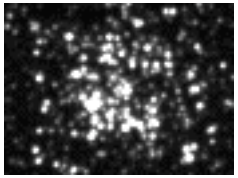
Cosmic Cast of Characters: Notes for Surveying the Universe

What's Out There?	Notes, Description	Where in the Universe?	Size Range **Note: 1 light year = 10 trillion (10^12) kilometers**	Notes about telescope observing
The "Bit Players" Planets Moons Comets Asteroids 	These objects (including our own Earth) are the left-overs from star formation… they orbit their parent star. They don't glow with their own visible light, but reflect the light of their star.	There are nine planets and oodles of comets and asteroids in our own solar system, here on the outskirts of the MilkyWay Galaxy. Using special telescopes and instruments, astronomers have discovered nearly 200 other stars with "Bit Players" -- planets -- circling them as well. The big question: are any of them a host for living organisms?	Bit Players can range from fist and house-size (asteroids) to Jupiter-size (around 10 times Earth's diameter, or 70,000 km). Much bigger and they no longer qualify as "bits" -- If Jupiter were much larger, it's gravity might cause it to start glowing on it's own to become a star!	As they orbit our Sun, 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. Because they are relatively close and reflect the Sun's bright light, exposure times for the moon and planets will be short.
The Stars Individuals Double stars Clusters of Stars 	These are the main source of visible light in the universe! Sunlight is starlight. The inward force of a star's great gravity causes nuclear fusion at its core--the source of a star's light & energy. Optical telescopes like Micro-Observatory 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; the farthest star clusters will be half-way across our Galaxy tens of thousands of light years away.	Active stars (nulear fusion in cores) range in size from a few hundred thousand km (our Sun is 700,000km) to a few million km. But even the largest stars are so far away that their apparent diameter is too tiny to resolve in most telescopes. Star clusters, however, range from a few light years across to 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) 	Nebulae are the great chemical recycling centers of the universe. Huge clouds of dust particles and gas molecules collapse under gravity to form new stars. Meanwhile, dying stars spew out their newly formed chemical elements in gentle puffs (e.g.,the Ring Nebula) or in violent explosions (supernovae). The atoms of carbon and calcium that make up your skin and bones were once in a great interstellar cloud at the beginning of the Solar System.	Nebulae, like the stars, are distributed around our MilkyWay galaxy, beyond our own Solar System. Most nebulae seen through your on-line telescopes will range from hundreds to thousands of 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.	Unlike stars, nebulae don't glow as a result of nuclear fusion. Rather they shine in one of 2 ways: they either scatter or reflect the light of nearby stars; or they absorb ultra-violet light from the nearby stars and "flouresce" like a glowing neon gas lamp. Because nebulae are mostly made of Hydrogen, and hydrogen glows with a red color, you'll find that nebulae are often brighter through the red filter than through the blue. Use long exposure times to gather the faint light from these diffuse cloudy objects.
Galaxies Spiral Elliptical Irregular Galaxy clusters 	These cosmic cast members could also be called the "Hollywoods of the Heavens" — they are huge cities of hundreds of billions of stars.	Everywhere! Our own Milkyway 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! 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*** our own galaxy.	Galaxies are VERY big, averaging about 100,000 light years across (that's 10^17 kilometers).	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!
Exotic stuff Black holes, Quasars, Pulsars	These wierd members of the cosmic stage are often special cases of stars or galaxies….	Found in our own galaxy as well as others	Stellar sizes to galactic sizes	Hard to observe with on-line scopes.