

Mission

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YOUR BODY IN SPACE

Space has tremendous effects on the human body! As we prepare for journeys to make more distant destinations like Mars, humankind must take these risks to ensure safe travel for our modern explorers. The impact of microgravity mirror aging and the complications of a sedentary lifestyle. By studying astronauts' health, we also help people on Earth. (Credit: Canadian Space Agency)

EXPERIMENT:

Use books and sponges to represent a human spine and understand why astronauts grow taller in space, where gravity is much weaker.

You will need:

- 4 large books (to represent vertebrae)
- 3 large flexible sponges (to represent the spongy tissue)
- 1 large rubber band or 1 rope (to represent gravity)
- Measuring tape

Stack books and sponges alternately to represent a human spine.



EXPERIMENT

YOUR BODY IN SPACE

THINK ABOUT IT:

Why are astronauts TALLER in space?

How to see the effect gravity has on your spine:

1. Stack the books and sponges alternately.
2. Press down on the stack of books and sponges to compress it.
3. Stretch the rubber band (or tighten the rope) around the stack to hold it in that position.
4. Measure the height of the stack.
5. Remove the rubber band (or the rope) while keeping the stack upright.
6. Once again, measure the height of the stack.
7. You will notice that the stack measures more without the rubber band (or the rope).

Height of book stack with NO compression: _____cm

Height of book stack while compressed: _____cm

What it means:

In this exercise, the books represent your vertebrae, the sponges represent the spongy tissue between your vertebrae, and the combination of the two represents your spine. The rubber band (or tightened rope) represents the force of gravity.

As you have seen, the force of gravity compresses the discs in the spinal column. When that force disappears, our spine stretches and we grow taller. That is why astronauts become taller when they are in space, where gravity is much weaker than on Earth.



Model represents segments of a human spinal cord.

Source:

<http://www.asc-csa.gc.ca/eng/activities/fun-experiments/astronauts-taller-in-space.asp>



HOW DOES SPACE AFFECT THE HUMAN BODY?

Space has tremendous effects on the human body! As we prepare for journeys to more distant destinations like Mars, humankind must tackle these risks to ensure safe travel for our modern explorers.

The impacts of microgravity mirror aging and the complications of a sedentary lifestyle. By studying astronauts' health, we also help people on Earth.

BLOOD

Blood cell production in the bone marrow is affected. Reduced red blood cells can cause anemia. Low white blood cell count leaves the body vulnerable to infection and is also linked with increased sensitivity to radiation.

RADIATION

Radiation doses are much higher. Overexposure can cause cataracts in the eyes, damage the DNA, and increase the risk of cancer.

BRAIN

Astronauts' sense of perception and orientation can become confused. They sometimes misinterpret the direction and speed of their movements. Some even experience "space sickness."

HEART & BLOOD VESSELS

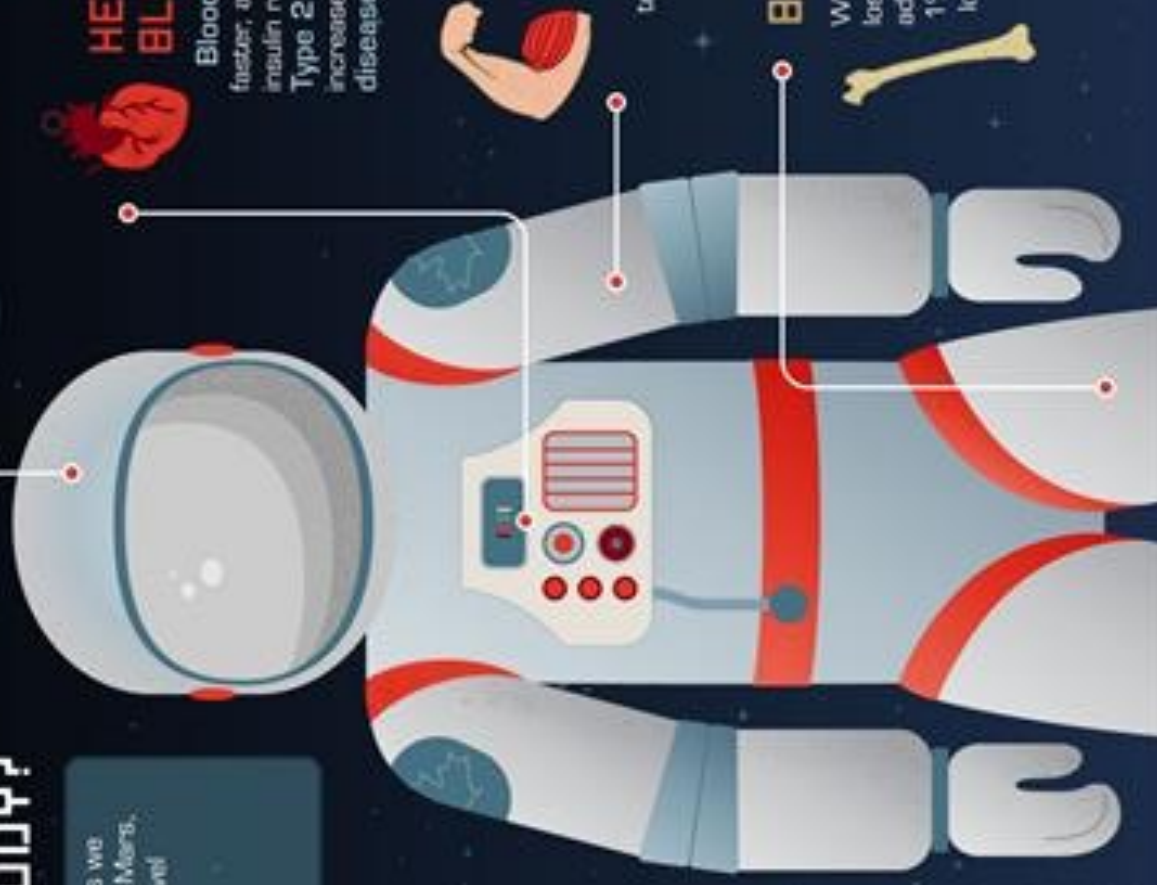
Blood vessels stiffen and age faster, and astronauts can develop insulin resistance, which may lead to Type 2 diabetes. These factors increase the risk of cardiovascular disease.

MUSCLES & NERVOUS SYSTEM

Muscles lose mass and strength. Reflexes slow down and exercise tends to be less effective in space.

BONES

When they don't bear weight, bones lose density and strength. While adults past age 50 typically lose about 1% each year, astronauts in space can lose up to 1.5% of their bone mass each month.



Canadian Space
Agency

Agence spatiale
canadienne

Canada

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CANADIAN SPACE AGENCY

The Canadian Space Agency (CSA) is responsible for:

- **advancing the knowledge of space** through science;
- **using its discoveries** for the good of Canadians and all of humanity.

What does the Canadian Space Agency do?

The CSA focuses its activities and resources on three main areas:

1. **Space exploration:** Participation in astronaut missions, astronomy and planetary studies, scientific research in space (execution and support).
2. **Space utilization:** Earth observation by satellite and collection of space data.
3. **Space science and technology:** Development of innovative space technologies and applications used on Earth.

670 PEOPLE WORK FOR THE CANADIAN SPACE AGENCY

The Canadian Space Agency can be a great resource for your team as you work through your INTO ORBIT project challenge.

Review the information provided to familiarize yourselves with the CSA, their mission, research and career options.

It is never too early to think about the future!

10 tips on how to pursue a career in the space sector

<http://www.asc-csa.gc.ca/eng/jobs/10-tips-on-how-to-pursue-a-career-in-the-space-sector.asp>

Internships and student jobs in the space sector

<http://www.asc-csa.gc.ca/eng/jobs/internships-and-student-jobs.asp>

SOURCE: Canadian Space Agency Website

<http://www.asc-csa.gc.ca/eng/default.asp>



\$9.6M invested in **Canada's space sector** in **2017-18**, with **benefits for life on Earth**

The Canadian Space Agency's **Space Technology Development Program (STDP)**

enables Canadian organizations to advance research and technology for potential future space missions.

For more information on the STDP, visit www.asc-csa.gc.ca.

ENVIRONMENT



Develop more sophisticated weather forecasting
ABB Inc.



Study the effects of atmospheric aerosols on climate change
COM DEV Ltd.



Enhance monitoring of forest fires
INO



Advance capacity to monitor coastal and inland waters
COM DEV Ltd. and ITRES Research Ltd.

EXPLORATION



Advance autonomous navigation
Neptec



Design technology to detect ice beneath planetary surfaces
MDA

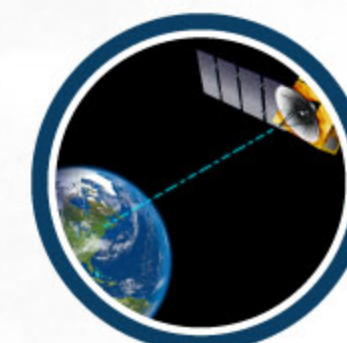


Design robotic tools needed to support future rover exploration missions
MDA

TECHNOLOGIES



Improve radiation testing performed on space electronics
DPL Science Inc.

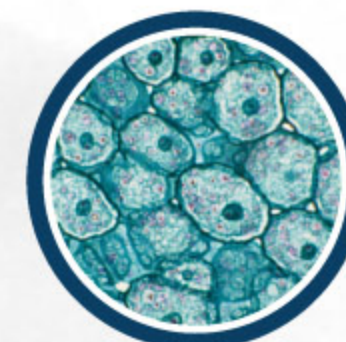


Increase the speed of information transmission
Neptec

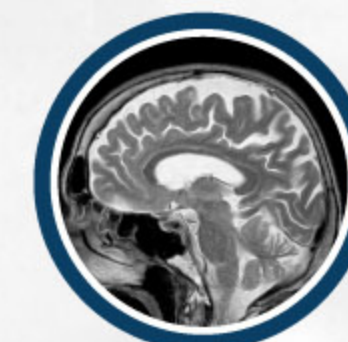


Deepen our understanding of space weather
COM DEV Ltd.

HEALTH



Automate and refine cell studies
Neptec



Make portable Magnetic Resonance Imaging (MRI) scanners
Univ. of Saskatchewan



Build a tool to test the immune system in challenging environments
Sensoreal Inc.



Canadian Space Agency

Agence spatiale canadienne

Canada



Dr. Alice Vibert Douglas

1894–1988

Dr. Douglas was the first Canadian woman to earn a doctorate in astrophysics and the first female president of the Royal Astronomical Society of Canada.



Dr. Jenni Sidey

1988–

A combustion scientist and lecturer at the University of Cambridge, Dr. Sidey was one of two astronaut recruits selected by the CSA in July 2017.



Dr. Laurie Rousseau-Nepton

1986–

Dr. Rousseau-Nepton made history as the first Quebec indigenous woman to earn a PhD in astrophysics. She is a resident astronomer with the Canada–France–Hawaii Telescope.



Dr. Sara Seager

1971–

Dr. Seager is an astrophysicist and planetary scientist at the Massachusetts Institute of Technology. She searches for extraterrestrial life by investigating exoplanets.



Stellar Women

Meet some of the Canadians who have made their mark in space science and exploration



Dr. Mary MacArthur

1904–1959

A famous botanist, Dr. MacArthur's food dehydration research paved the way for the technologies used today to prepare food for space travel.



Dr. Victoria Kaspi

1967–

A distinguished astrophysicist, Dr. Kaspi helped discover star clusters with a high concentration of pulsars, expanding our understanding of the cosmos.



Yvonne Brill

1924–2013

Yvonne Brill was the only known female rocket scientist in the USA in the mid-1940s. She developed a satellite propulsion system which became the industry standard.



Dr. Roberta Bondar

1945–

Dr. Bondar became the first Canadian woman and the first neurologist in space in 1992. A physician and a scientist, she has been recognized for her contributions to space medicine.



Julie Payette

1963–

A veteran of two space flights, Julie Payette was the first Canadian to visit the fledgling International Space Station in 1999. She was appointed Governor General of Canada in 2017.



Dr. Elizabeth Cannon

1962–

Dr. Cannon is a geomatics engineer known around the world for her research into global positioning systems and her development of related technologies.

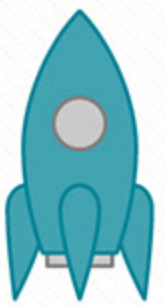




Funding to support **space research** in **Canadian post-secondary** institutions

Through its **Flights and Fieldwork for the Advancement of Science and Technology (FAST)** funding initiative, the Canadian Space Agency supports the development of space science & technologies and enables students and young researchers to gain hands-on experience in space-like missions.

FIELDS OF RESEARCH



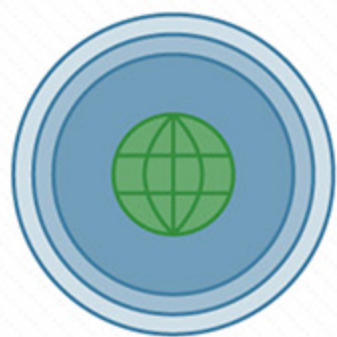
Space health and life sciences



Astronomy



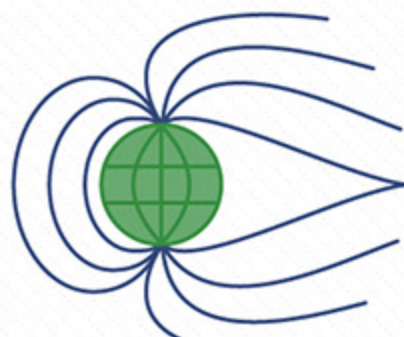
Planetary exploration



Atmospheric science



Earth system science (geoscience)



Sun-Earth system science



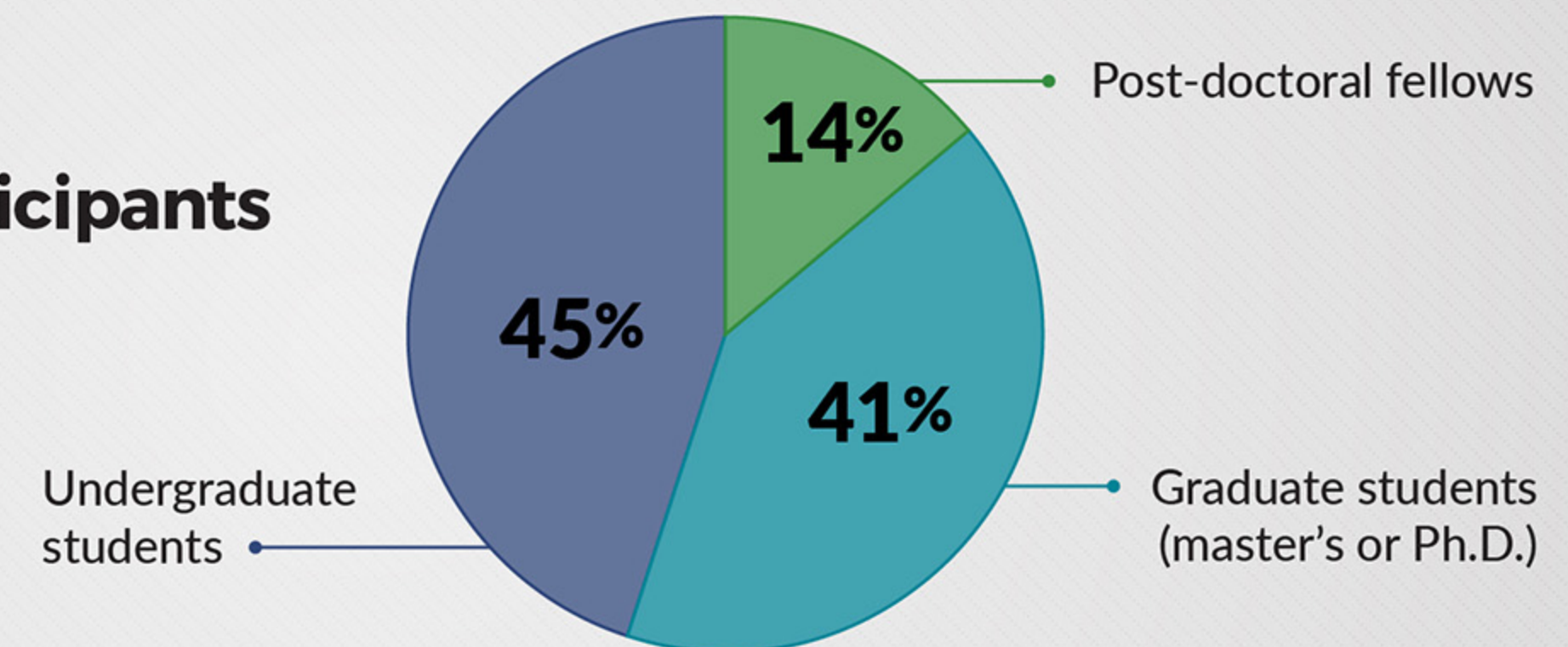
Innovative space technologies

SINCE THE INITIATIVE WAS CREATED IN 2010

47 projects funded in **20** Canadian universities

Over **\$15M** invested in the projects.

412 participants



Canadian Space Agency

Agence spatiale canadienne

Canada



GIRLS OF SCIENCE

THE POSSIBILITIES
OF CAREERS IN
SPACE
are ENDLESS!

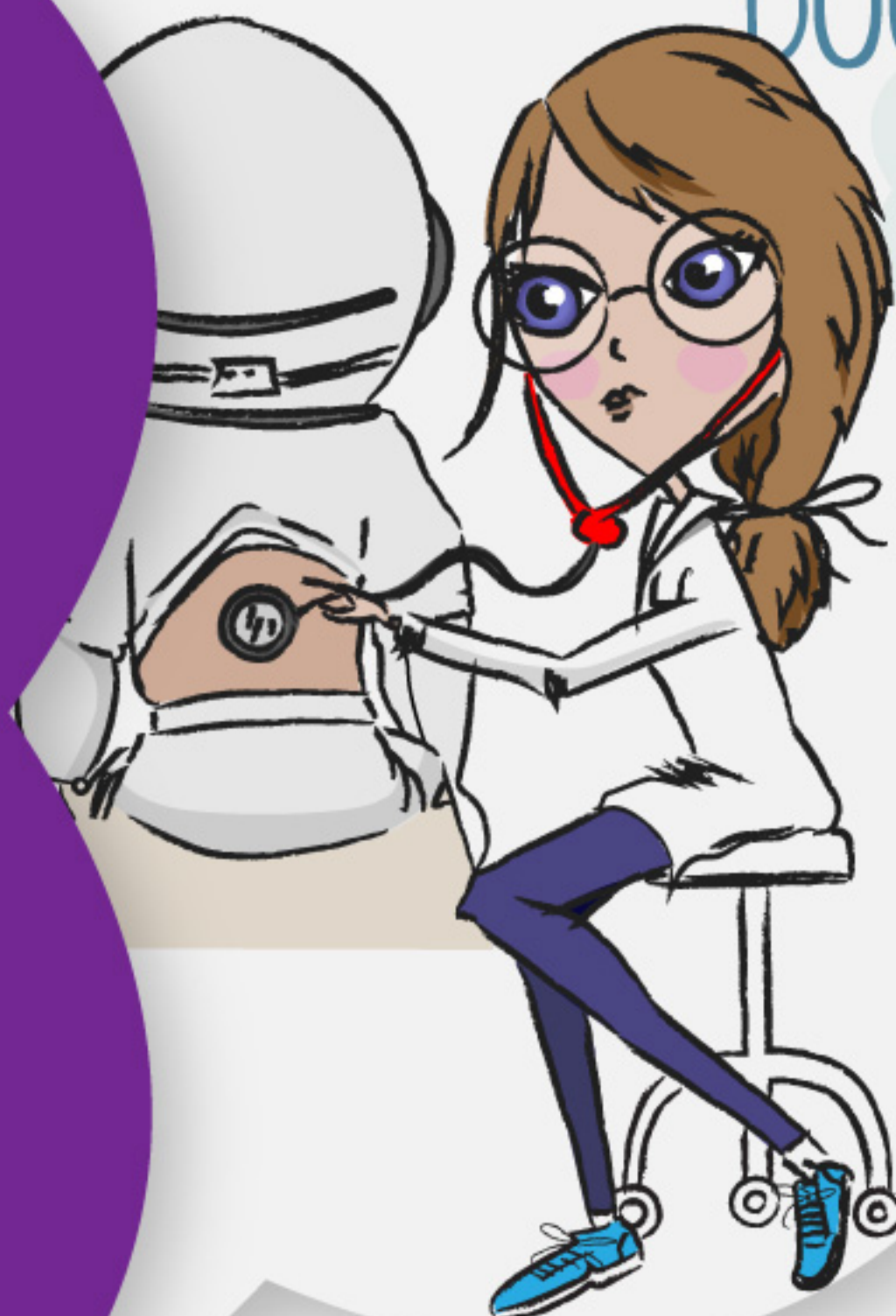
BIOLOGIST



GEOLOGIST

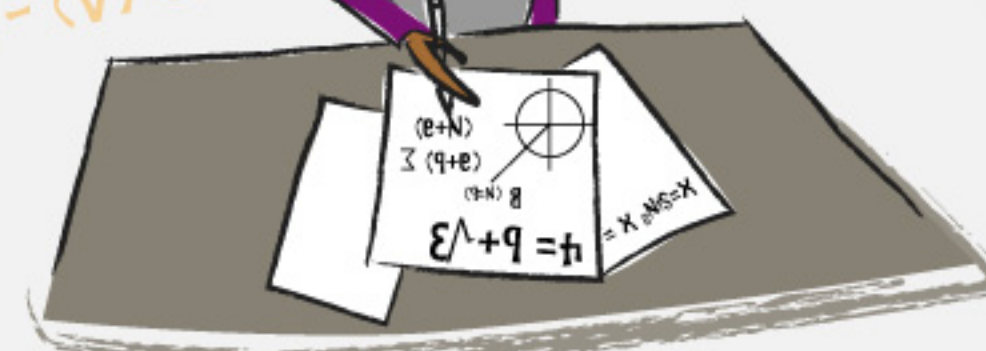


DOCTOR

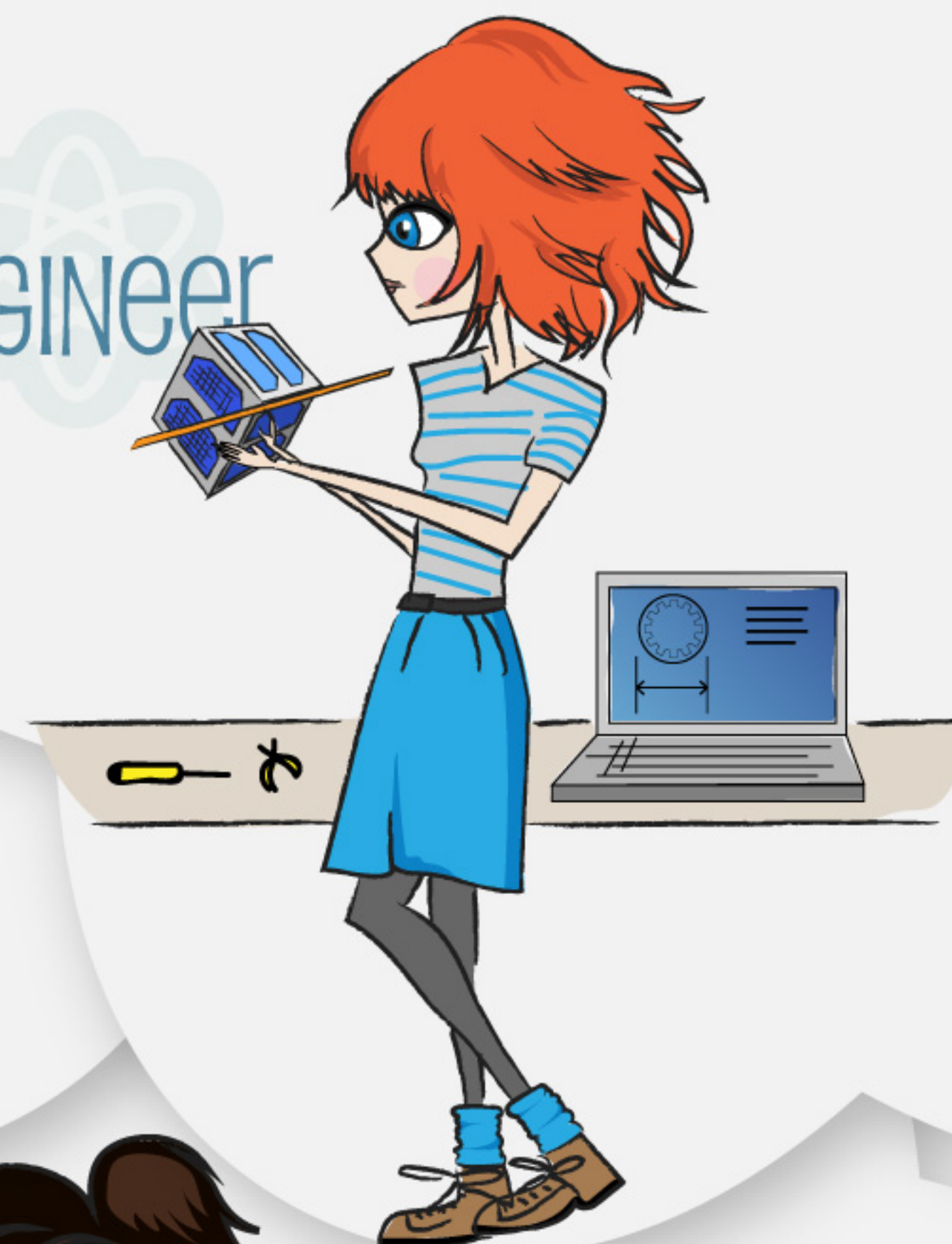


MATHEMATICIAN

$$T = \frac{T_0}{\sqrt{1 - (v/c)^2}}$$



ENGINEER



FLIGHT
CONTROLLER



ASTROPHYSICIST



PSYCHOLOGIST



KINESIOLOGIST



WHAT are YOU GOING TO BE?



Canadian Space
Agency

Agence spatiale
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www.asc-csa.gc.ca/careers

Canada



DID YOU KNOW?

THE INTERNATIONAL SPACE STATION



ORBITS THE EARTH
AT AN ALTITUDE OF

370 KM



HAS LIVING
QUARTERS
SIMILAR TO A
FIVE-BEDROOM
HOUSE



CIRCLES THE
GLOBE EVERY
90
MINUTES



YOU CAN
WATCH

CANADARM2
AND DEXTRE

during robotic operations
and follow the crew
working inside.



IS THE SECOND BRIGHTEST
OBJECT IN THE NIGHT SKY
AFTER THE MOON

It crosses the night sky like a bright
star and could easily be mistaken
for an airplane, but it does not have
blinking lights and it moves faster.



MOVES AT
28,000 KM/H



90
TIMES



FASTER
THAN AN F1 CAR

OFFERS A UNIQUE
ENVIRONMENT FOR
SCIENCE

20

CANADIAN
EXPERIMENTS

have been conducted,
some of which are still
underway.



IS ONE OF THE MOST
AMBITIOUS INTERNATIONAL
COLLABORATIONS



HAS A PERMANENT CREW OF

3 TO 6
PEOPLE



Mission

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DESIGN YOUR TEAM'S MISSION PATCH

What is important to your team during this *FIRST INTO ORBIT* challenge season?

What would you show as important team qualities on your patch?

Samples:

- Teamwork
- Space
- School
- Learning
- Robots
- Colours
- Project topic
- Logos: school - *FIRST* LEGO League - community - mascot
- And more.....

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Every Astronaut designs their own mission patch.

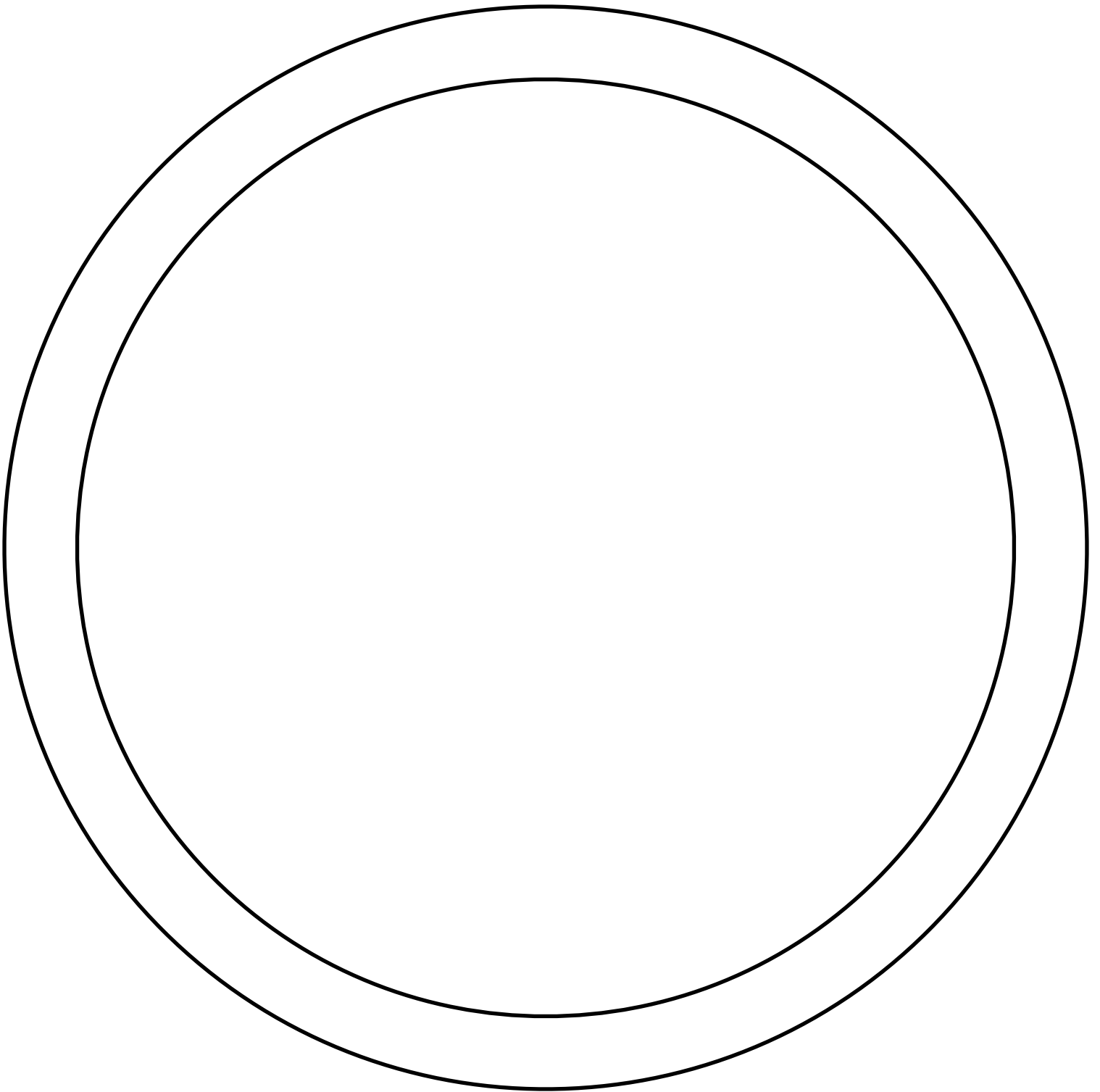
David Saint-Jacques' mission patch represents the power of dreams. By igniting human creativity and genius, dreams lead to progress. It also evokes the central role that space exploration has played in the evolution of our perspective of life on Earth.

The North Star (dreams) and compass rose (reason) make up the central element of the patch. In the same way that these have provided direction for explorers, dreams guide and inspire us without becoming an end in themselves.

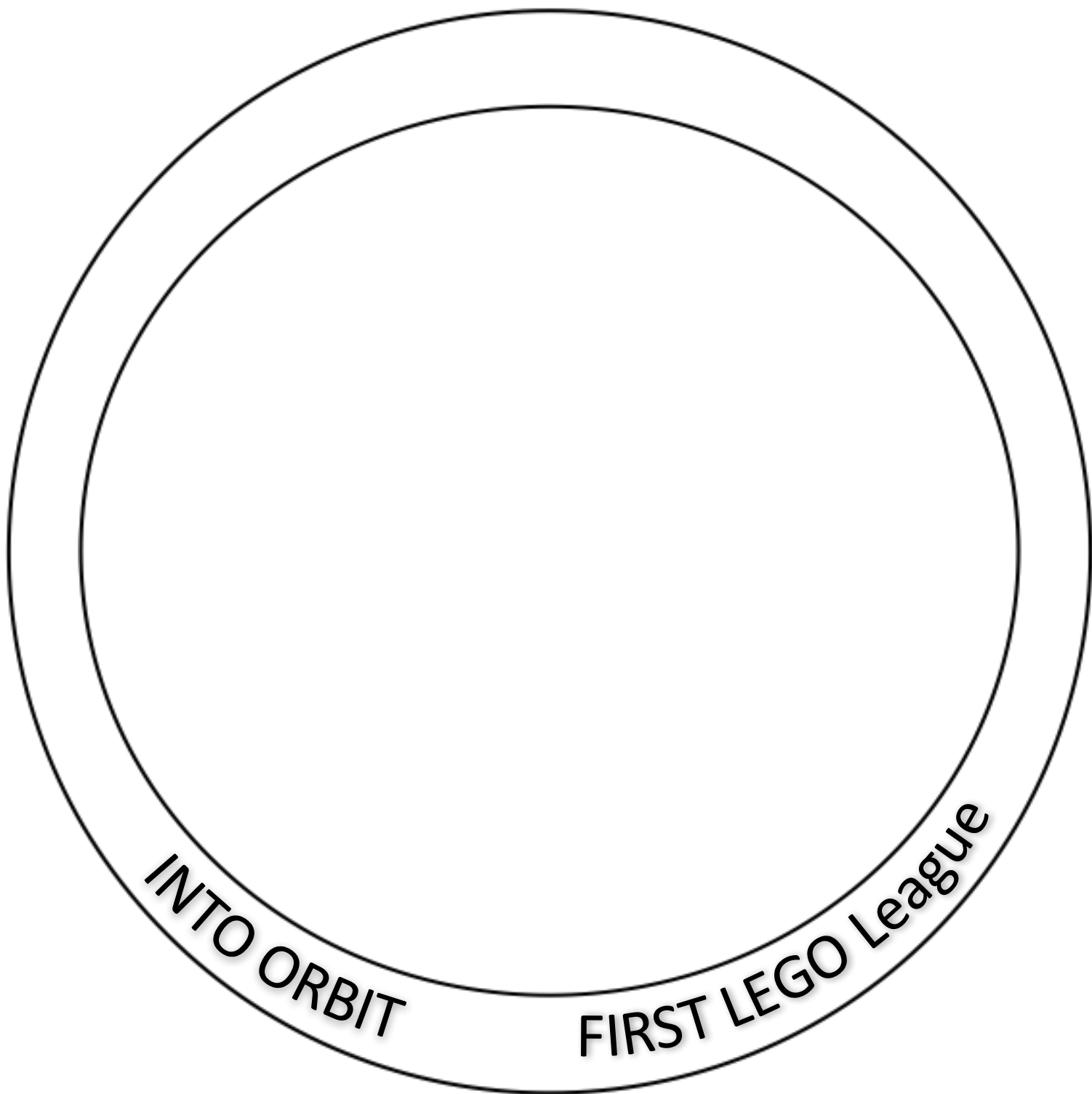
The trail of the star is composed of four colours. Red (energy and passion), orange (creativity) and white (science) stand for the human ability to innovate and push the limits of what is possible. The blue portion is crescent-shaped, resembling the reflection of a lens, and symbolizes the international collaboration so crucial to the space program in the past, present and future.

The other four stars represent the men and women who work behind the scenes, putting all their talent to work to ensure this Canadian mission is a success. They also signify the astronaut's family, the shining constellation of which he is most proud.

Finally, like a blue jewel in the universe, Earth figures prominently on the patch. From space, our planet can be seen in its full splendour but also in all its fragility. Space exploration gives us a new perspective on our world, fosters our environmental responsibility, and fuels our dreams of peace.



TEAM NAME: _____



TEAM NAME: _____

Mission

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RESEARCH

Research is key to every mission.

Your project topic will require your ability to find appropriate resources to help solve the INTO ORBIT challenge topic.

CHALLENGE:

To challenge your team's ability to find the right answers to questions you will search in the book provided for answers to questions.

One point for each correct answer.

One point for each page number listed.

There is a prize for the team with the most correct answers!

Team Name: _____

Answer as many questions as you can during the time limit.

One point for each correct answer.

One point for including the page number where you found the information.

1. Astronauts have their own hairstyle, what is it called?

1. Page number: _____

2. Answer: The _____

2. Name the two types of 'waste' astronauts refer to when talking about using the bathroom.

1. Page number: _____

2. Answer: _____ waste

3. Answer: _____ waste

3. How much can your body grow in space?

1. Page number: _____

2. _____ centimetres

4. How many sleeping pods are on the ISS (International Space Station)?

1. Page number: _____

2. _____ sleeping pods

5. How long would it take to get to Mars?

1. Page number: _____

2. _____ months.

6. How long do astronauts exercise each day in space?

1. Page number: _____

2. _____ hours.

7. What kind of baths do astronauts take in space?

1. Page number: _____

2. _____ bath

8. What is the correct name for a space suit?

1. Page number: _____

2. _____

9. What is the correct term for a space walk?

1. Page Number: _____

2. _____

10. Putting on a space suit is called donning.

1. Page number: _____

2. Removing a suit is called _____.

ANSWER KEY:

1. Astronauts have their own hairstyle, what is it called?
 1. Page number: **20**
 2. Answer: The **ASTRO**
2. Name the two types of 'waste' astronauts refer to when talking about using the bathroom.
 1. Page number: **8**
 2. Answer: **liquid** waste
 3. Answer: **solid** waste
3. How much can your body grow in space?
 1. Page number: **40**
 2. **5** centimetres
4. How many sleeping pods are on the ISS (International Space Station)?
 1. Page number: **44**
 2. **6** sleeping pods
5. How long would it take to get to Mars?
 1. Page number: **47**
 2. **6** months.
6. How long do astronauts exercise each day in space?
 1. Page number: **29**
 2. **2** hours.
7. What kind of baths do astronauts take in space?
 1. Page number: **19**
 2. **Sponge** bath
8. What is the correct name for a space suit?
 1. Page number: **26**
 2. **EMO - Extravehicular Mobility Unit**
9. What is the correct term for a space walk?
 1. Page Number: **16**
 2. **Extravehicular Activity**
10. Putting on a space suit is called donning.
 1. Page number: **26**
 2. Removing a suit is called **doffing**.

Mission

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Train like an astronaut.

Astronaut Training

David Saint-Jacques astronaut training required for his mission to the International Space Station has taken him more than two years to complete.

You don't have that much time!

Activity:

Each team member must assist another team member to put on the “astronaut gloves”. Once the gloves are on, the team member must then perform a task, once they have completed the task they have to put the gloves on the next team mate.

Continue until all teammates have had a turn as the astronaut.

TASK:

FIRST ASTRONAUT:

1. Open jar
2. Empty contents
3. Close jar

SECOND ASTRONAUT:

1. Open jar
2. Place item inside jar
3. Close jar

Repeat until every team member has had a turn.

