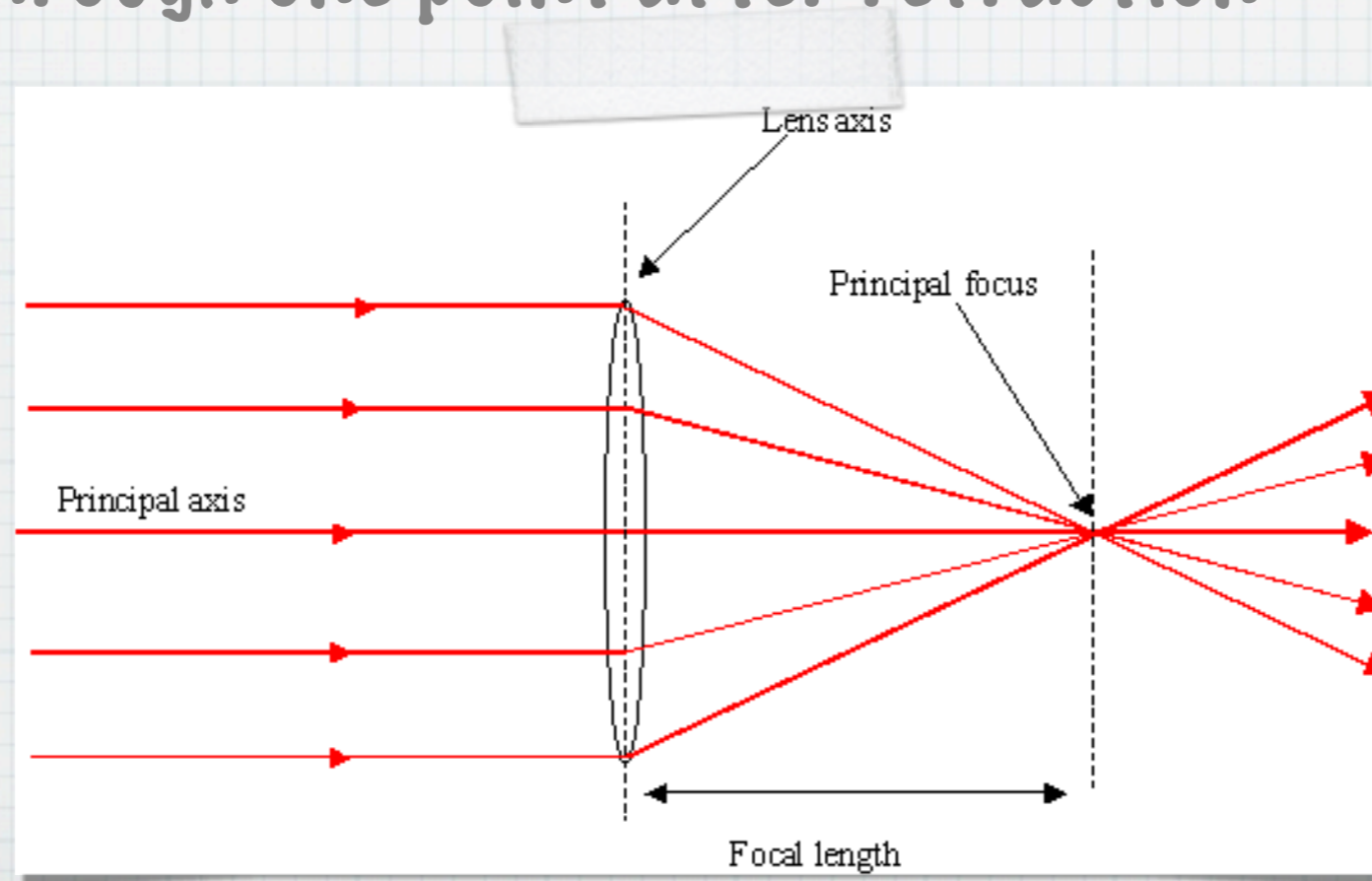


# Images in Lenses

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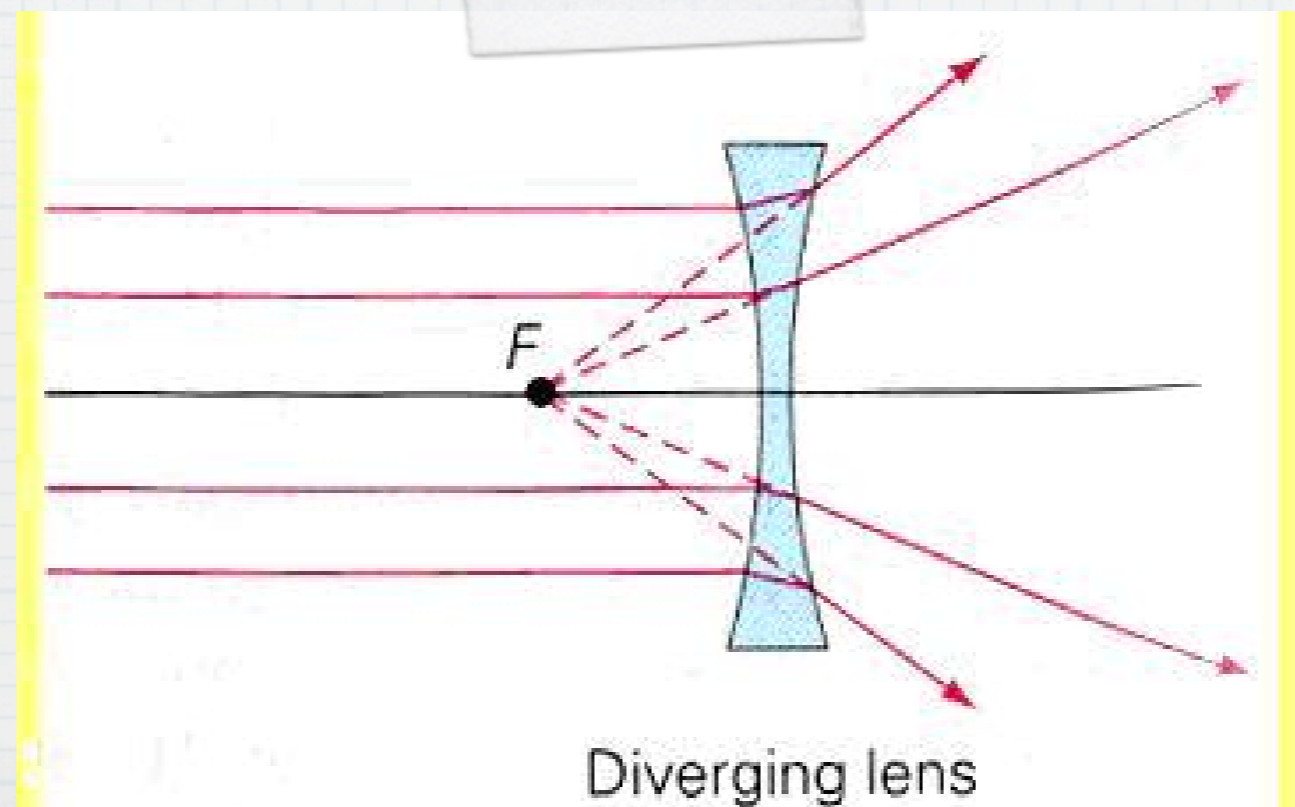
# Lenses and the Formation of Images

- \* **Converging Lens** - a lens that is thickest in the middle
- \* causes incident parallel light rays to converge through one point after refraction



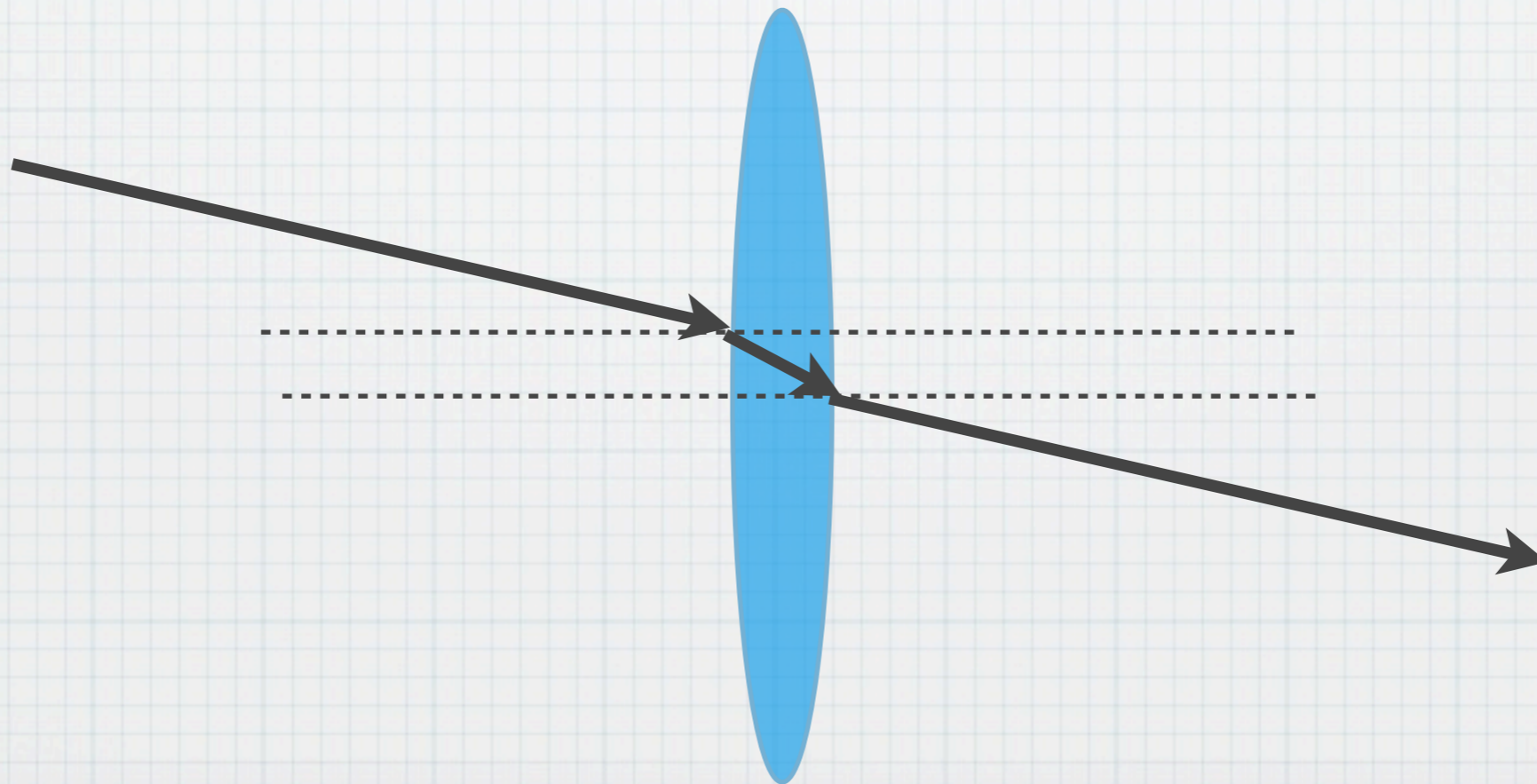
# Lenses and the Formation of Images

- \* **Diverging Lens** - a lens that is thinnest in the middle
- \* causes incident parallel rays to spread apart (diverge) after refraction



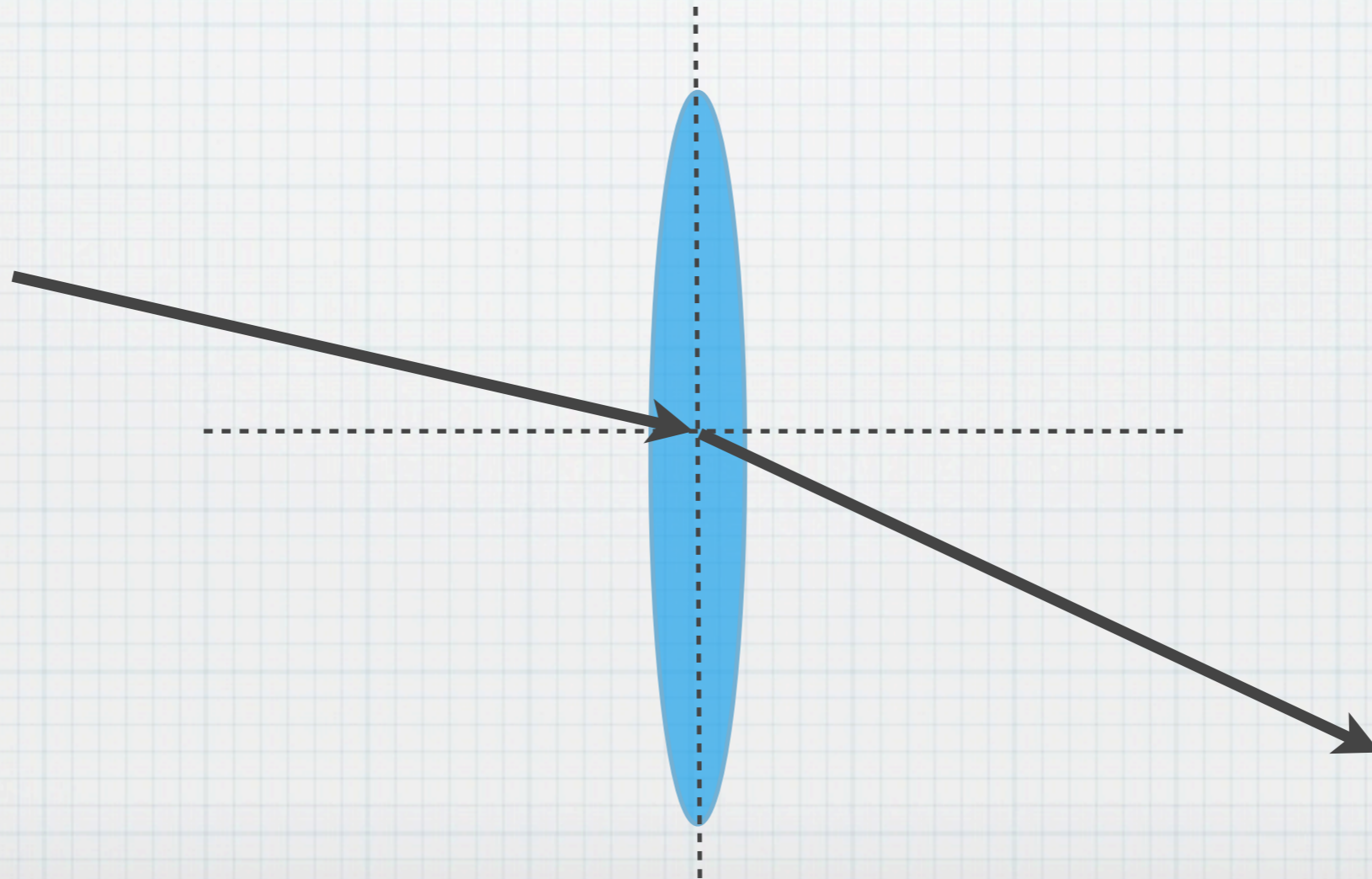
# A shortcut!

- \* Light is actually refracted twice when it goes through a lens. It refracts a first time when it enters the lens (as it goes from air to glass) and a second time when it leaves the lens (goes from glass to air).



# A shortcut!

- \* But we use a shortcut when drawing ray diagrams! Draw a dashed line through the middle of the lens and this allows to show the light being refracted one time.



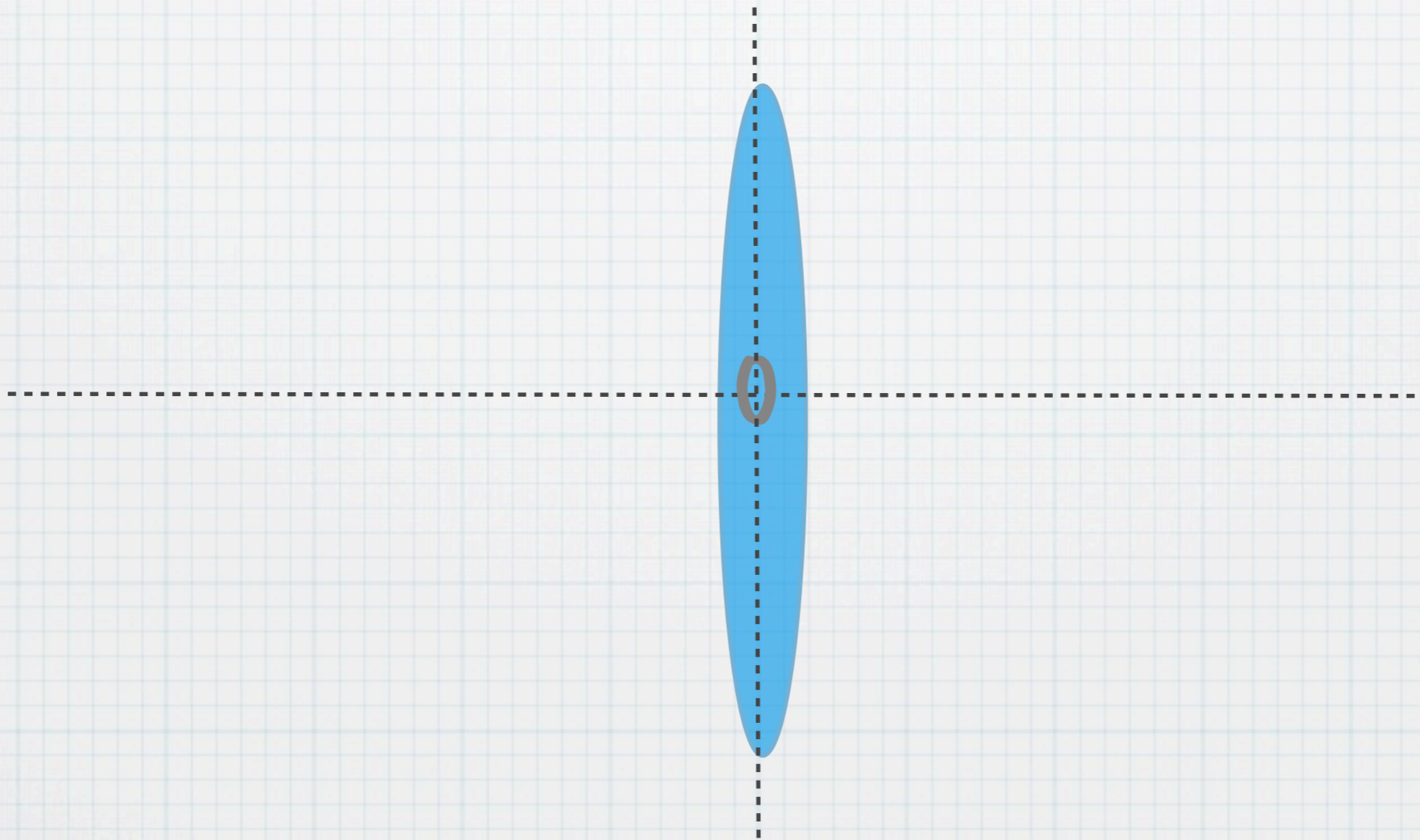
# Terminology for a converging lens

- \* **Optical Centre** - the centre of the lens (O)



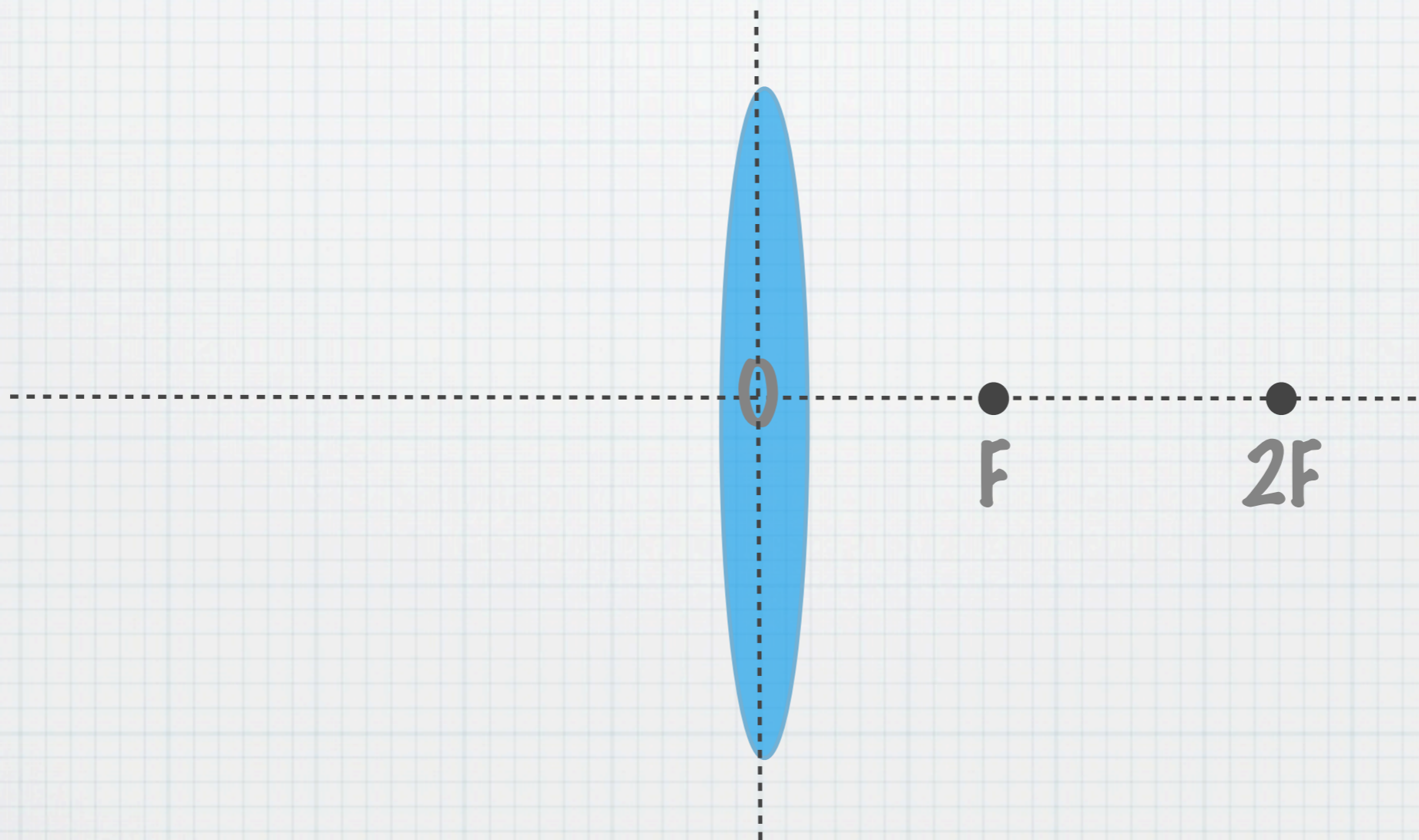
# Terminology for a converging lens

- \* **Principal axis** - Line through the optical centre that is perpendicular to the central dashed line of the lens



# Terminology for a converging lens

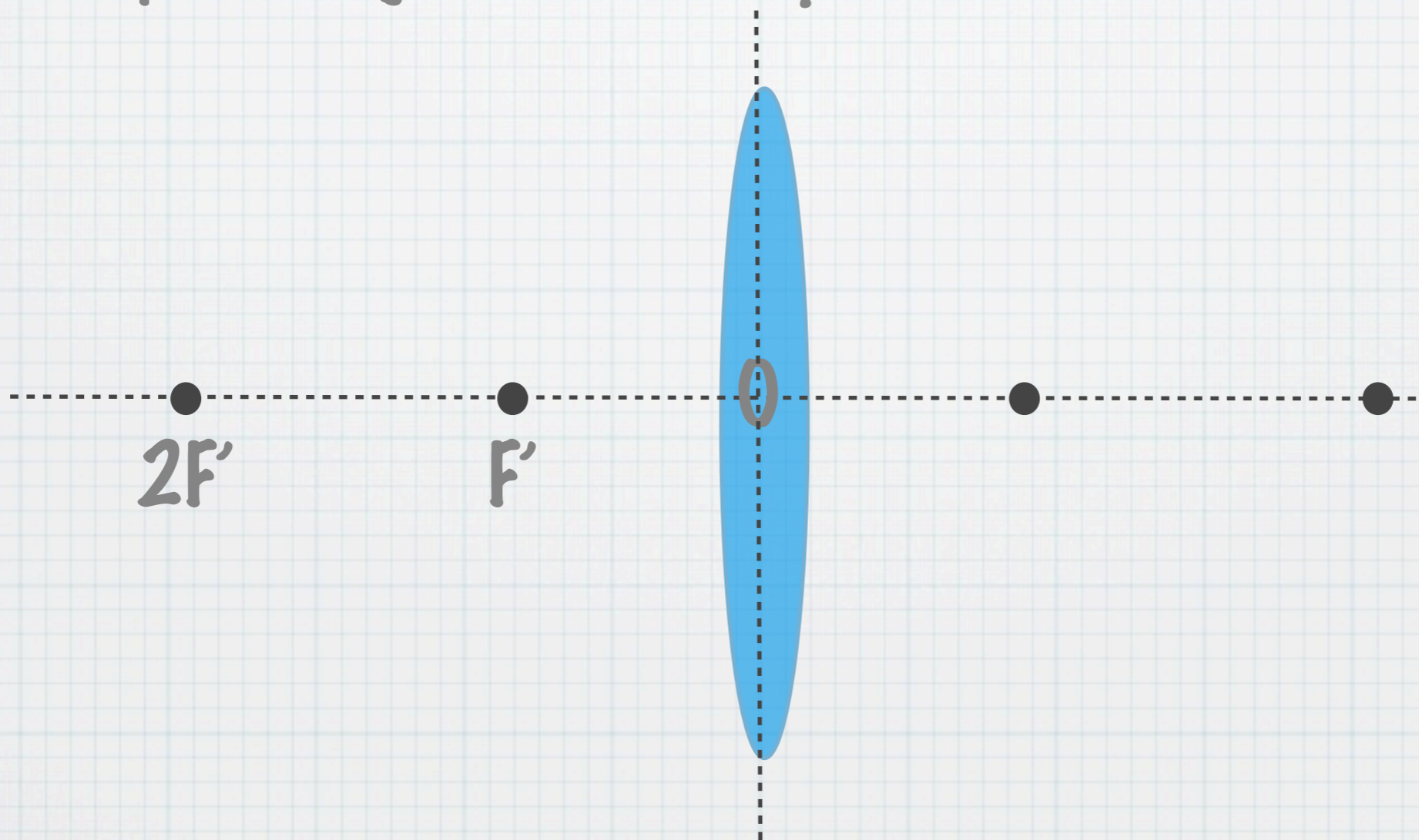
- \* **Principal focus-** Point on the principal axis where the light rays converge after refraction.





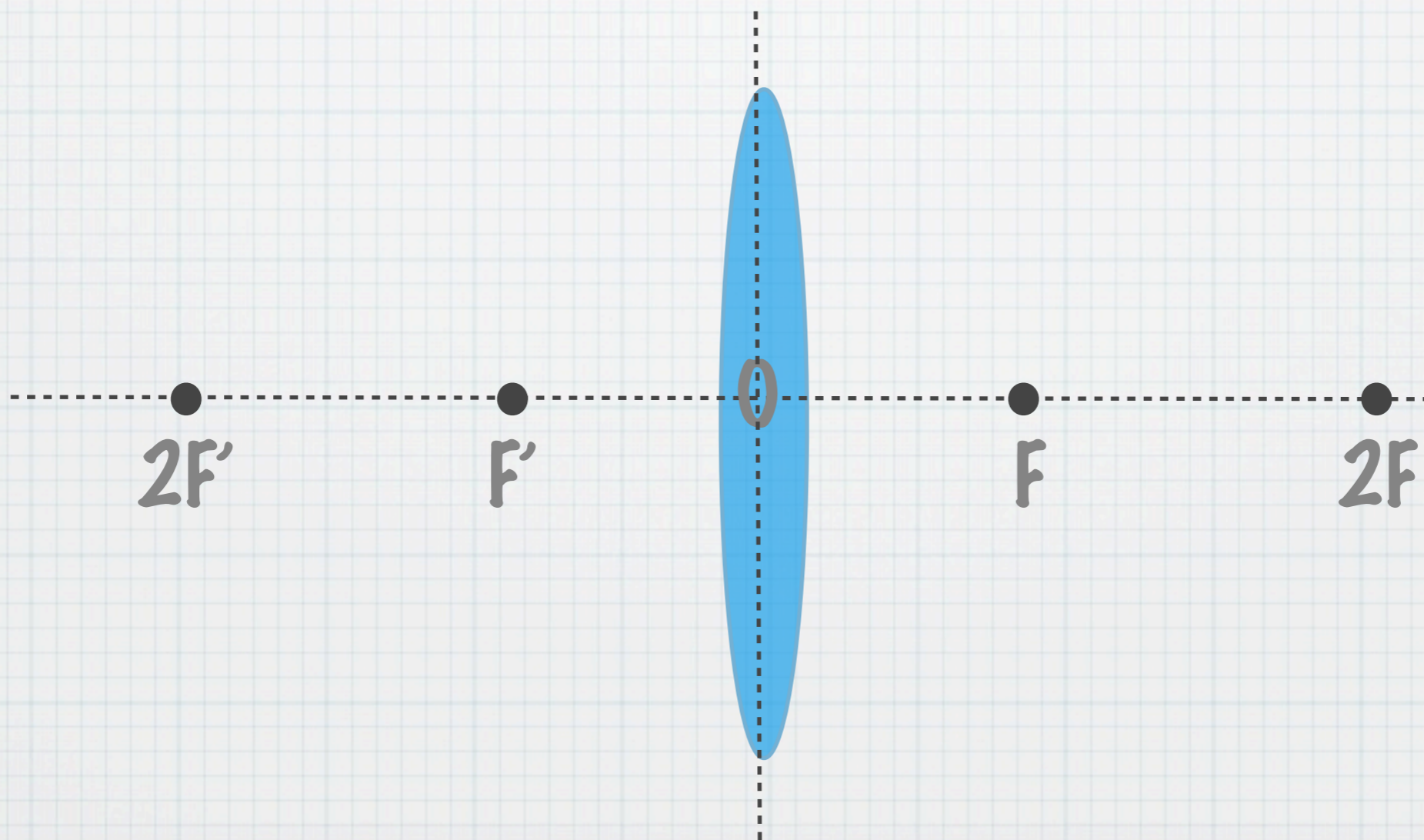
# Terminology for a converging lens

- \* Light can strike a lens from either side and both sides of the lens can focus parallel light rays. So you can get two focus points.



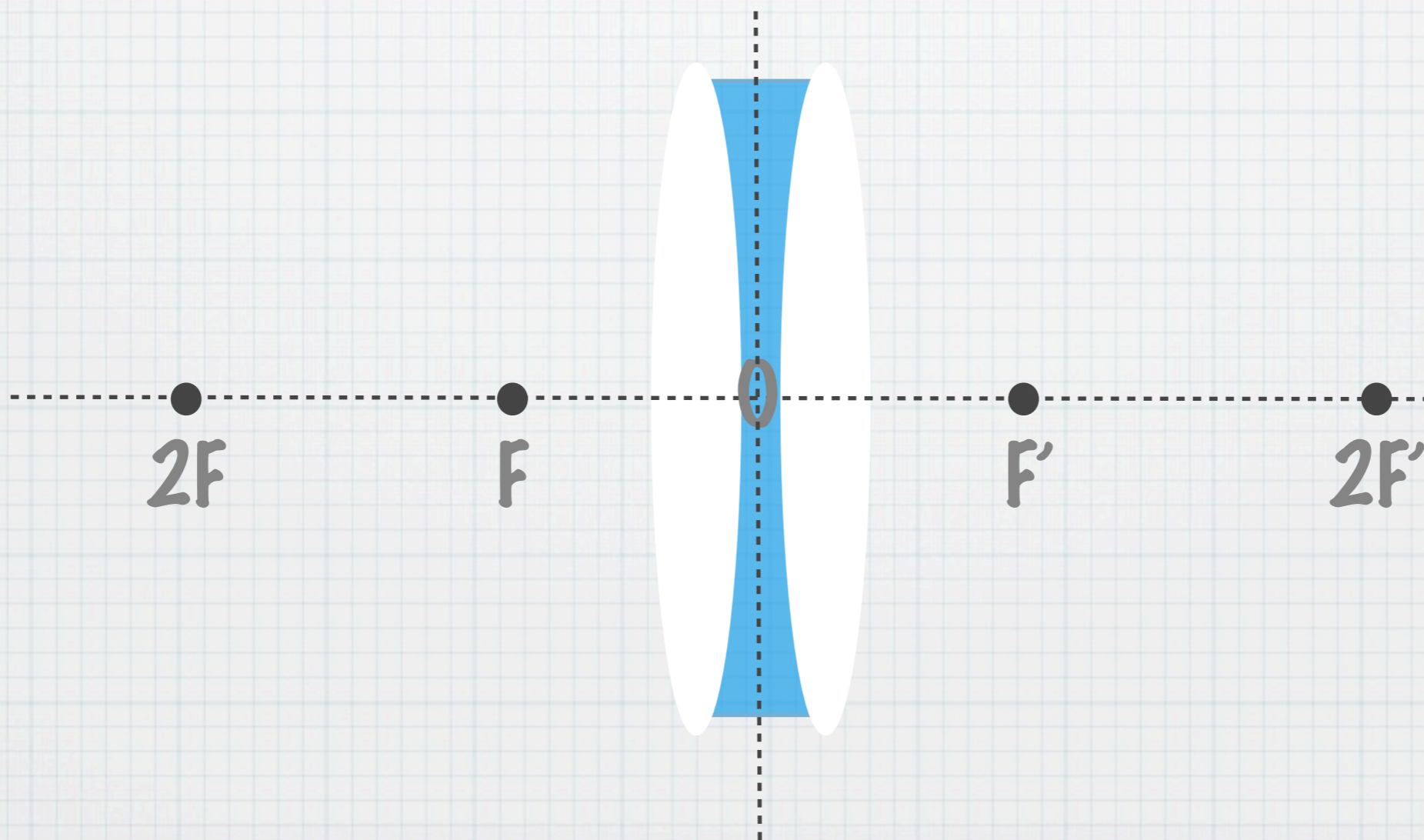
# Terminology for a converging lens

- \* **Secondary principal focus** - the focus that is on the same side of the lens as the incident rays



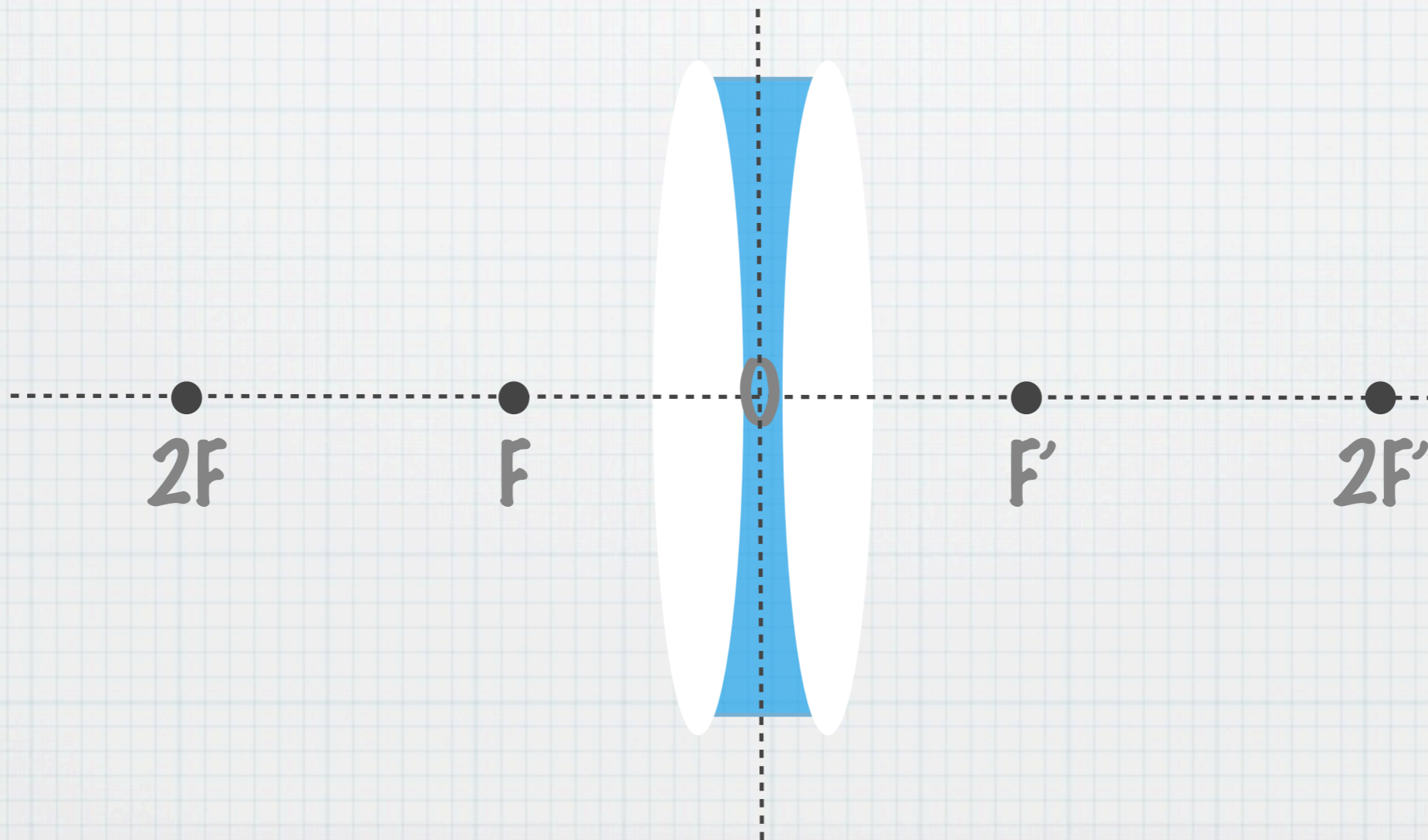
# Terminology for a Diverging lens

- \* Principal focus - is now on the side of the lens where the incident rays are



# Terminology for a Diverging lens

- \* Secondary principal focus - is on the refracted ray side of the lens



# Images in a Lens

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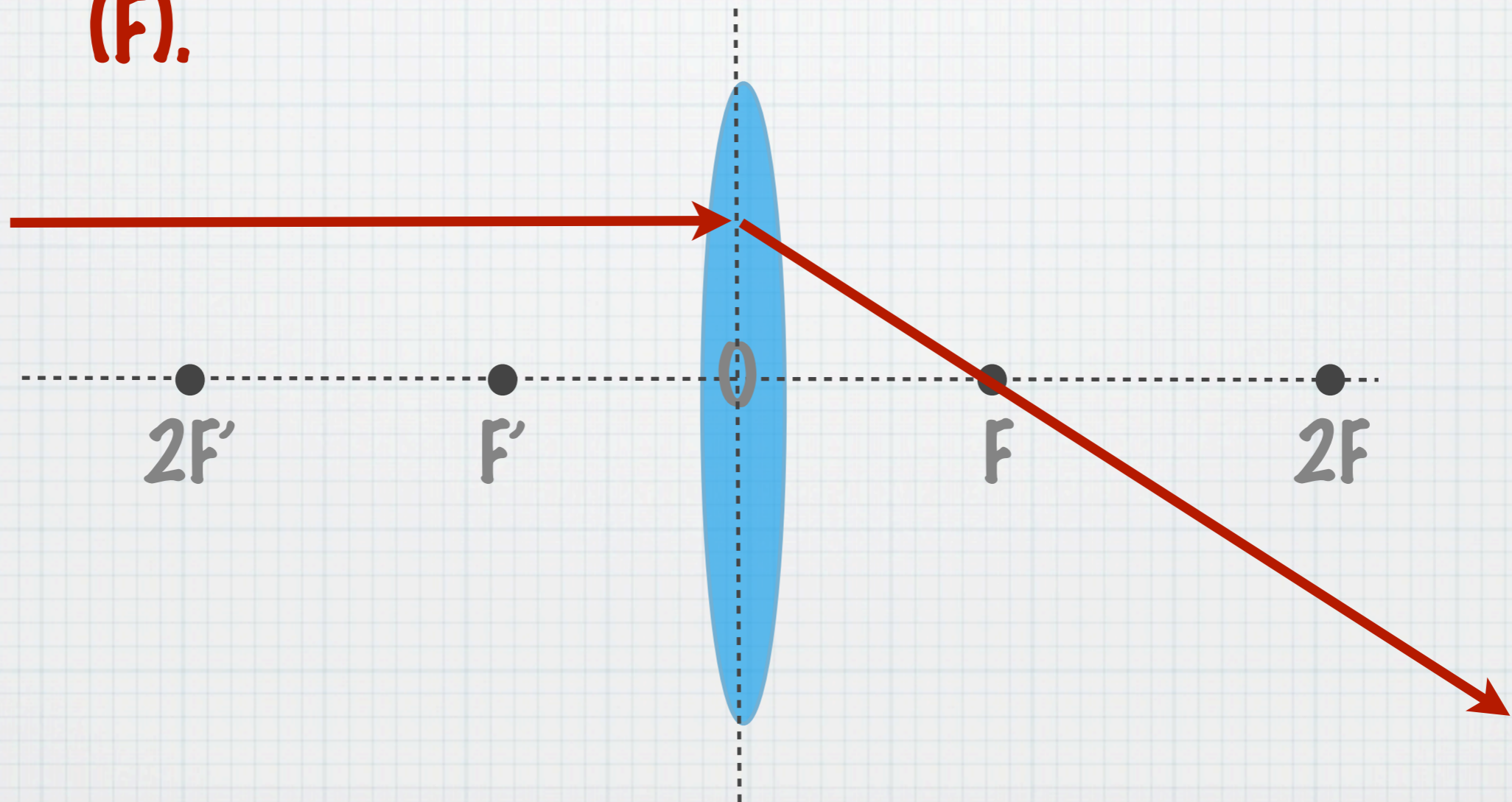
# Images in Lenses

- \* Emergent ray - the light ray that leaves a lens after refraction.
- \* A thick lens will cause more displacement than a thin lens.

# 3 rules for finding images in converging

## images in converging

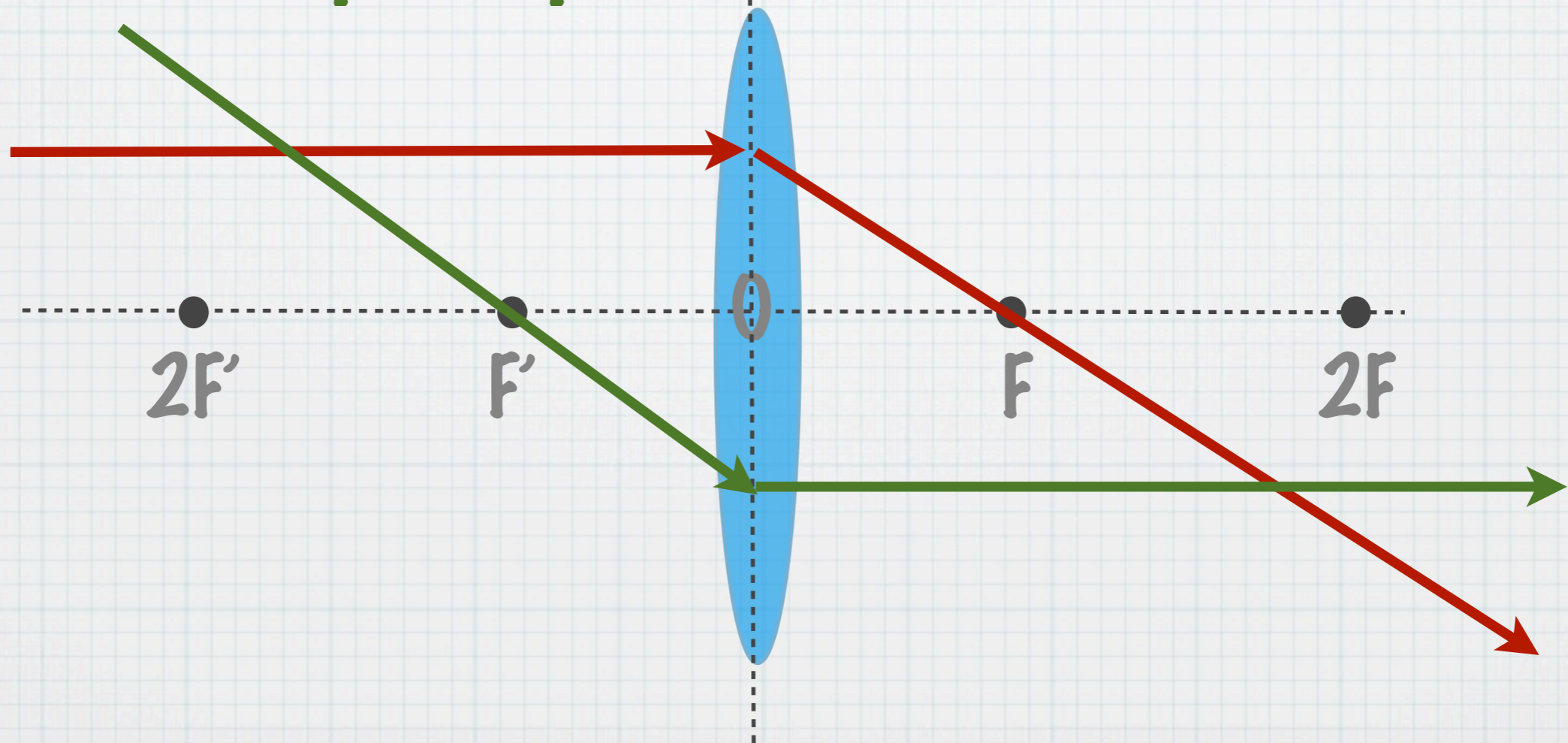
- \* 1) A ray parallel to the principal axis is refracted through the principal focus (F).



# 3 rules for finding images in converging

## images in converging

- \* 2) A ray through the secondary principal focus ( $F'$ ) is refracted parallel to the principal axis.

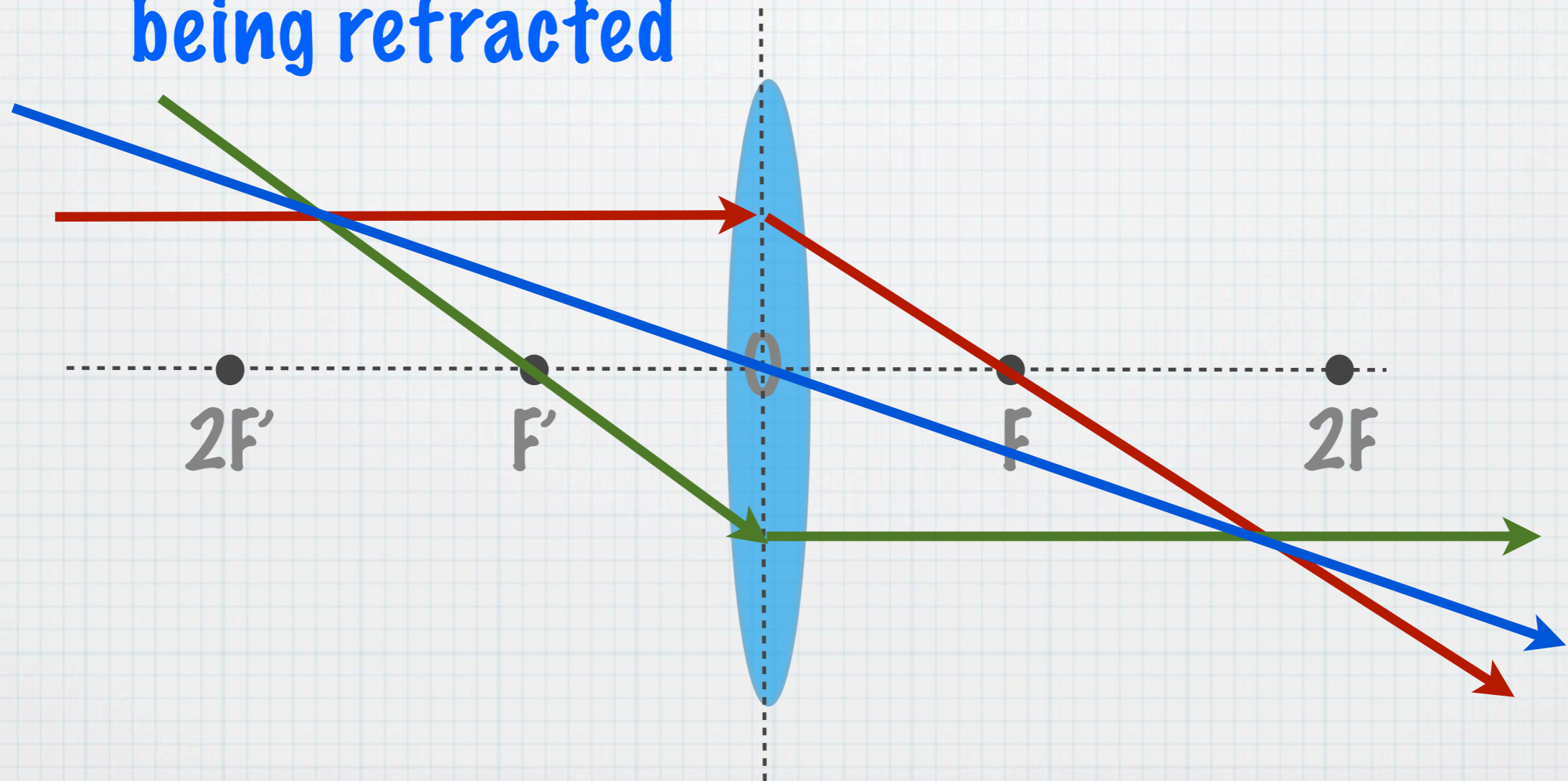




# 3 rules for finding images in converging

## images in converging

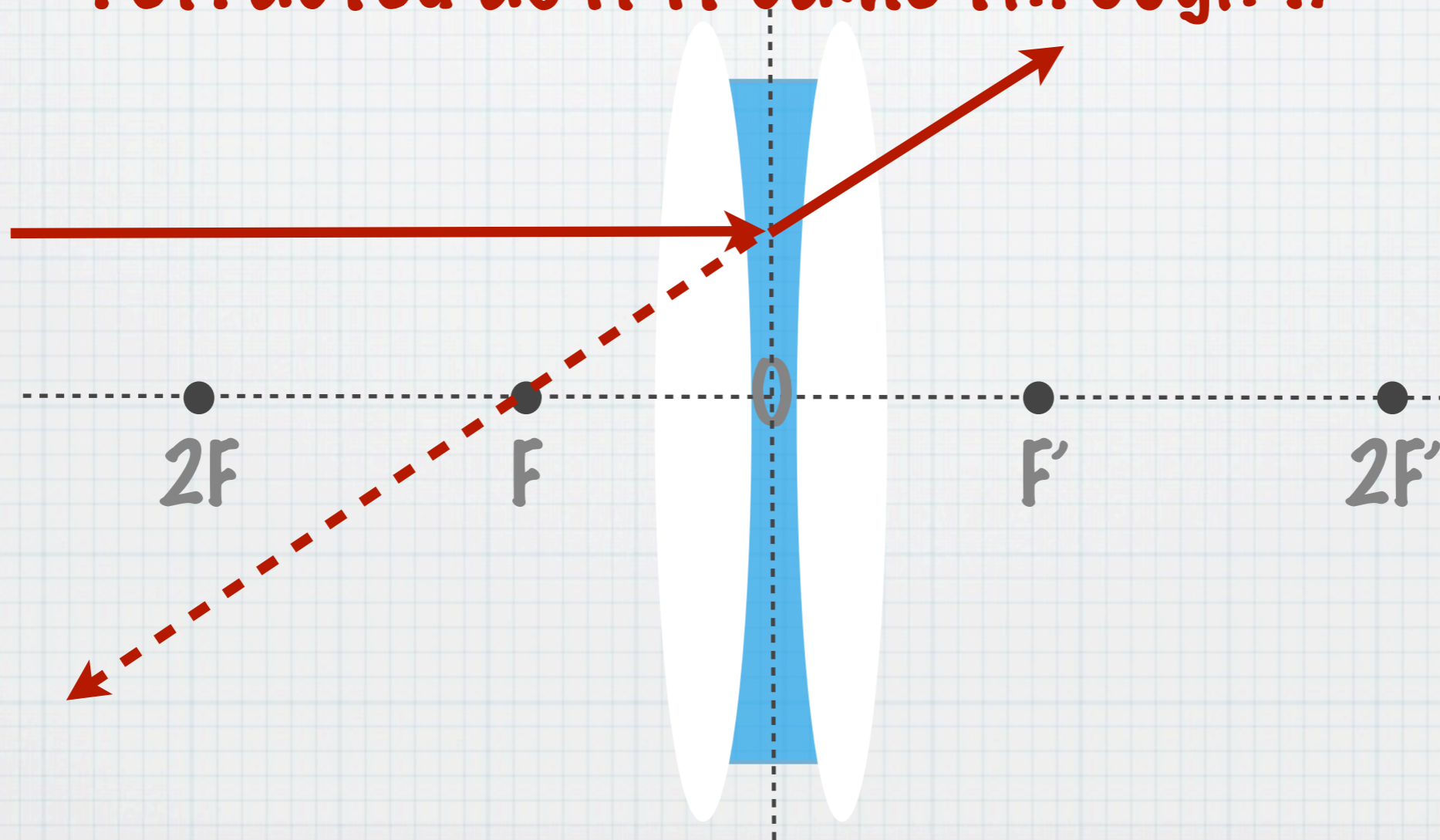
- \* 3) A ray through the optical centre continues straight through without being refracted



# 3 rules for finding images in converging

## images in converging

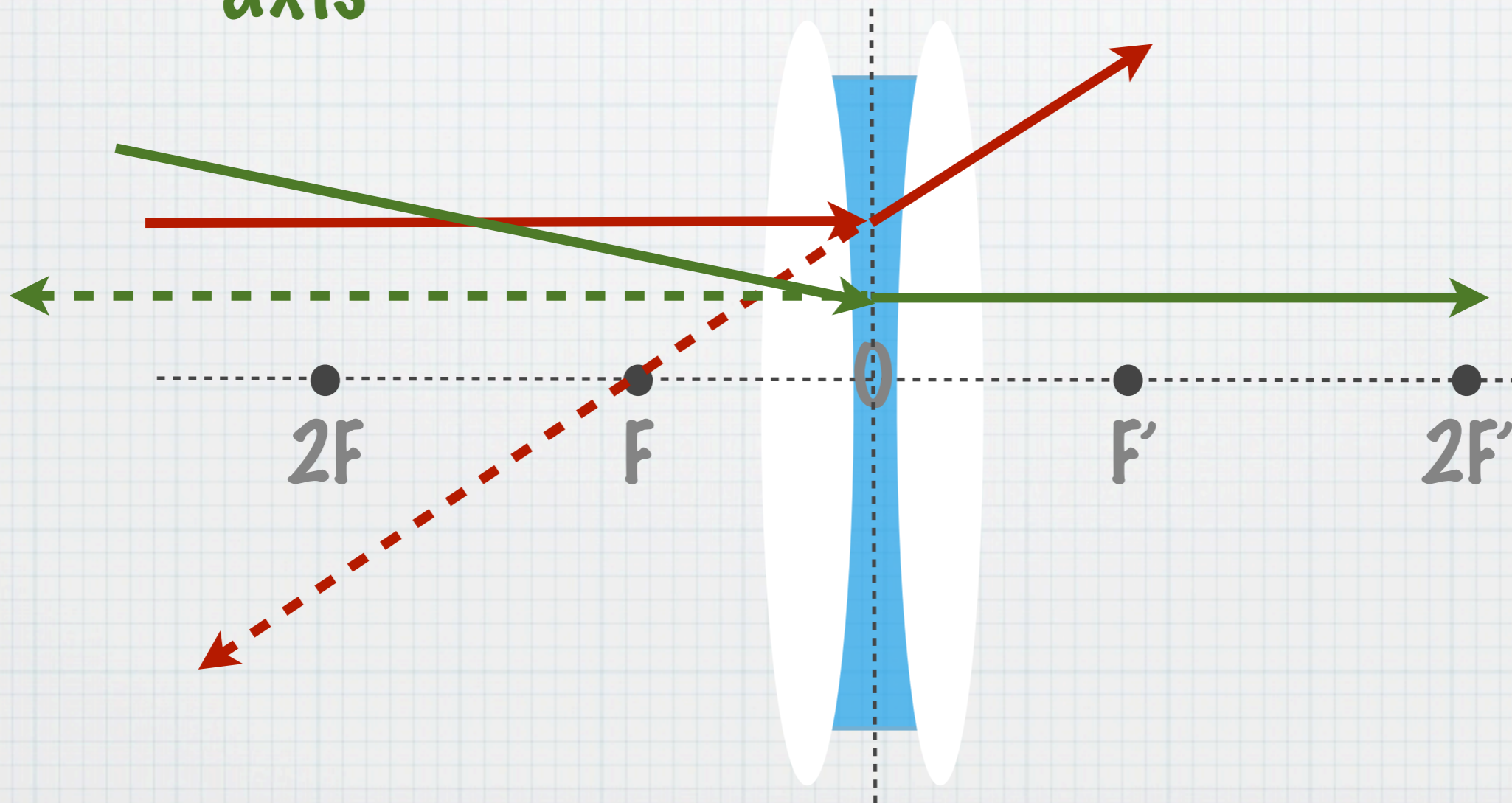
- \* 1) A ray parallel to the principal axis is refracted as if it came through  $F$ .



# 3 rules for finding images in converging

## images in converging

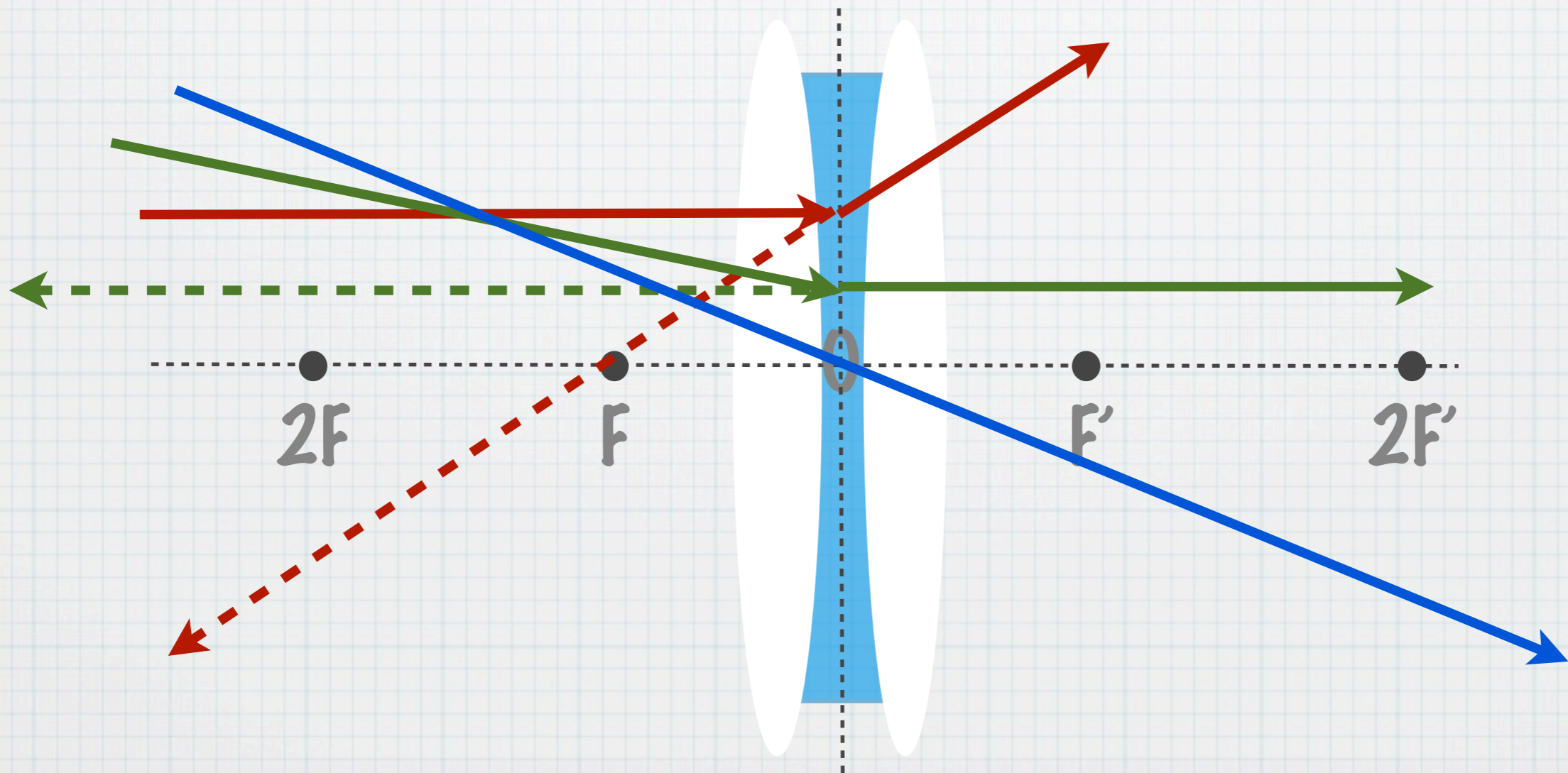
- \* 2) A ray that appears to pass through  $F'$  is refracted parallel to the principal axis



# 3 rules for finding images in converging

## images in converging

- \* 3) A ray through the optical centre continues straight through on its path.



# Homework

\* p 553 #3-6

\* Finish filling in 'Images in Lenses' sheet, us your textbook for help.

\* p 561 #2,3,5,6