



Science & Technology
Facilities Council



The Open University



Telescope Kits – Lesson Plans

Introduction

For many thousands of years people have looked up at the skies and wondered what is out there. There is much to see without telescopes but with a very basic telescope there is potentially so much more. Telescopes allow us to see more in two ways:

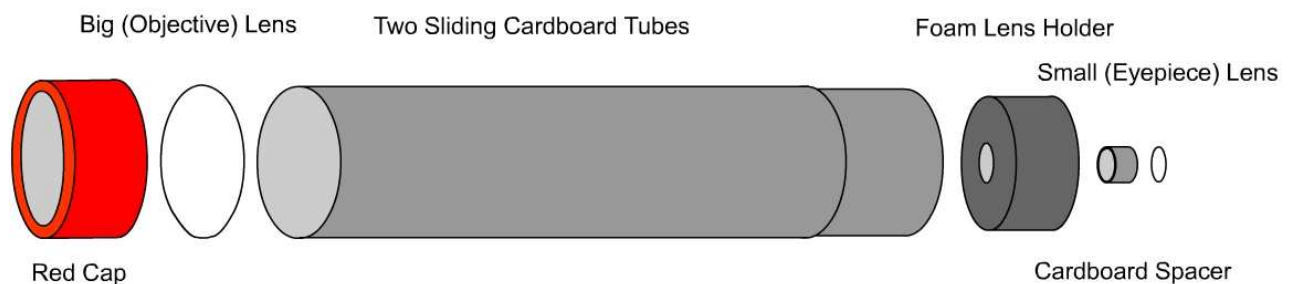
- the telescope aperture is bigger than the pupil of a human eye, so more light is collected, making faint objects visible
- the telescope magnifies the objects being viewed, making distant objects appear bigger

Galileo did not invent the telescope but he was one of the first to make systematic accurate observations using one that he made himself. The list of things he discovered with it is impressive, ultimately leading him to be convinced, as Copernicus had first suggested, that the Earth is not at the centre of the Universe.

The aim of these lessons is to stimulate an interest in science and technology and astronomy in particular. Students will build and test their own telescopes which they can then take home.

The activities are aimed at late KS2 and early KS3 students around level 4 or 5. No prior knowledge is required. The project is split here into two lessons of about 1 hour each. Obviously it is up to you what timing suits best your needs.

The kits consist of the following:



Two stickers:



Students should initially be given the red cap, the objective lens, the tubes and stickers (not the small eyepiece lenses and the cardboard spacers). The foam lens holders are inside the tubes. Students need to remove these for Lesson 1, keeping them to install the eyepiece lenses in Lesson 2.

Students should work their way through the workbook recording their observations neatly. To see the introductory PowerPoint the initial lesson will need to take place in a room equipped with a pc and projector.

Lesson 1 – Lenses

Objectives

- Know that light may change direction when it passes through glass
- Recognise a convex lens
- Measure the focal length of a convex lens

Equipment & Preparation

Set up bright filament lamps without shades so that all students will be able to view one from a distance of several metres.

Place a box of kleenex on each table, have rulers available.

Prepare one set of the following for each student:

- red cap,
- (larger) objective lens,
- cardboard tubes
- two stickers
- a workbook

Starter

Watch the PowerPoint **Telescopes** up to slide 8 and discuss the questions. (see notes)

Main Activities

Give each student the red cap, the objective lens, the tubes and stickers (not the small eyepiece lenses and the cardboard spacers) and a workbook.

Workbook – Lenses

1. Preamble: Tell them the name of the objective lens. **Emphasize the danger of looking at the sun**, stick stickers on the cardboard tubes.
2. To start with they can just look through the objective lenses and notice how things appear different.
3. Explore the shape of the objective lens. It is convex on one face and flat on the other. Students draw what the lens looks like from the front and side, exaggerating the side view.
4. (i) Using the telescope tube, red cap and a piece of kleenex, students form a real image of a filament lamp.
4. (ii) Using a distant filament lamp, students measure the focal length of the objective lens. It is the distance between the lens and the real image, when the image is in focus. Students record their focal lengths in the workbook.

(The focal lengths are approximately eyepiece = 3cm objective = 45cm)

Plenary

Name as many objects as you can that contain at least one lens.

Telescope spectacles your eyes microscope binoculars camera etc..

Lesson 2 – Making a Telescope

Objectives

- Make a telescope using the kit supplied

Equipment & Preparation

Prepare one set of the following for each student:

- Cardboard spacer
- (small) eyepiece lens

Main activity

Workbook –Making your Telescope

Preamble: Tell them the name of the eyepiece lens. **Emphasize the danger of looking at the sun.**

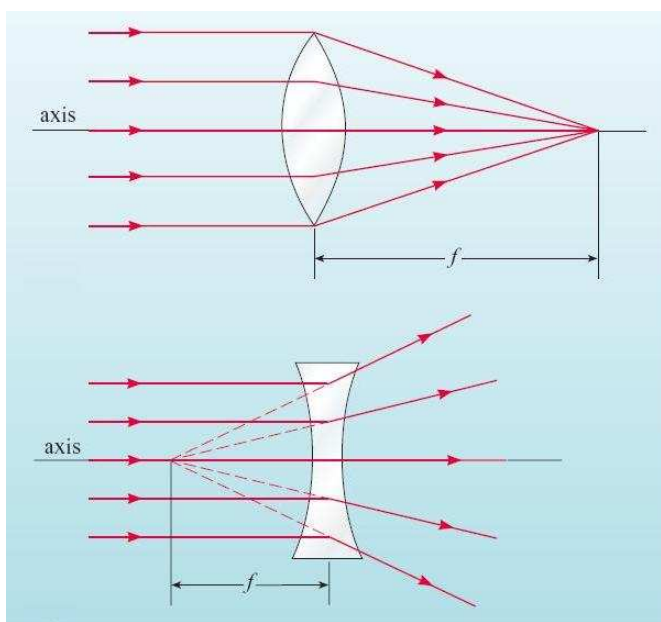
1. Students draw what the eyepiece lens looks like from the front and side.
2. Students complete the assembly of the telescope kits. Encourage them to follow the instructions carefully.
3. Students look through the telescope noting the image is inverted (appears upside down). Students explore the adjustments required to focus on objects at a variety of distances. (More distant objects should be focused with a shorter tube length)

YOU MUST TELL THEM NEVER TO POINT THEIR TELESCOPE AT THE SUN. IT CAN CAUSE PERMANENT EYE DAMAGE VERY QUICKLY.

Students can then have a play with the telescope. Point out the following:

- The image is upside down
- You have to slide the tubes to look at objects closer / further away

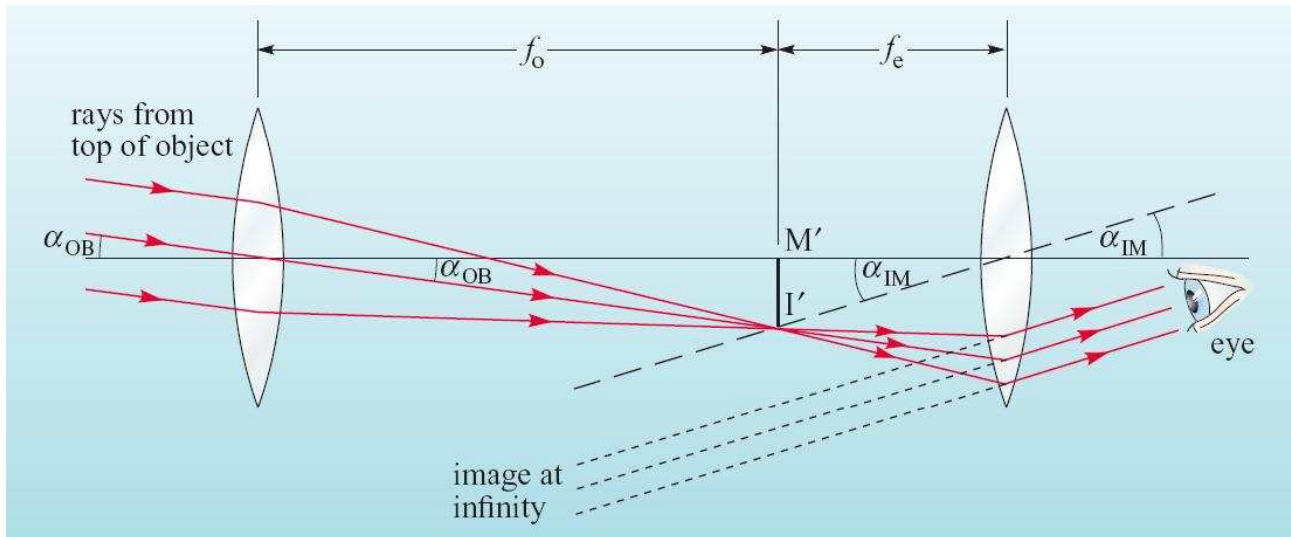
With brighter students you may want to discuss how lenses and telescopes work. The objective lens creates a real image of a distant object. The eyepiece then acts as a magnifying glass so that you see a large image.



A convex lens. Parallel light rays from a distant object are brought to a focus one focal length beyond the lens. This is how the real image is formed by our objective lens.

A concave lens bends light to make parallel rays diverge.

How our telescope works:



The magnification is:

$$M = \frac{f_{\text{objective}}}{f_{\text{eyepiece}}}$$

Finally, students may want to decorate their telescopes, e.g. with silver stars or pictures of celestial objects.



Activities at home

The final page of the workbook outlines a number of activities that students may wish to carry out at home.

These could form the basis of extended project work.

Have fun.

Further Reading for Interested Teachers:

“Observing the Universe” Edited by A.J. Norton, Cambridge University Press ISBN 0 521 60393 5

These learning materials were produced by David Drumm, Head of Physics at Stokesley School in North Yorkshire and Carole Haswell, Senior Lecturer in Astronomy at The Open University. We would love to hear your comments, suggestions etc.

The project was sponsored by the STFC Research Council and The Open University as part of the celebrations of the International Year of Astronomy 2009 and The Open University’s 40th anniversary.

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