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ONTARIO **SCIENCE** CENTRE



Exhibit Inquiry

Destination Space



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An agency of the Government of Ontario

Grade 4-8

Have students look for the following exhibits related to space travel during their visit to the Ontario Science Centre:

An Extra Arm for Astronauts

Where to go:

Entrance (Level 2)
Canadarm



What it's about:

This full-sized engineering model of the original Canadarm is similar to the robot arms that were carried on each Space Shuttle. A larger version is on the International Space Station. The arm uses a three-wire system to grasp things. This is called the "end effector".

What to say and do:

- Look closely at the Canadarm. Can you find a joint that looks like the shoulder of a human arm? An elbow? A wrist?
- The Canadarm has no fingers but can still pick up objects. How do you think it does this? (*The "hand" has three wires that tighten around an object to hold it.*)
- What are some things that the robot arm can be used for? (*Astronauts can stay inside the space station while using it to move cargo, retrieve and repair satellites and inspect the outside of the spacecraft.*)

Cosmic Rays

Where to go:

Space (Level 4)
Cosmic Rays



What it's about:

The spark chamber allows us to see the paths of cosmic rays coming from space. The paths are visible as small bolts of "lightning" moving from top to bottom. Cosmic ray paths are also visible in the cloud chamber. In space, cosmic rays can be dangerous. But the cosmic rays that reach Earth's surface, which is protected by its atmosphere and magnetic field, are harmless.

What to say and do:

- Cosmic rays are very small. How many would you have to line up to equal the width of a human hair? (*At least five billion.*)
- Cosmic rays are like tiny bullets moving nearly as fast as light. Why do you think we cannot feel them when they hit our bodies? (*They are too small. They pass through the spaces between our atoms.*)
- Watch the spark chamber for 10 seconds. Count how many cosmic rays paths you see. About how many would pass through the chamber in one minute? How many might pass through your body in the same time?

Rocket Chair

Where to go:

Space (Level 4)
Rocket Chair



What it's about:

The rocket chair glides on a friction-free cushion of air. The effect is like moving in space – once you start in a particular direction, nothing slows you down. Students fire air jets to manoeuvre the chair and learn how it feels to move in space.

What to say and do:

- What happens when the chair starts to move? (*The chair keeps moving until it hits a barrier.*)
- Why is it important for an astronaut to be tethered to a spacecraft? (*If the astronaut starts to move, he or she could travel beyond the reach of the spacecraft.*)
- How do you use the air jets to move in a particular direction? (*Fire the jets in a direction opposite to the direction you want to move.*)
- How could astronauts move in space? (*They could use portable jet packs. Shooting*

gas in a particular direction makes the astronaut move in the opposite direction.)

Where to go:

The Living Earth (Level 6)
Earth Globe



How Far is it to Space?

What it's about:

This relief globe is just under 2 metres across. The globe shows the highs and lows of our planet, both above and below the sea. The vertical scale is exaggerated. Students can use the globe to consider various aspects of space, such as where space starts.

What to say and do:

- The Space Shuttle and Space Station orbit about 400 km above Earth. Earth is almost 13 000 km across. If the Earth were really the size of this globe, about how far out would the Space Shuttle and International Space Station orbit? (*About 5 centimetres above the surface.*)
- Do you think that the features on this globe are to scale? (*No. Otherwise, the Space Station would have to fly around some mountains.*)
- Can you think of any possible dangers to Earth from spacecraft? (*e.g. A spacecraft coming out of orbit could crash on populated areas below.*)
- The Space Shuttle travels at about 28 000 km/h. How long do you think it takes for one orbit of the Earth? (*About 90 minutes.*)
- Have you seen or used information gathered in space this week? (*e.g. Weather forecasts based on satellite observations.*)

Space Pickup

Where to go:

Entrance to Space Exhibition Hall
(Level 4)
Space Shuttle



What it's about:

Designers faced many challenges when creating this vehicle to haul humans and equipment safely into space. The Space Shuttle model has transparent plastic portals that allow students to see inside.

What to say and do:

- Why is the space shuttle covered with tiles? (*The tiles make up the heat shield which protects the shuttle and the astronauts against the extremely hot gases that surround it when re-entering Earth's atmosphere.*)
- Where is the shuttle entry door? (*The "side-hatch" is visible as a white circle on the front, left hand side of the shuttle.*)
- A space shuttle stays in space for 7 to 14 days. Where does the crew of seven astronauts work, sleep and go to the washroom? (*The crew lives and works both on the flight deck and the mid deck. The sleeping coves are visible on the mid deck.*)
- Why is the Canadarm so much longer than the payload bay? (*It may have to move things quite far away from the shuttle. Once in orbit, astronauts use the arm, fitted with a camera, to inspect the entire shuttle and check for damaged tiles.*)
- Once the shuttle has reached orbit, the main engines are shut off. The pilots can still manoeuvre the shuttle using the joystick control that is visible on the flight deck. How does the shuttle turn the pilots' commands into movements? (*Small control thrusters at the front and back of the Shuttle push gas at high speed in one direction, creating a force in the opposite direction that moves the Shuttle. See the Rocket Chair exhibit to experience how this works.*)

Vocabulary

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|---------------------|---|
| Air pressure | The force exerted by the weight of air. |
| Asteroid | One of millions of chunks of rock orbiting the Sun. Most are between Mars and Jupiter. The largest is Ceres, nearly 1000 km in diameter. |
| Atom | A unit of matter, the smallest unit of an element, having all the characteristics of that element and consisting of a dense, central, positively-charged nucleus surrounded by a system of electrons. From the Greek for “uncuttable”. |
| Comet | An icy body orbiting the Sun and having a nucleus that, when close to the sun, is surrounded by a cloud that gets blown out into a tail. |
| Cosmic ray | High-speed sub atomic particles travelling through space. |
| Galaxy | A system of billions of stars, gas and dust held together by gravity and separated from other such systems by vast distances. |
| Gravity | The force by which a planet or other mass tends to draw objects towards its centre. |
| Hydrogen | The simplest and most common element in the universe, this gas is often used with oxygen as rocket fuel. |
| Mass | A measure of the quantity of matter an object contains. Does not change when the object is subjected to different gravitational forces. |
| Meteoroid | A tiny piece of rock, ice or metal, possibly from an asteroid, that travels through space and can damage spacecraft. If it passes through Earth’s atmosphere, it appears as a streak of light called a meteor. If it survives the trip and lands, it becomes a meteorite. |
| Moon | A natural satellite of a planet. |
| Orbit | The path that an object in space follows around a large object. |
| Planet | A large object moving in an orbit around a star and shining by reflected starlight. Upper and lower limits to planet size are under debate. |
| Rocket | A vehicle that moves by burning fuel and throwing the exhaust in one direction to get a push in the opposite direction. Several are used to launch the Space Shuttle. |
| Satellite | An object in orbit around a planet, moon or the sun. |
| Solar system | A system of planets, asteroids, meteoroids and comets in orbit around a star. |
| Star | A large ball of gas in space that produces its own light and heat. |
| Vacuum | A region where there is no matter. |
| Weight | The force of gravity acting upon a mass creates weight. Changes when the mass moves to a place with a different gravitational force. |

Internet Links

Canadian Space Agency

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

NASA Kids

<http://kids.msfc.nasa.gov>

NASA Human Spaceflight Page

<http://spaceflight.nasa.gov/home/index.html>

PLEASE NOTE: Programs and exhibits are subject to change without notice.