Lesson Concept: Reflection and Mirrors
Physical Science

Betty Jane Rohr - Opdyke-Belle Rive Grade School, Opdyke, IL

(Students have already received instruction on properties of light)

Target Grade: Sixth grade

Duration: 3 days - 120 minutes

Goal Area:

Illinois State Goal 11 - As a result of their learning students will understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.

11:A.3c Collect and record data accurately using consistent measuring and recording techniques and media.
11.A.3e Use data manipulation tools and quantitative and representational methods to analyze measurements.
11.A.3f Interpret and represent results of analysis to produce findings.
11.A.3g Report and display the process and results of scientific investigation.
11.B.3d Test the prototype using available materials, instruments and technology and record the data.
11.B.3f Using available technology, report the relative success of the design based on the test results and criteria.

Learner Outcome :

As a result of their schooling students will be able to demonstrate their ability to apply their ability to apply scientific thinking skills, including those of observation, inference, and prediction.

Performance Objectives:

1. Students will explain how light is reflected from rough and smooth surfaces.
2. Students will demonstrate how mirrors form an image.
3. Students will describe how concave and convex mirrors form an image.
4. Students will model and illustrate the law of reflection.
5. Students will demonstrate how convex and concave mirrors form an image.

EXPLORATION: DAY 1 (40 minutes)

Instructional materials/resources: flashlight, protractor, metric ruler, scissors, tape, small plane mirror at least 10 cm on a side, black construction paper, modeling clay, and white unlined paper

Safety considerations: Review with students experiment safety rules. Remind students to be very careful with mirrors.

Student Cooperative Group Roles:

Leader – The leader keeps other students on task and communicates with facilitator.
Materials – The materials student is responsible for retrieving and returning all materials/resources to science table.
Recorder – The recorder makes all written and visual data recordings for the group.

Instructional Events:

1. Assign students into groups of three or four. Have the "materials" student in each group retrieve all instructional materials/resources for his/her group.
2. Ask students to experiment with materials to determine if a relationship exists between the direction of incoming light rays and the direction of the reflected light rays.
3. My role will be that of a facilitator. The "leader" of each group will raise a green card if members are confused or off task. Questions will be used to assist those groups/students.
   What did you try?
   What else could you try?
   Did you carefully look at the mirror from different views?
   Did you carefully look at the position of flashlight?
   Is the mirror stable?
4. As students proceed, they will observe that the light ray strikes the surface of a plane mirror and is reflected, I will ask the "recorder" in the group to write or draw observable information.
5. Students will be asked to measure with the ruler to find the center of the bottom edge of the mirror and mark it. Then they will use their protractor and the ruler to draw a line on the paper perpendicular to the mirror from the mark. Students will label this line p. Using the protractor and the ruler, students draw lines on the paper outward from the mark of the mirror at angles of 30 degrees, 45 degrees, and 60 degrees to line p. They will answer the question: "What happened to the beam of light when it was shined along line p?" The group Recorder will write and draw results.

6. Students will complete worksheet (Attachment 1) in groups.
7. **A performance assessment** (Attachment 2) rubric will be used to determine students' understanding.

CONCEPT INTRODUCTION: DAY 2 (40 minutes)

Instructional materials/resources: concave and convex mirrors, video, computer lab, spreadsheet program

Instructional Events:

1. Students will be shown the video "How Light Travels." In groups they will record vocabulary words listed on worksheet in Day 1, and key concepts covered in the video. The leader of each group will share their findings with the whole class.
2. Teacher will distribute concave and convex mirrors to students so they have them available during concept introduction discussion. Students will be asked to compare/contrast the mirrors and record observations in their science journals.
3. Students will be asked to refer to their experimental data, worksheets, and video and journal recordings to answer and reflect on the following questions:
   a. What is the law of reflection?
   b. Does light reflect differently on rough and smooth surfaces?
   c. How do concave and convex mirrors form images?
   d. Is the angle of incidence always equal to the angle of reflection?
   e. Why does a rough surface cause a diffused reflection?
   f. What is a plane mirror (used in experiment Day 1)?
   g. How does a plane mirror form an image?
   h. Where would concave mirrors be used?
   i. What happens to the image in a concave mirror when an object is closer to the mirror than one focal length?
   j. Why do side mirrors on cars carry the warning that objects are closer than they appear to be?
   k. Students will be given the opportunity to ask for clarification of any concepts or vocabulary they are having difficulty understanding.

CONCEPT APPLICATION: DAY 3 (40 minutes)

Instructional materials/resources: Reflections and Mirrors worksheet, simulation program in Computer Lab, spreadsheet software in Computer Lab

Instructional Events:

1. In the Computer Lab students will be asked to design a table using spreadsheet software to compare the images formed by plane, concave, and convex mirrors. They will include in their table how the images depend on the distance of the object from the mirror.

2. To assist students with main application, students will complete a Mirrors and Reflections worksheet (see Attachment 3) with their parents as Day 3 homework. This assignment will be completed at home and returned on Day 4. Questions will cover performance objectives 1 through 5.

3. This application activity will be performed in the Computer Lab at the website: http://physics.gac.edu/~chuck/PRENHALL/Chapter%2026/AABXTEQ0.html Students will press the hyperlink on the Molecular Workbench website entitled Reflections in a Plane Mirror to complete this simulation. There are 11 open-ended questions for each student to complete. Each question will carry a value of 9 points.

4. Students who receive a score of 60% or below will receive after-school tutoring and review from Day 2. They will also be given an opportunity to retake the simulation assessment.

Attachment 1

Reflections & Mirrors - Physical Science

Worksheet/Study Guide

6th Grade – Betty Jane Rohr
Opdyke-Belle Rive Grade School, Opdyke, IL

PART A

Write definitions of the following vocabulary words.

mirrors -

concave -

wave -

transparent -

convex -

translucent -

opaque -

angle of incidence -

angle of reflection -

the normal -

Answer the following questions on the lines provided.

Light rays reflect off a <u>rough</u> surface.

Do the rays reflect in many directions or few? _____

What type of reflection is this? _____

Light rays reflect off a <u>smooth</u> surface.

Do the rays reflect in many directions or few?_____

What type of reflection is this? _____

Draw the following:

Plane Mirror -

Concave Mirror -

Convex mirror -

Fill in the blanks:

The law of reflection states that the _____ of _____ is

equal to the _____ of _____.

PART B

As a group, make a poster that shows the measured angles of reflection for angles of incidence of 30 degrees, 45 degrees, and 60 degrees. Write the relationship between the angles of incidence and reflection at the bottom.

Attachment 2

Performance Assessment

Building A Structure : Reflections and Mirrors

Physical Science - 6th Grade

Teacher Name: Betty Jane Rohr, Opdyke-Belle Rive School, Opdyke, IL
Student Name: _____

Date: _____

CATEGORY	4	3	2	1
Modification/ Testing	Clear evidence of troubleshooting, testing, and refinements based on data or scientific principles.	Clear evidence of troubleshooting, testing and refinements.	Some evidence of troubleshooting, testing and refinements.	Little evidence of troubleshooting, testing or refinement.
Function	Structure functions extraordinarily well, holding up under atypical stresses.	Structure functions well, holding up under typical stresses.	Structure functions pretty well, but deteriorates under typical stresses.	Fatal flaws in function with complete failure under typical stresses.
Scientific Knowledge	Explanations by all group members indicate a clear and accurate understanding of scientific principles underlying the construction and modifications.	Explanations by all group members indicate a relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by most group members indicate relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by several members of the group do not illustrate much understanding of scientific principles underlying the construction and modifications.

Information Gathering	Accurate information taken from several sources in a systematic manner.	Accurate information taken from a couple of sources in a systematic manner.	Accurate information taken from a couple of sources but not systematically.	Information taken from only one source and/or information not accurate.
Plan	Plan is neat with clear measurements and labeling for all components.	Plan is neat with clear measurements and labeling for most components.	Plan provides clear measurements and labeling for most components.	Plan does not show measurements clearly or is otherwise inadequately labeled.
Data Collection	Data taken several times in a careful, reliable manner.	Data taken twice in a careful, reliable manner.	Data taken once in a careful, reliable manner.	Data not taken carefully OR not taken in a reliable manner.
Construction - Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.
Construction - Care Taken	Great care taken in construction process so that the structure is neat, attractive and follows plans accurately.	Construction was careful and accurate for the most part, but 1-2 details could have been refined for a more attractive product.	Construction accurately followed the plans, but 3-4 details could have been refined for a more attractive product.	Construction appears careless or haphazard. Many details need refinement for a strong or attractive product.
Journal/Log - Appearance	Several entries made and all are dated and neatly.	Several entries are made and most of the entries are dated and	Several entries are made and most of the entries are dated and legible.	Few entries are made AND/OR many entries are not dated or very

		neatly entered.		difficult to read.
Journal/Log - Content	Journal provides a complete record of planning, construction, testing, modifications, reasons for modifications, and some reflection about the strategies used and the results.	Journal provides a complete record of planning, construction, testing, modifications, and reasons for modifications.	Journal provides quite a bit of detail about planning, construction, testing, modifications, and reasons for modifications.	Journal provides very little detail about several aspects of the planning, construction, and testing process.

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Attachment 3

Reflections and Mirrors - Physical Science

Skill Building – PARENT/SCHOOL CONNECTION

Betty Jane Rohr – 6th Grade

Opdyke-Belle Rive Grade School, Opdyke, IL

Name (Parent): _____

Name (Student): _____

Date: _____

1. Why are concave mirrors used in flashlights and headlights?

2. What happens to the image in a concave mirror when an object is closer to the mirror than one focal length?

3. Why do side mirrors on cars carry the warning that objects are closer than they appear to be?

FORMING HYPOTHESIS

When you look at a window at night, you sometimes see two images of yourself reflected from the window. Make a hypothesis to explain why two images are seen.