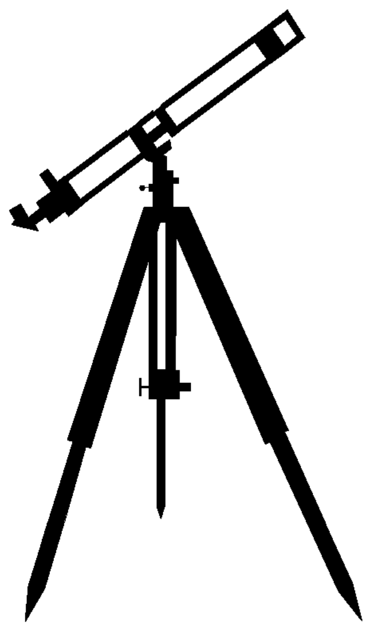
Universe Cycle

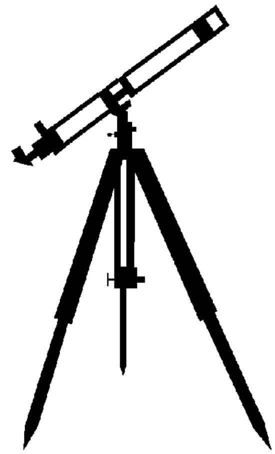
The Search for Our Beginnings

SIXTH GRADE

SOLAR SYSTEM



1 WEEK
LESSON PLANS AND
ACTIVITIES



UNIVERSE CYCLE
OVERVIEW OF SIXTH GRADE

UNIVERSE

WEEK 1.
PRE: *Exploring how the Universe may have evolved.*
LAB: *Comparing the night sky with zodiac signs.*
POST: *Comparing the different components of the Universe.*

SOLAR SYSTEM

WEEK 2.
PRE: *Exploring the structure of our Sun.*
LAB: *Calculating the weight of objects on different planets.*
POST: *Exploring astronomical themes in songs.*

EARTH

WEEK 3.
PRE: *Comparing the motion of the Sun, Earth, and Moon.*
LAB: *Discovering how the tilt of the axis causes the seasons.*
POST: *Analyzing literature with descriptions about Earth.*

GEOGRAPHY

WEEK 4.
PRE: *Discovering uses for maps.*
LAB: *Exploring military strategies using a map.*
POST: *Creating a three dimensional landscape.*

Students determine how the Sun compares to other stars.

PRE LAB

OBJECTIVES:

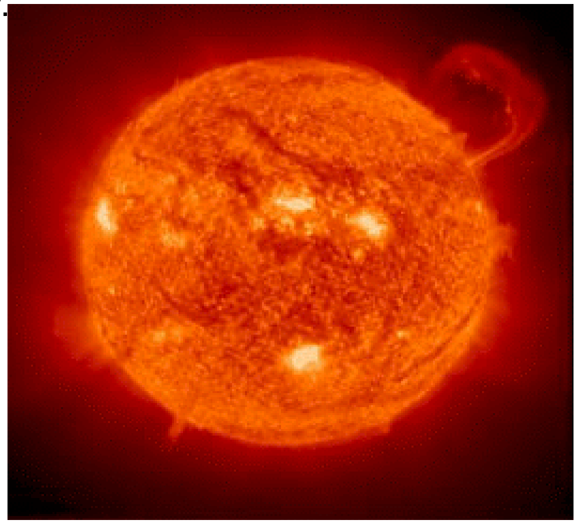
1. Exploring the structure of our Sun.
2. Comparing data on solar activity.

VOCABULARY:

chromosphere
corona
photosphere
solar wind
sunspot

MATERIALS:

worksheet



A view of the Sun's photosphere

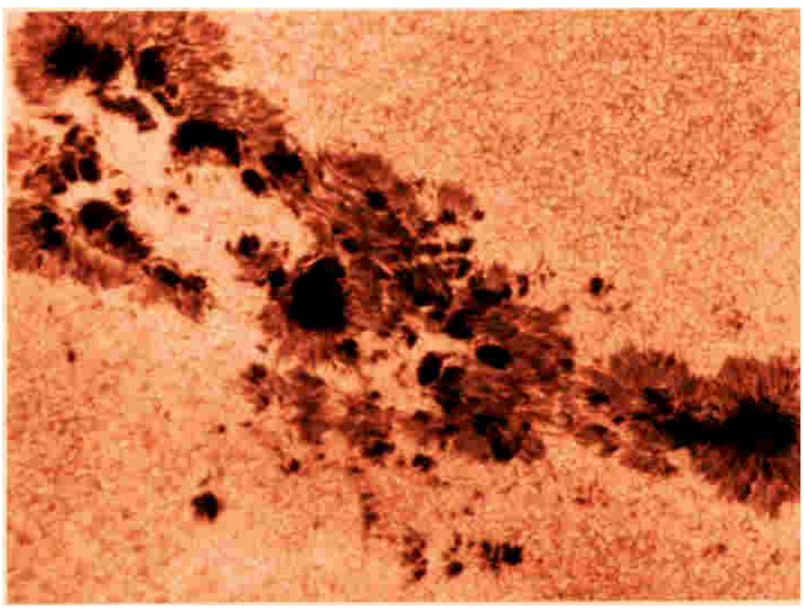
BACKGROUND:

The Sun is a star. A self-luminous sphere of gas and plasma that is held together by its own gravity, and energized by nuclear reactions in its interior. The Sun has a four part structure. The outermost layer is the corona, the Sun's outer atmosphere. This is a zone of super hot (temperatures vary, but range to millions of degrees centigrade). The corona is periodically hit by shock waves released from the Sun's surface. Combined with its high temperature, this produces the solar wind, a stream of subatomic particles that are "blown" or projected outward from the Sun. The solar wind moves at speeds of over 400 km/sec (893,000 mph) and extends well beyond the edge of the Solar System. Below the corona is a thin layer called the chromosphere, which is less than 200 kilometers thick. This lower part of the Sun's atmosphere is composed mainly of hydrogen, and has an average temperature of 5,000 C^{o}. Chromosphere means "color sphere", because when visible, this layer appears as a thin red crescent. The corona and chromosphere are visible only during solar eclipses, when the remainder of the Sun is hidden.

The visible surface layer of the Sun is the photosphere, which is a layer of plasma about 300 kilometers thick. It is composed of 94% hydrogen and 6% helium. Viewed from Earth, the photosphere has a grainy or spotted texture of light and dark patches. This texture is caused by temperature variations in the photosphere: the hot areas look brighter than the dark areas. These variations are caused by circulation within the photosphere. The photosphere also has a magnetic field, but unlike the magnetic fields of the planets, the lines of magnetic force here wind around the Sun's rotational axis, following lines of latitude rather than lines of longitude. The reasons for this are not fully understood.

The remainder of the Sun is its interior or core. The core consists largely of plasma composed of the nuclei of hydrogen atoms. Deep within the core, the temperature is approximately 15 million degrees centigrade. It has been calculated that a pinhead of material at core temperature would be lethal to a person who was 160 kilometers away!.

The pressure in the core is also enormous. It is calculated to be 70 trillion grams per square centimeter. The main feature of the Sun, of course, is that it radiates energy. This is caused by nuclear fusion. At core pressures and temperatures, four hydrogen nuclei undergo a series of fusion reactions, which eventually produce one heavier atom of helium. This process releases a huge amount of energy. This energy radiates into space, mostly as infrared and visible light. Other wavelengths, including ultraviolet radiation and gamma rays, are also emitted. Fusion reactions happen relatively rarely in the Sun, so it burns its hydrogen "fuel" fairly slowly. The Sun has been undergoing fusion for around 5 billion years, and should last another 2 billion years before it depletes is hydrogen.

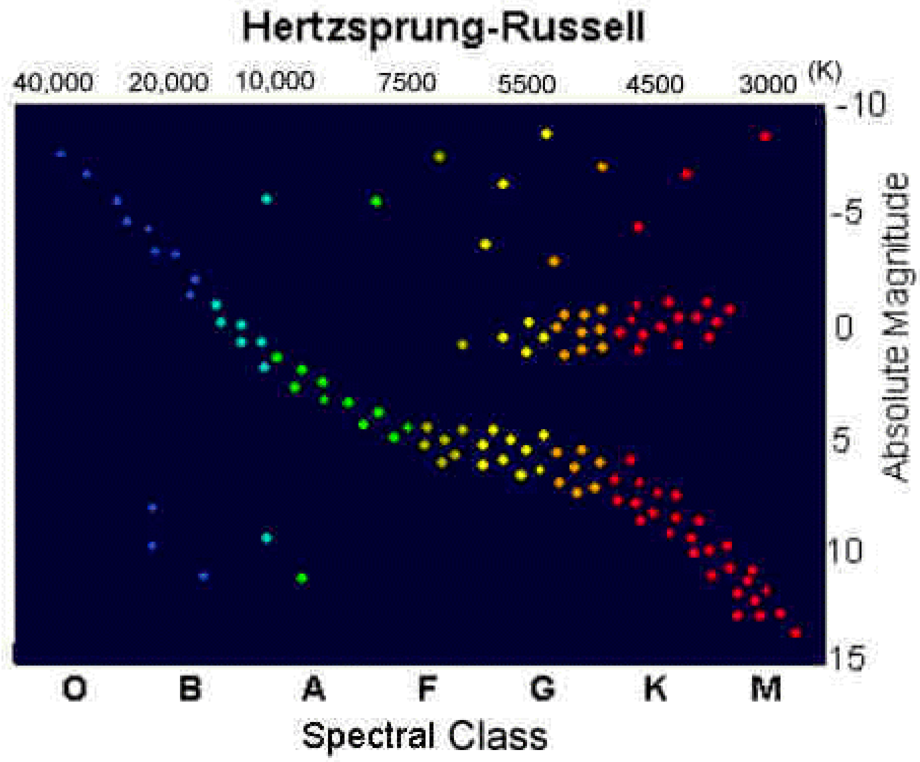


Sunspots

The magnetic fields of the Sun's photosphere are likely responsible for sunspots. Sunspots are patches of cool material on the Sun's surface, up to thousands of kilometers in diameter. Sunspots are transient; they generally last a few weeks to as much as two to three months. The number of sunspots varies over an 11 year cycle. From a minimum, the number of spots increases to a maximum in about 4 years, then wanes to a minimum in another 7 years. In the Pre Lab, students will examine a graph of sunspot activity, and try to recognize this pattern.

The Sun is about 1.39 million kilometers in diameter. Its mass is 2.0 x 10^{30} kg, about 330,000 times that of the Earth. These dimensions are close to the average mass and size of most stars in the Galaxy.

Astronomers classify stars using the Hertzsprung-Russell (or H-R) diagram, shown on the next page and worksheet. This diagram arranges stars according to their brightness (y-axis) and temperature (x-axis). On the H-R diagram, the Sun classifies as a main sequence star, specifically a G2 dwarf star. The spectral intensity is the wavelength of light released by the star, which for the Sun gives it its characteristic yellow color.



PROCEDURE:

1. Introduce the students to the Sun. Make sure that they have an understanding of sunspots.

2. Go over the graphs on the worksheet, making sure that the students understand and can read both of them.

3. Have the students complete the graphs. Make sure they understand that the x axis of the H-R diagram changes logarithmically. We recommend that they work in pairs, to aid in interpreting the graphs.

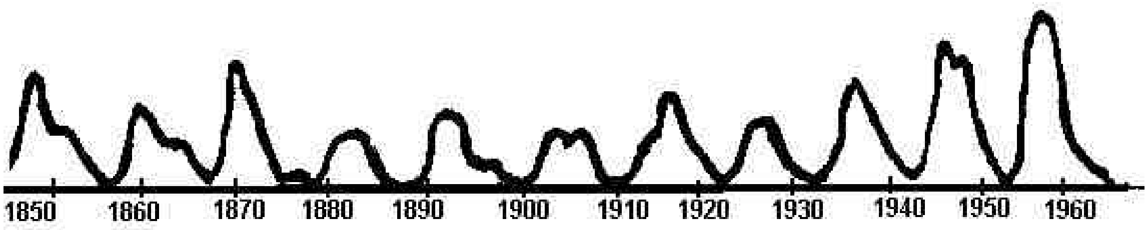
4. **ANSWERS:**

1. The students should recognize the 11 year sunspot cycle. They may generalize this to 10 years, which is acceptable, given the scale of the graphs. To mathematically determine the cycle, either measure the number of years between minimums and calculate the average, or do the same with maximums.

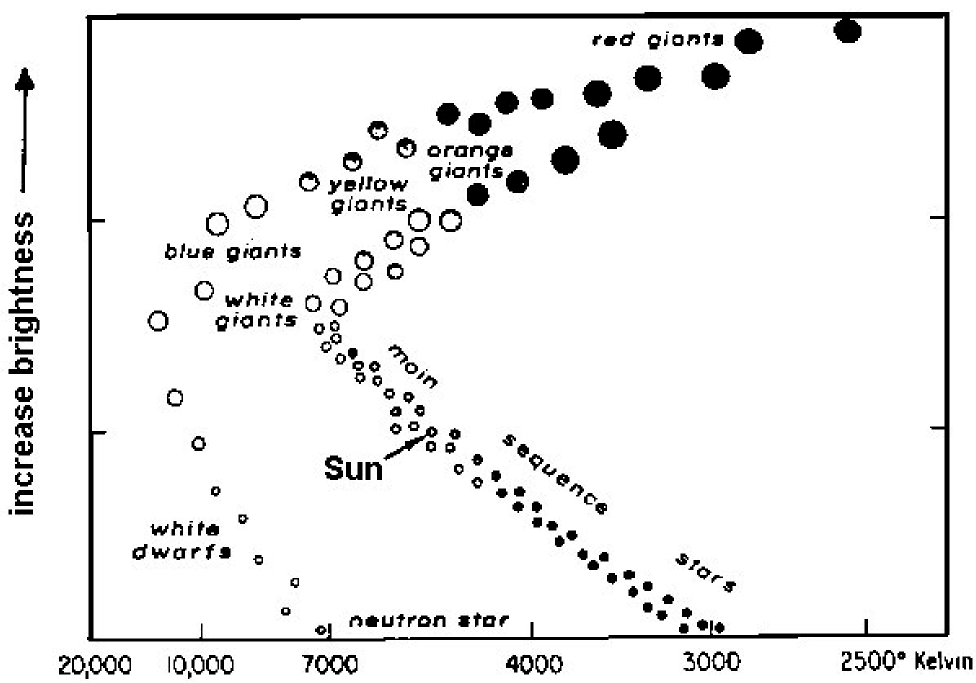
2. A. blue giants = 8,000 - 9,000˚K; B. orange = 5,000-4,000˚K; C. Red = 3500-2500˚K; D. white dwarfs = 9,000-10,000˚K . These are approximate values. Give students some latitude in their answers.

DATA ON SUNSPOT ACTIVITY

1. Can you determine a cycle from this graph? How can you determine the number of years between each minimum or maximum of activity? Show your work in the space below.



____
____
____



SIMPLIFIED HERTZSPRUNG-RUSSELL DIAGRAM

2. How hot are the following types of stars?
A. Blue giants _________________ B. Orange giants _________________
C. Red giants _________________ D. White dwarfs __________________

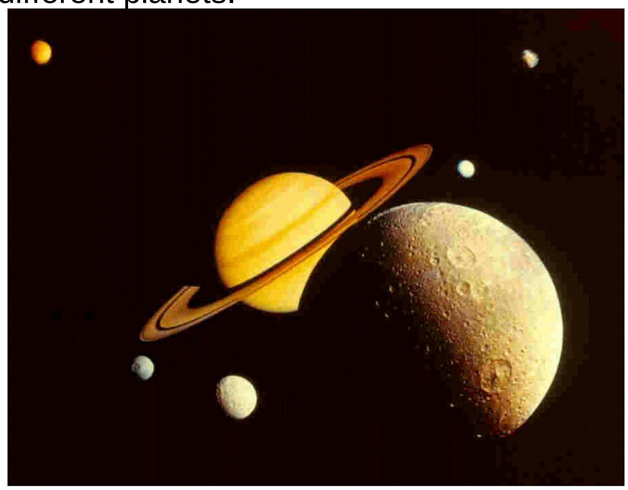
UNIVERSE CYCLE - SOLAR SYSTEM (6)

LAB

Students calculate the weight of objects on different planets

OBJECTIVES:

1. Exploring the difference between mass and weight.
2. Calculating the weight of objects on different planets.



VOCABULARY:

mass
spring balance
weight

MATERIALS:

spring balances

BACKGROUND:

The related properties of mass and weight are frequently confused. Mass is the measure of the inertia of an object, which is essentially a measurement of the density of matter within it. The mass of an object is constant, regardless of its location. Weight is a measurement of the force an object feels due to gravitational attraction, for example the pull a planet exerts on a person standing on its surface. The weight of an object can change, as the masses of the objects involved change. For example, a boy who weighed 30 kilograms on Earth would weigh only 5 kilograms on the Moon, because the mass of the Moon is only about 1/6th that of the Earth.

The units of mass and weight are different. In the metric system, grams and kilograms measure mass. The metric units of weight are called dynes (gram equivalents) and newtons (kilograms equivalent). These metric units are not used consistently, because on the surface of the Earth, 1 dyne of weight is almost equivalent to 1 gram of mass. People (scientists included!) often use grams and kilograms as units of weight. The source of this confusion is historical, and is related to efforts to equilbrate metric and English measurement systems. In the English system, 2.2 kilograms of weight are equivalent to 1 kilogram of mass. The students will make use of this relationship in the lab exercise.

PROCEDURE:

1. In this exercise, the students measure items using a spring balance, and then calculate what the item's weight would be on the different planets. The weight changes, as the masses of the planets are different. The spring balances measure the weight of

objects in grams. This is an example of the confusion cited in the Background. However, in the Lab, the students are calculating weight, not mass. Note that the weight conversion for Pluto is poorly known, because no spacecraft has visited the planet (yet).

2. Explain weight and mass to the class. Make sure that they understand the distinction between these properties. Tell them that they will be calculating the weights of different objects on various Solar System bodies.

3. Since many students may never have seen a spring balance, we recommend that you explain how to use one. Be sure to tell them that it measures weight, not mass. Remind students that the springs in the balances can be pulled out of shape easily, so they should not weight objects that are heavier than 500 grams.

4. For Exercise 1, give the students different objects to weigh. Have them then convert the metric weights to ounces by multiplying. This will give the students a way to "feel" the relationship of grams to pounds.

5. For Exercise 2, give the students the two items to weigh. Have them measure their own weight as well (this can be done in advance for homework) and then determine their own and the item's weights on other planets. Conversions are given in the "calculation" column for each planet.

UNIVERSE CYCLE - SOLAR SYSTEM (6) LAB

PROBLEM: How does the weight of an object change on different planets?
PREDICTION: ____
MATERIALS: spring balance (500 gm); items to measure, calculator
PROCEDURE: In your own words, explain the difference between mass and weight.

____

EXERCISE 1. Measure the following items(remember 1 pound = 16 ounces):

ITEM	GRAMS	CONVERT TO OZ. (1 lb = 16 ounces) (1 gm = .0353 ounces)

EXERCISE 2. Determine your own weight, and two other items that your teacher has provided. Calculate the weights of yourself and the two items on the planets. To find your weight in grams, use the calculation below.

weight in pounds = ______________ X .4536 = _______________ grams

planets	calculation	my weight on other planets in grams	item 1	item 2
MERCURY	**0.36**			
VENUS	**0.89**			
EARTH	**1.00**			
MARS	**0.39**			
JUPITER	**2.54**			
SATURN	**1.06**			
URANUS	**1.08**			
NEPTUNE	**1.38**			
PLUTO	**0.018**			

CONCLUSIONS: Why do things have different weights on different planets? Where would you be the heaviest and lightest? Why does Pluto have a question mark?

____

____

UNIVERSE CYCLE - SOLAR SYSTEM (6)

POST LAB

Students compose a poem on the planets.

OBJECTIVES:

1. Exploring astronomical themes in songs.
2. Creating a poem or song based on scientific facts.

VOCABULARY:

literature
poem

MATERIALS:

Poem*, "Put the Planets on a Line"*

BACKGROUND:

Students may not realize that many people who write music (not necessarily the ones who sing it), are people educated not only in music, but also in science. Many descriptive terms used in songs have roots in scientific information. The recommended poem, *"Put the Planets on a Lin*e" shows how the author Don Cooper is able to weave facts for all students to enjoy. This poem is also a song.

PROCEDURE:

1. Read the poem with the students. Ask them if they think the poem would help someone remember scientific features.

2. Ask the students if they like this type of poem, which weaves fact into an easy to read piece of literature.

3. As a homework assignment, have them choose a planet and write a poem about it.

PUT THE PLANETS IN A LINE

Chorus:
Put the planets in a line.
Count them, count them one through nine.
In order, racing round the sun,

Mercury is number one! Mercury:
Closest to the sun, 'm told,
It's boiling hot, then freezing cold!
No atmosphere or life, it's just
A small gray ball of rock and dust.
Ancient craters dot its face,
The fastest planet in the race!
Repeat chorus.

Venus is the second one! Venus:
It's like the Earth in shape and size,
But on Venus nothing can survive.
Steep mountaintops and dusty plains
'Neath sulfur clouds of poison rain!
These yellow clouds reflect sunlight -It's
the brightest planet in our night!

The planet Earth, we'll sing about,
A sweet home, yours and mine.
In order, racing round the sun,
It is the third in line. Earth!
Repeat chorus

Mars is fourth, the reddest one! Mars:
The Earth has one moon, Mars has two.
Life might exist, but not like you or me.
There are storms of swirling dust.
Volcanoes, canyons, ice, and rust.
The sun's so hot 'would burn our hair,
And plus, we couldn't breathe the air!

These first four planets we've described
Are terrestrial, there's land inside.
Beyond them, through the asteroid belt,
Is where the great gas giants dwell!
(Repeat chorus)

Jupiter is fifth, the biggest one! Jupiter:
It's a ball of liquid hydrogen,
If you stood on it, you'd sink in!
It's wrapped in clouds and colored rings
Of gas and rocks and whizzing things,
Its storm, the great Red Spot, goes zooming
Round it, so do sixteen moons!
You's see no life as you fly by
This shining giant in the sky.

(Repeat chorus)

Saturn's sixth, the ice-ringed one! Saturn:
Second largest of the nine,
This whirling ball of gas goes flying.
Through large, it's light enough to float
On water, like a giant boat!
Astronomers will always sing
Of Saturn and its dazzling rings!
(Repeat chorus)

Uranus is the seventh one! Uranus:
So far from Earth it's rarely seen,
Enwrapped in clouds of bluish green.
Tipped sideways, it's the only one
Whose top is pointed towards the sun!
Ancients eyes the other six,
Took a telescope to find Uranus!
(Repeat chorus)

Neptune's next, the eighth one! Neptune:
The last of the gas giants,
It has eight moons which accompany it.
Eight billion miles from Earth, it spins
Amidst blue clouds of hydrogen,
Named for the great god of the sea,
It swims around the galaxy!
(Repeat chorus)

Pluto's ninth, the smallest one! Pluto:
Pluto is so far away,
If you stood on it, you would say,
"From here the Earth looks like a star."
It's unexplored by man, so far
Last in line of those we know,
One moon goes where Pluto goes.

Put the planets in a line.
Count them, count them one through nine.
Just portions of our galaxy,
There's still much more to seek and see -The
universe...infinity!

by Dan Cooper
from *Star Tunes*