

## Scenario of the lesson on:

### **GLASSES AS A SIMPLE OPTICAL INSTRUMENT or from what it started ...**

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#### **Introduction**

Lesson on "Glasses as a simple optical instrument" is one of the last lesson of geometrical optics. It is intended as a repetition lesson, in which messages appear extending knowledge of physics, based on a historical foundation. In the presented version is designed for classes implementing the physics of the extended course due to the complexity of some set of tasks. After the substitution of any difficult tasks, this scenario can be used in the classrooms of a general profile.

#### **Main goals:**

1. Knowing and understanding the phenomenon of light passing through the lens and the lens unit and creating a sharp image in the eye of man. Understanding the issues in the context of everyday life.
2. Critical use of various sources of information

#### **Operational goals:**

Student:

1. knows and applies the concept of the focus, the focusing ability, the lens focal length,
2. used the known knowledge of the geometrical optics on lenses to explain the principles of the human eye operation,
3. understands, based on information from the geometrical optics, what is the foresight and how to correct this defect,
4. based on the given example calculates the focusing ability of the eye and lens. Can calculate the value of focusing of the corrective lenses by solving simple tasks.

#### **Methods:**

Multimedia presentation, a heuristic talk.

#### **Forms of work:**

whole-class and individual work

#### **Teaching resources:**

video, multimedia projector.

#### **The course of lesson**

##### **Introduction**

1. The teacher informs students that the subject of the lesson will be formulated after watching the short part of the film "Name of the Rose", directed by Jean-Jaques'a Annaud based on the book of the same title (this section begins at 32:08 and the time axis shows the moment in which the brother of William of Baskerville removed reading glasses). Introducing provides information about time and place of action (the end of November 1327 year, the Benedictine abbey in northern Italy). The teacher refers to the watched passage and with the help of students title of the lesson is formulated.



Photos from the film "The Name of the Rose", directed by Jean-Jaques'a Annaud

2. The teacher draws attention to the fact that in the scene shown the glasses are already known, but excites more attention of scribes, hence the conclusion, that the invention was born recently. Question: *Does the event shown in the film is fictitious or historic reason?*
3. The teacher presents a short presentation (preferably in the form of a presentation prepared for the computer) on documented information about the creation of glasses "for reading":
  - a) **1289** year Di Popozo "Traite de conduite de la famille" :  
"I'm so overwhelmed by age, that without the glasses known as spectacles, I could not read or write. they have recently been invented for the old people with poor eyesight".
  - b) **1306** year a fragment of a sermon Giordano Da Rial:  
"... Not yet passed twenty years from the time when the art of making spectacles were invented, but it has enabled a good vision and is one of the most useful discovery, which the world has (...) and I myself have talked with the man that has done this."
  - c) **1313** year died Aleksandro della Spina in Pisa, about him was written: "... He performed glasses and taught. others. Glasses previously were done by someone else, but who' did not want to say about..."
  - d) **1317** year Salwino Armato degli armati; epitaph in the church in Florence:  
"Here lies Salwino degli armati d'Armato of Florence, the inventor of spectacles. May God forgive his sins. He died Anno Domini 1317 "

**Teacher during the conversation with the students draws attention to the historical accuracy of film and determine jointly with the students the first time the creation of glasses per year around 1286.**

Suplement verbal information may be presentation of selected scenes paintings, in which appear glasses (see below illustrations, which should be treated as suggestions that can be exchanged freely). It is recommended to return to the scene of the movie and pay attention to the kind of spectacle there used..



Obraz Marinusa van Roymerswaele (1495 - 1567)

Marinus van Roymerswaele picture



Okulary starczowzroczne

Portret kardynała Hugo de Provincja fresk w kościele św. Mikołaja w Treviso

Senile glasses. Portrait of cardinal Hugo de Provencja. Fresco in the Saint Nicolas church in Treviso.



„Cyrulik”, detal  
- Jan Sanders van Hemessen (1500 - 1566)

„Barber”, detail - Jan Sanders van Hemessen



„Malarz” (ok. 1565)  
Piotr Breughel Starszy (1525 - 1569)

„Painter” (about 1565) – Piotr Breughel Older



Św. Piotr, detal obrazu  
„Hugh of St. Cher” - Crivellego (1352)

Saint Peter, detail picture, „Hugh of St. Cher” – Crivellego (1352)



Detal autoportretu  
Lamberta Lombardczyka (1505 - 1566)

Detail of self portrait of Lambert Lomardczyk (1505 – 1566)

## Fundamental part

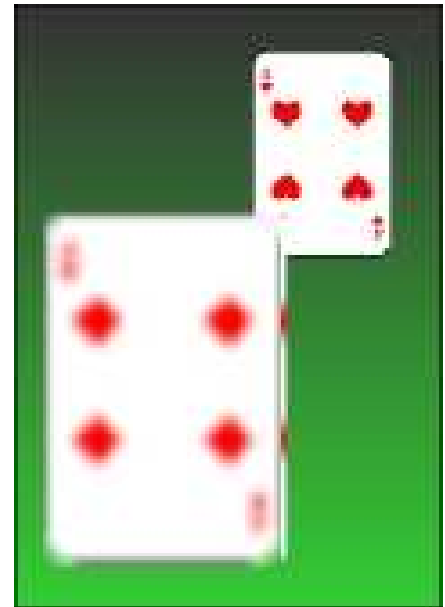
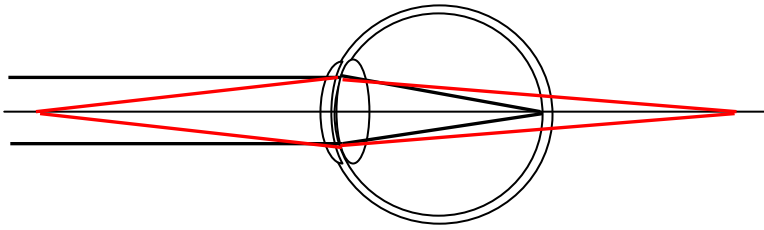
1. The teacher asks a question in turn:

- What is the sight defect that we have to do?
- What is this defect? Do you know someone with this defect?
- How can see a person with this defect?

Teacher together with the students formulate answers:

- **In most of the cases we are dealing with a sight defect associated with the human age (hyperopia).**
- **It consists in the fact that the eye lens is not able to set the focus (understood as the distinguishing details of the objects seen) on objects in a close distance.**
- **Man sees then as shown in this picture.**

In addition, the teacher explains that using the early prepared drawing.



*Explanations to the drawings:*

*Figure shows a situation in which the eye lens "set" so that the sharp image formed on the retina of the eye is an image of objects arranged at a greater distance (the run of rays shown in black).*

*If the viewed object is closer (run of rays shown in red), a sharp image is created outside the retina of the eye.*

The teacher asks a question:

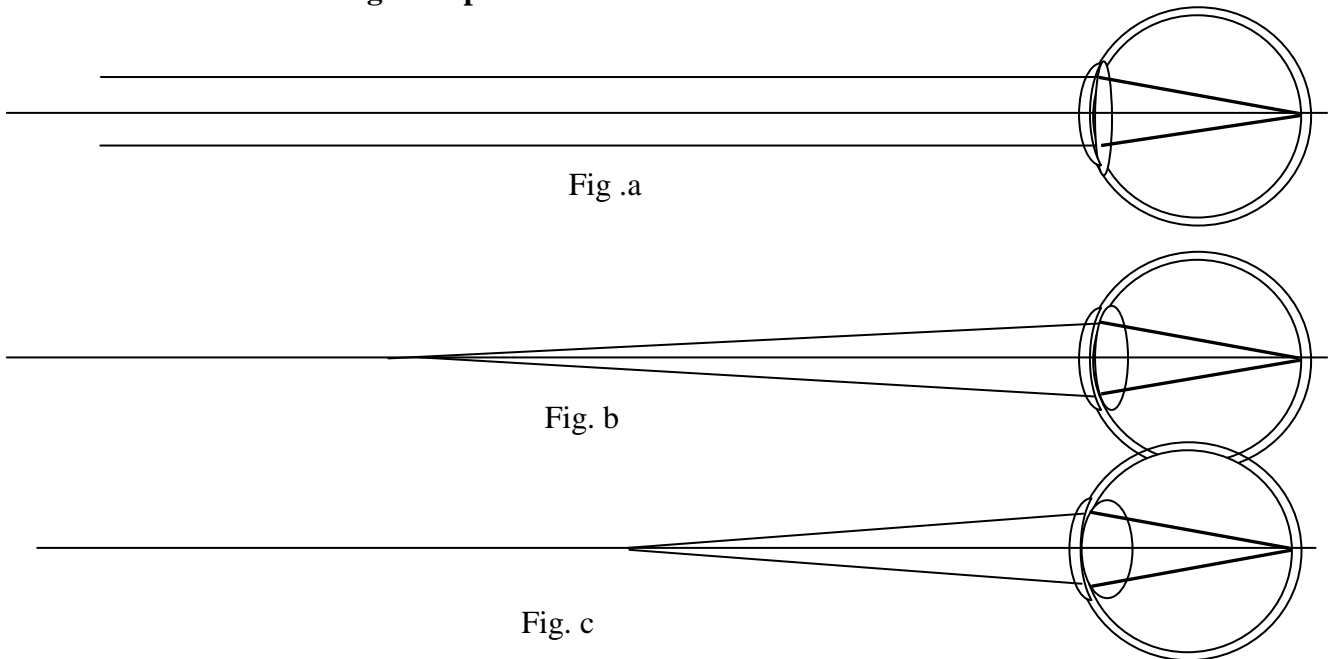
- How to set focus the eye on watched object?

• **Changing the ability of focusing the lens of the eye.**

The teacher presents the Fingers a, b, c, and asks:

- Explain the eye lens behaves, when the subject approaching the eye.

• Student: **Lens changes shape – the radius of curvature of the lens decreases.**



Teacher referring to the dependence of  $1 / f = (n-1) (1/R_1 + 1/R_2)$  asks:

- How will this change of shape affect the focusing ability of lens?

• Student: **The decrease in R increases its focusing ability.**

Pupil draw a short note, in which bear the observations made.

*For those interested students teacher is giving th data related to the rays of a human eye) for a small distance - 6 mm outer, inner - 5 mm, b) for a big distance - of 10 mm and 6 mm.*

Consolidation of the given part of material can be resolved on tasks at the lesson:

- Knowing that the zooming of a healthy eye ranging from 23 mm to 19 mm, calculate how will change eye focusing capability ( in dioptries) Assume: focusing capability  $Z$  of lens is  $Z=1/f$ .
- How the ability focusing the eye will change of a man, who initially looked at the stars and then moves eyes on a book set in a distance of 25 cm?

*It is desirable that solutions were prepared as a multimedia presentation, with emphasis on the behavior of the sequence of calculations, which will be gradually presented as progress in solving the task.*

To sum that part of lesson the teacher draws attention and compares the value achieved in the tasks.

2. Then the teacher returns to the problem of foresight.

Teacher:

- What defect of eye lens underlies the foresight?

• **Student: Focusing ability of lens is too small.**

Teacher:

- How can I correct the above defect of sight?

• **Student: By using the special focusing lens (only from XIII c.).**

The teacher points out that the eye lens and corrective lens create optical system whose capacity is the sum of the capacity of bringing together the two focusing lenses.

Complement this part of the task may be exercise:

A man see good the letters from a minimum distance of 40 cm. Calculate which corrective lenses requires his sight defect. Calculate the value of bringing together these lenses. (Tip: After applying the corrective lenses the eye see clearly at a distance of 25 cm).

*It is desirable that solutions were prepared as a multimedia presentation.*

## Completion of lesson

The teacher asks for a joint supplement the text, pointing to the earlier information given and the solved tasks.

Complete:

- In Europe, the glasses first appeared in the (time and place)..... . (end of XIII, Italy, Florence)
- The inventor of the glasses is considered to be ..... . (Salvino d'Armato degli armati from Florence)
- The first spectacles were used to correct sight defects known as ..... . They used glass lenses were ..... . (foresight, convex)
- The impetus for the spreading of glasses "for reading" has become a widespread readership in connection with the invention ..... in 1456 year. (print)
- Man with foresight sees a well-placed items in ..... distances. (bigger)
- For viewing objects located near focusing ability of the eye is ..... than when we see more distant objects. (bigger)
- For viewing objects located near the radius of curvature of the eye lens is ..... than when we see more distant objects. (less)
- What is the focusing ability of a system consisting of eye lenses and lens of corrective eye glasses? (total capacity of associating different elements of the system)

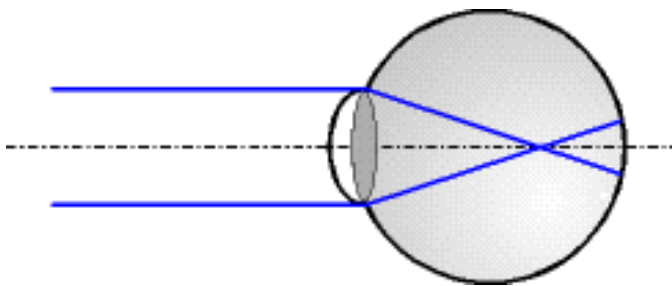
*Additional Information: underlying invention, which are glasses is probably observation of images, that arise when on the card with the text we place flat-convex lens made of glass or quartz. They were called "lapides ad legendum" - "reading stones". You can ask students to comply with the following observation: cut, transparent plastic ball place on the printed sheet of paper and observe the size of letters seen in the way.*

*Additional work for students passionate in photography, can be a task to make photos of two subjects are set so, that the focus was set: a) at the closer object, b) at the further subject.*

### Homework

The teacher announces that homework will concerned with the other eye defect. Then presents the ready information:

- first descriptions of the sight defect is due Aristotle (more than 300 years BC), the defect has often been encountered in ancient Rome,
- defect is determined from the Greek word "myopia" which means "to squint",
- letter sent by the Duke Francesco Sforza of Milan to his ambassador in Florence (year 1462) for a contract "three dozen pairs of glasses, one dozen of these are suitable for distant vision, that is for the young, the second of those with close vision, namely to old, and the third to the People with normal sight,
- People with this defect see blurred objects very far away (fig.).



By: Kamil Gorczyca

### Homework:

1. Please write how is called and what is the description of the defect of sight, which has been mentioned in the given information? Explain using a drawing, how to make the image on the retina in the case of the human eye with this defect. How do I can correct this defect of sight?
2. Task: A man apparently sees and reads from a distance of 15 cm. After application of corrective lenses "eye" sees clearly from a distance of 25 cm. Calculate the capacity of focusing lenses. Note the sign of the number received.

### References:

1. Zajac M., Sarnowska-Mobrat K., „Historia optyki okularowej” [w:] [www.optyka.if.pwr.wroc.pl/optometria/wyklady/historia\\_okularow.pdf](http://www.optyka.if.pwr.wroc.pl/optometria/wyklady/historia_okularow.pdf)
2. Bieganowski L., Małek J., „Nowe przyczynki do historii okularów w Polsce w XVI w.
3. Prezentacja multimedialna: Witkowska A., „Okulary i soczewki kontaktowe”

## Reflection

### Attention to the lessons conducted "Glasses as a simple optical device that is ...".

There were three classes: one class, in which physics was taught in the expanded, but two classes with the fundamental level of physics.

1. In all classes present physics in a historical context seemed a risky venture - the students prefer the briefly presented problems in a classroom, as a minimum. Despite, the lessons aroused interest in both the historical background and physical dependences.
2. The historical background has helped catch the theme of lessons by the students interested in the humanities.
3. In classes, in which physics is taught at the fundamental level, with a greater attention had to approach the tasks and to devote more time to solve them.
4. Number of learned information seems to be greater than in the "traditional" lesson.
5. Presented exercises could be considered as exemplary and as such can be modified. This applies especially to the physics "expanded" classes.

**Note:** This lesson was conducted during the implementation of the European Project FP7 Science in Society-on History and Philosophy in Science Teaching (HIPST).