



Grade 4 Science Unit: Light



By: Heather Novak

Overview:

In this unit, students will be studying light. They will look at characteristics of natural and human-made sources of light in their environment. They will look at the differences between human-made and natural light and how human-made light was designed to solve problems in the home and at school. Students will also study the characteristics and properties of light. They will examine how white light can be made up of colours. As well how light interacts with different types of objects and reflection and refraction will be explored. Lastly, students will look at technological innovations that were created with the help of light. Students will look at several different types of optical devices and how they interact with light. Students will then be able to construct one optical device that performs their specific identified function. This will use their knowledge of how light works and how it interacts with other objects. Students will be using their knowledge of light, reflection, refraction and so on that they learned during this unit to create these devices. Each lesson, experiment or activity used in this unit will provide opportunities for students to study, experiment and learn about the characteristics and properties of light.

Safety:

Safety will be emphasized in all the experiments that they do in this unit. As a class we will create safety rules that will be posted up in the classroom where students can see it and refer back to at any time. Some of the general safety rules that I would include would be:

1. All accidents must be reported to the teacher
2. If you spill a liquid, stay there and ask a student to get you something to clean it up with.
3. Do not touch, smell or taste anything that is not supposed to be.

4. Do NOT fool around when doing any of the experiments
5. If dealing with sharp objects like scissors and glass, use or handle with care.

Clean Up Procedures:

Like the Safety rules, as a class we will create clean up procedures that will as well be posted within the classroom where they can see it. The general procedures that I would include, but may change according to each class would be:

When finished experiments and activities clean up your work area:

1. Collect all materials that were used
2. Clean any materials that are dirty from experiment or activity
3. Throw anything that needs to be thrown away into the garbage can.
4. Clean up any spills in your work area
5. Return all items to the front of the class in a neat fashion

Science Journals:

For this unit I have created science journals that correspond to each of the lessons and are in order of the lessons. If you choose to change up the lessons then you can easily switch the pages in the science journals around with no problems. For each lesson there is a page in the science journals that corresponds with the lesson that the students will complete to complete the lesson. Science journals will be taken in once a week to see the students work and how they are progressing in the unit. There journals will be evaluated for quality writing, completeness, understanding of skills of scientific method and inquiry, use of diagrams/ illustrations and content and effort. A rubric will be used to evaluate this and an overall mark/evaluation will be given to the students at the end of the unit.

Lesson #1

Topic: Natural vs. Artificial Light

Objective: LI4.1 Identify the characteristics of natural and man-made sources of light in the environment

Indicator(s): a. Identify sources of natural and artificial light in the environment

5 E's: Engage

Materials: -Science Journals

-“Light: Shadows, Mirrors and Rainbows” book by Natalie M. Rosinsky

Description of Lesson: In this lesson, Students will be introduced to the unit of light by being read the book “Light: Shadows, Mirrors and Rainbows” by Natalie M. Rosinsky. This book will give students a broad idea of the light unit that they will be studying. As a class, discuss artificial and natural light and the difference between them. Many examples are given within the book. Students will then be working on a worksheet in their science journals where they have to identify whether the light sources are artificial or natural. They will also identify whether they give off heat or produce no heat.

Lesson #2

Topic: Emitting vs. Reflecting Light

Objective: LI4.1 Identify the characteristics of natural and man-made sources of light in the environment

Indicator(s): c. Make observations and collect information during investigations determine if an object emits its own light, and draw conclusions based on the evidence gathered.

d. Distinguish between objects that emit their own light and those that reflect light from another source.

5 E's: Engage and Explain

Materials: -Science Journals

-http://www.bbc.co.uk/schools/ks2bitesize/science/physical_processes/light_dark/play.shtml

Description of Lesson: In this lesson, Students will be learning about objects that emit light and others that reflect light. Students will be using their prior knowledge from last day about sources of light to determine what emits light and what reflects it. As a class, we will think of an example where there is a light source that emits light and where an object reflects that light. Students will then get out their science journals and turn to the 'Emitting vs. Reflecting Light' page and work on classifying objects as emitting light and reflecting light. They can go on to examples on the worksheet where students write in the boxes whether the object is a 'light source' or a 'reflector'. If some students get done early, they can go onto the computer and keep practicing with light sources and reflectors on the interactive website.

Lesson #3

Topic: Human-made sources of light

Objectives: LI4.1 Identify the characteristics of natural and man-made sources of light in the environment

Indicators: e. Provide examples of how human-made sources of light have been designed to solve problems in the home and at school.

g. Identify ways of conserving energy by reducing use of home lighting or using different types of light sources.

5 E's: Engage and Explain

Materials: -Science Journals

Description of Lesson: In this lesson, Students will be discussing and identifying the different types of human-made sources of light and the problems they were designed to solve. As a class, we will discuss some of the human-made sources of light and come up with one example of a human-made source of light and the problem it solved. Students will then get out their science journals and turn to the "Human-made sources of light" page. In partners, students will brainstorm using the chart provided the different sources of light in their school, home and community that was human made. They will explain the problem that source was designed to solve and how to conserve energy with that light source. They can conserve energy by reducing the length of use or by using a different source of lighting.

Lesson #4

Topic: Negative effects of exposure to light

Objectives: LI4.1 Identify the characteristics of natural and man-made sources of light in the environment

Indicators: f. Identify positive and negative effects of exposure to light (e.g., sun burns, skin cancer, increased vitamin D production).

5 E's: Engage and Explain

Materials: -Sunscreen (SPF 15, 30, and 45)

-UV Beads

-Styrofoam plates

-Science Journals

- <http://www.stevespanglerscience.com/product/1350>

- <http://www.stevespangler.com/tag/color-changing-beads/>

Description of Lesson: In this lesson, Students will be engaged in a lesson around the negative effects of sun exposure. Students will work in groups of three. Each group will get four Styrofoam plates, a handful of beads and three different types of sunscreen. The Students will write in their journal their predictions for the experiment. Students will then label each Styrofoam plate with ‘SPF 15’, ‘SPF 30’ ‘SPF 45’ and ‘Nothing’. They will then take some of the UV beads and place them on each of the Styrofoam plates. Student will then take each type of sunscreen and pour it on the UV beads on the corresponding Styrofoam plate. They will not pour any sunscreen on the plate labelled ‘Nothing’. Students will then take all four plates and put them in the sun for about an hour, observing it every fifteen minutes. Students will write down any observations that they see every fifteen minutes. While they are waiting between each observation, we will discuss the effects of the sun like sunburns and skin cancer. When done, the group will then write down their final observations and clean up by putting the beads with sunscreen on into a bowl full of water that will be provided and throw the plates away. As a group or individually, students will try to explain what they saw. *These instructions will be posted on the board for the students to refer to.

Extension: You can try and do this experiment on a cloudy day to show how sun exposure is still high on days that the sun is not even out.

Lesson #5

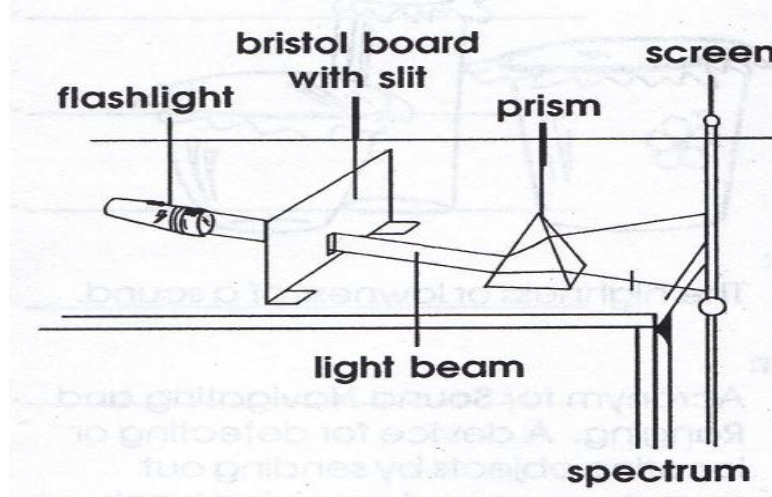
Topic: Light dispersion

Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: a. Demonstrate that white light can be separated into colours and use the term “dispersion” to describe this process.

5 E's: Engage, Explore and Explain

Materials: -Prism(s) -Bristol board or heavy paper
-Screen or wall -flashlight(s)



Description of Lesson: This lesson can be done either as a class or in groups of three or four people. If you do not have enough materials then you can do this experiment as a class. If you do have enough materials then it can be done in groups.

In this lesson, students will see that light appears to be white, but it is actually made up of colours. Before class cut a vertical, rectangular slit into the bristol board or heavy paper and fold the edges back so that it will stand up. When doing the lesson have students get out their science journals and turn it the “Light Dispersion Experiment” page. Have students predict what they think will happen to the light when it is shone into the slit in the bristol board and projected on the screen. Then predict what will happen when a prism is put between the bristol board and the screen. Then darken the room and shine the flashlight through the slit at the screen. Have students write down what they observe and draw a diagram of their observations. Then position the prism in front of the screen so that the beam of light passes through it. Have students observe and write down their observations down into their science journals and draw a diagram. Have students

write their own explanations for what they saw into their journals. After they have written their explanations, have a few students share with the class their explanations. After some discussion, explain dispersion to the class which is what they have observed in the experiment. Ask students, using their knowledge of dispersion to explain how rainbows appear in the sky. Write down their explanations in their journal. Have one or two students share their explanation. Explain the process to the students with a diagram.

A rainbow occurs when raindrops and sunshine cross paths. Sunlight consists of all the colors of light, which add together to make white illumination. When sunlight enters water drops, it reflects off their inside surfaces. While passing through the droplets, the light also separates into its component colors, which is similar to the effect of a glass prism. Each falling water drop actually flashes its colors to the observer for just an instant, before another drop takes its place.

Lesson #6

Topic: Colour wheels

Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: b. Follow a set of procedures to make and use a colour wheel
c. communicate and listen to others during investigations with colour wheels

5 E's: Engage, Explore, Explain, and Elaborate

Materials: -7 crayons: red, orange, yellow, green, blue, indigo (blue plus purple), and violet (purple); scissors; 24" of strong, thin string; sharpened pencil; flashlight and prism

Description of Lesson: In this lesson, students will be building on prior knowledge of last day that white light consists of primary colors. Bring out a flashlight and a prism again, turn down the lights and shine the flashlight through the prism projecting it onto the wall. Ask students to explain how the prism proves

that white light is made of the rainbow colours. (When light passes through the prism, it bends and splits the light into the colours of the spectrum.) Next, ask students to get out their science journals and turn to the ‘Colour wheels Experiment’ page. Once they have found the page, ask them to turn the page to the ‘Spinning White Light’ page and take it out of their package to use. Review the instructions and then have the students go ahead and begin creating their colour wheels. Have them predict what will happen when they spin the colour wheel. Once they are done creating them, divide the students into partners. Have one student in each partnering loop the string around their index fingers while the other partner turns the wheel repeatedly in the same direction to twist the thread tightly. Then have both students stare at the coloured side of the wheel as it is released. Let the students repeat spinning the wheel. Have the students record in their journals the observations that they see when the wheel is spinning. Through discussion, have the students write down their explanation for the observations that they saw when spinning the wheel. (The wheel spins too fast for the eyes to see each colour separately. The seven colours blend together and appear yellowish white.) As a class discuss what they saw and have them explain what happened.

Lesson #7

Topic: Light interaction with objects

Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: d. Investigate how a beam of light interacts with a variety of objects, in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light.

e. Record information using a format suitable to the task (e.g., chart, diagram)

5 E’s: Engage and Explain

Materials: Clear glass or transparent plastic wrap; waxed paper; cardboard, flashlight

Description of Lesson: In this lesson, students will experiment with three different types of objects and examine how light interacts with each object. Have students get out their science journals and turn to the ‘Light interaction with objects experiment’ page. Explain the experiment that they will be doing for this lesson. Put students into groups of four and have them grab each of the materials that are needed for this lesson. Have students in their groups make individual predictions for the experiment for each object and have them write it down in their journal. Have the students then take the transparent object, clear glass or plastic wrap and shine the flashlight on it. Have students look at the other side of the object and observe what they see. Have them write down their observation and draw a diagram of what they saw. Students will then come up with their own definition of what transparent is from their observations. They will next take the translucent object, waxed paper, and shine a light through it. Again, they will look on the other side of the object and observe. They will then write their observations and draw a diagram of their observations. Students will then come up with their own definition of translucent from their observations. Students will go through the same process with the opaque object, cardboard, too. *Instructions will be put up on the board. As a class, we will discuss their observations and their definitions. Put up the definitions of each and have students compare their definitions to the actual definitions to see how close they were.

Lesson #8

Topic: Opaque, transparent, translucent

Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: f. Classify materials and objects as opaque, transparent, or translucent

5 E's: Explore and Elaborate

Materials: writing paper; newspaper; plastic wrap; tin can; plain glass edged with tape; frosted glass edged with tape; magnifying glass; sunglasses; latex glove; construction paper; tissue paper; aluminum foil; white plastic lid; a leaf, etc.

Description of Lesson: In this lesson, students will use prior knowledge of transparent, translucent and opaque from the last lesson. This lesson is a classifying lesson. Students will get out their science journals and turn to the 'Transparent, Translucent and Opaque Classification' page. Put students into groups of four or five and give each group a basket full of the materials. Students are to go through each material and shine a flashlight through it. Students will then classify the object as translucent, transparent or opaque and write it down in the right column in their science journal. Students will continue this process until they have classified each object in the basket. Students will then clean up their area by putting everything back into the basket. *Instructions will be put up on the board*

Lesson #9

Topic: Changes in shadows

Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: g. Plan a procedure and make predictions and observations to determine changes in a shadow's location, shape, and relative size when an object is placed in different positions and orientations relative to a light source and screen (e.g., flashlight and puppet).

5 E's: Engage, Explain, Explore and Elaborate

Materials: Flashlights; puppets; science journals

Description of Lesson: In this lesson, Students will be experimenting with shadows. Students will get out their science journals and turn to the ‘Changes in shadows Experiment’ page. Students will get into groups of three or four and each group will get a flashlight and a puppet. Students will first predict what they think will happen in this experiment. Students will then follow each observation that they are to observe. One student will hold the flashlight and the other will put the puppet in the correct position that the observation asks them to do. Students will then observe and write and draw their observations in their journals. Students will go onto the next one and observe that one and continue this process throughout the experiment. Students will then try to explain what happened in this experiment. Then, students will move onto the extension of the lesson where they will try to use their knowledge that they gained from this experiment to draw the shadows of the house and where they would be at each time of the day.

Extension: Discuss with the students about sundials and how they were made for a specific function. Talk about how shadows work with this early invention of a clock.

Lesson #10

Topic: The path of light

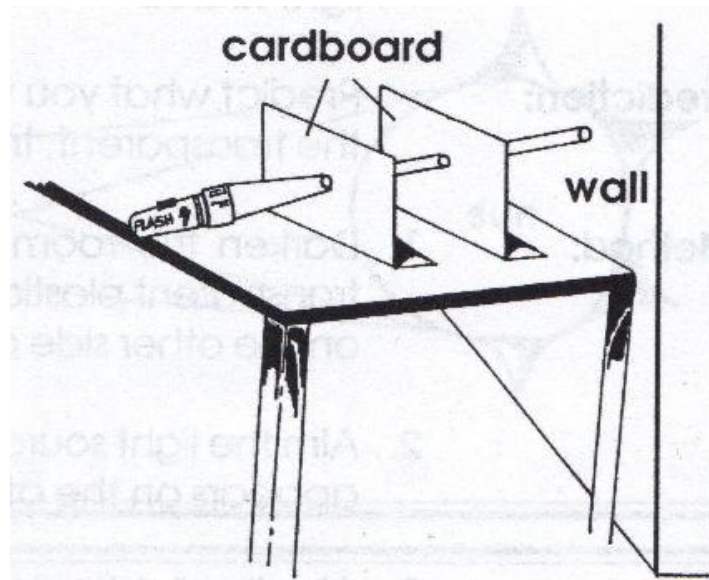
Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: h. Conclude that light travels in a straight line based on evidence gathered through research and observations

j. Demonstrate and describe how a variety of media can be used to change the direction of light.

5 E's: Engage and Explain

Materials: two pieces of bristol board with a hole in the center of each(x4-5); flashlight; modeling clay; scissors; mirrors



Description of Lesson: In this lesson, students will be learning about how light travels in a straight line and how direction of light can be changed by objects. Students will get out their science journals and turn to ‘The path of light Experiment’ page. We will go over the instructions for the experiment and then divide the students into groups of four or five. Students will make their own individual predictions for the experiment and then collect all of the materials that they need for the experiment. Students will then set up the experiment with aligning up the two pieces of bristol board and securing them with modeling clay. (A diagram on the board will be provided for the students to look off of for set up). Once they are set up, have one of the students shine the flashlight through the two pieces of bristol board. Have students write and draw what they observe happened to the light when it is shone through both pieces of bristol board. Students will then place a mirror in front of the bristol board and again shine the flashlight through the two pieces of bristol board and on the mirror. Students will then write and draw their observations into their science journals. Students will then clean up their work space and return all the materials to the front and then write down their explanations for what they observed in the experiment. As a class, we will discuss

the path of light and how it can be changed with not just a mirror but other materials as well.

Lesson #11

Topic: Reflective properties of different shapes and textures

Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: i. Plan a procedure and make predictions and observations and collect information about the reflective properties of surfaces of different shapes and textures (e.g., mirror, flat foil, crumpled foil, white paper, coloured paper, and spoon).

5 E's: Engage and Explain

Materials: Flashlight; mirror; flat foil; crumpled foil; white paper; coloured paper; spoon

Description of Lesson: In this lesson, students will learn about the reflective properties of different shapes and textures. Students will get out their science journals and turn to the 'Reflective properties of different shapes and textures' page. We will go over the instructions for the experiment and students will then make their own individual predictions for the experiment. Students will then be divided into groups of four or five. Each group will be given all of the materials that they need for this experiment. Students will first take the mirror and the flashlight and shine the light into the mirror and observe what happens. Students will write down and/or draw their observations in their science journals. Students will then take the next object, flat foil and again shine the flashlight on it. Students will then observe what they see and write and/or draw their observations in their science journals. Students will continue this process until they have observed the

effect of light on each object. Students will then clean up and return their objects to the front. Students will then write down their explanation for what they observed in this experiment. As a class, we will discuss reflection and its properties.

Lesson #12

Topic: Refractive properties of materials and shapes

Objectives: LI4.2 Investigate the characteristics and properties of light.

Indicators: k. Make observations and collect information about refractive properties of materials of different shapes.

5 E's: Engage and Explain

Materials: Drinking glass; ruler; pencil; prism; flashlight; 2 sheets with print on it; jar; water pitcher (or anything that holds enough water); water dropper; overhead transparency; water

Description of Lesson: In this lesson, students will be learning about the refractive properties of materials and shapes. Students will first get out their science journals and turn to the 'Refractive properties of materials and shapes Experiment' page. Explain the instructions to the students and that they will be doing the experiment in stations (task cards will be at each station for students to read and remind them of what they are supposed to be doing). Divide students into groups of six and assign each group a station to go to. Have the students predict and then do the experiment at the station writing down their observations. Students will then go onto the next station and do the same process as the first station and continue this process. Once they have finished each of the stations, the students will clean up whatever station they are last to do. Pour out any water and return items to the front of the class. Students will then write down their overall explanation of the mini experiments that they just did at the stations. As a class, we will discuss what

they observed at each station and what they think refraction means from what they observed at each station. Bring up convex and concave lenses and their definition as well as which stations they observed each lenses at. Have students then write out their extension question that they have in their science journals at the end of this experiment.

Station 1: Drinking glass half full of water; pencil; ruler

Have students look at the pencil and the ruler through the side of the glass and write down their observations.

Station #2: Prism and flashlight

Shine the flashlight through the prism and write down observations.

Station #3: Jar; sheet with print on it; Pitcher full of water

Have one student hold the printed sheet behind the jar so it can be seen by looking through the front of the jar. As you continue to look, ask another student to fill the jar with water from the pitcher. What do you notice? Write down observations.

Pour water back into the pitcher for next group.

Station #4: water dropper; water; overhead transparency; paper with print on it

Have students place an overhead transparency over a paper with print on it. Drop one or two drops of water onto the overhead transparency. What do you see? Write down your observations. Wipe water off overhead transparency for next group.

Lesson #13

Topic: Light and optical devices

Objectives: LI4.3 Assess the impact on society and the environment of technological innovations related to light.

Indicators: a. Compare how light interacts with a variety of optical devices such as kaleidoscopes, reading glasses, microscopes, periscopes, telescopes, and magnifying glasses.

b. Describe the knowledge of the properties of light that has led to the development of optical devices to extend our ability to observe.

e. Identify women and men in their community who have careers that deal directly with lenses, mirrors and prisms (e.g., optician, photographer, astronomer, and lab technician).

5 E's: Engage, Explore, Explain and Elaborate

Materials: Kaleidoscopes; reading glasses; periscopes; magnifying glasses.

Some of these optical devices can be made by groups of students if there is time or just make yourself

Description of Lesson: In this lesson, students will be using their prior knowledge of properties of light to examine and compare how light interacts with a variety of optical devices. Students will first get out their science journals and turn to the 'Light and Optical Devices' page. Go over the instructions for this experiment with the class. Students will first predict what they think is going to happen with each of the optical devices and then divide them into groups of three or four. Have the students examine each of the optical devices writing down each of their observations for each device. When students are finished looking at each of the devices, have them return them to the front of the class and then complete the questions in their explanation part of the experiment in their science journals. Then as a class, we will discuss what they observed and discuss more optical devices that we use today and the people who use these devices in their everyday job or career.

Lesson #14

Topic: Creating optical devices

Objectives: LI4.3 Assess the impact on society and the environment of technological innovations related to light.

Indicators: c. Use a technological problem solving process to design, construct, and test an optical device that performs a specific student-identified function.

d. Work with classmates to troubleshoot problems with a prototype of an optical device.

5 E's: Engage, Explain, Elaborate, Explore and Evaluate

Materials: Whatever is needed for each of the group's optical devices.

Description of Lesson: In this lesson, Students will be in partners constructing their own type of optical device that they will use for a specific function. Explain the final project/experiment in this unit. Students will be getting into groups of two or three and will pick one of the optical devices from the list that will be provided. Students will then research to find a way to construct this type of optical device with materials that are easy to obtain and print it off for reference. Students will then gather these materials from the teacher or from home to construct this type of optical device. Students will construct this optical device together. When finished students will test it out and complete the sheet in their science journal titled 'Creating optical devices'. If there optical device does not work then the students need to solve together the problem in their device and try to fix it so it does work. When all students have constructed their devices then they will present their optical device to the class and each student will have a chance to test out each of the devices to see if their peers were successful. Students can be evaluated on this particular project as it may take two to three lessons to research and construct their devices.

Science Journals Rubric

Name: _____ Date: _____

| Criteria | Developing- 1 | Proficient- 2 | Exemplary- 3 |
|---|---|---|--|
| Quality Writing | Organization or neatness needs attention. Uses little scientific vocabulary. Explanations are incomplete. | Ideas are somewhat organized and neat. Occasional use of scientific vocabulary used. Explanations are not fully complete. | Organized, neat, well thought ideas. Scientific Vocabulary used. Detailed, descriptive, complete explanations. |
| Completeness | Entry is not completed with any demonstrated effort. Most parts of entry are not filled out. | Entry is completed with some effort and length. Most parts of entry are filled out. | Entry is completed fully with great effort and length. All parts of entry are filled out. |
| Understanding of the steps and skills of the scientific method and inquiry. | Some steps of lab identified correctly. Explanations are not accurate/clear. | Most steps of labs identified correctly. Mostly accurate explanations. | All steps of labs identified correctly. Accurate explanations. |
| Use of diagrams & illustrations to communicate ideas | Not very accurate. Missing quite a few labels. Diagram/ illustrations are not very neat. | Accurate but not complete. Some labels used. Diagram/ illustrations are neat. | Accurate and complete. Everything is Labelled. Diagram/ illustrations are neat. |
| Content and Effort | The entry does not demonstrate thought or effort | The entry displays some thought and effort. | The entry displays a significant amount of thought and effort. |