

Building a Telescope

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Background and Motivation

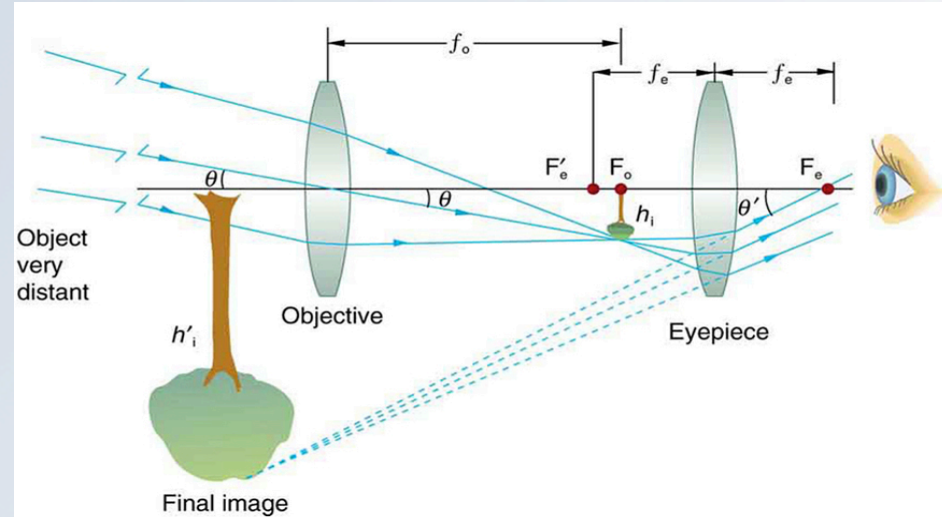
- IMSA offers “Physics: Sound and Light”—a one-semester, lab-based class, in which students learn and apply concepts of waves, sound and optics
- Telescope Project
 - Reinforces the concepts of geometric optics for lenses
 - Introduces the optical considerations concerning the design of a Galilean telescope
- Concepts Applied and linked: lens-maker equation, lens focal length, image formation, magnification

Refracting Telescope

- Incoming rays from very distant objects are essentially parallel
- The two lenses are arranged so that the objective lens forms a real, inverted image of a distant object at its focal point (f_o)
- This image is also near the focal point of the eyepiece lens
- The two lenses are separated by the distance $f_o + f_e$ which corresponds to the length of the tube

$$\text{Tube Length} = f_o + f_e$$

- The eyepiece forms an enlarged image of the first image—also inverted
- Overall magnification is $M = \theta/\theta_o = -f_o/f_e$
- To read lines of text, what would you change in this design????



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Project Requirements

- **Goal**

- For this project you will design, build, and use an optical device to read text from a long distance. You will learn the principles of optics as applied to refracting telescopes. You will use experimental techniques that you have already learned to measure focal lengths of lenses. The more lines of text your group can read, the more points you will score.

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- **Available materials**

- a variety of lenses
- cardboard tubes
- tape

Rubric

Device Built on Time	5	
Number of Lines of Text Read from the target: ½ point per line read correctly. (Line 1 = Times-Roman 52 point font; Line 10 = Times-Roman 10 point font)	5	.
Design/Report Write-up and Analysis of Results (1 write-up per group—see template.) This is a typed report that must include: <ul style="list-style-type: none"> • this cover page • measurements/data/calculations of lens focal lengths (Focal lengths must be determined by experiment/ calculation. Do NOT use printed focal lengths on envelopes—these are unreliable.) • tube length calculation and measurement of actual tube length • calculation of magnification • neat drawing of telescope showing lens placement, focal lengths and dimensions • explanation of lens selection criteria base on principles of optics • reflections on how well your design performed • what changes you would do to make your device better 	10	
Total points	20	

Your Turn

- **Build a telescope and see how many lines of text you can read!**