

## **MODULE ENM3070: INDUSTRIAL MATERIALS (PRIMARY MANUFACTURING)**

**Level:** Advanced

**Theme:** Technology and Applications

**Prerequisite:** ENM2070 Refining Rocks & Minerals

**Module Description:** Students investigate technologies used to convert petroleum and mineral resources into industrial (stock) materials used in secondary manufacturing processes, and they explain related career opportunities.

**Module Parameters:** Access to a primary manufacturing industry.

Access to a science, construction or fabrication 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 Module:** 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 and/or manufacturing 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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(continued)

Concept	Specific Learner Expectations	Notes
Industrial (Stock) Materials	<p><i>The student should:</i></p> <ul style="list-style-type: none"> <li>• compare primary and secondary manufacturing processes</li> <li>• describe major categories of nonrenewable resources (raw materials) used in primary manufacturing</li> <li>• identify and describe major types of industrial (stock) materials produced through primary manufacturing processes:               <ul style="list-style-type: none"> <li>– metallic</li> <li>– structural</li> <li>– polymeric</li> <li>– ceramic</li> <li>– composite</li> </ul> </li> <li>• describe standard forms for each type of industrial (stock) material:               <ul style="list-style-type: none"> <li>– plate, bar and rod</li> <li>– sheet, roll and film</li> <li>– pellet and powder</li> </ul> </li> <li>• describe major consuming industries for stock materials produced in Canada.</li> </ul>	<p>Obtain a copy of <i>Edmonton Beneath Our Feet</i> from the Alberta Geological Survey.</p> <p>Research applications of:</p> <ul style="list-style-type: none"> <li>• petroleum</li> <li>• natural gas</li> <li>• metallic ores</li> <li>• nonmetallic ores.</li> </ul> <p>For example, ferrous, non-ferrous.</p> <p>For example, sand, gravel, crushed stone.</p> <p>For example, thermoplastic, thermoset.</p> <p>For example, clay-based, refractory, glass, abrasive.</p> <p>For example, layered, fibre-reinforced, particle.</p> <p>Provide examples and assemble a display of each type of industrial (stock) material.</p> <p>Research applications of stock materials in:</p> <ul style="list-style-type: none"> <li>• secondary manufacturing</li> <li>• construction</li> <li>• consumer/domestic use.</li> </ul>
Properties and Applications	<ul style="list-style-type: none"> <li>• describe and compare the molecular structure of a metallic, polymeric, ceramic and composite material</li> </ul>	<p>For example:</p> <ul style="list-style-type: none"> <li>• atoms and molecules</li> <li>• molecular arrangement</li> <li>• attractions and connections.</li> </ul>

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(continued)

Concept	Specific Learner Expectations	Notes
<p>Properties and Applications (continued)</p>	<p><i>The student should:</i></p> <ul style="list-style-type: none"> <li>• construct models that illustrate the molecular structure of metallic, polymeric, ceramic and/or composite materials</li> <li>• conduct experiments to determine the properties of an industrial (stock) material:               <ul style="list-style-type: none"> <li>– mechanical</li> <li>– chemical</li> <li>– thermal</li> <li>– electrical and magnetic</li> <li>– optical</li> </ul> </li> <li>• relate the properties of an industrial (stock) material to its molecular structure</li> <li>• explain how the properties of an industrial (stock) material determine its applications in product design and secondary manufacturing processes.</li> </ul>	<p>For example, strength, elasticity and plasticity, malleability and ductility, hardness.</p> <p>For example, conductivity, melting/freezing point, combustibility, rate of expansion.</p> <p>For example, conductivity, resistivity, permeability.</p> <p>For example, opacity, reflectivity, colour.</p> <p>Research the development of new materials for specific environments and applications.</p>
<p>Primary Manufacturing Technologies</p>	<ul style="list-style-type: none"> <li>• research the conversion of a nonrenewable resource into an industrial (stock) material within one of Canada’s primary manufacturing industries</li> <li>• identify specific mineral ores and/or petroleum feedstocks used in the manufacturing process</li> <li>• describe techniques employed to manufacture the stock material</li> <li>• construct a flow chart outlining major stages in the manufacturing process</li> </ul>	<p>Distinguish between the refining of rocks and minerals (ENM2070) and the manufacture of stock materials used in secondary manufacturing (ENM3070).</p> <p>For example:</p> <ul style="list-style-type: none"> <li>• thermal</li> <li>• chemical</li> <li>• mechanical</li> <li>• electrical.</li> </ul> <p>Illustrate inputs, processes, outputs and feedback systems.</p>

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(continued)

Concept	Specific Learner Expectations	Notes
<p>Primary Manufacturing Technologies (continued)</p>	<p><i>The student should:</i></p> <ul style="list-style-type: none"> <li>• explain applications of electronic equipment and computer technology in monitoring and controlling manufacturing operations</li> <li>• describe storage facilities and distribution systems within the industry, and their impact on industry location and product costs</li> <li>• explain environmental assessment and management practices conducted by industry throughout manufacturing operations</li> <li>• describe industry initiatives that respond to environmental concerns</li> <li>• describe industry initiatives that address occupational health and safety requirements</li> <li>• describe industry initiatives in reprocessing and recycling to ensure a life-cycle approach to chemicals management.</li> </ul>	<p>Draw/construct a simplified model of a primary manufacturing facility.</p> <p>Construct flow charts that depict facilities/steps in storage and distribution.</p> <p>Research environmental standards and the enforcement of safe operating procedures throughout manufacturing operations.</p> <p>For example:</p> <ul style="list-style-type: none"> <li>• waste treatment</li> <li>• emission control.</li> </ul> <p>For example:</p> <ul style="list-style-type: none"> <li>• odour scrubbers</li> <li>• noise suppressants</li> <li>• water purification.</li> </ul> <p>Note links with ENM1090 (Fundamentals of Recycling).</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 within primary manufacturing industries; e.g.:               <ul style="list-style-type: none"> <li>– engineering</li> <li>– technical and support services</li> <li>– apprenticeship trades</li> <li>– environmental management</li> </ul> </li> <li>• explain the personnel structure within a primary manufacturing industry</li> <li>• evaluate current employment opportunities based on employment statistics</li> <li>• research trends in the manufacture of industrial (stock) materials, and future career opportunities; e.g.:               <ul style="list-style-type: none"> <li>– developing new materials</li> <li>– recycling and resource conservation</li> <li>– waste management.</li> </ul> </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>

