smarter science éduca sciences

INITIATE & PLAN

- Identifying a problem or need through curious observation
- Defining testable questions, researching and considering possible answers and solutions
- Revisiting observations and predictions to improve testable question

Observing
Using the 5 senses to find out about objects and events: their characteristics, properties, differences, similarities, and changes. Observation can be made directly with the senses or indirectly through the use of simple or complex instruments.

Questioning
A strategy to make meaning or wonder about uncertainties.

Searching
Gathering information from a variety of sources, developing self-reliance in acquiring library and Internet skills.

Interviewing
Asking and corresponding to gain primary information.

Inferring
Using logic to draw conclusions from the results of investigating/problem-solving.

Predicting
Predictions are not random guesses but speculations of what may occur in the future based on prior knowledge, observations, and reasoning.

Hypothesizing
Making educated guesses or predictions based on evidence that must be tested through experimentation to establish credibility. Hypotheses guide investigations from which further predictions can be made. Hypotheses generally follow an "If....., then....., because..." statement format.

Modeling
Constructing physical/concrete or abstract representations of ideas, objects or events to clarify explanations or demonstrate relationships. Models are used to reinforce concepts, demonstrate learning, and/or illustrate phenomena which cannot be directly observed.

Selecting
Choosing an action from various alternatives based on justifiable reasons.

PERFORM & RECORD

- Developing and safely carrying out an investigation
- Observing, collecting, and recording results

Using Instruments
Knowing the instrument's parts, how it works, how to adjust it, its proper use for a given task, its limitations; knowing how to store it and transport it safely.

Calibrating
Checking, adjusting, or determining by comparison with a standard (e.g., calibrating a thermometer, balance, timer or other instrument).

Measuring
Assigning numbers to observations, e.g., metric units, time, student-generated units, using appropriate measuring devices and techniques.

Recording
Noting, documenting, tabulating, charting; working systematically, working regularly.

Planning
Working systematically, regularly organizing for future, seeing possible results.

Designing
The overall plan or strategy by which hypotheses/research questions and technological problems are answered (with or without innovation).

Gathering Data
Collecting evidence through measurements, facts, figures, pieces of information, statistics (either historical or derived by calculation), experimentation, surveys, etc.

Demonstrating
Setting up apparatus, making it work, describing parts and functions, illustrating scientific principles.

Constructing
Putting together component parts; to build or erect.

Inventing
Designing something useful, for the first time, through the use of the imagination, ingenious thinking and/or experimentation.

Experimenting
Carrying out a designed investigation to test a hypothesis or answer a question.

ANALYZE & INTERPRET

- Reviewing results carefully by examining data and identifying patterns
- Deciding what the results mean
- Evaluating and refining solutions

Comparing
Looking for similarities.

Contrasting
Looking for differences.

Classifying
Putting things into groups and subgroups, identifying categories, deciding between alternatives.

Outlining
Employing major headings and subheadings; using sequential, logical organization.

Graphing
Visually representing data.

Reviewing
Picking out important items, memorizing, associating.

Analyzing
Seeing implications and relationships, discerning causes and effects, locating new problems.

Evaluating
Recognizing good and poor features; judging and assessing.

COMMUNICATE

- Explaining procedures and results through writing, speaking, visual or electronic means
- Reflecting on the process and checking with peers

Discussing
Engaging in oral, written, or any other appropriate form of communication with others.

Explaining
Clearly describing, clarifying main points and focusing on the "why" and/or "how" of the issue, concept or idea.

Reporting
Organizing and presenting information in a written or oral format.

Writing
Conveying information (e.g., questions, observations, experimental report) by graphical means.

Reflecting
The activity of either an individual or group that involves analyzing, judging the importance of, and making connections to the learning experience.

Defending
Supporting any and all aspects of inquiry using logical arguments backed up with evidence.

Teaching
Making meaning of concepts or processes by organizing them into key facts and ideas and clearly conveying them to others.

BEGINNING

EXPLORING

EMERGING

COMPETENT

PROFICIENT

ENGAGE | EXPLORE | EXPLAIN | EXTEND

ASSESS & EVALUATE

Adapted from research by Trowbridge, Bybee and Powell 2000

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Curricular Competencies per Grade Levels *(BC Science Framework Column)*

Questioning and Predicting *(Initiate & Plan)*

- **Wondering**
  - Demonstrate curiosity and a sense of wonder about the world (K-2)
  - Demonstrate curiosity about the natural world (3,4)
  - Demonstrate a sustained curiosity about a scientific topic or problem of personal interest (5-9)
- **Observing**
  - Observe objects and events in familiar contexts (K-4)
  - Make observations in familiar or unfamiliar contexts (5,6)
  - Make observations aimed at identifying their own questions about the natural world (7-9)
- **Questioning**
  - Ask simple questions about familiar objects and events (K-2)
  - Identify questions about familiar objects and events that can be investigated scientifically (3-4)
  - Identify questions to answer or problems to solve through scientific inquiry (5-8)
  - Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world (9)
- **Hypothesizing**
  - Make simple predictions about known objects and events (1-2)
  - Make predictions based on prior knowledge (3-4)
  - Make predictions about the findings of their inquiry (5-8)
  - Formulate alternative "If... then..." hypotheses based on their questions (7-8)
  - Formulate multiple hypotheses and predict multiple outcomes (9)

Planning and conducting (*Initiate & Plan; Perform & Record*)

- **Using Instruments**
  - Safely manipulate materials (K)
  - Safely manipulate materials to test ideas and predictions (1-2)
  - Safely use appropriate tools to make observations and measurements, using formal measurements and digital technology as appropriate (3-4)
  - Observe, measure, and record data, using appropriate tools, including digital technologies (5-6)
  - Observe, measure, and record data (qualitative & quantitative), using equipment, including digital technologies, with accuracy and precision (7-8)
  - Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (9)
- **Measuring and Recording**
  - Make exploratory observations using their senses; make simple measurements using non-standard units (K)
  - Make and record observations (1-2)
  - Make and record simple measurements using informal or non-standard methods (1-2)
  - Safely use appropriate tools to make observations and measurements, using formal measurements and digital technology as appropriate; collect simple data (3-4)

    - Observe, measure, and record data, using appropriate tools, including digital technologies; choose appropriate data to collect to answer their question (5-6)
    - Observe, measure, and record data (qualitative & quantitative), using equipment, including digital technologies, with accuracy and precision (7-8)
    - Use appropriate SI units and perform simple unit conversions (7-9)
    - Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (9)
- **Planning and Experimenting**
    - Suggest ways to plan and conduct an inquiry to find answers to their questions (3-4)
    - With support, plan appropriate investigations to answer their questions or solve problems they have identified; decide which variable should be changed and measured for a fair test (5-6)
    - Collaboratively plan a range of investigation types, including field work and experiments, to answer their questions or solve problems they have identified; measure and control variables (dependent & independent) in fair tests (7-8)
    - Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative & quantitative) (9)
- **Designing and Assessing**
    - Consider ethical responsibilities when deciding how to conduct an experiment (3-6)
    - Ensure that safety and ethical guidelines are followed in their investigations (7-9)
    - Assess risks and address ethical, cultural and/or environmental issues associated with their proposed methods and those of others (9)

Processing and analyzing data and information *(Analyze & Interpret)*

- **Representing**
    - Represent observations and ideas by drawing charts and simple pictographs (K)
    - Sort and classify data and information using drawings, pictographs and provided tables (1-4)
    - Use tables, simple bar graphs or other formats to represent data and show simple patterns and trends (3-4)
    - Construct and use a variety of methods, including tables, graphs, and digital technologies as appropriate, to represent patterns or relationships in data (5-6)
    - Construct and use a range of methods to represent patterns or relationships in data, including tables, graphs, key, scale models, and digital technologies as appropriate (7-8, implied in 9)
- **Analysing**
    - Discuss observations (K)
    - Compare observations with predictions through discussion (1-2)
    - Use tables, simple bar graphs or other formats to represent data and show simple patterns and trends (3-4)
    - Identify simple patterns and connections (1-4)
    - Identify patterns and connections in data (5-6)
    - Seek patterns and connections in data from their own investigations and secondary sources (7-8)

    - Seek and analyze patterns, trends, and connections in data, including describing relationships between variables and identifying inconsistencies (9)
    - Construct, analyze and interpret graphs (including interpolation and extrapolation), models and/or diagrams (9)
- **Explaining**
    - Identify simple patterns and connections (1-2)
    - Compare results with predictions, suggesting possible reasons for findings (3-4)
    - Compare data with predictions and develop explanations for results; demonstrate an openness to new ideas and a consideration of alternatives (5-6)
    - Use scientific understandings to identify relationships and draw conclusions (7-8)
    - Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (9)

Evaluating *(Assess & Evaluate)*

- **Reviewing and Reflecting**
    - Express and reflect on personal experiences of place (K-2)
    - Express and reflect on personal or shared experiences of place (3-4)
    - Express and reflect on personal or shared or others' experiences of place (5-6)
    - Express and reflect on a variety of experiences and perspectives of place (7-8)
    - Express and reflect on a variety of experiences, perspectives and worldviews through place (9)
    - Compare observations with those of others (1-2)
    - Make simple inferences based on their results and prior knowledge; reflect on whether an investigation was a fair test (3-4)
    - Evaluate whether their investigations were fair tests; identify possible sources of error; suggest improvements to their investigation methods (5-6)
    - Reflect on their investigation methods, including the adequacy of controls on variables (dependent and independent) and the quality of the data collected; identify possible sources of error and suggest improvements to their investigation methods (7-8)
    - Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions; describe specific ways to improve their investigation methods and the quality of the data (9)
- **Evaluating Ethics**
    - Experience and interpret the local environment (k-9)
    - Consider some environmental consequences of their actions (1-2)
    - Identify some simple environmental implications of their and others' actions (3-4)
    - Identify some of the social, ethical, and environmental implications of the findings from their own and others' investigations (5-6)
    - Consider social, ethical, and environmental implications of the findings from their own and others' investigations (7-9)
- **Evaluating Information**
    - Demonstrate an understanding and appreciation of evidence (3-4)
    - Identify some of the assumptions and given information in secondary sources; Demonstrate an understanding and appreciation of evidence (5,6)

- Demonstrate an awareness of assumptions and bias in their own work and secondary sources; demonstrate an understanding and appreciation of evidence (qualitative & quantitative) (7,8)
- Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and secondary sources; exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations to evaluate claims in secondary sources; critically analyze the validity of information in secondary sources and evaluate the approaches used to solve problems; consider the changes in knowledge over time as tools and technologies have developed; Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modeled (9)

Applying and innovating *(Extend)*

- Transfer and apply learning to new situations (K-9)
- Generate and introduce new or refined ideas when problem solving (K-9)
- Take part in caring for self, family, classroom and school through personal approaches (K-2)
- Take part in caring for self, family, classroom, school and neighbourhood through personal approaches (3-4)
- Contribute to care for self, others and community through personal or collaborative approaches (5-6)
- Contribute to care for self, others, community and world through personal or collaborative approaches (7-9)
- Co-operatively design projects (3-8);
- Contribute to finding solutions to problems at a local and/or global level through inquiry; Consider the role of scientists in innovation (9)

Communicating *(Communicate)*

- **Creating and Sharing**
  - Share observations and ideas orally (K)
  - Communicate observations and ideas using oral or written language, drawing, or role play (1-2)
  - Represent and communicate ideas and findings in a variety of ways such as diagrams and simple reports, using digital technologies as appropriate (3-4)
  - Communicate ideas, explanations and processes in a variety of ways (5-6)
  - Communicate ideas, findings, and solutions to problems using scientific language, representations, and digital technologies as appropriate (7-8)
  - Formulate physical or mental theoretical models to describe a phenomenon; communicate scientific ideas, information, and perhaps a suggested course of action, for a specific purpose and audience constructing evidence-based arguments and using appropriate scientific language, conventions, and representations (9)