SEEDS AND SIMILARITIES

Performance Standard 12A/11A/13A.D

Students will apply the process of scientific inquiry to examine the patterns of change in life cycles of plants accordingly:

- *Knowledge*: Identify the patterns of similarities and differences in the early stages of plant growth from collected data.
- *Application*: Germinate varieties of plants to compare and contrast the patterns of growth graphically.
- *Communication*: Explain the distinctions and similarities of early plant growth from collected and analyzed data.

Procedures

1. ***In order to know and apply concepts that explain how living things function, adapt, and change 12A and the concepts, principles and processes of scientific inquiry(11A), the principles of safety and scientific habits of mind (13A), and scientific technologies (13B),*** students should experience sufficient learning opportunities to develop the following:
   - Formulate inquiry questions associated with the comparative growth of plants from their seed structure and early growth stages.
   - Propose and conduct inquiry investigation which finds answers to posed hypotheses/questions with limited variable choices (using scientific technologies and incorporating appropriate safety precautions, as well as recognizing the necessity of controlled variables).
   - Collect data for analysis to resolve proposed hypothesis statements (identifying faulty procedural steps which could cause different results and recording observations accurately and honestly).
   - Communicate the findings associated with plant growth comparisons.
   - Generate further questions for future investigations.

   Note to teacher: This activity relates to knowledge associated with standard 12A, while addressing the performance descriptors for stage D within standard 11A. Applying scientific habits of mind noted in standards 13A are foundational to these activities. Using various technologies to estimate, measure and record data address some performance descriptors in 13B.

   (Preparation note: Prepare seeds by soaking them overnight in water to soften the seed coats. Students will need to have a tray which can contain the seeds placed on and covered by moistened paper towels.)
2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Begin contextual inquiry investigation for Patterns of Change in Plants with questions such as these: Where do plants come from? Do they start out the same or different-how? How can there be similarities in things that are different? How can they grow to big plants? How do they know when to start growing? (etc.) Introduce the investigation's premise of studying seeds to consider the similarities of plant growth. Provide a grouping of seeds (common beans, corn, grass, etc.) to each group of students. Construct initial observation charts which use applicable vocabulary terms and appropriate measurements for each seed. If they can identify their seeds from prior knowledge, record their information. Determine which variables will be altered in this investigation (different seeds, different growth measurements of roots and early leaves, etc.) and which will be kept constant (watering, maintained moisture levels, temperature, etc.) Each group will need to determine the design of its data table for the investigation. Ask the students for their predictions of growth patterns at daily intervals through at least one week (two weeks will be preferable). Include projected drawings and measurements of growing plants. As the plants begin to germinate, the students should make daily observations for measurements and observed changes. (Keep the paper towels evenly moistened; if they are too wet, the seeds may mold.)
4. After sufficient time (1-2 weeks), allow students to compare their data tables (for both the information that is recorded and the ways that other students recorded their information). Did all the seeds grow at the same rate? Did all of the same kind of seeds grow at the same rate? Did all seeds grow the same way? Did all of the same kinds of seed grow the same way? When did they grow the fastest or slowest? For each question generated, find data that can answer the question. What are different ways to display the same kinds of data? Which ways are better in which ways? What kinds of mistakes could be made? How can this be detected? How can errors be reduced? Allow time for students to present their observations and explanations to their posed hypotheses orally and in written format.

5. Encourage students to generate further questions which could follow from this initial investigation: How could our seeds have grown better or faster? How could the moisture levels be kept constant? Why did some of the seeds mold? Why did some of the seeds (from the same kind of plant) grow differently? Should we test that again, etc.? Also they should question their data collection and analysis ideas: What would my data look like on a bar graph or a line graph? How can we record all of the data from the same kind of plant in different groups, etc.?
6. Evaluate each student's work using the Science Rubric as follows and add the scores to determine the performance level:
   - *Knowledge*: The patterns of similarities and differences for plant growth were complete and correct. Data analysis processes were appropriate and complete.
   - *Application*: The investigation process was appropriate and followed class directions. The graphic displays of data were complete and correct.
   - *Communication*: The graphic and narrative explanations of comparative plant growth were thorough and well-reasoned. Questions for future studies were pertinent and applicable.

Examples of Student Work not available

Time Requirements
Initial introduction: 30-40 minutes; daily observations: 10-15 minutes; closure activities: 30-40 minutes

Resources
- Dried seeds (different beans, grass, corn, popcorn)
- Containment tray, moistened paper towels
- Science Rubric