The Milky Way Centre Aglow with Dust (NASA/JPL)

Fact 14: A Black Hole may be at the centre of our galaxy

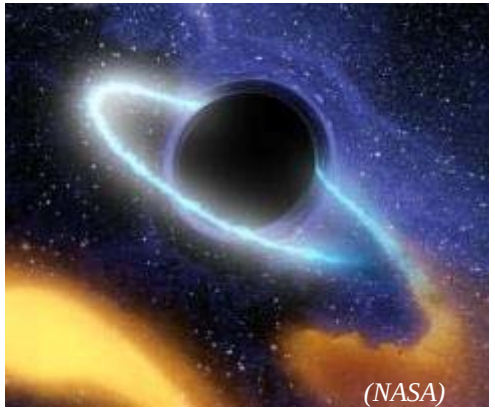
There are over 100 billion stars in the Milky Way Galaxy. Our sun and all the other stars are orbiting around the centre of the galaxy. We know that all objects rotate around a centre of gravity. So what is in the centre of our galaxy?

Unfortunately we may never know. The centre of our galaxy is hidden from view by clouds of dust that we simply can't see through. Other galaxies are too far away for us to see what is at the centre of them.

The Milky Way Galaxy has a diameter of at least 100,000 light years. That means that light from one side would take 100,000 years to reach the other side. There must be something with an incredible gravitational pull at the centre to stop everything floating away.

Scientists believe that that something could very well be a black hole.

14 Fun Facts About



BLACK HOLES

By Jeannie Meekins

A LearningIsland.org
15 - Minute Book

Editor: Jennifer Robinson
Pictures by the National Aeronautics and Space Administration (NASA) unless otherwise noted.

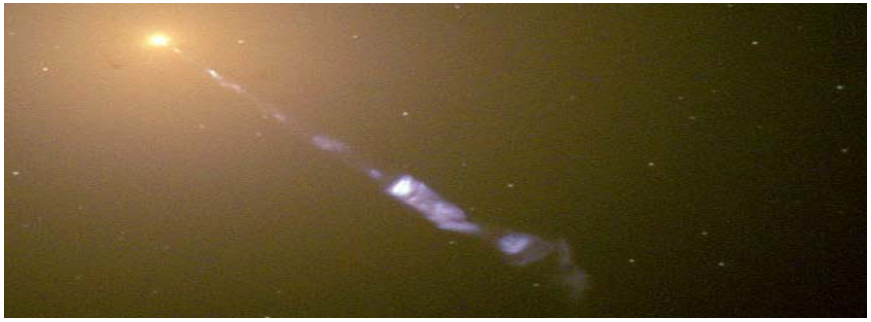
LearningIsland.org

14 Fun Facts About Black Holes/Jeannie Meekins
Summary: A brief look at Black Holes.

1. Black Holes. Juvenile Literature. 2. Space. Juvenile Literature.

Written in Australia. Book created in USA.

Words: 2253
Reading Level: 6.1



A black-hole-powered jet of electrons and other sub-atomic particles traveling at nearly the speed of light (NASA GSFC)

Fact 13: You can never get to the surface of a Black Hole

The gravitational pull of a black hole will stretch things out. If you jumped into your spaceship and travelled to a black hole, you would never get there.

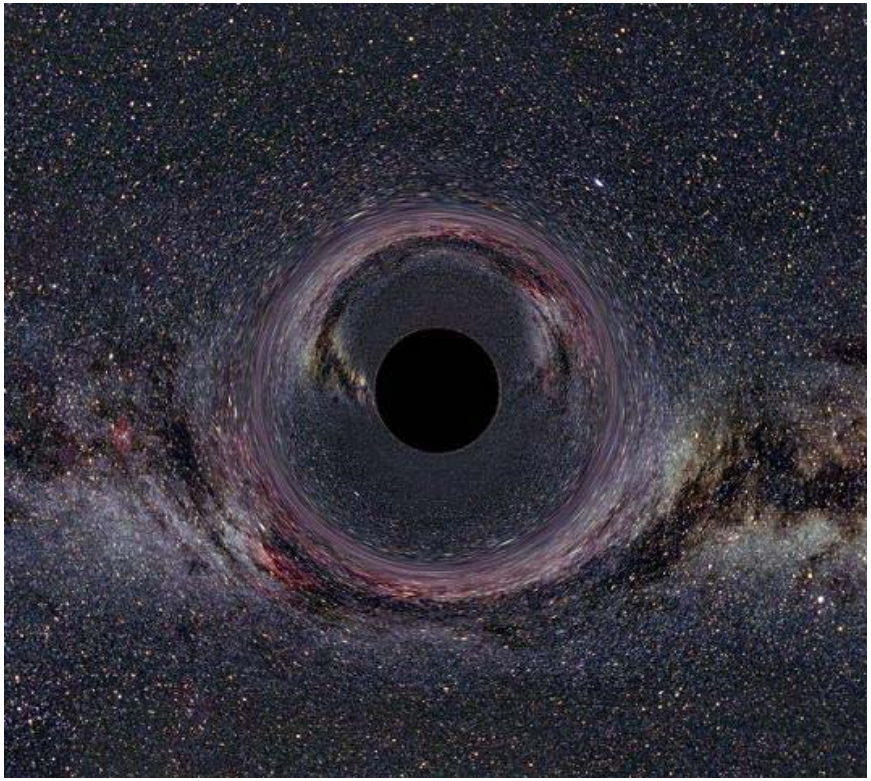
As soon as you were within reach, the gravitational pull would begin to draw you in. Maybe you are just on the edge. Your hand reaches in and is affected. The black hole draws in your hand. But the rest of you is still out of reach and is not drawn in.

The closer your hand is drawn in, the stronger the pull and your hand is pulled more and more. This will begin to stretch your fingers, your hand and your arm away from the part of you that is not yet being drawn in. You become entirely pulled in, but still the pull is greater on the closer parts of you.

The easiest way to show what is happening to you is with a spring. If you hold one end of the spring and pull on the other, the spring begins to stretch. Most of the stretch occurs at the end you are pulling. The bit you are holding will try to stay as it is. The more you pull, the greater the stretch at the pulling end. Keep pulling as hard as you can.

If you are clever enough to keep pulling on the spring while you move the whole spring towards an object, this will be like you moving closer to a black hole. Finally the spring will snap.

A black hole will stretch and snap you like a spring thousands of kilometres before you reached the event horizon.



Black Hole Milky Way by (Gallery of Tempolimit Lichtgeschwindigkeit/Ute Kraus)

Fact 12: Black Holes can distort time and space

This is the stuff of Science Fiction stories. It also has a basis in truth.

When we refer to time and space, we are talking about something that can be measured. A space is a distance between objects and time is something that happens that can be counted.

Gravity affects all physical measurements no matter where you are in the universe. All clocks will slow down and rulers will measure stretched out space near a black hole.

TV and movies will have you believing that black holes are huge holes in space and anything that falls into them is lost forever – possibly falling into another universe or another time. Or even falling forever.

You may think that black holes run around in space like huge vacuum cleaners sucking up everything in their path. This is not true.

But what actually is a black hole and what do they do? This book will help you find out.

A hole in the ground (© Richard Minske)

Fact 1: A Black Hole is not a hole

What does the word “hole” make you think of?

A hole in your bike tyre that lets the air out? A hole in your jumper? A hole in the ground that you can fall into?

A black hole is none of these things. In fact, a black hole is not even a hole.

Chandra Reveals Remains of Giant Eruption (NASA/GSFC)

Fact 2: A Black Hole is a star

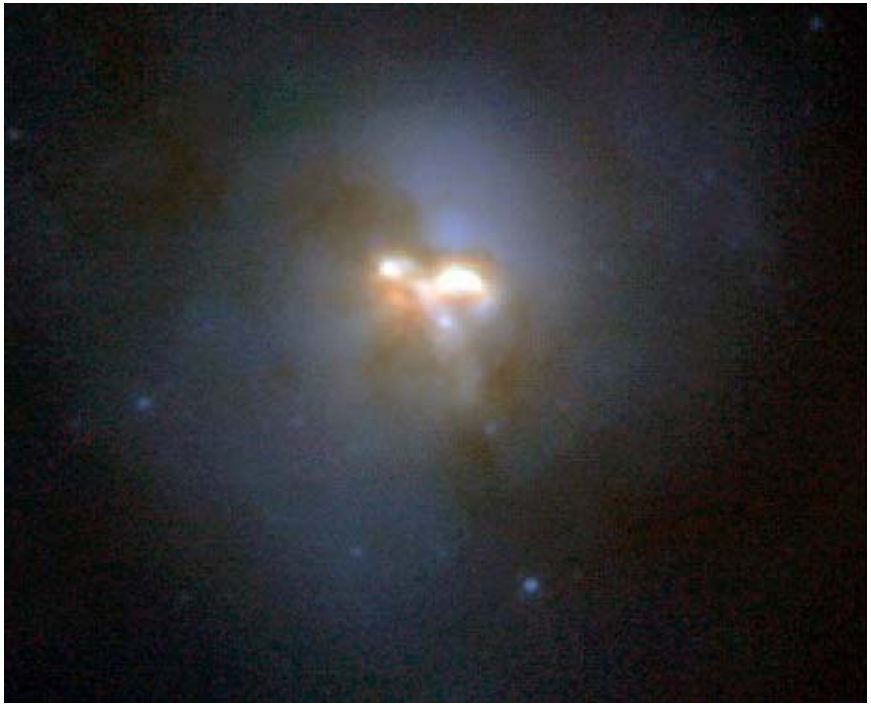
More accurately, a black hole was a star.

Stars, as we see them, are balls of burning gas. Eventually, this gas runs out. This starts off a whole range of chemical changes and nuclear reactions in the star.

In most cases, the star will blow up. It will get bigger and bigger, just like when you blow up a balloon. If you keep blowing into the balloon, it will eventually explode. The star becomes bigger and bigger and hotter and hotter and eventually explodes.

Sometimes the star will blow itself up completely and spew all its contents throughout space.

Sometimes a star is too big to blow up. It starts to get hotter, and it starts to get bigger. But its gravitational pull becomes so great that it won't let anything escape. It keeps pulling and pulling towards its centre and collapses in on itself.



Ultraluminous Infrared Galaxy (NASA)

Fact 11: A star needs to be about three times as massive as our sun to become a Black Hole

Our sun is considered a yellow dwarf and a main sequence star. That means that it's on the small side for stars, and is in the middle stages of its life.

If our sun became a black hole it wouldn't be able to suck in all the planets because its event horizon would only be about three kilometres. Earth and all the other planets would continue orbiting exactly the same as they do now.

But our sun won't become a black hole. Scientists predict that for a star to become a black hole, it would need to be at least three times as massive as our sun.

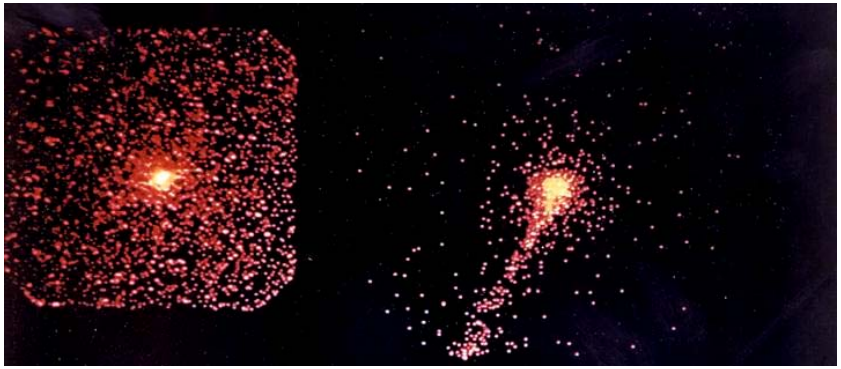


Image of the Black Hole, Cygnus X-1, Taken by the High Energy Astronomy Observatory (HEAO)-2 (NASA/MSFC)

Fact 10: A Black Hole continues to suck material from its companion

While a black hole may not have the ability to suck in its binary partner, it can suck in the burning gasses that are spewed off.

A star is a ball of fire and fires will always give off heat, light, radiation, and burnt particles of ash and smoke. As this material escapes the star, it gets pulled towards the black hole.

A black hole is small, but it can pull so much. The material can't all get sucked in at one time.

It's like when you have a bath and pull the plug. All that water can't get down the plughole in one go. It spirals around the plughole and waits it turn to get sucked down. So the material from the star has to wait its turn to get sucked into the black hole.

During this wait, the captured gases give off X-rays, which can be detected.

A black hole is predicted to be in the constellation of Cygnus in the northern skies of the Milky Way.

An unseen object orbiting with a visible companion star is seen to be doing all the things that a black hole should do.

Implosion (© Peter Woodman)

Fact 3: A Black Hole is a star that has collapsed upon itself

You probably know of old buildings in your area. As cities get bigger, more and more buildings are built. Old buildings can begin to fall apart and become dangerous.

There is no safe way to blow them up or knock them down because they might fall on other buildings, houses or even people.

The buildings are imploded.

Explosives are placed inside the building and set off in such a way that the building collapses in on itself. It falls to the ground in the very spot where it was standing.

The building will spew up bits of dust and rubble.

Imagine that it didn't spew up stuff, and that it sucked everything within its reach to the very spot that it falls on. This is similar to what happens with a black hole.

Black Hole Grabs Starry Snack, artist conception (NASA/JPL)

Fact 4: Black Holes are tiny and extremely dense

Most stars will explode and spew stuff into the universe.

Scientists predicted that some stars would be too massive to do this. The gravitational pull of the star is too great to let stuff escape. The star collapses in on itself, like the imploding building. What used to take up a big space now takes up a much smaller space.

This tiny object is called a “singularity”. A singularity is said to have zero volume and infinite density. That means that all the mass and gravitational pull of the original star is now an object so small that it can’t be measured and takes up no space at all.

That seems hard to imagine, and almost seems not real. So imagine that a star three times as massive as our sun was only the size of a pin prick. Then imagine much smaller.

Hubble serves up a view of the galaxy (NASA)

Fact 9: Black Holes can exist alongside other stars

Stars can exist individually, in groups of two or three, or even in clusters.

Let’s look at a pair of stars. This is known as a binary system. The gravitational pull of each star on the other is strong enough to stop them floating away in space, and they appear to orbit around each other.

At a certain distance between them, the pull of one star equals the pull of the other, and the affects cancel each other out. This is called the “centre of gravity” and this is what the stars are actually orbiting around. The location of this point depends on the sizes of the stars – which may vary a lot.

A black hole can be part of this system. It would have started life as an ordinary star and part of a pair. As long as the second star is far enough away, the two can continue to exist as a pair. One still shining and burning fuel, the other a collapsed and seemingly lifeless star – a black hole.

The big bead on the left of the mask is also the densest - some of its central stars might have merged to form a black hole. (NASA/JPL)

Fact 8: Black Holes are predicted by the affect they have on other objects

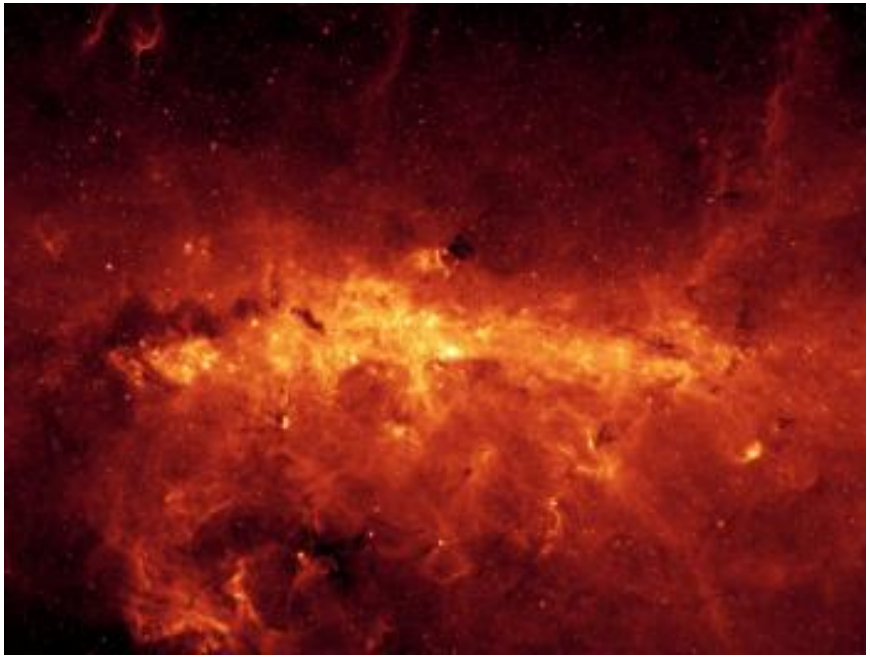
If we can't see black holes, how do we know they exist?

A lot of space discovery is done by guesswork and prediction. Scientists predict the existence of objects by the affect they have on other objects.

Neptune was discovered because of its gravitational pull on Uranus.

Planets the size of Jupiter and larger have been detected orbiting other stars because they are massive enough to have a pull on the star and make it wobble.

In the same way, we can predict where a black hole might be because of the affect it has on other objects.



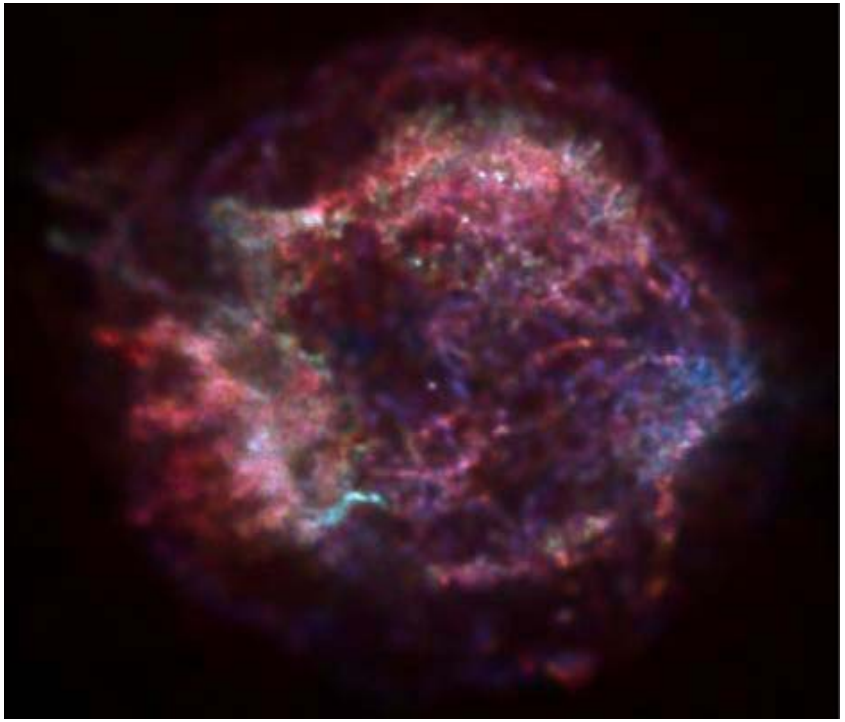
The brightest white spot in the middle is the very centre of the galaxy, which also marks the site of a supermassive black hole (NASA/JPL)

Fact 5: Our galaxy may contain up to 100 million Black Holes

Our galaxy contains over 100 billion stars. It is predicted that over 100 million of them have the capacity to become black holes. This is based on the notion that a star needs to be three times more massive than our sun to become a black hole.

But it is not only size that determines what happens to a star at the end of its life. It also depends on the composition of the star.

As stars can burn for millions or billions of years, it is hard to say exactly what will happen to them. We can only guess and observe what actually happens if we are lucky enough to see a star at the end of its life.



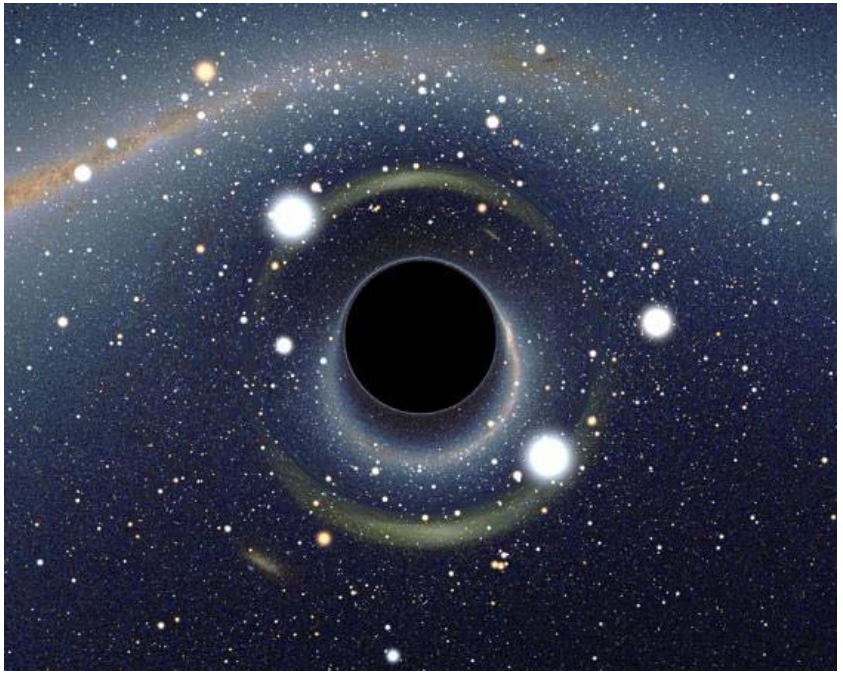
Chandra X-Ray Observatory Image of Cassiopeia A (NASA MSFC)

Fact 6: We can't see Black Holes

To see any object it must give off light or reflect light. A black hole does not give off light because it is no longer a burning star. It also does not reflect light. Any light that reaches a black hole cannot escape the gravitational pull.

We can't even see black holes form.

If you were to watch a star at the exact moment that it became a black hole, you would begin to see the star shrink very quickly and then stop. You would see the light become red and fade as it escaped. But you would not see the star collapse as this takes only one hundred-thousandth of a second.



Black Hole (© Alain R)

Fact 7: The "Event Horizon" is the point at which light cannot escape from a Black Hole

To escape the gravitational pull of an object, you need to travel fast. The closer you are to it, the faster you need to travel.

Nothing in the universe can travel faster than light.

When light gets within a certain distance of a black hole, even it cannot travel fast enough to escape again. (This distance depends on the size and gravitational pull of the hole. They are not all the same.)

If light cannot escape, then nothing else can escape.

The point at which light cannot escape from a black hole is called the "Event Horizon".