



# Maynard F. Jordan Planetarium

## A SKY ODYSSEY

Edited by Aaron Schlosser

Cosmic Classroom.....	3
The Program – A Sky Odyssey.....	3
State of Maine Learning Results Guiding Principles .....	3
State of Maine Learning Results Performance Indicators .....	4
Cosmic Classroom Activities	
Seeing Stars.....	7
Seeing the Invisible.....	9
Classifying Galaxies .....	11
A Ballooning Universe .....	13
Vocabulary List .....	15
The Universe At Your Fingertips .....	17
Some good books to use with A Space Odyssey .....	17
Some good web sites to use with A Space Odyssey .....	19
Lessons From The World Wide Web.....	19
Astronomy Web Sites Worth a Visit .....	20

### **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.

Material within this Cosmic Classroom package is copyrighted to the University of Maine Maynard F. Jordan Planetarium. Educators are granted permission to make up to 9 copies for personal use. Express written permission is required, and usually will be freely granted, for duplication of 10 or more copies, or for use outside the classroom.





# 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 – *A Sky Odyssey*

In recent years there have been amazing advances in how we view our galaxy. With the launch of the Hubble Space Telescope and the Chandra X-ray observatory cosmologists have been able to explore the furthest reaches of space. In conjunction with the many terrestrial observatories these new technologies are helping to redefining the properties of the universe. *A Sky Odyssey* takes you to our neighboring galaxies, brilliant nebulas and eventually to the edge of space as we know it. Along the way our visitors will encounter pulsars, quasars and giant black holes. During this short trip the planetarium staff will point out the constellations in the sky overhead this season.

We're 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 *A Sky Odyssey*, will 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.

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 life long 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 of the teamwork necessary to complete tasks
  - B. applying that understanding and working effectively in 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

## State of Maine Learning Results Performance Indicators

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

### Grades 5-8

#### **Science and Technology -**

##### G. Universe

- #1. Compare past and present knowledge about characteristics of stars and explain how people have learned about them.
- #2. Describe the concept of galaxies, including size and number of stars.
- #3. Compare and contrast distances and the time required to travel those distances on Earth, in the solar system, in the galaxy, and between galaxies.
- #4. Describe scientists’ exploration of space and the objects they have found.
- # 5. Describe the motions of moons, planets, stars, solar systems, and galaxies.

##### J. Inquiry and Problem Solving

- #1. Make accurate observations using appropriate tools and units of measure.
- #2. Design and conduct scientific investigations which include controlled experiments and systematic observations. Collect and analyze data, and draw conclusions fairly.

##### K. Scientific Reasoning

- #1. Examine the ways people form generalizations.

L. Communication

- #4. Make and use scale drawings, maps, and three dimensional models to represent real objects, find locations, and describe relationships.

**Social Studies -**

**Geography.**

A. Skills and Tools

- #1. Visualize the globe and construct maps of the world and its sub-regions to identify patterns of human settlement, major physical features, and political divisions.

**English Language Arts -**

H. Research Related Writing

- #1. Collect and synthesize data for research topics from interviews and field work, using note taking and other appropriate strategies.
- #2. Separate information collected for research topics into major components based on relevant criteria.

Secondary

**Science and Technology -**

G. Universe

- #1. Describe how scientists gather data about the universe.

J. Inquiry and Problem Solving

- #1. Make accurate observations using appropriate tools and units of measure.
- #2. Verify, evaluate, and use results in a purposeful way. This includes analyzing and interpreting data, making predictions based on observed patterns, testing solutions against the original problem conditions, and formulating additional questions.

K. Scientific Reasoning

- #3. Develop generalizations based on observations.

**Mathematics**

F. Measurement

- #1. Use measurement tools and units appropriately and recognize limitations in the precision of the measurement tools.





## Seeing Stars

### Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to demonstrate how the Hubble Space Telescope “sees” stars.
2. Learners will be able to describe how telescopes are one of the ways that scientists explore space and gather data about the universe (5-8. Science and Technology. G. #4) (Sec. Grades. Science and Technology. G. #1)
3. Learners will be able to explain how the Hubble Space Telescope has helped scientists learn more about stars (5-8. Science and Technology. G. Grades #1.)



### The General Idea:



The reconfigured Hubble Space Telescope has been producing incredible high-resolution pictures of celestial objects that are superior to any produced by a land-based telescope. The Hubble will remain in space for years, capturing light from distant objects and radioing images to NASA scientists on Earth. The images are transmitted byte by byte in numerical form (binary code) to waiting computers that store the data and interpret the numbers used to reassemble the images into high resolution photographs.

There’s no way you’re going to duplicate the imaging process in a classroom, of course. What you can do, though, is demonstrate in simple terms just how the process works. (This activity is adapted from an activity created by the Exploratorium, San Francisco, CA.)

### Getting Ready:

- Set up the slide projector in a large dark room (We recommend a gymnasium) and focus a recognizable slide at a distance of about 20 feet.
- Hold up a sheet of paper in the beam to focus the projector. Be sure the focus point is in the middle of the room. If it’s near a wall, the image will be too easy to make out (you want the image to be in focus on the paper you hold in the middle of the room, NOT on the wall).

### What You Need:



- Slide projector
- A color slide of a clearly defined object, such as Saturn
- One flat, white dowel rod, 1/2" x 36"
- A sheet of white paper
- A very dark room

### What To Do:

1. Turn on the projector to reveal the unidentifiable image on the wall.
2. Hold the white dowel rod in one hand, and slowly move it up and down, perpendicular to the projector beam, at the focus distance. Ask the students to try to make out the picture.
3. Gradually increase the speed of the rod’s movement. When the rod is moving very fast, the image will become very clear.

What To Discuss:

1. This activity demonstrates the imaging process used by the Hubble Space Telescope. By slowly moving the rod across the projector's beam, at a point where a projection screen is usually located, small fragments of the image are captured and reflected ("radioed") toward the students. Because the fragments are quickly forgotten, the addition of many more fragments, as the rod continues to move, confuse the image in the student's mind. However, as the rod is moved more rapidly, an important property of the eye comes into play. Light images are momentarily retained on the retina of the eye. This property is called "persistence of vision."



As the rod is moved rapidly, each image fragment remains just long enough to combine with other fragments to form a recognizable image. In this activity, the eye is an analogy of the image processing computer that stores numerical image fragments - collected and radioed to Earth by the Hubble Space Telescope - and reassembles them for use.

Continuations/Extensions:

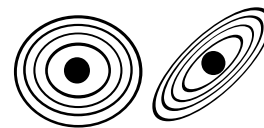
Using a flat rod positioned at varying heights on "hurdle" supports, project the image as in step #1. The images "data" can then be recorded on graph paper by the students. This also accurately exemplifies the light detector matrix or CCD (Charge Coupled Device) sensor in the telescope, digital cameras, and camcorders.



## Seeing the Invisible

### Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to describe different ways in which light energy travels (5-8. Science and Technology. H. #3. Sec. Grades. Science and Technology H #1)
2. Learners will be able to make observations using appropriate tools and units if measure. (5-8. Science and Technology. J.#1 Sec. Grades. Science and Technology. J. #1.)
3. Learners will be able to compare past and present knowledge about characteristics of stars (5-8 Science and Technology. G #1)
4. Learners will be able to describe how scientists gather data about the universe and current explanations for phenomena such as black holes and quasars. (Sec. Grades. Science and Technology. G #1 and G #2)



### The General Idea:

Scientists utilize the many forms of non-visible light in order to explore the outer reaches of our galaxy. Million dollar instruments like the Hubble Space telescope and the Chandra X-ray observatory use highly sensitive instruments to capture images of distant stellar phenomenon.

Students will study the invisible light given off by our own sun to better understand the galaxy around them. Most of the electromagnetic spectrum is invisible to our eyes, but these simple experiments created by William Herschel and Johann Ritter elegantly show the existence of longer wavelength *infrared* radiation and shorter wavelength *ultraviolet* light.

### **Activity 1:** Detecting Infrared Radiation: Herschel's Experiment

#### What You Need:

- Prism
- light source (the Sun)
- Three thermometers
- Pencil and paper

#### Getting Ready:

Find a table with easy access to a window or some other source of light. Place the prism on top of a box or stack of books so that the spectrum is projected onto the table.

#### What To Do:

1. Allow the three thermometers to register the ambient air temperature—about 5 minutes. Take careful note of the temperatures.
2. Create a spectrum on the table using sunlight and the prism.
3. Place thermometers at several points in the spectrum : one in the violet range, one in the center and one **just barely beyond** the red end. Leave the thermometers in the spectrum for at least five minutes, moving carefully as the sunlight moves the spectrum.
4. Observe the thermometers, changes may be very slight.

#### What To Discuss:

- Even though one of the thermometers was not in the visible spectrum there was an equal temperature change in all three. Why?
- What are the final readings on each of the three thermometers?
- Why would there be an increase in the temperature beyond the red end of the spectrum?
- What does this tell us about what exists beyond the visible red?

## **Activity 2:** Detecting Ultraviolet Radiation: Ritter's experiment

### What You Need:

- Several sheets of blueprint paper (available at your local blueprint or architectural firm)
- 1qt. of household ammonia
- flat pan
- prism
- light source (the Sun)
- felt pen

### Getting Ready:

Find a table with easy access to a window or some other source of light. Place the prism on top of a box or stack of books so that the spectrum is projected onto the table. Make sure to employ basic safety precautions, as ammonia can be harmful.

### What To Do:

Using the prism create a spectrum on the table. Make sure to use light from an open window, as glass blocks most ultraviolet radiation. Take care not to bump the table because this will move the spectrum, altering your results.

1. Working quickly to prevent exposure of the paper to too much light, cut a piece of the blueprint paper about four times larger than the spectrum. Place the blueprint paper into the spectrum. Quickly outline the area covered by the spectrum with a felt-tipped pen. Label the violet end.

*Note: Depending on the sensitivity of the paper, different exposure times will be needed. Most exposure times will be fairly brief, however: about 15 to 20 seconds.*

3. Put just enough ammonia in the pan to cover the bottom to a depth of about 0.5 in. (1 cm). In front of an open window or beneath a vent fan, hold the paper over the pan of ammonia so the fumes can process the paper. Notice the changes in the area outlined and the area just beyond the violet end. You may notice that this area began to change even before processing with ammonia.

### What To Discuss:

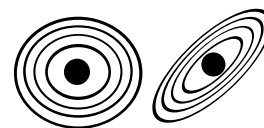
- Even though the entire piece of paper was not exposed to the light spectrum you may notice changes over the whole piece of paper. Why?
- What happened to the part of the paper lying where you can see violet?
- What happened to the part of the paper lying just beyond that violet section?
- What does this demonstrate about the area beyond the violet end of the spectrum?



## Classifying Galaxies

### Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to describe the different types of galaxies (5-8. Science and Technology. G. #2.)
2. Learners will be able to use scale drawings to appropriately represent galaxies (5-8. Science and Technology. L. #4.)
3. Learners will be able to place galaxies in their appropriate place on the tuning fork diagram (Sec. Grades. Science and Technology. J. #2.)



### The General Idea:

Through this lesson students will become familiar with the Hubble Tuning Fork Diagram, a system of classification, still in use today, for galaxies invented in the 1920's by the noted astronomer Edwin Hubble. Students will practice the technique, useful in science, of engaging a scheme or plan to classify objects in a group. In this lesson you will be able to look at images of different kinds of galaxies, taken by the world's best telescopes. In most high school astronomy texts and in some Earth science texts, the Hubble Tuning Fork Diagram is presented as a way to classify, or put into groups, the various types of galaxies observed in space. This lesson also reinforces the idea that there are many "right" answers in science.

### Getting Ready:

For this lesson you will need nine pictures of galaxies selected for differences in observable characteristics (i.e. color, size, shape, etc.). We recommend photographs from one of these WWW sites: <http://www.astr.ua.edu/normal2.html> OR [http://www.astro.princeton.edu/~frei/Gcat\\_htm/cat\\_ims.htm](http://www.astro.princeton.edu/~frei/Gcat_htm/cat_ims.htm). Please note that it is helpful if you select one galaxy for each of those on the Tuning Fork Diagram below and all in color. You can also use the images provided at the end of this activity; however they eliminate the category of color when classifying them.

### What You Need:

Nine pictures of galaxies  
Chalkboard or overhead projector for recording class key.  
Paper and pencils for student group recording.

### What To Do:

#### Part I:

1. Display the pictures of galaxies and discuss their similarities and differences.
2. Ask a volunteer to divide the photographs into two groups using an observable characteristic (i.e. blue and not blue, round and not round, etc.).
3. Record results of first division.
4. Continue to divide groups of pictures, using a different characteristic each time, until only one photograph remains in each group. Continue recording results.
5. Using the class key, identify "unknown" pictures (optional).

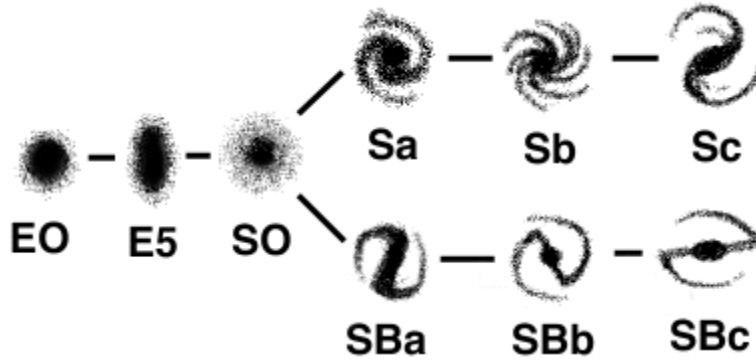


#### Part II:

6. Divide class into groups of four to six students.
7. Provide each group with a sample set of photographs or display the first set (numbered) in a place where all the students can observe them.
8. Ask each group to devise and test a way of classifying galaxies that is different from the class key and have them record their results.

What To Discuss:

1. Tell students about how in the 1920's Edwin Hubble, an astronomer, gathered pictures of many galaxies. When he noticed that they were not all alike, he decided to group, or classify them. To group the galaxies in the photographs he studied, he could have used any of the ways that your students came up with, and perhaps he did. Hubble decided to classify galaxies by their shape or form. He created the following diagram, which is still used today, to classify the galaxy shapes.



The first type of galaxy is an “elliptical” galaxy. The word elliptical refers to its degree of "roundness". Hubble used the letter "E" to stand for elliptical galaxies.

The second type of galaxy Hubble called a “spiral” galaxy. It reminded him of a pinwheel or whirlpool. He used the letter "S" to stand for spiral galaxies.

The third type of galaxy reminded Hubble of a spiral with a solid bar across the center. He called it a “barred spiral” galaxy. He used the letters "SB" to stand for barred spirals.

2. Early photographic processes and small telescopes could not capture color very well, if at all. Especially the most distant galaxies were too faint to capture color. These may have been reasons that Hubble did not classify galaxies by color.

Continuations/Extensions:

1. Repeat activity with other objects such as potato chips, candy, shoes, etc.
2. Emphasize that the way Hubble chose is not the only way to classify galaxies.
3. After each group has devised and tested a way of classifying galaxies that is different from the class key, have the class discuss the differences and similarities in the systems that were designed.



## A Ballooning Universe

### Objectives and State of Maine Learning Results Performance Indicators:

1. Describe the concept of galaxies, compare and contrast distances and the time required to travel those distances between galaxies and describe the motions of galaxies. (5-8 Science and Technology G#1, G#2, G#5)
2. Explain how astronomers measure interstellar distances. Describe how scientists gather data about the universe. (Secondary G#1, G#3)
3. Make accurate observations using appropriate tools and units of measure. (Science and Technology 5-8 J#1) (Science and Technology Secondary J#1)
4. Design and conduct scientific investigations which include controlled experiments and systematic observations. Collect and analyze data, and draw conclusions fairly. (Science and Technology 5-8 J#1) (Science and Technology Secondary J#1)

### The General Idea:

Does the universe have a center? What does it mean when astronomers say that the universe is expanding? How do astronomers measure that expansion? These questions are at the heart of cosmology, and they are often stated to students without giving them a chance for hands-on exploration. This simple activity allows students to "feel" the universe expanding and to develop their own personal understanding of an expanding, infinite universe. Along the way, the activity models the process of scientific measurement and data analysis.

Students, working in pairs, put marks on a balloon to represent galaxies, measure and record the distances between marks and then inflate the balloon. Repeated measuring as the balloon inflates demonstrates how the universe could expand, with all galaxies receding from each other. Students report their results to the class and discuss questions about their model.

### What You Need:

1. Balloons (1 per pair of students)
2. Marking pens (1 per pair of students)
3. Measuring tape (1 per pair of students) or do it your self measuring tape, master included.
4. Blank paper

### What To Do:

1. Imagine a universe of many galaxies distributed throughout space. We can make a two dimensional model of that universe by drawing galaxies on the surface of a balloon.
2. Hand out a balloon and pen to each pair of students. Have them take turns drawing several galaxies on the balloon. Have them mark a unique name (or number or letter) by each galaxy that they draw.
3. Hand out a tape measure for each of them. Alternatively, hand out the "do it your self" sheet of scissors and tape for each team. They can cut and tape the ruler strips from the sheet into one long strip to be used as a "paper tape measure" for measuring the distance around the balloon.
4. Have each student draw a "Distance Table" on a blank sheet of paper and label the rows:

"Distance 1---Between Galaxy \_\_\_\_\_ and Galaxy \_\_\_\_\_ circumference of Universe \_\_\_\_\_"  
"Distance 2---Between Galaxy \_\_\_\_\_ and Galaxy \_\_\_\_\_ circumference of Universe \_\_\_\_\_"  
"Distance 3---Between Galaxy \_\_\_\_\_ and Galaxy \_\_\_\_\_ circumference of Universe \_\_\_\_\_"  
"Distance 4---Between Galaxy \_\_\_\_\_ and Galaxy \_\_\_\_\_ circumference of Universe \_\_\_\_\_"

there should be three blank columns.

5. Have one student in each team blow up the balloon so that it just barely starts to inflate, then hold the neck of the balloon pinched between two fingers so that it does not lose air. Have the second student of the team measure the separations between three pairs of galaxies on the balloon and record the galaxy names and distance in the table. The second student also measures the distance around the balloon with the tape measure and records that distance in the last row of the table. The first student of the team can then release the balloon and copy the measurements onto his or her own distance table.
6. Ask the students to predict what the distance between the galaxies will be if they expand their balloon universe to twice the size that it was for their first measurement. Have them write their predictions by the distance entries that they recorded in their Distance Tables.
7. To see if their prediction is correct, one student holds the paper tape measure in a loop twice as big as the circumference of the balloon in their first measurement. The other student blows up the balloon to fit. It may take a few tries to get it just right. Once the balloon fits the right circumference, the balloon blower pinches the neck of the balloon to keep air from escaping, while the other team member measures the distance between the same three pairs of galaxies that were measured before, and records the measurements in the table.
8. Have the teams report on their results.

What To Discuss:

- Are the galaxies moving away from each other? (yes)
- Is there any “center” on the surface of the balloon? (No, the center of the balloon doesn’t count because two dimensional people living on the two-dimensional surface would not be able to go to that center)
- What are the weaknesses in our model of the universe?
- In what ways might our balloon Universe model be different from the real universe? [Background for the teacher: The real universe is not like the surface of a balloon; the universe has 3 dimensions of space, not just two; the universe is expanding in Einsteinian “space-time,” a Four-dimensional space that is not at all reasonable to common sense; the galaxies themselves are not expanding (the way they do on the balloon; it is the time and space between them that is expanding. One similarity: the real universe does not have a center, any more than the 2 dimensional surface of the balloon has a center.)]

In the real universe, evidence shows that all galaxies are moving away from each other. **Will our universe expand forever or will it stop expanding and start collapsing someday?**

# Vocabulary List

Axis	An imaginary straight line around which an object rotates.
Astronomical Unit - AU	The average distance from the Earth to the Sun, 93million miles.
Centimeter	A metric unit of length equal to 0.01 meter.
Classify	To arrange or put objects into categories.
Constellation	A grouping of stars, considered by humans to form a picture in the sky. Often related to mythology.
Data	factual information (as in measurements, statistics, etc.) that can be used as a Basis for reasoning, discussion, calculation, etc.
Day	The time it take for a planet to make one full rotation (on Earth, 24 hours).
Diameter	The distance from one side of an object to another as measure through the center.
Elliptical	Shaped like an ellipse or oval.
Galactic cluster	Galaxies tend to cluster together, sometimes in small groups and sometimes in enormous complexes, these are often called galactic clusters.
Galaxy	A very large group of stars and associated matter of which there are billions found throughout the universe.
Gravity	The force of attraction between two objects which is influenced by the mass of two objects and the distance between the two objects.
Meter	The base unit of length in the International System of Units that is equal to the distance traveled by light in a vacuum in $1/299,792,458$ second or about 39.37 inches.
Moon	A natural satellite orbiting a planet.
Orbit	A specific path followed by a planet, satellite, etc.
Planet	A massive object orbiting a star.
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.
Scale	Reducing all objects and distances by a percentage so that they are within a workable size.
Scale Model	A model of an object that is a percentage of its actual size.
Solar System	The system of planets, moons, and other objects revolving around a star (in our case, the Sun).

Space Probe	A vehicle designed to travel and explore remote locations in space and return information to astronomers and scientists.
Spiral	Winding around a center or pole and gradually receding from Or approaching it.
Star	a massive, self-luminous celestial body of gas that shines by radiation derived from its internal energy sources.
Sun	Sol, the star that is closest to Earth and from which we get heat and light energy.
Telescope	A device used to form magnified images of distant objects.
Ultraviolet Universe	Light rays lying just beyond the violet end of the visible spectrum. The vast expanse of space which contains all of the matter and energy in existence.
Volume	The amount of space occupied by a three-dimensional object as measured in cubic units.
X-ray	A ray or radiation of very short wavelength. that can penetrate solid substance.
Year	The time it take for a planet to make one full revolution around a star, in our case, the Sun (on Earth, 365.25 days).

# The Universe At Your Fingertips

In addition to the lesson plans included in this teacher guide, we recommend the following activities from [The Universe at your Fingertips: An Astronomy Activity and Resource Notebook](#) published by the Astronomical Society of the Pacific. This very comprehensive compendium of astronomy activities is an excellent resource that is available from the Maynard F. Jordan Planetarium. State of Maine Learning Results performance indicators are listed for each activity.

<b>State of Maine Learning Results Performance Indicators</b>	
<b>“Fingertips” Activity Title</b>	<b>Science and Technology Learning Results</b>
The Sun (B-1)	Gr.3-4. G. #2, H. #1 & Gr.5-8. G. #1
Observing a Planet (C-4)	Gr.3-4. G. #1. & Gr.5-8. G. #3., G. #5.
A Question of Scale (D-1)	Gr.5-8. G. #3.
Solar System Scale Model Sized to Your room (D-5)	Gr.3-4. G. #1. & Gr.5-8. G. #5.
Toilet Paper Solar System Scale Model (D-6)	Gr.3-4. G. #1 & Gr.5-8. G. #5.
The Thousand Yard Model (D-7)	Gr.3-4. G. #1. & Gr.5-8. G. #5.
Comparing the Sizes of Stars (G-1)	Gr.5-8. G. #1.
Among the Stars (G-2)	Gr.5-8. G. #1. & Secondary. G. #2. & #3.
Investigating Star Types (G-3)	Gr.5-8. G. #1.
Your Galactic Address (H-1)	Gr.5-8. G. #2. & #5.
How Many Stars? (H-3)	Gr.5-8. G. #1, G. #2., G. #3. Also, Math. Gr.5-8. F. #3.
The Expanding Universe (H-5)	
Visualizing the Expansion of Space (H-6)	
Parallax – How Far Is It? (J-2)	Gr.5-8. G. #1., #3. & #5. & Secondary. G. #3.

## Some good books to use with *A Space Odyssey*

### **Our Solar System**

Simon, Seymour. 1992, Morrow Junior Books

### **The Planets in Our Solar System**

Branley, F. 1986, Harper & Row.

### **Postcards from Pluto: A Tour of the Solar System**

Leedy, Loreen. 1993, Holiday House.

*Dr. Quasar gives a group of children a tour of the solar system*

### **I Didn't Know The Sun is a Star**

Petty, Kate. 1997, Copper Beech Books

### **Mercury**

Vogt, Gregory. 1994, The Millbrook Press

### **The Planet Venus**

Hunt, G. & Moore, P. 1982, Faber & Faber.

*An illustrated introduction.*

**The Home Planet**

Kelley, K. . 1988, Addison-Wesley.  
*A picture album.*

**The Moon Observer's Handbook**

Price, F. 1989, Cambridge University Press.

**Mars**

Vogt, Gregory. 1994, The Millbrook Press

**Destination: Jupiter**

Simon, Seymour. 1998, Morrow Junior Books

**Saturn: A Spectacular Planet**

Branley, F. 1983, Crowell.

**A Distant Puzzle: The Planet Uranus**

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

**Neptune : the farthest giant**

Asimov, Isaac. 1990, G. Stevens Children's Books.  
*Describes the characteristics and movements of the planet Neptune.*

**Pluto**

Vogt, Gregory. 1994, The Millbrook Press

**Galaxies**

Ferris, T. 1980 Stewart, Tabori & Chang.  
*Lavishly illustrated introduction to the large-scale cosmos by a noted science writer.*

**Galaxies**

Hodge, P. 1986, Harvard U. Press.  
*A thorough introduction to our modern understanding of galaxies.*

**Galaxies**

Simon, Seymour. 1988, Morrow Junior Books.  
*Identifies the nature, locations, movements, and different categories of galaxies.*

**Galaxies**

Sipiera, Paul P. 1997, Children's Press.  
*Examines what a galaxy is, the different types that exist, and some facts learned from them.*

**Galaxies and Quasars**

Kaufmann, W. 1979, Freeman.  
*Clear basic guide to what lies beyond our Milky Way Galaxy.*

**Our Vast Home: The Milky Way and Other Galaxies**

Asimov, Isaac. 1995, G. Stevens Pub.  
*Provides an insider's view of our own Milky Way and discusses the nature and behavior of galaxies in general.*

## Some good web sites to use with *A Space Odyssey*

### **www.galaxies.com**

An informative page put together by an amateur astronomer

### **space.jpl.nasa.gov**

NASA's Jet Propulsion Laboratory web site

### **emma.la.asu.edu/dsn\_solarsyst.html**

An astronomy information page compiled by Ken Edgett, Arizona State University

### **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.discovery.com**

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

### **www.eduref.org/cgi-bin/lessons.cgi/Science/Astronomy**

Lesson plans based of the popular PBS series, Newton's Apple

### **www.thegateway.org**

Sponsored by The U.S. Department of Education's National Library of Education and ERIC Clearinghouse on Information & Technology, this site offers lesson plans for all subjects and all grades

### **www.thursdaysclassroom.com**

Lesson plans, activities, and teacher resources presented from Science@NASA

# Astronomy Web Sites Worth a Visit

## **umainesky.com**

The Maynard F. Jordan Planetarium and Observatory home page

## **umainesky.com/tg/tgreso.htm**

The teacher resources and bibliography page on the Maynard F. Jordan Planetarium web site

## **www.dustbunny.com/afk**

A web site about astronomy, designed for kids, with tons of information

## **hawastsoc.org**

The Hawaiian Astronomical Society's home page

## **www.calacademy.org/planetarium**

Alexander F. Morrison Planetarium home page

## **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.