Exoplanet Art

Objectives

After this lesson is completed, students will be able to:

- Discuss ways Kepler and other telescopes have detected exoplanets.
- Discuss other exoplanet detection methods.
- Apply their own understanding of current planets to create fictional planets.
- Use art to express their own creative understanding of what an exoplanet might look like.
- Explain their reasoning on why their planet looks the way it does.

Suggested Grade Level

4^{th} – 6^{th}

Subject Areas

Space Science

Timeline

45 Minutes

Standards

- 4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen
- 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 Earth.
- MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system

Background and Resources

All of the planets in our solar system orbit around the Sun. Planets that orbit around other stars are called exoplanets.

All of the planets in our solar system orbit around the Sun. Planets that orbit around other stars are called exoplanets. Exoplanets are very hard to see directly with telescopes. They are hidden by the bright glare of the stars they orbit.

So, astronomers use other ways to detect and study these distant planets. They search for exoplanets by looking at the effects these planets have on the stars they orbit.

One way to search for exoplanets is to look for "wobbly" stars. A star that has planets doesn't orbit perfectly around its center. From far away, this off-center orbit makes the star look like it's wobbling.

Hundreds of planets have been discovered using this method. However, only big planets—like Jupiter, or even larger—can be seen this way. Smaller Earth-like planets are much harder to find because they create only small wobbles that are hard to detect.

The Kepler Space Telescope was launched in 2009 to 1) Determine the abundance of terrestrial and larger planets in or near the habitable zone of a wide variety of stars 2) Determine the distribution of sizes and shapes of the orbits of these planets 3) Estimate how many planets there are in multiple-star systems 4) Determine the variety of orbit sizes and planet reflectivity, sizes, masses and densities of short-period giant planets 5) Identify additional members of each discovered planetary system using other techniques 6) Determine the properties of those stars that harbor planetary systems.

In summary, Kepler is designed to find how many Earth-like planets might exist around other stars similar to our own sun in our Milky Way Galaxy. To do this, Kepler has a large field-of-view camera that stares at the absolute brightness of thousands of stars at once. Over time, it watches to see if any of the stars dim for a period of time and whether that dip in brightness is repeated 3 times (the qualification needed for a confirmed exoplanet). Astronomers can observe how the brightness of the star changes during a transit. This can help them figure out the size of the planet. By studying the time between transits, astronomers can also find out how far away the planet is from its star. This tells us something about the planet's temperature. If a planet is just the right temperature, it could contain liquid water—an important ingredient for life.

Over the history of Kepler, it has identified over 4,000 exoplanets to date. (See www.kepler.nasa.gov for the latest number). While Kepler's mission is officially over, scientists are still combing through terabytes of data to learn new things not only about possible exoplanets, but about the parent stars themselves. Kepler has been an invaluable tool in man's search for knowledge and understanding in space.

Other missions which have detected exoplanets: The Hubble Telescope, Ground-based Telescopes, The Spitzer Space Telescope, and Transiting Exoplanet Survey Satellite (TESS).

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- Fakhouri, O. (n.d.). Exoplanet Orbit Database | Exoplanet Data Explorer. Retrieved from http://exoplanets.org/
- What Is an Exoplanet? (2020, June 04). Retrieved from https://spaceplace.nasa.gov/all-about-exoplanets/en/

Vocabulary

1. Exoplanet – A planet outside our solar system, or *Extra-Solar Planet.*
2. Transit – The act of passing across or through.
3. Habitable – Capable of being inhabited.
4. Atmosphere – The gaseous envelope surrounding the earth or other planet; the air.
5. Orbit – The curved path, usually elliptical, described by a planet, satellite, spaceship, etc around a celestial body, as the sun.
6. Planet – Any of the eight large heavenly bodies revolving around the sun.
7. Galaxy – A large system of stars held together by mutual gravitation and isolated from similar systems by vast regions of space.
8. Stars – Any of the heavenly bodies, except the moon, appearing as fixed luminous points in the sky at night.
9. Telescope – An optical instrument for making distant objects appear larger and therefore nearer.

Materials

- Styrofoam balls 5 – 8 cm diameter (one per student)
- Modeling clay, various colors (four to five small pieces per student)
- Optional – clay shaping tools

Lesson

1. Talk about what an exoplanet is, missions which have detected exoplanets (like the Kepler Space Telescope, Spitzer, Hubble, etc), and how an exoplanet is detected. Exoplanets are detected using one or more of the following methods: Radial velocity (star wobble), ground-based telescopes, gravitational microlensing, infrared technology, and light transit.

2. Point out that we can know the size of the planet, how fast it orbits around its star, and basic elements that make it up, but that is all. Right now we don't have the capability to see these planets close up or to know if they contain vast amounts of water, a magnetic field, or other key factors for life.

3. Have students design a planet using the art supplies. Have them come up with a name and be ready to describe what their planet looks like and why. Have them identify key features such as craters, areas of liquid, etc. Is it a terrestrial or gas planet?

4. Each student will need one Styrofoam ball and 4 - 5 small pieces of modeling clay. They can choose which colors they need based on their initial description of their planet, key features, and if it is a gas or terrestrial planet.

5. Ask students questions as they are creating their planet. Use thought-provoking questions like: How close is the planet to the star? What would its weather be like? If life existed on this planet, what would it be like based on your design?

6. Allow students 20 minutes for creating their planet. Instruct them to spread the clay into a thin layer on the Styrofoam ball, as it will cover more of the surface of the ball.

Extensions

- Have students present their artwork, discussing details about their planet.
- Students can create another 3D model of their planet using papier-mache.
- Have students describe the ecosystem of their planet in writing.
- Have students come up with what life might be like on their planet based on its ecosystems and create a story about it.