

CHAPTER 2

Science Practices and Inquiry Process Skills: How Can I Help Children Use Science and Engineering Practices to Make Discoveries?

CHAPTER OVERVIEW

Chapter 2 provides an in-depth look at the NGSS Science and Engineering Practices. The chapter also serves to help students begin to understand how they will bring inquiry to life in their future classrooms. Specifically, the authors present the inquiry process skills and provide information about how elementary students can use these skills to make discoveries. The context for this chapter is helping students apply their knowledge about the use of inquiry process skills in their future elementary classroom.

Engage

Ask students to work with a partner to define and list on paper the 12 Inquiry Process Skills presented in the chapter. Students should be encouraged to refer to their textbook.

Explore

The following activity can be conducted with the class as a whole.

It's In the Bag Activity

Prepare paper bags containing "mystery objects". Use natural objects as the mystery objects. Mark the outside of each bag with a number and a large question mark. Staple or tape each bag shut. Ask students to number a piece of paper with as many numbers as you have bags. Place the bags in a highly visible place in the classroom and ask students to try to identify the objects by any method they wish except looking at the objects in the bags. Have students write their guess about the identity of each object next to the number on their paper corresponding to the number on each bag.

Explain

The following activity can be conducted with the class as a whole.

Reveal the mystery objects from the It's In the Bag activity. Have students work again with their partner from the

Engage activity to review the list of Inquiry Process Skills they created and indicate which skills they used during

their attempts to identify the mystery objects. Finally, initiate a discussion about the probable impact of this activity if used with children in an elementary science classroom.

Elaborate

The following activity can be conducted with the class as a whole.

Have students work once again with their partner from the Engage activity to outline a sketch of a lesson plan using the following template, the components of which will be explored more fully in the next chapter, for a chosen science topic. The teaching of the science topic should incorporate the teaching of the Inquiry Process Skills to students in an elementary science classroom. Have pairs of students share their lesson plans with the class as a whole.

Creating a Sketch for a Lesson Plan

Content to be Taught: Identify What You Want Students to Learn

Identify Common Misconceptions Commonly Held about the Core Ideas

Performance Objectives

Concept Development

Engagement

Exploration

Explanation

Evaluation (Assessment)

Accommodations

Evaluate

Multiple Choice Questions

1. According to the information provided in Chapter 2 regarding facilitating students' development of questions, which of the following is not a good example of a scientific question?
 - A. Can fish hear?
 - B. Why do trees have leaves?
 - C. Is litter on the beach worse than litter in the forest?
 - D. How do thermometers work?
2. According to the authors, which of the following is the most important component of discovery learning?
 - A. Knowing what to teach as well as what not to teach
 - B. Students understanding how to make sense of the world
 - C. Facilitating deep understanding at the beginning of a unit
 - D. Grounding teaching in learning theory
3. If a child observed the symmetry of a leaf, which of the following Inquiry Process Skills would the child be employing?
 - A. Using space/time relationships
 - B. Identifying variables
 - C. Using numbers
 - D. Classifying
4. Which Inquiry Process Skill is most closely identified with a child proposing a relationship to explain a phenomenon?
 - A. Observing
 - B. Communicating
 - C. Hypothesizing
 - D. Classifying
5. A child notices that the leaves on a plant sitting on the teacher's desk have new white spots on them. The child says to the teacher, "There might be mold growing on the plant." Which of the following most closely resembles the Inquiry Process Skill the child was using?
 - A. Identifying variables
 - B. Inferring
 - C. Hypothesizing
 - D. Using space/time relationships
6. The ultimate goal inherent in discovery learning is for a student to uncover new information or glean new insight about how to approach a problem or task and then
 - A. solve the problem or complete the task on his or her own.
 - B. apply the new information with guidance from the teacher.
 - C. collaborate with classmates to discover further information.
 - D. compare the information to what he or she already knew and discover the differences.
7. According to the authors, inquiry is defined as a
 - A. way of questioning students about prior knowledge before introducing a new lesson.
 - B. very careful and systematic way of presenting science content.
 - C. very careful and systematic method of asking questions and seeking explanations.
 - D. way of questioning students about the information they have discovered to test what they have learned.
8. Experimental Design consists of several variables, and identifying these variables is one of the Inquiry Process Skills. In Experimental Design, the variable that is being tested is the

- A. hypothesis variable.
 - B. independent variable.
 - C. dependent variable.
 - D. controlled variable.
9. Observing, question, and measuring are examples of Inquiry Process Skills commonly associated with
- A. experimental modeling.
 - B. instructional modeling.
 - C. explanatory modeling.
 - D. descriptive modeling.
10. According to information presented in Chapter 2 related to the science and engineering practices, which of the following should teachers do first to facilitate their students' abilities to seek explanations?
- A. Present interpreted data
 - B. Provide explanations
 - C. Evaluate students
 - D. Ask questions

Essay/Discussion Questions

1. In this chapter, the authors provide a vision for learning science and engineering through discovery. In a paragraph, reflect on the three most important components of this vision and explain why you feel these components are important.
2. This chapter centers on the idea that elementary students need to discover new knowledge that is meaningful and offers a better explanation than their prior understanding, so as to dispel common misconceptions. Describe how you would plan instruction for a unit that will help students correct the misconception that things sink if they are heavy and float if they are light.
3. Refine the instructional plan you described in number 2 above to include two of the science and engineering practices. Name the two practices, and explain in a paragraph how you would incorporate them into your unit.
4. Imagine that you are teaching a lesson on animals, and a student raises their hand to say that insects are not animals. Describe in a paragraph what you would do in your classroom to correct this misconception by engaging your students in discovery learning but not using live insects.
5. Identify and briefly define the seven Inquiry Process Skills associated with descriptive modeling.
6. Choose one of the Inquiry Process Skills you identified and defined in question 5, and describe in four or five sentences a science activity you could do in your future elementary school classroom to provide your students practice with using that skill.
7. Identify and briefly define the two Inquiry Process Skills used to create explanations.
8. Choose one of the Inquiry Process Skills you identified and defined in question 7 above, and describe in four or five sentences a science activity you could do in your future elementary classroom to provide your students practice with using that skill.
9. Identify and briefly define the three Inquiry Process Skills used to create experimental models.
10. Choose one of the Inquiry Process Skills you identified and defined in question 9 above, and describe in four or five sentences a science activity you could do in your future elementary classroom to provide your students practice with using that skill.

Chapter 2 Multiple Choice Answer Key

1. C
2. B

3. A
4. C
5. B
6. A
7. C
8. B
9. D
10. D

Chapter 2 Essay/Discussion Model Responses

1. The vision for learning science and engineering through discovery includes the following components (3 of which should be mentioned in the response):
 - Learning that builds upon past experiences and new interactions with ideas and phenomena through exploration and manipulation
 - Students making discoveries for him/herself
 - Students engaging in the practice of doing science rather than learning about science secondhand
 - Teachers knowing both what not to teach and what to teach
 - Students using the tools of scientific inquiry
 - Teachers respecting and valuing learners and their role in constructing knowledgeResponses will vary regarding why the identified components are important.
2. Responses will vary, but should mention providing hands-on, mind-stretching experiences.
3. The science and engineering practices are as follows:
 - Asking questions and defining problems
 - Developing and using models
 - Planning and carrying out investigations
 - Analyzing and interpreting data
 - Using mathematics and computational thinking
 - Constructing explanations and designing solutions
 - Engaging in argument from evidence
 - Obtaining, evaluating, and communicating informationResponses will vary regarding how the practices will be incorporated into a unit.
4. Responses will vary, but should mention using technology, studying classification systems, and/or using images.
5. The skills are as follows:
 - Observing
 - Using space/time relationships
 - Using numbers
 - Questioning
 - Classifying
 - Measuring
 - Communicating
6. Responses will vary, but must address one of the skills identified in item 5 above.
7. The skills are as follows:
 - Inferring
 - Hypothesizing and predicting
8. Responses will vary, but must address one of the skills identified in item 7 above.
9. The skills are as follows:
 - Predicting

- Identifying variables
 - Independent
 - Dependent
 - Controlled
- Designing experimental controls

10. Responses will vary, but must address one of the skills identified in item 9 above.