INTRODUCTION
The telescope is the astronomer’s window into the cosmos. The laws of optics govern how a telescope focuses incoming light to a focal plane. Smaller telescopes may be refracting or reflecting telescopes. A refracting telescope uses only lenses (refractive elements) to bring light to a focus while a reflecting telescope uses curved mirrors to bring light to a focus. Catadioptric telescopes use both lenses and mirrors. Refractors are more expensive and heavier than comparably sized reflecting telescopes. All professional observatory-sized telescopes are reflecting telescopes. Assuming that any telescope suitable for astronomical viewing is going to possess excellent optical components, the fundamental criteria for judging the quality of a telescope is its light-gathering power (LGP), which is determined by the aperture of the primary objective. Ultimately, regardless of aperture, the quality of the “seeing” will determine quality of the image produced by the telescope. Even the largest telescopes will produce blurred images if the atmosphere is not steady and clear. Adaptive optics, which are being used in most modern observatories, minimize or can even eliminate the effects of slow-moving atmospheric distortions in the telescopic image. Telescopes are not limited to viewing only visible light. High-altitude and orbiting observatories have been equipped with $\gamma$-ray, x-ray, UV, and IR telescopes. The high altitudes eliminate the absorption of the light due to the atmosphere. Ground-based telescopes may be optical or radio. Radio telescopes don’t suffer as much from the atmosphere since radio waves are only minimally affected by atmospheric conditions. However, the resolving power of a telescope is dependent on the observed wavelengths so radio telescopes must be very large (or combined as part of a long-baseline array) to achieve resolutions similar to optical telescopes.

GOALS
✓ It is important to know the different basic telescope designs and the different components which bring light to a focus.
✓ Lab investigations showed how different optical components responded to light and how to measure the focal length of a lens. In lab, it was also demonstrated how to make a simple refracting telescope and calculate its magnifying power.
✓ A basic knowledge of the different basic telescope mounts is useful when comparing different observatories.
✓ It is important to know the characteristics of telescopes which observe electromagnetic radiation other than visible light. Knowing the optimum location of the observatory (ground-based or space-based) and the reasons for the location the observatory are very important.
✓ As a complete understanding of the advantages and limitations of different telescopes, the concepts of aperture, light-gathering power (LGP), angular resolution, focal length, and Dawes Limit should be understood.
✓ With the improved data-handling and analysis capabilities of the late-20th and 21st centuries, long-baseline radio interferometry and long-baseline optical arrays are becoming more common. The advantages of constructing such arrayed telescopes should be understood.

DEFINITIONS
adaptive optics  chromatic aberration  diffraction
angular resolution  spherical aberration  diffraction grating
baseline  coma  eyepiece
Cassegrain geometry  Cassegrain focus  field
Catadioptric design  coudé focus  apparent field
charge-coupled device (CCD)  Newtonian focus  true field
focal length
<table>
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<tr>
<td>focal plane</td>
<td>focal point</td>
<td>reflecting telescope</td>
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<td>focal point</td>
<td>focus (as in a lens or mirror)</td>
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<td>grating</td>
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<td>primary mirror</td>
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