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. Fill in the missing letters to show what oil sands are made of.

   w __ __ r
   s __ __ d
   b __ __ u __ __ n

2. Order the events from 1 to 5 to explain how oil sands were formed millions of years ago.

   Plants are buried by layers of sediment.  Oil is soaked up into sandstone.  Alberta is covered in swampland.  Bacteria consumes lighter oil leaving bitumen behind.  Heat and pressure transform plants into oil and natural gas.

   __________  4  1  __________

3. In the past, First Nations people used bitumen for waterproofing _________.
   a) teepees
   b) snowshoes
   c) canoes

4. Complete the location names on the map to show where oil sands are found in Alberta.

   __ thabasca
   __ eace __iver
   __ old __lake
5. It is predicted that bitumen could meet Canada’s energy needs for the next _____ years.
   a) 100
   b) 500
   c) 800

   One method of extracting bitumen from oil sands is to add ________________.
   a) hot water
   b) cold water
   c) warm air

6. During the extraction phase, oil sands separate into three main parts. Label the beaker to show the layers that form.

   Word Bank:
   water    sand    bitumen

7. Turning bitumen into something useful requires two steps: upgrading and refining.

   a) Fill in the blank. First, bitumen is upgraded into a cleaner, runnier liquid called synthetic ________________ oil.

   b) At the refinery, oil is made into many useful products. Place a check mark beside any thing that can be produced from bitumen.

   □ vegetables         □ diamonds
   □ gasoline           □ diesel fuel
   □ petroleum products □ paper
VIDEO 2: MINING

1. Complete the chart to show what fraction of bitumen is MINEABLE at the surface.

   \[
   \frac{4}{5} \quad \text{MINEABLE} \\
   \text{NOT MINEABLE}
   \]

2. Create a timeline of oilsands formation by matching the date to an event.

<table>
<thead>
<tr>
<th>DATE</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early 1900's</td>
<td>Huge deposits of conventional oil are found and interest in the oil sands fade.</td>
</tr>
<tr>
<td>1925</td>
<td>Scientists and engineers explore ways to separate bitumen from oil sands.</td>
</tr>
<tr>
<td>1940's</td>
<td>Conventional oil supplies decline, demands for energy rise and oil sands are revisited.</td>
</tr>
<tr>
<td>Today</td>
<td>Karl Clark extracts bitumen by mixing oil sands with hot water.</td>
</tr>
</tbody>
</table>
3. Demonstrate the process used to mine oil sands by filling in the blanks using the words below.

<table>
<thead>
<tr>
<th>WORDBANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
</tr>
<tr>
<td>extraction</td>
</tr>
<tr>
<td>soil</td>
</tr>
<tr>
<td>trucks</td>
</tr>
<tr>
<td>sand</td>
</tr>
<tr>
<td>crushers</td>
</tr>
</tbody>
</table>

a. First, the __________ and vegetation called overburden is removed.

b. Next, power shovels scoop up the oil sands and load them onto big ______________.

c. The trucks carry the oil sands to the ________________, which break up any large chunks.

d. The oil sands are mixed with hot __________ and travel by pipeline to the extraction plant.

e. Along the way, the bitumen begins to separate from the _______________ and minerals.

f. The separation process continues in the _________________ plant.

4. Circle the word that best completes each sentence.

Waste materials that are left over from mining oil sands are called  ______________. They are placed into large artificial ponds.

a) tailings
b) garbage
c) overburden

If left untouched, tailings will take many __________ to settle.

a) years
b) decades
c) centuries

5. Companies working in the oil sands use different methods to keep wildlife away from tailings ponds. List the two methods that were suggested in the video:

a. 

b. 
VIDEO 3: IN SITU

1. Oil sands found deep underground can be extracted using *in situ* techniques. 
   In Latin, the word *in situ* means _____ ____________

2. Complete the words below to identify a common method used during in situ operations. 
   _S_ team 
   ___ ssisted 
   ___ ravity 
   ___ rainage

3. Fill in the missing words to describe the process of SAGD.

   **Word bank:** 
   steam 
   bitumen 
   water

   **STEP 1:**
   The upper well injects ___________ to heat oil sands.

   **STEP 2:**
   The lower well pumps up ___________ and water.

   **STEP 3:**
   The processing facility removes _______ and impurities.
4. To create steam required for SAGD the energy primarily comes from burning ______________.
   a) coal
   b) wood
   c) natural gas

5. What happens with the water after it is used in the SAGD process? (Check all that apply).
   - Water is recycled and used over again
   - Water isn’t used in SAGD
   - Water is put into Tailings Ponds
   - Water is injected deep underground

6. 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

7. Fill in the blank to complete the sentence.
   Researchers are constantly working to make the in situ process more productive and reduce its impact on the ___________________________.  
1. Circle the answer that correctly completes the sentence.
   In the future, it is expected that the demand for Alberta's oil sands will ____________.
   a) increase
   b) decrease
   c) stay the same

2. Complete the words on both sides of the scale to show which needs must be balanced when considering oil sands operations.

   E__er__y
   needs of our society

   E__vir__n__en__al
   needs of our planet
3. Use the words below to complete the environmental statements.

<table>
<thead>
<tr>
<th>WORDBANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>gas</td>
</tr>
<tr>
<td>tailings</td>
</tr>
</tbody>
</table>

a. Fresh ____________ is precious. We simply can’t waste it.

b. Eventually, researchers hope to clean up ____________ as quickly as they are produced.

c. Finding ways to reduce energy saves money and reduces greenhouse ____________ emissions.

d. Researchers believe they have found ____________ and enzymes that will digest bitumen.

e. Before any new oil sands project begins, it must include a plan for reclaiming the ____________.

4. Circle the word that correctly completes the sentence.
The oil sands industry provides jobs for ____________ of Canadians.

   a) hundreds
   b) thousands
   c) millions

5. Place a check mark beside all of the jobs that are directly related to oil sands development.

   □ environmental specialist
   □ dentist
   □ author
   □ truck driver
   □ hairdresser
   □ researcher

Can you think of any others? ________________________________
STUDENT WORKSHEETS ANSWER KEY

Video 1: What are the oil sands?

1. Water, Sand, Bitumen
2. 2, 4, 1, 5, 3
3. c) canoes
4. Peace River, Athabasca, Cold Lake
5. b) 500
   a) hot water
6. bitumen (top), water (middle), sand (bottom)
7. a) synthetic crude oil
   b) gasoline, diesel fuel, petroleum products

Video 2: Mining

1. MINEABLE – 1/5
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. 1) soil 2) trucks 3) crushers 4) water 5) sand 6) extraction
4. a) tailings
   b) decades
5. noise-making cannons, scarecrows
Video 3: In situ
1. in place
2. Steam
   Assisted
   Gravity
   Drainage
3. The upper well injects steam to heat oil sands.
   The lower well pumps up bitumen and water.
   The processing facility removes water and impurities.
4. c) natural gas
5. Water is recycled and used over again
   Water is injected deep underground
6. 1/4 to 3/4
7. environment

Video 4: Meeting the challenges
1. a) increase
2. Energy, Environmental
3. a) water b) tailings c) gas d) bacteria e) land
4. b) thousands
5. environmental specialist, truck driver, researcher
EXTENSION ACTIVITIES

From Toothpaste to Balloons
From the video, we learned that oil sands are refined into gasoline, diesel fuel and other petroleum products. To help students recognize their connection to these products, have them tally how many times in the past week they used each of items listed below.

List of Petroleum Products: Toothpaste, Crayons, Sneakers, Styrofoam cups, Garden hose, Laundry detergent, Candles, Basketballs, Bicycle tires, Fleece sweaters, Linoleum floors, Plastic water bottle, Bandages, Lipstick, Balloons

<table>
<thead>
<tr>
<th>Products Made from Petroleum</th>
<th>Number of Uses this Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toothpaste</td>
<td></td>
</tr>
<tr>
<td>Crayons</td>
<td></td>
</tr>
<tr>
<td>Sneakers</td>
<td></td>
</tr>
<tr>
<td>Etc...</td>
<td></td>
</tr>
</tbody>
</table>

The Conservation Situation
Oil Sands are a non-renewable resource; they cannot naturally replace themselves within our lifetime. Since there is a fixed supply of these resources, it is important to conserve and take care of them. We can do this by reducing the number of petroleum products we use everyday. As a class, discuss ways you could help reduce the amount of petroleum being used when:
- making your lunch
- traveling to school
- giving a gift to a friend
- Etc. . . .

Bird’s Eye View
To visualize the size and scope of oil sands operations in Alberta, check out http://www.baseloc.com/dls. Use the satellite images to prompt a comparison discussion of oil sands mining with SAGD development.

Follow the directions below to locate oil sands sites in Alberta.

1. Switch to the satellite view using the drop down menu in the top right corner.

2. Enter the following coordinates into the Lat Lng Decimal box on the right and press submit.
   a) Mining Operation (North of Fort McMurray) 57.0, -111.478
   b) SAGD Operation (Northwest of Cold Lake) 54.6, -110.45

3. Zoom toward the map marker indicating the location.
**Understanding the Issues**
Now that you are familiar with oil sands, brainstorm the opportunities and challenges of using bitumen as a resource. Encourage students to think critically about the many factors that need to be considered when exploring an issue. Create a chart and record ideas to support both opportunities and challenges.

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• creates jobs for Albertans</td>
<td>• extraction requires a lot of water</td>
</tr>
<tr>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

**In the News**
Encourage students to search online or in the local newspaper for articles that relate to oil sands in Alberta. Create a current events display where students can post their stories. Ask students to present their articles by summarizing the main points. Have them report the, who, what, where, when and why of their story.

**Separating Oil Sands**
If you would like to experiment with oil sands' separation in your classroom, Oil Sands Chemistry Kits (containing samples) can be purchased for $39.99 (+ GST and shipping) 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.

For more information contact:
Inside Education
11428 100 Avenue
Edmonton, AB T5K 0J4
Phone: 780-421-1497
Toll free: 1-888-421-1497
www.insideeducation.ca