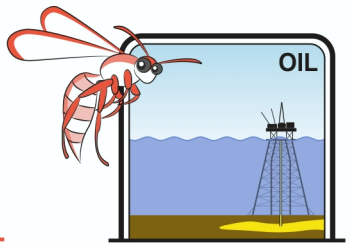
It's A Gas! – Teacher Notes



Organic material, such as plants and microbes, trapped within sediments can be changed, by increasing temperature and pressure during burial, into ***kerogen*** (a waxy dense ***hydrocarbon***). As these kerogens undergo further burial they are converted into oil and gas. The process of making hydrocarbons is very slow, taking at least 60 million years.

There are many different types of kerogen, depending on the type of organic material it formed from. Some kerogens are more likely to turn into gas than oil and vice versa, there is even a type of kerogen that doesn't turn into oil or gas.

In general:

- Hydrocarbons (oil and gas) are derived from the breakdown of organic material, typically plants and microbes.
- Oil typically forms between 3 and 4.5 km depth.
- Gas typically forms at about 4 to 6 km depth.
- Below 6km kerogen becomes carbonised and will no longer produce oil or gas.

The hydrocarbons are released over time. Being less dense than the rock they are contained within, they rise upward through interlinked pores or fractures in the overlying rock (these rocks are permeable). Both oil and gas can be found together in reservoirs (rock containers they have become trapped within).

If hydrocarbons reach the surface, they are usually digested by microbes.

Please fill in the blanks in the following cloze.

SUN ENERGY is converted to energy by **P**_____Plants_____, and **M**____Microbes____. Animals gain energy by consuming plants and other animals. Plants and microbes in our oceans can be buried and converted into **K**____Kerogen_____. If it is buried between 3 and 4.5 kilometres deep the kerogen is converted into **O**____Oil_____. Slightly deeper burial (4-6 km) produces **G**____Gas_____. Both oil and gas are sources of **E**____Energy_____.

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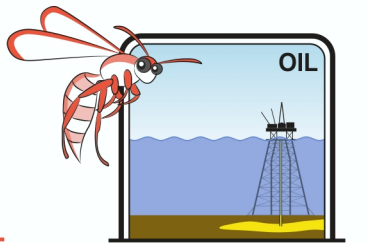
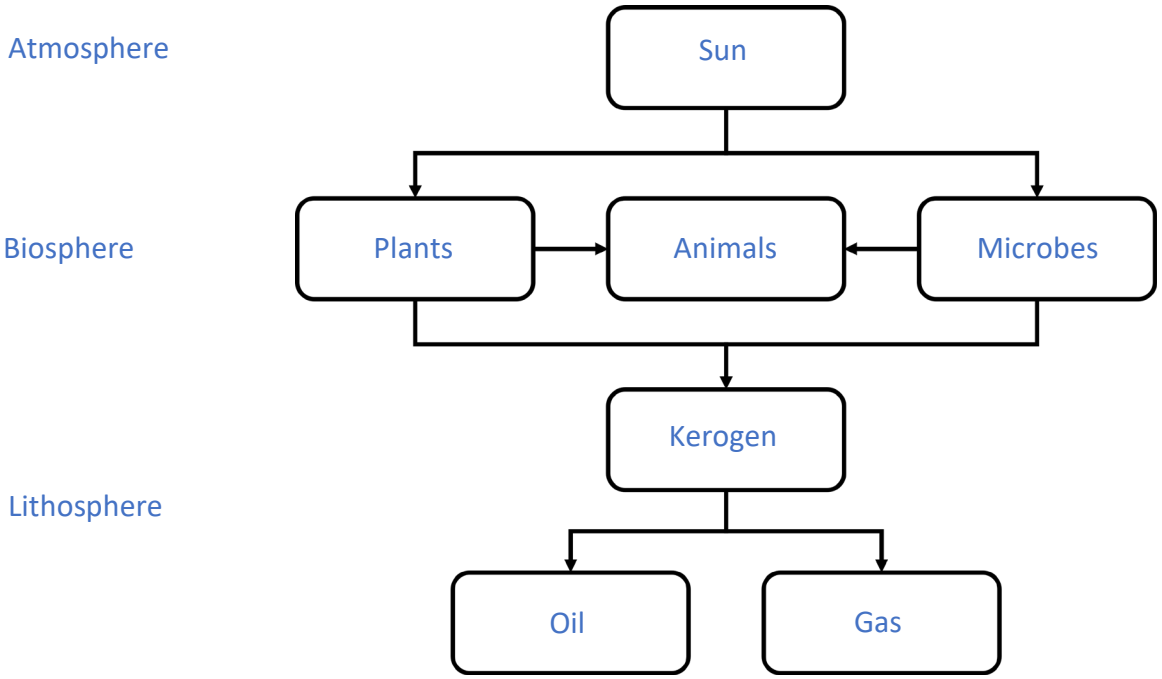


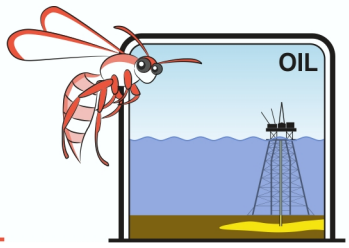
Complete the flowchart below showing the flow of energy using the information given above.

Extension: Add the words Atmosphere, Biosphere and Lithosphere



Interesting fact ***There are multiple different types of kerogens. Kerogen made of algae is more likely to turn into oil than gas, whereas kerogen made from plants is more likely to turn into gas.***

Environment	Kerogen Type		Origin	Hydrocarbon Potential
Aquatic	I	Algal/Sapropelic	Algae	Oil
	II	Planktonic	Plankton	Oil with some gas
Terrestrial	III	Humic	Pollen, leaves, spores	Gas
	IV	Residual	Oxidised woody debris	none



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Student Activity: It's a gas!

Aim: This fun experiment models the formation of hydrocarbons from plants and animals. Placing the materials in the bottle can be messy so old newspaper on desks or benches is a good idea. The gas produced is mostly methane.

This investigation can run for a few weeks, but gas formation is obvious in the first few days.

Materials

Bio-gas generator

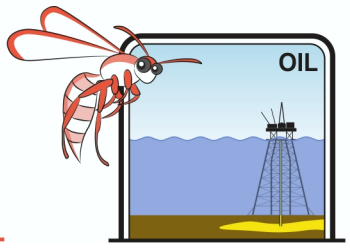
Bio-hazard label

Materials required per person or group:

- Newspaper to cover bench
- 2L plastic cool drink bottle *Tip: a cleaned, clear wine bottle works well to observe the changes*
- 1 large balloon (pre-stretched) or thin, soft rubber glove
- Strong sealing tape (gaffer or insulating) or rubber bands
- 5 shredded lettuce leaves (or any soft green plant)
- 1 tablespoon of tinned or fresh fish or any soft animal flesh *Tip: tinned tuna in spring water works well*
- Sand, soil and a funnel
- 1.5L pond water or water from drainage tray under plant pots

SAFETY NOTES

- Label bottle "DO NOT OPEN" with a biohazard symbol.
- Do not expose the equipment to open flame.
- Dispose of carefully after use.



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Method

1. Spread newspaper to cover the work area.
2. Using the funnel, place some sand in the bottom of the bottle
3. Add alternating layers of shredded lettuce, fish and sand to the bottle. Finish with a layer of soil.
4. Carefully add pond water to the bottle making sure to not damage the layers of organic matter and sand. *Tip: this can be achieved by using a 'rod' for the water to flow down or pouring down the side of the bottle.*
5. Inflate and deflate the balloon multiple times to ensure it is well stretched.
6. Fit the well-stretched balloon over the neck of the bottle and seal well with tape.
7. Create a biohazard label and tape it to the bottle.
8. Gently relocate the bottle to a warm place and watch the balloon slowly inflate with biogas over time.

Results

Days	Observations
0	

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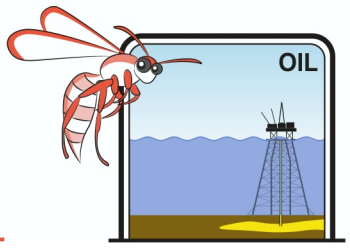


Discussion

What caused the balloon to inflate? Biogas

What was the source of this? The breakdown of organic material in the bottle

How can the results of this experiment be used to suggest alternative uses of garbage dumps? Separate organic material during processing to create biogases

Conduct some research to find where garbage is being used in this way.

a) Give the URL of your information source

_____

b) Give the location this is happening

_____

c) What is the gas used for?

_____

Why did we not create oil in the laboratory?

It'd be very hard to maintain optimal conditions for oil production

_____

Are oil and gas resources?

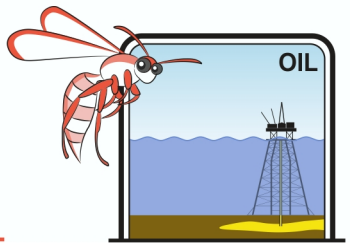
Yes

_____

Explain your answer

A resource is something that can be used. Hydrocarbons, like oil and gas, can be used for lots of different things such as energy production and machinery lubrication

_____



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With the aide of a diagram, explain the change that happens to the balloon

At first the there was no visible change to the balloon. However, after one day the balloon began to inflate. This is because as the organic material begins to decay it releases gases, such as methane. Eventually the balloon stops growing. This is likely because the balloon is made of rubber which has a natural elastic factor. This elasticity would result in an opposing force pushing down on the gases in the bottle, which can be compressed.

Diagram:

Note: Biogas can be generated relatively quickly, gas from kerogen takes millions of years to form (see above).

Interesting fact ***If rock containing oil and gas is raised closer to the surface, because of tectonic movements, the oil and gas will denature to a thick tarry bituminous mass due to the action of microbes. These are the tar pits, asphalt soaks and bitumen sources used by early humans.***