Deliver Change

Key Stage 3 (Year 7 & 8)
SCIENCE, BIOLOGY, CHEMISTRY

Lesson 2: "Global use of resources: The Air Pollution Edition"

Length of Lesson: 1 hour 15 minutes

National Curriculum in England, for teaching from September 2015
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381754/SECONDARY_national_curriculum.pdf *Chemistry page 63 & 64, Physics page 64, Geography page 92*

CURRICULUM

Chemistry
Earth and Atmosphere:
- Earth as a source of limited resources and the efficacy of recycling
- The composition of the atmosphere
- The production of carbon dioxide by human activity and the impact on climate.

CURRICULUM

Physics
Energy
- Fuels and energy resources

Energy changes and transfers
- Other processes that involve energy transfer: burning fuels..

CURRICULUM

Geography
Human and Physical Geography:
Understand how human and physical processes interact to influence, and change landscapes, environments and the climate; and how human activity relies on effective functioning of natural systems.

LESSON PLAN

Part 1. Start the lesson by describing how fossil fuels were formed and what such fuels may be (see teacher handout). Next, ask the class what they think coal, oil and natural gas are used for around the world. This section focuses on how humans are using fossils on global uses, including Europe, America, Asia and Africa.

Part 2: Here, students will learn about pollution in the atmosphere. To help students understand this, they can watch a video about the increasing production of air pollution, the product of burning fuels. The class is then asked to answer three questions about what they learnt in the video.

Students can take a look at the images provided to help them understand the formation of air pollution, its sources, transport, transformation, deposition and effects.

This is followed by asking the class a number of questions. Please write the four questions on the board or use power point slide:

1. What is your understanding of Air Pollution and of Air Quality?
2. Do you think the quality of air in your area is good or bad?
3. How do you know? What evidence is there to prove there is air pollution?
4. *Why do we need to talk about air quality?*

Guide the students to identify the importance of clean air. Explain that bad air can contribute to a variety of illnesses such as asthma and cancer.

Part 3: Depending on how much time there is, students can complete this task in class or at home as homework. Here students are asked to make a list of the pollutants they know, and to learn about the difference between primary and secondary pollutants.

LEARNING OBJECTIVES

- Students will know that fossil fuels are non-renewable sources of energy
- Students are introduced to the natural and human sources of air pollution
- Students will learn about the problem of air pollution and which pollutants to look out for.

LESSON REQUIREMENTS:

- White board
- Note book and pens
- Access to video weblink,
- Access to images: fossil fuels & pollution

Part 1

Teacher Handout and Notes

1. Fossil Fuels

Fossil Fuels are made of **organisms**. That means things that are alive, like plants and animals. But fossil fuels were formed in the past over millions of years.

The fuels might be:
- Coal,
- Oil
- (Natural) Gas
    - natural gas forms from the plants, animals, and microorganisms that lived millions of years ago.
    - Natural gas deposits are often found near oil deposits.

All three are found under the Earth's outer layer called the *crust*. Please see the images below for more information.
Humans gather the fossil fuels by digging them out of the ground and then use them for energy.

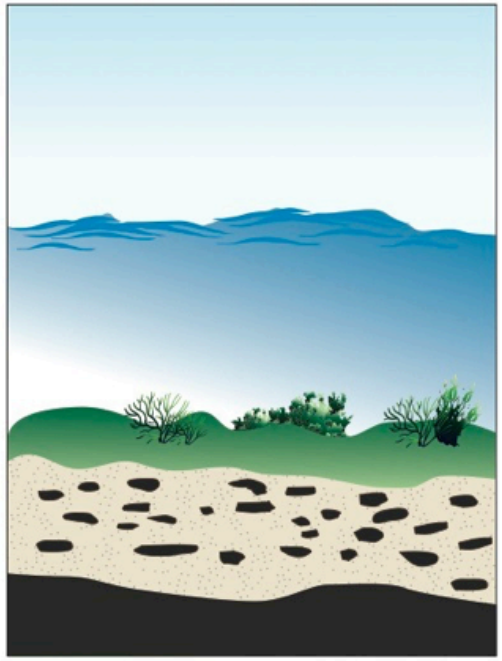
The problem with using fossil fuels is that they will run out! Because of this reason they are called **non-renewable** sources of energy. When they are gone, they are gone forever.

For this reason, it is very important for us to **recycle** a lot of the products that these non-renewable energy sources can transform into.

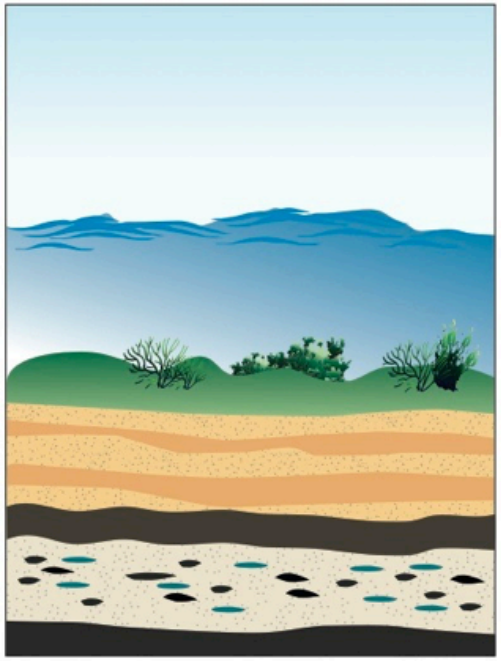
Ask the class: Which products are recycled in your household, and which products does the school recycle? Do you think that we recycle enough? Which products do you think are especially important to recycle?

Name .....

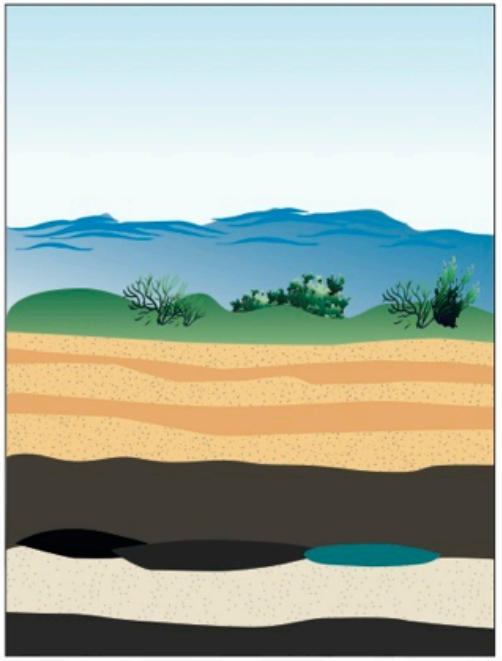
The Formation of Fossil Fuels



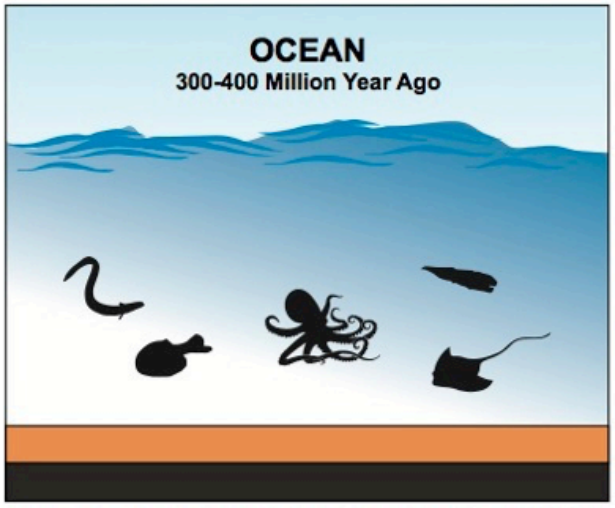
PART 1



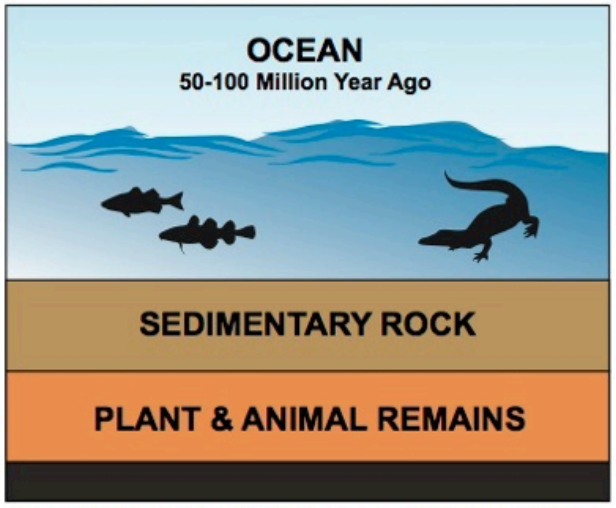
PART 2



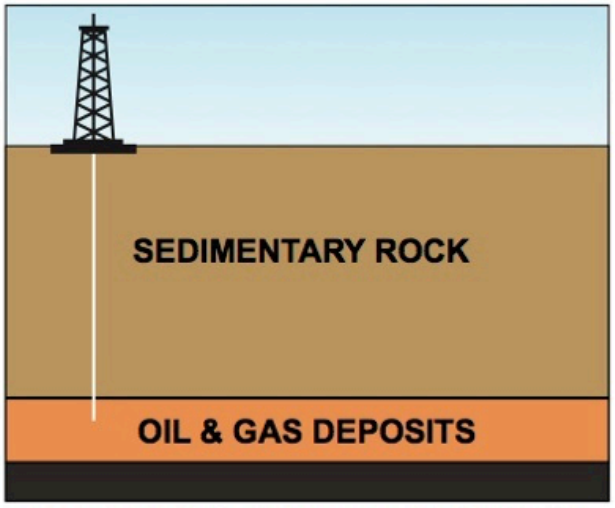
PART 3



Tiny sea plant and animals died and were buried on the ocean floor. Over time, they were covered by layers of sand and sediment, which turned into sedimentary rock.



Over millions of years, the remains were buried deeper and deeper. The emormous heat and pressure from inside the earth and the rock above turned them into oil and gas.



Today, we drill down thousands of feet through layers of sand and sedimentary rock to reach the rock formations that contain oil and gas deposits.

Please read the following descriptions of non-renewable energy, and answer the following questions for each box:

1. What type of products can be created from each fossil fuel?
2. Of these products, which do you and your family use on a day to day scale?
3. On a global scale, how much of each fossil fuel do we use?
4. When do you think the global availability of each fossil fuel will run out?

Oil

Oil, or Petroleum is used to create products, including: transportation fuels and fuel oils for heating and generating electricity, asphalt and road oil. Petroleum is also used as feedstocks, which is used to make chemicals, plastics, and synthetic materials. Think about how much plastic we use, meaning that this feedstock is found in nearly everything we use today.

Other, more unexpected, uses include the creation of soap panels, aspirin and chewing gum as well as lipstick!

About 74% of the 6.89 billion barrels of petroleum that we used in 2013 were gasoline, heating oil/diesel fuel, and jet fuel.

For more information on this please see link: http://www.livescience.com/24752-surprising-oil-uses.html.

Natural Gas

Today, natural gas is used in countless ways for industrial, commercial, residential, and transportation purposes.

In residential homes, the most popular use for natural gas is heating and cooking. It is used to power home appliances such as stoves, air conditioners, space heaters, outdoor lights, garage heaters, and clothes dryers.

Natural gas is also used on a larger scale. In commercial settings, such as restaurants and shopping malls, it is an extremely efficient and economical way to power water heaters, space heaters, dryers, and stoves.

Natural gas is used to heat, cool, and cook in industrial settings, as well. However, it is also used in a variety of processes such as waste treatment, food processing, and refining metals, stone, clay, and petroleum.

Natural gas can also be used as an alternative fuel for cars, buses, trucks, and other vehicles. Currently, there are more than 5 million natural gas vehicles (NGV) worldwide.

Source : http://education.nationalgeographic.co.uk/encyclopedia/natural-gas/

Coal

Coal has many important uses worldwide. The most significant uses of coal are in electricity generation, steel production, cement manufacturing and as a liquid fuel. Around 6.6 billion tonnes of hard coal and 1 billion tonnes of brown coal are used each year.

Since 2000, global coal consumption has grown faster than any other fuel. The five largest coal users - China, USA, India, Russia and Japan - account for 76% of total global coal use.

Different types of coal have different uses. Steam coal - also known as thermal coal - is mainly used in power generation. Coking coal - also known as metallurgical coal - is mainly used in steel production.

The biggest market for coal is Asia, which currently accounts for over 67% of global coal consumption; although China is responsible for a significant proportion of this. Many countries do not have natural energy resources sufficient to cover their energy needs, and therefore need to import energy to help meet their requirements. Japan, Chinese Taipei and Korea, for example, import significant quantities of steam coal for electricity generation and coking coal for steel production.

Other important users of coal include alumina refineries, paper manufacturers, and the chemical and pharmaceutical industries. Several chemical products can be produced from the by-products of coal. Refined coal tar is used in the manufacture of chemicals, such as creosote oil, naphthalene, phenol, and benzene. Ammonia gas recovered from coke ovens is used to manufacture ammonia salts, nitric acid and agricultural fertilisers. Thousands of different products have coal or coal by-products as components: soap, aspirins, solvents, dyes, plastics and fibres, such as rayon and nylon.
Source: http://www.worldcoal.org/coal/uses-of-coal/

Part 2

Fossil Fuel burning and the formation of Air Pollution

Another problem with using fossil fuels is that when they are burned they release pollutants into the air. These tiny bits of fuel are so small that humans cannot see them, but in some places we can see where lots of tiny bits have grouped together. Like the black soot on some buildings in the city, or the smog hanging over the city. This pollution can also cause problems for people who already have difficulties breathing, like those who have asthma.

Has air pollution been persistent?

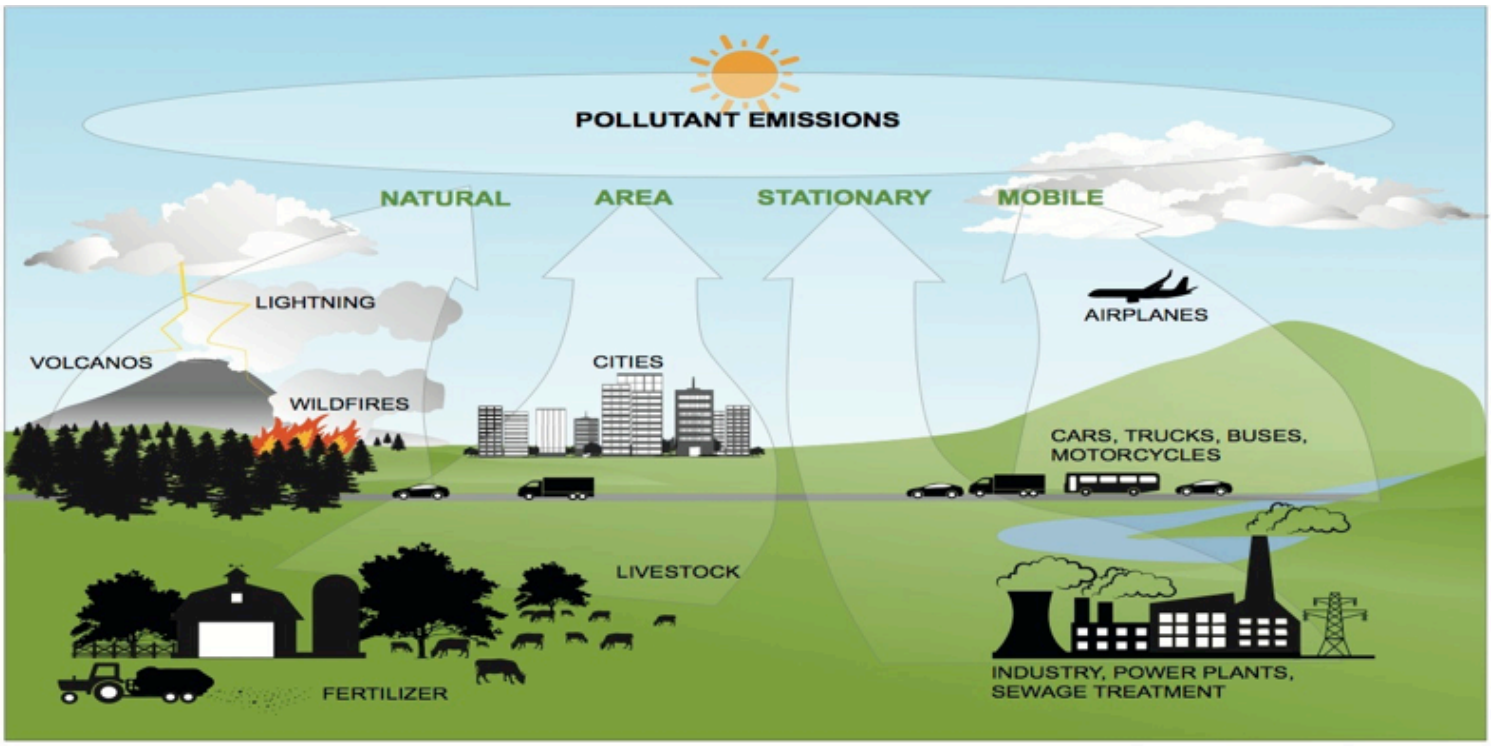
Air pollution has largely increased in the Earth's atmosphere due to human activity. We call these pollutants *anthropogenic,* meaning they are caused by man-made sources or activity.

However, the Earth has been around for far longer than human beings and long before we were here nature was pretty good at managing pollutants that were emitted from *natural* sources.

Nature was able to move particulate matter (the dust and dirt solids that pollute the air) through wind based dispersal and the water cycle was able to dissolve many substances, locking it away in the oceans or the ground. At the same time, nature also had plants at work, cleaning the air of carbon dioxide and replacing that with oxygen through the process of *photosynthesis* (more on that another time). Additionally, the wind caused the dispersal of gases to other areas of lower concentrations.

But it was the advancement of human society and the huge growth in urban living that lead

to the exhaustion of nature's own methods of pollution handling. There was suddenly too much pollution in the air for nature to cope with.



Sources of air pollution

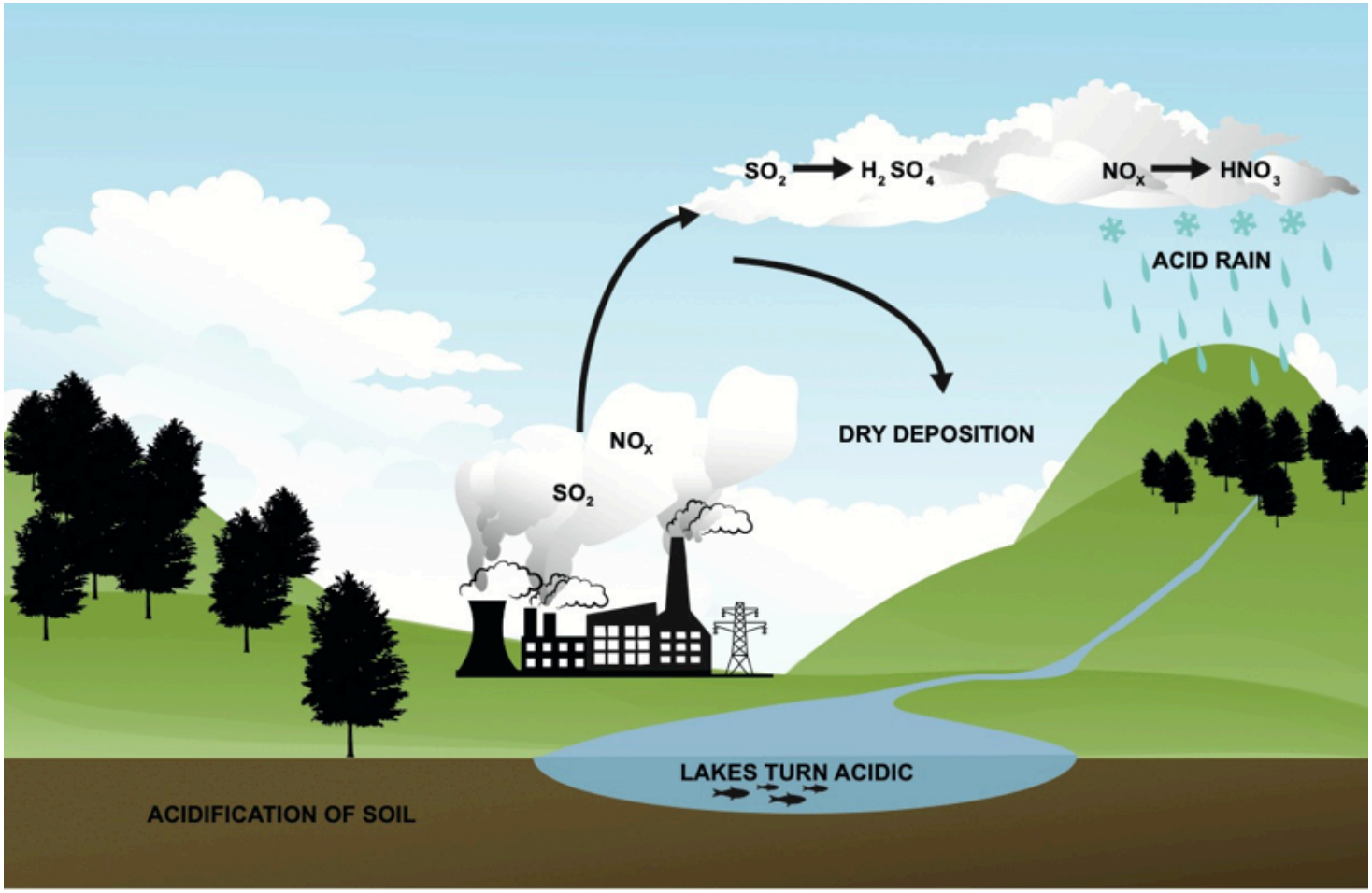
Q. Does anything surprise you about the diagram above? Are there any sources listed in the picture that you didn't expect? Can you think of any sources that are missing?

Watch this short video clip about the increasing production of air pollution from urban settlements around the world:
Video link here.

Q1. Describe what happens to the plumes of pollution including their direction of travel.
Q2. In your own words, describe what has happened on a global scale since 1901.
Q3. What do you predict will happen in the next 100 years unless something changes?

As you have seen in the earlier video, some forms of air pollution are a global risk. Though pollutants may be caused by anthropogenic or natural sources in one area, their effects may be felt in other areas as a result of being wind blown or by contaminating the environment. International cooperation is therefore essential for a resolution.

Some of the problem:



Part 3: in class or as a homework activity

Primary and Secondary Sources of Air Pollution - Students to complete in class, or as a Homework task

You have a couple of minutes to think about and list the pollutants you can think of. If you know, try to write the *source* of each pollutant, i.e. where the pollutant comes from.

Compare your list with your neighbour, or if you worked on your lists together, compare them with someone else.

With your lists we are now going to talk about *primary* and *secondary* pollutants.

Primary pollutants are those that are pumped directly into our atmosphere, such as carbon monoxide from car exhausts. Another example is sulphur dioxide, which is released during the combustion of coal, in fires or factories for example.

Secondary pollutants are those that are formed as a result of chemical reactions in the atmosphere. One example of this is ozone, which is formed when various pollutants, namely hydrocarbons (HC) and nitrogen oxides combine in the presence of sunlight. Another example is nitrogen dioxide, which is formed as nitrogen combines with oxygen in the air. Acid rain is a third example, which is formed when sulphur dioxide or nitrogen oxides react with water.