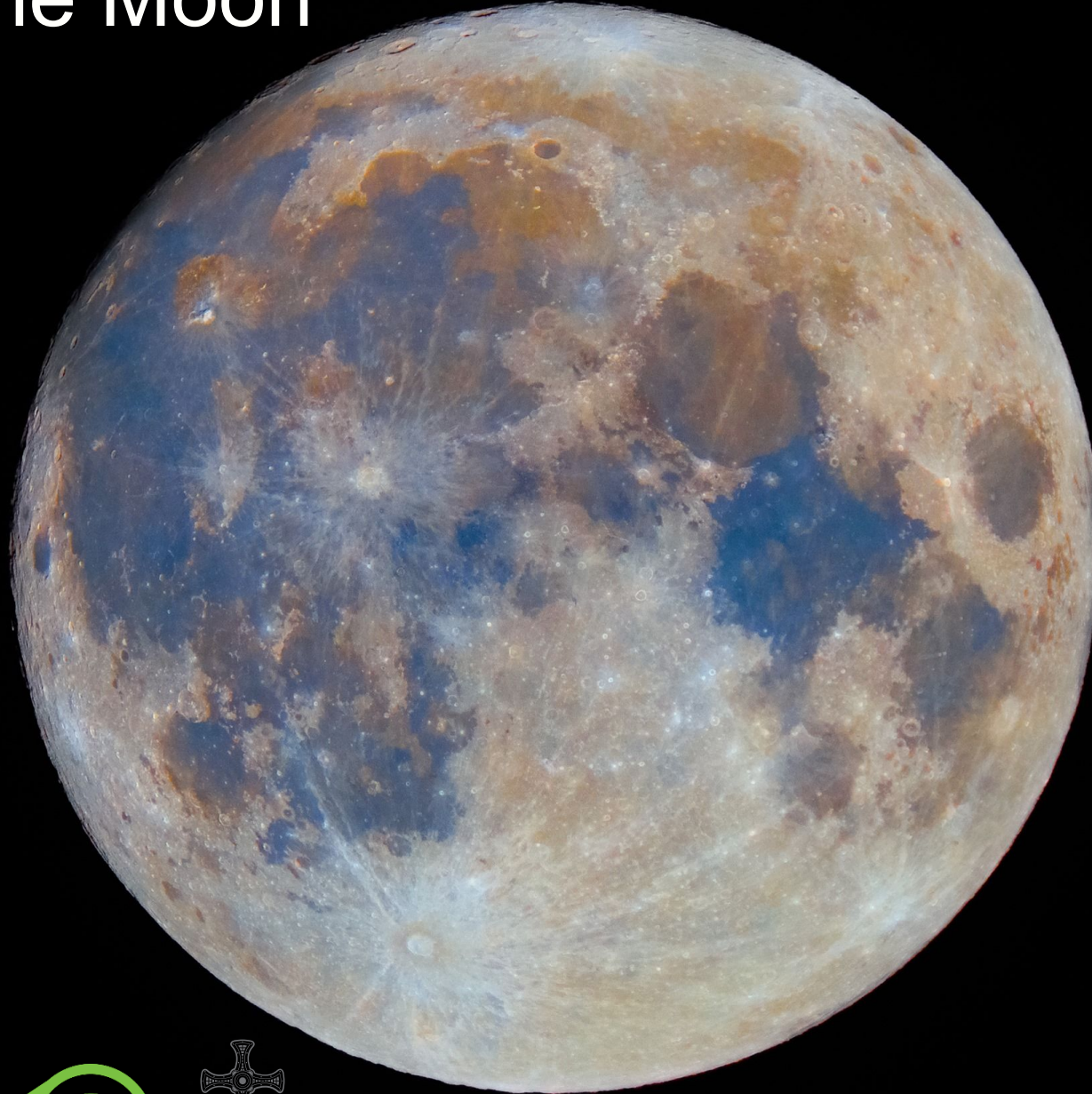


# Lesson Plan: The Moon



In association with:



**KIELDER  
OBSERVATORY**  
Infinite Inspiration



DURHAM  
CATHEDRAL

Mineral Moon, Daniel Monk, Kielder Observatory

## How to use this lesson plan

This lesson plan is suitable for anyone but we recommend it for ages 7 to 11. It's a lot of fun to go on this journey with parents, teachers or your friends, but it is designed so you can explore independently at your own pace. There are different types of questions to answer: can you discover, explore and invent? We think so. Check in with your parents or teacher if you need to, but you'll need a tablet, computer or smartphone. You can do this lesson plan on almost any device as long as you can get online and use a web browser.

There are 4 Chapters:

Chapter 1 - The Moon 45 minutes

Chapter 2 - Lunar Exploration 45 minutes

Chapter 3 - Other Moons 45 minutes

Chapter 4 - Museum of the Moon 30 minutes

You'll see some helpful signs on the way:



Useful information to guide you through the lesson.



Things you'll need to watch, read, learn and make things with during the lesson.



Digital activity time. Take quizzes and explore.



Estimated time to do a section of this lesson.



Explore online content. Discover videos, stories, or go and look at and zoom around pictures.



Activity time. This is where you get to design, make or write something of your own.



Headphones to listen to videos and audio.



## Things you'll need

Things that will help you during this lesson.



**Scrap Paper**



**Brush and Paint**



**Tablet or Computer**



**Scissors**



**Notepad**



**Pens and Pencils**

**What will you learn?**

1. Learn about the Moon
2. Discover how the Moon and the Earth are closely linked
3. Learn about how we have observed and explored the Moon
4. Explore other moons in our Solar System
5. Explore what life might look like on other worlds
6. Discover some of the history of astronomy
7. Understand the inspiration behind the Museum of the Moon sculpture

**After studying this lesson, you will be able to:**

1. Describe the Moon
2. Understand the importance of the Moon to life on Earth
3. Describe other moons
4. Design your own moon mission
5. Create your own artwork inspired by the Moon

**Vocabulary:** aliens, Apollo, axis, calculation, climate, core, crater, crust, Earth, exploration, gravity, light, lunar, mantle, mission, moon, motion, navigation, observation, orbit, phases, probe, rings, rotation, sky, solar system, spacecraft, species, time, volcano, universe, waning, waxing



# Chapter 1



What's this chapter about?  
The Moon



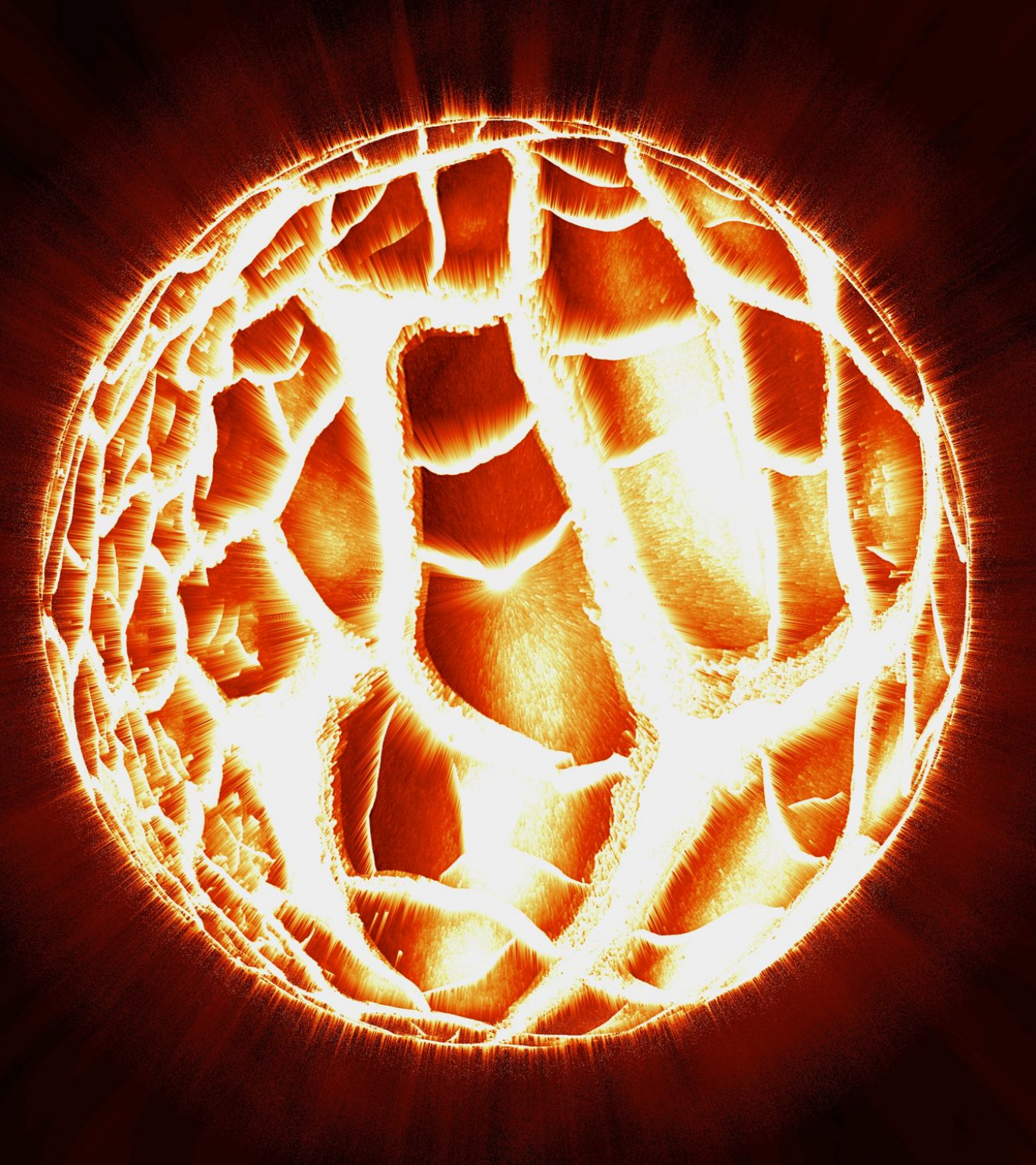
What will I do?  
Learn about the Earth's Moon, how the Moon formed and why it looks different as it orbits the Earth  
Learn about the Moon's importance to life on Earth



How long will this chapter take?  
45 minutes







## What is the Moon?

We've all looked at the Moon! That mysterious sphere in our night sky that changes from a crescent to a disc to a crescent.

Yet despite its mystery, it's the only other object in the Universe visited by humans and we know a lot about it.

Let's start with how it came to be.

Current thinking is that a Mars-sized body collided with Earth about 4.5 billion years ago. The resulting debris eventually collected together in the Earth's orbit and formed our Moon. The newly formed Moon was in a molten state, but the moon's crust formed within 100 million years of its formation.

What is the Moon made of?

Rock! Just like the Earth, the Moon has a core, a mantle and a crust. Its core is iron rich, surrounded by liquid iron, and a rocky crust on top.

Why does it orbit the Earth?

The debris thrown up by the initial impact could not completely escape Earth's gravity - over time, it collected together to form the Moon, which is now in a stable orbit around the Earth. But it is very slowly travelling away from us: every year, the Moon's orbit around the Earth is an inch further away.



Visit [here](#) to see the evolution of the Moon



Visit [here](#) to see an artist's impression of the "big splash"





Source: NASA/Bill Dunford

## Moon Phases

Why does the Moon look different at different times?

Firstly we need to understand that the Moon has no light of its own - moonlight is actually reflected sunlight.

Secondly, we need to know that we can only see half of the Moon from Earth, since the other side is always turned away from us.

Lastly, the Moon is orbiting the Earth (approximately once every 27 days).

Therefore, as the Moon travels around the Earth, we see different fractions of the Moon, as it is lit by the Sun.

“Waxing” means growing and is used to describe the Moon as it grows from new moon to full moon.

“Waning” means shrinking and is used to describe the Moon as it gets smaller from full moon to new moon.

We often use the word "lunar" to describe the Moon: this comes from the Roman name for the Moon: Luna was the sister goddess of Sol (the Sun) and Aurora (the dawn).



Click [here](#) to see phases of the Moon illustrated with Oreo cookies (and join in if you have some)



## Why the Moon is so important

The Moon has a very important effect on life on Earth. The Moon's gravity stabilises the Earth's "tilt" as we orbit the Sun. This means we have a more stable climate, allowing life itself to flourish and diversify.

There are three main ways the Moon is important for life on Earth: time, tides and light.

We are all tied into a moon "clock": its phases affect us and many species and some even have an internal compass to navigate precisely by the Moon.

Many species have evolved to live and navigate by the changing moonlight (and with increasing light pollution around the world, these species are under threat).

And tides - the most visible effect of the Moon. The Moon's gravity affects the movement of water all over the planet (and within us!) and many species have evolved to take direct advantage of the tides.



Click [here](#) to see some of these amazing stories





Click [here](#) to see facts and figures about the Moon, courtesy of NASA.



Crescent Moons over Kielder, Dan Pye, Kielder Observatory

# Questions for Chapter 1

Let's get started with some questions.

## **Discover:**

How much smaller than the Earth is the Moon?

## **Explore:**

Why have limpets evolved teeth stronger than Kevlar?

## **Invent:**

Think what life might be like without our closest neighbour, the Moon. No moonlight, no tides. How do you think we would function?





## 11





Galileo Galilei, by Justus Sustermans

## Observing our Moon

The Moon has been a source of wonder for as long as humans have been on the Earth.

Our closest neighbour in the vast Universe, the exploration of the Moon has always been part of our history.

While all civilisations have observed the Moon there are some people who made important contributions to our knowledge.

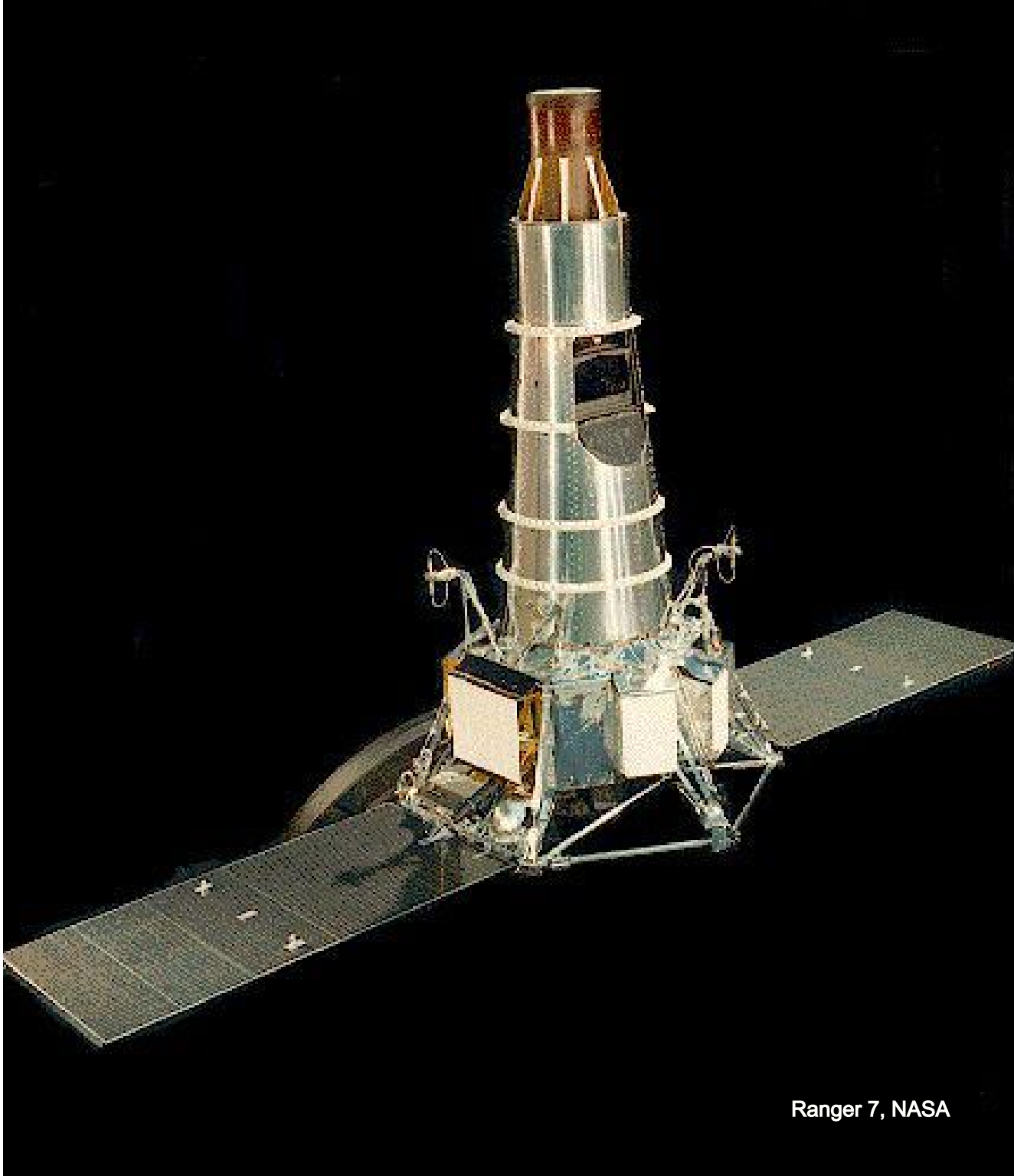
Galileo Galilei, for example, discovered in 1609 that the Moon was not a perfect sphere but, like Earth, had mountains and valleys.

In 1666, Adrien Azout deduced that there was no life on the Moon, as it seemed to have no atmosphere.

And it wasn't until the early 1900s that we understood moon craters were caused by impacts from meteorites, rather than volcanoes.



Click [here](#) to read about 11 moon heroes



Ranger 7, NASA

## Exploring our Moon

With centuries of observation of the Moon from Earth, we might think that we had enough information to enable humans to set foot on the Moon.

Not quite! In 1961, NASA launched the Ranger programme - a series of unmanned probes which would fly close to the Moon and send back as much information as possible.

The Ranger programme is a perfect example of, "If at first you don't succeed, try again": by 1964, NASA had sent 12 such missions to the Moon before Ranger 7 actually succeeded in sending back images of the Moon from close quarters.

Then, in 1967, NASA's Lunar Orbiter completed a detailed photomap of the Moon.

Who was first on the Moon? It was actually the Russians: in 1966, the unmanned Soviet spacecraft Luna 9 made the first soft landing on the Moon.



Click [here](#) to see a video from the 1960s about Ranger 7 and the images it sent back





Apollo 11, NASA

## Humans on our Moon

And so we come to Apollo, still the most celebrated space mission and with good reason. For the first time in our history, a human being set foot on another world.

In 1961, the President of the United States, John F. Kennedy, set a challenge, a moonshot: we would have humans on the Moon before the end of the 1960s. At this point, NASA had only had humans in space for a total of 15 minutes. It was an enormous challenge and the Apollo programme was born.

Apollo was a three-part spacecraft: the command module (CM), the crew's quarters and flight control section; the service module (SM) for the propulsion and spacecraft support systems (when together, the two modules are called CSM); and the lunar module (LM), to take two of the crew to the lunar surface, support them on the Moon, and return them to the CSM in the Moon's orbit.

It was Apollo 11 which succeeded, in July 1969, five months before Kennedy's deadline. Only 12 people have walked on the Moon in the entire history of the human race.



Click [here](#) for an overview of the Apollo missions



Click [here](#) for videos from the moon landing



# Questions for Chapter 2

Let's get started with some questions.

## **Discover:**

Name three of the 11 lunar observers

Which spacecraft landed first on the Moon?

Which Apollo mission landed humans on the Moon

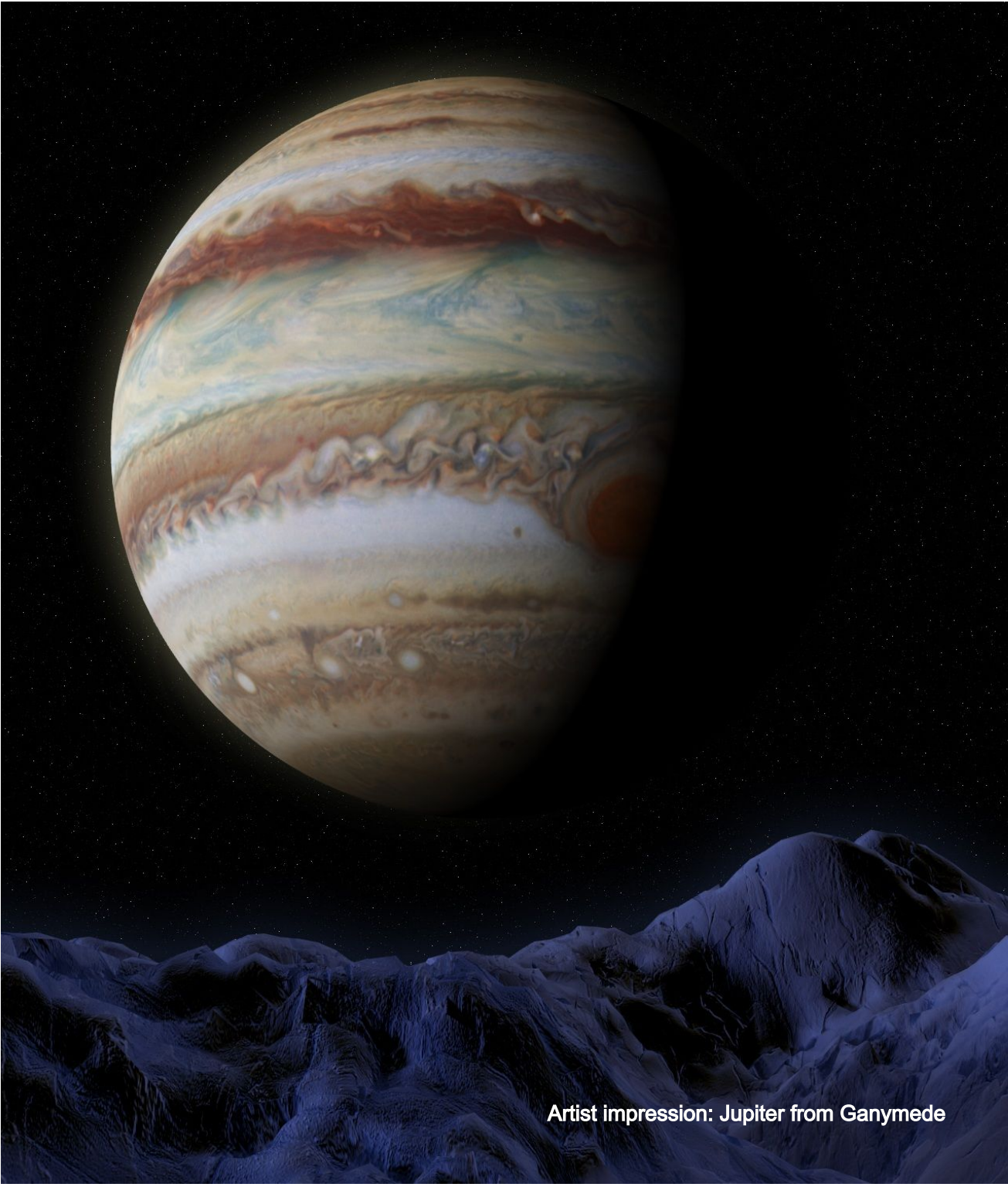
## **Explore:**

"We came in peace for all mankind." Why do you think NASA put this phrase on the plaque marking our first visit to the Moon?

## **Invent:**

Design your own moon mission - what would your spacecraft look like?





Artist impression: Jupiter from Ganymede

# Chapter 3



What's this chapter about?  
Other moons in the Solar System



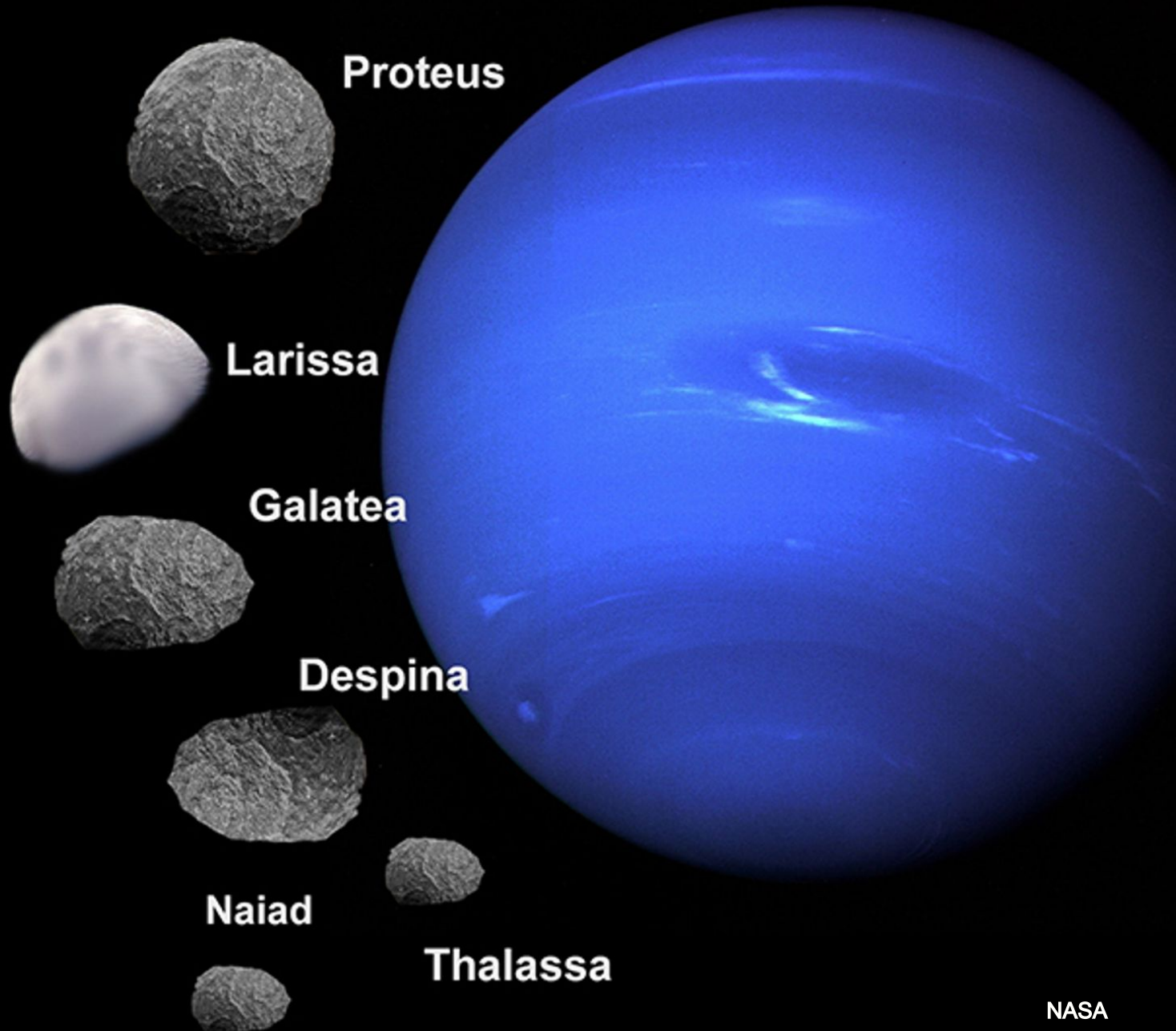
What will I do?  
Explore other moons in the Solar System and  
how they differ from our Moon  
Learn about the possibility of life on moons



How long will this chapter take?  
45 minutes



## ● Hippocamp



NASA

Did you know that our Moon is not the only Moon in the Solar System?

The Solar System is what we call the collection of planets that orbit our Sun (called "Sol"). Mercury, Venus, Mars, Earth, Jupiter, Saturn, Neptune and Uranus are the eight major planets that make up the Solar System.

Between them, there are hundreds of moons!

So what is a moon? A moon is defined to be a body that makes an orbit around a planet. As our methods of observing our solar system become more accurate, we have been able to identify more and more moons orbiting the planets of our Solar System.

Neptune, pictured left, has at least seven moons.



Click [here](#) to see what's happening in our solar system today



Click [here](#) to investigate the moons of other planets.



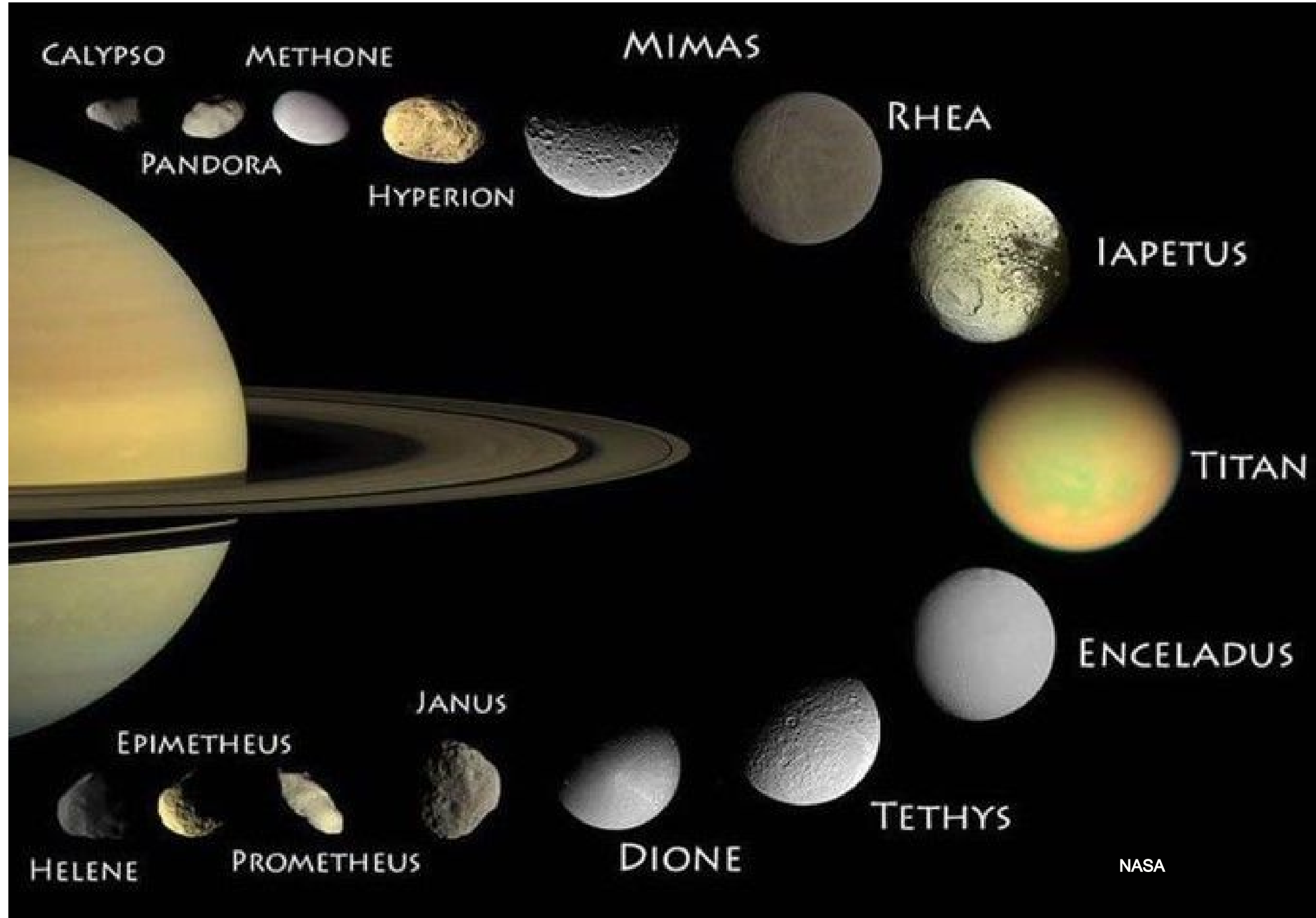
Saturn has many moons - different shapes and sizes and all wonderfully named.

It also has rings, but these aren't moons.



Click [here](#) to see some of Saturn's moons in orbit

Click [here](#) to learn about Saturn's rings





Click [here](#) to see an interactive video of Europa, a moon of Jupiter (and you might find aliens...)



# Questions for Chapter 3

Let's get started with some questions.

## **Discover:**

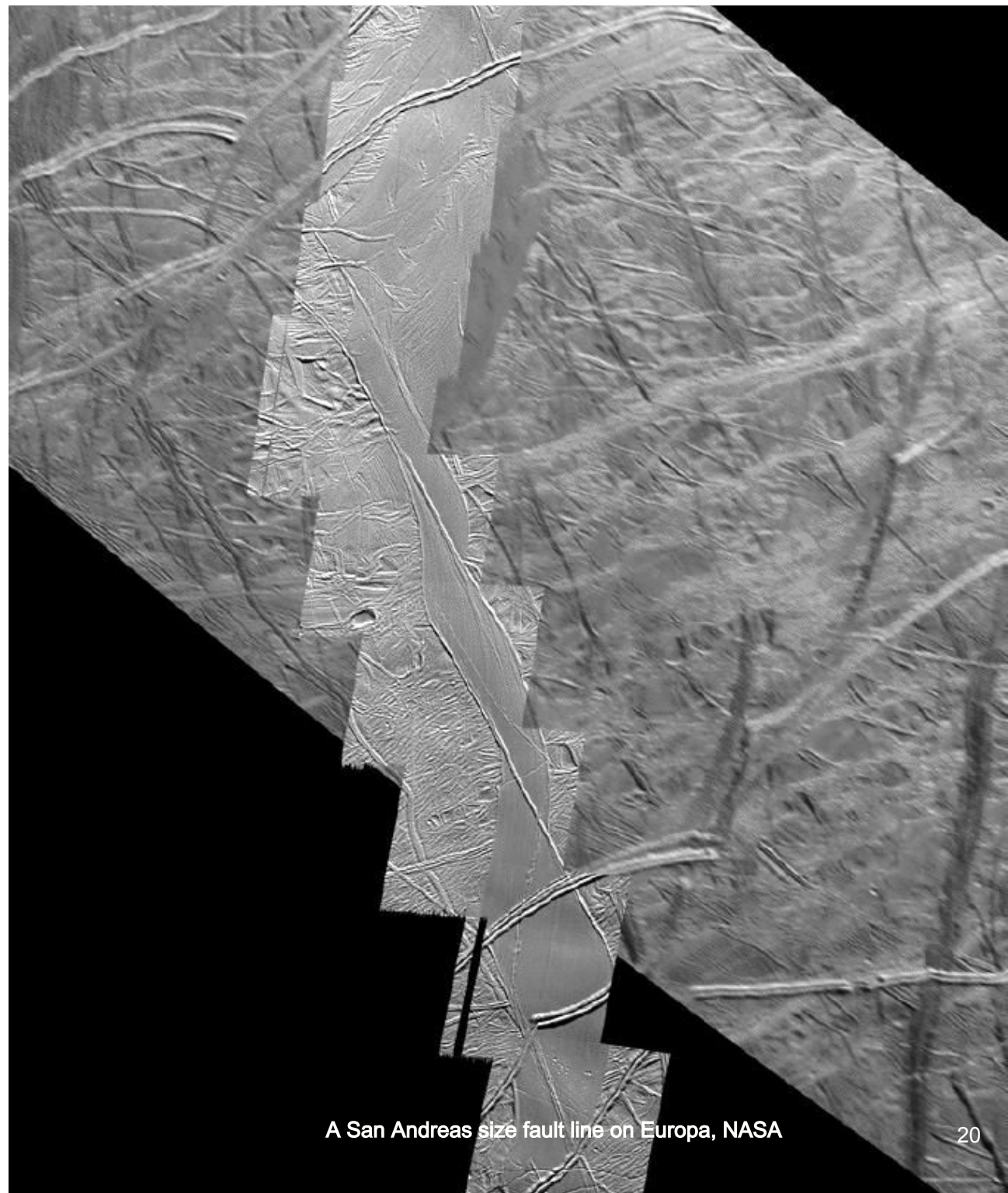
How many moons are there in the Solar System?  
Which planets have the most moons?  
What is astrobiology?

## **Explore:**

Why does Saturn have rings as well as moons?

## **Invent:**

Is there life on Europa, Jupiter's moon? Draw a picture of what you think life might look like there.



A San Andreas size fault line on Europa, NASA





Museum of the Moon

# Chapter 4



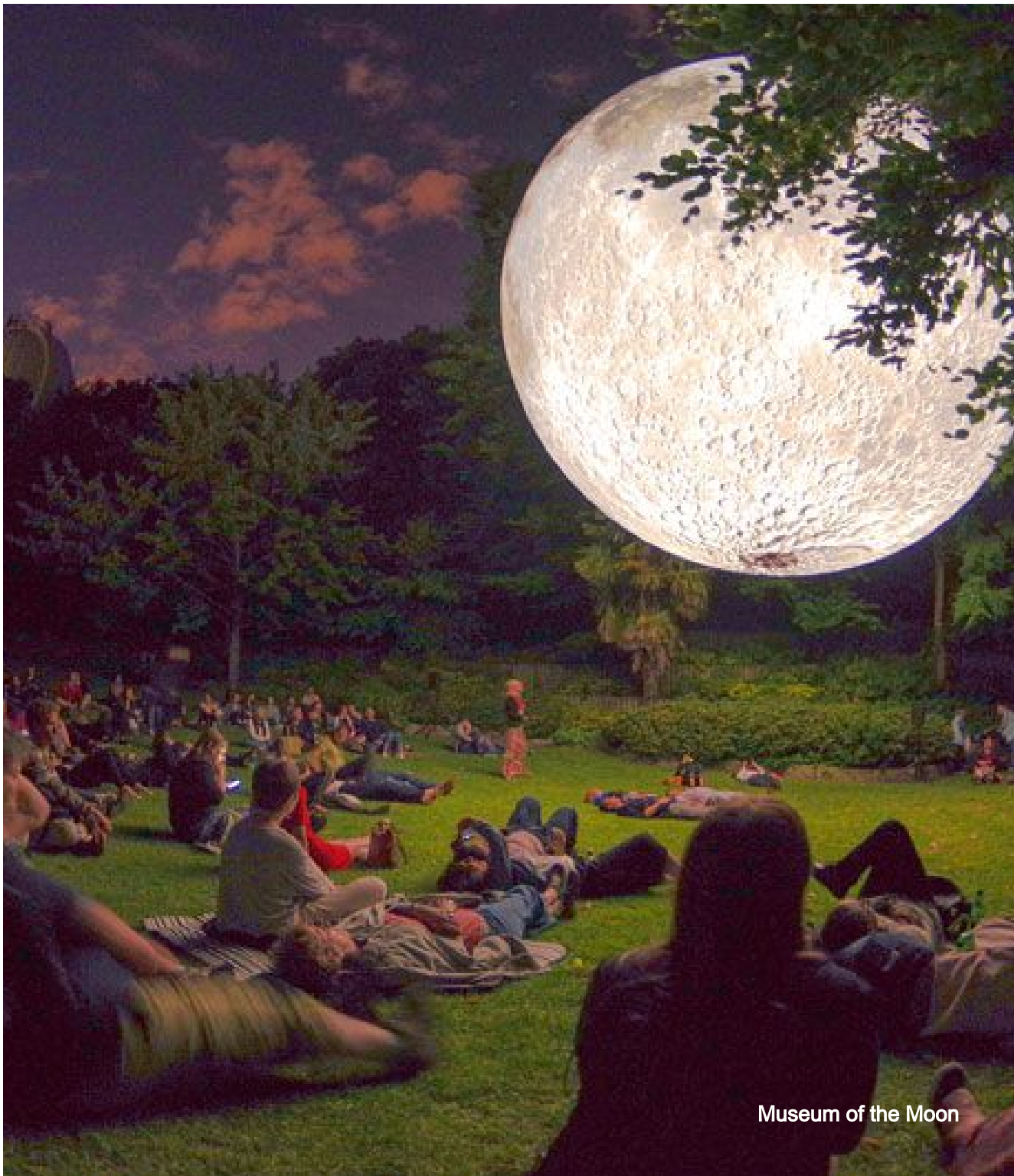
What's this chapter about?  
Museum of the Moon



What will I do?  
Learn about the Museum of the Moon art  
installation



How long will this chapter take?  
30 minutes



Museum of the Moon

## Museum of the Moon

Museum of the Moon is a touring artwork by UK artist Luke Jerram.

Measuring seven metres in diameter, the moon features 120dpi detailed NASA imagery of the lunar surface. At an approximate scale of 1:500,000, each centimetre of the spherical sculpture represents 5km of the moon's surface. The Moon is lit internally, ensuring a mesmerising and familiar glow.

Luke created Museum of the Moon, inspired by the way it connects us. Over the centuries, the Moon has been used as a timekeeper, a calendar and a source of light to aid nighttime navigation.

The Moon has inspired artists, poets, scientists, writers and musicians around the world. Different cultures have their own historical, cultural, scientific and religious relationships to the Moon. Yet somehow, despite these differences, the Moon connects us all.

Luke Jerram has had more than 600 exhibitions in 44 countries. Museum of the Moon itself has been presented over 200 times in 30 different countries!



Click [here](#) to see where Museum of the Moon has been



Click [here](#) to see a video of Museum of the Moon





Museum of the Moon at Durham Cathedral

## Astronomy and Durham Cathedral

Why install an artwork about the Moon in a cathedral?

The church and astronomy are perhaps more closely linked than we might think. Astronomy was a way to understand the mysteries of life and creation, and the Moon itself often occurs in Christian art, representing purity and peace.

Durham Cathedral has a collection of very rare astronomy books, including by Galileo and Newton. "Hunter 100" is a 12th century collection of texts on medicine and astronomy, including drawings of several, very familiar, constellations.

Perhaps most surprisingly, a 'local lad', the Venerable Bede, knew about the Moon and tides 1,000 years before it became accepted fact.

He wrote "On the Reckoning of Time" in 725 AD, which explained the effect of the Moon on our tides. 1,000 years later, Isaac Newton set out the laws of gravity and motion, which in turn laid the foundations for the calculations used in 1969 to work out the orbit of Apollo 11. Over 1,200 years ago, Bede's work helped to land a man on the moon – and bring him back safely.



Click [here](#) to learn more about Bede

# Questions for Chapter 4

Let's get started with some questions.

**Discover:**

How many times has Museum of the Moon been presented?

**Explore:**

How does Museum of the Moon make you feel?

**Invent:**

Create your own artwork inspired by the Moon







Extra credit! 10 things you might, or might not, know about Moons... [here](#)



Moon Halo, Daniel Monk, Kielder Observatory



Congratulations on  
completing this lesson plan!





# Answers to all the questions

## Chapter 1

Discover:

How much smaller than the Earth is the Moon? Answer: 3.7

Explore:

Why have limpets evolved teeth stronger than Kevlar? Answer: for scraping food from the rock surface

Invent:

Think what life might be like without our closest neighbour, the Moon. No moonlight, no tides. How do you think we would function?

Answers will vary, but should include some consideration of the impact on our climate, on wildlife and on ourselves.

## Chapter 2

Discover:

Name three of the 11 lunar observers. Answer: any from this list <https://skyandtelescope.org/astronomy-resources/before-apollo-scientists-who-discovered-moon/>

Which spacecraft landed first on the Moon? Answer: Luna 9

Which Apollo mission landed humans on the Moon? Answer: Apollo 11

Explore:

"We came in peace for all mankind." Why do you think NASA put this phrase on the plaque marking our first visit to the Moon?

Answers will vary but should include some reference to the enormous advance that this represented for the human race.

Invent:

Design your own moon mission - what would your spacecraft look like?

Answers will vary but should include consideration of power to escape Earth's gravity, protection for astronauts, and equipment needed on arriving.

# Answers to all the questions

## Chapter 3

Discover:

How many moons are there in the Solar System? Answer: Over 200

Which planets have the most moons? Answer: Jupiter and Saturn

What is astrobiology? Answer: The study of life in the Universe

Explore:

Why does Saturn have rings as well as moons?

Answer: Saturn's rings are thought to be pieces of comets, asteroids, or shattered moons that broke up before they reached the planet, torn apart by Saturn's powerful gravity.

Invent:

Is there life on Europa, Jupiter's moon? Draw a picture of what you think life might look like there.

Answers will vary but consideration should be given to the "ocean world" description of Europa.

## Chapter 4

Discover:

How many times has Museum of the Moon been presented? 200 times

Explore:

How does Museum of the Moon make you feel?

Any answer is acceptable.

Invent:

Create your own artwork inspired by the Moon

Any answer is acceptable.

With thanks to Durham Cathedral and the Kielder Observatory Volunteers, who provided material for this lesson plan.