Celestial Motions

Post-visit Packet

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Name ________________________________ Date ___________

Summary

Now that you've seen the program you may be wondering what to do next. We're here to help. In the following pages we've provided some samples of vocabulary, possible questions and discussion topics as well as some activities that could be done in the classroom or at home. These are simply suggestions and we encourage you to modify this packet to suit your particular needs.

Concepts covered in show:

1. **Night Sky**
   Light pollution is discussed as well as the current nighttime sky, including visible constellations and planets. The Milky Way is introduced as our galaxy and our solar systems placement in it is noted. A brief overview of the composition of our solar system is also provided. The Earth's rotation and its affects our view of the night sky is explained.

2. **Zodiac**
   The zodiac is defined as the path that the planets, the sun, and the Moon appear to travel on. This line is defined and examples of zodiac constellations are given.

3. **Seasons**
   The Earth orbits the sun once each year. The tilt of the Earth's axis is responsible for the changing seasons over the course of the year. The effect of the seasons on what we see in the sky is demonstrated.

4. **Moon**
   The moon's phases are explained through the use of diagrams. Students learn why they see different portions of the moon throughout the period of a month.

5. **Eclipses**
   Eclipses are defined in general terms with examples shown through images. Then the specific geometries required for both solar and lunar eclipses are explained. Solar and lunar eclipses are then compared and contrasted.

6. **Comets/Meteors**
   The composition of both comets and meteors is discussed. Meteor showers are defined and explained in context with the path of a comet.

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Vocabulary

1. **Polaris**
2. **Constellation**
3. **Milky Way**
4. **Precession**
5. **Zodiac**
6. **Axial tilt**
7. **Eclipse**
8. **Meteor**
9. **Meteor shower**
10. **Comet**

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Vocabulary-Key

1. **Polaris-** sometimes called the North Star; marks the direction of North and lies directly over the North Pole.

2. **Constellation-** group of stars that seem to form a shape; sometimes human shapes or animals. 88 official constellations make up a map of the night sky.

3. **Milky Way**- the spiral galaxy in which we live.

4. **Precession** – Caused by the gravitational tug of the Sun and Moon, precession is the wobble of the Earth's axis. Similar to the wobble of an unsteady top.

5. **Zodiac constellations**- Those constellations that lie on the apparent path of the sun and planets on our sky. That path is called the ecliptic.

6. **Axial tilt-** The tilt of a planets axis with respect to its orbital plane. On earth this tilt is 23.5 degrees, and contributes to us having relatively mild seasons.

7. **Eclipse-** Occurs when one object passes in front of another. Most common are solar, when the Moon comes between the Earth and the Sun, and lunar, when the Earth comes directly between the Sun and the Moon.

8. **Meteor-** a meteoroid that has entered the earth's atmosphere. Commonly called a shooting star

9. **Meteor shower**- Occurs when a large number of meteors appear together and seem to come from the same area of the sky.

10. **Comet-**a relatively small celestial body consisting of a frozen mass that travels around the sun in a highly elliptical orbit.

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Short Answer and Discussion Questions

1. What is Polaris? Define and explain its significance.

2. Why does the Earth have seasons?

Bonus question: What would seasons be like on a planet with a tilt of 90%?

3. Explain why the moon has phases, using a diagram if necessary.

4. What is a solar eclipse? Explain using a diagram if necessary.

5. What is a lunar eclipse? Explain using a diagram if necessary.

Bonus question: Why do we still see the moon during a lunar eclipse?

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Short Answer and Discussion Questions

1. What is Polaris? Define and explain its significance.

   The North Star. It is our pole star, that means our axis of rotation points to Polaris making it appear to stay in the same place as we rotate each night.

2. Why does the Earth have seasons?

   The Earth is tilted on its axis 23.5 degrees. Assuming we live in the Northern hemisphere, this means that during our summer the North Pole is tilted towards the sun and we receive more direct sunlight. In the winter the South Pole is tilted toward the sun and they receive the direct sunlight.

Bonus question: What would seasons be like on a planet with a tilt of 90%?

   They would be more extreme. Because the north and south poles would be pointed directly at the sun, the side aimed towards the sun gets A LOT of sunlight while the side away from the sun receives virtually no sunlight.

3. Explain why the moon has phases, using a diagram if necessary.

   When we see the phases of the moon what we are seeing is the portion of the moon illuminated by the sun. Because the moon orbits around us and we orbit around the sun, the amount of illuminated moon changes throughout its orbit around the Earth, which takes approximately a month.

4. What is a solar eclipse? Explain using a diagram if necessary.

   A solar eclipse occurs when the moon is aligned directly in between the Earth and the Sun. In that position the moon casts a shadow on the Earth. Total solar eclipses are only visible on a small part of the Earth and last only a few minutes.

5. What is a lunar eclipse? Explain using a diagram if necessary.

   A lunar eclipse occurs when the Earth is aligned directly between the Sun and the moon. In that position the Earth casts a shadow on the moon. Total lunar eclipses are visible over large portions of the Earth and can last several hours.

Bonus question: Why do we still see the moon during a lunar eclipse?

   The dim red light we see on the moon during an eclipse is sunlight that is refracted through the Earth's atmosphere landing on the moon.

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Classroom Activity

Phases of the Moon

Every 29½ days, or about once a month, the moon goes through a cycle of phases. Starting with new moon, when the moon is not visible, we can see more and more of the moon each night, until we can see the entire near side of the moon at full moon. After full moon, we can see less of the moon each night, until we have reached new moon again. The activity described below helps students to understand how the moon goes through its phases.

You will need:

- A ball, about 6 inches in diameter. Styrofoam balls work well, since they have a "cratered" appearance.
- A flashlight
- A dark classroom
- Two volunteers

What to do:

1. Turn off the lights in the room.
2. Pick one student to hold the flashlight. This student is going to be the **sun**.
3. Pick another student to hold the moon (Styrofoam ball). This student will be the **earth**. The two students should stand about five feet apart, depending on the strength of the flashlight. "Earth" should hold the moon in front of him at arm's length and start out facing "Sun." "Sun" should hold the flashlight close to her, at the same level as the moon. In this position, "Earth" should notice that the side of the moon that is facing him is completely dark. This is what happens at new moon. You may want to point out that since "Earth" sees "Sun" and the moon at the same time, the new moon is only up during the day.
4. Now, "Earth" should make a one-quarter (90-degree) turn to the left, continuing to hold the moon in front of his face. He should notice at this point that half of the moon is lighted. This is first quarter moon. (An easy way to remember this is that "Earth" has turned one quarter of the way around.)
5. After another quarter turn, the whole moon should be lighted. This is full moon. Since "Sun" is now behind "Earth," the full moon is on the opposite side of the earth from the sun. It can be seen all night long.
6. One more quarter-turn will cause half of the moon to be lighted again. This is last quarter moon. And a final quarter-turn brings us back to new moon. Point out that this marks the end of one month, or about 29½ days.

Throughout the activity, students elsewhere in the classroom should notice that, although "Earth" sees the moon differently at different times, half of the moon is always lit. Repeat the activity for as many different volunteers as time allows. Direct participation makes the concept much clearer than simply watching.

This activity was developed by Will Fischer of the Ritter Planetarium and Brooks Observatory.

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Classroom Activity

Hand Sundial

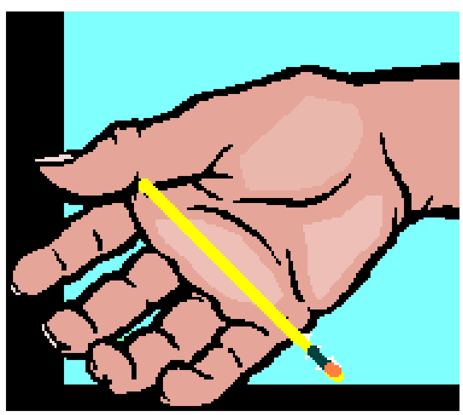
In the past, before the current age of technology, people had no mechanical clocks or watches yet still managed to tell time. This activity shows students how to use an astronomical body, in this case the sun, to tell time. They will need to know where the four directions are, a compass may be used if need be.

You will need:

- A sunny day(s)
- A pencil or pen

What to do:

1. Have the students hold out their hand palm facing up.
2. Lay the pencil across the palm and hold the end with the thumb of that hand.[See picture below.]
3. As you grasp one end of the pencil with your thumb, the other end of the pencil will rise to an angle of about 30 or 40 degrees. This will be the gnomon of the sundial. It should point north.
4. In the morning, put the pencil in your left hand and point your fingers west.
5. In the afternoon, put the pencil in your right hand and point your fingers east, keeping the pencil pointing north at all times.
6. The shadow of the pencil will fall across your hand indicating the approximate time. Read the time from the tip of your longest finger around the edge of your hand. Begin at six and count one hour for each fingertip.
7. Do this several times and compare to the times on your watch. Discuss reasons for differences (such as daylight savings time, or distance from the edge of your time zone.)



Extensions: Have the students discuss what would happen if it was cloudy and you did not have a watch to tell time.

This activity was developed by Lawrence Vogt, Pat Kramer, and Becky Bringardner.

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Classroom Activity

Build a Comet

In this activity students will better understand the composition of a comet by visually seeing a comet model.

You will need:

- Large bowl
- Wooden spoon
- Garbage bag
- 1 cup dirt
- 2 cups dry ice as fine as can be crushed
- 2 cups of water
- Eyedropper
- Can of coke
- Ammonia

What to do:

1. Explain that all the ingredients are actual composition and appearance of a comet and scaled down in proportion
2. Begin by placing the garbage bag into the bowl so that it acts as a liner.
3. Pour two cups of water in the bag.
4. Next pour in one cup of dirt and begin stirring.
5. Add a dash of ammonia (eyedropper).
6. Add a splash of coca cola (organic material)
7. Now for the fun part: pour in the 2 cups dry ice and stir until it gets the consistency of pudding. Timing is very important here. If you wait too long the mass will get lumpy.
8. Wrap the edges of the bag up around the mixture and squeeze into a nice ball.
9. When you unwrap this, you will have an excellent model of a comet.

Developed by: Dennis Shatz
Written by: Chuck Matlock, Jr.
UT-SPICA 1993

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When you wish upon a falling Star…

Stars don't actually fall or shoot through the sky, as people once believed, it only looks that way. In fact, falling stars are actually meteors, tiny pieces of rock about the size of a pea or grain of sand. Meteors look like stars that fall from the sky because they burn and glow as they plunge into the earth's atmosphere. To see why meteors get hot, try rubbing your hands together very fast. What happens? Right, they get hot! Now imagine that you could rub your hands together as fast as a meteor moves, up to 150,000 miles per hour, and you'll understand why these space pebbles look like falling stars!

The best place to see meteors is out in the country on a dark moonless night. There you might expect to see six to ten meteors per hour. There are times when it's much easier to see meteors, when the earth plows through the debris left by certain comets. When the earth runs into these tiny rocks, dozens and sometimes hundreds of meteors are seen. We call these events meteor showers. Because the paths of these comets are well know we can predict these times.

Some of the year's best meteor showers are shown below:

Name	**Date**	**Meteors/Hour**
Quadrantids	Jan. 3	40
Perseids	Aug. 12	50
Orionids	Oct. 21	25
Geminids	Dec. 13	50

To see a meteor shower, plan to get away from city lights. You may see more bright meteors before midnight when a meteor shower is happening, but if you want to see lots of meteors, plan to do your observing during the hours after midnight. Be sure to give your eyes ten minutes to adjust to darkness, and then let nature's fireworks dazzle you!

Special thanks to the following resource:
Minneapolis Planetarium Amazing Stargazing Activity Book

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Recommended Astronomy Web Sites

After seeing a program you may be interested in finding out more about a particular subject. These are some of our favorite websites.

Misc	
Ritter Planetarium-Brooks Observatory	**www.rpbo.utoledo.edu**
Search for Extra-Terrestrial Intelligence Inst.	www.seti.org
SETI@home	setiathome.ssl.berkeley.edu
Space.com	www.space.com
Space Ref	www.spaceref.com
Heavens Above (Satellite Tracking)	www.heavens-above.com
Education	
Windows to the Universe	windows.arc.nasa.gov
Bad Astronomy	www.badastronomy.com
The Nine Planets	seds.lpl.arizona.edu/nineplanets/nineplanets
NASA	
NASA Homepage	www.nasa.gov
NASA Human Space Flight	www.spaceflight.nasa.gov
NASA Jet Propulsion Laboratory	www.jpl.nasa.gov
Space Telescope Science Institute (Hubble)	www.stsci.edu
Telescopes	
Meade	www.meade.com
Celestron	www.celestron.com
Orion	www.telescope.com
Astromart	www.astromart.com
Magazines	
Sky and Telescope	www.skyandtelescope.com
Astronomy Magazine	www.astronomy.com
Societies and Organizations	
International Dark-Sky Association	www.darksky.org
The Astronomical Society of the Pacific	www.aspsky.org
International Astronomical Union	www.iau.org
The Planetary society	planetarysociety.org