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.
Water Cycle (rain)

Ms. Whitley is introducing the water cycle to her 2nd grade students. She plans to ask the students for their ideas about where rain comes from, and she also has an activity but is unsure where to use it in her lesson. The activity involves placing water and ice in a cup, sealing the cup in a plastic bag, placing it in sunshine, and observing what happens in the bag.

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

A. After hearing the students’ ideas, Ms. Whitley should introduce the activity and have the students do it. Then she should have the students report their observations and interpretations in a class discussion. She can then ask them to think about rain and what they might have learned from the activity about rain.

B. After hearing the students’ ideas, Ms. Whitley should explain how rain occurs as part of a water cycle. She can then have the students conduct the investigation, and at the end, explain how their observations relate to rain and the water cycle.

C. After hearing the students’ ideas, Ms. Whitley should introduce the activity and have the students do it. After they have finished their observations, she can lead a class discussion that helps them see the connection between the activity, rain, and the water cycle.

D. After hearing the students’ ideas, Ms. Whitley should explain how rain occurs as part of a water cycle. She should then conduct the activity as a class demonstration, relating what happens to rain and the water cycle.
Air takes up space

Mr. Jacobs is preparing a 2nd grade lesson on states of matter. He would like the students to learn that air takes up space.

Thinking about how you would teach this lesson, of the following, what would you most likely do?

A. Invite my students to think about whether air takes up space, and how they might use balloons to find out. I would then have them blow up the balloons and we would have a discussion on why the balloons got bigger and what that meant about air.

B. Begin by carefully explaining that although we can’t see air, it still takes up space. I would then have them blow up balloons, and explain that the expanding balloons show that air takes up space.

C. I would have the students play with balloons by blowing them up to different sizes. Students would then be asked to talk about what air is like, and write their own stories about air.

D. Begin by carefully explaining that although we can’t see air, it still takes up space. To help the students understand this idea, I would blow up a balloon in front of the class, and explain that the balloon expands because of the air I blow into it.
Planets and life

Having already learned the requirements for life on Earth, Ms. Taylor wants her 6th grade class to consider whether or not life might be possible on other planets. To do this, she has small groups of students research each of the other planets, paying special attention to the characteristics that would and would not make them suitable for life, and report back to the class on their findings.

Thinking about how you would teach this lesson, of the following, which best describes how you might change the lesson?

A. Instead of having students research the other planets, I would describe their characteristics and after that give them this group assignment.

B. I would instead simply pose the question of whether life might be possible on other planets, and allow the students to discuss and research this question in small groups, reporting back to the class.

C. I would instead describe the characteristics of the other planets for my class, highlighting whether the ones which are necessary for life are present or absent.

D. I would teach this lesson in a similar manner to Ms. Taylor, because she gives the students a focus but allows them to do their own research.
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.
Clouds

Ms. Mair is about to begin a Meteorology unit with her 1st grade students. The topic is cloud observations. Toward that end, she takes her students outside to observe the sky on several partly cloudy days. She has them record their observations by drawing pictures of what the clouds look like.

Thinking of how you would teach this topic, of the following, how would you evaluate Ms. Mair’s approach?

A. The unit seems fine as long as Ms. Mair concludes with a classroom sharing and comparing their cloud drawings.

B. The unit seems fine as long as Ms. Mair will introduce the different types of clouds after the activity, based on her students’ own observations outside.

C. Ms. Mair should have begun with a clear statement of what types of clouds students may observe in the sky. Then students could go outside to make their own observations and draw the cloud types that they see.

D. Ms. Mair should have begun with a clear statement of what types of clouds students may observe in the sky. Then when they went outside she could have specifically pointed out the clouds and had the students draw pictures of them.
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. 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.

B. 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.

C. 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.

D. 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.
Animal sorting

Ms. Lodge is teaching her kindergarteners that the process of sorting involves identifying characteristics and grouping accordingly. She gives each student a set of 10 animal cards, and asked them to sort the animals into groups with similar characteristics.

Thinking about how you would teach, of the following, how would you make this lesson more effective?

A. This lesson would be more effective if Ms. Lodge had started by explaining the process of sorting and then allowed the students to sort the animals based on characteristics.

B. I wouldn’t change this lesson; the students choose their own approach to sorting.

C. This lesson would be more effective if Ms. Lodge explained and demonstrated the process of sorting using animals cards.

D. This lesson would be more effective if Ms. Lodge had concluded by drawing on the students’ work to highlight the process of sorting.
Soil types

Ms. Cubbage wants her 7th grade science class to identify factors used to classify soil types, and be able to demonstrate their knowledge by correctly classifying some samples. Ms. Cubabbage has three soil samples. She also has a data table, where students can record soil color and texture (particle size), and two other characteristics that they notice about the samples.

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

A. I would ask the students to think about varieties of soils. After getting their thoughts, I would have students fill out the chart using the provided soil samples. They could then read a passage in their books to help identify each soil type based on its characteristics.

B. I would begin by having the students read a passage in their textbook on soil types. I would then show them the three soil samples and have them fill out the worksheet as I discussed each sample.

C. I would have students bring soil samples from home. I would have them compare and contrast all their samples, and record their observations in a data table of their own design. The lesson would conclude with a class discussion of their soil type classifications.

D. I would begin by having the students read a passage in their textbook on soil types. Then I would tell them that their task is to compare characteristics of each soil sample. They could then use those characteristics to identify the soil types, based on their reading.

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Fossils provide evidence for change

Ms. Jefferson’s 6th grade is learning about how fossils can provide evidence of how life has changed over time. She poses a question: “How do fossils help show us changes on Earth over time?” Ms. Jefferson continues by asking the students to examine several different rock samples, all containing different types of fossils.

Thinking of how you would teach this lesson, of the following, how would you evaluate this lesson so far?

A. The students are making asked to make observations before being instructed on what to look for. Instead, Ms. Jefferson should have described how fossils provide evidence of change over time, using the fossil samples as examples to demonstrate her point.

B. The students are asked to make observations before being instructed on what to look for. Instead, Ms. Jefferson should have described how fossils provide evidence of change over time, and then have the students examine the different rock samples to verify Ms. Jefferson’s explanation.

C. This lesson is fine the way it is. Ms. Jefferson states a question for the students to think about and then provides materials the students can utilize to explore this question.

D. Ms. Jefferson should have not posed such a detailed question prior to student investigations. The students should have been allowed to examine the rock samples and, as a class, discussed their ideas about the fossils.
Static electricity

Mr. Martin is teaching a 1st grade lesson on static electricity. He simply wants them to experience the phenomenon by seeing that some materials create more static electricity than others when rubbed against a balloon. Mr. Martin has balloons and a variety of different materials to rub against them, including wool, plastic bags, fur, glass, lettuce, and newspaper. Mr. Martin explains that they are to rub balloons with each of the items, and in turn, test how well each balloon sticks to the wall.

Thinking about how you would teach this lesson, of the following, how would you evaluate this lesson so far?

A. Mr. Martin should have first explained that a balloon will stick to the wall when rubbed by certain materials, but not others, then allow the students to carry out the activity themselves.

B. This lesson is good so far, as long as Mr. Martin concludes with a summary of how their findings relate to the lesson objective.

C. In order to encourage the students to be independent investigators, he should not have given such explicit instructions, but instead allowed the students to explore the balloons and materials on their own to see what would happen.

D. Mr. Martin should have first explained that a balloon will stick to the wall when rubbed by certain materials, but not others, and then demonstrated this to the students, rather than having them do it.
Hand sanitizers: a teachable moment

Ms. Simmons’ 8th grade class is learning about where bacteria are found and their influence on humans, when one of the students asks, “Why do we use hand sanitizers?” Ms. Simmons is not sure of the best way to respond to this student’s question with respect to the lesson objectives.

Thinking about how you would teach, of the following, which is most similar to how you would deal with this teachable moment?

A. I would encourage the students to think of ways to answer this question, and give them time and materials to pursue their own investigations.

B. I would give my students a brief explanation of how hand sanitizers work and tie this information to what we had been studying about bacteria. Then we would get back to the lesson objectives.

C. I would give my students a brief explanation of how hand sanitizers work and then ask my students if they could think of ways to test their effectiveness. I would conclude the lesson by tying their ideas back to the objectives.

D. I would elicit the students’ ideas about the question, including how to test those ideas. We would try some of those tests and I would conclude the lesson by tying their findings back to the objectives.
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. 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.

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. 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.
Mr. Hamid would like his 8th grade class to explore the concept of sand erosion as a function of water volume. He has available stream tables, which can be used to illustrate this by taking measurements of sand height at various points before and after adding water. Mr. Hamid also has a film clip that explicitly explains and illustrates the erosion process. He is unsure which of these to use, and when.

Thinking about how you would teach this lesson, of the following, which is most like how you would structure this lesson?

A. I would begin the lesson with the film clip and explain to the students how sand erosion is a function of water volume. Then I would demonstrate this using the stream table, calling the students attention to what they saw in the film clip and are now observing in the stream table demonstration.

B. I would begin the lesson by having students explore with the stream tables, and then have them discuss what they discovered. The lesson would revolve around the students’ explorations and conclusions, and not include the film.

C. I would begin the lesson by having the students investigate sand erosion by doing the stream table activity, followed by a class discussion of their observations. Then I would use the film clip to bring closure to the lesson.

D. I would begin the lesson with the film clip. Then I would have had the students do the water table activity so that they could see water erosion and the effect of water volume firsthand.
Plant misconceptions

The students in Mr. Gordon’s 3rd grade class are learning how plants grow, what parts plants are composed of, and what they can be used for. Mr. Gordon has the students create a book about what they are learning. As students work on their books, he notices that some have the misconception that plants “eat dirt.” What can Mr. Gordon do to address this misconception?

Thinking about how you would teach this lesson, of the following, which offers the best advice for dealing with this misconception?

A. Mr. Gordon should explicitly point out the evidence that indicates plants do not eat dirt. He should then reinforce this with an additional short activity that illustrates his point.

B. Mr. Gordon should explicitly point out the evidence that indicates plants do not eat dirt. The students can then revise their books to match this understanding.

C. Mr. Gordon should ask students to develop and conduct their own investigations into what plants eat.

D. Mr. Gordon should have students conduct a short activity that demonstrates that plants do not eat dirt. He should then ask them to challenge their ideas about what plants eat, given the results.
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 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.

C. 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.

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.
Linnaean system of classification

Mr. Clark is introducing his 8th grade students to the classification of organisms. He provided them with pictures of 25 organisms, representing the five Kingdoms, and had students group them according to observable characteristics. The class then discussed their ideas only to discover that they had chosen different characteristics on which to group the organisms. At this point, Mr. Clark told the class that scientists eliminated confusion over the classification of living things by adopting the Linnaean system of classification as a universal standard. Mr. Clark then explained that in this system, more characteristics are used than what can be seen in a photograph, such as what an organism eats.

Thinking of how you would teach, of the following, how would you evaluate Mr. Clark’s introductory lesson?

A. Having students try classifying on their own is good because they will better appreciate the challenges of constructing a universally accepted classification system.

B. Instead of first having students group the pictures in their own way, which could be confusing, he should have explicitly explained the Linnaean system of classification, and then had his students apply the system to the organisms in the photographs.

C. Instead of having students group the pictures in their own way, which could be confusing, he should have explicitly explained the Linnaean system of classification, using the photographs as examples.

D. This is a good lesson, except, rather than an explicit discussion of the Linnaean system, Mr. Clark should have had his students explain their reasoning for how they classified the organisms.