**Introduction to ray diagrams and derivation of**

**a thin lens formula**

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Figure 1

Open the file containing a convex lens, focal point, optical axis and object (red arrow on the left from the lens). Describe what the students see on the graph. “Let’s consider propagation of the light coming from the object.

1. “As we already know, parallel light (green) will be refracted to the focal point.” Draw the green ray parallel to optical axis and then going through the focal point.
2. “Light propagates through the lens center without any refraction, straight ahead.” Draw the blue ray.
3. “And the image is formed at the intersection of these lines.” Draw the image. Note that the image is inverted (upside down). So, you have an object on the left side of the lens and inverted image on the right.
4. The distance from lens to the object (BC) is denoted as do. And the distance from the image to the lens (CD) – di. We also know the focal length of the lens (CF) – f.
5. There is a thin lens formula:  . I am going to derive this formula for you.
6. Let us introduce heights of the object (ho) and of the image (hi).
7. Triangles ABC and DEC are similar:  or or .
8. Triangles GCF and EDF are similar too:  or  or .
9. From 7 and 8: .
10. We will define magnification (M) as the ratio image to object size: .

Two formulas to remember are , .