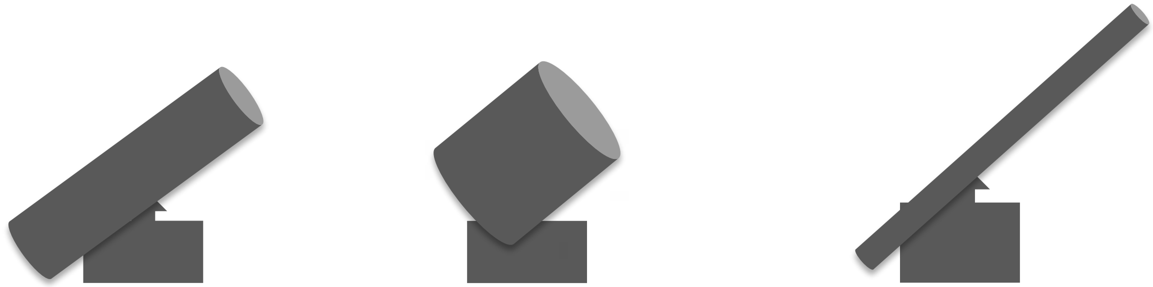
It is difficult to image doing astronomy without a telescope. The three main tasks of a telescope are to: (i) gather and focus light from distant objects; (ii) see fine details; and (iii) magnify nearby objects

LIGHT GATHERING POWER: The ability of a telescope to gather and focus light from distant objects is closely related to its diameter.



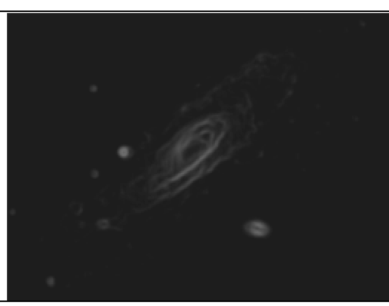
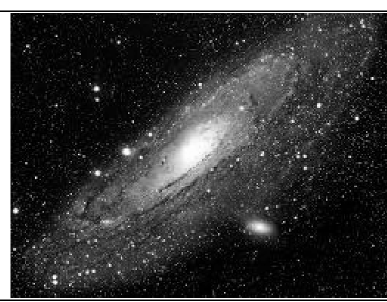
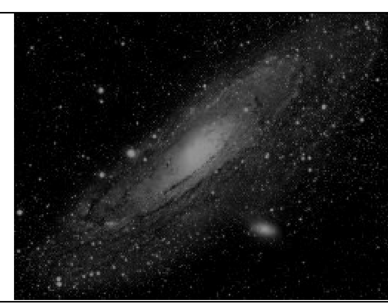
Telescope A   Telescope B   Telescope C

1. Rank order these telescopes (A, B, and C) from greatest to lowest light gathering power.

Greatest Light Gathering Power	_____ _____ _____	Lowest Light Gathering Power

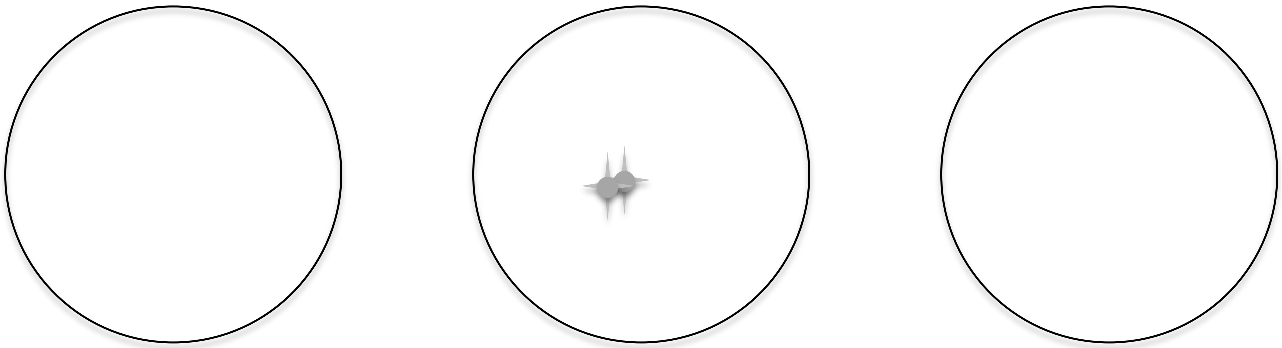
2. A telescope's light gathering power is largely based on its total collecting area, which can be calculated with the simple formula, πr^2, where "r" is the radius. How much more light gathering power does an 8-m telescope compared to a 2-m telescope?

SEEING FINE DETAIL: Better telescopes are able to resolve fine detail.

		
Picture from Tiger Telescope	Picture from Canary Telescope	Picture from Gomez Telescope

3. These three pictures are of the same galaxy of stars, taken by three different telescopes. Circle the one with the greatest ability to resolve fine detail.

4. Below is a sketch of how a binary star system looks through a telescope—where two stars are found very close together. On the left, sketch what a lower resolution would look like, and on the right, a higher resolution.



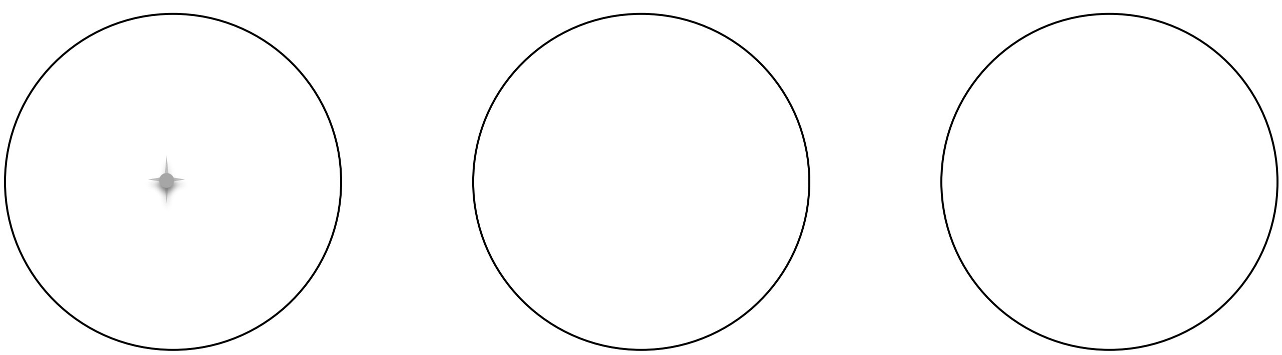
Picture from Green Telescope (*low resolution*)

Picture from Red Telescope (*medium resolution*)

Picture from Blue Telescope (*high resolution*)

MAGNIFICATION: The least valuable part of a telescope is its ability to magnify. This is because even the largest stars are so far away, that most stars will still look like the same tiny pinpoints of light, regardless of the telescope.

5. Here is a sketch of a star as seen in a low magnification telescope. In the remaining two circles, first sketch what a medium magnification would look like, and then on the right, a higher magnification would look like.



Sketch from a low magnification telescope

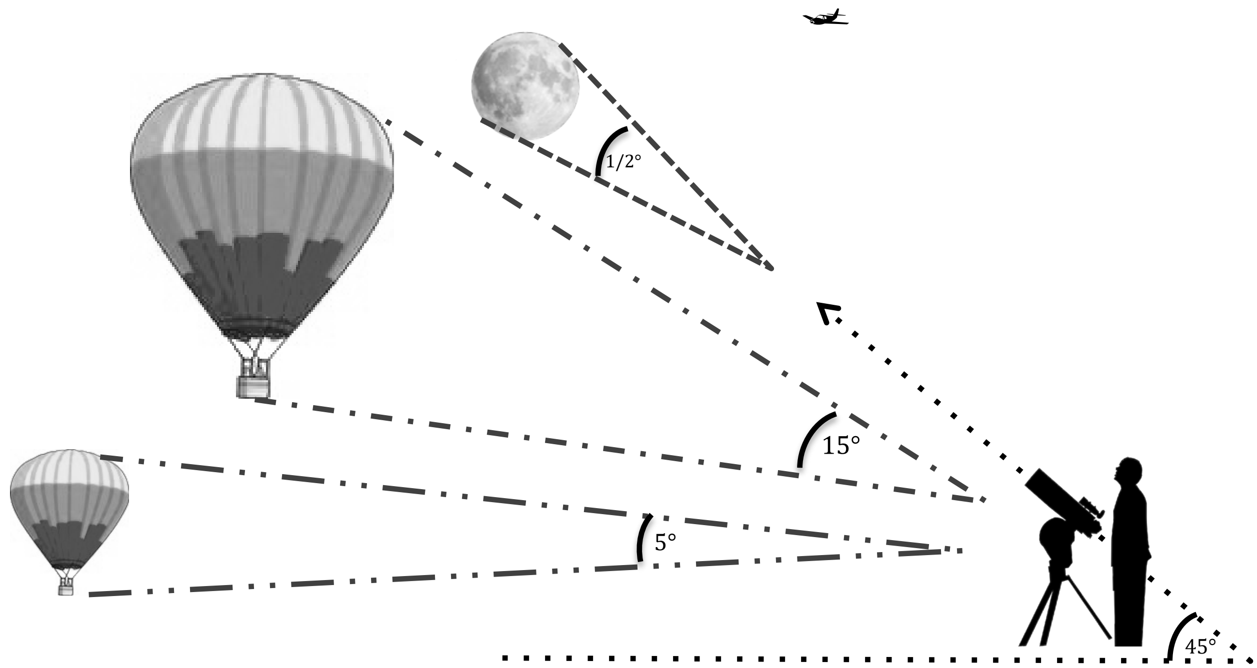
Sketch from a medium magnification telescope

Sketch from a high magnification telescope

Your brain normally wants to think that bigger—more magnification—must be better. In many cases that is true. However, in astronomy, we're usually looking at very distant objects whose size is too small to expand. Worse, by using magnification we can actually spread out the little light that is being captured, making the star harder to see.

Angular Size

When talking about how big objects appear in the sky, it doesn't make sense to say that the Moon is 2-in across or 6-m above the horizon. Instead, astronomers use angular sizes, measuring in degrees. Something that takes up the whole sky would be 180°, and something that takes up half the sky is 90°.



What is the apparent angular size or height for each of the items shown in the Figure above?

SMALL SIZES: In astronomy, many sizes and distances are smaller, and can be fractions of a degree.

In using angular measures, we often subdivide a degree of arc into 60 minutes, and subdivide a minute of arc into 60 seconds of arc.

1. Altitude of the Full Moon above horizon?

Circle one: ½° 5° 15° 45°

2. Apparent angular size of Full Moon?

Circle one: ½° 5° 15° 45°

3. Apparent angular size of nearby 5-story tall, hot air balloon?

Circle one: ½° 5° 15° 45°

4. Apparent angular size of 5-story tall, hot air balloon off in the distance?

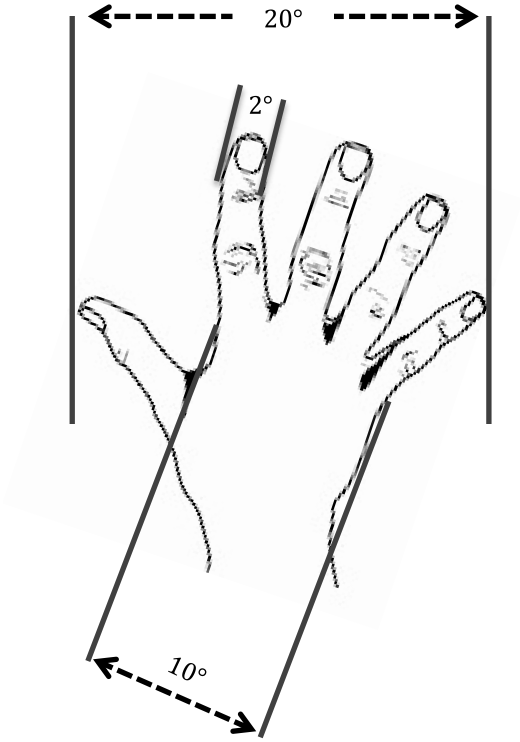
Circle one: ½° 5° 15° 45°

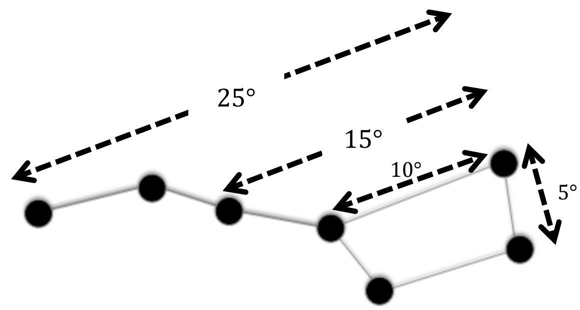
5. If the Full Moon extends about ½ of arc, how many minutes of arc is this?

Circle one: 30' 50' 3600"

6. The 20-m (60-ft) long airplane flying in the distance appears to be about ½ the size of the much larger 3,500 km (2,000 mile) diameter Moon. What is this airplane's apparent angular size?

Stretching out your arm as far as it will go, you can make angular size estimates using your hand as a sort of angular ruler. (*You can also do this with the Big Dipper, as shown at right.*)





7. What is the angular size of a cell phone at arm's length? (*measure the longest side*)

8. How big does that that same cell phone appear from about 5 feet away?

9. How big does the cell phone appear 10 feet away?

10. What is the angular size of the nearest window or door?