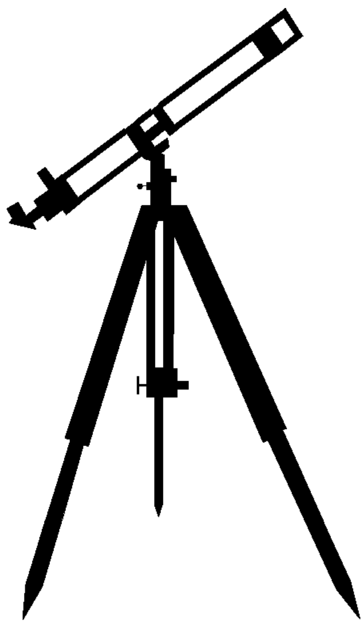
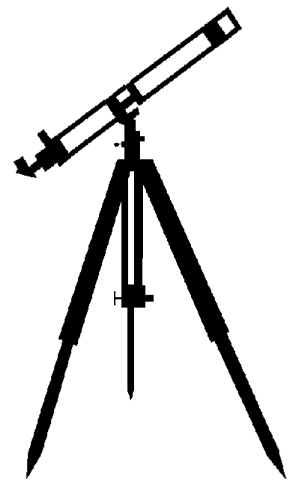
Universe Cycle
The Search for Our Beginnings

FOURTH GRADE
SOLAR SYSTEM



1 WEEK
LESSON PLANS AND
ACTIVITIES

UNIVERSE CYCLE
OVERVIEW OF FOURTH GRADE



UNIVERSE

WEEK 1.
PRE: *Comparing astrology and astronomy.*
LAB: *Contrasting the different types of galaxies.*
POST: *Exploring how galaxies evolve.*

SOLAR SYSTEM

WEEK 2.
PRE: *Plotting the relative distances of planets from the Sun.*
LAB: *Observing craters on the surface of planets and moons.*
POST: *Discovering new facts about the Solar System.*

EARTH

WEEK 3.
PRE: *Comparing the surface of the Earth and Moon.*
LAB: *Exploring the Earth/Moon system.*
POST: *Comparing the landscapes of the Earth and Moon.*

GEOGRAPHY

WEEK 4.
PRE: *Exploring the importance of soil on Earth.*
LAB: *Plotting data of soil locations.*
POST: *Deriving information from maps.*

UNIVERSE CYCLE - SOLAR SYSTEM (4)

PRE LAB

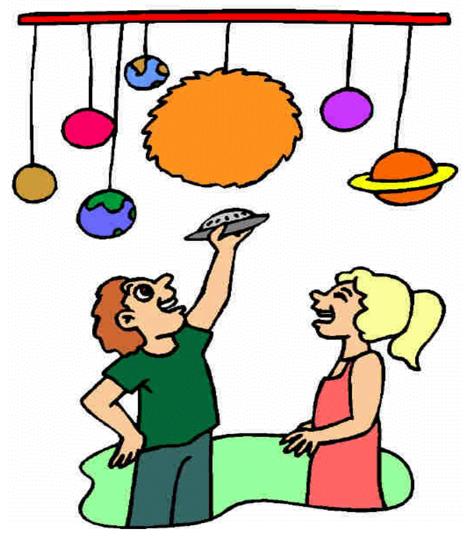
Students make a scale model of the Solar System.

OBJECTIVE:

1. Plotting the relative distances of planets from the Sun.
2. Exploring how some of the planets received their names.

VOCABULARY:

gas giants
planets
Solar System
terrestrial



MATERIALS:

worksheet
ruler

BACKGROUND:

The discovery of the planets took place over thousands of years. It was a widespread belief until the 1700's that everything revolved around the Earth. Early philosophers and scientists observed that a few bright objects in the sky did not keep their positions like the stars. They also observed that these objects all moved in a narrow band of the sky , which is now called the zodiac. These objects eventually came to be called planets, from the Greek word for "wanderer".

The Greeks and Romans associated the planets with their gods. Mercury, which is the quickest of all the planets, was named for the Roman fleet footed, fast running god. Venus was named after the goddess of love, because it shined so brightly before sunrise and sunset. Mars was named for the god of war, because it glows red and appears majestically high in the night sky. Jupiter, the largest planet, was given the name of the king of gods. Saturn appeared to move slowly in the sky, so it was named for the great grandfather of the gods. These were the planets that were apparent to early people. The other planets: Uranus, Neptune, and Pluto, were not discovered until after the telescope was invented.

Some historians have speculated that the 5 moving planets, plus the Sun and Moon may account for the special regard many cultures have for the number 7. In Europe, this became the number of days in the week. Sunday is the Sun's day, Monday is the Moon's day, and Saturday is Saturn' day. The other four days are named for the Viking gods, who were similar to the Greek and Roman gods. Tuesday was named for the god Tiw who was the same as the god Mars. Wednesday was named after Woden or the Greek's Mercury; Thursday is for Thor or Jupiter and Friday is for Freya, who was equivalent to Venus.

PROCEDURE:

1. You may wish to review the basic characteristics of the planets with the class. At this point, the students should be able to name the planets in order of distance from the Sun, and distinguish between the terrestrial and gas giant planets. Use the information charts below to guide your comments.

PLANETARY INFORMATION

DATA CHART I.

planet	diameter	low surface temp C°	high surface temp C°	distance from the Sun (km)	satellites
MERCURY	4,880	-170	+400	0.0579×10^9	0
VENUS	12,100	?	+480	0.1082×10^9	0
EARTH	12,740	-53	+50	0.1496×10^9	1
MARS	6,794	-127	-29	0.2279×10^9	2
JUPITER	143,200	?	- 148	0.7783×10^9	≥ 16
SATURN	120,000	?	-178	1.427×10^9	≥ 20
URANUS	51,800	?	-214	2.87×10^9	≥ 15
NEPTUNE	49,500	?	-218	4.497×10^9	≥ 8
PLUTO	2,500	?	-330?	5.9×10^9	0

Note that the temperatures for Jupiter through Neptune are average surface temperatures.

DATA CHART II.

planet	mass of planet	tilt of axis	revolution	rotation	eccen-tricity	rings
MERCURY	.054		88 days	59 days	.21	0
VENUS	.82		224.7 days	243 days	.01	0
EARTH	1	23	365 days	24 hrs	.02	0
MARS	.11	24	687 days	24 hrs	.09	0
JUPITER	318	3	12 years	10 hrs	.05	1
SATURN	95	27	29 years	11 hrs	.06	7
URANUS	15	98	84 years	15.5 hrs	.05	10
NEPTUNE	17	50	165 years	16 hrs	.01	4
PLUTO	.9(?)	?	248 years	6.5 days	.25	0

2. In this activity, students determine the relative distances of the planets from the Sun, and show these in a drawing. The students are asked to make the numbers proportional to real Solar System distances, so that they can make their drawings accurate. The model works best if the distances are converted into centimeters. The students may struggle to figure this out; but give them guidance as appropriate. You may want the students to work in groups of 2 or 3 to try and figure the problem out collectively. Remember to have the students start from the Sun and to round off the numbers.

First go over that you drop the 10^9 km because when you compare things that are the same, and they all contain the number you can disregard it. Have the students cross out all 10^9 km. Then look at the other numbers and have them round them off. You may have to reason with them and give them the rounded answers as listed below.

If students are not familiar with a metric ruler you may want to go over the fundamentals of centimeters and millimeters. It is easiest to use mm instead of cm, especially if you want it to fit on one page. However, if you have longer paper (i.e., butcher paper), cm will not be a problem. You could also make this fit on one sheet, by having the students divide these numbers by 2. If students cannot do division, do it with them and give them the answer. This helps them to understand why they should learn division.

If the students use centimeters, the drawing will not fit on one sheet of paper.

ANSWERS: [2 sheet solution] 0.6 cm or 6 mm (Mercury); 1 cm (Venus); 1.5 cm (Earth); 2.3 cm (Mars); 7.8 cm (Jupiter); 14 cm (Saturn); 29 cm (Uranus); 45 cm (Neptune); 59 cm (Pluto).

UNIVERSE CYCLE - SOLAR SYSTEM (4) PRE LAB

MEASURING RELATIVE DISTANCE OF THE PLANETS FROM THE SUN

1. The planets are millions of miles from the Sun. It would be impossible to make a real model of these distances. Instead, you will make a relative scale model. The model will use much smaller distances than in the real Solar System, but the spacing of the planets from the Sun will be the same. For example, Saturn will still be about twice as far from the Sun as Jupiter.

The table below shows information on how far the planets are from the Sun. Can you figure out what relative scale to use to make your model fit on one or two pages? Write the scale that you want to use in the space below.

2. The scale used is ________ cm for every ___________ km.

Planet	Distance from the Sun	Your Scale
MERCURY	0.0579×10^9 km	
VENUS	0.1082×10^9 km	
EARTH	0.1496×10^9 km	
MARS	0.2279×10^9 km	
JUPITER	0.7783×10^9 km	
SATURN	1.427×10^9 km	
URANUS	2.87×10^9 km	
NEPTUNE	4.497×10^9 km	
PLUTO	5.9×10^9 km	

3. Use two sheets of paper, or the back of this paper to draw your relative scale. The Sun will be at 0. Make a mark where each planet occurs, and label it.

UNIVERSE CYCLE - SOLAR SYSTEM (4)

LAB

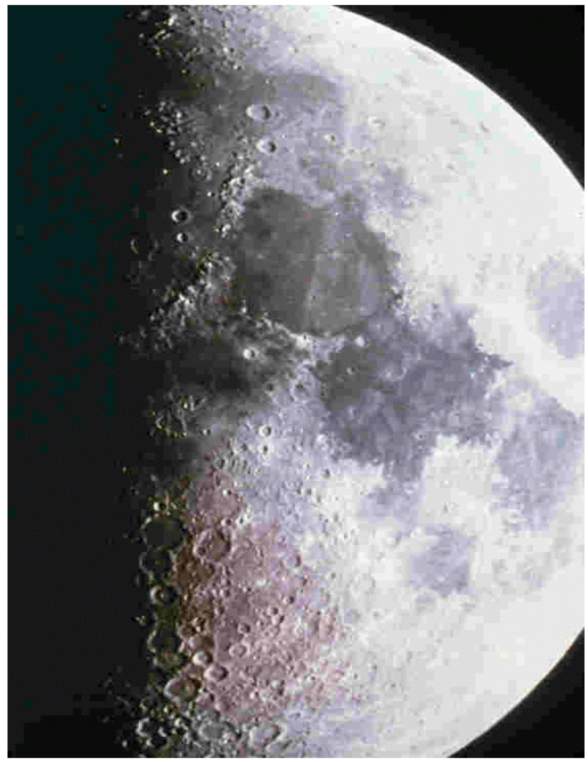
Students make craters.

OBJECTIVE:

1. Observing craters on the surface of planets and moons.
2. Speculating on the origin of craters in the Solar System.

VOCABULARY:

craters
mare
rays
rills
satellite photograph

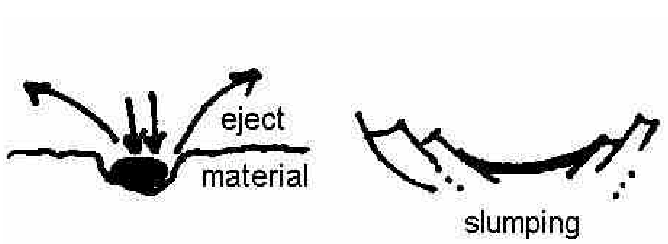


MATERIALS:

flour
corn meal (optional)
spoons
newspaper
measuring sticks
pans
magnifying glasses
lab sheet
photos of the moon

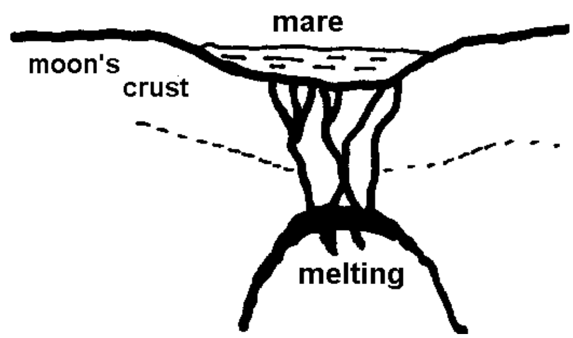
BACKGROUND:

The surfaces of the terrestrial planets are covered with impact craters, except for the Earth. Many of the Solar System's moons also have many craters. Impact craters form when a meteroite strikes the surface. The impact hits with so much force that it compresses the rock it strikes, forming the crater. The impact also vaporizes the impacting object. This impact plus the rebound of the compressed rock ejects material out of the crater. This material may spread up to thousands of kilometers away, depending on how much energy is released. The shape of the crater may change if its walls begin to slump inward, partially filling it up as shown in the figure to the left.



Craters may also be destroyed by surface processes, such as weathering, and flows of water, wind, and ice. This is why craters are rare on Earth. Old craters have been destroyed.

Our understanding of the origin of craters was limited until pictures and samples were returned from our own Moon's surface. We now have good photographic evidence for craters from the other terrestrial planets, especially Mars and Venus. Craters on these planets are difficult to interpret; some scientists think that some of them may be volcanic in origin.



On the Moon, the floor of a typical crater is below the average level of the surface. The crater is surrounded by a raised rim. Ejected material appears as piles of rubble or loose rock in a zone around the crater, or from larger craters, as a system of rays. Some craters are cut by rills, which are cracks in the surface. Rills may be faults, possibly caused by ancient tectonic activity or cooling processes.

Some very large lunar impact craters are filled by volcanic rock very similar to the terrestrial igneous rock basalt. These filled craters are usually called *mare*, from the Latin word for ocean. Scientists suggest that after a large impact, molten rock leaked up from the interior of the Moon along cracks, partially filling the crater.

In this activity the students first make their own craters, and then observe real craters using pictures from the lunar surface.

PROCEDURE:

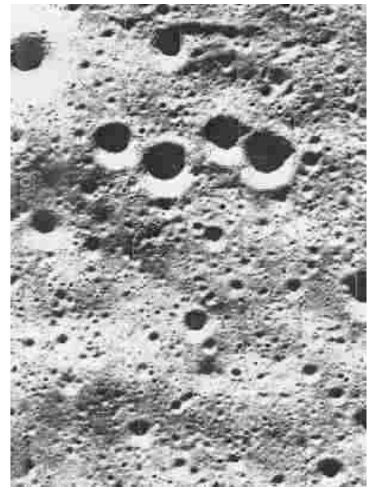
1. Explain how craters form to the students. You may wish to draw the diagrams shown in the background information to help. Explain the probable origin of lunar mare to the class. Again, you may wish to draw the diagram above on the board. Tell the student that they are going to make craters, and then look for real craters on the Moon.

2. Have the students work in groups. Have the students follow the directions on the lab sheet, or if you prefer, assemble the cratering materials in advance. Pour flour into each pan and level it into a layer at least 4-5 cm thick. Have the students work outside or spread newspapers on the classroom floor. Have each student stand on a chair and drop a spoonful of flour into the pan from a height of about a meter. This will form mini-craters in the flour that have the same raised rims and sloping sides as real craters.

If you have corn meal, you may want to mix that in with the flour. It gives the crater a more defined rim.

3. Alternatively, you may want to make several craters with a few students, and have the rest of the class observe and record the craters on their lab sheets.

4. You can also experiment by changing the angle of impact, by throwing the flour into the pan at an angle. This is how most “real” craters form; rarely if ever does an object strike exactly perpendicular to the Earth’s surface. Be careful, angled impacts can be messy! You should see, that unless the impact angle is very shallow, a circular crater is created. You may want to discuss with students that impacting objects do not hit the Earth straight on.



5. Divide the students into groups of four. Give each group a packet of Moon photographs. Make sure that they return the material to the same packet. Give each student a magnifier. Have them look at each of the four pictures to try and determine which ones show craters and which ones do not. Have them count the number of craters on each photo, and record the information on their lab sheets.

Have the students try to detect the difference between a mare and an impact crater. This is actually hard to see. You may wish to hint that the very large craters are usually mare. Instruct the students to look at the shadow. They may be able to tell the difference between a hill and a depression. But this is difficult also. It is good for the students to see the difficulty in this interpretation. Facing ambiguity is an important part of doing science.

UNIVERSE CYCLE - SOLAR SYSTEM (4) LAB

PROBLEM: How do craters form on the surface of a planets or moon?
PREDICTION: ____
EXERCISE 1:

MATERIALS: pan, flour, spoon, measuring stick

PROCEDURE: Put flour in a pan, making a layer 4 to 5 centimeters deep. Level the top of the flour layer. Take your pan outside, or if you work inside, put the pan on top of a sheet of newspaper. Stand on a sturdy chair, so your hand can be about 1 meter above the pan. Drop a leveled spoonful of flour into the pan. You and your partners should do one "drop" each. Look at the flour in the pan. Describe and draw the crater that you have created.

Describe the shape and size of the crater you have created.

____

____

Draw the crater you made in the box below.

EXERCISE II:

MATERIALS: 4 photographs of the Moon, magnifying glass

PROCEDURE: Look at the photos of Moon with the magnifying glass. <u>Please</u> be careful, these are the actual photos, and difficult to replace. In the space below, record the types of features you see; the number of craters in each picture, and if the crater resembles your flour craters. State if you think the crater is an impact crater or a mare.

PHOTO NUMBER	# OF CRATERS	DESCRIBE THE LANDSCAPE	MARE OR IMPACT

CONCLUSION: Is it difficult to determine the nature of craters? Explain your answer.

____

____

____

UNIVERSE CYCLE - SOLAR SYSTEM (4)

POST LAB

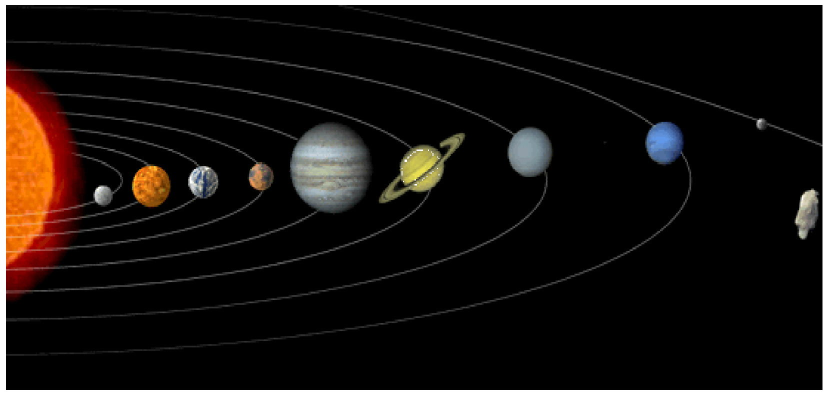
Students critique web sites and books on the planets.

OBJECTIVE:

1. Discovering new facts about the Solar System.
2. Comparing different web sites and books on the Solar System.

VOCABULARY:

critique
planetary scientist
planets



MATERIALS:

Internet
books on Solar System
worksheet

BACKGROUND:

Information about the planets changes with each new piece of data that is studied by planetary scientists. It is difficult to tell which books give you the best up-to-date information on the planets. The aim of this activity is to help students learn that scientific information is by definition provisional. It is always subject to change as new data is gathered, or as new interpretations are made. Students should begin to learn that when they read books about the planets or any other scientific topics, they should consider whether or not the information is up-to-date. They must not "believe" all they read.

For example, the number of planets in the Solar System is in debate. Some planetary scientists think the irregularities in the orbit of Pluto mean that another planet must exist further from the Sun.

In this activity, the students compare and contrast different web sites and books on planetary science. They will critique the books and web sites to learn if there are any inconsistencies in the information.

Here are some suggested web sites for you to assign to the students. You can use whatever books are available in your library. You can easily add other web sites or books to this lesson. The worksheet is generic, so you can have the students fill in the web sites or books you use.

PROCEDURE:

1. Have the students read the books and visit the web sites. Have them compple the worksheet and critique the information that they find.

2. The answers are dependent on how carefully a student reads the materials and whether they are looking for mistakes.

3. Here is a list of recommended websites:

http://www.windows.umich.edu/
Windows on the Universe - an excellent site with lots of information on the Solar System.

http://www.hawastsoc.org/
View of the Solar System, information on each of the planets.

http://oposite.stsci.edu/pubinfo/Anim.html
Animations of planets and galaxies. The main Hubble Space Telescope site contains many Hubble Space Telescope pictures.

http://pds.jpl.nasa.gov/planets/
An introduction to the planets from NASA, hosted by the Jet Propulsion Laboratory. Many excellent pictures.

http://www.nasa.gov/kids/kids_planets.html
A NASA link site that connects with much of the organization's student activities and information.

http://www.seds.org/nineplanets/nineplanets/nineplanets.html
An overview of the history, mythology, and current scientific knowledge of each of the planets and moons in our solar system. Many pages also have sounds and movies.

UNIVERSE CYCLE - SOLAR SYSTEM (4) POST LAB

CRITIQUE THE FOLLOWING BOOKS AND WEB SITES ON THE PLANETS

List the books or web sites. Summarize in one sentence each of these books or web sites.

1. Information obtained from:____

2. Information obtained from:____

3. Information obtained from:____

4. Information obtained from:____

Use the data chart below to help critique the books.

NAME OF BOOK/WEB	SCIENTIFIC CORRECTNESS	PICTURES	CONTENT