Astronomy Lesson Plan Proposal

for the

Audubon Society, Halberg Ecology Camp

presented by

Paloma Gonzalez &
The EMPACTS Astronomy Team of NWACC

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The following proposed lesson plan is to teach the youth at your camp some basic astronomy; and its relationship to ecology. Our goal is to broaden camper’s knowledge, encourage their curiosity of the universe, and further enrich their already diverse camping experience.

The lesson plan is designed to give instructors a structure to base their lessons on. It is divided into two day lessons: one for first year students on the reasons for the seasons, and construction of a sun dial; and another for second year students on the moon’s effects on tides, and on the solar system.

Also, there is a Night Sky Viewing lesson that will give senior camper’s the rare opportunity to take advantage of the camps night sky, free of light pollution, to view Saturn and some other night objects; through a telescope provided by our group. Thanks for taking the time to check it out!
Audubon Society, Halberg Ecology Camp

The Halberg Ecology Camp takes place in June at Camp Clearfork between Hot Springs and Mt. Ida. The Camp has two sessions, each lasting 5 days with about sixty two 11 and 12 year old youth, per session. The staff includes 2 co-directors, 14 teachers (mostly high school and college teachers), a kitchen staff (kids rave about the food!) and a nurse. The biological diversity and variety of habitats make it the perfect environment to teach campers in the natural disciplines of—aquatic biology, botany, entomology, geology, ornithology, mammalogy, herpetology, and hopefully astronomy!
The Earth’s axis remains pointed towards Polaris (the north star) throughout the year.

- The Earth's tilt (23.5°) on its axis causes sunlight to fall differently on Earth at certain times of the year.

- Seasons are caused only by the axis tilt and not by any change in distance from the sun.
Summer Solstice

- When the Northern hemisphere is pointed towards the sun, it is summer.
- Summer solstice occurs around June 21 each year.
During winter solstice the Earth is tipped away from the sun causing the Northern Hemisphere to receive less **direct** sunlight.

- Winter solstice occurs around December 21 each year.
Spring & Fall Equinoxes

- The Sun shines equally on both hemispheres.

- Spring equinox occurs on March 21.

- Fall equinox occurs on September 22.
Reasons for the Seasons Lesson Plan

The purpose of this lesson plan is to help give an understanding of the reason for seasons with a help of a visual aide.

Summary

In this lesson you will need a ball preferably a beach ball to help represent the earth. Also, you will need a flashlight that will represent the sun’s rays.

Discussion

Draw a line horizontally down the middle to represent the Earth’s equator. Using the beach ball as the representation for Earth, give it a 23.5° tilt. The Earth has a 23.5° tilt on its axis and for instructional purposes you can exaggerate the angle to be 45°.

Use the flashlight that represent the Sun’s rays and shine the beach ball. With the help of an aide place the flashlight in the middle pointing towards the beach ball. Have the beach ball move around the flash light varying its tilt for the lesson. Notice that the light hits directly only the part of the beach ball that points towards the light. This happens at summer solstice, the rest of the beach ball receives less direct light. As the Earth moves about its orbital path around the Sun, the Earth points away from the Sun causing the Southern Hemisphere to receive the direct light. At Fall and Spring Equinox the Sun’s rays are equally distributed.

Conclusion

The seasons are only caused by the Earth’s tilt and not by the distance from the Sun.
You might think that it is possible to figure out the time by looking at the shadow of something like a pole or tree. After a few days, it would become clear that this idea does not work. The shadow of a vertical object does not fall in the same direction nor extend to the same distance at the same time on successive days. This is because the Sun passes across the sky each day on a path which rises and falls with the changing seasons.
The sundial is the oldest known device for the measurement of time and the most ancient of scientific instruments. It is based on the fact that the shadow of an object will move from one side of the object to the other as the sun “moves” from east to west during the day. Of course, our sundial will indicate Sun Time, which may be slightly different from the time told by a watch. This is because the apparent circular motion of the Sun varies in speed with the time of year, so that a day may last for slightly more, or slightly less, than the annual average of 24 hours. At certain times of year, this causes Sundial Time and Clock Time to differ by as much as 16 minutes.
Checklist for making a Sundial

- Pencil
- Straw
- Two pieces of paper
- Protractor
- Ruler
- String
- Piece of cardboard
- Plate or flat piece
Make a triangle (aka the style) with one angle measuring 36 degrees (this is determined by the north star’s altitude or the latitude of where the sundial will be placed).

Draw a semi-circle on the lower half of a piece of paper, marking out angles of 15 degrees with a protractor. Fold back the upper half of the paper.

Attach the style (triangular piece) to the dial face (plate).
- Attach straw to style (triangular piece)

- Place paper vertically against the front of the style (at the 90 degree angle). Attach string to straw. Line the string up with each line and mark points on plate (sundial face).

- Use ruler to draw lines from the bottom of the straw to the previously marked points.
Make sure that your sundial is facing north, label, and enjoy.
Gravity. We have all heard of it a million times, it is what keeps us on the ground. Not only does gravity prevent us from floating away, but it effects the moon as well. Just like gravity pulls us to Earth, it also attracts the moon to Earth and keeps it in its orbit. We are close to Earth, so we stay on Earth, however, because the moon is so far away, the force is weaker which is why it is not crashing in to us.
The side of the Earth that is facing away from the moon has less attraction than the side that is facing closest to the moon.

Tidal Force: A force that is caused when the gravity on one side of an object is greater than that on the other side, causing the object to stretch.

Tidal forces cause bulges to form in Earth’s oceans.

The force of the moon’s gravity, also, stabilizes the earth on its axis, otherwise the earth would wobble, and cause such extreme seasons that humans wouldn’t be able to survive!
High Tides- There are two high tides because of the two bulges.

Low Tides- The lowest points between the two bulges.

High tides and low tides happen about every 12 hours and 25 minutes, because it actually takes the moon 24 hours and 50 minutes to rotate Earth.

The waves that the moon causes are critical for circulating minerals and chemicals critical for forming life!
High Tide

Low Tide

Nearly 10 feet of difference!
This is an example the worksheet that goes along with the Moon and Waves Lesson.

It is saved under Microsoft Word.
Moon Phases Demonstration

Lead campers into a darkened area with a flashlight (the yellow arrows represent the light form the flashlight); the flashlight is stationary.

One camper or a small group of campers represent the Earth, and are stationary, also; the flash light is pointing at them (earth) 6-8 feet away.

About 3 feet away from the Earth representatives, is a camper with a beach ball (or similar) who is a representative of the Moon.

The Moon circles around the earth, just as in this diagram, and children will be able to draw many conclusions about the phases of the Moon!
This lesson is, so that children can get a brief insight on the actual sizes of the planets. Many children really don’t know how much bigger the sun is compared to the planets, their distances from one another, and they way the planets orbit. You should start off by asking the students how big they think the earth is compared to the sun. Have them line up accordingly to how far they think each planet is from another. After they are done, present them with this information. Have the items (like the grape, lemons, etc) so, they can see a visual of what the size of each planet actually looks like compared to the sun. After this the student’s should have a better understanding of how big each planet is, their distances from one another, and their orbits around the sun.
One way to help visualize the relative sizes in the solar system is to imagine a model in which everything is reduced in size by a factor of a billion.

Then the model Earth would be about 1.3 cm in diameter (the size of a grape). The Moon would be about 30 cm (about a foot) from the Earth. The Sun would be 1.5 meters in diameter (about the height of a man) and 150 meters (about a city block) from the Earth. Jupiter would be 15 cm in diameter (the size of a large grapefruit) and 5 blocks away from the Sun. Saturn (the size of an orange) would be 10 blocks away.

Uranus and Neptune (lemons) 20 and 30 blocks away. A human on this scale would be the size of an atom but the nearest star would be over 40000 km away.
The solar system consists of the Sun; the eight official planets, at least three "dwarf planets", more than 130 satellites of the planets, a large number of small bodies (the comets and asteroids), and the interplanetary medium. (There are probably also many more planetary satellites that have not yet been discovered.)

- The inner solar system contains the Sun, Mercury, Venus, Earth and Mars.
- The main asteroid belt lies between the orbits of Mars and Jupiter. The planets of the outer solar system are Jupiter, Saturn, Uranus, and Neptune (Pluto is now classified as a dwarf planet).
The first thing to notice is that the solar system is mostly empty space. The planets are very small compared to the space between them.

The orbits of the planets are ellipses with the Sun at one focus, though all except Mercury are very nearly circular. The orbits of the planets are all more or less in the same plane (called the ecliptic and defined by the plane of the Earth's orbit). The ecliptic is inclined only 7 degrees from the plane of the Sun's equator.

They all orbit in the same direction (counter-clockwise looking down from above the Sun's north pole); all but Venus, Uranus and Pluto also rotate in that same sense.
Night Sky Viewing Lesson

The idea for this lab came from an experience I had at Camp Clear Fork, 2008; one of the children brought a telescope to camp, and nagged her cabin councilor to let her and the other children of the cabin, use it. The councilor, unable to resist their excitement, agreed to take the campers out (even though it was past curfew). It so happened to be that instructor Kelly Mulhollan and myself were taking advantage of the incredibly starry sky and mapping out constellations with the aid of some sky charts he had, when the children came. We helped set up the telescope, and pointed out some of the stars and constellations we were mapping. The campers enjoyed it very much and we all learned a little about the night sky!
I. Goal

a. To take the opportunity that the camp environment offers, of having a night sky uninterrupted from the light pollution of the city, to acquaint campers with: night sky objects, encourage their interest of the universe, and add to their camp experience.

b. To establish as an annual lesson by providing the means to have a telescope and other tools available.

II. Schedule and Location:

a. Lab Time: 10:30pm-11pm. The lab time is based on nightfall, during the month of June, which is dark enough for star viewing. Note: instructor should allow some time before lab to set up telescope.

b. Location: In open field adjacent to playing field of camp.

c. This is intended for second year students only. Due to the amount of campers and limited lab time it is not possible to accommodate all campers. Keep in mind that not all evenings are adequate for viewing, such as overcast skies.

a. One to two cabins are recommended per lesson.

b. At least two instructors should be present.
III. Tools:

a. A telescope, provided by the NWACC Astronomy Group (dandroes@nwacc.edu). The telescope is of the self-finding type: instructor sets a reference object following the prompts on a digital read out; once reference is set, a desired object is chosen on digital screen, and the telescope will automatically go to that location.

b. Star chart, printed copy of *Naked Eye and Constellation List*, and Fun Facts sheet (included in lesson plan).

c. Compass with azimuth (degrees) on it.

d. Preferably a red flashlight or headlamp for viewing chart, and setting up telescope. *A red light won’t dilate camper’s eyes like a white light, which would make it harder to see night sky objects.*

Lesson

I. Guide children to find, at least, five constellation and five stars with the naked eye.

   a. Following is a list with star and constellation names and their coordination’s present during the month of June. The list is designed to follow in order, because each object is near the next object on the list in the sky for easier navigating.

   b. Use compass, star chart, and red flashlight to aid navigating.

II. Guide campers to find several objects through provided telescope, including Saturn.

III. There is a *Fun Facts* sheet that follows to ask children during session.
This is an example of the Star and Constellation List, it also includes tips on finding altitude; available for print under Microsoft Word

<table>
<thead>
<tr>
<th>Star or Constellation Name</th>
<th>Azimuth (cardinal direction)</th>
<th>Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polaris (Star)</td>
<td>358° N</td>
<td>358°</td>
</tr>
<tr>
<td>Ursa Minor: The Little Bear (Const)</td>
<td>24° N</td>
<td>56°</td>
</tr>
<tr>
<td>Etamin (Star)</td>
<td>55° NE</td>
<td>61°</td>
</tr>
<tr>
<td>Draco: The Dragon (Const)</td>
<td>24° N</td>
<td>56°</td>
</tr>
<tr>
<td>Vega (Star)</td>
<td>72° NE</td>
<td>51°</td>
</tr>
<tr>
<td>Alphekka (Star)</td>
<td>161° S</td>
<td>78°</td>
</tr>
<tr>
<td>Northern Crown, or Corona Borealis (Const)</td>
<td>151° SE</td>
<td>83°</td>
</tr>
<tr>
<td>Arcturus (Star)</td>
<td>220° SW</td>
<td>66°</td>
</tr>
<tr>
<td>Bootes: The Herdsman (Const)</td>
<td>229° W</td>
<td>74°</td>
</tr>
<tr>
<td>Alkaid (Star)</td>
<td>312° NW</td>
<td>70°</td>
</tr>
<tr>
<td>Ursa Major: The Great Bear (Const)</td>
<td>310° NW</td>
<td>40°</td>
</tr>
<tr>
<td>Saturn</td>
<td>260° W</td>
<td>23°</td>
</tr>
</tbody>
</table>
Fun Facts

- How many stars are in our galaxy? About a 100 billion! That’s equal to counting all the grains of sand on all the beaches of earth to a depth of about 3 feet. It would take about 3,000 years to count them—no eating, no sleeping—just counting!

- How many galaxies are in the universe? Over a 100 billion as far as we can see now, but we have never seen the edge of the universe!

- How far is the closest star? The star Alpha Centauri is about 4.3 light years away! The distance of just one light second is equal to seven times around the earth. Remember that a light year is a distance, not a time.

- Is there high probability that there is life in the universe, besides on earth? Yes!!!

- What is our sun? A star!

- What does the earth, and all other planets in our solar system revolve around? Our star, the sun!

- How old is our sun? About 4.5 billion years old, and it has about 3 billion years left before it begins to die.
The EMPACTS Astronomy Team of NWACC

- EMPACTS stands for Educationally Managed Projects Advancing Curriculum, Technology, and Service.
- It is a project based learning model that creates an environment that practices team skills, communication skills, social skills, immerses you in your curriculum, and uses technology to solve real life problems, serving the community.
- The Empacts Astronomy Team is: Sergio Castaneda, Paloma Gonzalez, Brandi Howard, Donovan Netherland, and Suzanne Pichoff.

Thank you for looking over our proposal. We would love to hear your comments on it, and will work with you any way we can to serve your camp, and see some of these lessons take wings!

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