**Geo summary chapter 2 earth**

**Section 2. Planet earth.**

The ***universe*** consists of countless stars of which our sun is one. ***Planets*** revolve around our sun; these are cold spheres that are heated and lit by the sun. Compared to other starts, the distances in our solar system are short. Nevertheless, they are still so long the light of the sun takes 8 minutes to reach the earth. The earth is most similar to its neighbouring planets Venus and Mars. All three are roughly *the same size, consists of the same material, are similarly structured and are relatively close to the sun*. There are also differences, the conditions on Venus and Mars make any form of live impossible. The crust of the 3 planets also differs. The earth consists of 2 types of crusts: ***the ocean floor*** and ***the continents***. Because the ocean floor consists of the volcanic rock known as ***basalt***, which is heavy, this part of the earth’s crust is on average 4000 metres lower than the crust of the continents. The continental crust consists of lighter rocks, such as ***granite*** and ***sedimentary rocks.***

All rocks formed from the remains of plants and animals are called ***organic sedimentary rocks***.

CO2  was absorbed from the atmosphere during the life of these plants and calcium animals. This changed the composition of the atmosphere. Large amounts of CO2 are now stored in the earth’s crust due to the formation of rock. As such, enormous quantities of organic sedimentary rock is formed and it is now believed that the atmosphere of the earth consisted largely of CO2 in the past.

**Section 3. The face of the earth is changing.**

620 million years ago the ***Precambrian***:

The continents have an entirely different shape and position. The atmosphere contains more CO2 and less oxygen than it does now. Because there is no ozone layer, the harmful ultraviolet radiation can reach the earth. This is way organisms can only live below the water. The surface of the earth is completely barren. Almost no fossils are found of the organisms that live in this era, because they do not yet have any hard tissues.

270 million years ago the ***Permian***:

The seas are inhabited by a large variety of fish, molluscs and animals with shells, such as trilobites. The earth’s surface is grown with plants and trees. As a result, the oxygen concentration in the atmosphere increased strongly. Apart from plants, the land is inhabited by many different types of reptiles. The continents form one large super continent called Pangaea. Its enormous size means that a large part of the inland is dry as bones and has a desert climate where wind is given free reign. Only the borders of Pangaea have any influence from the sea.

100 million years ago the ***Cretaceous***:

The continents are separated from each other. This period is probably the hottest on earth and the sea level is 300 metres higher than its now. Many different species live in the seas, including ammonites, a squid with a striking shell that floated in the sea water. The calcium skeletons of algae amass at the sea floor and form thick layers of limestone. On land, the dinosaurs rule supreme. There now also plants that have flowers.

18000 years ago the ***Quaternary***:

The continents have reached their current position. A large ice cap covers the north of Europe and North America and the sea level is 100 metres lower than its now. On the tundra’s south of the land ice, mammoths and sabre-toothed tigers roam.

**Section 4. The diary of the earth.**

***Fossils*** end up in the rock. Rocks and the fossils embedded in them provide a lot of information about the past, about what it looked like and what the climate was. Rock was formed because layers of sand or clay have been deposited over each other. The lowest layer was formed earlier than the layer on top of that. Different conclusions can be drawn from these stacked rocks and the fossils contained in it:

1. The life on earth first consisted of only bacteria. New life forms formed in the following order: molluscs – crustaceans – fish – land plants – reptiles -mammals. This development is called the ***evolution of life***.
2. The different plants and animal species did not live in all eras. Many went extinct, because the conditions on earth changed.

When you do not know when layers where formed you do know in which order they were formed this is called the ***relative age***, the age with respect to each other.

You can determine how long ago the rock was formed based on the amount of radioactivity, this called ***absolute age***.

**Section 5. A coming and going of species.**

In our solar system, ***meteorites*** are circling between the planets. 65 million years ago the earth collided with a meteorite about 10 kilometres in diameter. The force of this impact was so big that it created a ***crater***. Part of the rocks from the crater and that of the meteorites were flung into the atmosphere as debris. This caused a lethal bombardment in a very large area. Another part of the rock became dust in the atmosphere. A part of the dust was sulphuric, causing acid rain. Upon impact, so much energy was released that the temperature rose to 1000 degrees celcius. Forests caught fire and animals were burned alive. Evidence for this was provided by the rocks again:

1. Everywhere on earth there is a thick layer of clay consisting of the substance iridium. This substance comes from meteorites.
2. In rocks older than 65 million years, there are fossils of dinosaurs and ammonites.
3. The crater in Yucatan is dated at 65 million years.

**Section 8. Fuel from the depths.**

The ground sometimes contains resources, such as coal and natural gas that is retrieved from the earth’s crust, because its useful to humans. In the ***carboniferous*** Europe was located around the equator and was one big tropical swamp. Dead plants ended up below the water and did not decay. That thick layer of undecayed plants formed ***peat***. The Netherlands is part of a subsiding area that also includes the bottom of the North Sea. It concerns a ***subsiding area*** when an area is filled with sediments transported there by rivers and seas. If the ground would have subsided faster, the plant residue would have disappeared into the sea. If the subsidence would have been slower, the dead plants residue would have would have decayed. The ***coalification process*** starts under high pressure and at high temperature. This process first changes peat into brown coal and subsequently into ***coal***. After the formation of coal, the temperature in the ground increases under the influence of magma, ***diamond*** or ***graphite*** can be formed from carbon. During the coalification process, water and ***natural gas*** are pressed from the plant residue. The natural gas finds its way up and first ends up in the sediment layer above the Carboniferous, after which its usually disappears into the air. During the Permian, a layer of sand was first deposited with an impenetrable layer of salt on top of that. This rock salt held back the gas. The gas is still stored in the pores of the sandstone layers. The porous rocks that store a resource are called ***reservoir rocks***. The rock in which the gas was formed is called the ***parent rock***. Sometimes, the rocks lie at the surface and can be dug using digging equipment. This ***open-pit mining*** results in the formation of a giant pit. If the rocks are located at a depth of around 300 metres, a vertical shaft is first dug. Horizontal tunnel networks are then dug from this shaft. This ***shaft mining*** is expensive as well as dangerous and unhealthy for the miners.

**Section 9. The black gold.**

Most ***crude oil*** on the planet was formed in the Triassic, Jurassic and Cretaceous. In those periods, there were shallow seas that were home to a lot of microorganisms. When these tiny plants and animals died, they floated to the bottom of the sea where they formed thick layers. This took place in subsiding areas. The depth at which there is a suitable temperature is called the ***oil window***. Together with crude oil, natural gas is often also formed. This gas is called ***associated gas*** or ***wet gas***.

We use a lot of crude oil. The biggest chance of dinging crude oil is in the areas that have met the following conditions: large amounts of plankton, sedimentary layers, right temperature, movement of the parent rock, a reservoir rock with sufficient amounts of open spaces and a covering rock that does not allow oil to permeate it. Oil extraction started on the land but nowadays there is a lot of off-shore extraction. This means that the oil is extracted at sea on the ***continental shelf***. This is a part of the sea bottom that borders a continent and that’s not deeper than 200 metres. If there is gas above the oil and there is pressure from water underneath the oil that rises when the oil is extracted. This situation is ***called gas*** cap or ***water drive***.

**Section 10. Filthy rich.**

Coal, brown coal, crude oil and natural gas are ***fossils fuels*** because they were formed from millions of years old plant and animal remains. Every mine and every oil or gas field reaches a maximum at a certain point after which the yield decreases. In the oil industry, this maximum yield is called ***peak oil***. It is difficult to say at which time peak oil will be reached in the world. ***Conventional oil and gas*** is oil and gas that has moved to reservoir rock after formation in the parent rock. However, it turns out oil and gas is also stored in the parent rock. This is called ***unconventional oil and gas***, which is much harder to extract. For instance, there is gas in ***shale*** that is very common in the Dutch soil. When extracting conventional oil and gas, vertical drilling is required. For unconventional oil and gas, you need to be able to drill horizontally into the rock layer containing the fuels. To release oil and gas, the rock must then be fractured. This is done using a technique called ***fracking***. A mixture of water, sand and chemicals is sprayed into the rock under high pressure which causes fractures. Together with the oil and gas, the water and chemicals are pumped back up, but chemical substances will remain in the ground.