

## CANADIAN NUCLEAR ASSOCIATION LESSON PLAN CORRELATION TO SASKATCHEWAN CURRICULUM

### PRACTICAL AND APPLIED ARTS ENERGY AND MINES 10, 20, 30

|   | <b>Expectation/Outcome</b>  | <b>Lesson Plan</b>  |
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|   | <b>Common Essential Learning:</b> To develop and practise appropriate research and analytical skills.   | Attack of the 50 Foot Mutant: Radiation in Popular Culture<br>Scientists on Stamps<br>The Atomic Age              |
| <b>Module 1: Introduction to Energy and Mines</b>               | <b>Foundational Objective:</b> To demonstrate knowledge of the diversity and significance of Saskatchewan energy and mining industries.   | Attack of the 50 Foot Mutant: Radiation in Popular Culture<br>Canada's Nuclear History Jeopardy<br>The Atomic Age |
|   | <b>Foundational Objective:</b> To become familiar with the technology of the energy and mining industry   | Canada's Nuclear History Jeopardy   |
|   | <b>Learning Objective 1.1:</b> To review forms and sources of energy in the context of human activity.  | Baseload vs. Peak Demand  |
|   | <b>Learning Objective 1.2:</b> To become familiar with Internet resources pertaining to human use of renewable and non-renewable energy   | Baseload vs. Peak Demand  |
| <b>Module 4: Sustainability</b>                                 | <b>Common Essential Learning:</b> To develop appropriate research and analytical skills to gather, examine and interpret statistical data.  | The Atomic Age  |
|   | <b>Common Essential Learning:</b> to gather and interpret information on complex social and environmental issues, from a variety of primary and secondary sources.  | The Atomic Age  |
|   | <b>Foundational Objective:</b> To demonstrate knowledge of the diversity and economic, social and environmental significance of Saskatchewan energy and mining industries.                                    | Attack of the 50 Foot Mutant: Radiation in Popular Culture<br>The Atomic Age                                      |
|   | <b>Learning Objective 4.2:</b> To collect and interpret data on the economic impact of the energy and mining industries on the local, provincial and national economies.                                      | The Atomic Age  |
|   | <b>Learning Objective 4.4:</b> To explore the environmental impact, both short-term and long-term, of common methods of mineral resource exploration, extraction, transportation, processing and consumption. | The Atomic Age  |
| <b>Module 12: Uranium – Formation, Location and Exploration</b> | <b>Foundational Objective:</b> To become familiar with some of the history of Saskatchewan's resource industries.   | Scientists on Stamps<br>The Atomic Age  |
|   | <b>Foundational Objective:</b> To assess the environmental impact of resource exploration, production, transport and processing.  | The Atomic Age  |
|   | <b>Foundational Objective:</b> To assess the efforts made by the resource industry to protect the environment.  | The Atomic Age  |
|   | <b>Learning Objective 12.3:</b> To outline major events in the history of uranium exploration and mining in Saskatchewan and some of the social changes that have taken place as a result of uranium mining.  | The Atomic Age  |
|   | <b>Common Essential Learning:</b> To research nuclear technology and nuclear issues using the Internet.   | Scientists on Stamps<br>The Atomic Age<br>Keeping the Genie in the Bottle   |

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| <b>Module 14: Uranium – Refinement, Distribution and Uses</b>        | <b>Common Essential Learning:</b> To use statistics and economic data in exploring aspects of the nuclear industry.   | The Atomic Age  |
|  | <b>Common Essential Learning:</b> To examine and present arguments on both sides of controversial issues.   | The Atomic Age  |
|  | <b>Learning Objective 14.1:</b> To explain the nature of a chain reaction, in relation to the two common isotopes of uranium.   | Atomic Theory Jeopardy  |
|  | <b>Learning Objective 14.5:</b> To explore Canada's historic role in the development and application of nuclear energy, including both commercial and military uses and our country's current research and development initiatives in the nuclear industry. | Scientists on Stamps<br>The Atomic Age<br>Keeping the Genie in the Bottle   |
| <b>Module 15: Workplace Safety, Environmental Safety and careers</b> | <b>Common Essential Learning:</b> To use the Internet in exploring career opportunities in the uranium and nuclear industries.  | About Careers Jeopardy<br>Careers in Electricity Generation<br>About Careers Jeopardy   |
|  | <b>Learning Objective 15.3:</b> To be aware of the waste products from nuclear power generation, the hazards they present and methods of transportation and storage of the materials.   | Safe and Secure: Nuclear Waste Storage  |
| <b>SCIENCE</b>   |   |   |
| <b>CHEMISTRY 20</b>  |   |   |
| <b>Unit 4: Atoms and Elements</b>                                    | <b>Foundational Objective:</b> Discuss the development of ideas about the structure of matter   | Atomic Theory Jeopardy  |
|  | <b>Foundational Objective:</b> Identify the relationships among the components of the atom.   | Atomic Theory Jeopardy  |
|  | <b>Foundational Objective:</b> Examine how elements are described and classified.   | Atomic Theory Jeopardy  |
| <b>CHEMISTRY 30</b>  |   |   |
| <b>Unit 1: Review of Basic Principles</b>                            | <b>Foundational Objective:</b> Exhibit an understanding of the language and organization of chemistry.  | Atomic Theory Jeopardy  |
| <b>PHYSICS 30</b>  |   |   |
| <b>Unit IV: Nuclear Physics A: Natural Radioactivity</b>             | <b>Common Essential Learning:</b> Use a wide range of possibilities for developing their knowledge of the major concepts within physics.  | Atomic Theory Jeopardy<br>Understanding Isotopes<br>Nuclear Technology at Work<br>Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy |
|  | <b>Common Essential Learning:</b> Understand the personal, moral, social, and cultural aspects of physics.  | Scientists on Stamps<br>Safety in the Nuclear Industry Jeopardy<br>Canada's Nuclear History Jeopardy<br>The Atomic Age<br>Keeping the Genie in the Bottle     |
|  | <b>Common Essential Learning:</b> Develop as "strong sense" critical  | Scientists on Stamps  |

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|   | and creative thinkers.  | Canada's Nuclear History Jeopardy The Atomic Age<br>Keeping the Genie in the Bottle   |
| <b>Unit IV: Nuclear Physics<br/>A: Natural Radioactivity</b>  | <b>Foundational Objective:</b> Recognize that people are constantly being exposed to radiation from natural and human-created sources.  | Flying the Radioactive Skies  |
|   | <b>Foundational Objective:</b> Recognize the potential danger of exposure to tissue and genetic material from radiation.  | Biological Effects of Radiation<br>Flying the Radioactive Skies<br>Biological Effects of Radiation Jeopardy   |
|   | <b>Learning Outcome 1:</b> Define the following terms: radioactivity, isotopes, alpha particles, beta particles, gamma rays, dosimetry, absorbed dose, dose equivalent, quality factor. | Atomic Theory Jeopardy<br>Understanding Isotopes<br>Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy<br>Flying the Radioactive Skies |
|   | <b>Learning Outcome 2:</b> State how radioactivity was discovered.  | Canada's Nuclear History Jeopardy   |
|   | <b>Learning Outcome 3:</b> Identify some naturally occurring radioactive ores.  | Canada's Nuclear History Jeopardy   |
|   | <b>Learning Outcome 4:</b> Realize that radioactivity is found in both natural and artificial sources.  | Attack of the 50 Foot Mutant: Radiation in Popular Culture  |
|   | <b>Learning Outcome 5:</b> Recognize that people are constantly being exposed to radiation from a variety of sources.   | Attack of the 50 Foot Mutant: Radiation in Popular Culture<br>Flying the Radioactive Skies<br>Biological Effects of Radiation Jeopardy                          |
|   | <b>Learning Outcome 6:</b> Recognize that , although exposure to radioactivity is inevitable, it should be minimized.   | Flying the Radioactive Skies<br>Biological Effects of Radiation Jeopardy  |
|   | <b>Learning Outcome 8:</b> State the number of different types of radiation found in nature.  | Attack of the 50 Foot Mutant: Radiation in Popular Culture  |
|   | <b>Learning Outcome 9:</b> Identify the composition of alpha particles, beta particles, and gamma rays.   | Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy   |
|   | <b>Learning Outcome 10:</b> Compare the penetrating power, speed, potential danger, and other important characteristics of alpha particles, and gamma rays.                             | Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy<br>Flying the Radioactive Skies   |
|   | <b>Learning Outcome 14:</b> Recognize that radioactivity cannot be detected by human senses.  | Attack of the 50 Foot Mutant: Radiation in Popular Culture  |
|   | <b>Learning Outcome 15:</b> Suggest some important implications arising from the fact that radioactivity cannot be detected by human senses.  | Attack of the 50 Foot Mutant: Radiation in Popular Culture  |
|   | <b>Learning Outcome 18:</b> Demonstrate an understanding of the units that are used to measure radiation.   | Flying the Radioactive Skies  |
|   | <b>Learning Outcome 19:</b> Recognize that absorbed radiation has different effects on different kinds of tissue.   | Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy<br>Flying the Radioactive Skies   |
|   | <b>Learning Outcome 20:</b> Recognize that there is disagreement among scientists on the cumulative effects of low dosage exposure to radiation.  | Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy<br>Flying the Radioactive Skies   |
| <b>Learning Outcome 21:</b> Understand that no exposure to radioactive emissions, for any period of time, should be regarded as being "safe" to humans or other living organisms. | Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy<br>Flying the Radioactive Skies   |   |
| <b>Unit IV: Nuclear Physics<br/>A: Natural Radioactivity</b>  | <b>Foundational Objective:</b> Recognize that scientists have a moral responsibility to bring about peaceful and humanitarian uses for their  | Safety in the Nuclear Industry Jeopardy   |

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|  | discoveries.  |   |
|  | <b>Foundational Objective:</b> Recognize the potential danger of exposure to tissue and genetic material from radiation.  | Nuclear Technology at Work  |
| <b>B: Nuclear Fission</b>  | <b>Learning Outcome 1:</b> Define the following terms: fission, moderator, nuclear mass defect, chain reaction, enrichment, control rods, nuclear reactor, critical mass. | Safety in the Nuclear Industry Jeopardy<br>Nuclear Technology at Work Jeopardy<br>Fission vs. Fusion  |
|  | <b>Learning Outcome 2 Describe what happens during fission.</b>   | Atomic Theory Jeopardy<br>Fission vs. Fusion  |
|  | <b>Learning Outcome 5:</b> Recognize that neutrons are released during fission.   | Atomic Theory Jeopardy<br>Fission vs. Fusion  |
|  | <b>Learning Outcome 6:</b> Recognize that a very large amount of energy is released during a fission reaction.  | Atomic Theory Jeopardy<br>Fission vs. Fusion  |
|  | <b>Learning Outcome 8:</b> Explain how the neutrons released during a fission reaction can help to sustain the reaction.  | Atomic Theory Jeopardy  |
|  | <b>Learning Outcome 11:</b> Recognize the devastating destructive power present in nuclear weapons.   | Safety in the Nuclear Industry Jeopardy<br>Canada's Nuclear History Jeopardy  |
|  | <b>Learning Outcome 12:</b> Explain that nuclear weapons release radioactive fallout.   | Safety in the Nuclear Industry Jeopardy<br>Canada's Nuclear History Jeopardy  |
| <b>B: Nuclear Reactors</b>   | <b>Learning Outcome 2:</b> Identify the type of fuel used in a nuclear reactor.   | Safety in the Nuclear Industry Jeopardy<br>Canada's Nuclear History Jeopardy<br>Fission vs. Fusion  |
|  | <b>Learning Outcome 3:</b> Outline the nuclear fuel cycle, from the initial mining of raw materials to the final storage of waste material.                               | Safety in the Nuclear Industry Jeopardy<br>Safe and Secure: Nuclear Waste Storage<br>Nuclear Technology at Work Jeopardy<br>Canada's Nuclear History Jeopardy<br>Fission vs. Fusion |
|  | <b>Learning Outcome 4:</b> Recognize the role that Saskatchewan and Canada play in nuclear technology.  | Scientists on Stamps<br>Canada's Nuclear History Jeopardy The Atomic Age  |
|  | <b>Learning Outcome 5:</b> Explain why a nuclear explosion is not possible in a nuclear reactor.  | Safety in the Nuclear Industry Jeopardy   |
|  | <b>Learning Outcome 6:</b> Identify some of the main features of the CANDU nuclear reactor.   | Nuclear Technology at Work Jeopardy   |
|  | <b>Learning Outcome 7:</b> Explain the purpose of using heavy water in CANDU reactors.  | Safety in the Nuclear Industry Jeopardy   |
|  | <b>Learning Outcome 8:</b> Identify some of the safety features that have been designed into the CANDU nuclear reactor system.  | Safety in the Nuclear Industry Jeopardy   |
|  | <b>Learning Outcome 10:</b> State some of the concerns that critics raise regarding the use of nuclear energy.  | Safety in the Nuclear Industry Jeopardy   |
| <b>Learning Outcome 13:</b> Using a solid knowledge base of all of the previous outcomes, develop a position which either supports or rejects the use of nuclear energy for peaceful purposes. | The Atomic Age<br>Keeping the Genie in the Bottle   |   |
| <b>Optional Unit VIII: Atomic</b>  | <b>Learning Outcome 1:</b> Define the following terms: atomic number,   | Understanding Isotopes  |

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| <b>Physics A: Atomic Theory</b>       | isotope, radioisotopes, nuclear binding force, average binding energy, nuclear mass defect, nuclear binding energy, photon.  |   |
|                                       | <b>Learning Outcome 2:</b> use the atomic number of an element to determine the numBer of protons in a nucleus.  | Understanding Isotopes  |
|                                       | <b>Learning Outcome 4:</b> Use the atomic mass number and the atomic number to determine the number of neutrons in the nucleus of an atom.                           | Understanding Isotopes  |
|                                       | <b>Learning Outcome 5:</b> Recognize that isotopes f an element have similar chemical properties, but different physical properties.                                 | Understanding Isotopes  |
|                                       | <b>Learning Outcome 6:</b> Give and example of an element which contains isotopes and show how those isotopes differ from each other.                                | Understanding Isotopes  |
|                                       | <b>Learning Outcome 7:</b> Explain that the average atomic mass of an element takes into account the relative proportions of its isotopes found in nature.           | Understanding Isotopes  |
| <b>Atomic Physics D: Applications</b> | <b>Learning Outcome 1:</b> Describe an application of nuclear energy (other than fusion reactors).   | Food Irradiation  |
|                                       | <b>Learning Outcome 2:</b> Identify the type of fuel used in that application.   | Food Irradiation  |
|                                       | <b>Learning Outcome 4;</b> Identify some of the main uses of the specific application of nuclear energy.   | Food Irradiation  |
|                                       | <b>Learning Outcome 6:</b> State some of the facts that supporters of nuclear energy use to substantiate their position for the use of that application.             | Food Irradiation  |
|                                       | <b>Learning Outcome 7:</b> Identify some of the concerns that critics raise regarding the use of nuclear energy for the specific application.                        | Food Irradiation  |
|                                       | <b>Learning Outcome 9:</b> Develop a position which either supports or rejects the use of nuclear energy for a specific application.                                 | Food Irradiation  |
|                                       | <b>Learning Outcome 10:</b> Defend a position which either supports or rejects the use of nuclear energy for a specific application.                                 | Food Irradiation  |
| <b>BIOLOGY 30</b>                     | <b>Common Essential Learning:</b> To enable students to understand and us the vocabulary, structure and forms of expression which characterize the study of biology. | Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy                                 |
| <b>Unit 3 Genetics</b>                | <b>Learning Objective 2.6:</b> Describe the causes and effects of both chromosome and gene mutations.  | Biological Effects of Radiation<br>Biological Effects of Radiation Jeopardy<br>Flying the Radioactive Skies |
| <b>SOCIAL STUDIES</b>                 |  |   |
| <b>SOCIAL STUDIES 20</b>              |  |   |
| <b>Unit 3 Concept: Environment</b>    | <b>Foundation Objective:</b> Know that resources are those parts of the environment considered valuable because they meet human needs.                               | Attack of the 50 Ft. Monster<br>Safety in the Nuclear Industry Jeopardy                                     |

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|  |   | Canada's Nuclear History Jeopardy<br>The Atomic Age |
|  | <b>Foundation Objective:</b> Practise dialectical thinking skills: make a value claim expressing what is good, right, or worthwhile concerning a problem; and provide lines of support for taking that particular position on the issue. Set out the counter argument to the issue and provide lines of support for it; and come to a dialectical conclusion. | Attack of the 50 Ft. Monster<br>The Atomic Age      |