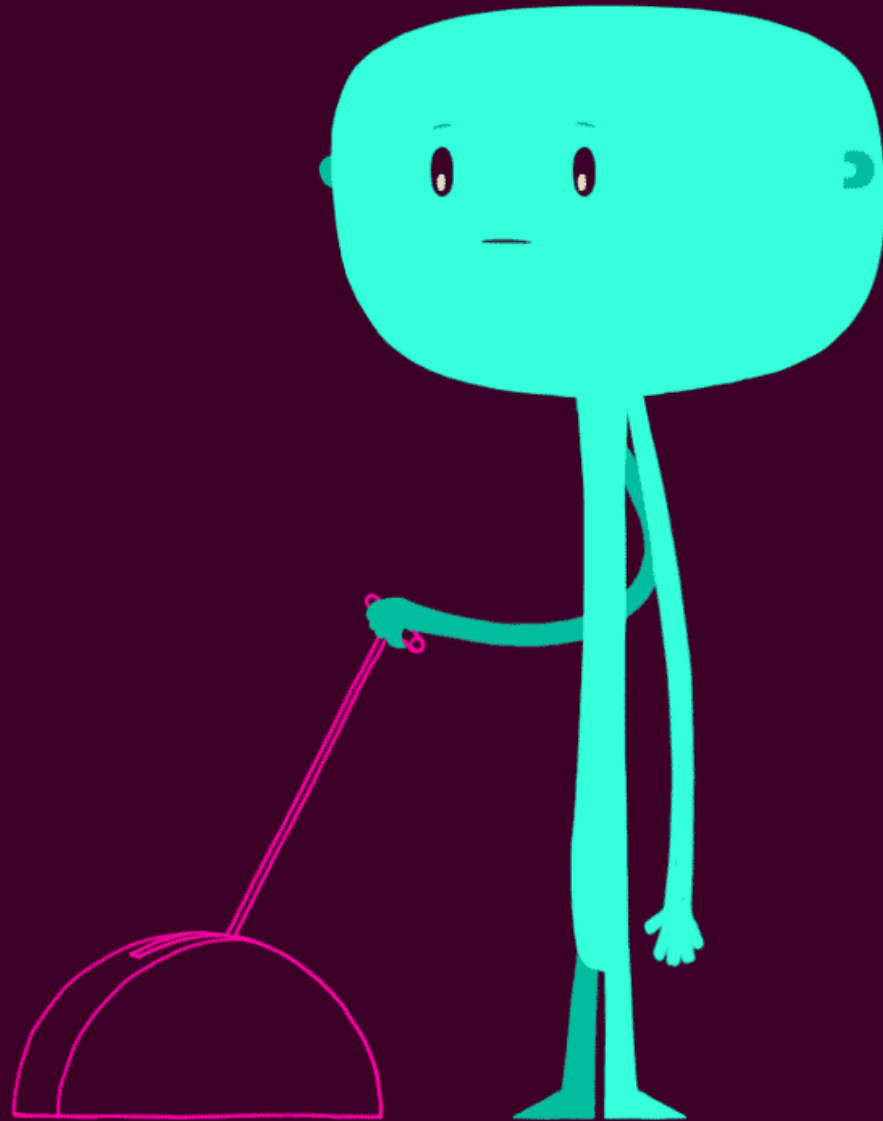


A black hole is depicted as a dark, circular void in the center of the image. It is surrounded by a bright, glowing ring of blue light, representing the accretion disk. The background is a vast field of stars, with many appearing as bright white and yellow points of light, and some as smaller, dimmer stars in various colors like green and orange. The overall scene is set in a dark, starry space.

Black Holes

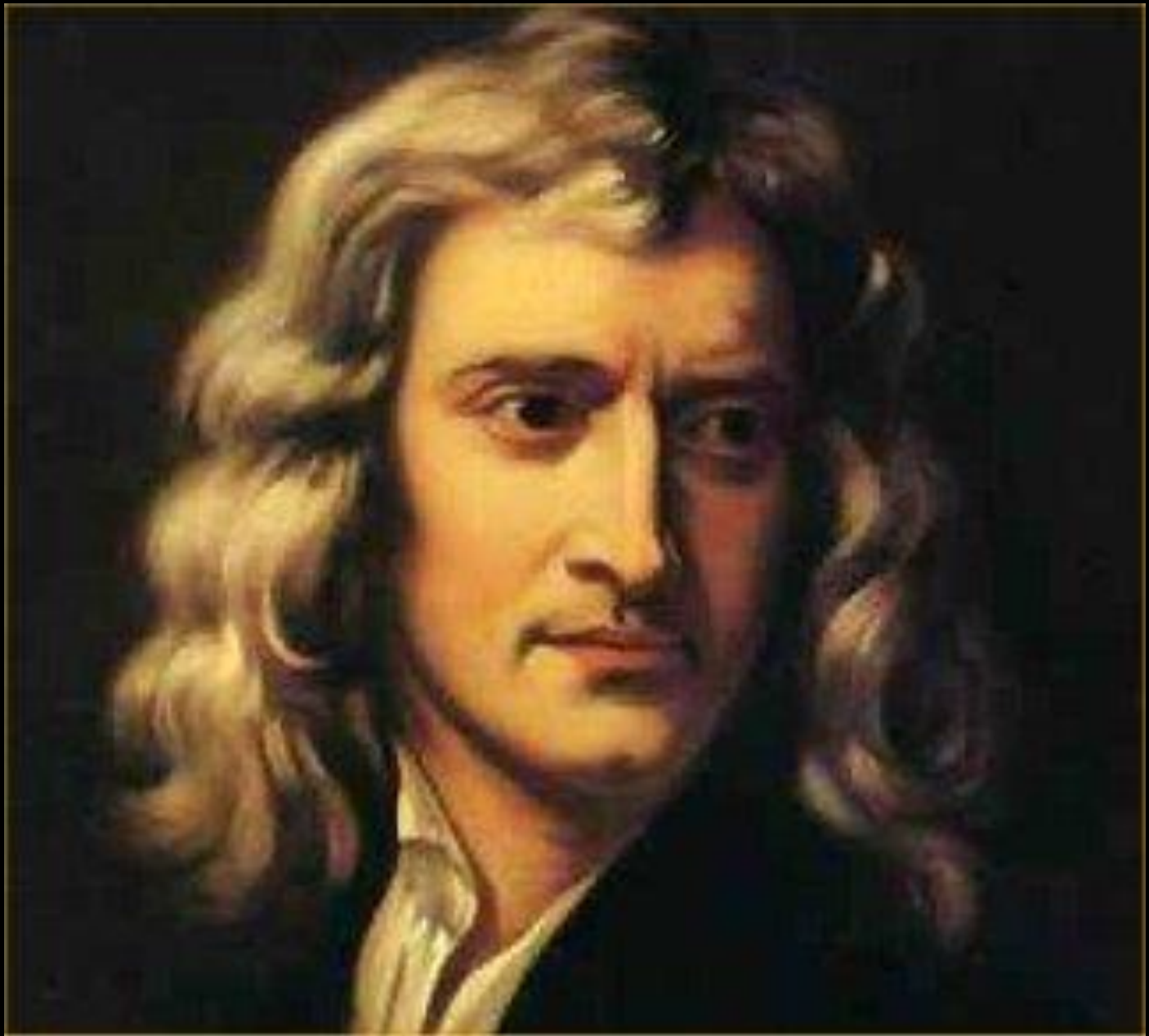




Aristotle

- 384 BC – 322 BC
- Elements move toward their natural place

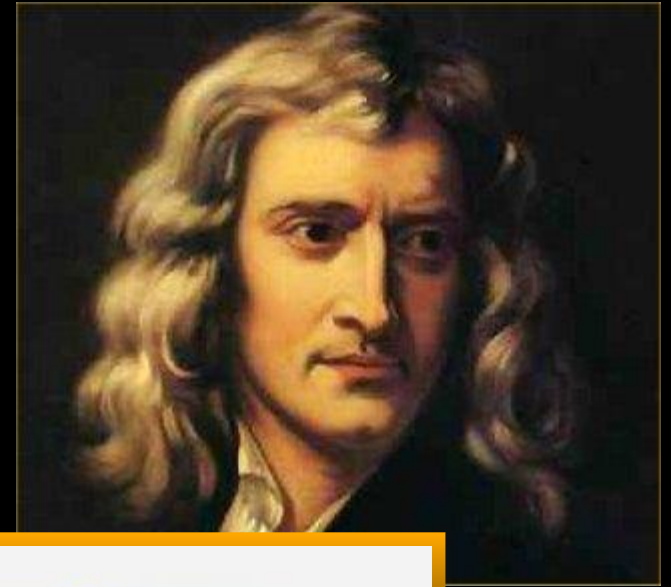






Isaac Newton

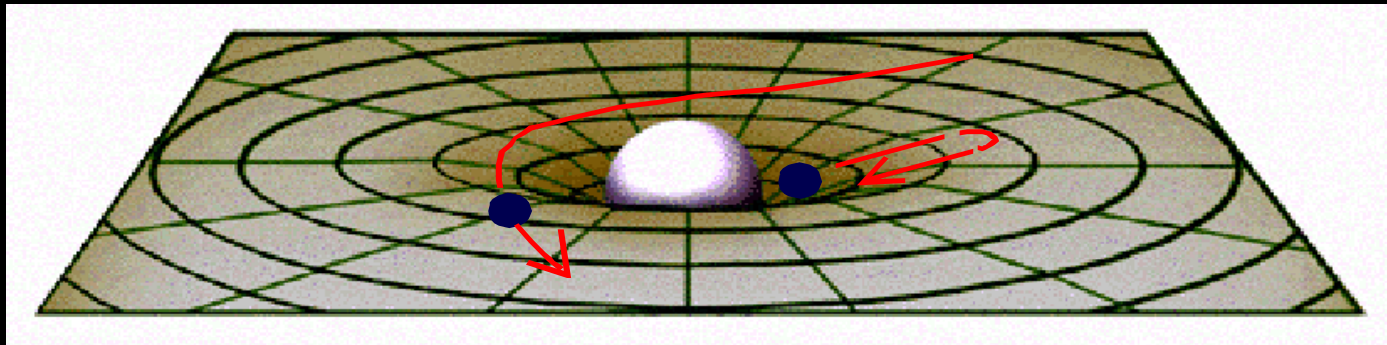
- 1642 –1727
- Gravity is a force that acts over a distance





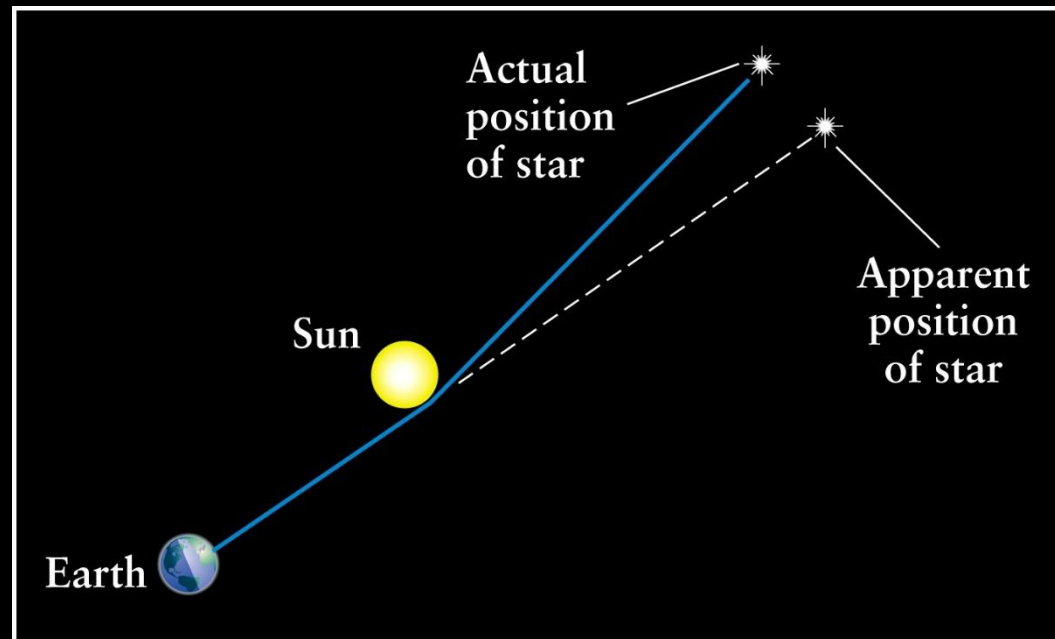
Albert Einstein

- 1879 – 1955
- Gravity is a distortion of space and time

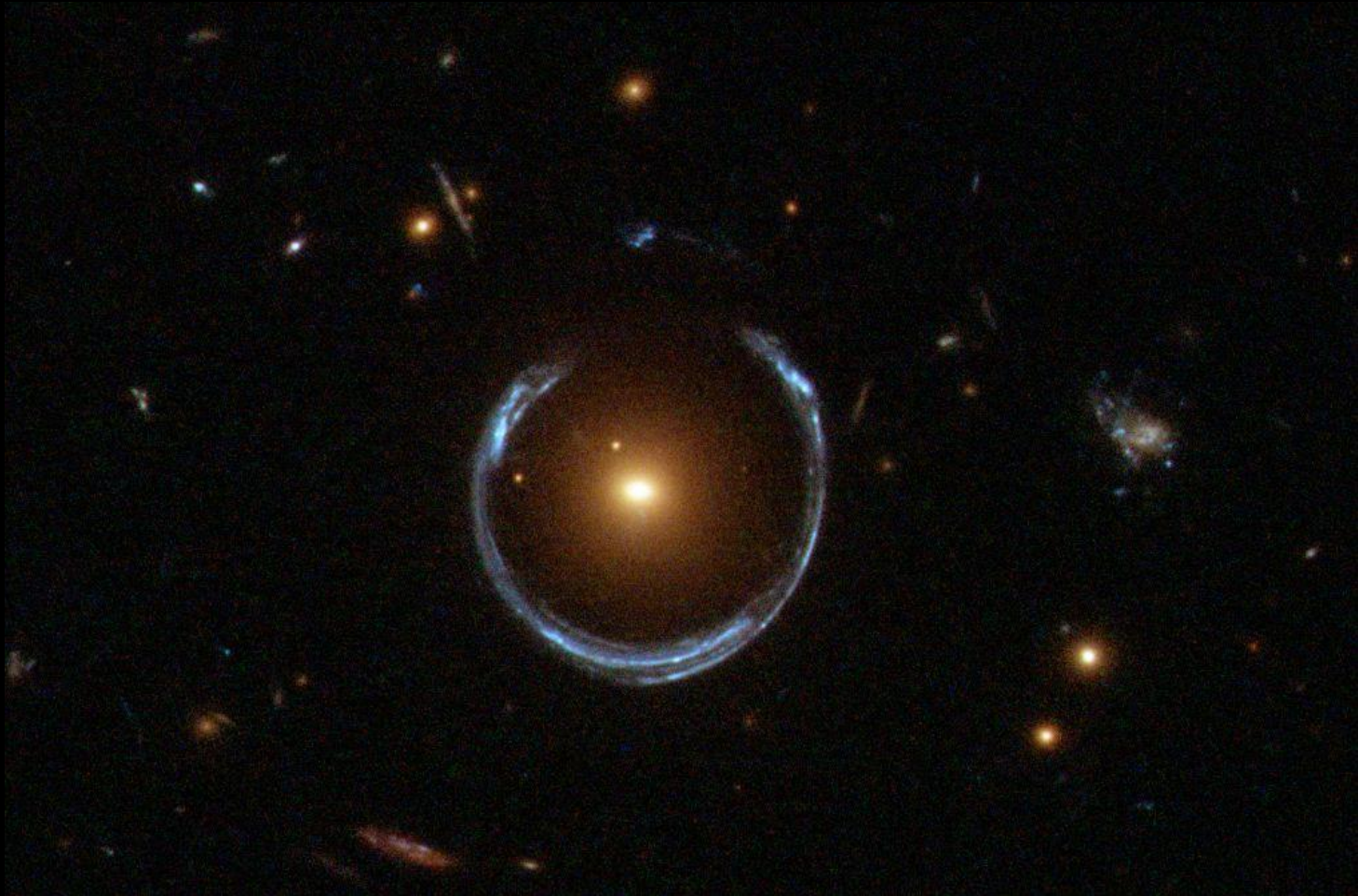


Observations confirming the predictions of general relativity

- **gravitational lensing** (bending of light by gravity) confirmed during a solar eclipse in 1919



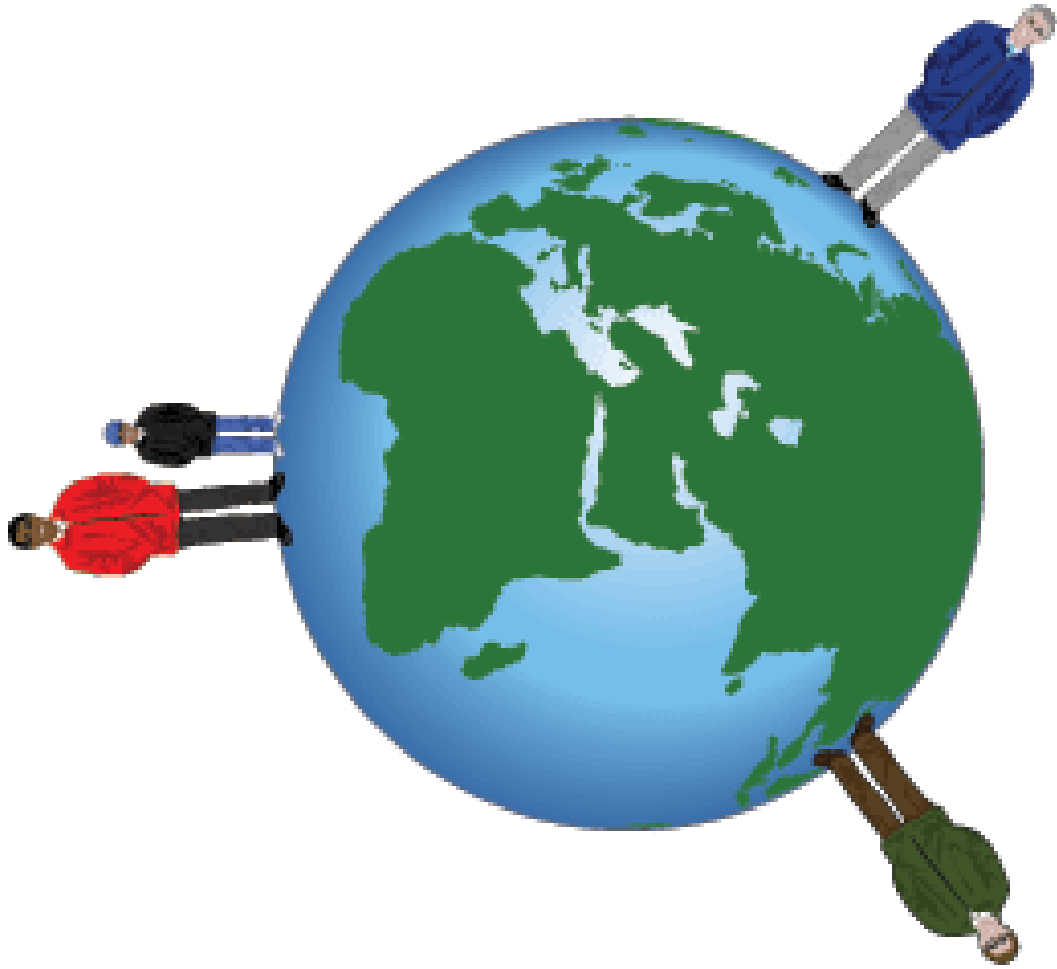
Gravitational Lensing

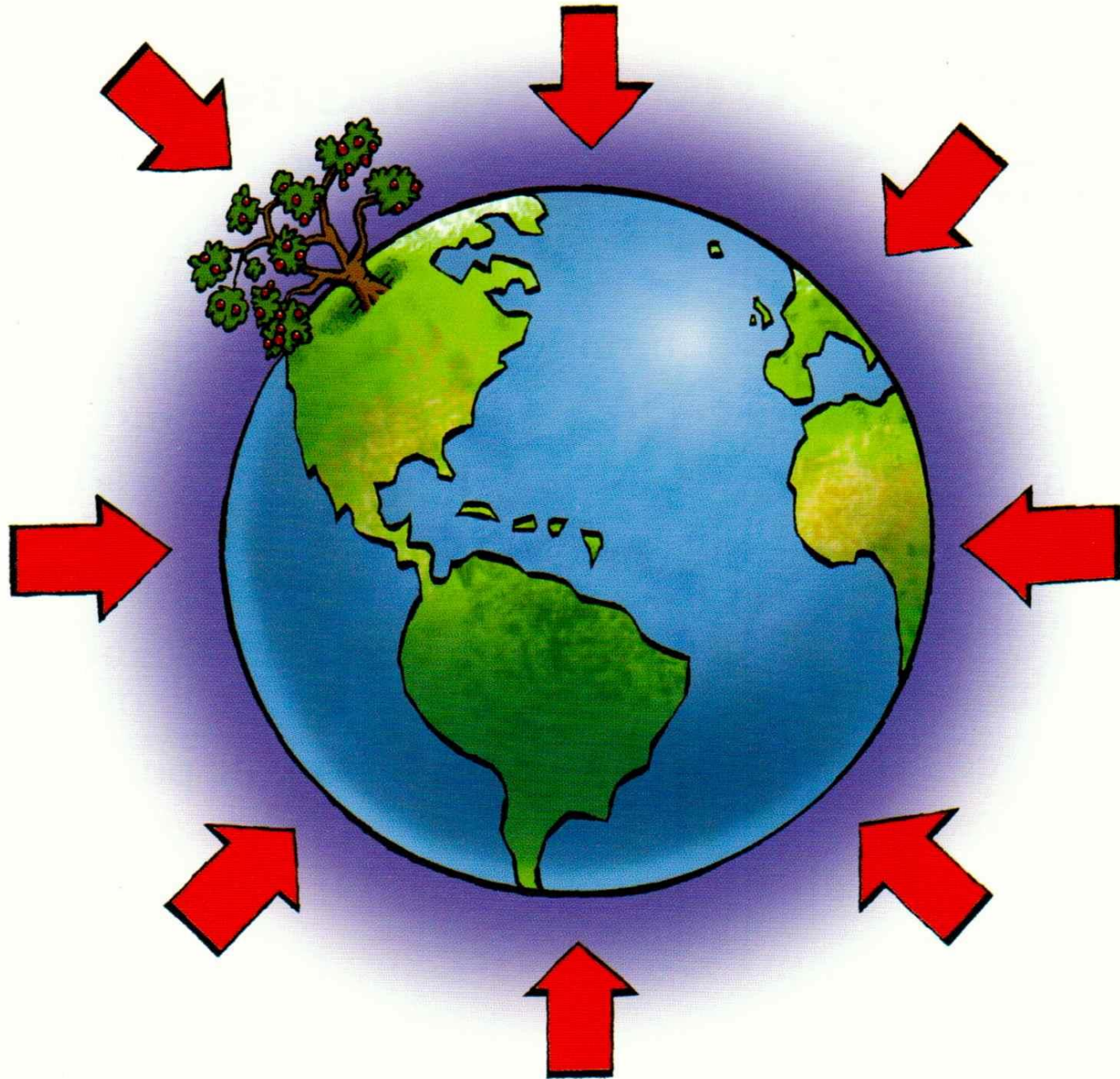




Gravity Questions

- Point at student living in Cape Town South Africa.





Gravity Questions

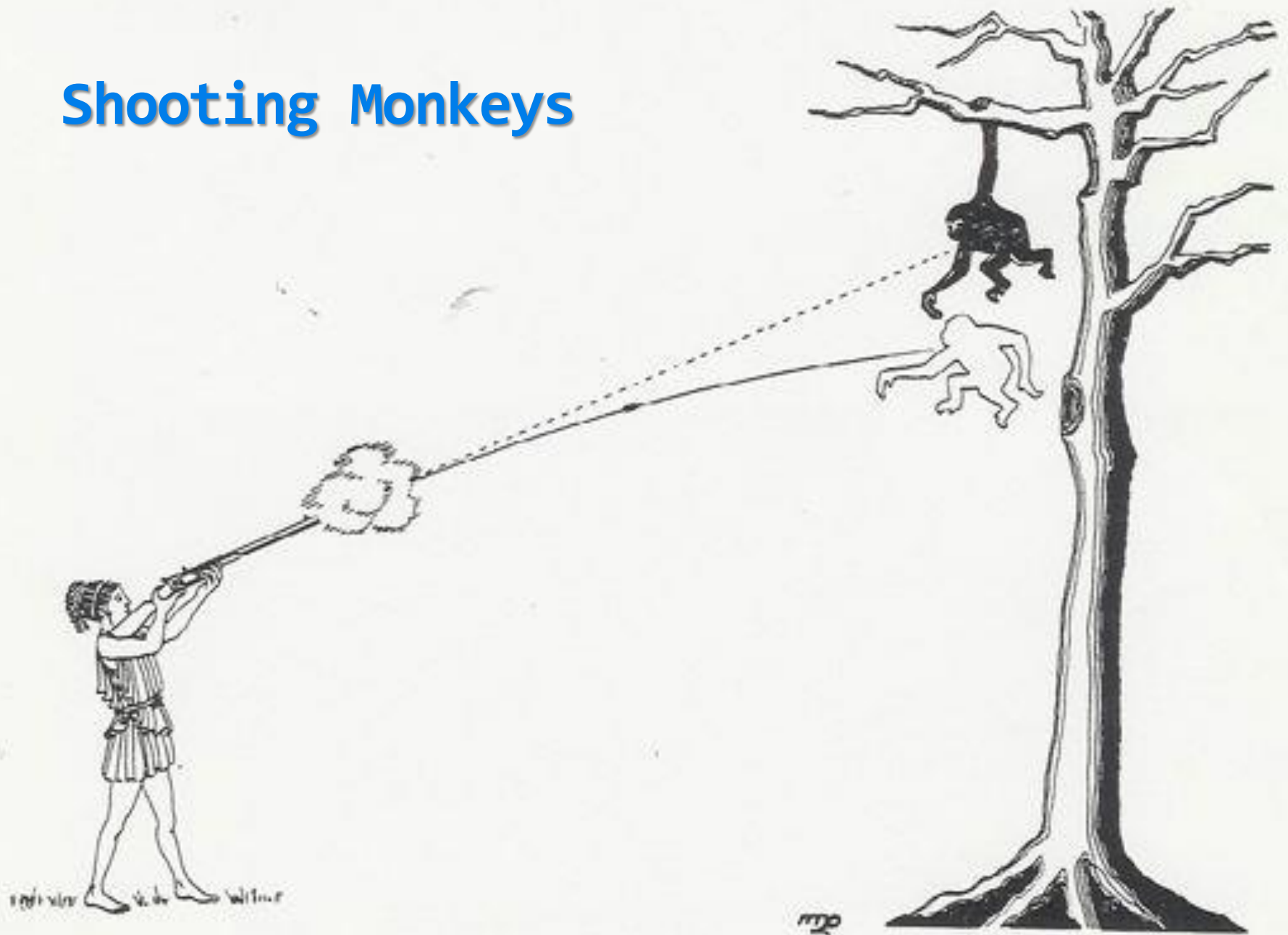
- Point at student living in Cape Town South Africa.
- Do heavier things fall faster than lighter things?



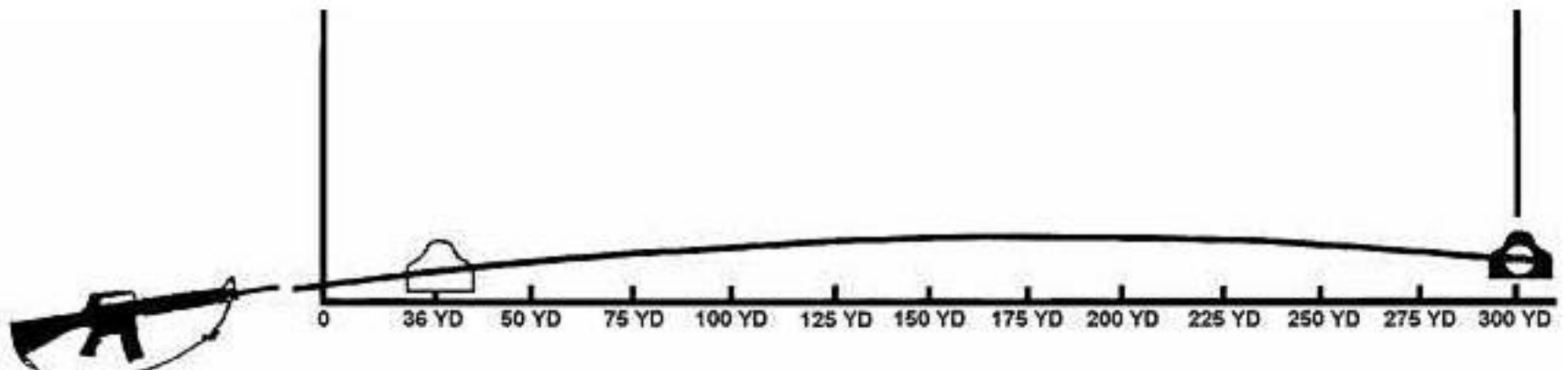
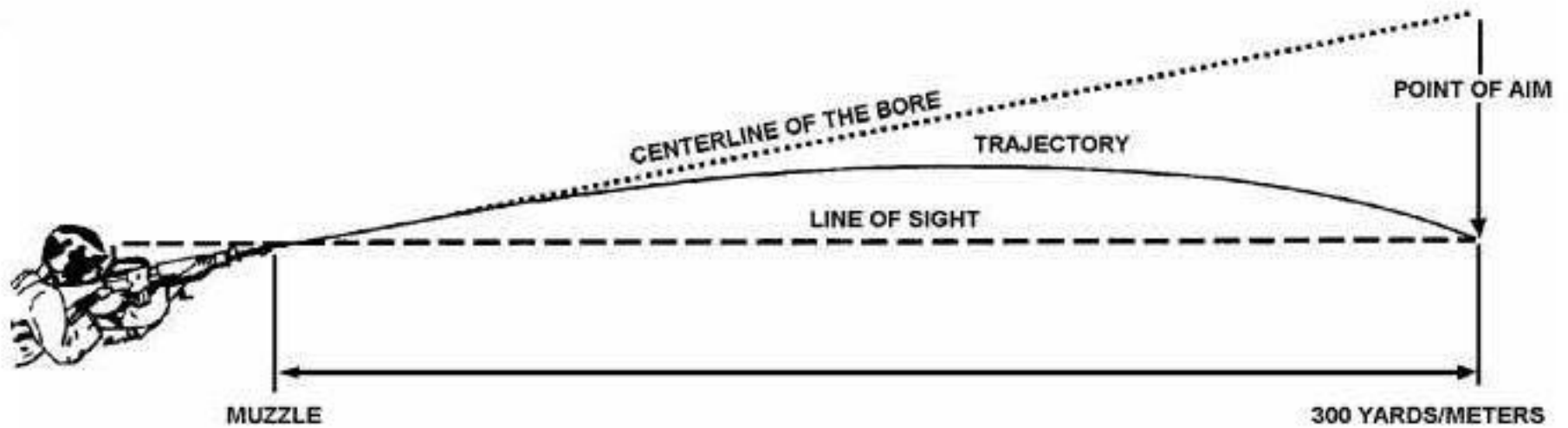
Gravity Questions

- Point at student living in Cape Town South Africa.
- Do heavier things fall faster than light things?
- Why doesn't a bullet fired from a gun fall?

Shooting Monkeys



Aiming a Rifle

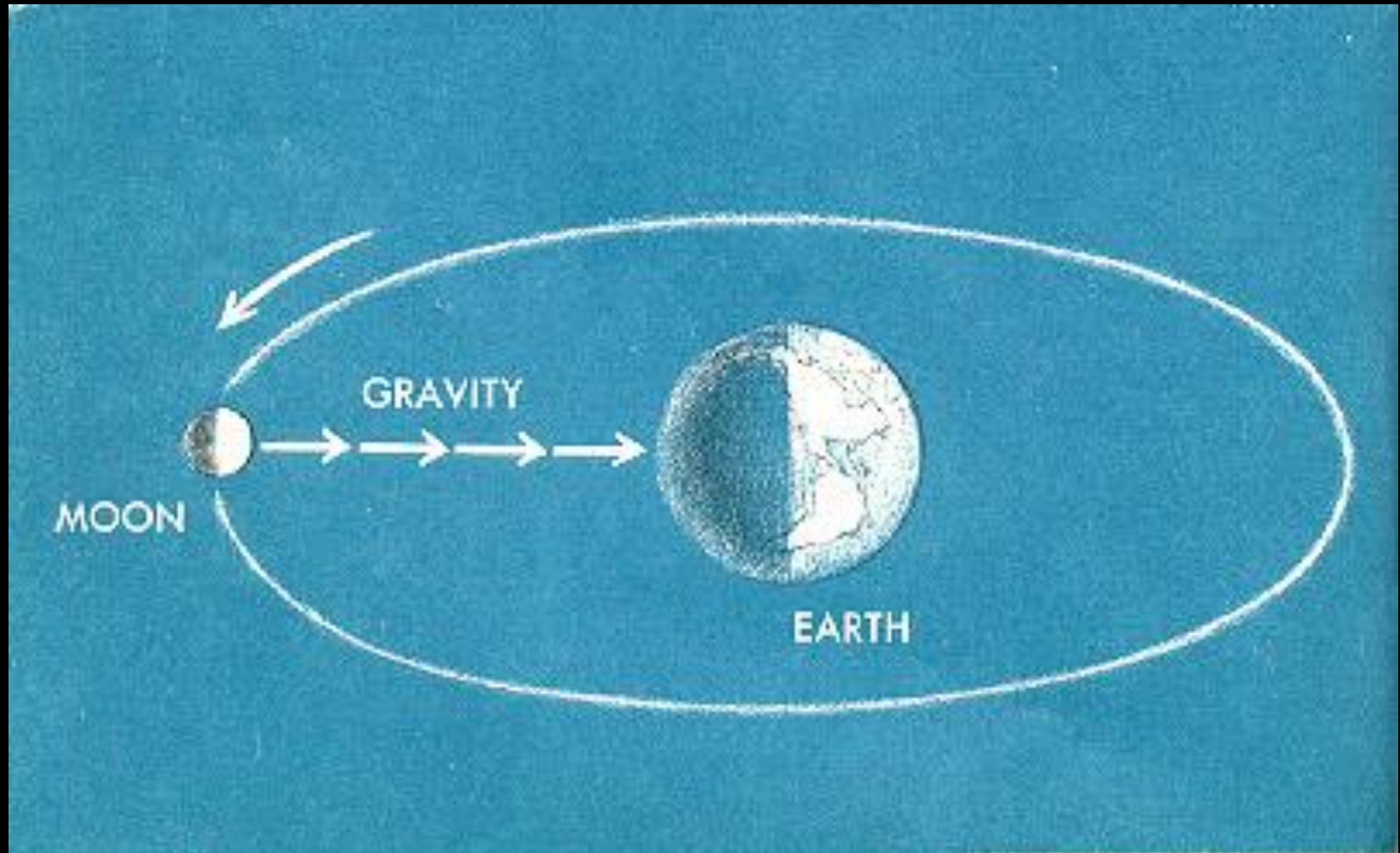




Gravity Questions

- Point at student living in Cape Town South Africa.
- Do heavier things fall faster than lighter things?
- Why doesn't a bullet fired from a gun fall?
- Why doesn't the Moon (or a satellite) fall to Earth?

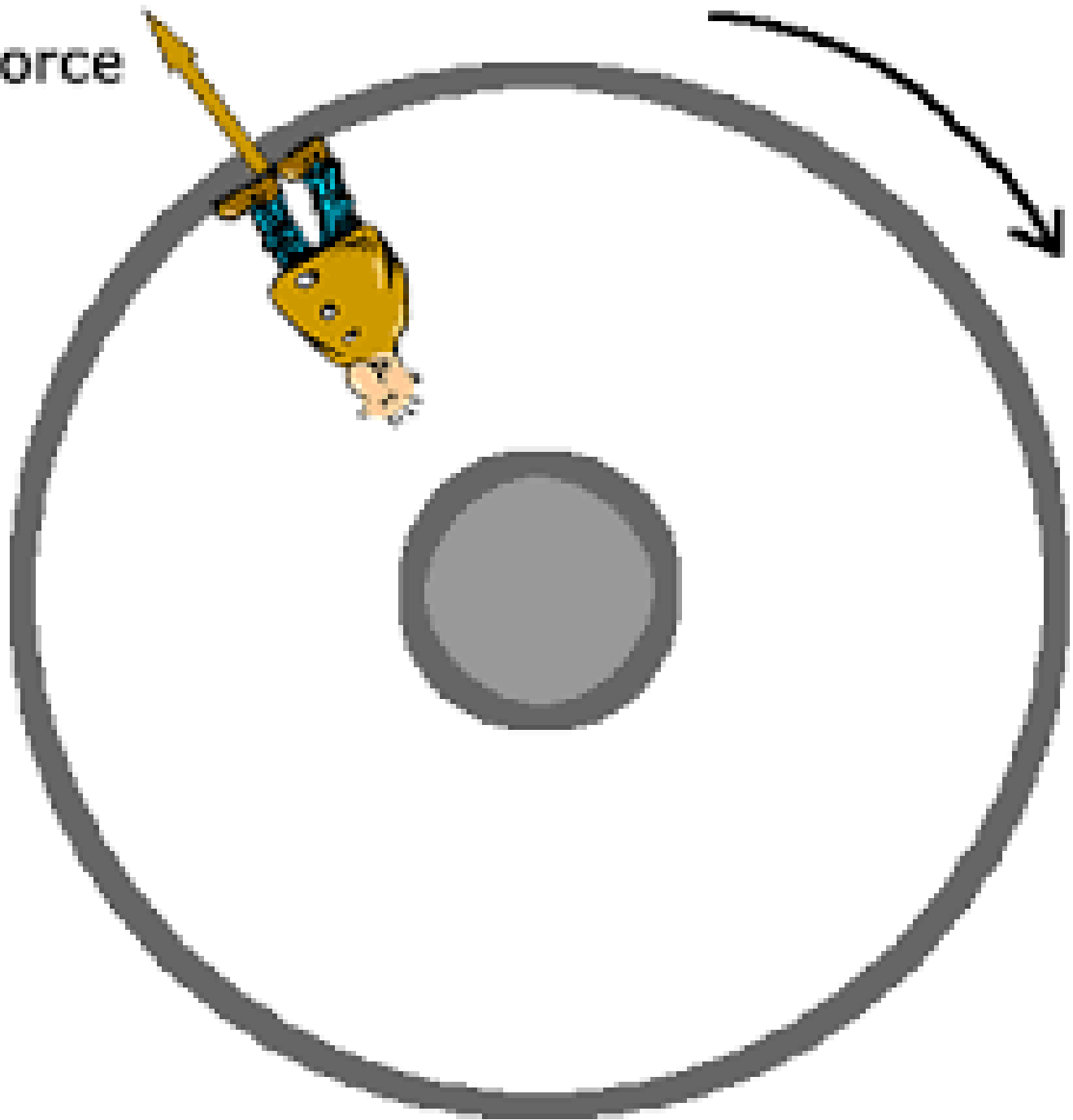
The Moon in Orbit



Gravity Questions

- Point at student living in Cape Town South Africa.
- Do heavier things fall faster than lighter things?
- Why doesn't a bullet fired from a gun fall?
- Why doesn't the Moon (or a satellite) fall to Earth?
- Why is there no gravity on the Space Station?

Force



Gravity Questions

- Point at student living in Cape Town South Africa.
- Do heavier things fall faster than lighter things?
- Why doesn't a bullet fired from a gun fall?
- Why doesn't the Moon (or a satellite) fall to Earth?
- Why is there no gravity on the Space Station?
- If I throw a rock or shoot a bullet at the Moon will it hit it?

Escape Velocity

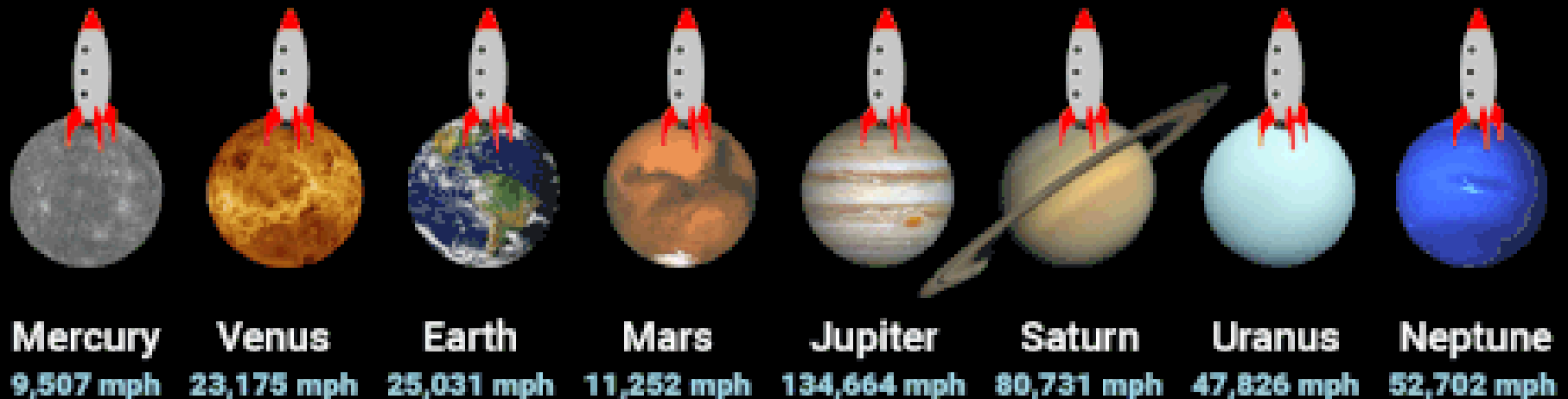
- How fast would a bullet need to go to leave Earth?

25,000 MPH!

Escape Velocity

Body	Escape Velocity in Miles/Hour
Ceres	1,430 mph
The Moon	5,320 mph
Earth	25,038 mph
Jupiter	133,018 mph
Sun	1,381,600 mph
Sirius B (a white dwarf star)	11,625,120 mph

HOW FAST A ROCKET WOULD HAVE TO GO TO LEAVE EVERY PLANET



I HAVE NO FRIENDS



I ATE THEM ALL...

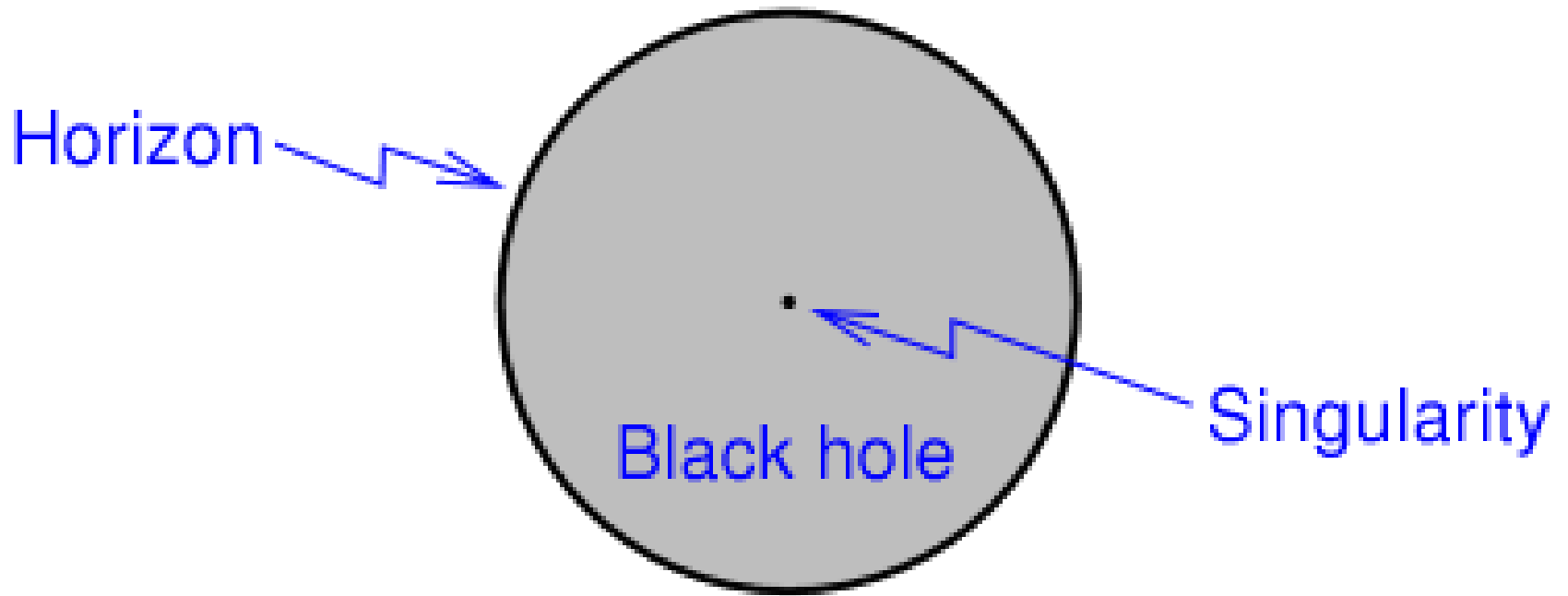
What is a Black Hole?



Mass is so great in such a small volume that the velocity needed to escape is greater than the speed of light

An unimaginably dense region of space where space is curved so completely that nothing, not even light, can escape.

Black Hole Structure





Falling into a Black Hole



Falling into a Black Hole



Not to Scale

Falling into a Black Hole



Falling into a Black Hole









There are 200 billion stars in our galaxy, the Milky Way

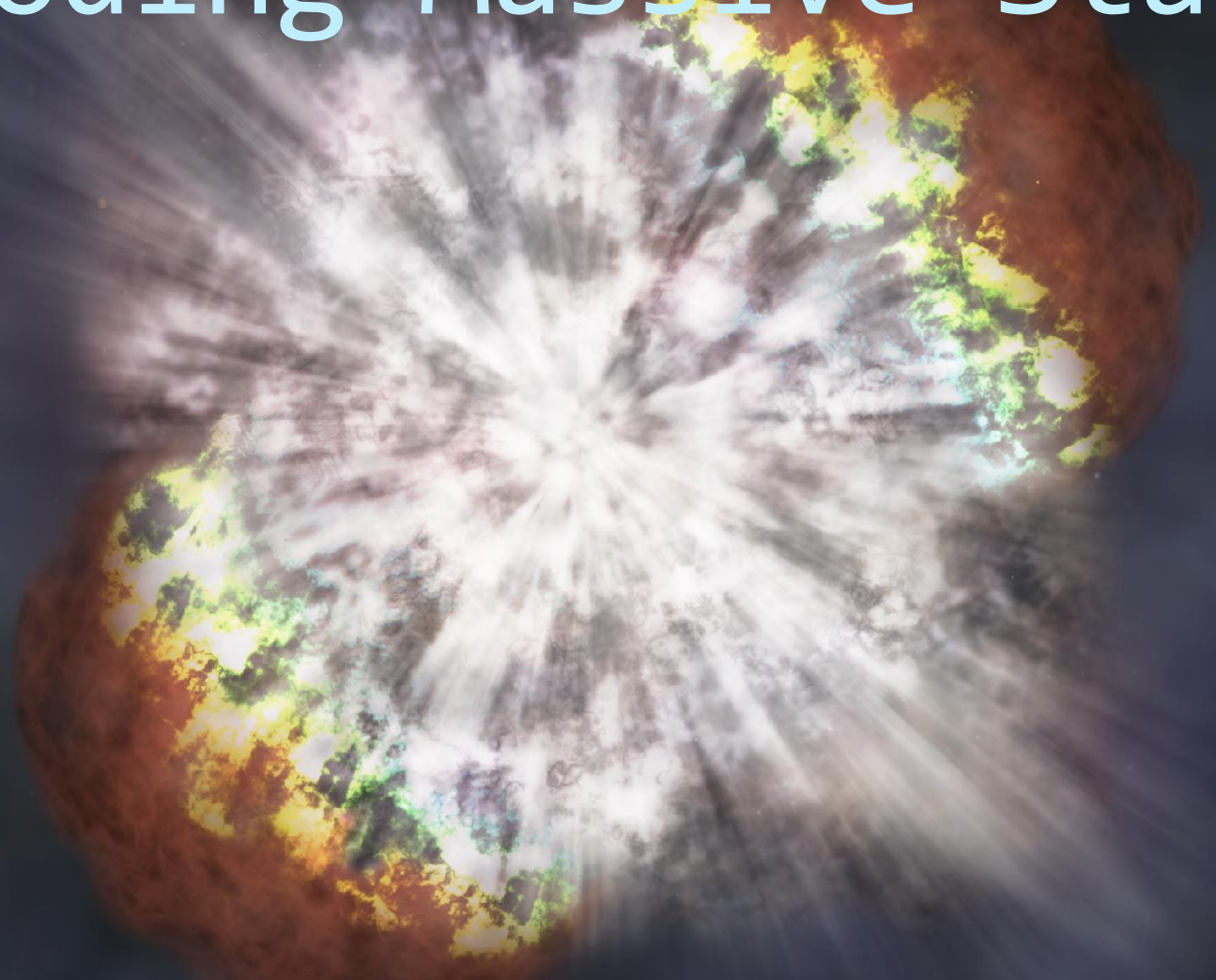
There are also millions of black holes

Including one giant black hole at the very
center.



Where do Black
Holes come
from?

Exploding Massive Star



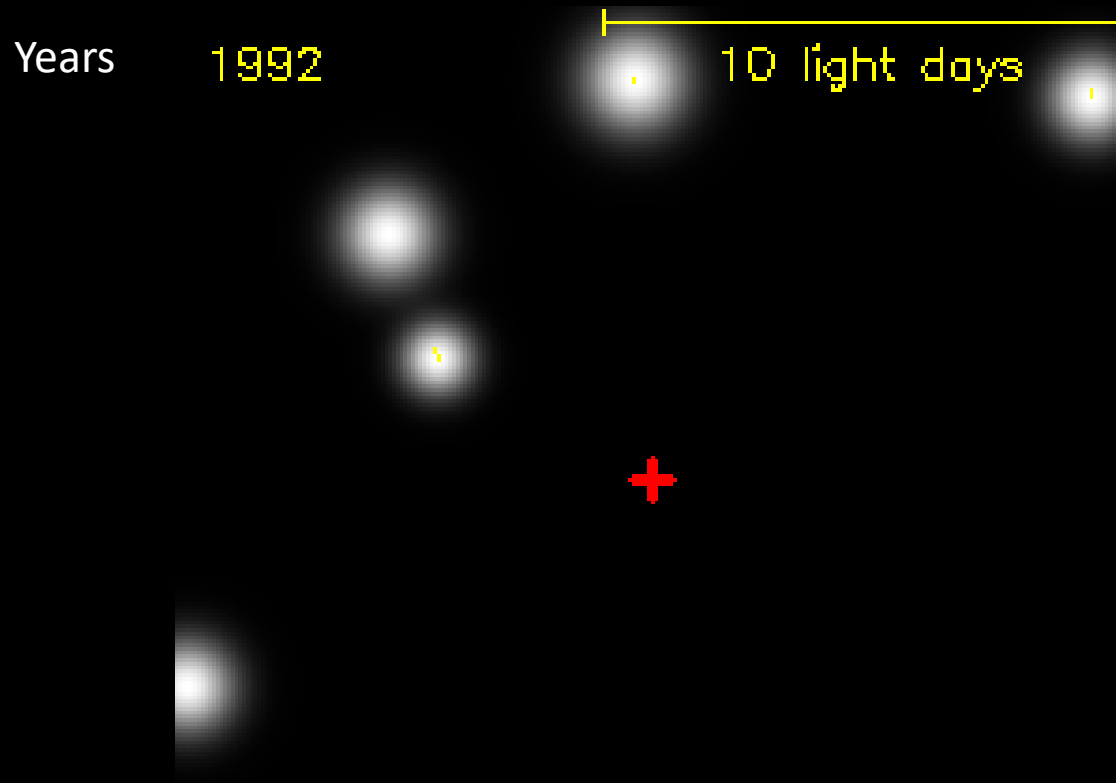
SUPERNOVA!

If You Can't See a Black
Hole, how do We Know it's
there?

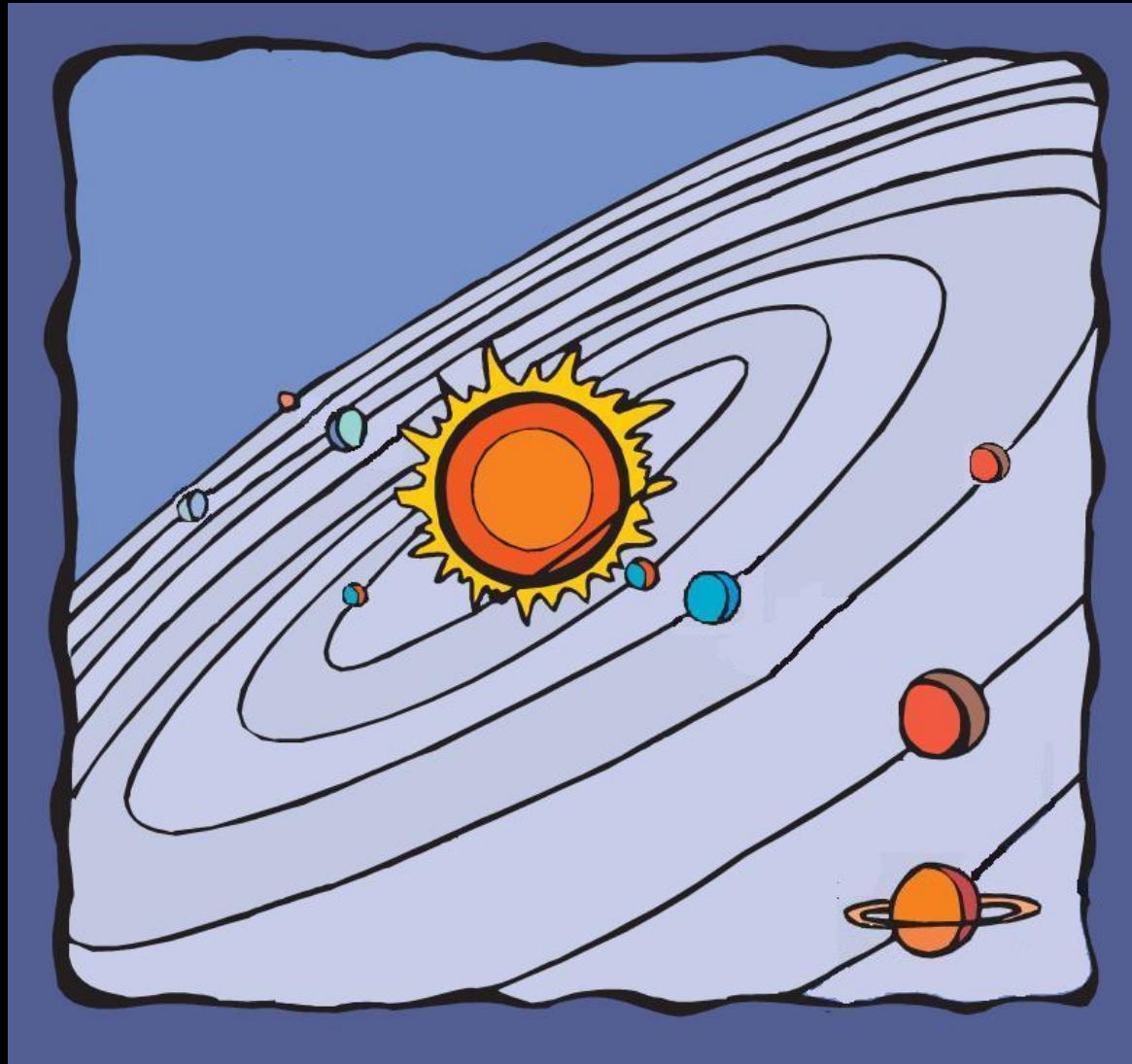
How Do We Know a Black Hole is There?

- Flares caused by stuff falling into the Black Hole.
- Spotting the jets coming off the Black Hole.
- Gravitational Lensing
- Weird motion of stars around the Black Hole.

How do we know it's there?

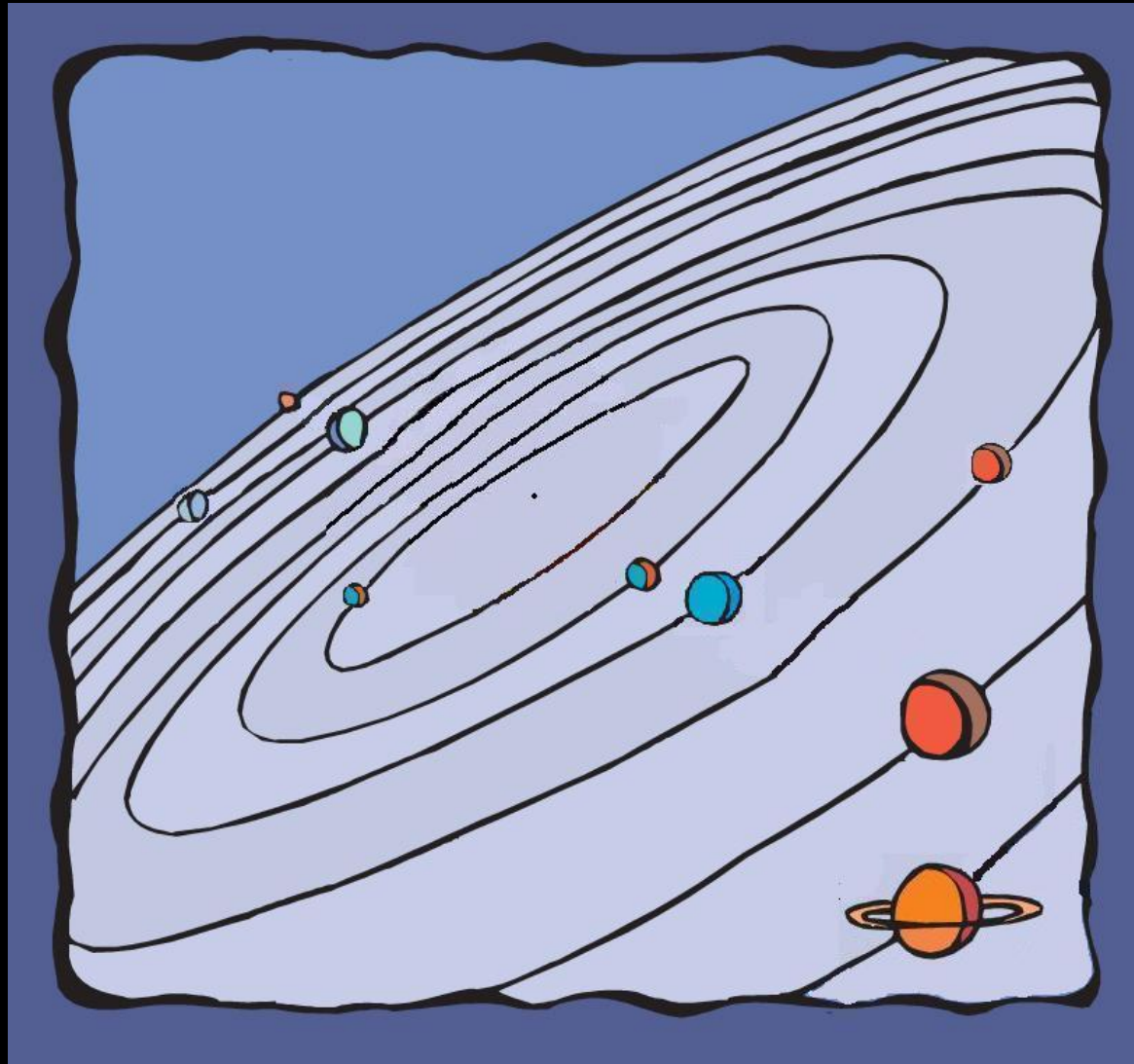


What would happen if the Sun
was...



Not to Scale

... changed into a Black Hole?



Not to Scale

A cosmic scene featuring a dark background filled with numerous stars of varying colors (white, yellow, orange, red). Two prominent galaxies are visible: a large, face-on spiral galaxy in the upper center and a smaller, edge-on galaxy in the lower center. The text 'The' is centered in the upper half of the image.

The

END

Mass



Concept of Mass

On Earth, let's say you weigh 150 lbs.

On the Moon, you'd weigh 25 lbs.

On Jupiter, you'd weigh 350 lbs.

On the Sun, you'd weigh 4,000 lbs.





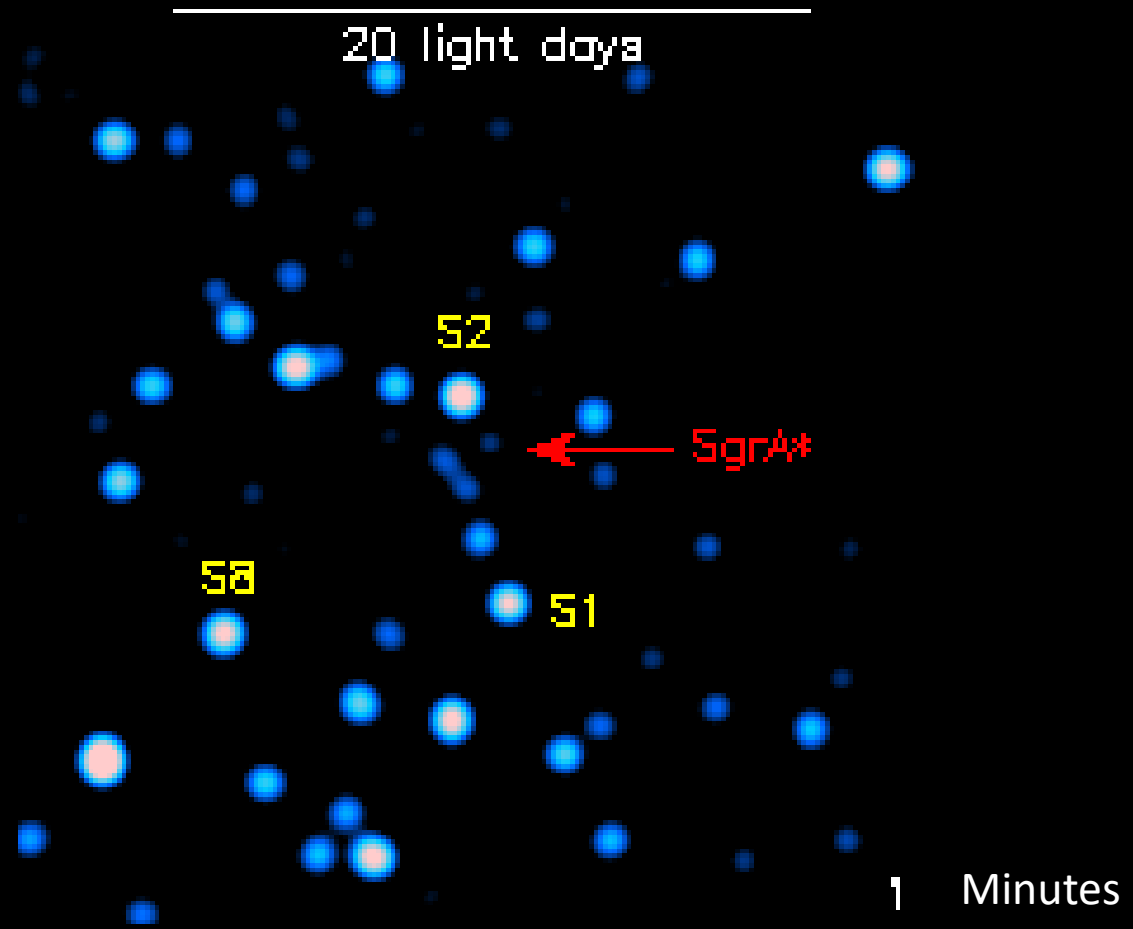
Weight 150 Pounds
Mass 68 Kilograms

Weight 25 Pounds
Mass 68 Kilograms



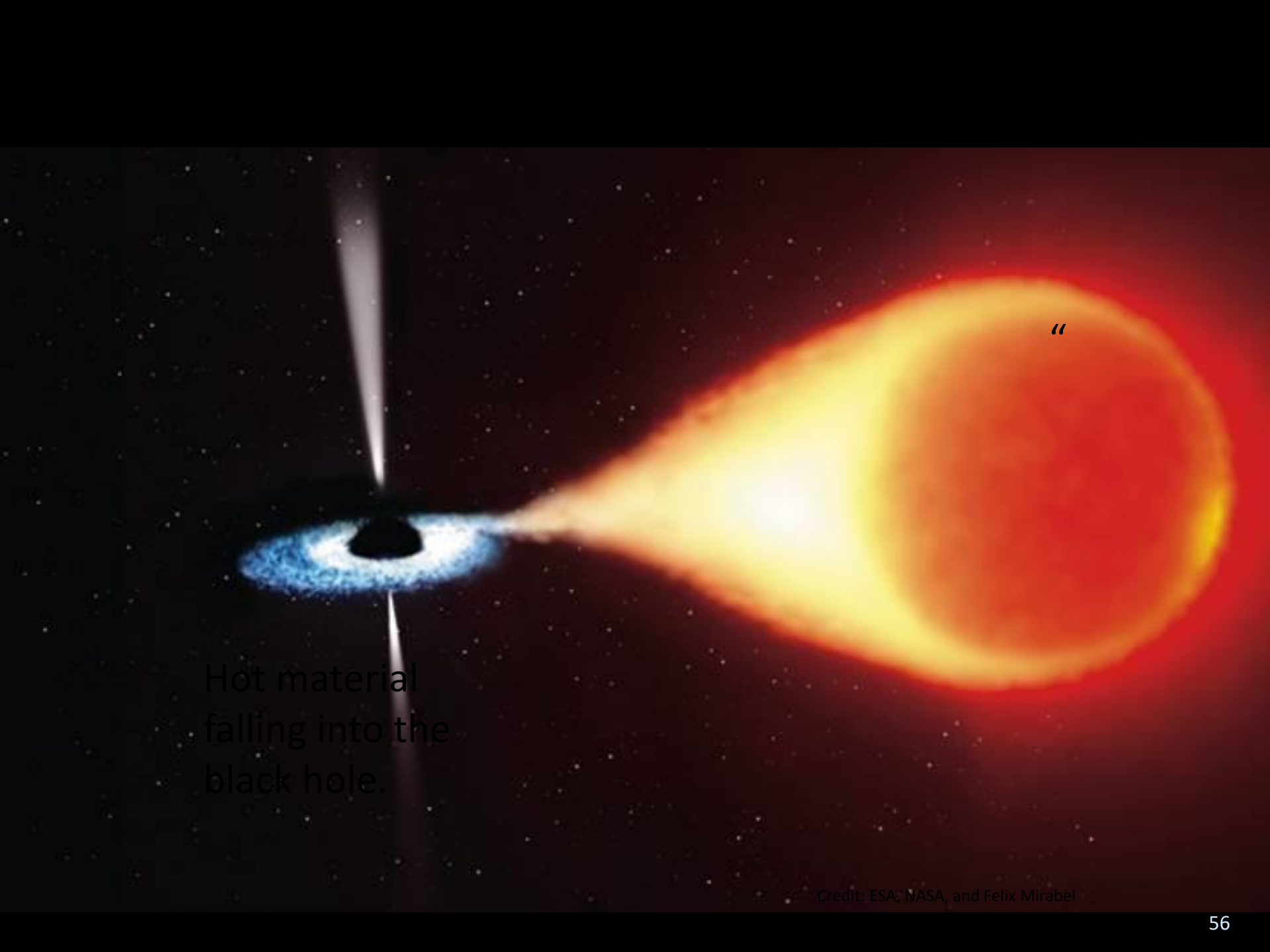
How Do We Know a Black Hole is There?

- Flares caused by stuff falling into the Black Hole.



How Do We Know a Black Hole is There?

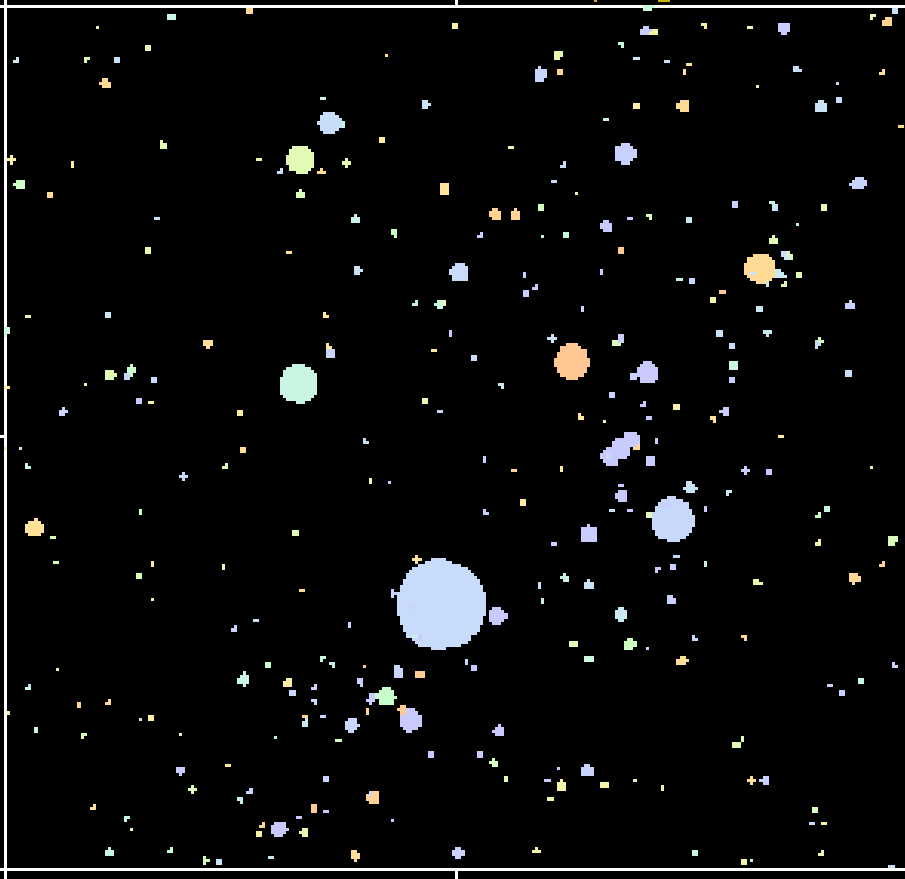
- Flares caused by stuff falling into the Black Hole.
- Spotting the jets coming off the Black Hole.



Hot material
falling into the
black hole.

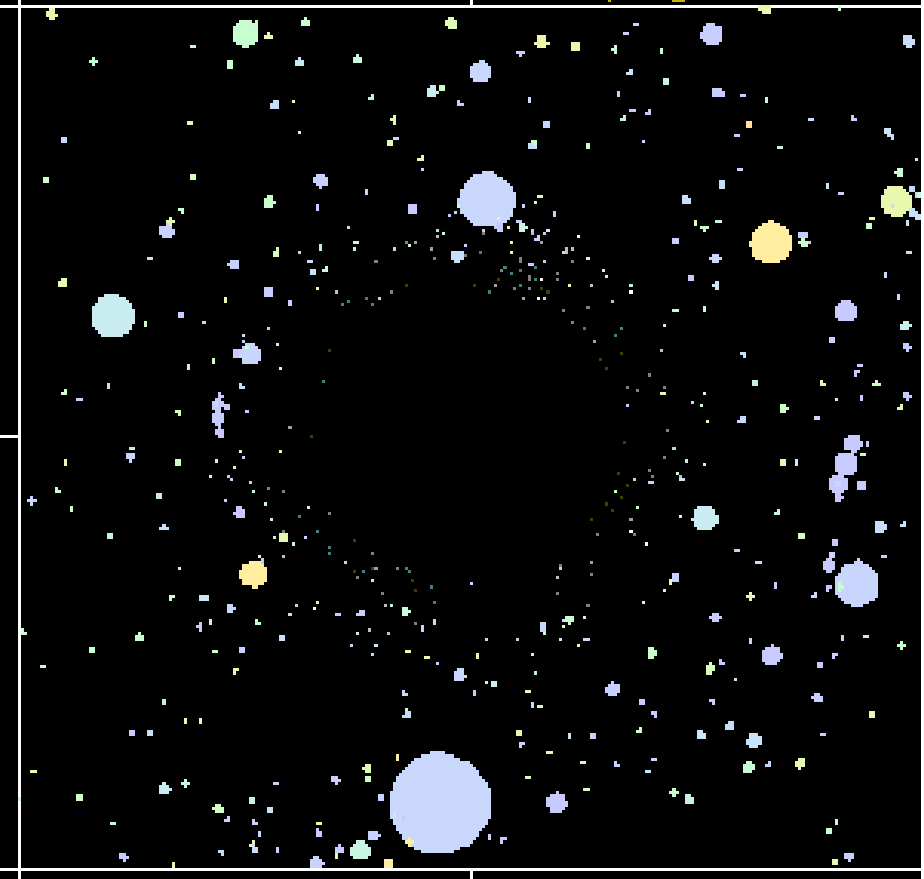
RJN

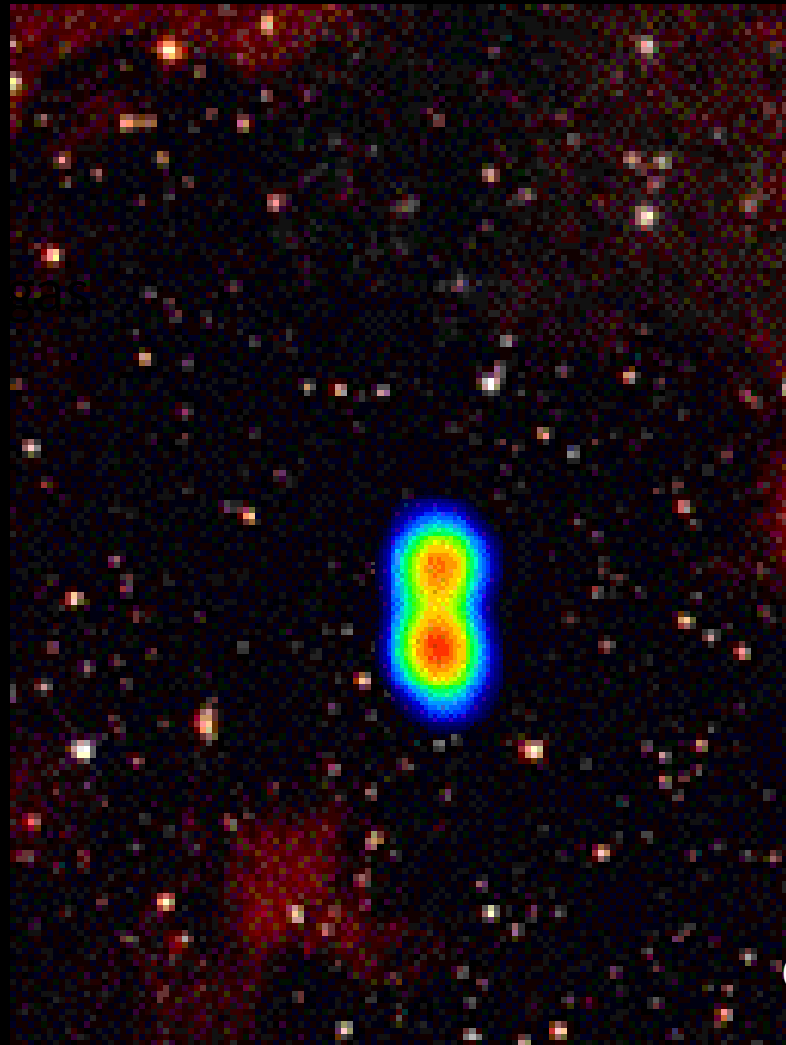
$r/R_g = 1000.$



RJN

$r/R_g = 10.00$





One month

How Do We Know a Black Hole is There?

- Flares caused by stuff falling into the Black Hole.
- Spotting the jets coming off the Black Hole.
- Weird motion of stars around the Black Hole.

How Much Would You Weigh”?

On Earth, let’s say you weigh 150 lbs.

On the Moon, you’d weigh 25 lbs.

On Jupiter, you’d weigh 350 lbs.

On the Sun, you’d weigh 4,000 lbs.

Near a Black Hole,
you’d weigh over
20 TRILLION POUNDS !!!

