

LIGHT GRADE 7

ASSESSMENT PACKET

Discover refraction, reflection, beam scattering, optical density, transmission, and absorption as you investigate the electromagnetic spectrum using lenses, mirrors and filters to build an electric eye, optical cameras, reflector telescopes, compound microscopes, laser shows and so much more!

Created by Aurora Lipper, Supercharged Science

www.SuperchargedScience.com

This curriculum is aligned with the National State Standards and STEM for Science.

Educational Goals

Scientists are still trying to make heads or tails of this thing called light, and near as they can tell, it sometimes interacts like a particle (like a marble) and other times like a wave (like on the ocean), and you really can't separate the two because they actually complement each other.

Energy can take one of two forms: matter and light (called electromagnetic radiation). Light is energy in the form of either a particle or a wave that can travel through space and some kinds of matter, like glass. We're going to investigate the wild world of the photon that has baffled scientists for over a century. Low electromagnetic radiation (called radio waves) can have wavelengths longer than a football field, while high-energy gamma rays can destroy living tissue.

Here are the scientific concepts:

- Low-frequency electromagnetic waves are called radio waves, which are *not* the same as sound waves.
- Light you can see (visible light like a rainbow) makes up only a tiny bit of the entire electromagnetic spectrum.
- Light has wavelength (frequency, or color), intensity (brightness), polarization (direction), and phase (time shift).
- Visible light is a small band within a very broad electromagnetic spectrum.
- For an object to be seen, light emitted by or scattered from it must enter the eye.
- Light travels in straight lines except when the medium it travels through changes.
- How simple lenses are used in a magnifying glass, the eye, camera, telescope, and microscope.
- White light is a mixture of many wavelengths (colors), and that retinal cells react differently with different wavelengths.
- Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection).
- The angle of reflection of a light beam is equal to the angle of incidence.
- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
- A sound wave needs a medium through which it is transmitted.
- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves.

By the end of the labs, students will be able to:

- Design and build both a refractor and reflector telescope using lenses.
- Show and describe a mathematical model for waves that shows how amplitude is related to the energy of a wave.
- Develop an experiment that shows how waves are reflected, absorbed, and transmitted.
- Know how to demonstrate how compound microscopes work.
- Understand how to determine how to measure the speed of light.
- Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Measure and estimate the weight, length and volume of objects.
- Formulate and justify predictions based on cause-and-effect relationships.
- Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- Construct and interpret graphs from measurements.
- Follow a set of written instructions for a scientific investigation.

Light Evaluation

Teacher Section

Overview: Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time: 45-60 minutes

Objectives: Students will be tested on the key concepts:

- Explain the different parts of the electromagnetic spectrum.
- Show how light has wavelength (frequency, or color), intensity (brightness), polarization (direction), and phase (time shift).
- Demonstrate how simple lenses are used in a magnifying glass, the eye, camera, telescope, and microscope.
- White light is a mixture of many wavelengths (colors), and that retinal cells react differently with different wavelengths.
- Design experiments that show how light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection).

Students will also demonstrate these principles:

1. Collecting and interpreting data from an experiment
2. Making valid observations based on their actions in lab

Materials (one set for entire class for the lab practical)

- | | |
|--|----------------------------|
| • scissors | • red and green gummy bear |
| • tape | • red laser |
| • pencil | • flashlight |
| • two handheld magnifier with concave lenses | • glass of water |
| • two convex lenses | • coin |
| • plain paper | • five dollar bill |
| • apple | |

Lab Preparation

1. Print out copies of the student worksheets, lab practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson

The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Light Grade 7 Evaluation

Student Worksheet

Overview: Today you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand about light and how it works. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to get started on your homework assignment. The assignment is due next week, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it. Choose one:
 - a. Write a short story or skit about cells from the perspective of a photon. You'll read this aloud to your class.
 - b. Make a poster that teaches the main concepts of your favorite part of the electromagnetic spectrum. This can be about radio waves, gamma rays, x-rays, infrared, microwaves, or visible light works or is used in our everyday life. When you're finished, you'll use it to teach to a class in the younger grades and demonstrate each of the principles that you've learned.
 - c. Write and perform a poem or song about lasers that teaches the audience what LASER stands for, how it generates a beam in the first place, and three ways a laser is different from a flashlight. This will be performed for your class.

Light Grade 7 Quiz

Teacher's Answer Key

1. Light you can see with your eyes is called _____light.(visible)
2. Sound waves _____ the same kind of waves as light waves.(are not)
3. Light travels in a straight _____, except when the medium it travels through changes.(lines)
4. A simple wave has a repeating pattern with a specific wavelength, _____, & amplitude. (frequency)
5. _____ can travel through the vacuum of space.(light)
6. The angle of reflection of a beam of light is equal to the _____.(angle of incidence)
7. Radio waves are _____energy, _____ wavelength electromagnetic waves.(low, long)
8. When light hits an object, it can either be absorbed, _____, or _____ through the object.(reflected, transmitted)
9. X-rays are _____ energy, _____ wavelength electromagnetic waves. (high, short)
10. White light is a mixture of many _____. (colors or frequencies of light)
11. Lasers produce _____ color(s) of light, whereas incandescent flashlights produce _____ color(s) of light. (one, many)
12. Microscopes and magnifiers use _____ lenses. (convex)
13. For an object to be seen, light emitted by it or reflected by it must enter the _____. (eye)
14. A crystal radio is a simple, early form of radio _____. (receiver)
15. The human eye cannot detect _____ from your remote control, however your video camera can. (infrared light)
16. A laser is a device that generates an intense beam of _____ light by _____ emission of _____ from excited atoms or molecules. (coherent, monochromatic, stimulated, photons)
17. When a beam of light spread out after passing through a narrow opening, it's called _____. (diffraction)
18. _____ happens when two waves combine to form a resultant wave that may be larger, smaller, or the same in amplitude. (interference)
19. Polarization is used in _____ to reduce the glare and haze by filtering out intense reflected light. (sunglasses)
20. Reflector telescopes use _____ and mirrors, and are better for deep-sky observing than _____ telescopes. (concave and planar/flat lenses, refractor)

BONUS QUESTIONS!

The size of a radio wave is about the size of _____.(students should write something about the size of football fields or buildings)

Microwaves are about the size of _____ (butterflies, etc...)

Infrared light waves are about the size of _____. (the point of a needle, etc...)

Visible light waves are about the size of _____. (protozoans, etc...)

X-rays are about the size of _____. (an atom)

The size of gamma rays are on the order of _____. (the nucleus of an atom)

Light Grade 7 Quiz

Student Quiz Sheet

Name _____

Fill in the blank:

1. Light you can see with your eyes is called _____ light.
2. Sound waves _____ the same kind of waves as light waves.
3. Light travels in a straight _____, except when the medium it travels through changes.
4. A simple wave has a repeating pattern with a specific wavelength, _____, & amplitude.
5. _____ can travel through the vacuum of space.
6. The angle of reflection of a beam of light is equal to the _____.
7. Radio waves are _____ energy, _____ wavelength electromagnetic waves.
8. When light hits an object, it can either be absorbed, _____, or _____ through the object.
9. X-rays are _____ energy, _____ wavelength electromagnetic waves.
10. White light is a mixture of many _____.
11. Lasers produce _____ color(s) of light, whereas incandescent flashlights produce _____ color(s) of light.
12. Microscopes and magnifiers use _____ lenses.

13. For an object to be seen, light emitted by it or reflected by it must enter the _____.

14. A crystal radio is a simple, early form of radio _____.

15. The human eye cannot detect _____ from your remote control, however your video camera can.

16. A laser is a device that generates an intense beam of _____ light by _____ emission of _____ from excited atoms or molecules.

17. When a beam of light spread out after passing through a narrow opening, it's called _____.

18. _____ happens when two waves combine to form a resultant wave that may be larger, smaller, or the same in amplitude.

19. Polarization is used in _____ to reduce the glare and haze by filtering out intense reflected light.

20. Reflector telescopes use _____ and mirrors, and are better for deep-sky observing than _____ telescopes.

BONUS QUESTIONS!

21. The size of a radio wave is about the size of ...?

22. Microwaves are about the size of ...?

23. Infrared light waves are about the size of ...?

24. Visible light waves are about the size of...?

25. X-rays are about the size of ...?

26. The size of gamma rays are on the order of...?

Light Grade 7 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- scissors
- tape
- pencil
- two handheld magnifier with concave lenses
- two convex lenses
- plain paper
- apple
- red and green gummy bear
- red laser
- flashlight
- glass of water
- coin
- five dollar bill



Lab Practical: Ask the student *Note: Answers given in italics!*

You will demonstrate two of the following:

1. The Lincoln Memorial has the names of 48 states carved into the two roof levels, but we can only see one side of the building on the five dollar bill. Is your state one of them? Design and run an experiment to answer this question.
 - a. *Refer to "Simple Microscope" experiment. Students make a compound microscope by stacking two concave lenses on top of each other, separated by 2-5" and look through both and adjust the spacing to bring the dollar bill into focus.*
2. Design an experiment that shows why an apple is red.
 - a. *Students explain that the apple is red because the apple absorbed all colors of the incoming white light but only reflects back red, so we see red. Shine a flashlight through a red gummy bear and you see red light coming out the back in a diffuse pattern. Shine a red laser through a red gummy bear and you see a spot of red coming out the back. Shine a red laser through a green gummy bear and nothing comes out the back because the gummy bear only reflects (or allows to transmit) green light.*
3. Drop a coin into a glass of water and find the viewing location where it looks like there are 2 coins in the jar. Explain what's going on.
 - a. *Refer to "Light Tricks" experiment. When light strikes a surface, part of the beam passes through the surface and the rest reflects back, and where it bounces back depends on where you're looking from. Light also changes speeds as it crosses from one medium to another, so if you were to stick a pencil in the jar, it would look broken from one angle and whole from another.*

Light Grade 7 Lab Practical

Student Exam

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- scissors
- tape
- pencil
- two handheld magnifier with concave lenses
- two convex lenses
- plain paper
- apple
- red and green gummy bear
- red laser
- flashlight
- glass of water
- coin
- five dollar bill

Lab Practical: You will demonstrate two of the following:

1. The Lincoln Memorial has the names of 48 states carved into the two roof levels, but we can only see one side of the building on the five dollar bill. Is your state one of them? Design and run an experiment to answer this question.
2. Design an experiment that shows why an apple is red.
3. Drop a coin into a glass of water and find the viewing location where it looks like there are 2 coins in the jar. Explain what's going on and draw the jar and coin with the path the light takes to get to your eye below.