QER for Schools

# QER Chemistry Lesson – Year 12

# Fractional distillation of crude oil

NOTES

The QER New Fuels Development Centre and oil shale mine at Yarwun near Gladstone is dedicated to the creation of low sulphur oil from shale to produce diesel and jet fuels. The secret to unlocking these and other fuels from oil is the process of fractional distillation. In this lesson, you will create your own miniature petroleum refinery.

In this lesson, students will:

- perform fractional distillation as a practical experiment
- investigate the organic chemistry of alkanes and its effect on boiling points

## LESSON-LEVEL CONTENT DESCRIPTIONS

### Queensland Chemistry Syllabus: Year 12

Key concept S2 – Materials can be categorised and represented symbolically, and their macroscopic properties can be explained and predicted from understandings about electronic structure and bonding.

Key Idea S2.2 – The macroscopic properties are related to their microscopic and atomic properties.

- the properties of solids, liquids and gases using the kinetic particle theory and relating the theory to phase changes

## LESSON OUTCOMES

The assessment focus of this lesson is formative: The classroom activities provide an opportunity for students to generate evidence with which the teacher can establish the student's progress towards understanding the concepts that are being developed in this lesson.

| Science Outcomes | Literacy Outcomes | Numeracy Outcomes |
|---|---|---|
| Students may/should be able to: | | |
| • perform fractional distillation as an experimental investigation | • listen<br>• read<br>• view<br>• write<br>• speak<br>• create print materials<br>• crate visual materials<br>• discuss scientific phenomena<br>• document scientific phenomena<br>• hypothesise about speculative ideas<br>• use technical terms in a scientific context | • measure practically<br>• collect data<br>• represent data<br>• interpret data<br>• measure using formal units<br>• collect qualitative data<br>• analyse data |

## BACKGROUND INFORMATION

Distillation is an advanced laboratory activity and students should be experienced in the use of laboratory apparatus and laboratory safety before commencing this activity.

Background knowledge:

- vapor pressure
- boiling points
- intermolecular forces
- molecular weight
- molecular chain length
- chemical formulae of common hydrocarbons

## PREPARATION LIST

- QER 3D animation video
- short video from the QER web site: www.qervisitorcentre.com.au -> Turning oil shale into fuel
- copy handout: Year 12 Chemistry Experimental Investigation: Fractional Distillation of Crude Oil
- prepare equipment for experiment:
  - safety glasses and aprons
  - bunsen burners
  - heatproof mats
  - round bottom distilling flasks with side arm
  - thermometers (0–360°C)
  - retort stands and clamps as required to secure all apparatus
  - rubber stoppers
  - condensing tubes
  - hoses for cool water delivery to condensing tube
  - conical receiving flasks
  - bent delivery tubes
  - boiling chips
  - teat pipettes for delivering crude oil substitute to distilling flask
  - "hard glass" (borosilicate) watch glasses
  - wooden splints
  - crude oil substitute. It is not permitted to use real crude oil as it contains more than 0.1% benzene, which is carcinogenic. It may be desirable to add a low boiling point fraction (such as cyclohexane) to obtain a fraction below 70°C

## DURATION

| | |
|---|---|
| Lesson 1 | Introduction |
| Lessons 2 & 3 | Experiment |
| Lessons 4 & 5 | Questions and report writing |

## ACTIVITY SEQUENCE

1. Introduce the QER New Fuels Development Centre and oil shale mine so as to set the context for fractional distillation of crude oil. There are a number of resources which you may like to incorporate into this introduction:

   - view the full QER 3D animation video
   - view the short video from the QER web site: www.qervisitorcentre.com.au –> Turning oil shale into fuel
   - talk through the PowerPoint Presentation: Paraho Process Presentation

NOTES

2. Introduce the activity Year 12 Chemistry Experimental Investigation: Fractional Distillation of Crude Oil by leading a discussion around the background outlined on the first page. Depending on the prior knowledge of students, it may be necessary at this point to recap the necessary background information.

3. Discuss safety considerations as outlined on page 3 of Year 12 Chemistry Experimental Investigation: Fractional Distillation of Crude Oil.

4. Have students draw up their data table prior to commencing the experiment (as per step 4 of the procedure).

5. Students conduct the experiment in groups.

6. Students complete the questions and write a formal report.

NOTES

**OPPORTUNITIES FOR CONDUCTING FORMATIVE ASSESSMENT**

- Observation of practical skills while conducting the experiment
- Understanding of fractional distillation and organic chemistry through marking formal written reports

## LINKS TO OTHER LEARNING AREAS

The following suggested activities may be used to provide a link between the content of this unit and that of other learning areas, in particular those related to Mathematics, English and ICT.

- use of word processing software to present written report.

## ADDITIONAL RESOURCES

- www.qervisitorcentre.com.au – Extensive overview of QER New Fuels Development Centre, including video snippets, animations, graphs, maps and explanations relating to:
  - Australia's fuel challenge
  - QER and sustainability
  - benefits for Australians
  - turning oil shale into fuel
- Oil Shale fact sheet www.oresomeresources.com/resources_view/resource/fact_sheet_oil_shale
- PowerPoint Presentations:
  - Paraho Process Presentation
  - QRC Oresome Resources – Formation of Oil Shale – Parts 1 and 2
- flow diagram The Paraho Process – Illustrative Process Flows