Classroom Assessment Resource Package Science 10-12

This resource package was developed by a team of secondary science teachers who applied the conceptual framework presented in the Framework for Classroom Assessment to create classroom assessment support materials focused on the Curricular Competencies of the Science 10-12 curriculum. The criteria categories, criteria, and sample applications included in this document have been developed by teachers for teachers. They are not required and are intended only to support teachers when developing their own criteria-based classroom assessment applications to inform their teaching and to support student learning.

BRITISH COLUMBIA | Ministry of Education

Criteria Categories and Criteria for Science 10-12

Criteria categories	Grades 9-10	Grades 11-12
Questioning	• Makes and records accurate and precise observations • Asks a testable question that can be answered through scientific inquiry • Makes multiple predictions for an outcome • Formulates multiple hypotheses	• Makes observations based on personal, local, or global relevance that could launch a sustainable and viable investigation • Asks testable, increasingly abstract questions suitable for answering through scientific investigations (including, but not limited to, inquiries, experiments, innovations, and studies) • Makes multiple justifiable predictions for an outcome • Formulates multiple hypotheses
Procedures and Evidence	• Plans and uses a variety of investigation methods and materials to safely collect reliable data • Performs experiments using dependent and independent variables • Accurately collects and records data using a variety of tools • Finds and uses data from a variety of reliable sources	• Designs a research protocol to collect evidence to support investigations • Conducts relevant background research to frame the problem or question being investigated • Plans and uses appropriate investigative methods and materials to safely collect reliable data • Uses a variety of tools to accurately collect and record data that reflect appropriate SI units, scientific notation, and significant figure
Analyzing and Evaluating	• Seeks, analyzes, and represents patterns and relationships among variables • Draws conclusions consistent with data • Evaluates experimental methodology and sources of error and their impact on data • Identifies bias and evaluates validity of data in primary and secondary sources	• Analyzes relationships and patterns among variables by performing calculations and constructing models (e.g., graphs, diagrams) • Draws conclusions consistent with evidence and connected with current scientific understanding • Identifies inconsistencies within and between multiple sources of evidence and suggests areas for further investigation • Evaluates experimental methodology, including sources of error and their impact on data, such as uncertainty • Suggests specific ways to improve their investigation methods and data quality • Evaluates the validity and limitations of a model or analogy

Criteria category	Grades 9-10	Grades 11-12
Perspectives and Ethics	• Evaluates social, ethical, and environmental implications in investigations • Considers perspectives relevant to a given context and/or place • Applies First Peoples perspectives and knowledge as sources of information	• Considers environmental, technological, economic, and ethical impacts and sustainability in planning and conducting investigations • Evaluates ethical implications and personal and/or cultural bias in the context of the scientific investigations, applications, and practices • Connects approaches, findings, and implications with the relevant context (e.g., place-based perspectives) • Applies First Peoples perspectives and knowledge as sources of information
Communication	• Creates an effective model to describe a phenomenon • Clearly and concisely communicates scientific ideas and information • Expresses and reflects on place through a variety of methods • Provides supportive and constructive feedback during collaborative planning, sharing, and reflection	• Creates and uses an effective model to describe a phenomenon • Clearly and concisely communicates scientific ideas and information, using appropriate scientific language and conventions • Contextualizes ideas and findings for a given audience and within our current scientific understanding • Provides supportive and constructive feedback during collaborative planning, sharing, and reflection, using appropriate scientific language and conventions

Sample Application for Science 10

Co-creating a Chemistry Experiment

This sample offers a student self-assessment tool that can be used in whole or in parts as students design and implement a lab procedure and analyze and communicate their findings. The author of this application develops student understanding of each science criteria category with her students before asking them to assess all aspects within one task.

Background

There are many opportunities for Science 9 and 10 students to collaborate and work with others to conduct scientific investigations. When working in groups, students have opportunities to think and communicate like scientists; they must agree on roles and ideas as they develop a design protocol for an experiment. Students develop not only their investigative skills but also their communication and collaboration competencies as they work together to carry out a shared task.

This sample addresses all of the Science 10 Curricular Competencies, drawing specific criteria from the Science assessment framework to support a laboratory design and implementation task. To prepare for reflection and self-assessment, students will need to be familiar with the Science 10 Curricular Competencies. This may require activation of prior learning from the previous school year. To ensure that my Grade 10 students are prepared, I start by strategically developing one to two Curricular Competencies at the beginning of Science 9. For instance, I usually focus on the “Communicating” and “Questioning and Predicting” organizers and layer the other Curricular Competencies in as we work toward our inquiry-based Science Fair, which addresses all of the Curricular Competencies.

As students are developing their skills during introductory learning tasks in Science 9, I start with observing how they share ideas, make predictions/hypotheses, use appropriate scientific language, and address a given audience. By scaffolding their learning around these competencies and strategically layering additional Curricular Competencies over time during our Science 9 course, by Science 10 students are well versed in the Science 10 Curricular Competencies. Given this context, the task below can be used to pre-assess students’ understanding and their ability to think and communicate like scientists.

Task

Students work in small groups (2-3 people) to design a chemistry experiment based on a given set of materials. They spend the first day deciding what they will investigate, agreeing on a research question and hypothesis, predicting possible outcomes, collaborating to discuss safety and ethical issues, designing their protocol, creating their data collection tables, and sharing their design with the teacher and/or the whole class. On the second day, they select roles and conduct their experiment, collect data, clean up, decide how to interpret and share their data, and work together to complete an analysis and conclusion, which they submit as a group.

Self-assessment applications

The following two self-assessments may be used as exit slips at the end of both days. The first day's self-assessment is designed to help determine whether students are ready for next steps, gain a better understanding of their skill development, and determine where they may need additional support going into the second day of the lab. The second day's self-assessment is designed to increase students' awareness of what they are learning and prompt them to consider what they have learned in the context of the chemistry unit.

For both self-assessments, I also include space for students to add anything else they want to share with me about the process, as well as space for me to provide feedback based on my observations as the teacher. The latter aims to guide students from one day to the next and to help them identify areas they may not have identified as areas to revisit before the second day. Teacher feedback on the second-day self-assessment aims to highlight areas of strength and areas of growth. Creating space for student voice and teacher observation in addition to the final lab write-up helps to create triangulation in these formative assessment pieces. Embedding formative feedback into daily practice will support students as they continue to develop their Curricular Competencies throughout the course.

Day 1: Self-assessment criteria

Criteria categories	Criteria
Questioning	• Asks a testable question that can be answered through scientific inquiry • Makes multiple predictions for an outcome • Formulates multiple hypotheses
Procedures and Evidence	• Plans and uses a variety of investigation methods and materials to safely collect reliable data • Performs experiments using dependent and independent variables
Perspectives and Ethics	• Considers perspectives relevant to a given context and/or place
Communication	• Provides supportive and constructive feedback during collaborative planning, sharing, and reflection

Day 1: Check-in

Answer the questions below and include evidence to show where you are with your planning and learning today.

How are things going so far?

Questions to consider	Choose one: **Working on it…** or **Got it!**	**Evidence to support your choice**
Do you have a solid research question/hypothesis? What predictions have you and your group made for what you think may happen tomorrow?		
How have you and your group considered safety as part of your planning? Have you and your group clearly defined your variables? Do you know what you are manipulating and what you are measuring?		
How did you and your group consider everyone's opinions? Did you consider multiple perspectives and more than one way of knowing about something?		
Did you and your group provide constructive feedback to others during your planning and sharing today? What role did you take in this process?		

What else do you want your teacher to know about your planning and learning today?

Here's what I noticed:

Day 2: Self-assessment criteria

Criteria categories	Criteria
Questioning	• Makes and records accurate and precise observations
Procedures and Evidence	• Accurately collects and records data using a variety of tools
Perspectives and Ethics	• Evaluates social, ethical, and environmental implications in investigations
Communication	• Clearly and concisely communicates scientific ideas and information • Provides supportive and constructive feedback during collaborative planning, sharing, and reflection

Day 2: Check-in

Answer the questions below and include evidence to indicate how everything worked out and what you and your group found out.

How did everything work out?

Questions to consider	Choose one: **Working on it…** or **Got it!**	Evidence to support your choice
How well did you and your group make observations today? Did you and you group make accurate and precise observations today? What could you have improved on?		
How did the data collection go today? Did you and your group accurately collect and record data? What methods did you use? What, if anything, would you have done differently?		
How did you and your group consider the implications of your data? How did you decide how/if it fits within what we know about chemistry so far? How did you and your group consider everyone's opinions when it came to analyzing the collected data?		
How did you and your group communicate your findings? Was this method the most effective? Did you and your group provide constructive feedback to others during the data collection and analysis process? What role did you take in this process?		

What else do you want your teacher to know about your learning process and your experimental findings from today?

Here's what I noticed:

Sample Application for Earth Sciences 11

Designing a Model that Demonstrates a Form of Geological Resource Extraction

This application features a single-point rubric for teachers and/or peers to provide formative feedback to students as they design a model. It is designed to support the development and assessment of competencies organized under the following criteria categories from the Science 11/12 framework:

- Analyzing and Evaluating
- Perspectives and Ethics
- Communication

Rationale

In Earth Sciences 11, we often use students' model building as a product and can miss the opportunity to develop and communicate the scientific thinking and communicating that goes on behind the scenes. If we take a content area (e.g., geological resource extraction) and layer on the thinking and communicating aspects as the focus of our work, can we enhance the transferability of the experience to new contexts.

In this activity, students are asked to synthesize information from multiple perspectives and to present it using a model that will allow their audience to clearly understand the extraction technique, the potential results of extracting geological resources, and ways to mitigate risks.

Through this learning activity, students may prototype and redraft models based on one or two opportunities for peer feedback. Feedback can be captured with the "Geological Resource Extraction Model – Feedback Sheet" outlining key criteria.

The learning activity

Research the methods used to extract geological resources extracted in B.C. and develop a model that would help explain the process to the general public.

The information shared on your model should include:

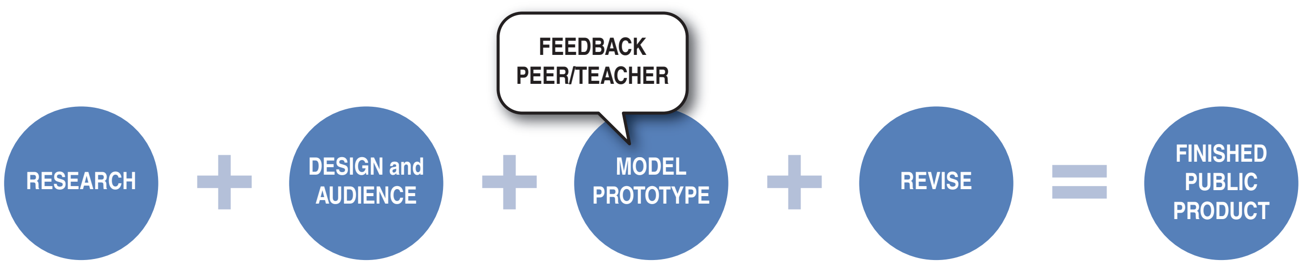
- economic impacts
- material science of extraction
- cause and effect
- reclamation

Teacher notes

- Target criteria categories and criteria:

Criteria categories	Criteria
Analysis and Evaluating	• Evaluates the validity and limitations of a model or analogy
Perspectives and Ethics	• Considers environmental, technological, economic, and ethical impacts and sustainability in planning and conducting investigations
Communication	• Creates and uses an effective model to describe a phenomenon • Clearly and concisely communicates scientific ideas and information, using appropriate scientific language and conventions • Contextualizes ideas and findings for a given audience and within our current scientific understanding

- Expose students to a wide variety of models and definitions of a model:
  - Students should be aware of what makes a quality model and could co-design the criteria for a model.
  - Students should be able to communicate possible shortcomings and challenges of models (e.g., plate boundary models, cell models, solar system models, atomic models)
- Have students discuss their intended audience and identify what their audience knows, as well as common misconceptions:
  - Students could have conversations with their parents, peers, or other adults in the school about their understanding of the form of geological resource extraction they are modelling.
  - Students can identify words that may be challenging to the public and that may need defining.



Geological Resource Extraction Model – Feedback Sheet

Name of model creator: ______________________ **Name of peer giving feedback:** ______________________

Project description: ____

	Recommendation	Criteria	Extensions
Analysis and Evaluating	•	Evaluates the validity and limitations of a model or analogy	•
Perspectives and Ethics	•	Considers environmental, technological, economic, and ethical impacts and sustainability in planning and conducting investigations	•
Communication	•	Creates and uses an effective model to describe a phenomenon	•
	•	Clearly and concisely communicates scientific ideas and information, using appropriate scientific language and conventions	•
	•	Contextualizes ideas and findings for a given audience and within our current scientific understanding	•

*Comments should be made on a minimum of three of the five criteria.

Sample Application for Environmental Science 11

Biodiversity Hotspot: Infographic

This sample application features a task designed to help students develop the Curricular Competencies of the Environmental Science 11 curriculum. The Science 11 criteria categories and criteria relevant to this task are outlined below. Also included is a rubric that may be used formatively by students and teachers as the work is happening and/or as a summative tool.

Criteria categories	Grade 11-12 criteria
Procedures and Evidence	• Plans and uses appropriate investigative methods and materials to safely collect reliable data • Uses a variety of tools to accurately collect and record data that reflect appropriate SI units, scientific notation, and significant figures
Analyzing and Evaluating	• Analyzes relationships and patterns among variables by performing calculations and constructing models (e.g., graphs, diagrams) • Draws conclusions consistent with evidence and connected with current scientific understanding • Identifies inconsistencies within and between multiple sources of evidence and suggests areas for further investigation • Evaluates experimental methodology, including sources of error and their impact on data, such as uncertainty
Communication	• Creates and uses an effective model to describe a phenomenon • Clearly and concisely communicates scientific ideas and information, using appropriate scientific language and conventions • Contextualizes ideas and findings for a given audience and within our current scientific understanding • Provides supportive and constructive feedback during collaborative planning, sharing, and reflection, using appropriate scientific language and conventions

Task

Conduct research about a biodiversity hotspot and create an overview by constructing an infographic.

Your infographic should clearly communicate information about the hotspot through images, charts, and some text. When deciding which information to include, select only the information that you consider essential for a clear understanding about the hotspot. Include references for all information used.

Content

1. Your infographic may include any of the following background information:
    - locations
    - socio-economic context
    - endemic species and impacts of alien species
    - major threats (indirect and direct)

- impacts of climate change
- impacts on the Aboriginal population (e.g., how has it impacted species used as food or medicine)

2. Propose a solution that would help manage a threat to the hotspot. Explain challenges (e.g., economic, social, or technological limitations) that could prohibit its implementation or effectiveness and suggest how to overcome these challenges (e.g., if the technology does not exist, describe what innovations are needed).

Submit all research and references with your infographic.

Assessment rubric

Criteria category	Emerging	Developing	Proficient
Procedures and Evidence	Gathers relevant information, including images, charts, and text with references.	Uses a variety of relevant, credible, and referenced sources that reflect current scientific understanding.	Uses a variety of relevant, credible, and referenced sources that reflect current scientific understanding. Bias considered when determining credibility of sources.
Analyzing and Evaluating	Proposed solution applies known ideas related to the threat. Identifies challenges.	Proposed solution applies new ideas related to the threat. Explains relevant challenges.	Proposes innovative solution to the threat. Addresses implications and limitations.
Communication	Images, charts, and text increase audience knowledge about hotspot.	Selected images and charts support clarity of text and audience understanding of hotspot. Language is appropriate to background of audience.	Selects essential and impactful information that promotes deep understanding of hotspot. Language and layout of the infographic are appropriate and effective.

Rubric design:

- This is a three-point rubric, consistent with the practice in the author's school.
- For a four-point rubric, *extending* exceeds the *proficient* benchmark. The lack of a description of extending criteria is intentional, as the author finds that a description limits student creativity – the very hallmark of the author's interpretation of *extending*.

Cross-curricular links: Related Big Ideas from Explorations in Social Studies 11:

1. Rapid industrialization, urbanization, and economic growth in Asia in the late 20th century have created complex social, political, and environmental challenges.
2. Decision making in urban and regional planning requires balancing political, economic, social, and environmental factors.

Sample Application for Life Sciences 11

National Energy Board (NEB) Oral Hearing

This sample application focuses on the development and assessment of the following Science 11/12 criteria categories and criteria:

Criteria categories	Grade 11-12 criteria
Perspectives and Ethics	• Considers environmental, technological, economic, and ethical impacts and sustainability in planning and conducting investigations • Evaluates ethical implications and personal and/or cultural bias in the context of the scientific investigations, applications, and practices • Connects approaches, findings, and implications with the relevant context (e.g., place-based perspectives) • Applies First Peoples perspectives and knowledge as sources of information
Communication	• Creates and uses a model to describe a phenomenon • Clearly and concisely communicates scientific ideas and information, using appropriate scientific language and conventions • Contextualizes ideas and findings for a given audience and within our current scientific understanding • Provides supportive and constructive feedback during collaborative planning, sharing, and reflection, using appropriate scientific language and conventions

The sample also features a rubric created using the Science 11/12 criteria categories, which may be used formatively by students and teachers as the work is happening and/or as a summative tool.

Scenario

The corporation BCOil has submitted an application to the NEB for the construction of an oil pipeline from the ABC oil field near Prince George through town LMN to Port XYZ near Prince Rupert. This pipeline would have a 60 cm diameter and transport heavy crude to oil tankers for overseas customers. BCOil also plans to construct a pipeline maintenance facility near LMN.

The NEB has scheduled an oral hearing at the community centre in LMN.

Reference: NEB *Hearing Process Handbook*

Question

Should BCOil be permitted to construct an oil pipeline from the ABC oil field through town LMN to Port XYZ?

Objective

Devise and present arguments and responses that support your assigned position – supporter or opponent – to a regulatory panel that will create a recommendation for the federal government.

Format

An NEB Panel will facilitate a hearing, with groups of supporters and opponents taking turns presenting evidence and cross-examining.

Three teams:

- NEB Panel – impartial group of 4-5 members who must be familiar with the potential benefits and impacts of an oil pipeline (i.e., must be familiar with economics, engineering, environment, law, etc.)
- Supporters – for example, representatives of the ABC oil field and BCOil, unemployed resident of LMN, store owner in LMN, First Nation with royalty agreement
- Opponents – for example, international environmentalist group, employed resident of LMN, ecotourism company in LMN, First Nation along coast near Port XYZ

Requirements for the NEB Panel:

1. Prepare a Hearing Order that outlines a List of Issues based on the public interest; for example:
    - design and safety of the project
    - environmental matters
    - socio-economic and land matters
    - impact of the project on directly affected Aboriginal groups
    - impact of the project on directly affected persons
    - financial responsibility of the applicant
    - economic feasibility of the project
    - Canadian public interest
2. Provide any stakeholder with clarification on the List of Issues as necessary. This may consist of arranging a Technical/Procedural Conference between Supporters and Opponents to identify, clarify, narrow, and/or resolve issues prior to the hearing.
3. Set up room seating for the speaker and witness, with areas for the Panel, Supporters, and Opponents.
4. Facilitate the hearing by coordinating speakers and witnesses, and maintain control of the hearing to ensure respect and fairness at all times. Supporters and Opponents must take turns presenting evidence and should only speak when called upon by the Panel.
5. Ask questions of speakers and witnesses to ensure that the evidence is reliable, thorough, and consistent.
6. Carefully listen to all evidence and responses provided by each stakeholder team to:
    - individually, prepare a written summary of your own decision and reasoning based on the List of Issues
    - collectively, devise and present a recommendation based on the List of Issues with reasoning that clarifies this recommendation; the recommendation may include limitations on the pipeline's construction to limit its impact on stakeholders

Requirements for stakeholder teams – Supporters and Opponents:

1. Elect a team leader who is responsible for coordinating evidence for your team and liaise with your teacher.
2. Prior to the hearing:
    - Conduct research to prepare evidence and a group of witnesses who can explain or answer questions on your evidence. Research should include contacting relevant organizations and professional experts. Evidence refers to reports, statements, photographs, and other material or information that supports your view and must be relevant to the List of Issues.
    - Provide written evidence for the NEB Panel and other stakeholder team that explains the impact on each of your stakeholders. All submissions must be organized, complete, and relevant to the List of Issues.
    - Create an Information Request to ask for additional information for clarification from the Panel or other stakeholder team as necessary.
    - For each speaker and witness, prepare oral statements of your evidence and potential responses for questions from the Panel and other stakeholder team. Statements should be supported with appropriate graphics.
    - Coordinate the order of speakers and witnesses. A speaker can call upon a witness to present evidence or respond to a question. **Note:** Each stakeholder should have multiple opportunities to contribute during the hearing.
    - Prepare a final argument that summarizes your evidence.
3. During the hearing:
    - During alternating turns, present an oral statement to the Panel.
    - During cross-examination, reply to questions from the Panel or other stakeholders about your evidence.
    - After an oral statement from the other stakeholder team, try to support your position by asking appropriate questions about their evidence.
    - Once both sides have presented all evidence, revise and present a final argument based on evidence presented during the hearing. Note: New evidence cannot be submitted in a final argument.

Timeline

Event	Date
Release of List of Issues	
Team preparations	
Technical/Procedure Conference	
Written submissions	
Hearing	
Announcement of Panel decision	
Individual reflection	

Assessment rubric

Criteria category	Emerging	Developing	Proficient
Perspectives and Ethics	Contributions (statements or responses) represent position of assigned stakeholder or team.	Contributions support position of assigned stakeholder or team. Connection with public interest is considered.	Contributions strongly support position of assigned stakeholder or team. Public interest (e.g., economics, environment, or social) impacts position and recommendations.
Communication	Presents arguments and responses that are supported with evidence.	Arguments and evidence contain sufficient detail to inform but not overwhelm Panel (i.e., in language and level appropriate to Panel members' background).	Arguments, evidence, and reasoning effectively inform and engage Panel emotionally or intellectually.

Rubric design:

- The benchmark for each level characterizes the evidence for that progression of quality.
- This is a three-point rubric, consistent with the practice in the author's school.
- For a four-point rubric, *extending* exceeds the *proficient* benchmark. The lack of a description of extending criteria is intentional, as the author finds that a description limits student creativity – the very hallmark of the author's interpretation of *extending*.

Other opportunities:

1. Cross-curricular: Coordinate with Social Studies class (e.g., Economics or Law) – Social Studies students can organize the legal process, while Science students gather and present evidence.

   Big Ideas:

   - Decision making in urban and regional planning requires balancing political, economic, social, and environmental factors (Urban Studies 12)
   - A society's laws and legal framework affect many aspects of people's daily lives (Law Studies 12)
   - Examining questions in philosophy allows people to question their assumptions and better understand their own beliefs (Philosophy 12)

2. Place-based: Adapt the process for a town hall meeting about a local topic (e.g., new fish farm, CNG plant, mine).

Sample Application for Physics 11-12

Summative inquiry project as a final assessment of Curricular Competencies

This sample application features a summative assessment of all Curricular Competencies through either an inquiry lab or an engineering design cycle. The criteria categories are used as design specifications and are shared with students so they know the framework for planning and conducting the assessment.

Goal

The goal of the summative inquiry project is for students to explore a topic of interest to them to in greater depth, while demonstrating mastery of Curricular Competencies. The project is intended as a final, summative assessment of Curricular Competencies. It is suggested that students conduct their project collaboratively with one partner.

Background

Now that students have developed an understanding of major course concepts, they are well equipped to apply this understanding in the design of their own investigation. Throughout the course, students have already developed Curricular Competencies through two different investigative structures: the scientific method ("inquiry lab") and the engineering design cycle ("design lab").

In an inquiry lab, students apply the scientific method to investigate a hypothesis and establish a relationship between variables. In a design lab, students follow the engineering design cycle to develop a solution to a problem through prototyping.

Students are familiar with both investigative structures, and they choose their preferred structure for the summative inquiry project. The investigative structures are detailed in the charts that follow. The Grade 11/12 Criteria column is for the teacher's reference and could be removed to allow the chart to function as a single-point rubric for summative assessment.

Topic examples

In previous investigations, the topic or inquiry question has been provided by the teacher. In the summative inquiry project, students select their own topic. Here are some examples of student-generated inquiry questions:

- Physics 11 (inquiry lab) – How are the number of pulleys in a simple machine related to the required applied force to lift a load over a vertical distance?
- Physics 11 (design lab) – How can we build a compact insulating device to optimize heat retention for a mug of hot water?
- Physics 12 (inquiry lab) – For a mass on a string swung in a horizontal, circular path, how is the centripetal force related to the radius of the string?
- Physics 12 (design lab) – How can we construct a paper loudspeaker using principles of electromagnetism?

Checkpoints

It is recommended that two checkpoints be established to support students in the preliminary stages of their investigations:

- Checkpoint 1: Students submit their topic of investigation
- Checkpoint 2: Students submit their tentative investigation plan

The purpose of these checkpoints is for students to share their ideas with the teacher and receive relevant feedback. At each checkpoint, student-teacher dialogue provides an important opportunity to support students in the early stages of their investigation and to formatively assess their progress.

Materials

Students are expected to acquire their own materials above and beyond what is available at the school, including instruments and tools for data collection. Because of the open-ended nature of this investigation, students may require support in sourcing the required materials.

Investigative Structure for Inquiry Lab

Criteria categories	Inquiry lab (Students will…)	Grades 11-12 criteria
Questioning	• Consider multiple outcomes to formulate testable **hypotheses** with clearly defined variables	• Asks testable, increasingly abstract questions suitable for answering through scientific investigations (including, but not limited to, inquiries, experiments, innovations, and studies) • Formulates multiple hypotheses
Procedures and Evidence	• Conduct detailed and relevant background **research** to support hypotheses • Choose appropriate investigation **methods** and equipment to collect relevant data • Use significant figures, SI units, and scientific notation appropriately to record **data**	• Conducts relevant background research to frame the problem or question being investigated • Plans and uses appropriate investigative methods and materials to safely collect reliable data • Accurately collects and records data using a variety of tools reflecting appropriate SI units, scientific notation, and significant figures
Analyzing and Evaluating	• Apply physics concepts and calculations during **data analysis** • Construct and interpret **graphs** to represent data trends • Explain **patterns** in data and **relationships** between variables • Formulate **conclusions**, consistent with evidence, that demonstrate deep understanding of concepts • Identify all **sources of error**, uncertainty, confounding variables, and/or possible alternative explanations • Suggest methods to **improve on** and **extend** the investigation	• Analyzes relationships and patterns among variables by performing calculations and constructing models (e.g., graphs, diagrams) • Draws conclusions consistent with evidence and connected with current scientific understanding • Identifies inconsistencies within and between multiple sources of evidence and suggests areas for further investigation • Evaluates experimental methodology, including sources of error and their impact on data, such as uncertainty • Suggests specific ways to improve their investigation methods and data quality
Perspectives and Ethics	• Connect investigation materials, methods, and outcomes with potential environmental, economic, social, and ethical **impacts**	• Considers environmental, technological, economic, and ethical impacts and sustainability in planning and conducting investigations • Connects approaches, findings, and implications with the relevant context (e.g., place-based perspectives) • Applies First Peoples perspectives and knowledge as sources of information
Communicating	• Create a professional, well-structured **lab report** that relies on scientific language to detail the investigative process	• Clearly and concisely communicates scientific ideas and information, using appropriate scientific language and conventions

Investigative Structure for Design Lab

Criteria categories	Design lab (Students will…)	Grades 11-12 criteria
Questioning	• Generate an **inquiry question** suitable for investigation using the engineering design cycle • Predict multiple imaginative **solutions**	• Asks testable, increasingly abstract questions suitable for answering through scientific investigations (including, but not limited to, inquiries, experiments, innovations, and studies) • Makes multiple justifiable predictions for an outcome
Procedures and Evidence	• Conduct detailed and relevant background **research** to support multiple imaginative **solutions** • Choose appropriate investigation **methods** and equipment to construct and test **prototypes** • Use significant figures, SI units, and scientific notation appropriately to record **data**	• Conducts relevant background research to frame the problem or question being investigated • Plans and uses appropriate investigation methods and material to safely collect reliable data • Accurately collects and records data using a variety of tools reflecting appropriate SI units, scientific notation, and significant figures
Analyzing and Evaluating	• Apply physics concepts and calculations during **data analysis** • Construct and interpret **graphs** to represent prototype performance • Formulate **conclusions**, consistent with evidence, that demonstrate deep understanding of concepts • Identify all **sources of error**, uncertainty, confounding variables, and/or possible alternative explanations • Suggest methods to **improve prototype** and data quality	• Analyzes relationships and patterns among variables by performing calculations and constructing models (e.g., graphs, diagrams) • Draws conclusions consistent with evidence and connected with current scientific understandings • Evaluates experimental methodology, including sources of error, and their impact on data, such as uncertainty • Suggests specific ways to improve their investigation methods and data quality
Perspectives and Ethics	• Connect investigation materials, methods, and the scale of prototype implementation with environmental, economic, social, and ethical **impacts**	• Considers environmental, technological, economic, and ethical impacts and sustainability in planning and conducting investigations • Connects approaches, findings, and implications with the relevant context (e.g., place-based perspectives) • Applies First Peoples perspectives and knowledge as sources of information
Communicating	• Create a professional, well-structured **lab report** that relies on scientific language to detail the design cycle process	• Clearly and concisely communicates scientific ideas and information, using appropriate scientific language and conventions