

How do we benefit from space exploration?

1. We develop technologies that shape our lives.

- There are many things that are linked to space explorations. These products are called spinoffs of space exploration. A **spinoff** is a product or a technology that is originally developed for one use but is modified for other uses. Examples of spinoffs are the following:
 - 1) **Quartz** timing crystals were used for the first human mission to the Moon, and are also used in some watches.
 - 2) Running shoes are made with **shock-absorbing** Moon-boot material.
 - 3) **Phones** are designed with miniature components created originally for the shuttle program to save space and weight on space missions.
 - 4) **UPC** codes on items were designed to track each of the millions of tiny pieces used to build a space capsule.
 - 5) Scratch-resistant coatings designed originally for the windows on the space shuttle are now used for **sunglasses**.
 - 6) High-temperature space materials are used to improve **brakes** in motor vehicles.
 - 7) **Robots** designed for space now fill dangerous jobs on Earth – handling hazardous chemicals, working with explosives, etc.

2. We are challenged to think and act locally, globally, and universally.

- Think **globally**, act **locally**. Among other things, this statement reminds us that there are consequences to the ideas we have and the actions we take in response to those ideas.
- **Nuclear-Powered Planetary Probes**. The **Cassini-Huygens** space probe was launched in **1997** and reached Saturn and its moon system in **2004**. However, its launch was controversial because it was carrying 33 kg of radioactive **plutonium** as a power source. The Cassini-Huygens probe successfully reached Saturn and has greatly expanded our knowledge of the great ringed planet and several of its moons. One of those moons, **Titan**, is the only moon known to have an **atmosphere**, and contains chemicals that could support life. So understanding Titan can help us understand life back here, on Earth.
- **Terraforming – New Horizons for Humanity**. Some scientists believe that it is technologically possible to transform alien, lifeless worlds or landscapes into life-sustaining ecosystems for future human colonies. Some scientists believe that the technology already exists. Transforming an alien environment into one that can support Earth life is called **terraforming**. ("Terra" means **land** or **earth**.)

3. We gain a deeper appreciation for ourselves and our home planet.

- Space exploration has influenced our sense of self – our understanding of where, when, and who we are, within and beyond the boundaries of our planet.
- We are **stargazers** – looking for patterns in the sky.
- We are **timekeepers** – using sky observations to draw the first lunar calendar.
- We are **navigators** – using predictable patterns of constellations and other celestial objects to find the way from home to there and back again.
- We are **explorers** – In 1961, cosmonaut **Yuri Gagarin** became the first person in space. In 1969, America astronauts **Neil Armstrong** and **Buzz Aldrin** set foot on the Moon. In 2005, cosmonaut **Sergei Krikalev** spent 2 years on the International Space Station.
- We are **voyagers** – Voyager 1 and Voyager 2 left Earth on a mission to observe and study the four outer planets.

Homework (WORKBOOK): p. 116

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Textbook pages 220–229

Before You Read

Exploring and learning about space costs billions of dollars each year. Should we spend that money on space exploration when there are problems to solve here on Earth?

Record your thoughts on the lines below.

✓ Reading Check

1. Name one benefit and one risk of space exploration.

✓ Reading Check

2. Do humans have the right to change the environments of other planets? Explain?

What technologies developed for space help us in our daily lives?

Space exploration has led to the development of many specialized products. Space helmets, shock-absorbing Moon boots, tracking devices, robots, and high-temperature space materials are just some of these products. Many of these products have been adapted for everyday uses. When these products or technologies are modified for another use they are known as spinoffs. Did you know that the shock-absorbing material of your running shoes came from Moon-boots? Or that the scratch-resistant coating on your sunglasses is similar to the windows on the space shuttle?

What are the benefits and risks of exploring space?

There are benefits and risks to exploring space. We need to “think globally, act locally.” This means that we need to think about the consequences of space exploration. What do we gain? What are the negative effects?

We have gained valuable knowledge by sending probes, space shuttles, and satellites into space but our actions have raised other issues. For example, some of the probes contain **radioactive** materials which could be accidentally released into Earth’s atmosphere at lift-off. Do you think that this risk is worth taking? ✓

Name _____

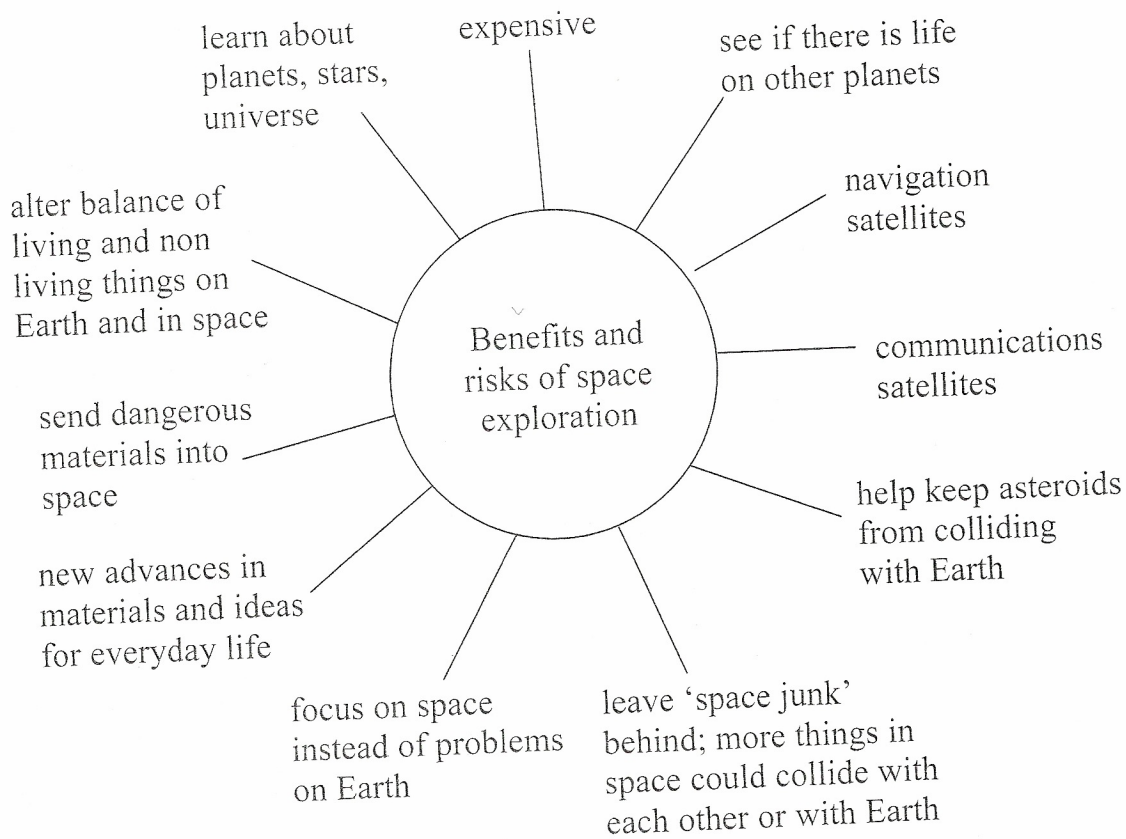
Date _____

Some scientists believe that we should be exploring other worlds and changing them into environments that support Earth life. This process is called terraforming. Terraforming could allow humans to move to other planets or moons. How do you think such a change could affect the balance in the universe? ✓

How has space exploration given us a deeper appreciation of ourselves and our planet?

Ancient observers gazed into the night sky and recorded patterns of stars, or **constellations**. Observations also led to the creation of the lunar **calendar** which represents the 29 days it takes for the Moon to go through its phases. These observations have helped sailors and explorers find their way home. Since the mid-1900s, we have sent cosmonauts into space, landed on the Moon, established the International Space Station, and sent probes to the outer edges of our solar system. Each of these events has allowed us to see our planet from a different perspective.

Benefits and risks



Use with textbook pages 220–229.

Exploring space

Vocabulary

constellations
lunar
Mars
Neil Armstrong
Polaris
robots
Saturn
Sergei Krikalev

space shuttles
spinoff
terraforming
transforming
UPC codes
Voyager probes
water cycle
Yuri Gagarin

Use the terms in the vocabulary box to fill in the blanks. You will not need to use every term.

1. Various everyday products that use materials developed by the space industry are called _____ technologies.
2. _____ that were designed for space now fill dangerous jobs on Earth, such as handling hazardous chemicals or working with explosives.
3. Originally, _____ were designed to track each of the millions of tiny pieces needed to build a space capsule.
4. The Cassini-Huygens space probe sent to _____ and its moon system was carrying radioactive plutonium.
5. Some scientists believe that it is technologically possible to transform an alien environment into one that can support Earth life by a process called _____.
6. For humans to live on Mars, we would need to develop a _____, plant life to generate and sustain an atmosphere, and nutrient cycles to sustain the plants.
7. Over 15 000 years ago Cro-Magnon people used their observations of the night sky to draw the first _____ calendar.
8. Sailors and wanderers rely on predictable patterns of _____ and other celestial objects to find their way home.
9. In 1961, the first person in space was _____.
10. The _____ are known for travelling further in space than any other human-made craft.

Name _____

Date _____

**Applying
Knowledge****Topic 3.5***Use with textbook pages 224–225.*

Consequences of space exploration

What ideas do you have about the benefits and risks related to each issue? What are other issues that you think we should consider when we decide whether to explore space? Record your ideas in the chart.

	Benefits	Risks
Nuclear-powered planetary probes	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>
Terraforming	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>
Other issues:	<hr/> <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/> <hr/>

Should Canada be involved in space exploration?

Technology related to exploration in space has led to the development of satellites, the International Space Station, specialized products, and discussions of terraforming other planets.

To what extent should Canada be a part of these adventures? Is space exploration worth the risks and costs? Use the space below to brainstorm some ideas related to this question, then write a short paragraph that explains how much you think Canada should be involved in these developments.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

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Use with textbook pages 220–229.

Match each term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ Polaris	A. means land or earth
2. _____ plutonium	B. probe sent into space to observe and study outer planets furthest from Earth
3. _____ satellite	C. the pole star found in the Northern Hemisphere
4. _____ spinoff	D. a product or a technology that is originally developed for one use but is modified for other uses
5. _____ terra	E. an electronic device put in orbit around Earth to relay information
6. _____ terraforming	F. a radioactive element used in many nuclear processes
7. _____ Voyager	G. transforming an alien environment into one that can support Earth life

8. What special characteristic found in the eyes of birds of prey led to a product used by astronauts?

9. Give two examples of spinoffs of space exploration.

10. What might be some difficulties that would be associated with terraforming a planet like Mars?
