THE SEARCH FOR LIFE

INTRODUCTION

In this lesson, students learn about the habitual zone for planets and how to search for new life in the universe.

LESSON OVERVIEW

Subject & Grade Level: Science, 5 – 8 Grade

Length: 30 minutes

Objectives

At the conclusion of this lesson students will be able to:

- Illustrate the conditions necessary to discover life on other worlds.
- Decide which planets are best suited and most likely to carry life
- Connect similarities between the Earth and other planets listed.

Key Questions

- What are the necessary conditions needed for life as we know it?
- Why is there not life on all of the planets in our solar system?

Standards

- NGSS MS-PS2-5: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
- CC WHST.6-8.7: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- CC MP.2: Reason abstractly and quantitatively.

Materials Needed

- SFL Reproducible 1
- SFL Reproducible 2
- Internet accessibility / ability to play a video from the internet

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Background Information: Teacher Knowledge

The search for life in our universe begins here on Earth. We examine what life needs to survive on Earth and try to find places in the universe that have those characteristics. Planets outside of our solar system that have those characteristics would be considered places where we might find life similar to life on Earth or "life as we know it". Those characteristics include the size of the planet, whether or not it has an atmosphere and how far away it is from the star it orbits.

Resources

Conditions that Support Life
http://learn.genetics.utah.edu/content/astrobiology/conditions/

Europa & Titan: Moons with Life?
http://earthguide.ucsd.edu/virtualmuseum/litu/10_3.shtml
http://www.nasa.gov/ames/kepler/nasas-kepler-discovers-first-earth-size-planet-in-the-habitable-zone-of-another-star/#.U8A5gZRdVg0

Discovering Exoplanets
https://www.youtube.com/watch?v=GDtPnK9sJ5s
https://www.youtube.com/watch?v=zFPnOUSdMdc
http://kepler.nasa.gov/

LESSON STEPS

Teacher Preparation

To prepare for this lesson, teachers must be familiar with the basic background information. This basic information can be read or heard through the various links above. Teachers should ensure that a solid internet connection is available in the classroom. Load the videos beforehand so that you can dodge buffer issues and advertisements. Make sure that all students have a copy of the attached charts.

Warm-Up

Divide the class into small groups of four to five students.

Allow students a few minutes to brainstorm their ideas and/or share with others in their group about the following questions: What constitutes life? What are the conditions for life?

Students will nominate one student within their group to share their ideas to be recorded on the board by the teacher or to be displayed for all to see on a dry erase board or electronic tablet.

After a brief discussion about what the students believed, watch the following short video as a group. Have students individually write down three things they learn from the video on a scratch piece of paper (TED ED video on the habitable zone).

Ask students:

What makes Earth a good place for life?

Answers should include things such as the gravity on Earth, the atmosphere and distance from our sun.

Activity

Hand out SFL REPRODUCIBLE 1 and SFL REPRODUCIBLE 2.

Students will utilize the descriptions to assist in filling out the table and formulating conclusions.

Walk students through the top planet (Earth) in the Conditions for Life Table.

Have students work through the rest of the table on their own.

Once students have finished, review the table one planet at a time to discuss the conclusions and the reasoning behind conclusions.

To conclude the lesson, make sure to remind the students that the activity they performed today was merely an estimation. Inform them that these charts and tables are the best resources we have to try and formulate our conclusions.

Size of the Planet ($M_\oplus$)

If a planet is too small, it cannot hold onto an atmosphere and will become too cold or too hot. If a planet is too large, deep ocean water could freeze and stop the planet's flow of life. Large planets also have large amounts of gravity, and too much gravity could make life impossible.

Planet size, in relation to Earth, is measured in a unit called Earth Masses $\mathbf{M_\oplus}$.

Earth = 1 Earth Mass
Mars = .3 Earth Masses smaller than the Earth

A planet that can support life as we know it would have an Earth Mass between **.03** and **2**.

What is in the atmosphere?

The make-up of an atmosphere is an important factor when trying to decide if life can exist. We look for gases similar to those we have on Earth.

These gases include **Nitrogen, Oxygen, Water** and **Carbon Dioxide**.

Not all potentially habitable planets need all of these gases, but the more gases there are, the more likely life becomes.

Is there an atmosphere?

Atmospheres regulate temperatures; oceans freeze or boil without an atmosphere to protect them. Life as we know it needs an atmosphere.

AU (Distance from the Sun)

The distance between our Earth and the sun is about 149 million kilometers. We call that distance an Astronomical Unit (AU).

1 AU is the distance between Earth and the sun
2 AU is twice the distance from Earth to the sun
.5 AU would be half the distance between Earth and the sun

For life as we know it to exist, a planet must be located somewhere between **.5 AU** to **1.688 AU** from its star.

Name_____ Date_____

Planet Name	Planet Size ($M_{\oplus}$)	Is here an Atmosphere?	What is in the Atmosphere?	AU (distance from Sun)	Is there Potential for Life?
Earth	1	Yes	Nitrogen, Oxygen, Carbon Dioxide, Methane	1.0	
KOI – 4356.01	.25	No	-	2.2	
Gliese – 581 G	1.1	Yes	Carbon Dioxide, Nitrogen	.72	
Kepler-186f	1.2	Yes	Nitrogen, Water, Carbon Dioxide, Methane	1.4	
KOI – 1686.01	.32	Yes	Carbon Dioxide, Argon	1.38	
Tau Ceti e	317	Yes	Helium, Hydrogen	4.95	

SFL Reproducible 2: Answer Key

Planet Name	Planet Size ($M_{\oplus}$)	Is here an Atmosphere?	What is in the Atmosphere?	AU (distance from Sun)	Is there Potential for Life?
Earth	1	Yes	Nitrogen, Oxygen, Carbon Dioxide, Methane	1.0	**Yes**
KOI – 4356.01	.25	No	-	2.2	**No**
Gliese – 581 G	1.1	Yes	Carbon Dioxide, Nitrogen	.72	**No**
Kepler-186f	1.2	Yes	Nitrogen, Water, Carbon Dioxide, Methane	1.4	**Yes**
KOI – 1686.01	.32	Yes	Carbon Dioxide, Argon	1.38	**No**
Tau Ceti e	317	Yes	Helium, Hydrogen	4.95	**No**