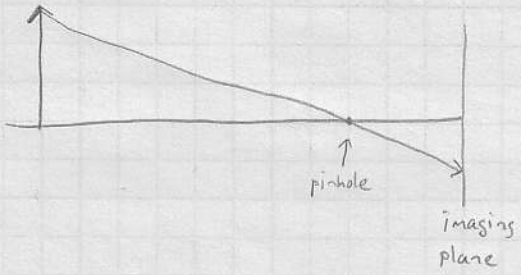
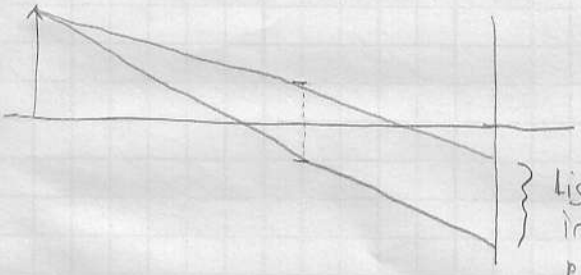
Pinhole Camera Model



+ Light from scene point only intersects with imaging plane at one location.

- Very little light from scene reaches imaging plane.

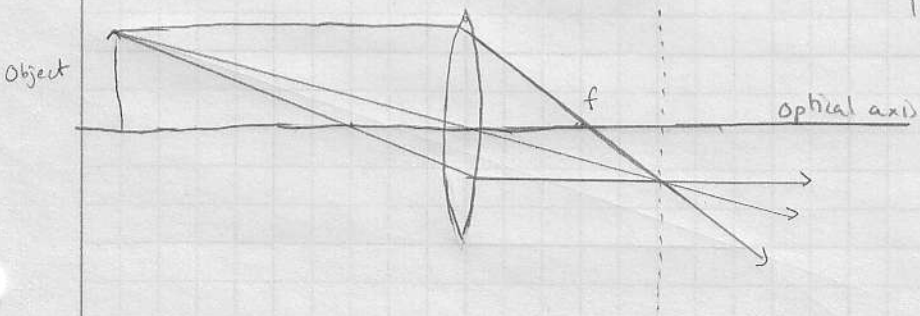
How about using a larger aperature (hole)?



Light from single scene point now intersects with a region of imaging plane. This will result in a blurred image.

The solution is to use a lens to focus the light.

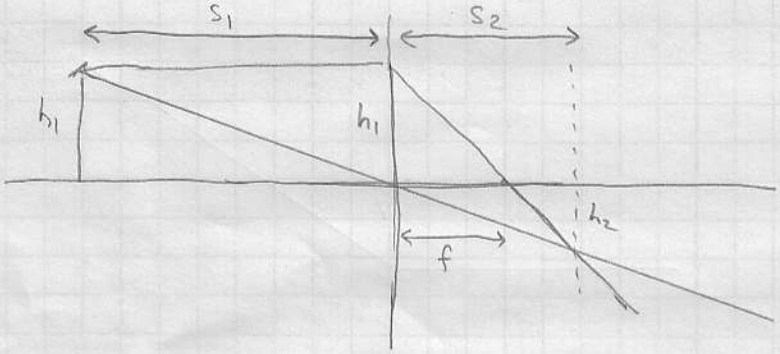
Thin Lens Model

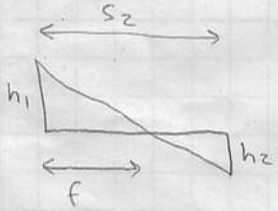


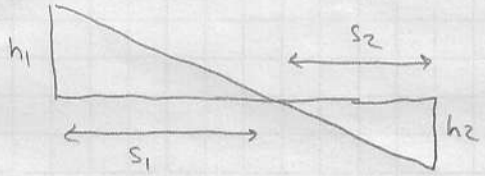
- Light travelling parallel to to the optical axis will be refracted through what's called the focal point f.
- Light hitting the center of the lens will not be refracted.
- Using this model, there will be a unique distance at which all the rays from the scene point will intersect.

If we place the image plane at this distance then the scene point will appear sharp or in focus.

What is the relation between the distance of the scene point, the focal distance and the optimal distance of the imaging plane?







$$\frac{h_1}{h_2} = \frac{f}{s_2 - f}$$

$$\frac{h_1}{h_2} = \frac{s_1}{s_2}$$

$$\frac{f}{s_2 - f} = \frac{s_1}{s_2}$$

$$s_2 f = s_1 s_2 - f s_1$$

$$\frac{1}{s_1} = \frac{1}{f} - \frac{1}{s_2}$$

$$\frac{1}{f} = \frac{1}{s_1} + \frac{1}{s_2}$$

For a fixed f, need to adjust the distance of the imaging plane so that a scene point is in focus.

$s_1 \uparrow \quad s_2 \downarrow$

$s_1 \downarrow \quad s_2 \uparrow$