**General Relativity and Black Holes**

**1 Read both parts of this article. Under each part of the article, there are definitions. To each definition find a word from the article which has the same meaning.** The definitions appear in the same order as the words in the article (that is, the definition for the word “suggested” will be somewhere at the beginning of the article)

When Einstein wrote his general theory of relativity, he found a new way to describe gravity. It was not a force, as Sir Isaac Newton had proposed, but a consequence of a distortion in space and time, conceived together in Einstein’s theory as 'space-time'. According to Einstein, matter and energy exist on a background of space and time. Objects distort the fabric of space-time based on their mass - more massive objects have a greater effect.

One of Einstein's contemporary astronomers - a theoretical physicist named [Karl Schwarzschild](http://turnbull.mcs.st-and.ac.uk/history/Biographies/Schwarzschild.html) was attracted to general relativity and shortly before his death in 1916, Schwarzschild completed his work titled On the Field of Gravity of a Point Mass in the Theory of Einstein, which became one of the pillars of modern relativistic studies. It provided support for a, then, seemingly implausible situation about the effects of severely compressed matter on gravity and energy.

Schwarzschild realized the escape velocity from the surface of an object depends on both its mass and radius. If the radius of a given mass is small enough, the escape velocity will increase until it reaches the speed of light. At that point, neither matter nor radiation can escape from the object's surface. Additionally, atomic or subatomic forces become incapable of holding the object up against its own weight. Therefore, the object collapses into an infinitesimal point - the original object disappears from view and only its gravity remains to mark its presence. As a result, it creates a bottomless pit in the fabric of space-time.

Suggested:

Alter:

Finished:

Evidence:

Improbable:

Tiny:

For this reason:

A large hole:

Scientists now refer to an object with zero-volume but all of its mass as a [singularity](http://curious.astro.cornell.edu/question.php?number=55). Schwarzschild also explained that a singularity was surrounded by a spherical gravitational boundary that forever trapped anything that ventured within. This boundary was called the [event horizon](http://archive.ncsa.uiuc.edu/Cyberia/NumRel/BlackHoleAnat.html). Nothing, not even light can escape from within this event horizon. It is called a horizon, because like the horizon on Earth, we cannot see beyond it.

Schwarzschild presented a formula that enabled the size of an event horizon to be calculated. This is now known as the Schwarzschild radius and it marks the edge of a bottomless pit in space-time. Venture beyond the brink and you will never return.

The idea of a singularity troubled many scientists, including Einstein. Leading thinkers of that period could not imagine conditions that would create a singularity but now we know they are common throughout the Universe. Over the past decade researchers realized that most galaxies have at least one black hole in residence in their central regions. Even our home galaxy, the Milky Way, has a four million solar mass [black hole](http://www.orbitsimulator.com/gravity/articles/mwblackhole.html) located at its center, about 27,000 light years from Earth.

Black holes are one of only a fairly small number of cases in the history of science where a theory was developed in great detail as a mathematical model before there was any evidence from observations that it was correct. Indeed, this used to be the main argument of opponents of black holes. How could one believe in objects for which the only evidence was calculations based on the dubious theory of general relativity?

Border:

Determined mathematically:

Important:

Circumstances:

Frequent:

Minimally:

Situated:

Created:

Uncertain, doubtful:

**2 Replace the words in bold with a word with the same meaning**:

**Circumstance created complete suggested pit implausible dubious calculate distorted leading**

1 The product was **developed** by a foreign company.

2 He **proposed** some changes at the meeting.

3 I can’t imagine a **condition** under which I could do that.

4 Her conclusions are pretty **doubtful**, if you ask me.

5 The journalist **altered** the original announcement beyond recognition.

6 The project took four months to **finish**.

7 The impact of the meteor created a large **hole** in the ground.

8 I need to **count** how long it will take me to drive to Chicago.

9 Some **important** scientists of the decade did not agree with the theory.

10 He gave me an **improbable** excuse for showing up late.

Key

1 Reading:

Suggested: proposed

Alter: distort

Finished: completed

Evidence: support

Improbable: implausible

Tiny: small, infinitesimal

For this reason: therefore

A large hole: pit

Border: boundary

Determined mathematically: calculated

Important: leading

Circumstances: conditions

Frequent: common

Minimally: at least

Situated: located

Created: developed

Uncertain, doubtful: dubious

2 Synonyms:

1 created

2 suggested

3 circumstance

4 dubious

5 distorted

6 complete

7 pit

8 calculate

9 leading

10 implausible