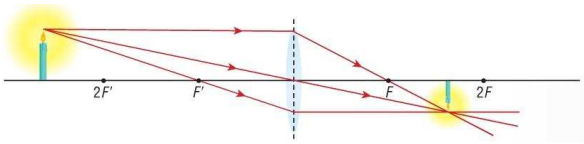
SNC2D PHYSICS

LIGHT & GEOMETRIC OPTICS

- Converging Lenses (P.452-454)

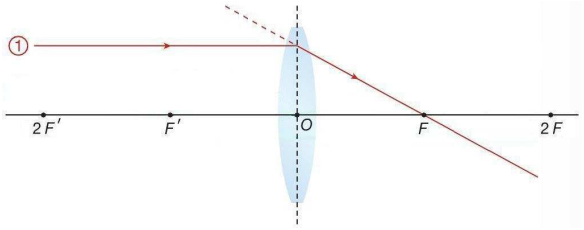
Locating Images in Converging Lenses

Just as you did with converging and diverging mirrors, you can determine the image characteristics of an object by drawing ray diagrams. And as before, you need to draw only two light rays to locate the image (the third ray acts as a check). The only difference is that with mirrors you considered reflected rays, but with lenses you consider refracted rays.



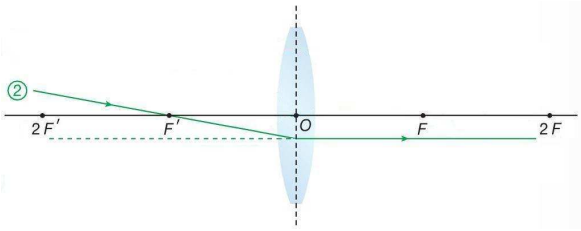
Drawing Ray Diagrams for Converging Lenses

1. *A light ray parallel to the principal axis (PA) is refracted through the principal focus (F).*



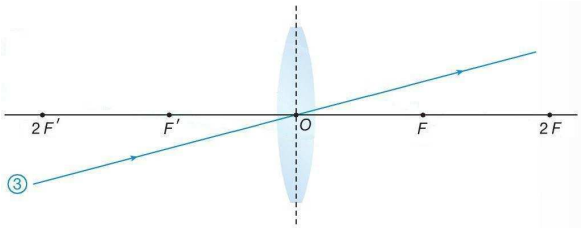
Drawing Ray Diagrams for Converging Lenses

2. *A light ray through the secondary focus (F') is refracted parallel to the principal axis (PA).*



Drawing Ray Diagrams for Converging Lenses

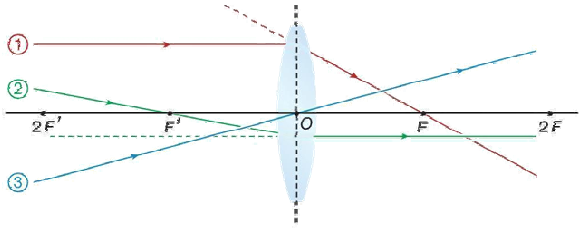
3. *A light ray through the optical centre (O) continues straight through without being refracted (ie a thin lens).*



Activity: Drawing Ray Diagrams for …

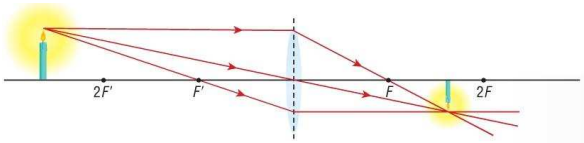
INSTRUCTIONS (2DPHYS - WS6)

A. Complete Part 2 (Converging Lens Ray Diagram Rules). Be sure to use a ruler and a sharp pencil and to draw lightly.



Drawing Ray Diagrams for Converging Lenses

Once we know these three paths, we can use them to predict the path of light from a point on an object. If we know how each ray is refracted as it passes through the lens, we can draw the image and predict its characteristics.



Activity: Drawing Ray Diagrams for …

INSTRUCTIONS (2DPHYS - WS6)

A. Complete Part 3 (Ray Diagrams for Converging Lenses). Be sure to complete the chart and Q.1 and 2.

NOTE!

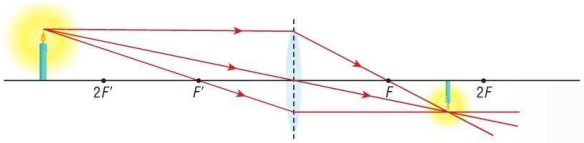
When drawing ray diagrams, remember the following:

- the object (real) is always shown as a solid erect arrow.
- a real image is always drawn as a solid arrow (because real rays were used to help locate it).
- a virtual image is always shown as a dotted arrow (because virtual rays were used to help locate it).

Activity: Drawing Ray Diagrams for …

PART 3: DIAGRAMS ① - ④

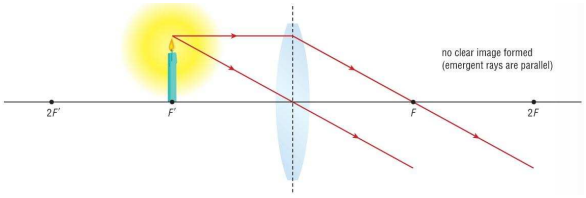
When an object is located in front of a converging lens at a distance beyond F', the refracted rays intersect to form a real and inverted image on the opposite side of the lens. However, the size of the image formed depends on the object's location relative to 2F'.



Activity: Drawing Ray Diagrams for …

PART 3: DIAGRAM ⑤

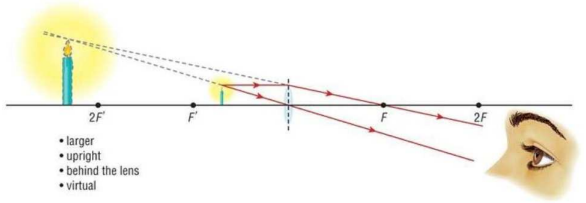
No image (either real or virtual) is produced when an object is located at F′ in front of a converging lens. The refracted rays are parallel and do not intersect to form an image. Even if you extend the rays behind the lens using dashed lines you cannot see a virtual image.



Activity: Drawing Ray Diagrams for …

PART 3: DIAGRAM ⑥

No real image is produced when an object is between F′ and O. The refracted rays spread apart, or diverge. The human brain, however, extrapolates the diverging rays backwards to where they appear to originate, which in this case is on the same side as the object. This results in a virtual image, which can only be seen by looking into the lens.



Activity: Drawing Ray Diagrams for …

PART 3: IMAGE CHARACTERISTICS (CONVERGING LENS)

The image characteristics vary depending on where the object is located.

Object	**Image**			
Location	Size	Attitude	Location	Type
distant	smaller	upside down	at F	real
beyond 2F′	smaller	upside down	between F & 2F	real
at 2F′	same size	upside down	at 2F	real
between F′ & 2F′	larger	upside down	beyond 2F	real
at F′	no clear image formed			
between F′ & O	larger	upright	same side as object	virtual

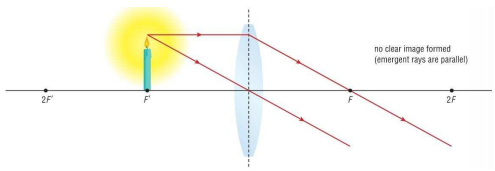
✔ Check Your Learning

1. How many light rays are required to predict the characteristics of the image produced by a converging lens?

   two rays are required to locate the image

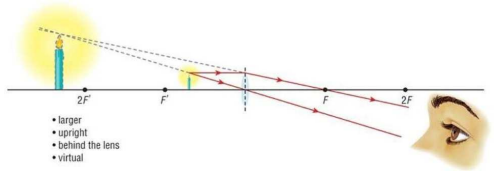
✔ Check Your Learning

2. Draw a ray diagram that shows the image produced when an object is located at the secondary focus (F') of a converging lens.



✔ Check Your Learning

3. What are the characteristics of the image produced by a converging lens when the object is between F' and the lens?



S – larger
A – upright
L – same side as object
T – virtual