MODULE ENM2060: REFINING HYDROCARBONS

Level: Intermediate

Theme: Technology and Applications

Prerequisite: None

Module Description: Students examine the principles and technologies involved in processing natural gas, refining crude oil, upgrading heavy oils and bitumen, or processing coal. Students also describe related career opportunities.

Module Parameters: Access to a hydrocarbon refining industry.

Access to a science laboratory.

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: ENM1060 Consumer Products & Services
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 processing 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.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • describe commodity inputs and consumer products characteristic of the hydrocarbon processing industry	*Assessment of student achievement should be based on:* • identifying and describing the range of products provided as a result of processing natural gas, refining crude oil, upgrading heavy oil/bitumen and processing coal. *Assessment Tool* Our Petroleum Challenge: Into the 21st Century, *Petroleum Communication Foundation* *Standard* *Identify 50 products, their derivatives, and general application/use*	20

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:* • given a specific hydrocarbon processing industry, identifying: – inputs to processing, refining or upgrading within the industry – economic, environmental, safety and other factors that influence industry practices. *Assessment Tool* *Research Process: Hydrocarbon Processing, ENM2060–1* *Standard* *Complete all components of research to a standard of 2 on the rating scale*	
• explain techniques used to process natural gas, refine crude oil, upgrade heavy oils and bitumen, or process coal	• through laboratory and/or field-based investigations: – identifying the physical and chemical properties of a hydrocarbon – relating properties of a hydrocarbon to techniques used for processing, refining or upgrading. *Assessment Tool* *Lab Investigations: Intermediate Level, ENMLAB–2* *Observation Checklist for Field-based Investigations, ENMOBS* *Standard* *Conduct lab investigations to a standard of 2 on the rating scale <u>and/or</u> complete all sections of the observation checklist for field investigations* • a flow chart that outlines major steps and processes used by the upstream sector to process natural gas, refine crude oil, upgrade heavy oil/bitumen or process coal. *Assessment Tool* *Assessment Criteria: Flow Charts, ENMFLO* *Standard* *Complete the flow chart to a standard of 2 on the rating scale*	60

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:* • a summary of environmental assessment and management practices conducted by industry throughout processing, refining or upgrading operations. *Assessment Tool* *Presentations/Reports: Intermediate Level, ENMPRE–2* *Standard* *Achieve a minimum rating of 2 on the rating scale for Presentations/Reports*	
• describe career opportunities relevant to the processing or refining sector of a hydrocarbon industry	• conducting research on technical, professional and/or labour-based careers that involve processing natural gas, refining crude oil, upgrading heavy oils and bitumen, or processing coal. *Assessment Tool* *Career Search: Intermediate Level, ENMCAR–2* *Standard* *Conduct research to a standard of 2 on the rating scale*	20
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
The Processing Industry	*The student should:* • describe the range of products and/or services provided as a result of: – processing natural gas – refining crude oil – upgrading heavy oils and bitumen – processing coal	Prepare posters and displays of products and services derived from different types of hydrocarbons (e.g., natural gas, crude oil, heavy oil/bitumen, coal).

Concept	Specific Learner Expectations	Notes
The Processing Industry (continued)	*The student should:* • describe inputs to processing within an oil, gas, oil sands or coal industry: – raw materials/feedstocks – financial, human and natural resources – technology requirements	Consider the sour gas industry and production of elemental sulphur used in the manufacture of fertilizers, paper, pharmaceuticals, etc.
	• identify factors that influence the nature of a processing or refining industry	Given a specific industry, research the influence of factors such as: • supply of feedstocks and/or other materials • allowable production volumes • access to markets.
	• explain how the mix of products produced may vary according to market demand	For example: • asphalt for road paving in summer • home heating fuels in winter.
	• identify environmental and safety concerns that influence practices within a processing or refining industry.	Discuss industry impact on: • workers and nearby residents • crops, forests, livestock and wildlife • air, soil and water quality.
Processing/Refining Techniques	• describe relatively simple field facilities used to prepare a raw hydrocarbon for further processing and/or refining in the upstream sector	Consider recovery-site or satellite facilities used for: • cleaning • separating • upgrading.
	• research more sophisticated techniques and technologies used in the upstream sector to process natural gas, refine crude oil, upgrade heavy oil and bitumen, or process coal; e.g.: – removal of contaminants/impurities – conversion into saleable products	Consider both sweet and sour facilities in the upstream sector. If studying crude oil, distinguish between the refining of crude oil (ENM2060) and the manufacture of petrochemicals (ENM3060).

Concept	Specific Learner Expectations	Notes
Processing/Refining Techniques (continued)	*The student should:*	
	• explain reasons for sulphur recovery throughout processing, refining and/or upgrading processes	For example, • to sweeten product for industrial/residential use • to produce elemental sulphur • to maintain environmental standards.
	• create a simplified model of a processing, refining or upgrading facility	
	• research the physical and/or chemical properties of a hydrocarbon, and relate these to technologies used for processing, refining or upgrading	Give examples of hydrocarbons that exist in their natural state as solids, liquids and gases. For a given hydrocarbon, conduct laboratory investigations of: • molecular structure • heat content • temperature/pressure/ volume relationships • catalytic reaction.
	• research basic fractionating, cracking and/or reforming processes used within the industry	Assemble and use a simple fractionating column to separate two or more liquids through the process of fractional distillation.
	• explain industry use of electronic equipment and computer technology in monitoring processing, refining or upgrading operations	Research sulphur-recovery technology. Discuss Canada as a world leader in developing technologies for recovering and safely handling sulphur.
	• describe storage facilities and distribution systems within the industry, and their impact on industry location and product costs	Construct flow charts that illustrate storage and distribution systems.
	• explain environmental assessment and management practices conducted by industry throughout processing, refining or upgrading operations	Research environmental standards and the enforcement of safe operating procedures throughout processing, refining or upgrading operations.

Concept	Specific Learner Expectations	Notes
Processing/Refining Techniques (continued)	*The student should:* • describe industry initiatives that respond to environmental concerns • describe industry initiatives that address occupational health and safety requirements.	For example: • advances in sulphur-recovery technology • development of clean-coal technology • waste treatment/ emission control. For example, • odour scrubbers • noise suppressants • water purification • personal protective equipment • emergency response strategies.
Career Opportunities	• research careers and the range of occupational opportunities within the processing and refining sector of a hydrocarbon industry; e.g.: – engineering – technical and support services – apprenticeship trades – environmental management • explain the personnel structure within the refining department of a hydrocarbon industry • evaluate current employment opportunities based on employment statistics • research trends in hydrocarbon processing and refining, and future career opportunities; e.g.: – upgrading heavy oil and bitumen – increased use of low ranked coals.	Plan for individual/group research and presentations that address: • job description • employment market • education/training • wage expectations. Contact the "Career Information Hotline" (Alberta Advanced Education and Career Development). See the National Occupational Profiles (NOC) in Section H: Linkages/Transitions. Arrange/facilitate: • information interviews • work study/experience • job shadowing.