Continuum of Science Skills Grades 9
DRAFT October 2017

Summary

By the end of **Grade 9,** students develop questions that can be investigated using a range of inquiry skills. They design procedures that include the control and accurate measurement of variables and orderly collection of data and describe how they considered ethics and safety. They analyse trends in data, identify relationships between variables and reveal inconsistencies in results. They scrutinize their methods and the quality of their data, and explain specific actions to improve the quality of their evidence. They evaluate others' methods and explanations from a scientific perspective and use appropriate language and representations when communicating their findings and ideas to specific audiences.

Focus on Scientific Inquiry

	Broad Areas / Skills	Grade 9
Science as a Human Endeavour	Nature and development of science	• Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community • Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries
	Use and influence of science	• People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions • Advances in science and emerging sciences and technologies can significantly affect people's lives, including generating new career opportunities • The values and needs of contemporary society can influence the focus of scientific research

	Broad areas of skills	Grade 9	
Scientific Inquiry Skills	Initiating and Planning: The skills of questioning, identifying problems and developing preliminary ideas and plans.	Asking questions and defining problems	• Identify questions based on observations • Identify questions to investigate arising from practical problems and issues (208-2) • Rephrase questions in a testable form and clearly define practical problems (208-1) • State a prediction and a hypothesis based on background information or an observed pattern of events (208-5) • Support a question or prediction with an explanation • Identify dependent and independent variables in the hypothesis (if-then) • Use models to make testable predictions based on scientific evidence
		Safety procedures	• Demonstrate a knowledge of WHMIS standards by using proper techniques for handling and disposing of lab materials (209-7) • Select and use apparatus and materials safely (213-8)
		Fair testing	• Identify and manipulate the appropriate variable, while keeping all others constant, when multiple variables are present. • Design an experiment identifying and controlling major variables (212-3)
		Experimental design	• Identify strengths and weaknesses of different methods of collecting and displaying data (210-3) • Evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making (212-8) • Select and defend the choice of using either a population or a sample of a population to answer a question
	Performing and Recording: The skills of carrying out a plan of action that include gathering evidence by observation and, in most cases, manipulating materials and equipment.	Procedure	• Follows and explain procedures and adapt or extend procedures where required • Compose procedures and test to identify the strengths and weaknesses of this procedure.
		Observing	• Make observations, form inferences, and collect information that is relevant to a given question or problem (205-5) • Use observable characteristics to distinguish an object or system from a similar object or system
		Measuring	• Determine surface area of composite 3-D objects to solve problems • Draw and interpret scale diagrams of 2-D shapes • Estimate measurements (209-2) • Identify potential sources and determine the amount of error in measurement (210-10) • Use instruments effectively and accurately for collecting data (213-3)
		Recording	• Use scientific terminology to label representations • Continue to use relevant computer technology for recording data • Explore more complex types of charts and graphs. • Select most appropriate form of data collection

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		Organizing Data	• Compile and display data by hand and computer in a variety of formats (including diagrams, flow charts, bar, line, and circle graphs) (210-2) • Organize data in a way that allows for analysis and comparison with known information and allow for replication of results (*209-4) • Predict the value of a variable by interpolating or extrapolating from graphical data (210-4) • Interpret patterns and trends in data, and begin to infer and explain relationships among the variables (*210-6) • Explore the effect of bias, use of language, ethics, cost, time and timing, privacy, and cultural sensitivity on the collection of data • Construct, label and interpret histograms to solve problems
	Analyzing and Interpreting: The skills of examining information and evidence; of processing and presenting data so that they can be interpreted; and of interpreting, evaluating and applying the results. Including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data.	Constructing Explanations	• Defend a given position on an issue or problem, based on evidence (*211-5) • Draw a conclusion based on experimental data and explain how evidence supports or refutes an initial idea (210-11) • Continue to devise ways of making something complex comprehensible such as inventing models or analogies • Construct models by selecting metaphors that help to explain phenomena and revises them in light of new information • Identify, and suggest explanations for discrepancies in data (210-7) • Evaluate the usefulness of different information sources in answering a given question (206-4)
		Evaluating and explanations	• Receive, understand, and act on the ideas of others (211-1) • Continue to identify flaws in own arguments and modify and improve the arguments, in response to criticism, • Identify potential applications of findings (210-12) • Use reasoning and evidence to construct a rebuttal or a counter argument to someone else's argument
	Communication and Teamwork: The skills of communicating scientific ideas and information for a particular purpose using appropriate scientific language, conventions and representations	Conventions, vocabulary and format	• Communicate questions, ideas, intentions, procedures and results using lists, notes in point form, sentences, charts, graphs, drawings, and oral language and other means (211-2) • Choose a format of communication appropriate to purpose (e.g. reports data tables, scientific models) • Consistently use the conventions of written language in final products • Work collaboratively to develop and carry out investigations

N.B. Check gr. 10 math for alignments

Focus on problem solving

Broad areas of skills	Grades 9 & 10
Initiating and Planning: The skills of questioning, identifying problems and developing preliminary ideas and plans.	• identify questions to investigate arising from practical problems • propose and assess alternative solutions to a given practical problem, select one and develop a plan • evaluate and select appropriate procedures and instruments for collecting data and information and for solving problems
Performing and Recording: The skills of carrying out a plan of action that include gathering evidence by observation and, in most cases, manipulating materials and equipment.	• research, integrate and synthesize information from various print and electronic sources relevant to a practical problem • construct and test a prototype device or system • troubleshoot problems as they arise • select and use tools, apparatus and materials safely
Analyzing and Interpreting: The skills of examining information and evidence; of processing and presenting data so that they can be interpreted; and of interpreting, evaluating and applying the results.	• evaluate designs and prototypes on the basis of self-developed criteria; e.g., function, reliability, cost, safety, efficient use of materials, impact on the environment • analyze alternative solutions to a given problem • identify potential strengths and weaknesses of each • recommend an approach to solving the problem based on findings • solve problems by selecting appropriate technology to perform manipulations and calculations • identify new questions and problems that arise from what was learned • evaluate potential applications of results
Communicating and Teamwork: The development and communication of science ideas are collaborative processes.	• work collaboratively to test a prototype device or system and troubleshoot problems as they arise • select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate findings and conclusions • evaluate individual and group processes used in planning and carrying out problem-solving tasks

N.B. Problem solving is an iterative process. The objective is to bring the desired decision or result closer to discovery with each repetition. It is approached differently from scientific inquiry where there is a skills progression. Good reference source, *Science Buddy Engineering Design Process* https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps#theengineeringdesignprocess