The practices of science and technological design support students in acquiring a better understanding of how scientific knowledge is produced and how solutions to practical problems are designed. Students engaging in scientific inquiry and design activities simultaneously use both knowledge and skills, which deepens their understanding of concepts and provides exposure to the many approaches that are used in science and technology. These practices are outlined in detail in *Grades 5 to 8 Science: Manitoba Curriculum Framework of Outcomes.*

**SCIENTIFIC INQUIRY**
- Asking Questions and Making Predictions
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Obtaining, Evaluating, and Communicating Information

**DESIGN PROCESS**
- Identifying and Defining Practical Problems
- Researching, Planning, and Choosing a Solution
- Constructing and/or Testing the Prototype or Consumer Product
- Evaluating and Optimizing the Solution

**INTERACTIONS WITHIN ECOSYSTEMS**
- Ecosystems and their changes
  - O1 02 03 04 05 06 07 7-0-8d 8f 8g 9a 9b 9e 9f
- The transfer of energy in ecosystems
  - O1 08 09 10 11
- The role of decomposers in ecosystems
  - O1 12 13 14 15

**PARTICLE THEORY OF MATTER**
- The particle theory of matter
  - O1 03 04 05 06 13 14 15 16 17 20 21 22 23
- Temperature and energy transfer
  - O1 02 07 08 09 10 11 12
- Pure substances and mixtures
  - O1 13 14 18 19 7-0-8d

**FORCES AND STRUCTURES**
- Internal and external forces
  - O1 03 04 05 06 07 11 12
- Shapes and components of structures
  - O1 02 08 09 10 11 12

**EARTH’S CRUST**
- Earth’s structure
  - O1 02 03 05
- Erosion and weathering
  - O1 04 09 10
- Geological resource extraction and its impact
  - O1 06 07 08 11 15 7-0-8d 8e 8g 9e
- Theories explaining continental movement and geological activity on Earth
  - O1 12 13 14 15 7-0-8b 9a 9b
**Curriculum Overview**

**Cluster 1: Interactions Within Ecosystems**
- Living things are dependent on their environmental interactions with other living things and with non-living factors; natural processes as well as human actions can have impacts on ecosystems.

**Cluster 2: Particle Theory of Matter**
- Scientific theories provide explanations for observable phenomena; they become accepted by the scientific community when they are shown to be the best explanation for the phenomena. For example, many properties of matter can be explained using the particle theory of matter.

**Cluster 3: Forces and Structures**
- Internal and external forces act on structures.

**Cluster 4: Earth's Crust**
- Earth consists of a hard but solid inner core, a liquid outer core, a mantle, and a crust. The processes that occur within Earth and on Earth's surface form different types of rock.

**Knowledge and Understanding**

- **CURRICULUM OVERVIEW**
- **DESIGN**
- **SCIENTIFIC**
- **QUESTIONING**
- **SELECTION**
- **EXPERIMENTATION**
- **ANALYSIS**
- **EVALUATION**
- **COMMUNICATION**

**SKILLS**

- **INTERACTING WITHIN ECOSYSTEMS**
  - 1a: As a question and make predictions.
  - 1c: Identify and define practical problems.
  - 2a: Plan and carry out investigations.
  - 2b: Research and choose a solution.
  - 2c: Analyze and interpret data.
  - 2d: Obtain, evaluate, and communicate information.

- **PARTICLE THEORY OF MATTER**
  - 3a: Ask questions and make predictions.
  - 3b: Plan and carry out investigations.
  - 3c: Analyze and interpret data.
  - 3d: Evaluate and optimize the solution.

- **FORCES AND STRUCTURES**
  - 4a: Ask questions and make predictions.
  - 4b: Plan and carry out investigations.
  - 4c: Analyze and interpret data.
  - 4d: Obtain, evaluate, and communicate information.

- **EARTH'S CRUST**
  - 5a: Ask questions and make predictions.
  - 5b: Plan and carry out investigations.
  - 5c: Analyze and interpret data.
  - 5d: Evaluate and optimize the solution.
## Science Practices

### ASKING QUESTIONS AND MAKING PREDICTIONS

Science inquiry begins with a child’s sense of wonder about the world. Asking questions stimulates curiosity, promotes the development of ideas, promotes discussion, helps clarify concepts, and can lead to a deeper understanding of a concept. As students progress across the grades, their questions should become more relevant, focused, and sophisticated, which requires teaching effective questioning strategies and giving students opportunities to ask and refine their questions. Making predictions is also an important part of science inquiry. Using prior knowledge, observations, and reasoning, students develop ideas to predict possible answers to questions, rather than simply making random guesses.

### PLANNING AND CARRYING OUT INVESTIGATIONS

Throughout their schooling, students are expected to plan and carry out, with appropriate levels of support, investigations in the field or laboratory, working collaboratively as well as individually; investigations gradually become more systematic and require clarifying what counts as data and identifying variables that could affect an investigation. The data and observations that are collected are used to test existing understandings, revise them, or develop new understandings.

### ANALYZING AND INTERPRETING DATA

Student investigations produce data that must be displayed and analyzed in order to derive meaning. Because patterns and trends in data are not always obvious, a range of tools including tables, graphical representations, and visualizations are used to identify significant features and patterns in the data and to interpret the results of the investigation.

### OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION

Students engage with multiple sources to obtain information that is used to evaluate the merit and validity of their claims, methods, and investigation designs. They develop facility with communicating clearly and persuasively the method(s) used and the ideas generated. Critiquing and communicating ideas individually and in groups is a critical activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as orally, in writing, and through extended discussions.

### IDENTIFYING AND DEFINING PRACTICAL PROBLEMS

Technological problem solving involves identifying and defining problems that need to be solved. In order to define a problem, students identify the goals or criteria (what the solution needs to have) as well as constraints (limitations such as available tools and materials, time, dimensions, cost, environmental impact, etc.). At the Middle Years level, a second facet of the design process is introduced to students. The evaluation of consumer products does not involve the construction of a model or prototype, but rather simulates the decision-making process of a consumer when purchasing a product.

### RESEARCH, PLANNING, AND CHOOSING A SOLUTION

Research can be necessary to better understand a problem and to identify possible solutions or to make the best choice. Students conduct their own research and consider multiple possible solutions to a given problem. They can then choose the best solution by comparing each possible solution against the criteria and constraints that have been identified.

### CONSTRUCTING AND/OR TESTING THE PROTOTYPE OR CONSUMER PRODUCT

Engineering uses models and simulations to analyze and test solutions to a problem. Students develop a plan to construct and/or test a prototype or consumer product against the criteria and constraints that were identified.

### EVALUATING AND OPTIMIZING THE SOLUTION

Optimizing the design solution involves a process in which solutions are systematically tested and refined and the final design or decision is improved by trading off less important features for those that are more important.

For more information about scientific inquiry and student expectations across the grades, consult *Grades 5 to 8 Science: A Foundation for Implementation*.

For more information about the design process and student expectations across the grades, consult *Grades 5 to 8 Science: A Foundation for Implementation*.