

## **MODULE ENM2030: OIL SANDS/HEAVY OIL/COAL 1 (RESOURCE EXPLORATION)**

**Level:** Intermediate

**Theme:** Technology and Applications

**Prerequisite:** None

**Module Description:** Students examine specific exploration techniques and technologies within the context of Alberta's oil sands, heavy oil or coal deposits, and they describe related career opportunities.

**Module Parameters:** Access to government and industry organizations involved in the exploration of nonconventional hydrocarbon resources (e.g., Fort McMurray Oil Sands Interpretive Centre, Western Research Centre).

This module requires off-campus learning experiences and should be combined with relevant work study, work experience and/or modules from the Career Transitions strand; consultation with the work-site supervisor will ensure that relevant safety considerations are addressed.

See the *Off-Campus Education Guide for Administrators, Counsellors and Teachers* (Alberta Education) for further information regarding off-campus learning.

**Supporting Modules:** ENM1020 Nonrenewable Resources  
CTR2210 Workplace Safety (Practices) [Career Transitions Strand]; recommended for off-campus learning

Students must have a general knowledge of potential hazards and accepted safety practices relevant to specific exploration sites prior to engaging in off-campus learning experiences. See Planning for Instruction in Section C of this Guide for further information regarding student safety.

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**Curriculum and Assessment Standards**

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> <li>• demonstrate knowledge of current and emerging technologies used in the exploration of oil sands, heavy oil or coal deposits</li> </ul>	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> <li>• completing a research project on nonconventional hydrocarbon exploration. Research to address:               <ul style="list-style-type: none"> <li>– the origin and formation of oil sands, heavy oil or coal deposits</li> <li>– surface and subsurface rock structures capable of containing oil sands, heavy oil or coal deposits</li> <li>– steps taken in locating potential oil- or coal-bearing formations prior to seismic and/or drilling operations</li> <li>– techniques used to estimate recoverable deposits of bitumen, heavy oil or coal.</li> </ul> </li> </ul> <p><i>Assessment Tool</i> <i>Research Process: Exploration of Nonconventional Hydrocarbon Deposits, ENM2030-1</i></p> <p><i>Standard</i> <i>Complete all components of research to a standard of 2 on the rating scale</i></p> <ul style="list-style-type: none"> <li>• through field-based investigations:               <ul style="list-style-type: none"> <li>– identifying applications of principles of science and technology in one or more areas of resource exploration (e.g., seismology, drilling)</li> <li>– examining the effect of overburden, oil density and viscosity, and/or rock porosity and permeability on recovery potential for an oil sand, heavy oil or coal deposit.</li> </ul> </li> </ul> <p><i>Assessment Tool</i> <i>Observation Checklist for Field-based Investigations, ENMOBS</i></p> <p><i>Standard</i> <i>Complete all sections of the observation checklist for field-based investigations</i></p>	<p>60</p>

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Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> <li>explain applications of low-depth drilling and log analysis in predicting the nature and extent of an oil sands, heavy oil or coal deposit</li> </ul>	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> <li>a concept test in which the student demonstrates knowledge of: <ul style="list-style-type: none"> <li>the characteristics and distinguishing features of three or more different oil- or coal-bearing formations</li> <li>seismic, drilling and/or other technology used in establishing the presence of nonconventional hydrocarbon deposits.</li> </ul> </li> </ul> <p><i>Assessment Tool</i> Energy Sources/Applications/Alternatives (Instructor's Manual)</p> <p><i>Standard</i> Response indicating 60% mastery</p> <ul style="list-style-type: none"> <li>a summary of environmental assessment and management practices conducted by industry throughout exploration operations.</li> </ul> <p><i>Assessment Tool</i> Presentations/Reports: Intermediate Level, ENMPRE-2</p> <p><i>Standard</i> Achieve a minimum rating of 2 on the rating scale for Presentations/Reports</p> <ul style="list-style-type: none"> <li>through field-based investigations, analyzing assays/core samples and sample log data to predict the nature and extent of an oil sands, heavy oil or coal deposit.</li> </ul> <p><i>Assessment Tool</i> Observation Checklist for Field-based Investigations, ENMOBS</p> <p><i>Standard</i> Complete all sections of the observation checklist for field-based investigations</p>	<p>20</p>

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(continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
<p><i>The student will:</i></p> <ul style="list-style-type: none"> <li>describe career opportunities relevant to the exploration sector of the oil sands, heavy oil or coal industry</li> <li>demonstrate basic competencies.</li> </ul>	<p><i>Assessment of student achievement should be based on:</i></p> <ul style="list-style-type: none"> <li>conducting research on technical, professional and/or labour-based careers within the exploration sector of an oil sands or coal industry.</li> </ul> <p><i>Assessment Tool</i> <i>Career Search: Intermediate Level, ENMCAR-2</i></p> <p><i>Standard</i> <i>Conduct research to a standard of 2 on the rating scale</i></p> <ul style="list-style-type: none"> <li>observations of individual effort and interpersonal interaction during the learning process.</li> </ul> <p><i>Assessment Tool</i> <i>Basic Competencies Reference Guide and any assessment tools noted above</i></p>	<p>20</p> <p>Integrated throughout</p>

Concept	Specific Learner Expectations	Notes
Exploration Technology	<p><i>The student should:</i></p> <ul style="list-style-type: none"> <li>explain basic theories and/or principles regarding the origin and formation of oil sands, heavy oil or coal deposits in Alberta; e.g.: <ul style="list-style-type: none"> <li>theories of origin/formation</li> <li>surface and subsurface geology</li> </ul> </li> <li>identify major geographical areas of Alberta in which oil sands, heavy oil or coal deposits are located, and relate geographic patterns to theories of origin</li> <li>compare and contrast physical and chemical characteristics of oil sands, heavy oil, conventional oil and coal</li> <li>compare known reserves of energy stored in oil sands and coal to known reserves of energy available through other fossil fuels; e.g.: <ul style="list-style-type: none"> <li>in Alberta</li> <li>in Canada</li> <li>in the world</li> </ul> </li> </ul>	<p>Describe and illustrate:</p> <ul style="list-style-type: none"> <li>theories of origin/formation</li> <li>source rock and migration</li> <li>the difference between porosity and permeability.</li> </ul> <p>For example:</p> <ul style="list-style-type: none"> <li>Why are oil sands and heavy oils in arc-like distribution patterns?</li> <li>Does this help to include/exclude areas for exploration?</li> </ul> <p>Identify major oil sands deposits in Alberta:</p> <ul style="list-style-type: none"> <li>Athabasca</li> <li>Cold Lake</li> <li>Peace River</li> <li>Wabasca.</li> </ul>

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Concept	Specific Learner Expectations	Notes
<p>Exploration Technology (continued)</p>	<p><i>The student should:</i></p> <ul style="list-style-type: none"> <li>• describe techniques used to estimate Alberta’s recoverable heavy oil, bitumen and coal</li> <li>• illustrate surface and subsurface rock structures capable of containing oil sands, heavy oil or coal deposits</li>   <li>• explain applications of aerial surveys and satellite imagery in locating nonconventional hydrocarbon deposits</li>   <li>• describe steps taken to gather further information about potential oil- or coal-bearing formations prior to seismic and drilling operations; e.g.:               <ul style="list-style-type: none"> <li>– first-hand observation of outcrop geology and surface features</li> <li>– review of geological reports and other published papers</li> </ul> </li> <li>• research current and emerging applications of seismic technology in the mapping and analysis of potential oil- or coal-bearing formations; e.g.:               <ul style="list-style-type: none"> <li>– seismic theory</li> <li>– data collection and processing</li> </ul> </li> <li>• research current and emerging applications of drilling or other exploration technology in determining the composition of subsurface rock and establishing the presence of nonconventional hydrocarbon deposits</li> </ul>	<p>Compare the concepts of “proved reserve,” “probable reserve” and “established reserve.”</p> <p>Compare coals from different regions of Alberta; e.g.:</p> <ul style="list-style-type: none"> <li>• mountain coals</li> <li>• foothills coals</li> <li>• plains coals.</li> </ul> <p>For example:</p> <ul style="list-style-type: none"> <li>• 3-D scanning</li> <li>• measurement of magnetic fields, gravity and radiation.</li> </ul> <p>Discuss information included in geological reports available from:</p> <ul style="list-style-type: none"> <li>• Alberta Geological Survey</li> <li>• Alberta Oil Sands Technology and Research Authority.</li> </ul> <p>Research applications of computer-assisted processing in providing 2-D and 3-D analyses of subsurface rock structures.</p> <p>Identify the general parts of a drilling rig and accompanying equipment.</p> <p>Explain the process of “making hole.”</p> <p>Discuss the use of cuttings and cores in determining the properties of subsurface rock structures.</p> <p>Research directional drilling.</p>

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(continued)

Concept	Specific Learner Expectations	Notes
Exploration Technology (continued)	<p><i>The student should:</i></p> <ul style="list-style-type: none"> <li>• explain environmental assessment and management practices conducted by industry throughout exploration operations; e.g.:               <ul style="list-style-type: none"> <li>– AEUB policies and guidelines</li> <li>– water, soil and wildlife impact studies</li> <li>– management plans</li> <li>– reclamation techniques</li> </ul> </li> <li>• describe technological advances used to address environmental concerns throughout the exploration process.</li> </ul>	<p>Research environmental standards and the enforcement of safe operating procedures throughout exploration activities.</p> <p>Gather information regarding exploration procedures followed to maintain environmental standards; e.g.:</p> <ul style="list-style-type: none"> <li>• horizontal drilling</li> <li>• disposal of drilling fluids</li> <li>• land surface restoration.</li> </ul>
Data Interpretation	<ul style="list-style-type: none"> <li>• explain basic terminology and methodology used in low-depth drilling and core analysis</li> <li>• given assays or samples, make predictions regarding the extent and grade of an oil sands, heavy oil or coal deposit</li> <li>• explain basic terminology and methodology used in geological log analysis; e.g.:               <ul style="list-style-type: none"> <li>– electric logs</li> <li>– sonic logs</li> </ul> </li> <li>• given sample log data from a bore hole, make predictions regarding the extent and grade of an oil sands, heavy oil or coal deposit</li> <li>• describe hydrocarbon content necessary to make a nonconventional hydrocarbon deposit economically viable; e.g.:               <ul style="list-style-type: none"> <li>– percentage of bitumen</li> <li>– rank of coal.</li> </ul> </li> </ul>	<p>Establish links with local industry for first-hand observation of technologies/techniques used in data interpretation. Only a <b><u>RUDIMENTARY UNDERSTANDING</u></b> of terminology and methodology needs to be developed at this time.</p> <p>Discuss types of information recorded in well log records.</p>

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(continued)

Concept	Specific Learner Expectations	Notes
Career Opportunities	<p><i>The student should:</i></p> <ul style="list-style-type: none"> <li>• research careers and the range of occupational opportunities related to the exploration of nonconventional hydrocarbon deposits; e.g.:               <ul style="list-style-type: none"> <li>– earth science:                   <ul style="list-style-type: none"> <li>• geologist</li> <li>• geophysicist</li> <li>• geochemist</li> <li>• paleontologist</li> </ul> </li> <li>– survey and land access:                   <ul style="list-style-type: none"> <li>• surveyor</li> <li>• land agent</li> </ul> </li> <li>– seismic and drilling service:                   <ul style="list-style-type: none"> <li>• contractor</li> <li>• mechanic</li> <li>• rig worker</li> </ul> </li> <li>– engineering:                   <ul style="list-style-type: none"> <li>• reservoir</li> <li>• mining</li> </ul> </li> <li>– environmental management:                   <ul style="list-style-type: none"> <li>• environmental auditor</li> <li>• environmental engineer</li> </ul> </li> </ul> </li> <li>• evaluate current employment opportunities in exploration based on employment statistics</li> <li>• research recent changes in prospecting and exploration technology, and resulting career opportunities and trends.</li> </ul>	<p>Plan for individual/group research and presentations that address:</p> <ul style="list-style-type: none"> <li>• job description</li> <li>• employment market</li> <li>• education/training</li> <li>• wage expectations.</li> </ul> <p>Contact the “Career Information Hotline” (Alberta Advanced Education and Career Development).</p> <p>See the National Occupational Profiles (NOC) in Section H: Linkages/Transitions.</p> <p>Arrange/facilitate:</p> <ul style="list-style-type: none"> <li>• information interviews</li> <li>• work study/experience</li> <li>• job shadowing.</li> </ul>

