DEFECTS IN SHARP VISION

- *Follow instructions in this worksheet, if you have difficulty understanding them, ask us.*
- *Write down both your partial and final results into the text and prepared graphs.*
- *If you want, you can record videos and take photos of conducted experiments, etc.*

The goal and idea of the experiment

You will explore the defects in sharp vision of the human eye.

Sharp vision

A sharp image is formed when all rays of light coming from a single point of an object intersect at a single point on the retina.

Sharp vision can be disrupted by several different factors, for example: change in the distance between the lens and the retina, change in the index of refraction of the eye, change of the curvature of the eye, etc. If any of these disruptions occur, light rays won't intersect at a single point and the vision won't be sharp.

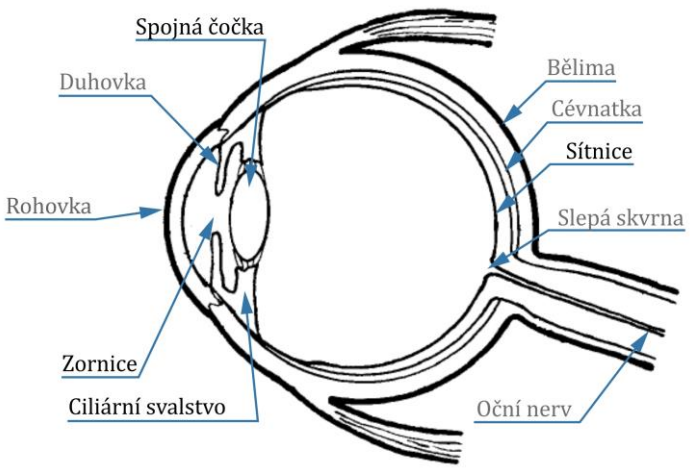
Optical kit

You will work with lasers which can damage the retina.

NEVER POINT THE LASER INTO THE EYES and be careful of where you point with them!

The kit contains laser source, which can shine with one, three or five laser rays. By pressing the button on the source, you can change between these modes. There also are four paper schematics which depict an eye (whose optical system will be symbolized by the lens and will be coloured red), the area for corrective lens and the area for lens simulating a near object (coloured blue).

We will work with three rays in our tasks. From a real object, an infinite amount of rays come into the eye, but all of them must intersect at a single point.

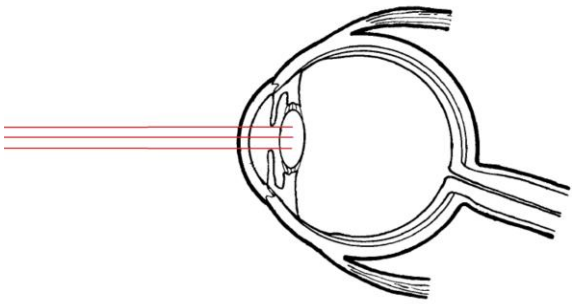


Picture 1: Schematics of upper view of the right eye.

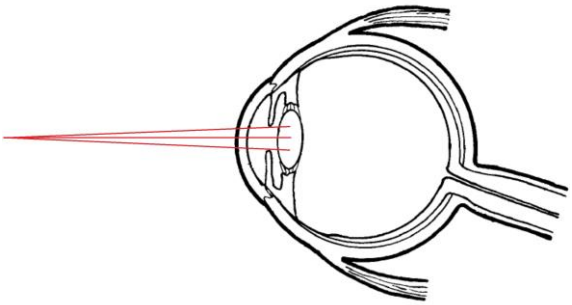
Task 1: Exploring the healthy eye

1. Estimate and draw into the picture at the right hand side how rays of light will traverse through a **healthy eye** from a distant object (up) and near object (down).

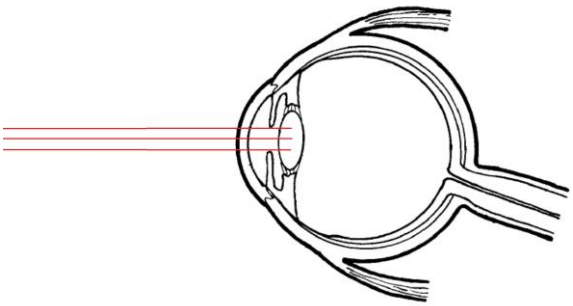
   Rays coming from a distant object can be viewed as parallel (this simplification can be proved in applet Rays.ggb).



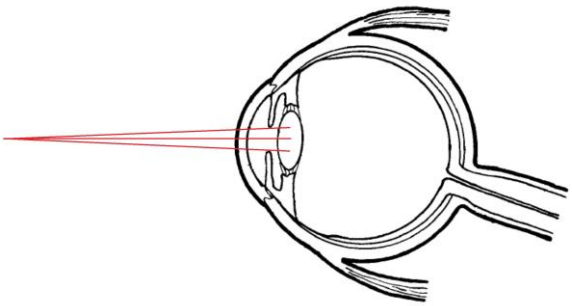
   Rays coming from a near object must be viewed as divergent. We will simulate this using a well-placed lens.



2. Open the **schematics Z** on the table and put **lens 3** into the place of the eye's lens. Shine with three lasers perpendicularly to the lens into the eye. Draw into the schematics how the rays traverse through the eye. Compare your observations with your estimate.

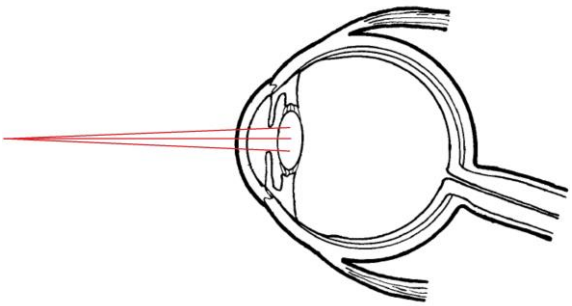


3. Put **lens 1** onto the spot opposite the eye. The eye is now looking onto a near object but hasn't focused on it (the rays intersect behind the retina). Eye accommodation will take place (change the lens 3 into **lens 4**). Draw what you observe and compare it with your estimate.



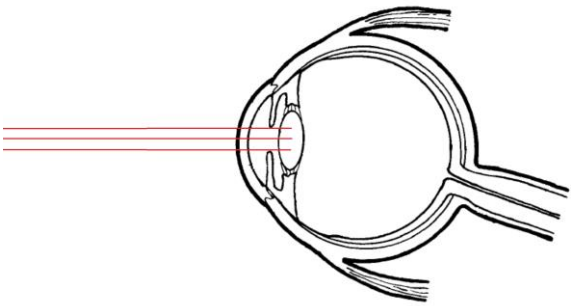
Task 2: Near-sightedness

1. We will use **schematics K** to simulate a near-sighted eye. Place **lens 2** to the designated place opposite of the eye to simulate a near object. The eye is now looking onto a near object and accommodates – place **lens 4** as the eye's lens. Draw what you observe.



2. Where did the rays connect?

3. **Remove lens 2** simulating a near object, which will cause the eye to look onto a far object and will accommodate (change lens 4 into **lens 3**). Draw, what you observe.



4. Where did the rays connect now?

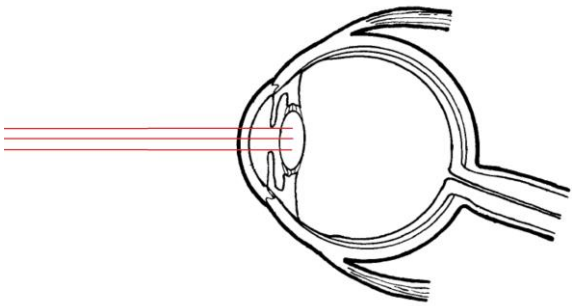
5. This eye can see well objects near/far.

6. Place one of the remaining lenses in front of the eye to help it see well far objects as well. What kind of lens (converging/diverging) is the corrective lens?

The examined defect is called near-sightedness, because the eye can see near objects well. This defect affects about 32 % of the human population and is usually caused by not being exposed to bright light as a young child which causes the eye to lengthen more than it should lengthen during its development.

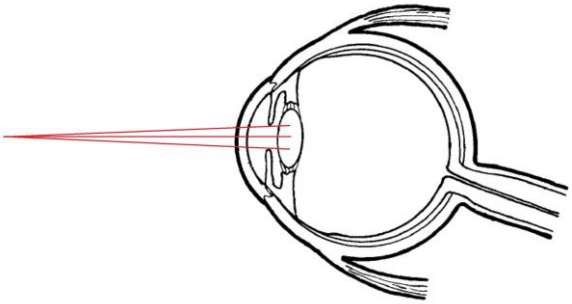
Task 3: Far-sightedness

1. We will use **schematics D** to stimulate a far-sighted eye. We will let the eye to see a far object using **lens 3** as the eye's lens. Draw what you observe.



2. Where did the light rays connect behind the lens?

3. Place **lens 2** on the designated place opposite of the eye to simulate a near object. The eye will accommodate to see the near object (change lens 3 to **lens 4**). Draw what you observe.



4. Where did you light rays connect behind the lens?

5. This eye can see well objects near/far.

6. Place one of the remaining lenses in front of the eye to help it see well near objects as well. What kind of lens (converging/diverging) is the corrective lens?

The examined defect is called far-sightedness, because the eye can see far objects well. This defect affects about 60 % of the human population and usually afflicts elder people because they lose the ability to accommodate the eye to a near object and thus become far-sighted.

Task 4: Unknown defect

1. An unknown defect will be simulated by **schematic N**. Place **lens 3** on the designated place opposite of the eye to simulate a near object and use **lens 4** as the eye's lens. What defect is being shown?

2. What lens will be used as the corrective lens?

3. Verify your estimate.

Conclusion

Near-sighted people can see _____ objects well and their sight is corrected using _____ lenses.

Far-sighted people can see _____ objects well and their sight is corrected using _____ lenses.