Northern Stars Planetarium, 15 Western Ave., Fairfield, ME 04937 (207) 453-7668

Our Family in the Sky Teacher's Guide

Mr. Sun

Our Family in the Sky is a planetarium presentation about the solar system designed especially for first and second graders. The idea and some of the drawings of this program were inspired and created by Joseph Noffsinger former director of the Adrian College Planetarium in Adrian, Michigan.

This program is presented partly on tape and partly live. The presentation begins by meeting Mr. Sun who proceeds to lead the class on a tour of his family--the planets. Each planet is personified with a personality that roughly corresponds with our understanding of that world. As the show progresses, the various planets and Mr. Sun interact with each other and occasionally with the children. By using these cartoon personifications of the planets, along with many actual photographs of the planets, the students will gain a basic understanding about the differences between the nine planets in our solar system.

Mr. Sun also will introduce his "cousins" the stars. The children will learn that the sun is a star, and that the other stars are just suns that are very far away from us. Several prominent constellations will be pointed out. They will be constellations that are visible during the time of year of our visit to your school.

Please Note: *Much of the information in this guide is for you, the teacher.* We present this information so that you will have a stronger background for teaching this subject. So many new discoveries are continually being discovered, that it is sometimes difficult to keep up with it all. We hope this guide helps solve that problem.

Study Questions

Please try to have discussed some of these questions with your class before they visit the planetarium.

1. What is a planet?
2. What is the difference between a star and a planet?
3. The word *planet* means *wanderer*, why do you suppose they were called wanderers?
4. How many planets are there? Name the planets in order from the sun out?
5. Can you ever see any planets in the sky? What do they look like?
6. What is the sun?
7. What are constellations? How many can you name?
8. Is earth a planet? Is the earth in space?
9. Is there life on any other planets in our solar system? Why not?
10. Which planet is the biggest one? Which one is the smallest?
11. Which planet is the closest to the sun? Farthest from the sun?
12. Which planet is the coldest? Which one is hottest?
13. Which planets have rings?
14. Which planets have moons?
15. Which planets are made of only gases and liquids?
16. Why is Pluto no longer considered a planet?

Vocabulary

Asteroid These small objects are also called *minor planets.* They vary in size from small rocks to objects several hundred miles in diameter. Most (95%) are found in the region of the solar system between Mars and Jupiter, this region is known as the *asteroid belt.*

Atmosphere The outer gases of a star or a planet. Not all planets have atmospheres.

Constellation Pictures drawn in the stars similar to connect-the-dot drawings, using the stars as dots. There are a total of 88 constellations. They are used for mapping the sky.

Crater Circular ridges with deep centers. They are caused by either meteorite impacts or volcanic activity. Planets with thin or no atmosphere have more craters than planets with thick atmospheres. Due to friction most meteoroids will burn up as they fall thick atmospheres like Earth's.

Gravity The force that attracts objects together. All objects have gravity, more massive objects have more gravity that less massive ones, therefore larger planets have more gravity that smaller ones. The sun's gravity is what keeps the solar system together.

Meteor The light that we call a *Shooting Star.* Actually this light is caused by a small rock or pebble burning up in our atmosphere due to friction as it falls to earth from space due to gravity. In space the rock is called a *meteoroid,* burning in the atmosphere it is called a *meteor,* and if it hits the ground, the rock left behind is called a *meteorite.*

Moon A moon is a small object (like a mini-planet) that is in orbit around a planet. Earth has one moon, Mars 2, Jupiter 67, Saturn at least 62, Uranus 27, Neptune 13, Pluto 5. The difference between a moon and a planet is not size, but what they go around; planets go around the sun, moons go around planets. Some moons are bigger than some planets, for example, Jupiter's moon Ganymede is bigger than both Mercury and Pluto.

Orbit The invisible path that a planet follows around the sun.

Planetarium A special room with a domed or round ceiling. Using special projectors, the ceiling looks like the night sky. It is an artificial environment. The planetarium is *not an observatory.* An observatory is a building that houses a telescope for viewing the real night sky.

Revolution The motion when one object goes around another. (ie. The earth revolves around the sun once every 365.25 days.)

Rotation The motion when an objects spins on an axis going through itself. (ie. The earth rotates or spins on its axis once every 24 hours.)

Space Probe This is a type of satellite that travels from earth to explore other planets. There are no people on board a space probe, it is run by computers. They take pictures and do scientific experiments to help us learn about these other worlds. Some examples of famous space probes are: *Voyager, Viking, Magellan, Galileo, Mariner, Pioneer, Pathfinder, Cassini, Spirit, Opportunity, & Curiosity.*

Making A Scale Model of the Solar System

This exercise is an excellent way for your students to gain a better understanding of the actual scale of our solar system, in terms of relative sizes, distances, and speeds. The materials needed are simple, inexpensive, and easily obtained. The activity is three-fold. First it deals with relative sizes. Secondly, it covers relative distances. And lastly, it demonstrates relative speeds.

Materials Needed:

1 Beach ball (preferably yellow or orange)
1 Set of Play Doh® or some other modelling clay
1 String (13 meters or 40 feet long)

Preparation:

Take the string and tie a loop about 5 centimeters (2") in diameter in one end. This is where you will place the beach ball sun later on. Then tie an overhand knot  at the appropriate distances that each succeeding planet will be from the beach ball sun. Use the following planet scale information chart to tell you how far away from the sun each knot should be tied.

Planet Scale Information Chart:

Planet	*Scaled Distance from the Sun*		*Scaled Diameter*
Mercury	13 cm 5 inches	(=58 million kilometers) (=36 million miles)	1.5 mm 1/16 inch
Venus	23 cm 9 inches	(=108 million kilometers) (=67 million miles)	6 mm 1/4 inch
Earth	31 cm 12 inches	(=150 million kilometers) (=93 million miles)	6 mm 1/4 inch
Mars	46 cm 18 inches	(=227 million kilometers) (=141 million miles)	3 mm 1/8 inch
Jupiter	155 cm 61 inches	(=779 million kilometers) (=483 million miles)	25 mm 1 inch
Saturn	274 cm 108 inches	(=1428 million kilometers) (= 886 million miles)	20 mm 3/4 inch
Uranus	572 cm 225 inches	(=2974 million kilometers) (=1782 million miles)	14 mm 1/2 inch
Neptune	889 cm 350 inches	(=4506 million kilometers) (=2794 million miles)	13 mm 1/2 inch
Pluto	1174 cm 462 inches	(=5913 million kilometers) (=3666 million miles)	1.3 mm 1/16 inch

Scale Model Solar System Continued....

Part One: Size Scale

HINT: You might want to make two or more model solar systems so that every student can partake.

Assign every student a planet and give them a lump of clay more than big enough to make their planet. If you are using Play Doh, you might want to use appropriate colors (ie. red for Mars, Blue for Earth, etc.). Explain that you want them to guess how big their planet would be if the beach ball were the size of the sun. It is best not to have them attempt to make rings for Saturn. Have each student make her planet out of clay according to how big she thinks it should be.

Almost always, everyone's planet will be too big. Once they are done, go through the group and change their planets to the correct size. Correcting the students in this fashion will make the actual size much more impressive. Every student must then be responsible for not loosing her planet. This isn't necessarily easy, as some planets, like Mercury and Pluto, are only about the size of a grain of sand!

Part Two: Distance Scale

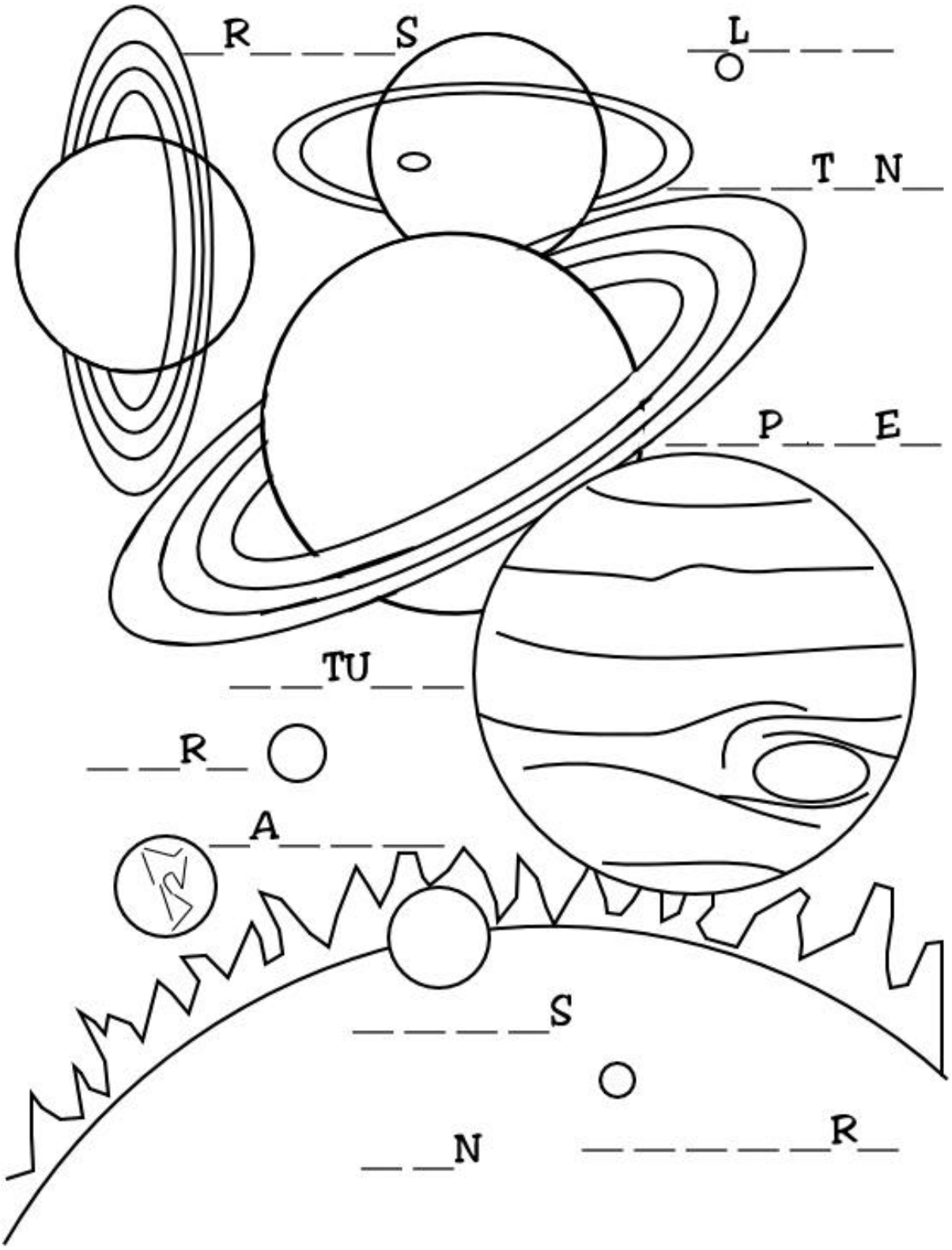
This part of the model should be done either in the gymnasium, cafeteria, or outside. In order to make the distance scale workable within a school environment, we found it best to represent distance on a smaller scale than that used to illustrate size (See the footnote on the previous page).

Separate your students into their various solar systems (if you have more than one). Have each student take her clay planet and place it where she thinks the appropriate distance for that planet should be from the beach ball sun. Once each student has placed her planet down where she thinks it belongs, take out the string with the proper distance scale measured out in knots. Then, one at a time, beginning with Mercury, have each student move her planet to its proper position. Again, this makes the students aware that their perspectives are different from reality. The solar system is probably much larger than any of them had guessed.

Part Three: Relative Motion

Now that your model solar system is laid out properly, have your students pick up their respective planets. Tell them to try to keep the same distance from the sun and have them walk at approximately the same speed around the sun (in their respective orbits!). Which planet goes around the sun first? Once Mercury makes one revolution, have them all stop and examine how much of their own orbits they have covered compared to Mercury's complete orbit. *(In actuality the distance is not the only factor in different period orbits. Inner planets do move faster than outer planets. However, for demonstration purposes, having the students all walk at about the same speed works well.)*

*The size scale is 1 cm=140,000 km (1"=225,000 miles) while the distance scale is about 32 times smaller with 1 cm=4,500,000km (1"=7,000,000 miles). We found it best to represent distance on a smaller scale than used for size. If we maintained the same scale for distance as for size, the string would have been 420 meters long rather than 13 meters!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Solar System Facts

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) Dia: 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). Dia: 3,031 mi. (4,878 km.) Gravity: 0.38 X Earth's. No moons or rings. Visited by the Mariner space probe.

VENUS Rotates: 243 days. Revolves: 224.7 days. Average Temp: 900°F (480°C) Dia: 7,541 mi. (12,104 km.) Gravity: 0.9 X Earth's. Thick Carbon Dioxide (CO_2) 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. Dia: 7,927 mi. (12,756 km.) Nitrogen & Oxygen atmosphere. 1 moon, no rings. The Earth is covered with three quarters of it's surface 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). Dia: 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 fossilzed 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, Phoenix, Spirit, Opportunity and Curiosity space probes and rovers.

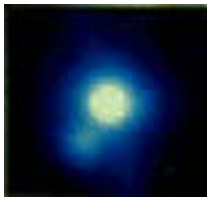
The Outer Planets:

JUPITER Rotates: 9 hrs. 48 min. Revolves: 11.86 yrs. Cloud top Temp: -140°F (-95°C) Dia: 88,733 mi. (142,796 km.). Gravity: 3 X Earth's. Composition: Mostly Hydrogen, Helium. 67 moons, 1 small ring. Visited by Pioneers 10 & 11, Voyagers 1 & 2, Galileo and Juno space probes.

SATURN Rotates: 10 hrs. 39 min. Revolves: 29.46 yrs. Cloud top Temp: -292°F (-180°C) Dia: 74,600 mi. (120,000 km.). Gravity: 1.32 X Earth's. Composition: Mostly Hydrogen, Helium. 62 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). Dia: 31,600 mi. ((50,800 km.). Gravity: 0.93 X Earth's. Composition: Mostly Hydrogen, Helium, some ammonia, methane. 27 moons, two distinct sets of rings. Uranus is tipped on its side. Visited by Voyager 2 in 1986.

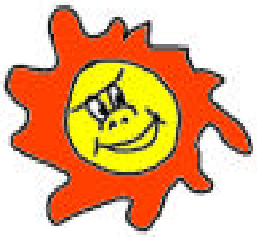
NEPTUNE Rotates: 16 hrs 3 min. Revolves: 164.8 yrs. Cloud top Temp: -364°F (-220°C). Dia: 30,200 mi. (48,600 km.). Gravity: 1.23 X Earth's. Composition: Mostly Hydrogen, Helium, some methane and ammonia. 13 moons, 3 thin rings, 2 broad rings. Visited by Voyager 2 in 1989.



PLUTO Rotates: 6 days, 9 hrs. Revolves: 248 yrs. Temp: -400°F (-238°C). Dia: 1900 mi. (3,000 km.). Gravity: 0.03 X Earth's. Has a very thin atmosphere. 5 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, it is instead a "Dwarf Planet."*

Word Search

Find the following words in the following word search puzzle. Words can be found horizontally, vertically, and diagonally. No words are written backwards. Good Luck!



Mr. Sun wishes you "Good Luck!"

SOLAR SYSTEM PLANET ORBIT STAR
ASTEROIDS COMET METEOR
SUN MERCURY VENUS EARTH
MARS JUPITER SATURN URANUS
NEPTUNE PLUTO GRAVITY

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

The Family of the Sun in Song

From *Exploring the Planets*, a booklet produced by the National Air and Space Museum, Washington, D.C. the words, by NASM's Melvin Zisfein and Robert W. Wolfe, are sung to the tune of *The Farmer in the Dell.* Used with permission.

The family of theSun.
The family of the Sun.
Here are nine planets in
The family of the Sun.

Mercury is hot.
And Mercury is small.
Mercury has no atmosphere;
It's just a rocky ball.

Refrain:
The family of the Sun
The family of the Sun.
Here's another planet in
The family of the Sun.

Venus has thick clouds
That hide what is below.
The air is foul, the ground is hot
It rotates very "slow."

(Repeat Refrain)

We love the Earth, our home,
Its oceans and its trees.
We eat it's food; we breathe its air
So no pollution, please

(Repeat Refrain)

Mars is very red.
It's also dry and cold.
Some day you might visit Mars
If you are really bold

(Repeat Refrain)

Great Jupiter is big.
We've studied it a lot
We found that it has 17 moons
And a big red spot.

(Repeat Refrain)

Saturn has great rings.
We wondered what they were,
Now we know they're icy rocks
Which we saw as a blurr.

The family of the Sun.
The family of the Sun.
Here are two more planets in
The family of the Sun.

Uranus and Neptune
We don't know much about.
Maybe you will study them,
And then we'll all find out.

(Repeat Refrain)

Pluto's last in line.
It's farthest from the Sun*
It's small and cold and icy too.
To land there won't be fun.

The family of the Sun.
The family of the Sun.
There are nine planets and
Now our journey's done.

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*Every 248 years, Pluto's orbit (tilted 17° out of the ecliptic) brings the planet inside Neptune's orbit for a period of 20 years. From 1979 to 1999, Neptune was the farthest from the sun.

Bibliography

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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.)

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Older Students:

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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:

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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!