

THE SKY TONIGHT

Teachers Guide

This Teachers Guide is designed for the planetarium show entitled *The Sky Tonight*. In this guide, you will find information that will help you better prepare your students for their upcoming visit to the Northern Stars Planetarium when it visits your school. The emphasis of this program will be to show you and your students objects that could be seen in the sky on the night of your visit to the planetarium. Both naked eye objects and telescopic objects will be included. All telescopic objects will be ones that are either visible in binoculars or through a small telescope.

SHOW SYNOPSIS

I. Overview of the night sky

1. Discussion about night vision and viewing location
2. Sky orientation and the directions: N - S - E - W - Z (zenith or up!)
3. Why some stars are brighter than others
4. Colored stars

II. A Tour of the evenings sky

1. Constellations
2. Deep Space Objects visible with a small telescope
3. Any visible planets, comets or the Moon

III. Other possible sightings for the evening

1. Meteors
2. Satellites
3. Aurora Borealis (or the Northern Lights)

THE SCALE OF SPACE

The Earth is about 8,000 miles in diameter, Jupiter is about 85,000 miles in diameter, and the Sun is just under 1,000,000 miles in diameter. Distance-wise, Earth is 93 million miles from the Sun, while Jupiter is approximately 600 million miles from the Sun.

To put this in a more realistic perspective, set up the following model for your students: Using a grain of sand to represent the size of the Sun, at this scale, the Earth would be about 3.5 inches away and would be about a quarter as big as the smallest speck of dust you can find (barely visible at all). The entire orbit of the Moon would be less than half the size of a single grain of sand. Jupiter would be 12 feet away and microscopic at this scale. The next closest star would be another grain of sand 15 miles away! Our galaxy, the Milky Way, has just under one trillion stars. Now imagine taking a trillion grains of sand and spread them out into a giant disk with an average of 15 miles between each and every grain. This Scale Model of our galaxy, having each star represented by a grain of sand, would fill the entire orbit of the Moon!

VOCABULARY

Aurora Borealis: Displays of flickering lights seen in the northern skies. They are caused by powerful magnetic storms on the Sun. When the energy from these storms reaches Earth, the energy is shielded from us by Earth's magnetic field; however, the energy does interact with the upper atmosphere near the north and south poles. This causes the air to glow, causing northern lights or Aurora Borealis.

Binary Star: Two stars that revolve around each other. Half of all the stars we see in the night sky are actually double or multiple star systems, but their distance from us makes them look like one star to the unaided eye.

Circumpolar Constellations: Constellations that are visible through the entire year. Located in the north, they circle around the North Star. For New England, they include the prominent constellations of Ursa Major the Big Bear, Ursa Minor the Little Bear, Draco the Dragon, Cassiopeia the Queen and Cepheus the King.

Constellations: Imaginary, dot-to-dot pictures drawn using the stars as the dots. These are used to map the night-time sky. There are 88 constellations all together. Forty-eight are of Greek origin the rest are a collection from various cultures worldwide.

Light Year: A light year is the distance that a beam of light will travel in one years time. Light travels at 186,000 miles per second! Astronomers use this unit to measure great distances in space. One light year equals about 6 trillion miles. For example, the closest star to the Sun is Alpha Centauri, which is 4.3 light years away or 25,278,000,000,000 miles away!

Meteor: A small rock, pebble or piece of dust that falls to Earth and burns or vaporizes due to friction with Earth's atmosphere. Floating around in space, its called a meteoroid; in the atmosphere, its called a meteor; and on the ground, its called a meteorite. Other favorite, though misleading, names for a meteor are shooting star and falling star.

Nebula: A huge cloud of hydrogen gas floating in space, usually many light years across in size. These hydrogen nebulae are slowly contracting and forming into new stars.

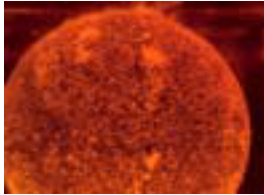
Planet: (*Official Definition*) Any object that is round, orbits a star, and is large enough to have cleared its orbit of smaller debris.

Planetary Nebula: A circular nebula, composed of many types of gases, that is expanding into space. It's the result of the death of an average star (like the Sun). The nebulosity you see is the outer layers of the star that have been blown out into space. Planetary nebula actually have no relationship to planets. They're called planetary because of their appearance only, which led early astronomers to mistake them for undiscovered planets.

Satellite: Any object that orbits another object. For example, the Moon is a natural satellite of Earth, but we've also placed hundreds of man-made satellites into Earth orbit as well. On any clear night, its possible to see many of these artificial satellites with the unaided eye.

PLANET FACTS & FIGURES

The Solar System's Only Star:



SUN Rotates: 26 days. Surface Temp: 12,000°F (6000°C) Core Temp: 27 Million°F (15 Million°C) Diameter: 865,000 mi. (1,395,161 km) A middle aged (4.5 Billion yrs. old), average sized star. It's outer atmosphere "the heliosphere" extends beyond Pluto.

The Inner Planets:



MERCURY Rotates: 58 days 16 hrs. Revolves: 88 days. High Temp: 700°F (350°C) Low Temp: -270° F (-170° C). Diameter: 3,031 mi. (4,878 km.) Gravity: 0.38 X Earth's. No moons, rings or atmosphere. Dominant feature is craters. Visited by the Mariner and Messenger space probes.



VENUS Rotates: 243 days. Revolves: 224.7 days. Average Temp: 900°F (480°C) Diameter: 7,541 mi. (12,104 km.) Gravity: 0.9 X Earth's. Thick Carbon Dioxide (CO₂) atmosphere. No Moons or rings. Visited by Pioneer Venus, Venera, Magellan, Galileo, and several other space probes.



EARTH Rotates: 23 hrs. 56 min. Revolves: 365.25 days. High Temp: 130°F (58°C) Low Temp: -126°F (-88°C). Gravity: 1 X Earth's. Diameter: 7,927 mi. (12,756 km.) Nitrogen & Oxygen atmosphere. 1 moon, no rings. The Earth's surface is 75% covered with water.



MARS Rotates: 24 hrs. 37 min. Revolves: 1.88 yrs. High Temp: 80°F (27°C). Low Temp: -190°F (-123°C). Diameter: 4,197 mi. (6,794 km). Gravity: 0.38 X Earth's. Thin Carbon Dioxide atmosphere. 2 moons, no rings. In 1996 scientist found evidence of fossilized bacteria in a meteorite believed to have originated on Mars-- perhaps long ago Mars had life! Visited by Viking 1 & 2, Pathfinder, Sojourner, Mars Global Surveyor, Spirit, Opportunity, Phoenix and several other space probes.

The Outer Planets:



JUPITER Rotates: 9 hrs. 48 min. Revolves: 11.86 yrs. Cloud top Temp: -140°F (-95°C) Diameter: 88,733 mi. (142,796 km.). Gravity: 3 X Earth's. Composition: Mostly Hydrogen, Helium. 63 moons, 1 small ring. Visited by Pioneers 10 & 11, Voyagers 1 & 2, and Galileo space probes.



SATURN Rotates: 10 hrs. 39 min. Revolves: 29.46 yrs. Cloud top Temp: -292°F (-180°C) Diameter: 74,600 mi. (120,000 km.). Gravity: 1.32 X Earth's. Composition: Mostly Hydrogen, Helium. 60 moons. It has a large ring system. Visited by Pioneers 10 & 11, Voyager 1 & 2, and the Cassini Space Probe.



URANUS Rotates: 16 hrs. 48 min. Revolves: 84 yrs. Cloud top Temp: -346°F (-210°C). Diameter: 31,600 mi. (50,800 km.). Gravity: 0.93 X Earth's. Composition: Mostly Hydrogen, Helium, some Ammonia, and Methane. 27 moons, 2 sets of rings. Uranus is tipped on its side. Visited by Voyager 2 in 1986.



NEPTUNE Rotates: 16 hrs 3 min. Revolves: 164.8 yrs. Cloud top Temp: -364°F (-220°C). Diameter: 30,200 mi. (48,600 km.). Gravity: 1.23 X Earth's. Composition: Mostly Hydrogen, Helium, some Methane and Ammonia. 13 moons, 3 thin rings, 2 broad rings. Visited by Voyager 2 in 1989.

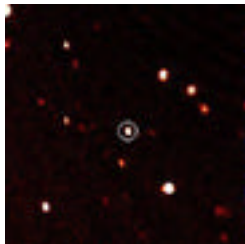
The Dwarf Planets Beyond Neptune:



PLUTO Rotates: 6 days, 9 hrs. Revolves: 248 yrs. Temp: -400°F (-238°C). Diameter: 1900 mi. (3,000 km.). Gravity: 0.03 X Earth's. Has a very thin atmosphere. 3 moons, no rings. The largest moon, Charon, is half the size of Pluto. Pluto's orbit is very elliptical and tilted; it actually crossed inside Neptune's orbit from 1979-1999. Pluto is no longer classified as a planet, but as a "Dwarf Planet."



QUAOAR & THE KUIPER BELT Quaoar is approximately 800 miles in diameter and is slightly farther away from the Sun than Pluto. It is made primarily of ices. It is the largest known object in the Kuiper Belt (other than Pluto!). The Kuiper Belt is a band of icy objects just beyond the orbit of Neptune; similar to the Asteroid Belt, the Kuiper Belt is made of objects too small to be labelled as planets. Both Quaoar and Pluto reside within the Kuiper Belt.



ERIS (formerly known as 2003 UB 313 or Xena) was first photographed in October 2003, but was not detected until January 2005. Its discovery was announced in August 2005. This object is larger than Pluto and currently about three times farther away from the Sun than Pluto. It is made of ices, much like Pluto. It takes this new planet 557 years to orbit the Sun just once. Its orbit is tilted nearly 45 degrees up at an angle compared to the plane of Earth's orbit. It has one moon.



SEDNA Sedna is the most distant object yet discovered in the solar system. It was discovered in 2003. It is roughly three times further away than Pluto, well outside the Kuiper Belt. It is approximately 1000 miles in diameter and takes nearly 10,500 years to go around the sun just once. Sedna was named after an Inuit Goddess of the Sea.



PROJECT IDEAS

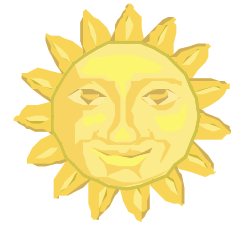


- 1. Night Vision.** An important principle for viewing the night sky properly is giving your eyes a chance to get dark adapted. This process takes five to ten minutes. To illustrate this phenomenon, take your class to a room without windows (if one is available). Perhaps there is such a room in the basement. Have everyone sit on the floor or in a chair so that no one will fall in the dark. Then turn out the lights. What can your students see? Right after turning the lights out, they shouldn't be able to see hardly anything. Have them sit in the dark for five to ten minutes and have them notice how their sight improves after a couple of minutes. Can they begin to see other objects in the room? At the end of the exercise, have them make a special note about how their eyes feel when you turn the lights back on. The light should seem very bright and make them squint. Now their eyes must adjust to the light!
- 2. Library Work.** Another idea to prepare your students for their visit with the Northern Stars Planetarium and to sharpen their library skills is:
Assign individuals or groups to look up names of different constellations. Have them try to find out where the constellations got their names and what stories are told about them. We have included a bibliography to help with this activity. Also, Indian sky legends and mythical lore are interesting topics for reading class.

TRUE OR FALSE

1. Half of all the stars we see in the night sky are binaries. (True)
2. All the stars we see in the night sky are part of the Milky Way galaxy. (True)
3. It's impossible to see artificial satellites in the night sky. (False)
4. There are only 5 of the 8 planets in our Solar System that we can see in the night sky without a telescope. (True: Mercury, Venus, Mars, Jupiter and Saturn)
5. Open star clusters contain between 500,000 and 1,000,000 stars each. (False: Globular clusters have this many stars. Open clusters have only 200-600 stars on average.)
6. Night vision is obtainable after approximately 3 minutes. (False: 10 minutes is a more reasonable amount of time.)
7. Ursa Major, or the Big Dipper, is visible year round from New England. (True)
8. The Constellations of the Zodiac are the constellations that the Sun travels through in the course of a year. (True)
9. There are twelve constellations of the Zodiac. (False: Actually there are thirteen. The thirteenth is called Ophiuchus, the Serpent Holder.)

STUDY QUESTIONS



- 1. What is a planetarium?** (a room that produces an artificial sky)
- 2. What planets (if any) can you see tonight if its clear?**
- 3. What causes the northern lights or Aurora Borealis?** (see vocabulary list)
- 4. What is a falling star?** (a meteor or small rock burning due to friction as it falls through Earth's atmosphere from space)
- 5. What is the Milky Way?** (our galaxy) Are we part of the Milky Way? (yes)
- 6. Why do the stars appear to move across the sky from east to west?** (because Earth is rotating or spinning). Are the stars really moving? (no) What causes day and night? (the rotation of the Earth)
- 7. Why is the North Star (Polaris) so famous?** (Because it is directly above the north pole of Earth and thus helps us find the direction north. It is not the brightest star.)
- 8. What is a light year?** (A light year is a way astronomers measure great distances in space. Its based on the speed of light: 186,000 miles per second. One light year is the distance that light can travel at that speed in one years time. A light year equals about 6 trillion miles. For example, the star Alpha Centauri is 4.3 light years away or 25,278,000,000,000 miles!)
- 9. What is a star?** (A large ball of mostly hydrogen gas that has sufficient internal pressures to cause nuclear fusion within its core.)
- 10. All are stars white?** (No. Stars actually are many different colors: Red, Orange, Yellow, Blue, Violet and White.)
- 11. Why can't we generally see the different colors of the stars?** (Because the part of our eye that we use to see faint objects, such as stars, is color-blind.)
- 12. What do the different colors of stars tell us about the stars?** (The temperature of the stars. Red stars are cool: 6,000-8,000 degrees F, Yellow stars are hotter: 12,000-14,000 degrees F, while Blue and White stars are the hottest: 16,000-30,000 degrees F.)
- 13. Why do stars twinkle?** (Stars don't really twinkle. The twinkling effect is caused by the Earth's atmosphere.)
- 14. Which is the nearest star to Earth?** (The Sun! The second closest star is Alpha Centauri, which is 4.3 light years away. However, Alpha Centauri is actually a triple star system the closest of the three stars is called Proxima Centauri.)

SKY TONIGHT WORD SEARCH



Try to find the vocabulary words listed on the bottom of this page hidden within this puzzle. Words can be written either horizontally, vertically or diagonally.

S U L B I G D I P P E R J U P V X
 L K T T W B I N A R Y G Q M O O N
 O S Y S P E A T M O S P H E R E R
 H P C T N C S U N S E T O T M S E
 I L I A O O N T F P D F T E J H D
 D A R R M N R B G L K L O O M S S
 G N C S E S I T E A U R O R A T U
 H E U K R T J G H N L I B F R A P
 O T M X C E U K H E E A S T S R E
 R A P N U L P R I T K B X G P C R
 I R O B R L I Z E B A P U Y O L G
 Z I L O Y A T S O L J V S L L U I
 O U A S A T E L L I T E A T A S A
 N M R I S I R E G S O U T H R T N
 F A H Z F O S W T O J H U Q I E T
 S O J V E N U S E D H T R U S R I
 M H N I G H T V I S I O N E F O J

Atmosphere
 Binary
 East
 Jupiter
 Meteor
 Night Vision
 Planetarium
 Satellite
 South
 Sunset

Aurora
 Circumpolar
 Galaxy
 Mars
 Moon
 North
 Polaris
 Saturn
 Star Cluster
 Venus

Big Dipper
 Constellation
 Horizon
 Mercury
 Nebula
 Planet
 Red Supergiant
 Sky Tonight
 Stars
 West

Maria or Seas:

- Mare Australe.....The Southern Sea
- Mare Crisium.....The Sea of Crises
- Mare Fecunditatis.....The Sea of Fertility
- Mare Frigoris.....The Sea of Cold
- Mare Humorum.....The Sea of Humors
- Mare Imbrium.....The Sea of Showers
- Mare Marginis.....The Sea of Margins
- Mare Nectaris.....The Sea of Nectar
- Mare Nubium.....The Sea of Cloud
- Oceanus Procellarum.....The Ocean of Storms
- Mare Serenitatis.....The Sea of Serenity
- Mare Tranquillitatis.....The Sea of Tranquility
- Mare Vaporum.....The Sea of Vapours

Craters:

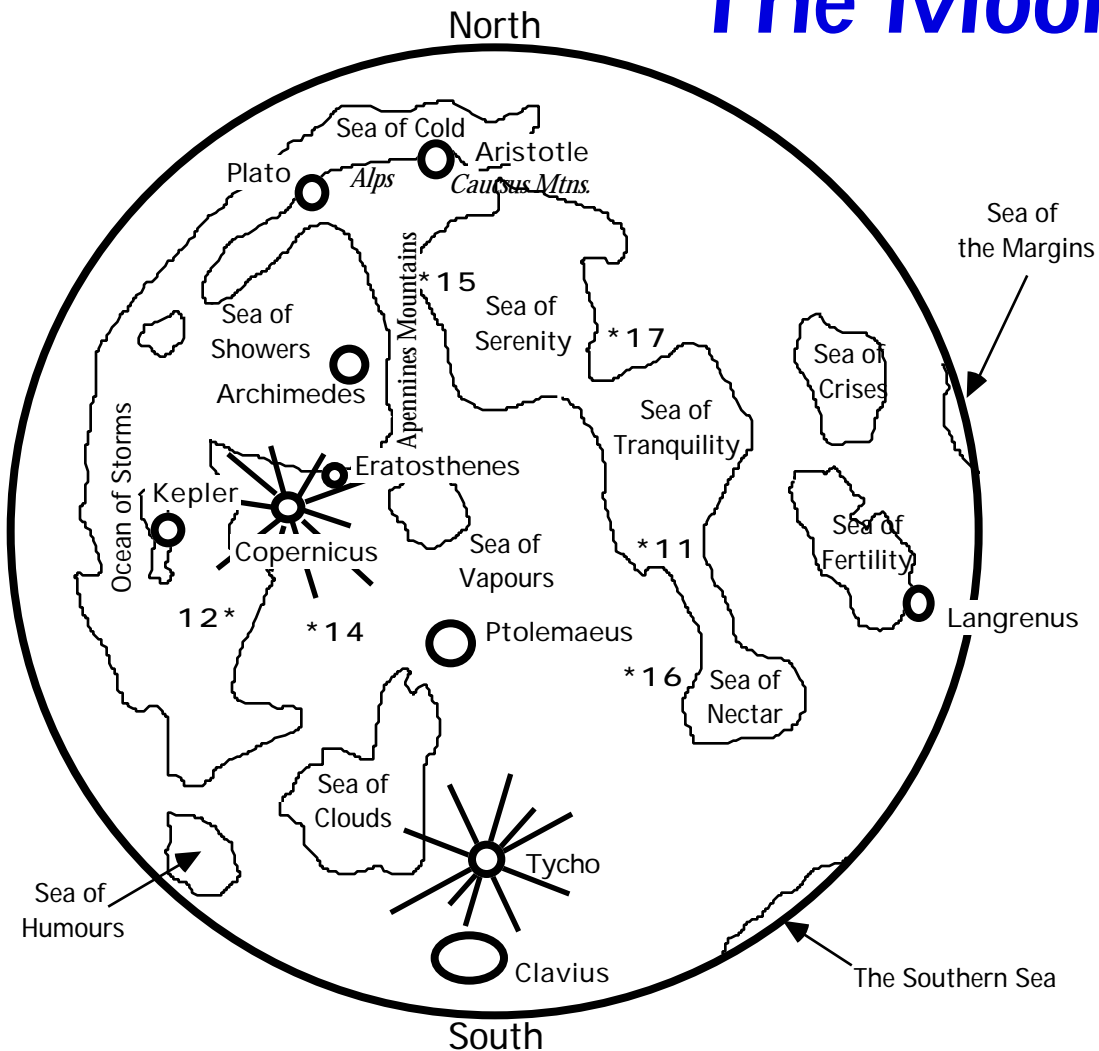
- Archimede
- Aristotle
- Clavius
- Copernicus
- Eratosthenes
- Kepler
- Langrenus
- Plato
- Ptolemaeus

Mountains Ranges:

- Alps
- Apennines
- Caucasus

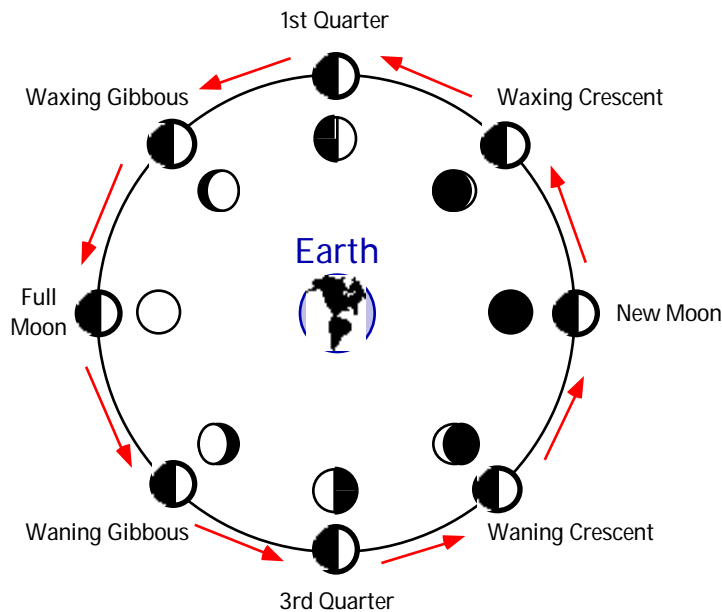
* Apollo Landing Sites

The Moon



PHASES OF THE MOON

The circles within the orbit show what the Moon looks like from Earth at that phase. Waxing means “getting bigger.” Waning means “getting smaller.”



1. What phase comes after a “1st Quarter Moon”? _____
2. What fruit most commonly resembles a Crescent Moon? _____
3. If the Moon is “waxing” is its phase getting: BIGGER or SMALLER ?
4. What phase comes just after the Full Moon? _____
5. What does the Moon look like at the “New Moon Phase”? _____
6. Is a “Waning Crescent” getting: BIGGER or SMALLER ?
7. Which phase of the Moon reflects the most light towards Earth? _____
8. What is the common unit of time that relates to one full set of phases? _____



USEFUL ASTRONOMY WEB-SITES

Northern Stars Planetarium: <http://www.northern-stars.com>

Astronomy Magazine: <http://www.kalmbach.com/Astro/Astronomy.html>

Astronomical Society of the Pacific: <http://maxwell.sfsu.edu/asp/asp.html>

Comet Hale-Bopp: <http://newproducts.jpl.nasa.gov/comet/>

Extra Solar Planets: <http://www.obspm.fr/departement/darc/planets/encycl.html>

Friends And Partners in Space (US & Russian Joint Efforts)
<http://solar.rtd.utk.edu/~jgreen/fpspace.html>

International Dark Sky Society: <http://www.darksky.org/~ida/index.html>

International Space Station Alpha: <http://issa-www.jsc.nasa.gov/>

***Jet Propulsion Lab (info on Space Probes):** <http://www.jpl.nasa.gov/>

Lick Observatory: <http://www.ucolick.org/>

Life on Mars? <http://cu-ames.arc.nasa.gov/marslife/>

Mars Pathfinder Mission: http://mpfwww.jpl.nasa.gov/mpf/fact_sheet.html

The Nine Planets: (an excellent resource on solar system information)
<http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html>

The NASA Homepage: <http://www.nasa.gov/>

Project Galileo: <http://www.jpl.nasa.gov/galileo/>

Sky and Telescope: <http://www.skypub.com>

Sky Watcher's Diary: <http://www.pa.msu.edu/abrams/diary.html>

Space Shuttle Archives: <http://shuttle.nasa.gov/>

Space Telescope Info: <http://www.stsci.edu/top.html>

Weather Net: <http://cirrus.sprl.umich.edu/wxnet/>

BIBLIOGRAPHY

Younger Students:

Branley, Franklyn M., *The Planets in our Solar System*, New York: Harper and Row, Harper Junior Books, 1987.

----- *The Sky is Full of Stars*, New York: Harper and Row, Harper Junior Books, 1981.

Cole, Joanna, *The Magic School Bus, Lost in the Solar System*, New York: Scholastic, Inc., 1990.

Fradin, Dennis B., *Comets, Asteroids, and Meteors*, Chicago: Children's Press, New True Books, 1984.

Rey, H.A., *The Stars, A New Way to See Them*, Boston: Houghton Mifflin Co., 1976. (This is probably the best book for learning constellations for any age level.)

Ride, Sally & Okie, Susan, *To Space and Back*, New York: Lothrop, Lee & Shepard Books, 1986.

Older Students:

Beatty & Chaikin, *The New Solar System, 2nd Ed.* Cambridge: Cambridge University Press, 1990. (High school to college age level)

Couper & Henbest, *New Worlds, In Search of the Planets*, Reading, MA: Addison-Wesley, 1986.

Gallant, Roy, *Our Universe, 2nd Ed.*, Washington D.C.: National Geographic Society, 1986.

Miller & Hartmann, *The Grand Tour: A Traveller's Guide to the Solar System*, New York: Workman Publishing, 1981.

Moeschl, Richard, *Exploring the Sky, 100 Projects for Beginning Astronomers*, Chicago: Chicago Review Press, 1989. (Contains lots of project ideas for both teachers and older students.)

Pogue, William, *How Do You Go To The Bathroom in Space?* New York: Tom Doherty Associates, 1985. (Younger Readers may also enjoy this Q & A book about space flight.)

For Teachers:

Braus, Judy, Editor, *NatureScope: Astronomy Adventures*, Washington, D.C.: National Wildlife Federation, 1986.

Universe in the Classroom, Astronomical Society of the Pacific, Teacher's Newsletter, Dept. N. 390 Ashton Ave., San Francisco, CA 94112 (free to all teachers, request on school letterhead.)

Planetarium Program Evaluation

After the Northern Stars Planetarium has visited your class, please take a moment to fill out this evaluation. Your suggestions are very valuable to us!

Mail the completed evaluation to:.....Northern Stars Planetarium
15 Western Ave.

Fairfield, Maine 04937

Or Email To:.....info@northern-stars.com

1. Show Name: _____

2. Group grade/age level:_____

3. Was the material presented at an appropriate level for your class? _____

4. Was the amount of material discussed: Enough Overwhelming Not Enough

5. Should any parts of the presentation be developed further? _____. If so, which parts?

6. Was there sufficient time for questions and answers? Yes No

7. Were you studying astronomy or another related subject at the time of the planetarium's visit?

Yes

No

If so, was the planetarium visit helpful? _____

8. Was the Teacher's Guide helpful in preparing your class for the planetarium visit? Yes No

Which parts were most helpful? _____

Which parts were least helpful? _____

9. Did the presenter present the material in a clear and understandable fashion? _____

10. How would you rate the overall program given to your class in the planetarium? _____

11. (Optional) Your name & school:_____

Thank you for your time! Your Comments Make a Difference!