

Appendix B

Detailed Summary of Learner Outcomes, Tasks, and Resources

Module 1: Doing Science / Science Standards

Learner Outcomes:

STUDENTS WILL . . .

1. Experience how both children and adults learn about the world around us.
2. Examine the processes that scientist use to discover the world around us. Compare that process to the process that children use to discover their world.
3. Compare the difference between an observation and an inference and the role each plays in science.
4. Become familiar with the Next Generation Science Standards (NGSS) as well as grade band endpoints.

Tasks and Resources:

1. “Can I See Myself?” Activity

- a. Access Document on Blackboard.
- b. Complete the science lesson and take a photograph to archive your work (participating in a procedure, evidence collected, written notes, etc.).
- c. Participate in the designated [Discussion Board](#) (start with INSTRUCTIONS).

2. “Float Your Boat” Activity

- a. Access Document on Blackboard.
- b. Complete the science lesson and take a photograph to archive your work (participating in a procedure, evidence collected, written notes, etc.).
- c. Participate in the designated [Discussion Board](#) (start with INSTRUCTIONS).

3. What is Science / How Do Scientists Do Science

- a. Watch “Nature of Science” PowerPoint on Blackboard
The presentation is narrated so make sure you have the volume on your speakers turned up. Also slide advances are imbedded in the PowerPoint so you should not advance the slides (at least the first time through). There are occasional long pauses to give you a chance to think about the question being asked.
- b. **Textbook Reading p. 1-13**

4. What is STEM: Science, Technology, Engineering, and Math

- a. This is included at the end of the Nature of Science PowerPoint

5. Children and Play (How does the process children go through as they “play” similar to and different from how scientists do science?)

- a. Reading: <http://news.mit.edu/2013/laura-schulz-profile-0214>

6. Observations (quantitative/qualitative) vs Inferences

- a. Video: <https://www.youtube.com/watch?reload=9&v=D-5HCOUGDdg> (For fun make three observations and two inferences as instructed at the end of the video.)
- b. Video: <https://www.youtube.com/watch?v=Lt3FuRpQNmE>
- c. Activity: Observation vs. Inferences
 - i. Observations vs Inferences Activity PowerPoint on Blackboard
- d. Complete written portion on **Independent Work** TEMPLATE

7. Next Generation Science Standards (NGSS)

- a. Watch the following
 - i. NGSS Overview: <https://www.youtube.com/watch?v=o9SrSBGDNfU>
 - ii. Cross-Cutting Concepts: <https://www.teachingchannel.org/video/crosscutting-concepts-achieve>
 - iii. Disciplinary Core ideas: <https://www.teachingchannel.org/video/disciplinary-core-ideas-achieve>
 - iv. NGSS Science and Engineering Practices: <https://www.teachingchannel.org/video/science-engineering-practices-achieve>
 - v. NGSS 3-dimensional learning in action:
 1. Introduction: <https://www.youtube.com/watch?v=XJBN6BX04Ms>
 2. Core ideas and cross cutting concepts: <https://www.youtube.com/watch?v=7axBNmfJhJM>
 3. How practices change: <https://www.youtube.com/watch?v=Jal6uAlZcsw>
 - vi. Supporting talk: <https://www.youtube.com/watch?v=l0-u0gMa-pU>
- b. **Textbook Readings: p. 13-24**
- c. Access the Next Generation Science Standards by Topic: <http://ngss.nsta.org/AccessStandardsByTopic.aspx> and explore for a few minutes.
- d. Examine at the PowerPoint titled “NGSS Explained” which is posted on Blackboard. Hopefully this will make the standards a bit easier to understand.
- e. Now go back and look at the Next Generation Science Standards by Topic again: <http://ngss.nsta.org/AccessStandardsByTopic.aspx>
- f. Skim the grade band endpoints documents on Blackboard.
- g. Supplementary Materials

- i. Bozeman Science NGSS Video Series:
https://www.youtube.com/playlist?list=PLlIVwaZQkS2rtZG_L7ho89oFsaYL3kUWq
- ii. Short videos on each aspect of NGSS: cross-cutting concepts, disciplinary core ideas, and practices: <http://www.bozemanscience.com/next-generation-science-standards>
- iii. The Wonder of Science: <https://thewonderofscience.com/>

8. **Familiarizing yourself with NGSS** (respond to the following prompts on the **Independent Work** TEMPLATE):

- a. In a couple of sentences, explain the significance of each of three parts of the standards (crosscutting concepts, disciplinary core ideas, and practices).
- b. What does 3-dimensional learning mean?
- c. Complete Exploration 1.4 on page 22 of your textbook. Answer the reflection questions

9. **Module 1 Reflection** (respond to the following prompts on the **Independent Work** TEMPLATE):

- a. What did you discover in Module 1?
- b. How can Module 1 be improved?

Module 2: Inquiry Based Learning

Learner Outcomes:

STUDENTS WILL . . .

1. Articulate what is meant by “teaching through inquiry.”
2. Apply the 5E method in your teaching.
3. Select an appropriate lesson to meet a given performance standard.

Tasks and Resources:

1. Inquiry-Based Learning (IBL)

Inquiry-Based Learning is also referred to as Teaching Through Inquiry

c. Watch the following:

i. What is Inquiry-Based Learning?:

<https://www.youtube.com/watch?v=u84ZsS6niPc>

ii. The Benefits of Inquiry-Based Learning:

<https://www.youtube.com/watch?v=2ylmVT5lkck>

iii. The Teacher's Role in Inquiry-Based Learning:

<https://www.youtube.com/watch?v=mdVWb27z0Zc>

iv. Constraints in adopting IBL:

<https://www.youtube.com/watch?v=DRtiNVDYTFQ>

d. Textbook readings: Chapter 4 “Learning Science with Understanding”

2. Science Instruction Scenarios – Google Survey

a. Go to the “Science Instruction Scenarios” Google Survey

(<https://forms.gle/QrS9YriZ21QQMcyT8>) and examine four K-5 science teaching vignettes similar to teaching practices one can find in any classroom today. As you read each vignette, think about what you’ve learned about inquiry based learning in this module.

b. Your assignment for each of the four scenarios is:

i. Choose the letter which best describes the lesson being taught as an inquiry-based lesson.

ii. Provide any other comments or questions (optional).

iii. You can also find a PDF containing the scenarios and options in the Module 2 folder.

iv. A summary of class results will be shared following the due date.

- v. *Note:* Completing this survey counts toward your **Discussion Board** Participation for this Module.

3. The 5E Model for Inquiry-Based Learning

- a. Watch the following
 - i. 5E Overview: <https://www.youtube.com/watch?v=OSo5R3sDXAc>
 - ii. Engage: <https://www.youtube.com/watch?v=j-wkE7V-Vxw>
 - iii. Explore: <https://www.youtube.com/watch?v=aFM4GsyR-EE>
 - iv. Explain: <https://www.youtube.com/watch?v=foNqMIFU5Ts>
 - v. Elaborate (or Extend):
<https://www.youtube.com/watch?v=PoPzxB90Ew>
 - vi. Evaluate: <https://www.youtube.com/watch?v=qsLi1hs65OY>
 - vii. 5E Review: <https://www.youtube.com/watch?v=hWCnAJ6ax6Q>
 - viii. Example of a 5E investigation:
<https://www.youtube.com/watch?v=Hlr5Th9TYGw&t=71s>
- b. 5E documents on Blackboard
 - i. The 5Es vs. Traditional Teaching
 - ii. The “5E Model Roles Summary” document list the role of teachers and students during each of the “Es.”
 - iii. Example - Identifying NGSS’s 3-dimensions and the 5Es in the Reflection Activity you did in Module 1
- c. **Textbook readings: Chapter 5 “Engaging in Inquiry-Based Instruction and Using the 5E Model”**
- d. It is important to remember that some lessons may not have all of the 5Es and that is okay. It is also true that in some lessons an activity which is part of that lesson may fall into two different Es and that is alright as well.

4. Identifying the 5Es in Science Lessons (Respond to the following prompts on the **Independent Work** TEMPLATE.)

- a. Look at and answer the **Reflection Questions 1-6 for Exploration 5.5** on page 101 of your textbook. (Note: this also involves reading Vignette 5.3 on pages 102-104 of your textbook.)
- b. Identify the 5Es in the “Float Your Boat” Activity we did in Module 1. List them in the table on the TEMPLATE and respond to additional questions reviewing NGSS/3D (standards).

5. “Inquirize” a science lesson (“decookbooking a cookbook lesson”) so that it is inquiry-based.

- a. Review two articles about “inquirizing” or “decookbooking” science lessons (in Module 2 folder on Blackboard).
 - Everett, S., & Moyer, R. (2007). “Inquirize” your teaching. *Science and Children*, 44(7), 54-57.
 - Shiland, T.W. (1997). Decookbook it! *Science and Children*, 35(3), 14-18.
Note: In addition to getting lesson ideas in these articles, highlight and

use the example strategies to transform “cookbook” lessons.

- b. Examine the “Magnets and Magnetism” 3rd grade science lesson (in Module 2 folder).
 - c. Consider ways you could transform this “cookbook” lesson into an INQUIRY-based science lesson, modeled after the “5E” approach and NGSS/3D instruction.
 - d. Participate in the designated [Discussion Board](#) (start with INSTRUCTIONS).
- 6. Lesson Plan Preparations:**
- a. Review information about your “Inquiry-Based” Science Lesson Plan project.
 - b. Overview on Syllabus (20% of overall course grade).
 - c. Additional resources in the designated folder in Blackboard → Information & Materials.
 - d. Prepare now for designing this lesson (target content, student/class context, safety measures, teacher behaviors, materials, etc.), including how you can apply content learned in this course (5E, NGSS/3D, and more to come).
- 7. Module 2 Reflection** (respond to the following prompts on the [Independent Work TEMPLATE](#)):
- a. What did you discover in Module 2?
 - b. How can Module 2 be improved?

Module 3: Developing an Inquiry-Based Learning Environment

Learner Outcomes:

STUDENTS WILL . . .

1. Develop an Inquiry-Base Science Lesson Plan.
2. Describe a classroom environment that is conducive to science discovery and safety.
3. Articulate how to use open-ended questions to probe student knowledge and understanding both before and after a lesson.

Tasks and Resources:

1. **Reminder: Ongoing Lesson Plan Preparations**

- e. Apply content and resources from class modules to develop your “Inquiry-Based” Science Lesson Plan project.
- f. Overview on Syllabus (20% of overall course grade).
- g. Additional resources in the designated folder in Blackboard → Information & Materials.
- h. Continue work in designing this lesson (target content, student/class context, safety measures, teacher behaviors, materials, etc.), including how you can apply content learned in this course (5E, NGSS/3D, and more to come).

2. **Creating a classroom environment conducive to science discovery and safety**

- a. Readings / Videos
 - **Textbook reading: Chapter 3 “Creating a Positive Classroom Environment”**
 - Classroom rules: <https://www.youtube.com/watch?v=ddvTFgzkS5M>
 - Science Lab Rules:
<https://www.youtube.com/watch?v=tsAHtOFiwNM&t=14s>
- b. In most cases at the elementary level, general classroom rules will be sufficient when performing a science investigation. However, working with chemicals or projectiles also requires the proper type of eye protection.

3. **Science safety (or not) in popular culture (Discussion Board)**

- a. Participate in the designated **Discussion Board** (start with INSTRUCTIONS).
- b. Apply safety content shared in the resources above.

4. **Establishing a Positive Classroom Climate**

- a. Review Exploration 3.2 on page 53 of your textbook

- b. Answer the reflection questions 1-3 (p. 53) in the context of a classroom environment that is conducive to science discovery and safety.
- c. Respond to these prompts on the **Independent Work** TEMPLATE.

5. Questioning Strategies

a. Readings/ Videos

- Read the following articles (All in Module 3 folder)
 1. Bergman, D.J. (2009). Quality questions. *New Teacher Advocate*, 16(4), 4-5.
 2. Bergman, D.J. (2010). Quality responses. *New Teacher Advocate*, 18(1), 13.
 3. Illinois Center for Innovation in Teaching & Learning: “Questioning Strategies.” Available at <http://citl.illinois.edu/citl-101/teaching-learning/resources/teaching-strategies/questioning-strategies>
- Watch the following video “5 Skills to Become an Inquiry Teacher” at https://youtu.be/cwG_JvEpEuk
 - *Overview: Identify which of your teacher skills you exercise as you lead Inquiry-Based lessons in your classroom: Be Flexible - Guiding Open Ended Questions - Setting Up Proper Expectations - Going Beyond “I don’t know” – Designing Great Activities.*
- **Textbook Reading: Chapter 6 “Effective Questioning”**

- b. Participate in the designated **Discussion Board** (start with INSTRUCTIONS).

6. Module 3 Reflection (respond to the following prompts on the **Independent Work** TEMPLATE):

- a. For which “E” in Table 6.2 (p. 120-1) are there not any questions listed? Why do you think this is the case?
- b. What did you discover in Module 3?
- c. How can Module 3 be improved?

Module 4: Science Assessment, Integration, and Accessibility

Learner Outcomes:

STUDENTS WILL . . .

1. Be mindful of student misconceptions and how to work with students to overcome them
2. Describe multiple ways to assess Science Learning
3. Demonstrate the ability to integrate science with other subjects
4. Examine possible student use of a science notebook
5. Articulate how to make science accessible for all learners

Tasks and Resources:

1. **Reminder: Lesson Plan Due.**

- a. Use the provided lesson plan template with 5E inquiry addendum.
- b. Email as attached Word document.
- c. Show evidence of content understanding and application of resources from class modules.
- d. Overview on Syllabus (20% of overall course grade)

2. **Student Misconceptions**

- a. Readings / Videos
 - i. Look at the articles at:
 1. "Correcting Student Misconceptions" by S. Wali Abdi (*Science Scope*) – in Blackboard module folder
 2. <https://www.nap.edu/read/5287/chapter/5#29>
 3. <https://ssec.si.edu/stemvisions-blog/examining-students-thoughts-important-part-teaching-science>
 - ii. Review **pages 78-81 in your text.**
 - iii. Watch the video: <https://www.youtube.com/watch?v=LqaDf2fuUH8>.
 1. This is a rapid-fire list of common misconceptions, some are more about historical recognition as opposed to science concepts.
 2. Either way, it's a fun review of some common incorrect ideas. How many do you have?
 3. Note that even though this is a rapid-fire list (and well-edited video), it takes much more time and effort to promote examination and "conceptual change" in students.

- iv. Extensive list of common misconceptions:
<https://secure.lcisd.org/GlobalImages/Children%20Misconceptions%20%20PDF.pdf>
- b. Participate in the designated **Discussion Board** (start with INSTRUCTIONS).
- c. Respond to the following prompts on the **Independent Work** TEMPLATE.
 - i. Review the Inquiry-Based Lesson Plan you will submit/have submitted for class.
 - 1. What potential misconceptions might students have related to your topic?
 - 2. What are some questions or prompts you can pose to draw out these ideas and help students reconsider them?
 - 3. What strategies, activities, or resources could you structure into your lesson to help students come to correct understandings?

3. Use of a Science Notebook or Journal

- a. Readings / Videos
 - i. View the video at: <https://www.youtube.com/watch?v=Ti3nUDNK8iA>
 - ii. Read the article at: <https://www.nsta.org/noteworthy-connection>

4. Assessing Science Learning

- a. Readings
 - i. **Textbook Reading: Chapter 7 “Assessing Science Learning”**
 - ii. Pay particular attention to the variety of science-specific examples of assessments and evaluations (including notebook/journals).
- b. Participate in the designated **Discussion Board** (start with INSTRUCTIONS).

5. Integration of a science lesson into another subject area

- a. In a normal classroom, the time for teaching science is limited. One way to overcome this issue is to take a literacy or math lesson that has a science component within it and extend the lesson by exploring that science component.
- b. Readings / Videos
 - i. <http://www.teachhub.com/integrate-science-across-curriculum>
 - ii. <https://y4y.ed.gov/toolkits/afterschool/science/integrating-science-across-curriculum> (also watch the video)
 - iii. <https://www.edutopia.org/practice/departmentalization-and-integration-deeper-learning-elementary-students>
 - iv. **Textbook Reading: Chapter 9 “Connecting Science with Other Subjects”**
- c. Respond to the following prompts on the **Independent Work** TEMPLATE.
 - i. Review the alignment of science with other subjects in Tables 9.1, 9.3, 9.4, and 9.5.
 - ii. Review the Inquiry-Based Lesson Plan you will submit/have submitted for class.

1. How could you integrate this science lesson with the other “core” subjects or additional disciplines?
2. With which subject/discipline do you see the strongest alignment and potential for integration? In what ways?

6. Making science accessible for all learners

a. Readings

i. **Textbook Reading: Chapter 10 “Making Science Accessible for All Learners”**

b. Respond to the following prompts on the **Independent Work** TEMPLATE.

i. Review the Inquiry-Based Lesson Plan you will submit/have submitted for class.

1. What are some potential challenges in your lesson for students with exceptionalities?
2. Based on the resources in Chapter 10 (and other credible references), describe how you could adapt your science lesson to increase accessibility for at least TWO of the following students:
 - Non-native English speaker
 - Visually-impaired student
 - Hearing-impaired student
 - Student with limited mobility
 - Student identified as gifted and talented

7. Module 4 Reflection (respond to the following prompts on the **Independent Work** TEMPLATE):

- a. What did you discover in Module 4?
- b. How can Module 4 be improved?
- c. Overall, what questions do you still have about teaching science?
- d. What are some resources you will use? (Keep these handy 😊)