FOSSIL FUELS UNCOVERED

(1) What is a fossil fuel? The Oxford English dictionary defines a fuel as "a material, such as coal, gas or oil that is burned to produce heat or power". Most of the fossil fuels on Earth were created 300-400 million years ago. So "fossil" refers to old, but it also refers to actual fossils, meaning fossil fuels were created from the dead remains of ancient plants and animals. Contrary to popular belief, these fossil fuels are not the remains of dead dinosaurs. The first dinosaurs appeared 230 million years ago when most of the fossil fuel deposits on Earth were already created. How is it possible that ancient dead plants and animals were turned into coal, natural gas and oil (petroleum)? The answer to this question involves a bit of biology, a bit of geology and a bit of chemistry (biogeochemistry).

(2) Living things like plants and animals are made up mostly of six elements when they are alive. Carbon (C), hydrogen (H), oxygen (O), sulfur (S), phosphorus (P) and nitrogen (N). All forms of fossil fuels are made of hydrocarbons. This means that the processes that produce fossil fuels get rid of most of the oxygen, sulfur, phosphorus and nitrogen, and leave behind concentrated hydrogen and carbon compounds, which are very easily burned (combusted). Fossil fuel formation can only be accomplished given specific biogeochemical conditions.

(3) Though all fossil fuels can be burned, they don't all form in the same way or in the same locations. Natural gas (mostly methane gas – CH_4) and oil were formed in ancient oceans and lakes by the continual deposition of dead aquatic plants and animals, including phytoplankton and zooplankton. Unlike oil and natural gas, coal formed mostly on land in huge prehistoric swamps, wetlands and forests. The organic remains of coal come from trees, ferns and terrestrial plants. In most cases, when organisms died, they were eaten by other organisms like scavengers, and in other cases organic remains were rapidly broken down by decomposers like aerobic (requiring oxygen) bacteria. Only under certain conditions did organic remains turn into fossil fuels.

(4) The conditions that create all fossil fuels are similar. Whether on land or in the water,

organic remains need to be in low oxygen or oxygen free conditions. This prevents rapid decomposition of the remains by aerobic bacteria. In the oceans, as the dead remains built up and got covered by layers of sediment (rocks, sand and mud), the remains became buried hundreds or thousands of feet deep. This helped to create the high pressure, high temperature and low oxygen conditions needed to transform the remains to fossil fuels. On land, a similar transformation took place. The plant matter in the swamps, wetlands and forests got flooded by water and sediment and became buried. Again this created the high pressure, high temperature and low oxygen conditions necessary for coal to form on land.

(5) As the oil and natural gas formed, some escaped through small air pockets in the sediment and earth above, but some got trapped underground when they hit rock or clay that is impermeable. This impenetrable layer is called "caprock" and we find our gas and oil deposits under this layer. Some oil and natural gas is found on land because over time, ancient oceans dried up and filled with sediment to form land. The movement of the Earth's tectonic plates also shifted the surface of the planet so that some ancient sea beds lifted to the surface and now form land masses. Since a lot of natural gas and oil is still found in oceans, offshore drilling is common. It involves drilling a tunnel under the seabed in hopes of finding and extracting petroleum and natural gas. In April 2010, a huge offshore drilling oil rig called "Deepwater Horizon", owned by BP (British Petroleum), was drilling in the Gulf of Mexico when it exploded and sank causing the largest oil spill in history. It was one of over 200 offshore oil rigs in the Gulf of Mexico.

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(6) Unlike oil and natural gas that can seep through sediment layers, coal, once formed, is trapped under the earth. Coal is more accessible than the other fossil fuels, easier to obtain and the cheapest to harvest. For these reasons, coal was the first fossil fuel to be used widely, however, when burned, it is also the most polluting by far. Not only does coal release a lot of carbon dioxide (a greenhouse gas) when burned (as all fossil fuels do), coal often contains contaminants that cause it to release other forms of toxic pollution like sulfur dioxide and nitrogen oxide.

(7) Though fossil fuels are useful and we have designed our economies and societies to become dependent on them, this dependency comes with a huge environmental cost as burning of all fossil fuels lead to the production of greenhouse gases. The concern over anthropogenic (human caused) climate change is mounting and there's a larger cry from scientists, the public, environmental organizations and even some governments to "Keep It In The Ground". This slogan champions moving away from fossil fuel dependency to renewable resources of energy and a more sustainable way of living. Though some fossil fuels continue to be formed via the same processes that have been mentioned in ancient times, the rate of fossil fuel formation is so slow that fossil fuels are considered a non-renewable resource. We can't renew or regenerate it as quickly as we are using it up.

Article Questions

1) What are fossil fuels made from?

2) What is <u>one</u> main difference between the formation of oil (petroleum) and coal?

3) Why do organic remains need to be in anaerobic conditions for fossil fuel formation to occur?

4) Besides anaerobic conditions, what other conditions need to be present for fossil fuels to form?

5) Why is coal the most widely used fossil fuel?

6) Though fossil fuels have been and are still very useful for providing us with heat and energy, they can produce serious problems. List <u>three</u> problems that were discussed in this article.

7) What do you think "Keep It In The Ground" actually means?