1 Fuels

There are lots of different fuels used around the world.

- Why do we need fuels?

  1. _____

  2. _____

- Sort out these fuels into the correct columns.

bio-diesel	**charcoal**	**coal**	**crude oil**	**diesel**
ethanol	**methane**	**natural gas**	**recycled cooking oil**	
petrol	**rubbish incineration**		**straw**	**wood**

fossil fuels	bio-fuels
(5)	(8)

- Which fuels do you use in your home?

  _____

- Which fuels are used in a power station to generate electricity?

  _____

  _____

- What do you think a bio-fuel is?

  _____

  _____

- Why are bio-fuels becoming more popular?

  _____

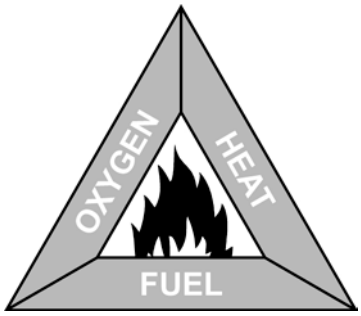
  _____

2 The fire triangle

- Watch this clip about the fire triangle: http://www.youtube.com/watch?v=SWxH4qjst94

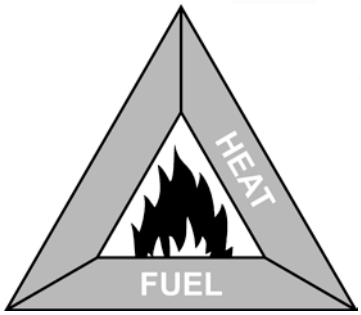
  Fires need three things: **heat** **fuel** **oxygen**

  Often we draw a fire triangle like this:



If we take one of these away, then the fire goes out.

- Look at this diagram. The fire will not burn.



What is missing? _____

- Watch this clip http://www.youtube.com/watch?v=GjSoxJF3RD4 about fire extinguishers and fill in the table about them.
- Watch the demonstration about putting out fires

What can you do to put out a wood fire?

1. = _____ 2. = _____

Explain how they work to stop the fire _____

_____

What did you see? _____

Was it messy? _____

Notes to teacher:

This demo has been left on sheet #2B from previous series of entry level science, and included here for convenience.

What your teacher needs

eye protection	metal tray
heat resistant mat	few wood shavings
squeezy bottle of water	beaker of sand

What your teacher will do

1. Place the metal tray on the heat resistant mat.
2. Put a few wood shavings on the tray.
3. Set fire to the wood shavings.
4. Gently squirt water over the burning shavings.

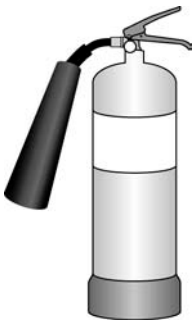
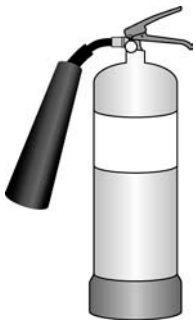
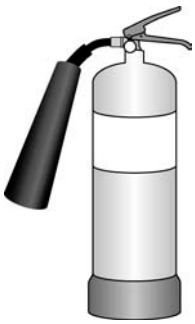
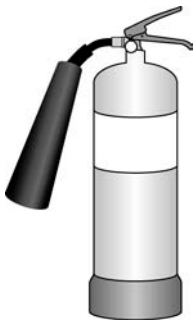
   OR Pour some sand over the burning shavings.
   The fire should go out.
5. Leave it to cool down.

2A Fire extinguishers

There are five different types of fire extinguishers.

- Use the internet to find out information about each type, then fill in the chart.
- Colour in the panel on the extinguisher for each extinguisher,
- Choose words from this box. (they can be used more than once)

cooker fires	**electrical fires**	**flammable liquids**	**high voltages**	
paper	**solid materials**	**wood & textiles**		

water fire extinguisher	**foam fire extinguisher**	**dry powder fire extinguisher**	**carbon dioxide fire extinguisher**	**wet chemical fire extinguisher**
				
Used for:	Used for:	Used for:	Used for:	Used for:
It removes the _____	It removes the _____	It removes the _____	It removes the _____	It removes the _____

Sometimes a fire blanket is used in a kitchen.

What type of fire is this best for? _____

What does part of the fire triangle does it remove?

_____

2B Fighting fires — questions

What should you do if a fire starts at school?

_____

_____

_____

What should you do if a fire starts at home?

_____

_____

_____

If a fire starts in a room, should you leave the doors and windows open or closed?
(Hint: think of the fire triangle)

_____

Explain why _____

_____

What should you do if you are in a room where the smoke from a fire is very thick?

_____

_____

_____

What should you do if your clothes catch fire?

_____

_____

_____

_____

Putting fires out — 1

Your teacher will demonstrate an experiment on burning fuels.

What your teacher needs

eye protection

heat resistant mat

beaker of sand

metal tray

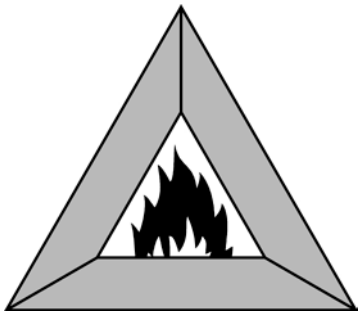
few wood shavings

What your teacher will do

1. Place the metal tray on the heat resistant mat.
2. Put a few wood shavings on the tray.
3. Set fire to the wood shavings.
4. Pour some sand over the burning shavings.
   The fire should go out.
5. Leave it to cool down.

Write on the fire triangle to show which two things were present.

Choose from air, fuel, and heat.



Is it easy to clean up after the fire? _____.

Would you use sand to put out a large fire? _____

Why? _____

_____

Putting fires out — 2

Your teacher will demonstrate another experiment on burning fuels.

What your teacher needs

eye protection

heat resistant mat

squeezy bottle of water

metal tray

few wood shavings

What your teacher will do

1. Place the metal tray on the heat resistant mat.
2. Put a few wood shavings on the tray.
3. Set fire to the wood shavings.
4. Gently squirt water over the burning shavings.
   The fire should go out.
5. Leave it to cool down.

Why did the fire go out? _____

_____.

Did you see any steam? _____.

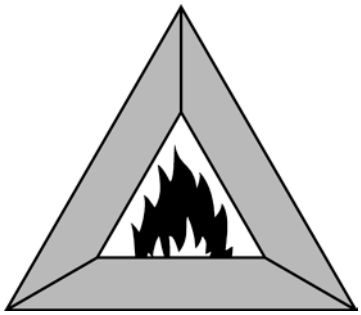
How did the water remove the heat side of the fire triangle?

_____

_____.

Write on the fire triangle to show which two things were present.

Choose from air, fuel, and heat.



Putting fires out — 3

Is it easy to clean up after the fire? _____

_____

Would you use water to put out a large fire? _____

_____

Why? _____

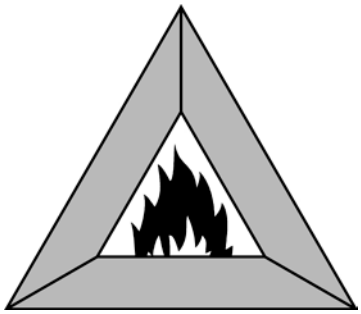
_____

We need _____ and

_____ and

_____ to make a fire burn.

Write the missing words on the fire triangle to make a fire burn.



3 What happens when a fuel burns.

When a fuel burns, the reaction taking place is called **combustion**.

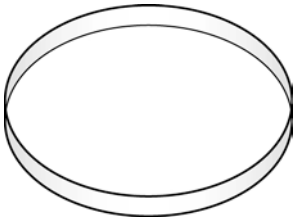
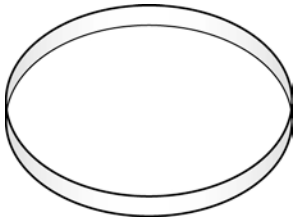
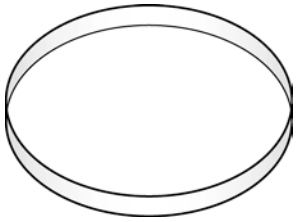
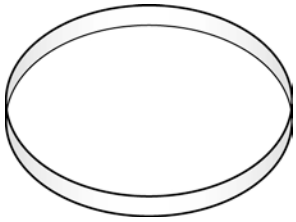
All fuels contain carbon compounds.

Burning or combustion is a chemical reaction where oxygen from the air combines with carbon in the fuel.

If **all** the carbon burns, you get a clean flame with no soot or smoke.

This is called *complete* combustion.

- Watch the demonstration of burning some different fuels.
- Draw or write down what you see happen.
- How long did each one burn for?

			
Name = _____	Name = _____	Name = _____	Name = _____
Time alight = _____	Time alight = _____	Time alight = _____	Time alight = _____

Which one burned with a blue flame and left no smoke? _____

Which one burned with the most smoke? _____

Which was the best fuel? _____

Explain your answer _____

_____

How can you make this a fair test? _____

_____

- Watch this video about comparing fuels.

  http://www.youtube.com/watch?v=b7xK6jNwagg&NR=1&feature=endscreen

- Was this a fair test? .....

Some students searched the internet to find out what the problems are with incomplete combustion.

This is the answer they found.

- Read the text and answer the questions below.

When something burns with lots of smoke, it is called ***incomplete*** combustion.

It happens when there is not enough oxygen. This means that CO (carbon monoxide) and C (carbon or soot) is produced as well as CO_2 (carbon dioxide).

If you breathe it in, **soot** can irritate your lungs. It can block sunlight getting to plants therefore they cannot photosynthesise and produce oxygen.

Carbon monoxide is a toxic gas. It can cause breathing difficulties, headaches, fatigue, unconsciousness, and even death. It alters the haemoglobin in our blood so that cells in our body do not get enough oxygen. You can't smell or taste carbon monoxide, so you don't know when it is there.

Why is incomplete combustion dangerous for plants?

_____

_____

Why is incomplete combustion dangerous for people?

_____

_____

What other problems can incomplete combustion cause? (Hint: think about burning fuel in a car or a burner.)

_____

_____

Notes to teacher:

Any four alcohols are fine for the demonstration…..generally use the first four or five

CH_3OH	methanol
C_2H_5OH	ethanol
C_3H_7OH	propanol
C_4H_9OH	butanol
$C_5H_{11}OH$	pentanol

The video is a good preparation for the next lesson on comparing alcohols; they repeat tests, so you may only want to watch the first half.

http://www.youtube.com/watch?v=b7xK6jNwagg&NR=1&feature=endscreen

4 Comparing fuels

What is most important when choosing a fuel?

- Discuss this with a partner and then put these in order.
  Use 1 for the most important, 2 for the next important and so on.

property of fuel	importance
What it looks like	
If it be transported easily	
If it is a solid or liquid or gas	
How much heat it gives off when it burns	
How expensive it is	
If it burns without soot	
If it is renewable or not	
If it is easy to store	
If it is easy to light	

Your answers will be different from another groups' answers, because it depends on where and when you want to use the fuel.

The fuel you use to cook with or heat your house depends on where you live. Many people will use natural gas, but some will use bottled gas or heating oil. But many people just use electricity which been produced by burning fuels in power stations.

- Do the investigation into burning alcohol fuels.
- Complete the results table.

alcohol	start temperature	final temperature	temperature rise
methanol			
ethanol			
propanol			
butanol			

- Answer these questions.

Which fuel heated the water the most? _____

How did you make it a fair test?

1._____

2._____

3._____

4A Burning alcohols

You are going to find out which alcohol gives out the most heat when it burns.

Your teacher has filled some small burners called spirit burners. Each one has a different alcohol. When you burn the alcohol, you will heat the same amount of water in a flask for the same time.

What you need:

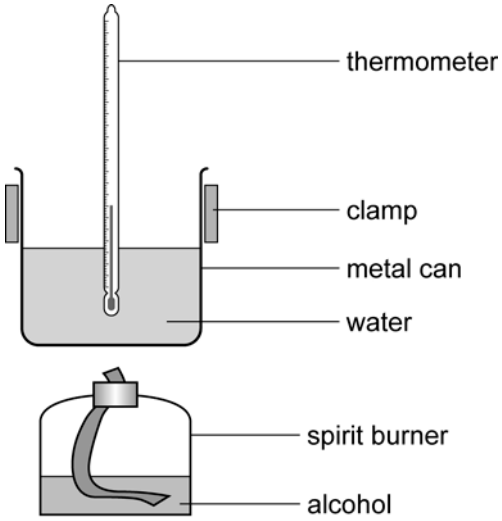
● retort stand and clamp ● copper can ● thermometer ● stop-clock ● heat mat ● 100 ml measuring cylinder	● spirit burners containing ● methanol (**Highly flammable**) ● ethanol (**Highly flammable**) ● propanol (**Highly flammable**) ● butanol (**Highly flammable**)

Safety:

- Wear eye protection.

What to do:

1. Put 100 ml of water into the copper can and clamp the copper can so that the spirit burner can be placed underneath it.



2. Put the thermometer into the water and record the temperature.
3. Write down the start temperature of the water.
4. Put the spirit burner under the flask and light it.
5. Start the stop-watch and time for 5 minutes.
6. Put the cap on the spirit burner to put out the flame.
7. Record the final temperature and write it down in the table.
8. Repeat steps 1 to 7 for the different spirit burners. Use 100 ml of fresh cold water each time.

Teaching tips

Stress the importance of fair testing, for example the height of the calorimeter above the wick.

A temperature sensor attached to a computer can be used in place of a thermometer. It can plot the temperature change on a graph.

If the students have not already watched it, this video is appropriate.

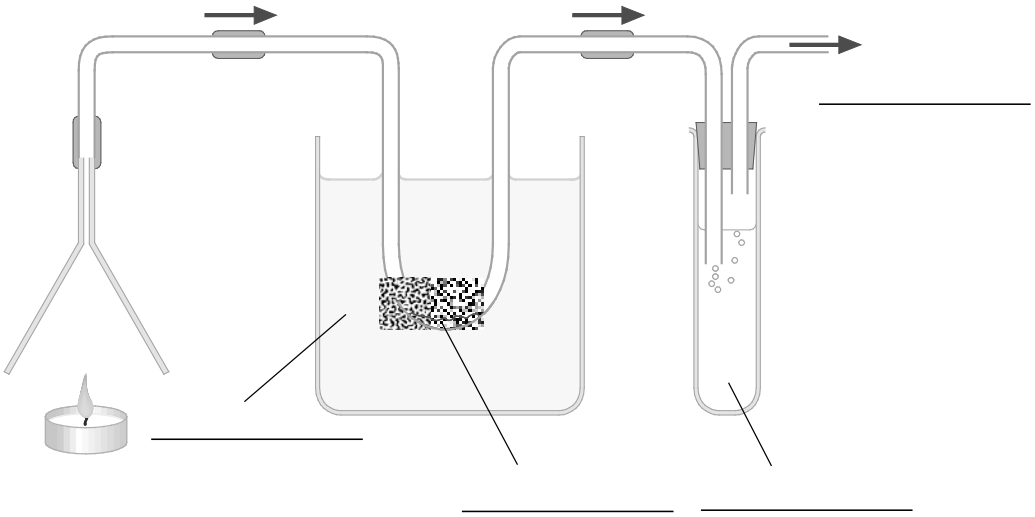
http://www.youtube.com/watch?v=b7xK6jNwaqg&NR=1&feature=endscreen

5 What substances are formed when we burn a fuel?

- Complete the sentences by joining them up with a straight line to the ends.

Start of sentence	end of sentence
Burning a fuel releases lots of	carbon and hydrogen
Fuels are made up of compounds called	heat
These compounds contain	hydrocarbons
The carbon combines with	oxygen from the air
When the hydrogen in the fuel burns it combines with oxygen to make	water

- Your teacher will show you this demonstration.
- Complete the diagram by adding labels from the box.



cold water	limewater	to pump	U-tube

- Complete the sentences using words from this box.

blue	**carbon dioxide**	**cloudy**	**ice**
liquid	**suck**	**water**	**white**

The filter pump is used to _____ gases from the burning fuel through the apparatus.

The _____ cools the gases and a colourless _____ forms in the first test-tube.

In the second test-tube, the limewater turns _____

This shows that there is _____ in the gases.

Afterwards, some of the colourless liquid is added to anhydrous copper sulphate.

It turns from _____ to _____

This shows that _____ is made when a fuel is burnt.

- We can write a word equation to show what happens when a fuel is burnt.
- This is the word equation for complete combustion

fuel + oxygen → water + carbon dioxide

- When we have incomplete combustion, we get more products.

fuel + oxygen → water + carbon dioxide + carbon monoxide + carbon (soot)

These equations only show us the *substances* involved.

Which of the gases released is toxic? _____

However, the reason a fuel is burnt, is because it releases _____

which is a form of energy.

- Write down three uses for burning a fuel.

1._____

2._____

3._____

Notes to teacher:

At this point it is not necessary to mention acid gases or other pollutants.

6 Formation of fossil fuels

There are 3 common fossil fuels. These are _____ , _____

and _____. Some scientists also include peat as a fossil fuel.

- Use the internet or text book to help you answer these questions.
- You may find this link helpful. http://www.hk-phy.org/energy/power/source_phy/flash/formation_e.html
- Suggest why these fuels are called fossil fuels _____

  _____
- When were fossil fuels formed? _____
- What was the climate like when fossil fuels were formed? _____

  _____
- What is coal formed from? _____

  _____
- Where is coal formed? _____

  _____
- What is oil and gas formed from? _____

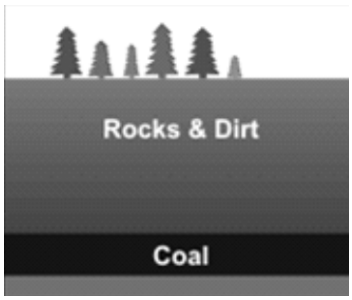
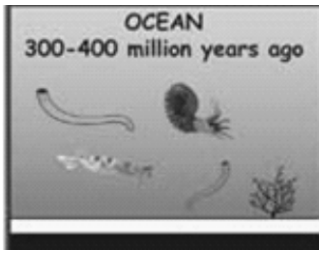
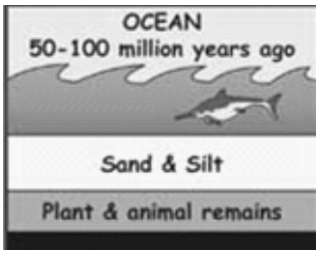
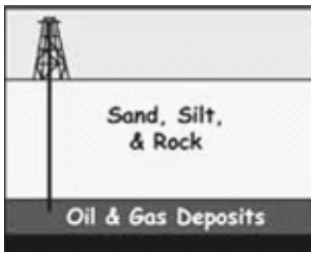
  _____
- Where is oil and gas formed? _____

  _____
- What conditions were needed to form the coal and gas? _____

  _____
- How did we get these conditions? _____

  _____

- Match up the labels to the diagrams to show the formation of coal & oil.

Coal formation				
				
Heat and pressure turned the dead plants into coal.		Before the dinosaurs, many giant plants lived in swamps		Over millions of years, the plants were buried under water and dirt.
Oil & gas formation				
				
Over millions of years, the remains were buried deeper and deeper. The enormous pressure and heat turned them into oil and gas.		Today we drill through layers of sand silt and rock to reach the rocks that contain oil and gas.		Tiny sea animals and plants died and were buried on the ocean floor. Over time, they were covered by layers of silt and sand.

- Where in the world can we find oil and gas today? _____

  _____

- How do geologists find the oil and gas? _____

  _____

Notes to teacher:

These videos are useful for this topic

http://www.hk-phy.org/energy/power/source_phy/flash/formation_e.html excellent animation but no sound…students will have to read the text.

http://www.teachertube.com/viewVideo.php?video_id=200563 unit 1especially

http://scicast.org.uk/films/2009/04/formation-of-crude-oil.html hilarious student vid. ...worth a watch!

http://www.youtube.com/watch?v=IC40mZHu2ZQ excellent but 90 mins long, so may be more suitably watched in sections over several lessons.

7 Crude Oil

Watch the video about producing crude oil. http://www.youtube.com/watch?v=9Py8-Xy9MKo

These sentences describe how crude oil can be separated into its different parts or **fractions**.

The starts of the sentences are in order, but the ends are not.

- Draw one line from each start to its end. The first one has been done for you.

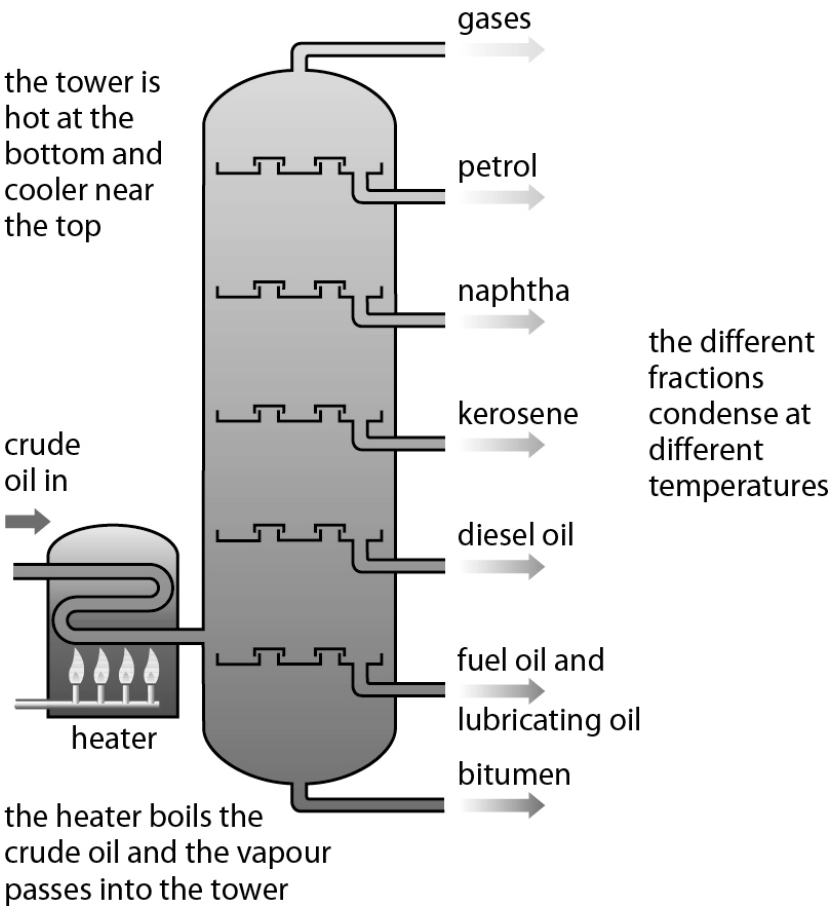
Crude oil is a variable mixture of	boiling points and appearance.
A hydrocarbon contains	fractional distillation.
The different hydrocarbons	has a range of boiling points.
So every different crude oil	have different boiling points.
The different boiling points are used	hydrocarbons.
This type of separation is called	hydrogen and carbon only.
An oil fraction has similar	to separate crude oil.

An oil distillery has many distillation columns.

The photograph shows a typical oil distillery with many columns.

The columns are usually very big: up to 6m across and 60 m in height.

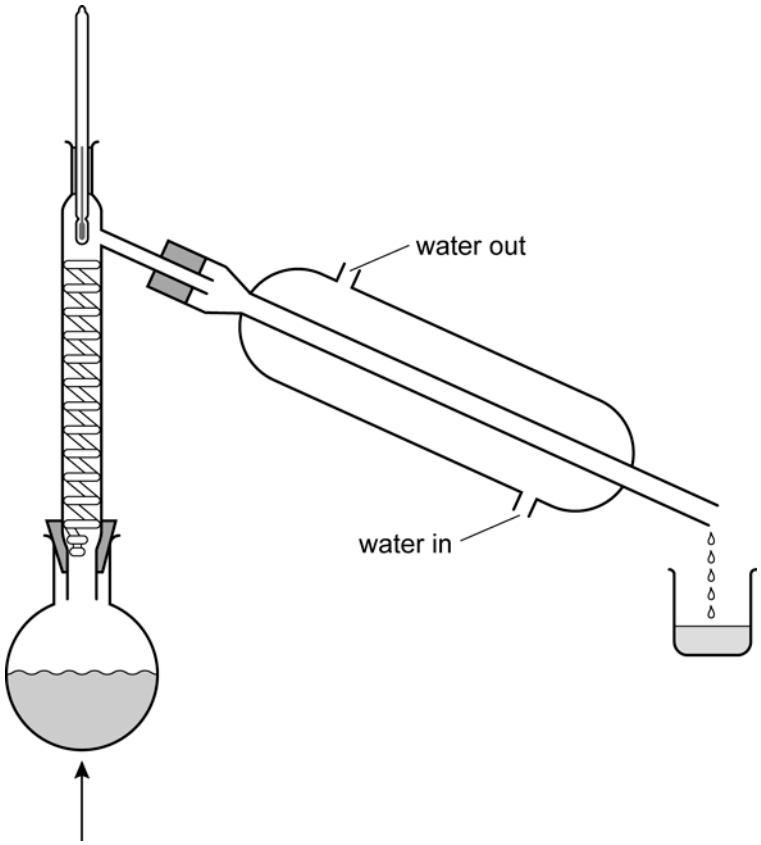
Crude oil is separated into fractions by fractional distillation. The fractions at the top of the fractionating column have lower boiling points than the fractions at the bottom. The heavy bottom fractions are often cracked into lighter, more useful products. All of the fractions are processed further in other refining units.



We can use a much smaller version in school.

This can be used to separate a school version of crude oil.

- Complete the labels on the diagram.



As most crude oils are toxic, the teacher carrying out this demonstration should use an artificial oil mixture and not real crude oil.

In the video, the scientists always used plastic gloves when handling crude oil.

Give a reason for both of these _____

_____

Crude oil is very important because we can make so many different things from it.

The fractions listed in the box can be obtained from crude oil. Each fraction has different uses.

- bitumen
- diesel oil
- fuel oil
- gases
- kerosene
- petrol

Which fraction (or fractions):

a. can be used for making roads _____

b. is the most viscous _____

c. is used in jet engines _____

d. has the smallest number of carbon atoms in the molecules _____

e. is used as fuel for engines in motorbikes and most cars _____

f. is used as fuel for engines in lorries and trains _____

g. can be used for making flat roofs _____

h. is used for heating homes? _____

Notes to teacher:

Suggested video is quite long at 14 mins, but is quite entertaining

http://www.youtube.com/watch?v=9Py8-Xy9MKo

also see:

http://www.bbc.co.uk/bitesize/standard/chemistry/materialsfromoil/how_crude_oil_was_formed/revision/1/

http://www.chemia.uj.edu.pl/cities/index.php?link=fuels.html

If preferred, you can use this diagram

8 Pollution!

Pollution is when you or your surroundings are damaged by unwanted compounds or gases or sound or light.

We say that the environment has been ***contaminated***.

Noise:

This is caused by sounds which are t__ l_____ or u_____

The loudness of a sound is measured in decibel (units dB).

Some people are so annoyed that there is now a world noise day.

- Watch these videos about noise

http://www.youtube.com/watch?v=z7Dckph9Dhk
http://www.youtube.com/watch?v=IDYkpY8v3n0

- Which of these loud sounds is noise pollution? (Put a tick or a cross against each one)

		noise pollution?
school bell for end of lesson		
alarm clock in the morning		
motor bike without a silencer		
a 'boom box'		
a train		

Light:

Many people get concerned about light pollution.

Unnecessary upward light causes sky glow and means that people in towns and cities can't _____

It wastes e_____ and disturbs the sleep of people and _____

Which side of the image below shows the view of the sky from the countryside?

_____.

Explain your answer

_____.

_____.

_____.

- Use one of these sites to check how dark the sky is where you live.

http://www.britastro.org/dark-skies/simulator.html#
http://www.need-less.org.uk/#ukatnightsim

- Write down two things we can do to reduce light pollution.

1_____

2 _____.

Heat:

This is another pollutant that wastes e_____ and m_____

Nearly every electrical appliance gives out excess heat.

Power stations also emit excess heat, usually in the

form of warm water or s_____

Notes for teacher:

Activity 1 on this site could be a suitable homework

http://astrosociety.org/edu/publications/tnl/44/lightpoll4.html

This clip is good but you might want to omit the last 10 s or so.
http://www.youtube.com/watch?v=LomQYGKcEXg

9 Pollution 2 – Polluting gases and acid rain

Nowadays, many people are worried by these pollutants.

- Suggest why people are worried.

……..

Pollution in the air:

This has been a problem for a long time.

Look at the photograph of London in 1952 taken during The Great Smog.

What can you see?

_____.

_____.

_____.

Smog is a ground level cloud of tiny particles of soot and other pollutants.

We get smog because we burn fossil fuels.

These women wrapped their scarves around their faces. Suggest a reason for this.

_____.

Smog is still a problem today as this photograph shows.

The smog is caused by our cars and buses burning petrol and diesel.

Often we can't see the air pollution because it is made from colourless gases.

- Use the internet to write a list of polluting gases.
- Use this site to help you.

http://eschooltoday.com/pollution/air-pollution/causes-of-air-pollution.html

1 _____ 2 _____

3 _____ 4 _____

These gases dissolve in the water vapour in clouds and create **acid rain**.

- Write down what does acid rain does to

plants _____

buildings _____

fish in rivers and the sea _____

9A The effects of acid rain

You are going to investigate some of the effects of acid rain.

Carry out the following tests and answer the questions that follow.

What you need:

● 2 × small beakers ● 2 × test tubes ● 2 × Petri dishes and lids	● cotton wool ● marble chips ● iron filings ● cress seeds ● 'acid rain'

Safety:

- Wear eye protection.

What to do:

Acid rain and buildings

Many buildings are constructed from limestone, marble or concrete – all of which contain calcium carbonate.

- Put a few pieces of marble in each of two beakers.
- Cover the pieces in one beaker with water and those in the other beaker with 'acid rain'.

Acid rain and metals

Metals are used for many purposes. Iron, in the form of steel, is one of the most commonly used metals.

- Put some iron filings in each of two test tubes.
- Cover the iron filings in one test tube with water and those in the other test tube with 'acid rain'.

Acid rain and plants

- Put pieces of cotton wool in each of two Petri dishes.
- Moisten one with water, and the other with 'acid rain'.
- Sprinkle cress seeds into both Petri dishes and put a cover on the dishes.
- Leave the dishes in a warm place for a few days. Make sure the cotton wool is kept moist.

Results

1 Describe what happened in each of the tests.

_____.

_____.

_____.

2 The 'acid rain' you used is more concentrated than even the most polluted rainfall. Explain how using a more concentrated acid could have affected each of your results.

_____.

_____.

_____.

3 Write a report comparing the possible effects of acid rain on buildings, metals and plants.

_____.

_____.

_____.

_____.

_____.

_____.

9B Acid rain questions

1 These statements describe how acid rain occurs. Write numbers in the boxes to put them in the correct order.

☐ The acidic clouds can be transported by the wind from other countries.

☐ Sulfur forms sulfur dioxide when it burns.

☐ Some fuels contain sulfur.

☐ Acid rain falls from the clouds.

☐ The sulfur dioxide dissolves in water droplets in the air and forms an acidic solution.

2 Write a word equation to show how sulfur reacts with oxygen to form sulfur dioxide.

_____

3 **a** Write down three problems caused by acid rain.

_____

_____

_____

b 'Scrubbers' can be fitted to the chimneys of power stations to remove the acidic gases such as sulfur dioxide in the waste gases. Write down one advantage and one disadvantage of this technology.

Advantage _____

Disadvantage _____

4 The speech bubble shows one person's opinion about acid rain.

> It costs money to remove sulfur from fuel. Why should we bother? There isn't much of a problem with acid rain in the UK.

What would you say to this person?

_____

_____

_____

Notes to teacher:

For the ‘acid rain’ a dilute solution of a weak acid is enough (pH3-4 is fine e.g. vinegar).

10 Pollution 3 – Carbon dioxide, global warming

Carbon dioxide is also a pollutant.

It can cause the **greenhouse effect**.

- Watch this video about the greenhouse effect.

http://www.youtube.com/watch?feature=player_embedded&v=VYMjSule0Bw

- Use words from the box to complete these sentences.

The Earth's atmosphere does the same thing as a……

During the day, the Sun shines through the…… and the Earth's surface …… in the sunlight.

At night, the Earth's surface……..and releases the heat back into ……

But some of the heat is ……by greenhouse gases such as carbon dioxide and……in the atmosphere.

If we have too much greenhouse …….. then we can get ……

atmosphere	climate change	cools	gases	greenhouse
methane	space	trapped	warms	

Climate change is sometimes called **global warming**.

Most of the problems are caused by people.

Draw a straight line to join the cause with its effect.

cause	effect
burning fossil fuels	this stops trees from taking in carbon dioxide
cutting down forests	which release more methane into the air
having more farm animals	this adds more carbon dioxide into the air

- Use this website to explore some of the signs of climate change.
- http://epa.gov/climatestudents/expeditions/index.html
- Write a list of some of these effects.
  http://epa.gov/climatestudents/impacts/effects/index.html

1 _____ 2 _____

3 _____ 4 _____

Do your bit to help save energy - Recyling

- Watch one of these videos

http://www.youtube.com/watch?v=SKvGgb3YcDQ&list=PL344E409D475351A3
http://www.youtube.com/watch?v=loeHhmUh-nE&list=PL218610C9F143AAEA

- What materials can you recycle

at your home? _____

at the supermarket recycling centre? _____

Why is it better to recycle these materials? (hint–what would happen to them if we did not recycle?)

_____.

_____.

Plastic bags are a problem because they don't r_____ or d_____

Recycling saves energy and it

saves m_____ reduces p_____

Notes for teacher:

Worth a look http://climatekids.nasa.gov/greenhouse-effect/

Quite nice clear diagram on here
http://envis.tropmet.res.in/kidscorner/greenhouse.htm

Students will enjoy this even if the punch line is in Dutch (translated as 'afraid of dustbins')!

http://www.youtube.com/watch?v=-sZlYcm9fZY&list=PL218610C9F143AAEA

This gives some simple recycling tips

http://www.youtube.com/watch?v=pgDJ_H-BzFo&list=PL218610C9F143AAEA&index=13