

## Topic

A value chain is a series of events that takes a raw material and with each step adds value to it. In the petroleum industry, the value chain is divided into three parts:

- Upstream
- Midstream
- Downstream

## Objective

Students will gain an overall picture of the sequence of processes that make up the petroleum industry value chain. Students will learn about the exploration, production, refining, and chemical manufacturing of oil and gas by exploring and researching each part of the value chain.

## Materials

- *Oil and Natural Gas* books
- 15 large sheets of paper (poster sized post it notes)
- Copies of the following for each student, which are provided at the end of this lesson plan:
  - Exit Exam
  - Grading Rubric
  - Student Scoring Rubric
  - Useful Web Sites.

## National Science Education Standards

### Science as Inquiry Content Standard A

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

### Earth and Space Science Content Standard D

- Structure of the Earth system

### Science and Technology Content Standard E

- Abilities of technological design
- Understandings about science and technology

### Science in Personal and Social Perspectives Content Standard F

- Risks and benefits
- Science and technology in society

### History and Nature of Science Content Standard G

- Science as a human endeavor
- Nature of science
- History of science

**Reading topics** are also included.

## Engagement

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How long do you think you could live without your cell phone? Without computers? Take about 2-3 minutes to list your morning routine. List 6 to 10 things you use from the time you wake up until you arrive to school. Now, look over your list and see which of the materials you listed would be possible without petroleum products.

## Exploration

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### Value Chain Scavenger Hunt

- Split students into 14 groups (One for each chapter in the *Oil and Natural Gas* book pages 20-47)
  1. Natural Gas p. 20-21
  2. Unconventional natural gas p. 22-3
  3. Oil Traps p. 24-25
  4. Solid Oil p. 26-27
  5. How Oil is found p. 28-29
  6. Advanced technology p. 30-31
  7. Getting the oil out p. 32-33
  8. Deep sea drilling p. 34-35
  9. Deep water technology 36-37
  10. Piped oil p. 38-39
  11. Oil on the ocean p. 40-41
  12. Refining Oil p. 42-43
  13. Energy & Transportation 44-45
  14. Materials from Oil p. 46-47
- Each team must find information about the topic of the page number assigned to their group.
- Teams prepare a chart on poster paper with the following information:
  - Title of their assigned section and page numbers
  - Which part of the value chain it represents
  - Three facts
  - Illustrations
- Each team takes about 2 minutes to share their posters and report their findings to the class. Hang posters around the room.

Tell the class that in the petroleum industry the sequence of processes used in oil production is called a value chain. A value chain is a series of events that takes a raw material and with each step adds value to it. In the petroleum industry, the value chain is divided into three parts: upstream, midstream and downstream. Upstream is the process of finding and extracting crude oil from the ground. Midstream is the process of transporting and storing petroleum. Downstream is the process of refining crude oil into sub-products that can be used for various functions, marketing and distributing refined products to consumers.

- Review the charts shared by the students and discuss which part of the value chain they represent.

Teachers - Refer to the *Oil and Natural Gas* book. Pages 20-24 will be used as an introduction and explanation of where oil comes from.

Pages 25-28 "Oil Traps," "Solid Oil," and "How oil is found" are Upstream.

Page 30 on "Advanced technology" and page 42 "Refining Oil" are Midstream.

## Explanation

Teachers can present this lesson within their individual classroom as a research project or classes can work together as a collaborative team. For example, in working with other classrooms: Science class (Biology, Earth Science or Geology) would do the Upstream research, Math (Geometry) would do the Midstream research and English would do the Downstream research. The classes would share presentations with other classes. This could be made into a contest if you wish. The team that wins the competition in each classroom would be the team to share with other classes. If a teacher wanted to do the research within their own class, the Upstream, Midstream and Downstream would be assigned to a group of students to work together as a team. The teams would then present their findings to the class.

Teams of 4 or 5 will work corroboratively to complete this project. Your research should include the following:

- A 3-page typed research paper that includes the LA guidelines. (You may want to have a certain number of required sources to be cited, bibliography etc.)
- A PowerPoint presentation to the class that explains the research - (Hand out the grading rubric)
- A poster illustrating the main findings of your research

Each teammate should contribute equally to each part of the assignment. The project will be partially graded on teamwork and each member's contribution to the team.

The group presentations will serve as the explanation to each portion of the petroleum value chain.

## Evaluation

The evaluation will be based upon the research paper, the PowerPoint presentation and the poster. It will also include the following Exit Exam questions:

1. List and briefly describe the three parts of the petroleum value chain.
2. List 5 petroleum products we use every day.

## Elaboration

Ask students to prepare a statement on what they think is the most important product created from crude oil and the reasons why. List the answers of each student's opinion. Debate the choices. For example, which is more important: diesel fuel to ship goods, gasoline for personal transportation, medicines, or plastics for heart valves?

## Grading Rubric for Presentation Project

Grade	Content	Organization	Originality	Workload
4	Project covers the topic in-depth with many details and examples. Subject knowledge is excellent.	Content is very well organized and presented in a logical sequence.	Project shows much original thought. Ideas are creative and inventive.	The workload is divided and shared equally by all members of the group
3	Project includes essential information about the topic. Subject knowledge is good.	Content is logically organized.	Project shows some original thought. Work shows new ideas and insights.	The workload is divided and shared fairly equally by all group members, but workloads may vary.
2	Project includes essential information about the topic, but there are one or two factual errors.	Content is logically organized with a few confusing points.	Project provides essential information, but there is little evidence of original thinking.	The workload is divided, but one person in the group is viewed as not doing a fair share of the work.
1	Project includes minimal information and there are several factual errors.	There is no clear organizational structure, just a compilation of facts.	Project provides some essential information, but no original thought.	The workload is not divided, or several members are not doing their fair share of work.

# The Petroleum Value Chain



Exit Questionnaire

SECONDARY STUDENTS

Name: \_\_\_\_\_

## Questions

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1. List and briefly describe the three parts of the petroleum value chain.

2. List 5 petroleum products we use every day.



### Student Scoring Rubric for Team Members

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Name: \_\_\_\_\_

Name of report: \_\_\_\_\_

#### Score for group members:

- 4 = This member completed all of their workload
- 3 = This member completed the majority of their workload
- 2 = This member completed some of their workload
- 1 = This member did not do their work, thereby creating extra work for other members

List all members of your group below. Put a score by each member's name that you feel they deserve. Be sure to include your name and the score for yourself. Feel free to add any comments you think will be helpful.

### Useful Websites

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Energy4me - Essential Energy Education provided by the Society of Petroleum Engineers  
[www.energy4me.org](http://www.energy4me.org)

Society of Petroleum Engineers  
[www.spe.org](http://www.spe.org)

Captain Offshore Platform Virtual Tour  
<http://resources.schoolscience.co.uk/SPE/index.html>

A child's visit to an offshore oil rig  
[www.mms.gov/mmskids/explore/explore.htm](http://www.mms.gov/mmskids/explore/explore.htm)

EnergyZone, provided by UK's Energy Institute  
<http://www.energyzone.net/>

Facts, games, and activities about energy, plus links  
[www.eia.doe.gov/kids/index.html](http://www.eia.doe.gov/kids/index.html)

A US Department of Energy site about fossil fuels  
[www.fossil.energy.gov/education/index.html](http://www.fossil.energy.gov/education/index.html)

A comprehensive guide to oil refining  
[www.howstuffworks.com/oil-refining.htm](http://www.howstuffworks.com/oil-refining.htm)

Shell's Energy Minds for students  
[http://www.shell.us/views/energy\\_minds.html](http://www.shell.us/views/energy_minds.html)

Basic geology, how oil forms, and how it is found  
[www.priweb.org/ed/pgws/index.html](http://www.priweb.org/ed/pgws/index.html)

All about fuel cells, Smithsonian Institute  
[americanhistory.si.edu/fuelcells/basics.htm](http://americanhistory.si.edu/fuelcells/basics.htm)

The Alliance to Save Energy's kids site  
[www.ase.org/section/\\_audience/consumers/kids](http://www.ase.org/section/_audience/consumers/kids)

Plenty of links on the topic "Recycle, Reduce, Reuse"  
[42explore.com/recycle.htm](http://42explore.com/recycle.htm)

The US's National Institute of Environmental Health Sciences site on recycling and reducing waste  
[www.niehs.nih.gov/kids/recycle.htm](http://www.niehs.nih.gov/kids/recycle.htm)

How Oil Drilling Works  
[www.Howstuffworks.com/oil-drilling](http://www.Howstuffworks.com/oil-drilling)

EIA Report on Demand  
US Energy Information Administration  
[www.eia.doe.gov/oiaf/ieo/oil.html](http://www.eia.doe.gov/oiaf/ieo/oil.html)

The Outlook for Energy - A View to 2030 ExxonMobil  
[www.exxonmobil.com/Corporate/energy\\_outlook.aspx](http://www.exxonmobil.com/Corporate/energy_outlook.aspx)

Energize Your Future Shell  
<http://www.shell.com/us/energizeyourfuture>

Students' page from American Geological Institute  
[www.earthsciweek.org/forstudents/index.html](http://www.earthsciweek.org/forstudents/index.html)