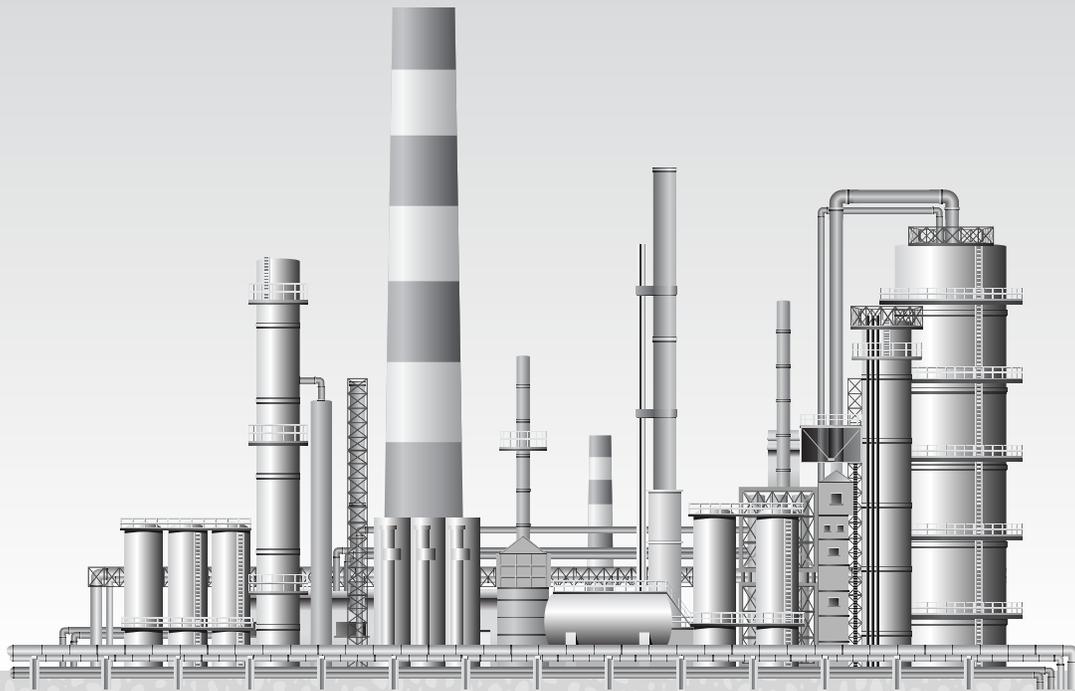


OILSANDS FIELD TRIP

Teacher's Guide
Grades 7-9



The logo for 'Inside education' features the word 'Inside' in a large, stylized font with a sun icon above the 'i'. Below it, the word 'education' is written in a smaller, simpler font.

WELCOME TO AN OIL SANDS FIELD TRIP!

Why an educational resource on oil sands?

Oil sands development in Northern Alberta is significant to our province. From economic contributions, to job creation, to the energy and petroleum products Albertans use everyday; the impact of the oil sands is far-reaching.

With so much attention given to Alberta's oil sands, information can sometimes be confusing or overwhelming. This video series aims to provide science background and current information that is student friendly and encourages critical thinking.

What is included in this resource?

Oil Sands Field Trip DVD

This video series provides students in *grades four through nine*, background information on oil sands recovery and development. The DVD contains four video segments, each approximately five minutes in length, covering key topics related to the oil sands.

Video 1: What are the oil sands? - Explains the composition of oil sands, how they formed, where they are found and shows how bitumen can be extracted from oil sand.

Video 2: Mining - Provides a history of oil sands mining projects, outlines the steps involved in mining and introduces tailings.

Video 3: In situ - Presents an alternative method for extracting bitumen from deep reserves through SAGD (Steam Assisted Gravity Drainage).

Video 4: Meeting the challenges - Proposes concerns and solutions to oil sands' production, striking a balance between energy and environmental needs.

Teacher's Guide

This teacher's resource includes:

- **Student Worksheets** contain questions that focus on key concepts presented in the videos - Page 3
- Student Worksheet **Answer Keys** - Page 11
- **Extension Activities** that encourage students to further their knowledge of the oil sands - Page 13
- A **Glossary** of important terms and definitions - Page 15
- **Additional Resources** that support oil sands education - Page 16

STUDENT WORKSHEETS

VIDEO 1: WHAT ARE THE OIL SANDS?

1. What are the two substances that cover sand particles, making up the oil sands?

W _____

B _____

2. Order the events to show how oil sands were formed.

| Order (1-5) | Event |
|-------------|--|
| | Plants are buried by layers of sediment. |
| | Oil is gradually soaked up into sandstone. |
| 1 | Millions of years ago Alberta is covered in swamp. |
| | Bacteria consumes lighter oil, leaving bitumen behind. |
| | Heat and pressure transform plants into oil and natural gas. |

3. Fill in the Blanks.

First Nations boiled the oil sands to make _____ for their _____.

4. Place a check mark beside the areas where the oil sands are found in Alberta.

| | | | |
|-----------|--|-------------|--|
| Athabasca | | Peace River | |
| Calgary | | Lethbridge | |
| Jasper | | Cold Lake | |

5. Circle the answer that correctly completes the sentence.

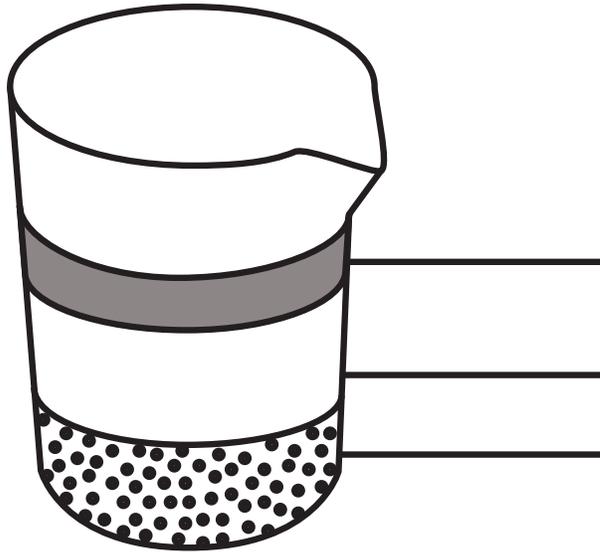
It is predicated that bitumen could meet Canada's energy needs for the next ____years.

- a) 100
- b) 500
- c) 750

6. What is added to oil sands to separate the bitumen from the sand?

- a) Hot Water
- b) Cold Water
- c) Compressed Air

7. In the **extraction plant**, the three main components of the oil sands are separated. Label the beaker with the names of the components and the order in which they would separate in the extraction plant.



8. Making bitumen into a useable product involves two steps. Fill in the blanks to describe where the steps occur using the following two words: **upgrader, refinery**
- At an _____, immense heat and pressure are used to break down bitumen into a liquid called Synthetic Crude Oil.
 - At a _____, oil is converted into gasoline, diesel, and other petroleum products.

VIDEO 2: MINING

1. What percentage of bitumen can be mined from the surface? _____
2. Create an oil sands timeline by matching the date to the event.

DATE

Early 1900's

EVENT

Huge deposits of conventional oil are found and interest in the oil sands fade.

1925

Scientists and engineers explore ways to **separate bitumen** from oil sands.

1940's

Conventional oil supplies decline, **demands for energy rise** and oil sands are revisited.

Today

Karl Clark extracts bitumen by mixing oil sands with hot water.

3. Demonstrate the process used to mine oil sands by filling in the blanks using the words below.

overburden

trucks

crushers

hot water

shovels

extraction

- a. The first step in mining oil sands is to remove the soil and vegetation, which is called _____.
- b. Next, power _____ scoop up the oil sands and load them into large _____.
- c. The oil sands are transported to _____ which break up any large oil sands chunks.
- d. The broken up oil sands are then mixed with _____ and fed into a pipeline.
- e. The mixture is transported to the _____ plant where the bitumen separation process takes place.

4. What is the name of the water mixture that contains bitumen, water, sand and clay and is stored in large artificial ponds? _____

5. If left on their own, tailings ponds will take many decades to settle.

True or False

6. Companies working in the oil sands use different techniques to keep wildlife away from tailings ponds. List the two techniques that were given in the video:

a.

b.

VIDEO 3: IN SITU

1. Oil sands found deep underground can be extracted using in situ techniques. The word *in situ* is Latin for ____ _____.
2. Complete the words below to name a common method used during in situ operations.

____team

____ravity

____ssisted

____rainage

3. Match the terms on the left with the process on the right to describe how SAGD operates.

SAGD Equipment

Process

Wells

Injects steam, which heats the oil sands and softens the bitumen.

Upper Well
(Steam Injection Well)

Water and impurities are removed here.

Lower Well
(Production Well)

These are drilled into the oil sands formation, one on top of the other.

Processing Facility

Collects the liquid bitumen and pumps it to the surface.

4. To create the steam required for SAGD, the energy primarily comes from burning _____.
- a) Coal
 - b) Natural Gas
 - c) Wood
5. What happens to the water that is used in the SAGD process? (*Circle the best answer*)
- a) Water isn't used in SAGD
 - b) Waste water is injected into underground formations
 - c) The water can be recycled
 - d) Answers b and c
6. Many SAGD operations use _____ groundwater that can't be used for drinking or agriculture.
7. Not all of the bitumen found in deep oil sands can be extracted using SAGD.
Complete the fractions to show how much bitumen is left behind. /4 to /4

VIDEO 4: MEETING THE CHALLENGES

1. Why is the demand on Alberta's oil sands to provide energy for Canada going to increase in the future?
 - a) Supplies of regular crude oil are shrinking
 - b) Oil sands are a cleaner burning fossil fuel
 - c) More products can be made from the oil sands
2. The video states *"we have to find ways to balance the energy needs of our society with the environmental needs of our planet."* Use the words below to complete the statements describing the processes that try to minimize the impact of oil sands operations on the environment.

fire reclaim bacteria salty enzyme

- a. In situ operations use _____ water instead of fresh water for their operations.
- b. Researchers are trying to find ways to get _____ and _____ to break down bitumen instead of using heat and pressure.
- c. Rather than using steam to heat bitumen, some in situ operations pump air into the oil sands and then light the air on _____ to liquefy the bitumen.
- d. Before an oil sands project can begin, the project must include a plan that outlines how the oil sands company is going to _____ the land once the bitumen is extracted.

3. When the oil sands are reclaimed, they have to support healthy and productive ecosystems.
True or False.
4. The oil sands provide _____ of jobs for Canadians.
- a) hundreds
 - b) thousands
 - c) millions
5. List three of the four careers that the oil sands industry generates as mentioned in the video?
- a. _____
 - b. _____
 - c. _____

STUDENT WORKSHEETS ANSWER KEY

Video 1: What are the oil sands?

1. Water
Bitumen
2. **2, 4, 1, 5, 3**
3. **tar** for their **canoes**
4. **Athabasca, Peace River, Cold Lake**
5. **b) 500**
6. **a) hot water**
7. **bitumen** (top), **water** (middle), **sand** (bottom)
8. 1. **upgrader**
2. **refinery**

Video 2: Mining

1. **20%**
2. **Early 1900's** - Scientists and engineers explore ways to **separate bitumen** from oil sands.
1925 - **Karl Clark** extracts bitumen by mixing oil sands with hot water.
1940's - **Huge deposits** of conventional oil are found and interest in the oil sands fade.
Today - Conventional oil supplies decline, **demands for energy rise** and oil sands are revisited.
3. a) **overburden** b) **shovels /trucks** c) **crushers** d) **hot water** e) **extraction**
4. **tailings**
5. **true**
6. **noise-making cannons, scarecrows**

Video 3: In situ

1. **in place**
2. **S**team
Assisted
Gravity
Drainage
3. **Wells** - These are drilled into the oil sands formation, one on top of the other.
Upper (Injection) Well - Injects steam, which heats the oil sands and softens the bitumen.
Lower (Production) Well - Collects the liquid bitumen and pumps it to the surface.
Processing Facility - Water and impurities are removed here.
4. **b) natural gas**
5. **d) Answers b and c**
Wastewater is injected into underground formations
The water can be recycled
6. **saline**
7. **1/4 to 3/4**

Video 4: Meeting the challenges

1. **a) Supplies of regular crude oil are shrinking**
2. a) **salty** b) **bacteria** and **enzymes** c) **fire** d) **reclaim**
4. **true**
5. **b) thousands**
6. **researchers, scientists, environmental specialists, truck drivers**

EXTENSION ACTIVITIES

Understanding the Issues

The video highlighted some of the opportunities and challenges associated with oil sands development in Alberta. Encourage discussion of the issues by setting up a debate in your classroom. Inform the students that an oil sands company is proposing to develop a mining or SAGD operation near their community. A town hall meeting will be held where all interested stakeholders can voice their support or concerns for the development. Possible stakeholder groups include:

- Representatives from an oil sands company
- Local government
- Provincial government
- Aboriginal groups
- Environmental groups
- Local community members

Heating the Oil Sands

Oil sands companies face different challenges when accessing, transporting and processing bitumen due to its high viscosity. Set up an experiment with your class that will help students recognize that technologies like SAGD use heat to access the bitumen in the oil sands. Using the scientific process, ask the students to answer the following question:

How does temperature affect the viscosity of a fluid?

The students will use molasses to simulate bitumen and pour it down an inclined plane to find its flow rate. Have students make a prediction, record their observations and discuss their findings.

| Trial | Fluid | Temperature | Estimated Time (seconds) | Actual Time (seconds) |
|---------|----------|------------------|--------------------------|-----------------------|
| Trial 1 | Molasses | Room Temperature | | |
| Trial 2 | Molasses | Chilled | | |
| Trial 3 | Molasses | Heated | | |

Science and Innovation

Research plays a large role in the petroleum industry, especially when it comes to the oil sands. In groups, students examine one current research project involving oil sands. Ideas include: bird deterrent systems, toe-to-heel air injection, carbon capture and storage, co-generation, the use of saline water, using microorganisms to reduce toxins in tailings ponds or other projects. Each group could present their results to the class through a poster, newspaper article, jeopardy game, newscast, scrapbook, etc., addressing the who, what, where, and why of their story.

Alberta's Changing Landscape

The video stated that the oil sands have the potential to meet Canada's energy needs for the next 500 years. Compare the map from the video to one that illustrates Alberta's towns and cities. As a class, point out communities located close to oil sands operations. Using quality of life indicators (ex. health, education, safety, housing, jobs, environment) discuss the different ways that quality of life may change in those communities as the oil sands are developed. Have students record their ideas in a table format.

| Before Oil Sands Operations | During Oil Sands Operations |
|---|---|
| <ul style="list-style-type: none">••• | <ul style="list-style-type: none">••• |

Energy Dialogue

Energy is required to transform natural resources into products that people can use. The video states; "it takes energy to make energy from the oil sands." Encourage students to think critically about this statement. Guide class discussion using the following prompting questions.

- What sources of energy are being used to develop the oil sands?
- Where is energy used in the oil sands? What stages of oil sands production require energy?
- Why would oil sands' companies be interested in reducing the amount of energy they use?
- Do you think its worth the energy used to produce the oil sands?
- Where do you think energy could be conserved when developing the oil sands?

Petroleum Products and Stewardship

From the video, we learned that oil sands are refined into gasoline, diesel fuel and other petroleum products. Split the class into groups and assign each group a product that is made from the oil sands (a list is provided below). Have each group research the life cycle of the product from manufacturing to disposal followed by a discussion of stewardship and incorporating the 4 R's (Reduce, Reuse, Recycle, Repair).

List of Petroleum Products: Fuel for heating buildings, Fuel for transportation, Asphalt, Carpet, Auto parts, Toothpaste, Crayons, Sneakers, Styrofoam cups, Garden hose, Laundry detergent, Candles, Basketballs, Bicycle tires, Fleece sweaters, Linoleum floors, Plastic water bottle, Bandages, Lipstick, Balloons, Plastic Bags

Oil Sands Sample

If you would like to have an example of oil sands in your classroom, Oil Sands Chemistry Kits (containing samples) can be purchased from the:

Oil Sands Discovery Centre
515 Mackenzie Blvd. Fort McMurray, Alberta T9H 4X3
Phone: (780) 743-7167 Toll Free: 310-0000
www.oilsandsdiscovery.com

GLOSSARY

Bitumen - a thick, sticky form of unconventional oil found in oil sands. It is similar in consistency to molasses at room temperature.

Conventional crude oil - liquid oil, produced by drilling wells and pumping it to the surface.

Crusher - a machine that receives oil sand from the mine, breaks up lumps and removes rocks.

Environmental monitoring - the process of checking, observing and measuring the environmental quality of the air, land and water.

Extraction - the processes involved in separating bitumen from the oil sands.

Heavy hauler - the largest trucks in the world. They are used to transport the oil sand from the mine to the processing facility. They can carry up to 400 tonnes of oil sand.

In-situ - a Latin term meaning "in place." It describes the method used to recover deeply buried bitumen deposits.

Oil sand - grains of sand surrounded by a layer of water and film of bitumen.

Open-pit mine - an open hole, dug for the purpose of extracting natural resources.

Overburden - the topsoil and vegetation that sits on top of an oil sands deposit.

Petroleum products - useful materials derived from refining crude oil.

Reclamation - the process of returning the disturbed landscape back to a healthy, productive ecosystem.

Refinery - the facility where impurities are removed and oil is converted into gasoline, diesel and other petroleum products.

SAGD - an in-situ method that uses steam injection to heat and separate the bitumen from the oil sands. Once the bitumen is more fluid it can be pumped to the surface.

Synthetic crude oil - the product derived from upgrading bitumen at a processing facility. It has a similar density and viscosity to conventional crude oil.

Tailings - the wastewater left over from the extraction process; containing sand, clay and traces of bitumen.

Upgrader - the facility where heat and pressure are used to break down bitumen into synthetic crude oil.

ADDITIONAL RESOURCES

www.canadaoilsands.ca

Producers of the oil sands respond to concerns related to the environmental and social impacts of developing unconventional oil. This website provides a forum for discussion, current news articles and updates on innovations and technology.

www.capp.ca/oilsands

The Canadian Association of Petroleum Producers represents and supports companies involved in the oil and natural gas industry. This website contains extensive information and short video clips answering many questions about oil sands development.

www.centreforenergy.com/

The Centre for Energy represents a diverse group of energy stakeholders. They partner with organizations to explore energy and environmental issues and to develop educational resources.

www.oilsands.alberta.ca

This Government of Alberta website is a comprehensive source for oil sands information. The Oilsands Information Portal is a valuable resource focusing on the cumulative effects of oilsands development

www.oilsandsdevelopers.ca

The Oil Sands Developers Group works in cooperation with multiple interest groups to address issues related to oil sands development. On this site you will find fact sheets, current project information and an interactive map of the oil sands region.

www.oilsandsdiscovery.com

The Oil Sands Discovery Centre is an educational facility whose goal is to increase awareness and appreciation of the oil sands industry. Oil sands samples and other teaching tools can also be found here.

www.pembina.org/oil-sands

The Pembina Institute aims to find practical, multi-stakeholder solutions to energy and environmental issues. On this Oil Sands Watch website, you will find fact sheets and report summaries that provide an environmental perspective on oil sands.

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