

## APPLY SCIENTIFIC INQUIRY AND SCIENTIFIC HABITS OF MIND

### Performance Standard 11A/13A/13 B.G

Students will apply the concepts, principles and processes of scientific inquiry within classroom investigations accordingly:

- *Knowledge*: Understand the concepts, principles and processes of scientific inquiry.
- *Application*: Apply the appropriate scientific habits of mind when investigating science concepts.
- *Communication*: Incorporate scientific technologies and the processes of scientific inquiry into classroom investigations and reports.

**Note to teacher:** These concepts could be embedded into scientific inquiry investigations. Suggested activities for standards 12 A, 12 B, 12 E and 12 F at stage G, incorporate many of the performance descriptions for Standard 11A.

### Procedures

1. ***In order to know and apply the concepts, principles and processes of scientific inquiry (11A) and the accepted practices of science (13A) and apply scientific technologies (13B)***, students should experience sufficient learning experiences to develop the following:
  - Construct inquiry cause-effect hypothesis associated with the classroom curricular concepts.
  - Differentiate qualitative and quantitative data and their appropriate usefulness in the investigation.
  - Use appropriate models (conceptual, mathematical or physical, etc.) for foundation of investigation.
  - Deliberate and explain the choice of applicable variables to test hypothesis.
  - Determine choice of direct, indirect or remote investigation processes.
  - Preview pertinent sources of scientific research related to historic and current foundations for similar studies as primary reading sources.
  - Design and conduct inquiry investigation which finds answers to posed hypotheses/questions.
  - Use scientific technologies to collect, store, retrieve and communicate data, as applicable.
  - Incorporate appropriate safety precautions and materials and equipment handling directions to minimize safety hazards.
  - Follow classroom rules for preparation, procedures and clean-up.
  - Recognize the necessity of controlled variables, carefully and accurately recorded objective observations and replicable multiple trials.
  - Prepare data tables, charts and visualizations.
  - Document observational and graphic data (using appropriate labels and metric units) accurately with appropriate precision.
  - Identify faulty procedural steps which could cause different results and record observations accurately and honestly.
  - Interpret and represent analysis of results to produce findings.
  - Observe trends within data sets.
  - Evaluate data sets to explore and explain outliers, sources of error, or discrepancies in the data set.
  - Analyze observations and data which may support or refute hypothesis.
  - Cite applicable scientific principles and theories.
  - Explain why similar investigations should, but may not produce similar results or conclusions.
  - Communicate the investigation's hypothesis, procedure and explanations orally and in written format for peer review within the classroom (or beyond classroom).
  - Critiquing findings from investigations (self and peers).
  - Generate further questions which address alternative investigations.
  - Reflect on procedural refinements.
  - Evaluate related investigations for consolidation or refinement of procedures or explanations.
  - Identify how scientific habits of mind (scientific reasoning, insight, skill, creativity, intellectual honesty, tolerance of ambiguity, skepticism, persistence, and openness to new ideas) are integral in the investigation.

2. Separated assessment of 11A may not be practical. Significant research has demonstrated the value of inquiry-based life-long learning for students. The emphasis of scientific inquiry is incorporated into the wording of all performance descriptions for Goal 12, in stages A-J. A spiraling inquiry-based curriculum is encouraged for all classrooms at all stages. Specific performance descriptions may be emphasized in different inquiry investigations in order to build mastery of each concept or process of scientific inquiry.
3. See suggested procedures for 12A, 12B, 12E, and 12F at stage G for specific assessment features.

**Examples of Student Work not available**

**Time Requirements**

- Initial introduction of processes may require additional time as needed by students.