Constellation, Star, and Deep Sky Object Names

Andromeda: ***M31 Andromeda Galaxy***
Aquila: Altair
Auriga: Capella
Bootes: Arcturus
Cancer: ***M44 Beehive Cluster***
Canes Venatici: ***M51 Whirlpool Galaxy***
Canis Major: Sirius
Canis Minor: Procyon
Cassiopeia: ***Cassiopeia A*** & ***Tycho's "Star"***
Centaurus: Proxima Centauri
Dorado/Mensa: ***Large Magellanic Cloud (LMC)***
Gemini: Castor & Pollux
Hercules: ***M13 Globular Cluster***
Lyra: Vega & ***M57 Ring Nebula***
Ophiuchus: ***Bernard's Star***
Orion: Betelgeuse, Rigel & ***M42 Orion Nebula***
Perseus: Algol
Sagittarius: ***Sagittarius A****
Taurus: Aldebaran, ***Hyades Star Cluster***, ***M1 Crab Nebula*** & ***M45 Pleiades***
Tucana: ***Small Magellanic Cloud (SMC)***
Ursa Minor: Polaris
Virgo: Spica
Milky Way Galaxy

Characteristics of Stars (Compared with Sun)						
Class	Color	Temp. (1000 K)	Absolute Magnitude	Solar Luminosity	Solar Mass	Solar Diameter
O	Blue	60-30	-7	1,000,000	50	100 to 1000
B	Blue-White	30-10	-3	10,000	10	10 to 100
A	White	10-7.5	+2	100	2	2 to 10
F	White-Yellow	7.5-6.5	+4	10	1.5	1 to 2
G	Yellow	6.5-4.5	+4.6	1	1	1
K	Orange	4.5-3.5	+11	1/100	0.5	0.5
M	Red	3.5-2.8	+15	1/100,000	0.08	0.1

Magnitude

Magnitude scales: The smaller the magnitude number, the brighter the star
Every 5 magnitudes = 100 times the brightness of object
Every magnitude = 2.512 times the brightness of object
Apparent magnitude = the brightness of object as seen from the viewer's viewpoint (Earth)
Absolute magnitude = "true brightness" – brightness as seen from 10 parsecs (32.6 light years) away

Distance Measurement

1 astronomical unit = distance between Earth and Sun = 150 million kilometres or 93 million miles
1 light year ≈ 6 trillion miles / 9.5 trillion km
Parsec = parallax second of arc – distance that a star "jumps" one second of a degree of arc in the sky as a result of the earth's revolution around the sun. 1 parsec = 3.262 light years
Distance in astronomy is measured in light years, parsecs, or astronomical units. Metric prefix for AU and parsec, time for light-based.

Deep Sky Objects

Pulsar – supernova remnant ≈ 20 miles across with mass of 2-3 times our sun and composed completely of neutrons (neutron star)
Black Hole – supernova remnant where ≥ 3-4 solar masses are compressed into infinitely small space, gravity around it is so intense that not even light can escape the gravitational field.
Galaxy – large system of stars controlled by common gravity, "island universe", may come in clusters, 3 types of galaxies

- Elliptical - egg-shaped, may look like footballs or spheres
- Spiral - bulge/nucleus, disc/spiral arms, can be barred
- Irregular - no basic shape or regular structure

Clusters – groups of stars

- Open clusters – few hundred to few thousand stars, spread out, O/B class stars, found in plane of galaxy
- Globular clusters – spherical distribution of stars, 10,000 to a few hundred thousand stars (up to a few million), densely packed, older, smaller, M class stars, found in halo of galaxy

Nebula – cloud of gas and dust, key star and planet forming regions, created by either outer shell of star or supernova

- Bright – may be internally lit by stars
    - Emission – lit by ionized gas, glow red
    - Reflection – light reflected off of dust particles, glow blue
- Dark – dust and gas dense enough to obscure light from background stars, best seen silhouetted against bright nebulas

Binary/Multiple Stars – double stars, may have more stars than two, and may contain black holes (Cygnus X-1). The stars orbit each other and may eclipse each other. One star may "steal" material from the others, or they might be in contact in each other. Some such stars may go supernova prior to the others. Some systems can be visually separated. One star may be "dominant" over the other(s). If the stars are in contact with each other, they may eventually merge.

Hertzsprung-Russel diagram – compares temperature or class (x-axis) to absolute magnitude (y-axis)

Stellar Evolution

Stars change size and temperature due to creation of new elements in core from nuclear fusion.
The key is the initial mass of star, mass controls life cycle of all stars

Star of 1-3 solar masses

- 100 million years condensing into a protostar from cloud of gas/dust
- 10 billion years changing hydrogen into helium (on main sequence)
- 10-100 million years as red giant (fusing helium to carbon)
- > 10 million years as planetary nebula (core is collapsing)
- Rest of life as white/black dwarf (black if completely cooled)

Star of less than 1 solar mass (M class)

- 1 billion years condensing into a protostar from cloud of gas/dust
- 20 billion years changing hydrogen into helium (on main sequence)
- Scientists do not know what happens next because there has not been enough time for the stars to evolve past this stage.

Star of 10 to 20 solar masses

- 10 million years condensing into a protostar from a cloud of gas and dust
- 1 billion years changing hydrogen into helium (on main sequence)
- 10 – 100 million years creating new elements in its core by fusion
  - Hydrogen to helium (main sequence)
  - Helium into carbon/oxygen (red giant)
  - Carbon into oxygen (supergiant)
  - Oxygen into silicon
  - Silicon into iron
- Iron is heaviest element a star can fuse in its core, and when star tries to make element heavier than iron, fore of gravity and fusion pressure physically tear star apart ➔ SUPERNOVA!!!
- As gravity pulls on star, some of the material may get crushed into a very small space. Result could be a pulsar of a black hole. Once again, mass is the determining factor.

Pulsar – supernova remnant ≈ 20 miles across with mass of 2-3 times our sun and composed completely of neutrons (neutron star)

Black Hole – supernova remnant where ≥ 3-4 solar masses are compressed into infinitely small space, gravity around it is so intense that not even light can escape the gravitational field

Supernovae

Type Ia – If a carbon-oxygen white dwarf star goes over the Chandrasekhar Limit of about 1.38 solar masses, due to the extra heat and pressure, the star will begin to fuse carbon into oxygen. This will increase the temperature in the white dwarf, and because such stars do not have the have the means to regulate fusion reactions, this will release enough energy to unbind the star and cause a supernova. Most often, the critical mass required for such a reaction to occur is from either a binary system with a white dwarf and a supergiant which loses its outer gas layers to the white dwarf. A second, less common occurrence is a binary system with two white dwarfs that merge, sending the mass over the threshold.

Type II – When a massive star consumes all of its fusion material and ends up with a solid iron core with concentric rings of progressive lighter elements surrounding it, the core reaches Chandrasekhar-mass (1.38 solar mass) and starts to collapse. The inner part of the core is compressed into neutrons, causing material falling into the core to bounce off the denser neutrons and form a shockwave. The shockwave starts to stall, but it is re-invigorated by neutrino interaction (which we have yet to understand). The surrounding material is blasted away by the shockwave, leaving only a small remnant. If the mass of the core remnant is below the Tolman-Oppenheimer-Volkoff limit of roughly 4 solar masses, then a neutron star will form. If not, then the core will collapse even further to form a black hole.

Perhaps this will produce a (still theoretical) hypernova explosion. In the proposed hypernova mechanism (known as a collapsar) two extremely energetic jets of plasma are emitted from the star's rotational poles at nearly light speed. These jets emit intense gamma rays, and are one of many candidate explanations for gamma ray bursts.