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Nuclear Mousetraps

Quebec - Achievements and Competencies

Learning Outcomes

Cycle 2 (Gr. 9-10)	Chemistry (Sec. 5)
Nuclear changes	Reaction rate
Transformation of energy	
Structure of matter	

The Quebec Achievements and Competencies are based on the Progression of Learning Outcomes derived from the Quebec Education Plan set by the Ministere de l'Education, du Loisir et du Sport.

Specific Expectations

GENERAL EDUCATION PATH

CYCLE 2 (Gr. 9-10) — Secondary 3

MATERIAL WORLD

B. Changes
   5. Transformation of energy
      a. Forms of energy
         i) Describes different forms of energy (chemical, thermal, mechanical, radiation)
         ii) Identifies the forms of energy involved in a transformation (e.g. electrical to thermal in a toaster, electrical to radiation in an infrared lamp)

In this activity, students will set up and watch a chain reaction, which is analogous to the chain reaction that occurs in nuclear fission. Students should identify that at the very beginning of the reaction, the system of golf balls and mousetraps has a little bit of kinetic energy in the form of the first rolling ball. The system has mostly potential energy in the form of the set mousetraps.

C. Organization
   1. Structure of matter
      a. Atom
         ii) Defines the atom as the basic unit of the molecule

Students should discuss the similarities and differences between the nuclear mousetrap model and a real nuclear reaction. They should identify that each mouse-trap-and-golf-ball unit is analogous to an atom in a nuclear reaction, with the golf ball representing a neutron. Have them note that most atoms contain multiple neutrons, and that in a nuclear fission reaction the nucleus of the atoms split apart to form two new atoms.

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EST Secondary 4

MATERIAL WORLD

B. Changes
- 3. Chemical changes
  - m. Endothermic and exothermic reactions
    - i) Distinguishes an endothermic reaction from an exothermic reaction according to perceptible signs (e.g. temperature variations, emission of light)

In *Nuclear Mousetraps*, students will learn that nuclear fission is an exothermic reaction because it releases energy in the form of heat, electromagnetic radiation, and kinetic energy. An endothermic reaction absorbs energy into the system from the environment, rather than releasing energy.

- 4. Nuclear changes
  - b. Radioactivity
    - i) Defines radioactivity as the emission of particles or energy by the nuclei of atoms following nuclear transformations

Students will learn that nuclear fission releases electromagnetic radiation. Teachers can use this activity to introduce the concept of radioactivity, which is defined as the emission of particles or energy by the nuclei of atoms following nuclear transformations - in this case, fission.

  - c. Fission and fusion
    - i) Distinguishes nuclear fission from nuclear fusion

Students will come to understand nuclear fission through this activity. They will learn that a nuclear fission reaction is a nuclear chain reaction where a neutron hits the nucleus of an atom, resulting in more free neutrons that hit the nuclei of other atoms.

C. Organization
- 1. Structure of matter
  - a. Atom
    - ii) Defines the atom as the basic unit of the molecule
  - b. Molecule
    - i) Describes a molecule using Dalton's atomic model (combination of atoms linked by chemical bonds)
  - i. Neutron
    - i) Describes the position and electrical charge of the neutron in an atom

Students should discuss the similarities and differences between the nuclear mousetrap model and a real nuclear reaction. They should identify that each mouse-trap-and-golf-ball unit is analogous to an atom in a nuclear reaction, with the golf ball representing a neutron. Students should note that most atoms contain multiple neutrons, and that in a nuclear fission reaction the nucleus of the atoms split apart to form two new atoms.

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APPLIED GENERAL EDUCATION PATH

CYCLE 2 (Gr. 9-10) — Secondary 3

MATERIAL WORLD

B. Changes
- 4. Transformation of energy
  - a. Forms of energy
    - i) Describes different forms of energy (chemical, thermal, mechanical, radiation)
    - ii) Identifies the forms of energy involved in a transformation (e.g. electrical to thermal in a toaster, electrical to radiation in an infrared lamp)

In this activity, students will set up and watch a chain reaction, which is analogous to the chain reaction that occurs in nuclear fission. Students should identify that at the very beginning of the reaction, the system of golf balls and mousetraps has a little bit of kinetic energy in the form of the first rolling ball. The system has mostly potential energy in the form of the set mousetraps.

C. Organization
- 1. Structure of matter
  - a. Atom
    - ii) Defines the atom as the basic unit of the molecule
  - b. Molecule
    - i) Describes a molecule using Dalton's atomic model (combination of atoms linked by chemical bonds)

Students should discuss the similarities and differences between the nuclear mousetrap model and a real nuclear reaction. They should identify that each mouse-trap-and-golf-ball unit is analogous to an atom in a nuclear reaction, with the golf ball representing a neutron. Have them note that most atoms contain multiple neutrons, and that in a nuclear fission reaction the nucleus of the atoms split apart to form two new atoms.

SE Secondary 4

MATERIAL WORLD

B. Changes
- 3. Chemical changes
  - m. Endothermic and exothermic reactions
    - i) Distinguishes an endothermic reaction from an exothermic reaction according to perceptible signs (e.g. temperature variations, emission of light)

In *Nuclear Mousetraps*, students will learn that nuclear fission is an exothermic reaction because it releases energy in the form of heat, electromagnetic radiation, and kinetic energy. An endothermic reaction absorbs energy into the system from the environment, rather than releasing energy.

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Strategies

A. EXPLORATION STRATEGIES

4. Becoming aware of his or her previous representations
6. Formulating questions
7. Putting forward hypotheses (e.g. individually, in teams, as a class)
10. Imagining solutions to a problem in light of his or her explanations
11. Taking into account the constraints involved in solving a problem or making an object (e.g. specifications, available resources, time allotted)
13. Using different types of reasoning (e.g. induction, deduction, inference, comparison, classification)
16. Collecting as much scientific, technological and contextual information as possible to define a problem or predict patterns
19. Considering various points of view on scientific or technological issues

B. INSTRUMENTATION STRATEGIES

4. Using different tools for recording information (e.g. diagrams, notes, graphs, procedures, logbook)
5. Using a variety of observational techniques and tools

C. ANALYTICAL STRATEGIES

1. Identifying the constraints and important elements related to the problem-solving situation
3. Using different types of reasoning (e.g. inductive and deductive reasoning, comparison, classification, prioritization) in order to process information
4. Reasoning by analogy in order to process information and adapt scientific and technological knowledge

D. COMMUNICATION STRATEGIES

3. Exchanging information
4. Comparing different possible explanations for or solutions to a problem in order to asses their relevance (e.g. full-group discussion)
5. Using tools to display information in various formats (e.g. data tables, graphs, diagrams)