IMAGINING LIFE BEYOND EARTH

Careers in Astrobiology and Design Your Mission

ARIZONA ASTRO BIOLOGY CENTER
aabc.arizona.edu

OVERVIEW

In this lesson, students will explore various career paths in astrobiology and related scientific fields, learning how different disciplines, such as biology, chemistry, geology, engineering, and astronomy, contribute to the search for life beyond Earth. Building on this understanding, students will work in groups to design a fictional space mission, applying their knowledge of astrobiology while considering the roles and responsibilities of different scientific careers. By planning and presenting their missions, students will reflect on their own skills and interests and see how collaboration and interdisciplinary teamwork are essential in real-world scientific exploration.
Duration: 3 activities totaling 2-3 hours

LEARNING OBJECTIVES

- Explore potential careers in astrobiology and related fields.
- Understand how different scientific disciplines contribute to space exploration and the search for life.
- Connect personal skills and interests to real-world scientific careers.
- Collaborate in groups to plan a fictional space mission.
- Understand the ethical and practical considerations of space exploration.
- Reflect on personal interests and how they connect to space science careers.

ARIZONA STANDARDS

Core Ideas - U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.

6th Grade - 6.E2U1.7 The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

This lesson also fulfills some of the Arizona Department of Education **Career Exploration Standards** for grade 6-8, including healthcare careers, education careers, science and technical careers, and the benefits of technology to careers and work.

NEXT GENERATION SCIENCE STANDARDS

- **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts.
- **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ESS1-3**: Analyze and interpret data to determine properties of objects in the solar system.
- **Science and Engineering Practices - Asking Questions and Defining Problems** (Students explore scientific questions related to space missions and the search for extraterrestrial life)
- **Science and Engineering Practices - Obtaining, Evaluating, and Communicating Information** (Students analyze how different scientific careers contribute to astrobiology and space exploration and reflect on how their own skills align with different scientific fields)
- **Nature of Science (NOS) Connections - Science is a Human Endeavor** (Scientific discoveries result from collaboration between people of different backgrounds, disciplines, and expertise)

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MATERIALS	• "What is Astrobiology?" video • Europa Clipper mission video • Mars Perseverance Video • Titan Dragonfly Video • "Careers in Astrobiology and Design Your Mission" student worksheets (available on the AABC website) • Career Cards (available on the AABC website) • Planet Scenarios (These can be found on the AABC website in the form of a PowerPoint. We recommend you print them so that you can hand out one scenario to each group. If you did the "Extreme Life" lessons prior to these lessons, you can also choose to use the planets students created in those lessons.) • Sticky notes (5 per student) • Whiteboard or paper for group brainstorming • Art supplies (optional, for designing presentation posters, spacecraft or mission patches)
BACKGROUND KNOWLEDGE	Students should have basic knowledge of the following: • General knowledge of the planets in the solar system and their moons. • The basic definition of astrobiology
VOCABULARY	• **Astrobiologist:** A scientist who studies the possibility of life beyond Earth. • **Analog:** In astrobiology, an analog refers to an Earth-based environment, organism, or system that serves as a model for understanding conditions on other planets. For example, Antarctica's subglacial lakes are considered analogs for potential extraterrestrial habitats on icy moons like Europa. • **Interdisciplinary Science:** A scientific field that combines multiple areas of expertise, such as biology, chemistry, and planetary science. • **Instrumentation:** Tools and technology used in space missions to collect and analyze data. • **Unmanned Mission:** A robotic space mission without human crew members.
SET UP	• Prepare video clips for class viewing. • Ensure all students have their copy of the lesson worksheet. • Distribute sticky notes to each student. • White board (or similar) for brainstorming as a class in activity 3. • Distribute a set of career cards to each group (in activity 2 and 3) for reference. • Distribute art supplies (optional)
LESSON PROCEDURE	**Warm Up (15 minutes)** 1. Watch the "What is Astrobiology?" video. Ask students to listen for the four different components of astrobiology mentioned in the video. 2. Explain that today they will refine their understanding by focusing on the different careers that contribute to astrobiology.

LESSON PROCEDURE

3. Have students look at the first page of the worksheet, "The Four Components of Astrobiology" (Origin, Evolution, Distribution, and Future of Life). Facilitate a discussion:
    - What do these words mean?
    - Why do they matter in the study of astrobiology?
    - What types of scientists or careers might focus on each component?
    - Encourage students to write down key words or draw small illustrations to help them remember each concept.

Activity 1: Missions in Astrobiology (20 minutes)

4. Show this video clip about the **Europa Clipper** mission. Explore the following questions with the students as time and interest levels allow.
    - How does this mission relate to astrobiology?
    - Which of the four components of astrobiology does it connect to?
    - What types of careers are involved in this mission?
    - What analog environments on Earth are similar to this environment?
    - What adaptations would an organism need to have to survive this environment?
    - What types of instruments is this space mission using to explore the possibility of life?
    - What challenges does this mission have?

5. Repeat Step 4 and the resulting discussion for the following video clips, as time allows:
    - Mars Perseverance Rover (also called the Mars 2020 Rover)
    - Dragonfly Mission to Titan

Activity 2: Career Exploration (40-50 minutes)

6. Turn to page 2 in the worksheet titled “About Me”
    - Instruct the students to think of at least 5 strengths, skills, or interests that they have, and write them in their worksheet.
    - Pass out 5 sticky notes to each student. Have the student write the same strengths/skills/interests on the sticky notes, one per sticky note.

7. Place the students into groups of 3-5 students each and pass out the career cards.
    - Instruct the students to read the career cards out loud as a group, discussing and asking questions as they go.
    - If they find a career that fits with one of their 5 strengths/skills, they should place that sticky note on the career card.
    - Encourage students to help each other place their sticky notes on careers that match.
    - After they have gone through all the careers, have each student choose the two careers they are most interested in, and fill in pages 3-4 in their worksheets with:
        - The career name
        - How their skills connect with this career
        - A drawing of themselves practicing this career

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LESSON PROCEDURE

Activity 3: Space Mission Design (60-80 minutes)

1. Keep the students in the previous groups.
2. Ask the class what things they think are essential for a successful space mission. Discuss as an entire class and write their ideas on a white board that everyone will be able to see for the rest of the class period.
2. Announce that each student group is now a team of scientists planning a space mission.
   - Hand out each Planet Scenario, showing the class the picture of the planet and reading the description, before handing it off to a group.
     - Alternative 1: For smaller classes, you can have each group choose which planet they will visit.
     - Alternative 2: If you completed the "Extreme Life" lessons, you could have students choose to instead visit the fictional planets they created.
   - Note to Teacher: The illustrations on these Planet Scenarios are artists' renditions. These planets are too far away for us to obtain a real picture.
3. After each group has been assigned which planet they are going to explore, have them review the two careers they wrote down in their worksheets in the previous activity.
     - Each person in the group should pick one of those two careers to focus on during the next part of the assignment.
     - Ideally, every person in the group will have a different career.
4. Next, the group should turn to page 5 and 6 in their worksheet, titled "Mission to _____" and "Career Notes."
     - Explain that the students will discuss all of the questions on page 5 with their group.
     - During the discussion, they do not need to write down the answers to every question. Instead, they should take notes on how that question is related to their job, and what mission responsibilities they will have related to that question. Encourage students to help each other recognize when a question is a part of their career responsibilities.
5. The last two pages of the worksheet titled "Mission Design" are for open-ended use. For groups that finish their discussion early, you might have them draw a picture of their spacecraft or design a mission patch in this space.
6. Have students present their mission plan to the class.
     - If time allows, you might choose to have them create posters or a slide show.
     - If you are short on time, you can have the students describe their planet and their career duties as part of the mission team.

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LESSON PROCEDURE

Reflection (10 minutes)

8. Explore the following questions with the students as time and interest levels allow. You might also choose one of these questions as an "exit ticket" type of activity.
    - What careers were the most exciting or unexpected?
    - How do different careers in astrobiology work together?
    - What careers did you explore that are not strictly "scientist" careers, but are still important to space missions?
    - Notice that the career cards included people who work on manned space missions, but none of the missions we discussed (Europa, Mars, Titan) are manned missions. Why do you think this is so?
    - How did your extreme environment influence your mission plan?
    - How important are teamwork and collaboration in mission design?
    - How does your mission connect to real-world space exploration?
    - What careers in astrobiology and space exploration seem most exciting to you now?

EXTENSIONS AND TAKE HOME ACTIVITIES

Here are some additional activities you might consider to extend the lesson or expand learning beyond the classroom.

- Have students research a scientist working on one of the four components of astrobiology (Origin, Evolution, Distribution, Future) and present their findings.
- Encourage students to interview a scientist or engineer (in person, via email, or by watching online interviews) and report back on what they learned.
- Have students create a short story or comic about a future astrobiologist and their discoveries.
- Have students take home the career cards and discuss with family members. Which careers do those family members like best? Which have matching skills or interests to those family members?
- For a longer project: tell each group that they are competing for NASA funding to fund their mission, and they need to put together a presentation to convince NASA to fund their project.
- Have students create a mission logo that represents their team's goal.
- Have students research real-life planetary protection policies and write a short reflection.
- Write a science fiction story based on their mission.