Oil Products

**Age group**

12-14 years old (KS3, S1-2)
14-16 years old (KS4, S3-4)

**Curriculum focus**

Science

**Learning objectives**

Students will:
- name some key stages in the formation and extraction of oil and some key products of crude oil
- complete simple practical tasks to: explain in simple terms how oil can naturally be released from a reservoir, due to pressure; how this can lead to blow-outs; and how to build basic hydrocarbon models based on the carbon chain structure
- optionally list some positive and negative points about building a new oil refinery, the groups that might express these and their reasons why.

**Time needed**

90 – 110 mins

**About this activity**

- This activity uses hands-on activities to take students through the journey of oil from extraction (upstream operations) to refining (downstream operations).
- Students first watch a slide presentation about the story of oil and its formation deep underground.
- They then complete two practical activities that simulate how oil is forced from the ground by the pressure of the rocks that surround it, and how if not controlled, this pressure can cause a blowout.
- They use the ideas that arise from these activities to improve their mental models of how oil reservoirs function due to underground pressure.
- Students then discuss their ideas for how oil is transformed into the many products that we use today. They are shown the basic hydrocarbon chain structure using molecular models and then explore hydrocarbon structures by creating and identifying their own long-chain molecules from grapes and cocktail sticks.
- To place oil refining and the importance of the products of oil in a wider context, students can optionally use a role-play to explore some of the views that can affect the location of an oil refinery.
What you will need

Note: Your Area Coordinator should be able to supply you with most of these.

- Oil products box
- Fractional distillation poster
- Molecule model kit
- Red/green grapes or black/green olives (10 – 20 of each colour per pair or group of three)
- Cocktail sticks (one box per pair or group of three)
- Oil-soaked shale
- Pieces of sandstone
- Sample of crude oil substitute
- Student workbooks (one set per student)
- Role Cards (optional - one set per group of 8 – 10 students)
- Presentation slideshow
- Kitchen roll
- Kettle or source of hand-hot water*
- Paper and pencils*
- Projector or interactive whiteboard

Per student group:

- Transparent tank or deep tray*
- Sponge (standard size for car washing / home use, each with a hollow cut into one face, 3cm dia. x 1cm deep)
- Bowl or saucer*
- 2 x weights (each 1kg) *
- Cooking oil
- Curved teat pipette*
- Flexible rubber/plastic tube*
- Large transparent beaker*
- Glass or clear plastic funnel (small enough to fit in beaker when inverted)*
- Rubber bung (to fit in the end of the funnel – you can substitute with sticky tack or modeling clay, or even students’ fingers)*

*the school may be able to provide these
**Timings and structure**

**90 - 110 mins**

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*optional activity

**Deliver the activities**

**Introduction and Q&A (5 mins)**

**Introduce yourself and the topic of oil.**

1. Introduce yourself and what you do at BP. Explain that you’re going to help students learn more about oil, from when it formed millions of years ago to how it’s extracted and processed today.

2. Use slide 2 to review what will happen during the session.

**Activity 1: Why is oil so important? (10 mins)**

**Find out what students already know about oil and the things that are made from it.**

1. Ask students to suggest or explain what BP does as a business. Expand on their answers and use slides 3 - 5 to illustrate how BP is an ‘energy business’ that also invests in renewable sources of energy: biofuels, solar electricity and wind power.

2. Make it clear that oil is still fundamental to the business and reframe this by asking students why oil is so important to their lives today: what oil products are around them or have they used today?

3. Gather and discuss ideas, which should include plastics and fuels.

4. Use slide 6 to emphasise that without liquid fuels, which are a compact and transportable form of stored energy, modern transport could not exist (developing batteries with the same energy density as petrol is the main expense and limitation on electric cars, for example).

**Prior knowledge and preparation**

- Find out if the school can provide sets of the equipment indicated on the list above.
- It is helpful if students are familiar with the idea of molecular models that show atoms and bonds using balls and sticks.
5. Draw students’ attention to ‘hidden’ products of oil: use slide 7 to show that this includes ingredients in cosmetics, toiletries, medicines and even food ingredients like ethanoic acid (for vinegar and pickles).

6. Explain that students are going to find out more about how oil formed and how BP gets it from thousands of metres underground.

Activity 2: How do we get oil from the ground? (20 - 30 mins)

Take students through the story of oil and the work of BP Exploration and use a practical task to discover how oil is stored under pressure.

1. Begin by asking students if they know how oil first formed, and when. Use slides 8 - 12 to take students through the story of oil. Explore an oil system in more detail and explain porous rocks and traps (dispel many students’ misconception that an oil reservoir is a cave filled with oil).

2. How does BP find oil? Talk students through the main stages in locating petroleum systems and establishing production, using slides 13 – 17.

3. Demonstrate rock porosity (or let students try this) by dripping water onto sandstone to see how it is absorbed. (With time, you could try to saturate the rock and explain that by understanding the rock structure, BP can estimate how much crude oil a given volume of rock might contain.) Introduce the word ‘permeable’ and link this idea to the sponges you will use next.

4. Read through page 1 of the student workbook, using slide 18 to help you. You may want to demonstrate the activity in a ‘dry run’ (without oil and water) before students have a go.

5. Students complete the ‘Pores and pressure’ activity. Refer to the background notes (see separate PDF). These provide practical tips and how to explain how the experiment is a model of a petroleum system.

6. Suggested questions:
   - What does the sponge represent?
   - What do the weights represent?
   - Why are we using warm water and not cold?
Activity 3: What is a blowout? (10 - 20 mins)

Students build on their understanding of the model petroleum system and explore.

1. Remind students (or tease out using questions) that the previous activity worked because the ‘rocks’ are under pressure. Ask them to predict what this might make happen when the reservoir is first opened up (e.g. the drill penetrates the trap rocks and enters the porous oil-containing rock)?

2. Discuss briefly the idea of blowouts and how these were common in the early days of oil exploration.

3. Read through page 2 of the student workbook, using Slides 19 - 20 to help you. You may want to demonstrate the activity in a ‘dry run’ (without oil and water) before students begin.

4. Students complete the ‘Blow out!’ activity. When needed, refer to the Background PDF for guidance.

5. Suggested questions:
   - What does the air represent?
   - Why does the oil go where it does, at first?
   - What’s stopping the oil escaping?
   - What happens when the bung/clay/finger is removed, and why?
   - Why might a blow-out be a hazard?

7. Explain that, today, the chance of a dangerous ‘blow out’ is reduced by pumping thick drilling mud down the borehole and by fitting valves, called blow out preventers, around the top of the hole.

Activity 4: How do we turn oil into products? (20 mins)

Students find out about fractional distillation and make hydrocarbon models.

1. Explain that crude oil is not very valuable in the form that it comes out of the ground. Ask students why this is (it’s not a useful product). Use slides 21 - 23 to explain how crude oil is a mixture of molecules of different lengths. Use the molecule model kit to show the basics of long-chain hydrocarbon structure. (If time permits you could also demonstrate a ring molecule.)

2. Show the slides 24 - 25 (and / or the poster) and show examples from the oil products box. Discuss how they are different (e.g. viscosity) but don’t ask for reasons yet.

3. Ask students if they can explain how BP might separate the different hydrocarbons into each fraction.

4. Ask students to imagine two cardboard boxes – one with 50 pieces of short string and the other with 50 long pieces. Which would be quicker to separate? Build on this analogy and explain that taking longer represents the fact that it takes more heat energy to separate long chains than short ones. Use this to clarify that the fractionating column is hottest at the bottom, where long molecules are separated, and coolest at the top, where small molecules separate out. Return to your oil product samples and show that the viscosity is an indication of chain length.
5. Show slide 26 and challenge students to use page 3 to draw, label and then construct their own hydrocarbon molecules out of grapes or olives, using cocktail sticks for the bonds. Make sure they attach hydrogen atoms to each carbon atom as per slide 23: each carbon atom needs to have four bonds to other atoms.

6. Students can then take turns trying to identify which fraction another group’s model represents.

7. Emphasise that all this is done to create the most value from crude oil. Since each type of crude oil differs, it’s not possible to refine the same amounts of each product from every crude. But each refinery is set up to process each fraction to best meet regional demand for each type of product. (With more able students you could discuss cracking and use the molecular model to demonstrate.)

Activity 5: Should we have a refinery? – optional extension (20 - 30 mins)

Optionally, students role-play or discuss some of the issues that might be aired if BP unveiled plans for a new refinery, enabling a discussion of how we may or may not be prepared to accept some of the consequences of our appetite for the products of crude oil.

1. Show slide 27 and ask students what they think of the photo. Briefly discuss the fact that we all want the products of crude oil, but processing it isn’t possible without large refineries like this.

2. Set the scene that BP wants to build a refinery in the area and that there has been a mixed reaction from local residents.

3. Split the class into groups of 8 – 10 and assign roles at random, using the Role Cards. Use page 4 to briefly review the scenario and each role.

4. Give students 5 – 10 minutes to make notes on how they might represent their role and think of arguments for or against. Circulate between groups to help stimulate ideas.

5. Announce an ‘open meeting’ to discuss the planned refinery (choose whether to do this as a role-play or as a discussion, and whether to run it as a whole group, or to leave students in their groups and then convene to share and reflect).

6. Appoint a chair (or act as one) and allow each role, in turn, to have their say. Allow a few minutes for questions or counter arguments after each role, or after everybody has spoken.

7. Discuss the sentiments and arguments that emerge. Optionally, let the class (as themselves) vote for or against a new refinery and discuss the implications of the outcome (e.g. if nobody allowed refineries, we wouldn’t have any oil products like plastics or fuels).

Round up (5 mins)

1. Thank students for listening.

2. Ask general questions to review what students have learned about the story of oil and how it is refined into the products that we value.

3. Wish students well for the future and remind them to put their learning into practice – BP recruits geologist, scientists and engineers to make every stage of this process possible.