Description: *Pacific Northwest Skies* is an introduction to backyard astronomy, with a focus on the night sky as seen from Oregon and surrounding areas. Students learn major constellations for each season, and the current positions of the planets. This show encourages the concept that stargazing is for anyone, anywhere, anytime.

Activities: Observing the Moon, the sizes of the planets, understanding the seasons, developing a new constellation.

Process Skills Focus: Inquiry, observation and communication.

Topics: The night sky, constellations, planets.
Scientific Inquiry Standards:

- K.3S.1 Explore questions about living and non-living things and events in the natural world.
- K.3S.2 Make observations about the natural world.
- 1.3S.2 Record observations with pictures, numbers, or written statements.
- 1.3S.3 Describe why recording accurate observations is important in science.
- 2.3S.2 Make predictions about living and non-living things and events in the environment based on observed patterns.

Engineering Design Standards:

- 1.4D.3 Show how tools are used to complete tasks every day.
- 2.4D.3 Describe an engineering design that is used to solve a problem or address a need.

Earth and Space Science Content Standards:

- K.2E.1 Identify changes in things seen in the sky.
- H.2E.3 Describe how the universe, galaxies, stars, and planets evolve over time.

Physical Science Content Standards:

- K.2P.1 Examine the different ways things move.

NEXT GENERATION SCIENCE STANDARDS

Practices
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
7. Engaging in argument from evidence

Crosscutting Concepts
1. Patterns
2. Cause and effect
4. Systems and system models
## DCIs

<table>
<thead>
<tr>
<th>Disciplinary Core Idea</th>
<th>K</th>
<th>1</th>
<th>2</th>
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<th>MS</th>
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### DCI Grade Band Endpoints

**ESS1.A** Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (By end of grade 2).

The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (By end of grade 5).

Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (By end of grade 8).

Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (By end of grade 8).

**ESS1.B** Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (By end of grade 2).

The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause
observable patterns. These include day and night; daily changes in the length and
direction of shadows; and different positions of the sun, moon, and stars at
different times of the day, month, and year. (By end of grade 5).

This model of the solar system can explain eclipses of the sun and the moon.
Earth’s spin axis is fixed in direction over the short-term but tilted relative to its orbit
around the sun. The seasons are a result of that tilt and are caused by the
differential intensity of sunlight on different areas of Earth across the year. (By end
of grade 8).

**Performance Expectations**

1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.

1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.

5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth.

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
**Asterism:** A group of stars that form a recognizable shape. Asterisms are part of a constellation, but not a whole constellation.

**Asteroid:** Small rocky or metallic bodies in the Solar System.

**Asteroid Belt:** The region between Mars and Jupiter containing numerous rocky asteroids.

**Circumpolar stars:** Stars that always appear above the horizon and do not set below the horizon as the earth turns.

**Constellation:** A group of bright stars that seem to form a pattern. There are 88 modern constellations recognized by the International Astronomical Union.

**Deep sky objects:** Objects outside the Solar System, like nebulae, star clusters and galaxies. Most deep sky objects are faint and not visible to the naked eye.

**Double star:** Two stars that appear very close together, either because they are physically close and orbit each other (a binary star system), or because they are projected close to one another.

**Dwarf planet:** A classification of a minor body which is neither a planet nor a satellite of a planet (i.e., a moon). Dwarf planets in our Solar System include Pluto and Ceres, where Ceres is located in the asteroid belt.

**Equinox:** Two specific times of the year when the path of the Sun intersects the celestial equator. At these times, the tilt of the Earth’s axis is neither away from nor toward the Sun. The vernal (spring) equinox is around March 20th and the autumnal equinox is around September 22nd.

**Galaxy:** A grouping of billions of stars held together by gravity. We live in the Milky Way galaxy. Galaxies contain stars, planets, gas, and dust.

**Globular cluster:** Groups of tens to hundreds of thousands of old stars that are tightly bound by mutual gravitational attraction. An example of a globular cluster is M13, the Hercules cluster, in the constellation of Hercules the Hero.
Moon: A satellite orbiting a planet.

Nebula: A cloud of dust, gas and plasma (ionized gas). Many nebulae are regions where stars are being born. The Orion Nebula and the Eagle Nebula are examples of nebulae.

Open cluster: Groups of a few hundred to a few thousand young stars. Open clusters are loosely bound by mutual gravitational attraction and will only remain clustered together for a few million to a few hundred million years. An example of an open cluster is the Pleiades.

Orbit: (noun) The path of a body through space. (verb) The action of moving through space.

Planet: A body orbiting a star. Planets must be massive enough to be roughly spherical in shape but not massive enough to undergo thermonuclear fusion in their cores like a star. From Greek, the world planet means “wanderer”, as the planets of our Solar System appear as points of light moving against a background of apparently “fixed” or unmoving stars.

Retrograde: The apparent backwards motion of a body. Planets can show retrograde motion relative to one another: as seen from Earth, Jupiter briefly appears to move backwards relative to the background stars when Earth overtakes Jupiter in its orbit around the Sun.

Rotation Period: The time that it takes for a body to rotate on its axis. The Earth has a rotation period of roughly 24 hours.

Solar System: The arrangement of eight planets orbiting around the Sun. The asteroid belt between Mars and Jupiter is also part of the Solar System.

Solstice: Two specific times of the year when the path of the Sun is at its highest or lowest point relative to the celestial equator. At these times, the tilt of the Earth’s axis is oriented the most steeply toward or away from the Sun. The summer solstice is around June 21st and the winter solstice is around December 21st.

Sun: Our nearest star, located approximately 93 million miles from Earth.
Check your comprehension of the planetarium show!

1) What constellation is the Big Dipper part of?

2) What is the altitude of the North Star here in Portland?

3) What is the cloudy band across the night sky that is only visible under dark skies?

4) Name three constellations talked about today.

5) Which planets (if any) are visible in tonight’s sky?
Observing the Moon

Description: In this activity, students observe the Moon over several nights and learn how its appearance changes.

TIME REQUIRED

<table>
<thead>
<tr>
<th>Advance Preparation</th>
<th>Activity</th>
<th>Clean Up</th>
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<tbody>
<tr>
<td>5 minutes</td>
<td>30 minutes</td>
<td>5 minutes</td>
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SUPPLIES

- Notebook
- Pencil
- Binoculars
- Clear skies
- Tape

ACTIVITY

- Figure out when you can see the Moon. It’s best to observe the Moon when it’s partially full, because then you can see more shadows from craters and mountains.

- In your notebook, draw two 10-cm circles. List the time, date, sky conditions, and location. In one circle, sketch in the light and dark areas on the Moon that you can see with your eye. A soft pencil works best.
Repeat your observations of the Moon, this time using binoculars. Sketch what you see.

After approximately five days, repeat your observations of the Moon using both your eye and binoculars. How does the Moon look different?
Model the Planets’ Relative Sizes

Description: In this activity, students become familiar with the relative sizes of the planets in the Solar System.

TIME REQUIRED

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<tbody>
<tr>
<td>5 minutes</td>
<td>30 minutes</td>
<td>5 minutes</td>
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</table>

SUPPLIES

- Construction paper
- Rulers
- Scissors
- Compasses to draw circles (one for each student or group)
- Tape

ACTIVITY

- Students should work in groups. Measure, draw, and cut construction paper circles of appropriate diameters to demonstrate the general appearances and relative sizes of each planet. Display the model planets in the classroom. They may be able to be hung from the ceiling or taped to the walls. Be sure students understand that, while the relative sizes of the planets are to scale, the distances between the planets will not be.

- The paper should be cut to the following sizes, depending on the planet. Paper colors are also suggested.

<table>
<thead>
<tr>
<th>Object</th>
<th>Paper Diameter</th>
<th>Paper Color</th>
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<tbody>
<tr>
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<td>Yellow</td>
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<tr>
<td>Mercury</td>
<td>½”</td>
<td>Gray</td>
</tr>
<tr>
<td>Planet</td>
<td>Model Size</td>
<td>Color</td>
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<tr>
<td>Venus</td>
<td>1&quot;</td>
<td>Yellow</td>
</tr>
<tr>
<td>Earth</td>
<td>1&quot;</td>
<td>Blue</td>
</tr>
<tr>
<td>Earth’s moon</td>
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</tr>
<tr>
<td>Mars</td>
<td>½&quot;</td>
<td>Red</td>
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<tr>
<td>Jupiter</td>
<td>11&quot;</td>
<td>Tan</td>
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<tr>
<td>Saturn</td>
<td>9&quot;</td>
<td>Tan</td>
</tr>
<tr>
<td>Uranus</td>
<td>4&quot;</td>
<td>Green</td>
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<tr>
<td>Neptune</td>
<td>4&quot;</td>
<td>Neptune</td>
</tr>
<tr>
<td>Pluto</td>
<td>¼&quot;</td>
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This activity can be expanded for older students to include the moons of the planets. Have the students determine the scaling factor for the model by finding the actual diameters of the planets and comparing that with the diameters in the model. After looking up the actual diameters for the moons of the other planets, they can calculate the model size for each moon using the equation below.

\[
\frac{\text{(planet's model size)}}{\text{(planet's actual size)}} = \frac{\text{(moon’s model size)}}{\text{(moon’s actual size)}}
\]
Seasons: The Angle of the Sun’s Rays

Description: This activity investigates how light hitting a surface at different angles results in different temperatures.

As shown in the previous activity, the Northern Hemisphere is tilted toward the Sun during the spring and summer. As a result, the Sun’s rays fall more directly on that hemisphere during those times. During the fall and winter, the Northern Hemisphere receives indirect light, which is light that comes in at an angle less than 90 degrees.

This activity can be done as a class or in small groups.

TIME REQUIRED

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<tr>
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<tr>
<td>5 minutes</td>
<td>30 minutes</td>
<td>15 minutes</td>
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SUPPLIES

- Two small, flat boxes
- Two thermometers
- Sand or dry dirt
- Four small blocks or bricks
- Sunlight

ACTIVITY
• Fill each box with an equal amount of sand (or dry dirt). Place a thermometer in each box, with the bulb covered by the sand or dirt. Set the boxes in the sunlight. Place one box flat on two blocks so that it is off of the ground. This technique will keep the ground temperature from affecting the box’s temperature. The sunlight should fall at an angle onto this first box. Prop the second box up so that the sunlight falls directly (at right angles) onto the dirt inside it. The other two blocks may come in handy here.

• Leave the boxes in the sun for about 15 minutes. Then come back and check the temperatures. Notice that when the Sun’s rays fall on the dirt at an angle, such as in the winter, the temperature is lower than when the light strikes at a right angle, as in the summer. This is because the Sun’s rays are spread out over a larger area when they come in at an angle and, as a result, they don’t provide as much concentrated heat.

• Discuss with your students that it’s hotter in the summer than the winter because the sunlight falls more directly on the earth’s surface in the summer. (The change in temperature between summer and winter has nothing to do with the distance of the Earth from the Sun. In fact, the Earth is slightly closer to the Sun in January than it is in July!)
Make a Constellation

Description: Students will create their own constellation and project it on a ceiling “sky”.

TIME REQUIRED

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SUPPLIES

- Cardboard tube from a paper towel roll
- Pencil
- Scissors
- Pin
- Black construction paper
- Rubber band
- Ruler
- Flashlight

ACTIVITY

- Trace a square on the black construction paper that is three inches long on each side. Trace the rim of the paper towel roll onto the middle of your square with your pencil and then use your scissors to cut out the whole square.

- Inside the circle you just traced, use your pencil to draw different stars in any pattern you choose. Take your pin and poke holes where you drew your stars. Be sure to be careful that you don’t rip the paper.
- Stand up your paper towel roll and line it up with the circle, making sure that the opening of the paper towel roll is over the circle of stars. Fold down the extra sides of the paper square and place a rubber around the tube to secure the sides.

- Shut off the lights in a dark room and place a flashlight on the opposite end of the tube. Point your stargazer up to see the constellation on the ceiling! Can you make a constellation that looks like Orion?
RESOURCES

NASA Education
http://www.nasa.gov/offices/education/about/index.html

Monthly Skymaps
http://www.skymaps.com/

Updates About Satellites, Comes, and Meteors
www.heavens-above.com

The Night Sky
www.google.com/sky

Hubble Space Telescope Images
www.hubblesite.org