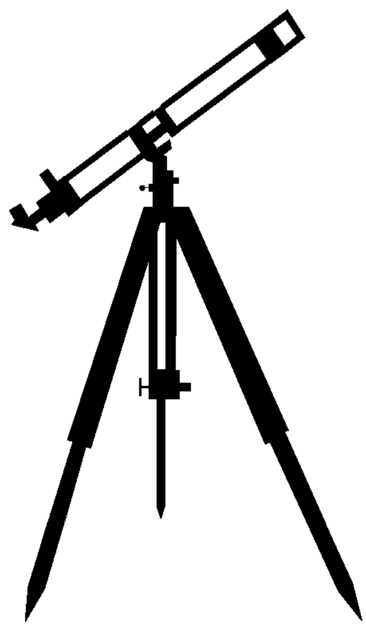
Universe Cycle

The Search for Our Beginnings

FIFTH GRADE

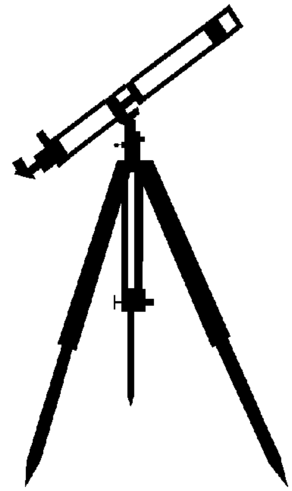
UNIVERSE



1 WEEK
LESSON PLANS AND
ACTIVITIES

UNIVERSE CYCLE

OVERVIEW OF FIFTH GRADE



UNIVERSE

WEEK 1.
PRE: *Comparing components of the Universe.*
LAB: *Exploring how the Universe may have formed.*
POST: *Comparing constellation charts with celestial globes.*

SOLAR SYSTEM

WEEK 2.
PRE: *Comparing and contrasting the features of the planets.*
LAB: *Comparing meteorites to Earth rocks.*
POST: *Discovering the atmosphere on different planets.*

EARTH

WEEK 3.
PRE: *Exploring how planets are formed.*
LAB: *Comparing landforms of the Moon, Mars, and Earth.*
POST: *Discovering influence of ice, rain, and wind.*

GEOGRAPHY

WEEK 4.
PRE: *Exploring how topographic maps are made.*
LAB: *Comparing and contrasting topographic maps.*
POST: *Understanding topographic maps.*

UNIVERSE CYCLE - UNIVERSE (5)

PRE LAB

Students use the Internet to learn about the Universe

OBJECTIVES:

1. Differentiating terms used to describe the Universe.
2. Comparing the components of the Universe.

VOCABULARY:

galaxy
globular cluster
white dwarf star
neutron star
black hole
binary star
main sequence star
quasar
pulsar
planet
solar system
asteroid
comet

A barred spiral galaxy

MATERIALS:

Internet
worksheet

BACKGROUND:

The Universe contains many components, which vary considerably in size. In this exercise, students will use the internet to research definitions for a number of astronomical objects, which are listed in the "Vocabulary." Here are definitions to help you guide the student's work.

A *galaxy* is a large scale aggregate of stars, plus some gas, dust, and possibly solar systems, which are held together by gravity.

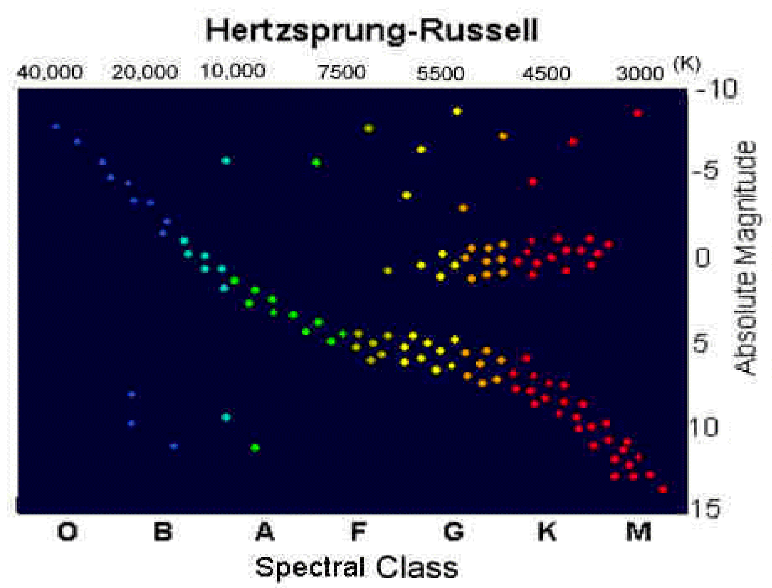
A *globular cluster* is a roughly spherical group of hundreds of thousands to about a million stars, also held together by gravity. Globular clusters seem to be made of very old stars.

A *star* is a ball of hot gas held together by its own gravity. Gravity also causes stars to undergo nuclear fusion within their interior. The energy release causes the star to shine. The energy of fusion balances the star's gravity, preventing it from collapsing. However, when a star's internal energy dwindles, the star may fade from sight into a *white dwarf* star, or a *neutron star*, an extremely high density object composed of 99% neutrons. Neutron stars are probably remnants from supernova explosions. A *pulsar* is a rapidly spinning neutron star. For reasons that are not fully understood, pulsars emit regular bursts "pulses" of radiation.

Stars come in a variety of types. These include:

1. *Binary Stars* - A system of two stars, orbiting around one another. Binary (and other multiples) stars are very common. Astronomers estimate that about half of all stars are members of multiple-star systems.

2. *Main Sequence Stars* - Stars on the "main sequence" part of the Hertzprung-Russell (H-R) diagram, which classifies stars in terms of absolute magnitude and temperature. Main sequence stars get brighter as they get hotter. Our Sun and the majority of the stars in the Universe are on the Main Sequence.



3. *Giant and Supergiant Stars* - Large stars that occur above the main sequence, which are unusually large and cool. Supergiant stars are brighter than giant stars.

A *quasar (*short for quasi-stellar radio source*)* is a point source, no more than one light year in diameter that emits tremendous amounts of energy, as much as hundreds of galaxies. Current hypotheses suggest that quasars are powered by super massive black holes.

A *solar system* is an arrangement of planets and other small bodies around a central star or stars. The planets are kept in place by gravity.

A *planet* is a spherical body which circles a star in a regular orbit.

A *comet* is a kilometer-scale mass of frozen gas and rock which orbits the Sun. Comets are leftovers from the formation of the Solar System.

An *asteroid* is a mass of rock and minor amounts of frozen gas. Like comets, asteroids are leftovers from forming the planets. Most asteroids are in orbits between Mars and Jupiter. They range in size from dust specks to over 300 kilometers in length.

PROCEDURE:

1. Have the students define the words on the worksheet using the Internet or other

resources. We recommend the Internet because information on the Universe continues to increase as we develop new ways to gather data. Many sites on the Internet can allow students to easily learn the latest astronomical discoveries. You can easily do a search on each of the vocabulary words.

2. You may want to use the following sites:

http://oposite.stsci.edu/pubinfo/Anim.html
Animations of planets and galaxies. The home page for this site contains links to many Hubble Space Telescope pictures.

http://www.damtp.cam.ac.uk/user/gr/public/
Cambridge Relativity of Cambridge University. Discusses Cosmology, Black Holes, Inflation, Cosmic stings, and more. Good illustrations and graphics.

http://windows.ivv.nasa.gov/
Windows to the Universe from NASA - a comprehensive educational website for planetary science and astronomy.

http://www.nationalgeographic.com/features/97/stars/
Star Journey - a National Geographic site which includes star charts of the night time sky.

http://www.astro.wisc.edu/~dolan/constellations/
The Constellations and their Stars. A detailed website that includes interactive sky charts and pictures of stars and galaxies.

UNIVERSE CYCLE - UNIVERSE (5) PRE LAB

NAMING OBJECTS IN THE UNIVERSE

Using the Internet or other sources given by your teacher, put the following terms in order from largest to smallest. In addition, using outline form, show which terms are subsets of more general terms

galaxy, globular cluster, star, white dwarf star, neutron star, black hole, binary star, giant star, supergiant star, main sequence star, quasar, pulsar, planet, solar system, asteroid, and comet.

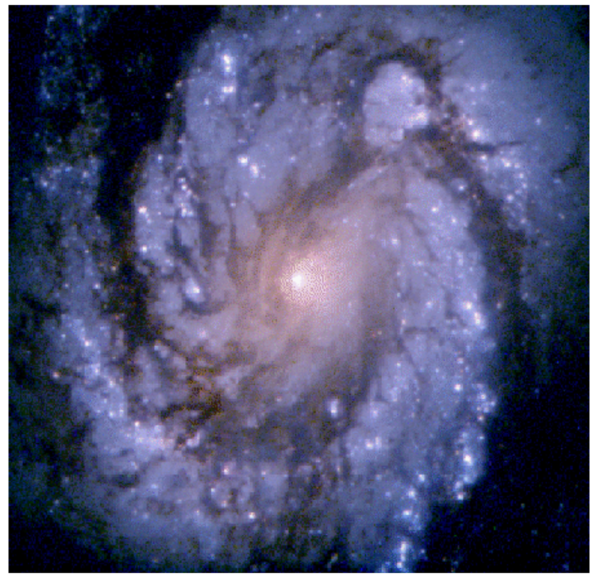
UNIVERSE CYCLE - UNIVERSE (5)

LAB

> Students experience motion and the shapes it produces.

OBJECTIVES:

1. Interpreting indirect evidence.
2. Exploring how the Universe may have formed.



VOCABULARY:

astronomer
observation
physicist
verify

MATERIALS:

fickle form
orbiter
Snapper Hands

BACKGROUND:

Astronomers who study the Universe must often use indirect evidence to develop a working hypothesis about what they are observing. For example, how do we know the stars are different temperatures if we cannot touch them? How do we know what the other planets in the Solar System are made of if we cannot visit them all? How do we know what elements are most abundant in space?

Put another way, astronomy is primarily an observational science rather than an experimental one. Developing hypotheses plays an important role in this field, more than other sciences. An astronomer makes a prediction that is later verified or disproved by observation. However, confirmation often takes a long time. For instance, black holes were first hypothesized to exist nearly 40 years ago. However, it wasn't until recently that black holes were confirmed to exist, through a combination of observation and subsequent mathematical modeling.

The question of whether other stars have planets revolving around them has always been speculated, but was not isn't until recently that mathematical confirmation in other sectors finally make this possibility a reality.

In this lab, students learn that indirect evidence can help test different hypotheses. The students look at several pieces of indirect evidence and try to see how these models can help describe or predict what might be out in space. The lab is designed to get students to think, rather than learn facts about the Universe. Remind the students to do the exercises slowly and try to observe the finer points of the experiments.

PROCEDURE:

1. The first exercise asks students to look at fickle foam, a heat sensitive material. The students should observe that the color of the foam gives some idea of how hot it is without directly measuring its temperature. Putting a finger on the pad forms a sequence of colors. The bluish color reveals the warmest areas and the red the coolest. You can determine the shape of the object from its outline, and compare its relative temperature to other objects. Note that cold objects make no record on the foam, indicating that there are limits to indirect evidence.

2. The orbiter and the stretchy material exercise is designed to help students recognize that the speed of rotation and revolution can distort the shape of an object. As the orbiter rotates faster, the shape becomes more disk-like, while remaining in the same plane. When the sticky substance is spun, it follows an elliptical path. The faster you go, the more eccentric the orbit becomes.

These are examples of motion in the Universe. For example, it is hypothesized that stars and solar systems form from rapidly spinning clouds of dust and gas, which flatten out into a disk-like shape. The shapes of galaxies and planetary systems thus evolve as they move. You may wish to reinforce these points at the conclusion of the lab.

UNIVERSE CYCLE - UNIVERSE (5) LAB

PROBLEM: How do astronomers make predictions about objects that they cannot sample?

PREDICTION:____

PROCEDURE:

EXERCISE 1. Put your finger on the fickle foam. Describe what happens.

____

Rub your hands together 50 times (make them warmer). What happens when you touch the fickle foam now?

____

Have your partner put one of his or her fingers on the fickle foam without you seeing which one they use. Try to figure out which finger was put on the pad. Record your prediction and reasoning in the box below.

prediction:	why:	actual:

After you predict which finger your partner used, have them tell you if you were right or wrong. Record the actual answer. Could you determine which finger without seeing the finger?

____

Are there limits to finding the shapes of objects using fickle foam? What are the limits?

____

____

EXERCISE 2: Spin the orbiter. Describe what happens to its shape as you spin it.

____

Spin the orbiter faster and pulsate it. What happens?

____

____

EXERCISE 3. Use the stretchy material. Spin it slowly. Describe what happens.

____

____

Spin the stretchy material faster. What happens to the shape of its orbit?

____

____

CONCLUSION: Can scientists use indirect observations to derive useful information? Will this data always be correct?

____

____

UNIVERSE CYCLE - UNIVERSE (5)

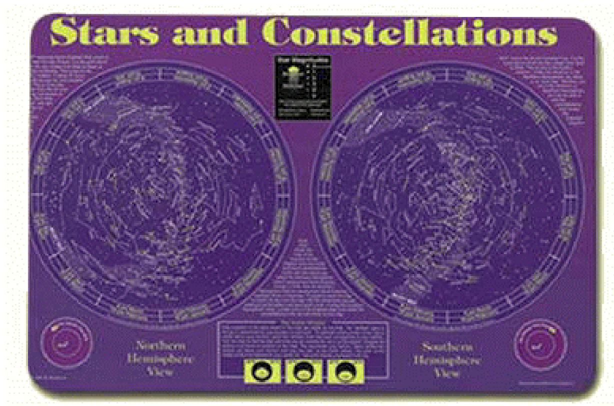
POST LAB

> Students learn how to obtain data.

OBJECTIVES:

1. Comparing Constellation Charts with Celestial Globes.
2. Exploring stars.

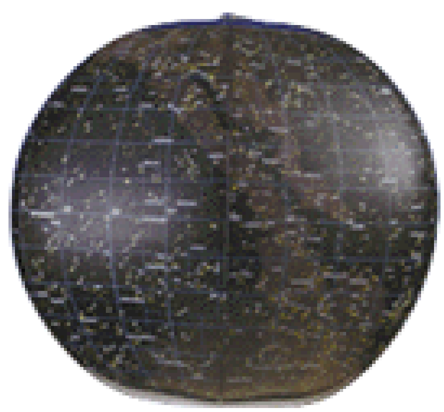
VOCABULARY:



apparent brightness
constellation
galaxy
planet
space
star
Universe

MATERIALS:

Constellation Placemats (laminated)
Inflatable Celestial Globes
Celestial Globe



BACKGROUND:

Stars are a basic unit of the night sky. Recognizing individual stars takes careful observation. Locating stars on a map is difficult. You can purchase star charts. However, if you don't buy the correct latitude and the correct time of the year you are viewing, you many not find the stars. In order to locate position patterns of stars were defined.

The patterns that the stars seem to permanently form are called constellations. There are 88 recognized constellations that help locate and map other objects in the sky. Constellations have their roots in ancient cultures and mythology. These peoples used constellations for navigation, and to foretell changes in the seasons. Currently, constellations are used by astronomers and amateurs astronomers to locate different areas of the night sky.

We cannot see all of the constellations from one point of the Earth's surface, because some are located close to the poles. For example, the North Star, which helps navigators locate geographic north, is not visible in the Southern Hemisphere.

PROCEDURE:

This exercise allows students to compare different types of star maps. If you have different star finders, bring them in to show students.

1. Show students the celestial globe and ask them what it represents. The Earth inside shows how the different positions on the Earth see different portions of the Universe. For example, people in Africa see the southern hemisphere, where Europeans see the northern hemisphere of the celestial globe.

2. Have the students work in groups. Give each group a Constellation Placemat and inflatable Celestial Globe. Have them complete the worksheet as they compare the two different types of star maps.

3. They should discover that the Constellation Placemat is very simplified whereas the Celestial Globe is very complicated and shows a complete picture of the night sky throughout the year. The Celestial Globe outlines all the sectors of the Universe from Earth. The Constellation Placemat, on the other hand, shows only the constellations in the Northern Hemisphere. The Placemat doesn't show apparent brightness, but the Celestial Globe does. The Placemat doesn't show any galaxies, while the Celestial Globe identifies both their locations and names. Both maps show stars, but only the Celestial Globe shows nebulas and clusters. Students should conclude that the Celestial Globe is much more accurate than the Placemat.

UNIVERSE CYCLE - UNIVERSE (5) POST LAB

COMPARISON OF CONSTELLATION PLACEMAT AND CELESTIAL GLOBE

Look at the Constellation Placemat and the Celestial Globe. Compare how the placemat and globe illustrate the items listed below. If one of them does not distinguish the items, note that as well.

	PLACEMAT	GLOBE
APPARENT BRIGHTNESS		
GALAXIES		
NEBULA		
CLUSTERS		
STARS		

What is the difference between the Constellation Placement and the Celestial Globe?
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____
____
____