a WOW Lab BLUEPRINT

'c' is for Chocolate

Quebec - Achievements and Competencies

Learning Outcomes

Cycle 2 (Gr. 9-10)
Waves

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

E. Waves

a. Frequency

i) Defines the frequency of a wave as the number of cycles per second (Hz)

In *'c' is for Chocolate*, students will melt chocolate in a microwave oven in order to measure the wavelength of the electromagnetic waves of the microwave. They will then use the value for the wavelength, as well as the frequency of the microwave oven, listed in the manual, to calculate the speed of light. It is important that students understand the concept of frequency and its role in this experiment.

b. Wavelength

i) Defines wavelength as the distance between two identical points on a wave at a given time (e.g. distance between crests)

ii) Describes the relationship between wavelength and energy (e.g. X-rays, which are high-energy waves, have a short wavelength)

Students will measure the distance between the melted antinodes in the chocolate to determine the wavelength of the electromagnetic waves of the microwave. Students can discuss that high-energy waves have a short wavelength. They will recognize that the energy of microwaves is greatest as the antinodes.

e. Electromagnetic spectrum
   i) Locates different areas on the electromagnetic spectrum (e.g. radio waves, visible light, X-rays)

Students learn that microwaves use electromagnetic waves, which have an electric and a magnetic component. They carry both energy and momentum. The energy at the antinodes is the highest, so the chocolate melts at the antinodes. Teachers can use this activity to introduce the electromagnetic spectrum to students and use it to discuss other waves, such as radiowaves and X-rays.

APPLIED GENERAL EDUCATION PATH

CYCLE 2 (Gr. 9-10) — Secondary 3

MATERIAL WORLD

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   b. Wavelength
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Techniques

A. Technology
- 2. Manufacturing
  - b. Measuring and laying out
    - i) Identifies the unit of measurement on the instrument
    - ii) Positions the measuring instrument to obtain reliable reference points
    - iii) Adopts the appropriate position for reading an instrument

B. Science
- g. Collecting samples
  - i) Collects samples appropriately (e.g. sterilizes the container, uses a spatula, refrigerates the sample)

C. Techniques common to Science and Technology
- b. Interpreting the results of measurement
  - i) Determines the error attributable to a measuring instrument (e.g. the error in a measurement made using a graduated cylinder is provided by the manufacturer or corresponds to half of the smallest division on the scale
  - ii) Estimates the errors associated with the user and the environment when taking a measurement
  - iii) Expresses a result with a significant number of digits that takes into account the errors related to the measure (e.g. a measurement of 10.35 cm taken with a ruler graduated in millimetres should be expressed as 10.4 cm or 104 mm)

Strategies

A. EXPLORATION STRATEGIES
- 3. Referring to similar problems that have already been solved
- 4. Becoming aware of his or her previous representations
- 5. Drawing a diagram for the problem or illustrating it
- 6. Formulating questions
- 7. Putting forward hypotheses (e.g. individually, in teams, as a class)
- 8. Exploring various ways of solving the problem
- 9. Anticipating the results of his or her approach
- 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)
- 12. Examining his or her mistakes in order to identify their source
- 13. Using different types of reasoning (e.g. induction, deduction, inference, comparison, classification)
- 14. Using empirical approaches (e.g. trial and error, analysis, exploration using one's senses)
- 15. Ensuring that the procedure is appropriate and safe and making the necessary adjustments
- 17. Generalizing on the basis of several structurally similar cases
- 19. Considering various points of view on scientific or technological issues

B. INSTRUMENTATION STRATEGIES

3. Using technical design to illustrate a solution (e.g. diagrams, sketches, technical drawings)
4. Using different tools for recording information (e.g. diagrams, notes, graphs, procedures, logbook)
5. Using a variety of observational techniques and tools
6. Selecting suitable techniques or tools for observation

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)