APPLY SCIENTIFIC INQUIRY AND SCIENTIFIC HABITS OF MIND

Performance Standard 11A/13A/13 B.J

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 issue investigations. Suggested activities for standards 12 A, B, C, and F at stage J, incorporate some 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 (13) A and concepts that describe the interaction between science, technology and society (13B),*** students should experience sufficient learning experiences to develop the following:
    - Formulate an issue-specific hypothesis**,** such as:
        - Challenges created by international cooperation and competition in scientific knowledge and technological advances.
        - Scientific breakthroughs in terms of societal and technological effects.
        - Environmental impact studies.
        - Local, state, national or global scientific policies in terms of costs, benefits and effects.
        - Scientific and technological progress and effects on job markets and everyday life.
    - Generate inquiry questions for the issue investigation.
    - Review literature as primary reading sources to validate the context for the issue investigation.
    - Trace citations from research studies for validity and reliability.
    - Differentiate qualitative/quantitative and subjective/objective data and their appropriate usefulness in the investigation.
    - Research appropriate models (conceptual, mathematical or physical, etc.) for foundation of investigation.
    - Examine applicable existing surveys or impact studies.
    - Question sources of information and representation of data.
    - Recognize selective or distorted use of data.
    - Design and conduct inquiry investigation which finds answers to posed hypotheses/questions.
    - Propose applicable survey and interview instruments and methodologies.
    - Determine pertinent research, analysis and communication components.
    - Select and test appropriate simulation models.
    - Choose applicable mathematical processes and calculations.
    - Project possible viewpoints, variables, data sets and formats for consideration.
    - Conduct issue investigation, following all applicable procedural and safety precautions.
    - Use scientific technologies to collect, store, retrieve, assimilate and communicate data, as applicable.
    - Recognize the necessity of controlled variables, carefully and accurately recorded objective observations and replicable multiple trials.
    - Follow established formats for random sampling.
    - Interview associated entities or experts.
    - Prepare data tables, charts and visualizations.
    - Document applicable observational and graphic data (using appropriate labels and metric units) accurately with appropriate precision and objectivity.
    - Interviewing scientists about how they address validity of scientific claims and theories.
    - Recognize limitation of investigation methods, sample sets, technologies or procedures.
    - Interpret and represent analysis of results to produce findings.
    - Project trends within data sets.

- Evaluate data sets to explore explanations of unexpected responses and data distractors.
- Evaluate survey validity and reliability.
- Analyze research and data which support issue resolution options.
- Substantiate basis for inferences, deductions and perceptions.
- Report, display and defend the process and findings in oral and written format for peer review within the classroom or public forum.
- Present final report for action response actions.
- Critiquing findings from investigations (self and peers).
- Generate further questions or issues for consideration.
- Reflect on procedural refinements.
- Evaluate comparable issue resolutions or responses for action for applicable correlations, consolidation or explanations.
- Generalize public opinion responses.
- Distinguish opinion from supported theory.
- Recognize discrepancies and poor argument.
- 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, or 13A 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 issue investigations in order to build mastery of each concept or process of scientific inquiry.
3. See suggested procedures for 12A, 12B, 12C and 12F at stage J for specific assessment features.

Examples of Student Work not available

Time Requirements

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