Topic 3.3
What has space exploration taught us about our solar system?

Overview

In this topic, students will learn about the composition of the planets in our solar system and consider other solar system objects such as dwarf planets, asteroids, comets, and meteoroids. They will explore the great distances that separate the objects in the solar system.

Common Misconceptions

- **Some students may still consider Pluto to be one of the planets of the solar system.** Explain that Pluto was discovered in 1930 and was considered the ninth planet of the solar system for 76 years. However, in 2006, the International Astonomical Union (IAU) determined that Pluto should be classified as a dwarf planet, along with Ceres, Eris, Haumea, and Makemake. This was due to its size, highly eccentric orbit and orbital inclination, and several other factors. There was great controversy surrounding this decision and there were even protests to return Pluto's planetary status. However, with the discovery of Eris in 2005, which is 27 percent larger than Pluto, the arguments to retain Pluto as a planet are unconvincing. An excellent graphic that shows the relative sizes of these dwarf planets and dwarf planet candidates as compared to Earth can be found at **www.scienceontario.ca**.
- **Students may be unaware of or confuse the terms *meteor, meteorite*, and *meteoroid*.** Have students look up these terms in the dictionary or use the Internet to find out what they mean. If you have established a class word wall, you may wish to have students include these new terms. Or, draw a diagram showing Earth and its atmosphere, and label a meteoroid outside of the atmosphere, a meteor travelling toward Earth in the atmosphere, and a meteorite on Earth's surface. Leave this diagram on display for students to refer to.
- **Students may have a somewhat static view of the universe and certainly of the solar system, thinking that scientists have discovered all the objects to be discovered and learned everything about them.** Tell students that the science of astronomy is still a science of discovery. Use Pluto as an example of how scientists' understanding of the solar system (and the universe) changes, depending on what new discoveries are being made. Point out that with the invention of new technologies, objects are still being discovered, even in our own solar system. Interested students can research new discoveries and share them with the class.
- **Students may confuse comets, asteroids, and meteoroids.** Explain that objects are classified based on what they are made of and where they are. Create a table on the chalkboard comparing these objects, and have students refer to pages 202 and 203 of the student textbook as you fill in the table.
- **Students may believe that the planets in our solar system exist in an empty vacuum.** Explain to students that there are other objects that share the solar system (for example, asteroids, comets, and meteoroids).

Specific Expectation

- **D3.2** compare the characteristics and properties of celestial objects that constitute the solar system, including their motion and their distance from other celestial objects in the solar system

Skills

- identify and locate sources
- select, organize, and record information
- communicate in a variety of formats
- use appropriate modes of representation and units of measurement
- express results accurately and precisely

Materials

Please see the teaching notes for each activity for a list of the materials required. Please see page TR-45 for a summary of the materials required in this topic.

Background Knowledge

In 2004, Sedna, a possible dwarf planet, was discovered. It was named after the Inuit goddess of the sea, due to its very cold temperatures. It is located 90 AU away, three times the distance from the Sun to Pluto, and is the farthest object in the solar system to be discovered. It is considered to be located in the scattered disc or possibly the Oort Cloud.

The Sudbury Basin is also known as the Sudbury Crater. It was created by the impact of a meteorite about 10 km across that struck the area about 1.85 billion years ago and left a crater 250 km wide. The Sudbury Crater is the second largest on Earth. The largest meteorite crater, the Vredefort Crater, is located in South Africa, and is 300 km across. The third largest is the Chicxulub Crater located in Yucatan, Mexico. For more information about, and definitions of, meteorites and meteors, as well as information on NASA's Near Earth Object Program, visit **www.scienceontario.ca**.

The Asteroid Belt is an area between the inner and outer planets, that is, between Mars and Jupiter. It is often referred to as the "main belt" to distinguish it from the Kuiper Belt and other collections of objects in the solar system. It is composed of millions of asteroids whose total mass is less than that of Earth's Moon. One theory is that the asteroids were once planets that were destroyed by collisions. However, scientists now believe that the asteroids represent planets that did not form. Scientists have catalogued most of the asteroids that are 100 km across or more; however, as many as 1 million smaller asteroids (1 km or less) remain uncatalogued. Ceres is the largest asteroid at 914 km and in 2006 was classified as a dwarf planet. It represents about 25 percent of the entire mass of the Asteroid Belt. Other large asteroids in the belt include Ida, Gaspra, Mathilde, Eros (not to be confused with Eris, a dwarf planet located beyond the Kuiper Belt in the scattered disc), Pallas, Vesta, and Hygiea. Useful websites for students can be found at **www.scienceontario.ca**.

The Kuiper Belt is located beyond Neptune's orbit. Unlike the objects in the Asteroid Belt, the objects in the Kuiper Belt are composed of rocks and ice, similar to comets. Pluto is considered to be the largest of the Kuiper Belt objects. So far, scientists have discovered about 800 Kuiper Belt objects, but they expect to find many more.

The Scattered Disc is an area beyond Neptune and the Kuiper Belt, although sometimes it overlaps the Kuiper Belt. Objects in this area are thought to have been "scattered" by the gas giant planets, although these objects are still subject to Neptune's gravitational effects. Like the Kuiper Belt objects, the Scattered Disc objects are icy and roughly spherical, although usually quite large. It is thought that the periodic comets in our solar system originate here. Eris, a dwarf planet, and its moon, Dysnomia, are considered the largest scattered disc objects.

At the outer edge of the solar system, the farthest reaches of the Sun's influence is the Oort Cloud. It is hypothetically a vast, roughly spherical cloud that is approximately three light-years from the Sun, or 30 trillion km. The Oort Cloud contains comets that are spread very far apart. Two recent comets, Hyakutake and Hale-Bopp, originated here.

Literacy Strategies

Before Reading

- ELL Use a concept map to review what students have learned about space in Topics 3.1 and 3.2. Include concepts relating to stars, the Sun, and the Moon. Invite students to suggest other information they know about the solar system and add it to the concept map. As you do this, introduce the Key Terms. Encourage English language learners to use sketches to help them understand and remember the vocabulary.

During Reading

- Have students make jot notes, perhaps in table format, about each of the planets and keep their notes handy to refer to often. Remind them to use their notes for review before attempting to answer the Topic Review questions. Model for students how to select the main idea of each chunk, and supporting details. You may wish to do this as a class for the first chunk of text.
- ELL In order to promote oral communication skills as well as co-operative learning skills, encourage English language learners to compare their jot notes with a partner and to explain why they selected certain points as main ideas and others as supporting details.

After Reading

- DI To benefit interpersonal learners and students who need to develop this skill, have students create their own classroom astronomical society. Regularly schedule meetings and encourage students to discuss the new information they learned, using correct terminology. Have students bring in articles about new discoveries, shuttle launches, new technology to study space (for example, telescopes), and have them read the articles aloud, or post them in the classroom. Encourage students to theorize how these discoveries may change what we know about the universe.
- Remind students of the text navigation skills you explained in Topic 3.1. As a review, select a few key concepts and have students find the relevant section on that concept.

Assessment FOR Learning

Tool	Evidence of Student Understanding	Supporting Learners
Learning Check question 3, page 200	Students list the outer planets and provide information about them.	• Students may find it easier to draw four circles, one for each outer planet, and list the characteristics of the planets, or you could provide copies of **BLM 3-14 Compare and Contrast the Planets** for students. Then, have students choose two colours of markers or highlighters for similarities and differences. For example, yellow would be differences and blue would be similarities. Students would use yellow to highlight the number of moons for each planet, since each outer planet has a different number of moons. • If students need additional support, suggest categories of characteristics to compare, for example, size and number of moons.
Learning Check question 1, page 203	Students identify the differences in composition and origin between comets and meteoroids.	• Have students use a Venn diagram or **BLM G-38 Venn Diagram** for their comparison. This type of organization will help English language learners and spatial learners organize their thoughts. Encourage English language learners to use diagrams or sketches within their Venn diagram, if they prefer.
Activity 3.11, page 205	Students manipulate the formula and the distances in the solar system.	• Provide mathematics remediation and support as necessary. Give students copies of **BLM G-24 Using Scientific Notation** and work through it together for extra practice.
Topic 3.3 Review question 5, page 207	Students construct a bar graph and rank the planets in order of size.	• Review how to create a bar graph with students. Together, look at Numeracy Skills Toolkit 4: Organizing and Communicating Scientific Results with Graphs on page 370 of the student textbook, to help students create a bar graph. Show students some examples of bar graphs, such as on student textbook page 372. Point out the features (for example, the axis title, the axis label, the title, and the bars). • Provide students with a sheet of graph paper on which to construct a bar graph. Survey the class and record students' favourite foods, movies, TV shows, or hobbies. Have students graph the data, and then discuss their bar graphs as a class.

Topic 3.3 (Student textbook pages 196–207)

Using the Topic Opener (Student textbook pages 196–197)

- Students may be familiar with meteors and meteorites from watching popular movies, such as *Armageddon* and *Deep Impact*. Dispel any misconceptions or fears that students may have from watching these films.
- To introduce students to the idea of how the impact of a meteorite this large might have affected Earth, you may wish to have them view a computer simulation of a large impact, found at **www.scienceontario.ca**. (Remind students that there is very little threat of such a large object impacting Earth now or in the future, however.)
- If possible, schedule a starwatching event with the class on an evening that there will be a meteor shower. Check the dates of upcoming meteors at **www.scienceontario.ca**.
- Ask students how scientists are able to find meteorites that fall to Earth in order to study them. Explain that there are many people, just like these scientists, who are excited about finding a meterorite—a piece of rock from outer space. The International Meteor Organization is a group of amateur meteorite hunters who search for fallen meteorites in order to study them.
- Enrichment—Have interested students research the International Meteor Organization and find out what they do. They can start their search at **www.scienceontario.ca**.
- After students read the opener, you could assign Activity 3.10 on page 204 because it links directly to the topic opener. The Background Information in this section contains information that may be helpful to students.
- Bring in a large topographical map or globe and have students see and feel the Sudbury Crater. This is an excellent activity for both English language learners and bodily-kinesthetic learners. Ask students to suggest where else there may be impact craters on Earth's surface. (Some scientists suggest that the entire Hudson Bay area was formed by a meterorite.)

Starting Point Activity (Student textbook page 196)

Pedagogical Purpose

This activity will activite prior knowledge on meteorites and other objects in our solar system. Students will share their knowledge with the class.

Planning	
Time	15–20 min in class

Skills Focus

- communicate in a variety of formats

Background Knowledge

The inner planets (Mercury, Venus, Earth, and Mars) are the closest planets to the Sun. The outer planets (Jupiter, Saturn, Uranus, and Neptune) are the farthest from the Sun. Asteroids are rocky objects that orbit the Sun, and are located in the Asteroid Belt—the region between the orbits of Mars and Jupiter. Comets are chunks of rock and ice that come from the outer areas of the solar system. Meteoroids are chunks of rock or metal, or both, that come off an asteroid or a comet. A meteorite is a part of a meteoroid that gets through Earth's atmosphere and lands on Earth's surface.

Activity Notes and Troubleshooting

- Students can work in groups and record their thoughts about the solar-system words on large chart paper. Then, as a class, review the groups' notes. Invite each group to share interesting ideas from their paper. Add the words to the class word wall, if you have one. Or, have students add these definitions to their notebooks.
- During the group work, circulate and make a note of any misconceptions you may hear in students' conversations. Ensure these misconceptions are addressed and corrected early.
- Alternatively, you may wish to have a class brainstorming session to find out students' thoughts on the solar-system words. In this case, use the board or a large sheet of chart paper to record students' answers. Post the notes in the classroom for students to refer to later.

Additional Support

- DI ELL Try to involve students with intrapersonal intelligence and English language learners in class discussions and ensure they have an opportunity to share their thoughts and participate, if they wish. You might provide easier ways for them to participate, such as drawing diagrams on the board or providing photographs for them to describe.
- DI Students with interpersonal and linguistic intelligence will enjoy this activity. Group discussions will help other students to develop these skills.

Answers

Students should communicate what they already know about the solar system words listed.

Instructional Strategies for Topic 3.3

The four inner Earth-like planets are small and rocky.

(Student textbook pages 198–199)

- Direct students' attention to Figure 3.14 on page 198, and have them read the caption. Ensure that they understand that the large call-out at the top of the figure is an enlargement of the Sun and the four inner planets, not additional stars or planets.
  - DI Ask students to consider the scale used in this image. Do they think that the image is a fair representation of the size and scale of the planets? (No, neither the size of the planets and the Sun, nor the positioning of the planets in relation to each other, is accurate.) Ask students why they think the planets are displayed in this way. (This representation gives students an idea of the size differences and position. However, because there is such a huge difference between the size of the smallest planet and the largest planet, it would be impossible to show both to scale on one page. Also, planets are orbiting the Sun in different locations, so it would be impossible to show all planets in a two-dimensional drawing.) Encourage logical-mathematical learners who understand the concept to explain it to other students who are having trouble.
- Distribute copies of **BLM 3-15 Planetary Collector Cards**. Have students cut the sheets into the card shapes, and focus on the inner planets. You may wish to have students glue or photocopy the cards onto card stock. You could also have a set of class cards for reference in the class resource centre. Students can play a game in which one student makes up a "What am I?" riddle about one of the planets, and the other student uses their cards to help them solve the riddle.

- ELL Encourage English language learners to put sticky notes beside words that they do not understand. Provide simpler synonyms (single words or phrases) for these words, for example, *rotation* → turn; *orbit* → go around; *atmosphere* → gases around something; *origin* → where something comes from; *symbol* → sign.

The four outer "gas giant" planets are large and ringed.
(Student textbook pages 200–201)

- Have students read their planetary collector cards. Encourage discussion of, and comparison between, the inner and outer planets.
  - ELL English language learners can add notes in their first language, or sketches, about the planets on the back of their planetary collector cards.
- DI To benefit bodily-kinesthetic learners, have eight students line up in the order of the planets' distance from the Sun, and have each student say the name of the planet, and one fact about his or her planet. Students can use their planetary collector cards for the outer planets as cue cards.
- ELL To help students, including English language learners, become more familiar with the characteristics of the planets, play trivia games as a class. Students can work in teams to discuss strategies and vote on answers.

Rocky chunks of various sizes make up the rest of the solar system.
(Student textbook pages 202–203)

- Ask students to work with a partner or in small groups and list the objects other than the planets and the Sun that share the solar system. Then, as a class, create a list of all the objects, and compare the list to the opening paragraph on page 202. If the class list is incomplete, update it and add it to the class resource centre. Discuss what students know about these objects.
- Have students read pages 202 and 203. Then, have them reread the pages and distribute copies of **BLM 3-16 Asteroids, Dwarf Planets, Comets, and Meteoroids Collector Cards** for students to fill in.
- Enrichment—When Pluto's planetary status was changed to a dwarf planet, many people were outraged. Students could research this controversy and report their findings to the class.
- Enrichment—Have interested students plot a time line of new discoveries of objects in our solar system to help them understand that astronomy is an exciting career of discovery.

Learning Check Answers (Student textbook page 198)

1. The inner planets of our solar system are Mercury, Venus, Earth, and Mars.
2. The inner planets are known as the terrestrial (Earth-like) planets, because they have many features in common with Earth.

3. Students' answers could include a table similar to the one shown below.

Planet	Distance from Sun (AU)	Size (Diameter) (km)	Temperature Range (°C)	Time for One Rotation (days)	Time for One Orbit (days)	Moons	Atmosphere
Mercury	0.39	4 878	-184 to 427	59	88	0	Almost non-existent, but does include water vapour
Venus	0.72	12 104	457	243	266	0	97% carbon dioxide
Earth	1.0	12 756	-89 to 58	1 (23 hours, 56 minutes)	365 days (plus 5 hours)	1	78% nitrogen, 20% oxygen, 2% other gases (including carbon dioxide)
Mars	1.5	6 785	-140 to 20	1 (24.6 hours)	686.41 (1.88 years)	2	95% carbon dioxide, small amount of oxygen

Learning Check Answers (Student textbook page 200)

1. The four outer planets are Jupiter, Saturn, Uranus, and Neptune.

2. Another name for the outer planets is "gas giants."

3. Students' answers could include a table similar to the one shown below.

Planet	Distance from Sun (AU)	Size (Diameter) (km)	Average Temperature (°C)	Time for One Rotation (hours)	Time for One Orbit (years)	Moons	Atmosphere
Jupiter	5.2	142 800	-150	9.8	12	63	Mostly hydrogen and helium
Saturn	9.5	120 536	-170	10.7	29.5	61	Mostly hydrogen and helium
Uranus	19	51 120	-215	12.2	84	27	Mostly hydrogen and helium, with a small amount of methane
Neptune	30	49 530	-235	16.1	165	13	Mostly hydrogen and helium, with a small amount of methane

Learning Check Answers (Student textbook page 203)

1. Comets are chunks of loosely held rock and ice that are thought to come from the Kuiper Belt and the Oort Cloud. Meteoroids are chunks of rock, metal, or both that are shed from asteroids or comets. When a meteoroid enters Earth's atmosphere and starts to burn up, it makes a streak of light across the sky. A meteoroid that lands on Earth's surface is called a meteorite.

2. A dwarf planet is larger than an asteroid but smaller than a planet, and it does not have enough gravity to pull all the rocky debris around it out of the path of its orbit. At the time of printing this textbook, five dwarf planets were recognized, although there are several candidates for dwarf planets, including Sedna, which are currently being studied.

3. Comets are unlike any other object in the night sky. People living in ancient cultures mapped and predicted the movement of constellations and some of the planets. However, the appearance of comets must have appeared to be very erratic and unpredictable, which may have led people to believe that comets were part of a supernatural phenomenon. Other civilizations believed that the arrival of comets was an indicator of impending doom.

Activity 3.10 News from NEOs (Student textbook page 204)

Pedagogical Purpose

This research activity will allow students to learn more about meteoroids in our solar system and practise their research skills.

Planning	
Materials	Access to the library and/or the Internet **BLM G-13 Citing Sources** (optional)
Time	60 min in class for research 60 min to develop the news report

Skills Focus

- identify and locate sources
- select, organize, and record information

Background Knowledge

Near-Earth Objects (NEOs) are comets and asteroids that are orbiting in areas that are close to Earth, within 1.3 AU of the Sun. The gravitational pull of the planets could cause an object's orbit to change so that it crosses Earth's, making it a potentially hazardous object. It is important to study these objects to determine if their raw materials are useful for future exploration, and also to learn the best way to divert potentially hazardous objects, if necessary, so they do not collide with Earth. For a multimedia presentation, visit **www.scienceontario.ca**.

Activity Notes and Troubleshooting

- A week before this activity, reserve time at your school's resource centre and/or computer lab for students to conduct their research.
- You could assign this activity immediately following the Topic Opener, as it introduces the subject matter.
- The Background Information in this topic contains information that may be helpful to students using the Internet to research.
- Students could work in small groups, with a partner, or individually for this project.
- If you have not already done so, take this opportunity to review with students your school's plagiarism policy before they begin their research. Ensure that students are aware that information copied directly from the Internet is plagiarism. You might provide copies of **BLM G-13 Citing Sources** to assist students.

Additional Support

- Provide students who are struggling with a list of key words or websites to use for researching on the Internet.
- You might provide students with guidelines on how to write a news report. A student's news report should have three parts:
  1. an introduction that states the news in a sentence or two
  2. details to explain what, who, why, when, where, and how; can be quotes.
  3. a statement or prediction of the effects of this news

- ELL To assist English language learners and other students who require more time to complete this project, have students work in groups of three, and have each student concentrate on one aspect of the assignment only, rather than on all three bullet points. English language learners could also work with a partner for support. Monitor progress and offer feedback during the project.
- ELL Encourage English language learners to pause after reading complex sentence structures, such as the first sentence of this activity, and restate the sentence in their own words. ("When the planet was young, there were a lot of large objects near it.")
- DI Pair linguistic learners with students who need more practice with their writing skills.
- DI Students could submit a script of their TV or radio news report for evaluation, rather than doing an actual presentation. Alternatively, some students, including spatial learners, may wish to use computer presentation software or graphic programs for their report.
- Enrichment—Interested students could make a video of their news report, including music and graphics if possible. Students can then show their videos to the class.

Activity 3.10 Answers

Students should present their information accurately and clearly, stating the facts with details and perhaps quotes.

Activity 3.11 Bike Me to the Moon, and Beyond

(Student textbook page 205)

Pedagogical Purpose

In this activity, students apply mathematical skills with calculations and scientific notation, to develop an appreciation of the vast distances between objetcs in the solar system.

Planning	
Materials	calculators (optional) **BLM 3-17 Bike Me To the Moon, and Beyond** (optional) **BLM G-24 Using Scientific Notation**
Time	30–40 min in class

Skills Focus

- use appropriate modes of representation and units of measurement
- express results accurately and precisely

Background Knowledge

One astronomical unit (AU) is equal to the distance between the Sun and Earth—about 150 000 000 km. The distance from the Sun to Neptune (the farthest planet from the Sun in the solar system) is about 30 AU. Distances in galaxies are even greater, and are measured in light-years. Light travels at the speed of 300 000 km/s, and in one light-year, light can travel about 9.5 trillion km. Some stars and galaxies are millions of light-years away.

When expressing these large numbers in kilometres, scientific notation can be used. Although students may have seen scientific notation before, they will not have a lot of experience calculating with it. Suggestions are provided below to help students apply it to complete this activity.

Activity Notes and Troubleshooting

- Before assigning this activity, work through a few examples as a class. Review the sample with students, and point out the formula: time = distance ÷ speed. You might choose to provide students with copies of **BLM 3-17 Bike Me To the Moon, and Beyond** to keep track of their answers. Ensure students understand the abbreviations and what values to plug into the formula. Remind students that the value for speed is provided: 20 km/h.
- You may wish to allow students to use calculators for this activity.
- In the textbook example, model for students how to get from the second step to the third step.

$$t = \frac{5.2 \times 10^3 \cancel{\text{km}}}{20 \cancel{\text{km}}/\text{h}}$$

$$= \frac{5.2}{20 \times 10^3 \text{ h}}$$

$$= 0.26 \times 10^3 \text{ h}$$

$$= 2.6 \times 10^2 \text{ h}$$

Point out the two key points:

1. You divided the numbers first, and left the power until the end.
2. You multiplied the result by 10 to get a number between 1 and 10, and then divided the power by 10 to compensate.

- Distribute **BLM G-24 Using Scientific Notation** to students who require extra practice.
- Enrichment—Assign What Did you Find Out? question 2.

Additional Support

- DI Logical-mathematical learners will enjoy this activity. Pair them with students who need more support doing the calculations.

Activity 3.11 Answers

What to Do

Description of Trip	Approximate Distance	Calculated Time at Speed of 20 km/h
Canada, from west coast to east coast	5.20×10^3 km	260 h; 10.8 days
Around Earth's equator	4.00×10^4 km	2 000 h; 83.3 days
From Earth to the Moon	3.85×10^5 km	19 250 h; 802.1 days; 2.20 years
From Earth to Mars	5.80×10^7 km	2 900 000 h; 331.1 years
From Earth to the Sun	1.50×10^8 km	150 000 000 h; 17 123.29 years
From Earth to Jupiter	9.30×10^8 km	930 000 000 h; 106 164.38 years
From Earth to Neptune	4.30×10^9 km	4 300 000 000 h; 490 867.58 years
From Earth to the outer regions of the solar system	9.46×10^{12} km (at least)	9 460 000 000 000 h; 1 079 908 676 years (1.08×10^9)

What Did You Find Out?

1. Answers may vary. Students may say that their answers were close or not close, depending on the accuracy of their predictions.
2. Students' answers may vary; however, most students will likely answer that Earth to the Moon, Mars, and the Sun are practical trips in that they would take a reasonable amount of time.

Activity 3.12 Map the Solar System (Student textbook page 206)

Pedagogical Purpose

This activity will allow students to understand the distances between the planets and objects of the solar system by applying the scale to a map of their own community.

Planning	
Materials	map of your community sticky notes coloured pencils or markers ruler **BLM 3-18 Planet Distances from the Sun** (optional)
Time	30–40 min in class

Skills Focus

- use appropriate modes of representation and units of measurement
- express results accurately and precisely

Background Knowledge

The distance of each planet from the Sun is shown below:

Planet	Distance from Sun (AU)
Mercury	0.39
Venus	0.72
Earth	1.0
Mars	1.5
Jupiter	5.2
Saturn	9.5
Uranus	19
Neptune	30

Activity Notes and Troubleshooting

- Dollar stores or local tourism offices may have inexpensive (or free) community maps available.
- Satellite image maps, although more difficult to find, will be very interesting to students. Visit **www.scienceontario.ca** for some examples.
  - Enrichment—Have students use a satellite map of your community. Have them repeat What to Do steps 4 to 7 of the activity using the satellite map.
- Have students work with a partner or in a small group for this activity.

- Students may be completely unfamiliar with the solar system objects (the Asteroid Belt, the Kuiper Belt, and the Oort Cloud) mentioned in the Inquire Further section. If you plan to assign this extension activity, spend a few minutes of class time explaining these phenomena to students. Or, have students choose one of these topics and research it on the Internet. Have them report their findings to the class.

Additional Support

- You may wish to provide **BLM 3-18 Planet Distances from the Sun** to help some students organize their work.
- ELL Students with literacy challenges may find this activity daunting. Provide a photocopy of this activity and have students highlight the important information in each question. For example, in What Did You Find Out? question 2, the important information to highlight would be "five times farther from the Sun." Ensure that English language learners understand this math language. Demonstrate it by using classroom objects and measured distances within the classroom.
- ELL Demonstrate how to do this activity for English language learners by mapping one planet together as a class.
- DI Have spatial learners work with students who need to develop these skills.
- Enrichment—Students could create a scale model of the planets in our solar system. On their model, they could label the planets and the distances in astronomical units.

Activity 3.12 Answers

What Did You Find Out?

1. Students' answers will vary, depending on their community maps and the scale used. Ensure students understand the concept of 1 km representing 1 AU.
2. Jupiter
3. Students might say that they found it more difficult to mark the inner planets on their map, as these distances were closer together.
4. The locations that students chose to represent each planet on their map will vary, but the distances should be the same.

Inquire Further

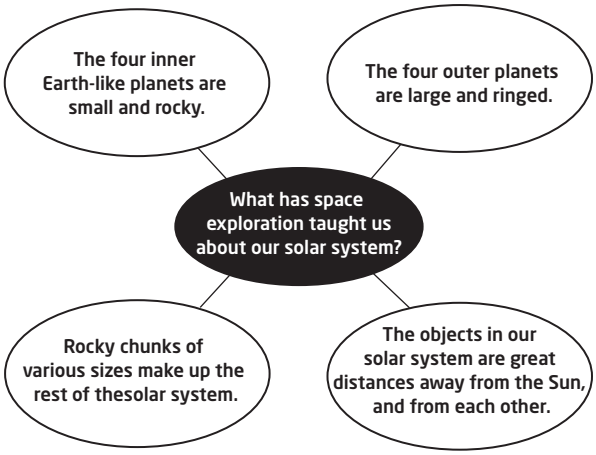
Students may need to research these solar system objects. The Asteroid Belt is located between the orbits of Jupiter and Mars. The Kuiper Belt extends from Neptune's orbit to about 55 AU away from the Sun, so, depending on the scale they are using, students would map this location past Neptune on their maps. They may need to extend their maps. The Oort Cloud is about 50 000 AU away from the Sun, so students would need to include an inset to show this location.

Topic 3.3 Review (Student textbook page 207)

Please see also **BLM 3-19 Topic 3.3 Review (Alternative Format)**.

Answers

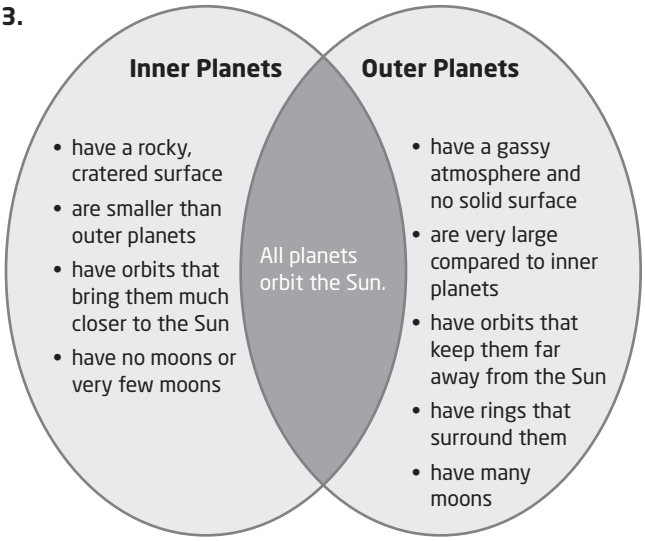
1.



2.

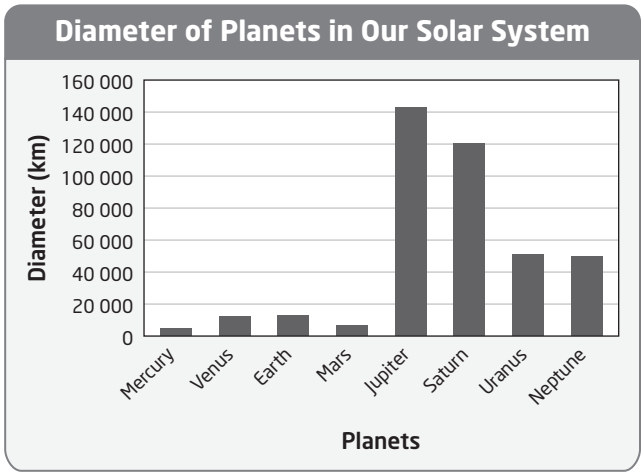
	Asteroid	Comet	Meteoroid
Description	Rocky objects; some are round; some are irregular-shaped; some are dozens or hundreds of kilometres across, but most are smaller	Chunks of loosely held rock and ice	Chunks of asteroids or comets that enter Earth's atmosphere
Origin	Originate in the region between the orbits of Mars and Jupiter, in the Asteroid Belt	Originate from the Kuiper Belt and Oort Cloud	Most burn up as they enter Earth's atmosphere, but those that land on Earth's surface are called meteorites

3.



4. Like Earth, Mars is near the Sun (less than 2 AU away). It has a similar rotation time as Earth (about 1 day). Its atmosphere contains carbon dioxide and oxygen, as Earth's does, although the amounts are different on Mars. It is possible that life might exist (or might have existed) on Mars.

5. Students' graphs should be similar to the following example.



The planets in order from the smallest to the largest diameter are as follows: Mercury, Mars, Venus, Earth, Neptune, Uranus, Saturn, and Jupiter.

6. Students' answers should include the prediction that *Voyager 2* used Jupiter as a slingshot. Jupiter is a massive planet that could exert strong gravitational attraction on the spacecraft. Also, Jupiter is between Earth and Neptune so a likely candidate for altering *Voyager 2*'s orbit.

7. Venus' atmosphere is composed mostly of carbon dioxide, which traps heat from the Sun, so the temperature always stays the same.

8. Venus is about the same diameter as Earth. Venus also has mountains, valleys, and volcanoes similar to those found on Earth. It is a similar distance away from the Sun, and has a similar time for one orbit.