

# Life Cycle of Stars Script

Edited by SJ on 29<sup>th</sup> June 2011.

This first show is based loosely on the Life Cycle of Stars. It is aimed at students studying GCSE Astronomy. If the kids are younger than GCSE or below, nicer to start with Planets and Ecliptic and star signs stuff, detailed in Optional Start, leaving out more complex stuff on Neutron Stars and Black Holes.

Stellarium commands are in blue

Red notes are optional facts to add, and depend on age of audience and time.

The talk should take 20-30 mins depending on how much science/mythology you elaborate on. Suggest that it is nice to do this show condensed into 20 mins at the end of We are Astronomers... to give a 40-45minute show.

## Optional easing-in start

Do this if audience have no real knowledge of the stars and planets - best starting point for younger kids, if GCSE probably not needed can jump straight in at Finding North, but check!

In stellarium start with sky as it is with sun (a for atmosphere) and ground, g. and at current time 8.

Ask 'Can we see any stars in the night sky?'

Expect responses such as 'Only the Sun, no because it's too bright'-

Ask 'so why can't we see the other stars in the day?' -

Get response cos our star the sun, too bright, light bounces off atmosphere, stops us seeing the other stars. Mention the light pollution in cities bouncing off the inner atmosphere stopping us seeing stars even at Night!

Speed up time <L> and see sun moving across the sky, ask why the sun is moving?

Explain that sun is not actually moving it's us that is moving about on our axis and this makes the sun appear to rise in the East and set in the West. Normal time rate <k> Get to some time tonight, about 9pm by speeding up, then switch to Normal time.

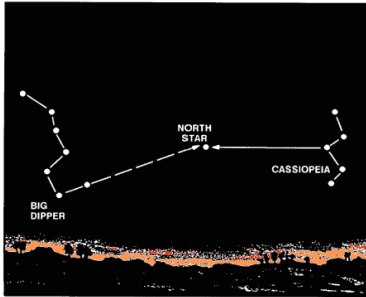
Turn the sun off (a) and the planets and ecliptic on <, >.

Explain what the ecliptic is (all the planets in our solar system are in the same plane so as we look out at them they all seem to follow the same path on the sky, (red curved line in stellarium) Point out the planets they should be able to see tonight.

Turn on the constellation pictures of all the stars signs (c - constellations v - names r - art). Explain that a constellation is a grouping of stars made by the ancient greeks they used them to navigate and made up stories about different constellations. You will notice that all the zodiac constellations, ie. Star signs lie along this line called the ecliptic. These star signs divide the ecliptic up into 12 equal zones, which is why they are 12 of them. (Leave constellations on but pictures off! r)

From here can either start explaining how to find North and follow show from there , or (Cut out north and Cass and Andromeda )  
Go straight into Orion and start talking about life cycle of stars just within Orion.

### Finding North



Starting with Big dipper, which is an asterism, part of the constellation ursa major, which means the Great Bear. And Ursa Minor, which means small bear. The lowest two stars in the saucerpan point to North Star.

It looks like a saucerpan, with a handle and a place to put your beans, counting from the 2 stars at the end of the pan, count in a straight line about 5/6 steps (at a step distance of the gap between those 2 stars). There you will find

Polaris aka the North star. Many people think North Star is the brightest in the sky! It isn't! it is only important because it is directly above the North Pole, and stays above the north pole as the earth spins on its axis causing all the other stars to spin around! Think about spinning top (from Christmas cracker) the top part, which you spin around with your fingers, doesn't appear to move while the sides of the top are whizzing around. The middle of the top represents the North Pole with the North Star is right above it. Make sure they realise none of the stars actually move, and it's us that are moving?

(speed up time L in Stellarium so they can see stars going around in arcs)

Mentioned Axis of Earth ( if time mention Southern Hemisphere doesn't have a star above south pole :( They use Southern Cross and point to an area which is above/below the South Pole)

Constellations    Make sure can see both Cass and big dipper

Ask 'what is a constellation?'    Explain these are 48 constellations in total.

Turn on constellation art press 'r' key

Patterns of stars in sky, imagine the ancient Greeks without TVs very bored so used to join the stars together like a dot to dot, Mention that the Saucerpan/Big Dipper is an Asterism not constellation, as it is part of the great bear. Turn off constellation art r

### Circumpolar stars

Explain that the constellations of Cassiopeia and Andromeda and Ursa Major etc are Circumpolar constellations and never set.

### **Cassiopeia**

Cass looks like a W or an M for McDonalds, find her from the Big Dipper by drawing a line through North Star. Cass is a queen married to King Cepheus (he is in sky near by looks like a house drawn by a child). Andromeda is Cass's daughter.

## Andromeda

Locate Andromeda.. go along same line from Polaris, to Cass, and thru to Andromeda.. (Search Fn-F3 for M31, and zoom in using / in stellarium)

When in Andromeda constellation, say it is our nearest spiral galaxy Andromeda (in local group.) Andromeda looks a lot like our own galaxy and you can imagine if you were flying in space outside our Milky Way it would like very similar to Andromeda. Mention that Andromeda is actually alot bigger than the Milky Way, has many more stars!, make sure they know the Milky Way is our galaxy! Say that the light from Andromeda is actually blue shifted! Ask if they know what this mean? So MW and Andromeda are actually moving toward each other in space, attracted to each other by gravitational forces due to their large masses, in 4.5 billion years they will collide making a much larger galaxy.

### Milky Way (MW)

Make sure they know MW is our galaxy, talk about the reason for the name, i.e. the ancient Greeks thought it looked like someone had spilt milk across the sky. Spiral arms are dust and gas that is orbiting a supermassive black hole which exists at the centre of all galaxies. We are in Orion arm of our galaxy. (Leads into talking about Orion, then can miss out Andromeda and Cass story if not much time)

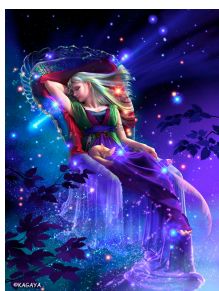
Can mention other **satellite galaxies**, LMC and SMC

### Andromeda-Cassiopeia story

(only do this story if have time!, best for Year 8 and below.)

If you have seen the recent film Clash of the Titans you will know this story already, but you might not know how it relates to the stars...

Put on constellation art r , Make sure all people in story are in sky and point to them with laser



Cass Queen and Mother and daughter Andromeda were both very beautiful but Cassiopeia committed a 'sin' in the eyes of the Greek gods, by saying that herself and her daughter were even more beautiful than the sea nymphs. This made Poseidon, god of the sea really mad so he struck the water with his Trident and flooded the lands, calling up the sea monster, Cetus, to destroy the kingdom. Cepheus her husband the King, was scared for his kingdom so he asked an oracle how he could save the kingdom and she said "you will you have to sacrifice your daughter to the sea monster to save it"...

So he decided he would sacrifice his daughter, so Andromeda was chained to a rock with the sea monster sent on her. Luckily Perseus who was very strong and handsome decided he would save Andromeda so he flew to her on Pegasus and said, "Hey I'll kill the monster if become my wife" so of course she did, since he was handsome, and there was the fact she was just about to face certain death. However, the story doesn't end here though, because the people of the kingdom were not happy that Perseus and Andromeda were together, one person with a problem with this was a former lover of Andromeda, he set 200 hundred warriors to attack the couple (and her mother was involved in organising this, also, you can see from this story that Andromeda parents

weren't really very nice, her mother especially evil). Luckily Perseus had the head of the Medusa which he used to wear on his belt (handy!) and anytime you look into the eyes of Medusa she will turn you all to stone, so he was able to turn them all to stone by angling her head at the 200 warriors. The Gods flung Cassiopeia into heavens as punishment for causing all this to happen for being so vain. She sits on her throne the W in the sky and as we learned earlier she is circumpolar goes from M to W she is being banged on her head (with her skirts flying up over her with each revolution)...And Perseus and Andromeda lived happily ever after! [Turn off constellation art r](#)

### Milky Way to Orion



#### [From Cass through Perseus to Auriga then Orion, or Search for Orion Fn-F3 M43,](#)

The constellations we see depend on the time of year. Because the aswell as the earth is spinning around on its axis , which gives us day and night, the earth is moving along its orbit around the Sun, this gives us seasons and also means we are looking into different parts of the sky during the course of the year. The constellation Orion is a Winter Constellation, and is very famous because of the 3 stars which make up orions belt. [Point out 3 stars and then turn on constellation art, explain about him being a hunter, shape of his body then turn off.](#)

**Orions belt** 3 stars these are young blue stars, baby stars if you will. Introduce Betelgeuse on the shoulder. Ask which stars are hottest type of stars or coldest?

[Zoom in / Search Fn-F3 M43 Orion Nebula, Talk about stars being born out of dust and gas. In Orions sword.](#) Star forming region nursery. Like Orion is pregnant. Tell them about the different colours recap, blue, young star, yellow, teenage star, red giant star dieing... then finally death brings...large explosion...BOOM! Our Sun, is considered to be a low mass gently throw outerlayers out in a planetary nebula, burned out core that remains is a White Dwarf.

High mass stars like Betelgeuse which I will talk about in a moment, end their lives by , powerful supernovae explosions which can be as lumionous as an entire galaxy of stars! These Supernovae throw out particles called neutrinos, and leave behind a Neutron Star or a Black Hole. [\(If kids old enough mention that if Star was bigger than 1.4 times the Mass of sun NS if bigger than 3 times the size of sun BH.\)](#)

Heavy elements formed inside star are now enriching space, recycling, new stars are born from this. We are all made from the elements formed in stars :)\*\*\*\*\* For example the process of Fusion combines H to He then to Oxygen then to Carbon, and us Humans are known as Carbon based life forms.

**Betelgeuse** -arabic for armpit of the central one.

This super giant star has been in news recently because astronomers think it might blow up or go supernovae very soon (in fact it may have already blown up). This is red star, which is cooling down because it is coming to the end of its life. Our star the Sun is in the stable phase of its life. If we think of the new born stars (protostars) as mainly made of H where the process of Fusion hasn't started. The sun has been Fusing it H into

He steadily for 4.5 Billion years, this steady phase is called the main sequence, and it will be another 4.5 billion years before it runs out of all its H and swells up into Red giant star. When the sun ends its life it is not big enough to cause a supernova explosion it will just leave a small star called a white dwarf.

Betelgeuse is a supergiant red star about 500 light years away - that means it would take the light from Betelgeuse 500 years to reach us on earth. So when astronomers are looking at B they are actually seeing the star in the past, as it was 500 years ago. This is why it is difficult to tell if has blown up. Now nothing can travel as fast as light, for example the Sun is 8 light minutes away from us. This means light from the sun takes 8 mins to reach us. So even if for some reason the sun suddenly stopped emitting light to us, it would be 8 minutes before we would know about it.

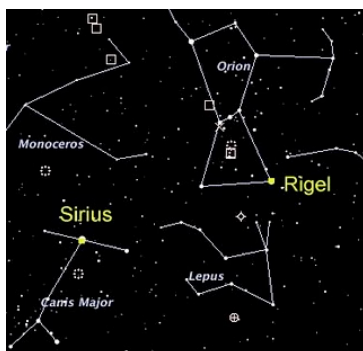
B is so big if you placed it into our solar system in the place of the sun it would extend out past Mars and the asteroid belt and into the orbit of Jupiter. The reason why it is so big that it has run out of H and can't fuse atoms together. This means the forces on the star are no longer balanced which is why the outer layers start to swell outwards and eventually it will go boom! When it does go 'boom' even though it is over 500 light years away it will be very bright, we may even be able to see it for several weeks in the daytime. However, do not fear if it does go supernovae within our lifetime (could go bang tomorrow could be the next million years) it won't affect us, apart from the firework show.

For kids older than Year 9 can say astronomers call the young blue stars, O stars these are 33,000 K, hottest, and the coldest, M stars, red 3,700K (say degrees), compare this with the temperature of the sun 6,000K. Can also explain light year, 6trillion miles! (6 with 12 zeros which is a distance equivalent to 240 million times the circumference of Earth.

### Sun

When our sun becomes a red giant star in about 8 billion years from now it will actually swell up so big it will knock us out of orbit.

### Sirius



Line drawn from Orion's belt to Sirius, point out with laser , Talking about different stars, leads on to asking if 'Anyone know what the brightest star in the sky is?'

Sirius, which is Greek for 'glowing or scorching' is an example of a massive young white star and also that this is the brightest star in the sky and is on the eye

Zoom in to /collar of Orion's dog.

Ask 'why is it so bright?'

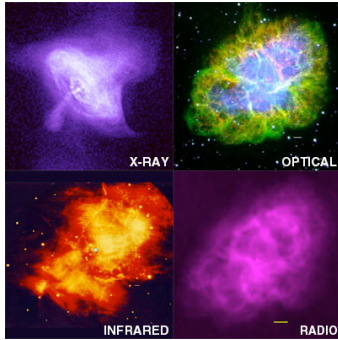
Hopefully they will say because it's close by, yes it is only 8.7 light years away which when you compare it with

Betelgeuse its very close, another reason why it is so bright is because it is actually 2 stars in what astronomers call a binary system, the one star is size of sun, and other is twice size of sun.

### Crab



Try not to repeat stuff, which is talked about for Betelgeuse with the Crab Go to Taurus, NW of Orion, Search for Fn F3 M1 / zoom in then back out\, on one of horns of the Bull, Taurus.



Link with B if talked about it, explain that this is the Crab nebula, star that went supernovae in 1054 and the Chinese saw it first. Now even though it is 6,500 lyrs away (about a 100 times further than B), it was brightest thing in the sky except for moon, so this just shows you how bright these explosions are when massive stars die! It got its name, the Crab, because it has these extended filaments make it look like a crab? **see if you agree in photo later...if doing photos.**

The Crab Nebula, has exploded and left a very dense type of star at its centre, called a Neutron star. These stars are extremely dense, Ask if they know what dense means? Give example that a NS the mass of our sun would be the size of a city like Southampton. Or another way of thinking of it, one tablespoon of material from a NS would have the same weight as Everest. Neutron star held up by neutrons only, everything else has been squashed out by the strong gravitational forces acting on the star, which act due to its great mass. In order to escape from the surface of a NS you would have to travel at 1/2 the speed of light, which is equivalent to about 300Million miles an hour! **Pulsars are an example of a spinning neutron star, which is spinning due to the conservation of the angular momentum of the original star.**

Make sure zoomed out \ and can see all of Taurus....

**Pleiades** are the most famous star cluster in the night of sky and the Greeks said this cluster was like the 'fleas on the back of Taurus'

These are bright white/blue stars called then seven sisters; you may have seen these on the badge of the Car, Subaru. The native Indians used these as an ancient eye test. If you could see maybe 6-9 by the naked eye you could become a hunter, but if you can only see about 3 or 4 you had to be a farmer. This doesn't apply if you are looking from Soton because of light pollution from the city you will be lucky to see Taurus, never mind the Pleiades. This cluster actually has hundreds of stars, which are gravitationally bound to each other. **Zoom in to see Pleiades / by searching for it. FnF3**

Can zoom back out and speed up time L, to see Orion chasing Taurus across sky he is a hunter after all.

### **Black hole M87**

Navigate from Crab in Taurus to Virgo or, Search Fn-F3 M87 (back to ursa major/big dipper, thru Bootes, and then Virgo is there) Zoom / see elliptical galaxy

M87 is an example of a black hole. Black holes are either formed at the end of the life of a star and these small black holes can exist within our galaxy, the MW and have masses about 10 times that of the sun, other supermassive black holes like M87 are 1000, million times that of the sun!! These are thought to be formed in the beginning of the Universe when large galaxies were merging together **(M87 is at the centre of an elliptical galaxy Jet goes out 5,000 light years, which is astounding when you think that**

about as far as we are from the Crab Nebula.). For a collapsed or dead star with a mass of about 8 suns where there is such extreme gravity between the remaining mass, that even the neutrons can hold up the star, and these neutrons get squashed out, making a hole in space time. Ask 'What speed do you need to travel to escape from a black hole?'- Hopefully answer is speed of light, which is equivalent to a speed of 600 million miles an hour! Go onto explain this is why we can't see black holes. Astronomers (as shown in We are astronomers) use the EM Spectrum to look at the light from stars, be it the gamma rays, X-rays or visible light that we can detect with our eyes. Black holes suck in all those different types of light, so the only way astronomers know they are these is by measuring the speed of objects which are orbiting them, or looking for high energy X-rays being given off by material falling into the black hole.

Compare with our Sun as a BH.

If you replaced our own Sun with a black hole of the same mass, the planets etc would all still orbit around in the same way, we wouldn't get sucked in, the only time you get sucked in is when you get too close.

Now it might shock you to know that our Solar System is orbiting in our galaxy around a Supermassive black hole

These supermassive BH were predicted by Einstein's theory of general relativity. They exist at the centre of all galaxies, a million times that of sun. The BH in our MW is actually 4 million times mass of sun! Ask 'how do you think astronomers know the mass? Cos they can't just weigh it with a scales?' Using Keplers Third Law, equation which relates the speed of orbits stars to the mass of the thing they are orbiting, exactly how we measure the mass of the Sun.

Astronomer measured high speeds of stars orbiting around an object known as Sagittarius A\* which is at the centre of our galaxy the MW. [Can zoom / into Sagittarius A\\* / search for Sagittarius using Fn-F3. Can't see much there, turn off the constellations, c and search fnF3 for M25 this is a near by cluster of stars](#) explain that at the centre of our galaxy astronomers measure the speeds and orbits of stars just like that's how they know there is a supermassive black hole there!

Ending thought about black holes.

Most people think of black holes as monsters but Astronomers now think they play a large part in the early formation of galaxies. As we learn more about how galaxies were formed in early universe it seems that the BH at the centre plays a large part in forming galaxies, remember that the jet from the centre of the galaxy can reach into other galaxies, these jets of particles might start star formation to occur in galaxies where it might otherwise not have occurred. This means that without our blackholes the universe might of not formed galaxies. And without galaxies there wouldn't be stars, without the stars, no solar systems of planets and with out planets, no humans, so black holes may not something to be afraid of.