**Appendix A**

**Course Materials**

**Course Material 1: Student Worksheet**

Student name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Lab section: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- | --- | --- |
| Form groups of 4 or 5 to complete this activity. You will be provided with two Mystery Boxes to find out what items are in the boxes **without opening them**! These boxes are relatively sturdy, so you don’t need to handle them delicately. **1** | Look at the set of paper slips that covers some of the important scientific inquiry practices. Arrange them to represent how scientists conduct scientific inquiry. Preserve your arrangement for a later activity. **2** | Within your group, take turns playing with the boxes **without** talking. Write down your hypothesis about the objects in the boxes and list evidence supporting the hypothesis.

|  |  |
| --- | --- |
| **A** | **B** |
| Hypothesis about the objects contained in the box:Evidence to support your hypothesis: | Hypothesis about the objects contained in the box:Evidence to support your hypothesis: |

**3** | After all members in the group have played with the boxes, share your hypotheses and the evidence within your group. Are you able to come up with a consensus hypothesis about the object(s) in each of the boxes? In either case, write or draw your hypotheses on the whiteboard. **4** | What could you do to further test your hypotheses? Describe your approach(es) in sufficient detail, and predict the relevant results.**5** | Examine the provided candidate objects. Which of them are most likely to be those in the box? Test your hypothesis/hypotheses using candidate objects and tools. Record your data below. Do the newly collected data support your hypotheses? If yes, how? If not, what are your new hypotheses? Refine your hypotheses below and on the whiteboard.**6** | Discuss your entire investigation process on the boxes. How does this activity resemble a **scientific** inquiry process? Feel free to revise your original inquiry practice slips if needed. Prepare to explain your revisions to the rest of the class. **Course Material 2: Inquiry Slips****Course Material 3: Class Discussion Questions****Big Guiding Questions (same as the guiding questions for student reflective writing)**1. Did the lab activity reinforce what you have known about scientific inquiry and nature of science (NOS)? How?
2. Did the lab activity reveal any aspects of scientific inquiry and NOS that you have not noticed before? If so, what are those aspects?
3. Do you disagree with any of the tenets of scientific inquiry and NOS discussed in class? If so, which ones? Explain why you disagree.
4. Did the lab activity demonstrate all the tenets of scientific inquiry and NOS? If not, which ones were not reflected in the activity?

**Specific Questions of NOS (adapted from Views of Nature of Science Questionnaire; (Abd-El-Khalick et al., 2001)**1. What is an example of observation in the activity? What is an example of inference? How are they different from and/or related to each other?
2. When scientists study something that cannot be directly observed (e.g., dinosaurs), how do scientists know it really existed? For example, how certain are scientists about the way dinosaurs looked?
3. When scientists produce scientific knowledge, do you think this knowledge may change in the future? Explain your answer.
4. Scientists try to find answers to their questions by doing investigations or experiments. Do you think that scientists use their imaginations and creativity when they do these investigations or experiments?
	1. If no, explain why.
	2. If yes, in what part(s) of their investigations (e.g., planning, experimenting, making observations, analysis of data, interpretation, reporting results) do you think they use their imagination and creativity? Give examples if you can.
5. Is there a difference between a scientific theory and a scientific law? Illustrate your answer with an example.
6. After scientists have developed a scientific theory (e.g., atomic theory, evolution theory), does the theory ever change? Explain and give an example.
7. Is there a relationship between science, society, and cultural values?
 |

**Reference**

Abd-El-Khalick, F. (2001). Embedding nature of science instruction in preservice elementary science courses: abandoning scientism, but ... *Journal of Science Teacher Education*, *12*(3), 215–233. [https://doi.org/10.1023/A:1016720417219](https://doi.org/10.1023/A%3A1016720417219)

**Course Material 4: Complete Materials List for a Class Section With 25 Students**

* 15 cardboard boxes, dimension: 9” X 9” X 9”: 10 boxes for sealing objects and 5 empty boxes for students in each group to test their hypotheses
* Duct tape for sealing the boxes
* 20–30 small solid objects varying in shape, material, and size, such as toy blocks, balls, batteries, tubes, etc.
* 3–5 digital scales
* 10 heavy-duty magnets (2 per group)
* Whiteboard or sticky chart sheets (We suggest 2 sheets per group, 1 for SI [inquiry slip] arrangement and 1 for presenting group ideas while working through the WiB activity.)
* Colored markers (2 per group) in different colors
* 5 sets of inquiry practice slips (1 set per group)
* 25 activity sheets (1 per student)