Reflection Lesson Plan

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AMY-Northwest Middle School
Three Days – May 2006 (45 minute lessons)

1. GUIDING INFORMATION:

   a. Student and Classroom Characteristics

      These lessons will be taught to three sections of seventh grade students, focusing on a particular section of students who completed pre-assessment questions on light in October. This class is made up of 27 seventh grade students, 13 boys and 14 girls. Three of the students are classified as MG (mentally gifted); one student is in the process of being tested for exceptionality. Our school is unique in that it is not a neighborhood middle school; our students come from across the city of Philadelphia. Eighty-five percent of the students qualify for free or reduced lunch. The section of seventh graders participating in this assessment is commonly known as the “best” seventh grade class in terms of academic performance and behavior by most staff members.

      Students work in groups of four or five during science classes. Students are accustomed to a routine in class: warm-up, lesson or activity, and then a closing. The students can be talkative during independent work, but generally work well in their group and finish assigned tasks. As a whole, this group tends to be curious and engaged throughout most lessons. Many students in this class struggle with written communication skills. Therefore, one of the goals of this lesson will be to have students reflect in writing about the activities and concepts.

   b. Prior Knowledge

      A pre-assessment administered in October showed the majority of the students have not yet grasped the idea that light is required for sight. Many believed our eyes, not the light entering our eyes, allow us to see in different situations.

      Nearly all of the students represented light in some sort of straight-line path, with many adding direction (or multiple directions) with arrows. Also, the majority of my students recognized the reflection occurring through the mirrors, glass and other smooth surfaces. What they did not recognize, however, was the diffuse reflection occurring as light interacted with all of the objects in the room.

      Students supported their ideas – even though they were often misguided – by using their personal experiences. This shows that the students need to experience the scientific concepts through hands-on activities so the concepts can become part of their personal experience. Although students struggled with some ideas about light interactions, most understood light traveled in straight-line paths. This will be a good point to build upon in benchmark lessons.

      It is assumed that these lessons will take place after a study of wave behavior and an introduction to light.

2. PURPOSES:

   a. Major Concepts
The study of light falls under the category of physical science. Light can only be studied indirectly in terms of how it behaves, and therefore we have to derive the properties of light from our observations of its behavior. When something produces light, such as the sun, stars, a candle flame or a light bulb, it is said to be luminous. All other objects or particles of matter are classified as nonluminous. When visible light is given off by high temperatures, it is said to be incandescent (Tillary 128). In the explanation of light in Integrated Science, the authors use the electromagnetic wave model to explain how incandescent objects produce light and thus enable us to see it. The electromagnetic wave model shows the relationship between electricity, magnetism and light. An electromagnetic wave forms whenever an electric charge is accelerated by an external force (Tillary 130). This acceleration produces a wave consisting of both electric and magnetic fields, which continuously exchange energy back and forth. As the acceleration of the wave increases, the frequency of the wave increases. This frequency determines the wave’s place on the electromagnetic spectrum, which ranges from radio waves to gamma waves. Visible light is found in the middle portion of this electromagnetic spectrum (Tillary 130).

Electromagnetic radiation is given off from matter at any temperature (Tillary 131). This radiation comes from the acceleration of charged particles near an object’s surface. The frequency of this radiation is determined by the temperature of the object. As the temperature of an object increases, there is an increase in the amount of radiation given off, and the radiation shifts toward higher frequencies and shorter wavelengths. As incandescent objects - such as a light bulb or a candle flame - reach these higher temperatures, the radiation they emit falls into the range of visible light.

Though the path of light is not itself visible, light is commonly represented through light ray models. These models show light as a line drawn to represent the straight-line path of light. A ray of light travels from its source in a straight line until it runs into an object or particle of matter. The result of this interaction depends on the material the light encounters, the angle at which it strikes the surface and the smoothness of the surface (Tillary 132). If the surface of the object is smooth, the light rays will reflect and leave the surface parallel to each other. If the surface is rough, the light will reflect in random directions. Most of the objects we see are visible from this diffuse reflection (Tillary 132).

The material the light encounters also affects the interaction. Transparent materials, such as glass, allow light to transmit through them. Other materials are opaque and do not allow light to transmit through them; these opaque materials instead either reflect or absorb the light. The angle of the light ray combines with the nature of the material in determining whether light is absorbed, transmitted or reflected. A vertical ray of light will transmit through a material much more than an angled ray. It is important to note that most materials experience a combination of these interactions, yet they are often classified by the interaction that occurs most. For example, we characterize a mirror by its reflection of light, yet it also transmits a small amount of light (Tillary 133).

Visible objects like these are necessary for us to experience sight, in addition to our own eyes and light itself. As mentioned previously, light is emitted by luminous sources and is scattered or reflected by secondary sources. Some of this light reaches our eyes, enters and produces an effect on the retina which is interpreted in the brain (Shelley 714). The person involved has no action in the event prior to the arrival of light into the eye; he or she does not emit any rays, does not pull on the light or guide it through the air (Shelley 714).
The above information provides a content background for the students’ two-day lesson. Through this two-day lesson, students will learn several concepts:

**Students will need to be able to differentiate between a light source and a reflection.**

Objects that produce light are called luminous and are considered sources of light. It is possible to see a light source (even in the dark) because the light passes directly into the eyes. The sun, light bulbs and flames are light sources. While most objects are not luminous, they are still visible because light from light sources reflects off of the objects and travels to the eyes.

**They will be able to differentiate between regular reflection and diffuse reflection.**

Regular Reflection: occurs when light beams are reflected at the same angle. When your eyes detect the reflected beams, you can see a reflection on the surface.

Diffuse Reflection: occurs when light beams reflect of many different angles. You can’t see a reflection because not all of the reflected light is directed toward your eyes.

**Students need to be able to explain the Law of Reflection.**

The Law of Reflection states that the angle of incidence is equal to the angle of reflection.

**b. Learning Goals**

Students will build on their personal experiences and prior knowledge of light to explain light interactions. Students will use hands-on activities to extend their understanding of reflection, explore the Law of Reflection and use this law to create a working periscope. This activity will allow students to experience the Law of Reflection for themselves, as well as connect the lesson to a real-world product.

**c. Objectives**

1. Students will be able to use the terms *luminous* and *illuminated* to label a variety of objects.
2. Students will be able to differentiate between *regular* and *diffuse reflection* and give examples of each.
3. Students will be able to transfer knowledge of reflection to create a working periscope using the *Law of Reflection*.

**d. State Standards**

The National Science Education Standards address students’ understanding of light as part of Physical Content Standard B: Transfer of Energy. Part of this standard states that students in grade 5 through 8 should understand that “light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object - emitted by or scattered from it - must enter eye” (NSCS 154).

The Pennsylvania State Standards also address students’ understanding of light with standard 3.4.7 Physical Science, Chemistry and Physics, C: Identify and explain the principles of force and motion (Philadelphia Core Curriculum, 2004).

**3. RATIONALE:**
This lesson will allow students to build on personal experience, use a hands-on approach to understand more about reflection and connect this scientific concept to a real-life activity. My students work well in groups, are more engaged when presented with hands-on activities and struggle with putting ideas into words. I believe this lesson will highlight the group’s strengths by using methods that have worked in the past, while including writing activities to improve the students’ skills. On the first day, students will activate prior knowledge and brainstorm what they know about light sources and reflection. They will use a standing mirror, bouncing balls and a protractor to test the law of reflection. This day will focus on concrete information and exploration of the concepts. This lesson will also connect the ideas of reflection to everyday objects used by the children. By using a basketball, students will be able to start thinking about reflection in terms of objects and movement other than glass surfaces. On the second day, students will be able to apply this new knowledge as they work in teams to create periscopes. This will illustrate the connection between a scientific concept and a real-life application.

4. CLASSROOM PREPARATION:

a. Instructional Materials
1. examples of light sources (day one)
2. two basketballs (day one)
3. standing mirror (day one)
4. 6 protractors (day one)
5. 6 combs (day one)
6. graphic organizer for students to list 5 definitions and examples (day one)
7. One of the following for each of the 6 groups (day two)
   a. Cardboard box
   b. Scissors
   c. Two mirrors
   d. Modeling clay
   e. Flashlight
8. Written reflection handout (27 copies) (day two)

b. Management and grouping patterns

These two days will include whole group instruction, independent work and cooperative groups. On Day One, students will begin by brainstorming ideas with a whole group. They will work with a partner to label light sources and illuminated objects and list examples of diffuse and regular reflection. The students will work within their groups to explore the law of reflection through several activities, and then will work independently to complete a graphic organizer.

On Day Two, students will work in their cooperative groups to complete the periscope challenge. We will review the procedures and brainstorm ideas as a whole group, then break into cooperative groups. I will monitor the class by circulating throughout the room. The timekeeper in the group will keep the group on task with the help of our classroom overhead timer (this tool is used often in class). We will finish Day Two with a whole class discussion. Students will solidify their understanding by completing an individual written reflection at the end of class or at home.
c. Safety
Safety should not be an issue for these two days. We will review procedures for correct use of the materials each day before beginning any activities.

5. TEACHING METHOD(S), INSTRUCTIONAL PROCEDURES, AND LEARNING ACTIVITIES:

Day 1

a. Phase of Inquiry:
Engagement: Students will be engaged in a prior knowledge activity in which they can see how their ideas relate to the actual concept of light and reflection. Students will also be engaged in activities testing the law of reflection.
Exploration: Throughout the lesson, students will be exposed to five main terms that relate to reflection. While they will be engaging in short activities designed to expose them to these concepts, they will also receive direct instruction to explain the more technical aspects. The students will receive all information on Day One necessary to do the activity on day two.
Explanation: Students will analyze the three Day One activities to clarify and explain what they saw.

b. Content
On Day One, students will review the idea of light sources and visible objects. They will understand that illuminated objects are visible because of reflection, and learn the difference between regular and diffuse reflection. They will learn the Law of Reflection and test this law through several short, group activities.

c. Motivational opening
Students are accustomed to starting each class with a warm-up activity. Today’s activity will be a list of objects written on the board. Students will be asked to label each object as a “light source” or as a “visible object.” (2 min). I will ask for student volunteers to share their thoughts. We will use this warm-up activity to create a working definition of both terms and to discuss why we can see those objects that do not produce light (reflection).

d. Core Learning Activities
1. The teacher (myself) will refer back to pre-assessment questions from October, in which most students said light reflected off of only mirror and glass. Explain to students that light reflects off of all surfaces, even though we can only see our reflection in certain surfaces. Introduce terms regular reflection and diffuse reflection. I will show several examples of surfaces (using overhead) and ask students to identify whether this would be regular or diffuse reflection.
I will explain that to tell the difference, it is necessary to understand the law of reflection. Students will view a diagram of the law of reflection and review the diagram as a group.
Tell students we will be testing this law in three different activities. Their job – as a group – will be to explain how the activity shows the law of reflection.

_activity one_: Ask two volunteers to bounce a basketball between them. Ask students to pay attention to the angle that the student bounces the ball, and the angle it bounces off the ground. Have volunteers try to bounce the ball from several different angles. Tell students to write how this shows the law of reflection in their science journals.

_activity two_: Ask for two more student volunteers. Student A should stand in front of the standing mirror. Student B should move to find where he/she can see Student A’s reflection through the mirror. Again, have volunteers try this from several different angles. Tell students to write how this shows the law of reflection in their science journals.

_activity three_: Pass out supplies to each group. Put procedures for activity on overhead (so students can reference them if necessary) and review them as a group. Students will work in cooperative groups to test the law of reflection using a flashlight, comb, protractor and a mirror.

    Students will place a mirror on one edge so its reflecting side faces the group. They will place the paper in front of the mirror and the protractor on the paper. They will place the flashlight pointed toward the mirror at an angle and turn it on. The comb should be placed in front of the light. The students will trace the path of one of the beams and note the angle at which the beam strikes the mirror. The students will compare that angle with the angle of reflection.

_e. Critical Questions_
How do light sources and visible objects differ?
What are regular reflection and diffuse reflection?
What is the Law of Reflection?

f. Closure
Students will gather back into a whole group for a final discussion. The reporter for each group will share the group’s observations from the final activity. Graphic organizer handout (including the law of reflection diagram) will be handed out and reviewed so students understand what is expected for homework. Before they leave, students will be presented with tomorrow’s challenge.

Day 2

a. Phase of Inquiry
_Exploration_: Students work in groups to plan how to use the Law of Reflection to build a working periscope.
_Explanation_: Students will complete a written reflection to explain their periscope and relate it to the Law of Reflection.
_Extension_: This team periscope activity gives students the chance to expand and solidify their understanding of the concept and apply it to a real world situation.

b. Content
Students will solidify their understanding of the Law of Reflection by using this concept to create a working periscope. In addition to focusing on this scientific concept, students will reinforce teamwork and design skills.
c. Motivational opening
Again, students are accustomed to entering class and immediately doing a warm-up activity. Today’s activity will be a diagram of a bowling ball nearing the pins. Students will label the angle of incidence and the angle of reflection in the diagram.

d. Core Learning Activities
After reviewing the warm-up question, students will be presented with today’s challenge: use the materials provided to create a periscope. (Ask for a volunteer to share what a periscope is, how it is used and its importance). Students will be given a shoebox with 3 cm openings on diagonal opposite sides, two mirrors and modeling clay. They must use the modeling clay to arrange the mirrors in such a way that someone can look through the one hold and see out of the other hole. Students will be given the materials, the reflection sheet and a time limit (using our overhead timer). Before they begin to use the materials, they will record their procedures. These procedures may be adjusted as they manipulate the materials. As students work, I will circulate the classroom to monitor the group work and act as a resource if necessary. I will also have a more complex version of this activity (a similar shoebox with a simple maze inside) for any group that might need a more challenging task. As students complete their periscopes, they will complete a written reflection explaining how their device works. (Students are in the habit of writing reflections and know what is expected in terms of supporting detail). Students must reference the “Law of Reflection” in their written explanation.

e. Critical Questions
How does the Law of Reflection connect to a real-life situation?

f. Closure
At the end of the construction time period, students will gather back for a whole group discussion. Each group will present its creation and explain its process. As groups report out, we will record similarities on the board. Class will end with a journal entry: “How did you use the law of reflection while building your periscope?”

6. EVALUATION STRATEGIES
Evaluation strategies will include both informal and formal methods. Teacher observations and classroom discussions will provide immediate, informal feedback and guide instruction during two days. For example, if a student discussion shows misunderstanding of a certain concept, I will adjust my instruction, making sure to elaborate on the concept and provide more support. Students will also be formally assessed through their science journals and the group periscope activity. Students’ periscopes will be assessed with a rubric (attached) based on whether they successfully used the Law of Reflection and completed the “challenge.” Students will also be evaluated based on their written reflections about the periscope activity; they must be able to explain how the Law of Reflection connects to the activity.
These reflections will drive instruction for the subsequent lessons; students will be moving on to absorption, scattering and refraction. Students will have a formal assessment (test) at the end of this unit on light interactions.

7. REFLECTION: Not applicable at this time

8. ATTACHMENTS:

a. graphic organizer (students write relationships between concepts on lines, definitions in boxes)
b. periscope activity/reflection
c. periscope rubric
Works Cited


National Science Education Standards, National Committee on Science Education Standards and Assessment, National Research Council: 1996.
