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THE SPACE FOR SCIENCE

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SPACE WEEK
Our Planet · Our Space · Our Time

Classroom Resource Booklet

Engineering in Space: Astronauts and the International Space Station

curious minds
Discover STEM

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/

curious Minds/ESERO Framework for Inquiry

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

Engage

The Trigger	Wondering	Exploring
What is it like to be an astronaut? (What would you wear? How would you breathe? How would you move?) Live location of the ISS: http://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/Where_is_the_International_Space_Station Images of Astronauts aboard the ISS from http://esero.ie/wp-content/uploads/2015/01/38_Feel-like-an-astronaut.pdf Book: *The International Space Station* by Franklyn M. Branley (ISBN: 978-0-06-445209-0)	How can we make a model of the ISS? ESA Kids: Space Stations: http://www.esa.int/esaKIDSen/SpaceStations.html How can we make a working robot arm? How can we pick up items with a robot arm? Videos of the Robot arm being used aboard the ISS MissionX: https://www.youtube.com/watch ?v=3p GHf1o RHpg Canadian Space Agency: https://www.youtube.com/watch?v=K7NvsxcoDKo	A Real Spacesuit: ESERO 20 for Junior Classes - how does clothing stop us losing heat? - how do astronauts carry their own air supply? How was the space station built? TEDed lesson http://ed.ted.com/lessons/the-incredible-collaboration-behind-the-international-space-station-tien-nguyen and ISS Primary Education Kit http://esamultimedia.esa.int/docs/primedukit/en/PrimEduKit_ch3_en.pdf/ includes shapes of the modules 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 Canadarm Effector https://trainlikeanastronaut.org/sites/default/files/A-Robotic-Arm-Student-and-Teacher.pdf 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.

Curious Minds/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? 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. *"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 … Present results in a table, chart or diagram	Compare their own results to other robot arms. 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. *"I think the snares should be made of fishing line because it is flexible."*	Modify the design of the end effector and test. Record findings in a table or chart.	Compare their own results to other groups. 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

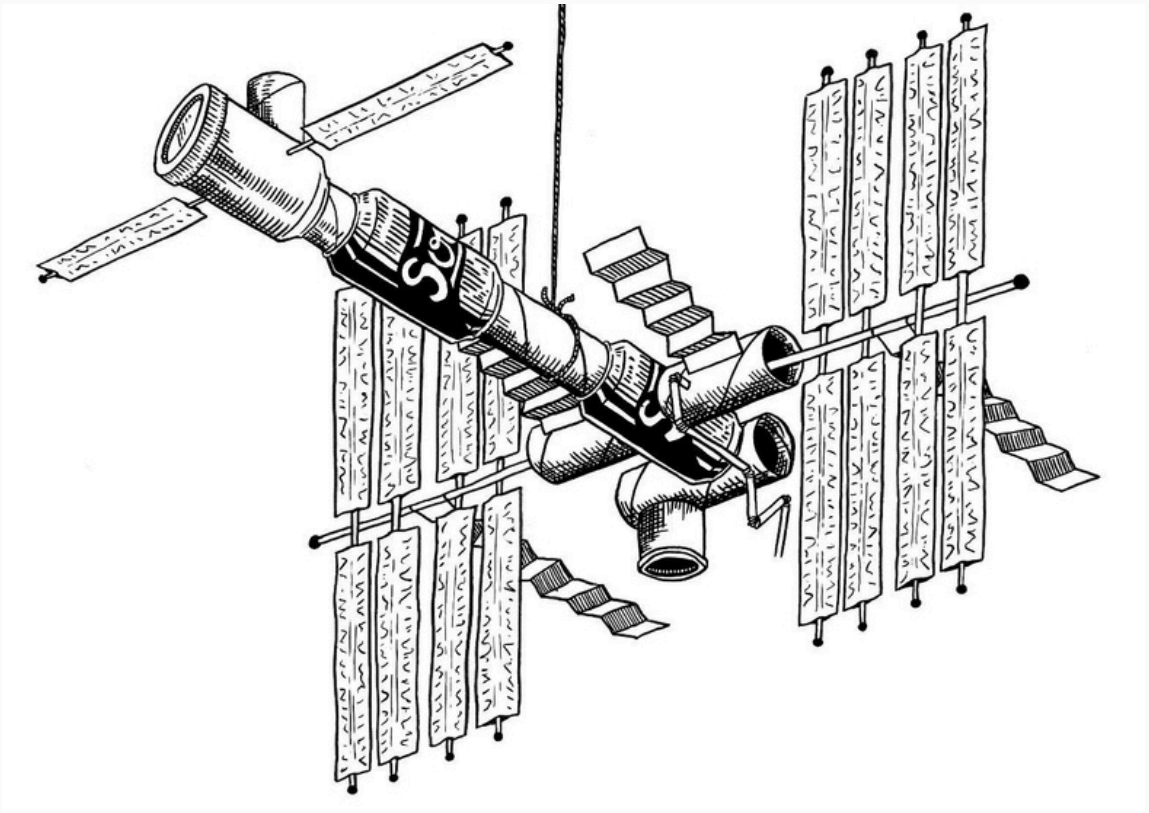
Make a bottle garden http://blackrockec.ie/node/130

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

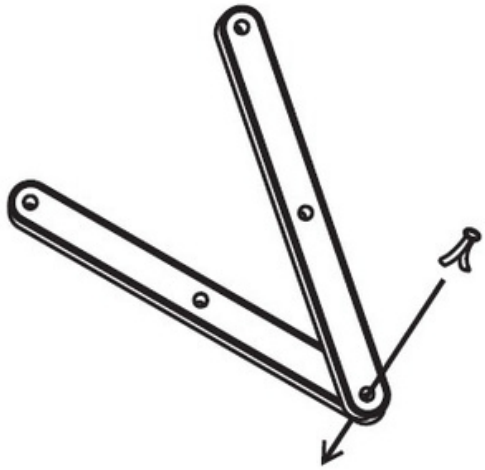
What worked well?
Would I change this activity?
Did the students engage with the topic?
What questions did the students ask?
Does this lead on to further investigations? Can we carry any of these out?

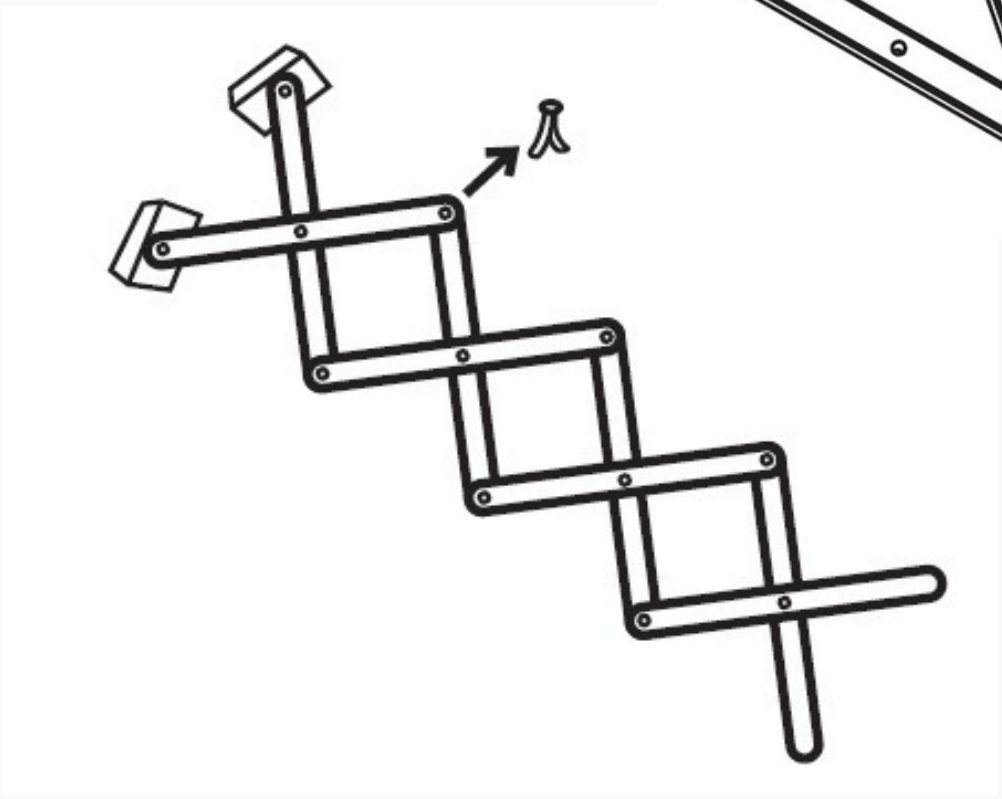


The International Space Station in 2010, viewed from Space Shuttle Endeavour Credit: NASA

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?

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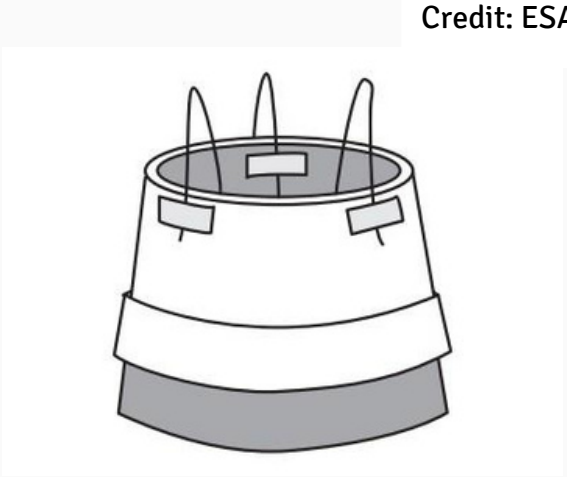
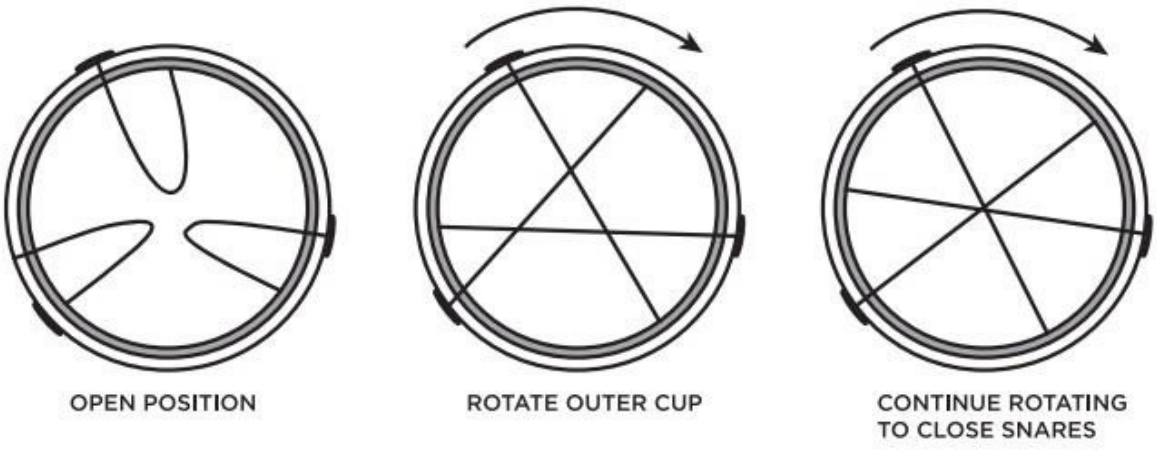
Canadarm2 End Effector

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