

## APPLY SCIENTIFIC INQUIRY AND SCIENTIFIC HABITS OF MIND

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

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, B, C, and 13A at stage I, incorporate many of the performance descriptions for Standard 11A, 13A and 13B.

### 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 the concepts that describe the interaction between science, technology and society (13B)*, students should experience sufficient learning experiences to develop the following:

- Formulate inquiry hypothesis, associated with:
  - Pure and applied life, environmental, chemical, physical, earth or space science concepts.
  - Questions to test, confirm, or compare science concepts, investigations, models, theories or laws.
  - Claims used in advertising and marketing strategies.
  - Personal and future interests.
- Propose options for appropriate questions, procedural steps and necessary resources.
- Reference pertinent reliable prior research as primary reading sources.
- Design inquiry investigation which addresses proposed hypothesis.
- Determine variables, experimental error and control groups.
- Choose appropriate technologies for observing and measuring directly, indirectly or remotely.
- Incorporate all procedural precautions, materials and equipment handling directions and data-collecting preparations.
- Follow established procedures to maintain personal and environmental safety when handling and disposing of chemicals.
- Estimate risks/benefits to alternative procedures.
- Consider use of scale models, prototypes and simulations to test hypothesis.
- Secure approval for all procedures, equipment use and safety concerns.
- Conduct scientific investigation.
- Use selected technologies using all procedural steps and safety precautions.
- Complete multiple, statistically-valid trials.
- Record all data accurately and precisely.
- Interpret and represent analysis of results to produce findings.
- Project trends within data sets.
- Evaluate data sets to explore and explain outliers and sources of error in the data set.
- Apply statistical methods to compare mode, mean, percent error and frequency functions.
- Analyze observations and data which may support or refute hypothesis.
- Cite applicable scientific principles and theories.
- Research classroom and real-world standards for peer review.
- Report, display and defend the process and findings of investigation for peer review in open forum.
- Critiquing findings from investigations (self and peers).
- Generate further questions which address alternative investigations.
- Explaining impact of possible sources of error.
- Reflect on and evaluate peer critiques.
- Evaluate comparable investigations for consolidation or refinement of procedures or explanations, and

- Identify how scientific habits of mind (scientific reasoning, insight, skill, creativity, intellectual honesty, tolerance of ambiguity, skepticism, persistence, openness to new ideas and sheer luck) are integral in the investigation.
2. Separated assessment of 11A, 13A or B 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, 12C and 13A at stage I for specific assessment features.

**Examples of Student Work not available**

**Time Requirements**

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