5E Integrated STEM Lesson Plan – Template

Lesson Title: International Space Station Experiment-14-NASA (MISSE-14-NASA)
Author: Sarah Roi
Topic: Investigating the viability of seed propagation in space.
Targeted Grade Level: High School 9-12
Time Needed: 5-50 minute class periods.
Subject Integration:

- Science
- Engineering
- Math

Justification:

The premise of the mission is to research the performance and durability of materials regularly used here on here to the harshness of space. One such material is crop seeds. 11 species of seeds (Lettuce, Scarlet Frills, Amara, Garnet Giant, Pac Choi, Radish, Mizuna, Tomato, cauliflower, Pepper, and Arabidopsis) were exposed to the space environment for 6 months aboard the International space station. The purpose is to see how long exposure to space radiation affects the quality, storage, and germination of these species. The aim is to ultimately grow food on the ISS. There is a lot of storage, travel, and money spent on just sending food to the ISS. Many of the food stuff is dehydrated, freeze dried and/or processed. Very few fresh produce is available for the Astronauts. The ISS would like to ultimately be self-sustaining and needs the research on how to farm produce in outer space.

Standards:

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Constructing Explanations and Designing Solutions ● Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2) **Obtaining, Evaluating, and Communicating Information** ● Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity	**HS-ESS3: Earth and Human Activity** ● organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ● A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)	**Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8),(HS-LS4-6) **Scale, Proportion, and Quantity** ● The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1) Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2) **Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6),(HSLS2-7)

and reliability of the claims, methods, and designs. ● Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3) **Engaging in Argument from Evidence** ● Engaging in argument from evidence in 9–12 builds from K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8)	**LS3.B: Variation of Traits** ● Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3) **LS4.C: Adaptation** ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5),(HS-LS4-6) ● Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5)	

	LS4.D: Biodiversity and Humans ● Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (HS-LS4-6)	

Common Core State Standards:

Common Core State Standards Connections:
ELA/Literacy –

- RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-6),(HS-LS2-7),(HS-LS2-8)
- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-8)

- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-LS2-6),(HS-LS2-7),(HS-LS2-8)
- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-6),(HS-LS2-7),(HS-LS2-8)
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS2-1),(HSLS2-2)
- 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.
- RI.9-10.3: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them
- WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS4-6)
- WHST.9-12.7 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. (HSLS2-7),(HS-LS4-6)

Mathematics –

- MP.2 Reason abstractly and quantitatively. (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-7)
- MP.4 Model with mathematics. (HS-LS2-1),(HS-LS2-2)
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-1),(HS-LS2-2),(HS-LS2-7) HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-1),(HS-LS2-2),(HS-LS2-7)
- HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-1),(HS-LS2-2),(HS-LS2-7)
- HSS-ID.A.1 Represent data with plots on the real number line. (HS-LS2-6)
- HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (HS-LS2-6)
- HSS-IC.B.6 Evaluate reports based on data. (HS-LS2-6)

ITEEA Standards

(*N/A)*

Measurable Student Learning Objectives:

- Students will be able to describe Characteristics needed for life
- Students will be able to describe the independence of life on Earth and infer that relationship in space.
- Students will be able to Investigate and explain the International Space Station Experiment-14-NASA (MISSE-14-NASA)
- Students will be able to identify the effects of space environment on seeds to determine positive or negative effects on living systems.

Nature of STEM:

Scientific Knowledge is Open to Revision in Light of New Evidence

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-3)

Science is a Human Endeavor

- Technological advances have influenced the progress of science and science has influenced advances in technology . (HSLS3-3) Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

Engaging Context/Phenomena:

Living life outside of the safety and security of the Earth is a mysterious and exciting thought. Everyone is engaged for a rocket launch or watching an astronaut working ANY random task in outer space. By starting a discussion about what students think or what questions they have about space exploration is a fantastic way to begin this lesson.

Data Integration:

The First the Seed Tomoatosphere project requires students to grow seeds that have been exposed to the space environment. In addition students are provided seeds that have NOT been exposed to the space environment. The goal is to see if there are adverse effects to the seeds that have been exposed to the space environment. by conducting a basic experiment growing tomato seeds.

Students will be able to track qualitative and quantitative data as well as controlling the growing environment to conduct an experiment to determine if the environmental effects of space are harmful or helpful to tomato plants.

Differentiation of Instruction:

- This can easily be conducted as a teacher-led experimentation where teachers can walk the students through the exercise guiding them to the correct conclusion.
- This lesson can be shortened or lengthened as needed
- These documents can be translated using google translate or some other such translation tool

Real-life Connection

Space travel is very time consuming and expensive and the resources in space are very limited. The aim of this investigation is to ultimately grow food on the ISS. There is a lot of storage, travel, and money spent on just sending food to the ISS. Many of the food stuff is dehydrated, freeze dried and/or processed. Very few fresh produce is available for the Astronauts. The ISS would like to ultimately be self-sustaining and needs the research on how to farm produce in outer space.

Possible Misconceptions:

- Underestimate the importance of the atmosphere
- Gravity does not affect a plants metabolism
- Gravity does not affect a plants ability to maintain homeostasis
- Plants will do great in space because they are right next to the sun
- That our facilities used for space travel and habitation are anything like Hollywood has portrayed.

Lesson Procedure:

5E Model	5E Objectives

Engage: 1-50 minute class period.	**Procedure part 1:** Using their Electronic MISSE-14-NASA Interactive Notebook complete slide 2. ● Students should list as many of the food items they consumed and where they got it over the last 24 hours. ● What the Youtube video Eating on the Space Station. ● List on slide 2 of your interactive notebook what the Astronauts ate and where you think it came from ● List any additional questions or thoughts that came to mind as you were completing this activity **Modifications** ● Work in small groups or even as a class to complete this activity. **Procedure Part 2:** Using their Electronic MISSE-14-NASA Interactive Notebook complete slide 3. ● Students will be reading the Actively learn article "First Cookies Baked in Space Oven by Astronauts" ● As they are reading the students are completing the black box check for understanding questions ● After they have read complete slide 3 brainstorming "what challenges might astronauts face while cooking food in space?" **Modifications** ● Have teacher read the article to students allowed or have ipad "speak Text" ● Actively Learn can translate articles to other languages as needed. **Standards Addressed** NGSS Disciplinary Core Idea: ● HS-ESS3: Earth and Human Activity organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. NGSS Science and Engineering Practices: ● Analyzing and Interpreting Data to provide evidence for phenomena ● Obtaining, Evaluating, and Communicating Information by constructing an explanation that includes qualitative or quantitative relationships between variables that predict and/or describe phenomena Literacy: ● 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.

	• RI.9-10.3: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them **Formative/Summative Assessments** • Answer to the Black Box check for understanding questions on Actively Learn. **Resources** • Electronic MISSE-14-NASA Interactive Notebook • Eating on the Space Station. • Actively learn article "First Cookies Baked in Space Oven by Astronauts"
Explore: 1-50 minute Period	**Procedure:** Using the websites: A Day in the Life Aboard the International Space Station • Research how Astronauts on the ISS get through the day. • Write down your observations on how tasks need to be done in space as compared to how they are done here on Earth on slide 4 of the Electronic MISSE-14-NASA Interactive Notebook • Consider What CAN NOT be done in space that can be done here on Earth? • If there's time Review Challenges the students identified either from the prior days Explore activities or the new challenges students identified as they learned about the International Space Station and life as it is compared to the students' day life. • Focus items: o how difficult it is to do simple things like brush your teeth or eat o limited room to move and store things o how everything needs to be attached or tethered to the walls/floor o lack of convenient stores like Walmart or target. o Lack of alone time

- The fact that they CAN do all the things that we can do here on Earth, it's just really different.

For homework:

- Complete the Actively Learn Activity "What happens when you wring a wet washcloth in space?"
- Be sure to answer the Activity questions in the black question boxes.

Modifications

- This entire activity can be done as a gallery walk or in Expert Groups to save time and/or assist lower level learners.

Standards Addressed

NGSS Science and Engineering Practices:

- Analyzing and Interpreting Data to provide evidence for phenomena
- Obtaining, Evaluating, and Communicating Information by constructing an explanation that includes qualitative or quantitative relationships between variables that predict and/or describe phenomena

NGSS Crosscutting Concepts:

- Cause and Effect- cause and effect relationships may be used to predict phenomena in natural or designed systems
- Stability and Change- small changes in one part of a system might cause large changes in another part

Formative/Summative Assessments

- Responses to the observations and inferences the students gathered during their webquest.
- Responses to the Actively Learn Activity "What happens when you wring a wet washcloth in space?"

Resources

- A Day in the Life Aboard the International Space Station
- Electronic MISSE-14-NASA Interactive Notebook
- Actively Learn Activity "What happens when you wring a wet washcloth in space?

Explain: 1-50 Minute period	**Procedure:** ● Use the MISSE-14-NASA website ● As you are reading about the MISSE-14-NASA mission fill out the Scientific Process sheet on slide 5 of your Electronic MISSE-14-NASA Interactive Notebook. ● Finish the class by working as a class to identify the Scientific Process that MISSE-14-NASA is using. **Modifications** ● This could be done in small groups or as a class. ● This could be done in expert groups as well. **Standards Addressed:** NGSS Crosscutting Concepts: ● Stability and Change- small changes in one part of a system might cause large changes in another part Literacy: ● RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-8) ● 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. ● RI.9-10.3: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them Obtaining, Evaluating, and Communicating Information ● Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. ● Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3) **Formative/Summative Assessments** ● Correctly identify each of the Scientific Process aspects for the MISSE-14-MASA mission

	Resources ● MISSE-14-NASA website ● Electronic MISSE-14-NASA Interactive Notebook
Elaborate: 1-50 Minute class period.	**Procedure:** ● Complete the CK-12 Ecosystem: Food Pyramid PLIX Activity as a review of Ecosystem structures. Answer the "Challenge me" Questions. The 5th Challenge questions should be added to your Electronic MISSE-14-NASA Interactive Notebook on slide 8 as a thought bubble. ● Read the article "10 Ways Space is trying to Kill You" watch the video linked in the article "4 Ways Space is Trying to Kill You". Complete Slide 9 in your Electronic MISSE-14-NASA Interactive Notebook ● Discuss negative effects of life in space as a class. Highlight negative effects and how they not only affect humans but can/could also harm plants. ● Review plants life processes such as photosynthesis, cellular respiration, reproduction, mitosis and meiosis. All of these will be affected by the space environment. **Modifications** ● Complete this activity as a whole group or small group discussion ● Provide and elaborate the major ways that space is harmful that are specific to plants versus animals/humans during the discussion so that the students understand that Earth is special as it allows living things to maintain homeostasis fairly easily. Space is not so helpful. **Standards Addressed** NGSS Crosscutting Concepts: ● Cause and Effect- cause and effect relationships may be used to predict phenomena in natural or designed systems ● Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1) Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2) ● Stability and Change- small changes in one part of a system might cause large changes in another part Literacy: ● 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.

	• RI.9-10.3: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them **Formative/Summative Assessments** • Students' responses as they identify and discuss the issues with life in space. • Students should correlate the issues humans face with issues plants may face as well. **Resources** • CK-12 Ecosystem: Food Pyramid PLIX Activity Ocean • Electronic MISSE-14-NASA Interactive Notebook • "10 Ways Space is trying to Kill You" • "4 Ways Space is Trying to Kill You"
Evaluate- **1-50 min. class** **7-10 min.data collection sessions.**	**Procedure:** ***WARNING: Teachers must sign up for this event ahead of time. Seeds will be sent to you so be sure you have planned for enough lead time! Register here*** ***Teacher Prep:*** • ***Register for the program- please do this several months ahead of time.*** • ***60-peat pots*** • ***60- seeds from First the Seed Foundation (be sure to register ahead of time)*** • ***Germination trays (enough to safely hold the 60 peat pots)*** • ***Spray bottles for misting*** • ***Stable location with consistent temperature for the seed to germinate*** • ***Before you begin recommendations from First the Seed Foundation.*** • ***Suggested Conducting the experiment from First the Seed Foundation.*** • ***Seed Starting-How To from First the Seed Foundation*** • ***Collecting and Recording your data from First the Seed Foundation*** • ***Scientific Process in Detail from the First the Seed Foundation*** • Present the students with the websites

	○ Tomatosphere:Sowing the Seeds of Discovery through Student Science ○ First the Seed Foundation ○ Your Tomato Seeds ● Allow the students to read through the sites and complete slides 10-12 of their Electronic MISSE-14-NASA Interactive Notebook. ● Review as a class the parts of the scientific process to insure each student has filled out their slide correctly and accurately. This site can be helpful for teachers prior to this class discussion. *Scientific Process in Detail from the First the Seed Foundation* ● As a class, set up the data table that will be needed to collect quantitative and qualitative data. First The seed foundation has a suggested data collection sheet if inspiration is needed. ● **Once seeds have arrived:** ● Establish groups, roles, experimentation site location and set up the experiment. Some helpful resources to get you started ○ Suggested Conducting the experiment from First the Seed Foundation. ○ Seed Starting-How To from First the Seed Foundation ● Encourage students to take pictures as they are setting up their areas as documentation of the process to be inserted in slide 11 of their Electronic MISSE-14-NASA Interactive Notebook ● **After set up:** ● Students should check their plants daily for signs of germination (Collecting and Recording your data from First the Seed Foundation), mist their plants as they dry out and fill out their data table on slide 12 of their Electronic MISSE-14-NASA Interactive Notebook. ● Encourage students to take pictures as they are collecting data as documentation of the process to be inserted in slide 11 of their Electronic MISSE-14-NASA Interactive Notebook. **Upon completion:** ● Officially "completion" is the basic germination of the seeds, however, you may want to continue the experimentation and grow mature tomato plants to see if they flower and produce fruit. This will take more than a week but is completely acceptable. ● Regardless of your choice to end or continue, please submit your class data to First the Seed Foundation. **Should you decide to continue growing your plants, more supplies will be needed:**

- Area to grow germinated seeds/larger pots for the germinated seeds
- soil
- watering cans
- cages/ latus to support the plants
- light source
- Here is a source for Growing Tomatoes in pots should an outside garden area not be available.

Modifications

- Complete the scientific Process Prior to the discussion with the students.
- Complete the entire investigation as a class rather than individually.
- Collect the data as a class rather than individually/in groups.

Standards Addressed

NGSS Science and Engineering Practices:

- Analyzing and Interpreting Data to provide evidence for phenomena
- Obtaining, Evaluating, and Communicating Information by constructing an explanation that includes qualitative or quantitative relationships between variables that predict and/or describe phenomena
- Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds from K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8)

NGSS Crosscutting Concepts:

- Cause and Effect- cause and effect relationships may be used to predict phenomena in natural or designed systems
- Stability and Change- small changes in one part of a system might cause large changes in another part

Literacy:

- 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.

	• RI.9-10.3: Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them Math: • CCSS.MP2: Reason abstractly and quantitatively. • CCSS.MP7: Look for and make use of structure. **Formative/Summative Assessments** • Final Conclusion and analysis of the results. Due to the fact that this is a blind experiment you don;t actually know if you received seeds that traveled to space. So it is really important to look at the result and make logical educated inferences on what your specific class data suggests. Once you have turn in your data the foundation will let you know about your seeds exposure so you can then re-evaluate your thoughts. **Resources:** • **Register for the First The Seed Foundation program** • **Before you begin recommendations** • **Before you begin recommendations from First the Seed Foundation.** • **Suggested Conducting the experiment from First the Seed Foundation.** • **Seed Starting-How To from First the Seed Foundation** • **Collecting and Recording your data from First the Seed Foundation** • **Scientific Process in Detail from the First the Seed Foundation** • Tomatosphere:Sowing the Seeds of Discovery through Student Science • First the Seed Foundation • Your Tomato Seeds • Electronic MISSE-14-NASA Interactive Notebook

Teacher Background:

This lesson would be best served after units on characteristics of life, ecosystems, food chains, and interdependence of species have been discussed. Before planning is a must! Sending away for the seeds needs to be done in plenty of time to receive the seeds;

suggesting that this registration is done in the summer prior to the fall start or at minimum register at the beginning of the school year for a Spring start. Teachers should also be mindful that this experiment is just to see if the seeds germinate. If you want to grow the seeds to full mature plants, a larger growing area is needed, seeds may be transplanted into pots and kept in a classroom with light or a greenhouse.

The teacher must be familiar with how organisms maintain homeostasis and how the earth's atmosphere helps to keep an environment stable in order for living things to thrive. Returning to these points is key for the students to draw the connections between plants and animals and the major differences between the earth and space environment.