



Advancing the Science  
and Technology of Light



RICE

Rice University – Optical Society of America (OSA) Student Chapter – Educational Optical Demos

### 1. ENGAGE

Questions for group discussion:

- What are some sources of light?
- How do different objects interact with light?
- Does light travel in a straight line?
- Can light be bent?

### 2. EXPLORE

Take some time to explore the items listed below using the LED white light source and the lights in the room. Describe in second column, and save writing in the third column until Part 3.

Item	Description of how object interacts with light	Definition (Part 3)
Lens (small)		
Lens (big)		
Rainbow Peephole		
Prisms		
Mirrors		
“Magic Stripes” Polarizers		
Glass Slide		
Tissue Paper		
Colored Plastic		
Black Plastic		
Cardboard		

### 3. EXPLAIN

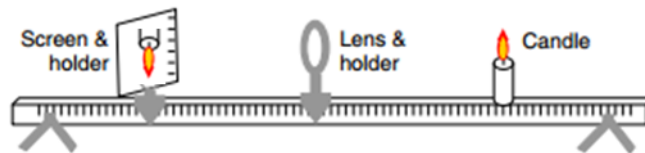
Here are some definitions and terms. Apply these terms to the item descriptions in the third column above. Some objects could exhibit properties of one or more of these terms.

- Reflect: Light bounces off the surface of the object at an angle equal to the incident ray.
- Refract: Light goes through an object, exiting at a different angle depending on the refractive index of the medium.
- Beam splitter: An optical device for dividing a light beam into two beams by both reflecting and refracting light.
- Dispersion: Light is spread into a rainbow or multiple colors.

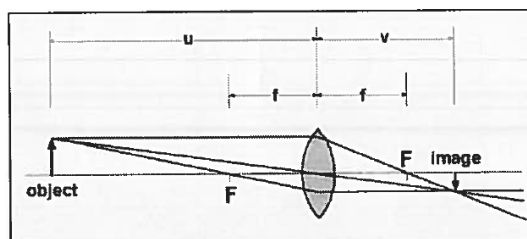
- Focus: Light rays converge to a point, and the formed image has sharp edges.
- Transparent: Light passes through the object.
- Translucent: Some light passes through the object, detail is lost.
- Opaque: No light passes through the object.

#### 4. ELABORATE

Focal Length Measurement. BE CAREFUL AROUND THE FLAME!



- Use the meter stick setup.
- Place the white card at 10" on the meter stick.
- Place the candle to the first position listed below. Light the candle.
- Between the candle and card, place the lens. Move the lens back and forth until the image of the candle flame is sharp and in focus. Record the position of the lens.
- Repeat measurement and recorded lens position for each candle position.
- Using the Thin Lens Formula, calculate the focal length of the lens.



$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$u$  = Candle Position - Lens Position

$v$  = Lens Position - Card Position

#### Lens (Small)

Candle Position (independent variable)	Lens Position (record value)	$u$ (record value)	$v$ (record value)	$u \cdot v$ (do math)	$u+v$ (do math)	$f = u \cdot v / (u+v)$ (do math)
22"						
26"						
30"						
34"						

#### Lens (Big)

Candle Position (independent variable)	Lens Position (record value)	$u$ (record value)	$v$ (record value)	$u \cdot v$ (do math)	$u+v$ (do math)	$f = u \cdot v / (u+v)$ (do math)
22"						
26"						
30"						
34"						

Laser Obstacle Course. NEVER LOOK INTO THE LASER BEAM OR SHINE IT IN SOMEONE'S EYES!!!

- Recreate Figure 1. The laser should be pointing straight at the target.
- Recreate Figure 2 by adding an opaque object to the beam path, such that no light is transmitted to the target.
- WITHOUT moving the laser, obstruction, or the target, how can you redirect the light to hit the target again?
  - What objects could you use to redirect the laser light?
  - Could you use an object that reflects light?
  - How about an object that refracts light?
  - Can you do it with less than four objects?
  - BE CREATIVE! This process is called aligning a laser beam.
- Remove all objects besides the laser, target, and obstruction. Recreate Figure 3 by placing a second target at a 90° angle from the first target.
- WITHOUT moving the laser, obstruction, or either target, can you redirect the light into two beams to hit both targets at once?
  - Which objects should you use? How fast can you do it?



Figure 1. Laser pointed in a straight line path to the target.

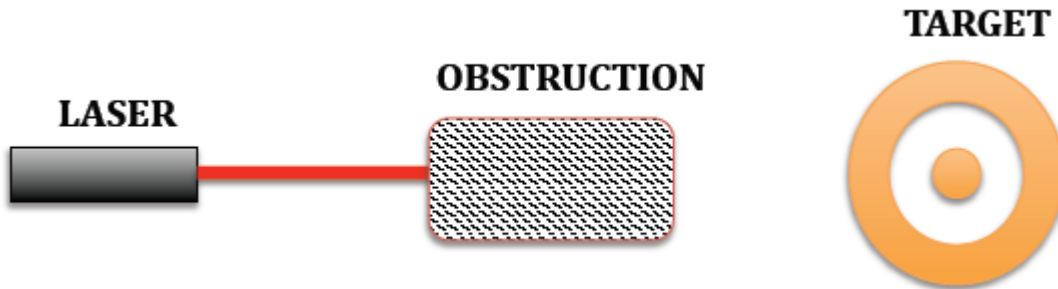


Figure 2. Laser light is now blocked and does not reach the target.

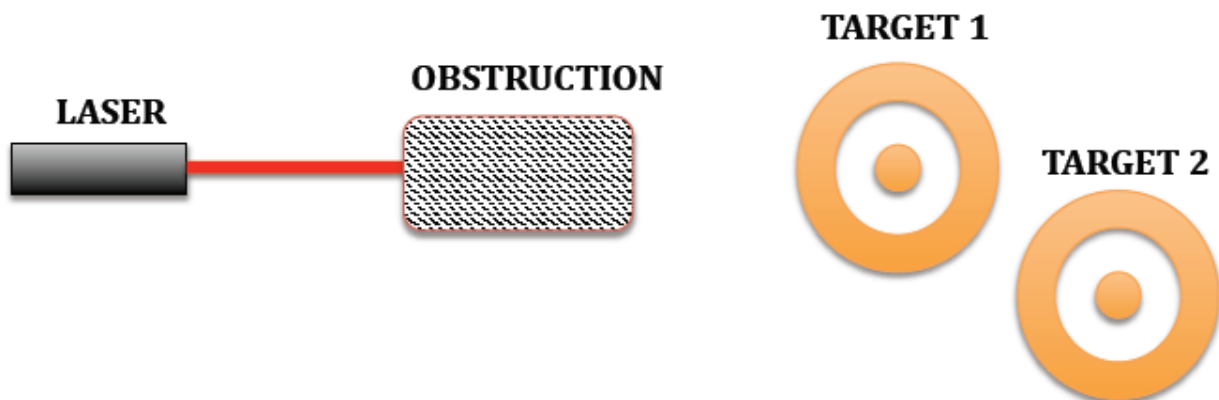


Figure 3. Aim the laser light to hit two targets at once.

## 5. EVALUATE

- Even though you measured the lens at different distances, what did you notice about the focal length?
- Does a lens reflect or refract light?
- Why is the flame image upside down on the card?
- Does a mirror reflect or refract light?
- How can you split a laser beam into two beams of light?
- How easy is it to direct light to particular object?
- What's the difference between transparent, translucent, and opaque objects?
- When is it okay to look into a laser?