

# Visiting the Moon



## Teachers' Notes and Suggested Activities

Key Stages 1 and 2



# Foreword

These teaching notes have been prepared by Monica Grady, Professor of Planetary and Space Sciences at the Open University, on behalf of the EURO-CARES consortium. Monica was advised by a small team of teachers who work with a range of age groups from Early Years (EY) to KS2; the team also included a SEND specialist. The notes were 'road tested' on children of different age groups from schools in different Local Education Authorities in England.

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The work was part of the EURO-CARES project, which received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 640190.

The teacher in the story is Mrs Grady, in memory of Professor Grady's mother, who was an EY teacher for over 50 years, still working in a local school up until she died in January 2017.

**EURO-CARES:**  
**European Curation of Astromaterials**  
**Returned from the Exploration of Space**

<http://www.euro-cares.eu/>



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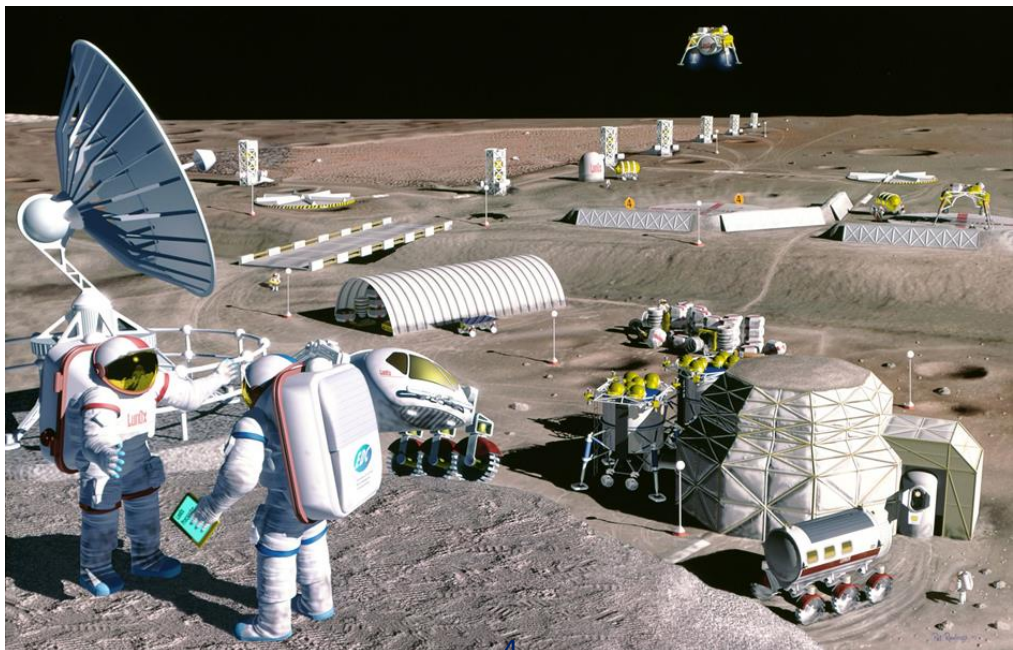
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# Introduction

The general principle of scientific observation and experimentation are introduced to students from the very earliest of stages in the national curricula of the different nations within the United Kingdom. The excitement of scientific discovery is demonstrated through experiments that the students can undertake themselves, either on their own or in groups. There is a careful attempt to link observations to everyday life, and a gradual progression in the complexity of the material taught.



This series of workplans for Keystages 1 and 2 (KS1, KS2) is based on the National Curriculum in England (NCE). We have extended application of scientific discovery beyond Earth, to explore our nearest neighbour, the Moon. We have taken the idea of 'Visiting the Moon' as a framework for activities that reinforce the learning objectives of the NCE. In doing this, we hope to strengthen the interest that younger students have in space and space exploration. After all, they are the generation that will be designing and building spacecraft for tourism, and it may be their children who are the first to live and work on the Moon.



# How the Workbook Works



The premise behind this workbook is that we have produced a guided, self-consistent learning session that can be used by teachers without them having to search the library or the internet for additional material. The plan, which can be stretched over several sessions, should, we hope, stand alone, complementing the curriculum that is being taught.

The booklet comes in three parts: KS1 (ages 5 – 7), KS2 (ages 7 – 11) and Additional Resources. In preparing this material, which is an enhancement of the NCE, we have assumed that the statutory sections of the NCE have already been introduced. A precis of the relevant section is given at the start of each session, to act as a quick recap or revision.

The Additional Resources comprise images, games, puzzles, etc, which can be freely copied. The images can also be found in a downloadable powerpoint presentation, that can be found [here](#):

There is no time length set for the sessions – there should be about 2 hours of classroom work in each part, and the material can be broken down into shorter chunks for ease of delivery. There is also a practical activity – building a lunar lander - which should be expected to take around two hours. This activity is intended as an exercise in communication and team-working, as much as being about the Moon. A list of materials required is given, along with some simple instructions.

The sessions are structured around a story set in 2030, about a class that has been told it is going on a trip to the Moon to stay at the Lunar base. As the children in the story ask questions, it is intended that children in the ‘live’ classroom situation would also ask questions to explore the idea of a trip to the Moon. Clearly, the story framework can be adapted to the local situation, or dropped entirely; it is merely intended to serve as a mechanism for introducing concepts and enabling discussion.

We hope that this is a useful resource: we would value comments and suggestions – please send any feedback to [monica.grady@open.ac.uk](mailto:monica.grady@open.ac.uk)

# KeyStage 1



# Acorn Class goes to the Moon



Teaching Note: This is written assuming that the students have been introduced to the concepts of day and night, the length of day and the changing seasons on Earth. They will know that the Earth orbits the sun, giving us the year, and that the Earth turns on its axis, giving us the day. They will also know that the Earth is tilted on its axis, giving us the seasons. Some of these concepts are revised here, and the session explore these concepts from the standpoint of the Moon.

It is October in the year 2030, and at Park Primary School, Acorn class are waiting to hear what their school trip would be. Mrs Grady, Acorn's class teacher, came into the classroom looking excited.

"We are going to take the whole class to the Moon" she said "to visit the lunar base. There is a new spaceship that can get us there – but we have to do some training first"

The class started cheering. Emily put up her hand.

"When will we go?" she asked

"In 4 weeks' time" replied Mrs Grady "As long as everyone is ready"

Dan was next.

"What training will we do – does it mean we have to be super-fit?"

"No" said Mrs G "you don't have to be super-fit for this trip, just be in good health, and able to use your brain."

"What about me?" asked Ash. "Can I come too?"

Ash had to use a wheelchair because his legs and back didn't work properly.

"Of course you can come" said Mrs G. "There is space for wheelchairs on the rocket, no problem."

Ash looked really pleased, but was still a bit worried

"Will my wheelchair work on the Moon? Or will the motor get clogged with dust?"

"It will work inside the lunar base" replied his teacher "but not outside, on the surface. For that, you will have to travel on a lunar rover – and I think you would enjoy steering one of those."

Ash was now beaming with pleasure:

"I can't wait" he said.

"Any more questions before we get to work planning the trip?"

Mrs Grady knew that her class would have lots of things to ask

Ishan raised his hand:

"How many days will we go for?"

"Are there any animals there" questioned Ellie "I mean, I know we haven't ever seen any, but could they live in burrows, like the Clangers"

Ellie was talking about one of the programmes that children watched in the olden days, and which were being repeated on InterWebTV.

"Let's talk about that in a minute" smiled Mrs Grady.

Imani was next:

"Is it summer or winter on the Moon at the moment? Will we need a torch?"

"What about clothes" asked Jordan "Will we need pyjamas, and where do we get our spacesuits from?"

"Can we play football on the Moon" called out Cara "or will the ball float away"



Isabel looked worried:

“Will it be really cold? Should I bring my woolly socks” she said.

Sami had remembered seeing a programme on the TV about astronauts living in space. He rushed out several questions at once:

“What will we eat – and will we have to eat through a straw, like on the space station and will there be proper toilets?”

Mrs Grady clapped twice. The class knew what that meant – it meant that they had to be quiet and listen.

“They are all good questions – but I will only answer some of them. The ones I don’t answer, we will work out together. So let’s start with Jordan’s and Isabel’s questions about clothes. Yes, you will need a space suit for the journey, and for when we are outside, but the company running the trip will provide those. When you are inside the lunar base, you will just wear ordinary clothes – so, Jordan, you will need your pyjamas.”

Jordan looked pleased – he had got some Star Wars Next Generation pyjamas for his birthday, and he wanted to show them off.

“Isabel – in a minute, we will talk about the temperature on the moon, so you can decide after that if you need your woolly socks”

Mrs Grady noticed that Kartik was looking a bit upset.

“What’s wrong Kartik,” she asked.

“I don’t think I can go” said Kartik

“Why not?”

“Because I wear specs, and you can’t put a space helmet over glasses” replied Kartik

“Who told you that?” said Mrs Grady. “Because it isn’t true – the new design of space helmet fits over spectacles – I wear glasses too, and I’m definitely going!”

Kartik beamed and wriggled with excitement and his specs bounced up and down on his nose!

Mrs Grady continued

“What would you like to eat Sami,” she asked.

“Pizza” was his reply.

“I’m sure they have pizza on the Moon, and a whole lot of other foods as well”

“Great” said Sami. “I was worried that we might just get to eat food pills, like on TV”.

“Remember we’ll be inside the Moon Base for most of the time” replied Mrs Grady “So we’ll get proper food, but there won’t be a lot of choice. And there won’t be much fresh fruit or vegetables – just dried fruit, like raisins and banana chips. Can you think why?”

The class was silent for a bit, then Matt put up his hand.

“Is it because the fresh fruit weighs more, so the supply ship can’t carry so much?”

“Exactly right” said Mrs Grady “And there are two other reasons as well. Any idea what they might be?”

“I think I might know” said Jess. “Is it because you get banana peel and apple cores and stuff, and then you have to throw that away?”

“Good” said Mrs Grady “That’s correct. Anyone got an other ideas why dried fruit might be better than fresh? I’ve given you a clue in what I just said”

“Dried fruit lasts longer than fresh fruit, and it doesn’t go bad” said Matt



“Well done. Now Sami, if we have stopped you worrying about whether you’ll get enough to eat, shall we think about how you will go to the toilet? “

The class all laughed. Sami thought for a moment.

“On the space station, you have to go in a tube and it gets sucked away.”

“That’s right” Mrs Grady replied “but it won’t be quite that bad—there are proper toilets on the Moon Base, with a seat to sit on, but with a smaller opening. The girls will be OK—but you boys are going to have to learn how to go for a wee like girls do. Start practising at home”

The boys all looked embarrassed and shifted about on their seats awkwardly whilst the girls laughed at them. Mrs Grady started speaking again.

“Now, that’s all the questions I’m going to answer for the moment. It is time for you to do some thinking. We’ll work together to find out the answers to the questions that Ishan , Isabel and Imani asked: How many days are we going to go for? Is it summer or winter on the Moon? Is it very cold? First of all, though, what does the Moon look like in the sky? Is it always the same shape?”

Mrs Grady was pleased to see that almost everyone had their hand up.

“What’s the answer Zac?”

“Sometimes it’s round, and sometimes it looks like a banana going this way and sometimes it looks like a banana going that way” replied Zac

“Good – do you know what the banana shape is called?”

“I can’t remember”, Zac shook his head sadly.

“Anyone else know what a banana-shaped Moon is called? No? It’s called a crescent Moon”.

**Teaching Note:** There is a picture in the Resource section of phases of the Moon to explain why we see the Moon as different shapes. Also why we can often see it during the day, and not just at night.

Next, let’s remind ourselves of how long a day is on Earth. Hands up who can tell me?”

Almost everyone stuck their hand up.

“Go-on then Ishan, you tell us – and also say what the day is measuring”

A day is 24 hours” answered Ishan. “it is the time taken for the Earth to go through one complete turn”

“Very good” said Mrs G. “Now though, how long is a day on the Moon? How long does it take for the Moon to turn once on its axis?”

This time, no-one put up their hand.

“Well” said Mrs Grady “maybe you will be surprised to find that the Moon takes about 28 days to turn once on its axis. So a day on the Moon would last 28 days on Earth. So, Ishan, it is a good job that we are going to the Moon for 5 Earth days and not 5 Moon days – else we would be away from Earth for 5 Earth months – and that means that you would miss Christmas and all the other winter celebrations”

**Teaching Note:** there is a short animation that could be shown to explain this, but probably a bit too complicated for KS1 [here](#)

“Here’s something else to think about. How long does it take the Earth to go round the Sun, and what is that length of time called?”

Everyone’s hand shot up

“All right Jess, what is the answer?”

“It takes 365 days, and that’s a year”

“Correct. What is unusual about the Moon, though, is that the length of its year is almost the same as its day, because it takes about 28 days to go round Earth, and about the same length of time to turn on its axis. That is why we always see the same side of the Moon.

“Now let’s see if we can answer Imani’s question – will it be summer or winter on the Moon? Imani – why do we have seasons on Earth?”

“Erm” said Imani “is it because the Earth goes round the Sun?”

“Partly, but it’s not just that is it? What can you tell me about the Earth’s axis?”

“Oh, right, it’s tilted isn’t it? And its summer for the half that’s tilted towards the Sun and winter for the half that’s tilted away”

“Well done Imani” said Mrs Grady “That’s correct. The half of the Earth that is in summer receives more light from the Sun than the half that is in winter.

**Teaching Note:** There is a graphic illustrating this in the Resource section

“Now, let’s think about the Moon. Does the Moon orbit the Sun? Hands up if you know”

Again, everybody could answer that question

“All right Shelley, what is the answer”

“The Moon orbits the Earth, not the Sun” replied Shelley.

“Correct. Now, Imani has just told us that we have seasons on Earth because it is tilted on its axis. The Moon is only tilted a tiny bit, not enough to make much difference to the amount of light the northern and southern halves of the Moon receive. So the Moon doesn’t really have any seasons.”

Mrs Grady looked at Isabel.

“We haven’t answered your question about whether or not you should take woolly socks. Now we have to think about what temperature it is on the Moon. Would anybody like to guess? Is it hot or cold? Hands up those who think it’s hot? Hands up who thinks it’s cold? Hands up if anyone thinks it’s both?”

Nobody seemed keen to answer, so Mrs Grady explained:

“It is both hot and cold – the part in the Sun gets very hot, and the part in the dark gets very cold, so there is a massive difference in temperature between the sunlit and dark areas. This is very different from the Earth. What do we have that keeps us from getting too hot in the daytime and too cold at night? I’ll give you a clue – it’s why we don’t need a spacesuit on Earth.

This time, plenty of hands shot up.

“Go for it Ned, what’s the answer?” encouraged Mrs Grady

“Is it air?” answered Ned.

“That’s right – our atmosphere acts like a blanket, keeping the heat in at night, but also preventing too much sunlight hitting the Earth during the day. Without the atmosphere, parts of the Moon that are in direct sunlight get hotter than boiling water, and those in the dark are nearly 200 degrees below freezing”

“So I’d better take my woolly socks then” said Isabel

“I don’t think we’ll be camping out overnight on the Moon” laughed Mrs Grady, “and the lunar base is heated inside, so you should be OK without them. And, Imani, that helps to answer your question about a torch – we won’t be going anywhere in the dark. In fact, it will be the opposite – we’ll be arriving in the early morning of a lunar day, so that we aren’t completely boiled, but there will still be sufficient sunlight to make us very hot in our spacesuits. The spacesuits are much lighter than the ones the early astronauts wore – but they are still white, to reflect as much sunlight as possible, and the face plates are like mirrors, again to reflect the light. You should probably take sunglasses rather than a torch Imani!

“Now then Year 1, it is time for morning break. We’ve done a lot of work about the school trip to the Moon. We’ll have another session next week, and find a bit more out about gravity. Off you go”

Mrs Grady dismissed her class, watching them run out into the playground. She was pleased to see that Ash had two of his friends helping with his wheelchair. As they went past, she heard them talking about what speed Ash would be able to get up to in a lunar buggy, and whether it had indicator lights for turning.

She smiled to herself. This was going to be a fun trip!

**Teaching Note:**

Possible activities: Discussion about whether the children would like to go to the Moon? What questions would they ask Mrs Grady?

*Additional activities: word-games, puzzles, etc at the start of the Resource section*

Mrs Grady came into the classroom, bouncing a football.

“Cara” she said “What was the question you asked about our trip?”

“Will we be able to play football on the Moon?”

“Well, the Moon’s gravity is only about 1/6<sup>th</sup> of Earth’s, and there is no atmosphere, so what effect do you think that would have on a game?”

Cara thought a bit before answering:

“Well, with low gravity, the ball would be much lighter, so when you kicked it, it would go further, and higher.”

“Good, said Mrs Grady “anything else? How would the players get on?”

“They’d have to wear space suits, so even though they should be able to move faster, the spacesuits will probably slow them down.”

Mrs Grady could see Rachel, Cara’s twin, with her hand up.

“Go-on Rachel, what would you like to say?”

“There isn’t any sound in space, so you wouldn’t be able to hear the crowd cheering”

“or the referee’s whistle,” added Cara “and there’s no wind, so the linesman’s flag wouldn’t flutter”

“Why isn’t there any sound in space?” asked Mrs Grady.

“Because there’s nothing for the sound waves to travel through” replied Rachel.

“That’s very good. Shall we take a football with us to see if we can have a game?”

“Yes” shouted the twins together “yes please”.

“There’s one thing you haven’t mentioned”, said Mrs G. “and that’s the pitch. What do you think that will be like?”

“A bit stony, maybe” replied Rachel. “Or dusty” added Cara.

“That’s right” agreed Mrs Grady “probably very dusty – and every time the ball bounced, or you were bounding across the pitch, you would raise clouds of dust – which might stop you seeing where you were going and clog up your spacesuit”

“Hmm, that’s a bit of a problem” said Cara.

Becky now had her hand up.

“Go-on Becky” said Mrs Grady

“I’ve had a better idea – we could play rugby. Throwing the ball, not kicking it”.

Mrs Grady nodded.

“But there is a snag with rugby as well” she said “would you be able to score a try? I’m not sure a spacesuit would survive if you threw yourself on the ground.”

Tim was waving his hand in the air

“I’ve got an idea” he burst out

“Well done” said Mrs Grady “tell us about it”

Mrs Grady was really pleased that Tim had put his hand up – he often did not join in with the lesson, but fidgeted and wandered around the classroom.

“I could take my jacket and put the ball in that and it wouldn’t float away”

“Wow” said Mrs G “That is a good idea – make the ball heavier. I like it – but I think we might have to use something other than your jacket. Your parents won’t be very pleased if it comes back all torn from the rocks on the lunar surface”

Tim had to wear a special jacket in school that was quite heavy. It helped him to sit still so he could concentrate on what was going on in the lesson.

“Will Tim’s jacket be as heavy on the Moon anyway?” asked Ana “If the football is lighter, then won’t his jacket be as well?”

“That is very true – Tim’s jacket will feel lighter, but it will still be heavier than other jackets. But we don’t need to worry about that as he will be wearing a spacesuit like everyone else, won’t you Tim?”

Tim nodded, and seemed pleased that his idea was a good one.

“Miss, Miss” Ellie called out.

She was frantically trying to catch Mrs Grady’s attention. The teacher looked up

“All right Ellie, it’s your turn. What would you like to ask?”

“I asked this last time. Are there any animals or plants on the Moon?” You know, underground, not on the surface?”

“Let’s think about that” said Mrs Grady “What does a plant need to live?”

“Water” answered Ellie

“Correct. What else? Let someone else answer”

Mrs Grady looked at the class. Ash had his hand up.

“Ash—what do you think?”

“Air to breathe, and food”

“Exactly. Now, first of all, there is water on the Moon—it is there as ice at the poles—but in places where it is so cold that it would be very unlikely there was anything alive - do you remember how cold I said it was?”

Ellie was looking unhappy.

“You said it was 200 degrees below freezing, and I suppose because it’s do cold and there’s no air, nothing can live”

“Never say never” said Mrs Grady “people are discovering new things all the time. Who can say what might be found deep below the surface where it is warmer? But I don’t think there will be anything living on the Moon that is more complicated than bacteria”

“Apart from us, Mrs Grady” said Jordan with a grin.

All the class laughed, and Mrs Grady was smiling as she answered

“Very clever Jordan. But we must get on. Before we learn anything else about the Moon, we need to think about our trip – we have to give it a name. There have been some famous mission names: the Apollo series of missions went to the Moon, and the one that landed Neil Armstrong and Buzz Aldrin was called “Eagle”. Tim Peake’s mission to the Space Station was called “Principia”, which is the name of the book that Isaac Newton wrote where he described gravity. We also need to design a mission patch – that is the badge sewn onto your spacesuit with a symbol of the mission on it. So Neil Armstrong’s mission patch had an eagle on it – which is the symbol of America. Tim Peake had an apple, to symbolize gravity. So we need a mission name and a symbol, to go on the mission patch. Then once we have done that, we will have a go at designing a lunar lander”.

**Teaching Note:** Have the groups of children discuss potential mission names and symbols. The rest of the session is taken up with working in groups to design the mission patch. Plus other games, puzzles, etc. There are examples of mission patches in the Resource section of the book

# KeyStage 2



For KS2 students, the framework story of a trip to the Moon is probably not required – although that does not preclude it being used!

## What is the effect of low gravity on the human body?

The first part of the session is a recap of what the students know about the function of bones and blood in the human body.

What do we have bones for?

- To support our body
- To protect internal organs
- To help us move

What does our blood do?

- Transports oxygen and carbon dioxide and nutrients around the body

We would still need these functions if we were on the Moon. But what happens to bones and blood when you are in space for a long time?

Our bones are dense, because they have to be strong to support us against Earth's gravity – without bones, we would collapse, like a jellyfish. That's why the biggest creatures without bones live in the sea – the water helps to support them.

**Activity:** A short diversion into the difference between mass and weight, which can be demonstrated using a spring balance.

Using a spring balance, weigh a familiar item, say a litre carton of milk or fruit juice. It weighs about 1 kilogram. You can see how far the spring of the balance had to stretch to weight the carton. This is because the force of gravity is pulling the spring down. Imagine if the gravitational force were lower – the pull would not be as strong, so the spring would not stretch as far, so the carton would not appear to weigh as much. But the carton hasn't changed – it has still got the same amount of juice in it. So it has the same mass, but a different weight.

Why should things be any different on the Moon? Because the gravity on the Moon is  $1/6^{\text{th}}$  that of Earth's gravity, so the pull on bones would not be as great as it is on Earth. This means that bones would not have to be as strong to support the same mass.

This sounds as if it might be a good thing – if we weigh less, we are not putting so much load on our legs and knees, so they would not wear out so quickly.

But what astronauts living for 6 months on the International Space Station have found is that being in space makes your bones weaker. They start to get more spongy inside – which is really bad for when the astronaut returns to Earth, because the bones can no longer support their weight.



Being in space affects other parts of the body: your heart does not have to work so hard to pump blood around the body, so it starts to get smaller. Your eyesight can change because the fluid inside your eyeball is at a different pressure, so you might need to wear different glasses.

**Activity:** A short (2 min) video interview with NASA astronaut Leland Melvin explains some of the things that happen to the human body: <https://ed.ted.com/featured/QS6sEKzz> There is also a series of multiple choice questions with the video.

These effects have been noticed on astronauts living for 6 months in the zero gravity environment of the space station. Things might not be quite as extreme on the Moon, because there is some gravity. But even so, it will be essential to take plenty of exercise to make sure that muscles and bone don't waste away.

**Activity:** Imagine that you were born and have grown up on the Moon, living in the Moon Base, so that your body is used to the low gravity. You are also used to having to be careful with water – so that means only having 1 shower a week. What do you think you would look like? Would you be tall, because gravity doesn't pull you down? Or would you be short because your bones don't need to be so big to support your weight? (We don't know the answer to this). Would you like to have long hair that floats round you? Or short hair so that it doesn't get in a mess because you can't wash it so often? Draw yourself as a Moon child!

## What type of rock is the Moon made from?

Recap of rocks on Earth: some have come from volcanoes, and crystallised from molten lava, whilst others were built up from layers of mud and sand and might have fossils inside them. Soil is made from rocks and organic matter – leaves, roots, bits of twig, insects and so on.

When Neil Armstrong became the first person on the Moon, he said as he stepped onto the lunar surface:

“One small step for a man, one giant leap for mankind”

NASA engineers were very relieved when he got down from the ladder safely, because they had been worried about the Moon’s surface – no-one knew how deep the dust was. They had wondered if it might be so deep that the astronauts and the lunar lander got stuck. Fortunately, that wasn’t the case. The astronauts brought some of the lunar soil back with them.

**Teacher note:** There is an image of lunar regolith in the Resources section – you can see that it is a lot of particles of broken crystals. No twigs or bits of leaf!

### Activity:

Q. On Earth, soil is defined as having organic matter in it, from plants and animals. Why is it wrong to talk about “lunar soil”?

A. Because there are no plants and animals on the Moon, so there is no organic matter in the surface layer.

Q. Do you think there are rocks like clays that were laid down in water on the Moon? Do you think there are any rocks with fossils in on the Moon?

A. No – there are no clays, or any other rocks, like limestone, that were produced in water – because there is no water on the Moon. Also, because there is no life there, there are no fossils in any of the rocks.

We call the surface layer of the Moon its Regolith.

Moon rocks are igneous rocks – the ones that have come from volcanoes.

There are two different types of Moon rock, and you can see them when you look at the Moon: there are dark patches and lighter patches.

The dark patches are called ‘Mare’, plural Maria (pronounced Mah-Ray and Mah-reeya) from the Latin word for sea. This is because people who first described the Moon thought the dark patches were lunar oceans. We now know that the regions are dark because of the type of rocks they are made from.

The light parts are the highlands and are made of a different rock type from the maria. Here, the rocks contain a lot of a very bright crystal, which reflects a lot of light.

**Teacher note:** There are pictures of both rock types in the Resources section.

We can look at pieces of the Moon using a microscope: a slice is cut from a rock, and then polished until it is very thin, so that light can be shone through it. Thin sections of lunar samples can be accessed through the internet: <https://www.virtualmicroscope.org/>.

**Activity:** Access the virtual microscope, and select the Apollo rock collection:

<https://www.virtualmicroscope.org/collections/apollo>

You can look at any sample, but these three are the ones illustrated in the Resources section:

Regolith: <https://www.virtualmicroscope.org/content/70181-85-mature-mare-regolith>

Mare: <https://www.virtualmicroscope.org/content/15476-36-porphyrific-pigeonite-basalt>

Highlands: <https://www.virtualmicroscope.org/content/67559-9-highland-basalt>

In each case, follow the link, and then click on the “View Microscope” icon:

There are three options to view the sections:

PPL – this is Plane Polarised Light – light has been shone through a polariser (like a pair of sunglasses), which produces a parallel beam of light;

XPL – crossed polarised light – after the light goes through the sample, it passes through another polariser before being detected. The colours are an indication of how much the beam of light has been bent as it travels through the mineral crystals (as light is bent in a water droplet in a rainbow), and is an indication of the composition of the grains.

REF - reflected light, where light is bounced off the surface of the section. It shows where metal grains are – but there is not much metal in lunar samples.

The images have one or two numbered red circles:

If you click on them, it takes you to a page where you can see how the appearance of the rock changes as it is rotated (It can take about 30 s for the page to load).



# Resources



# Building a Lunar Lander

## Materials:

1 Egg box	Paper clips
Bubble wrap	String
Balloons	Kitchen Towel
Sellotape	Plastic carrier bag
Scissors	Aluminium foil

Something heavy – not necessarily a magnet, but that would do. Maybe a teaspoon? Or 3 or 4 pencils bundled together.

Something delicate to be the astronauts. Something that would squish if dropped hard. Grapes? over-ripe cherry tomatoes?

Before starting, the children should be divided into groups of not more than about 6. Introduce the subject of landing on the Moon – if you have used the School Trip story, then you will probably need to stress that they are going to build a very simple version of a lander, and not one that would carry 25 students and teachers.

There should be discussion before starting, including giving the mission a name, the lander a name, the astronauts names – here you can draw on the images in the Resources section. It is also a good opportunity to stress that there are many women astronauts as well as men.

The egg box is the landing craft. The grapes/tomatoes are the astronauts. Balloons are for landing bags. Bubble wrap is insulation. Aluminium foil for reflecting sunlight. The plastic bag is a red herring

The children have to make various decisions:

Can they put the astronauts directly in the egg box?

- It is better to wrap them in a bit of kitchen towel and Sellotape them in for safety during take-off and landing.

Do you need a parachute to slow down the capsule as it approaches the surface?

- No – there is no atmosphere, so a parachute would not be any use

Do the balloons go all round the landing capsule, or just on the bottom?

- They should just go on the bottom – but in space, how do you decide which is the bottom? This is where they need to be imaginative. Use the magnet/teaspoon/bundle of pencils as a weight to pull the capsule down

How will you stop the lander bouncing back off the surface?

- An anchor made from string and paperclips on the underside of the capsule

After the craft is built, then the groups should throw them across the playground, or out of a top floor window, to see whose astronauts survive.....



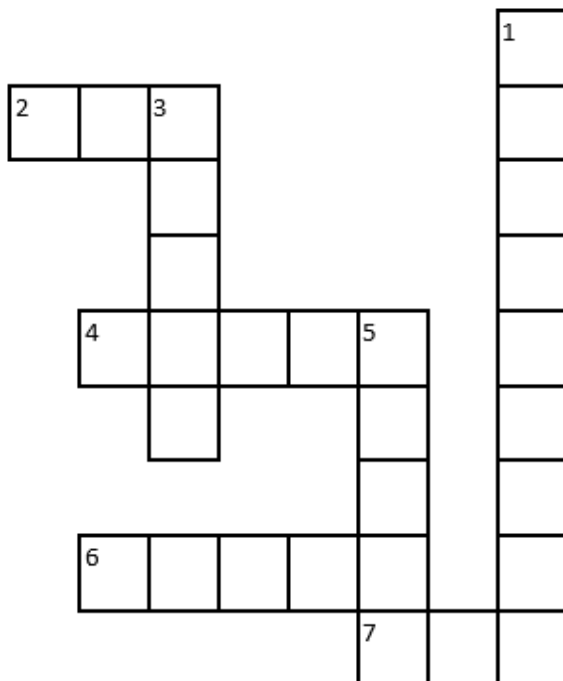
# Games and Puzzles



Q	U	O	C	N	Y	I	O	Z	N
D	A	Y	T	J	E	S	L	K	I
B	I	R	A	D	A	B	O	A	G
Y	U	V	S	E	R	H	R	E	H
E	M	A	U	G	S	T	B	L	T
M	O	O	N	L	Y	S	I	W	T
K	N	D	F	E	A	R	T	H	U
F	T	H	P	M	O	B	R	I	D
S	H	I	N	E	Z	Q	U	A	F
G	R	J	T	W	F	A	C	E	X

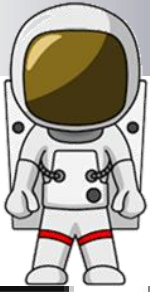
Find the hidden words:

DAY            MOON          MONTH  
 SUN            YEAR          NIGHT  
 FACE          EARTH        SHINE

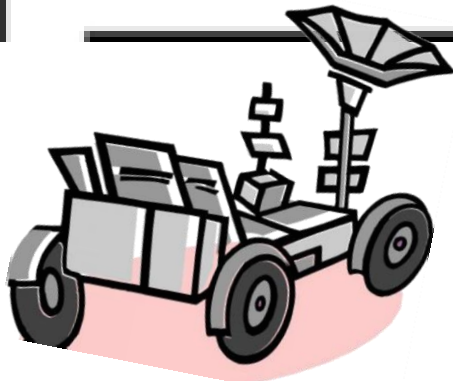


## CLUES

1. A space traveller
2. Our star
3. Bedtime?
4. What we like the Sun to do
5. Our home
6. What we call the path the Earth takes round the Sun
7. What the temperature is when the sun shines in summer



Can you help the astronaut get back to her moon buggy?





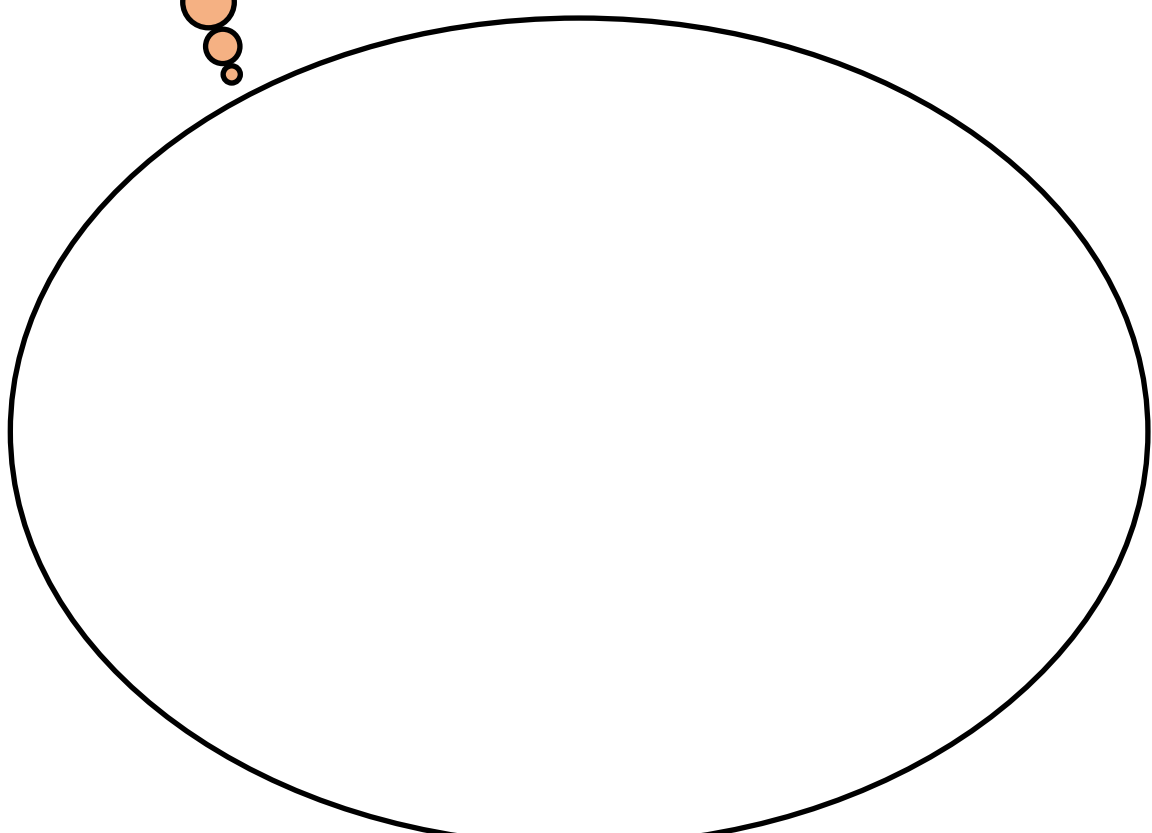
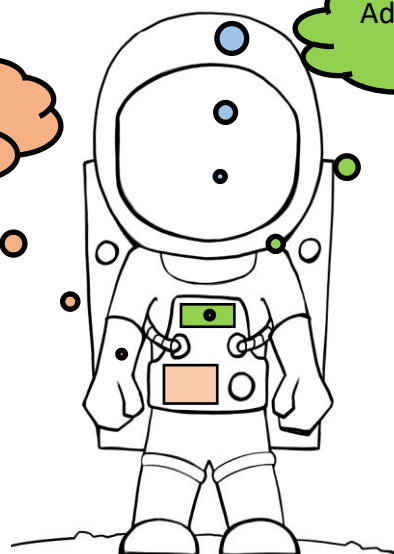
Draw yourself as an Astronaut  
Where is your space mission going?  
Can you design a mission patch?

Draw your face

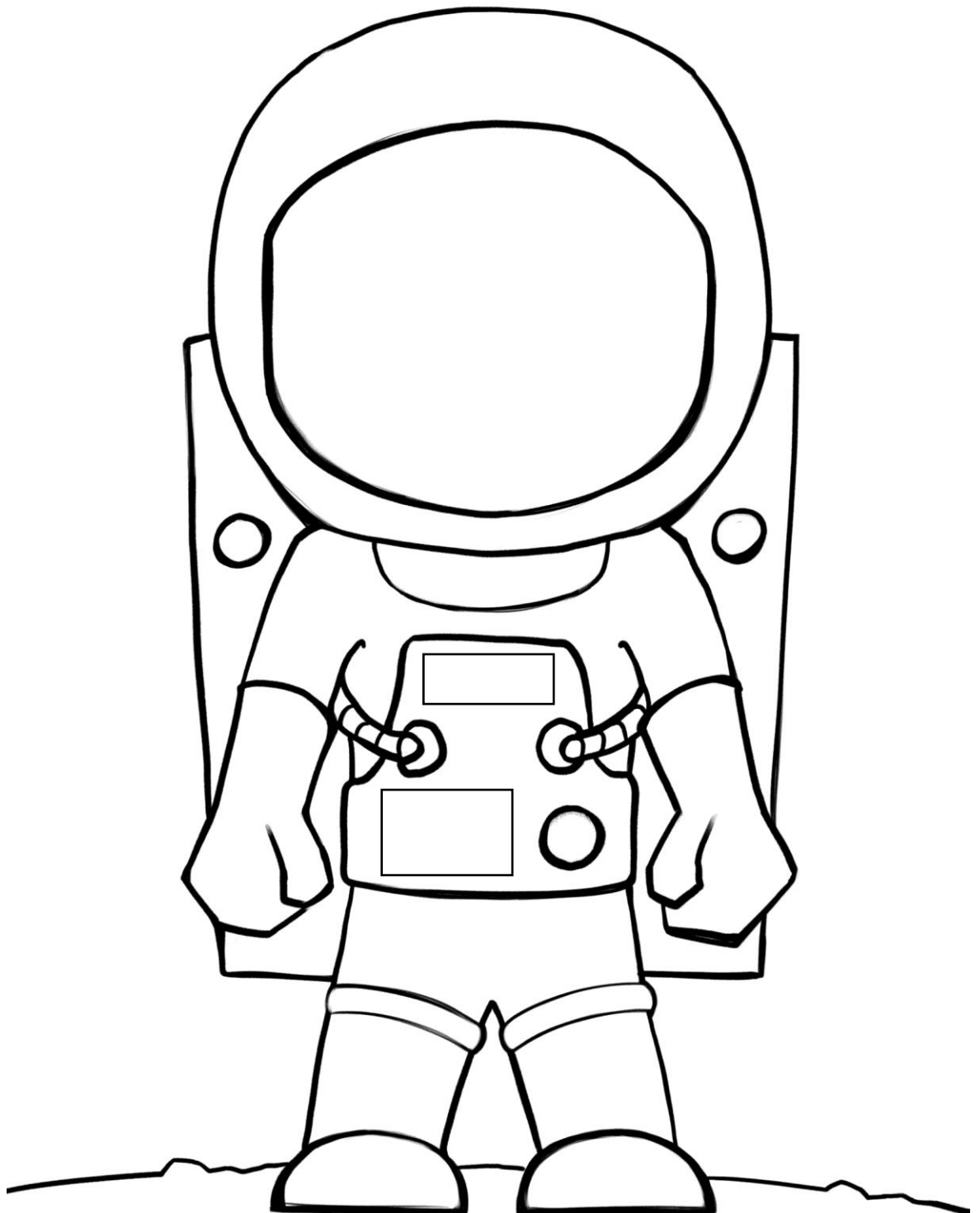
Add your name

Add your flag

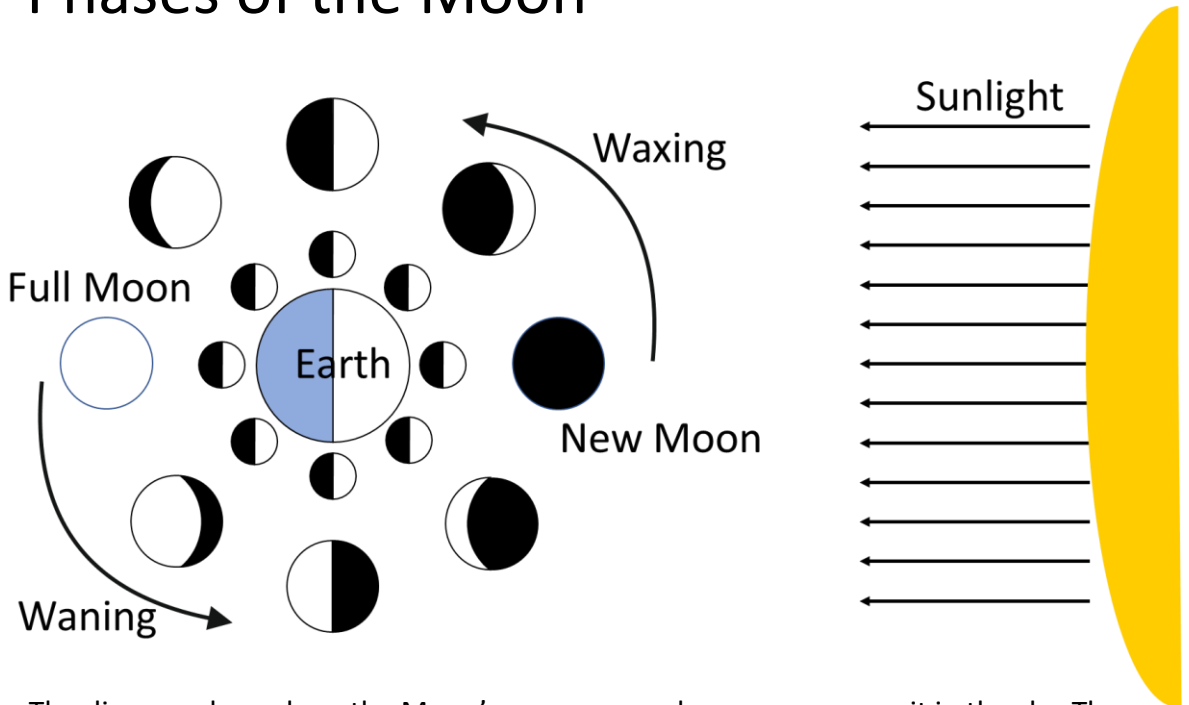
Draw your  
mission patch



I am going on a space mission to -----

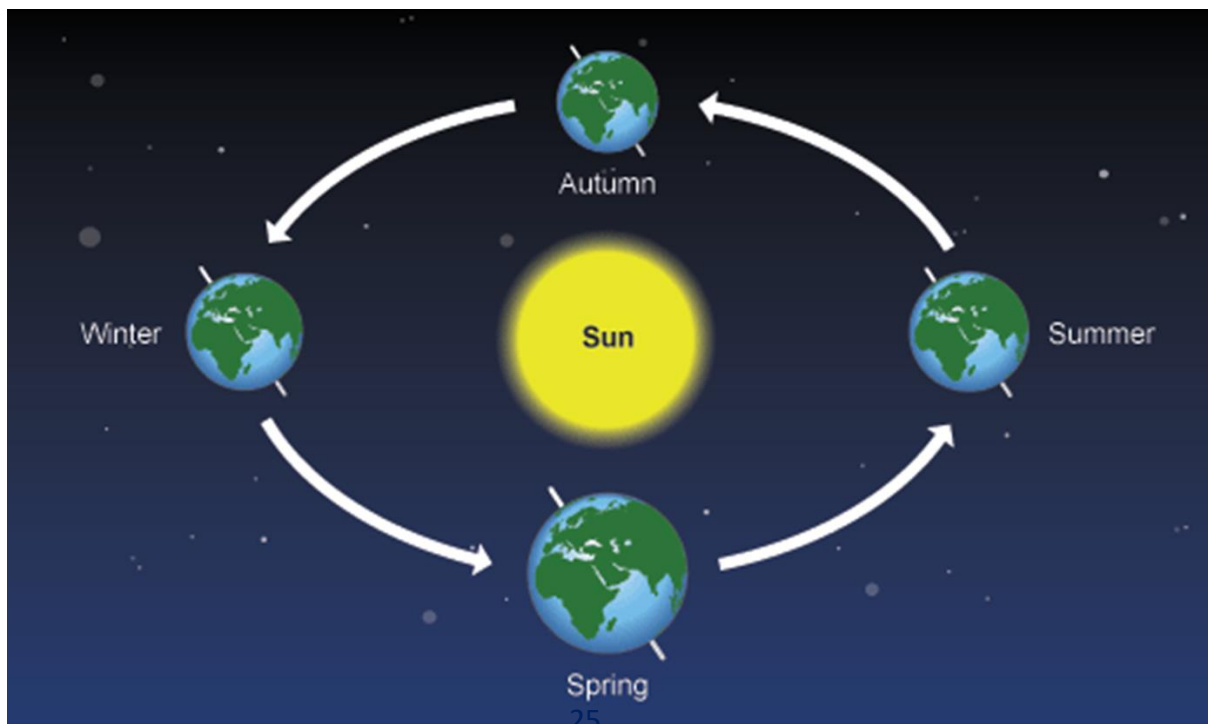


# Phases of the Moon



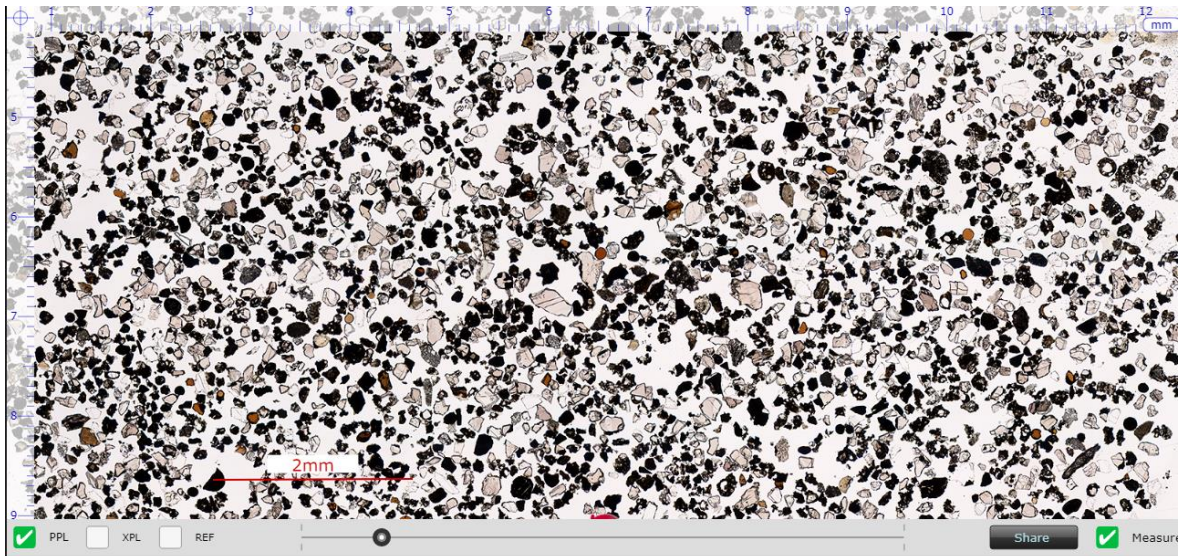
The diagram shows how the Moon's appearance changes as we see it in the sky. The Sun's rays illuminate the sun-facing hemisphere of the Earth, casting half the Earth in shadow. It does the same to the Moon, as shown by the inner circle of moons, which are half in sunlight, half in shadow. The shape of the Moon that you see looking into the sky from the Earth's surface is shown by the outer circle of Moons.

# The Seasons



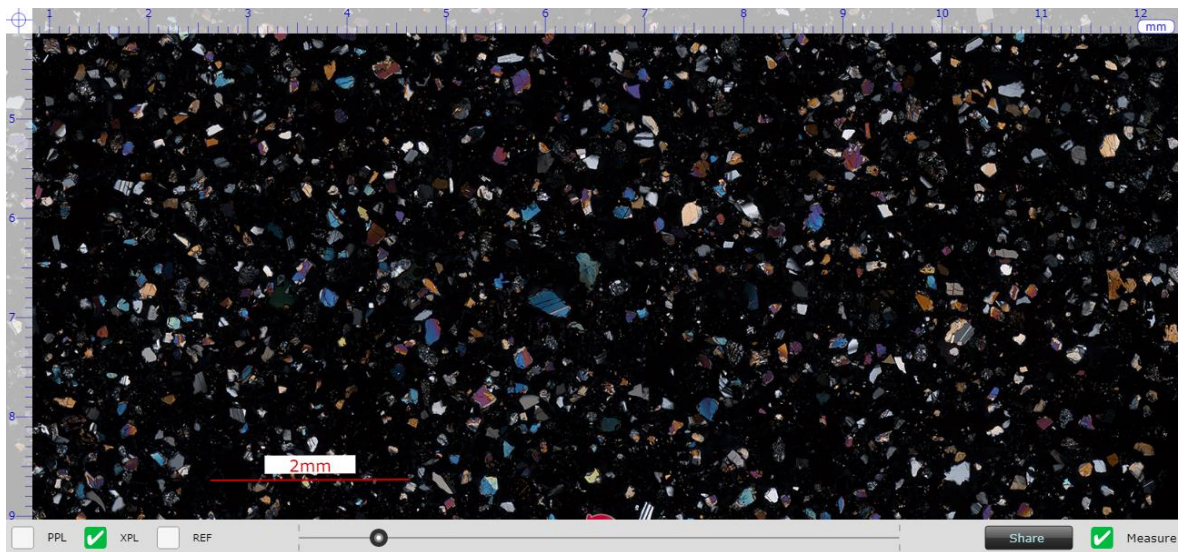
## Apollo 17 regolith sample 70181

### Plane Polarized light



The image shows fine-grained shards of broken mineral grains, fragments of rock clasts and small orange spherules. The spherules are from splashes of molten volcanic rock. There are agglutinates: clusters of grains welded together by micrometeorite and cosmic ray bombardment at the lunar surface.

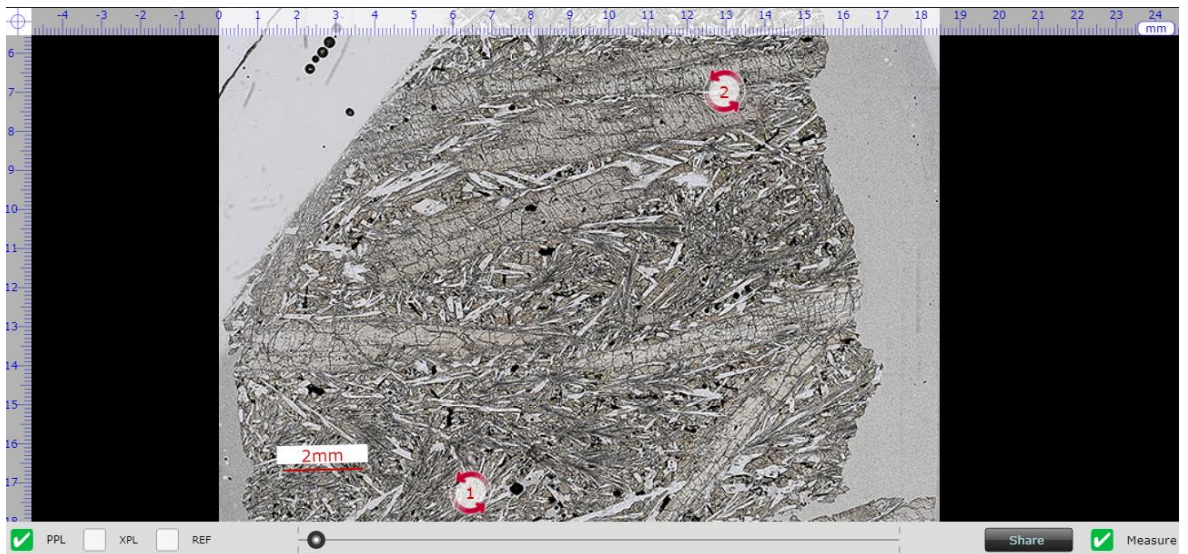
### Cross Polarized light



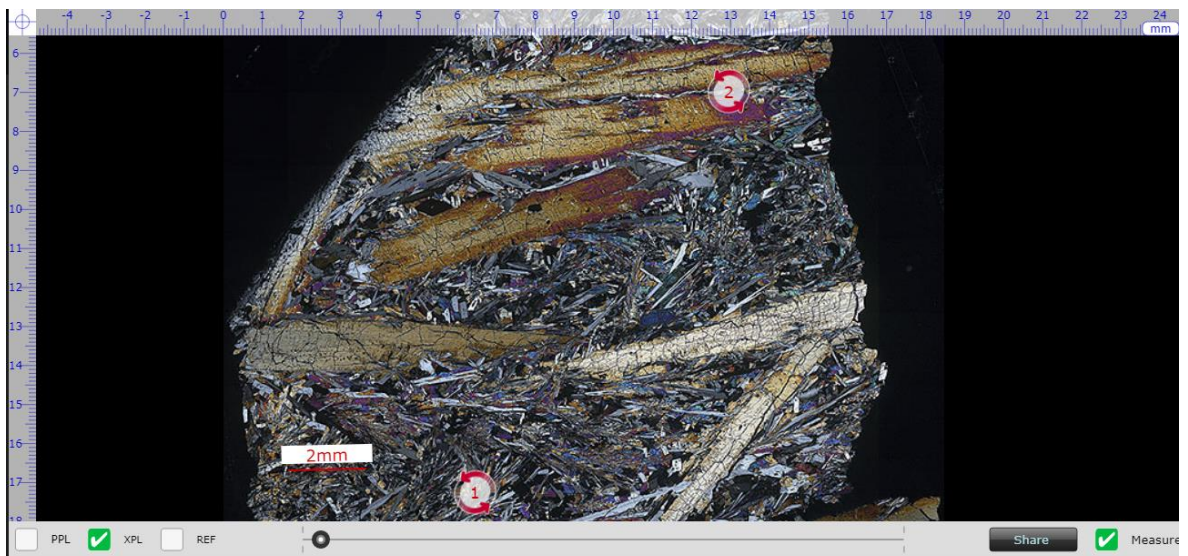


# Apollo 15 mare basalt 15476.

## Plane Polarized light

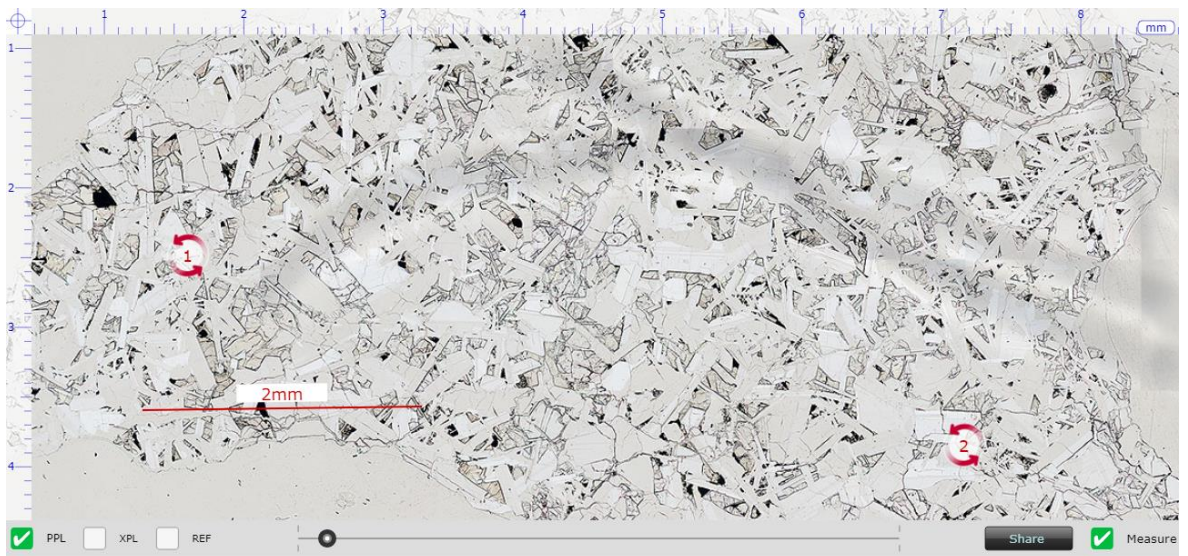


## Cross Polarized light

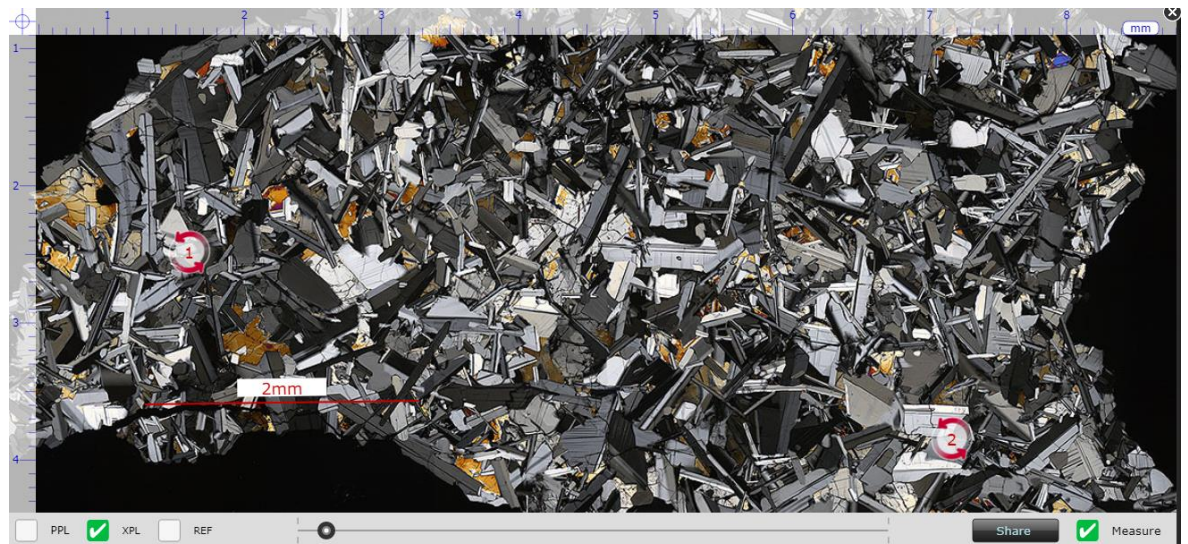


## Apollo 16 highland basalt 67559

### Plane Polarized light



### Cross Polarized light







Sam Cristoforetti (Italy)



Thomas Pesquet (France)

André Kuipers (Netherlands)







Tim Peake (UK)



Claudie Haignere (France)





PRIME CREW OF FIFTH MANNED APOLLO MISSION  
NEIL A. ARMSTRONG                      MICHAEL COLLINS                      EDWIN E. ALDRIN, JR.





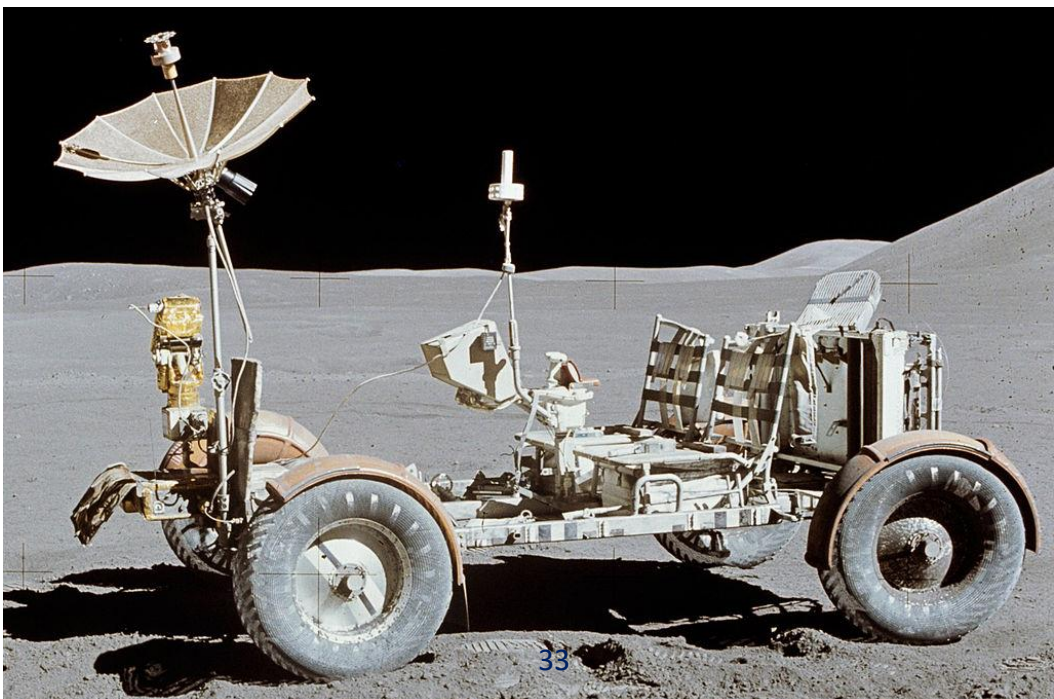


The first picture of the Earth from Space:

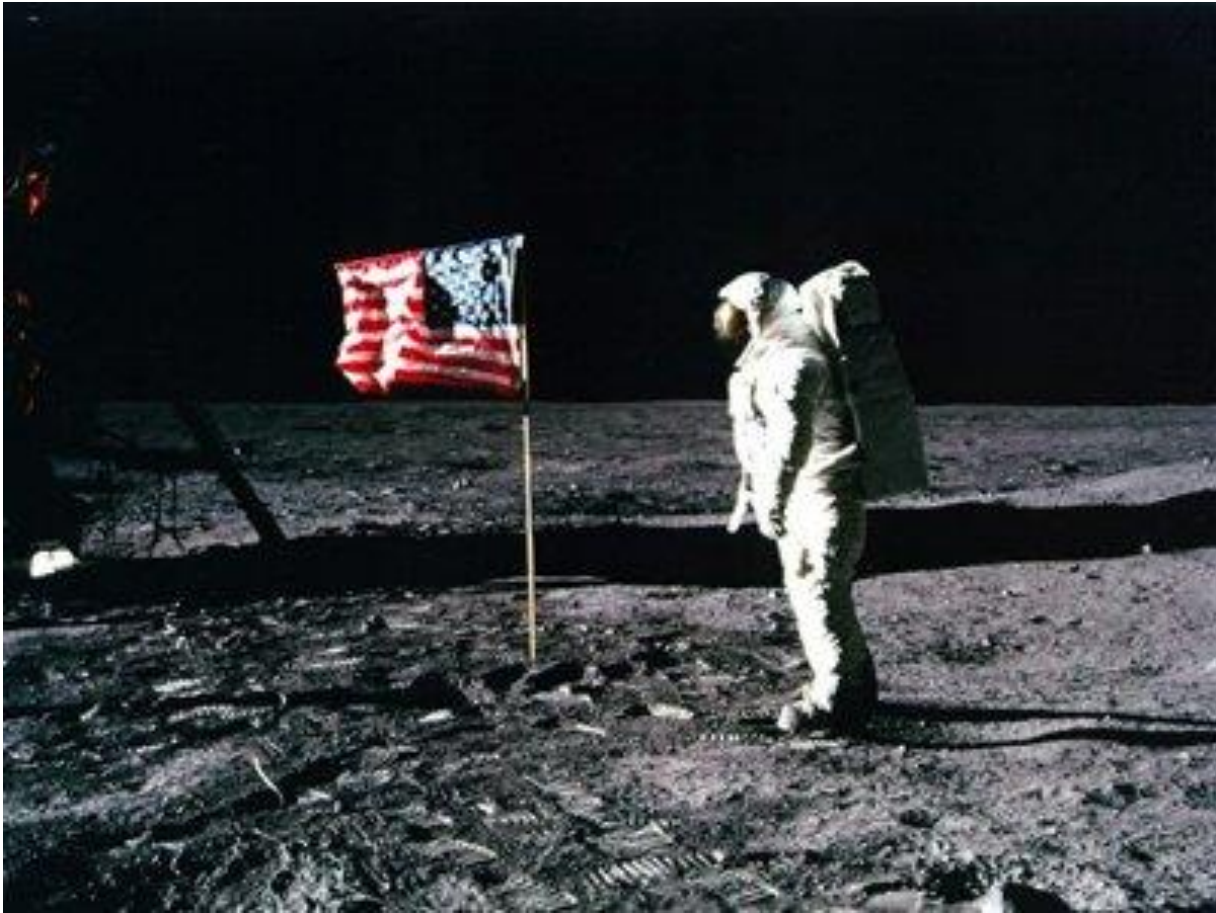


Apollo 8, the first manned mission to the moon, entered lunar orbit on Christmas Eve, Dec. 24, 1968. That evening, the astronauts-Commander Frank Borman, Command Module Pilot Jim Lovell, and Lunar Module Pilot William Anders-held a live broadcast from lunar orbit, in which they showed pictures of the Earth and moon as seen from their spacecraft. Said Lovell, "The vast loneliness is awe-inspiring and it makes you realize just what you have back there on Earth." Image and Caption credit: NASA

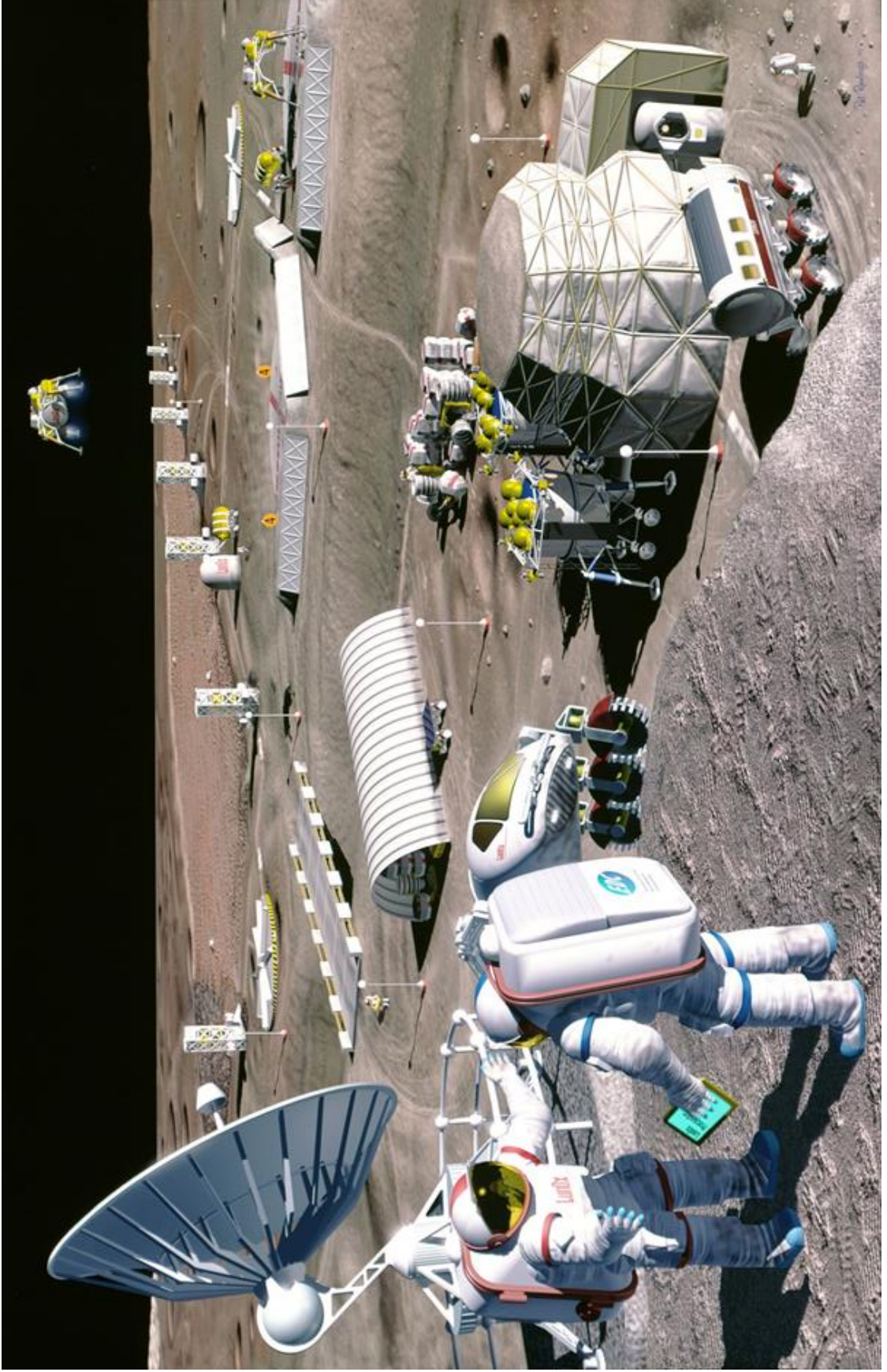
## Apollo 15 Moon Buggy



## Flag and Footsteps









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Images courtesy of NASA, ESA and members of the EURO-CARES consortium