Current and Future Space Exploration

Session Time: Three, 50-minute

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Develop interest in one or more aviation/aerospace career pathways and learn what is required to pursue future employment in the industry. (EU3)

Aspire to the highest level of technical proficiency as it relates to flight operations and engineering practices. (EU5)

ESSENTIAL QUESTIONS

1. What do we gain from the exploration of space?
2. What is the future of space exploration?
3. Is there a place for you in the future of space exploration?

LEARNING GOALS

Students Will Know

- The definition of space exploration
- The main areas of current and future space exploration and research
- The careers that are available in space exploration

Students Will Be Able To

- *Describe* and *explain* the basic reasons for space exploration. (DOK-L2)
- *Summarize* a current research project in space exploration. (DOK-L2)
- *Formulate* a future project for space exploration. (DOK-L3)

ASSESSMENT EVIDENCE

Warm-up
Students answer a driving question about why we explore space and then complete a quick Think-Pair-Share exercise.

Formative Assessment
Students will look to conduct further research within one of the seven areas of current and future space exploration and make oral presentations on their chosen mission or project.

Summative Assessment
Students will formulate a future space exploration project and deliver an “elevator speech” that summarizes what their project is, what it will do, and why it’s a good idea.

LESSON PREPARATION

MATERIALS/RESOURCES

- Current and Future Space Exploration Presentation
- Current and Future Space Exploration Student Activity

LESSON SUMMARY

Lesson 1 Current and Future Space Exploration

The first session of this lesson begins with a brief video about human space exploration, and students will then answer the question, “Why do we explore space?” Through a presentation, students will explore the different categories of current and future space exploration in greater detail. In small groups, students will read and take notes on an article from NASA about the future of space exploration. Once groups have completed their readings, students will revisit a list of space exploration topics developed at the beginning of the lesson and submit suggestions to be added to the list.

In the second session, small groups of students will be assigned to one of the seven areas of current and future space exploration. Each group’s task will be to research the topic and find a mission or a project that is focused on that area. The groups will make short presentations on their chosen mission or project.

Finally, students will formulate a future space exploration project and deliver an “elevator speech” that summarizes what their project is, what it will do, and why it’s a good idea.

BACKGROUND

For the purposes of this lesson, current and future space exploration and research has been grouped into seven categories.

1. Launch Vehicles for Deep Space
2. Studying Earth
3. Living in Space
4. Studying the Solar System
5. Studying the Universe
6. Space Tourism
7. Space Mining

These categories are not meant to be all-inclusive topics in space exploration. Time will be spent in future lessons learning about living in space, particularly, on Mars. Students should recognize that space exploration has many facets and is much broader than humans traveling to space.

DIFFERENTIATION

To support student motivation in the **EXTEND** section of the lesson plan, allow students the option to use multimedia or other visual aids to enhance their oral presentation.

To support metacognition in the **EVALUATION** section of the lesson plan, model for students how to create an elevator speech. This may be a new concept for students, and being able to witness the instructor modeling the assignment will provide students an example of expected behaviors and outcomes for the assignment.

LEARNING PLAN

ENGAGE

Teacher Material: Current and Future Space Exploration Presentation

Slides 1-3: Introduce the topic and learning objectives for the lesson.

Slide 4: Conduct the **Warm-up**.

Students will watch a NASA video then engage in a quick Think-Pair-Share exercise. Allow up to 10 minutes to complete the warm-up. [DOK 2; relate, DOK 3; hypothesize]

- "We Are the Explorers" (Length 2:35)

  http://video.link/w/DHJd

Warm-Up

At the conclusion of the video, ask students to respond to the question, "Why do we explore space?" Have students share their responses with a neighbor and then give them the opportunity to share their ideas with the entire class.

EXPLORE

Teacher Material: Current and Future Space Exploration Presentation

Slides 5-7: Inform students that in its simplest form, space exploration is the discovery of outer space. Space exploration is accomplished from the Earth using tools like telescopes. It is also accomplished by physical exploration by humans or unmanned space probes.

There is no definitive place where space begins. The Karman LIne is commonly referenced as the place where Earth's atmosphere ends and outer space begins.

Slide 8: Group students into teams of four to five and ask them to compile a list of as many different examples of space exploration topics as they can. Lists can include missions that NASA is responsible for, visiting planets or other celestial bodies, or they may list activities that private space exploration companies (such as SpaceX, Blue Origin) are engaged in. Suggest that they consider what they hear on the news, see in social media, read online, have learned in other classes, etc.

After students have had time to write down their ideas, gather the student responses in a class discussion. Make a master list of these items and keep it in a place where the students can reference it.

As the lesson continues over the next few days, add items to the list as they are discussed and explored.

Teaching Tips

To help students get started, share information about the **International Space Station (ISS)** or the **Mars Exploration Rover** mission. Other possible responses include the **Soyuz** (Russian spacecraft that transports humans to space), satellites, telescopes, and many more.

EXPLAIN

Teacher Material: Current and Future Space Exploration Presentation

Slide 9: Lead the class in a discussion highlighting seven areas of current and future space exploration.

1. Launch Vehicles for Deep Space
2. Studying Earth
3. Living in Space
4. Studying the Solar System
5. Studying the Universe
6. Space Tourism
7. Space Mining

Slides 10-11: Launching Vehicles for Deep Space

NASA's newest vehicle, the Space Launch System (SLS), is being constructed and tested now to support future missions to the Moon, Mars, and beyond. The Orion spacecraft will carry astronauts on these missions and is destined to travel beyond where NASA has sent astronauts before. Presently, the Kennedy Space Center is modernizing its ground systems and facilities to meet the demands of the most powerful rocket ever built.

Have students watch a video about the Orion Spacecraft.

- "5 Incredible Facts About the Orion Spacecraft" (Length 2:06)

  http://video.link/w/B6Rd

Slides 12-13: Studying Earth

NASA studies the Earth by using satellites to capture images. As an example, the Landsat 8 satellite captures images of the entire Earth every 16 days. These images are available at no charge on various websites, including https://earthexplorer.usgs.gov/. Satellites help provide data that assist those working in agriculture, geology, forestry, regional planning, mapping, global change research, as well as emergency response and disaster relief.

Slides 14-15: Living in Space

Currently, the International Space Station is the only orbiting habitat in which astronauts live and work. Previous floating laboratories that served as "home" for a time existed, such as the United States' Skylab, which will be discussed later in this course, and also Russia's Mir space station. Future habitats could look significantly different and might include expandable materials.

Slides 16-17: Studying the Solar System

NASA has sent more than 250 robotic spacecraft beyond the Earth's atmosphere. For the first time, in 2018 (August), NASA is launching a probe to the sun, "Solar Probe Plus", the last region of our solar system left to explore. This program has taken more than 50 years to develop. The James Webb telescope is planned for launch in 2021 and will venture one million miles from Earth to orbit the Sun.

Slides 18-19: Studying the Universe

An example of one of NASA's most productive spacecraft ever built, the Hubble telescope has captured not only images from our solar system, but has examined other stars in our galaxy, asteroid belts, other solar systems, and much more.

Slides 20-21: Space Tourism

Many private companies are eager to complete manned flights to space. Training flights, stays at luxury space hotels, and orbits around the moon may all be possible for civilians in the future. All of this can be part of a tourist's space vacation for a hefty price.

Slides 22-23: Space Mining

This topic may be more controversial than others. Planning is underway to assess the value of cosmic materials as resources. Some believe that space mining is a necessary part of expanding long-term human dwelling in places besides the Earth. Some argue that it might negatively impact Earth, muddy international law, or create conflicts between public interest and profitability.

Teaching Tips

Optional Approach: Time permitting, show students any of the following videos in this section.

- "Life on Station: (Length 5:03)

  http://video.link/w/MHJd

- "Driving on the Surface of Mars" (Length 3:11)

  http://video.link/w/NHJd

- "Space Tourism Could Be Possible in Near Future" (Length 1:45)

  http://video.link/w/SHJd

Slide 24: Form small groups and have students read and take notes on the space exploration topics discussed in the article below.

- "What's Next For NASA?"
  https://www.nasa.gov/about/whats_next.html

Once groups have completed their reading, revisit the list of space exploration topics developed at the beginning of the lesson and ask students to provide suggestions to add to the list.

Slide 25: Ask students to give ideas about careers that exist in space exploration and what jobs they think will be needed in the future based on what they've learned during this session.

They might mention astronauts, engineers (aerospace, aeronautical, avionics, computer, materials, mechanical, robotics, spacecraft, and telecommunications engineers), space scientists (astrophysicists, biologists, chemists, geologists, medical doctors, meteorologists, and physicists), communications technicians, computer aided design operators, drafters, electricians, laser technicians, quality assurance specialists, radar technicians, robotic technicians, and satellite technologists.

EXTEND

Teacher Material: Current and Future Space Exploration Presentation
Student Material: Current and Future Space Exploration Student Activity

Slide 26: Conduct the **Formative Assessment.**

During the second session, students will conduct further research within one of the seven areas of current and future space exploration.

Form seven different groups of students and assign one of the seven topics to each of the groups. Have students keep their assignments hidden from other groups. Provide students with **Current and Future Space Exploration Student Activity 1** to guide them through the assignment.

Each group's task is to research the assigned topic and find a current mission or a project that is focused on that area. For example, a group assigned to "Studying the Solar System" might research NASA's Juno mission. Or a group assigned to "Space Tourism" might dig into Virgin Galactic's human spaceflight project.

The groups will make three to four minute oral presentations on their chosen mission or project without making mention of their given topic. Groups may also include videos and still images to bring their presentation to life. At the end of each presentation, the other students should write down which of the seven areas they think were just presented. After all presentations are complete, reveal the assignments. The presentations may continue into the third session of this lesson.

[DOK 3; investigate, DOK 2; make observations, organize]

Formative Assessment

Students will conduct further research within one of the seven areas of current and future space exploration and make oral presentations on their chosen mission or project.

EVALUATE

Teacher Material: Current and Future Space Exploration Presentation

Slide 27: Conduct the **Summative Assessment.**

The previous two sessions have explored the categories of current and future space exploration. In session three, assess student understanding of the myriad activities and categories involved in space exploration by having them formulate a future space exploration project. They will prepare and deliver a 30-second "elevator speech" to communicate what their project is, what it will do, and why it's a good idea.

Each student should write out their elevator speeches prior to delivery. Collect student work and grade the speeches using the Summative Assessment Scoring Rubric. [DOK 2, summarize; DOK-4, create]

Summative Assessment

Students will use what they've learned during this lesson to create a future space exploration project. They will prepare and deliver a 30-second "elevator speech" to their classmates that summarizes what their project is, what it will do, and why it's a good idea.

Summative Assessment Scoring Rubric

- Follows assignment instructions

Elevator speech includes:

- Uses evidence from what was learned in class
- Demonstrates knowledge of the basics of space exploration
- Understands the reasons for space exploration
- Summarizes their project idea, what it will do and why it's a good idea

Contributions show in-depth thinking including analysis or synthesis of lesson objectives

Points	Performance Levels
9-10	Consistently demonstrates criteria
7-8	Usually demonstrates criteria
5-6	Sometimes demonstrates criteria
0-4	Rarely to never demonstrates criteria

GOING FURTHER

NASA has a number of space exploration resources for educators: https://www.nasa.gov/audience/foreducators/index.html

For the first time in history, in 2018, NASA will send a mission to the sun. If students to learn more about this exciting mission, go to http://parkersolarprobe.jhuapl.edu/.

STANDARDS ALIGNMENT

NGSS STANDARDS

Three-dimensional Learning

- **HS-ETS1-1** - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
  - Science and Engineering Practices
    - Asking Questions and Defining Problems
    - Constructing Explanations and Designing Solutions
  - Disciplinary Core Ideas
    - ETS1.A: Defining and Delimiting Engineering Problems
  - Crosscutting Concepts
    - Systems and System Models
    - Influence of Science, Engineering, and Technology on Society and the Natural World

COMMON CORE STATE STANDARDS

- **RST.9-10.1** - Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

- **RST.9-10.2** - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- **RST.9-10.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **WHST.9-10.2** - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
- **WHST.9-10.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- **WHST.9-10.7** - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- **WHST.9-10.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- **WHST.9-10.9** - Draw evidence from informational texts to support analysis, reflection, and research.

REFERENCES

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