BLACK HOLES

Scientists believe that some regions of space exert so much gravity that they act like giant vacuum cleaners. Anything that gets too close gets sucked in. That matter is crushed to zero size and therefore infinite density. (Remember, density is an object's weight divided by its size, so as size gets infinitely small, density gets infinitely large.) It disappears forever.

The event horizon, the boundary of these giant vacuums, is formed by the rays of light that can't quite get away from the black hole, but stay forever, hovering on the edge. The gravity is so intense that it tugs at space and time, slowing down time and stretching out space. Not even light, the fastest thing in the universe, can't go fast enough to escape this enormous gravity. When light is being pulled down into a balck hole it looses energy an for the external observer light in the near of a black hole appears redder.

At the center of a black hole lies the singularity, where matter is crushed to infinite density, the pull of gravity is infinitely strong, and spacetime has infinite curvature. Here it's no longer meaningful to speak of space and time, much less spacetime. Jumbled up at the singularity, space and time cease to exist as we know them.

In 1969, the American physicist John Archibald Wheeler appropriately named these dark, devouring voids "Black Holes"! It was because of the black hole of Calcuta. In the 19th century this was a cell for 3 prisoners. Once they put in 46 people and 24 of them died. Like in black holes there was so much matter on a small space.

For most of their lives, stars remain a constant size because they have a balance of forces: Heat made by burning fuel pushes the star out, and the effect of gravity pulls it in.

Black holes are the evolutionary endpoints of massive stars at least 10 to 15 times as massive as the Sun, that is about 10^31kg or 10,000,000,000,000,000,000,000,000,000,000kg.

Oppenheimer and Snyder proved that if the star has more than 3.2 times the mass of the Sun (known as 3.2 solar masses*), there is* nothing to stop it from collapsing completely.

On the end of the lifetime of stars they explode as a supernova. The violent explosion still lefts a remnant there. If the remnant is less or more than 1.4 solar masses it becomes a white dwarf (a kind of hot dead star that isn't bright enough to visibly shine)

or neutron star (a rotating star with magnetic field). if then the remant of the neutron star is more than 3 solar mases it becomes a black hole.

We know 3 tipes of black holes:

- Static black holes: no charge, no rotating
- Charged black holes: it has two event horizons. The matter is being pulled in between them, but when it reaches the inner event horizon the matter isn't being pulled in anymore.

- Rotating black holes: 2 event horizons. The matter is being pulled in and rotating between them, but when it reaches the inner event horizon the matter just being pulled in without rotating.

It is argued that really massive black holes, equivalent to a hundred million stars like the Sun, could exist at the centre of some galaxies.

Wormholes are related to black holes in that they, like black holes, bend space around them into a funnel-like shape. Unlike a black hole, however, a wormhole's mouth is two-way. Once you cross the event horizon of a black hole, you are trapped inside forever. On the other hand, after you enter the mouth of a wormhole, you are not. It connects to another point in space which may be far away from the point you entered.

If you looked through the spherical mouth of the wormhole in the figure, you would be able to see through the wormhole, getting a glance at the light from Vega. The subject of wormholes has been worked on extensively by John Wheeler and his research group in the 1950's, and more recently by Kip Thorne and his colleagues at the California Institute of Technology.

One very interesting possibility that comes up when talking about wormholes is the thought of traveling through time. Since wormholes, like black holes, bend not only space but also time (remember, they are connected in the space-time continuum), this could be possible.

Furthermore, even if a wormhole were formed, it is thought that it would not be stable. Even the slightest perturbation (including the perturbation caused by your attempt to travel through it) would cause it to collapse.

Finally, even if wormholes exist and are stable, they are quite unpleasant to travel through. Radiation that pours into the wormhole (from nearby stars, the cosmic microwave background, etc.) gets blueshifted to very high frequencies. As you try to pass through the wormhole, you will get fried by these X-rays and gamma rays.

What would you feel if you traveled into a black hole?

At first, you don't feel any gravitational forces at all. Since you're in free fall, every part of your body and your spaceship is being pulled in the same way, and so you feel weightless. (This is exactly the same thing that happens to astronauts in Earth orbit: even though both astronauts and space shuttle are being pulled by the Earth's gravity, they don't feel any gravitational force because everything is being pulled in exactly the same way.) As you get closer and closer to the center of the hole, though, you start to feel "tidal" gravitational forces. Imagine that your feet are closer to the center than your head. The gravitational pull gets stronger as you get closer to the center of the hole, so your feet feel a stronger pull than your head does. As a result you feel "stretched." (This force is called a tidal force because it is exactly like the forces that cause tides on earth.) These tidal forces get more and more intense as you get closer to the center, and eventually they will rip you apart.

For a very large black hole like the one you're falling into, the tidal forces are not really noticeable until you get within about 600,000 kilometers of the center. Note that this is after you've crossed the horizon. If you were falling into a smaller black hole, say one that weighed as much as the Sun, tidal forces would start to make you quite uncomfortable when you were about 6000 kilometers away from the center, and you would have been torn apart by them long before you crossed the horizon. (That's why we decided to let you jump into a big black hole instead of a small one: we wanted you to survive at least until you got inside.)

What do you see as you are falling in?

Surprisingly, you don't necessarily see anything particularly interesting. Images of faraway objects may be distorted in strange ways, since the black hole's gravity bends light, but that's about it. In particular, nothing special happens at the moment when you cross the horizon. Even after you've crossed the horizon, you can still see things on the outside: after all, the light from the things on the outside can still reach you. No one on the outside can see you, of course, since the light from you can't escape past the horizon.

How long does the whole process take?

Well, of course, it depends on how far away you start from. Let's say you start at rest from a point whose distance from the singularity is ten times the black hole's radius. Then for a million-solar-mass black hole, it takes you about 8 minutes to reach the horizon. Once you've gotten that far, it takes you only another seven seconds to hit the singularity. By the way, this time scales with the size of the black hole, so if you'd jumped into a smaller black hole, your time of death would be that much sooner.

Once you've crossed the horizon, in your remaining seven seconds, you might panic and start to fire your rockets in a desperate attempt to avoid the singularity. Unfortunately, it's hopeless, since the singularity lies in your future, and there's no way to avoid your future. In fact, the harder you fire your rockets, the sooner you hit the singularity.

Suppose you have found a region of space where you think there might be a black hole. How can you check whether there is one or not?

The first thing you'd like to do is measure how much mass there is in that region. If you've found a large mass concentrated in a small volume, and if the mass is dark, then it's a good guess that there's a black hole there.

Since a black hole is a region of space from which nothing can escape, the time-reversed version of a black hole is a region of space into which nothing can fall. In fact, just as a black hole can only suck things in, a white hole can only spit things out.

It doesn't mean that they actually exist in nature. In fact, they almost certainly do not exist, since there's no way to produce one. (Producing a white hole is just as impossible as destroying a black hole, since the two processes are time-reversals of each other.)

I've got this information from these websites:

- http://library.thinkquest.org/10148/mainmenu.shtml
- http://library.thinkquest.org/C0122665/emain1.htm
- http://physics.syr.edu/courses/PHY312.98Spring/projects/jebornak/
- http://physics7.berkeley.edu/Education/BHfaq.html
- http://imagine.gsfc.nasa.gov/docs/science/know_l1/black_holes.html
- http://imagine.gsfc.nasa.gov/docs/science/know_l2/black_holes.html
- http://www.owlnet.rice.edu/~spac250/steve/

- http://csep10.phys.utk.edu/guidry/violence/blackholes.html