Laser Maze

How many mirrors can you use to hit the target? Can you determine the best angle needed to reach your goal? Explore light and the law of reflection as you create a laser maze from a series of mirrors!

TEKS:

MATH 4.7C: The student is expected to determine the approximate measures of angles in degrees to the nearest whole number using a protractor.
SCI 4.6A: The student is expected to differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.
SCI 5.6A: The student is expected to demonstrate that light travels in a straight line until it strikes an object and is reflected or travels through one medium to another and is refracted.

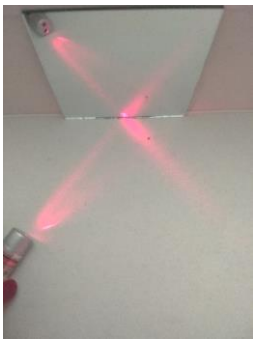
Materials:

- Cardboard box without lid (like a shoebox)
- Masking tape
- 6 1-inch mirrors – can be purchased here
- Pencil
- Protractor
- Red laser pointer with button switch – can be purchased here
- Ruler
- Safety goggles

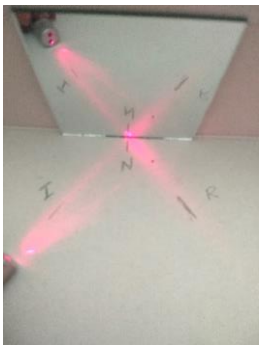
How To:

1. **Safety: Put on safety goggles. Do not shine lasers in the face or eyes.**
2. Start with an open cardboard box, one laser pointer, and one mirror. Use masking tape to place the mirror on one inside wall of the box.
3. Place the laser pointer in the box opposite of the mirror with the light pointing at the mirror. Turn on the laser and observe what happens.
4. Now try moving the laser side to side while still aiming the light at the mirror. Observe how the light changes when you aim the laser towards the mirror at different angles.
5. Notice that when a laser is pointed straight at the mirror, it shines directly back in the same direction. When the laser is pointed at an angle, it changes direction. This is called the law of reflection.

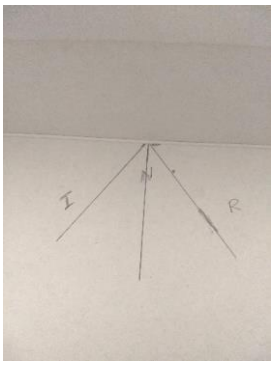
6. Place the laser on the bottom of the box and point the laser at an angle towards the mirror.



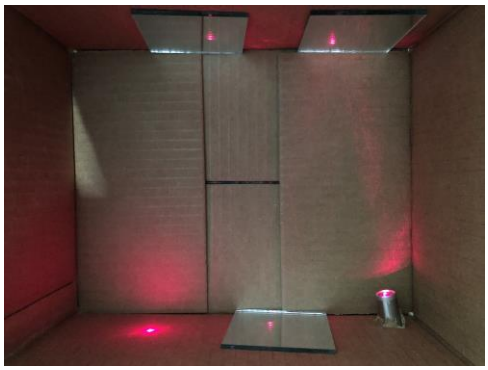
7. On the bottom of the box, use a pencil to mark the point where the laser hits the mirror and mark "N" for normal. Trace a small line along the laser ray and mark it "I" for ray of incidence. Trace a small line on the reflected laser ray and mark "R" for ray of reflection.



8. Then, use a ruler or other straight edge to draw a line straight down the middle of these two lines to the point marked "N" for the normal line. Draw a straight line from "I" to "N" and "R" to "N".



9. Use a protractor to measure the angles between "I" and "N" and "R" and "N".
10. What do you find about the angles? They are equal! This is the law of reflection. The angle at which you point a laser at a reflective surface (called the ray of incidence) is equal to the angle it will reflect off (called the ray of reflection).
11. Use this knowledge and discovery to create a laser maze inside the cardboard box.
12. Pick a spot on one of the inner box walls to be the target.
13. Place the laser in a different spot to act as the starting point. Your starting point and target cannot move!
14. Place as many mirrors as desired at different angles inside the box to get the laser light to reflect off mirrors so that it lands on the target! Next, challenge yourself to use as few or as many mirrors as possible!



STEM Explanation:

Light is a unique form of energy because it has characteristics of both waves and particles, called the duality of light. Light is a form of energy that we can see. It travels in waves through lines in all directions like the Sun's rays. Waves give light its color (wavelengths) and its ability to travel far distances. Light particles, called photons, help the energy of light, or radiation, be measured. Photons give off radiation energy we see as light when energy gets released from particles inside light atoms. This is how lasers are made. Atoms of light inside a laser work together to produce a sharp, strong line of colored light. Inside a laser, there are many atoms giving off light photons that bounce off reflective coils and mini mirrors within the laser body. This explains how the acronym L.A.S.E.R. was formed - light amplification by stimulated emission of radiation!

Just like mirrors inside of a laser, the mirrors that make up the laser maze reflect the laser pointing at them. Mirrors reflect light allowing it to bounce off the shiny surface and shine back. When light hits a mirror, it is reflected and the angle at which the light is reflected off the mirror is equal to the angle at which the laser was pointed at the mirror. This is known as the law of reflection. By following this law, multiple mirrors can be used to bounce the laser light through the box to create a maze of lasers!

Career Connection:

Optical engineers design components of optical instruments such as lenses, microscopes, telescopes, and other equipment that use properties of light. They must have knowledge about the physics of light and how light reacts to the outside world and materials to control, direct, and manipulate light to behave in a certain way. Optical engineers can work in research or product development. They may make an existing product better or invent something new. Optical engineers may work at electronics companies, computer manufacturers, and medical equipment companies.

Resources:

http://www.physics4kids.com/files/light_reflect.html
http://www.lovemyscience.com/cat_reflectinglight.html
http://photonterrace.net/en/photon/duality/
http://www.physicsclassroom.com/class/refln/Lesson-1/The-Law-of-Reflection
https://www.youtube.com/watch?v=-YPixpL6Rnc

