



Hologram Illusion Projector Kit

Grade Level:

Middle School and High School

Introduction:

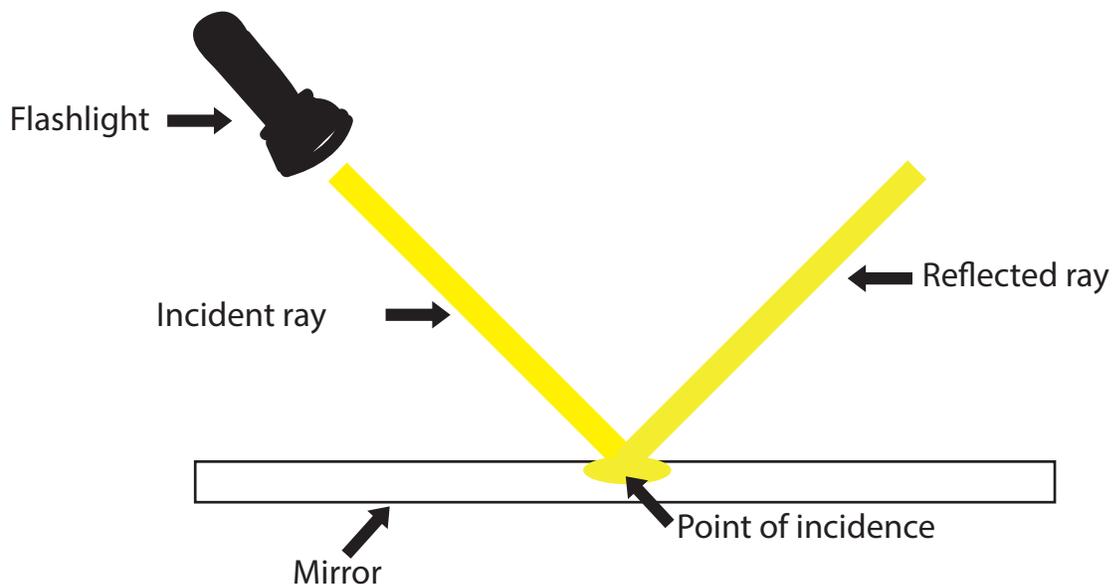
What do you see when you look into a mirror? Can you describe what is happening, in terms of physics?

Lesson:

REFLECTION

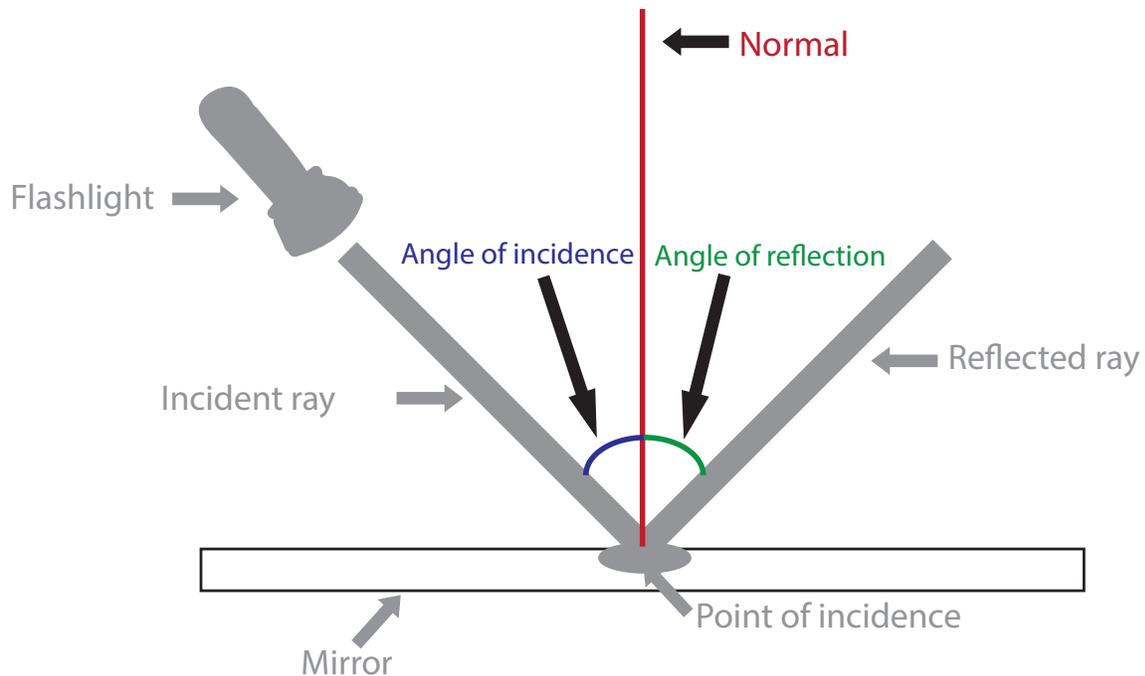
When light encounters a boundary, like the surface of a mirror, it will 'bounce' or reflect back in a single direction. This is called specular reflection.

If we were to shine a flashlight on a mirror, the light ray coming from the flashlight is called the incident ray. A synonym for incident is event, so you can remember that the incident ray comes from what started the event- the flashlight. When the incident ray hits the mirror, that spot is called the point of incidence. The ray that 'bounces' or reflects back from the point of incidence is called the reflected ray.



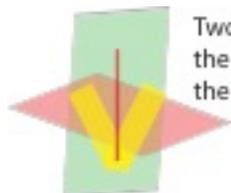
LAWS OF REFLECTION

In the photo below, you can see three new terms: normal, angle of incidence (represented by the symbol θ_i) and angle of reflection (represented by the symbol θ_r). Normal is a term from geometry. The normal refers to a line that is perpendicular to an object. The angle of incidence is the measurable angle between the incident ray and the normal. The angle of reflection is the measurable angle between the reflected ray and the normal.



There are three Laws of Reflection:

1. The incident ray and the reflected ray are on opposite sides of the normal.
2. The incident ray, the normal and the reflected ray are all on the same plane.



Two planes, one red and one green. The normal, the incident ray and the reflected ray are on the green plane.

3. The angle of incidence is equal to the angle of reflection.

$$\theta_i = \theta_r$$

From these three Laws of Reflection, you may gather that everything with specular light reflection is symmetrical and constant.

Real Life Application:

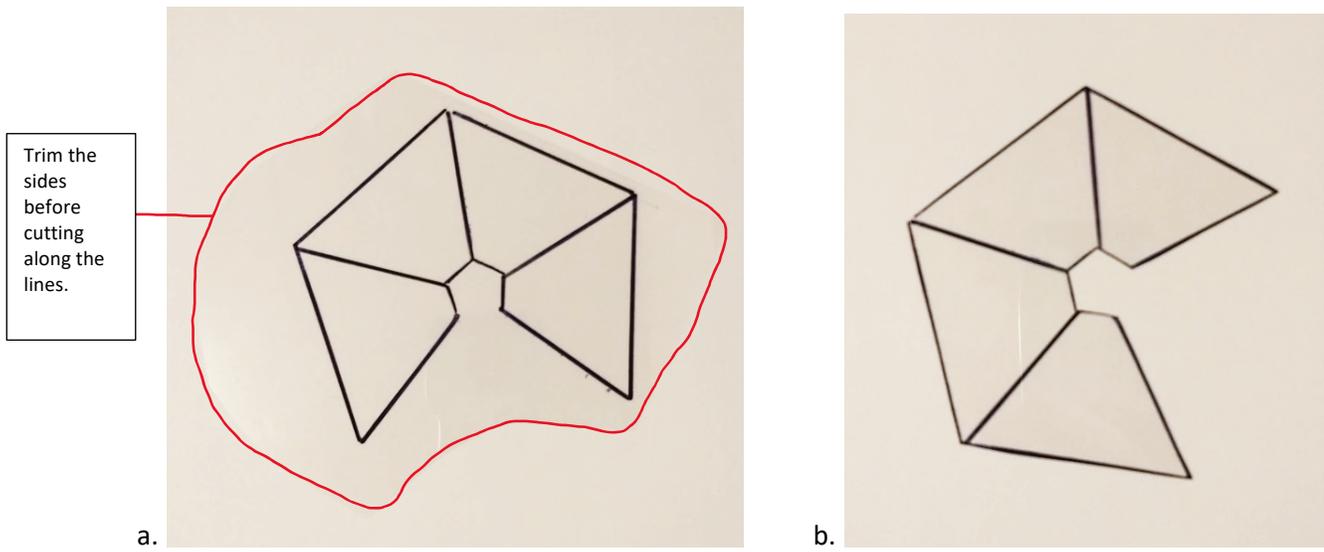
When driving, the physics of light reflection is used to drive safely. If a driver uses their rear-view or side-view mirror, specular reflection allows them to see what objects are behind them.

Activity:

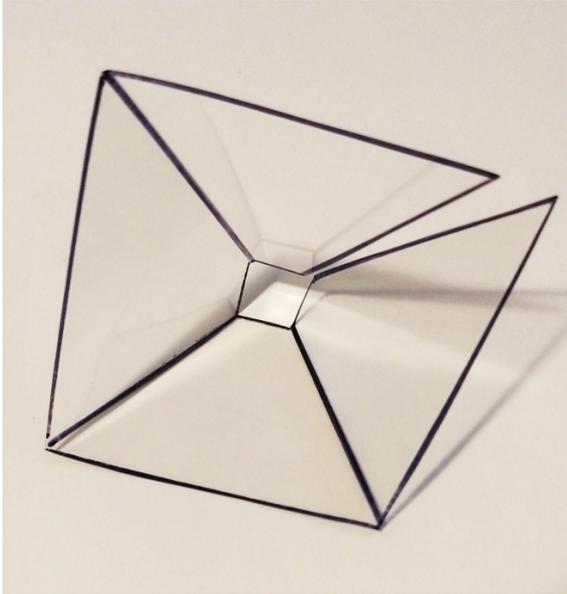
When an incident ray is projected onto a transparent medium, it can be used to make us see ‘floating’ images, or hologram illusions. John Pepper first used a hologram illusion in 1862 to project the image of a ghost for the audience at his play. In 2012, the Coachella Valley Music & Arts Festival used a hologram illusion for one of their main musical acts.

Supplies needed: The Hologram Illusion Kit, a scissors, a ruler (helpful but not necessary), a cell phone that can play a YouTube video.

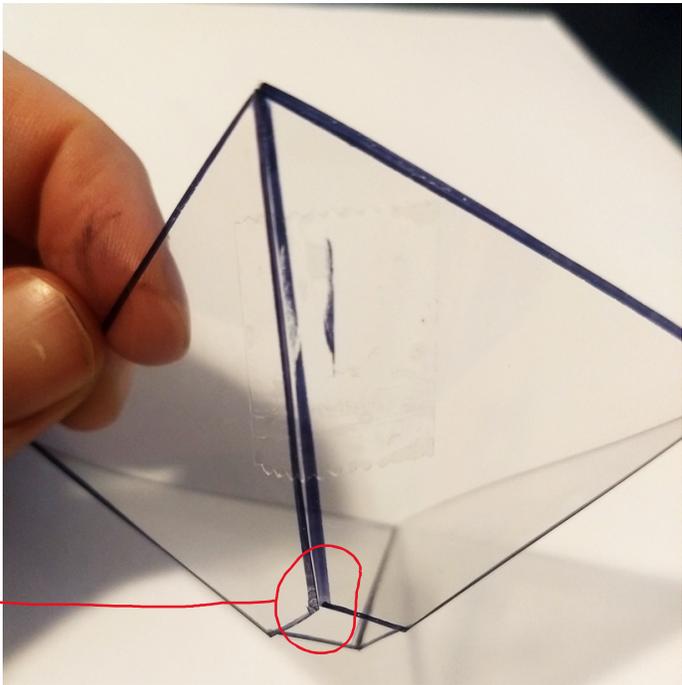
Step One: Cut the frustum shape out. It may be less frustrating if you trim down the sides first.



Step Two: To form the 3-D frustum shape a.k.a. hologram illusion projector, crease and unfold the shape along each black line. Laying a ruler along one of the lines and bending the shape over the ruler may aid you in making a straight crease.



Step Three: Align the edges the best you can and tape them together. In order to ensure your hologram illusion projector can set upside down and balance on its own, you may have to un-tape the edges, realign them, then tape them together again. But don't worry, you'll get it!



Alignment that will allow the hologram illusion projector to stand upside-down, on its own.

Step Four: Now that you have a hologram illusion projector, find a video that is appropriate for using it! Here is one from *Holosgramma DIY*: <https://tinyurl.com/y3urnk7q>. You can type the link into your web browser. When you play the video, a large 'X' will appear. Align your hologram illusion projector along these lines and then position yourself to be at eye-level with the projector. Now, can you see the hologram illusion of a floating moon because of the reflection?

