Eye in Focus

Can you count the number of things you look at in one day, or, even in one minute? It is simply impossible! If you had a camera instead of your eye, you would need a different lens for each object that you see each depending on its distance from you, its shape and size! But how does the eye give perfect images for so many objects, big and small, near and far, and only with one lens?

1) Hold your finger about 30 cms away and focus only on your finger. Now slowly bring it closer to your eye while still looking at it. Stop when your finger starts to look blurry/double and ask someone in your group to roughly measure the distance from your eye to your finger and write it down below.

____

Is this distance about the same for everyone in the class? Compare your answers with other groups, your teacher will help you here.

____

If you or someone in your group wears glasses, do this experiment with and without glasses on. Did you find a difference in the distance? If so, approximately how much is the difference?

____

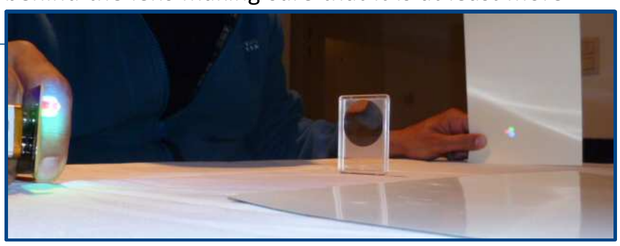
The average distance from the cornea of the eye to the retina is about 24 mm. ***The thin lens formula*** can help you to calculate the minimum focal length of your eye. Fill in the distances as you measured them in Step 1:

$$\frac{1}{\text{finger to eye}} + \frac{1}{\text{cornea to retina}} = \frac{1}{\text{focal length}}$$

$$(S1) \qquad (S2) \qquad (f)$$

Minimum focal length of my eye = ______________________________

2) **Preparation:** You will need two convex lenses with focal lengths 150 mm and 30 mm, a long ruler and the LED module. First, you will need to prepare a screen. Think about using something that will stand steady. Place the 150 mm focal length lens at one spot and place the screen behind the lens making sure that it is at least more than 150 mm away from the lens.



3) **Shine any colour from the LED** onto the lens and move the LED farther or nearer the lens until you see a sharp image on the screen. When the image is sharpest, write down the distance from the LED to the lens.

Focal length = 150 mm; Distance = ______________________________

4) Replace the lens with the 30 mm one making sure that you don't change anything else and repeat Step 3.

Focal length = 30 mm; Distance = ______________________________

For you to see the sharpest image, which lens had the LED placed farther away from the lens and which lens was placed closer to the lens?

5) If you have lenses with focal lengths between 30 – 150 mm, what is the farthest and nearest object you can look at? (Hint: use the thin lens formula.)

You have just seen that you had to use two lenses just to see one object at two distances. The lens in the eye has the special feature that it can change its shape or **curvature** to suit the object. For instance, to see far away objects, the the lens is flat – therefore the focal length is longer. To see objects closer to the eye, the lens is more rounded – so the focal length is shorter. This process is called **'accommodation'** and is very special to the human eye. In both cases, a sharp image is formed on the retina. Someone with "normal vision" can clearly see an object about 20 feet away from them. Either you or your friends might wear glasses for "short-sight" or "long-sight". A short sighted person can see objects near by clearly but not far away objects and vice-versa for a long sighted person.

6) Can you tell what the fault is with the curvature of the lens in their eye (i.e. not flat enough or not round enough) and the focal length (i.e. not long enough or not short enough)? Draw what happens in each kind of eye if this will help you.

Short sight (image forms in front of retina)

Long sight (image forms behind retina)

7) Discuss what kind of lens can be used to correct each fault.