

Classroom Resource Booklet

Engineering in Space: Astronauts and the International Space Station



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 Strand Units: heat, forces, properties and characteristics of materials, materials and change Curriculum Objectives: <ul style="list-style-type: none"> 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: <i>The International Space Station</i> 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/esa/KIDSen/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=3pGHf1oRHpg 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/prim-edukit/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://trainlikean astronaut.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.	Considerations for inclusion Offer concrete support materials as needed.
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.

DPSM/ESERO Framework for Inquiry

Investigate: Robot Arms			
Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results
<p>How do robot arms work? How can the design be improved?</p> <p>Does the <i>number of struts / position of pins / material the struts are made from</i> make a difference?</p>	<p>Prediction for variable being tested, with appropriate explanation.</p> <p><i>"I think the struts should be made of wood because it won't bend."</i></p>	<p>Modify the design of the robot arms and test if it <i>can pick up more material or reach further</i> or ...</p> <p>Present results in a table, chart or diagram</p>	<p>Compare their own results to other robot arms.</p> <p>Explain their findings.</p>
Investigate: End effector			
Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results
<p><i>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? ...</i></p>	<p>Suitable prediction for variable being tested, with appropriate explanation.</p> <p><i>"I think the snares should be made of fishing line because it is flexible."</i></p>	<p>Modify the design of the end effector and test.</p> <p>Record findings in a table or chart.</p>	<p>Compare their own results to other groups.</p> <p>Explain their findings.</p>
Take the Next Step			
Applying Learning	Making Connections	Thoughtful Actions	
<p>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</p> <p>5 Ways Space Travel Affects the Human Body https://www.youtube.com/watch?v=HSrVO5C9kwQ</p> <p>Being an astronaut: Activities from ISS Primary Education Kit Chapter 1, pdf available: http://esamultimedia.esa.int/docs/primedukit/en/PrimEduKit_ch1_en.pdf</p> <p>Make a bottle garden http://blackrockec.ie/node/130</p> <p>Create a timeline of Astronaut activity (use internet sources to find out key events or see <i>History Windows on the World</i> 3rd class (EDCO))</p> <p>The DPSM/ESERO Journey into Space booklet has many cross-curricular ideas: http://www.primaryscience.ie/media/pdfs/journey_into_space_resource_booklet.pdf</p>			
Reflection	<p>What worked well?</p> <p>Would I change this activity?</p> <p>Did the students engage with the topic?</p> <p>What questions did the students ask?</p> <p>Does this lead on to further investigations? Can we carry any of these out?</p>		



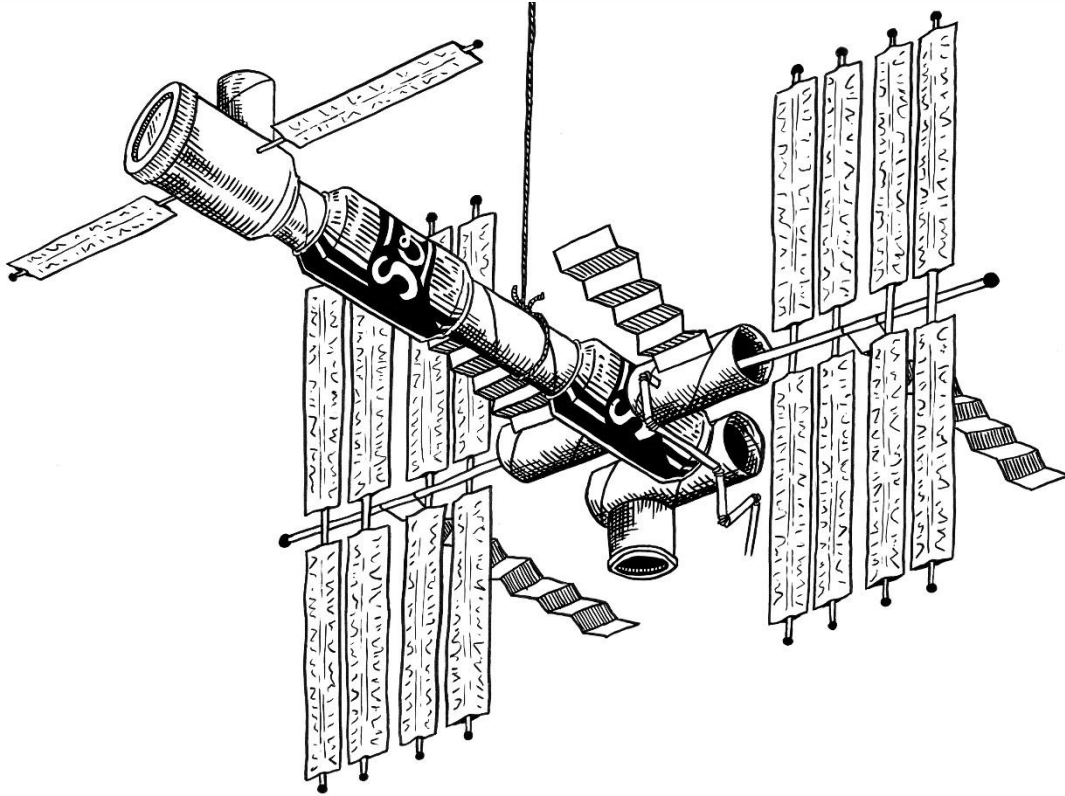
**BLACKROCK
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Science
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For what's next



SPACE WEEK
Our Planet · Our Space · Our Time



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

Credit: NASA

www.spaceweek.ie

ROBOT ARM

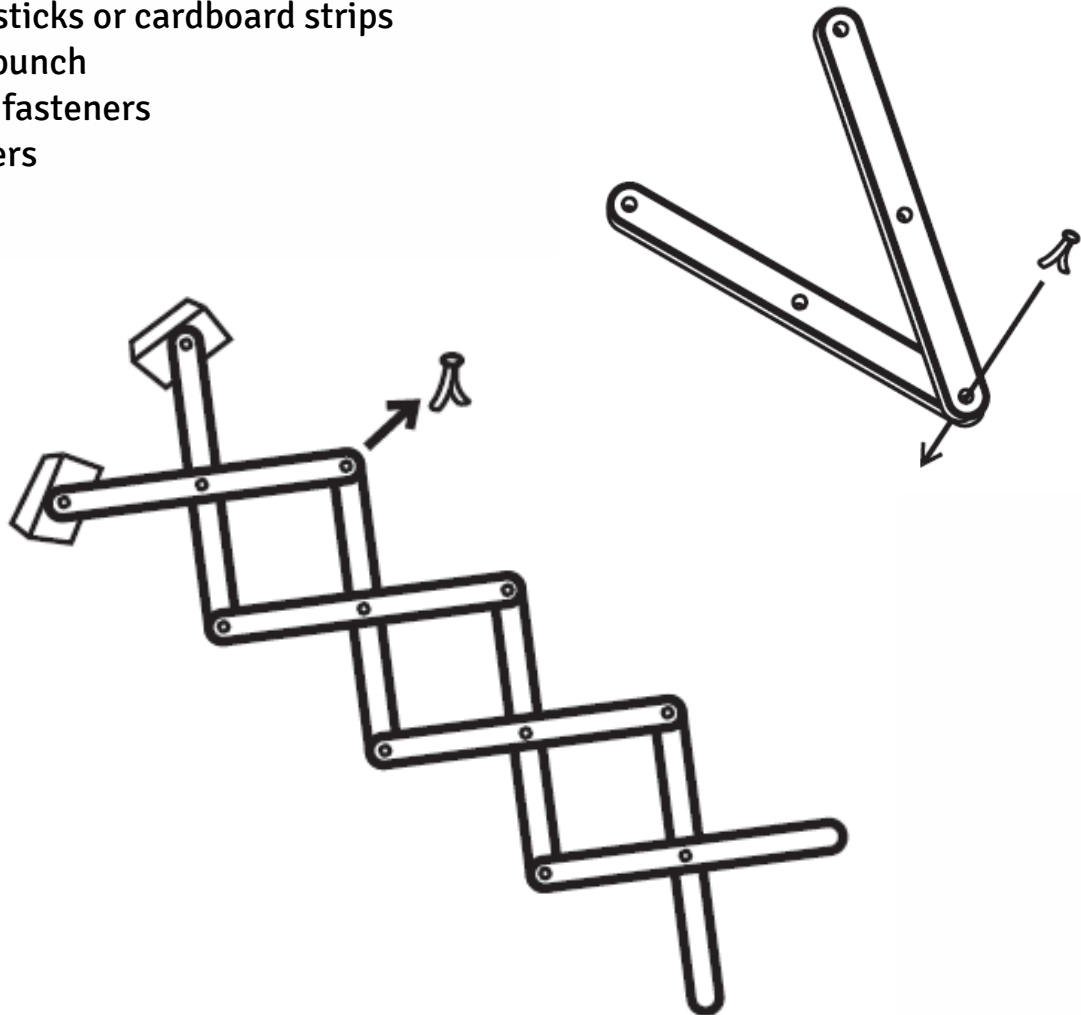
Materials needed:

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?

CANADARM2 END EFFECTOR

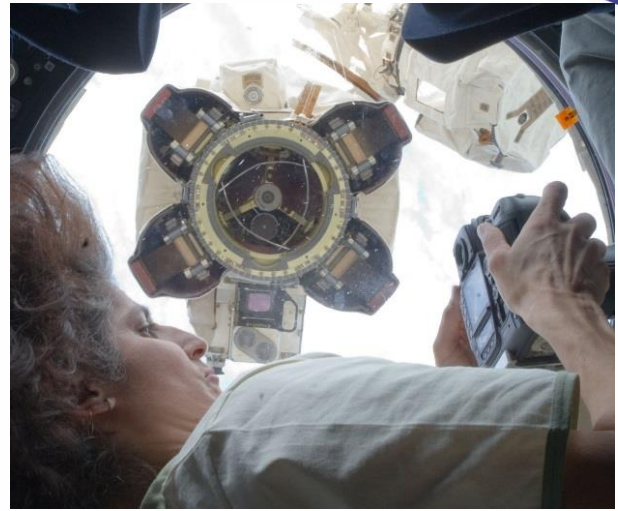
Materials needed:

2 Styrofoam / paper cups

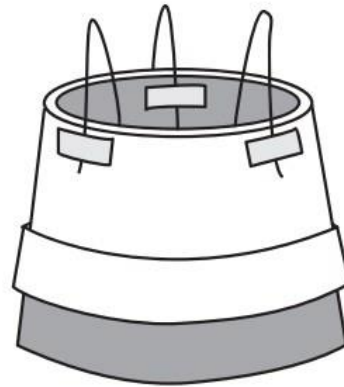
Plastic knife / scissors

String / fishing line / yarn

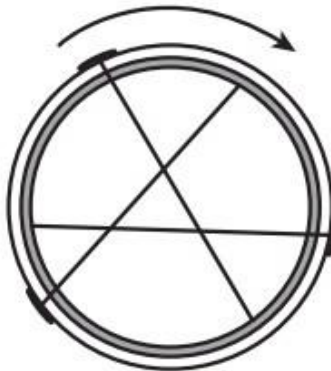
Tape



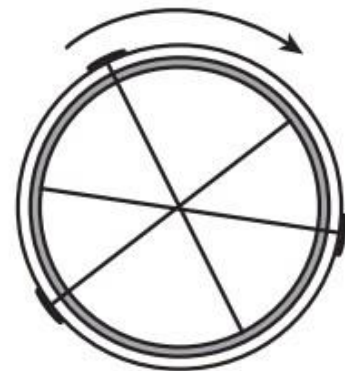
Credit: ESA/NASA



OPEN POSITION



ROTATE OUTER CUP



CONTINUE ROTATING
TO CLOSE SNARES

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