Teacher's Notes for

A Day in Space

GroundStation Canada presentation of the H.R. MacMillan Space Centre

The GroundStation Canada Theatre is sponsored by MacMillan Bloedel

Program description: This live presentation introduces students to the world of the ISS where astronauts live and work. With the help of student volunteers we investigate living and working in earth's environment versus the micro-gravity environment of the ISS. In this presentation we address the most intriguing questions about life in space, including eating, sleeping, bathing, working and playing and everyone's favourite, "How do you go to the bathroom in space?"

Advance preparation: Studies have shown that people, especially children, learn better when they feel secure in their surroundings and know what is expected of them. We recommend that you orient your students to the main areas of our facility, make sure the purpose of the field trip is clear and link the trip to the students' learning in the classroom. For a map of the facility and more suggestions for a successful field trip download the Orientation Package on our website www.hrmacmillanspacecentre.com.

These Teacher's Notes are designed to help you further prepare your students and include enrichment activities that can be done before or after your visit. *These activities cover topics <u>related</u> to those in your programme and are therefore not necessarily the same.*

Curriculum connections: Grades 2, 3 and 4

Earth and Space Science IRP Connections:
P=Living in Space presentation, A=Suggested Classroom Activities

It is expected that students will:

Grades 2-3	
describe the unique features of the Earth that sustain life	L/A
Grade 4	
outline the importance of water for life	L/A

Background Information – The International Space Station

The International Space Station (ISS) or Alpha is an amazing engineering achievement, involving work contributions from more than 16 nations (the United States, Russia, Japan, Canada, Italy, Belgium, the Netherlands, Denmark, Norway, France, Spain, Germany, Sweden, Switzerland, the United Kingdom and Brazil) around the globe. Once complete, it will be the largest spacecraft in history, measuring 88 meters in length, 109 meters wide, and weighing nearly 450,000 kilograms. Using a variety of launch vehicles (the American Space Shuttles and Russian Proton and Soyuz rockets), it is being launched one or two pieces at a time on more than 40 launches. It is currently circling approximately 407 kilometers above the Earth at 27,358 km/h, completing one orbit every 90 minutes.

The International Space Station will measure 108 metres across and 88 metres long, and will provide 1,218 cubic meters of research space in six scientific laboratories. This is about equal to the space in 3 average houses, providing more space for research than any spacecraft ever built. In total, the International Space Station will take almost over 7 years for its assembly on-orbit to be completed.

ISS is unique in that it offers astronauts the opportunity to do something quite special: live and work in the micro-gravity (often incorrectly called weightless) environment of space, longer than ever possible before. Due to limited consumables, such as fuel and food, Space Shuttle flights generally last less than 2 weeks. On ISS, astronauts will remain in Earth's orbit for up to 6 months at a time, giving them the opportunity to study the long-term effects of micro-gravity on biological and material samples. This type of research has never been possible on the Space Shuttle.

Activity One – Where is the ISS?

Objective
Using a distance model, students will establish where things are in space relative to the Earth. This activity begins with the Earth and Moon and ends with students estimating where the ISS is between the Earth and Moon.

Materials
- earth globe (you may substitute this with a student's head)
- string (approx 15m long)
- tennis Ball (you may substitute a second student's fist)
- a student's finger

Teaching Tip
Expect this activity to go from one corner of the classroom right to the other!

What to do:
Begin a discussion with students about the Earth and the Moon. Ask students if they know how far away the Moon is? How long did it take astronauts to reach the Moon? Was it a long or short time?

1. Give the Earth globe to a student-volunteer.
2. Give the tennis ball (the Moon) to another student-volunteer.
3. Ask the class to determine how close or far the Moon (tennis ball) should be from the Earth. Allow them to call out "farther" or "closer" to the volunteer holding the tennis ball (Moon). Let this continue until the Earth and the Moon are at a distance away from each other which the class feels represents the actual Earth and Moon.

4. The actual distance between the Earth and the Moon is approximately 9.5 times the circumference of the Earth. Ask for 2 more volunteers to come up, and give them the string. Ask the volunteers to wrap the string around the Earth globe 91/2 times, and then cut the string at that length.
5. Unwind the string. Give one end to the volunteer holding the Earth globe, and the other end to the volunteer holding the tennis ball. Have them stretch out the string between them.
6. Using your finger to represent the International Space Station, ask the class to determine how close or far it orbits from the Earth. Repeat the procedure above. At this scale, to accurately represent the distance from the earth to the ISS, your finger should be practically touching the globe!

Wrap-Up
This is the comparative distance of the Earth to the Moon! Compare the position of the Moon now, with the guess students made earlier. You may wish to end with a discussion about the Earth's atmosphere, and spacecraft (such as the Space Shuttle, or International Space Station) which orbit just beyond it. Ask students if they know where the atmosphere ends, and where space begins? How far away do orbiting spacecraft go? Another way of understanding how far out the atmosphere extends is to imagine that the earth has shrunk to the size of an apple. At that scale, the atmosphere is only the thickness of the skin of the apple.

Activity Two – Space Food

Objective: Students will better understand why astronaut food is usually dehydrated.

Materials: Per student group or 1 of each for a class demo
a bowl, single-serving package of soup mix
250 millilitres of boiling water, a cup
5 teaspoons cocoa mix, 250 millilitres of hot water
a scale

What to do:
1. As a class demo or with students working in groups, weigh the empty bowl and record its weight.
2. Empty the package of soup mix into the bowl. Weigh the bowl of dehydrated soup mix and record the weight.
3. Add the boiling water to the soup mix in the bowl. Weigh the bowl of rehydrated soup and record the weight.
4. Repeat steps 1-3 with the cup, cocoa, and boiling water.
5. Compare and discuss results, having students answer the question, "Why is dehydrated food taken on a space mission?"

Activity Three – Disorientation Maze

Objective: Students will be able to better understand the difficulties associated with the disorientation astronauts feel when they first enter a microgravity environment.

Materials: pencils
1 “Disorientation Maze”/pair of students (page5)
small hand mirrors (one per pair of students)
stopwatches (or clock/watches with second hand)

What to do:

1. Have students work in partners.
2. Using the Disorientation Maze on the last page of this Teacher’s Guide, have one student draw through Maze A, without lifting the pencil, as fast as possible without touching the sides. The other student records the time it takes for the student to complete the maze.
3. Now have the student who just completed Maze A hold a hand mirror so that (s)he can see the reflection of Maze B in the mirror. The other student should take a piece of blank paper and cover the drawing hand of the student who is going to complete Maze B so that (s)he can only see the reflection of the maze in the mirror and not her/his hand. Looking only at the reflection in the mirror, the student should draw through Maze B and the other student should record the time it takes for the student to complete the maze.
4. Have the students switch roles and do the activity again.
5. Compare the times it took to draw through the maze without the mirror and with the mirror. Which took longer? Which was more accurate (staying in the lines)? What made the task more difficult? Do you think you could improve your performance with practice?

Resources

NASA Space Online – hundreds of well researched and well organized free space resources for teachers http://spacelink.nasa.gov/

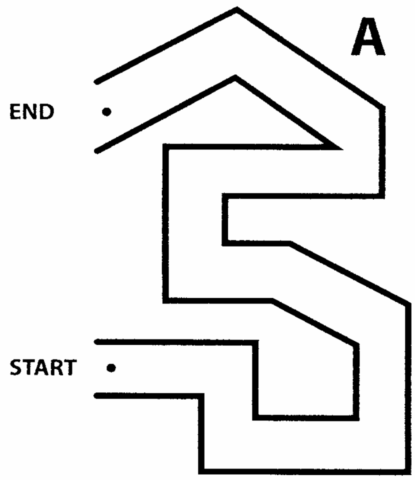
Sighting Opportunities for ISS and other Spacecraft
http://spaceflight.nasa.gov/realdata/sightings/

H.R. MacMillan Space Centre (astronomical information)
http://hrmacmillanspacecentre.com or 604-738-7827 ext. 228

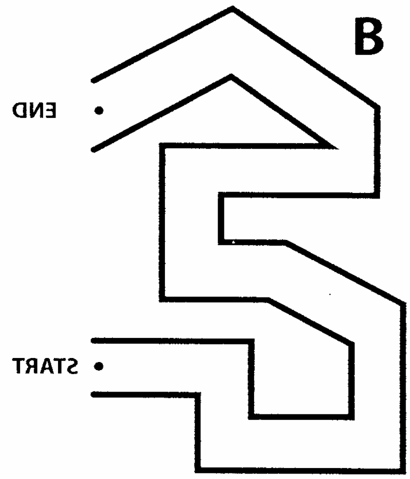
Canada In Space – A student centered web experience highlighting the International Space Station and Canada’s contribution to space (available October 31st, 2003 at canadainspace.ca)

DISORIENTATION MAZE

■ YOU

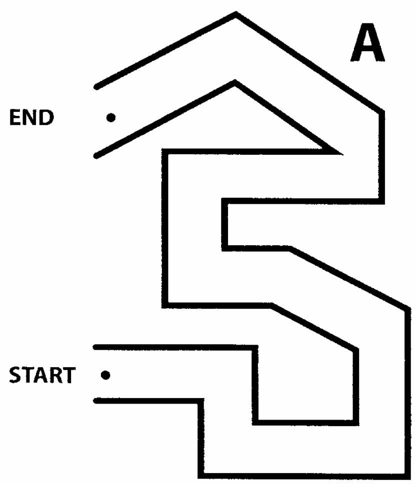


Time without mirror: ______ seconds

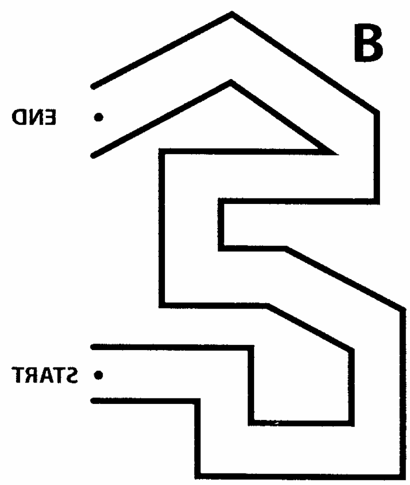


Time with mirror: ______ seconds

■ YOUR PARTNER



Time without mirror: ______ seconds



Time with mirror: ______ seconds