

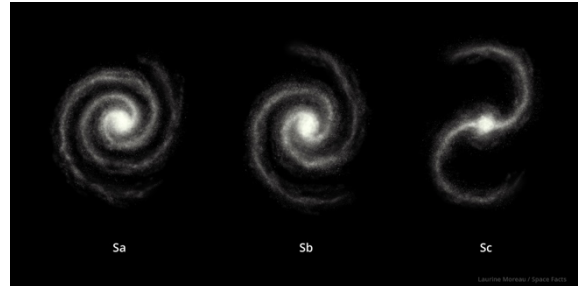
# Galaxies and Stars

A Galaxy is a huge group of stars, gas, and dust that is held together by gravity. There might be as many as several billion galaxies in the universe and each galaxy might contain billions of stars. Our own star the sun is part of a galaxy we call the Milky Way Galaxy. A nebula is a dense cloud like collection of gas and dust in space. Some nebulae (plural of nebula) are places where stars are born.

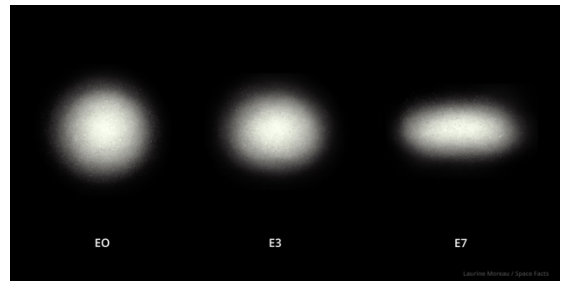
Galaxies are classified as one of four basic shapes: spiral, elliptical, irregular and peculiar. Watch the Crash Course on Galaxies to get an intro into each one.

(<https://www.youtube.com/watch?v=I82ADyJC7wE&feature=youtu.be>)

- Spiral Galaxies: If you could look down at a spiral galaxy from above, it would look like a pinwheel. If you could look at it from the side, along its edge, it would look like a plate with a ball in the centre. Spiral galaxies have lots of gas, dust, and young stars. Our own Milky Way galaxy is a spiral galaxy.



- Elliptical galaxies: An ellipse has the shape of a flattened circle. Elliptical galaxies come in a variety of shapes that range from a perfect sphere to a stretched-out sphere, like a football. Astronomers think that over half of all galaxies in the universe are elliptical. The stars in elliptical galaxies are the oldest stars in the universe, and there is very little gas and dust.



- Peculiar galaxies: Peculiar galaxies are galaxies that show a particular shape and structure, but that shape and structure varies. Peculiar galaxies are thought to be the result of the collision of two or more galaxies together. The gravity of the stars of the galaxies warp the structure of the galaxies and gives them their peculiar shapes.



- Irregular galaxies: Galaxies that do not have any shapes or structure as listed above, are irregular galaxies. Irregular galaxies have lots of gas and dust, which are the building blocks of stars. Irregular galaxies can give rise to many new stars.

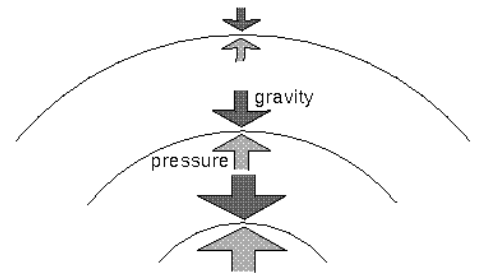


## Star clusters vs Galaxies

Star clusters are groups of stars that are found within galaxies. There are two main types of star clusters. Globular clusters are collections of 100,000 to 1,000,000 stars held together by gravity. These groups of stars are arranged in spherical shapes. Open clusters, on the other hand, are collections of up to a few thousand stars. These stars tend to be roughly the same age.

## Stars

A star is a massive gaseous, spherical object in space that gives off light and other forms of energy due to nuclear reactions that take place at its core. The power of these nuclear reactions (fusion) explodes the atoms outwardly from the star. However, the mass and gravity of the star is so much so that it pulls the atoms back toward it, continuing the process of nuclear fusion over and over again. Stars fuse hydrogen atoms to create helium. Eventually they can run out of hydrogen gas and the outward explosions are overcome by the inward pull of gravity collapsing the star onto itself. This can result in various outcomes based on the mass of the star.



Deeper layers have more gravity compression, so they have greater outward pressure to compensate.

## Star's Life Cycle

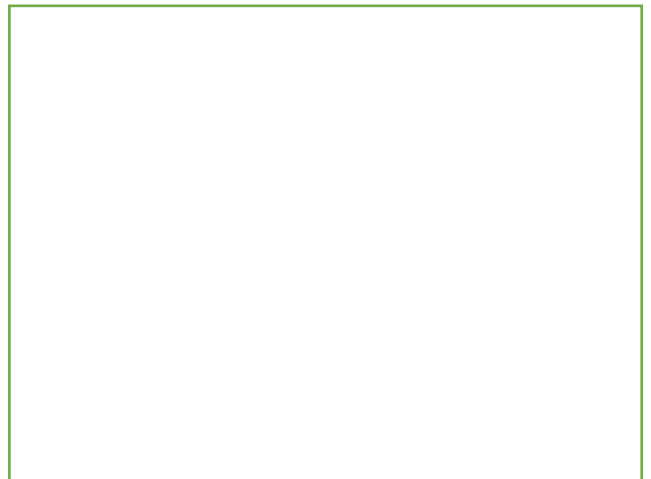
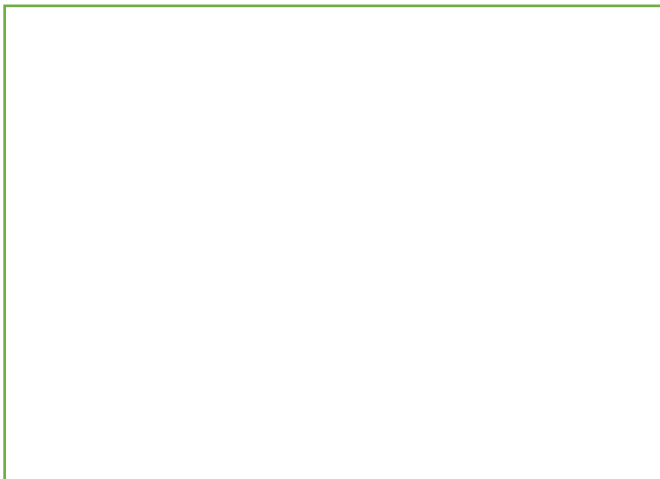
All stars start from nebulas. Nebulas being a cluster of gas and dust pull together due to gravity creating a Main Sequence Star. The rest of the life of a star depends on its mass.

- **Low mass stars** use up their hydrogen slowly and can last as long as 100 billion years. These stars are called red dwarfs. As they use up their hydrogen, they lose mass and end their lives as small, dim white dwarf stars and eventually lose all their heat and become a cold, dark black dwarf.
- **Intermediate mass stars** like our sun, use up their hydrogen more quickly – over about 10 billion years. When the hydrogen is used up, the core of the star contracts (shrinks), the temperature starts to rise, and the outer layer of the star expands. These cooler outer layers have a red colour, so stars at this stage of their lives are called red giants. As they continue to age, the red outer layer expands into the universe and becomes dust and gas and the inner core becomes a hot white dwarf eventually cooling off and becoming a black dwarf.
- **High mass stars** use up their hydrogen very quickly (millions of years). When nearing the end of its life, the core of a high mass star collapses in a dramatic, powerful explosion called a supernova. This explosion is so high in energy that it will fuse atoms together to make the heavier elements on the periodic table (elements with atomic numbers beyond iron). Nickel and copper are common metals we use in everyday life. These metals came into existence through supernovas. A supernovas blast these newly built atoms into outer space. What remains is a neutron star. Neutron stars are EXTREMELY large, dense stars that burn blue and create the strongest magnetic fields that we know of. If the exploding star is massive enough, it will turn into a black hole. Black holes are such massive stars, that their gravity pulls all energy back into it including light. Other than its even horizon we don't know what happens inside a black hole.

## Summary

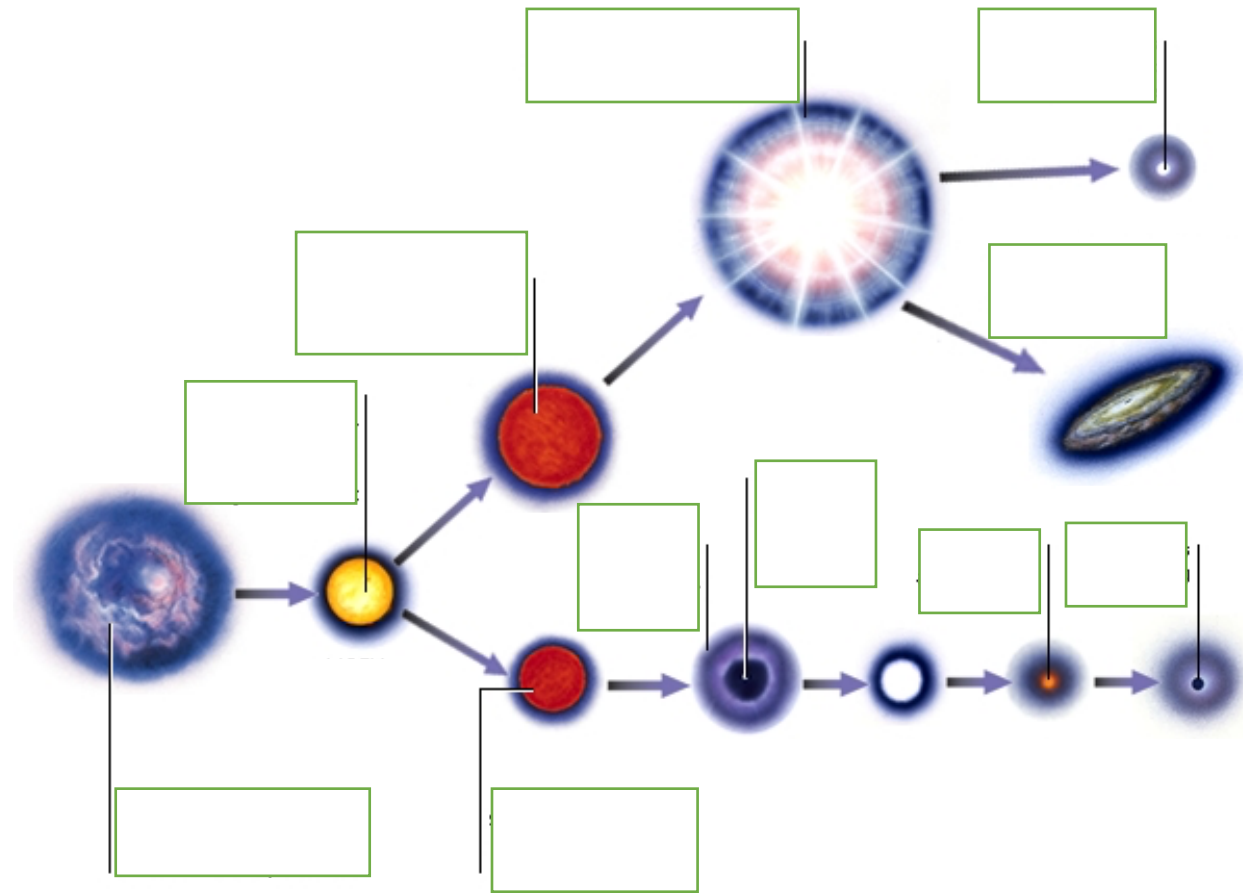
Complete the questions below as a way to summarize your learning.

1. What are galaxies and how many of them are there in the observable universe?
2. How many stars are there in galaxies?
3. In the boxes below do a quick sketch of each type of galaxy and IN YOUR OWN WORDS, briefly describe their characteristics (can be point form)



4. What causes a star to continually burn for millions of years without spilling its guts into the universe? (describe the processes)

Label the diagram of the star life cycle below.



What type of star life cycle is missing from the diagram above?