BLACKROCK CASTLE OBSERVATORY
THE SPACE FOR SCIENCE

Ireland esero

Science Foundation Ireland sfi For what's next

SPACE WEEK
Our Planet · Our Space · Our Time

# Classroom Resource Booklet

## Engineering in Space: Astronauts and the International Space Station

Discover Primary Science and Maths
www.primaryscience.ie

www.spaceweek.ie

Engineering in Space: Astronauts and the International Space Station

German V-2 rockets (which were weapons) were the first to reach 100 kilometres above the Earth's surface; this is the distance that's accepted as "the beginning of space". The first satellite reached orbit in 1957 (Russia's Sputnik satellites).

Fruit flies, monkeys and a Russian dog flew into space before humans even tried! The first human in space was Yuri Gagarin, a Russian cosmonaut. Since then, many astronauts from many countries have flown into orbit and 24 people have gone as far as the Moon (12 of those people walked on the Moon).

The International Space Station (ISS) is a satellite the size of a football field which is managed by the space agencies of Canada, Europe, Japan, Russia and the United States. The ISS is a space laboratory that is home to dozens of scientific experiments and the astronauts who conduct them. The first part of the ISS was launched into space in 1998. It has been occupied continuously since 2000. There have been at least three people on the ISS at any given moment since 2000. Crews are always coming and going, and stay for typically a few months at a time.

The European Space Agency (ESA) contributes to the ISS and sends astronauts to live and work there. Recent ESA astronauts include Thomas Pesquet, Tim Peakes, Andreas Mogensen and Samantha Cristoforetti.

For Teachers:
http://esamultimedia.esa.int/multimedia/publications/Getting_ready_for_space_EN/

# DPSM/ESERO Framework for Inquiry

| Theme | Engineering in Space: Astronauts and the International Space Station |
|---|---|
| Curriculum | Strands: Energy and Forces / Materials / Environmental Awareness and Care<br>Strand Units: heat, forces, properties and characteristics of materials, materials and change<br>Curriculum Objectives:<br>• Identify ways of keeping objects … warm and cold<br>• Investigate how forces act on objects<br>• Become aware of … breathing<br>• Investigate how materials may be used in construction.<br>Skills Development: investigating, measuring, estimating, recording, predicting, **designing and making.** |

## Engage

| The Trigger | Wondering | Exploring |
|---|---|---|
| What is it like to be an astronaut?<br>(What would you wear? How would you breathe? How would you move?)<br>Live location of the ISS: http://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/Where_is_the_International_Space_Station<br><br>Images of Astronauts aboard the ISS from http://esero.ie/wp-content/uploads/2015/01/38_Feel-like-an-astronaut.pdf<br><br>Book: *The International Space Station* by Franklyn M. Branley (ISBN: 978-0-06-445209-0) | How can we make a model of the ISS?<br>ESA Kids: Space Stations: http://www.esa.int/esaKIDSen/SpaceStations.html<br><br>How can we make a working robot arm?<br>How can we pick up items with a robot arm?<br>Videos of the Robot arm being used aboard the ISS<br>MissionX: https://www.youtube.com/watch?v=3pGHf1oRHpg<br>Canadian Space Agency: https://www.youtube.com/watch?v=K7NvsxcoDKo | A Real Spacesuit: ESERO 20 for Junior Classes<br>- how does clothing stop us losing heat?<br>- how do astronauts carry their own air supply?<br>How was the space station built? TEDed lesson http://ed.ted.com/lessons/the-incredible-collaboration-behind-the-international-space-station-tien-nguyen<br>and ISS Primary Education Kit http://esamultimedia.esa.int/docs/primedukit/en/PrimEduKit_ch3_en.pdf/ includes shapes of the modules<br><br>Attempt to pick up items with chopsticks, from A Robot Arm: ESERO 60 http://esero.ie/wp-content/uploads/2015/01/60_A-robot-arm.pdf<br>Canadarm Effector https://trainlikeanastronaut.org/sites/default/files/A-Robotic-Arm-Student-and-Teacher.pdf<br><br>Make each robot arm, explore how they work, then consider how to improve the design. |

## Investigate: Model the ISS

| Starter Question | Predicting | Conducting the Investigation | Sharing: Interpreting the data / results |
|---|---|---|---|
| What is the best way to make a model of the ISS? | Choose materials and explain why they would be suitable. | Create a model of the space station. | Compare their model to actual photographs / diagrams of the ISS. |

Considerations for inclusion

Offer concrete support materials as needed.

# DPSM/ESERO Framework for Inquiry

## Investigate: Robot Arms

| Starter Question | Predicting | Conducting the Investigation | Sharing: Interpreting the data / results |
|---|---|---|---|
| How do robot arms work? How can the design be improved?<br><br>Does the *number of struts / position of pins / material the struts are made from* make a difference? | Prediction for variable being tested, with appropriate explanation.<br><br>*"I think the struts should be made of wood because it won't bend."* | Modify the design of the robot arms and test if it *can pick up more material* or *reach further* or …<br><br>Present results in a table, chart or diagram | Compare their own results to other robot arms.<br><br>Explain their findings. |

## Investigate: End effector

| Starter Question | Predicting | Conducting the Investigation | Sharing: Interpreting the data / results |
|---|---|---|---|
| *What material is best for the snares? Should they be taut or loose? What shapes can the end effector grab onto? What is the heaviest thing that can be picked up? …* | Suitable prediction for variable being tested, with appropriate explanation.<br><br>*"I think the snares should be made of fishing line because it is flexible."* | Modify the design of the end effector and test.<br><br>Record findings in a table or chart. | Compare their own results to other groups.<br><br>Explain their findings. |

## Take the Next Step

| Applying Learning | Making Connections | Thoughtful Actions |
|---|---|---|

How does being in space affect humans? Feel Like an Astronaut: ESERO 38 http://esero.ie/wp-content/uploads/2015/01/38_Feel-like-an-astronaut.pdf

5 Ways Space Travel Affects the Human Body https://www.youtube.com/watch?v=HSrVO5C9kwQ

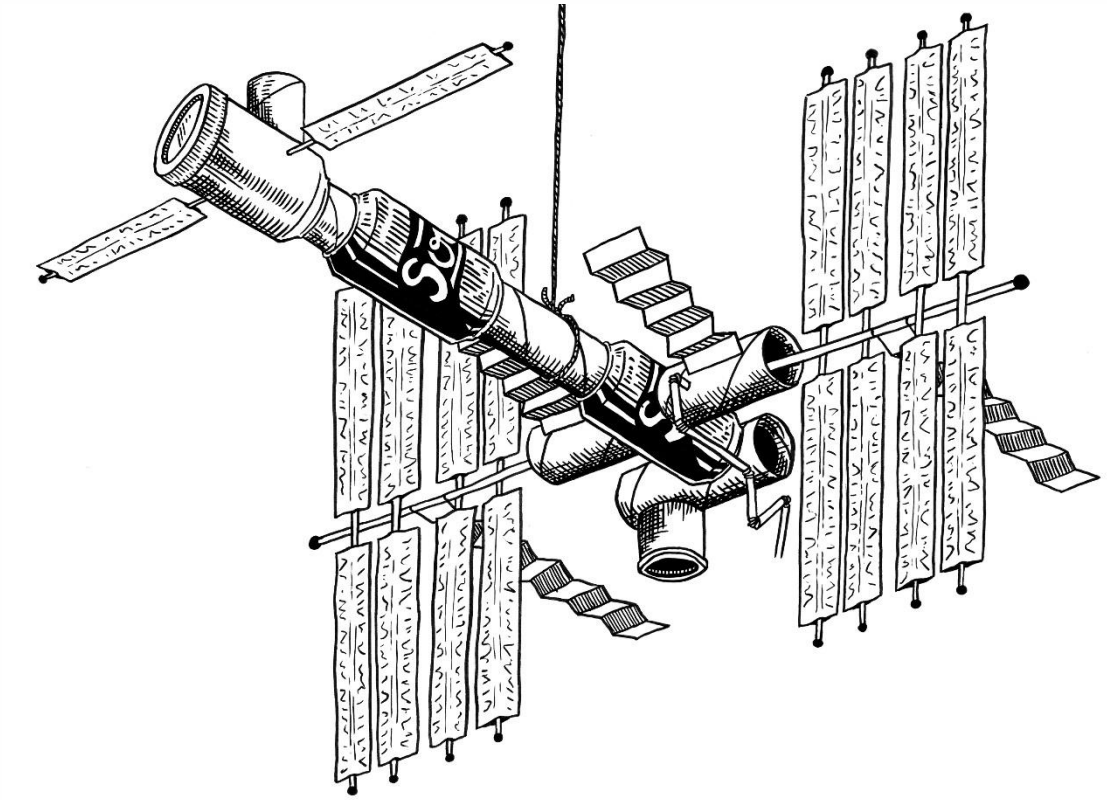
Being an astronaut: Activities from ISS Primary Education Kit Chapter 1, pdf available: http://esamultimedia.esa.int/docs/primedukit/en/PrimEduKit_ch1_en.pdf

Make a bottle garden http://blackrockec.ie/node/130

Create a timeline of Astronaut activity (use internet sources to find out key events or see *History Windows on the World* 3rd class (EDCO))

The DPSM/ESERO Journey into Space booklet has many cross-curricular ideas: http://www.primaryscience.ie/media/pdfs/journey_into_space_resource_booklet.pdf

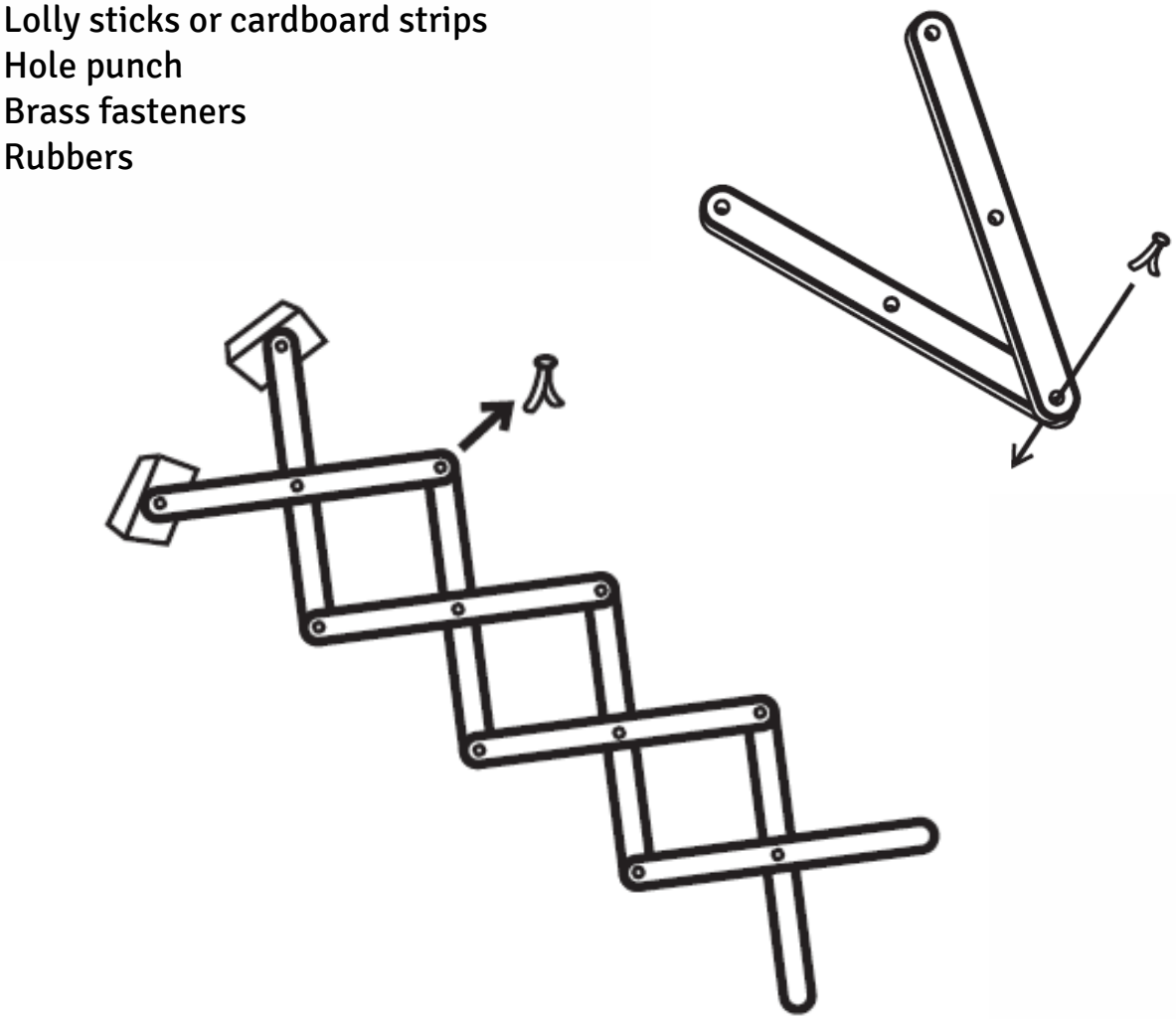
| Reflection | What worked well?<br>Would I change this activity?<br>Did the students engage with the topic?<br>What questions did the students ask?<br>Does this lead on to further investigations? Can we carry any of these out? |
|---|---|



The International Space Station in 2010, viewed from Space Shuttle *Endeavour* Credit: NASA

# ROBOT ARM

Materials needed:
Lolly sticks or cardboard strips
Hole punch
Brass fasteners
Rubbers



How could you make the robot arm work better? What happens if you make it longer? Or shorter? Is it easier to work with a long or a short robot arm?
What else could you use – instead of rubbers – for the grippers?
Remove some of the split pins. Does the robot arm still work?

BLACKROCK CASTLE OBSERVATORY
THE SPACE FOR SCIENCE

Ireland esero

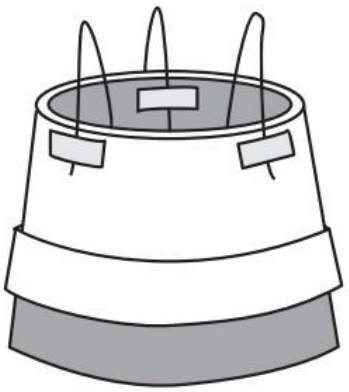
Science Foundation Ireland sfi For what's next

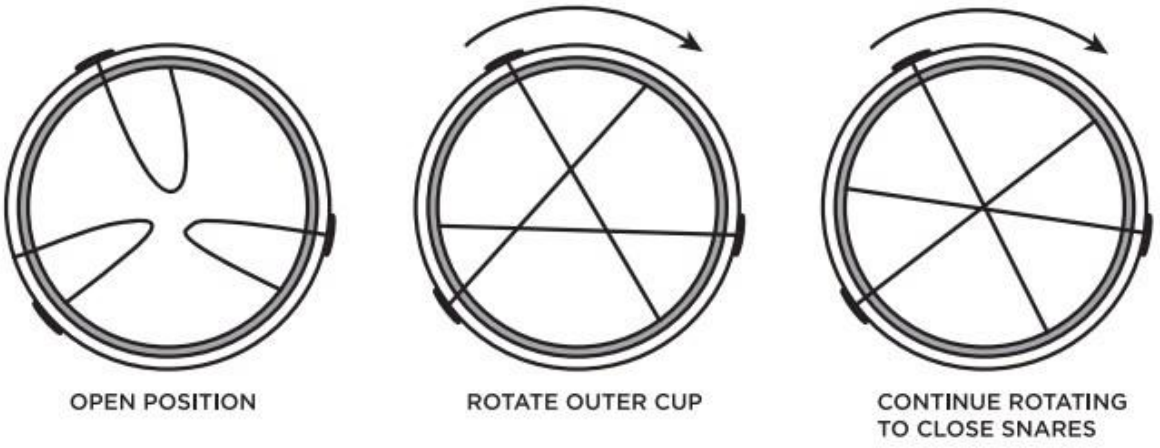
SPACE WEEK
Our Planet · Our Space · Our Time

# CANADARM2 END EFFECTOR

Materials needed:
2 Styrofoam / paper cups
Plastic knife / scissors
String / fishing line / yarn
Tape

Credit: ESA/NASA






Adapted from: https://www.scienceworld.ca/resources/activities/canadarm-end-effector and part of MISSION X: Train Like an Astronaut