Scenario of the lesson on:

Optical instruments - telescopes

dr Krzysztof Rochowicz,
5th higher secondary school, Torun, Poland

The aims of the lesson

- general (student):
  - learns about basic astronomical tools: optical telescopes
- operational (student):
  - knows, that there are two kinds of refractors, which give straight or reverse image
  - knows, that there are two kind of telescopes, refractors and reflectors

Methods

- searching: talking with students (questions and answers);
- practical: students' experiments.

Forms

- group,
- individual.

Didactical tools:

- student's textbook,
- experimental set – different kinds of lenses,
- pictures and drafts of the first telescopes on projector's screen, illustrations of spherical and chromatic aberration,
- optional: presentation "Optical Telescopes"; DVD „Eyes on the skies" (excerpt).

Lesson's scenario

TEACHER'S ACTIVITIES	STUDENTS' ACTIVITIES
1. Welcome. Introduction.	
- Today we will learn how to build one of the optical instruments, very important for astronomy. (I show the lenses). Are you aware, which instrument we can build using two lenses?	- They answer (possible answers): magnifying glass, refractor, telescope.
- (If it is necessary, I notice that magnifying glass is a single lens and it is used for observing nearby objects in close-up). Do you know, who and when pointed the telescope in the sky for the first time?	- They answer, after putting on the right track, that it was Galileo Galilei. Probably they don't know the year.
- It was exactly 400 years ago and that is why 2009 is an International Year of Astronomy. (You can show „Eyes on the skies" excerpt)	

- Introduces the lesson's subject.	- They write it down in their notebooks.
2. Lesson's ellaboration – learning the basic concept of the telescope by experimenting.	
- Distribution of the lenses among students, to look at them and study their properties	- They play with lenses, trying to get some images.
- What can you tell about these lenses?	- Possible answers: They are different in size and shape.
- What conclusion can you draw on this basis?	- Possible answers: There are two kinds of lenses; convex – focusing the light beam – and concave – spreading the light.
- Let's try to combine two lenses 20-30cm distant, to get the image.	- They try to put together the lenses in pairs and check out if an image appears; they give their propositions.
- The original Galileo's telescope was build as a system of a plano-convex object lens and plano-concave eye lens; what kind of image can we obtain this way?	- Students put together the lenses in the recommended way, they check an image characteristics; they give their propositions.
- Galilean telescope gives the straight image.	- They fill in the worksheets (p. 1 and 2).
- Let's check out if we can use two planoconvex lenses to get an image.	- Students put together two planoconvex lenses, trying to derive an image; they share their experience.
- It is the principle of Kepler telescope; his instrument gives the upside down image.	- They fill in the worksheets (p. 3 and 4).
- We say refractors or telescopes; what is the difference between them?	- They can give various answers; the teacher explains (generally there is no difference; sometimes we mean reflectors by telescopes, but it is not obvious).
- Why modern big telescopes use mirrors instead of lenses?	- They try to guess; the teacher answers.
- The short explanation of spherical and chromatic aberration based on the pictures.	
- What is the size of the world's largest astronomical telescopes?	- One student searches for this information using internet; they fill in the worksheets (p.5)
- Points out the SALT telescope, co-financed and co-used by Polish Scientific Research Committee; recommends webpage with the „Optical Telescopes" presentation	
3. Summary	
- What was today's lesson about?	- Answer: telescopes
- What kind of telescopes do you know?	- Answer: refractors and reflectors
- What kind of image do we get by Kepler's telescope?	- Answer: the reverse one
- What kind of image do we get by Galilean telescope?	- Answer: the straight one
- Makes students' work evaluation.	

Attachements:

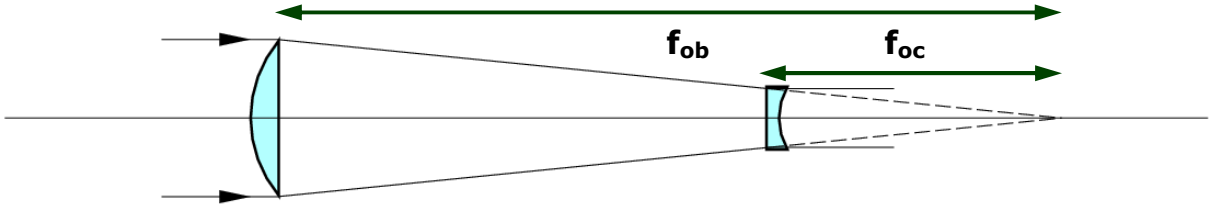
1. Worksheet
2. The pictures and drafts of the first telescopes
3. Illustrations explaining chromatic and spherical aberration

Worksheet

Firstname and surname:_____ **Class** _____ **Date** _____

Subject _____

1. Describe the optical elements of the Galilean telescope marked in blue (give the name of the lenses).



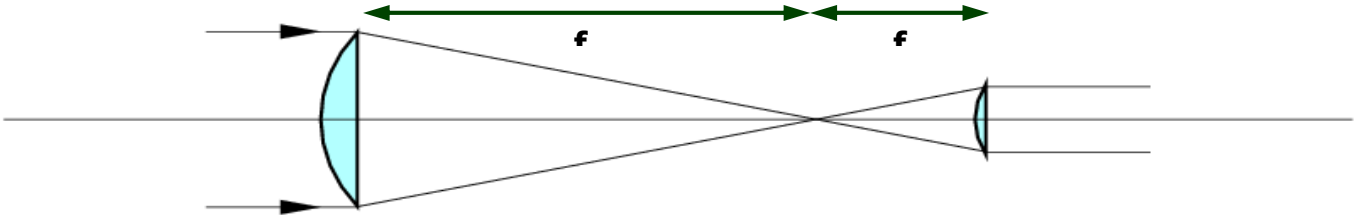
2. Complete the sentences:

Galilean telescope consists of the _____ object lens

and _____ eye lens. The eyepiece is located _____ the focus.

This instrument gives the _____ image.

3. Describe the optical elements of the Kepler's telescope marked in blue.



4. Complete the sentences:

Kepler's telescope consists of the _____ object lens

and _____ eye lens. The eyepiece is located _____ the focus.

This instrument gives the _____ image.

5. Complete:

The world's largest astronomical telescopes have diameters up to _____ metres.

These are systems with the _____ , the so-called _____.

These systems are less affected or do not have the defects characteristic for lenses, including

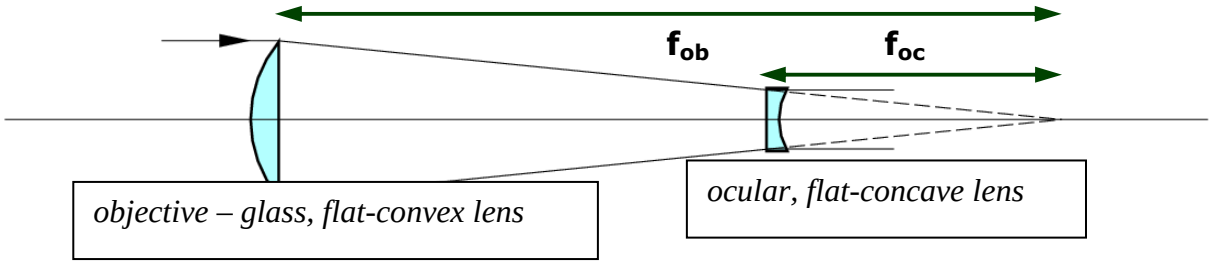
_____.

Predicted right answers in the worksheet

Firstname and surname:_____ **Class** _____ **Date** _____

Subject: Optical instruments – telescopes _____

6. Describe the optical elements of the Galilean telescope marked in blue (give the name of the lenses).



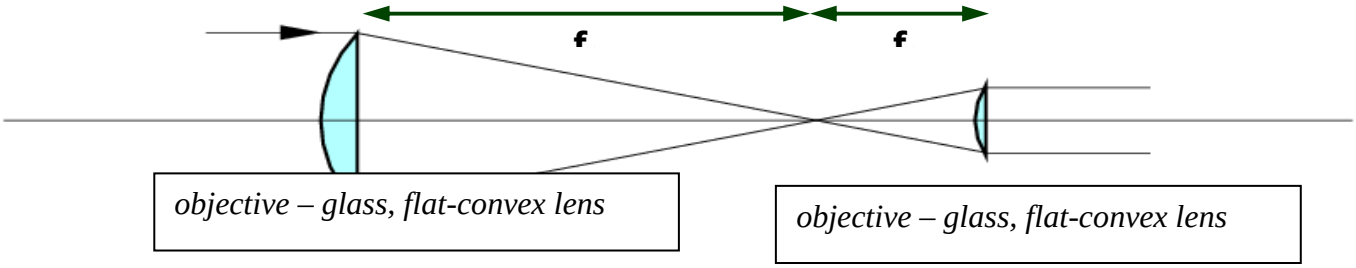
7. Complete the sentences:

Galilean telescope consists of the _____*flat-convex* _____ object lens

and ____ *flat-concave* _____ eye lens. The eyepiece is located ___*before*__ the focus.

This instrument gives the ___*direct*__ image.

8. Describe the optical elements of the Kepler's telescope marked in blue.



9. Complete the sentences:

Kepler's telescope consists of the _____ *flat-convex* _____ object lens

and _____*flat-convex* _____ eye lens. The eyepiece is located _after_ the focus.

This instrument gives the ___*reversed*____ image.

10. Complete:

The world's largest astronomical telescopes have diameters up to ____*10*_____ meters.

These are systems with the ____*mirrors*___ , the so-called __*reflectors*_____.

These systems are less affected or do not have the defects characteristic for lenses, including

_*spherical and chromatical aberration*_____.