SCHOOL AND VISITORS GUIDE

ASTRONAUT

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Exhibitions

CONTENTS

EXHIBITION OVERVIEW

There's no other job where you can find yourself quite as far above the Earth as that of an astronaut. From the Moon landings to the Mars One project, astronauts have become synonymous with adventure, exploration and endeavor.

Through hands-on and full-body displays, this revealing science exhibition investigates the reality of what it takes to be a space explorer. 26 exhibits relay the physical and psychological effects of living in microgravity on the human body and the technology used to complete a mission. If you've ever wondered what it's like to sleep, eat, shower and use the toilet in space, Astronaut gives you the opportunity to find out.

The exhibition also focuses on teamwork to solve problems, accurately perform tasks and overcome challenges such as communicating with mission control, monitoring damage to your space craft or landing a capsule.

Visitors will be captivated and surprised by this absorbing study into the importance of science in space and the future of space exploration.

ASTRONAUT ZONES

The exhibition is divided into three zones:

1. A 'training zone' where visitors experience some of the challenges involved in becoming an astronaut
2. A 'rocket launch' that simulates blast off
3. A 'space lab' where life and science in space is explored

KEY MESSAGES

1. Astronauts conduct a multitude of science experiments in space
2. Astronauts collaborate closely to complete their missions
3. A wide range of jobs support astronauts on every step of their journey
4. Physical and psychological limits are tested and understood to support astronauts

TRAINING ZONE

GLOVEBOX

Dexterity and good motor skills are required to make repairs and undertake experiments in unusual conditions. Pressurized EVA suits make this task even harder. See if you can assemble nuts and bolts using 'Astronaut' style gloves in our test glovebox.

SCIENCE LINKS: Human Biology

G-FORCE

As astronauts accelerate, the effects on their bodies can cause problems. Training on a centrifuge helps astronauts to cope with these difficulties. Climb into our 'centrifuge' capsule and turn the wheel to increase the speed of rotation. An accelerometer will tell you how many 'G's' you can spin.

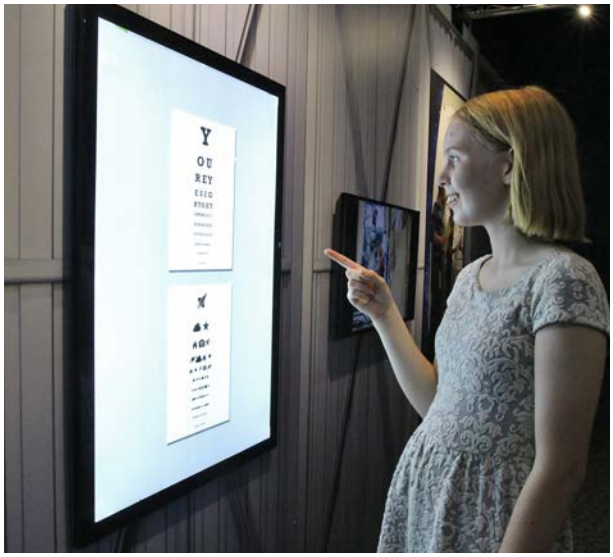
SCIENCE LINKS: Physics, Human Biology

TRAINING ZONE

PHYSICAL TRAINING

Your body is affected by the microgravity of space. Explore how your height or eyesight might change and learn about the importance of exercise to maintain bone and muscle strength.

SCIENCE LINKS: Human Biology, Exercise Science



TRAINING ZONE

HOUSTON WE'VE HAD A PROBLEM

Astronauts and Mission Control must communicate to solve a series of problems, clear and accurate two-way communication is vital to the success of a mission.

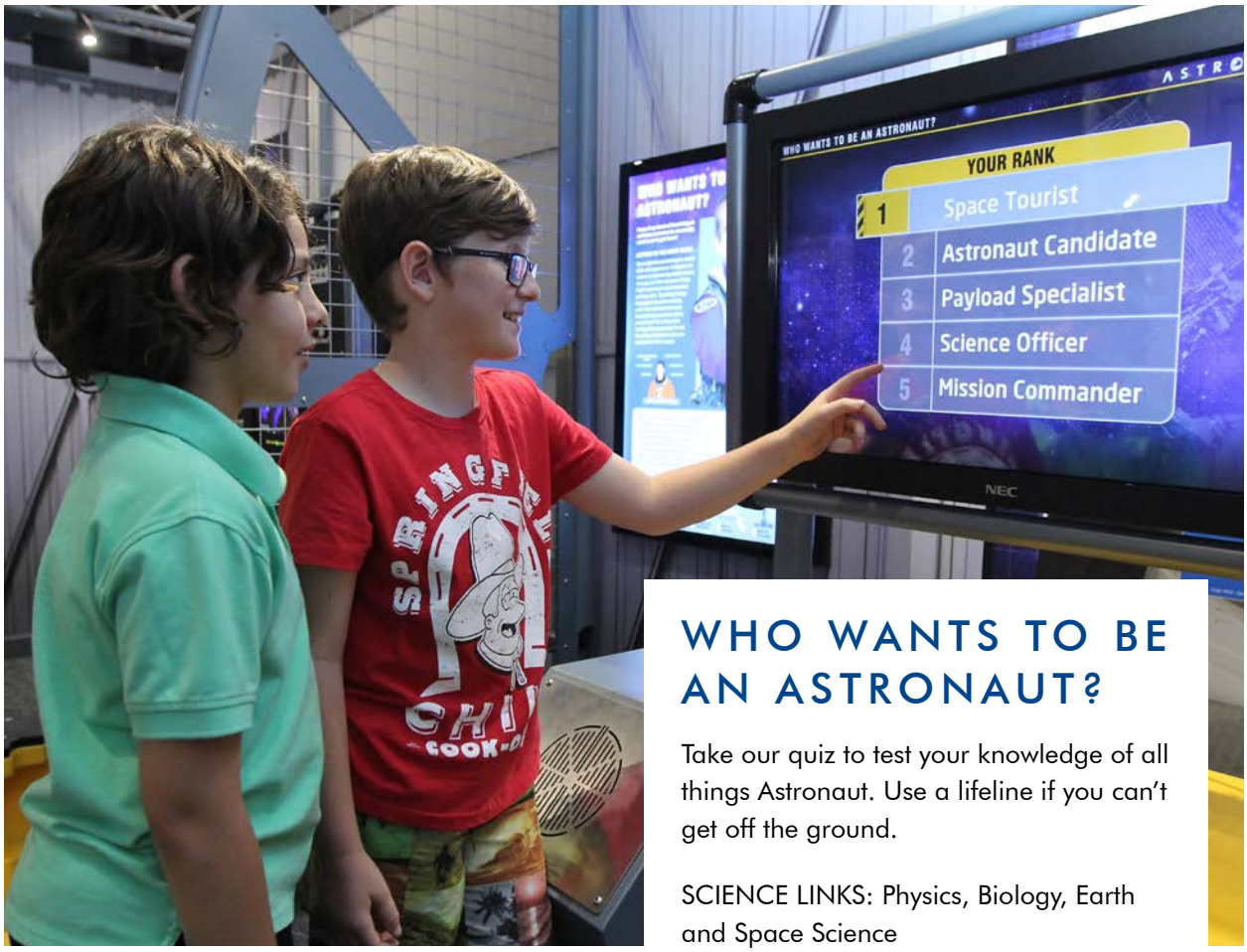
SCIENCE LINKS: Psychology, Social Science

TEAM ASTRONAUT

Astronauts need to work together. Each has an important role to play, but success comes through collaboration. This four player game needs quick thinkers, good communicators and fast reflexes.

SCIENCE LINKS: Psychology

TRAINING ZONE



WHO WANTS TO BE AN ASTRONAUT?

Take our quiz to test your knowledge of all things Astronaut. Use a lifeline if you can't get off the ground.

SCIENCE LINKS: Physics, Biology, Earth and Space Science

HEAVY HANDS

Earth re-entry increases G-Forces, making arm movements difficult. Astronauts must train to overcome these forces in order to operate controls. Find out what it's like to manipulate switches and buttons under these difficult conditions.

SCIENCE LINKS: Physics, Human Biology

TRAINING ZONE

SPACE CLOTHING

Don a flight suit and use your imagination to become an astronaut as you explore the exhibition. Astronaut also features a number of life size images featuring current and experimental space suits

SCIENCE LINKS: Human Biology, Earth and Space Science, Materials Science

PICK YOUR TEAM

Psychological analysis is an important factor in determining the right mix of personality types required to succeed on a mission. Choose your team and see if you've got what it takes to be a leader.

SCIENCE LINKS: Social Science, Psychology

ROCKET LAUNCH

ROCKET LAUNCH

"5..4..ignition sequence commenced..2..1 we have lift off". Taking off into space involves huge amounts of energy. Climb into our rocket, wait for the countdown and experience what it might be like to blast off into space.

SCIENCE LINKS: Physics, Human Biology, Chemistry

PROJECTILE LANDER

Could you put a lander safely down on another planet? Launch a capsule, parachute and change variables to land it on the target?

SCIENCE LINKS: Physics, Space Science, Mathematics

SPACE LAB

SPACE BAG

Sleeping in space is a very different experience. Wrap yourself into a sleeping bag and imagine yourself as a sleeping astronaut. Video of astronauts sleeping in space will help you understand how difficult this might be.

SCIENCE LINKS: Human Biology, Physics

SPACE GARDEN

Longer space missions will need astronauts to grow their own food. Experiments are needed to find out how plants grow in reduced gravity. Investigate our space garden and see what's growing.

SCIENCE LINKS: Plant Biology

SPACE LAB

SPACE LIFE

Even everyday tasks like washing your hair and eating can be a challenge in space. Watch how astronauts overcome the trials of daily life in space.

SCIENCE LINKS: Physics, Human Biology

SPACE FOOD

Storage, nutrition, taste and enclosed spaces are all considerations for what to eat in space. Could you choose the right types of food? Select items from our on-screen vending machine and get feedback on each one.

SCIENCE LINKS: Chemistry, Food Science, Physics

SPACE LAB

SPACE REACTION TIMER

Are your reflexes as good as they can be? Astronauts suffer from fatigue, shift work and disruption to circadian rhythms. They must perform regular self-tests to check their performance. Test your reflexes to stop the timer.

SCIENCE LINKS: Human Biology, Exercise Science

SPACE TESTING

Collecting rock samples from other planets can provide important information about the structure, history and possible life on a planet. Examine and test rock samples for magnetism, and radioactivity using a mock Geiger counter, in an enclosed glove box.

SCIENCE LINKS: Geology, Astrobiology

SPACE LAB

SPACE TOYS

Gravity and lack of gravity makes things behave differently. Play with toys in a gravity environment and watch a video of the same toys in space.

SCIENCE LINKS: Physics

SPACE TOILET

Perhaps the most commonly asked question of an Astronaut is "How do you use the toilet in space?" This exhibit is a genuine replica of a space toilet. It contains on-screen interviews with astronauts.

SCIENCE LINKS: Human Biology, Physics

SPACE LAB

SPOT THE DAMAGE

Heat shielding is vital for the safe operation and return of spacecraft as any damage can be catastrophic. Infrared cameras allow astronauts to monitor spacecraft for potential damage. Manipulate an infrared camera to detect damage to the heat shield on the outside of our Space Lab.

SCIENCE LINKS: Physics, Technology, Earth and Space Science, Materials Science.

ISS LIVE

There are Astronauts living and working in space right now. See what they are doing or what they can see. You can view live vision from the International Space Station or can view recorded footage.

SCIENCE LINKS: Human Biology, Earth and Space Science, Physics

EARTH VIEW

Space gives us a unique view of our planet. Astronauts often experience the overview effect of seeing the world without boundaries. Users can view images of earth through a space station cupola.

SCIENCE LINKS: Earth and Space Science, Psychology

RESEARCH QUESTIONS, AGES 4-8

Have you ever wanted to be an astronaut and explore space? There's a lot to do before you get there! Go through the checklist and you will find lots of fun things to do to help you prepare for your mission, and different tasks for your time on the Space Lab.

IN THE TRAINING ZONE

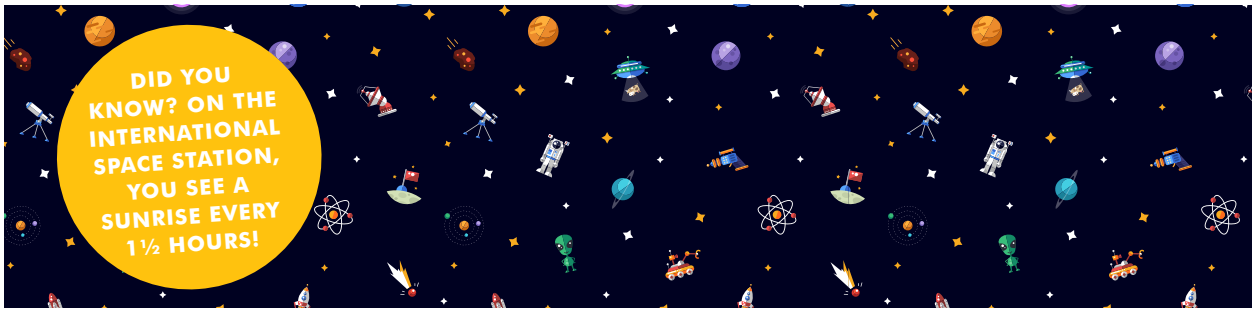
☐ 1. Measure your height. How tall are you? _____

☐ 2. Measure your grip strength. Which hand is stronger? _____

☐ 3. Go in the human centrifuge. How many 'G's' did you measure? _____

☐ 4. Practice launching a landing module. Did you hit the target? _____

☐ 5. Test your reactions. What was your fastest time? _____



ON THE SPACE LAB

☐ 1. Find four rubber chickens in the pictures.

☐ 2. Find the space toilet.

☐ 3. Look at the different foods in the vending machines. Which food is the messiest? _____

_____

☐ 4. Test the space rocks. Draw the rock that is magnetic in the space below

☐ 5. Check the hull for hot spots with the infrared camera. How many hot spots did you find?

_____

RESEARCH ANSWERS, AGES 4-8

IN THE TRAINING ZONE

1. Measure your height. How tall are you? *[Student's choice]*
2. Measure your grip strength. Which hand is stronger? *[Student's choice]*
3. Go in the human centrifuge. How many 'G's' did you measure? *[Student's choice]*
4. Practice launching a landing module. Did you hit the target? *[Yes / No]*
5. Test your reactions. What was your fastest time? *[Student's choice]*

ON THE SPACE LAB

1. Find four rubber chickens in the pictures.
   There is a chicken in each of the three entrance pictures by the space toilet. One is hard to find because it is in the microwave. The fourth is in the picture near the space vending machine exhibit.
2. Find the space toilet.
   It's in the Space Lab
3. Look at the different foods in the vending machines. Which food is the messiest? *[Student's choice]. Likely to be the baked beans, cola, or fruit puree.*
4. Test the space rocks. Draw the rock that is magnetic in the space below.
5. Check the hull for hot spots with the infrared camera. How many hot spots did you find?
   There are four

RESEARCH QUESTIONS, AGES 8-12

Welcome to Astronaut! In this exhibition you will find out about what it takes to be an astronaut, and what life is like on a space lab floating above our planet. "The exhibition is split into three sections: the training zone, rocket launch and space lab. The following questions relate to the training zone and space lab. Find each exhibit to answer the questions - you may need to read the signs or watch the videos to find out the answers.

IN THE TRAINING ZONE

ASTRONAUT VISION:

☐ 1. How many astronauts get eye damage after being in space? _____

YOUR BODY CHANGES IN SPACE:

☐ 2. Name three changes that happen to your body in space _____

_____

SPACESUITS:

☐ 3. What is the Biosuit? _____

☐ 4. How does it pressurize the body in space? _____

☐ 5. Why is it better than the original model of space suits? _____

LANDING SAFELY:

☐ 6. What three things can help give a soft landing? _____

_____

ON THE SPACE LAB

TOYS IN SPACE:

☐ 1. Watch video number two. Why does the top spin for longer in space than on earth? _____

_____

☐ 2. Watch video number four. Why does the ball move faster than the kandama? _____

_____

SPACE TOILET:

☐ 3.What happens to urine on the International Space Station? _____

_____

ON THE SPACE LAB

SPACE FOOD:

☐ 4. What could happen if you drank fizzy drink in space and why? _____

_____

☐ 5. Why can't you eat chips in space? _____

☐ 6. Would astronauts eat more fresh fruit or fruit puree and why? _____

_____

RESEARCH ANSWERS, AGES 8-12

IN THE TRAINING ZONE

ASTRONAUT VISION:

1. How many astronauts get eye damage after being in space? *29% on short flight missions, 60% on long duration ISS missions.*

YOUR BODY CHANGES IN SPACE:

2. Name three changes that happen to your body in space. *Possible answers: bone loss, muscle loss, reduced vitamin D, fluid collects in your head leading to a puffy face, space sickness from inner ear confusion in microgravity, increased fluid pressure in eyes, get taller.*

SPACESUITS:

3. What is the Biosuit? *An alternative to the traditional space suit.*

4. How does it pressurize the body in space? *With tight fitting elastic.*

5. Why is it better than the original model of space suits? *Gives greater mobility*

LANDING SAFELY:

6. What three things can help give a soft landing? *Engines, parachutes and air bags.*

ON THE SPACE LAB

TOYS IN SPACE:

1. Watch video number two. Why does the top spin for longer in space than on earth? *There is not as much friction as it is not touching the floor due to microgravity.*

2. Watch video number four. Why does the ball move faster than the kandama when they are stretched apart and then released? *It is lighter. (Extension: the lighter body must move faster to conserve momentum.)*

SPACE TOILET:

3. What happens to urine on the International Space Station? *It gets recycled back into drinking water*

SPACE FOOD:

4. What could happen if you drank fizzy drink in space and why? *You might burp liquid, as due to microgravity, gas does not rise to the top and therefore separate from liquid. So if you burped the gas up, the liquid would come with it.*

5. Why can't you eat chips in space? *The crumbs would float everywhere and damage equipment*

6.Would astronauts eat more fresh fruit or fruit puree and why? *Puree, because fruit goes bad so quickly.*

POST-VISIT CLASSROOM ACTIVITIES

These activities explore different challenges faced by astronauts and the skills they need to solve them.

COMMUNICATION

Astronauts have to work closely as a team and communicate very clearly so that tasks can be completed efficiently and safely. This activity can be done with students of all ages. If you would like to combine this with a math lesson on graphing skills, you can simply print the shape onto graphing paper.

WHAT YOU NEED (PER PAIR):

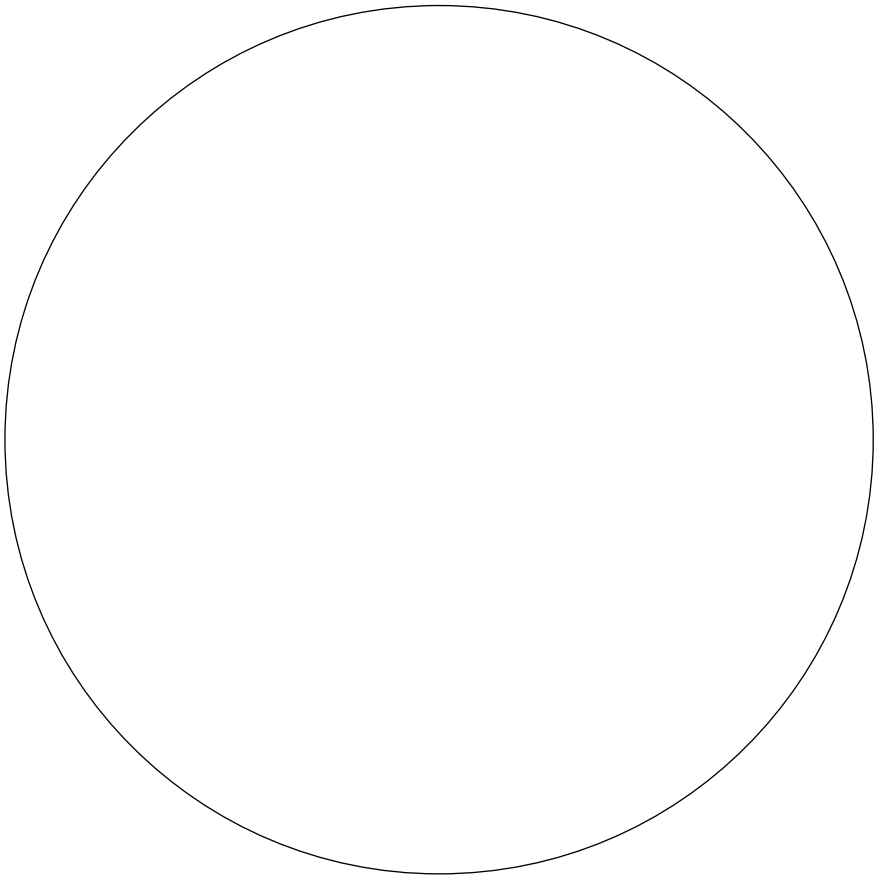
- One copy of the shape sheets from the following two pages.
- Paper and pen.
- Rulers (optional for a graphing lesson)

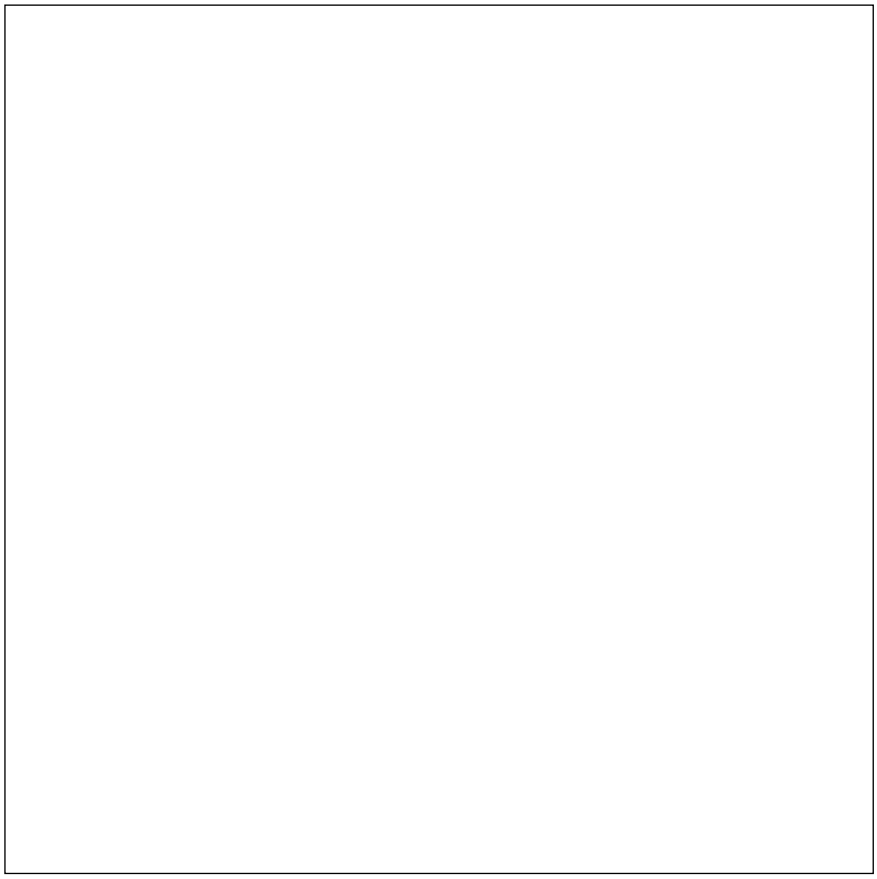
WHAT TO DO:

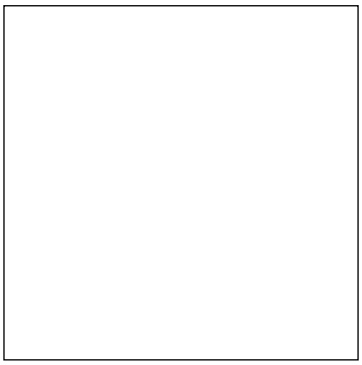
- Have students pair up and sit back to back.
- Give one student in each pair the copied sheet and the other the pen/pencil and paper.
- The student with the blank sheet needs to reproduce as exactly as possible the sheet that his or her partner has, with only verbal instructions to go by.

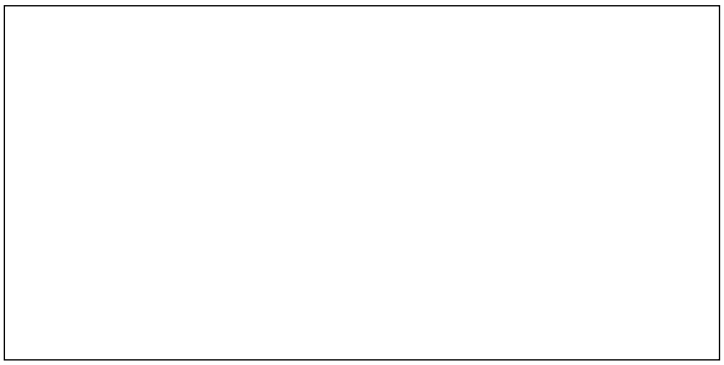
DISCUSS AND EXTEND:

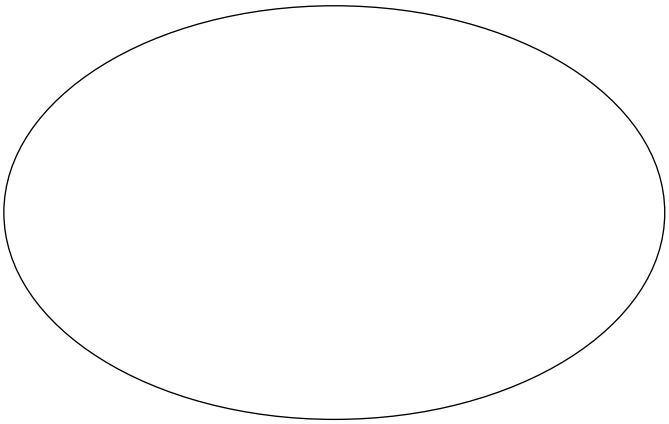
- Questions for explainers: Was it hard to get your partner to understand you? What was particularly hard to explain? What was easy to explain? Can you think of ways you could have communicated better?
- Questions for drawers: What sorts of things did you need to communicate with your partner? Was asking questions helpful? What type of questions were the most helpful? What type of questions were not helpful?
- Have students research a time when communication problems hindered work in space and how those problems were solved.

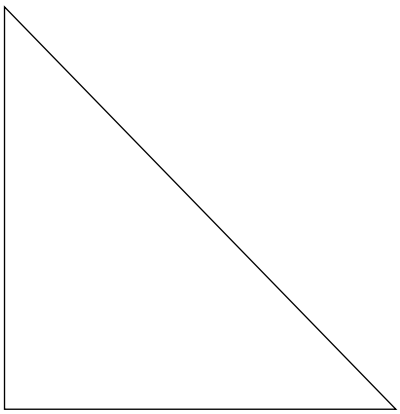










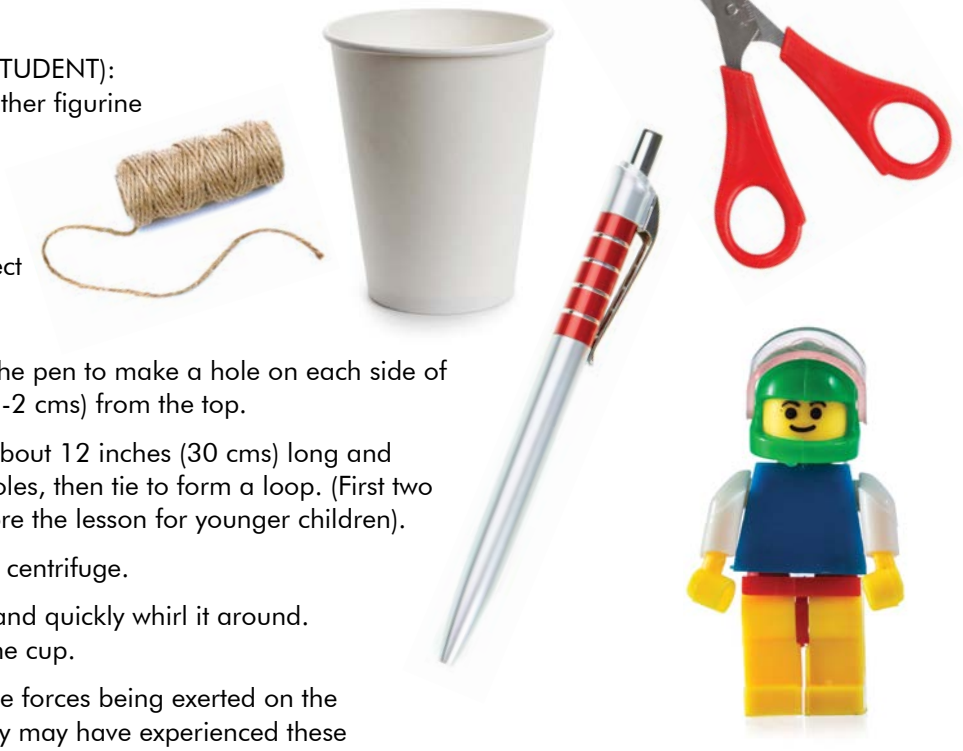


DID YOU KNOW?

Centripetal force is the name we give to the inward force of the cup on the Lego figure, which keeps the figure continuing around in a circle instead of flying off on a tangent. Centrifugal force is the name we give to the sensation the Lego man might feel of being pushed outward against the cup.

FORCES AT PLAY

This activity explores centripetal force and the concept of G-force. Astronauts feel tremendous amounts of G-force during lift-off in space craft and they train for these forces by spinning around quickly in a "human centrifuge"



WHAT YOU NEED (PER STUDENT):

- Small Lego person or other figurine
- Paper cup
- String
- Scissors
- Pen or other sharp object

WHAT TO DO:

- Have the children use the pen to make a hole on each side of the cup about 1 inch (1-2 cms) from the top.
- Cut a length of string about 12 inches (30 cms) long and thread it through the holes, then tie to form a loop. (First two steps can be done before the lesson for younger children).
- Optional: Decorate the centrifuge.
- Put figurine in the cup and quickly whirl it around. Object should stay in the cup.
- Discuss with children the forces being exerted on the figurine in the cup. They may have experienced these forces at fairground rides, or in a car going around a corner.
- You may also like to show a video of a "human centrifuge". Many examples can be found on YouTube.

DISCUSS AND EXTEND:

- What sorts of sensations might you feel if you were in a human centrifuge?
- Do astronauts experience extra gravity when lifting off into space?
- Students could research other aspects of the training astronauts undergo to prepare for space, or even create a simple version of an astronaut training zone for other students to try.
- What would happen to the Lego figurine if the cup suddenly disappeared?

GLOVES GALORE

When in space, special equipment must be worn, but this equipment presents special challenges of its own.

WHAT YOU NEED (PER GROUP):

- Several different types of gloves (gardening, dish washing gloves, mittens etc.)
- Duplo or Lego blocks
- Pencils and paper.
- String

WHAT TO DO:

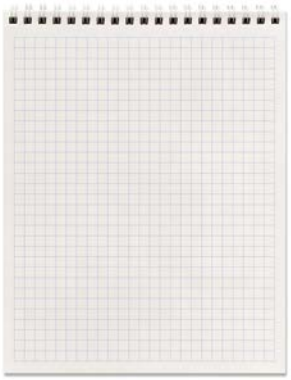
- Have children examine and try on he different types of gloves and discuss in their groups or as a class what the different gloves are for and what the differences are.
- Have children try the following tasks with all the different gloves and without gloves:
  - o Build a tower with the blocks
  - o Write a word or draw a picture
  - o Tie a knot in the string

- Discuss with children what was the easiest and what the hardest type of glove was. Why? Are there any tasks which may be easier with gloves than without? Were any of the gloves particularly well suited to one type of task but not another?
- Discuss why astronauts need gloves. What sort of gloves would astronauts need?

DISCUSS AND EXTEND:

- For extension, students could research materials science and learn about what types of materials could best withstand the harsh environment of space, and what sorts of special conditions there are in space.

HOW TALL ARE YOU?



This activity is a good introduction to the idea that our bodies change in space, even the attributes we think of as being mostly static, such as height.

WHAT YOU NEED:

- Measuring stick or measuring tape for students to share.
- Graph paper for each student

WHAT TO DO:

- Each student must measure their earth height and put it on a graph.
- They must then add 3% onto the height and plot it again as space height.
- The lack of the effect of gravity in space means that astronauts increase in height by 3% while in space.

DISCUSS AND EXTEND

- Would your height change if you were standing on the moon? How about Venus? Or Jupiter?
- Discuss weight changes on different planets and how this is distinct from mass, which stays the same.
- Have students research and present on what else changes in space (weight, muscle tone, bone density, vision etc.)

DESIGN A LANDING MODULE

This activity sits well in an engineering, design or technology curriculum. It can be a fun introduction to a unit or the culmination of one. Materials can be changed depending on what you want your students to get out of the activity.

WHAT YOU NEED (PER GROUP):

- One boiled egg
- A piece of paper
- Five cotton balls
- Two or three lengths of string
- Four popsicle sticks
- One balloon
- One plastic cup

YOU WILL ALSO NEED:

- A landing target
- A ladder/elevated walkway
- Pen and recording paper.

WHAT TO DO:

- The children need to design a landing module for the egg.
- The aim is to land the egg uncracked and in the center of the target.
- Give children a set amount of time to complete the challenge, then test the landers one by one.

DISCUSS AND EXTEND:

- Research and discuss how real landing modules are built. How are different landers built for differing cargo (e.g. people versus machine parts)?
- Designing a mini Mars rover can be a great extension for older students as part of a robotics or programming course.

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