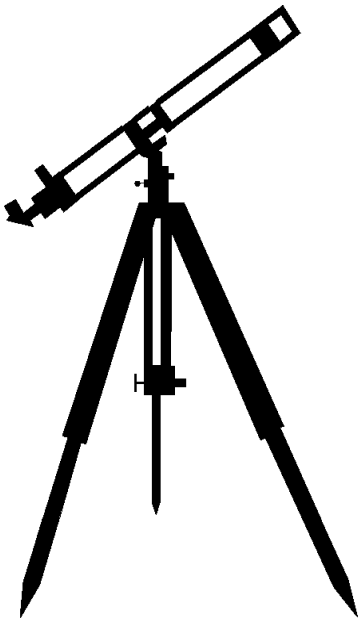
Universe Cycle

The Search for Our Beginnings

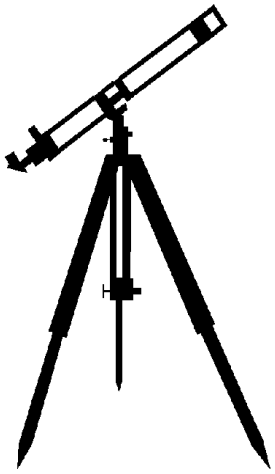
THIRD GRADE

SOLAR SYSTEM



1 WEEK
LESSON PLANS AND
ACTIVITIES

UNIVERSE CYCLE
OVERVIEW OF THIRD GRADE



UNIVERSE

WEEK 1.
PRE: *Contrasting different components of the Universe.*
LAB: *Comparing and contrasting stars.*
POST: *Comparing relative and absolute brightness.*

SOLAR SYSTEM

WEEK 2.
PRE: *Distinguishing between revolution and rotation.*
LAB: *Discovering the terrestrial planets.*
POST: *Investigating the gas giants.*

EARTH

WEEK 3.
PRE: *Comparing lunar and solar eclipses.*
LAB: *Discovering how landforms are created on Earth.*
POST: *Exploring the reasons for seasons.*

GEOGRAPHY

WEEK 4.
PRE: *Describing different types of maps.*
LAB: *Exploring how to make a map.*
POST: *Comparing maps and globes.*

UNIVERSE CYCLE - SOLAR SYSTEM (3)

PRE LAB

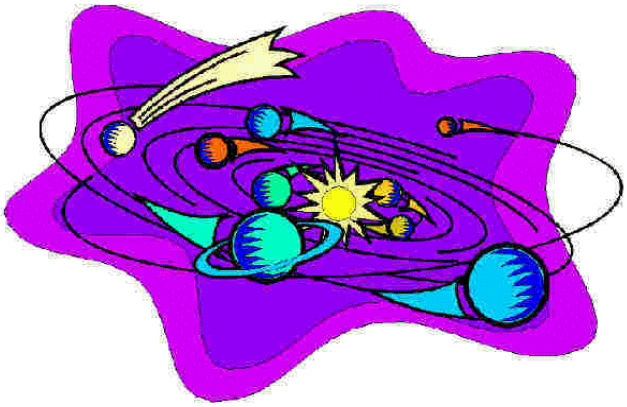
Students learn about rotation and revolution.

OBJECTIVES:

1. Describing and comparing motions in our Solar System.
2. Distinguishing between rotation and revolution.

VOCABULARY:

axis
orbit
revolution
rotation



MATERIALS:

worksheet
Solar System Placemats

BACKGROUND:

Students should now be aware of the great movements that occur in the Universe. Movement is also present throughout our Solar System. Even the Sun moves within the Milky Way Galaxy! You may want to ask them what evidence suggests to us that the Earth moves. The rising and setting of the Sun and Moon implies that one of the objects is moving. The changing positions of the stars, Sun, and Moon also implies movement of longer occurrence.

The key concepts to emphasize are that the Earth revolves around the Sun or orbits around a central point. The Earth also rotates on its axis or on itself. Although simple, these terms are easily confused. Use the worksheet to help student understand.

An example of revolve and rotation is a person who is sitting on a horse attached to a Ferris wheel. The person in the horse is revolving around the center, however rotation of the horse and person would occur if the person in the horse spins. The Earth, spinning on its axis, revolves around the Sun. The Moon, rotating on its axis, revolves around the Earth.

Rotation is a little more involved because students need to understand an axis. An axis is an imaginary line around which an object spins on itself. The Earth's axis is an imaginary line that runs through the north and south poles. You can use a basketball spinning on a finger as an example of rotation. Rotation causes day and night, and the tilt of the axis (23 ½ °) causes the seasons. The quality of the sunlight caused by the tilting of the axis is the major factor causing the seasons, not the distance from the Sun.

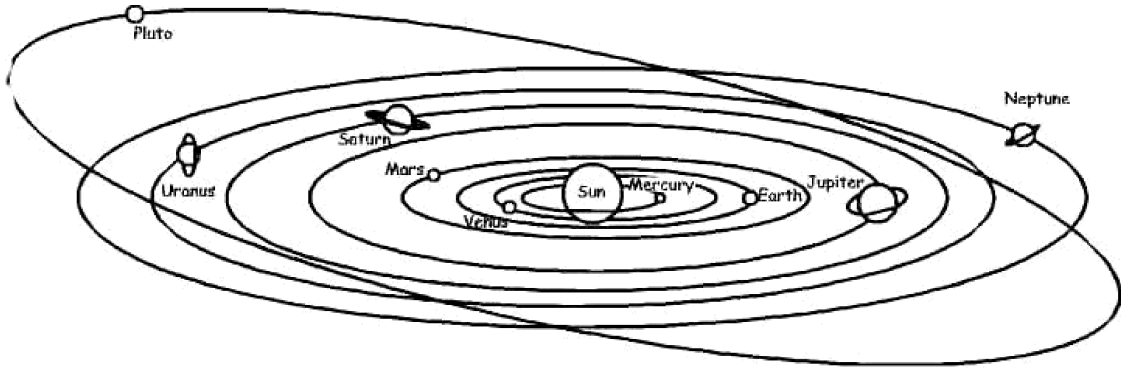
PROCEDURE:

1. Ask the students what evidence suggests to us that the Earth moves. Explain how the passing of day and night are cause by rotation.

2. You may want students to work in groups of 4 or 5 and have them illustrate to you the difference between revolution and rotation. Students should revolve around a central student, but they should also be rotating on their axis as they revolve.

3. The placemats are a way to get students to learn to observe and collect information. The orbit of each planet defines their revolution around the Sun. Point out the rings around Jupiter, Saturn, Uranus, and Neptune to the students. Tell them that the rings define the planet's rotation. These objects circle the planet in a band . The planet's axis is perpendicular to this band.

4. Draw a picture of the orbits using the diagram below as a model. Ask students to look closely at the orbits. Point out that the planets revolve in very defined areas, along the lines. Tell them the orbits are not wild! The only planet that has an eccentric (a little on the wild side) orbit is Pluto. Its orbit actually brings Pluto closer to the Sun than Neptune during some years.

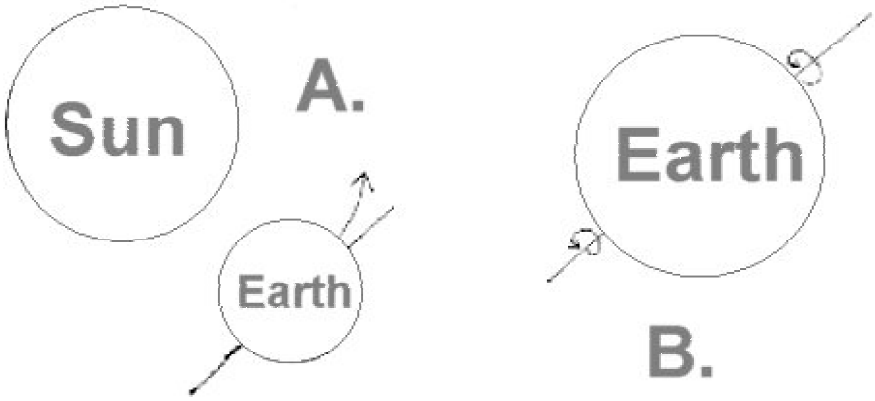


5. Have the students use the Solar System placemat to help answer the questions on the worksheet.

Answers: A = revolves; B = rotates; 1. An axis is an imaginary line through an object around which it spins. The point on the axis does not move. 2. The Earth revolves around the Sun. 3. The Earth rotates on its axis. 4. Yes. The axis points away from the Sun as it rotates. 5. The orbits of Mercury through Neptune are "flat" - they all lie in the same plane. The orbits of these planets are also almost circular. Pluto is the exception: its orbit is tilted about 20^{o} from the other planets, and it has an elliptical (oval) shape.

HOW DOES OUR EARTH MOVE?

revolve = to orbit a central point
rotate = to turn or spin on an axis



1. What is an axis? _____

2. The Earth _____ around the Sun.

3. The Earth _____ on its axis.

4. Does the Earth rotate and revolve at the same time? Does the axis of the Earth move? Explain your answer.

_____
_____
_____

5. Describe and compare the orbits of all of the planets around the Sun.

_____
_____
_____
_____

UNIVERSE CYCLE - SOLAR SYSTEM (3)

LAB

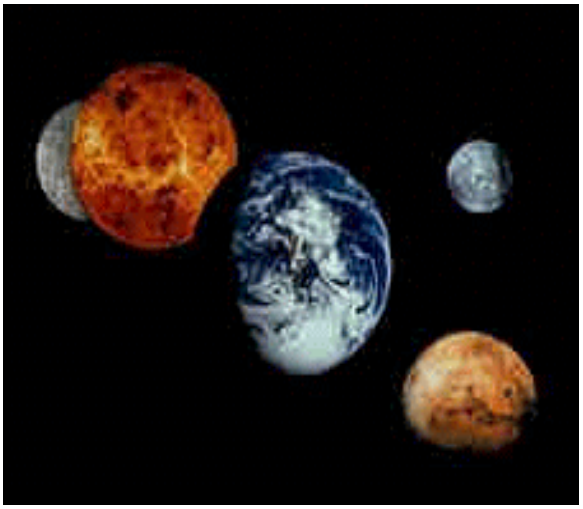
Students make a model of how the inner planets orbit around the Sun.

OBJECTIVES:

1. Discovering the terrestrial planets.
2. Exploring the rotation of the inner planets.

VOCABULARY:

inner planets
revolution
rotation
terrestrial planets



terrestrial planets - Mars, Earth, Venus, Mercury, and Pluto

MATERIALS:

brads (very small nails)
construction paper
compass or circle templates (see below)
Solar System Placemats

BACKGROUND:

The Solar System consists of our Sun (a star) and an assemblage of smaller bodies that revolve around the Sun. The smaller bodies include the planets and their moons, asteroids, comets, and interplanetary dust.

The major planets, in order of increasing distance from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. Scientists commonly divide these into two groups. The terrestrial planets (also called inner planets), Mercury, Venus, Earth and Mars and the gas planets of Jupiter, Saturn, Uranus, and Neptune. Pluto is considered a terrestrial planet, but not an inner planet.

Moons, or natural satellites, are bodies that revolve around a planet. The Earth has one moon, while the other planets have none to many. Moons have varying compositions. The Earth's Moon is essentially rock. Other moons, particularly those of Jupiter and Saturn, appear to have rocky cores, but are surrounded by gaseous atmospheres.

Venus

Asteroids are small bodies of rock and frozen gas. They tend to be concentrated in a belt between the orbits of Mars and Jupiter. Some asteroids also orbit the Sun, on paths that cross the Earth's orbit. These objects began in the asteroid belt, but were pushed into orbit around the Sun by the gravitational effects of Jupiter, or

Mercury

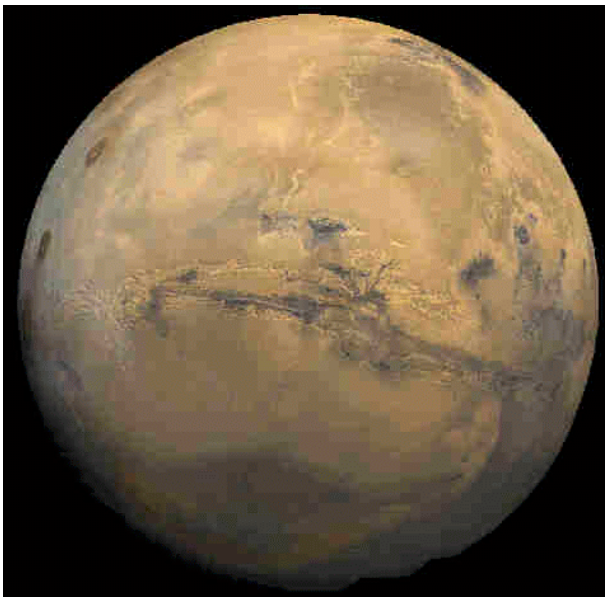
collisions with other asteroids. Meteors or "shooting stars" refers to flashes of light that dart across the night sky. These occur when an asteroid enters the Earth's atmosphere and burns up.

A comet is a small body composed of frozen gas and small amounts of rock. Comets are leftovers from the formation of the Solar System. Most comets reside in a belt outside the orbit of Pluto., or much further away in a huge shell surrounding the Solar System. Comets travel inward toward the Sun, developing elliptical orbits. As a comet approaches the Sun, solar radiation heats it up. Escaping gas and dust form the comet's tail.

Mercury is the closest planet to the Sun. It orbits the Sun quickly, once every 88 days. Because it is so close to the Sun, it is difficult to see. Mercury's orbit is very elliptical, ranging from 46-70 million km from the Sun. It rotates slowly once every 59 days. The Sun appears 2.5 times larger from Mercury than it does from Earth. Surface rocks facing the Sun roast to 400°C while the long night surface cools to -170°C. Mercury is small, about 4850 kilometers (~3000 miles) in diameter. The surface of Mercury looks like the Moon, but is gray-orange in color. There are many impact craters and large areas of lava, like the Moon's large plains.

Venus the second planet away from the Sun, is Earth's closest neighbor. It is about the same size as the Earth, a little over 12,000 kilometers (7300 miles) in diameter. It is sometimes considered to be the Earth's twin. Venus rotates counterclockwise once every 242 days. This is opposite to all the all other planets. Venus has a very thick atmosphere, composed largely of sulphuric acid and CO_2. The surface temperature of Venus has been recorded as high as 475°C, which is hotter than Mercury. This is because of the greehouse effect of Venus's atmosphere. The clouds within the atmosphere trap heat, raising the surface temperature. The surface of Venus is covered with craters, volcanoes, and large ridges which may be evidence of mountain building.

Mars has a diameter of 6790 km, just over half of the Earth. It takes Mars 687 days to revolve once around the Sun. Its orbit is elliptical, ranging from 206-249 million km in diameter. The surface of Mars has an intense reddish orange hue, which is caused by large amounts of iron oxide in rocks. Mars has a very thin atmosphere, which is composed largely of CO_2. Its surface is very cold, and is covered with craters, volcanoes, and large canyons, which may indicate the past presence of water. Maximum surface temperatures range from -29°C to -100°C. Mars has two tiny satellites called Phobos and Deimos. Phobos is fast; it travels 3 times around Mars in one day!



Mars

PROCEDURE:

1. In this exercise, the students will construct a model of the orbits inner or terrestrial planets. First, go over some of the information on the terrestrial planets, making sure students are able to compare and contrast the different planets.

2. Have the students use compasses to make the appropriate sized circles for each orbit. If you do not have compasses, you can either make circles that act as templates before the exercise or use two pencils tied together with a string measured at the appropriate distance.

Use the following ratio for the orbits: Sun: Mercury: Venus: Earth: Mars = 0: 1: 2: 3 1/2: 4 1/2. For example, if you are using the metric system, the Sun would be 0 cm. Mercury's orbit would be 10 cm in diameter, Venus' orbit is 20 cm, Earth's orbit is 35 cm and Mars' orbit would be 45 cm. If your paper is not large enough for these dimensions, cut the diameter of each of the planets by half.

Have the students cut out the orbits.

3. Have the students push a brad through a sheet of paper. This will represent the Sun. Stack the orbits on the brad, starting with the largest orbit (Mars), then Earth, followed by Venus, and finally Mercury.

4. Have the students revolve each disk in the correct direction, using the chart on the worksheet for guidance. All four planets should revolve counterclockwise.

5. Remind the students that the orbits of the planets are not circular, but have elliptical shapes, as shown on the Orbits of the Planets picture (from the Pre Lab). Have the students compare this with the Solar System Placemat. It is a closer look at the planets.

UNIVERSE CYCLE - SOLAR SYSTEM (3) LAB

PROBLEM: How do the inner planets orbit the Sun?

PREDICTION: _____

MATERIALS: brads, construction paper, compass or circle templates, scissors

Directions:

1. Make circles with the following dimensions.
   Mercury orbit - 5 cm
   Venus orbit - 10 cm
   Earth orbit - 17 cm
   Mars orbit - 22 cm
2. Push a brad through a piece of paper, so the sharp end is sticking up. Put the Mars orbit circle on top of it, so that the brad pokes through the center of the circle. Stack The Earth circle on top of Mars the same way, then Venus, then Mercury. Draw a picture of each planet on the edge of its orbit. Use the information your teacher provided.
3. Make the planets revolve by moving the circles. Use the chart below to find the correct direction. Have your teacher check your movements.

	ROTATES	REVOLVES
Mercury	59 days (clockwise)	88 days (counterclockwise)
Venus	242 days (counter)	225 days (counterclockwise)
Earth	24 hours (clockwise)	365 days (counterclockwise)
Mars	24.5 hours (clockwise)	687 days (counterclockwise)

4. Answer the questions below “YES” or “NO”.

Mercury revolved faster than the Earth.	
Venus revolves faster than Earth, slower than Mercury	
Mars rotates slower than Earth	

CONCLUSION: Describe the orbits of the terrestrial planets around the Sun.

_____

_____

UNIVERSE CYCLE - SOLAR SYSTEM (3)

POST LAB

Students look at magnetic fields of gas giants.

OBJECTIVES:

1. Investigating the gas giants.
2. Comparing Jupiter, Saturn, Neptune, and Uranus.

VOCABULARY:

gas giants
kelvin
magnetic field
rotation

Jupiter

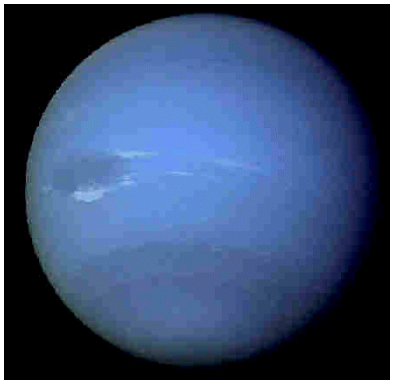
MATERIALS:

worksheets

BACKGROUND:

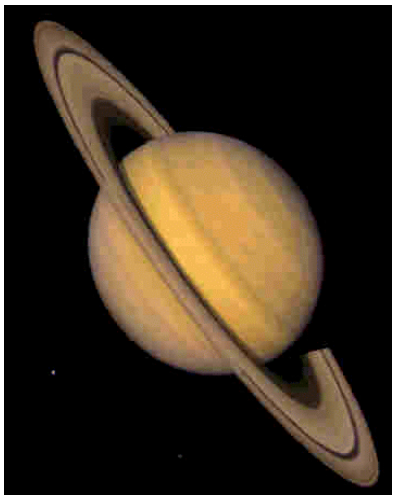
Our knowledge of the gas giant planets comes from two sources, ground based telescopes and spacecraft. Because of their great distance from Earth and the interference of the Earth's atmosphere, telescopes are of limited use in gathering scientific information about these planets. The most detailed information about the gas giants has come from 1) the Voyager 1 and 2 spacecraft, which visited these planets, starting in 1979, and from the Galileo probe which orbited around Jupiter. Scientists are really just beginning to learn about these planets. They have only a general understanding of their composition, structure, magnetic properties, and other characteristics.

The atmospheres of the four gas giant planets are composed largely of hydrogen and helium. The upper atmospheres of both Jupiter and Saturn are mostly hydrogen; scientists hypothesize that much of this material has sunk into the interiors of the two planets. The upper atmospheres of Uranus and Neptune seem to have somewhat larger fractions of helium.



Uranus

The colors of the gas giant planets are due to gasses in their upper atmospheres. The visible surface clouds of Jupiter and Saturn are mainly ammonia ice. Trace impurities give these clouds their coloration, such as the reddish tints of Jupiter's Great Red Spot. Methane is 10 times as abundant in the atmospheres of Uranus and Neptune as the atmospheres of Jupiter and Saturn. The abundance of methane makes

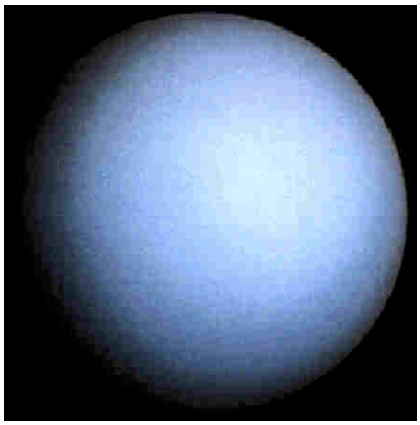


Saturn

Uranus and Neptune both appear blue to human eyes. Methane absorbs red and orange light in their atmospheres.

On each of the gas giant planets, the atmospheres are organized into zones that run parallel to the equator. These zones range from prominent on Jupiter and to almost indistinguishable on Uranus. These zones are controlled by a stable pattern of planetary winds. On Jupiter wind speeds vary with latitude and shift from easterly to westerly many times between the equator and the pole. Storm activity, in the form of swirling oval patches, can be seen on Jupiter, Saturn, and Neptune but not on Uranus.

The temperatures of the upper atmosphere of the gas giants are quite hot. For Jupiter the temperatures are in excess of 1000°K, 600-800°K for Saturn, and 750-800°K for Uranus and Neptune. The minimum temperature for Jupiter is 110°K, for Saturn is 80°K, Uranus is 52°K, and Neptune is 50°K.



Neptune

All four of the gas giants have magnetic fields. Scientists explain how the fields are generated using the dynamo theory. Essentially, each of the gas giants has a core which is partially liquid metallic hydrogen. As this material circulates, it generates electrical energy, which creates the magnetic field. The magnetic fields are dipolar; they have well defined north and south magnetic poles. Magnetic forces travel from the negative to the positive pole. On the student's diagram below, the magnetic field is shown as imaginary lines of force. The magnetic poles of the gas giant planets correspond only poorly with the their rotational axes. The reasons for this, especially the wide divergence seen in Uranus, are not clear.

PROCEDURE:

1. Use the worksheets to compare the gas giant planets with Earth. You may wish to review their relative sizes, distances from the Sun, rotational speeds, and other features.

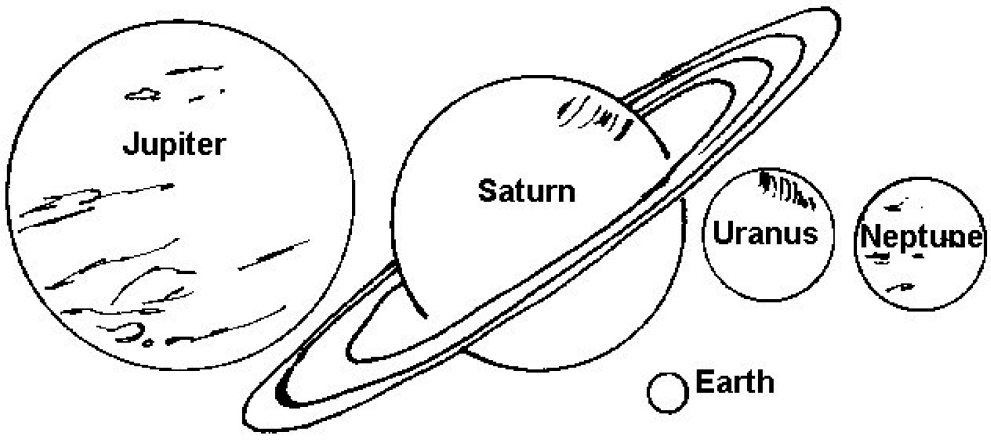
2. Compare the magnetic fields of each of the planets using the diagram. The dashed line shows the planet's rotational axis, the solid straight lines show the equator of each planet, and the curved solid lines show the directions of the magnetic field. In particular, note that magnetic fields of Uranus and Neptune are vastly different from the Earth's because they are greatly offset from the rotational axis.

3. Stress to students that scientists do not know all there is about these gas giants.

New information in the future will help us to understand these giants. Remember these worksheets are for students to compare and contrast, not to memorize.

UNIVERSE CYCLE - SOLAR SYSTEM (3) POST

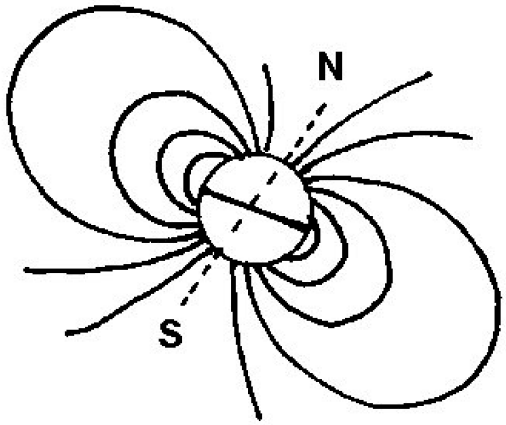
RELATIVE SIZES OF THE GAS PLANETS COMPARED WITH EARTH



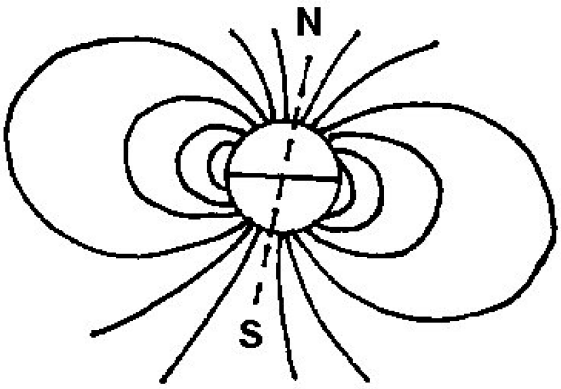
	EARTH	JUPITER	SATURN	URANUS	NEPTUNE
DISTANCE FROM SUN (10^9 KM)	0.1496	0.7783	1.4294	2.8750	4.5043
VOLUME (EARTH=1)	1	1321.3	763.6	63.1	57.7
MASS OF PLANET (EARTH=1)	1	317.892	95.184	14.536	17.148
ROTATION	23.9 hrs	9.9 hrs	10.6 hrs	17.2 hrs	16.1 hrs
TILT OF EQUATOR	23.4	3.08	26.7	97.9	28.8
MOONS	1	16	20	15	8
RINGS	0	1	7	10	4

UNIVERSE CYCLE - SOLAR SYSTEM (3) POST

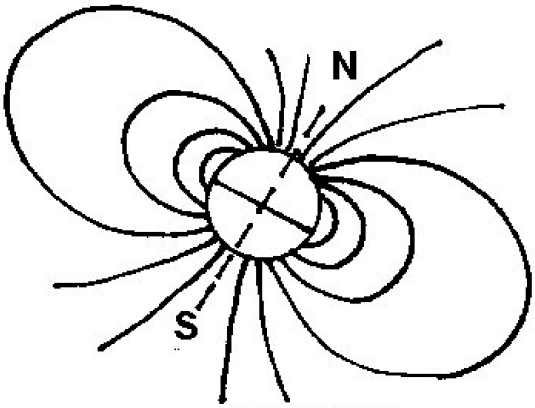
MAGNETIC FIELDS OF THE GAS GIANTS COMPARED TO EARTH



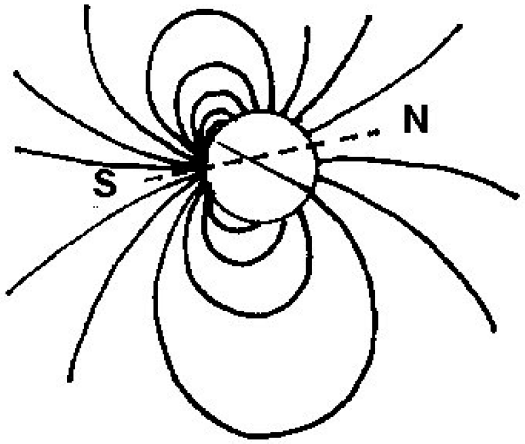
EARTH



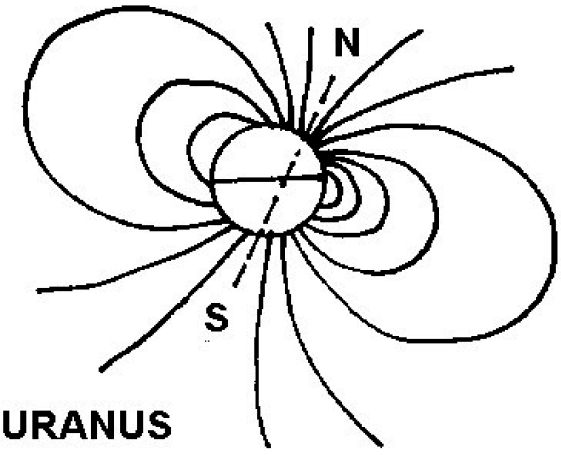
JUPITER



SATURN



NEPTUNE



URANUS