

# Black Hole

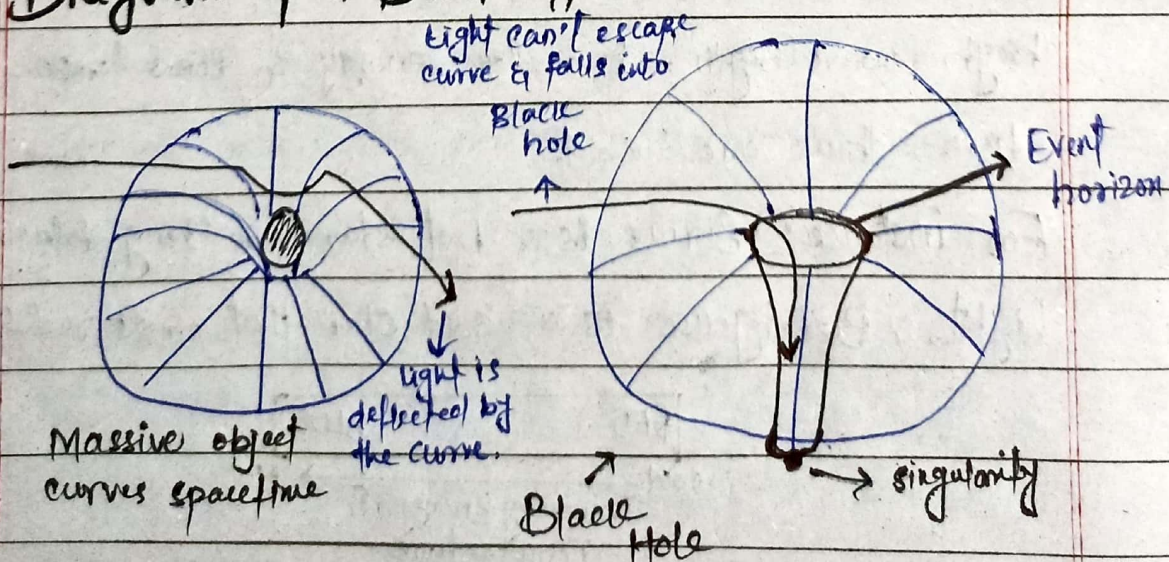
## 1. Definition of a Black Hole:

- Black holes are regions in space where an enormous amount of mass is packed into a tiny volume. This creates a gravitational pull so strong that not even light can escape. The theory of general relativity predicts that a sufficiently compact mass can deform spacetime to form a black hole.

## Example of a black hole:

- Black hole can be found in in Cygnus X-1, a binary X-ray system consisting of a blue supergiant & an invisible companion 14.8 times the mass of the Sun.
- Another example is Sagittarius A\*, a supermassive black hole that sits at the centre of the Milky Way Galaxy.

## Diagram of a Black Hole:



## 2. Discovery of Black Hole:

- Albert Einstein first predicted the existence of black holes in 1916, with his general theory of relativity. However, the term "black hole" was coined many years later in 1967 by American astronomer John Wheeler.

### The Discovery of first Black Hole:

- The first black hole ever discovered was Cygnus X-1, located within the Milky Way. Astronomers saw the first signs of the black hole in 1964 when a sounding rocket detected celestial sources of X-ray according to NASA.
- Moreover, in 1971, astronomers determined the X-rays were coming from a bright blue star orbiting a strange dark object - an all-consuming black hole.

### Black Hole Latest discovery - NASA Telescope Discover Record - Breaking Black Hole:

- On 6 Nov, 2023, Astronomers found the most distant black hole ever detected in X-rays using the Chandra and Webb space telescope. The black hole is at an early stage of growth that has never been witnessed before, where its mass is similar to that of its host galaxy, which explain the formation of first

Supermassive black hole in the universe.

### 3. Formation of Black Holes:

- Black holes are formed through the gravitational collapse of massive objects, typically massive stars, under certain conditions. The process includes:

#### i. Massive Star Formation:

- Black holes are often formed from the remnants of massive stars. These stars undergo nuclear fusion, converting hydrogen into helium and progressively heavier elements during their lifetime.

#### ii. Nuclear Fusion and Stellar Evolution:

- Massive stars go through various stages of nuclear fusion. Eventually, when the star starts fusing iron, it no longer generates enough outward pressure to counter the force of gravity pulling everything inward.

#### iii. Collapse of Gravity:

- Gravity takes over during the collapse phase when the star's core can no longer support itself against gravitational forces. The outer layers of the star are expelled into space during a supernova explosion, leaving behind the collapsed core.

#### iv. Formation of Singularity:

- The remaining core, if it is sufficiently massive, collapses to an extremely small and dense

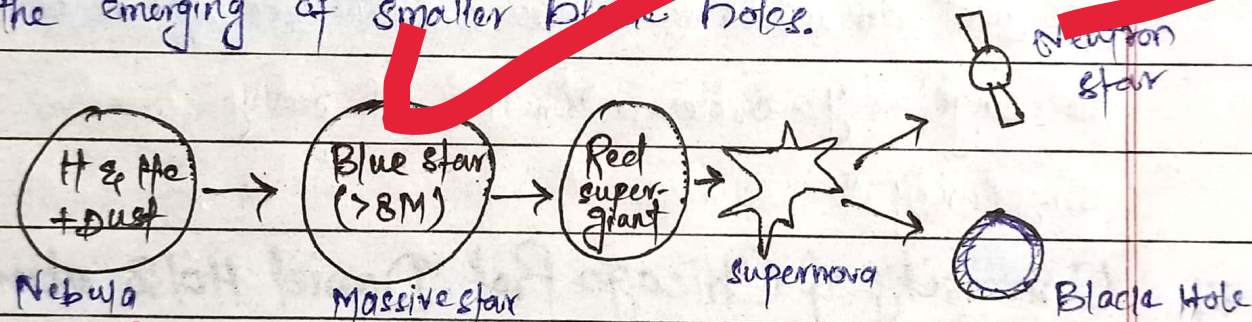
Point called a singularity.

v. **Event Horizon - Boundary of the Black Hole:**

- The event horizon - a theoretical boundary surrounding the singularity where the escape velocity equals the speed of light. Once anything, including light, crosses this boundary, it is inexorably drawn toward the singularity.

vi. **Formation of Stellar & Supermassive Black Holes**

- Stellar black holes are formed from the collapse of massive stars, while supermassive black holes, found at the centres of galaxies, are a result from the merging of smaller black holes.



Overall a good answer!?