PROPOSED ACTIVITIES

The Canadian Space Agency's primary educational goal is to interest Canada's young people in science and technology and to help them prepare for new and exciting space-related challenges in the next millennium.

The activities are designed to provide teachers with additional classroom materiel. Lessons have been prepared to be hands-on and fun for students as they learn more on gravity, weightlessness, microgravity sciences which can influence blood circulation, bone and muscle structures and the sense of orientation and balance.

Feel free to distribute and adapt the material as you see fit.

Influence on the Hemic System

Activity: Puffy face/bird leg syndrome

Objective: To demonstrate the phenomenon of fluid shift towards the upper body.

Materials:

- Camera (preferably Polaroid)
- Measuring tape
- Erasable marker
- Adjustable bench or any inclined plane

Method:

- Have a student lie on the bench with the head about 30 cm lower than the feet and remain in this position for a few minutes.
- Take a picture of his or her face at the beginning of the experiment and another at the end, 5 or 10 minutes later.
- Now, note the observable differences: veins more swollen, smoother skin, blood rushing to the head as in zero g.
- To observe the reduced volume of the ankles, measure their girth at a particular spot (draw a circle on the ankle) at the beginning and end of the subject's stay on the inclined plane (5 to 10 minutes).
- Discuss these results with your students.

Influence on bone structure

Activity: Stretching of the spine

Objective: To demonstrate that a person grows taller in zero g

Materials:

- 3 large flexible sponges (to represent the spongy tissue)
- 4 large books (to represent vertebrae)
- 1 large rubber band
- 1 photo of the spine

Method:

- Stack the books and sponges alternately.
- Press down on the book and sponge assembly to compress it. Stretch the rubber band around the assembly to hold it in that position. *The rubber band illustrates the force of gravity, which compresses the discs in the spinal column when the astronaut is on Earth.*
- Have the students measure the height of the assembly.
- Remove the rubber band while keeping the stack upright.
- Have the students take another measurement. *Explain to students that the difference in height results from the removal of the rubber band — or, in real life, the disappearance of the Earth's gravity once the astronaut is in space.*

Activity: Reduction in a person's height during the day

Objective: To measure the effect of gravity on a person's height.

Materials:

- Measuring tape
- Sticky tape

Method:

- Choose two volunteers from the class. They should preferably be the tallest and the shortest.
- Measure each student's height accurately at the beginning and end of the day. *To ensure that the experiment is accurate, the same student should always take the measurements. Make sure the volunteer keeps heels and head against the wall and*

head level. Take the measure by placing a book flat on the volunteer's head and a length of sticky tape just below the book where it meets the wall. That way you will have two marks to compare.

- Compare the results. *The students grew shorter during the day. The reason is the effect of gravity on their spines: when they were in bed, lying horizontal, the vertebrae eased apart a little, but through the day they were squeezed together again by gravity.*
- Ask the students to redo this experiment for a few days at home. Compile the results in class and derive the average height increase for all students.
- Hold a class discussion of the possible causes of any variations in the results.

Influence on balance and the sense of orientation

Activity: Astronauts' balance test

Objective: To demonstrate the importance of the eyes in keeping your balance.

Materials:

- Plank (2" x 4" x 24")
- Chronometer
- Blindfold

Method:

- Lay the plank flat on the ground. Have two students hold either end to keep it steady.
- Have a volunteer stand on the plank with the toe of one foot touching the heel of the other and arms crossed on his or her chest.
- Time how long he or she can balance on the 2x4 **with eyes open.**
- Repeat the experiment and time it again **with the person blindfolded.**
- *Explain why the volunteer lost his or her balance more quickly the second time, when he or she no longer had any visual cues.*

Activity: Disorientation test

Objective: To show the importance of the inner ear in keeping your balance.

Materials:

- Swivel chair
- Blindfold
- Volunteers (as monitors)

Method:

- Blindfold the chosen volunteer.
- Have the student sit on a swivel chair and turn slowly around a few times. Remove the blindfold and tell the student to open his or her eyes quickly *Note that there is minimal loss of balance and little dizziness. The fluid in the inner ear's semicircular canals stabilizes quickly.*
- Repeat the experiment by having the student turn faster and for a longer time *When the subject opens his or her eyes the dizzy feeling is stronger and the subject's balance has begun to be more disturbed, as the fluid in the semicircular canals is taking longer to stabilize.*
- Repeat the second experiment with the subject's head forward, chin on chest *His or her sense of balance will be even more uncertain, since this way the semicircular canals are turned through 90 degrees (see sketch of inner ear) and the feelings of dizziness are that much stronger.*
- Have the volunteer describe his or her sensations and discuss the results.

Additional activities

⇒ Talk with students about real-life experiences that might remind them of some of the physical symptoms associated with a space mission.

⇒ Ask students to list human beings' biological needs and suggest how they could be supplied in space *The primary needs are: atmosphere (oxygen, pressure, temperature, odours), water, food, health and fitness, hygiene and psychological needs. To these may be added the need for protection from radiation, the vacuum of space, debris and meteorites.*

⇒ Ask students how gravity might be simulated aboard a spacecraft to create more natural conditions for the human body.

⇒ Ask students to design a game for astronauts that would take into account the conditions and environment of microgravity.

⇒ Explain to the class the function of the inner ear and its role in controlling balance and orientation.