

A Journey Through the Solar System

Lesson Plan

Grade(s): 3-5

Goal/Purpose:

The purpose of this lesson is for students to acquire information about the objects in the solar system, how they are viewed from Earth, and how light pollution can affect viewing of, research on, and our understanding of our solar system and the universe.

Desired Learning Outcomes:

1. Students will learn that the Earth is one of several planets orbiting the sun.
2. Students will learn that there are nine planets varying in size, structure, appearance, and distance from the sun.
3. Students will learn that comets and asteroids are part of the solar system
4. Students will learn that artificial outdoor light changes the night sky and our visibility of solar bodies and others throughout the universe.
5. Students will learn that negative changes can occur in the Earth's ecosystems when there is too much artificial outdoor lighting (light pollution).

New Vocabulary:

Pollution: Introducing unnatural elements into a natural environment. This often changes the environment in ways that may harm living resources and ecosystems and endanger human health.

Light Pollution: Too much outdoor light (glare and light trespass) that causes a glow above a city. It interferes with viewing the night sky and can disrupt surrounding environments.

Atmosphere: The gases surrounding an object in space, such as the air surrounding Earth.

Mass: A measurement of how much material an object is made of.

Diameter: The distance of a straight line across the center of a circle.

Photosphere: The layer of the sun that emits the light seen from Earth.

Elements: Different types of material that space objects can be made out of, such as hydrogen and helium.

Erosion: The natural processes of wind and rain that wear away and change the shape of the land.

Orbit: The path that an object in space follows around another object, such as the path the Earth follows around the sun.

Telescope: An optical device that uses lenses and mirrors to collect and focus light so humans can see distant objects.

Crater: A depression or cavity that is made on a space object when it is struck by another object.

Retrograde rotation: When an object rotates opposite directions from the usual rotation of nearby celestial bodies. For example, an observer looking down on the entire solar system would see that all of the planets rotate counter-clockwise, except for Venus and Uranus which rotate clockwise.

Plate Tectonics: The theory that plates underneath the surface of a planet move, which creates mountains, trenches, and volcanoes, and cause earthquakes, tsunamis, and volcanic eruptions.

Hemisphere: Either the top half of a planet or the bottom half of a planet. Earth is divided in half by the equator.

Asteroid: A rock that orbits the sun in the solar system but is too small to be considered a planet.

Galileo: An Italian scientist who contributed to several different sciences. In astronomy, he is noted for being the first person to use a telescope for astronomical purposes.

Galaxy: A collection of stars that orbit around a common center point. For example, our sun is one of over 2 billion stars that orbit around a large black hole. All of these stars are known as the Milky Way Galaxy.

Fully-Shielded: A light fixture that is designed to focus light toward the ground. No light shines above the 90 degree plane or directly towards the stars.

Sky glow: A brightening of the night sky by manmade outdoor lighting that blocks the view of the stars.

Nocturnal animals: Animals who are mostly active during the night instead of the day.

Artificial lighting: Light that is human made, not by nature.

Glare: An intense and blinding halo of light that causes you to squint. It comes from an unshielded or partially shielded light fixture and contributes to sky glow.

Light Trespass: Outdoor lighting that falls where it is not wanted or needed, such as through a bedroom window when you are trying to sleep.

Migration: When animals of the same species travel to different locations for different seasons, such as birds, elk, salmon, whales, etc.

Amphibians: A vertebrate (having a backbone) that lives on both land and water, such as frogs, toads, and salamanders.

Wattage: A measurement of the power needed to operate an electrical device, such as a hair dryer or a light bulb.

Motion Sensors: A device that turns security lights on if movement is detected.

Timers: A timing device that turns lights on and off at specific times of the day or night.

Satellite: A manmade electronic device that orbits Earth, such as the satellites that allow you to transmit cell phone calls.

Background:

Light pollution was unheard of until far after 1854 when the light bulb was invented. As lights became more common, light pollution became more of an issue. Today, bubbles of light fill the sky over human populations, blotting out the planets, stars and galaxies that humans have spent thousands of years learning from. The effects of light pollution are often underestimated by society since light has become such an integral part of nighttime safety, but in truth, light pollution is a major environmental hazard.

Light pollution is a major factor in energy waste. Every year, bad lighting that shines into the sky wastes billions of dollars and gross amounts of fossil fuels. Much energy would be saved if proper lighting were used. This means energy efficient lighting that only shines light toward the ground where people are. Another overlooked factor of the effects of light pollution is the impact it has on the nighttime ecosystem. By turning our night into day, we are changing the habitats of millions of plants and animals. Some animals, like loggerhead sea turtles, are becoming extinct because of this.

Perhaps the most visual effect of light pollution is how it blocks the stars and planets from our view. Humans have been using the night sky as a resource to develop culture and technology for thousands of years. Many modern technologies (such as cell phone satellites) have been developed using physical properties discovered while studying the stars. By erasing the night sky, humans are erasing a rich history and possible future technology. It is important that

humans study the night sky, and learning about the solar system is the first step to a greater understanding it.

General Misconceptions:

- The Earth is at the center of the solar system.
- Scientists know everything about the solar system.
- The biggest object in the solar system is Earth.
- The solar system includes all of the stars and galaxies.
- The sun is not a star.
- The solar system is small.
- We can blow up the sun.
- It is easier to see at night when there is a lot of light.

Preparation Time:

Instructor should allow time to thoroughly review presentations and materials.

Presentation Time:

Presentation time will take approximately 40-55 minutes.

Physical Layout of Room:

The room requires a projection screen. In classrooms where there are skylights or windows that cannot be covered, it may be necessary to use an alternative space or method of presentation, such as through color copies or transparencies. In a classroom where a projector and a computer are available, students will need to be arranged so that the projector can be placed in the center of the room.

Materials:

- Computer with PowerPoint 2000 or above. Computer should be attached to a projector. PowerPoint Reader 2003 is included on the CD for computer without PowerPoint.
- Computer should have Adobe Reader. It is included on the CD.
- A Journey Through the Solar System PowerPoint presentation
- A Journey Through the Solar System: Shakedown game
- Solar Quest card game
- Flash cards
- Internet scavenger hunt

Procedure/Directions:

• **Introduction**

The instructor will guide students through the PowerPoint presentation. Each slide is organized with graphics and text to lead students through the components of the solar system and light pollution. At the end of the presentation, students will be assessed with an interactive card game and/or a Jeopardy style game.

- **Engagement Activity**

Here are some suggestions:

1. Have students draw pictures of the planets and what they think the solar system looks like without prior research.
2. Have the students write a short story about one of the planets and why they would like to live there.
3. Have the students draw pictures of what the lights around their homes and communities look like.
4. Have the students brainstorm and discuss what Earth would be like without the use of lights.

- **Step-by-Step Instructions**

A Journey Through the Solar System Presentation:

1. If you need to install Adobe Acrobat Reader, open the presentation CD and find your operating system under the Adobe folder. Double click on the .exe file under your o/s version and follow the onscreen instructions. If your version is not listed, please visit http://www.adobe.com/products/acrobat/readstep2_allversions.html for more options.
2. If you need to install PowerPoint Reader, double click on ppviewer.exe and follow the onscreen instructions.
3. Before beginning, you may choose to open AJourneyThroughtheSolarSystem.ppt and print the slide notes by: click on 'file' → 'print' → under 'print what?' choose 'notes pages' and click 'ok.'
4. The slide notes are written in a bulleted format to make it easy to choose which facts will be used to teach the presentation. However, it is recommended to use all of the facts if time permits. Facts are written based on the national science standards for this grade level.
5. Setup computer and projector in a dark classroom. Open AJourneyThroughtheSolarSystem.ppt in PowerPoint in 'slide show' mode.
6. Use slide notes to give the presentation.

Solar Quest Card game:

1. Each student is provided a card from the interactive card game. If there are some cards left over, some students can have two.
2. The first student reads the information contained on their card and challenges the remaining students with the questions on the card. The student with the card that answers the questions goes next. The process continues until the cards are read and the questions answered.

Solar System Shake Down

1. Open Solar System Shakedown.ppt in PowerPoint or PowerPoint reader. In order for the game to work properly, it must be opened in 'slide show' mode. It is recommended to read the game instructions, which are included within the game.
2. The main menu should be on the screen. Use the mouse to click on the available button choices. 'Instructions' will take you to the instructions for playing the game, 'play game' will take you to the game board and 'quit' will exit the game.
3. Once inside the game, click on 'main menu' at the bottom right of the game board and then 'quit' to exit the game.
4. Solar System Shake Down is designed to compliment the information given in the presentation. If you chose not to use all of the slide notes in the presentation, then you can use the Solar System Shake Down study sheet to make sure students are prepared to answer the questions.

Evaluation/Assessment

Students can be evaluated with a quiz. Some other suggestions are:

- Have the students complete a fill-in-the-blanks worksheet during the presentation.
- Have the students do a report on their favorite object in the solar system.
- Have the students write a short story about a boy/girl who grows up never seeing the stars or planets in the night sky.
- Have the students draw an alien that lives on a specific planet. The students must use the information learned in the presentation to explain the alien's appearance.

Follow-Up Activities

1. Using bottles of different weights, students guess which planet each one is and place them in the correct order from the sun to Pluto.
2. Students will use the internet to complete an astronomy/light pollution scavenger hunt.
3. Students will work in groups to construct a human habitat for a specific planet. Students will use information from the presentation to help them decide features for their habitat.
4. Students will demonstrate a scale model of the solar system using the following scale:

- | Planet | Distance |
|---------------|-----------------|
| • Mercury | 5 inches |
| • Venus | 9 inches |

- Earth 1 foot
- Mars 1 foot 6 inches
- Jupiter 5 feet 2 inches
- Saturn 9 feet 6 inches
- Uranus 19 feet
- Neptune 30 feet
- Pluto 39 feet

5. Students will write down 5 questions that they still have after the presentation and then research the answers.
6. Students will write a story about how different astronomy would be if there was no light pollution.
7. Students will write a poem about dark skies and astronomy.
8. Students can draw a picture of how they think the night sky looks, and then compare it with an image of how the night sky looks without light pollution.
9. Students can write a letter to a group of people moving to Mars about how they can keep light pollution from ruining their new planet.
10. Students can research how many songs/stories/books/plays/poems/paintings they can find that utilize the stars and/or planets in their titles.
11. Play *Astronomy Shakedown!*
12. Students will fill out the *Solar System: Above and Beyond* workbook.

One Computer Classroom

Classrooms Without Computers

Here are some suggestions:

1. If you have access to a computer at home or in the school library, you may print selected parts of the lesson as paper copies or transparencies.
2. If your school has projection capabilities in the library or another room located outside your classroom, use this location as your presentation site.

Home Schooled

This lesson can easily be followed and conducted in a home school group session as long as the district-mandated prerequisites are met. Parents should review the lesson information and fully examine the teacher's guide beforehand.

Addendum

Solar System: The expanse of space near the sun, which includes Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, asteroids, comets, and meteors.

The Sun: The star nearest to Earth which provides the solar system with most of its natural energy and consumes more than 98% of all the mass in the solar system. Most objects in the solar system orbit around it.

Jupiter: This planet is 11 times the size of Earth. It is made of gas, has over 60 moons, and has a famous storm that is at least twice the size of Earth and has lasted for over 300 years.

Mercury: This planet is nearest to the sun, small, and has no atmosphere. This means there is no wind or rain to erode the land and change the way it looks.

Venus: This planet is known for rotating backwards (clockwise) and being the hottest planet in the solar system, 900° F on the average day. Its day is also longer than its year.

Earth: This planet is known for being the only one with liquid water and life.

Mars: This planet is known for being the most likely planet to have had life before Earth. Its also is the most explored planet by unmanned spacecraft.

Saturn: This planet is known for its massive rings. It is also the second largest planet in the solar system, being 9 times larger than Earth. It is completely made of gas.

Uranus: This planet is known for being “the lazy planet” because it orbits on its side. It’s also mostly made of the gas helium.

Neptune: This planet is known for being the first planet discovered mathematically rather than by observation. It is mostly made of a gas called methane.

Pluto: This (minor) planet is known for being the furthest from the sun. It is made mostly of rock and ice. Recently, it has become a highly controversial subject as to whether or not it is actually a planet.

Asteroids: These are rocks that range in size from about 1 km to 1000 km across. Most of them orbit the sun between the orbits of Mars and Jupiter.

Comets: These are known as the “dirty snowballs” of the solar system because they are made of dirt and ice. When they get close to the sun they begin to melt, which gives them the famous tail we see.

Meteors: These are smaller rocks that are in the solar system. Once they enter Earth's atmosphere they are known as meteoroids. When they reach the ground they are known as meteorites.