Science Learning Guide

5th Grade: Light Energy

Safety

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.

STAGE 1: Identify Desired Results

Enduring Understandings	Essential Questions
Light behaves differently as it interacts with different kinds of matter.	How does light interact with different kinds of matter?
OBJECTIVE **Students will need to KNOW . . .**	**TASK ANALYSIS** **Students will be able to DO…**
1. Summarize how light can interact with matter through reflection, refraction and absorption 2. Observe how light travels and interacts with matter 3. Demonstrate understanding of how an object can be seen (reflection, refraction and absorption) through scientific investigations 4. Design and conduct investigations of transparent, translucent, and opaque as applied to light 5. Observe the physical interactions of light and matter and the effect on color perception due to refraction, reflection, absorption, transmission, and scattering 6. Investigate careers, scientists, and historical breakthroughs related to light energy ***(from Northwest TIA Document)***	1. Develop a working knowledge and comprehension of essential vocabulary. 2. Summarize how light can interact with matter through reflection, refraction, and absorption. 3. Describe how light travels and interacts with an object or material. 4. Conduct experiments with light using a variety of objects and materials. 5. List examples of reflection, refraction, and absorption. 6. Demonstrate and explain examples of reflection, refraction and absorption. 7. Demonstrate understanding of how an object can be seen (reflection, refraction, and absorption)) through a scientific investigations. 8. Find examples of transparent, translucent, and opaque. 9. Design and conduct investigations of transparent, translucent, and opaque as applied to light. 10. Identify examples of reflection, refraction, absorption, transmission, and scattering. 11. Investigate the physical interactions of light and matter and the effect on color perception. 12. Use appropriate reference materials. ***(from Northwest TIA Document)***

Arkansas Frameworks

1. PS.7.5.1 Summarize how light can interact with matter through absorption, refraction, and reflection.
2. PS.7.5.2 Investigate how light travels and interacts with an object or material.
3. PS.7.5.3 Conduct investigation demonstrating how an object can be seen.
4. PS.7.5.4 Design and conduct investigations of transparent, translucent, and opaque as applied to light.
5. NS.1.5.1 Make accurate observations.
6. 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.
7. NS.1.5.4 Interpret scientific data using: data table/charts, bar graphs, circle graphs, line graphs, stem and leaf plots, Venn diagrams

National Standards

Science as Inquiry

1. Demonstrate abilities necessary to do scientific inquiry;
2. Use appropriate tools and techniques to gather, analyze, and interpret data:
3. Develop descriptions, explanations, predictions, and models using evidence:
4. Think critically and logically to make the relationships between evidence and explanations:
5. 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; and
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:

21st Century Skills

Technology

Use technology as a tool to research, organize, evaluate and communicate information, and the possession of a fundamental understanding of the ethical/legal issues surrounding the access and use of information

Critical Thinking and Problem Solving

1. Exercise sound reasoning in understanding
2. Make complex choices and decisions
3. Understand the interconnections among systems
4. Identify and ask significant questions that clarify various points of view and lead to better solutions
5. Frame, analyze and synthesize information in order to solve problems and answer questions

Communication and Collaboration

1. Articulate thoughts and ideas clearly and effectively through speaking and writing
2. Demonstrate ability to work effectively with diverse teams
3. Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
4. Assume shared responsibility for collaborative work

Academic Vocabulary

light	absorb
energy	matter
transparent	interact
opaque	transmission
translucent	scattering
reflect	properties
refract	**review:** natural light, artificial light, molecules, density

Stage 2 : Assessment Evidence

Instructional Diagnosis

Prior Knowledge/Skills:
PS.7.1.1 Compare natural and artificial sources of light
PS.7.1.2 Investigate the properties of transparent, translucent and opaque objects
PS.7.2.1 Classify materials as transparent, translucent, or opaque
PS.7.3.1 Classify materials as those which can reflect, refract, or absorb

Historical Data:
1. Targeted Formative Assessment or Learning Institute Data
2. ACTAAP data and released items
3. NAEP released items
4. Student notebooks from previous year (if applicable)

Potential Misconceptions:
1. Visible light is the only type of light.
2. Filters change the color of light.
3. The primary colors of light are identical to the primary colors of pigment.
4. Red objects in space are hot; blue objects in space are cool.

Formal Pre-Assessment:
1. Pre/Post test developed for reflection, refraction, and absorption (electronic survey)
2. Suggestion: Light Probe: "Can It Reflect Light", pages 25 - 30 from "Uncovering Student Ideas in Science: 25 Formative Assessment Probes, Vol. 1" by NSTA Press (can be purchased online at http://www.nsta.org/)

Evidence of Learning

Performance Tasks/Labs:
1. Use various types of inquiry investigations with light to explore: opaque, transparent, translucent, reflection, refraction, absorption, conservation of energy, and color perception.
2. Use Frayer Model to explain opaque, transparent, translucent
3. Use Venn Diagram to compare reflection and refraction
4. Design and build solar home models to demonstrate understanding of conservation of energy as it applies to reflection, refraction, and absorption.
5. Measure and compare angles in investigations of reflection and refraction.
6. Record, analyze data from investigations in science notebook.
7. Communicate evidence of learning to peers through collaborate grouping, reflections, and oral presentations.

Quizzes, Tests, Academic Prompts:
Pre/post content tests
Science notebook including sections for:
- academic vocabulary building
- experiment logs
- journal entries
- reflection logs
- open response prompts

Products
1. Science notebook including sections for:
   - academic vocabulary building
   - experiment logs
   - journal entries
   - reflection logs
   - open response prompts
2. Property of light collaborative project rubric (solar homes)

Student Self-Assessment Tool(s):
1. Lab manual or science notebook
2. Property of light collaborative project rubric (solar homes)
3. RAFT (see literacy connections)
4. Each individual lesson includes a formative assessment

Unprompted Evidence:
1. Graffiti Wall:Tell students to look for examples of light interactions outside of the classroom. Have a designated area where students can record "real world" examples (prompt them to do this before or after school). Share out during science period. Leave this up for the duration of the unit, adding to it as much as possible.
2. Reflection journal (in student notebook)

Evaluation Criteria

Formative:	**Summative:**
Pre/Post test developed for reflection, refraction, and absorption	Posttest

Open Response: Samples are in the resource section and lessons

Stage 3: Plan Learning Experiences and Instruction

Learning Plan:	**Personalized Learning**
Link to Teacher Guide For Lessons: (attached) Lesson 1: Opaque, Transparent, Translucent Lesson 2: Reflection Lesson 3: Refraction Lesson 4: Conservation of Energy - Absorption	

Modifications/Special Accommodations for Learners:

1. Cooperative learning groups designed to accommodate special needs
2. Differentiated instruction
3. Teachers will modify tasks and assessments for individual student AIP's and IEP's.

Interventions/Corrective Strategies:	**Intellectual Challenges:**
	Web quest: This web quest allows students to explore the way light is reflected, refracted, and absorbed. Students will explore several different websites and write reflections in their science notebooks. (Websites included in the resource section of the teacher guide)

Cross-curricular Applications / Real World Connections:

Literacy

1. Word origins and meanings: Have students research the origin and meanings of the following words: reflect and refract, hologram, chromatography and chromatogram, bioluminescence
2. Listen to the book SWITCH ON THE NIGHT by Ray Bradbury, Leo Dillon, and Diane Dillon. Pretend you are a book reviewer and write a review of this book for fellow classmates.

RAFT Activity A: Take a look at the illustrations in the story and write a letter to the illustrators and tell them what your favorite illustrations are and why you like them.

RAFT Activity B: As the cricket in the story, write a letter to the young boy describing what the world is like without light.

RAFT is a writing-to-learn strategy see appendix.

Math

1. "Multiplying Money": This is a great way to teach students about how the angle of mirrors changes the number of images one sees. This activity also reinforces predicting: M.12.5.1, M.13.5.6, DAP.16.5.1
2. Use shadow length to determine size of various objects. Students will use proportions to make accurate observations. AR math standards: M.12.5.1, A.6.5.1,A.5.5.1, A.4.5.1
3. In this lesson, students explore how variations in solar collectors affect the energy absorbed. This real world problem gives students an opportunity to use the science they have learned and apply it using math. AR Math Frameworks: NO.2.5.1, A. 6.5.1
4. Reading a Light Bulb Package: Students will learn the math behind the science of lighting bulbs. This is a great "real-world" connection, too!

Social Studies

Students will build their solar homes for specific biomes in which students study in their social studies frameworks.

Art

1. Shadows and Light, Science and Puppetry: This cross-curricular connection, produced by ArtsEdge and 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.
2. Art exercise which shows students how to mix watercolors using the palette and diluting with water to get shades of each.
3. Analyze the work of Roy Lichtenstein. Identifying his use of primary colors, cartoon imagery, and dramatically worded text bubbles.
4. Use the book Color Analyzers by LHS GEMS and do the activity Decoding Secret Messages. Kids color pictures then use color gel wands to view the pictures then a secret message jumps off the page at them. Color wands can be made for one class and then be reused for years. The kids can then make their own secret message pictures by using what they have learned from color analysis.
5. Light and Art Podcast: "We're Peter, Emma, Aaron, Ixchel, and Kaitlyn. We're in our school's science club. Our teacher gave us a special assignment. We need to come up with a colorful art display that doesn't use paints! We went to the most colorful place we know in San Francisco, a cool museum called the Exploratorium. Our question: "How can we produce colorful are, without using paint?"

Music

Objects and Light: This song is by Ron Brown and is a really fun and catchy tune that fifth graders will love!

P.E./Health

1. Research and report on the human eye and vision, particularly rods and cones.
2. Conduct a color blind test on themselves.
3. Search health textbooks or the internet for test circles.
4. Have students determine what color is being tested by the colors in the activity.
5. Research the effects of UV rays on the skin.
6. Compare and contrast the benefits of UV rays include the dangers.
7. Purchase UV beads from Oriental Trading, Steve Spangler's website, or Rainbow Symphony website. Have the students wear bracelets with a couple of beads on them to determine the risk of UV damage by comparing how bright the beads get. (Steve Spangler has additional lessons for the UV beads on his website)

   http://www.orientaltrading.com
   www.SteveSpanglerScience.com
   www.rainbowsymphony.com

Enrichment:

Technology Applications

1. Use light probes to record the lumens in the "Light in a Can" (See Opaque, Translucent, and Transparent lesson)
2. "How We See Things" - interactive website- can be used on a SMART Board or as a workstation http://kids.earth.nasa.gov/seawifs/ocean_color.htm
3. List of websites in the 5th grade Delicious and Wiki accounts.
4. PSET videos used in the teacher introduction, "Understanding Children's Ideas About Light"
5. United Streaming clips

Media

Light and Art Podcast: "We're Peter, Emma, Aaron, Ixchel, and Kaitlyn. We're in our school's science club. Our teacher gave us a special assignment. We need to come up with a colorful art display that doesn't use paints! We went to the most colorful place we know in San Francisco, a cool museum called the Exploratorium. Our question: "How can we produce colorful are, without using paint?"

Parental/Community Involvement Opportunities:

On campus

1. Host a science night for families to view students' solar home projects.
2. Invite community members and/or parents who work with light concepts as a part of their jobs to present to the class.

Reinforcements at home

1. Mix colors at home. Mixing different powdered drinks or gelatin flavors will create new colors and tastes.
2. Compare and contrast mixing powders with mixing liquids.
3. Collect and examine newsprint both black and white and colored papers. Use a magnifying glass to observe and notice the different colors of dots used to create the images.
4. Observe what happens when sunlight passes through a glass of water.
5. Make a CD spectroscope using a paper towel tube and old CD.

Materials and Supplies

Light box	Large coffee cans
Diffracting grates	Color construction paper (assorted)
He-Ne Laser (Wal-mart keychain laser will work)	Thermometers or temperature probes
Flat mirrors	Small clear plastic bin (shoebox size)
Prism box	Clear hot glue sticks
Index cards (4 per participant)	Various pieces of material (opaque, transparent, translucent)
Mag-light	Dry milk
Single hole punch	Polarized film (some sunglass lenses will work)
Aluminum foil	Travel size can of aerosol hairspray
Wax paper	Tape
Concave and convex lenses	Vegetable Oil (Wesson -high quality
Small block of wood	Sponge
2 identical objects such as: pencils, fruit, balls, or etc.	Old CD
Concept strips (laminate stability)	Plastic sandwich bag
Yarn or kite sting	Lunch size brown paper sack
12 Binder clips or clothes pins	White cardstock

Literature Connections

1. Delta Science Readers. Color and Light
2. Exploring Light, Light and Shadow, We Use Light-Discovery Links Newbridge Leveled Readers
3. Lasers Taking Light to the Extremes: Lisa Benjamin-Newbridge Reading Quest
4. Spectacles , Ellen Raskin, New York: Atheneum, 1968
5. Shadows, Blaise Cendrars, translated by Marcia Brown, New York: Macmillan, 1982
6. Arthur's Eyes, Brown, Mac. Boston: Little, Brown, 1979
7. Five Secrets in a Box, Brighton, Virginia, New York: E.P. Dutton, 1987
8. Piping Down the Valleys Wild: Poetry for the Young of all Ages, New York: Delacorte Press, 1985
9. What Did They See, John Schindell, Henry Holt Publishing, 2003 – More Picture Perfect Science, Lesson Mirror Mirror
10. I See Myself, Vicki Cobb, Harper Collins Publishing, More Picture Perfect Science, Lesson Mirror Mirror
11. Hailstones and Halibut Bones: Adventures in Color, Mary O'Neill, 1961

Professional Texts

1. Stop Faking It: Light by Bill Robertson
2. Uncovering Student Ideas in Science: 25 Formative Assessment Probes by Page Keely, Fracis Eberle, and Lynn Farrin
3. Exploratopia by Exploratorium
4. Color Analyzers, Lawrence Hall GEMS
5. Color and Light Delta Science Modules
6. Sci-Tech Connections Integrating Literacy Links, Curriculum Plus