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## Eyemodel with changeable lens

The frame of the model is made of plexiglass and mounted on a wooden plate.

### The length of the eye can be changed

The length of the eye can be changed by moving the rear wall (sclerotic coat) forwards and backwards. On the plexiglass plate three positions are marked: short eye (long-sighted), normal eye and long eye (near sighted).

### The shape of the lens can be changed

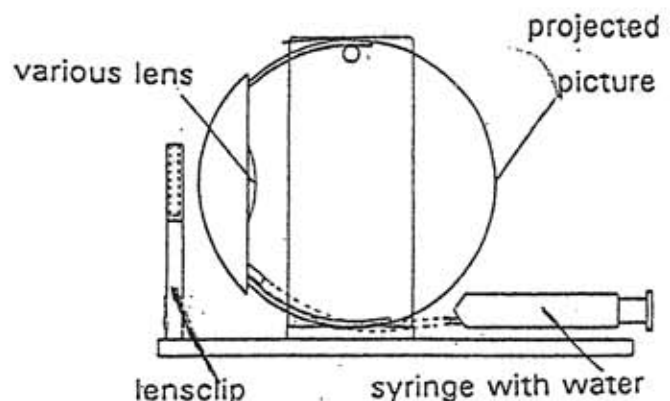
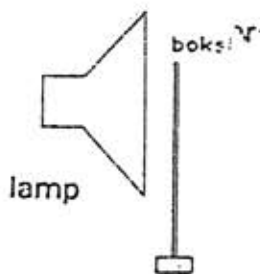
The lens with ciliary body and details for fastening on the frame are made of crystal clear silicone. By using a syringe containing water, the shape of the lens can be changed.

### Objects can be projected

Pictures of objects on various distance from the model can therefore be projected on the retina, a white plastic plate. The yellow spot and the blind spot are marked on this plate. The plate can be moved so that the yellow spot always is placed in the centre line of the eye.

### The glass lenses.

The two glass lenses should be used for demonstrating near- and long-sightedness and presbyopia. The indications for the length of the eye and the test manuals are adapted for these two lenses (-0,5 D and +1,0 D).



### Filling the lens with water

1. Unscrew the front casing (the cornea). Remove the lens with plastic tubing and syringe from the frame of the model.
2. Remove the lens from the plastic tubing. Leave the tubing on the syringe.
3. Fill the syringes with water, preferably distilled water. Remove air bubbles from the syringe. A minimum of 100 ml water should remain in the syringes.
4. Suck the air out of the lens with your mouth and then squeeze the connection tubing of the lens between your fingers.
5. Assemble the lens with plastic tubing and the syringe without letting air into the lens.
6. Fasten the parts on the frame. Replace the cornea.
7. The lens is ready to use.

### Cleaning

The parts of the model can be cleaned with a damp cloth. Strong solvents should not be used. The lens is best cleaned with soap under running warm water. Dry the lens carefully with soft paper.

# How to use the model

## The parts of the eye

Use the text and pictures of the textbook, posters, anatomic models etc and compare to the parts of the model. Write down the names of the different parts of the eye and learn them.

## The shape of the lens can be changed

How does the lens look when the syringe is pressed in? How does it look when the syringe is pulled out? When the shape of the lens changes the light refraction in the lens also changes. Note that the lens is suspended in threads, attached to a sphincter. In our own eyes the shape of the lens can be changed too. Find out what happens when the shape of the lens changes in our eyes.

## The eyes adjustment to distance, accommodation

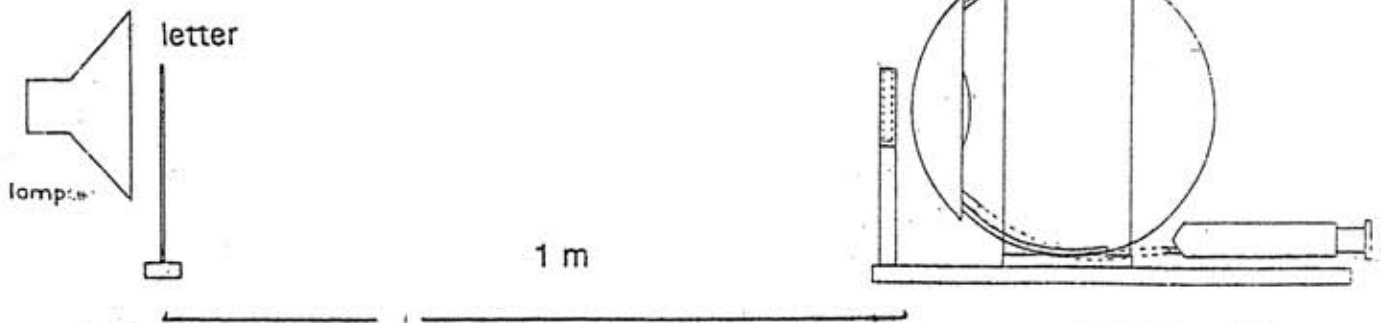
- a. Place a lamp approx 1 meter in front of the eye model. Place the plexiglass plate with the letter just in front of the lamp so that it becomes illuminated. Change the shape of the lens by using the syringes so that a sharp picture of the letter appears on the retina of the model.
- b. Move the eye closer to the letter (approx 0,5 m from the eye). How does the picture look now? Change the shape of the lens so that the picture becomes sharp again. How must the lens be changed to present a sharp picture at close range?
- c. Repeat the test with other ranges. Note that the shape of the lens must change when the range is being changed. What does the lens look like when the eye is adjusted for vision at short range? How does it look if the object is far away?

## Nearpoint of vision

Make the lens as thick as possible. Move the eye towards the letter until the picture on the retina becomes sharp. This is the shortest range at which the eye can produce a sharp picture of an object. The letter is now in the nearpoint of the eye. Try to find the nearpoint of your own eye.

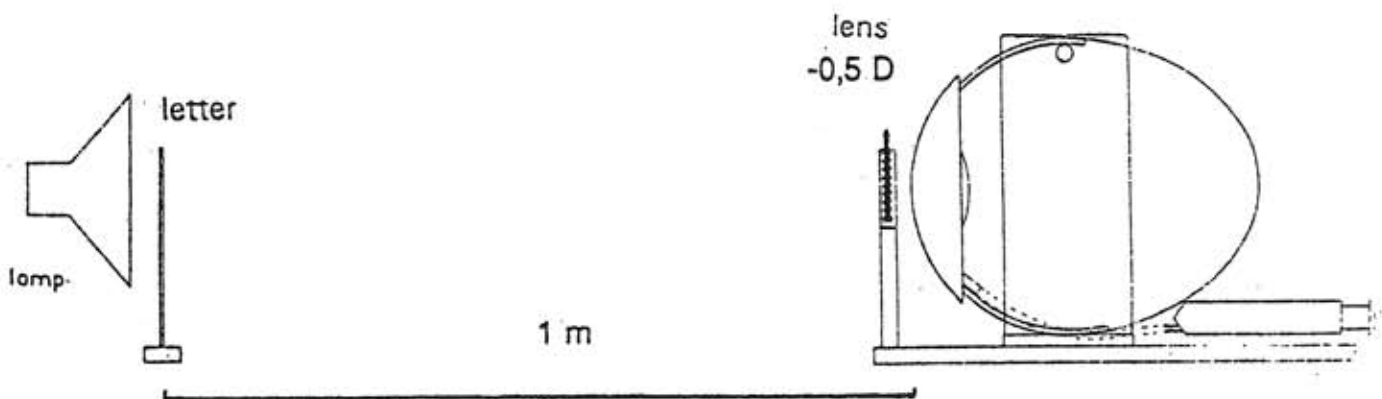
## Demonstration of near-sightedness

Place the eyemodel (normal length of the eye) and the plate with the letter as shown in the picture below. Adjust the shape of the lens with the syringe to make the picture of the letter in the eye sharp.



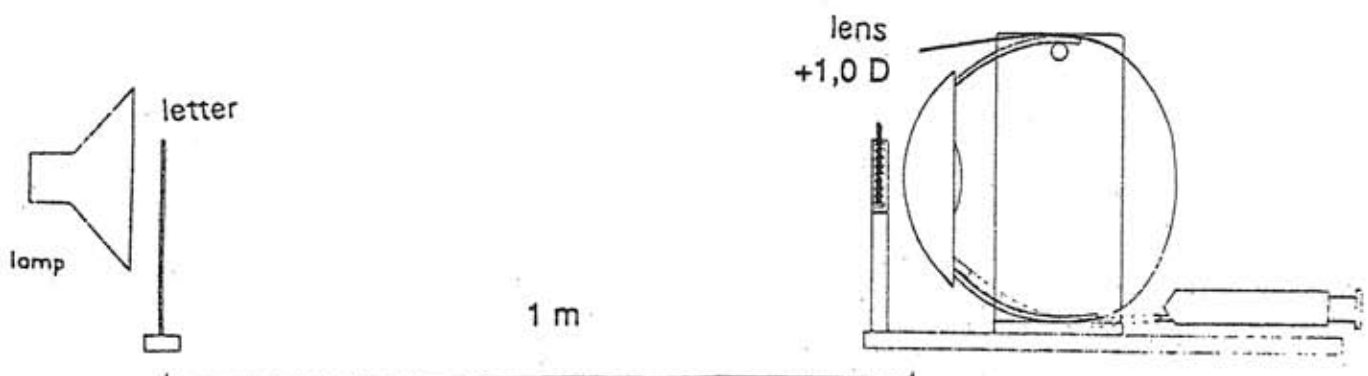
Make the eye longer as the picture shows. The eye has become nearsighted and the picture has become unclear. Without changing the shape of the lens the letter can become sharp again in two ways:

- a. the letter is moved closer to the eye or
- b. correction with glass lens, in this case a lens with the strength  $-0,5\text{ D}$ .  
 Put this lens in the lens holder and the picture becomes sharp again.



## Demonstration of long-sightedness

1. Place the letter 1 m from the eye, make the same basic adjustment as above.
2. Make the eye shorter as shown in the picture. The eye has become long-sighted and the picture has become unclear. The picture can become sharp again if you correct the visual defect with a glass lens; a convex lens ( $+1,0\text{ D}$ )



## The yellow spot and the blind spot of the eye

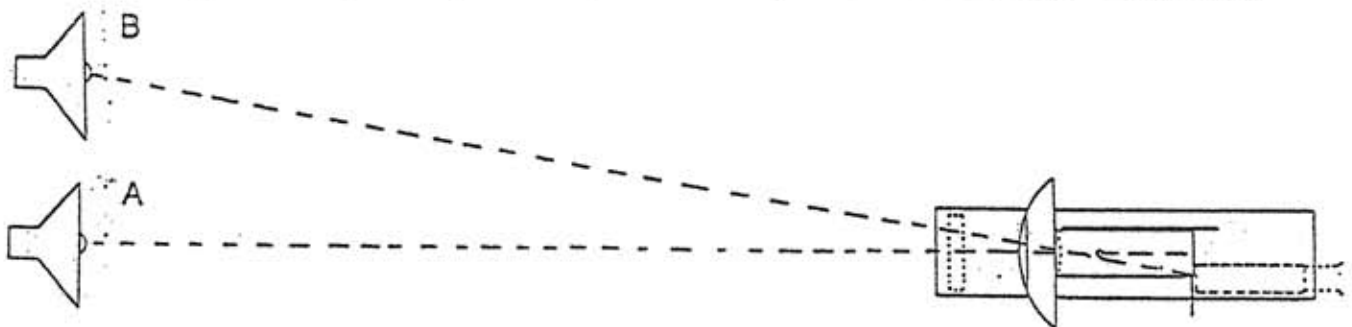
Objects that are looked upon, produces a picture in the yellow spot, which contains cones. The blind spot is the place where the visual nerve exits. At that spot there are no visual cells. Use the picture below and do like this to establish the blind spot in your own eye;



Hold the paper in front of you with straight arms and look at the cross with your right eye. The picture of the cross then is in the yellow spot but you can also see the black circle, which is projected at the side of the yellow spot (indirect vision). Then move the paper closer to the eye and look at the cross the whole time. At a certain distance the picture of the circle will be in the middle of the blind spot and the circle becomes invisible. If you move the paper closer to the eye the circle appears again.

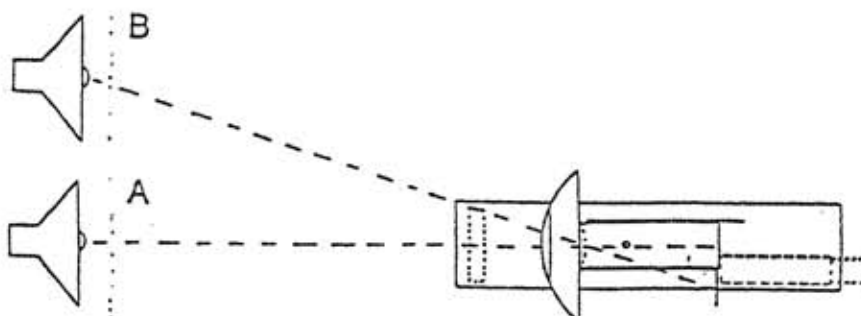
The same thing can be shown with the eyemodel in the following way:

Place two lamps next to each other (the bulbs approx 15 cm from each other). The eyemodel is a right eye with the visualnerve (the blind spot) somewhat to the left towards the nose. Place the model as shown in the picture below and adjust to a sharp picture of lamp A in the yellow spot. The picture of lamp B now is next to the yellow spot.



Range approx 1 m

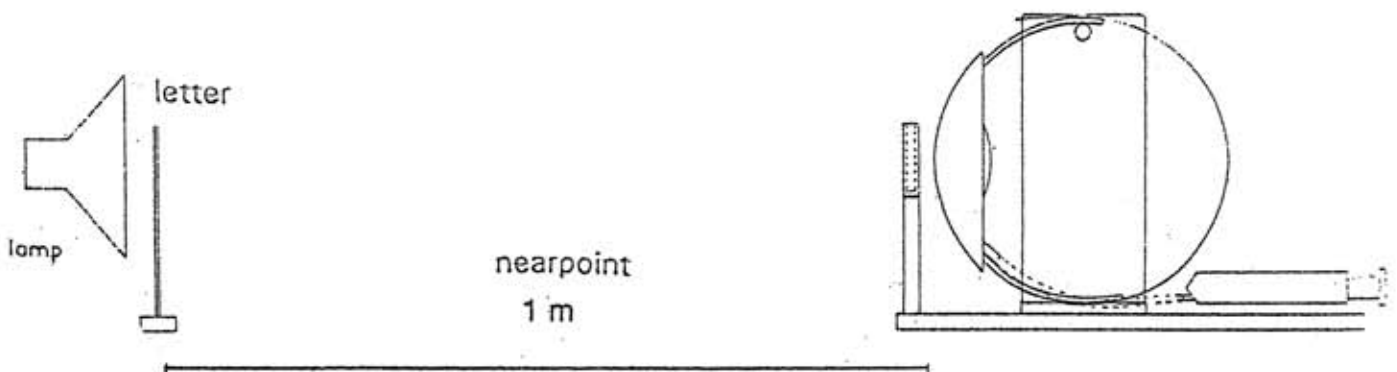
Then move the eyemodel slowly towards lamp A but continue to keep the picture of the lamp in the yellow spot. At a certain range the picture of lamp B will be in the blind spot.



## Demonstration of presbyopia

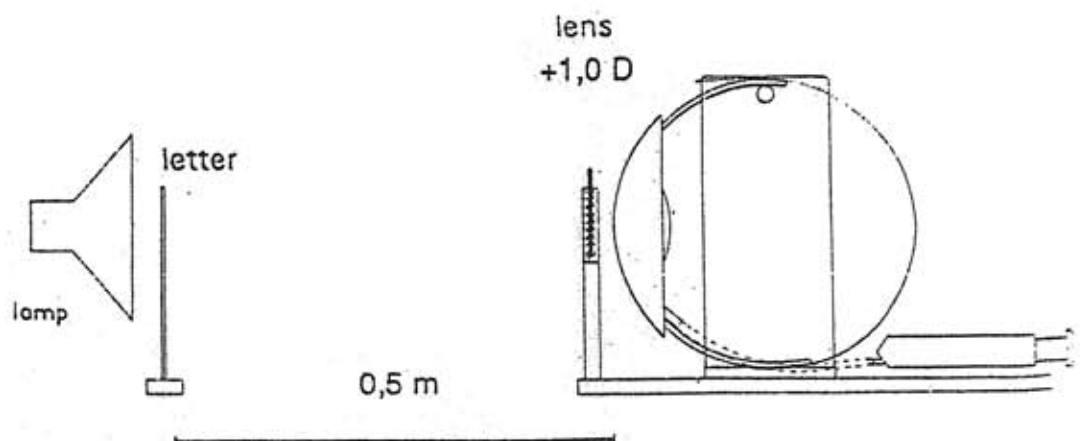
The elasticity of the eye lens decreases when we become older. We therefore need glasses to see well at close range.

1. Place the eyemodel (normal length on the eye) and the plate with the letter as shown in the picture below. Adjust the shape of the lens by using the syringe until the picture in the eye becomes sharp. Suppose that the letter is in the nearpoint of the eye and that the lens cannot accommodate more. The lens cannot produce a sharp picture of objects at closer range.



2. Move the letter closer to the eye as in the picture below without changing the shape of the lens. The letter will then be closer than the nearpoint of the eye and the picture of the letter becomes unclear. The refraction capacity of the eye is no longer sufficient.

The visual defect can be corrected with a convex lens (+1,0 D), which produces a sharp picture at this range. Reading glasses for older people moves the nearpoint closer to the eye.



## Stereoscopic vision

By looking with two eyes at the same time we can easier judge distances to objects at different distances. The eyes see the objects from different angles. The pictures on the retinas do not become exactly alike but in the brain the two pictures are joined to a picture with character of depth.

In the two retinas there are corresponding points. When looking at a photograph the eyes are directed so that every looked upon part of the photograph is projected in corresponding points on the retinas. The projections of the left and the right eye are the same and in the brain they are joined in to a picture without depth.

When looking at objects at different range from the eyes all details cannot be projected simultaneously exactly in corresponding points on the retinas. If pictures are projected close enough to corresponding points on the retinas we experience the picture in three dimensions, we see the depth in it. **Double vision appears when objects are not projected in corresponding points.**

### Show double vision in yourself in the following way:

Hold both your pointing fingers at different distances in front of the eye, e.g. 2 dm and 4 dm. Then look with both eyes at the finger furthest away. The other finger then appears double as the pictures of the finger is not in corresponding points on the retinas.

### Show double vision by using eyemodels.

Place two eyemodels next to each other to make a pair of eyes with normal distance between the eyes. Place the lamp and the plexiglass plate with the arrow 1 m in front of the models. Direct and adjust the eyes so that the picture of the arrow is in the centre of the yellow spot. The two pictures now are in corresponding points on the retinas. The brain would perceive this as one single arrow.

Then place the other arrow 10 cm in front of the first arrow. The other arrow will not be projected in corresponding points on the retinas.

The left eye thus gives one picture and the right eye an other.  
The brain cannot join these pictures to one, instead we see double pictures