HISTORIC EARTH SCIENCE INNOVATIONS

Performance Standard 12E/11B/13A/13B.I

Students will apply the processes of technological design to research the engineering feats, innovations or models of earth sciences accordingly:

- *Knowledge*: Understand the scientific concepts, societal demands and technological design considerations faced by earth scientists historically.
- *Application*: Construct a model which replicates the engineering processes associated with the development of an earth science feat or innovation.
- *Communication*: Report the findings of the investigation and generate societal impact statements associated with the success (or failure) of the selected earth science innovation or feat.

Procedures

1. ***In order to know and apply concepts that describe the features and processes of Earth and its resources (12E), the concepts, processes and principles of technological design (11B), the accepted practices of science (13A) and the concepts that describe the interaction between science, technology and society (13B),*** students should experience sufficient learning opportunities to develop the following:
   - Identify an historic earth science engineering feat or innovation from research of the settings that necessitated new scientific or engineering solutions about:
     - Earth's atmosphere and it changes.
     - Earth's hydrosphere and its changes.
     - Earth's lithosphere and its changes.
     - Earth's interior and its changes.
   - The changing perspectives of the Earth in or from space.
   - Brainstorm the kinds of barriers or circumstances that existed in the historic setting, along with the science that was current at the time.
   - Identify the simulation materials and procedural sequence which can simulate the historic conditions.
   - Determine success criteria, design constraints and testing logistics that were encountered originally.
   - Sketch progressive schematics of the design and its construction steps.
   - Collect appropriate materials, supplies, and safety equipment.
   - Construct earth science innovation/feat model.
   - Conduct multiple trials of model/prototype according to success criteria, scale and design constraints.
   - Collect pertinent test data.
   - Compare and summarize trial data.
   - Correlate historic conditions and observations to model testing.
   - Analyze the role of pure and applied sciences in the progression of this engineering feat.
   - Identify how scientific reasoning, insight, creativity, skill, intellectual honesty, tolerance of ambiguity, skepticism, persistence, openness to new ideas and sheer luck were integral to the research.
   - Determine sources of error of testing and design flaws.
   - Communicate design evaluation report for peer review, using appropriate graphs and charts.
   - Relate historic setting and impact to scientific or engineering solution and eventual progression of designs.
   - Generate alternative design modifications which can be or could have been tested.
   - Identify how the scientific conclusions were (are) open to modification as new data are collected.

   Note to teacher: This activity relates to knowledge associated with standard 12E, while addressing the performance descriptors for stage I within standard 11B. The societal impact and accepted practices of science as described in standards 13A and 13B may be addressed effectively in the context of this study.
2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. This activity and assessment can be incorporated into various earth science curricular settings. Within that context, students should brainstorm the possible historic feats, innovations, devices that led to advances in earth science knowledge and capabilities. Brief the students about the expectations for this modeling assignment. Distribute the Student Task Sheet with checkpoint dates for periodic progress.

4. Evaluate each student's work using the Science Rubric as follows and add the scores to determine the performance level:
   - *Knowledge*: The underlying scientific concepts, historic setting, societal demands and technological design considerations for the earth science innovation were explained thoroughly with appropriate interconnections.
   - *Application*: The model was constructed and tested according to appropriate investigational procedures.
   - *Communication*: The findings of the investigation were presented in a well-detailed and thorough fashion with appropriate, well-detailed societal impact statements.

Examples of Student Work not available

Resources
- Student Task Sheet
- Science Rubric

Time Requirements
1-2 class periods for explanation of expectations and stage setting; 2-3 weeks for research and construction; 1 week for presentations and reflections

HISTORIC EARTH SCIENCE INNOVATION INVESTIGATION

The following steps outline the process for the creating a model of an historic engineering feat or innovation associated with earth science. Document your research and findings on separate pages.

1. Identify an historic earth science engineering feat, innovation or model from research of dilemmas that necessitated new scientific or engineering solutions to study:
   - Earth's atmosphere and it changes.
   - Earth's hydrosphere and its changes.
   - Earth's lithosphere and its changes.
   - Earth's interior and its changes.
   - The changing perspectives of the Earth in or from space.
2. Brainstorm the kinds of barriers or circumstances that existed in the historic setting of its creation.
3. Identify the simulation materials and procedural sequence which can simulate the historic conditions.
4. Determine success criteria, design constraints and testing logistics that were encountered originally.
5. Sketch progressive schematics of the design and its construction steps.
6. Collect appropriate materials, supplies, and safety equipment (with teacher approval).
7. Construct earth science innovation/feat model.
8. Conduct multiple trials of model/prototype according to success criteria, scale and design constraints.
9. Collect pertinent test data.
10. Compare and summarize trial data.
11. Correlate historic conditions and observations to model testing.
12. Analyze the role of pure and applied sciences in the progression of this engineering feat.
13. Identify how scientific reasoning, insight, creativity, skill, intellectual honesty, tolerance of ambiguity, skepticism, persistence, openness to new ideas and sheer luck may have been integral to the research.
14. Determine sources of error of testing and design flaws.
15. Communicate design evaluation report for peer review, using appropriate graphs and charts.
16. Relate historic setting and impact to scientific or engineering solution and eventual progression of designs.
17. Generate alternative design modifications which can be or could have been tested.
18. Identify how the scientific conclusions were (are) open to modification as new data are collected.

Progress check points:

Date:_____ Steps:_____
Date:_____ Steps:_____
Date:_____ Steps:_____