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.
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 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.

B. Write a clear statement of Newton’s 2nd Law on the board and explain it carefully for 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.

C. 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.

D. Write a clear statement of Newton’s 2nd Law on the board and explain it carefully for 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.
Bar charts

Ms. Beck is teaching her kindergarten class how to make a simple bar chart. She begins by handing out an example of a bar chart she already made comparing the numbers of red and blue blocks in a box.

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

A. Count the red and blue blocks aloud for the students and show them how the bar chart represents the count for red blocks and the blue blocks. I would also plan to have some green and yellow blocks that the students could work with. I would have the students count the green and yellow blocks and then make their own chart following the example of the chart for the red and blue blocks.

B. Rather than handing out the bar chart example, I would hand out sets of blocks and ask the students to draw pictures that showed how many blocks of each color there were. After discussing their pictures, I would pass out “my drawing” (the example bar chart), and I would have the students discuss how this picture might also represent how many blocks of each color there were.

C. Count the red and blue blocks aloud for the students and show them how the bar chart represents the count for the red blocks and the blue blocks. As we counted out the green and yellow blocks, I would show the students how to make a chart for the green and yellow blocks.

D. Give the students sets of the red and blue blocks and ask them if they can figure out what the bar charts tells us about the blocks. After discussing their ideas, I would have them demonstrate their understanding by having them make their own charts using another set of green and yellow blocks that I would have ready to pass out.
Earth materials

Mr. Sanchez wants his 3rd grade students to be able to recognize and describe different types of earth materials, namely rock, mineral, clay, gravel, sand, and soil samples, which he has available for use in the lesson. Mr. Sanchez is considering four different approaches to the lesson.

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

A. I would write the different types of earth materials on the board and define them for my students. Then I would individually describe the unique characteristics of each type of material to the students, and pass the samples around.

B. I would have the students sort and describe the various earth materials displayed on their tables, according to their unique characteristics. I would then guide a class discussion about these different types of earth materials.

C. I would write the different types of earth materials on the board and define them for my students. Based on the descriptions on the board, I would then ask the students to sort the earth materials, and describe why they sorted the materials the way they did.

D. I would ask the students to think about what types of materials the earth is made up of. The students would be free to explore this question with different earth materials in the classroom, and then report back on their conclusions.
Thermometers and how they work

Mr. Dole is developing a science lesson for his 4th grade students, in which he would like them to acquire an understanding of thermometers and how they work. He has real thermometers available. He also has materials that students could use to assemble their own basic thermometers (small bottle as bulb, cork with hole, straws and colored water). Mr. Dole considers four different ideas about how to structure and teach the lesson.

Thinking about how you would teach, which one of the following is most similar to the approach you would take?

A. Start by telling the class that today they will discover something for themselves. Each group will have a bottle, cork, straw and colored water, plus containers of hot and cold water. Show them how to assemble the materials but give no further guidance. They can explore as they wish and come up with ideas, which they can then report to the class.

B. Start by telling students that today they will make a mystery device, see how it behaves and then try to conclude what it might be used for. Then show the students how to put their materials together, and have them explore what happens to the water column in the straw when they put the bulb in cold and hot water. Ask them to suggest what they have ‘invented’ and what it can be used for. Finally wrap up with a discussion of thermometers and how they work.

C. Ask the class what they know about thermometers. List student responses on the board, and then working from some of their ideas, draw a thermometer and explain how it works. Then have students use thermometers at their tables, measuring the temperatures of cold and hot water.

D. Write the lesson title ‘Thermometers’ on the board and draw a thermometer diagram. Then explain how a thermometer works and answer student questions. Conclude by placing a real thermometer in cold and hot water and showing students how the thermometer reading changes.
Inheritance

Mr. Montgomery was teaching his 7th graders about inheritance. After introducing the topic and demonstrating how to use a Punnett square to determine genotypes and phenotypes of possible offspring, he asked students to solve a variety of application problems in small groups.

Thinking about how you would teach, how would you end this lesson?

A. Since students would have already discussed the problems in their small groups and developed their own understanding of the topic, I would end the lesson here.

B. I would give the students the right answers to the problems.

C. I would ask students to explain their answers to the class. Drawing on their explanations, I would guide them to the correct answers.

D. I would review the correct answers to the problems with the students as a class discussion.
Sundial

Ms. Navetta is planning a 7th grade lesson on the changing position of the sun in the sky during the day and how this is the basis of a simple ‘sundial’ to tell time of day. The basic sundial is a simply a vertical stick on a piece of board, and in sunlight the angle of the stick’s shadow can be marked on the board. Ms. Navetta also has a larger demonstration model with lines marked at various angles and labeled with hour of day. Ms. Navetta considers various ways to conduct the lesson.

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

A. Explain how a sundial works related to sun position in the sky. Have each group assemble a basic sundial, using a prepared handout sheet with lines and hour markings. Then take the students outside to try out their sundials and see that they indicate the correct time of day.

B. Do not explain sundials but take the students outside and have each group set up a stick and board. Ask them to brainstorm what this might be useful for, and to expand on their ideas. Have them come back every hour, anticipating that they will mark a series of shadow lines to make a sundial.

C. Explain how a sundial works, in relation to sun position in the sky. Then gather the class outside around the demonstration model, so they can see how the sundial indicates the correct time of day. Come back an hour later to see that the shadow has moved to the next marking.

D. Instead of explaining sundials take the students outside and note the location of the sun in the sky. Have each group set up a stick and board and mark the position of the shadow. Ask them to suggest how this might be used as a ‘shadow clock’ to tell time of day. Have them come back every hour and mark a new shadow angle, labeling it with the hour, to make a sundial.
Magnetic attraction

Mr. Golden is beginning a unit on Magnetism with his 1st grade students, and his objective is for them to learn about magnetic attraction. He gives each student group a bar magnet and a tray that contains a paper clip, a coin, an iron nail, school scissors, a pencil, some keys, a marble, a crayon, aluminum foil, some sand, and students can add a few objects of their own. Mr. Golden introduces the term "magnetic attraction," and demonstrates how to test a couple of objects with a magnet. Student groups are then asked to sort the objects in their trays according to whether they are attracted by the magnet or not.

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

A. Instead of beginning with terminology, Mr. Golden should have had the students first test the various objects themselves and discuss their ideas about it. In wrapping up the session, Mr. Golden could introduce the term magnetic attraction, and how it applies to what they observed.

B. This is a good lesson because Mr. Golden introduces the important terminology right at the start. However, having demonstrated how to test an object using a magnet, he might as well have demonstrated what happens with all the objects, sorting as he goes.

C. Mr. Golden should have allowed the students to explore freely with magnet and objects, without bringing up terminology. He could then let them discuss any ideas they might have about it and share these with the class. The only contribution he needs to make is to present the term magnetic attraction at the end.

D. This is a good lesson because Mr. Golden introduces the important terminology right at the start, and follows up with the students doing a hands-on activity, testing and sorting the objects themselves.
Succession

Ms. Tutt’s 6th grade class has just finished an introductory lesson on plant succession. The students now understand that succession can be initiated either by the formation of a new, unoccupied habitat (primary succession) or by some form of disturbance of an existing community (secondary succession). She is now considering the use of a follow up activity at a green space near campus and has several options.

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

A. Provide the students with a map of the green space demarcating succession. I would then walk the students through the succession areas pointing out the plant life specific to each area.

B. Provide the students with a map of the green space demarcating succession. The students’ task would be to identify the types of plant life in each succession area.

C. Ask the students if they thought they could identify succession and how they would do it. Then we would go to the green space, and the students’ task would be to map out succession at the green space, developing and documenting their own maps.

D. Take the students to the green space and ask them to observe as much as they could corresponding to our recent studies on succession. I would leave it to the students’ own imaginations on how best to use their observations of a real succession environment, and how to document those observations.
Volume and displacement 1

Ms. Katinka is doing a lesson on volume in her 6th grade classroom. Part of the lesson will involve using a graduated cylinder partially filled with water for determining the volume of small irregular objects.

Thinking about how you would teach this lesson, of the following choices, how would you advise Ms. Katinka to structure her lesson?

A. Ms. Katinka should open the lesson by clearly stating the learning objective: the use of displacement as a measure of volume. The teacher then asks the students what happens to the water level in the bathtub when they climb in. She tells them that this is an example of displacement and then assigns an activity using graduated cylinders where the students measure the displacement caused by various objects.

B. Ms. Katinka should open the lesson by asking the students what happens to the water level in the bathtub when they climb in. She uses their ideas to introduce an activity using graduated cylinders where the students measure the displacement caused by various objects. Following further discussion of their observations, the teacher clarifies that the students have been measuring volume.

C. Ms. Katinka should open the lesson by having the students freely explore what happens when various objects are placed in the graduated cylinder. The students should first record their observations and then discuss their findings amongst themselves and with the teacher.

D. Ms. Katinka should assign an appropriate reading in a science textbook on volume and displacement. The students read in class, then the teacher shows the students how to determine the volume of an irregularly shaped object by water displacement in a graduated cylinder. The teacher then has the students find several objects around the room to test on their own using the displacement method.
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.
Sediments and water

Ms. Downey would like her 8th grade students to understand the erosive effect of water on various types of sediment, and that running water erodes some types of sediments more easily than others.

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

A. I'd ask the students if they think water erodes some sediments more easily than others, and allow them to complete an activity using sand and silt to help them determine the potential for each to erode.

B. I'd explain that the more water a sediment can hold, the more erosion will occur, and use samples of sand and silt to demonstrate.

C. I'd explain that the more water a sediment can hold, the more erosion will occur, and have the students do an activity themselves to verify this.

D. I'd ask the students to explore the effect of water on various sediment samples and come to their conclusions on each sediment’s potential to erode.
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.
Photosynthesis

Ms. Hamid has been teaching her 8th grade students about photosynthesis, and in particular that chlorophyll production in plant leaves is light-induced. She sets up an example to illustrate this. She has placed fast-growing seedlings where they are exposed to different levels of light intensity. The students observe the growing plants over several days and estimate the amount of chlorophyll using a color chart to record leaf color. They record their data in their science notebooks and on a classroom data table. On the last day, Ms. Hamid reviews the role of light in chlorophyll production as illustrated by the activity.

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

A. This is a good lesson design overall because Ms. Hamid begins with an explanation of the concepts she wants the students to learn followed by an activity for students to confirm that chlorophyll production is light-induced.

B. Ms. Hamid begins appropriately with an explanation of the concepts she wants the students to learn. This being so, it is not clear that the activity is needed, especially since it requires so much class time.

C. Ms. Hamid’s approach is too pre-organized and prescriptive. It would be better for students themselves to decide how to set up plants and lights, see what happens, and figure out a way to compare chlorophyll production in the leaves.

D. The instructional sequence would be better if the students do the plant observations first, showing that chlorophyll is light-induced, after which Ms. Hamid can explain the process more fully.
Sink or float

Ms. Hoo has her Kindergarten students gather around a small pool of water. She has a set of objects of different sizes and different materials; some will sink and some will float. Ms. Hoo’s goal is for her students to first distinguish the objects by whether they sink or float, and then realize that this does not depend on the size of the object but on what it is made of (e.g., the stones will all sink no matter how big or small they are, and the wooden blocks will all float).

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

A. Drop objects one by one into the water, and have the children notice that some sink and some float. Point out that all the stones sank, no matter how big or small, and all the wooden blocks floated, etc. Conclude by stating the lesson objective, that it is not size that matters but the material the object is made of.

B. Have students come by one by one and drop an object into the water, with everyone calling out whether it sank or floated. Ask them to suggest what this depended on; when some suggest size and others what it is made of, have them test these ideas by dropping more objects. Then have them agree on a conclusion.

C. Have all the students drop various objects in the water and seeing what happens. Then have them talk among themselves about this and ask volunteers to give their ideas about it, with others saying if they agreed or not.

D. Have students come one by one and drop an object into the water, with everyone calling out whether it sank or floated. Point out that all the stones sank, no matter how big or small, and all the wooden blocks floated, etc. Conclude with the lesson objective, that it is not size that matters but the material the object is made of.
Varieties of wheat

Ms. Coker will be teaching her 3rd graders a unit on edible plants. Today’s topic is that wheat comes in many different varieties.

Thinking about how you would teach, of the following, which is most similar to how you would use a transparency such as the one shown in this diagram?

A. I would give my students many types of wheat to sort by appearance. Once the task was completed, I would show the transparency and ask the students how their sorting compared with the pictures on the transparency. I would then conclude the lesson by reviewing the intended learning outcome.

B. I would give my students samples of wheat to look at. As I explained the concepts to be learned, I would have them identify the wheat samples by referring to the transparency.

C. It is important to state the intended learning outcome at the start of the lesson, so I would use the transparency as I explain the concepts to be learned, and show them an example of a wheat stalk of each kind.

D. I would not use a transparency such as this, as it would make the lesson too teacher directed. I would give my students samples of wheat to sort by characteristics of their choosing and then record their results. The lesson would conclude with a discussion of their findings.