



Carbon, Climate, and Energy Resources

Module 4. Fossil Fuel Formation

Activity 4. The Origin of Oil — Student Worksheet

Directions: Cut the statements on the paper below into strips and organize them into the correct chronological order of how petroleum forms.

Oil floats on water, and gas is even lighter than oil, so petroleum and natural gas move upward within the reservoir rock until they are stopped by an impermeable sedimentary layer such as shale, which forms a **trap**. **A**

The crude oil is transported to a **refinery**, where it is separated by distillation and other processes into fuels such as gasoline, butane, kerosene, liquid petroleum gas, jet fuel, diesel fuel, fuel oil, and chemicals used to manufacture plastics. **B**

Over time, layer upon layer of marine sediments accumulate, containing the remains of planktonic organisms. **C**

With even more heat and pressure, the hydrocarbons are broken down into **petroleum** (oil) and **natural gas**. **D**

As the planktonic organisms die, their remains begin to settle to the sea floor under anoxic conditions (without oxygen). **E**

Wells are drilled into the ground in the oil field to extract the petroleum, which is called **crude oil**. **F**

The story of oil and gas begins with planktonic organisms living in the ocean (or in lakes). **G**

With the high temperatures and pressures of greater depth of burial, the kerogen begins to change into **hydrocarbons**. **H**

More and more petroleum and natural gas accumulate and become concentrated in the trap, forming an **oil field**. **I**

The petroleum and natural gas migrate into porous and permeable sedimentary rocks such as sandstone, which serves as a petroleum **reservoir** rock. **J**



Thick sequences of sediments are deposited, and the planktonic organisms buried in them are heated and compressed until the organic matter begins to change into **kerogen**, a solid, waxy organic material. **K**

Zooplankton eat phytoplankton (algae) that use the Sun's energy to produce organic matter and energy through photosynthesis. **L**

Geologists use various tools, such as seismic surveys, to study Earth to locate oil fields beneath the ground. If a location seems promising, drilling may begin. **M**

Once you have completed organizing the statements above regarding petroleum formation, determine where **tar sands**, **oil shale**, and **shale gas** fit into the sequence.

Oil shale is sedimentary rock containing **kerogen** that has not been heated enough within Earth to change the kerogen into hydrocarbons. Oil shale can be mined, but it must be subjected to a high temperature before petroleum-like liquids can be separated from the rock.

Tar sands (sometimes called oil sands) form when oil moving upward within a reservoir of porous, permeable sand is not stopped by an impermeable sedimentary layer. Oil begins to escape from the sand at the surface, and is biodegraded by oil-eating bacteria, causing the oil to become highly viscous asphalt or tar called **bitumen**. Tar sands can be mined and processed with hot water to separate the bitumen from the sand.

Shale gas forms in organic-rich black shales where extremely deep burial and extremely high temperatures have broken petroleum down into natural gas (methane). Shales have low permeability, so to extract the methane gas, it is necessary to create artificial fractures. Wells are drilled to thousands of feet deep, and then drilled horizontally along the shale bed. High-pressure fluids and sand are injected to hydraulically fracture the shale, releasing the trapped methane gas (fracking).