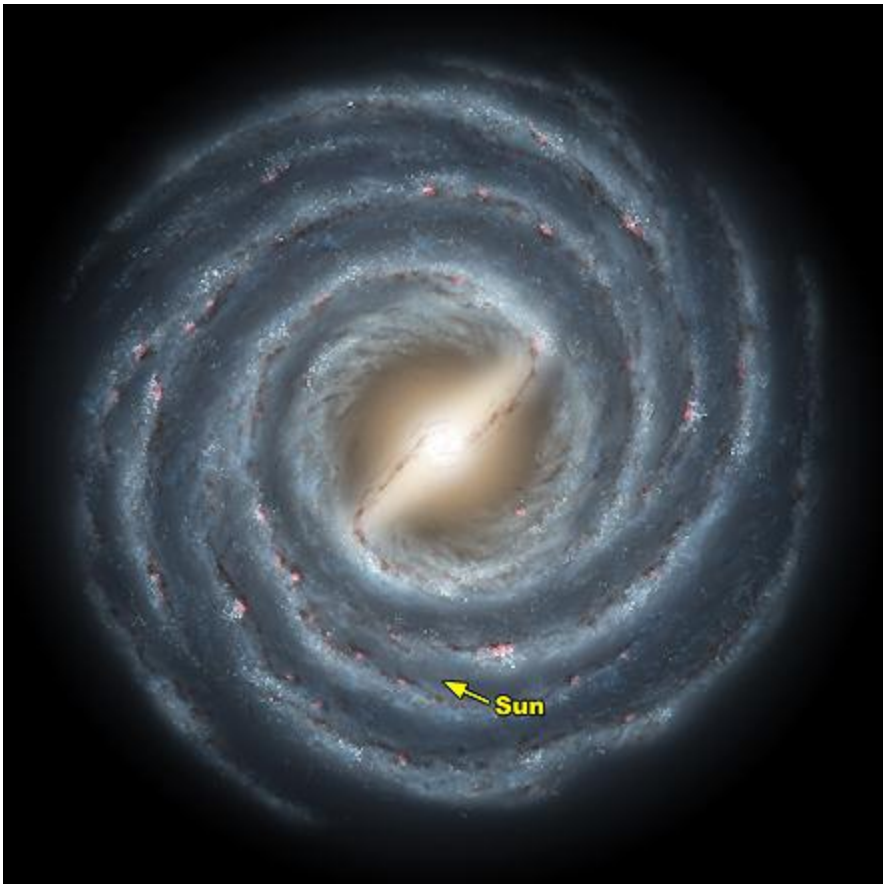
Astronomy 101
Deep Space Objects



Our home **galaxy** in the **universe** – the **Milky Way** – is like a city of stars (200 billion, give or take a few million) and other deep space objects.

The Sun – Earth's local star – sits about 2/3 of the way out to the edge of this cosmic 'city,' like being in a distant suburb, looking 'downtown' in one direction (people in the Southern Hemisphere see the densely-populated core of our galaxy) and looking into the countryside the opposite direction (here in the Northern Hemisphere, we look mainly out toward the edge of the Milky Way and beyond to Andromeda, the next galaxy beyond our own).

Like any city, the Milky Way has many different neighbourhoods: 'construction zones' where clouds of gas form into new stars (such areas are called nebulas), established 'upscale' neighbourhoods (where large groups of older stars collect, called globular clusters), new subdivisions (younger open star clusters) and rough parts of town (black holes).

Here's a closer look at some of the neighbourhoods you might run into on a faster-than-light trip through our home in deep space:

Stars

Like the different colours of a flame, hotter **stars** burn yellow, white and even blue. Less hot stars burn orange, or red in especially dim cases.

Unlike our Sun, most stars are part of two, three, four, even five or six-star systems, where such 'Suns' orbit around the largest of the group or a common centre of gravity.

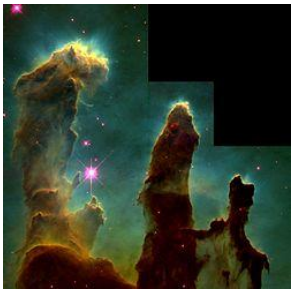
Stars can range in size from objects about the size of the planet Jupiter to objects wider than Jupiter's *orbit* around our Sun.

Star clusters

Large groups of older stars often collect together, via gravity and over time, into multi-hundred-thousand-star clumps called **globular clusters**.

Like min- galaxies within galaxies, such clusters tend to orbit around the centre of our galaxy. There are about 150 globular clusters in the Milky Way.

On the other hand, 'open' clusters contain hundreds or sometimes a few thousand stars, recently formed in the beautiful multi-coloured clouds known as nebulas.



Nebulas

New stars form inside **nebulas**, clouds of gas and dust that can span *thousands* of times the diameter of our entire Solar System.

Some nebulas form when gas – mostly hydrogen and some helium – collects together in the space between existing stars. Others form due to the death of a star.

After another 5-7 billion years of shining like it does everyday, our Sun will likely lose its outer layers and balloon out into a 'planetary' nebula (so-named because they look like planets through a telescope).

Extremely large stars may create nebulas as they die via spectacular explosions.

Novas and Supernovas

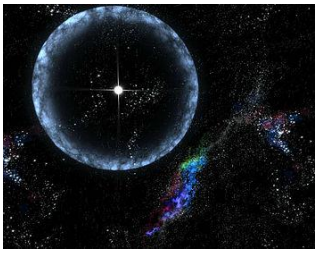
A **nova** is an out-of-control nuclear explosion that happens when a **white dwarf** star sucks hydrogen from another star in the same system.

At a certain point, increasing amounts of material are drawn to the surface of the white dwarf, which cause a runaway nuclear fusion cataclysm.

A **supernova** is an extremely bright, powerful explosion that often briefly outshines its entire galaxy.

Supernovas happen when a nova progresses out of control to the next level of destruction or when the core of a *very* massive star collapses, causing the violent expulsion of its outer layers.

Pulsars, Neutron Stars and Black Holes



Excessively big stars may collapse to the point of being **neutron stars** – objects composed almost entirely of neutrons that can't collapse any further, but have the mass of 1-3 Suns in a space no bigger than Toronto.

Highly magnetized, rotating neutron stars

that emit a beam of **electromagnetic radiation** are called **pulsars**.

Astronomers use the beams of pulsars that happen to point toward us as highly precise measuring tools to make new discoveries from Earth.

Ridiculously big stars may collapse with so much force that they actually tear a hole in the 'stuff' that space and time are made of (a 'fabric' called space-time), creating a deadly vortex that almost nothing – usually not even light – can escape. This is known as a **black hole**.

One scientist once likened a black hole to "an object that dug a hole, jumped in the hole, then pulled the hole in after itself."

Galaxies and Quasars

Today astronomers generally believe that one or more super-massive black holes live at the centre of all galaxies, devouring nearby Suns in their star-dense nuclei and adding those stars' mass to their own.

As far as we can see, galaxies themselves are the main building blocks of our universe.

Galaxies can be a fraction the size of our Milky Way, or dozens or more times larger. They can be shaped like ellipses, spheres, spirals, or "irregular" objects.

Imagine something the size of an AA battery emitting the power of a nuclear reactor – that basically the idea behind **quasars**. A quasar is generally a galactic nucleus in the energetic early stages of formation, emitting up to two trillion Suns' worth of energy from an area barely larger than our Solar System

Larger Structures

Galaxy clusters, superclusters and supercluster chains (the largest-known structure in the universe) round out the realm beyond individual galaxies.

While the theoretical boundary of the universe exists about 7 billion light years away (i.e. if we could travel to the Moon and back in 2 seconds, it would still take 7 billion years to make the trip), we could never reach it, because the universe is expanding in all directions like raisins on a loaf of rising raisin bread.

Objects we *can't* see (and don't know about)

While you consider that, also consider that all these exotic objects – from nebulas to quasars and everything in-between – only account for about 10% of the mass of the universe, as we've "measured" it from Earth.

The other 90%+ belongs to something scientists have termed '**dark matter**' and '**dark energy**.' While that sounds

pretty official, it's a broad term for what we 'think' might make up for that missing mass (and energy).

Researchers at the world's top theoretical physics facilities – from Cambridge, UK to Waterloo, Ontario – are hard at work trying to make sense of this – perhaps the greatest of all mysteries.

As Far As the Eye Can See (And Then Some)

So next time you look up and see the river of stars that make up the Milky Way from a dark site at night, remember all the varied, amazing deep space objects that live in our local city of stars.

One last thing to consider:

When you look up at that river of stars, you're actually looking from the inside of just one spiral arm of the giant 'pinwheel' of the Milky Way out at the next spiral arm over from ours.

While it might seem like you're looking at every single star in our galaxy on a clear night, there are millions of times more stars in our galaxy that you *can't* see…

…As if you needed another reminder of just how big things get in the distant reaches of deep space.