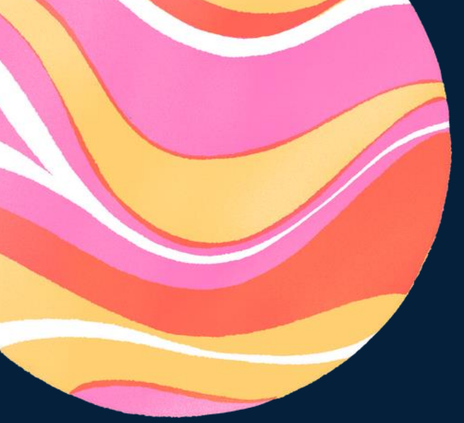

HOW DO TELESCOPES WORK?
HOW DO THEY UNLOCK THE SECRETS OF THE UNIVERSE?

HELLO THERE!

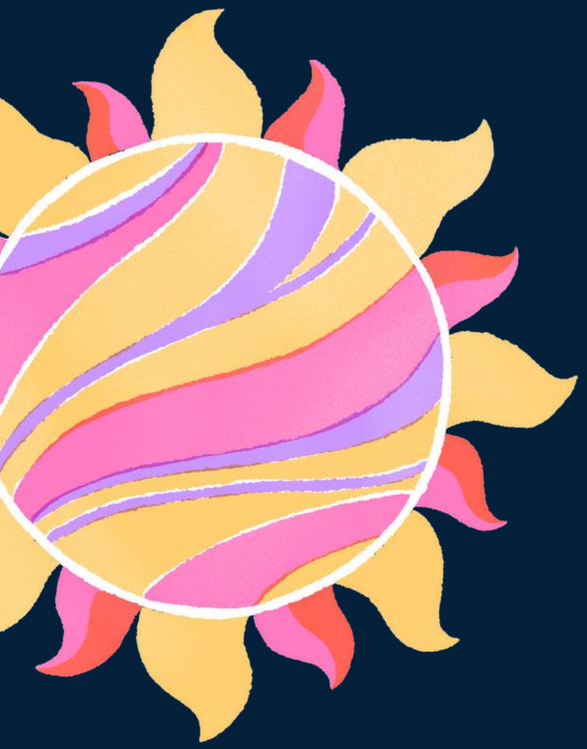
I’m Teja Teppala, an astronomy graduate student at Mizzou!

I study star formation in distant galaxies.

SO, WHO REALLY INVENTED THE TELESCOPE?



NO,
IT WASN'T GALILEO!



NO,
IT WASN'T GALILEO!

Who was it then?

ANSWER

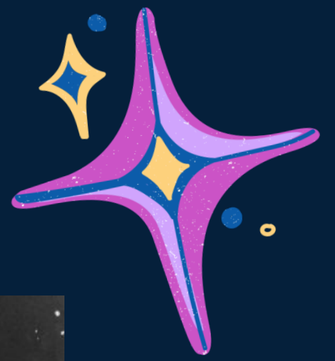
HANS LIPPERSHEY!

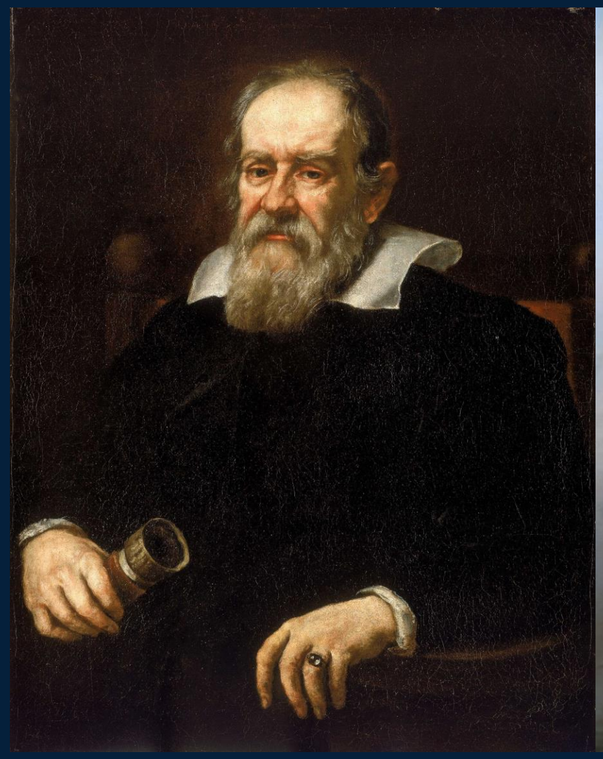
ANSWER

HANS LIPPERSHEY!

He was a German-Dutch spectacle maker, and was the first inventor to patent the design, in 1608 AD.

GALILEO WAS THE FIRST TO USE A TELESCOPE FOR ASTRONOMY!





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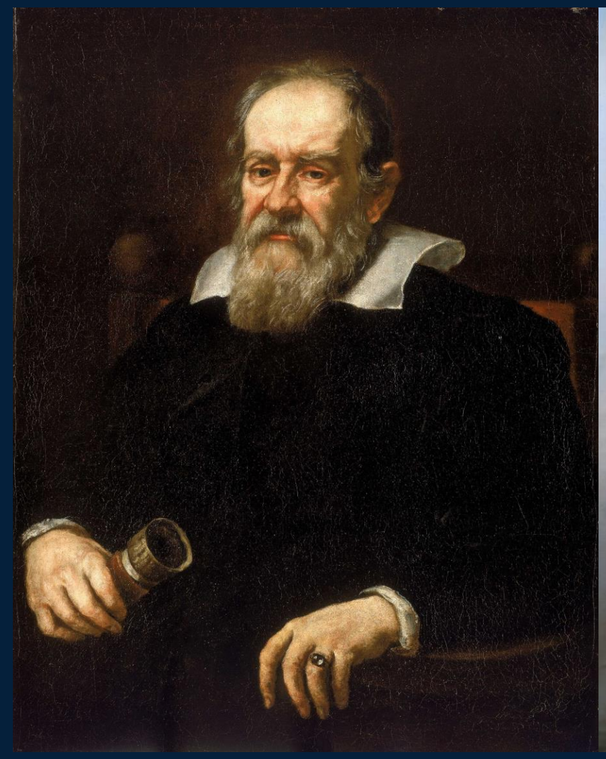
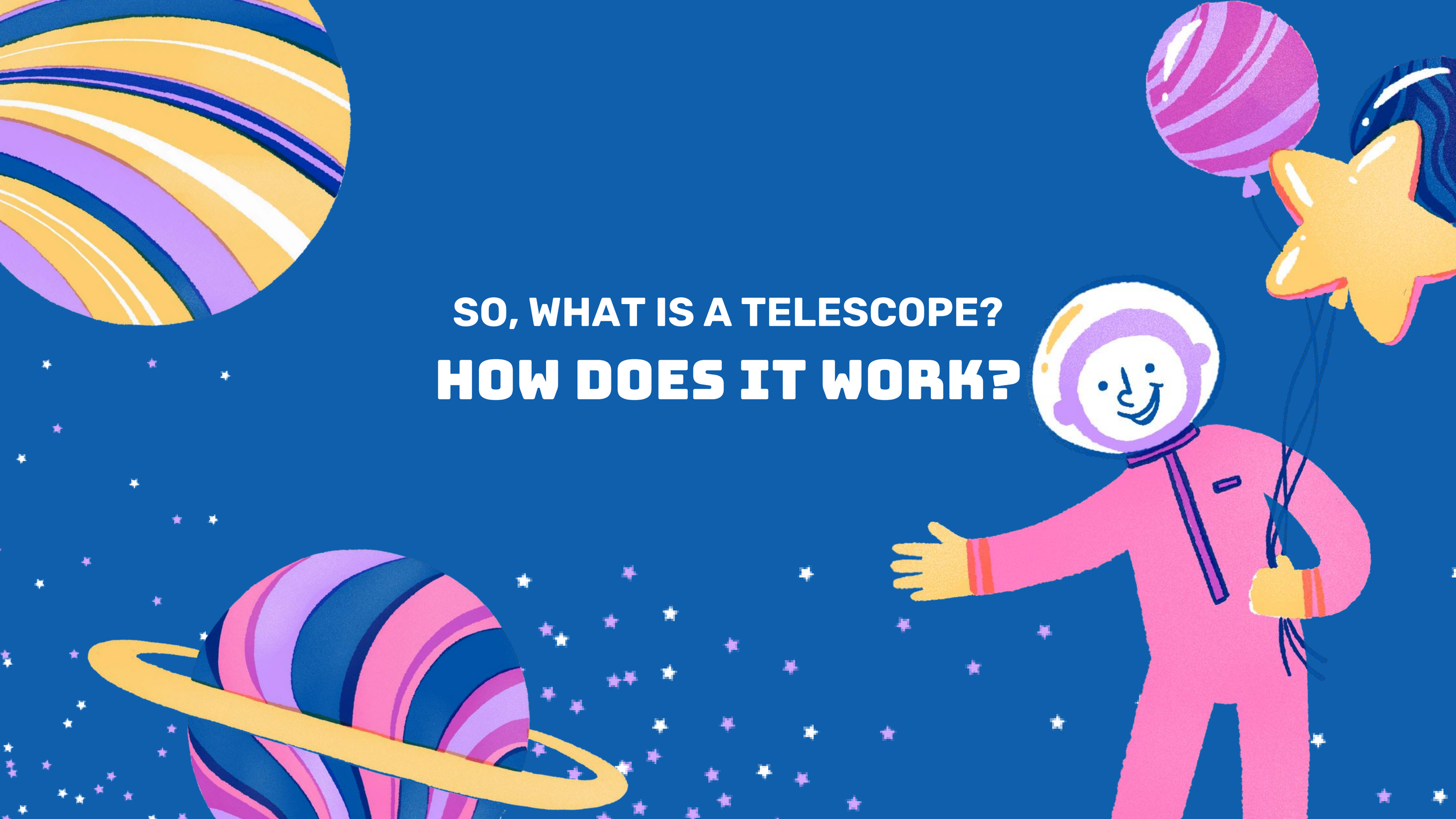


Galileo invented the telescope independently, and was the first to use it for astronomy.


SO, WHAT IS A TELESCOPE?
HOW DOES IT WORK?

WHY CAN'T YOU SEE AN OBJECT THAT'S FAR AWAY?

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A TELESCOPE USES THIS TRICK!

WHAT IS A TELESCOPE?

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A telescope has two main components:

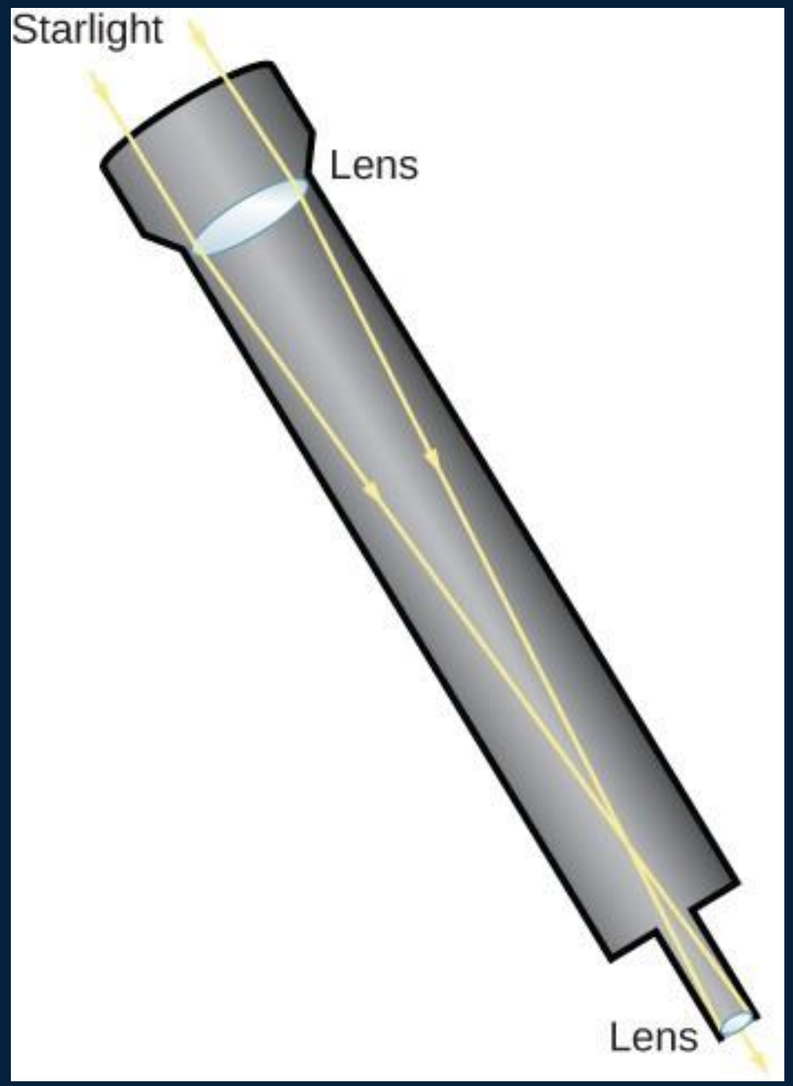
(a)Objective

(b) Eyepiece

OBJECTIVE

OBJECTIVE

An objective gathers a lot of light from a distant object, and brings that light to a point, or focus.



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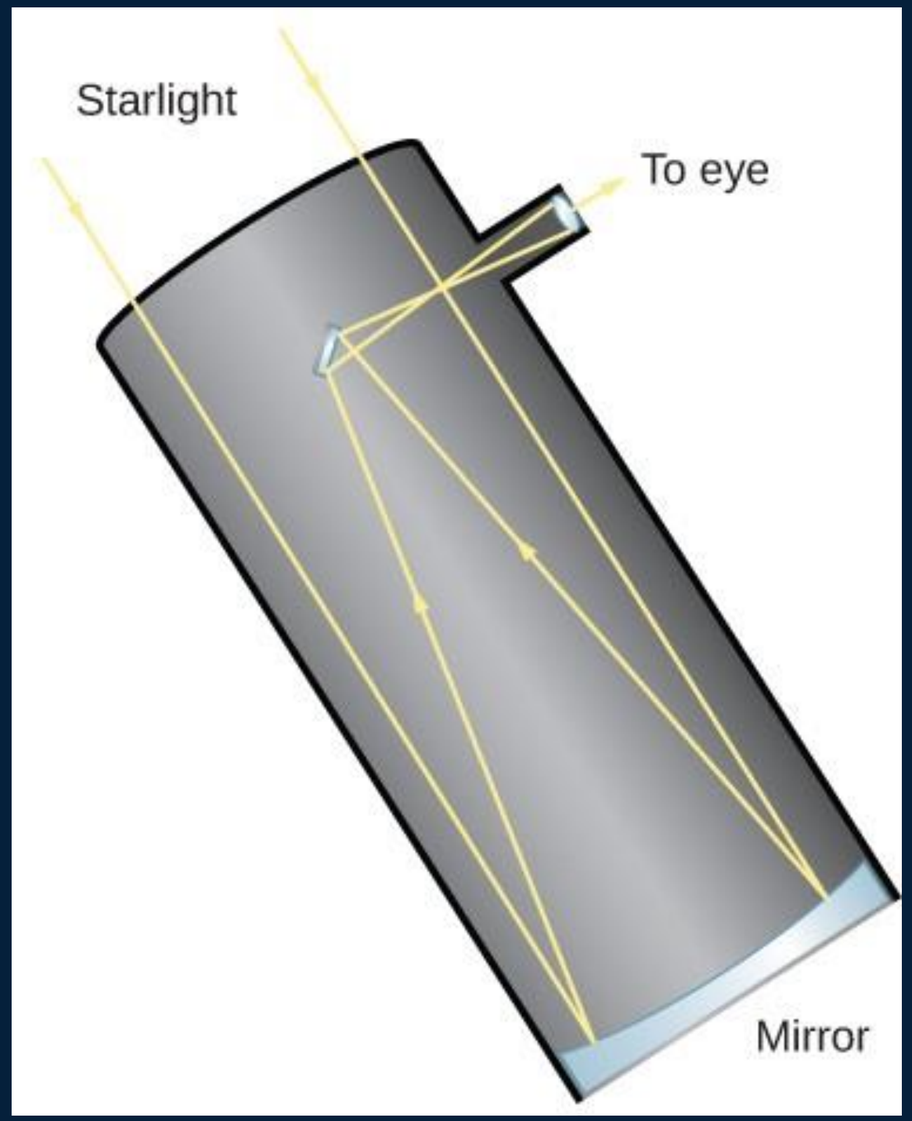
If the objective is a lens, it is called a **REFRACTOR** telescope.



OBJECTIVE

An objective gathers a lot of light from a distant object, and brings that light to a point, or focus.

If the objective is a mirror, it is called a **REFLECTOR** telescope.

EYEPIECE

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The eyepiece takes this light at focus, and spreads it out so that it makes a big image on your eye’s screen.

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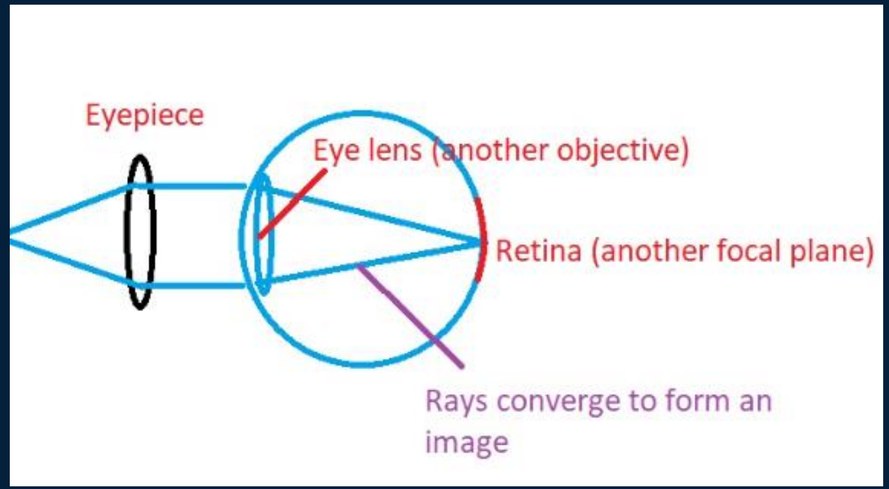
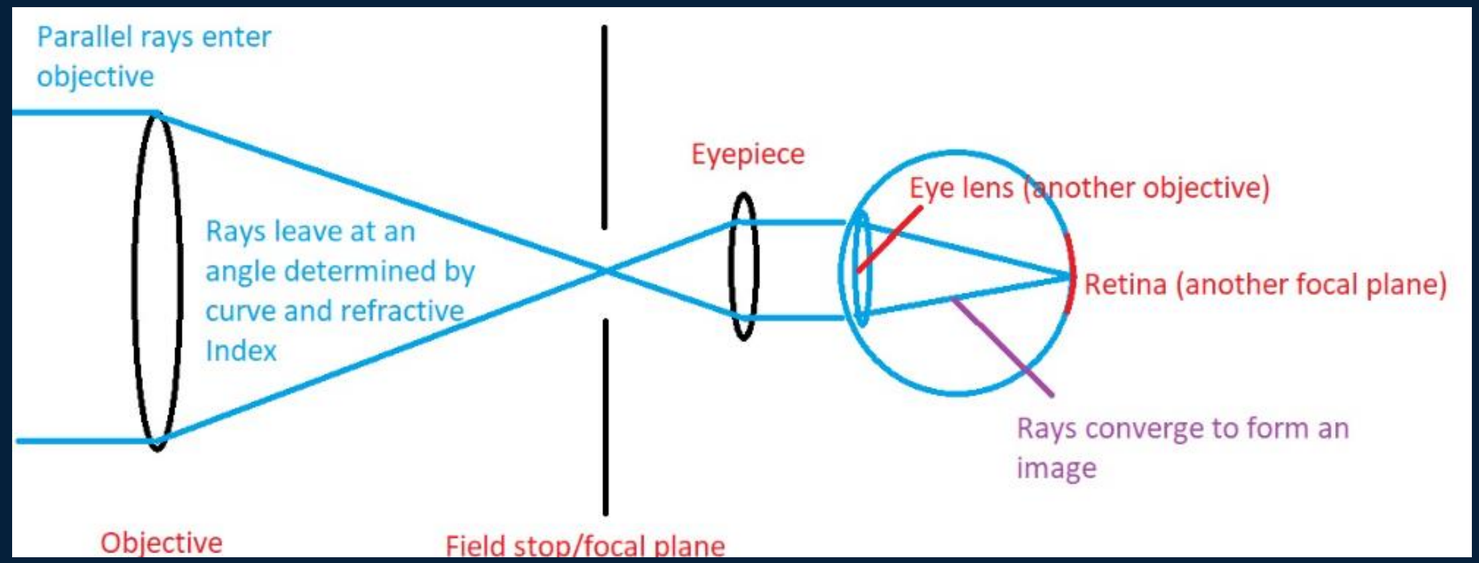


WHEN YOU COMBINE THE OBJECTIVE WITH AN EYEPIECE, YOU HAVE A TELESCOPE!



NOW, LET'S SEE THE WORKING

OF TELESCOPES

IN ACTION!

NOW, SOME BIG QUESTIONS...

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Is Earth the center of the universe?

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Is Earth the center of the universe?

How far are the stars? What are they made of?

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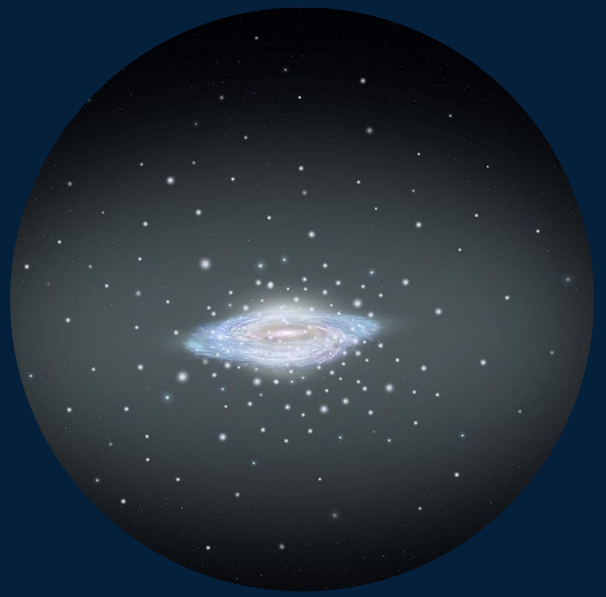

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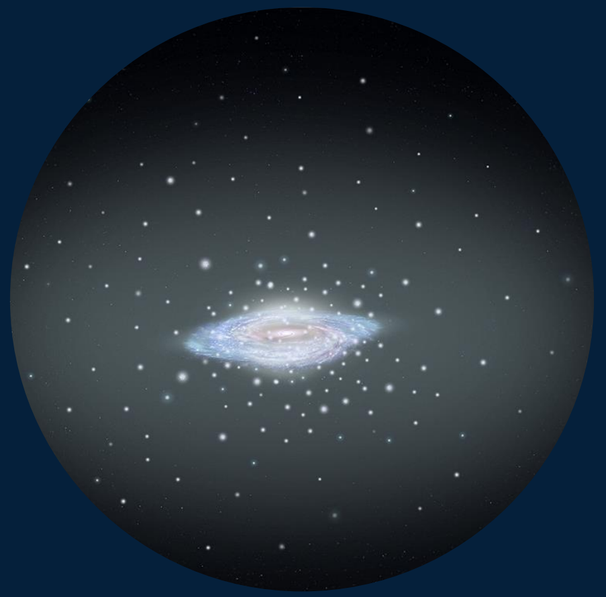

Is the Solar System at the center of the Galaxy?

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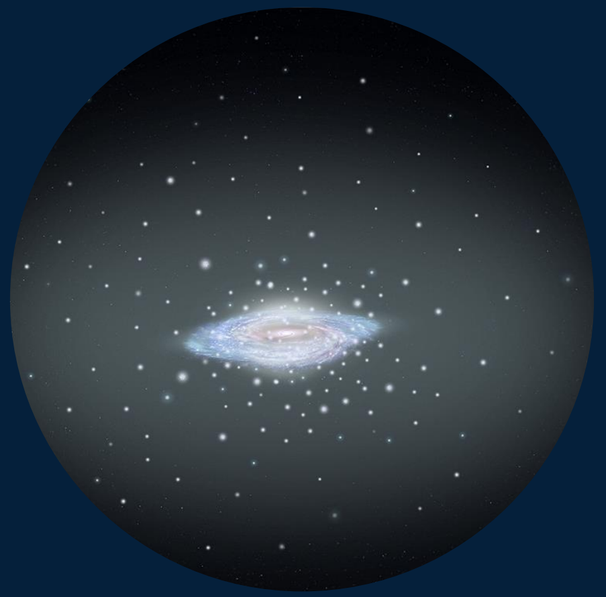

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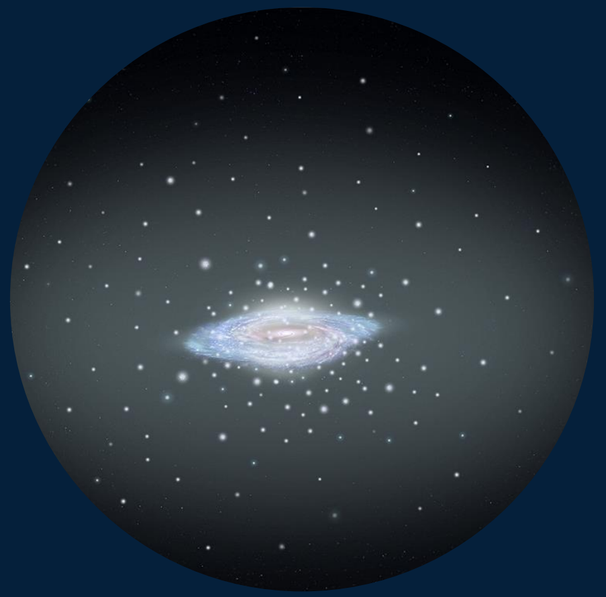

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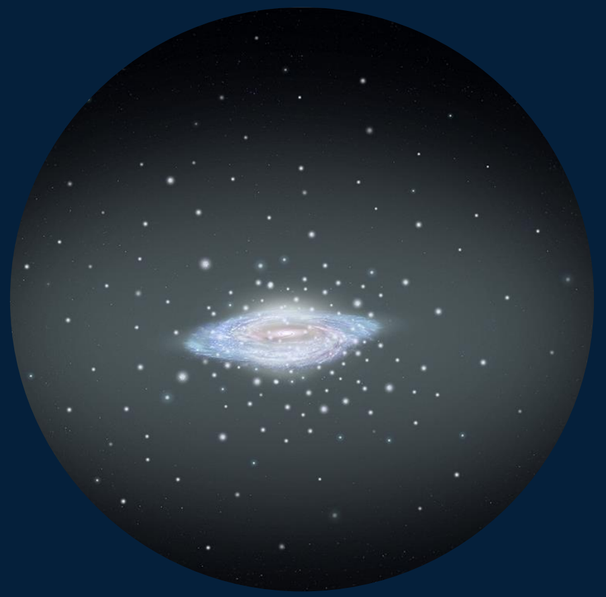

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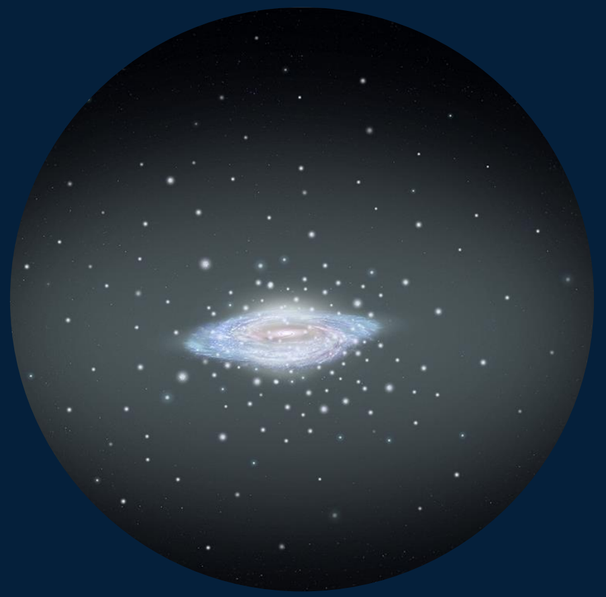

Is the Solar System at the center of the Galaxy?

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How old is the universe?

SO HOW DID TELESCOPES HELP ANSWER THESE QUESTIONS?

IS EARTH THE CENTER OF THE UNIVERSE?

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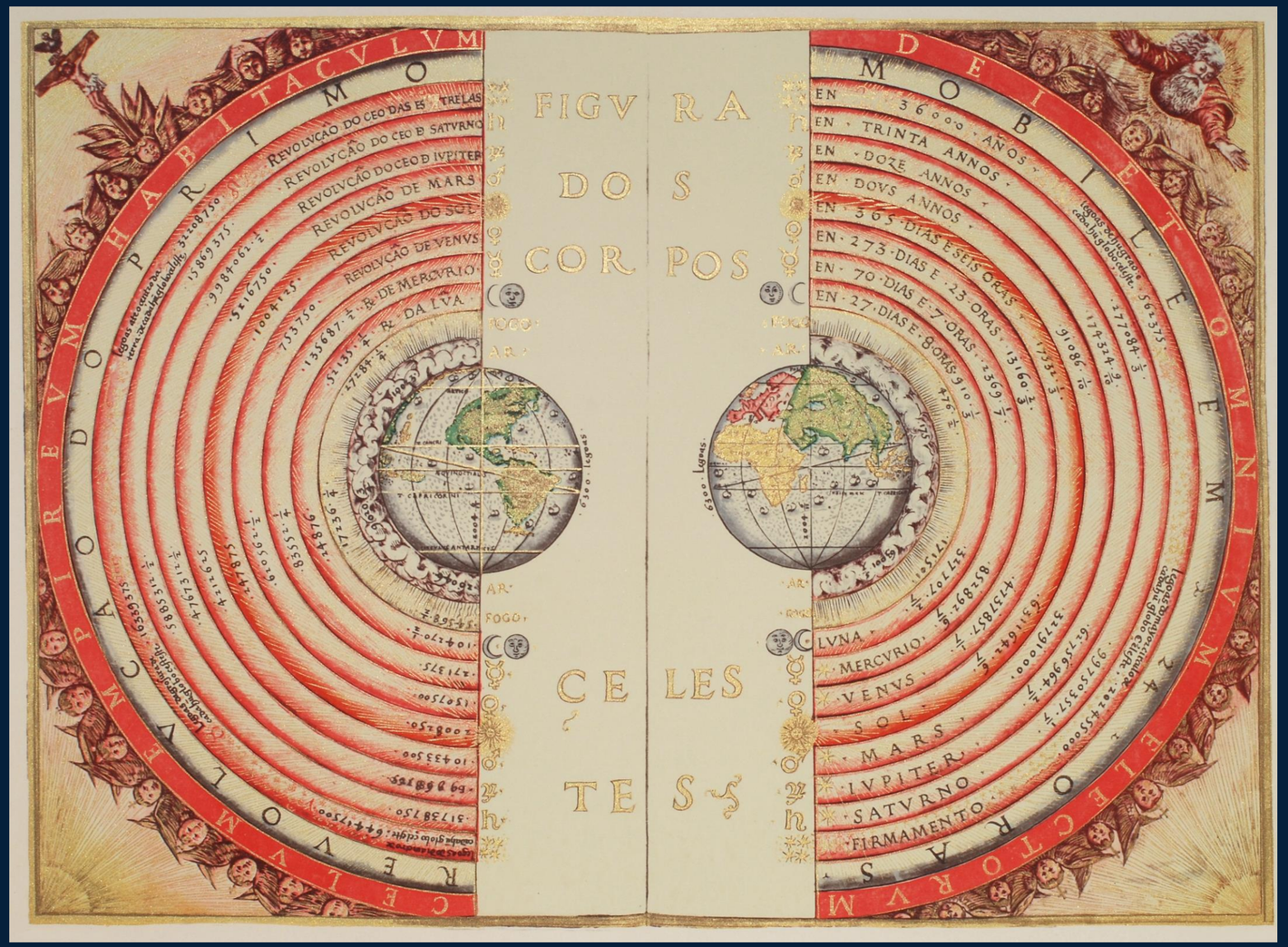
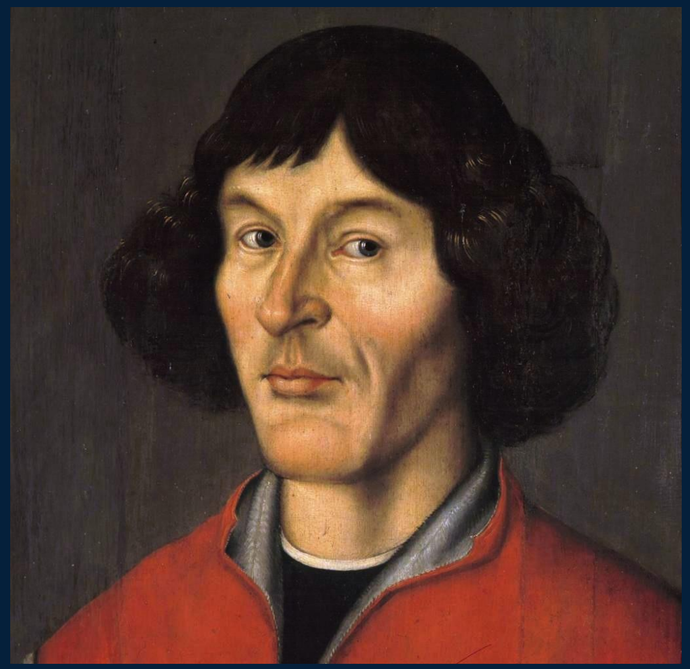
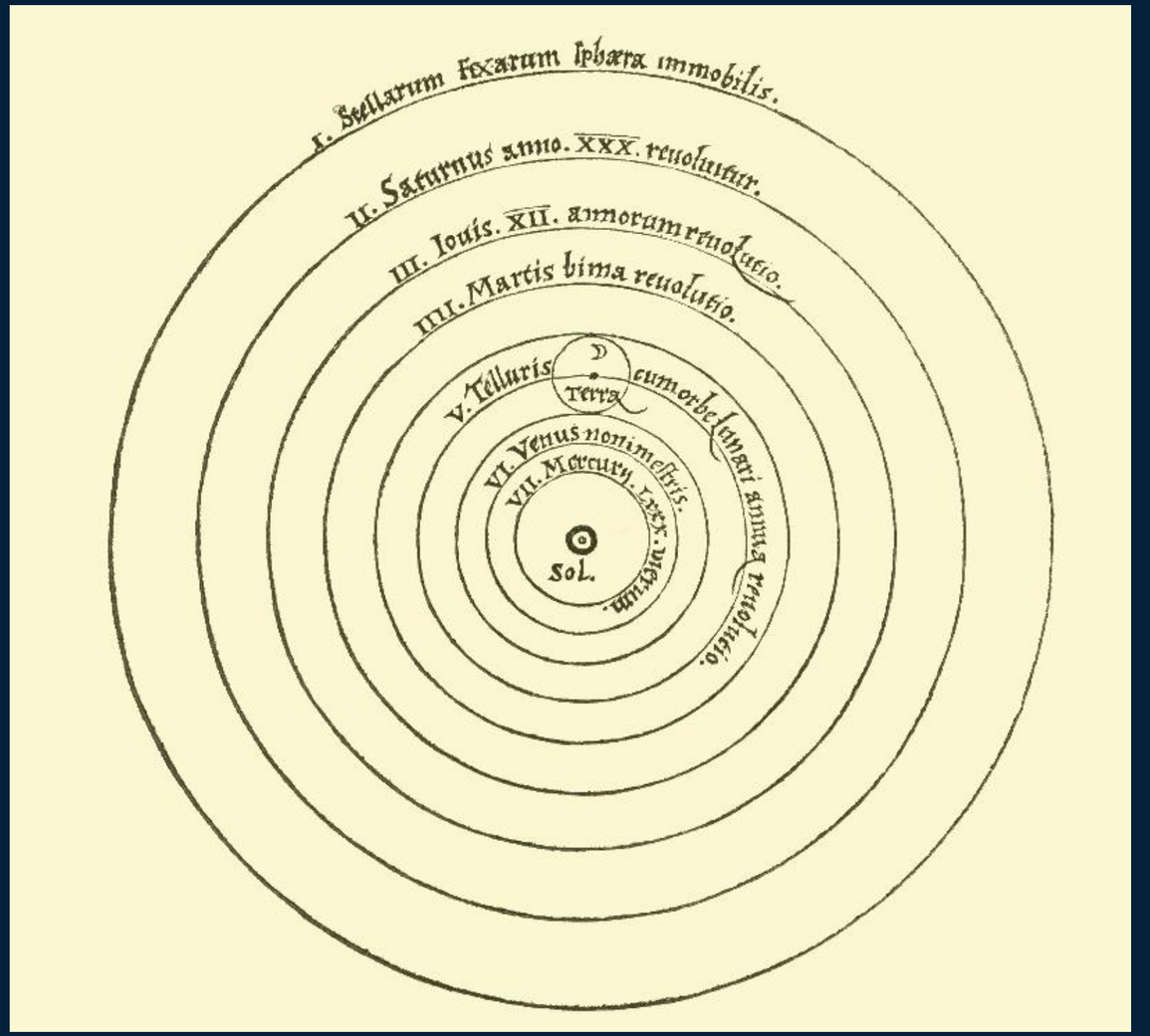
Aristotle said “Earth”.



IS EARTH THE CENTER OF THE UNIVERSE?

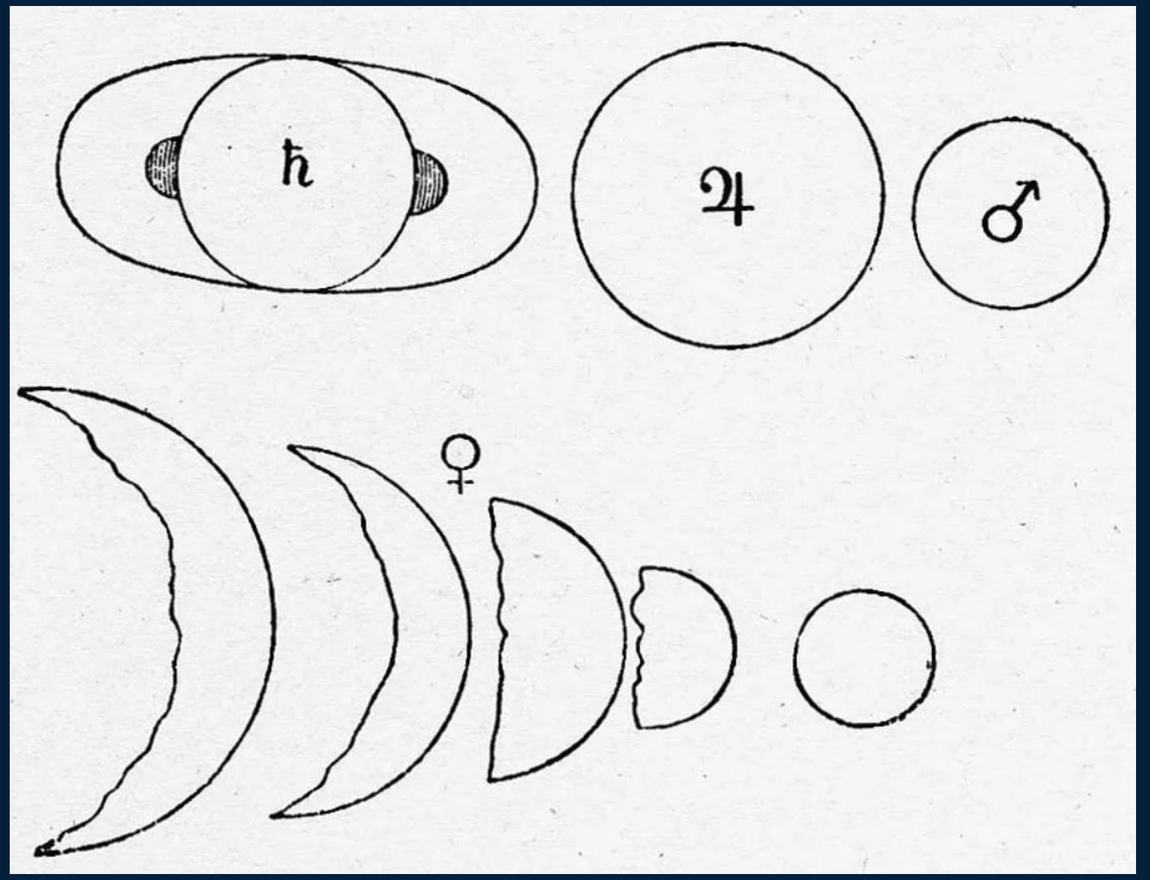
Copernicus said “Nope, it is the Sun”.





IS EARTH THE CENTER OF THE UNIVERSE?

Galileo observed the phases of Venus with his telescope and determined it is the Sun.



HOW FAR ARE THE STARS?
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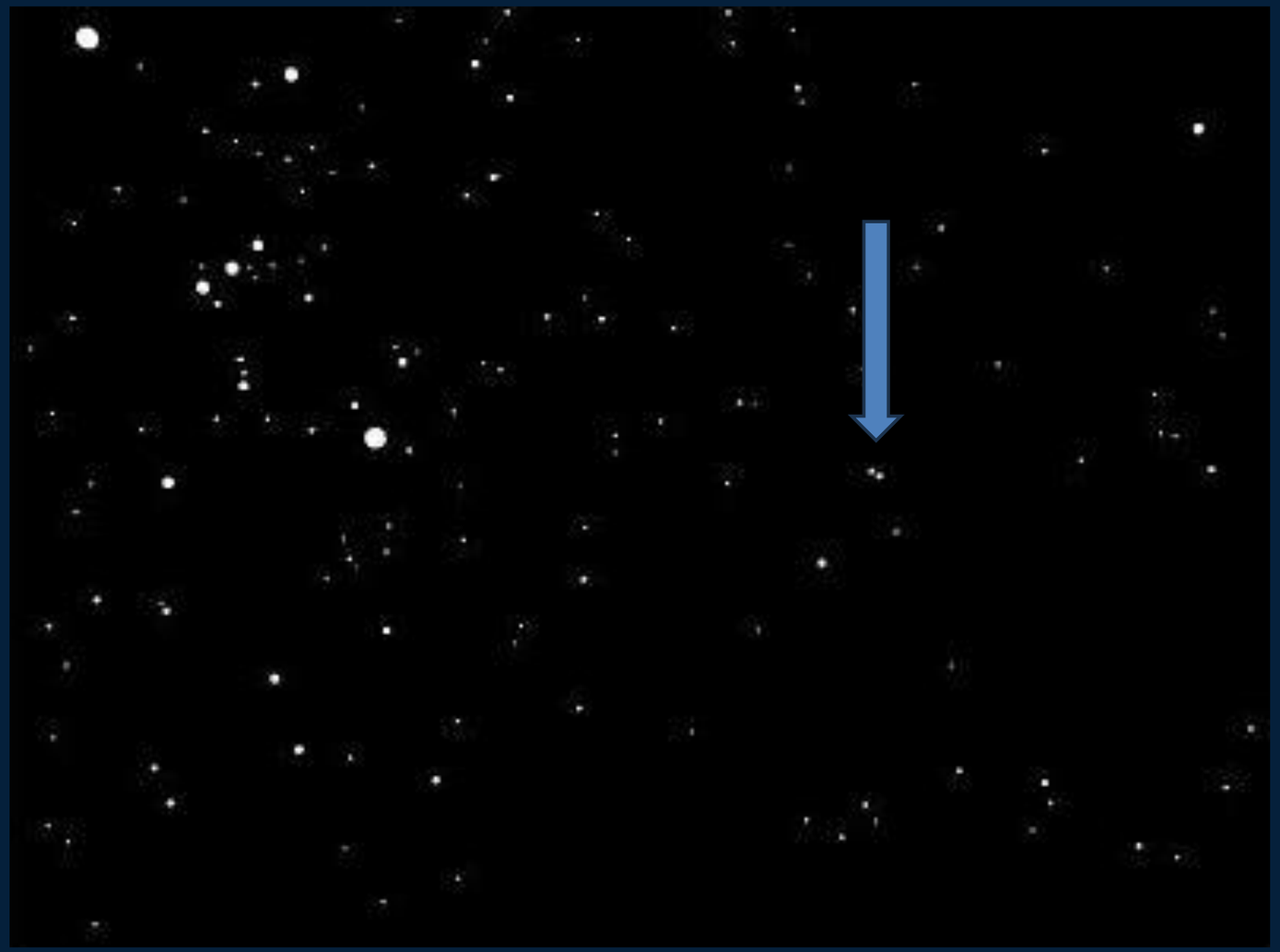
We started noticing the positions of stars shifted of the course of an year.



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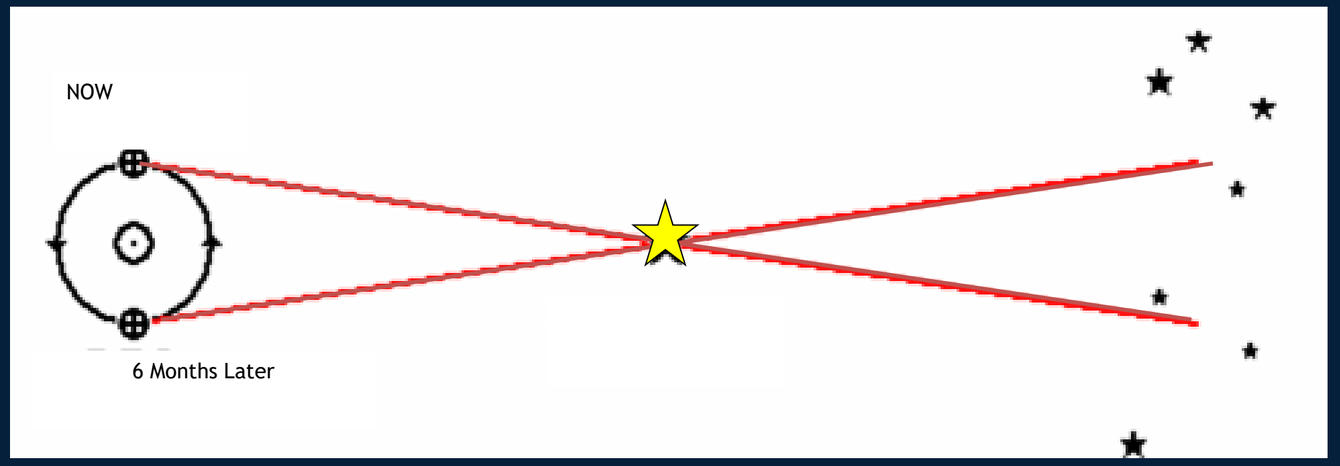
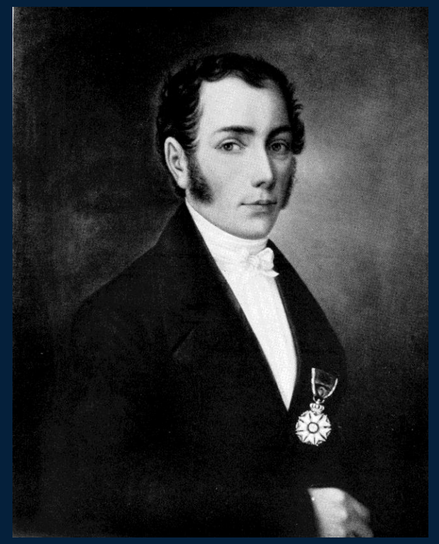
We started noticing the positions of stars shifted of the course of an year.

Six months later..

HOW FAR ARE THE STARS? WHAT ARE THEY MADE OF?

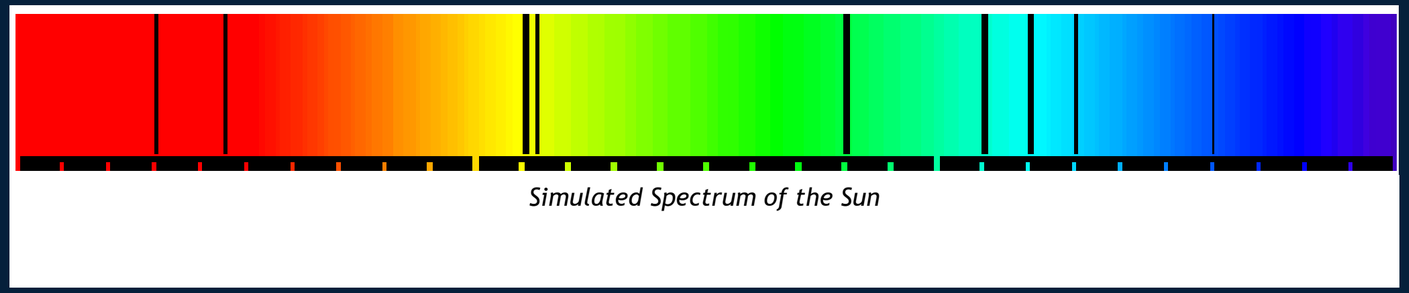
Using this difference, Friedrich Wilhelm Bessel measured the accurate distances to the stars using instruments at the Königsberg Observatory.



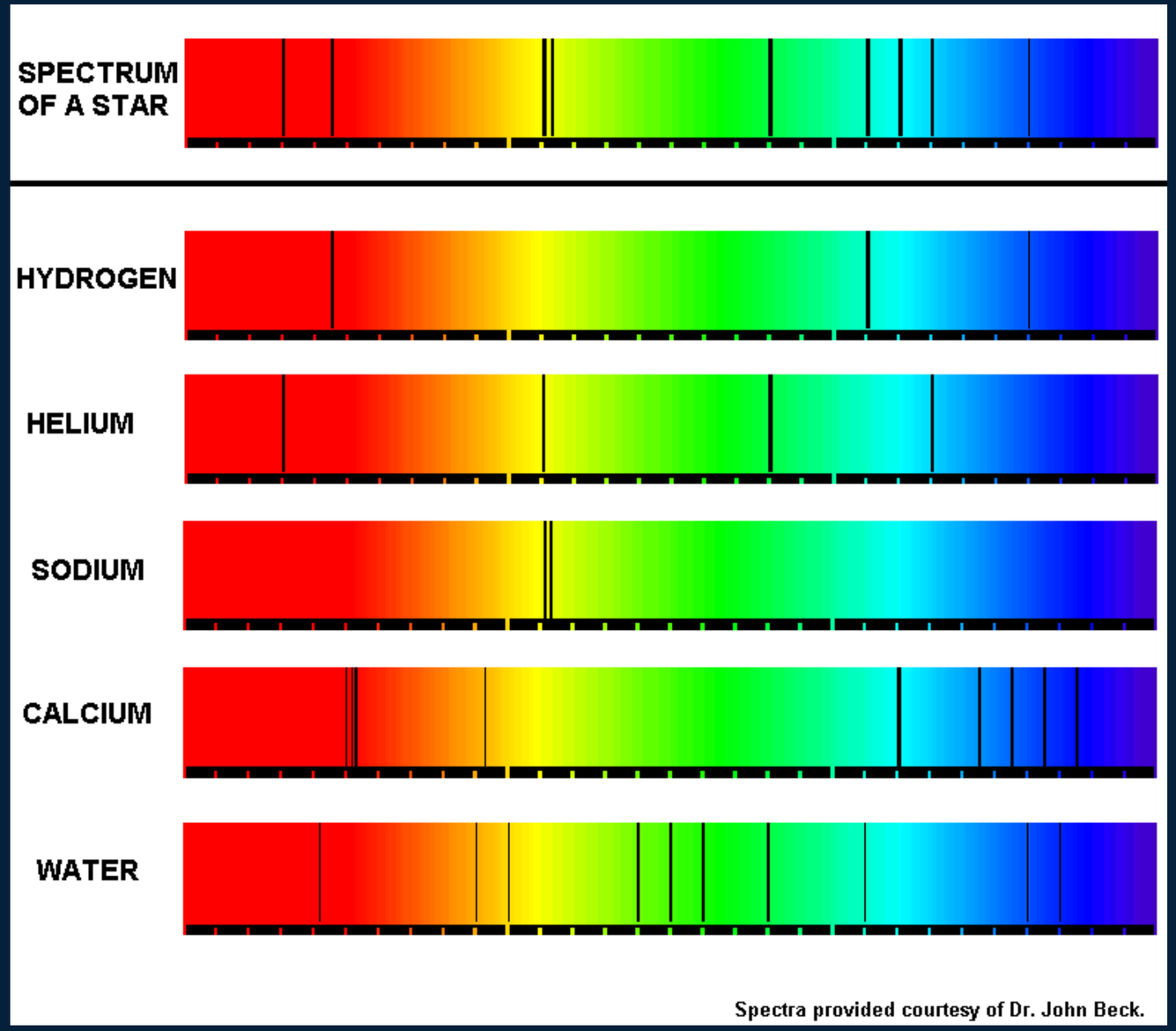


HOW FAR ARE THE STARS? WHAT ARE THEY MADE OF?

Using instruments at the Königsberg Observatory, Joseph von Fraunhofer studied the white light from the Sun, and observed colors like the rainbow, with some dark lines. He called it a spectrum.



Simulated Spectrum of the Sun



HOW FAR ARE THE STARS? WHAT ARE THEY MADE OF?

Those dark lines turned out to be the fingerprints of the elements that made up the atoms of the Sun's atmosphere!

Soon, the spectra of stars revealed these same dark lines!

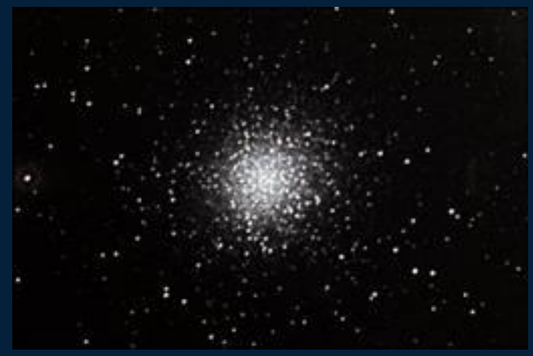
Time for a small activity!

IS SUN THE CENTER OF THE UNIVERSE?

Less than 100 years ago, Sun was thought to be the center of the universe.

IS SUN THE CENTER OF THE UNIVERSE?

Harlow Shapley, observed bunches of stars called globular clusters, using the 60 inch reflector telescope at the Mount Wilson Observatory.

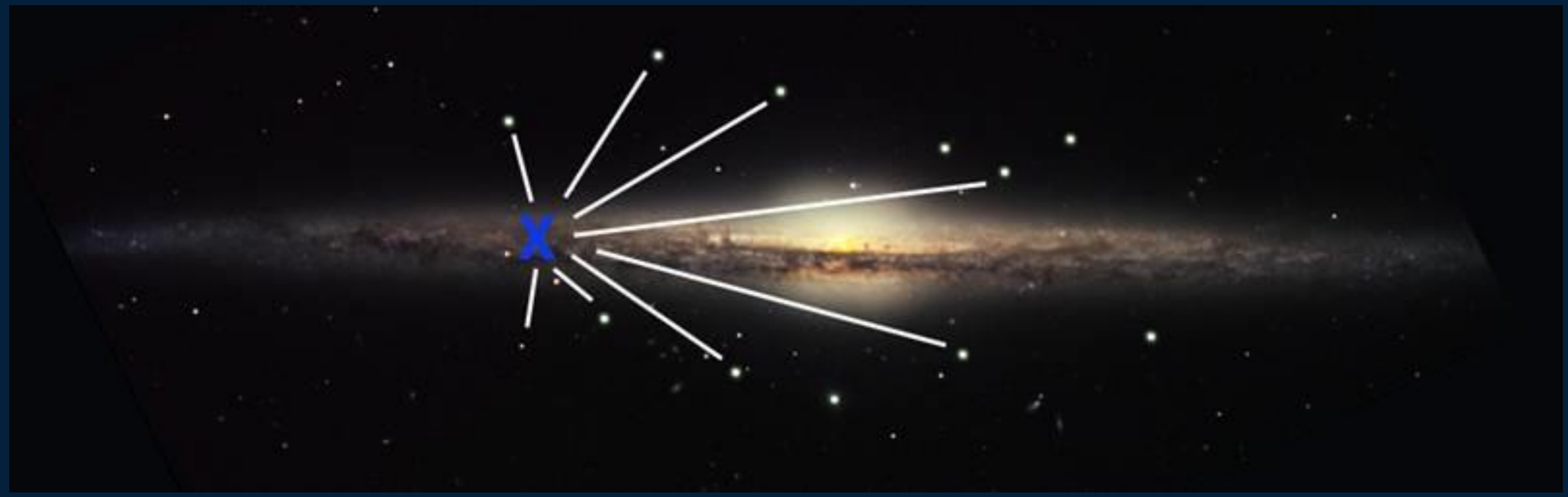


IS SUN THE CENTER OF THE UNIVERSE?

If we were at the center of the galaxy, these star clusters should be randomly distributed in all directions around us. But what did Shapley discover?

IS SUN THE CENTER OF THE UNIVERSE?

He found clusters to be in a spherical distribution in one direction – toward the constellation of Sagittarius. The location of the center of our galaxy had been determined, and we weren't there! In fact, the Solar System (the sun and its planets) was far from the center – out in the suburbs!

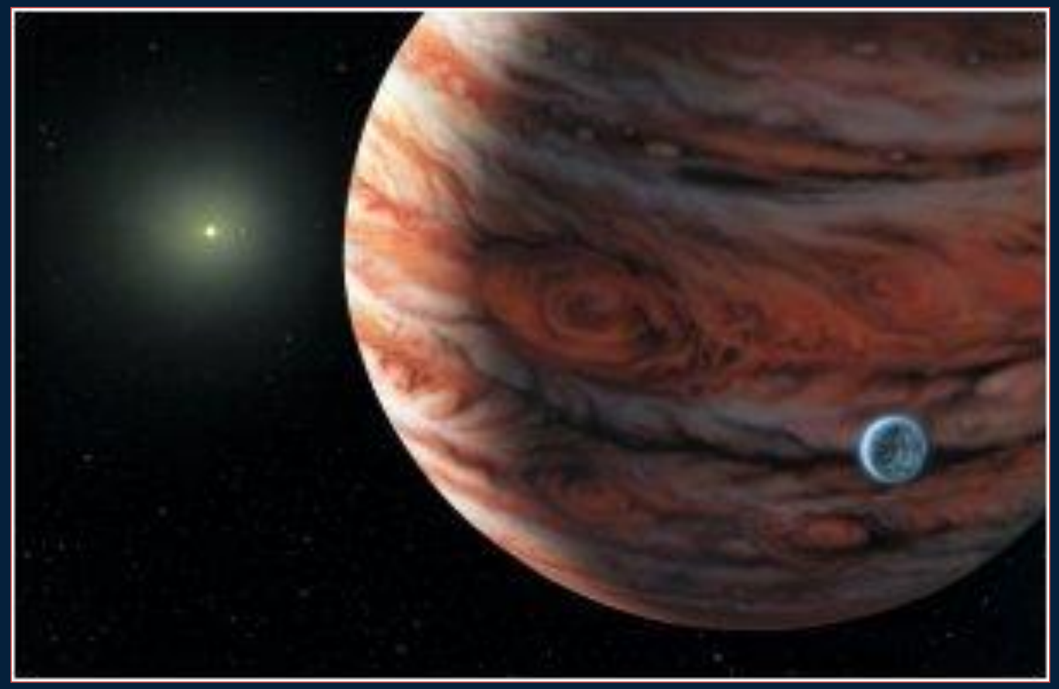


ARE THERE OTHER PLANETS?

Before telescopes, we only knew of 6 planets around the Sun: Mercury, Venus, Earth, Mars, Jupiter, and Saturn.

William Herschel built the largest telescope of his time, 48-inch reflector; he discovered the first planet beyond Saturn: Uranus!

Neptune (and Pluto) were eventually discovered using telescopes.



ARE THERE OTHER PLANETS?

Are there any planets beyond the solar system?

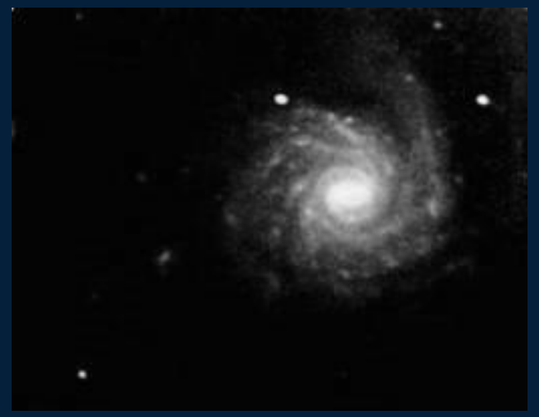
Scientists first started finding planets around other stars in our Galaxy in the 1990s.

Since they are so far away, we cannot really ‘see’ them; instead we search for eclipses around stars!

ARE THERE OTHER GALAXIES?

Less than 100 years ago it was still unknown whether our galaxy was the whole universe or just one of many galaxies.

“Spiral nebulae” had been observed and studied since the early 19th century. The term “nebulae” refers to their fuzzy or gaseous appearance. There was variety in their structure or shape that could be documented, but their size was unknown because their distance was unknown.



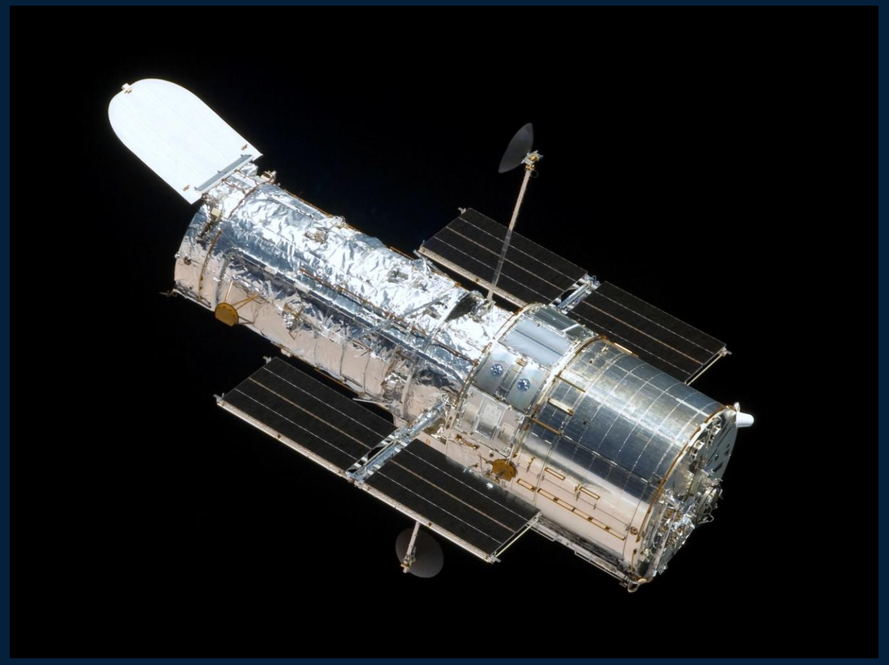
ARE THERE OTHER GALAXIES?

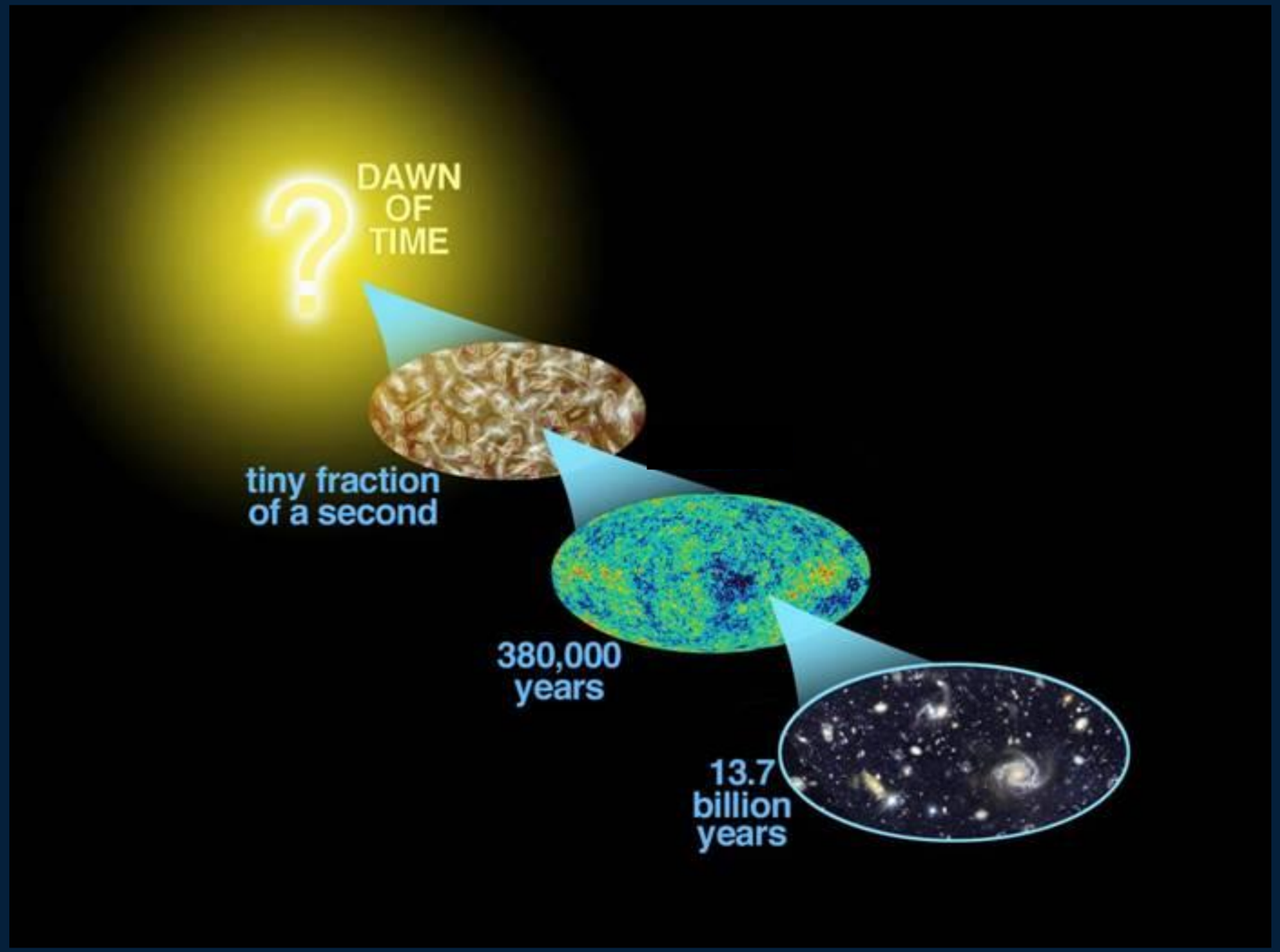
In 1924, Edwin Hubble, using the newly built Mt Wilson 100-inch telescope, estimated the distance to the stars and the nebula in Andromeda galaxy.

The huge distance he measured (2 million light years) meant that Andromeda itself was huge, and a galaxy in its own right.

ARE THERE OTHER GALAXIES?

Suddenly, our Universe was not just the Milky Way galaxy, but a cosmos filled with galaxies!





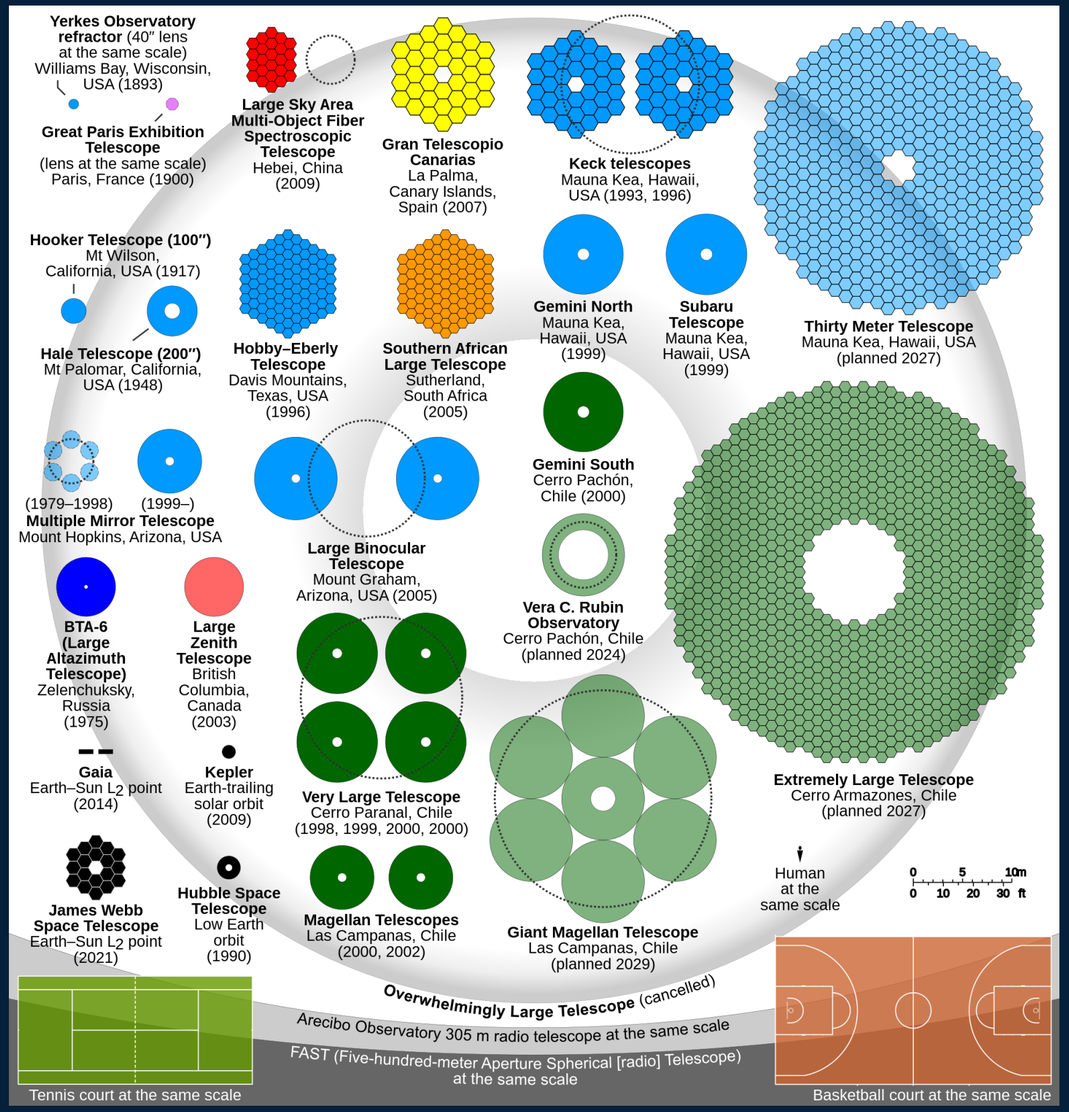
HOW OLD IS THE UNIVERSE?

Hubble also discovered that these distant galaxies are moving faster away from us!

The universe is expanding!

By measure the rate at which these galaxies are moving, we estimate that the universe started with a Big Bang, 13.6 Billion years ago!

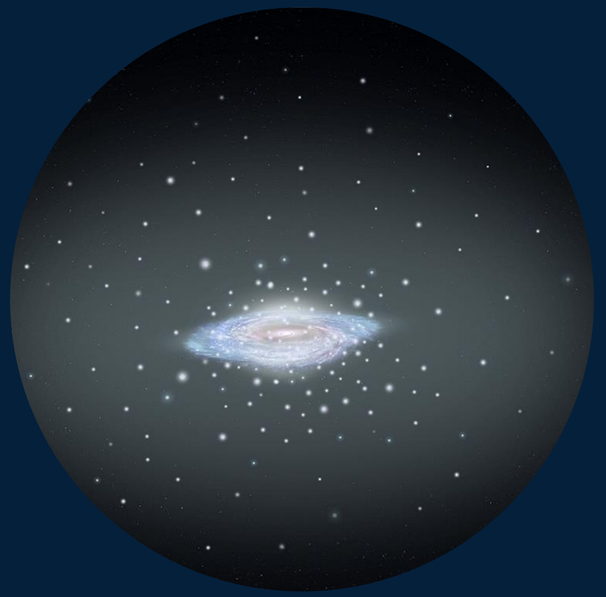
TELESCOPES HAVE CHANGED OUR UNDERSTANDING OF THE UNIVERSE...



ANSWERING BIG QUESTIONS...

Is Earth the center of the universe?

How far are the stars? What are they made of?



Is the Solar System at the center of the Galaxy?

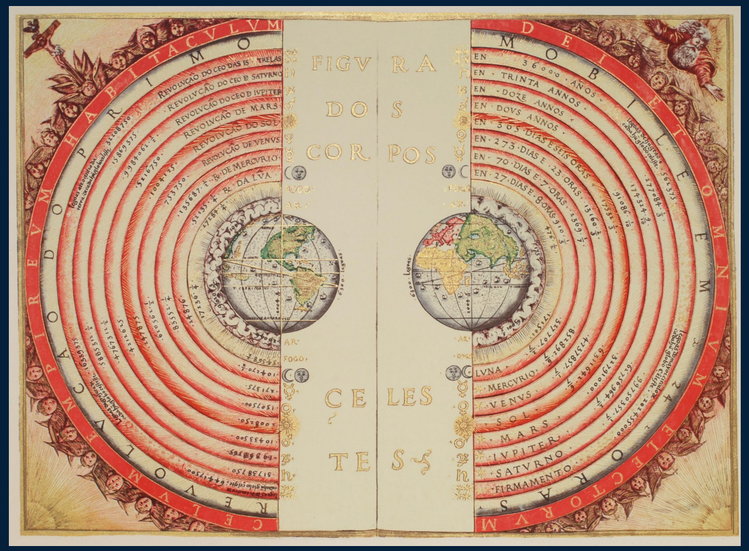
Are there planets outside of our solar system?

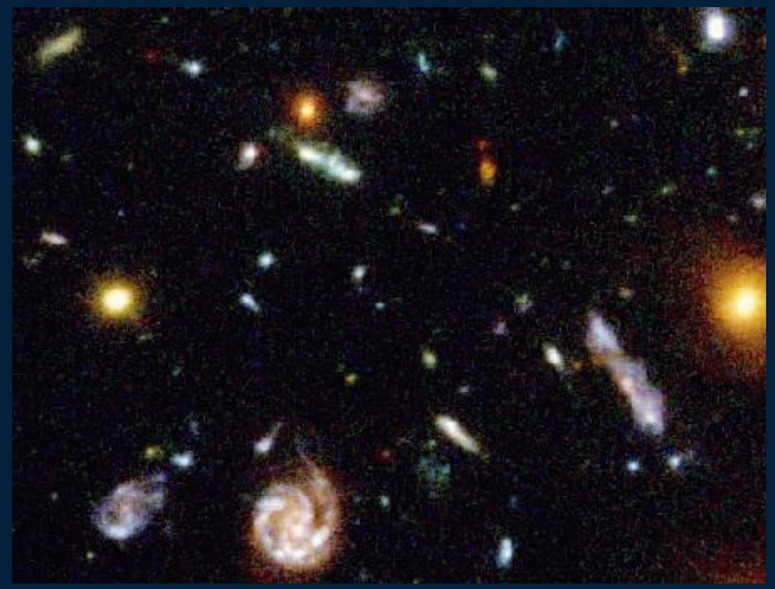
Are there more galaxies?

How old is the universe?

CHANGING OUR UNDERSTANDING OF OUR PLACE IN THE UNIVERSE!

From the center of the universe...





... to a very small planet in an immense expanding universe

QUESTIONS?

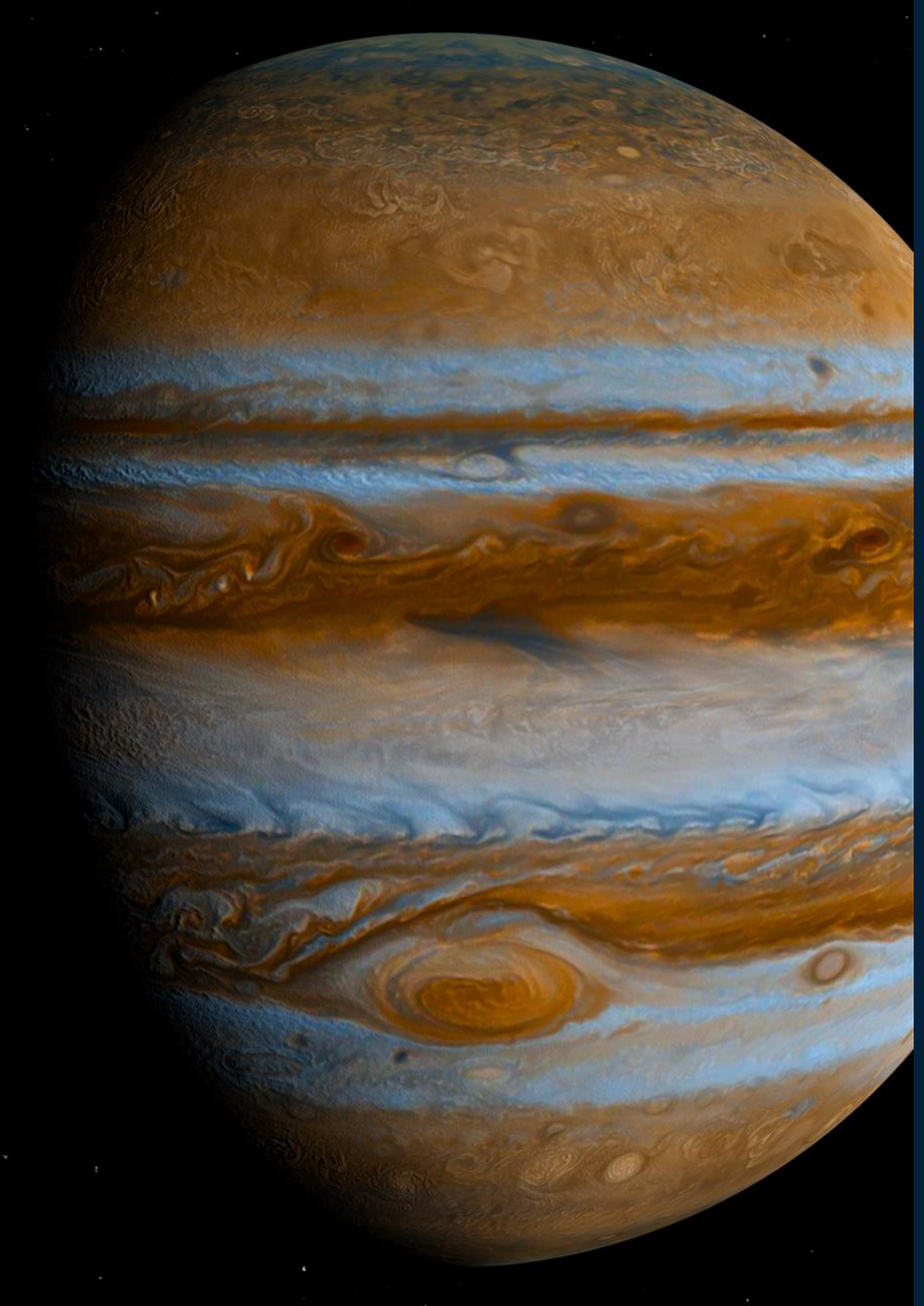
THANK YOU!

Teja Teppala

ANSWER

A. HOT AND POISONOUS

Venus is surrounded by thick, acidic clouds around 30 miles above its surface.

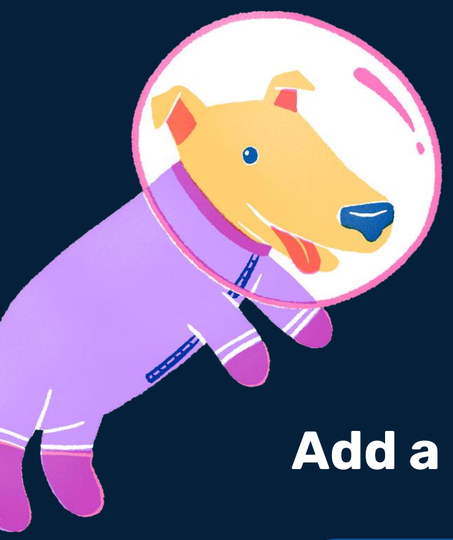


ANSWER

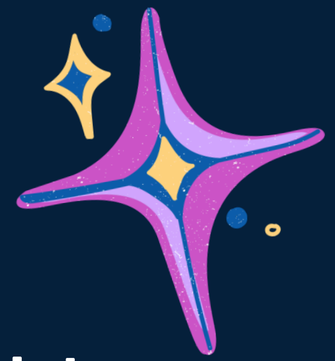
A. JUPITER

Jupiter is the largest planet in our solar system, with a diameter of 86,881 miles!

WHY CAN'T YOU SEE AN OBJECT THAT'S FAR AWAY?



QUIZ CATEGORIES



Add a main point

Briefly elaborate on what you want to discuss.

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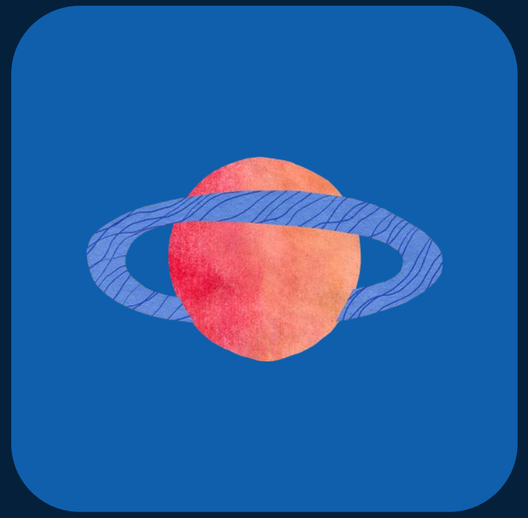

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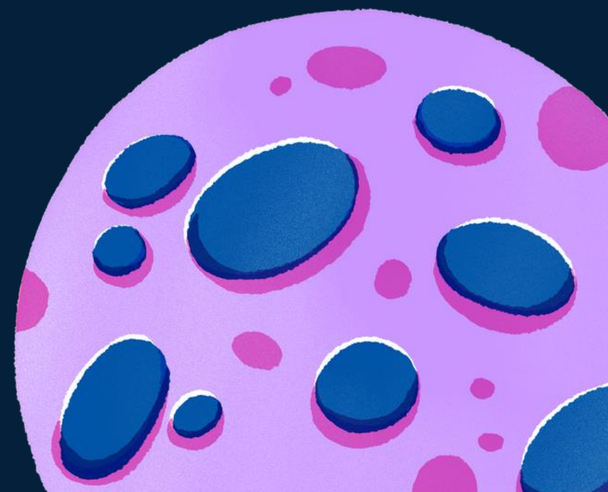

ADD AN AGENDA PAGE

SECTION A

01

Describe the topic of this section.

SECTION B

02

Describe the topic of this section.

SECTION C

03

Describe the topic of this section.

WRITE YOUR TOPIC OR IDEA

The Solar System

Briefly elaborate on what you want to discuss.

Planets

Briefly elaborate on what you want to discuss.

The Sun

Briefly elaborate on what you want to discuss.

QUESTION 1

WHAT IS THE NAME OF THE LARGEST PLANET IN OUR SOLAR SYSTEM?

A
Jupiter

B
Saturn

C
Uranus

D
Neptune

MULTIPLE CHOICES

WHICH OF THESE BEST DESCRIBES THE ATMOSPHERE SURROUNDING VENUS?

- **A** Hot and poisonous
- **B** Bright and sunny
- **C** Cold and snowy
- **D** Cold and wet

RESOURCE PAGE

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CREDITS

Slides Carnival

This presentation template is free for everyone to use thanks to the following:

SlidesCarnival for the presentation template

Pexels for the photos

HAPPY DESIGNING!