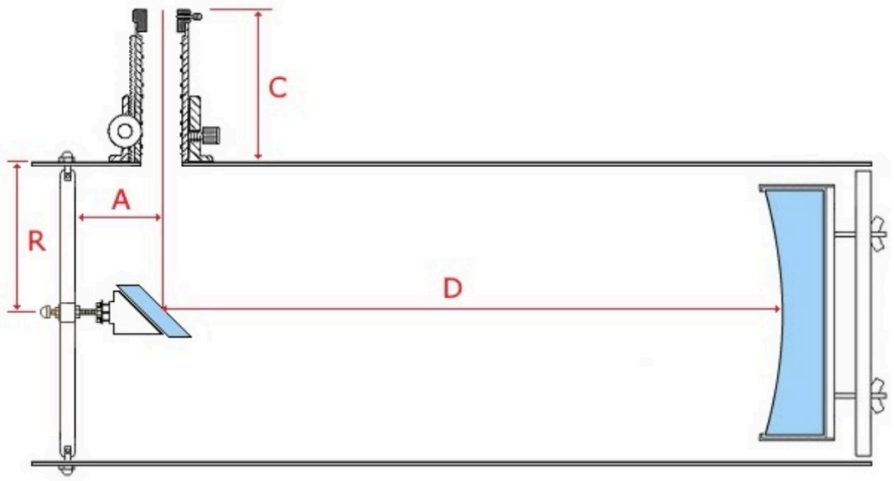
Building a Newtonian Telescope

During the pandemic, I transferred from a school that followed an American calendar to a Brazilian calendar school. As a result, I spent a lot of my time catching up on subjects that I had missed due to this change. While studying optics, I became fascinated by telescopes, and decided I wanted to buy one. However, this idea soon fell apart because of their price. So I decided to build one.

Why a Newtonian Telescope: This decision was really straight forward. Newtonian Telescopes have the same zoom power as Keplerian Telescopes, but are smaller in size. Secondly, it would not require optical lenses that were large and quite expensive. Newtonian telescopes, instead, require a primary convex mirror and a secondary smaller mirror used to reflect the image to the eyepiece.

First Step: Finding the mirrors and pieces I would need to buy. It would be a huge waste of time to start building the telescope and don't have the essential parts at the end. Therefore, I conducted thorough research, and ultimately decided to buy a kit that contained a primary convex mirror with a diameter of 180mm and a focal length 1300mm, a secondary mirror with its support, and a 12 mm eyepiece. These pieces were bought from the following website: https://www.telescopiosastronomicos.com.br/suportes.html

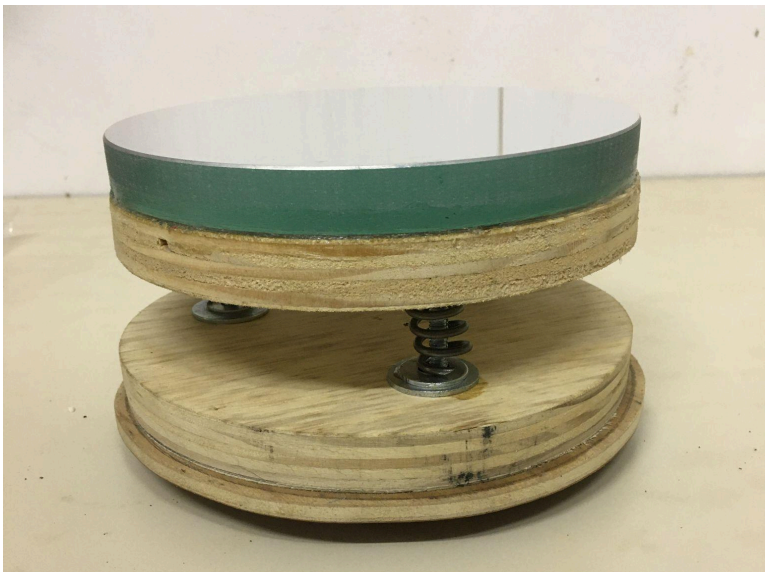


The image above came in a basic manual that was sent by the store when I bought the mirror kit. The manual gave an idea of the dimensions of the support and what each piece should look like, but defining how each piece would be built was up to me, and measurements later got way more complex than I expected From the image above it looks simple—if the focal distance is 1300mm, then D+R+C must be equal to that. However, it gets a bit more complicated.

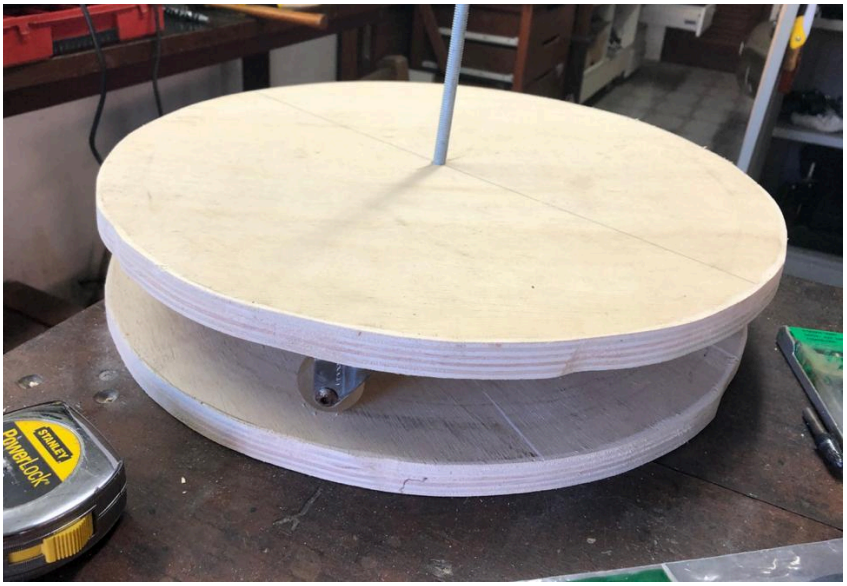
Second Step: The first thing I did to start building the telescope was buy a PVC tube with a diameter of 200mm, cut it to the right size and paint it with matte black paint. This can be seen in the picture below, in which I was painting the interior of the tube. I figured out later that painting the tube with it lying on the ground was not the best idea. So I ultimately connected my painting roller to a wood stick and painted the tube standing vertically.

Next, I built the telescope's support and the support for the primary mirror. For this phase, I invited my grandfather to participate; he has a lot of experience with woodcraft.

We began by assembling the support for the primary mirror, which has these three screws with springs so its angle can be adjusted for the telescope calibration.



In the picture above, it can be seen that the primary mirror was glued to its support. After that we moved into building the support for the telescope.



The picture above shows the main rotatory base for the telescope support. The initial suggestion from the mirror kit seller was that we should put one circle on top of the other, separated by a layer of teflon that would allow it to move freely. However, we were not able to find the teflon layer. I had the idea of connecting wheels to the top circle and gluing them in a way that the axis of the wheel points to the center of the circles, meaning the wheel makes a 90 degrees angle. This allows it to move smoothly without the wheel changing sides like a supermarket cart.

After finishing all the woodcraft pieces we started the gluing and attaching process. The pictures below show the main base finalized and the lateral supports being glued to the PVC tube.

Later, I also ended up buying a focuser, which is attached to the telescope and eyepiece and allows the user to change the position of the eyepiece to reach the point where the image is being formed. This piece can be seen in the picture below.

Then we connected the support to the telescope and calibrated the mirrors using a laser that goes in the same place as the eyepiece (top part of the focuser). After that the telescope was finished as can be seen in the picture below.

Third Step: Most importantly, we needed to check that it worked. Our first trial happened during the day and one of the pictures we took can be seen below.

It worked! However, the goal was to be able to see the moon. Unfortunately, the day we finished the telescope the Moon was at its New phase, so we had to wait some days to get the pictures below.

In retrospect, this project taught much more than I expected, not only about optics, but also improving my problem solving and critical thinking skills. From the optics side there were many more details and dimensions to take into consideration than I had imagined. However, this project, for me, reaffirmed the great value of a hands-on approach: things never go fully according to plan, problems appear, and you need to find creative ways of adapting your approach to find new solutions.