Exercises

Light Wave Exercises

1. Can light change speeds? How about sound waves?

2. Can you see ALL electromagnetic waves with your eyes?

3. Which has a longer wavelength, red or blue light? Which has more energy?

4. Give three examples of a light source.

5. Are radio waves the same thing as sound waves?

6. How does a microwave cook your food?

7. How is a snake like a TV remote?

8. Does UV light have more or less energy than the visible light that we can see with our eyes?

9. Is light a particle or a wave?

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10. What was so cool about Einstein's red light/blue light experiment?

11. How do you make yellow light? Yellow *paint*?

12. What does a prism do?

13. How far do you need to rotate sunglasses to block most (if not all) light?

14. Why does the pencil in a glass of water appear bent? Is it always bent?

15. How can you make a glass container disappear?

16. How does a microscope work?

Exercises

Lasers Exercises

1. What does LASER stand for?

2. How is a laser different from an incandescent bulb?

3. What are two things that can split a laser beam?

4. How do you make a laser beam visible?

5. What's the secret behind the laser light show?

6. How do lasers damage things?

Answers to Light Exercises

1. Light can change speed the same way sound vibrations change speed. (Think of how your voice changes when you inhale helium and then try to talk.) The "speed limit" of light is 186,000 miles per second—that's fast enough to circle the Earth seven times every second, but that's also inside a vacuum. You can get light going slower by aiming it through different gases. In our own atmosphere, light travels slower than it does in space.

2. No. Human eyes can only detect a small portion of all light (in the visible range).

3. Red light has a LONGER wavelength and LESS energy than blue light.

4. Campfire, the sun, and a neon OPEN sign.

5. No. Radio waves are LIGHT waves that are very low energy and have a looooooong wavelength.

6. By aiming light beams at your food. The beams are specially tuned to excite the water molecules. Since all foods have water, this works to heat up your food. Excited molecules are ones that jiggle and zip around fast, which is also called *heat*.

7. Both use IR (infrared) light. The snake is a detector and the TV remote is an emitter.

8. Longwave UV are black lights you can get on Halloween that make things glow and fluoresce, and these types of lights are not damaging to living tissue even though they have more energy than visible light. Short wave UV (which have shorter wavelengths and more energy), however, *are* damaging and can burn your skin.

9. Both, and you really can't separate the two.

10. When you aim a blue light on a metal plate, electrons shoot off the surface. Red light doesn't cause electrons to eject, however, no matter

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how bright you make the red light. It's the wavelength, not the intensity that matters with the photoelectric effect.

11. Mix together green and red light to get yellow light. Yellow paint is a fundamental color that can't be made from any others—you have to start with yellow.

12. A prism "un-mixes" the light beams into their separate colors.

13. The sunglasses need to be 90 degrees from each other.

14. The pencil appears bent (or broken) because the water and the glass change the speed of light. Depending on where your line of sight is, you can make the pencil appear broken or whole.

15. Besides hiding it in a closet, you can also place a Pyrex glass container inside a glass container filled with mineral oil, vegetable oil, or light Karo syrup. The index of refraction is the same for both, so our eyes are unable to see the difference between the two.

16. A microscope uses lenses that bend the light to make things appear larger. Using two convex lens magnifiers, you can find the tiny owl in the upper corner of the dollar bill that's normally hidden to the naked eye.

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Answers to Lasers Exercises

1. Light can change speed. The word LASER stands for Light Amplification by Stimulated Emission of Radiation.

2. Light from a regular incandescent light bulb covers the entire spectrum as well as scatters all over the room. A laser beam is monochromatic—the light that shoots out is usually one wavelength and color, and is in a narrow beam.

3. Glass (like a window pane) and clear plastic (like a water bottle).

4. Take it in a steamy room, like just after a hot shower, or aim it through a glass of water that has a drop of milk in it.

5. The laser beam hits a spinning mirror that's off-center. The more angled the mirror mount, the larger the image that the laser traces out, which is why this is a perfect project for kids—the sloppier they build it, the better the laser light show.

6. High-power CO_2 lasers have an intense amount of heat that melts through metal. These aren't the lasers we're going to be working with! The lasers at the grocery store are Class I lasers, which will harm your eyes if you stare into them without blinking once for at least 15 minutes. These 'keychain' lasers are Class II and III lasers, some of which can overpower your retina in less than a minute, and the damage is irreversible. When I work with kids in a live Laser Lab class, I have a zero-tolerance rule (which is explained beforehand): if misused, I just walk over, take the laser without a word, and keep it. Class proceeds as normal, and it's up to the kid to figure out how to finish the project.

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