

# Ray Diagram Simulator: Lenses & Mirrors

Classroom worksheet · Interactive simulation: <https://lkforge.com/tools/physics/geometric-optics/>

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Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Learning objectives

- Construct ray diagrams for converging and diverging lenses and mirrors.
- Relate object distance and focal length to image position, size, and orientation.
- Distinguish real from virtual images.

## Variables to change

- Lens/mirror type
- Focal length
- Object distance
- Object height

## Procedure

1. Select a converging (convex) lens and place the object beyond twice the focal length ( $2f$ ).
2. Move the object to between  $f$  and  $2f$ , then to inside the focal point (closer than  $f$ ).
3. Switch to a diverging (concave) lens and observe the image for any object distance.
4. Record whether each image is real or virtual, upright or inverted, magnified or reduced.

## Observations

For each configuration note the image distance, magnification, orientation, and whether the image is real or virtual.

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## Questions

1. With a converging lens and the object beyond  $2f$ , describe the image.
2. What happens to the image as the object moves toward the focal point?
3. When the object is inside the focal length of a converging lens, what kind of image forms?
4. Can a diverging lens ever form a real image of a real object?
5. Write the thin-lens equation and the magnification relation.

### Answer key (instructors)

- **1.** Real, inverted, and reduced, located between  $f$  and  $2f$  on the far side.
- **2.** The image moves farther away and grows larger; at the focal point no clear image forms (rays emerge parallel).
- **3.** A virtual, upright, magnified image on the same side as the object — this is how a magnifying glass works.
- **4.** No. A diverging lens always forms a virtual, upright, reduced image.
- **5.**  $1/f = 1/d_o + 1/d_i$ , and  $m = -d_i/d_o = h_i/h_o$ .

*Ray diagrams predict images by tracing standard rays through a lens or mirror.*

*Converging optics can make real, inverted images or, for close objects, virtual magnified ones; diverging optics always make virtual, reduced images. The thin-lens equation quantifies the same results.*