Thinking about Science Teaching

Dear Students:

This assessment is composed of classroom science teaching vignettes similar to teaching practices one can find in any classroom today. Practicing teachers contributed ideas for many of the vignettes; others are based on teacher observations, or on science curriculum standards.

As you read each vignette, think about how you might teach science in a similar situation. Respond accordingly.
Frog dissection 1

Mr. Goodchild is doing a frog dissection with his 8th graders to help teach them about anatomy.

Thinking about how you would teach a lesson, of the following, which is most similar to what you believe is the best way to incorporate a dissection into a lesson?

A. It should be used as a stand-alone step-by-step activity for students to explore the frog’s anatomy and raise discussion questions on their own.

B. It should be used as a follow-up step-by-step student activity after Mr. Goodchild explains exactly what students will need to notice about the frog anatomy.

C. It should be used as a step-by-step student activity while answering probing questions, followed up by teacher-led discussion and clarifications.

D. It should be used as a step-by-step demonstration by Mr. Goodchild while he explicitly points out what students need to know about frog anatomy.
Organisms respond to environment

Ms. Pendleton wants to teach her 1st-grade students that living organisms respond to their environment. The students did an experiment on how earthworms respond to their environment. Then in small groups they discussed a series of questions about the experiment. Ms. Pendleton now needs to wrap up the lesson.

Of the following, which one is most similar to how you would wrap up this lesson?

A. Have the students come up with a general conclusion based on the evidence they gathered from their earthworm experiment, guiding them toward the concept objective.

B. Restate the concept objective for the students, and ask students to provide supporting evidence from their earthworm experiment.

C. Have students report their conclusions, based on the evidence gathered from their earthworm experiment.

D. Restate the concept objective for the students, relating it to the observations they gathered in their earthworm experiment.
Earth Rotation

Ms. Rice is about to begin teaching her 1st grade students that the rotation of the Earth causes day and night. She begins by shining a light (the sun) on a rotating globe (the earth). She asks the students to pay attention to a bright red dot she has placed on the globe, and asks several questions about where the dot is in relation to the light. Ms. Rice reinforces student learning by explaining how day and night are related to the Earth’s rotation, while again demonstrating this with the light and globe.

Thinking about how you would teach, of the following, how would you change this lesson?

A. First I would have begun the lesson by explaining how day and night are related to the Earth’s rotation. The class could then predict if the red dot would be in the light or dark during demonstration.

B. First, I would have had students closely observe what happens at the red dot as I rotated the globe. Then, I would ask the students to draw their own pictures of their observations. The lesson would end with a class discussion of their observations.

C. I would have begun the lesson by explaining how day and night are related to the Earth’s rotation using the light bulb and globe to demonstrate my explanation.

D. I would conduct this lesson in a similar way to Ms. Rice.
Lesson on force and motion

Ms. Brandt is preparing a lesson to introduce her 5th grade students to the relationship between force and motion, namely that a net force will cause an object to speed up or slow down (Newton’s 2nd Law). The classroom has available a loaded wagon to which a pulling force can be applied. Ms. Brandt is considering four different approaches to the lesson.

Thinking about how you would want to teach this lesson, of the following, which one is most similar to what you would do?

A. Write a clear statement of Newton’s 2nd Law on the board and explain it carefully to my students. Then I would demonstrate the law by pulling on a loaded wagon with a constant force in front of the class as they observe the motion.

B. Raise the question of what kind of motion results from a constant force. I would then guide my students to explore the question themselves by pulling on a loaded wagon and observing what happens. From the evidence they would then propose a possible law.

C. Write a clear statement of Newton’s 2nd Law on the board and explain it carefully to my students. I would then have the students verify the law by pulling on a loaded wagon themselves and confirming what type of motion results.

D. Raise the question of whether there is any relationship between force and motion. My students would then be free to explore this safely in the lab. Afterward we would have a class discussion of their findings.
Air is matter

Ms. Harvey’s class has been learning about matter. She now wants her 4th grade students to learn that gases (like those in air) are also a form of matter. She plans to introduce her lesson by raising some questions with her students about whether air is matter, and how they could find out.

Ms. Harvey is still considering what to do next. Thinking about how you would teach this lesson, of the following which one is most similar to what you would do?

A. I would ask students to think up ways to test if air is matter using whatever equipment we have in the classroom. I would then allow them to go ahead and try their ideas.

B. I would help the students develop ways to test the question of whether air is matter, allow them to investigate with fans, and use their findings to conclude that it is.

C. I would tell the students that air is indeed matter, and that although air is not very dense, there is something there that can be felt. I would then ask them to use fans at their desks to see if they could find evidence that air was indeed matter.

D. I would tell the students that air is indeed matter, and that although air is not very dense, there is something there that can be felt. I would then demonstrate this property to the class by having them feel the air from a fan.
General wrap-up of unit

Mr. Nelson’s 6th grade students have just completed a unit in their earth science class. As a “wrap-up,” Mr. Nelson would like students to re-examine the three learning objectives that served as the focus for this entire unit.

Of the following, which is most similar to how you would like to conduct the wrap-up?

A. I would ask the students what the main things are that they have learned in the unit, according to their own ideas of what is important or interesting, and have them list these as the unit wrap-up.

B. I would restate the three learning objectives for the students, and then relate each of them to the specific concepts that arose in the unit.

C. I would ask the students to reflect back on their work, and identify for themselves what the important central ideas of the unit were, then have them relate these to the original learning objectives.

D. I would restate the three learning objectives, then ask the students to say how the various concepts that arose in the lesson related to each of these.
Structure and function

Mr. Danzit will be teaching his 3rd grade students a lesson on “structure and function” as applied to digestive systems. He has a set of pictures showing the mouths of different animals, including a finch beak, a dog jaw with teeth, and horse jaw with teeth. He also has a chart that he can distribute to the students, which will allow them to fill in information about what each of these animals can and cannot eat.

Thinking about how you would teach this lesson, of the following, which is the best statement on how Mr. Danzit should begin the lesson?

A. Mr. Danzit should begin the lesson by carefully explaining the concept of structure and function as it relates to the digestive system, specifically mouth parts. He should then ask the students to fill out the chart using the pictures and his discussion as a guide.

B. Mr. Danzit should allow the students to explore a set of photos showing animal mouths. He should then have the students write their own stories about how these animals are similar and different, including what they eat.

C. Mr. Danzit should begin the lesson by carefully explaining the concept of structure and function, while helping students fill in their charts, so they can clearly see examples of this concept as it relates to digestive systems.

D. Mr. Danzit should begin the lesson by showing his students a picture of a shark mouth, asking student what this animal might eat. After a discussion, he should give each student a copy of the chart and the other pictures, asking students to complete the chart based on their early discussion.
Field trip

Ms. Piper is taking her 3rd grade class to the local nature center. Because they are currently studying food webs, she would like to use the field trip as a way to learn more about this topic.

Thinking about how you would teach, of the following, how would you most likely use a field trip to teach students about food webs?

A. I would inform them that on our upcoming field trip they will be looking for examples of food webs. During the field trip, students could make their own list of interactions they observe relating to food webs, which we would discuss later as a group.

B. I would inform students before the field trip that we are going to look for specific examples of food webs, providing them a checklist of interactions they should see. During the field trip, I would point out to them interactions, having them mark off each as we go.

C. I would not tell students exactly what to look for during the field trip, but would ask them to make observations about any of the interactions they see between organisms. Afterwards we could discuss what they saw relating to food webs.

D. I would inform students before the field trip that we are going to look for specific examples of food webs, providing them a checklist of interactions they should see. During the field trip, students could look for those examples and mark them off as we go.
 Predator and prey

Mr. Peoples is conducting a unit on food chains and is about to introduce his 7th grade students to predator/prey relationships. He has a good computer simulation game for this subject that he can use with his class.

Thinking about how you would teach this lesson, of the following, which is the best advice for conducting this lesson?

A. Mr. Peoples should explain to his students that balance typically exists in nature such that the numbers of predators and their prey are related. For example, he can tell them that a rabbit population will increase if disease reduces the coyote population in the same region. He should then project the simulation game to demonstrate relationships between rabbit and coyote populations.

B. Mr. Peoples should explain to his students that balance typically exists in nature such that the numbers of predators and their prey are related. For example, he can tell them that a rabbit population will increase if disease reduces the coyote population of the same region. Using the computer simulation game, he should have the students monitor and record the rabbit levels over a simulated ten year period during which the population of coyotes rises and falls, so that they can confirm the predator/prey concept he explained.

C. Mr. Peoples should ask what would happen with rabbits if many coyotes died suddenly of disease. After some discussion, Mr. Peoples should suggest that the students explore their ideas using the computer simulation game he has for this subject, by recording yearly counts over a simulated period of ten years. The students will then have data to be used in a class discussion on predator/prey relationships.

D. Mr. Peoples should begin by asking the students what they know about predators and prey. Without responding other than to encourage their ideas, Mr. Peoples should then show them the computer simulation game he has for this subject and invite them to use the simulation in any way they wish to explore their ideas. The lesson would end with students writing up their findings.
Soil porosity

Ms. Cubbage’s 7th grade science class has been learning about soil types by observing soil color and texture (particle size). While making observations of soil samples, the students notice that some soil types seem more “fluffy” than others. Ms. Cubbage realizes that her students are referring to porosity (how densely the materials are packed together, ability to allow water to move through) which is one of the key concepts later in her unit.

Thinking about how you would teach this lesson, of the following, which is most similar to how you would respond to the students’ observation?

A. I would congratulate the students on such a good observation, then explain to them porosity is a description of how densely packed soils are. I would then tell students how to test soils for it, and follow up by doing tests on our soil samples for porosity.

B. I would congratulate the students on such a good observation, and ask them what they thought they were looking at. Through discussion I would try to get them to think about packing and how one might test for packing. We would do tests and based on their findings, I would introduce the concept of porosity.

C. I would recognize that what is most important here is that the students were being independent investigators, not necessarily that they were stumbling upon the idea of porosity. I would simply encourage their scientific attitudes and have them continue their investigations.

D. I would congratulate the students on such a good observation, then explain to them that what they observed was called porosity. Using a demonstration, I would show the students that more porous soils are less packed and that water moves more easily through porous soils.
Rain and water flow

Ms. Walters wants to start teaching her 2nd grade students about water movement and bodies of water on Earth, i.e., to understand that when rain falls on Earth the water flows downhill into bodies of water (streams, rivers, lakes, oceans), or into the ground.

Thinking of how you would design a lesson for your students, which of the following approaches would you suggest Ms. Walters take?

A. Have student groups shape soil into hills and valleys and sprinkle water onto it, but don’t tell them in advance what it is about or what to focus attention on. Have them report what they observe happens and suggest if this is similar to anything on Earth.

B. Project a diagram showing rain falling onto the earth, and water running downhill to form streams, rivers, lakes and oceans, with some going into the ground. Then go over each aspect carefully while pointing to it on the diagram, taking questions along the way.

C. Tell students that rain falling on the ground will flow downhill to form streams, rivers, lakes and oceans. Demonstrate this with a model: a large shallow box of soil, shaped into hills and valleys. Students watch as she sprinkles water from the spray nozzle of a watering can, and asks them to notice how it flows downhill to form streams and then ponds.

D. Provide a box of soil at each bench and have groups shape landscapes in it with hills and valleys. Have them suggest what might happen if they sprinkle water on it to represent rain. Then have them try it out, report their observations and relate that to what happens on Earth.
Magnets and materials

Mr. Golden has introduced the topic of magnetism to his 1st grade students, and they have learned that bar magnets attract certain kinds of materials that have iron in them. For today’s new lesson, he has available bar magnets and a variety of food containers, made of plastic, iron, aluminum, steel, and glass.

Thinking about how you would teach, of the following, which is most similar to how you would conduct this lesson?

A. I would tell the students that our assignment for the day is to solve the puzzle of which food containers contain iron and which do not. Students would be asked to think of how they could find out, and they would either come up with or be prompted to use bar magnets to test the various kinds of food containers.

B. I would remind the class that magnets attract materials which contain iron (including most steels), and then show them how the bar magnet attracted the containers made from steel or iron, but not any of the other containers.

C. I would tell the class to recall that magnets attract materials which contain iron (including most steels), and then have small groups of students use bar magnets to sort the food containers into those which do contain iron and those which do not.

D. Each group of students would be provided with a bar magnet and the various kinds of food containers. I would not outline a specific task but ask them to find out what they can about the collection, and report back their observations and conclusions.
Light reflection

Ms. Baker is teaching her 8th grade students the law of reflection: when a ray of light strikes a mirrored surface, it leaves at the same angle as when it arrived. Ms. Baker has to decide how she will teach the lesson.

Thinking about your own teaching, of the following, which is most similar to how you would teach the lesson?

A. I would write the law of reflection on the board and illustrate with a diagram. Next I'd show them a real example, using a light ray source, mirror, and protractor. Then we would discuss any questions the students might have.

B. I would ask students to find out what they can about light behavior around mirrors by exploring on their own with an assortment of available items, including light ray sources, mirrors, and protractors. Then the students would report back on what they did and what they found out.

C. I would first pose a question about reflection for the students to explore. The students could investigate using light ray sources, mirrors, and protractors, and then discuss their findings. I would close the lesson by giving them a summary of the law of reflection.

D. I would write the law of reflection on the board and illustrate with a diagram. Then I'd have the students verify the law using light ray sources, mirrors, and protractors. We would then discuss their findings.
Light & shadows (a prediction task)

Ms. Adams’s fifth grade students have learned that light travels in a straight path and that shadows arise when an object blocks light. Ms. Adams wants her students to be able to apply these ideas to make predictions about shadow behavior. She turns out the main room lights, and has one child Sam stand in the light from a lamp on the floor, casting a shadow on the wall. Students draw ray diagrams in their notebooks showing how Sam’s shadow is being formed. Ms. Adams says that once we understand how shadows form we can predict what will happen to the shadow if Sam moves further from the lamp.

Thinking about how you would teach, how would you suggest Ms. Adams continue this part of the lesson?

A. Have students follow her directions to make a second diagram in their notebooks with Sam further away, and point out to them how this shows the shadow becomes smaller. Then have Sam move to confirm the prediction.

B. Draw a ray diagram on the board to show that the shadow will be smaller when Sam is further from the lamp. Then have Sam move to confirm this prediction.

C. Ask students to predict what will happen to the shadow, in whatever way they wish, and explain their predictions. Then have Sam move to check the predictions. If there are discrepancies let the students discuss and resolve.

D. Ask each student to make their own prediction of what will happen to the shadow, based on what they have learned about shadow formation, using a ray diagram. Then have Sam move to check their predictions. If there are discrepancies, discuss with the students and resolve.
Ms. Katinka is teaching her 2nd grade class about the concept of volume. She begins the lesson by showing her students two differently sized jars, each filled with jelly beans. She explains that the jelly beans are a kind of measurement with the number of jelly beans telling how much room is in the jar, that is, the **volume** of the jar. She then has the students count the number of jelly beans in each jar and compare the volume. She then finishes her lesson on volume.

Thinking about how you would teach, of the following, which is the best evaluation of this lesson so far?

A. I would teach this lesson much the same way, except that I would tell the students how many jelly beans were in each jar, so there were no mistakes.

B. I would have begun by asking students which jar they believe holds more jelly beans and how they could find this out, which would naturally lead to counting the jelly beans. After this I would suggest that the jelly beans could be used as a way to measure volume.

C. Rather than the teacher explaining that the jelly beans are a kind of measurement, she should have first allowed the students to experiment by filling jelly beans into jars of different sizes and shapes, and then elicited the students’ ideas about what the different numbers of jelly beans tells us about the different jars.

D. I would teach this lesson much the same way.
Moon in the daytime (a teachable moment)

Ms. Luna had taught her 8th grade students how the phases of the moon are due to its illumination by the sun at different angles. As part of her lesson she used the picture shown, illustrating how the various phases look at night. Toward the end of the lesson one student Max looks out the window at the sky. He is surprised: he excitedly tells Ms. Luna he can see the moon but it is daytime! He is puzzled and asks how that can be. Ms. Luna wants to use this as a ‘teachable moment’ to enhance their understanding of how moon phases arise. She congratulates Max on his observation and has everyone go outside to look before coming back in.

Thinking about how you would teach, how would you suggest Ms. Luna continue when back in the classroom?

A. Throw back Max’s question to the students: ask them to explain the observation by drawing sky diagrams for that day showing moon and sun and applying what they have learned about light and illumination.

B. Tell the class there is no reason that the moon cannot be seen in the daytime. Then ask students to apply what she has taught them and draw diagrams showing how the moon is being illuminated by the sun that particular day.

C. Tell the class there is no reason that the moon cannot be seen in the daytime. Then draw a sky diagram on the board showing how the moon is being illuminated by the sun that particular day.

D. Throw back Max’s question to the students: have them come up with ideas and possible explanations and report these to the class, followed by discussion.