

STEAMing through Dark Skies and Biodiversity

Module 1:

Our Earth in Space

Taighde Éireann Research Ireland

curious minds Discover STEM

esa European Space Agency

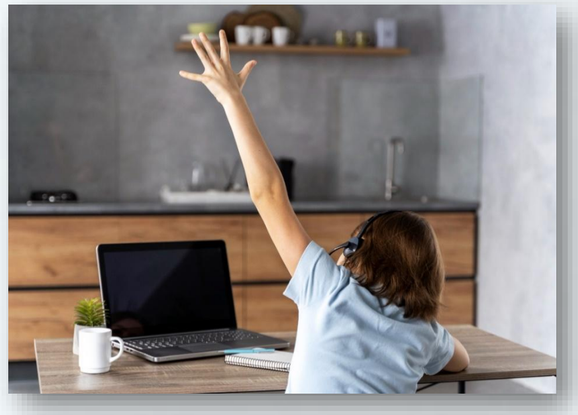


Áine Flood
ESERO Ireland Manager

Learning Outcomes for Module 1

As a result of this module, you will

- Understand how The STEM Education Policy Statement and Action Plan provides a comprehensive framework for promoting STEM education in schools.
- Understand what the Curious Minds/ESERO Framework for Inquiry is and how to use it to plan and teach a STEM activity.
- Be aware of how you can use Curious Minds and ESERO resources to help teach the STEM subjects.
- Improve your own understanding of the science underlying the "Earth in Space" in the primary SESE curriculum
- Participate in practical activities related to "Earth in Space" that are suitable for primary students
- Consider how to engage your students with these activities.



Module 1 Topic Outline

1. STEM Education in Irish Schools
2. Gravity as the Force that keeps the Universe together.
3. Gravity on the Moon and other planets
4. Earth and Sun: Day and Night - Sun and Shadows toolkit
5. Earth and Sun: Seasonal changes

Module 1 Assignments Choose from:

1. Gravity/Weight - Assemble an Earth Tube and one other planet tube – decorate in a suitable manner.
2. Construct a sundial in your immediate area or plan for your school grounds to see where a sundial could be placed
3. Plan how your students could “observe and record the positions of the sun when rising and setting and at different times of the day”
4. ESERO 30 Day and Night in the World
5. One Year on Earth - Understanding the Seasons Resource (ESA)

Share a descriptor (150 words minimum) in the forum on how you would engage your students with this activity.

Curious Minds

Taighde Éireann Research Ireland

Research Ireland aims to increase interest in STEM among students, teachers and members of the public.

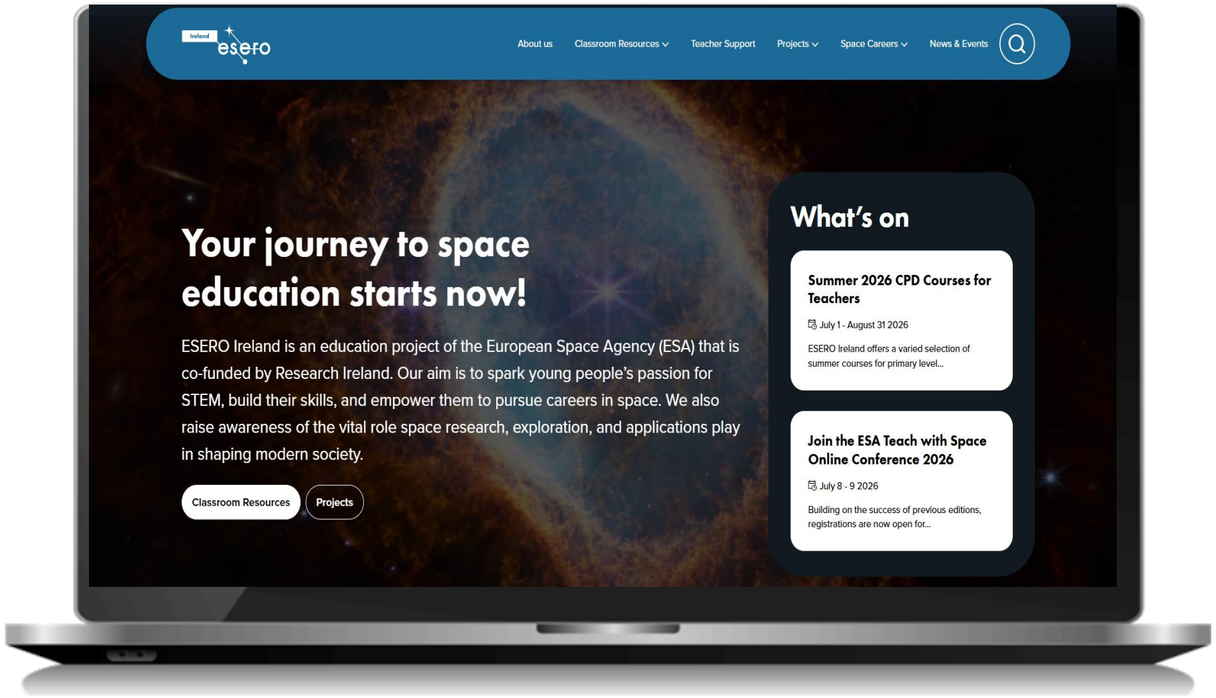
Key Curious Minds activities:

- Interactive website Curious Minds
- Curious Minds Awards
- 60+ Research Ireland Discover Centres.
- Professional development for teachers.
- Curious Minds Teacher Planning Guide



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ESERO Ireland: www.esero.ie



- Classroom resources Investigations sorted by strand/strand unit
- Teacher CPD Summer Courses
  - Climate and Space
  - Dark Skies & Biodiversity
- Space related videos and images from ESA
- Space themed projects
  - Climate Detectives
  - Cansat

WHAT IS STEM?

- Read and reflect on:
  - The STEM Education Policy Statement and Action Plan
  - Recommendations on STEM and the Arts in Education (March 2023)

- Read the article by Dr Maeve Liston: Unravelling STEM: Beyond the acronym of Science, Technology, Engineering, and Mathematics.

- As you progress through this course, reflect on how you can apply the concepts and skills that are outlined and shared to your own teaching practice, in alignment with the STEM Education Policy Statement.

Establishing the Links between Maths and Science

Mathematical Skills

Implementing
Understanding and
Recalling
Applying and
Problem-Solving
Communicating and
Expressing
Integrating and
Connecting
Reasoning

+

Scientific Skills

Working Scientifically

Questioning
Observing
Predicting
Investigating and Experimenting
Estimating and Measuring
Analysing - Sorting and Classifying
- Interpreting
- Recognising Patterns
Recording and Communicating

Designing and Making

Explore Plan
Make Evaluate

→

Establishing the Links

What Mathematics and Science skills could be developed through this activity?



[Download PDF]

Curious Minds/ESERO Framework for Inquiry



ENGAGE			Considerations for inclusion
Prompt	Wondering	Exploring	
INVESTIGATE			
Starter question	Predicting	Conducting the investigation	
TAKE THE NEXT STEP			
Applying learning	Making connections	Thoughtful actions	
REFLECTION			

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Curious Minds/ESERO Framework for Inquiry Introduction



Curious Minds / ESERO Framework for Inquiry Introduction

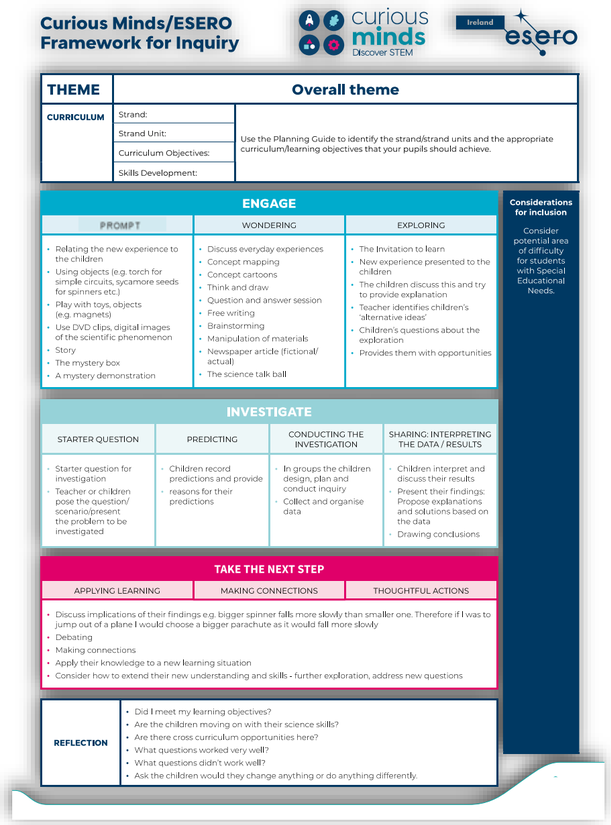
Curious Minds / ESERO Framework for Inquiry In Action



Curious Minds / ESERO Framework for Inquiry In Action

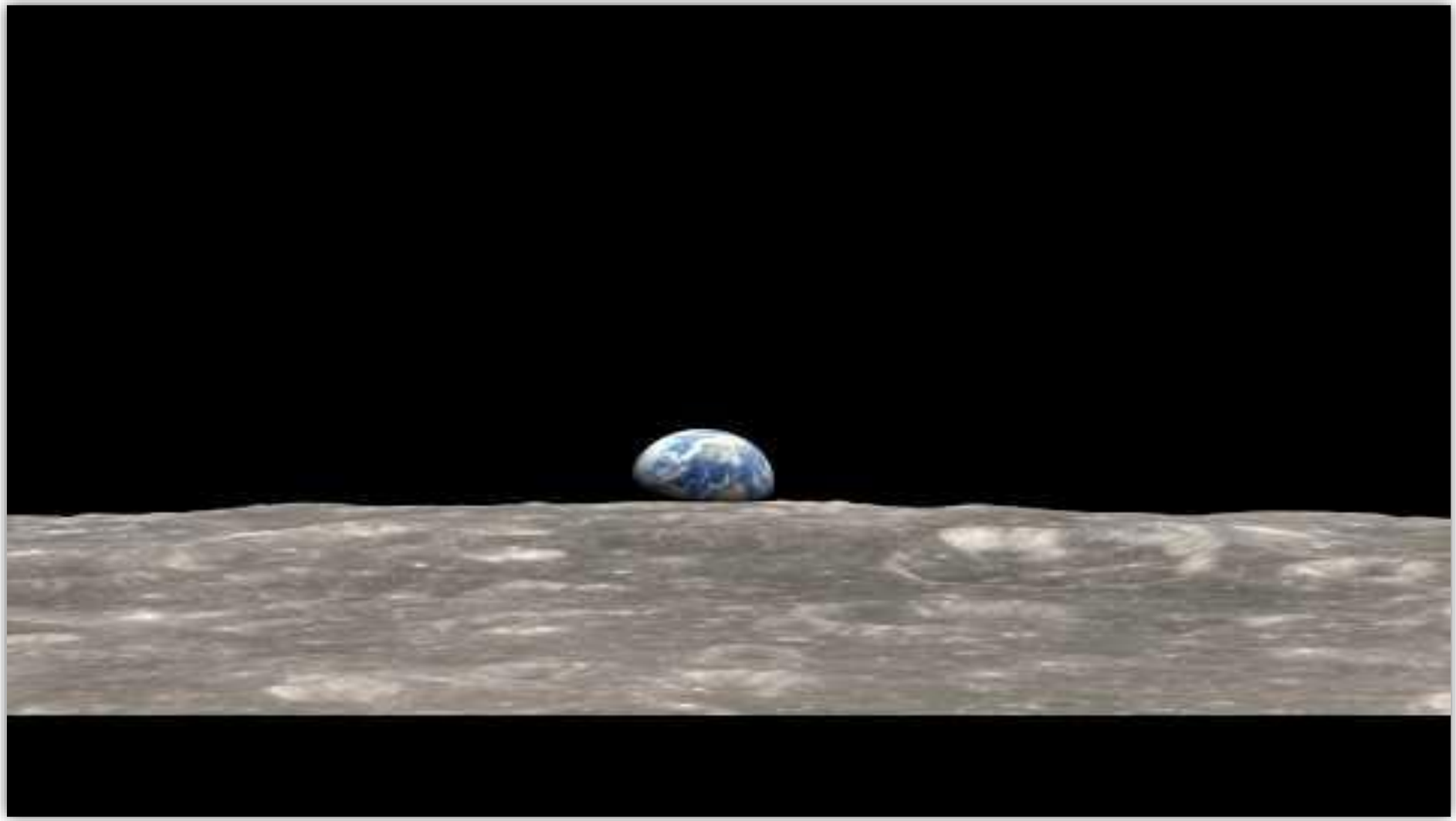
Curriculum Objectives

Theme	Module 1: The Earth in Space
Curriculum	Science > Energy and Forces > Light: • discuss differences between day and night, light and shade • explore how shadows are formed. Science > Energy and Forces > Forces • come to appreciate that gravity is a force • become aware that objects have weight because of the pull of gravity Geography > Natural environments > Planet Earth in space • develop familiarity with the spherical nature of the Earth • identify the sun, the moon, stars • observe, describe and record the positions of the sun when rising and setting and the changing lengths of day and night during the seasons • investigate the relative lengths and directions of shadows and the intensity of sunlight at different times of the year • recognise that the Earth, its moon, the sun, other planets and their satellites are separate bodies and are parts of the solar system, develop a simple understanding of the interrelationship of these bodies, including day and night Skills Development: Observing, questioning, predicting, measuring, investigating and analysing. Maths: Record and Display data.



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ENGAGE			INVESTIGATE				TAKE THE NEXT STEP			REFLECTION
PROMPT	WONDERING	EXPLORING	STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	INTERPRETING DATA/RESULTS	APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS	



Trigger: Earthrise

Wonder / Explore



- What holds the Earth around the Sun? and the Moon around the Earth? -> gravity activities
- What holds people on the Earth? On the Moon? How much would you weigh on the Moon or on another planet?

- Why is the Earth only half lit up?
- How fast does the Earth turn? -> day and night activities
- How fast does the Moon turn and orbit? -> Moon activities
- How long does it take the Earth to go around the Sun? -> seasons activities

- How did they take that picture? Why were they going around the Moon?

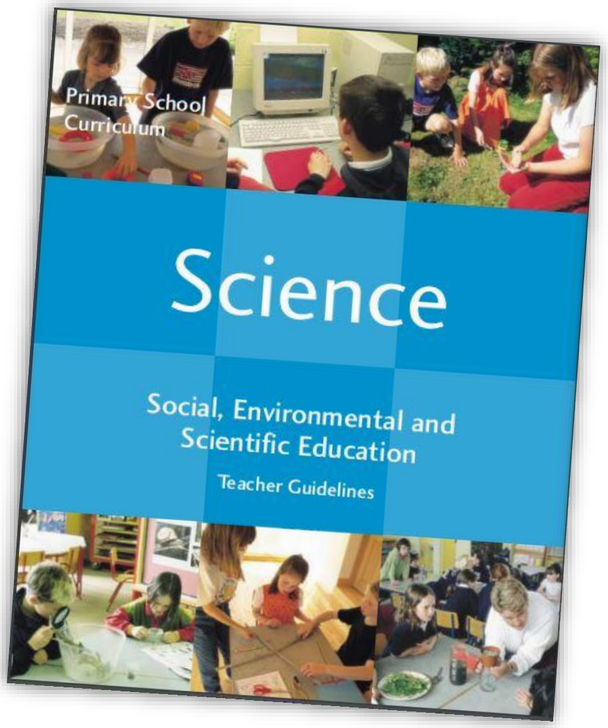
What does gravity do? Eolaíocht sa Spáis: Imtharraingt



Weight and Mass in Science Teacher Guidelines

p.18 In the science curriculum document and in these guidelines no distinction is made between the terms mass and weight. The mass of an object is the amount of material or matter it contains; the weight of an object is the amount of force being exerted on it by the pull of gravity. Most children during the primary years will not have developed the ability to grasp the distinction between mass and weight, and therefore, for general classroom use, the term ‘weight’ is used in these guidelines.

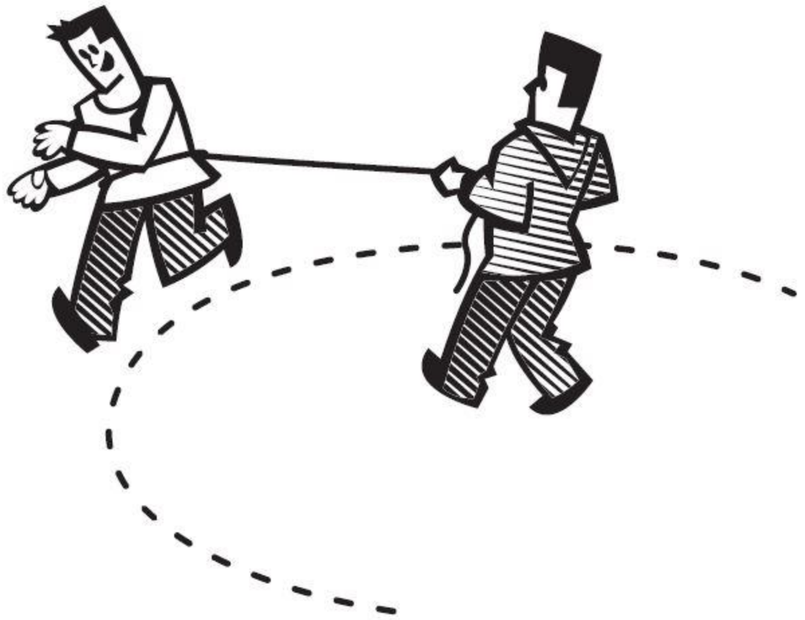
p.110 Gravity All objects attract one another. The force of attraction which an object exerts is in proportion to its mass. The Earth has a large mass, and so the force of attraction between it and other objects is big, and this force pulls objects to the Earth. This force is called the ‘weight’ of an object. The weight of an object is a measure of how much the Earth pulls on it.



ESERO 68: How much do you weigh on other celestial bodies?

ESERO 68 (PDF)

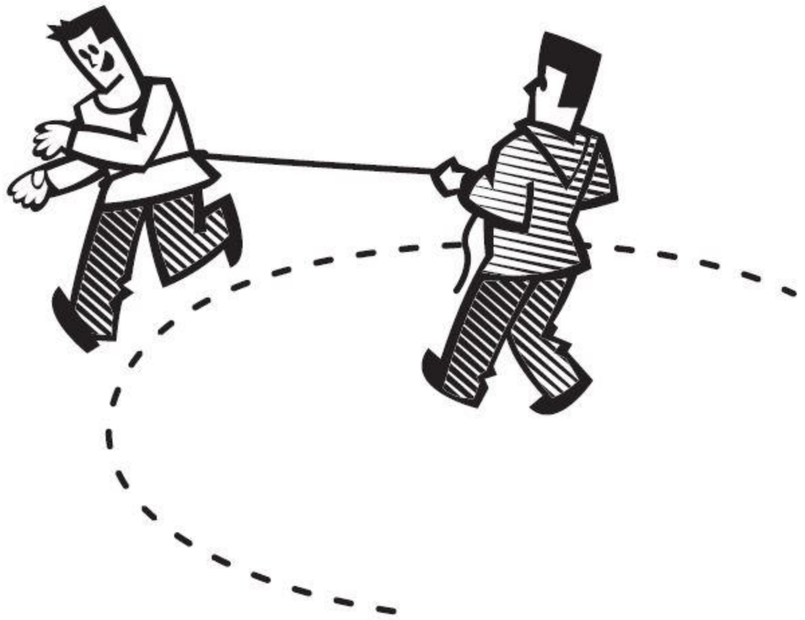
Modelling the force of gravity



1. Gravity pulls objects towards each other.
2. The force of gravity depends on the mass of the objects and the distance between them (LC Physics!)
3. Larger objects (like stars and big planets) have a bigger pull of gravity.
4. Smaller planets (and moons) have a smaller pull of gravity.
5. The force of gravity keeps planets in orbit around the Sun.

ESERO 68: How much do you weigh on other celestial bodies?

Modelling the force of gravity



How would you engage your students with this activity? What Maths and Science connections can you make?

Sections:

1. What pulls us?
2. What is weight?
3. Lifting on the Moon
4. Your weight on other planets
5. Weight and gravity
6. What is your mass?

The Force of Gravity and Orbits: ISS Primary Education Kit



A: The astronaut has so much forward speed that he ends up in outer space.

B: The astronaut runs and has some forward speed as he jumps off the tower. After a while, he falls to the ground.

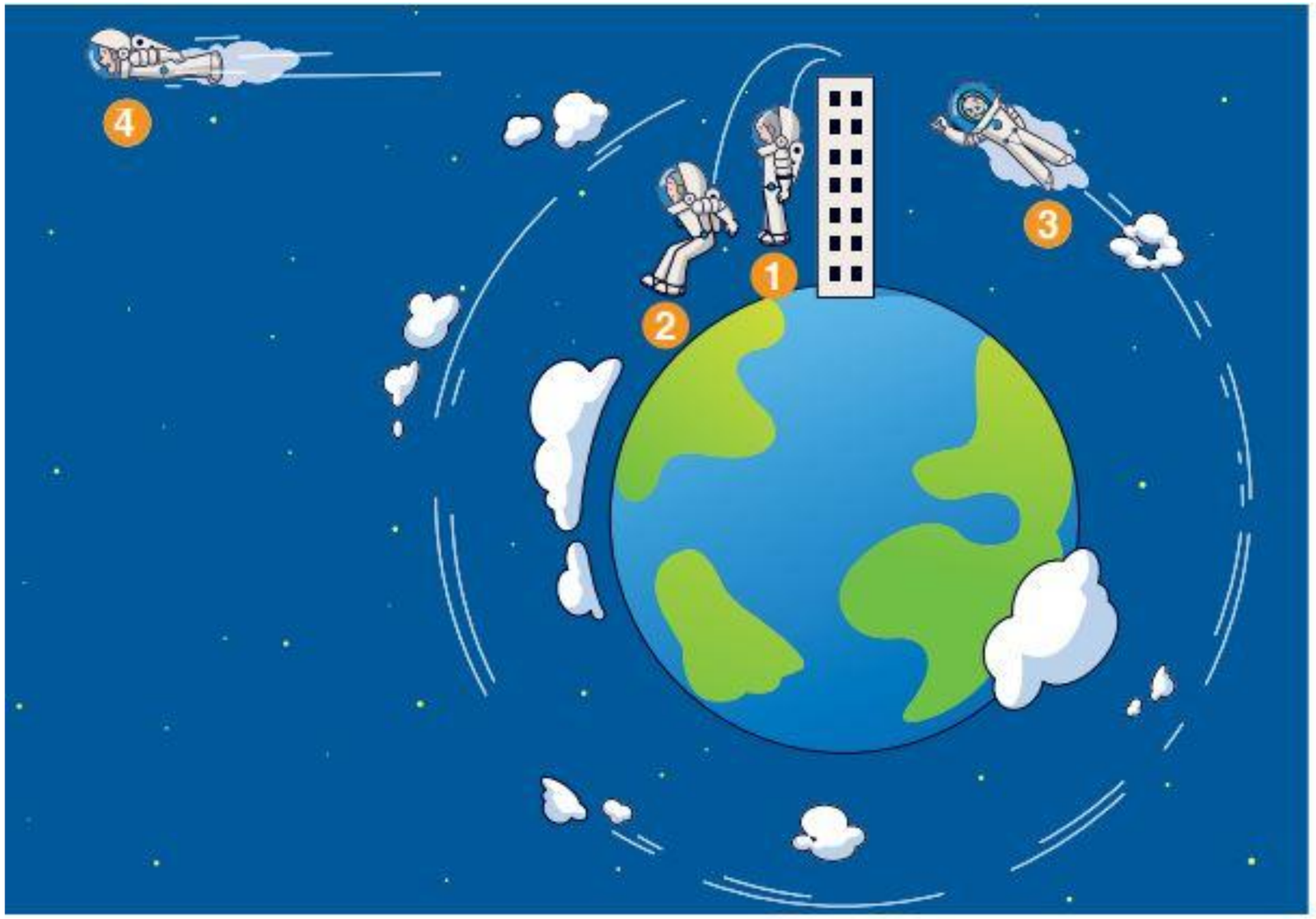
C: The astronaut has the exact direction and speed needed to fall and fall around the Earth without hitting the ground. He is in orbit.

D: The astronaut jumps straight off the tower. He has no forward speed. He falls to the ground immediately.

ISS Primary Education Kit (PDF)

Optional Reading: Types of Orbit

The Force of Gravity and Orbits: ISS Primary Education Kit



A: The astronaut has so much forward speed that he ends up in outer space.



B: The astronaut runs and has some forward speed as he jumps off the tower. After a while, he falls to the ground.



C: The astronaut has the exact direction and speed needed to fall and fall around the Earth without hitting the ground. He is in orbit.



D: The astronaut jumps straight off the tower. He has no forward speed. He falls to the ground immediately.



Why does the Moon orbit the Earth?



Gravity and Weight

The force of gravity is different on different sized planets, so objects will weigh more or less on different planets

In this practical activity, children experience how the force of gravity varies around the solar system by feeling how the weight of a familiar object, a tube of crisps, would change on different planets.



[Phizzi practical: planetary picnic]

Your Weight on the Moon

On the Moon everything weighs 1/6 of what it weighs on Earth – ESERO 68



Apollo 17 astronauts Gene Cernan and Jack Schmitt sing while walking on the moon during the last Apollo lunar landing mission.

Starter Question: How would weighing less affect how you move or jump on the Moon?

Prediction: I think the astronauts on the Moon will..... because.....

Conducting the Investigation – watch the video (and this video: youtu.be/g5aPoRtF2vw) – how would you describe the motion? Compare to how people walk / jump on the Earth. Different children might try to jump, measuring the height that they can jump. Compare to the height that the astronaut can jump on the Moon.
Mathematics connection: estimate the height of the astronaut jump from the video. He jumps as high as his knee – what distance is that on an adult man?
Sharing: Interpreting the data / results – compare difference between individuals in the class to the astronaut.

Take the Next Step: can you move like an astronaut on the Moon? Does the "moonwalking" dance look like real moon-walking?

Optional Reading: Cosmos: The Infographic Book of Space – High Jump | Curious Kids: how high could I jump on the moon?

Paxi and the Solar System

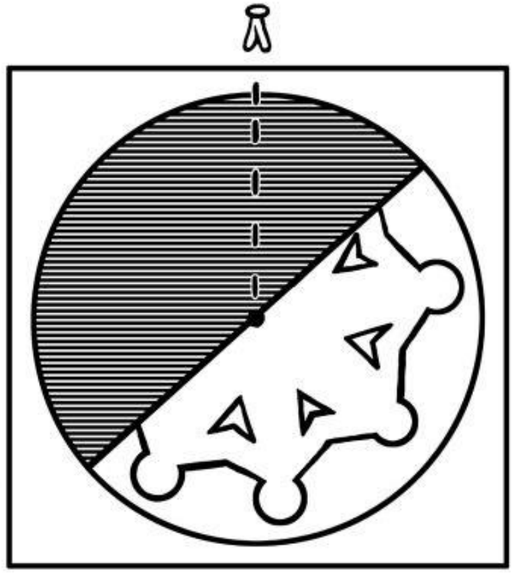


Day and Night

- Day/Night Song
- To the tune of “Are You Sleeping / Frère Jacques”
- The sun is shining, the sun is shining. (Face the lamp.)
- It is day, it is day.
- The sun is gone and now it’s night. (Rotate so backs are facing lamp.)
- We can’t see without a light.
- CHORUS
- Day and night, (Rotate twice.)
- Day and night.

- SESE Science: - Light
- -- recognise that the sun gives us heat and light, without which people and animals could not survive

ESERO 30 Day and Night in the World



ESERO 30 (PDF)

Use Models to demonstrate Day and Night

Use the models to make predictions about what part of the world will be in darkness when another part is in daylight.
Emphasise the source of daylight is the Sun and the cause of day and night is the Earth turning so that one side is in the Earth's own shadow.

The importance of modelling Day and Night & Seasonal appearance of the Sun



Paxi –
Day, Night and the Seasons

Covers two complex topics

Observing the Seasons

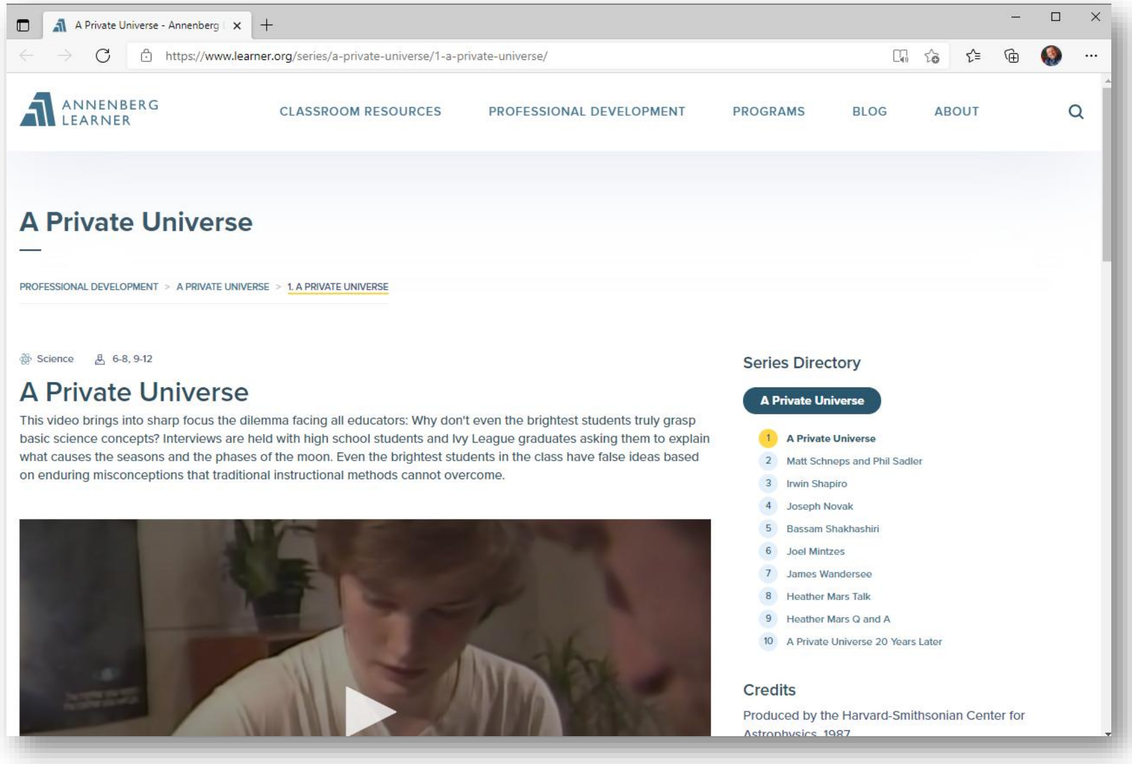
Children should be familiar with the effects of the seasons before they can explain them. SESE Geography emphasises the observable effects, with models and explanations only in 5th and 6th class.
Consider what observations children might make:

- Duration of daytime over different seasons
- Time of sunrise and sunset
- Direction of sunrise and sunset
- Position of the Sun at different times of the day and at different times of the year.

Observing the Seasons

Misconceptions about the seasons have been explored in A Private Universe:
A Private Universe

Reference this article: Learning about Seasons: A Guide for Teachers and Curriculum Developers
Article in Astronomy Education Review · December 2011



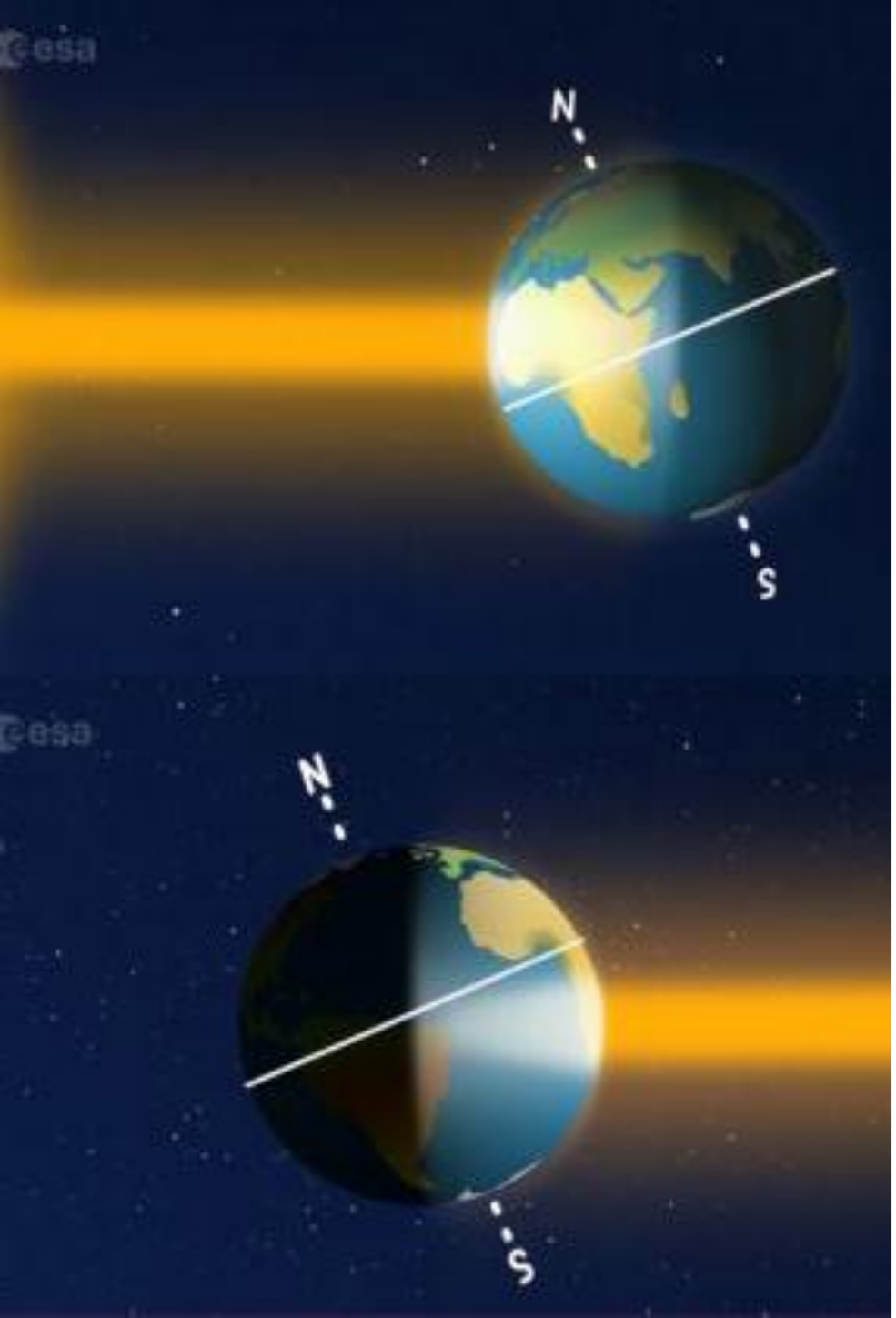
How to make a Sundial





Resource Book for Teachers
Topic: The Sun and Shadows

ESERO 29 - Where is the Shadow? | ESERO 52 – The Sundial



One Year on Earth - Understanding the Seasons

- One Year on Earth - Understanding the Seasons
- Review this activity resource for the background science content.
- How could you use this with children to link the abstract model to what they can see in the sky?
- What alternate ideas do children have about the seasons?
- What mathematics and science connections can be made?

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