Teacher's Guide

Grade: 5
Unit: Light Energy
Title: Opaque, Transparent, Translucent

Topic:	Opaque, Transparent, Translucent
Lesson Summary:	The purpose of this lesson is to provide experiences which allow students to explore how light energy interacts with various types of matter: opaque, transparent, translucent.
Arkansas Frameworks:	http://www.arkansased.org/teachers/word/science_k-8_011006.doc
Science Standards	PS.7.5.1 Summarize how light can interact with matter through absorption, refraction and reflection. PS.7.5.2 Investigate how light travels and interacts with an object or material. NS.1.5.1 Make accurate observations. NS.1.5.2 Identify and define components of experimental design used to produce empirical evidence: hypothesis, replication, ample size, appropriate use of control, use of standardized variables. NS.1.5.4 Interpret scientific data using: data table/charts, bar graphs, circle graphs, line graphs, stem-and-leaf plots and Venn diagrams. NS.1.5.5 Students will communicate results and conclusions of the scientific inquiry.
Math Integration	DAP.15.5.1 Interpret graphs such as line graphs, double bar graphs, and circle graphs. DAP.16.5.1 Make predictions and justify conclusions based on data. DAP.17.5.1 Identify and predict the probability of events within a simple experiment. DAP.14.5.2 Collect numerical and categorical data using surveys, observations and experiments that would result in bar graphs, line graphs, line plots and stem-and-leaf plots. DAP.14.5.3 Construct and interpret frequency tables, charts, line plots, stem-and-leaf plots and bar graphs.
Literacy Integration	OV.3.5.1 View a variety of media (e.g., posters, film clips, periodicals, charts, cartoons, etc.) to enhance and show understanding of a specific topic. OV.3.5.3 Use visual aids to convey information. W.4.5.2 Organize ideas by using such graphic organizers as webbing, mapping, and formal outlining with main topics. IR.12.5.4 Gather information from a source appropriate to purpose and topic.
National Frameworks: Science Standards	**Science as Inquiry** Demonstrate abilities necessary to do scientific inquiry. 1. Use appropriate tools and techniques to gather, analyze, and interpret data. 2. Develop descriptions, explanations, predictions, and models using evidence. 3. Think critically and logically to make the relationships between evidence and explanations. 4. Communicate scientific procedures and explanations. **Physical Science** 1. Document that light can be treated as if it travels in a straight line until it strikes an object. Light can be reflected by a mirror, refracted by a lens, or absorbed by the object. 2. Document that light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). An object is only seen if it emits or scatters light. **Science and Technology** 1. Demonstrate abilities of technological design. 2. Implement a proposed design. 3. Evaluate completed technological designs or products.
Objectives:	To explore the different ways in which light interacts with different types of matter?
Focus Question:	How does light interact with matter?

Background Information:

Often in life, we take many things for granted. Light is something we think will always be there when we need it. Experiencing power failure to a home can cause many problems. One of the problems is what do we do after the sun sets for the day. In a situation like this, we soon realize that without a source of light, we are unable to see any object. We stumble over chairs, bump into walls, knock objects off of tables and trip on stairs. We quickly become bored because we can't read, write or play games.

Now, we truly understand that light is needed in order for us to see objects. What kind of light can we use if the sun has set and the electricity is not working? Most people search for alternate sources of light such as candlelight, firelight, battery operated flashlights, or kerosene lanterns.

In this first lesson of the SciKeys 5th grade light energy module, how light interacts with different types of matter will be explored. Light is a form of energy which is visible to the human eye. Under normal conditions light from distant sources behaves like it travels in a straight line. However, it can be manipulated to take detours, mostly in straight lines.

Students should be encouraged to use flashlights or maglites to explore their surroundings and observe what happens to the light as it strikes an object or material. Objects or materials are usually described as being transparent, translucent or opaque. In some cases, light may be fluorescent.

Students have seen demonstrations of transparent materials when the teacher uses a transparency on the overhead projector in the classroom. Students may not realize that there is actually a light bulb in the projector. This might be a great time to show students. Students have been exposed to all types of transparent material such as glass, some plastic, very thin material, water and air. However, no one has made the connection to concept of light energy for them. When light is directed toward a transparent material, the light is able to pass all the way through the material.

Translucent materials such as frosted glass windows, some plastics, fog or thin paper allow some light to pass through it. Light does not pass directly through the materials. It changes direction many times and is scattered as it passes through. This scattering of the light makes objects on the other side of a translucent object appear fuzzy and unclear.

Students do not think of opaque materials such as: walls, desks, apples, pencils, thick paper, wood, stone, metals etc… as needing or interacting with light. However, without light we would not see the object or the color of the object. Opaque materials allow absolutely NO light to travel through. All light is either reflected by the object, refracted by the object, and/or absorbed and converted to heat. In the lesson, Conservation of Light Energy, students will begin to understand the importance of light interactions with opaque materials.

Essential Vocabulary

light – the thing that allows us to see objects. Light can be modeled as rays, electromagnetic waves, or photons.
light energy - the form of electromagnetic energy that is visible to the human eye.
light ray - represents a thin beam of light which helps illustrate how light works.
matter – anything that has mass and occupies space. (ADE framework)
opaque - describes matter that does NOT allow light to pass through. (ADE framework)
transparent - a medium that transmits light and also can reflect or refract a fraction of the light, but does allow objects to be seen clearly through it.
translucent - describes matter that allows, some but not all, of the light that hits it to pass through and that scatters some light. (ADE framework)

Timeline:

This lesson should take one to two 50 minute periods of time to complete.

	Instruction	Teacher's Notes
Materials:	**Elicit** – ***Scattering Light with Lasers Demonstration*** • Laser light (for teacher use only) • Aerosol hairspray or chalk dust **Engage** – ***Uncovering Children's Ideas about Light*** • Mirror (square and flat – no frame) • Flashlight or maglite • Student data sheet for prediction **Explore** – ***Light in a Can*** (per group of students) • 1 Large (approx. 2 lbs.) plastic coffee container with lid • 1 Flashlight • Squares of various materials (Approximately seven square per group) : foil, plastic wrap, wax paper, construction paper, typing paper, fabric of different colors and thickness, overhead transparencies, metal mesh, foam meat trays, black plastic, clear plastic, sandwich bag, etc. *Optional: High Tech - Light probe with computer or LabQuest type instrument **Explain** – ***Frayer Model*** • Frayer Model handout (1 copy per student) **Elaborate** - ***Now You See It – Now You Don't*** • plastic sandwich bag • lunch size brown paper sack • 2 identical objects such as: pencils, fruit, balls, or etc. • Minute Paper (1 copy per student) **Evaluate -** • "Light in a Can" lab sheet and/or science lab notebook **Extend** – See http://artsedge.kennedy-center.org/content/3895/	
	1. **Laser lights, Sunlight, Flashlights, or Maglites** - looking directly into the light or pointing the light in the eye can cause serious permanent damage to the retina. Only the teacher should use the laser light during the experiments. 2. **Hairspray** - be sure to aim the can away from face and eyes. Goggles should be used for young children. 3. **Light bulbs** - heat generated by the bulbs can cause serious burns / bulbs made of glass can break and cut the skin or eyes (especially halogens) / salt and oils from bare hands can cause bulbs to shatter when turned on. 4. **Mirrors** - be aware of sharp edges 5. **Lenses and Mirrors** - can magnify the intensity of the light. Teacher should monitor students carefully to avoid reflection into someone's eyes or causing heat which will burn. 6. **Batteries** - should not be installed backwards, put in fire, or mixed with other battery types. This may cause exploding or leaking. 7. **Broken bulbs or old batteries** - should be handled by the teacher and not the student. 8. **Disposal of bulbs or batteries** - wrap glass bulbs before throwing them away / recycle batteries in the proper place (The local post office may have a battery recycling box). 9. **Eating** should be avoided in the science lab area. 10. **Arrange room** and put away unneeded items to avoid tripping and allow for free movement of students during the experiences that require the room to be dark.	
Teacher Preparation:	***Light in a Can*** • Gather coffee cans and spray paint the inside with a Flat Black Paint. • Cut a small hole in the lid that will be the same size as the flashlights the students will be using. • Cut another small hole on one side toward the bottom of the container (not on the actual bottom of the container). • The hole should either be a circle large enough for a student to peer in with one eye or for the high tech version the size of your light probe	

Elicit Inquiry	***Scattering Light with Lasers Demonstration*** 1. Ask students if they have ever seen where actors in a movie will spray hairspray to determine where a laser is pointing so they can avoid it (Think: Mission Impossible). 2. Turn out the lights; beam the laser to a wall or ceiling. 3. Ask students to explain how the light was able to appear on the wall or ceiling. 4. Spray hairspray in its path. 5. The droplets will provide an opportunity for students to view the scattering of light. 6. Have students illustrate what they saw in their science notebooks. 7. Repeat steps 2-5 using a flashlight or maglight. 8. Connect this to future learning, by discussing as a whole class how scattering is just one property of light and over the next few days, students will be learning about different properties of light. 9. Review the word, "properties," with students.	Adding some Mission Impossible music and dressing in all black will heighten the effect!
Engage Formative Assessment	***Understanding Children's Ideas About Light*** 1. Arrange students in groups of 4 around a desk or square table. 2. Place a piece of white copy paper in the center of the desk or table. 3. Place a square mirror in the center of the paper. 4. Give the students the data sheet with the picture of 4 students around a table. 5. Ask students to write (on the picture) their prediction for what each person will see if the light is turned off and a flashlight is directed at the mirror. 6. Have students position themselves around the desk or table in the order of the students in the picture. 7. Turn off all lights in the room. 8. Ask the student with the flashlight to turn on the flashlight and direct the light toward the mirror. 9. Listen to the students discuss what they are seeing? 10. Have the students rotate around clockwise until all students have been in each spot at their desk or table. The flashlight stays in the same spot and students will operate the flashlight when they rotate into that spot. 11. Continue listening to the students' conversation.	Use what you have learned about the 7 common ideas that students have about light to assess where your student's are in their understanding of light. Record student statements on a white board, poster, or bulletin board, so they can see their ideas and change or build on them as their knowledge level develops.

Explore Inquiry	***Explore: Light in a Can*** 1. Give each group of students a coffee container, flashlight, and their choice of several different materials to test. 2. Students will place one material at a time over the hole in the lid and then stand the flashlight on top of the material. 3. They will then either view the light that has passed through the material into the container through the eye hole or measure the light using a light probe. 4. Students will then record results in the data sheet(s) provided without completing the property of material column. 5. After all students have tested all of their materials, have a class discussion about which materials allowed light to pass through and which did not. 6. At this time, vocabulary should be introduced (transparent, translucent, opaque) 7. Then, students will complete the final column on their data sheet.	Students use a simple coffee container and easily obtained materials from home, to investigate the properties these objects have to transmit light. Low tech version has students using a flashlight and their eyes to make the observations and the high tech version used a flashlight and a light probe to accurately measure how much light is transmitted through the materials. Math (optional) - Measure and compare the lines of reflection.
Explain Formative Assessment	**Frayer Model** Use textbook, websites, background information in this lesson, and any other non-fiction text for opaque, transparent, and translucent to fill in a Frayer Model for each type of material. 1. Students work in collaborative groups to make a brainstorming list of as many examples of opaque, transparent, and translucent as possible. 2. After the list is completed, students analyze the examples to describe what they have in common. This gives the students the characteristics of the types of materials: opaque, translucent, and transparent. 3. The students list their examples on their Frayer Model grid. 4. Then, they list the essential characteristics which the examples have in common. 5. Students continue filling out the grid to create a picture and the non-examples.	This can be done as whole group. Also, students can read a non-fiction text such as textbook and verify or add additional information to their grid. **Additional resources:** The websites below provides videos and additional information. http://www.teachersdomain.org/resource/lsps07.sci.phys.energy.lighttravel http://www.promotega.org/hgr07009/index.htm (site created by 5th graders) www.howstuffworks.com/light.html For more information on the Frayer Model, see the note section at the end of this lesson.

Elaborate Inquiry	***Now you see it – Now you don't*** 1. Without letting students see, place any object such as a pencil in a transparent plastic sandwich bag. 2. Without letting students see, place an identical object in a lunch size paper bag. 3. Place both bags in the room where everyone can see. 4. Have student describe what they see. Students should be able to describe the object in the plastic sandwich bag completely (size, shape, color). They will probably get frustrated trying to describe the object in the lunch paper bag. They should state the size, shape, and color of the object in the paper bag only. 5. Lead the class in a discussion comparing the two types of bags and how light is needed to see the objects. The students should be using the words transparent and opaque in their discussion. 6. Have the students write their reflection for this activity on the minute paper in their notebooks.	**Optional:** Add a third bag that is translucent. The student should see some details of the object in the bag but not clearly.
Evaluate Formative Assessment	• Lab chart for Light in a Can • Frayer Model for Opaque, Translucent, Transparent – Explain section • Minute Paper from Now You See It – Now You Don't • Open Response Practice Question	
Extend Technology	***Shadows and Light, Science and Puppetry*** Choose one or several activities from the website below: This cross-curricular connection, produced by ArtsEdge The Kennedy Center, introduces students to the art of puppetry and how different materials (translucent, transparent, and opaque) create different types of shadows. The activity can take up to six periods but can easily be condensed if students do not explore the indicated website.	http://artsedge.kennedy-center.org/content/3895/
Cross-Curricular Integrations:	Literacy - Frayer Model Literacy - Minute Paper Math - Record Data on Chart Math - Measure the lines of reflection Art - Shadows and Light, Science and Puppetry	
Technology	Light Probe used in *Light in a Can* - if available	
Resources:	The websites below provides videos and additional information.	
	http://www.teachersdomain.org/resource/lsps07.sci.phys.energy.lighttravel	
	http://www.promotega.org/hgr07009/index.htm	
	www.howstuffworks.com/light.html	
	http://artsedge.kennedy-center.org/content/3895/	

Parental/Community Involvement	
Notes:	The Frayer Model is a graphic organizer that differentiates characteristics, defining an important concept from those merely associated with it. A Frayer model grid contains sections for: essential characteristics, non-essential characteristics, examples, and non-examples. In science, it may be necessary to change non-essential characteristics to a drawing of the concept. It can be used as a worksheet to guide the students as they read though a section or by the teacher to guide classroom discussion. To introduce the activity, the teacher and class lists on the board as many examples of the concept as possible. Students work in cooperative groups to analyze the terms for what they have in common and place the terms in the appropriate places on the grid. Students should add to the grid as they read and be able to justify their placement of the terms. This model emphasizes making connections, determining importance, and improves questioning ability.
Document Links:	Picture of students around the desk Frayer Model Minute Paper Light in the Can Data Chart