**Exploring Exoplanets and Their Suns**

**By Tanya Anderson**

Level: Grades 6-8 Time: 1-2 class periods

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**Lesson Overview**

After completing a class KWL chart students will watch the video and complete the video question worksheet.

**Educator Background Knowledge**

Educators will need to understand the basic knowledge of what an exoplanet is and how they are identified and can visit the specific NASA websites for background knowledge of exoplanets focusing on the key vocabulary listed above.

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**Learning Goals**

Using videos and NASA websites students (in small groups) will investigate what an exoplanet is and how they are being discovered.

**Learning Objective**

Students will identify and describe specific features of exoplanets through the exploration of several different NASA websites and videos.

**Framework for Heliophysics Education**

NASA Question: How do the Earth, the solar system, and heliosphere respond to changes on the Sun? Big Idea: Life on Earth has evolved with complex diversity because of our location near the Sun. It is just right!

**NGSS Performance Expectations**

[MS-ESS1-1 Earth's Place in the Universe](https://www.nextgenscience.org/pe/ms-ess1-1-earths-place-universe): 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.

[MS-ESS1-2 Earth's Place in the Universe](https://www.nextgenscience.org/pe/ms-ess1-2-earths-place-universe): Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system..

**Targeted STEM Skills**

* Teamwork, Collaboration, Communication, Intellectual Curiosity, Planning, Presenting, Problem Solving, Decision Making, and Creativity

**Materials:**

* Laptops/Tablets to watch videos and access websites
* Each small group will need the following materials:
* Colored pencils/crayons to color exoplanet printouts
* Each student will need access to the following:
* Paper or notebook for students to record their data and observations and a pen/pencil

**Handouts**

* KWL Chart
* Student Video Questions Worksheet: **What is an Exoplanet?** (see Handouts)
* Students will need to be able to print out the **coloring pages for the Exoplanet Travel Bureau** activity. These pdfs are at the website under “Tour the Galaxy”. Hover over the image and click on **Color It**. They will be in English and Spanish and downloadable as a pdf.
Here is a sample: <https://exoplanets.nasa.gov/resources/2227/kepler-16b-coloring-page/?layout=magic_shell&travel_bureau=true>

**Links to Digital Resources for Students**

* NASA video: What is an Exoplanet?: <https://www.youtube.com/watch?v=0ZOhJe_7GrE>
* SETI video: What is an Exoplanet? <https://www.seti.org/what-exoplanet>
* NASA Exoplanet Exploration website: <https://exoplanets.nasa.gov/>
* NASA Eyes on Exoplanets interactive website: <https://exoplanets.nasa.gov/eyes-on-exoplanets/#/>
* Exoplanet Travel Bureau website: <https://exoplanets.nasa.gov/alien-worlds/exoplanet-travel-bureau/>
* NASA Hubble Telescope website:

<https://hubblesite.org/science/exoplanets>

**Key Vocabulary**

Solar system, exoplanet, star, Milky Way

**Material Preparation**

* Educators may want to have printouts of the exoplanet coloring pages printed out ahead of time or they can have students print out their coloring page during the activity.

**5E Steps**

**Engage**

Ask students what they know about exoplanets to create a class KWL graphic organizer on the board. List what students think they know about exoplanets, and additional questions they have about them. Pass out the student worksheet with the video questions and give the students a moment to look through the questions so they have an idea of what they are listening for as they watch the video. See Handouts.

* Show the NASA video **What is an Exoplanet?**

<https://www.youtube.com/watch?v=0ZOhJe_7GrE> and

* The SETI video: **What is an Exoplanet?**  <https://www.seti.org/what-exoplanet>

**Explore**

**Part A: Students will explore the website: NASA Exoplanet Exploration:**

<https://exoplanets.nasa.gov/>

* From the toolbar at the top of the website homepage students should spend time reading and watching the videos embedded in the “What is an Exoplanet” section and “The Search for Life” section of the website.
* Students should record information they found interesting or surprised them to share with their small groups at the end of class.

**Part B: Students will explore identified exoplanets on the interactive website** **NASA Eyes on Exoplanets:** <https://exoplanets.nasa.gov/eyes-on-exoplanets/#/>.

* Students will spend time using the website to explore different exoplanets and characteristics of the star they revolve around. Students should record their findings to share with the small groups at the end of class.

**Part C:**

**Students will use the Exoplanet Travel Bureau in NASA’s Exoplanet Exploration:** <https://exoplanets.nasa.gov/alien-worlds/exoplanet-travel-bureau/> to continue exploring different exoplanets and their stars.

* Students should first watch the trailer which can be found by clicking the “Watch Trailer” button.
* Next students can print and color the poster for their favorite exoplanet by clicking on the “Tour the Galaxy” button.
* They can then present it to their group/class.
* Finally they can click on the “Explore Space Telescopes” button and learn about different space telescopes.
	+ If they choose a telescope that has a “Explore in 3D” button they will be able to see a 3D model of the telescope that they can manipulate.

**Explain**

At this point it is important to have students reflect on how different **exoplanet stars** are compared to our Sun. Students can compare exoplanet stars they investigated in **Explore Part B** with our own Sun in terms of a) luminosity, b) activity level (sunspots, major storms, super flares), and c) age.

Students can read more about the Sun and other types of stars; and about exoplanet stars and habitable planets at these NASA websites:

* **How does our Sun compare to other stars?**: <https://spaceplace.nasa.gov/sun-compare/en/>
* **The Habitable Zone**: <https://exoplanets.nasa.gov/search-for-life/habitable-zone/>

***Teacher Information:*** Our Sun is an average-sized star and there are both smaller and larger stars, even up to 100 times larger. Many other solar systems have multiple suns, while ours just has one. There are several types of stars that exoplanets can orbit. Our Sun is classified as a G-type star. Stars less massive and cooler than our Sun are K dwarfs, and even fainter and cooler stars are the reddish M dwarfs.

Exoplanet stars are stars that have planets orbiting around them outside of our solar system. Some exoplanets orbit small red dwarf stars, which are much smaller and cooler than our Sun. Different star types have different habitable zones, which is the area around a star where conditions are just right for liquid water to exist on a planet’s surface.

If a star is too active, orbiting planets would likely not be habitable. Stars slightly cooler than our Sun, called **orange dwarfs**, are considered better for advanced life because they can burn steadily for tens of billions of years. The most abundant star type **red dwarf stars** have even longer lifetimes but are active as x-ray sources, producing strong solar flares, planets in their habitable zones would be exposed to extreme levels of X-ray and ultraviolet radiation.

A star’s activity level is particularly important for the most common star type: red dwarf stars, which. The exoplanets near red dwarf stars are likely so close to the star they would be hit with a lot of this solar radiation, making them uninhabitable even if they have liquid water, like Proxima Centauri and Tau Ceti. The very young and old stars tend to be more active with a long middle period where they are more stable.

**Extend**

* Students can expand upon their knowledge of exoplanets and the exploration of these planets by visiting the NASA Hubble website: <https://hubblesite.org/science/exoplanets>
* Here students can learn about the discoveries specific to the Hubble Space Telescope.

**Evaluate**

* Refer back to the classes KWL and fill in what students have learned about exoplanets and see if all of their questions have been answered. Educators will evaluate student understanding of exoplanets through individual exoplanet coloring page presentations.

**Resources**

* KWL Chart
* Student Video Worksheet and Answer Key
* Coloring pages for the Exoplanet Travel Bureau activity

**Links to Digital Resources for Students**

* NASA video: What is an Exoplanet?: <https://www.youtube.com/watch?v=0ZOhJe_7GrE>
* SETI video: What is an Exoplanet? <https://www.seti.org/what-exoplanet>
* NASA Exoplanet Exploration website: <https://exoplanets.nasa.gov/>
* NASA Eyes on Exoplanets interactive website: <https://exoplanets.nasa.gov/eyes-on-exoplanets/#/>
* Exoplanet Travel Bureau website: <https://exoplanets.nasa.gov/alien-worlds/exoplanet-travel-bureau/>
* NASA Hubble Telescope website:
* <https://hubblesite.org/science/exoplanets>
* How does our Sun compare to other stars?: <https://spaceplace.nasa.gov/sun-compare/en/>
* The Habitable Zone: <https://exoplanets.nasa.gov/search-for-life/habitable-zone/>

**Handouts**

These begin on the next page.

**K-W-L Chart**

**TOPIC:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

| What I **K**now | What I **W**ant to Know | What I **L**earned |
| --- | --- | --- |
|  |  |  |

**What is an Exoplanet? Video Worksheet**

Watch the [NASA video: What is an Exoplanet?](https://www.youtube.com/watch?v=0ZOhJe_7GrE) And answer these questions.

1. What does the term exoplanet mean?
2. Do all exoplanets orbit stars?
3. Since exoplanets are so far away how do we study them?
4. Are there more stars or planets?
5. Why are exoplanets so hard for us to see?
6. How many planetary systems are there in the Milky Way?
7. Are all stars the same? Which types of stars last longer?
8. What is the primary reason for studying exoplanets?
9. What is considered a strong indicator that life might exist on another planet?
10. What is another major reason scientists study exoplanets?

**What is an Exoplanet? Video Worksheet Answer Key**

1. What does the term exoplanet mean? ***A planet outside our solar system.***
2. Do all exoplanets orbit stars? ***Most but not all.***
3. Since exoplanets are so far away how do we study them? ***Telescopes on the ground and in space.***
4. Are there more stars or planets? ***More planets than stars.***
5. Why are exoplanets so hard for us to see? ***They are so far away and fainter than their stars.***
6. How many planetary systems are there in the Milky Way? ***As many as there are stars.***
7. Are all stars the same? Which types of stars last longer? ***No. The smaller the star the longer they last.***
8. What is the primary reason for studying exoplanets? ***Searching for life on other worlds.***
9. What is considered a strong indicator that life might exist on another planet? ***Those with the most similar conditions to our own.***
10. What is another major reason scientists study exoplanets? ***Learning what makes a planet habitable.***

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