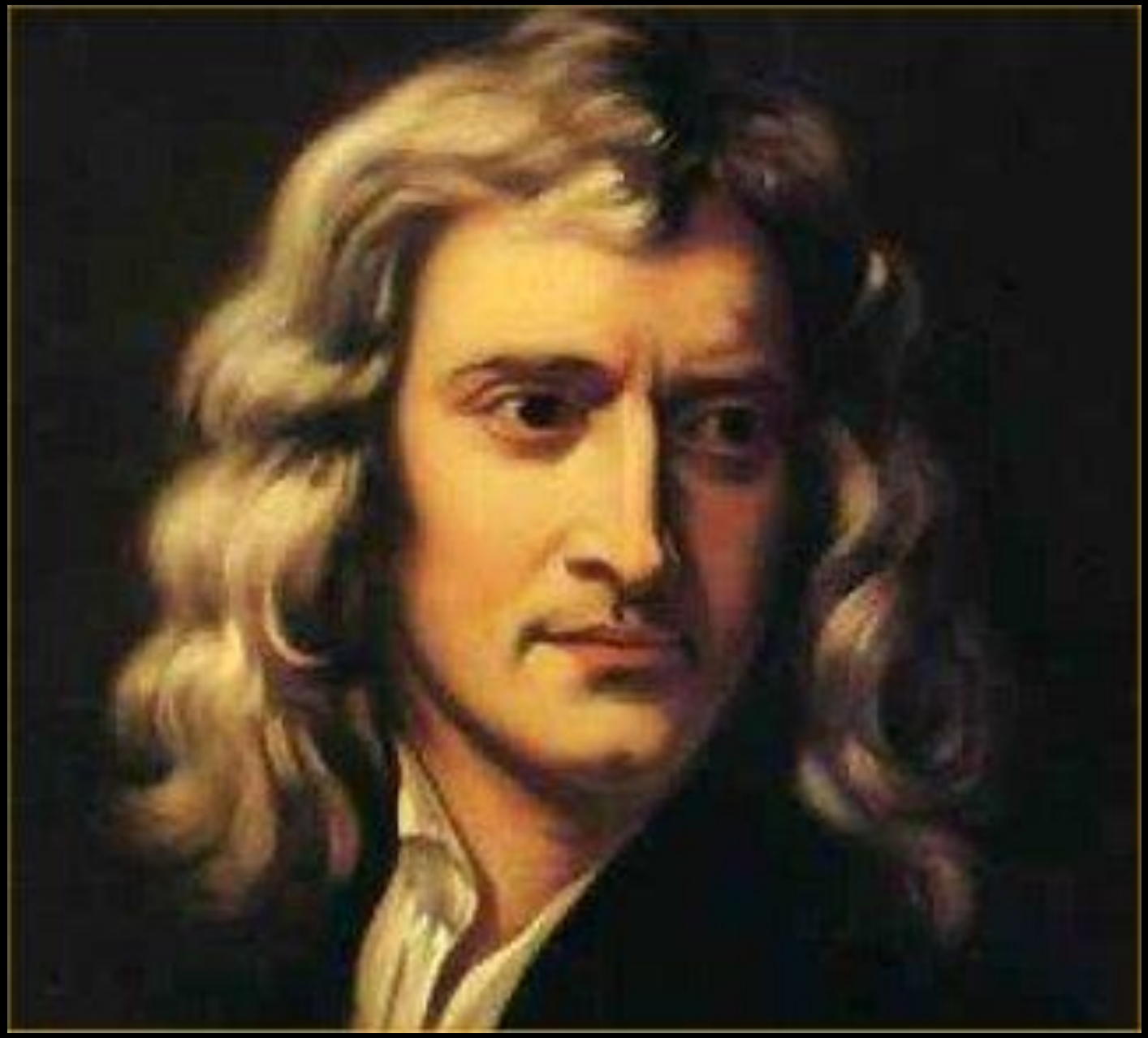
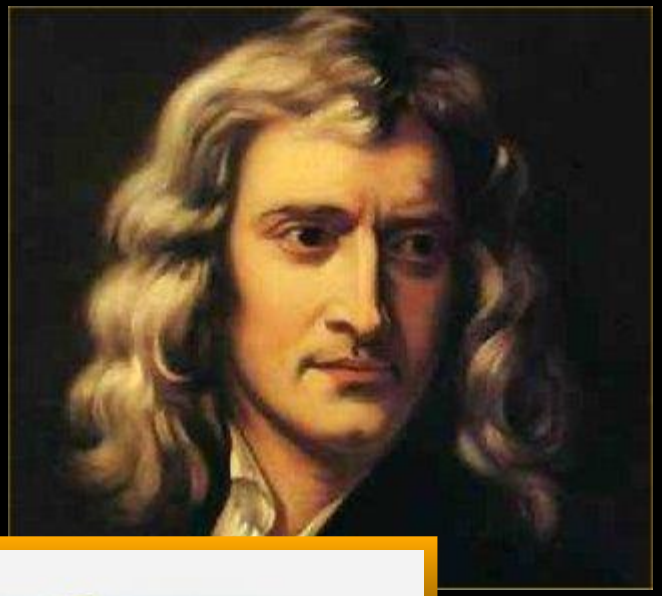
Aristotle

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

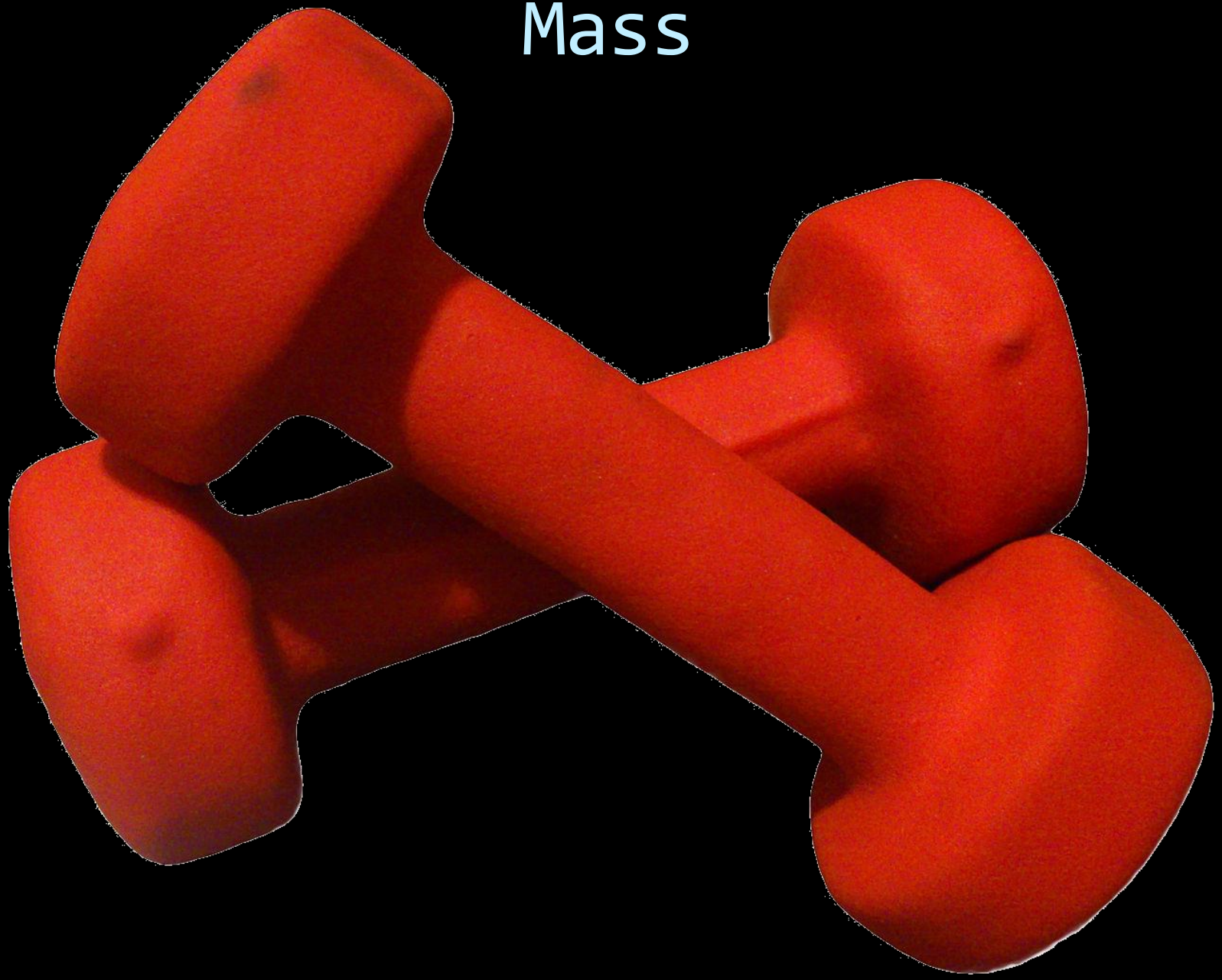


Isaac Newton



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

Mass



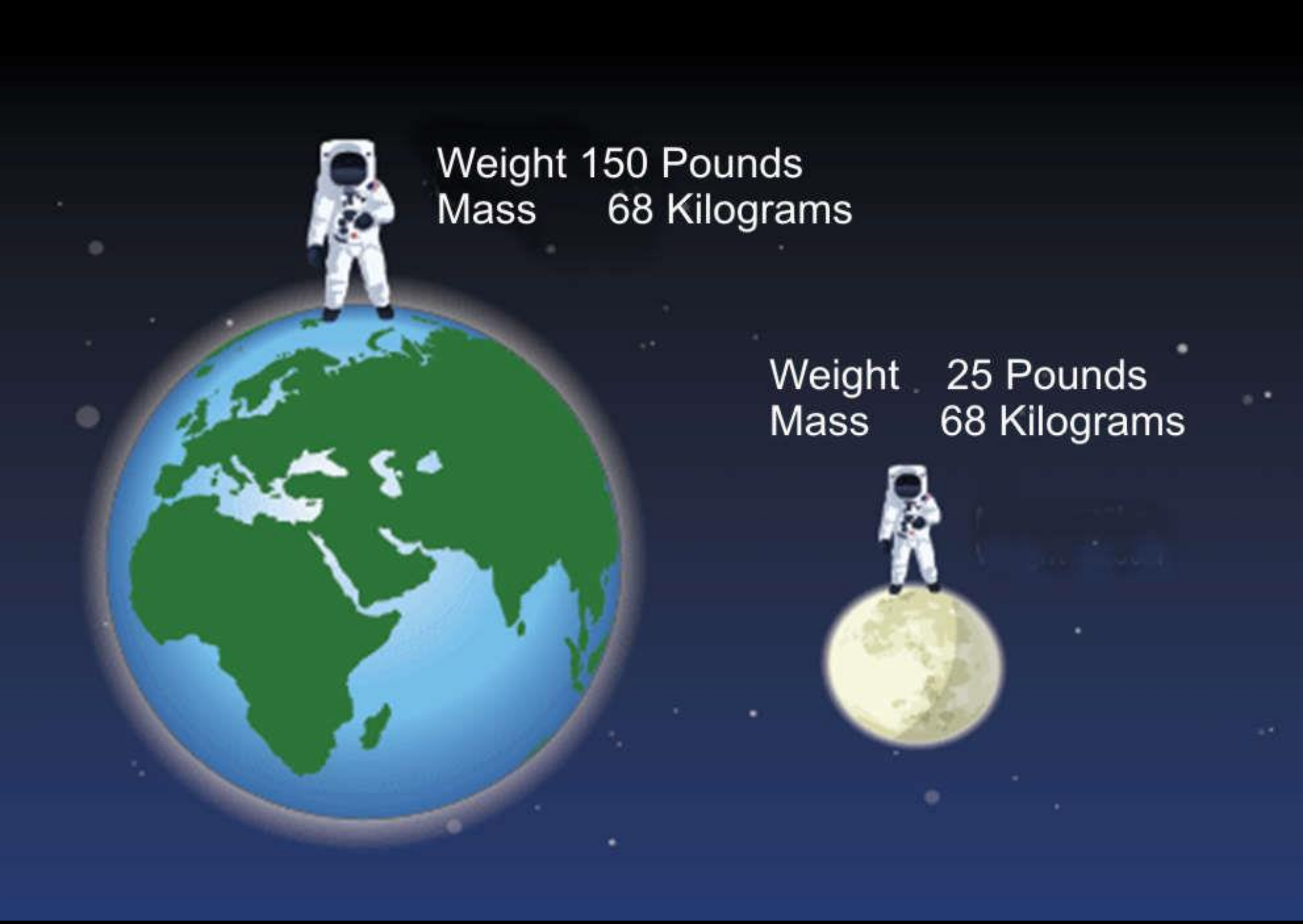
Concept of Mass

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

On the Moon, you'd weigh 25 lbs.

On Jupiter, you'd weigh 350 lbs.

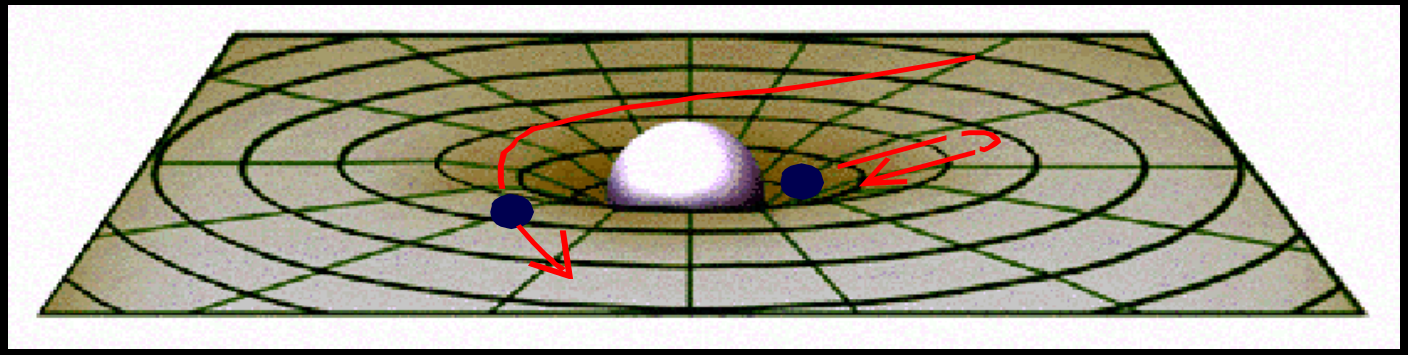
On the Sun, you'd weigh 4,000 lbs.


Weight 150 Pounds
Mass 68 Kilograms
Weight 25 Pounds
Mass 68 Kilograms


1912

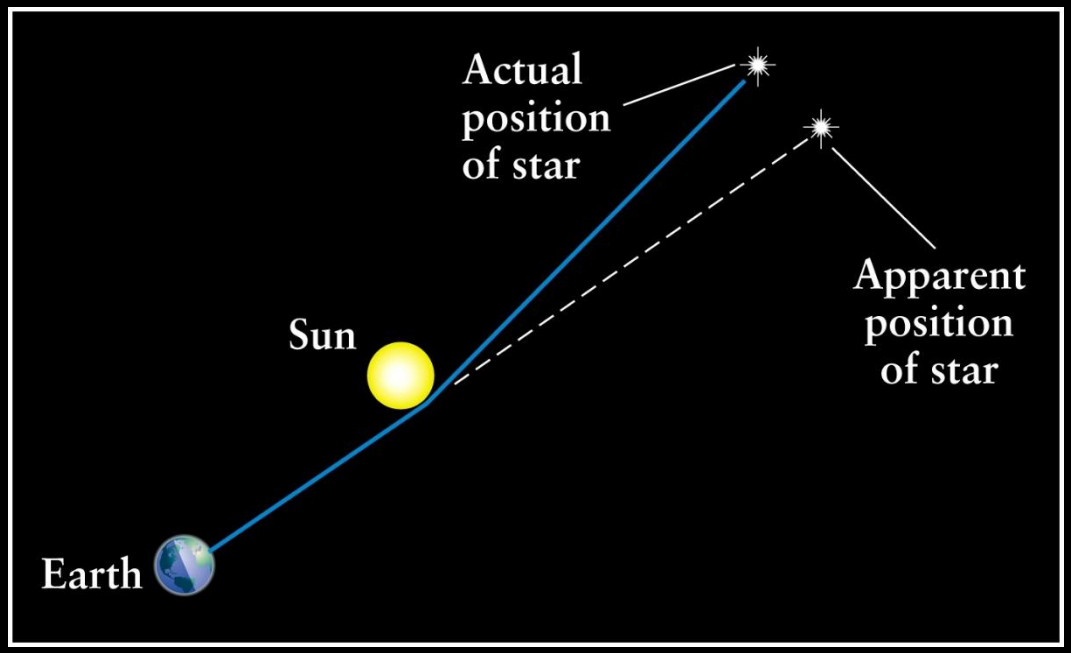
Albert Einstein

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

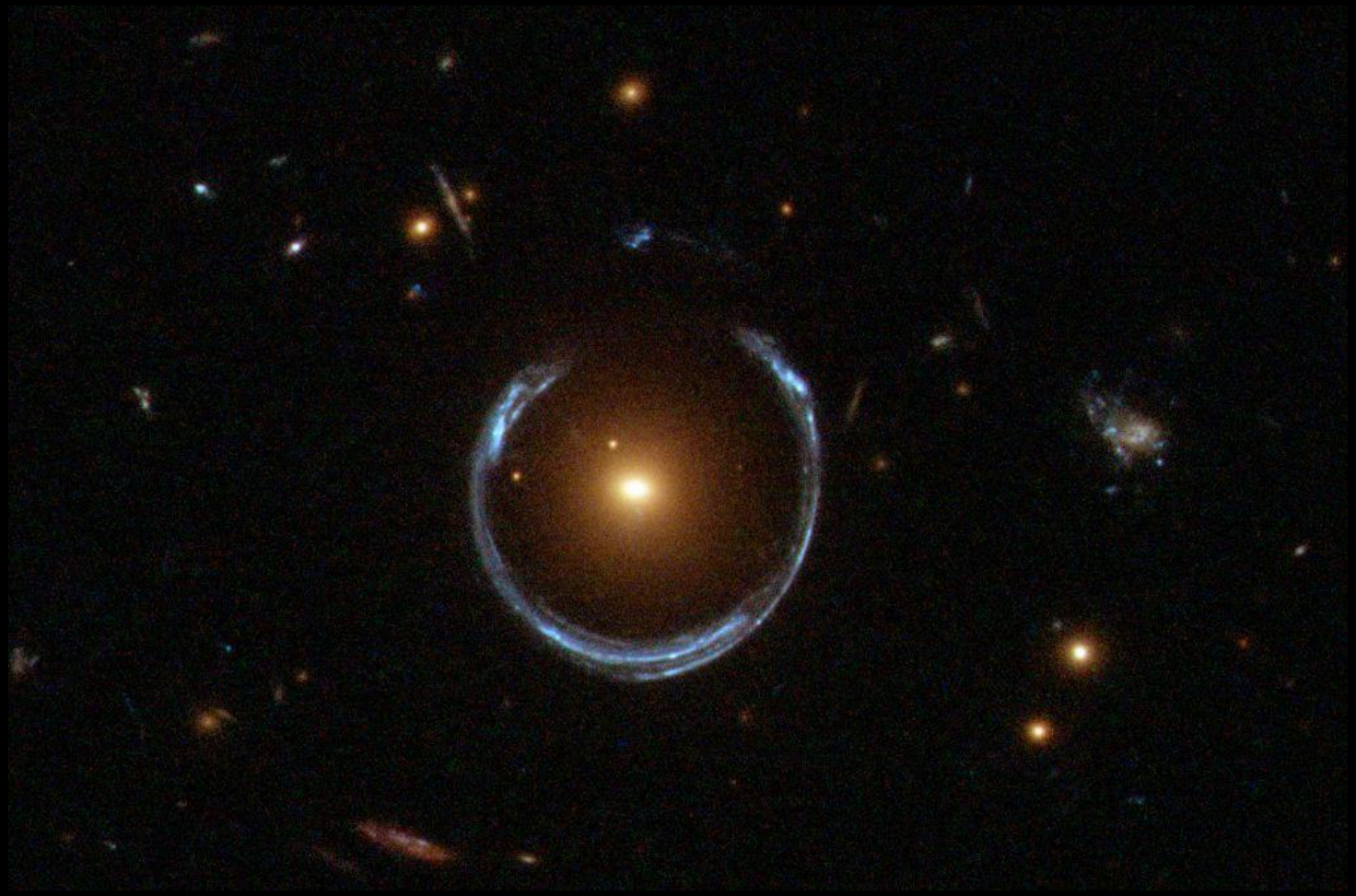


Observations confirming the predictions of general relativity

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

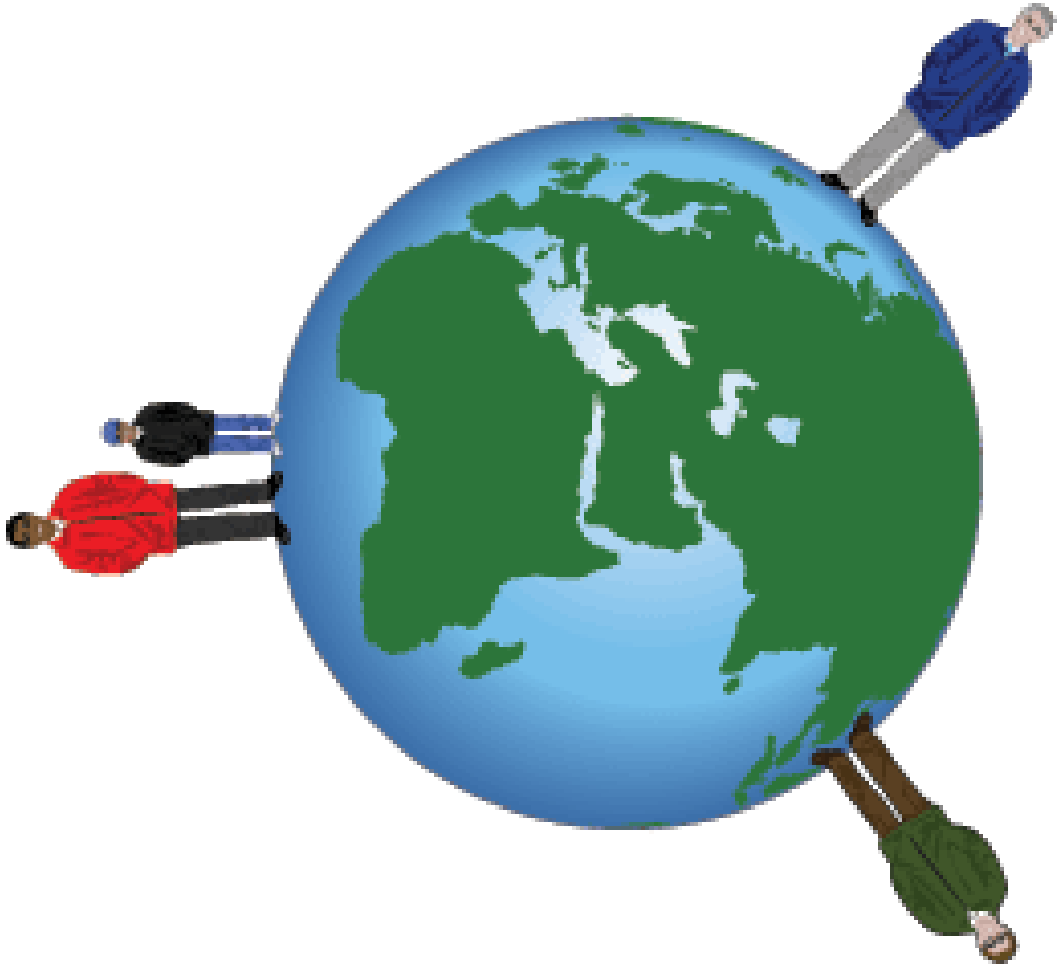


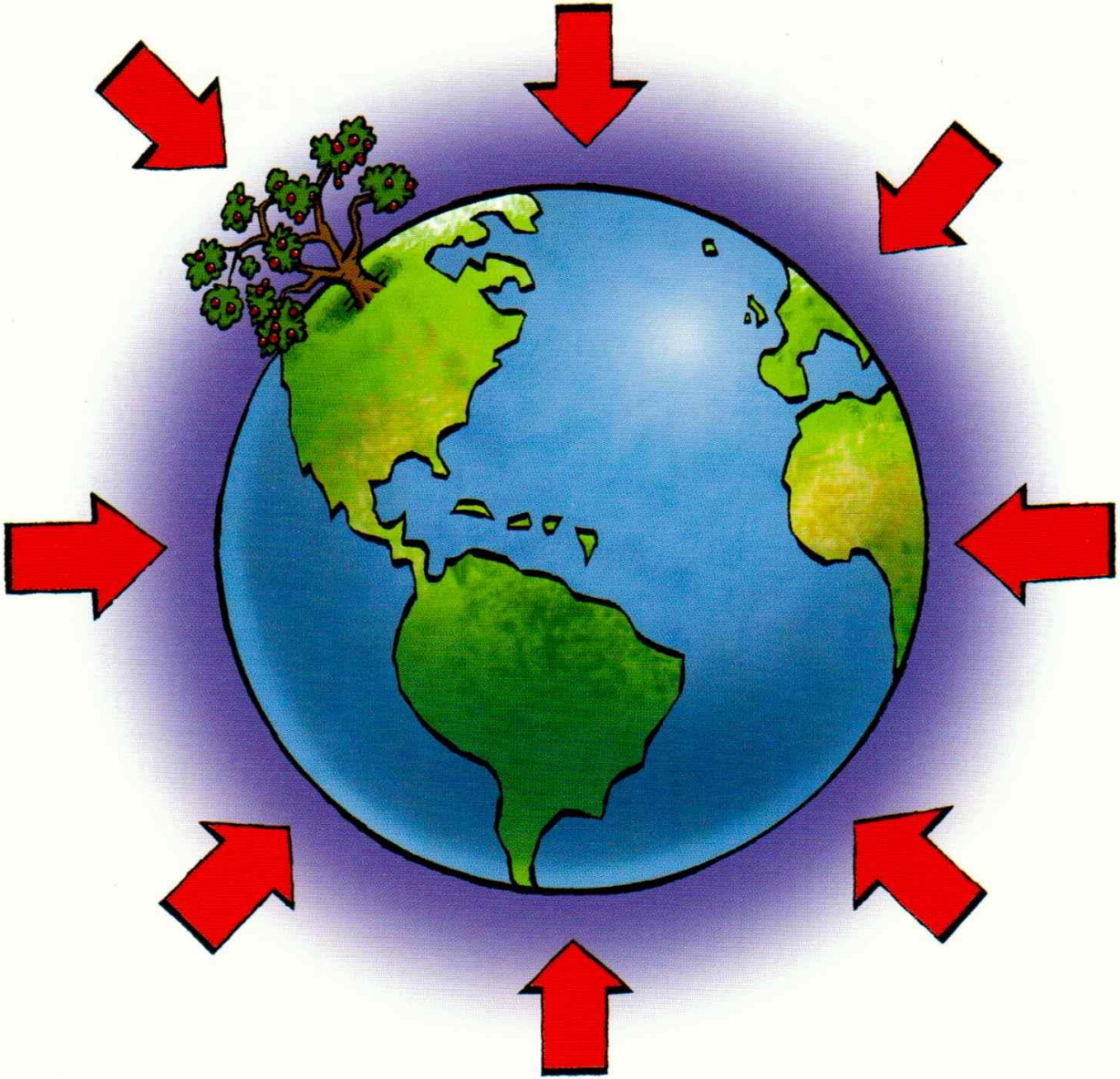
Gravitational Lensing



Gravity Questions

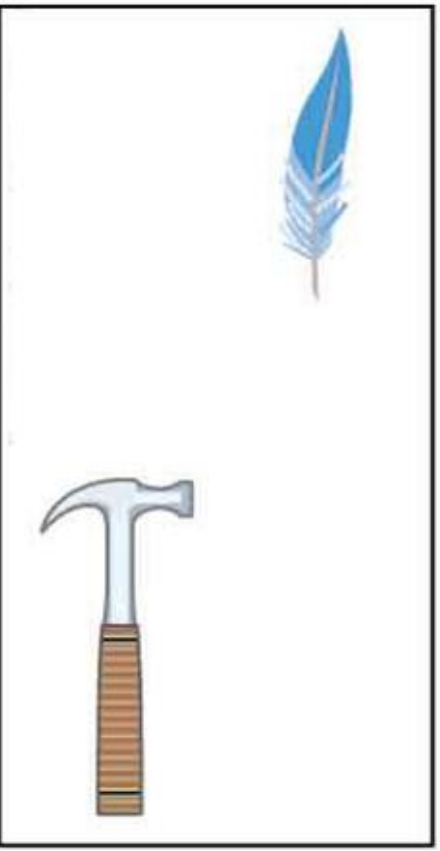
- Point at student living in Cape Town South Africa.



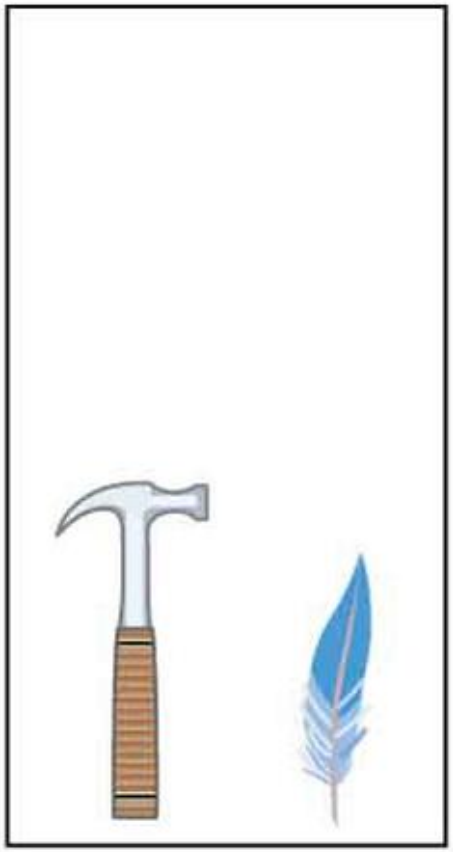


Gravity Questions

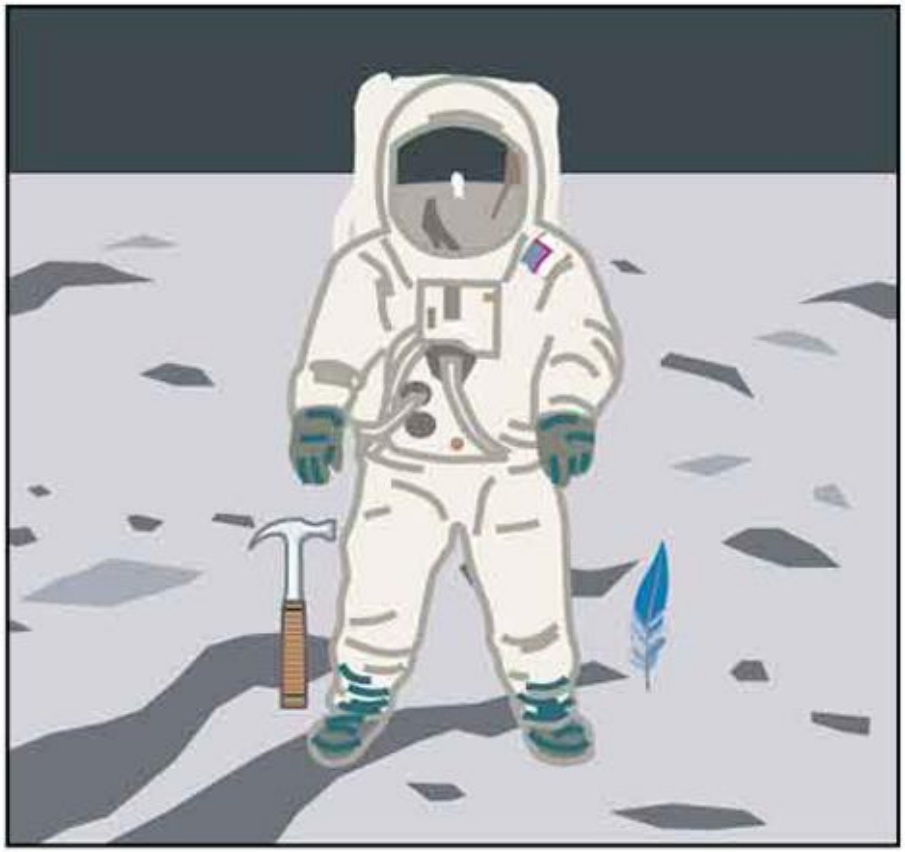
- Point at student living in Cape Town South Africa.
- Do heaver things fall faster than light things?



In air



In a vacuum



In a vacuum (the hard way)

Gravity Questions

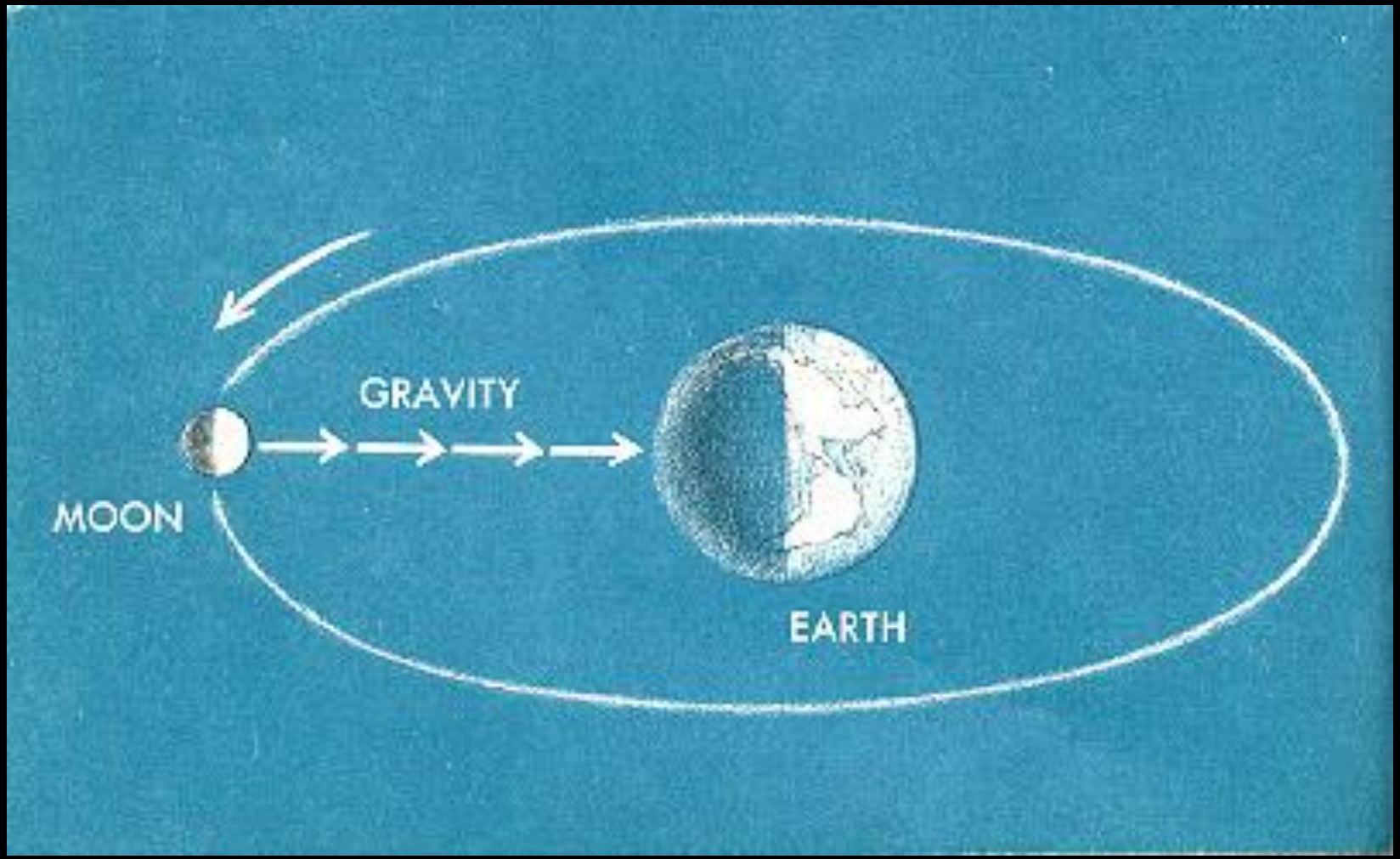
- Point at student living in Cape Town South Africa.
- Do heaver things fall faster than light things?
- Why doesn't a bullet fired from a gun fall?

Shooting Monkeys

Gravity Questions

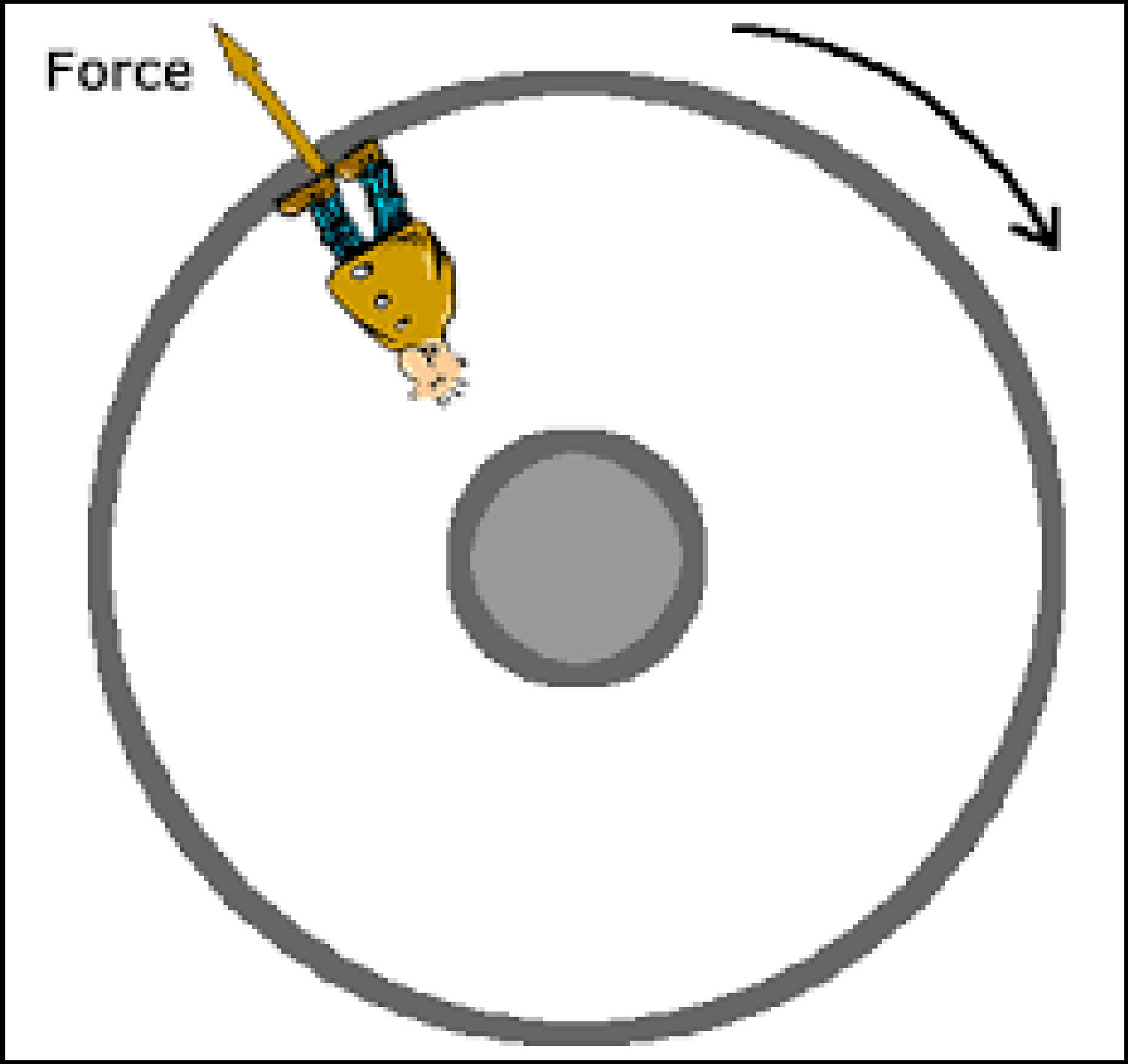
- Point at student living in Cape Town South Africa.
- Do heaver things fall faster than light things?
- Why doesn't a bullet fired from a gun fall?
- Why doesn't the Moon (or a satellite) fall to Earth?

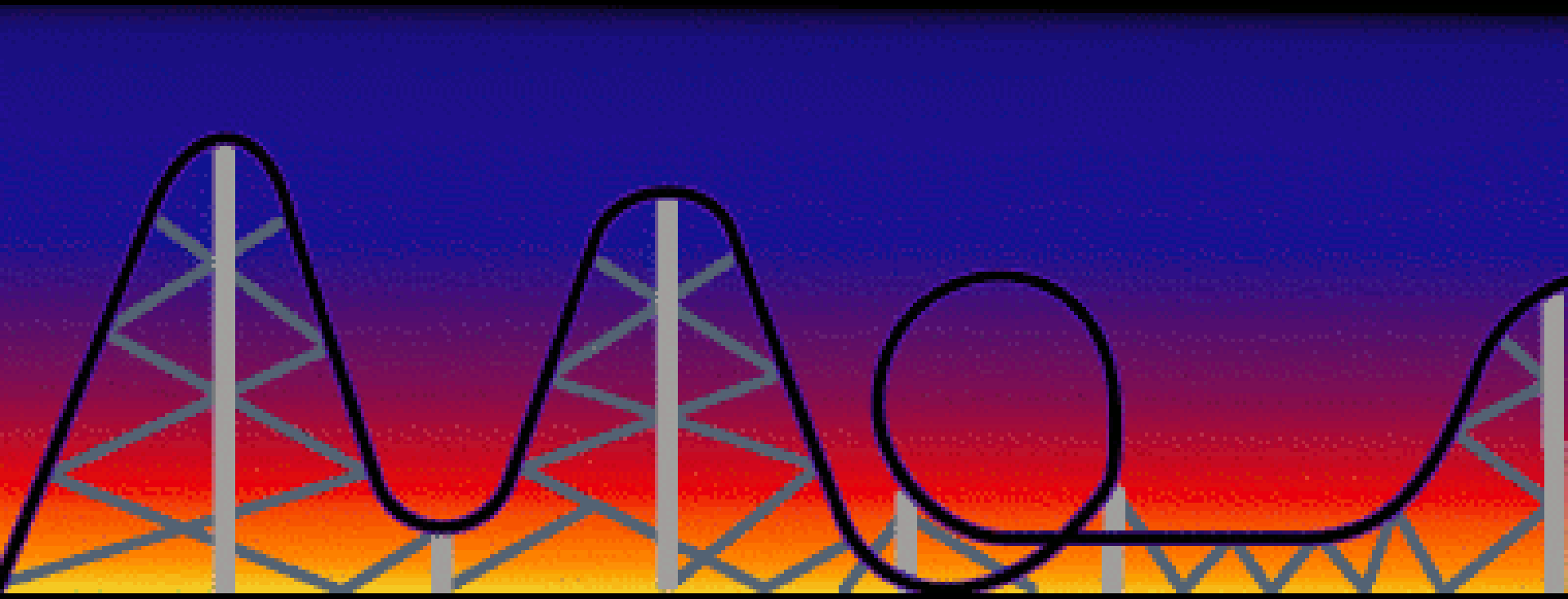
The Moon in Orbit



Gravity Questions

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


Force



Gravity Questions

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

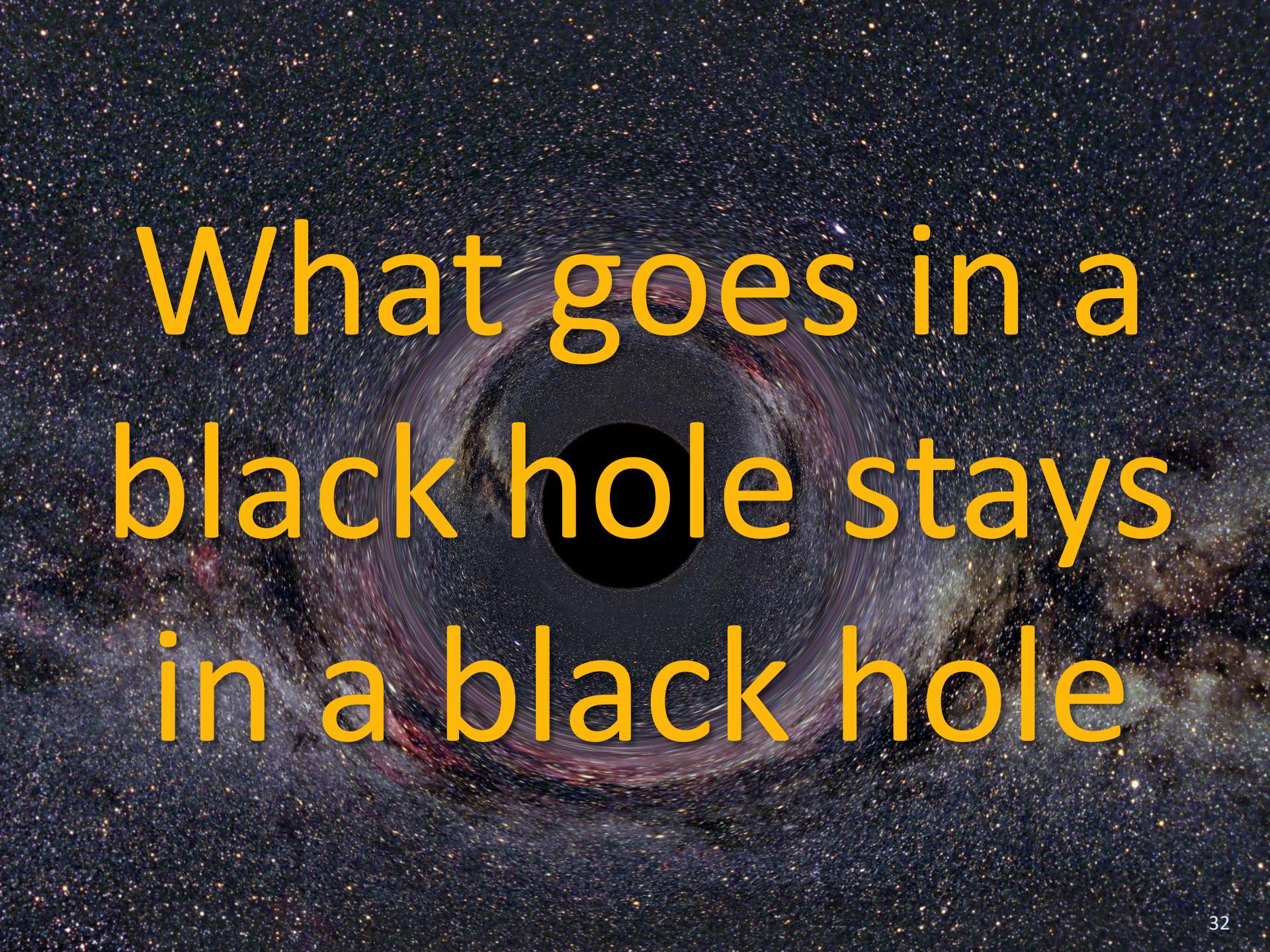
25,000 MPH!

Escape Velocity

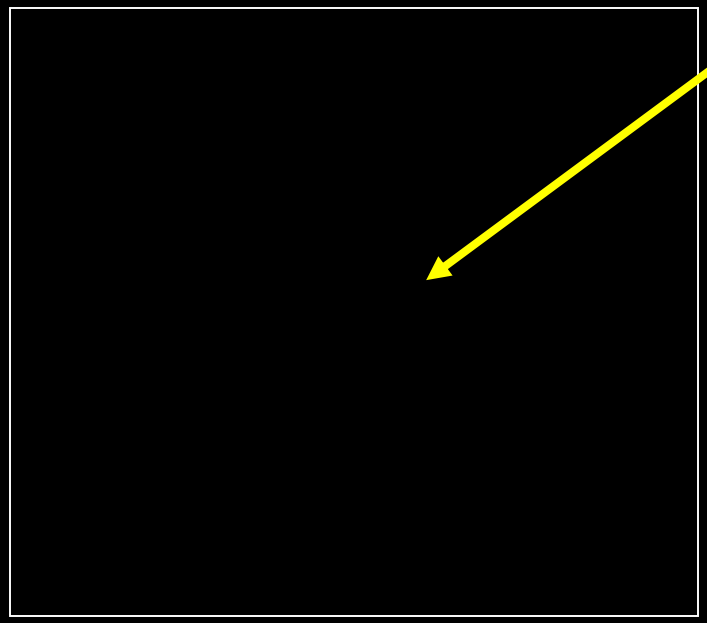
Body	Escape Velocity in Miles/Hour
Ceres	1,430 mph
The Moon	5,320 mph
Earth	25,038 mph
Jupiter	133,018 mph
Sun	1,381,600 mph
Sirius B (a white dwarf star)	11,625,120 mph

Gravity Waves

- Vibration in the fabric of space.
- Predicted by Einstein.
- Could give us a whole new way to learn about the universe.


What goes in a
black hole stays
in a black hole

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.

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.

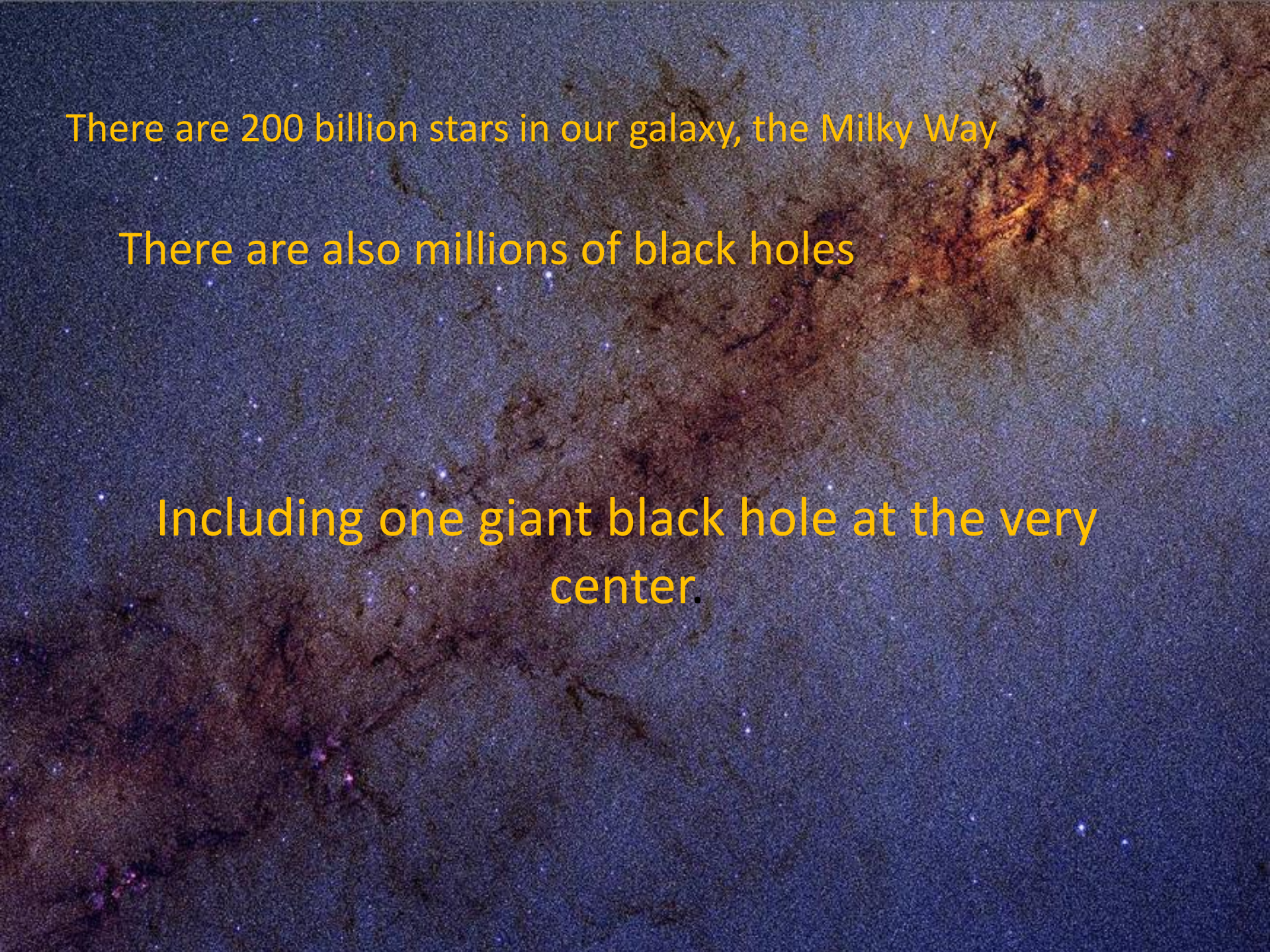
Near a Black Hole,
you’d weigh over
20 TRILLON POUNDS !!!

Falling into a Black Hole

Falling into a Black Hole

Falling into a Black Hole

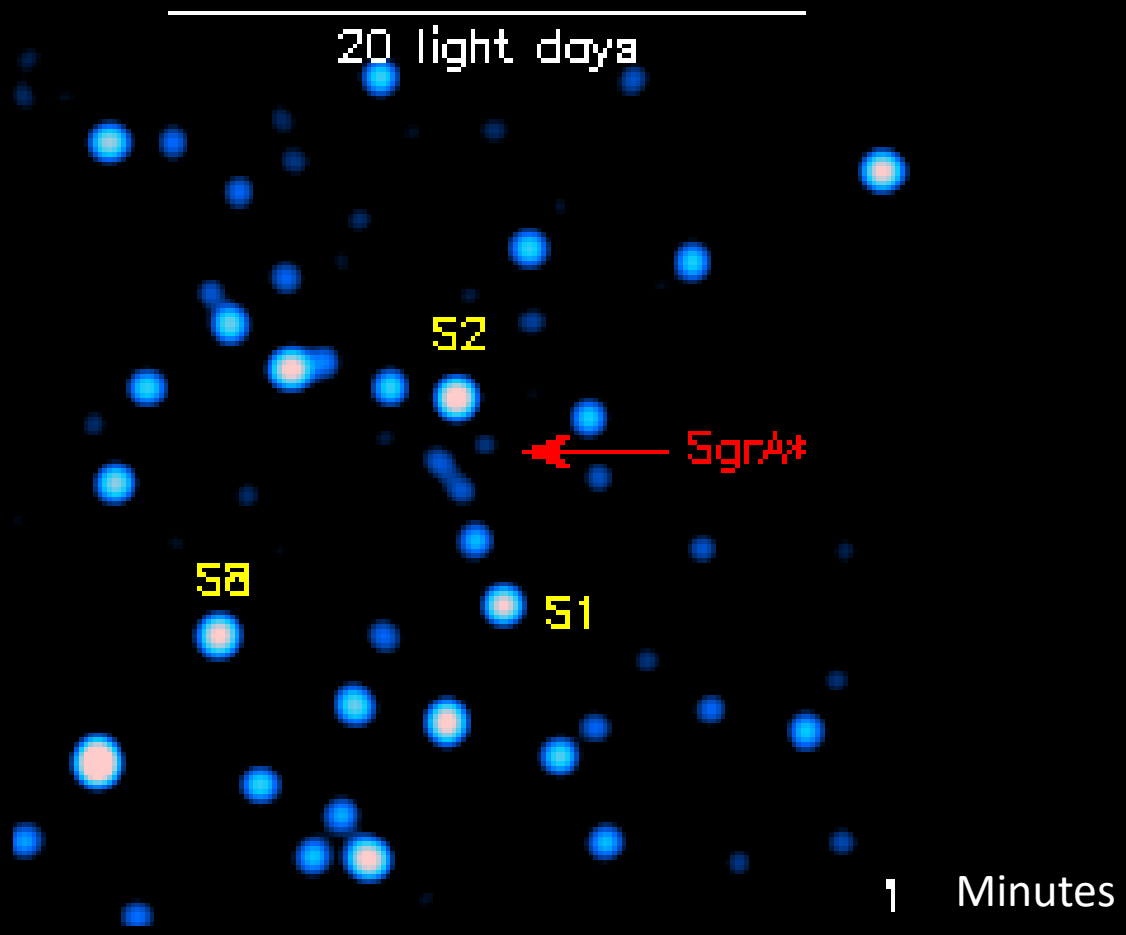
Falling into a Black Hole


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.

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

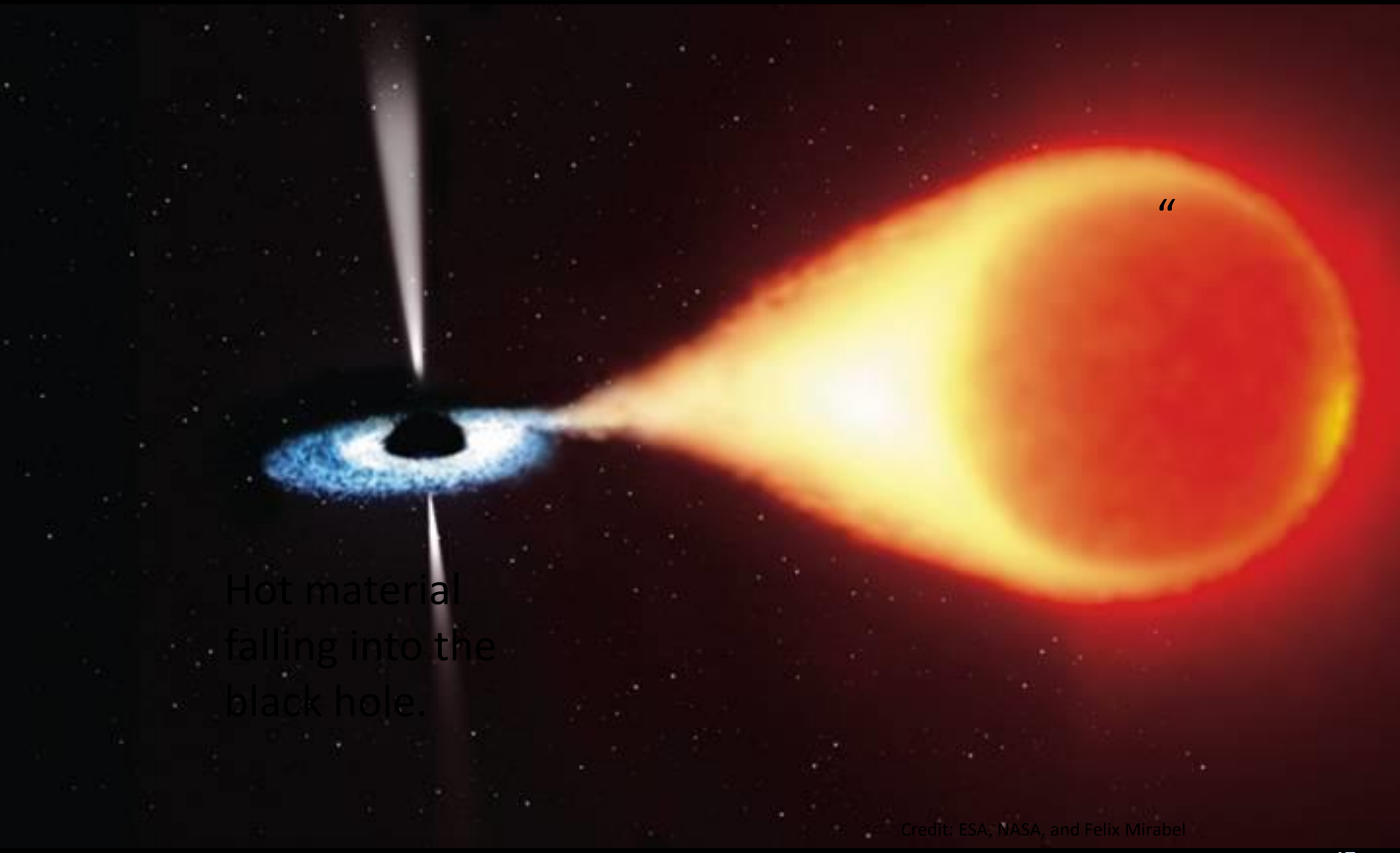
How Do We Know a Black Hole is There?

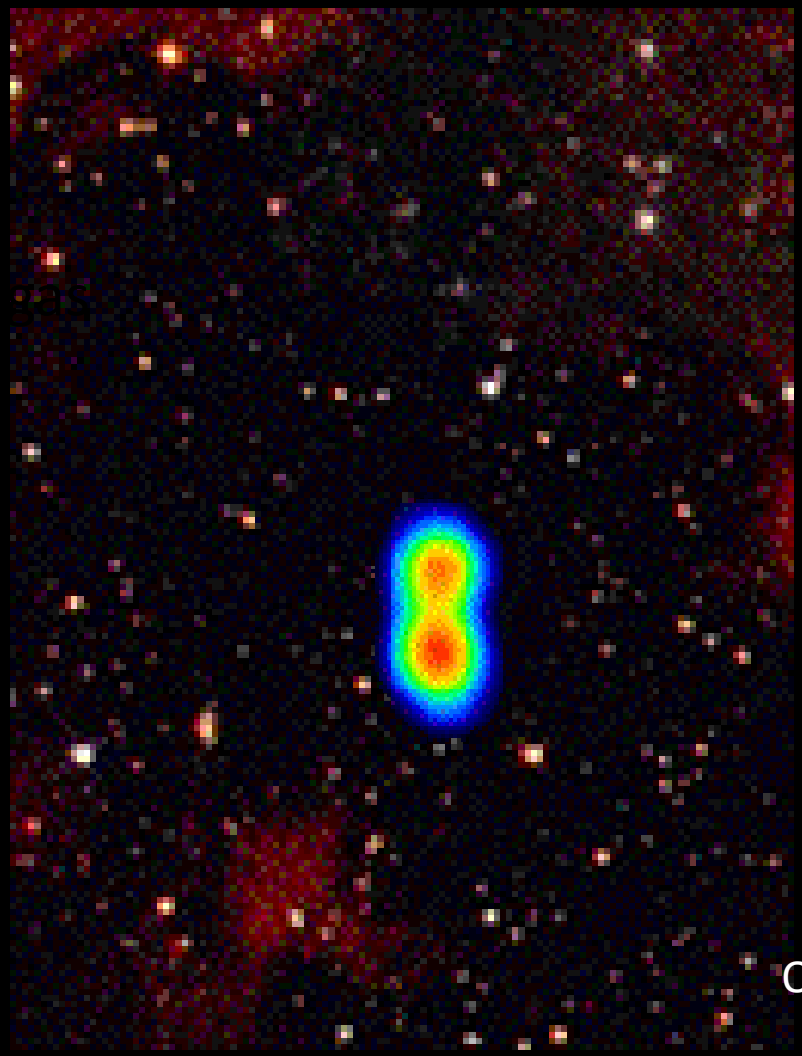
- Flares caused by stuff falling into the Black Hole.


20 light days
S2
SgrA*
S8
S1
1 Minutes

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.
Credit: ESA, NASA, and Felix Mirabel

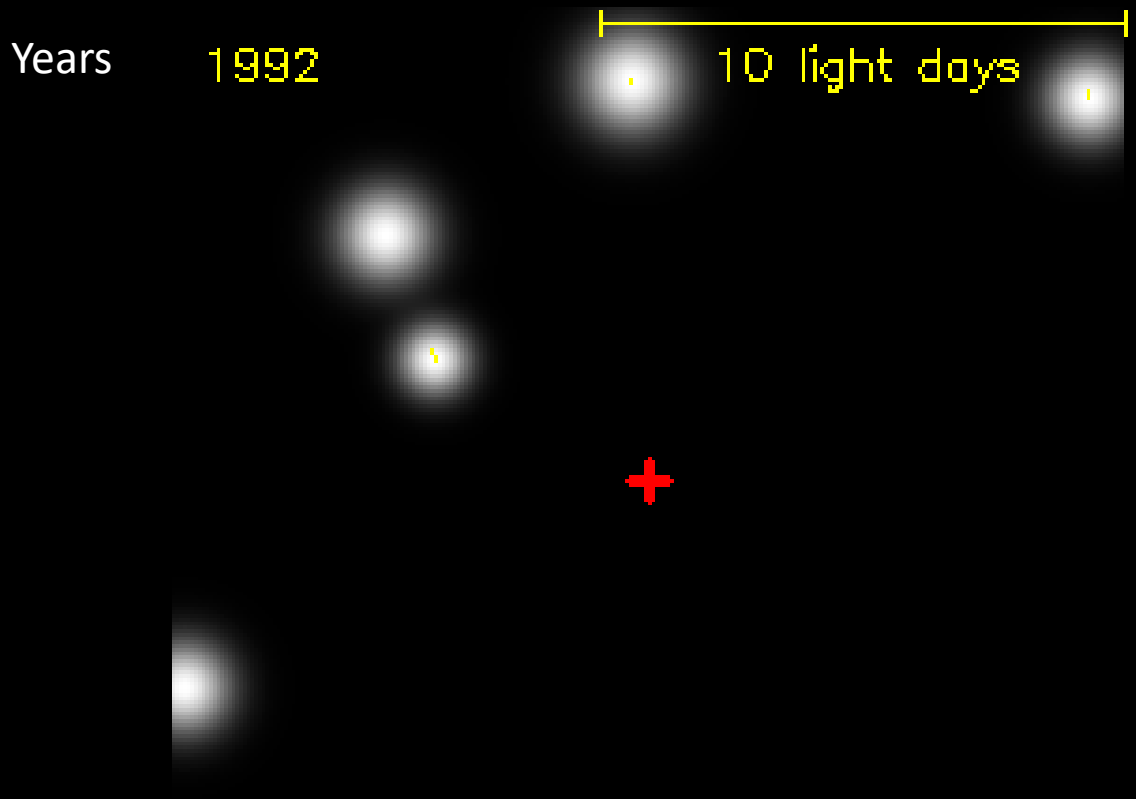


One month

How Do We Know a Black Hole is There?

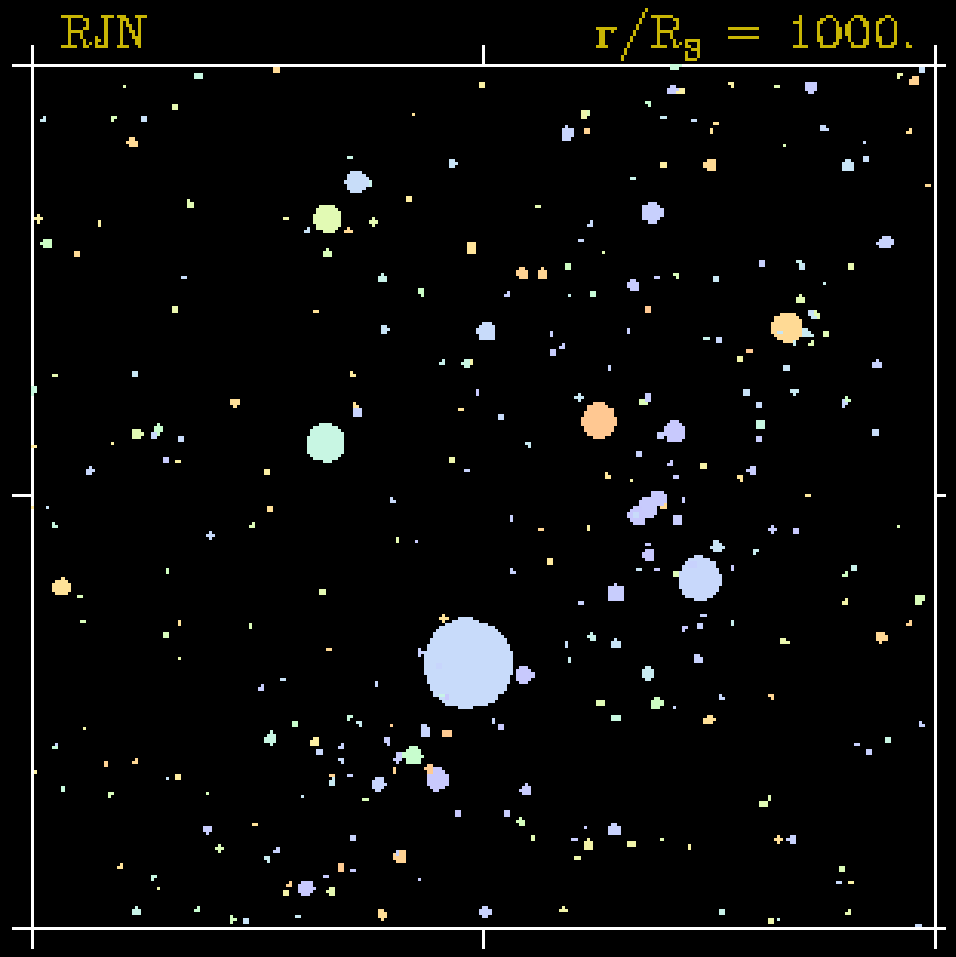
- Flares caused by stuff falling into the Black Hole.
- Spotting the jets coming off the Black Hole.
- Weird motion of stars around the Black Hole.

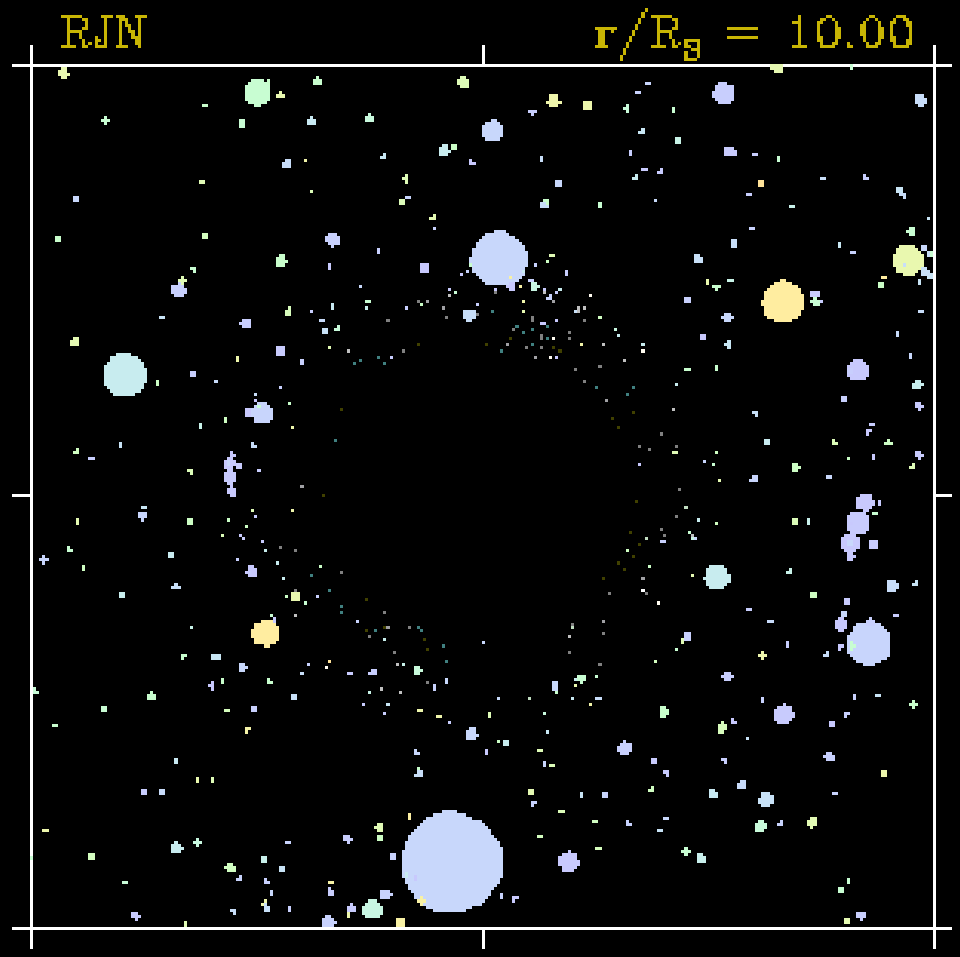
How do we know it's there?



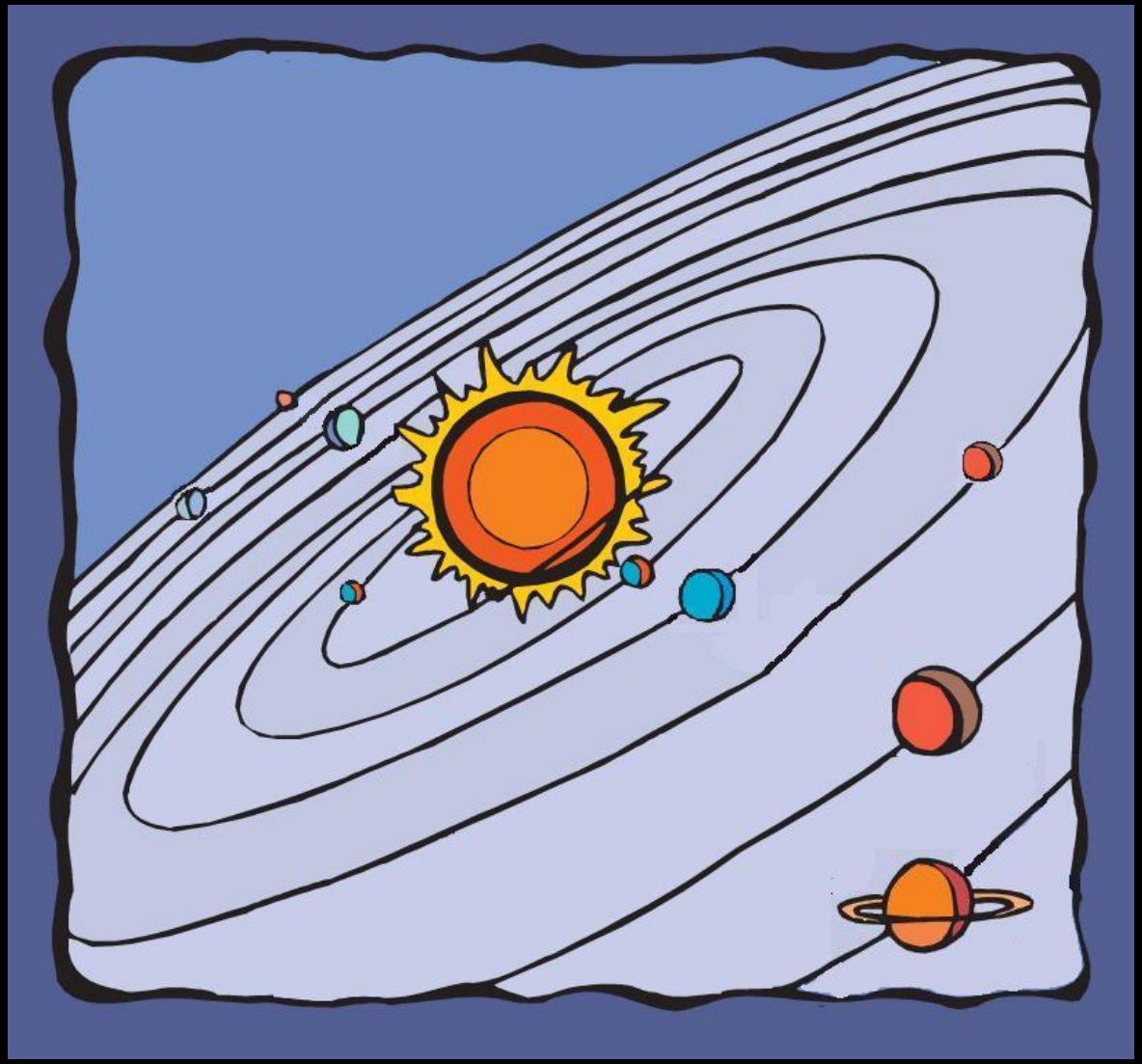
How Do We Know a Black Hole is There?

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


RJN
r/Rs = 1000.

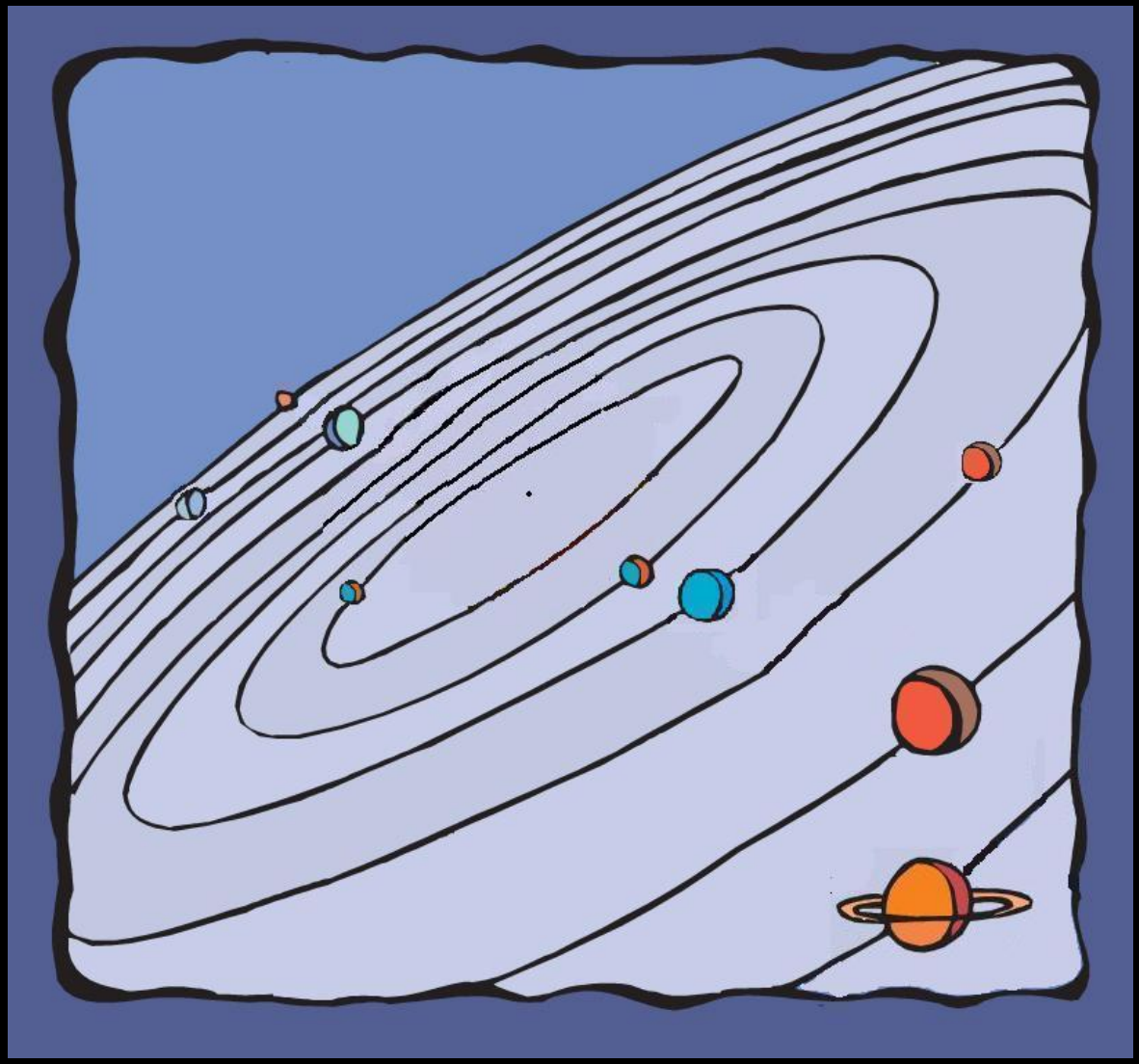

RJN
r/Rs = 10.00

What would happen if the Sun was…

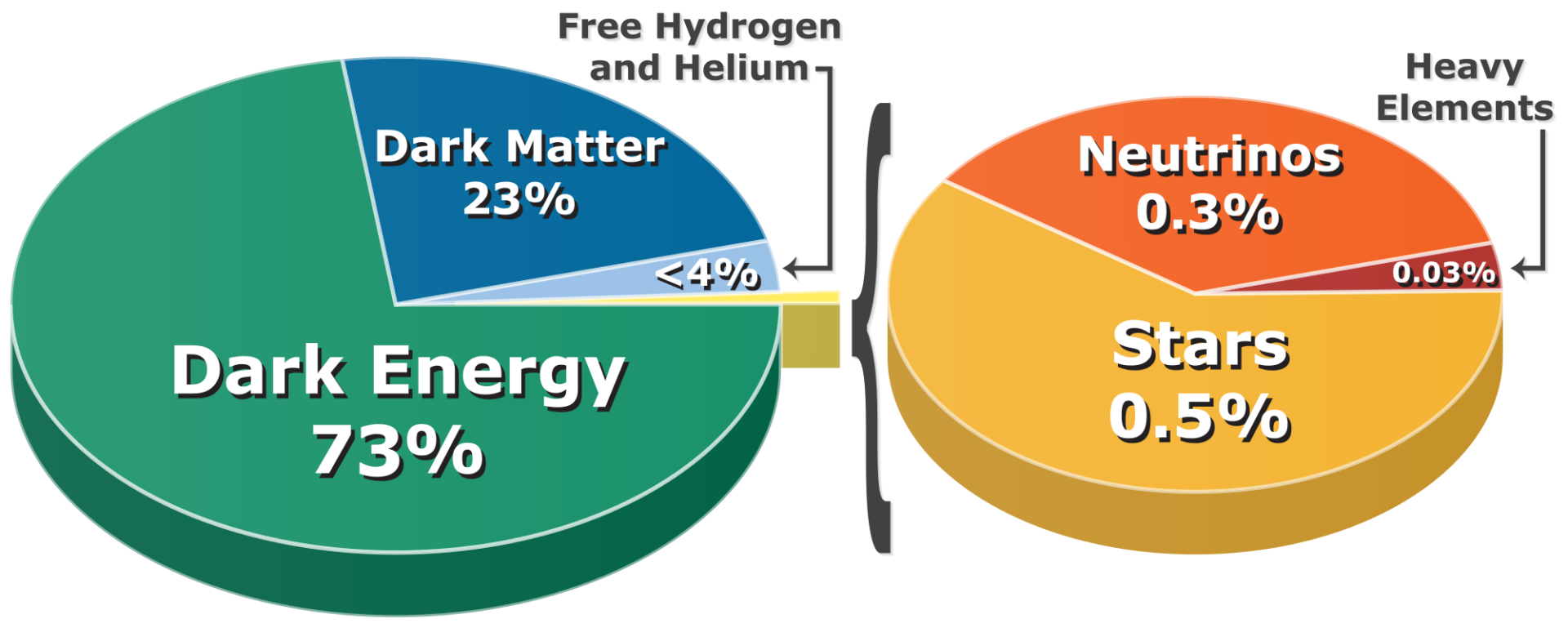


Not to Scale

… changed into a Black Hole?



Not to Scale


Free Hydrogen
and Helium
Dark Matter
23%
<4%
Dark Energy
73%
Heavy
Elements
Neutrinos
0.3%
0.03%
Stars
0.5%


THE
END