Emera Astronomy Center
and M. F. Jordan Planetarium

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Cosmic Journey: A Solar System Adventure

COMPILED AND EDITED BY LEISA PREBLE

THE UNIVERSITY OF MAINE

A Member of the University of Maine System

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and M. F. Jordan Planetarium

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Mission Statement:
The mission of the Maynard F. Jordan Planetarium of the University of Maine is to provide the University and the public with educational multi-media programs and observational activities in astronomy and related subjects.

Cosmic Classroom

Looking for fun and interesting space activities? The planetarium staff has prepared a collection of materials we call the Cosmic Classroom for you to use before and/or after your visit. These materials are entirely for use at your own discretion and are not intended to be required curricula or a prerequisite to any planetarium visit. The Cosmic Classroom is one more way that the Jordan Planetarium extends its resources to help the front line teacher and support the teaching of astronomy and space science in Maine schools.

The lessons in this Cosmic Classroom have been edited and selected for the range of ages/grades that might attend a showing of this program at the Jordan Planetarium. Those activities that are not focused at your students may be adapted up or down in level. Our staff has invested the time to key these materials to the State of Maine Learning Results in order to save you time.

The State of Maine Learning Results performance indicators have been identified and listed for the program, the Cosmic Classroom as a package, and each individual activity within the package. The guide also includes related vocabulary and a list of other available resources including links to the virtual universe. We intend to support educators, so if there are additions or changes that you think would improve, PLEASE let us know.

Thank you, and may the stars light your way.

The Maynard F. Jordan Planetarium Staff

The Program – *Cosmic Journey*

Welcome aboard the Jordan Planetarium for an out-of-this-world journey to the planets! Our home planet, Earth, may seem very large to us, but it's only a tiny piece of the vast expanse we call our Solar System. This perennial favorite program blasts off on a tour that passes the Sun, planets, moons and other important parts of our star's family. The sometimes hostile environment of each planet, the differences and similarities to our own Earth are explained by mission specialists. Free time during the return home allows the planetarium host to point out constellations of the current sky.

We are very glad that you have chosen to visit our planetarium with your group. We hope that this guide either will help you prepare your group or help you review their experience at the University of Maine's sky theater.

State of Maine Learning Results Guiding Principles

The lessons in this guide, in combination with *Worlds of Wonder*, help students to work towards some of the Guiding Principles set forth by the State of Maine Learning Results. By the simple act of visiting the planetarium, students of all ages open an avenue for self-directed lifelong learning. A field trip encourages students to think about learning from all environments including those beyond the schoolyard. A Jordan Planetarium visit also introduces visitors to the campus of the largest post-secondary school in Maine and encourages them to think of this as a place which holds opportunities for their future education, enjoyment and success.

Other sites on the University campus, including three museums, explore a variety of subjects, and the Visitors Center is always willing to arrange tours of the campus. A field trip can contribute to many different disciplines of the school curriculum and demonstrate that science is not separate from art, from mathematics, from history, etc. The world is not segregated into neat little boxes with labels such as social studies and science. A field trip is an opportunity for learning in an interdisciplinary setting, to bring it all together and to start the process of thinking. For a more complete discussion of field trips, please visit the Jordan Planetarium web site at http://umainesky.com.

If used in its entirety and accompanied by the Planetarium visit this guide will help students to:

Become **a clear and effective communicator** through

A. oral expression such as class discussions, and written presentations
B. listening to classmates while doing group work, cooperation, and record keeping.

Become **a self-directed and lifelong learner** by

A. introducing students to career and educational opportunities at the University of Maine and the Maynard F. Jordan Planetarium.
B. encouraging students to go further into the study of the subject at hand, and explore the question of "what if?"
C. giving students a chance to use a variety of resources for gathering information

Become **a creative and practical problem solver** by

A. asking students to observe phenomena and problems, and present solutions
B. urging students to ask extending questions and find answers to those questions
C. developing and applying problem solving techniques
D. encouraging alternative outcomes and solutions to presented problems

Become **a collaborative and quality worker** through

A. an understanding the teamwork necessary to complete tasks
B. applying that understanding and working effectively in their assigned groups
C. demonstrating a concern for the quality and accuracy needed to complete an activity

Become **an integrative and informed thinker** by

A. applying concepts learned in one subject area to solve problems and answer questions in another
B. participating in class discussion

State of Maine Learning Results Performance Indicators

In conjunction with the Maynard F. Jordan Planetarium show *Worlds of Wonder,* this guide will help you meet the following State of Maine Learning Results Performance Indicators in your classroom.

Grades 3-5

Science and Technology –

B1. Skills and Traits of Scientific Inquiry

d. Use data to construct and support a reasonable explanation.

e. Communicate scientific procedures and explanations.

D1. Universe and Solar System

a. Show the locations of the sun, Earth, moon, and planets and their orbits.

b. Observe and report on observations that the sun appears to move across the sky in the same way every day, but its path changes slowly over the seasons.

c. Recognize that the sun is a star and is similar to other stars in the universe.

D2. Earth

a. Explain the effects of the rotation of Earth on the day/night cycle, and how that cycle affects local temperature.

e. Recognize that the sun is the source of Earth's surface heat and light energy.

D4. Force and Motion

d. Give examples of how gravity, magnets, and electrically charged materials push and pull objects.

Mathematics

C1. Geometric Figures (Gr. 3)

b. Know how to put shapes together and take them apart to form other shapes.

Grades 6-8

Science and Technology -

A2. Models

a. Compare different types of models that can be used to represent the same thing (including models of chemical reactions, motion, or cells) in order to match the purpose and complexity of a model to its use.

B1. Skills and Traits of Scientific Inquiry

e. Use logic, critical reasoning and evidence to develop descriptions, explanations, predictions, and models.

f. Communicate, critique, and analyze their own scientific work and the work of other students.

C4. History and Nature of Science

b. Describe a breakthrough from the history of science that contributes to our current understanding of science.

D1. Universe and Solar System

a. Describe the different kinds of objects in the solar system including planets, sun, moons, asteroids, and comets.

b. Explain the motions that cause days, years, phases of the moon, and eclipses.

D4. Force and Motion

c. Describe and apply an understanding of how the gravitational force between any two objects would change if their mass or the distance between them changed.

Secondary

Science and Technology -

D4. Force and Motion

a. Describe the contribution of Newton to our understanding of force and motion, and give examples of an apply Newton's three laws of motion and his theory of gravitation.

Performance Indicators Snapshot

The Show

<u>Grades 3-5</u>

Science and Technology
B1.a; D1.a, c
English Language Arts
E2.a.

<u>Grades 6-8</u>

Science and Technology
C4.b, D3.f.

The Guide

<u>Grades 3-5</u>

Science and Technology.
B1.d, e; D1.a, b, c; D2.a, e; D4.d.
Mathematics
C1.b

<u>Grades 6-8</u>

Science and Technology.
B1.e, f; D1.a, b; D2.a; D4.c

<u>9-Diploma</u>

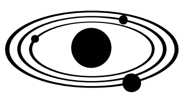
Science and Technology
D4.a

The Maynard F. Jordan Planetarium - Cosmic Classroom Activity

A Planetary Day, A Planetary Year

Based on A planetary day is caused by one rotation. A planetary year is causes by one revolution. by Susan Reynolds and Onondaga-Cortland-Madison Board of Cooperative Educational Services math, Science and Technology.

Objectives and State of Maine Learning Results Performance Indicators:



1. Learners will be able to describe the cycle of day/night and attribute it to the turning of Earth. (6-8. Science and Technology. D1.b.)
2. Learners will be able to define rotation and explain how it causes a planetary day (3-5. Science and Technology. D2.a.)
3. Learners will be able to define revolution and identify a planetary year as one revolution. (3-5. Science and Technology. D1.b.)

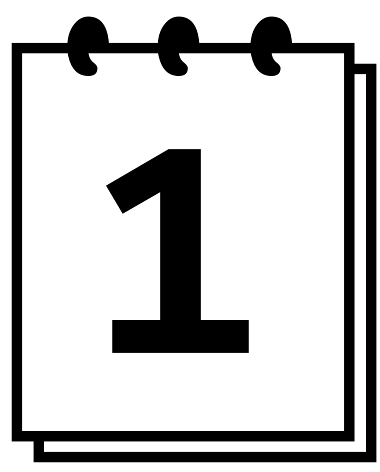
NGSS
Space Systems
1. MS-ESS-1. Learners will be able to develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
2. MS-ESS-1.A. Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.

The General Idea:

How do we measure a day? A year? Students often take for granted that a day has 24 hours in it and that there are 365 days in a year. But how do we determine what a day really is? Or how many days there are in a year? This activity will help students to understand that a planetary day is the amount of time that it takes for a planet to rotate once around its axis and a year is the amount of time it takes for a planet to revolve once around the Sun.

Getting Ready:

- Set up the globe and light



What You Need:

Globe
Small piece of clay
Light

What To Do:

1. Using the globe, place a piece of clay on your state
2. Shine the light on the globe
3. Slowly rotate the globe from west to east

What To Discuss:

1. What does it represent when our state faces the light?
2. What does it represent when our state faces away from the light?

3. How long does this combination of daytime and nighttime take on Earth?
4. What do we call a 24-hour period on the planet Earth?
5. If this 24-hour period is called an Earth day, what would a day on Jupiter be called? On Mars? (*Jupiter day, Mars day*)
6. How might we name a day so that we could talk about a day on any planet? (*a planetary day, one rotation around a planets axis causes one planetary day no matter which planet you are on.)*

What To Do:

1. Using the light to represent the Sun, walk around the light carrying the globe to represent revolution.
2. You can also spin the globe as you walk so that students can see the difference between the rotation and the revolution of the Earth.

What To Discuss:

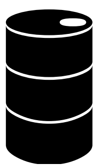
1. How long does it take for the Earth to revolve once around the Sun?
2. How many days are there in a year?
3. One revolution of the Earth around the Sun equals one Earth Year. If we were talking about any planet what would you call one revolution? (*a planetary year*).

How Much Would a Can of Soda Weigh?

Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to demonstrate that gravity is what causes objects to have weight. (3-5. Science and Technology. D4.d.) (6-8. Science and Technology. D4.c.)
2. Learners will be able to explain that the nine planets do not exert the same amount of gravitational force (6-8. Science and Technology. D4.c.).

The General Idea:



Weight is the name we give to the force acting in a direction toward the center of a planet. The pull of gravity is the natural force of attraction exerted by a planet upon objects at or near its surface. The force depends both on the mass of the planet and its diameter. (For example: a planet having twice the mass, but with the same diameter, of Mars would result in a surface gravity twice that of Mars). This activity will help students understand this concept by comparing the various relative weights of a can of soda if placed on the surface of each of the nine planets and our Moon.

Getting Ready:

- Mark each can with the name of one of the nine planets and our Moon.
- Place the number of pennies (from the chart below) in each can.

Planet	Number of pennies
Mercury	42
Venus	100
Earth	Full can of soda
Moon	18
Mars	42
Jupiter	275
Saturn	117
Uranus	99
Neptune	125
Pluto	7

What You Need:

10 clean, empty soft drink cans
approximately 850 pennies
a permanent marker

What To Do:

1. Allow each student to pick up and compare the weights of the cans

What To Discuss:

1. After the students have all had a chance to lift the cans and feel the differences in weight, ask students to discuss why they think the same can of soda would have different weights on different planets and our Moon.

Continuations/Extensions:

1. Place a half-gallon plastic milk jug upright and punch a small hole 2.5 cm (1") up from the bottom. Placing your finger over the hole, fill the jug with water. Go to a playground with a friend as an observer. Find a high place and make sure nobody is standing directly below. Take your finger off the hole and drop the jug. What does the observer see happening to the flow of water during the drop?
2. Does the weight of objects affect how fast they fall? Take 14 pennies. Make two piles of seven. Tape one pile together. Hold one pile in your right hand and the other in your left. Reach both hands up high and cleanly drop the two piles at the same time. The taped pile is at least seven times the weight of each penny in the other pile. Any conclusions?
3. How old would you be on another planet? If a year is described as the amount of time it takes for a planet to revolve around the Sun, for the Earth it's 365.25 days, then your age would be different on each planet. Use the chart below to figure out how old you would be.

Planet	**Number of days in a planetary year**	**Multiply your age by**
Mercury	87.97	4.152
Venus	224.7	1.626
Earth	365.25	1
Mars	687	.53
Jupiter	4,333	.084
Saturn	10,759	.034
Uranus	30,685	.012
Neptune	60,188	.006
Pluto	90,700	.004

There are now two ways for you to figure out your age. The first is to multiplying your age by 365 (to find the number of days) and then divide that number by the number in the middle column above to find out you age on that planet. For example, if you are 20 years old here on Earth and want to know your age on Jupiter, 20 X 365 = 7300 and then 7300X4900 = (approximately) 1.5. That means you'd be one and a half years old on Jupiter!

The second method is to multiply your age by the number in the right hand column. For example, if you are 20 and want to know your age on Neptune, 20 X .006 = .12 (years).

The Scaled Solar System

Objectives and State of Maine Learning Results Performance Indicators:

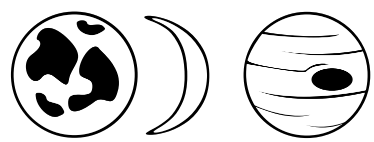
1. Learners will be able to explain the scale of the solar system in terms of size and distance (3-5. Science and Technology. D1.a.) (6-8. Science and Technology. A2.a)
2. Learners will be able to identify generalizations that people may have about the solar system and exceptions to those generalization (6-8. Science and Technology. B1.e).
3. Learners will be able to reflect on and what they are learning in this activity (6-8. Science and Technology. B1.f.)

The General Idea:

Most of us have seen models of the solar system at some point. And most of those models placed planets the size of baseballs just a few inches apart. With models like these it's no wonder that students often understand the differences in size between the planets without actually understanding the scale of the solar system. This activity deals with relative sizes ***and*** distances in the Solar System.

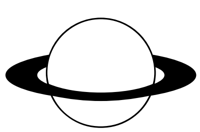
What You Need:
index cards

Scale models for all the planets and the moon.



What To Do - Part I Relative Size:

1. On the front of each index card write the name of a planet, the moon, the Sun, etc.
2. On the back of each index card write the diameter of the object using the chart following this lesson.
3. Show the students the scale models you are using to represent the objects, but do not tell the students which models represent which objects.
4. "Deal" out the index cards and have each student in turn come up and pick a model that they think represents the object on their index card. (If a student cannot find a suitable model among those that are left s/he may take one from another student and that student can choose another object)
5. Stop the game when all the students have the correct models for the objects indicated on their index cards.



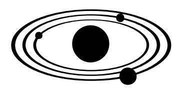
What To Do - Part II Relative Size and Distance:

1. Using the objects from Part I, try scaling the distances in the Solar System to the same scale you used for size (see attached table). The idea is for the class to discover that this cannot be reasonably done because the bodies are very, very small compared to the distances between them. That is, the Solar System consists mostly of empty space.
2. Now, to scale these relative distances to size, we note that the Earth is 11,730 times its own diameter away from the Sun. So, for whatever size we have chosen for the Earth it would have to be placed nearly 12,000 times that distance from the Sun. Clearly we cannot easily represent our miniature Solar System model by tying distance to size.

What To Do - Part III Relative Distance:

1. To get a relative distance model, we will ignore size.
2. For this final part, the class will construct a relative distance model of the Solar System based on the Distance-Scale Chart listed in Part II. In this case, however, all bodies in the solar system will be considered the same size (even though we know from Part I that they truly are not). Ping pong balls, marbles, balloons, Styrofoam or metal balls could all be used. One could even use the models from Part 1, as long as it is made clear that the Earth-Sun distance is arbitrarily picked, and not in scale to the Earth-Sun sizes.
3. The Earth-Sun distance is again the standard, and it could be set at, say, 10 cm. This would place Mercury, the nearest planet to the Sun, at 4 cm, and Pluto out at 400 cm, or 4 m. This appears to be a reasonable range for the classroom. You might want to double these by making the Earth 20 cm from the Sun if you have a fairly large room. The planet, Sun and Moon models should be physically placed at their respective relative distances (on the floor) so a good general view of the spacing of the planets can be seen.
4. Note that even at a 20 cm Earth-Sun distance, the Earth-Moon distance would be only 0.6 mm (less than 1 mm) and so they would be virtually touching each other!

What To Discuss:



1. Which planet is the biggest? The smallest?
2. How many times larger is the biggest planet than the smallest?
3. Is the Sun bigger than the biggest planet?
4. Is the Moon smaller than the smallest planet?
5. If Saturn's rings are included in its size, how much bigger than Jupiter is it?
6. Which planet is closest to Earth in size?
7. Which planet's size would be hardest to determine? Why?
8. Place the bodies of the Solar System in 4 groups by matching up their relative sizes.
9. List the planets from smallest to largest, including Earth.
10. Which 2 planets are closest together? Farthest apart?
11. Which planet is closest to Earth?
12. Which body in the solar system is closest to Earth?
13. Which planet do you think is the hottest? (Discuss Mercury and Venus).
14. What does the Solar System mostly consist of? Think of when we tried to make the true model by tying distance to size.
15. How are the planets spaced from the Sun? Evenly?
16. What is true for the inner planets? Are they relatively close or far?
17. Neptune and Pluto actually switch their places sometimes. How can this be? Will they collide? Why or why not?
18. List the planets from closest to the Sun to farthest from the Sun, including the Earth.
19. How does the Earth-Moon distance compare to the planet distances?
20. Are the planets always in a straight line? If not, are they ever in a straight line?

Continuations/Extensions:

1. For a more advanced class, you could calculate the distance of the nearest star to the Sun, Alpha Centauri, in the scaled model. At 4.3 light years, which is about 25 trillion miles, it would be 27.2 km, or about 17 miles away for an Earth-Sun distance of 10 cm!
2. Take the activity outside and set up the models without putting the planets in a straight line. This helps the students avoid the "beads on a string" image that many of them may have.

Planet	Diameter	Scale size	Scale distance to Sun	Suggested objects
Mercury	3,005 miles	0.38 X Earth	0.39 AU	Small marble dried pea
Venus	6,406 miles	0.81 X Earth	0.72 AU	Large marble Round button
Earth	7,908 miles	1	1 AU *	Shooter marble Ping Pong ball
Moon	2,151 miles	0.272 X Earth		Dried pea Plastic bead
Mars	4,191 miles	0.53 X Earth	1.52 AU	Large marble Small rock
Jupiter	88,570 miles	11.2 X Earth	5.2 AU	Basket ball Small beach ball
Saturn	74,335 miles	9.4 X Earth	9.54 AU	Soccer ball Volley ball
Uranus	31,632 miles	4 X Earth	19.2 AU	Tennis ball Apple
Neptune	30,683 miles	3.88 X Earth	30.1 AU	Tennis ball Racket ball
Pluto	1,423 miles	0.18 X Earth	39.5 AU	Tiny bead Tiny pebble

*AU (Astronomical Unit) = The diameter of object being used to represent Earth / 11,730

Interplanetary Tourism

Objectives and State of Maine Learning Results Performance Indicators:

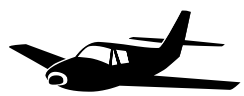
1. Learners will be able to describe the characteristics of the planets (3-5. Science and Technology. D1.a)
2. Learners will be able to present information effectively and persuasively (3-5. Science and Technology. B1.f)
3. Learners will be able to use various types of evidence to support the claims that they make about their planet (3-5. Science and Technology. B1.d.) (6-8. Science and Technology. B1.e)
4. Learners will be able to work effectively in groups, including activities such as brainstorming (3-5. Science and Technology. B1.e)

The General Idea:

This is an effective and enjoyable project for teaching the properties of each planet. By researching the characteristics of the planets and promoting tourism on each, teams of students will discover interesting and practical information about the planets. Encourage your students to be as creative as possible and to use their imaginations. In addition to learning about the planets, students will investigate ways that information can be slanted and after the activity they will look at real travel brochures and discuss where the information in them might be slanted as well.

What You Need:

Books about all the planets
Travel brochures



What To Do:

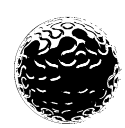
1. Divide the class into teams.
2. Assign each team a planet.
3. Each team is challenged to develop a TV commercial, sales pitch, or travel brochure (look at the travel brochures to develop an idea of what is expected) that would glamorize the properties of their planet (believe me, that's a challenge. For example, who would want to vacation on Venus with a night-time temperature of 900 degrees?)
4. Each team should research their planet in order to cover as much detail as possible.
5. You might want to create a brochure of your own along with you students.

What To Discuss:

1. Of all the planets covered, which one would the class ***really*** want to visit? Why? Why not the others?
2. What are some of the strategies that students used to slant the information about their planet in order to make it appealing?

Continuations/Extensions:

1. Considering what the class came up with as far as slanting information, look at the travel brochures and speculate about things that might not be as good as they sound and why.



Rotation of the Earth

Based on The rotation of the Earth causes apparent movement of the constellations. by Susan Reynolds and Onondaga-Cortland-Madison Board of Cooperative Educational Services math, Science and Technology.

Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to infer that the rotation of the Earth causes apparent movement of the constellations in the night sky (3-5. Science and Technology. D1.b)
2. Learners will be able to recognize the patterns of the stars from various directions. (3-5. Mathematics. C1.b)

The General Idea:

If you look at the night sky on a regular basis you will see that it doesn't always appear the same. Actually it very seldom appears the same. From season to season the constellations twist around the north star. Many students may wonder if the constellations are really spinning around us as they appear to be doing. In this activity students will view constellations from various directions so that they will begin to understand how the stars appear to move through the sky, when in fact it is Earth that is moving through the sky.

Getting Ready:

- Convert the enclosed star chart to an overhead transparency
- Locate a large piece of paper for the students to trace the projected star chart onto

What You Need:

Star chart transparency
overhead projector
large piece of paper
tape

What To Do:

1. Project the star chart onto the piece of paper
2. Have students trace the constellations on to the paper
3. Tape the paper to the ceiling
4. Have students lay on the floor and look up at the constellations
5. Each student should write down which constellation is on top
6. Have all the students move to another place and look at the constellations
7. Again have them record which constellation is on top

What To Discuss:

1. Circumpolar constellations are those that never set.
2. What did you notice as you changed positions and viewed the constellations?
3. Did the pattern of the constellations change? (lead students to notice that the patterns remained stationary but appeared to move as the students changed position).

Stars Give Off Light

Based on Stars give off light. The moon and planets reflect light. by Susan Reynolds and Onondaga-Cortland-Madison Board of Cooperative Educational Services math, Science and Technology.

Objectives and State of Maine Learning Results Performance Indicators:

1. The learners will be able to explain that stars give off light (3-5. Science and Technology. D2.e)
2. The learners will be able to demonstrate an understanding that moons and planets get their light from stars. (3-5. Science and Technology. D1.c)
3. The learners will be able to show that the Sun is a star. (3-5. Science and Technology. D1.c)

The General Idea:

To the untrained eye, the night sky is ablaze with the light of thousands of tiny dots. From here on Earth it is sometimes hard to tell the stars from the planets. This activity will help students understand that while both the stars and planets appear to shimmer in the night sky, they are very different objects indeed.

Getting Ready:

- Provide half of the students with Styrofoam balls of varying sizes and the other half with flashlights of varying brightness.

What You Need:

Styrofoam ball
Flashlights
Slide projector
Penlight

What To Do:

1. Hand out the Styrofoam balls and flashlights
2. Darken the room
3. Have the students with the flashlights (the "Stars") shine away from the Styrofoam balls (the "planets")
4. Now have the "stars" shine ON the "planets"

What To Discuss:

1. Are the "planets" easy to see?
2. Is it easier to see the "planets" with the "stars" shining on them?
3. Do moons and planets give off light of their own?

What To Do:

1. Have a student hold a penlight next to a an unlit slide projector
2. Ask the students how easy it is to see the light from the penlight (easy)
3. Turn on the slide projector (warn students NOT to look into the light from the slide projector because it could hurt their eyes)
4. Ask the students if it's still easy to see the penlight or if they can see it at all now (no)

What To Discuss:

1. Why couldn't we see the penlight as well when the projector was on?
2. If the slide projector is the Sun and the penlight is a star, what effect does the Sun have on our ability to see stars during the day?
3. Why can't we see stars during the day?

Extensions/Continuations:

1. Have students create "legends" about why we cannot see stars during the day, perhaps putting them together into a class book or a book for the library.

A-Cross the Solar System

Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to recall the bodies that make up our solar system based on their characteristics. (6-8. Science and Technology. D1.a)

The General Idea:

This crossword puzzle is a fun way for students to review the members of the solar system as well as study the characteristics of each. This crossword can be used for review before a test, taken home as homework or given out just for fun.

Getting Ready:

- Photocopy the provided "A-Cross the Solar System" crossword puzzle

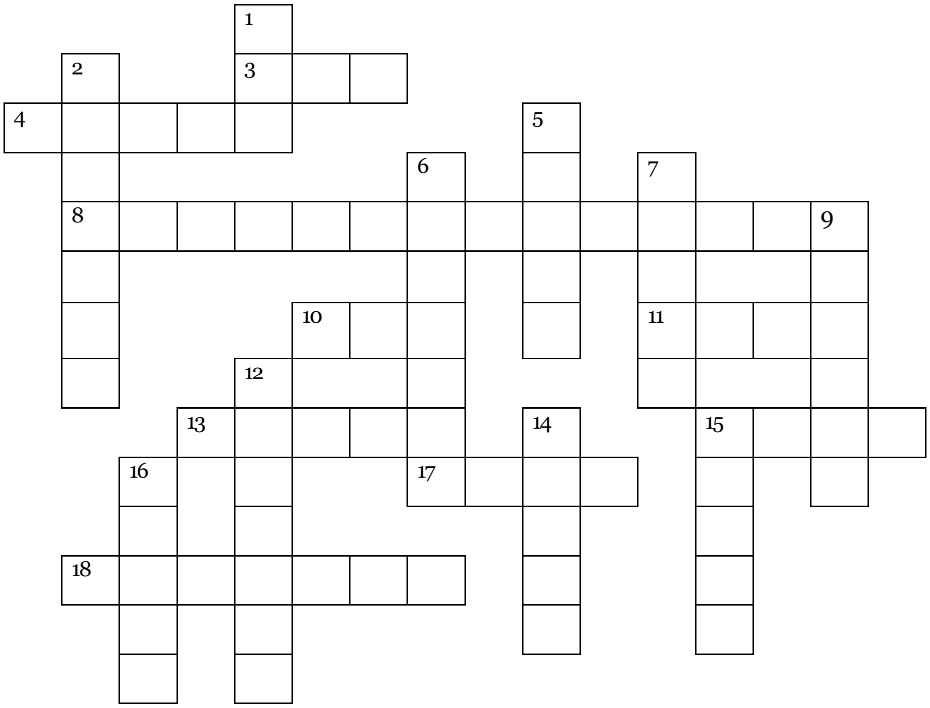
What You Need:

A copy of "A-Cross the Solar System" for each student

What To Do:

1. Hand out the crossword puzzles for review before a test on the solar system, homework, just for fun, or for another activity that you have chosen to use it for.

A-Cross the Solar System



Across

3 The gases in our atmosphere are called ______.
4 The hottest planet with land is called ______.
8 Imaginary pictures made of stars are called ______.
10 The name of the closest star to Earth is ______.
11 ______ from the sun warms our planet.
13 The path a planet follows around the sun is called ______.
15 The Red Planet is ______.
17 A ball of burning gas is a ______.
18 The largest planet in our solar system is ______.

Down

1 Jupiter and Saturn are ______ giants.
2 The closest planet to the Sun is ______.
5 The Solar System has more of this than anything else.
6 Bodies that travel around a star are called ______.
7 Stars produce their own ______.
9 The planet with the largest rings is ______.
12 ______ is an invisible force that holds the solar system together.
14 The planet with life on it is ______.
15 Natural objects that travel around planets are called ______.
16 The smallest, coldest planet is ______.

Vocabulary List

Apparent Motion	The motion of celestial objects as observed from Earth
Asteroid	A large rocky body in orbit around the sun; most asteroids are found in orbit in the asteroid belt between Mars and Jupiter
Astroid belt	A large group of asteroids in orbit around the sun between Mars and Jupiter
Axis	An imaginary straight line around which an object rotates.
Core	The innermost layer of a planet, moon, or star
Full Moon	A moon that appears as a whole circle in the sky; a full moon occurs once each lunar month, when the moon is on the opposite side of Earth from the sun.
Gas Giants	The large, gaseous outer planets of the solar system, including Jupiter, Saturn, Uranus, and Neptune; these planets are sometimes referred to as the Jovian planets.
Gibbous Moon	The shape the moon takes when it is between a full moon and a half moon or between a half moon and a full moon.
Gravity	A physical force that attracts objects to each other, the more massive an object, the stronger its gravitational force.
Half Moon	The shape of the moon when it looks like half a circle; sometimes called a quarter moon.
Heliocentric	A system in which the sun is at the center.
Inner Planets	The four planets orbiting closest to the sun, Mercury, Venus, Earth, and Mars; these planets are relatively small, rocky planets with few or no moon.
Jovian Planets	A term used to describe the large, gaseous planets of Jupiter, Saturn, Uranus, and Neptune.
Kuiper Belt	An area beyond Neptune containing thousands of small objects, including short-period comets.
Meteor	A meteoroid that has entered Earth's atmosphere; often called shooting stars.
Radiate	Sends out rays or shines brightly.
Reflect	Light bouncing off an object.
Relative Distance	The distance between two objects as compared to something else.
Relative Size	The size of an object as compared to another object.
Revolution	The circling of a smaller object around a larger object.
Rotation	The spinning of an object on its axis.
Meteor	A meteoroid that has entered Earth's atmosphere, often called called shooting stars.

Meteorite	A meteor that has fallen to Earth.
Meteoroid	Small rocks or pieces of metal that travel through space
Moon	A natural satellite that orbits a planet or other object
Nebula	A cloud of gas and dust found I space; stars are born in nebulae.
New Moon	The moon phase in which the moon is not visible because the side of the moon facing the Earth is not lit by the sun.
Oort Cloud	A cloud of rocks and dust that surrounds our solar system beyond the Kuiper Belt; believed to be the source of most of the comets in the solar system.
Outer planets	The planets orbiting farthest from the sun, including Jupiter, Saturn, Uranus, and Neptune; also called the gas giant planets as they are large gaseous, ringed, and have many moons.
Planet	A large body orbiting a star that does not shine on its own.
Seasons	Periods of time on Earth – winter, spring, summer, and autumn; caused by the tilt of Earth's axis; seasons can occur on other planets as well.
Waning	Shrinking in size; used to describe the phases of the moon.
Waxing	Growing in size; used to describe the phases of the moon.

Some good books to use with *Cosmic Journey*

Atlas of the Solar System
Moore, P. & Hunt, G. 1983, Rand McNally.
Large illustrated atlas, a nice reference book.

The Cambridge Photographic Atlas of the Planets
Briggs, G. & Taylor, F. , 2nd ed. 1986, Cambridge U. Press.
Has many high quality photographs.

Cosmic Catastrophes
Chapman C. & Morrison, D. 1989, Plenum.
Violent events in the solar system.

The Grand Tour: A Traveler's Guide to the Solar System
Miller, R. & Hartmann, W. 1981, Workman.
A beautiful primer.

Our Solar System
Asimov, 1. 1988, Gareth Stevens.
Briefly describes the characteristics of the sun and planets

Planets Beyond: Discovering the Outer Solar System
Littmann, M. 1988, Wiley.

Planets of Rock and Ice
Chapman, C. 1982, Scribners.
A readable introduction to the inner planets.

Rings
Elliot, J. & Kerr, R. 1984, MIT Press.
Guide to our discovery & current knowledge of rings around the outer planets.

Our Solar System
Simon, Seymour. 1992, Morrow Junior Books

Traveler's Guide to the Solar System
Barnes-Svarney, Patricia. 1993, Sterling Publishing Company

The Sun
Simon, Seymour. 1986, William Morrow And Company, Inc.

The Moon Observer's Handbook
Price, F. 1989, Cambridge University Press.

A Distant Puzzle: The Planet Uranus
Asimov, Isaac, 1994, Milwaukee : Gareth Stevens Pub.,
Revised edition of "Uranus: The Sideways Planet"

Some good web sites to use with *Cosmic Journey*

jpl.nasa.gov
NASA's Jet Propulsion Laboratory web site

ssd.jpl.nasa.gov
A site about our solar system maintained by the Solar System Dynamics Group of the Jet Propulsion Laboratory.

www.nineplanets.org
A Multimedia Tour of the Solar System from the Students for the Exploration and Development of Space

Lessons From The World Wide Web

Also, a wide variety of lesson plans and activities can be found on the World Wide Web. These sites are dedicated to lesson planning in a variety of subjects.

btc.montana.edu/ceres
Maintained by the Burns Telecommunications Center, this page links to educational activities and classroom resources.

spaceplace.jpl.nasa.gov/spacepl.htm
This California Institute of Technology and NASA Jet Propulsion Laboratory site for kids offers information and activities.

school.discoveryeducation.com
This Discovery Channel education site allows teachers to search for lesson plans by grade and subjects.

Astronomy Web Sites Worth a Visit

Astro.umaine.edu
The Emera Astronomy Center and Maynard F. Jordan Planetarium & Observatory home page

hawastsoc.org
The Hawaiian Astronomical Society's home page0

www.nss.org
The National Space Society web site

stardate.org
Learn what's going on TODAY in astronomy on the "Star Date" web page, maintained by the University of Texas' McDonald Observatory

The Maynard F. Jordan Planetarium does not guarantee that the information given on the above web sites to be accurate, accessible, or appropriate for students.