

TWO CANADIANS MEET IN SPACE

Introduction



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Focus

An extraordinary event in Canadian space history took place in July 2009 when two Canadians were in Earth orbit at the same time. This *News in Review* story looks at the work of the Canadian Space Agency, the two history-making astronauts, and recent developments and possible future programs in space exploration.

Did you know . . .

A list and description of every experiment conducted on the ISS is available from NASA at www.nasa.gov/mission_pages/station/science/experiments/Expedition.html.

The important role that Canada has played in the history of space exploration is one that few Canadians appreciate. Many are really only aware of two contributions. The first of these is the Canadarm, that long crane we see sticking out of every space shuttle, waving some large piece of shuttle freight at its end. The second contribution is our astronauts. We may not have a lot of astronauts, but they have played an important role in the exploration of space.

Canada has made other major contributions to space exploration. One of these is in the area of robotics. Canada has created some of the most useful tools available in space. Canada is also a leader in satellite technology as a developer of advanced communication satellites and Earth-observation satellites.

Canadian astronauts tend to receive more attention than do our other contributions to space exploration. Our astronauts are the people with “the right stuff.” In July, two of them—Julie Payette and Bob Thirsk—were the first Canadians to meet in space. For each of these astronauts, it was their second visit to space. This time, they met at the International Space Station, the premier location for low-gravity experimentation.

Payette had been to the International Space Station before. In fact, she was one of the group of astronauts who first “turned on the lights” at the station,

making it ready for its first full-time resident scientists. On this second visit she was to continue construction on the almost-completed station. Payette’s mission will be one of the last of the shuttle flights, as the shuttle program is scheduled to end in 2010.

Bob Thirsk had also flown on a shuttle mission before. This time, however, he reached the space station in a Russian Soyuz spacecraft. Thirsk is the first Canadian to make an extended stay on the station. He will be there for six months, during which time he will perform more than 100 experiments. Many of these will deal with the effects of lengthy space travel on the human body.

Lengthy space travel may well be the future of space exploration. The U.S. National Aeronautics and Space Administration (NASA) has plans for manned flights to the moon by 2020 and a manned flight to Mars, perhaps as soon as 2035. Economic conditions may slow these plans but they are unlikely to end them.

Canada, too, is demonstrating continued interest in space exploration. In 2009, the Canadian Space Agency (CSA) was given extra money to increase its research and development program in robotics. And in May, two new astronauts were selected to carry on the proud tradition of Canadians in space.

To Consider

Are young people interested in space exploration? Did you and any of your friends talk about the Canadians who went into space in 2009? If you didn’t talk about it, why not? Should there be more media coverage of space missions, or do you think there is already enough?

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Video Review

Did you know . . .

Every space shuttle flight is numbered sequentially. Julie Payette has been on the 96th and 127th flight. The same is true of Soyuz flights to the International Space Station (ISS) when astronauts remain on board the ISS and perform experiments. Bob Thirsk flew to the ISS on Expedition 20 and will remain on the station during Expedition 21 for a total of six months in space.

Pre-Viewing Discussion

During the course of the video, you will be introduced to two Canadians who are truly enthusiastic about their opportunities to go into space. What aspects of space travel do you think would lead to this enthusiasm? What things might make you want to be part of a space mission?

Viewing Questions

Answer the following questions in the spaces provided.

1. What great event in the history of space exploration was celebrated in 2009?

2. How long will Bob Thirsk spend on the International Space Station?

3. Who was the first Canadian to board the International Space Station?

4. How does NASA prepare astronauts for their missions?

5. In her interview, what does Julie Payette describe as critical for her on her current mission?

6. Why was the shuttle fleet grounded in 2003?

7. When is the shuttle program expected to end?

8. How long ago was Julie Payette's last visit to the International Space Station?

9. Why did the shuttle do a back flip as it first approached the International Space Station?

10. What country built the platform for the experiments installed by the shuttle astronauts?

11. How long will the International Space Station remain in orbit?

Post-Viewing Discussion

1. Based on what you have seen on the video, what type of mission would appeal most to you as an astronaut? Would it be Julie Payette's 14-day flight to supply and continue construction of the International Space Station? Or would you prefer Bob Thirsk's six-month assignment as a resident scientist performing a variety of experiments? Why?

2. Construction on the International Space Station began in 1998 and is scheduled to be completed by 2011. It has been staffed, and experiments have taken place there, since 2000. The station may be decommissioned as early as 2015. Do you think that 16 years of experimentation, only four or five of which will take place when the station is complete, are worth the time and effort involved in the project? Why or why not?

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Canada's Space Program

Further Research

The CSA Web site is at www.asc-csa.gc.ca/eng/default.asp.

Further Research

Learn more about Canada's newest astronauts at www.cbc.ca/technology/story/2009/05/13/new-canadian-astronauts.html.

Further Research

Read more about Canada's satellites at www.asc-csa.gc.ca/eng/satellites/default.asp.

As of 2009, eight Canadian astronauts have journeyed into space. Beginning with Marc Garneau in 1984, Canadians have been part of 14 shuttle missions. Many of these missions have been part of the effort to build the International Space Station (ISS). Now that the ISS is able to house its full complement of six researchers, Bob Thirsk is in residence and will be the first Canadian to spend six months in space.

There was much news coverage of the fact that Thirsk and Payette would meet in space. But our astronauts' participation in space missions is only one small part of Canada's space program.

The Canadian Space Agency

The Canadian Space Agency (CSA), which reports to Canada's Minister of Industry, is the government department that directs most of Canada's efforts in space research. Established in 1989 by the Canadian Space Agency Act, its mandate is "To promote the peaceful use and development of space, to advance the knowledge of space through science and to ensure that space science and technology provide social and economic benefits for Canadians" (www.asc-csa.gc.ca/eng/about/mission.asp).

Astronauts

One CSA responsibility is Canada's astronaut development program. Through the National Research Council, Canada established a permanent astronaut corps in 1983 to conduct Canadian experiments in space. Bob Thirsk was hired in the first competition, when over 4 000 applications were received for the six available positions.

A second hiring was announced in 1992. Over 5 000 Canadians applied, and

four new astronauts were added to the corps. One of these was Julie Payette. In 2009, retirements led to a new call for applicants for the astronaut corps, and in May of that same year two new positions were filled. The successful applicants were Jeremy Hansen, a fighter pilot, and David Saint-Jacques, a medical doctor. They began training at the Johnson Space Center in Houston, Texas, in August. There were 5 351 applicants for the jobs.

Canada expects that a Canadian astronaut will be part of the research staff on the ISS once every three years.

Satellites

The CSA's satellite program has likely had the biggest impact on the lives of most Canadians. These include the development of:

- science satellites that research Earth's atmosphere and the farthest reaches of space
- communications satellites that keep remote communities in touch with the more heavily populated parts of Canada
- Earth-observation satellites that help us monitor the environment and our natural resources

In December 2007, Canada launched its most impressive satellite to date: Radarsat-2. The CSA helped fund its construction and launch, but the satellite is privately owned and operated. The CSA will recover its investment through the supply of data to the government. The satellite will provide data for hundreds of projects that monitor the environment across Canada and around the world. It can provide sharp detail through both clouds and the night sky.

Definition

The *payload* is the carrying capacity of an aircraft or space ship, including cargo, munitions, scientific instruments or experiments.

Further Research

The Canadarm and Canadarm2 story is at www.asc-csa.gc.ca/eng/canadarm/default.asp.

Robotics

Equally significant has been Canada's contribution to the use of robotics in space. In 1975 the (U.S.) National Aeronautics and Space Administration (NASA) asked Canada to design and build a Shuttle Remote Manipulator System (SRMS). This was to be used to handle large payloads in space. Canada would assume the cost of developing the hardware, which would be used on the shuttle *Columbia*. Its success would result in the purchase of three more SRMSs from Toronto's Spar Aerospace, the main contractor. The result was the Canadarm, which is now prominent on

video of every shuttle mission.

The Canadarm was such a success that Canada was asked to design and build a second arm specifically for the ISS. It is designed to remain permanently with the space station and can travel the entire length of the station to complete its tasks.

Recently added to the ISS was a helpful Canadian robot named Dextre. Dextre is designed to remove and replace small components—which require very careful handling—on the outside of the space station. Scientists expect Dextre to greatly reduce the number of space walks by ISS researchers.

For Discussion

The CSA often makes the case that the space research it has sponsored has real application here on Earth. It is easy to demonstrate the value of the CSA's work with satellites. Can you think of ways in which the research resulting in the two Canadarms and Dextre might lead to new breakthroughs here on Earth?

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Julie Payette

Further Research

Learn more about Julie Payette at www.asc-csa.gc.ca/eng/astronauts/biopayette.asp.

Note

A CBC feature about Payette's first shuttle mission is available at archives.cbc.ca/science_technology/space/clips/16827/.

Julie Payette is an extraordinary person.

Born in 1963, Payette is a native of Montreal, where she attended both elementary and secondary school. She holds a bachelor's degree in electrical engineering from McGill University. She also earned a master of applied science degree in computer engineering from the University of Toronto. Before she became an astronaut, Payette worked in computer research and systems engineering in both the public and private sectors.

The Canadian Space Agency lists the following information in Payette's personal profile: ". . . Ms. Payette enjoys running, skiing, racquet sports and scuba diving. She has a commercial pilot licence with float rating. Ms. Payette is fluent in French and English, and can converse in Spanish, Italian, Russian and German. She plays the piano and has sung with the Orchestre symphonique de Montréal, the Piacere Vocale in Basel, Switzerland, and the Tafelmusik Baroque Orchestra in Toronto. She is married and has two children."

In 1992, Payette was one of 5 330 applicants to the Canadian astronaut program. She was one of four who were selected for training, and the second woman selected (Canada's first female astronaut was Roberta Bondar).

After her initial Canadian training, Payette's computer expertise resulted in her being selected as the technical advisor for the Mobile Servicing System, a robotics system developed by Canada for the International Space Station (ISS).

In August 1996, Payette began her astronaut training with NASA in Houston. She completed her basic training in 1998 and then worked on robotics issues until her first shuttle mission.

STS-96

Julie Payette's first shuttle mission was STS-96. The mission lasted from May 27 to June 9, 1999. This mission was the first time that a shuttle manually docked at the ISS (it was unoccupied at the time). The shuttle also delivered more than 3.5 tonnes of supplies to the ISS.

Before the flight, Payette described her job as that of a construction worker (www.asc-csa.gc.ca/eng/missions/sts-096/responsibilities.asp). She had a lengthy list of responsibilities, including performing any necessary repairs to the ISS, supervising the installation and storage of new equipment, and operating the Canadarm on three different occasions.

STS-96 was an especially important mission because it readied the ISS for its first resident crew. It was the last shuttle flight before an American and two Russians arrived via Soyuz spacecraft on November 2, 2000. The ISS has been occupied ever since.

Following the completion of her first mission, Payette served as the representative of the NASA astronaut corps at the European and Russian space agencies. From 2003, she has worked as a Spacecraft Communicator and has been responsible for communications between the ground controllers and astronauts during shuttle flights.

STS-127

Payette has had the rare experience of seeing the ISS just before it opened and again almost at its completion.

Space shuttle flights are due to be retired in 2010, and her most recent mission—named STS-127—was one of the last major construction flights to the ISS. Its main cargo consisted of

Further Research

A series of videos of Julie Payette discussing the STS-127 mission is available at www.asc-csa.gc.ca/eng/missions/sts-127/videos.asp#clip4.

the final components needed for Kibo, an experimental module contributed by the Japanese Aerospace Exploration Agency. The shuttle also carried a full load of supplies and experiments for the six scientists now residing at the ISS. Among these was a Canadian, Bob Thirsk. Payette and Thirsk were the first two Canadians to be in space at the same time.

Payette's work was critical to the success of this mission. As a robotics specialist, she operated three different robot arms during the completion of Kibo and the installation of its first experiments. Much of the construction

required payload items to be removed from the shuttle's hold and placed inside the ISS. This involved the operation of both the Canadarm and the Canadarm2. Payette also had to operate a third arm—a Japanese-designed arm that is part of Kibo—to install some of the new experiments.

Hand-offs in space are very difficult to execute. In all, Payette performed eight hand-offs from one arm to another—a record.

Payette completed what is expected to be her final shuttle mission on July 31, 2009.

For Discussion

1. In an editorial on May 27, 1999, *The Globe and Mail* described Julie Payette as "massively overqualified" for her job as shuttle astronaut. Here's what the editorial had to say:

"It's great, but is it really important? The problem is, some things about her space-faring idyll don't make sense. First, she is massively overqualified for what she is doing. While it is impressive that she speaks six languages, can fly a plane, has competed in triathlons, sings, holds two engineering degrees and plays the flute and piano, it hardly matters for the tasks at hand.

"She is, as most of the astronauts are, a glorified tradesman-cum-lab-technician. Her main job is unloading a tonne's worth of material and helping to operate the Canadarm. The reason she has so many qualifications has much more to do with a dearth of astronaut positions than it does with what she must accomplish."

Do you think that the newspaper's assessment is a fair one? Does an astronaut really need to have all of the qualifications that Payette possesses? Could her skills be better used in other areas? If you think so, what might those areas be?

2. What are the qualifications that you feel are most important for a Canadian astronaut? Make a list of the top three. Share your list with your classmates and see if there is any consensus on what makes the perfect astronaut candidate.

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Expedition 20/21

Further Research

More about Bob Thirsk is available at www.cbc.ca/technology/story/2009/05/22/space-robert-thirsk-space-station-astronaut.html. His official CSA biography is at www.asc-csa.gc.ca/eng/astronauts/biothirsk.asp.

The International Space Station (ISS) was created as a platform for scientific research. Construction in low-Earth orbit began in 1998 and is expected to be completed in 2011. The first crew entered the station in 2000, and the ISS has been continuously staffed ever since. It will remain in operation at least until 2015 and likely even beyond.

The ISS is a joint project of the space agencies of several countries: the United States, Canada, Japan, Russia, and 11 European countries that are part of the European Space Agency. Brazil also participates through a separate contract with NASA.

Canada and the ISS

Canada's major contribution to the ISS is the Mobile Servicing System (MSS), consisting of the Canadarm2, a mobile base system, and Dextre, a robot designed to work in areas on the exterior of the ISS where precise handling of equipment is necessary. Working together, the elements of the MSS will greatly reduce the number of space walks required to repair and replace parts of the space station.

Canada's reward for its contribution is research time at the station for some of its astronauts. The Canadian Space Agency helps Canadian university and industry researchers develop experiments that can be carried out at the ISS during those times when a Canadian scientist is in residence. Most of these experiments are concentrated in two areas:

- robotics, especially as they apply to the MSS
- microgravity and life sciences, exploring the effects of low gravity on living things

Robert Thirsk

Canada's latest scientist on the ISS is Robert "Bob" Thirsk, a medical doctor with a special interest in aeronautics. He also holds degrees in engineering and business administration. Thirsk was born in 1953 in New Westminster, British Columbia. He was one of the first group of astronauts selected by the National Research Council (NRC).

Thirsk decided he wanted to be an astronaut the night he saw the first man walk on the moon—July 20, 1969. He was 15 at the time. That ambition finally became a reality in 1983. The NRC—because of the success of the Canadarm—was asked by NASA to form a Canadian astronaut corps so that Canadians could fly on the shuttle.

Just before Thirsk's latest space mission, NASA asked him how an engineer/doctor/MBA ended up as an astronaut. Thirsk had this reply: "Well, this is going to sound funny but I simply answered an ad in the newspaper. Canada, during the first recruitment of astronauts, placed an ad in all the major newspapers across Canada saying that they were now starting an astronaut program, they were looking for people with these kinds of qualifications, and I looked at the qualifications that they were looking for. I realized that I had a lot of that, and these dreams that I had of being an astronaut when I followed the careers of John Glenn and Neil Armstrong came flooding back to me. So my application was in the next day. Of course, it was a long period of time, a lot of cuts or a lot of selection steps, before I was finally accepted, but I was very honoured and very fortunate to be part of Canada's first astronaut corps" (nasa.gov/mission_pages/station/expeditions/

Note

Weekly summaries of Bob Thirsk's work are available on the CSA website at www.asc-csa.gc.ca/eng/missions/expedition20-21/weekly.asp.

[expedition20/thirsk_interview.html](http://www.asc-csa.gc.ca/eng/missions/expedition20-21/weekly.asp)).

Thirsk's first space flight was in 1996, on shuttle mission STS-78. On that flight he performed several experiments dealing with the effects of space flight on plants, animals, and humans. He also performed additional experiments in materials science. Many of these experiments helped space agencies to prepare for future work on the ISS. Its construction was planned to begin two years later.

In 2004, Thirsk was asked to be the back-up astronaut on a Russian-Italian expedition to the ISS. It was then that he began the training (in Russia) that led to his participation in Expedition 20/21.

When Thirsk's 2009 mission began, he became the first Canadian to go into space on a Soyuz spacecraft. His mission took him to a space station that was almost complete and that was able to hold a full six-person team for the first time since construction began. He would be spending six months helping to perform about 100 experiments.

NASA personnel are preparing for a new series of flights to the moon and hope soon to be able to send a manned

spacecraft to Mars. Because of these plans, many of the Expedition 20/21 experiments will study how people adapt to long space flights (many of the experiments arrived on the shuttle flight that also brought Julie Payette to the ISS). One area Thirsk is especially interested in is bone loss, a major problem for astronauts. Thirsk was given many other mission responsibilities. He is the crew's medical officer. As flight engineer, he is responsible for the maintenance and repair of the ISS. As a robotics expert, it is his job to operate the Canadarm2. He will also be the caretaker for Kibo, the new Japanese science laboratory, as there is currently no Japanese scientist aboard the ISS.

Asked to identify his mission priorities, Thirsk listed two. The first is to ensure that the station is indeed capable of supporting a crew of six scientists. The second is to help turn a space station under construction into a world-class facility for research and development. The CSA and NASA have no doubts that they have chosen the right man for the job.

Quick Research

During his NASA interview, Thirsk mentions John Glenn and Neil Armstrong as two people who inspired him to become an astronaut. Who were they and what did they do? Research their careers and write a paragraph on each describing their most significant accomplishment(s) as an astronaut.

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Future of Space Exploration

Did you know . . .

The International Space Station could not have been built without the space shuttle. It is the only vehicle large and powerful enough to carry many of the station's components into orbit.

What is the future of space exploration? This is a question that is being studied by many of the major space agencies, including Canada's.

For many people, the most exciting element of future space exploration includes manned flights to the moon and to Mars, our nearest planetary neighbour. The U.S. has already announced that it expects to be back on the moon by 2020 and hopes to visit Mars with a manned flight as early as 2035. Other countries, including China, have also announced plans to have their astronauts walk and work on the moon in the near future.

Manned space flight, however, remains both dangerous and extremely expensive. Two of the 127 shuttle missions have failed, with significant loss of life. Many experts point to the successes of unmanned missions and argue that these are both a more cost-effective and safer way to explore the cosmos.

Major Changes

Travel to space in the immediate future seems about to change dramatically. The most obvious change is likely to be the planned retirement of the entire NASA shuttle fleet in 2010. The shuttle is currently the only manned spacecraft used by NASA, and the spacecraft are getting old. The shuttle's major drawback—besides its vulnerability to certain kinds of accidents—is that its range is limited. It can never venture farther into space than Earth orbit.

Under a new project named Constellation, NASA is intending to replace the shuttle with a new craft: Orion. Orion will look and behave more like the Apollo spacecraft that first took men to the moon. Orion will first launch into Earth orbit atop a new rocket, Ares.

Later flights will take it to the moon and eventually to Mars.

Orion, however, will not be ready before 2015. This means the United States will be without a manned spacecraft for at least five years. Those are the very years when the most important research will be conducted at the International Space Station (ISS). All personnel transfers will have to take place on Russian Soyuz spacecraft. Supplies, new experiments and new materials will all have to be delivered by unmanned spacecraft or Soyuz rockets.

The United States, worried about this lack of manned spacecraft, has formed a special commission to study the future of manned space travel. The commission's aim is to outline a program that is safe, innovative, affordable, and sustainable. It may even advise extending the life of the shuttles until the new Orion is ready to fly.

Meanwhile, other countries have expressed an interest in manned space flight. China has already launched a manned orbital flight. Japan and India also have planned missions.

Even the private sector is getting involved. Virgin Galactic is testing its sub-orbital space plane, *SpaceShipTwo*, and expects to have it taking tourists into space within a year or two. It will carry a crew of two plus six passengers for about CAD\$220 000 per person, per trip.

Unmanned Exploration

The unmanned exploration of space will certainly continue even as new plans for manned travel develop. NASA, in particular, has had tremendous successes with its unmanned probes and robot explorers. One of its greatest successes has been the exploration of Mars by the

Further Research

Follow the rover mission at marsrovers.nasa.gov/home/index.html. An overview of all NASA's current missions—manned and unmanned—is available at www.nasa.gov/missions/current/index.html.

twin rovers Spirit and Opportunity. The robots were designed to last only 90 days on the surface of Mars. Both arrived on Mars in January 2004. As of August 2009, both are still functional.

NASA has a wide range of probes and satellites exploring planets and other astronomical objects within our solar system—and well beyond. It also has several satellites studying Earth, its climate, and its resources. Many more are scheduled for launch in the next few years. In 2010, NASA will begin sending a series of robotic probes to the moon to prepare for future manned missions.

However, like other United States government agencies NASA is feeling pressure to cut programs and save money. Keeping a very expensive manned space flight program operating may mean cutbacks in unmanned exploration. The special commission's report should help clarify how future space exploration will develop.

Canada and the Future

Canada is also in the process of reviewing its plans for space exploration.

The government and the Canadian Space Agency (CSA) have made some decisions recently that point to future activities.

Two new astronauts were recently selected to ensure that Canada has the astronauts to conduct research on the International Space Station. They would presumably be available to participate in other manned space flights—additional shuttle missions and Orion flights.

The 2009 budget included \$110-million, distributed over the next three years, to be devoted to robotics projects. These would include refinements to Canadian successes like the Canadarm. The money would also be used to develop new kinds of robotic vehicles, including landers to explore the moon and Mars.

Canada will also continue to develop its expertise in Earth-observation satellites. Its launch of Radarsat-2 has made it one of the leaders in environmental monitoring, surveillance, and mapping. The success of this public-private partnership points the way for many of the CSA's future activities.

For Discussion

Just before Julie Payette's first space mission, columnist Margaret Wentz wrote an opinion piece for *The Globe and Mail* (May 27, 1999) that argued that manned space flight was necessary for one main reason: favourable publicity. She wrote: "Why shoot people into space? Unmanned exploration, critics say, is more productive and a lot cheaper. But governments know that space with a human face is a much more saleable story to taxpayers. They can gabble on forever about industrial spinoffs, but all their press releases are not worth one good quote from a well-scrubbed astronaut. 'Ride the mighty rocket I will!' vowed Julie in *Maclean's*. Now, that's a good quote."

Do you agree with Wentz that the astronauts are salespeople for space exploration? How much attention do you believe most people pay to Canada's space program and its astronauts?

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Activity: Reconsidering Canada's Role

It has been a topic of debate for many years: Should Canada spend millions of dollars on space exploration activities? Could the money be better spent on social programs?

As long ago as April 24, 2001, *The Globe and Mail* asked its readers the same question:

"Imagine how much low-income housing could be built with the \$1.4-billion spent on Canadarm2, the Canadian-designed robotic arm successfully deployed aboard the orbiting International Space Station yesterday for the first time. Or visualize how that same money could benefit famine relief, or any number of equally worthy causes. With social initiatives and charities hard-pressed for resources, does space exploration justify such an outlay?"

The *Globe's* editors answered with a resounding yes. But with the pressures of the current recession many are again asking the same questions.

The Canadian Space Agency's (CSA) budget for 2009-2010 is over \$365-million. Is this money well spent? Does our space program produce results that justify that kind of budget?

Or should that money be spent elsewhere? Would it be more useful to hire 1 800 new doctors? To hire 7 300 new nurses? To feed and shelter 15 000 homeless people?

How would you distribute that \$365-million? Would you leave it with the CSA? Or would you earmark it for a specific social program or programs?

Your Task

Prepare a brief report (two or three paragraphs) on how you would allot the money. If you would leave it with the CSA, explain why you think its programs are valuable to Canadians. If you would spend it elsewhere, be precise on how much it might affect a specific social program and why it would be money well spent.

Your teacher may ask you to complete this task by yourself, with a partner, or in a small group. Be prepared to share your report with your classmates.

The *Globe* gave as its most persuasive argument the following statement that you may want to consider as you make up your mind: ". . . Space exploration will continue regardless of whether Canadians participate. For as long as humans have walked the Earth, they have been anxious to unlock its secrets. Journeying into space marks the next, inevitable level of that innate curiosity."