Great Science Adventures

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What is light?

Light and Sound Concepts:

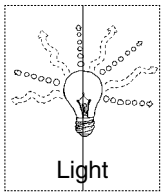
- Objects are visible when light strikes them.
- Light is a mixture of electrical and magnetic energy.
- The electromagnetic spectrum includes visible and invisible light.
- White light is a combination of all the colors of the rainbow, or spectrum.

Vocabulary: visible light invisible light wave particles *electromagnetic spectrum

Activities:

Light - Graphic Organizer

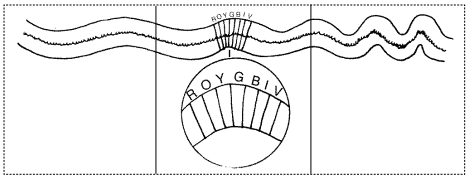
Paper Handouts: 12" x 18" construction paper Graphic 1A
Graphic Organizer: Make a Shutter Fold. Glue/copy Graphic 1A on the cover of the Shutter Fold, and title it *Light.*
Teacher's Note: This *Light Desktop Project* will be used through Lesson 6.



Electromagnetic Spectrum - Graphic Organizer

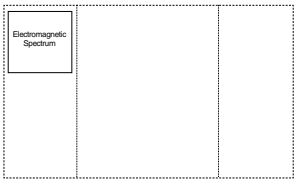
Focus Skill: recalling information
Paper Handouts: sheet of 8.5" x 11" paper a copy of Graphic 1B *Light Desktop Project*
Graphic Organizer: Fold the paper into a Hot Dog. Glue/draw Graphic 1B on the cover of the Hot Dog. Cut the ends of the Hot Dog paper at Graphic 1B and cut on the dotted lines to make a 3 Tab Book. Color the middle tab. Open the middle tab.

✎ Draw a line using markers or crayons of each color of the rainbow.
✎✎ Complete ✎. Write the colors of the rainbow: *red, orange, yellow, green, blue, indigo, violet*
✎✎✎ Complete ✎ ✎✎. Explain visible white light.



Open the left and right tabs. Under each tab:
✎ ✎✎ Write *Invisible Light.*
✎✎✎ Label the electromagnetic spectrum.

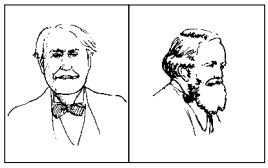
Fold the right and left tabs of the *Electromagnetic Spectrum Graphic Organizer* over the middle tab. Title the cover *Electromagnetic Spectrum*.
Open the left tab of the *Light Desktop Project.* Glue the *Electromagnetic Spectrum Graphic Organizer* on the top section.



Speed of Light

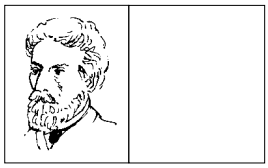
Focus Skill: calculating
Activity Materials: calculator
Activity: Calculate the distance light travels in one minute: **186,000 mi. x 60 (300,000 km x 60) = A**
Calculate the distance light travels in one hour: **A x 60 = B**
Calculate the distance light travels in one day: **B x 24 = C**
Calculate the distance light travels in one year: **C x 365 = D**
D equals one light-year.

Who's Who? - Graphic Organizer



Focus Skills: researching and reporting
Paper Handouts: two sheets of 8.5" x 11" paper
a copy of Graphics 1C-E
Graphic Organizer: Make two Large Question and Answer Books. Glue them side-by-side. Glue/draw Graphic 1C on the first tab. Write *Thomas Edison* and his birth and death dates. Glue/draw Graphic 1D on the right tab. Write *James Clerk Maxwell* and his birth and death dates. Glue/draw Graphic 1E on the left tab of the second Large Question and Answer Book. Write *Wilhelm Roentgen* and his birth and death dates. Open the tabs and complete the following:

- ✎ Draw a picture of each scientist, object or concept that relates to his achievements in the study of light.
- ✎✎ Write clue words about each scientist and his achievements in the study of light:
  Edison: *American inventor, developed light bulb;*
  Maxwell: *British physicist, light forms electromagnetic waves;*
  Roentgen: *German physicist, x-rays.*
- ✎✎✎ Research each scientist and write a paragraph about key points in his life.
  Teacher's Note: This is an ongoing project. Your students will glue more Large Question and Answer Books side-by-side in future *Who's Who* activities.



Experiences, Investigations, and Research

Select one or more of the following activities for individual or group enrichment projects. Allow your students to determine the format in which they would like to report, share, or graphically present what they have discovered. This should be a creative investigation that utilizes your students' strengths.

1. Determine what percent of the matter around you emits light and what percent reflects light. Is the majority of matter in the universe emitting light or reflecting light? Explain your answer. Is the majority of the matter on Earth emitting light or reflecting light? Why?

2. Design experiments to determine what surfaces reflect the most light. Document the texture, color, and composition of each surface tested. Determine how to control the amount of light to be used and how to measure the amount of reflection. Draw conclusions about reflection based upon your experiments and observations.

3. Is it true that nothing is faster than light? Research virtual particles (quantum field theory) and the Heisenberg uncertainty principle to see how these virtual particles are allowed to go faster than light.

4. Observe different types of lighting and the light produced: candle, lantern, incandescent, fluorescent, neon, halogen, others.

5. http://www.intl-light.com/handbook - International Light

6. http://inventors.miningco.com/science/inventors/ - About the Human Internet - Type "Thomas Edison" and "James Clerk Maxwell" in their search engine.

7. http://observe.ivv.nasa.gov/nasa/education/reference/emspec/emspectrum.html

Notes

How does light travel?

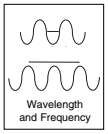
Light and Sound Concepts:

- Everything in the universe is either matter or energy.
- Light travels in waves and in streams of particles, called photons.
- Light waves have different wavelengths and frequencies.
- A long wavelength has a low frequency and carries less energy.
- A short wavelength has a high frequency and carries more energy.
- When light moves from one medium to another, it bends and slows down.
- Light can only be seen if there is something for it to reflect off of.

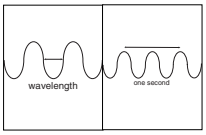
Teacher's Note: An alternative assessment suggestion for this lesson is found on pages 86-88. If Graphic Pages are being consumed, first photocopy assessment graphics that are needed.

Vocabulary: distance wavelength bounce *reflect *constant

Activities:



Wavelength and Frequency - Graphic Organizer

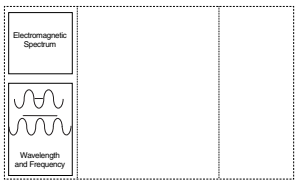


Focus Skill: illustrating concepts
Paper Handouts: 8.5" x 11" sheet of paper a copy of Graphics 2A-C
Light Desktop Project (made in Lesson 1)
Graphic Organizer: Make a Large Question and Answer Book. On the cover, glue/draw Graphic 2A and title it *Wavelength and Frequency*. Open the Large Question and Answer Book and label the tabs *wavelength* and *frequency.* On the left tab, glue/draw Graphic 2B. Draw an arrow to show the distance between two peaks. Open the tab.

✎ Draw three light waves showing different wavelengths.

✎✎ On the top section, complete ✎. On the bottom section, write clue words about wavelengths: *distance between the peaks of a wave, longer wavelength means lower frequency and less energy, shorter wavelength means high frequency and more energy.*

✎✎✎ On the top section, complete ✎. On the bottom section, define a wavelength. Describe the difference between a short wavelength and a long wavelength. How does this affect its frequency? In the spectrum of visible light, which color has the longest wavelength? Which color has the shortest wavelength?



On the right tab, glue Graphic 2C and number the peaks 1, 2, 3. Open the tab.

✎ Draw three light waves showing different frequencies.

✎✎ On the top section, complete ✎. On the bottom section, write clue words about frequency: *number of waves that pass a point every second*

✎✎✎ On the top section, complete ✎. On the bottom section, define *frequency.* Describe the difference between a low frequency and a high frequency.

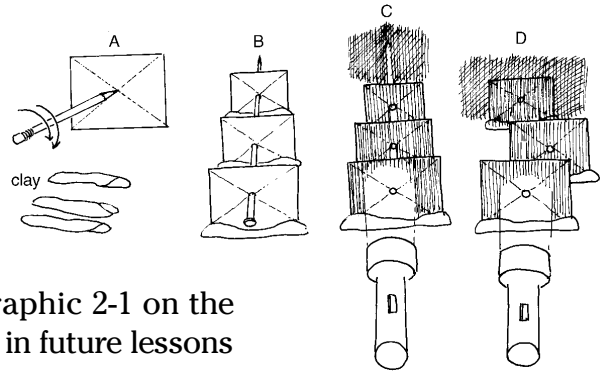
Open the *Light Desktop Project.* Glue the *Wavelength* and *Frequency Graphic Organizer* on the bottom of the left tab.

How Light Travels – Investigative Loop - Lab 2-1

Focus Skill: demonstrating a concept

Lab Materials: 3 index cards flashlight
modeling clay hole puncher
knitting needle or skewer

Paper Handouts: sheet of 8.5" x 11" paper
a copy of Lab Graphic 2-1
Lab Record Cards (index cards or 3" x 4" pieces of paper)



Graphic Organizer: Make a Pocket Book. Glue Lab Graphic 2-1 on the left pocket. This is the Lab Book. It will be used in future lessons and can be added to as needed.

Question: How does light travel?

Research: Read *Lots of Science Library Book #2* and review the Question.

Prediction: Label a Lab Record Card "Lab 2-1" and write your prediction on the card.

Procedure: Punch a hole in the middle of the three index cards. Be sure the holes are positioned in the same place on all three cards. Use modeling clay as a holder for the index cards. Stand the index cards about 1 foot (30 cm) apart, as shown. Poke a knitting needle or skewer through the holes to make sure the holes are lined up in a straight line. Remove the needle or skewer without moving the cards. Ask your partner to shine the flashlight in front of the first hole. Stand on the other end and look through the last hole. For the second part of the lab, move one card about an inch to one side. Repeat the procedure.

Observations: Observe the light in both parts of this lab. What did you see when you looked into the last card?

Record the Data: Label a Lab Record Card "Lab 2-1" and draw pictures or describe both parts of the lab.

Conclusions: Review the data. Based on your observations, how does light travel?

Communicate the Conclusions: Write your conclusions on another Lab Record Card or in the form of a newspaper article. Store all the Lab Record Cards for this lab in the left pocket of the Lab Book.

Spark Questions: Discuss questions sparked by this lab.

New Loop: Design an *Investigative Loop* to answer one or more of these questions.

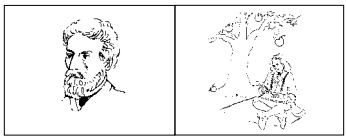
✎✎✎ Design Your Own Experiment: Select a topic based upon this *Investigative Loop* experience. See page viii for more details.

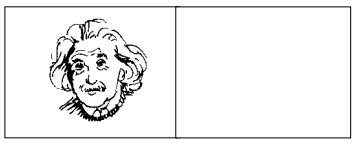
Who's Who? - Graphic Organizer

Focus Skill: researching and reporting

Paper Handouts: two sheets of 8.5" x 11" paper a copy of Graphics 2D-G *Who's Who Graphic Organizer* from Lesson 1

Graphic Organizer: Make two Large Question and Answer Books. Glue them side-by- side to the *Who's Who Graphic Organizer* from Lesson 1. Glue/draw Graphic 2D on the right





tab of the *Who's Who Graphic Organizer.* Write *Isaac Newton* and his birth and death dates. On the remaining tabs, glue Graphics 2E-G and write *Christian Huygens, Max Planck,* and *Albert Einstein* accordingly. Write the birth and death dates for each. Open the tabs and complete the following.

- ✎ Draw a picture of the scientist, or something relating to his achievements in the study of light.
- ✎✎ Write clue words about the scientist's achievements in the study of light:
  Newton: *English physicist, said light was made up of tiny particles;*
  Huygens: *Dutch, said light acted like waves;*
  Planck: *German physicist, said light was a combination of wave and particles;*
  Einstein: *German-American scientist, researched wave and particle idea of light.*
- ✎✎✎ Research the person and write a paragraph about key points in his life.

Teacher's Note: You will add more information to the *Who's Who Graphic Organizer* on Isaac Newton in Lesson 18.

Experiences, Investigations, and Research

Select one or more of the following activities for individual or group enrichment projects. Allow your students to determine the format in which they would like to report, share, or graphically present what they have discovered. This should be a creative investigation that utilizes your students' strengths.

1. Astronomers describe the incredibly long distances of space using three different units of measurement. Investigate each of these units and explain when they would be used. Make a table showing the following information and include examples of each.

   1 astronomical unit, or AU: 93.0 million miles, 150.0 million kilometers, 0.0000158 light-years, 0.00000485 parsecs
   1 light-year: 5.88 trillion miles, 9.46 trillion kilometers, 63,200 astronomical units, 0.307 parsecs
   1 parsec: 19.2 trillion miles, 30.9 trillion kilometers, 206,000 astronomical units, 3.26 light-years

2. Compare and contrast light waves to ocean waves. Diagram and label each.

3. Discuss and hypothesize as to why space is dark if there are millions of stars in our galaxy producing vast amounts of light.

4. http://www.osha.gov - Type "electromagnetic waves" in the search engine.

5. http://inventors.miningco.com/science/inventors/ - About the Human Internet - Type *Isaac Newton, Max Planck (radiation law),* and *Albert Einstein* in the search engine.

Notes

What is sunlight?

Light and Sound Concepts:

- Sunlight is Earth's main source of light.
- About 30% of the Sun's energy that reaches Earth is reflected back into space.
- About 70% of the Sun's energy is absorbed by the Earth's atmosphere, land, and water.
- The Sun's energy is essential to life on Earth.
- Many plant and animal behaviors are influenced by sunlight.

Vocabulary: plants animals *cold light *luminous

Activities:

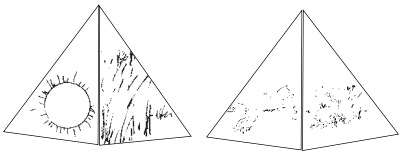
Food Web - Graphic Organizer

For this activity, choose Option 1, a 3-dimensional activity, or Option 2, a lay-flat activity.

Option 1 – 3D activity

Focus Skill: sequencing a process

Paper Handouts: 4 sheets of 8.5" x 11" paper index card
a copy of Graphics 3A-D



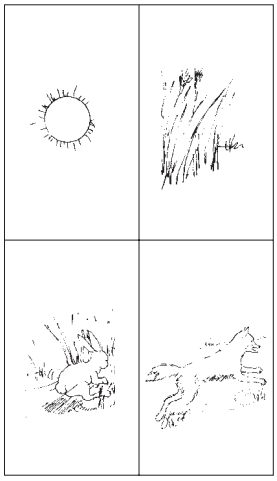
Graphic Organizer: Option 1: Make four Pyramids and glue them together to make a Diorama. On the first Pyramid, draw/glue Graphic 3A. Turn the Diorama clockwise, and on the second Pyramid, draw/glue Graphics 3B. Turn clockwise, and on the third Pyramid, draw/glue Graphic 3C. Turn clockwise, and on the fourth Pyramid, draw/glue Graphic 3D. Using your Diorama, tell at least one person about the food web.

✎✎✎ On an index card, explain the food web including the importance of sunlight.

Option 2 – Lay-flat activity

Paper Handouts: 8.5" x 11" sheet of paper a copy of Graphics 3A-D

Graphic Organizer: Make a 4 Door Book. On the cover, write Food Web. Beginning with the top left door, glue/draw Graphic 3A. On the top right door, glue/draw Graphic 3B. On the bottom right door, glue/draw Graphic 3C. On the bottom left door, glue/draw Graphic 3D. Open each tab.



✎ Draw a picture from that part of the food web.

✎✎ Write clue words about that part of the food web: *sunlight shines on Earth, plants use sunlight to make food, rabbits eat plants, foxes eat rabbits.*

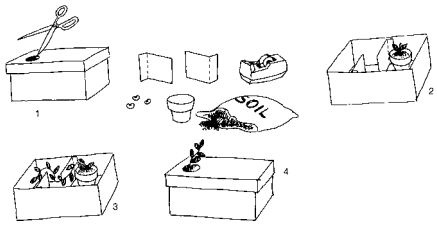
✎✎✎ Explain each part of the food web, including the importance of sunlight to all living things on Earth.

Winding Plant

Focus Skill: observing a concept

Activity Materials: shoebox with lid 3 bean seeds cardboard potting soil paper cup

Activity: Cut two pieces of cardboard and tape them securely in the shoebox to make a maze. Fill the paper cup with potting soil. Plant the seeds in the cup. Keep the soil moist but do not over-water. When the seeds have sprouted, place the paper cup at the bottom of the shoebox. Cut out a hole at one end of the lid. Cover the shoebox with the lid, making sure that the hole is on the opposite end of the paper cup. Place on the windowsill and water the soil as needed. Open the lid daily and observe the plant's growth.

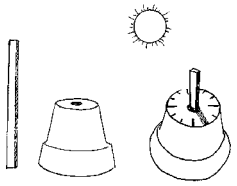


Sundial

Focus Skill: applying information

Activity Materials: flower pot with single drain hole in the middle marker wooden dowel (to fit in the hole of the flowerpot, about twice the height of the pot)

Activity: Find a sunny location outside. Place the flowerpot upside down. Insert the dowel through the flowerpot hole and secure it in the ground. Observe the shadow made by the stick on the flowerpot. Trace the shadow and mark the time. Repeat the procedure about every two hours. What were your observations? Which direction did the shadow move? Did the shadow move in the same proportions throughout the day?



Experiences, Investigations, and Research

Select one or more of the following activities for individual or group enrichment projects. Allow your students to determine the format in which they would like to report, share, or graphically present what they have discovered. This should be a creative investigation that utilizes your students' strengths.

1. Research how the length of daylight influences human behavior. What happens, physically and mentally, to humans who aren't exposed to sunlight for long periods of time?
   Investigate the numbers of hours of sunlight received seasonally in arctic regions. How have plants and animals adapted?

2. Discover the cause and effect of bioluminescence. Select several bioluminescent animals and research their habitats and behaviors. Determine what the bioluminescent animals that you researched have in common.

3. There are about 1,900 species of fireflies, or lightning bugs. Describe the form and function of their abdomens.

4. http://hea-www.harvard.edu/scied/SUN/SunIntro.html