WORKSHEETS FOR PUPILS

Activity name	Expected duration	Difficulty of the activity	Age of children for which the activity is suitable	Tools and material used	Objective of the activity
Practical Exercise 1:	1 lesson	medium	14 – 15 years	drawing supplies	Deepening the knowledge of geometrical optics.
Practical Exercise 2:	1 lesson	higher	12 – 14 years	small and large magnifying glass, ruler, tube for drawings, saw, scissors, glue gun, calculator	Deepening the knowledge of geometrical optics and the principle of telescope construction.
Practical Exercise 3:	1 lesson	higher	12 – 14 years	small and large magnifying glass, ruler, tube for drawings, quarter sheet of paper, saw, scissors, glue gun, calculator	Deepening the knowledge of geometrical optics and the principle of telescope construction.
Practical Exercise 4:	1 lesson	medium	12 – 14 years	scissors, ruler, calculator	Understanding the principle of mirror construction from segments.
Practical Exercise 5:	1 lesson	medium	12 – 14 years	two quarter sheets of paper, aluminium foil, pin, drawing supplies, scissors, adhesive tape	The principle of a pinhole camera.

Practical Exercise 2: A SIMPLE KEPLER-TYPE TELESCOPE

In this exercise you will assemble a simple Kepler-type astronomical telescope. The objective lens consists of a converging lens with a larger diameter and a larger focal length, the ocular lens consists of a converging lens with a smaller diameter and a shorter focal length. Place the lenses in the tube so that the image point of the objective lens coincides with the focal point of the objective lens (see diagram).

1. Determine the focal length of the lenses used. The easiest way to do this is to place the lens (use e. g. a laboratory stand, or just a hand when there is no other option) under a source of light and try to create a sharp image of the source on the table or floor above the lens. The height of the lens above the image (table, floor) equals to the focal length of the lens. Write the measured values in the table:

OBJECTIVE LENS

Measuring No.	f_{ob} / cm
1	
2	
3	
4	
5	

f_{ob} = _____ cm

OCULAR LENS

Measuring No.	f_{ok} / cm
1	
2	
3	
4	
5	

f_{oc} = _____ cm

2. Place the objective lens and ocular lens in a paper tube. The tube should be shortened with a saw so that it is approximately five centimetres shorter than the sum of focal lengths. A good idea is to darken the inside of the tube with a matte black colour.

3. Attach the objective lens to one end of the tube with a glue gun, then glue the ocular lens to the opening in the paper stopper that closes the tube. The telescope can be focused by moving the stopper at the end of the tube.

Scheme of Kepler telescope

Never look at the sun through the telescope! This could cause an irreversible damage to the eyes!

4. With your telescope you can observe terrestrial objects, and you can quickly make sure that the image is indeed inverted laterally and vertically. For instance, when observing the Moon in its full phase, you will also find out that light is actually dispersed.

Length of the telescope = $f_{ob} + f_{oc}$ = _____ cm + _____ cm = _____ cm

Magnification of the telescope = $\frac{f_{ob}}{f_{oc}} = \frac{\text{cm}}{\text{cm}} =$ _____

In practice, in astronomical telescopes, parameters are often given in the format

focal length of the objective lens / diameter of the objective lens

Finally, write down the parameters of the telescope you constructed: _____mm