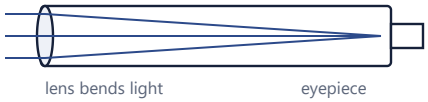
ASTRONOMY MERIT BADGE · HANDOUT

TELESCOPES: WHICH KIND DOES WHAT?

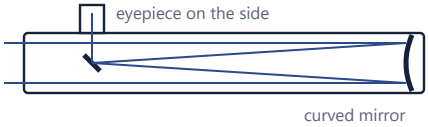
Requirement 3: why telescopes matter, the main types, and what each is good for.

The big idea: a telescope's main job is to **collect light**. The wider its main lens or mirror (the **aperture**), the fainter the things it can show you. Magnification is easy: swap the eyepiece. Aperture is what you pay for.



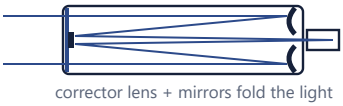
REFRACTOR (lens telescope)

How: a lens at the front bends the light to a focus at the back.
Good for: the Moon, planets and double stars. Sharp, sturdy, sealed tube, almost no upkeep.
Watch out: big lenses get heavy and expensive fast, and cheap ones show color fringes.
Famous one: Yerkes Observatory's 40-inch in Wisconsin, the largest refractor ever used for research. Binoculars and finder scopes are small refractors.



REFLECTOR (mirror telescope: Newtonian, Dobsonian)

How: a curved mirror at the bottom collects the light, and a small flat mirror sends it out the side to the eyepiece.
Good for: faint galaxies, nebulae and star clusters. The most aperture for your money. A **Dobsonian** is a reflector on a simple rocking base, a great troop telescope.
Watch out: the mirrors need lining up (collimating) now and then, and it needs time outside to cool down.
Famous ones: almost every big research telescope is a reflector: the Gran Telescopio Canarias, Keck, Hubble and Webb.



COMPOUND (catadioptric: Schmidt-Cassegrain, Maksutov)

How: a thin corrector lens plus two mirrors fold the light path, so a long telescope fits in a short tube.
Good for: the Moon, planets, astrophotography and travel. Many come on computer "GoTo" mounts that find objects for you.
Watch out: costs more for the same aperture, and the front lens fogs up with dew.

BEYOND VISIBLE LIGHT

RADIO



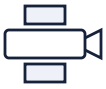
Big metal dishes catch radio waves from cold gas, pulsars and black holes. They work day or night and through clouds, but need radio-quiet places: no cell phones near Green Bank or FAST.

INFRARED



Sees heat, and sees through the dust clouds where stars are born. Water vapor in the air blocks much of it, so infrared telescopes go high and dry, or to space like Webb.

X-RAY AND ULTRAVIOLET



Earth's air blocks these completely, so these telescopes must fly in space. Example: the Chandra X-ray Observatory, named for Yerkes astronomer Subrahmanyan Chandrasekhar.

PICK THE RIGHT TOOL

I want to see...	Use
The Moon and planets up close	Refractor or compound telescope, higher power eyepiece
Faint galaxies, nebulae, star clusters	The biggest reflector you can get (a Dobsonian), low power, dark site
The Milky Way, star fields, a first look	Binoculars. "10x50" means 10 times magnification and 50 mm lenses. The best first instrument.
Camping and travel	A small refractor or a Maksutov: light, tough, quick to set up
The Sun	**Only** with a certified solar filter covering the front of the telescope. Never look at the Sun through any telescope, binoculars or camera without one. **And never look at the Sun with your bare eyes, not even for a second.** To see it safely without a telescope, use certified eclipse glasses (ISO 12312-2) or project its image onto paper.