' ingredient of the plant
- How do chemists extract the useful chemicals from the plants?
- Are there other treatments that these medicines can be used for?

Learning Outcomes - Carbohydrates

Lesson No.	Learning Outcome	Tick
		✓
12	I can explain photosynthesis including reactants, products and other requirements	
12	I can state the elements present in carbohydrates	
13	I can explain respiration including reactants and products	
13	I can describe the importance of carbohydrates, giving examples	
14	I can name chemical tests and results for glucose, sucrose and starch	
15	I can explain how starch is made from glucose	
15	I can describe what happens during starch digestion	
16	I can give examples of raw materials used to make alcoholic drinks	
16	I can explain the role of yeast in making alcoholic drinks	
16	I can explain fermentation including reactants, products and other requirements.	
17	I can explain how alcoholic drinks can be made more concentrated.	
17	I can explain why water and alcohol can be separated by distillation	
18	I can state the number of units of alcohol in alcoholic drinks	
18	I can describe some of the long term effects of alcohol on the body.	
19	I can explain what is the difference between a drug and a medicine	
19	I can name some of the plants used in making medicines	