MODULE ENM2040: METALS/NONMETALS 1 (RESOURCE EXPLORATION)

Level: Intermediate

Theme: Technology and Applications

Prerequisite: None

Module Description: Students examine specific exploration techniques and technologies within the context of a metallic and/or nonmetallic mineral deposit, and they describe related career opportunities.

Note: Industry often refers to a third category of minerals called "structural materials"; i.e., minerals used primarily in construction, including sand and gravel, decorative and building stone, cement, clay and limestone. Modules ENM2040 and ENM3040 include structural materials within the broader category of nonmetallic minerals.

Module Parameters: Access to government and industry organizations involved in the exploration of metallic and/or non-metallic minerals.

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 for further information regarding student safety.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate knowledge of current and emerging technologies used in the exploration of economic mineral deposits	*Assessment of student achievement should be based on:* • completing a research project on the exploration of economic mineral deposits. Research to address: – the origin and formation of metallic and nonmetallic minerals – surface and subsurface rock structures capable of containing metallic and nonmetallic minerals and structural materials – steps taken in locating potential mineral-bearing formations prior to seismic mapping and/or drilling operations – techniques used to estimate recoverable mineral deposits. *Assessment Tool* *Research Process: Exploration of Mineral Deposits, ENM2040–1* *Standard* *Complete all components of research to a standard of 2 on the rating scale* • through field-based investigations: – identifying applications of principles of science and technology in one or more areas of resource exploration (e.g., seismology, drilling) – examining factors that affect the recovery potential for a mineral deposit (e.g., depth of overburden, size/nature of deposit). *Assessment Tool* *Observation Checklist for Field-based Investigations, ENMOBS* *Standard* *Complete all sections of the observation checklist for field-based investigations*	60

MODULE ENM2040: METALS/NONMETALS 1 (RESOURCE EXPLORATION) (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:* • a concept test in which the student demonstrates knowledge of: – the characteristics and distinguishing features of six or more different metallic or nonmetallic minerals found in Alberta – seismic, drilling and/or other technology used in establishing the presence of economic mineral deposits. *Assessment Tool* Exploring Manufacturing *(Instructor's Manual)* *Standard* *Response indicating 60% mastery* • a summary of environmental assessment and management practices conducted by industry throughout exploration operations. *Assessment Tool* *Presentations/Reports: Intermediate Level, ENMPRE–2* *Standard* *Achieve a minimum rating of 2 on the rating scale for Presentations/Reports*	
• interpret geological logs in order to predict the nature and extent of a metallic or nonmetallic mineral deposit	• through field-based investigations, analyzing assays/core samples and sample log data to predict the nature and extent of a metallic and/or nonmetallic mineral deposit. *Assessment Tool* *Observation Checklist for Field-based Investigations, ENMOBS* *Standard* *Complete all sections of the observation checklist for field-based investigations*	20

MODULE ENM2040: METALS/NONMETALS 1 (RESOURCE EXPLORATION) (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe career opportunities relevant to the exploration sector of the mineral industry	• conducting research on technical, professional and/or labour-based careers within the exploration sector of a mineral industry. *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
Exploration Technology	*The student should:* • explain basic theories and/or principles regarding the origin and formation of metallic and nonmetallic minerals and structural materials in Alberta • illustrate surface and subsurface rock structures in which metallic and industrial minerals are commonly found • describe the mineral potential of major geological areas of Alberta; e.g.: – Precambrian Shield – Interior Plains – Foothills – Rocky Mountains • identify geographical areas of Alberta in which occurrences of specific minerals are known to exist, and relate geographic patterns to theories of origin	Describe and illustrate: • theories of origin/ formation • surface and subsurface geology. Contact the Alberta Geological Survey to obtain *Edmonton Beneath Our Feet.* Request the current *Mineral Deposits and Occurrences in Alberta* map and data base from the Alberta Geological Survey. For example: • Why is a mineral found in a particular distribution pattern? • Does this help to include/exclude areas for exploration?

Concept	Specific Learner Expectations	Notes
Exploration Technology (continued)	*The student should:* • explain possible reasons why the potential of the minerals industry in Alberta has not been fully established, nor have known deposits of industrial and metallic minerals been fully developed • explain applications of aerial surveys and satellite imagery in prospecting for metallic and nonmetallic minerals • describe steps taken to gather further information about potential mineral-bearing formations prior to seismic mapping and/or drilling operations; e.g.: – first-hand observation of outcrop geology and surface features – review of geological reports and other published papers • research current and emerging applications of technology in the mapping and analysis of potential mineral-bearing formations • research current and emerging applications of drilling technology in determining the composition of subsurface rock and establishing the presence of mineral deposits • summarize recent developments in Alberta regarding gold, diamonds and base-metals • explain environmental assessment and management practices conducted by industry throughout exploration operations • describe technological advances used to address environmental concerns throughout the exploration process	Contact Natural Resources Canada for its map (produced annually) of energy and mineral developments in Canada. Discuss information included in geological reports available from: • Alberta Geological Survey (industrial and structural materials, metals) • Geological Survey of Canada (metals). For example: • air and ground magnetics • electromagnetics • gravity • radioactivity • geochemistry of soils and other overburden. Gather information on rig components, drilling techniques and logging/ testing procedures. Research environmental standards and the enforcement of safe operating procedures throughout exploration activities. Gather information regarding exploration procedures followed to maintain environmental standards; e.g.: • horizontal drilling • disposal of drilling fluids • land surface restoration.

Concept	Specific Learner Expectations	Notes
Data Interpretation	*The student should:* • explain basic terminology and methodology used in core analysis • given assays or samples, make predictions regarding the extent and grade of a mineral deposit • explain basic terminology and methodology used in geological log interpretation; e.g.: – electric logs – sonic logs • given sample log data from a bore hole, make predictions regarding the extent and grade of a mineral deposit.	Establish links with local industry for first-hand observation of technologies/ techniques used in data interpretation. Only a **RUDIMENTARY UNDERSTANDING** of terminology and methodology needs to be developed at this time. Discuss types of information recorded in log data from bore holes.
Career Opportunities	• research careers and the range of occupational opportunities related to the exploration of metallic and nonmetallic mineral deposits; e.g.: – earth science: • geologist • geophysicist • geochemist – technologists and technicians: • field • laboratory – computer analysis: • data base • data entry • Geographic Information Systems – survey and land access: • surveyor • land agent – seismic and drilling service: • contractor • mechanic • rig worker – environmental management: • environmental auditor • environmental engineer • evaluate current employment opportunities in mineral exploration based on employment statistics	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.

Concept	Specific Learner Expectations	Notes
Career Opportunities (continued)	*The student should:* • research recent changes in prospecting and exploration technology, and resulting career opportunities and trends.	Arrange/facilitate: • information interviews • work study/experience • job shadowing.