SCIENCE WEEK
#scienceweek
7-14 Nov 2021

Ireland esero

Humans in Space

Primary Classroom Resource Booklet

BCO The Space For Science

Science Foundation Ireland SFI For what's next

Background Information: Humans in Space

For many years the only way to get into space was as an astronaut or cosmonaut working for one of the huge space agencies like NASA, ESA or Roscosmos. Now, private companies have built spacecraft and you can launch to space with them, like the 4 astronauts of Inspiration 4 who went to space in September 2021 with the company SpaceX.

If you cannot afford to pay for your own spaceflight, ESA are currently selecting a new class of astronauts (Selection begins | ESA’s next astronauts).

With the new spacecraft have come new designs and controls. Most parts of a spaceflight are now controlled by computers. Compare the interior of the Crew Dragon, Blue Origin, and Boeing Starliner to the older models like Soyuz or the Apollo spacecraft that went to the Moon. On a side note, the astronauts like the Dragon the most! https://youtu.be/AwHaZwumwC8.

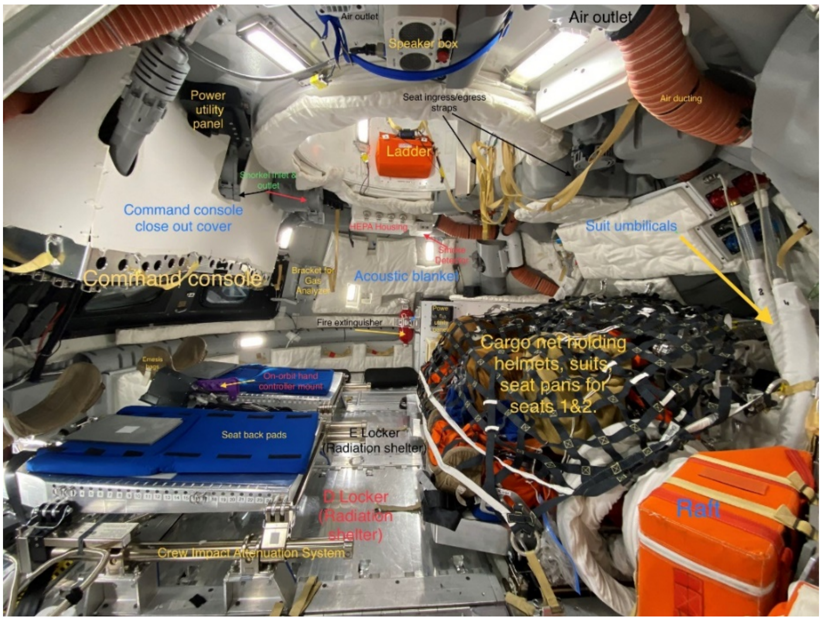
Soyuz – watch the start of this video: https://youtu.be/fr_hXLDLc38 (10 min video of the launch of the Soyuz MS9 in 2018, note the central astronaut has a stick to reach the control panel).

SpaceX Crew Dragon: https://youtu.be/IOW5Yk5kPg0 (7 min video, with a short section in the middle when the video shows only mission control).

A new spacecraft, the Orion capsule, with the European Service Module is being developed to take humans to the Moon.

Artemis-1 is a planned uncrewed test flight due to take place in late December 2021 (see more at the media kit).

Children might create a spacecraft capsule in the classroom – what needs to be included? Teachers, see this video for hints #NASAatHome: Preparing the Orion Crew Capsule for Artemis Missions.



This is the interior of the Orion mock-up. Source: J Hutt on Twitter

One thing to think about is: how do the astronauts fit into the space capsule when they want to sleep?

The current range of heights of astronauts is between 150cm and 190cm. Orion is designed to take astronauts between 147cm and 196cm. The Orion capsule is 5m across and has an interior of 11 cubic meters.

Designers have had to plan in case all the astronauts have the same, tallest, height – would they all fit? How would they arrange their sleeping bags? Their actual sleeping bags have been designed to be lightweight, comfortable and have loops to allow them to be hung in many ways.

An astronaut's height changes when they are in microgravity. Just as our spines get longer when we are lying down, astronauts get taller when they are in space. This can be used as the basis of a class investigation, see: https://storytimefromspace.com/human-effects/.

Students can read about the effects of space travel on the human body.

Explore how it feels to be an astronaut with activities from ESERO 38: Feel like an Astronaut.

To study the effects of weightlessness, volunteers on Earth stay in bed for months at a time. They must eat, bathe, and use the toilet from their beds, and always keep one shoulder touching their bed. Find out more about these bed-rest studies.

Terms: weightlessness, microgravity, and zero-g vs "there is no gravity in space."

When astronauts are in space, they are still affected by the Earth's gravity. What is different to being on the Earth is that when they are in orbit, their spacecraft is also being pulled to the Earth by the Earth's gravity, so they feel "weightless." It isn't that there is no gravity, but that they don't feel the spacecraft pushing up on them, they don't feel "weight." This is the same for parachutists in free-fall. Astronaut trainees and scientists use special "zero-g" aircraft flights to experience weightlessness, see: https://youtu.be/O3A9uhU4Cx0.

Astronaut training in zero-g Credit: ESA–Anneke Le Floc'h

Children can explore this with the demonstration of the falling cup of water – when the cup falls, the water stops flowing out of the cup, because the water and the cup are falling together. For a brief moment, the water is weightless. See 1.3 Weightlessness from the ISS Primary Education Kit and this video of the activity: https://youtu.be/KgwiDDBrizc.

DPSM/ESERO
Framework for Inquiry

Theme	Humans in Space
Curriculum	**Strand: Strand Unit:** **Living things>Myself** … measure physical similarities and differences between individuals **Materials>Properties and characteristics of materials** … identify how materials are used **Energy and forces>Forces** …come to appreciate that gravity is a force, become aware that objects have weight because of the pull of gravity. **Skills Development:** Working Scientifically: Questioning; Investigating & Experimenting; Analysing. Designing and Making: Exploring; Planning; Making; Evaluating. **Mathematics**: Measures>Length, Data>Representing and Interpreting Data

Engage

The Trigger	Wondering	Exploring	Considerations for inclusion
Images of interior of spacecraft, including Crew Dragon, Soyuz, Orion and Apollo. Demonstration of falling cup of water, see https://esero.ie/wp-content/uploads/2015/01/28_Feel-gravity.pdf See also Water doesn't Leak.	Can you escape the force of gravity? See 1.3 Weightlessness from the ISS Primary Education Kit. Discuss: What does it feel like at the moment a roller coaster starts to go upwards? What it does it feel like just as it starts to go downwards again? What does it feel like if you jump up just as a lift starts to go down? What are the effects on the human body from being in space: Life after Space and Gravity and Weightlessness? Effect of spaceflight on the height of astronauts: https://youtu.be/Rb89NYTS12U	Play the game Simon (available as a web app). What affects how well you can follow a long sequence of actions? Who can follow the most steps? Is there a wide range across the class? How might this affect the design of spacecraft control board? Can there be *too many* buttons? Astronauts take written instructions with them for take off and landing, but the computers do most of the steps. Mathematics: What is the range of the children's heights in the classroom? Children can come up with their own questions about the range of heights.	

Design and Make a Space Capsule

Explore	Plan	Make	Evaluate	
Create a spacecraft capsule in the classroom – what needs to be included? Consider: How long is your journey? How many crew members?	Watch videos of spaceflights, or study pictures of the interiors of spacecraft. List the important parts of a spacecraft interior. List the materials in the classroom that could be used to represent those parts.	Create a full-scale mock-up in the classroom. Use a range of materials to represent each part of the interior.	Can the crew move around easily? Is there enough space to sleep? Enough storage? Can the controls be reached from the seats?	

Design and Make a Sleeping Bag / Sleep Pod

Explore	Plan	Make	Evaluate	
See: Esa Kids. How big does the sleeping bag/sleep pod need to be? How will the sleeping bag be attached to the space capsule?	Children should design their sleeping bag/sleep pod, taking into account the factors they have listed as they explored the topic.	Children can make small scale sleeping bags, showing how they will attach, fold up and be used. Children might test to see if the sleeping bag	Can they fit four sleeping bags into their capsule? How much did their model sleeping bag weigh? How much would a	

How much space is there in the capsule? (Orion has a diameter of 5m, and 11 cubic meters of habitable volume). What materials are very lightweight, yet warm?	Children might carry out an investigation to find the best warm, yet lightweight material.	hooks hold the sleeping bag steady.	full-size sleeping bag weigh? How is the sleeping bag attached?	

Investigate: Astronaut Height

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results	
How does my height change over the course of a day? Older children: Do taller people have a bigger change in height each morning? (Like Shane who grew taller than Peggy). Possible extension questions: Does it matter how much time you are lying down? Does it matter how quickly you measure your height in the morning after you wake up?	Children should predict if their height will change in the same way that an astronaut's height does. Older children might consider if starting height affects the amount of change of height.	Children should plan to measure their height first thing in the morning over the course of a week. Children may mark their heights and see if it changes from day to day, or from morning to evening. To compare to other children, they will need to measure their actual height with a meter stick or tape measure.	Combine data from the whole class: who had the largest change in height? Was it dependent on their actual height? (i.e., did taller people have a bigger change in height?) How much did the class "shrink" over the course of the day?	

Take The Next Step

Applying Learning | Making Connections | Thoughtful Actions

Who will be the next ESA astronauts? Astronaut selection is underway.

Can the children carry out a simulation of the bed rest experiments? In these experiments the participants must always keep one shoulder on their bed, even when they are bathing, using the toilet or eating.

Do astronauts need a pillow? See this article for background information. Can the children design and make a pillow for a long-distance space flight?

Human Spaceflight: What would you do if something went wrong? Create a drama in your "space capsule" based on the Apollo 13 mission: https://youtu.be/C3J1AO9z0tA

Reflection	
	Did I meet my learning objectives? What went well, what would I change? Are the children moving on with their science skills? What questions worked very well? What questions didn't work well? Ask the children would they change anything or do anything differently. Are there cross curriculum opportunities here? What further questions did students have?

Feel gravity
Gravity

28

time
45 minutes.

learning outcomes
To:
- know that gravity is a force
- learn that gravity pulls everything towards the centre of the Earth.
- learn that you can feel the force of gravity yourself

materials needed
- plastic cup
- embroidery needle
- water
- bucket

Preparation

For the activity **Falling water** you will need a plastic cup, an embroidery needle and a bucket.

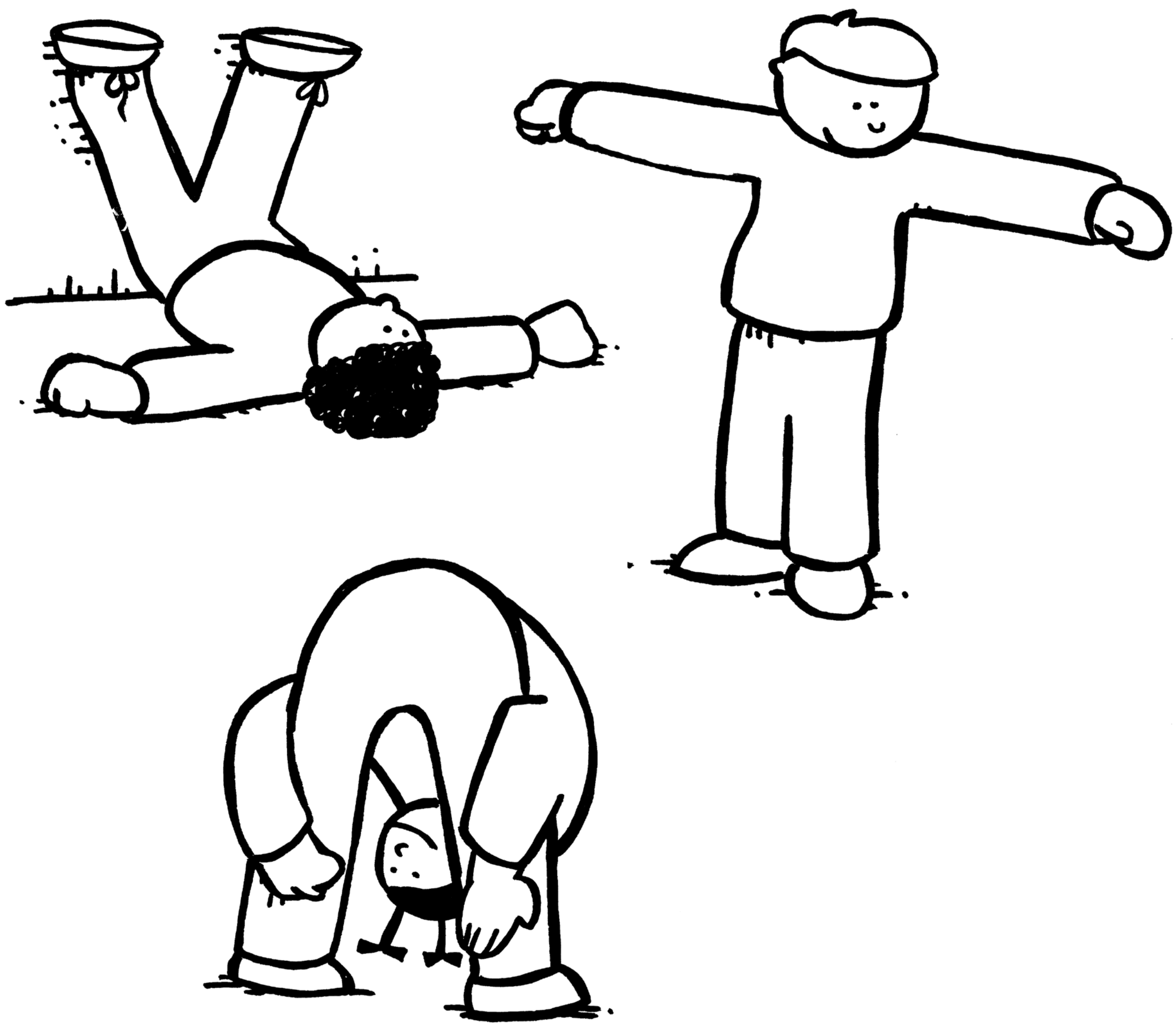
Falling water 10 min.

Sit in a semicircle with the children. Take the plastic cup.
Let it fall. Ask the children what happened. Why did the cup fall? Explain that this is caused by gravity. Gravity is an invisible force that pulls people, animals, plants and objects towards the centre of the Earth.
Use the embroidery needle to make a hole in the bottom of the plastic cup. Make sure the children can see what you are doing. Ask what will happen if you fill the cup with water. Hold the cup over the bucket and fill it with water. What happens? The water runs out through the hole.
Cover the hole with your finger. Now the water stays in the cup. Ask the children if the water will still run out if you drop the cup. Allow some time for discussion. Then drop the cup. The children will see that the water stays in the cup. Why does the water stay in the cup? Explain that this is because the water is falling at the same speed as the cup.

The children investigate what gravity is.

Hanging head 10 min.

Now encourage the children to feel gravity for themselves. They are going to stand and bend over with their head between their knees and look at the child behind them. Then ask them to stand upright and stretch out their arms as shown in the picture.



What does it feel like to bend over like this? Where can they feel the blood flowing? Do they find it difficult to stand with their arms stretched? What force makes this difficult?
Explain that when they bend over, more blood flows to their head. This is because of gravity 'pulling' the blood downwards. The same force makes it difficult to hold your arms outstretched.
You need strength to hold your arms up, but eventually gravity pulls them back down again.

On its head? 15 min.

Give each child a pencil and together look at the picture of the Earth for Task 1 of the worksheet. Read through the instructions together. First of all the children turn over the page and draw what they have read about. Once they have drawn the boy with the cloud and the rain, they turn the paper 180 degrees. When they have finished drawing the girl with a cloud and rain, encourage them to examine their drawing closely. What do they notice? What happens to the rain? In what direction do the raindrops fall? Do the raindrops fall towards the Earth or away from it? Reach the conclusion that in one of the drawings the raindrops fall 'down', and in the other drawing they appear to fall 'upwards', but in both drawings they actually fall towards the Earth. Ask the children why this is. Explain clearly that gravity is always pulling everything towards the middle of the planet. That is why you can never fall off the planet, even if you are standing on the opposite side!

What do you know about gravity? 10 min.

Ask the children what they have learned in the previous activities.
What did they find out from the falling cup of water? What did they feel when they were bent over? And when they had their arms outstretched? What did we find out from the drawing on the worksheet? Explain that gravity is always present, but that you don't always notice it. The children complete Task 2 on the worksheet. Reach the conclusion that the Earth's gravity pulls everything towards the centre of the planet.

28 worksheet

Feel gravity

1 On its head?

Read the instructions

Finish the drawing on the back of the worksheet.

1 Draw a boy standing on the planet.
2 Draw him holding an umbrella.
3 Draw a cloud above the umbrella.
4 Draw rain falling out of the cloud.
5 Turn the paper.
6 Draw a girl standing on the planet.
7 Draw her holding an umbrella.
8 Draw a cloud above the umbrella.
9 Draw rain falling out of the cloud.

2 What do you know about gravity?

Put a tick against what you know. There is more than one right answer.

Because of gravity:

- O rain always falls towards the Earth.
- O your hair hangs down.
- O you can hold your arms outstretched.
- O we stay standing on the ground.

Design the Interior of a Spacecraft.

Which of these spacecraft would you rather fly in?

Andreas Mogensen in the Interior of the Soyuz simulator, 2014. Credit: ESA

Bob and Doug in the SpaceX Crew Dragon simulator March 2020. Credit: NASA

Explore:
List the items that are needed inside a space capsule. Use the videos for background information (Fire in Space: https://youtu.be/oE5Z3Uxbezc, Tour of Crew Dragon https://youtu.be/IOW5Yk5kPg0, Inside Orion https://youtu.be/GT8B9AxWwmM). See also: http://www.destinationspace.uk/mission-modules/make-astronaut-sleep-pod/

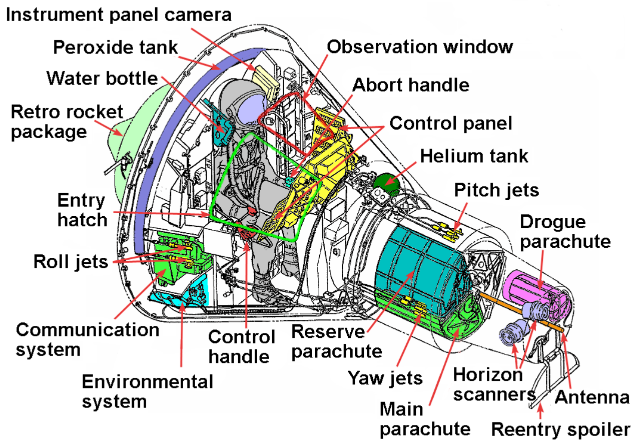
Consider how many crew members and how much space they will need for food, water and personal items.

Consider the mission, what equipment might be needed for that particular spaceflight, where will it be stored?

Consider safety and the design of the launch seats.

Consider the materials to be used, the interior of a spacecraft should not allow bacteria or fungi to grow.

Consider the weight of every item. It costs a lot of money to launch to space, so lightweight materials are preferred.



Mercury Space craft design, one person crew, short journey

Plan:

Create a drawing of your design. Make a scale drawing for increased accuracy, or use side, top and front elevations.

List the materials in the classroom that could be used to represent the most important parts of the capsule.

How will you stop small items floating away? Plan how you will fix items to surfaces.

What would you do if something went wrong during the spaceflight, what emergency items would you need?

Make:

Identify appropriate materials and construct a model from cardboard or other suitable materials.

Or make a full-scale mock-up in the classroom. For a full-scale version, mark the outside edge of the spacecraft capsule with tape or string. Use chairs as the launch seats and fit all the items that are required within the given space.

Evaluate:

Evaluate the initial design and completed model.
Does the final model have all the required parts of a space capsule?
Did you encounter any problems? How did you fix problems?
Did the plan change as you developed it?
How would you improve your design?

DPSM/ESERO

Framework for Inquiry - Promoting Inclusion

SPECIAL EDUCATION SUPPORT SERVICE
building on ability

When planning science activities for students with Special Educational Needs (SEN), a number of issues need to be considered. Careful planning for inclusion using the framework for inquiry should aim to engage students in science with real purpose. Potential areas of difficulty are identified below along with suggested strategies. This list is not exhaustive, further strategies are available in the Guidelines for Teachers of Students with General Learning Disabilities (NCCA, 2007).

ENGAGE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Delayed language development/poor vocabulary/concepts	• Teach the language of science demonstrating meaning and/or using visual aids (material, property, strong, weak, textured, dimpled, absorbent, force, gravity). • Have the student demonstrate scientific phenomena, for example gravity —using 'give me, show me, make me,' as much as possible. • Assist the student in expressing ideas through scaffolding, verbalising a demonstration, modelling. • Use outdoor play to develop concepts.

INVESTIGATE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Fear of failure/poor self-esteem/fear of taking risks	• Model the speculation of a range of answers/ideas. • Repeat and record suggestions from the students and refer back to them.
Understanding Time and Chronology	• Practice recording the passing of time, establish classroom routines that draw the students' attention to the measurement of time. • Teach and practice the language of time.
Fine/Gross Motor Difficulties	• Allow time to practice handling new equipment. • Allow additional time for drawing diagrams, making models etc. • Give students the option to explain work orally or in another format.
Short Term Memory	• Provide the student with visual clues/symbols which can be used to remind him/her of various stages of the investigation.

TAKE THE NEXT STEP

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Developing Ideas	• Keep ideas as simple as possible, use visuals as a reminder of earlier ideas. • Discuss ideas with the whole group. • Repeat and record suggestions from students and refer back to them. • Encourage work in small group and in pairs.
Communicating Ideas	• Ask students to describe observations verbally or nonverbally using an increasing vocabulary. • Display findings from investigations; sing, do drawings or take pictures. • Use ICT: simple written or word-processed accounts taking photographs, making video recordings of an investigation.

REFLECTION

- Did I take into account the individual learning needs of my students with SEN? What differentiation strategies worked well?
- Did I ensure that the lesson content was clear and that the materials used were appropriate?
- Was I aware of the pace at which students worked and the physical effort required?
- Are there cross curriculum opportunities here?
- Are the students moving on with their skills? Did the students enjoy the activity?

More strategies, resources and support available at **www.sess.ie**

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