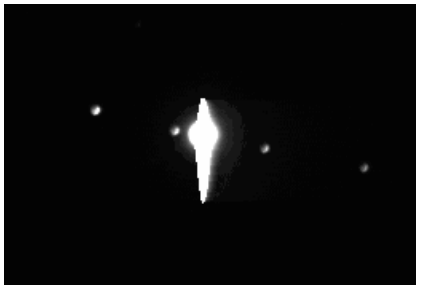
Cosmic Cast of Characters: Notes for Surveying the Universe **Name:** _____

What's Out There?	Notes, Description	Where in the Universe? Note: 1 light year = distance that light travels in one year	Size Range Note: 1 light year = distance that light travels in one year	Notes about telescope observing
The "Bit Players" Planets Moons Comets Asteroids	These objects (including our own Earth) are the leftovers from the formation of a star … the Sun in our case. Planets, comets and asteroid orbit their parent star. Moons orbit their own planet. Some of these objects are made mainly of rocky materials (like the Earth and Mars or asteroids for example). Other are mostly made of gas (like the giant planets such as Jupiter and Saturn). They don't glow with their own visible light, but reflect the light of their star.	There are eight planets and oodles of comets and asteroids in our own solar system, here on the outskirts of the Milky Way Galaxy. Other stars probably have lots of "Bit Players" circling them as well, but those other planets are too tiny and dim for most telescopes to see. The distance between the earth and the Sun is about 10,000 Earths diameters. Light takes 8 minutes to travel that distance. Light travels the distance between Pluto and the Sun in a about 5 hours.	Bit Players can range from fist and house-size (asteroids) to Jupiter-size (around 10 times Earth's diameter). Much bigger and they no longer qualify as "bits" -- If Jupiter were much larger, it's gravity might cause a high enough temperature in its core for it to start glowing on it's own and become a star!	Solar system objects move around with respect to the far-away background stars, so you'll need to use the pull-down pointing menu, or, for comets and asteroids, look up the coordinates for the exact time you want to observe.



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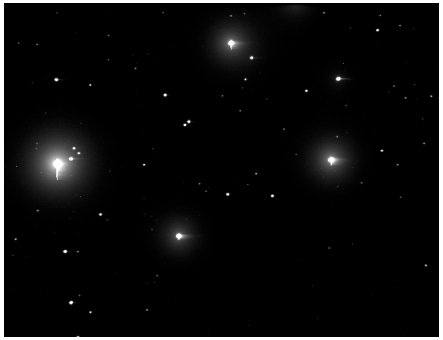
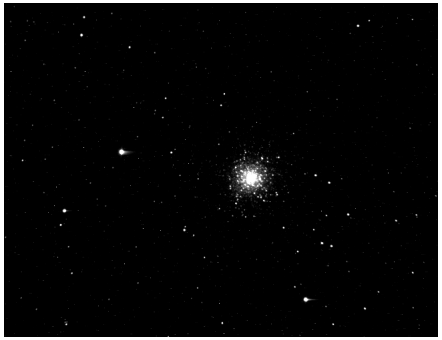
The Stars Individuals Double stars Clusters of Stars: Open Clusters and Globular Clusters	These are the main source of visible light in the universe! Sunlight is starlight. Stars are huge balls of gas, such as Hydrogen and Helium. Because they are so big, the inward force of a star's great gravity causes nuclear fusion at its core--the source of a star's light & energy. Telescopes are starlight recorders.	All the stars you see in the night sky, and all the stars you will observe with your on-line telescopes, are located outside our Solar System but inside our Milky Way Galaxy. The closest stars you will observe will be several light-years away: If we were traveling at the speed of light it would take about 3-4 years for us to reach the closest star to our Sun. The farthest globular star clusters will be halfway across our Galaxy tens of thousands of light years away.	Our sun is a relatively small star: its diameter is about 100 times the Earth's diameter. Stars range in size from a little smaller than our Sun to 50-100 times the size of our Sun. Even the largest stars though are so far away that they still look like tiny dots in our telescopes. Star clusters, groups of hundred to hundred thousands of stars, however are pretty big: Open star clusters range from 10-30 light years across while Globular star clusters can be hundreds of light years across.	Most stars and star clusters will require an exposure time of 10 to 20 seconds. Stars come in different colors, which you can investigate by taking images through different colored filters.





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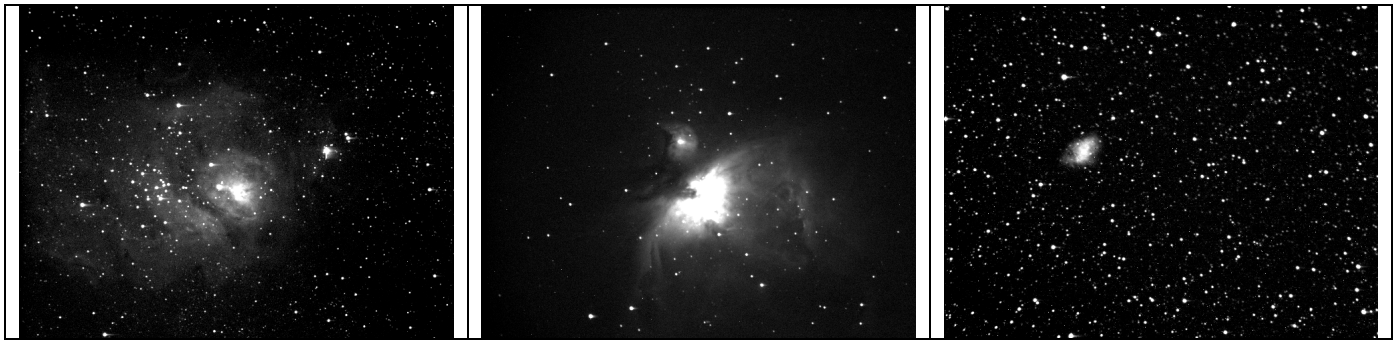
Nebulae Clouds of gas and dust Star birthplaces (e.g. Orion Nebula) Stellar graveyards (e.g. Crab Nebula or Ring Nebula)	Nebulae are huge clouds of dust and gas. Some nebulae collapse under their own gravity to form new stars. Meanwhile, dying stars spew out their newly formed elements in gentle puffs (e.g. the Ring Nebula) or in violent explosions called supernovae (e.g. the Crab Nebula). Interesting fact: The atoms of carbon and calcium that make up your skin and bones were once in a great interstellar cloud out of which the Solar System formed. Nebulae are indeed the great chemical recycling centers of the universe.	Nebulae, like the stars, are distributed around our Milky Way galaxy, beyond our own Solar System. Most nebulae seen through your on-line telescopes will range from hundreds to thousands of light years away. The Orion nebula is about 1200 light years away. The Ring Nebula is about 2300 light years away while the Crab Nebula is about 6500 light years away.	These clouds of gas and dust can range from a light year across to tens of light years. Typically star-forming clouds are bigger than the star-death remnants of supernovae or "planetary" nebulae. The Orion Nebula is about 24 light years across. The Ring Nebula is about 1 light year across and the Crab Nebula is about 11 light years across.	Unlike stars, nebulae don't glow as a result of nuclear fusion. Rather they shine in one of 2 ways: they either reflect the light of nearby stars or absorb light from nearby stars and then re-emit that light. More advanced: Nebulae absorb ultra-violet light from the nearby stars and then re-emit the light in a process called "fluorescence". This is the same way a neon gas lamp emits light. Because nebulae are mostly made of hydrogen, and hydrogen fluoresces with a red color, you'll find that nebulae are often brighter through the red filter than through the blue.



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Galaxies Spiral Elliptical Irregular Galaxy clusters	Galaxies are huge groups of stars, much bigger than star clusters. These cosmic cast members could also be called the "Hollywoods of the Heavens" — they are huge metropolises of hundreds of billions of stars. While galaxies had been observed since the invention of the telescope, it was only in the 1920s that we realized they were huge islands of stars ***outside*** of our own galaxy.	Everywhere! Our own Milky Way Galaxy (which we cannot see from the outside since we are inside) is but one of billions of galaxies that appear to populate the cosmos all the way out to the very limits of the observable universe! The Andromeda galaxy, the closest galaxy to the Milky Way, is about 2.5 million light years away: it takes 2.5 million of years for the light of Andromeda to reach our telescopes! The Whirlpool Galaxy is even further away; its distance is about 23 million light years.	Galaxies are VERY big, on average about 100,000 light years across. The distance between the Milky Way and Andromeda is equivalent to about 25 galaxies. But the distance between the Milky Way and the Whirlpool Galaxy is about 250 galaxies apart!	Because galaxies are very far away (millions to billions of light years) -- they are dim, so you'll need long exposure times. When you see an image of a galaxy, you're seeing the combined light of billions of stars, but no individual stars can be resolved by our telescopes. In fact, at the scale of a typical galaxy image (say 2 inches across or 100 pixels), a single star would be much smaller than an atom!