

SPACE LESSON PLAN 1- EYES ON EARTH COURSE

Lesson: Mission to Mars- What's Stopping Us?

Teacher: Emily McAfee

Grade-band: High School Biology- 10th grade

Length of Lesson: 3 Blocks- 1 hour and 20 minute each class

Topics: NASA Curiosity Rover, International Space Station, Long-term Space Travel, and Engineering Design

Materials Needed: Chromebook, Google Slides, Handouts, SpaceCraft Engineering Design Notebook, Padlet, Tinkercad, Article handouts

Cross-cutting Subjects: Science, Technology, Literacy

Standards:

HS-LS3-2.

Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

CCSS.ELA-LITERACY.RL.9-10.1

Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Measurable Student Learning Objectives:

- Students will be able to identify radiation as well as stress as environmental factors affecting gene expression and can propose a solution for better protection in future space travel missions.

NASA Space Mission Focus/Real-Life Connection:

Mission: International Space Station- *Human Research Program*

Although students will be introduced briefly to the lesson by examining photographs taken of Mars from the Curiosity Rover, the lesson will quickly begin to examine the mission of Scott Kelly on the International Space Station. The research taking place (twin study and others) is in preparation for a mission one day to Mars. For now, students will use the hopes of a trip to Mars as motivation to study happenings on the ISS.

Finally, after deciding that radiation in the environment can affect the astronauts gene expression, students must design a product that is a more spacecraft that is more efficient at protecting against radiation.

Data Integration:

Students will be interpreting one aspect of the data collected by the NASA Twin Study. The graph students will be analyzing can be found on page 5 of this research article summary. [Research Article](#)

Lesson Plan:

5E Model	Student Experience	Resources/ links
<p>Engage Approx. 30 minutes (day 1)</p>	<p>Overview: Students will gain background knowledge of the ISS and learn that our mission on the ISS is preparation for a future trip to Mars.</p> <p>Students will create a KWL on Padlet (online collaborative tool) to open a discussion about what they know about the risks of space travel. The teacher will help students arrive at a main question: what risks are there with long-term space travel?</p> <ol style="list-style-type: none"> 1. Start with discussion stemming from Mars Rover photographs. Visual for Engagement and Exploration, and Explanation Slides for Space Lesson "Why would we want to travel here and what is stopping us?" 2. On paper students will brainstorm a KWL first on paper about what they know/don't know about space travel. 3. *Students will share 1 idea from the first two sections of the brainstormed section of the KWL on Padlet. 4. Teacher-facilitated, student-led discussion will lead students to ask the question "What risks are present for humans with long-term space travel?" 5. Introduce the International Space Station (ISS) and its mission to answer that very question- what risks come with humans for space travel? 6. Teacher will ask the question: why would NASA be so excited about learning that Astronaut Scott Kelly had a twin brother. Discussion on how this is a beneficial scenario for study will stem from a "write, pair and share on the question" on their handout. 7. Students will examine the logo of "Space Flight Standard Measures" and brainstorm what each of the logos could represent by thinking about what they think would be beneficial to study about a human in space. 8. Discussion on how this is a beneficial scenario for study will stem from a "write, pair and share on the question" on their handout. <p>Modifications: Extended time and rewording of questions for those with 504 and in the ESL grouping.</p>	<p>Google Slides with photos and cues</p> <p>https://padlet.com/emilymcafee/kmqi62xdyi2ouliX</p> <p>https://docs.google.com/document/d/1vSvdr4mDRj_B2x-wY187CsEBoPKMZ5pZENzMYEIMJ0/edit</p> <p>https://www.nasa.gov/hrp/i1ymp/spaceflight-standard-measures</p>
<p>Citations:</p>	<p>Images. (2019, August 08). Retrieved September 23, 2020, from https://mars.nasa.gov/msl/multimedia/images/?page=0</p>	

	<p>Edwards, Monica. (2020, February 6). NASA’s Twins Study Results Published in Science Journal. Retrieved September 22, 2020, from https://www.nasa.gov/feature/nasa-s-twins-study-results-published-in-science</p> <p>Perez, J. (2018, September 04). Spaceflight Standard Measures. Retrieved September 22, 2020, from https://www.nasa.gov/hrp/i1ymp/spaceflight-standard-measures</p>	
<p>Explore Approx. 30 minutes (day 1)</p>	<p>Students will then be tasked to work with NASA to help analyze the data they collected on board the ISS.</p> <ol style="list-style-type: none"> 1. Students will receive the task to interpret the “biomarker” aspect of the data collected from Scott Kelly on the ISS. 2. Students will answer a series of questions on handout to help scaffold student thinking. 3. Once students have had time to grapple with the data and form a conclusion students will participate in a discussion about what happened to Scott’s DNA during his preflight and post-flight. 4. The teacher here will solidify the results they read by dissecting the graph as a group and coming to the conclusion as a class that the environment can have an effect on our genetic make-up. 5. Lastly, students will brainstorm what environmental factors could have been present to cause such changes. Students will begin a discussion based on their dialogue opened from a “write, pair and share on the question” on their handout. 	<p>Exploration piece of Space lesson</p> <p>Google Slides with photos and cues</p> <p>https://www.nasa.gov/feature/nasa-s-twins-study-results-published-in-science</p>
<p>Citations:</p>	<p>Edwards, Monica. (2020, February 6). NASA’s Twins Study Results Published in Science Journal. Retrieved September 22, 2020, from https://www.nasa.gov/feature/nasa-s-twins-study-results-published-in-science</p> <p>Garrett-Bakelman, F. E. (2019). The NASA Twins Study: A multidimensional analysis of a year-long human spaceflight. Human Physiology, 5. doi:10.1063/pt.5.028453</p>	
<p>Explain Approx. 30 minutes (finish on day 2)</p>	<p>Students will read an article from.... Create a Mindmeister concept map from the reading.</p> <ol style="list-style-type: none"> 1. The first step in explaining this phenomenon will come from an expert at NASA speaking about the chromosomal changes seen in space and what they 	<p>Google Slides with photos and cues</p>

	<p>learned from studying gene expression in space as well as the “molecular risks”.</p> <ol style="list-style-type: none"> 2. During this portion of the lesson I will bring students back to the concept of mutations that they are familiar with, reminding them that not all mutations are negative but some actually help produce diversity. Students will identify that environment had an effect on the mutation of genes- thus discovering the third piece to this standard. 3. Students will read an article from Times magazine and create a concept map on Mindmeister. 4. Students will use a second, more academic article from NASA (that summarizes the results of the Human Research study) to fill in the gaps and add to their concept map. <p>Modifications: ESL students: the video will have Spanish closed captioning for those with Spanish as a first language.</p>	<p>We Finally Learned What a Year in Space Did to Astronaut Scott Kelly's Body</p> <p>https://www.youtube.com/watch?v=Dbq-9faXThA&feature=emb_logo</p> <p>https://mm.tt/1607262420?t=JBhugsBoWq</p>
<p>Citations:</p>	<p>Edwards, Monica. (2020, February 6). NASA's Twins Study Results Published in Science Journal. Retrieved September 22, 2020, from https://www.nasa.gov/feature/nasa-s-twins-study-results-published-in-science</p> <p>Kluger, J. (2019, April 11). Scott Kelly's Year in Space Took a Toll On His Body. Retrieved September 23, 2020, from https://time.com/5568522/kelly-twins-year-in-space/</p>	
<p>Elaborate (days 2 & 3)</p>	<p>After analyzing the effects that long-term space travel had on Astronaut Scott Kelly, students will be tasked with engineering a solution for future long-term space travel missions.</p> <p>Students will decide on what environmental factors likely caused the mutations and will be challenged with an engineering design task to minimize these effects. (For this part I expect most students to zone in on radiation effects and possibly design a spacesuit to counteract these effects.)</p> <ol style="list-style-type: none"> 1. Students will complete the *engineering design notebook by researching and planning their prototype on paper. 2. Once their planning is complete and approved, students will scan the QR code and complete their 	<p>https://www.youtube.com/watch?v=MAhpfFt_mWM</p> <p>https://docs.google.com/document/d/14it4XVtggS9KX3_CnFmO3GQFLvPSYldQbFQruOADeCE/edit</p>

	<p>prototype on tinkercad.</p> <ol style="list-style-type: none"> Students will evaluate and give feedback to another group based on the requirements of the assignment. Students will refine based on the feedback and overall level of need for adjustment. <p>** adapted from Teach Engineering Design Maker Challenge: Bouncy Ball Factory</p> <p>Modifications: Students will be grouped in mixed ability groups to allow for a beneficial working environment for each level of student.</p>	<p>https://www.tinkercad.com/</p>
<p>Citations:</p>	<p>Zachary, H. A. (2020, July 28). Bouncy Ball Factory - Maker Challenge. Retrieved September 23, 2020, from https://www.teachengineering.org/makerchallenges/view/rice-2406-bouncy-ball-factory-engineering-challenge</p>	
<p>Evaluate</p>	<p>Students will be evaluated based on their Engineering Design Notebook, Prototype, and Pitch to the class. The pitch will be where the students will showcase their understanding of the standard at hand.</p> <ol style="list-style-type: none"> Students will “pitch” their ideas to the businessmen funding NASA. Students will know the pitch requirements by viewing the project rubric and the Spacecraft Engineering Design Notebook. <p>They must explain:</p> <ol style="list-style-type: none"> the need for long-term space travel (Mars- duh!) the current problems with the uncertainty of long-term space travel and safety hazards specific description of what effects that radiation can have on DNA. Remember these are businessmen be sure to explain what DNA is, how it can be affected by the environment, and why it needs to be protected. <p>Modifications: Students will be grouped in mixed ability groups to allow for a beneficial working environment for each level of student.</p>	<p>Prototype rubric</p>
<p>Citations:</p>	<p>Zachary, H. A. (2020, July 28). Bouncy Ball Factory - Maker Challenge. Retrieved September 23, 2020, from https://www.teachengineering.org/makerchallenges/view/rice-2406-bounc</p>	

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