



**ERASMUS+ 2017-1-ES01-KA219-038074\_1**  
**OUT OF THE DARK: ASTRONOMY AS UNIFYING THREAD FOR CULTURES.**



## ***Building telescopes and using them***

### ***Introduction***

The telescope is an instrument that consists of lenses or curved mirrors and that allows to see larged image of a distant object, especially the heavenly bodies.

The telescope that Galileo built in 1609 was a refracting telescope, with a convex front lens and a concave eye piece. With it he discovered for example the phases of Venus, a phenomenon that indicated that this planet revolves around the Sun.

### ***Materials***

#### **Galilean telescope with convergent lenses.**

- 50mm diameter PVC pipe.
- Joint for pipe of diameter 50 mm.
- Female joint sleeve of 50 mm.
- Male cuff of 50 mm.
- 50-25 reduction cup.
- 25-20 reduction cup.
- Converging lens of 1000 mm focal length and 50 mm in diameter.
- Converging lens of 44.4 mm of focal length of 22 cm in diameter

#### **Galilean-Kepler's telescope.**

- 40 mm diameter PVC pipe.
- 25 mm diameter PVC pipe.
- Jointfor pipe of 40 mm.
- Jointfor pipe of 25 mm.
- Femalejoinsleeve of 40 mm.
- Malecuff of 40 mm.
- 32-25 reduction cup.
- 25-20 reduction cup.
- Achromatic doublet of 286 mm of focal length and diameter 40 mm.
- Two converging lens 59 mm of focal length of 22 mm in diameter.

#### **Galilean telescope.**

- 50 mm diameter PVC pipe.
- Joint for pipe of 50 mm.
- 50-25 reduction cup.
- 25-20 reduction cup.
- Male cuff of 50 mm.
- Female joint sleeve of 50 mm.
- Converging lens of 1000 mm focal length and 50 mm in diameter.
- Diverging lens of -66mm focal length and 25mm in diameter.



## Procedure/Method

1. The first thing we have to consider is the lenses that we have, because they determine the quality of the image the telescope increases and its dimensions.

We have to consider two characteristics:

- a) The diameter of the objective which will mark the opening (the amount of light that the telescope can collect).
- b) The focal distances of the objective and the ocular.

The quotient: focal distance of the objective is called focal relation. For values lower than 6 we get a very distorted image, with a bluish halo around and they are difficult to build. It is recommended a value of ratio higher than 8.

The quotient: focal distance of the objective determines the number of increases.

It is recommended not to exceed twice the increases of the opening because the image can be distorted and it would get blurry. (If the diameter is 50 mm the increases have to be less than 100 mm)

2) If we don't know the focal distance (or if we want to check them) we can go to an optics to measure the diopters.

$$\text{DIOPTERS} = 1 / \text{FOCAL DISTANCE (in meters)}$$

3) Known the lenses diameters and their focal distances, we can set the distance between the lenses and the diameter of the tubes.

- a) The lenses have to be separated at a distance that will be the sum of the focal distances.
- b) The tube's diameters are the same to the lenses diameter (or from the diameter of the eye piece we introduce reductions until the eye piece diameter).

4) Once we know the lenses distance, we calculated the length of PVC tube or tubes.

For the length between the lenses, we subtract the lengths of the pieces that we adapt to the main tube.



5) We cut the PVC to size, we sand them, paint them black on the inside with a spray and let dry.

6) We fit the lenses and parts and we check that the telescope is working properly. If it doesn't, we have to correct the length of the tube.

7) Made adjustments to attach parts (with glue, tape...) and decorate with our project logo.

8) We complete the process by making a solar filter. To do this, we cut out two rings of cardboard with the diameter of the tube and a circle of the solar filter that we previously bought. We paste the two rings, one on each side of the filter circle. Let it dry and check that it fits well on the end of the telescope tube.



## Results

After following all the steps, we built three kind of telescopes. These telescopes were used later to look at the stars and also the Moon, we discussed the differences between each telescope while we were looking at the different celestial bodies, specially in the Learning, teaching and training activity celebrated in Sweden.



## Conclusions

This activity was realised with plumbing materials and two kinds of lenses, this lead us to learn more about basic engineering, plumbing and how do lenses work, we also had the opportunity to look at the sky and the different celestial bodies through a telescope, which was so interesting for the students.

In the end, this was a useful and refreshing activity that everyone enjoyed during the Science Fair celebrated in the final meeting with the whole Erasmus team.



## Bibliography

<http://outofthedarkerasmus.blogspot.com/search/label/Building%20telescopes>

Building telescopes in Gualdo Tadino.

[https://www.youtube.com/watch?time\\_continue=13&v=KosWuOcaznw](https://www.youtube.com/watch?time_continue=13&v=KosWuOcaznw)

Building telescopes in Eskilstuna

[https://www.youtube.com/watch?time\\_continue=11&v=OgthLhB0Sk4](https://www.youtube.com/watch?time_continue=11&v=OgthLhB0Sk4)

Building telescopes in Fuenlabrada

[https://youtu.be/z1\\_qK9Iq5TQ](https://youtu.be/z1_qK9Iq5TQ)

<https://www.youtube.com/watch?v=VCBVtlp4MUM>