

Title of Unit: Project Mars

Statement of Purpose:

Integrating math into the unit will enhance student's understanding of the health impacts of space travel. By quantifying the effect of radiation, students have a better understanding of how radiation exposure in space is not only different than exposure on Earth, but also how the accumulation of radiation exposure will occur over extended time in space. When students look at astronaut's prescribed exercise in space on exercise equipment, they explore the mathematical relationship between power, voltage, and speed as a function of constant variation. This helps students understand how the exercise machines are a tool used to maintain astronaut health.

The unit is developmentally appropriate as it uses 10th grade level math and ELA standards, as well as high school level NGSS standards. Students have been exposed to project-based learning in 9th grade, and during this unit the students are provided with teacher support as well as rubrics which provide clarity on expectations. This unit begins near the end of the trimester, so students have had previous opportunities to work in groups, research health issues, create presentations, and receive feedback on previous work.

During this unit, students will practice math skills related to analyzing quantitative data, which is an essential part of science. Specifically, students will practice the skills related to direct variation, calculating slope, solving linear equations, and estimating data based on a graph. These analysis will allow students to explore the affect of radiation on astronauts in space and explore a tool (exercise equipment) provided to astronauts to help maintain their health while in space.

Differentiation during the unit includes the assignment of students into a group and the teacher support provided to the group. I create groups of 3 students, ensuring that groups have no more than 1 lower performing student. This provides peer support to students who may be struggling. I also monitor group progress and provide additional support as needed, such as providing feedback, asking directed questions, and providing samples of previous student work as an example. In addition, since students are working in groups, the product is worked on by all students in the group.

NASA Resources/Data:

I have included 2 NASA Resources: [Exercising in Space](#) and [A Study of Astronaut Radiation Doses](#), which are part of the 'Explore' portion of the unit. In addition, the whole concept of the project centers around space missions and the eventual mission to Mars, so the entire project has a focus on NASA.

Time Length: 16 days

Grade Level: 10**Standards:****NGSS**

- HS-ETS 1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- SEP Asking Questions and Defining Problems: Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- SEP Constructing Explanation and Designing Solutions: Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

CCSSM

- MP.2: Reason abstractly and quantitatively
- MP.4: Model with Mathematics
- CCSS.MATH.CONTENT.HSA.REI.B.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- CCSS.MATH.CONTENT.HSS.IC.B.6: Evaluate reports based on data.

CCSS

- 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.
- RST.11-12.9: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- CCSS.ELA-LITERACY.W.9-10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
- CCSS.ELA-LITERACY.W.9-10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
- CCSS.ELA-LITERACY.SL.9-10.4: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
- CCSS.ELA-LITERACY.SL.9-10.5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Essential Question:

How is astronaut's health affected by long term space travel?

Objectives:

Students will:

- research health conditions associated with space travel
- design a tool/device to be 3D printed
- create an informative presentation
- write an informative blog post
- identify direct variation from ordered pairs by calculating the constant of variation
- calculate slope from two points using the slope formula
- determine independent and dependent variables
- solve linear equations
- estimate based on data presented in a graph

Materials:

- laptops (for student use)
- paper (for tool design/drawing)
- Teacher materials:
 - [Intro Project Mars](#)
 - [Exercising in Space](#)
 - [A Study of Astronaut Radiation Doses](#)
 - [Project Mars Choices](#)
 - [Student Blog Post instructions](#) (and rubric)
 - [PSA Student Directions](#)
 - [PSA Rubric](#)
 - [Presentation Rubric](#)

Lesson Plan	Honors Anatomy and Physiology
Engage	<u>Day 1</u> <ul style="list-style-type: none"> • Launch: introduce students to the project

Lesson Plan	Honors Anatomy and Physiology
	<ul style="list-style-type: none"> o Resource: Intro Project Mars
Explore	<p><u>Day 1</u></p> <ul style="list-style-type: none"> • Students complete Exercising in Space individually, then compare answers in small groups <p><u>Days 2-3</u></p> <ul style="list-style-type: none"> • Students complete A Study of Astronaut Radiation Doses individually, then compare answers in small groups • Assign students into groups of 3 for project <ul style="list-style-type: none"> o In assigned groups, students research health conditions that can happen during long term space travel and what tool/device they could design to be 3D printed to help with the health condition o Each group completes Project Mars Choices which includes the groups 1st through 3rd choice (of health condition) for the project o Each group meets with the teacher to discuss their choices. <ul style="list-style-type: none"> ▪ The discussion centers on: questions the group has, what additional information the group may need (both on the project itself or the health condition), and the feasibility of the health condition and 3D printed tool. ▪ The teacher approves one of the choices OR asks the group to continue research if needed. ▪ Groups must have an approved choice before moving on.
Explain	<p><u>Days 3-5</u></p> <ul style="list-style-type: none"> • Student groups continue to research their health condition and work on the design of the 3D printed tool/device • Student groups create a ‘design specification’ to be handed off to Engineering students to 3D print <ul style="list-style-type: none"> o The design specification includes a drawing of the tool/device with basic measurements/proportions • Student groups create a slideshow presentation about the health condition and tool/device
Elaborate/Extend	<p><u>Days 6-15</u></p> <ul style="list-style-type: none"> • Student groups work with Engineering student groups and Media student groups to create the 3D

Lesson Plan	Honors Anatomy and Physiology
	<p>printed tool/device, a blog post about the health condition, and a PSA.</p> <ul style="list-style-type: none"> ○ The Engineering student groups will work on the 3D printed tool/device for 5 days (days 6-10) <ul style="list-style-type: none"> ▪ The Engineering student groups will be matched with the student groups from Anatomy and Physiology(A&P). One group from A&P will be matched with one group from Engineering. ▪ A&P will collaborate with Engineering during the 3D printing process as needed ▪ <i>Note: the Engineering teacher is still developing the rubric for the 3D printed tool</i> ○ The Media student groups will work on the PSA and Blog post for 5 days (days 11-15) <ul style="list-style-type: none"> ▪ The Media student groups will be matched with the student groups from Anatomy and Physiology(A&P). One group from A&P will be matched with one group from Media. ▪ A&P will collaborate with Media in the creation of the Blog post and the PSA ▪ Student Blog Post instructions (and rubric) ▪ PSA Student Directions ▪ PSA Rubric
Evaluate	<p><u>Day 16</u></p> <ul style="list-style-type: none"> • Student groups (including Engineering students and Media students) present to a audience of professionals from the local community <ul style="list-style-type: none"> ○ Included in the presentation: the PSA, the 3D printed tool, and the slideshow ○ Presentation Rubric

Sources:

Dunbar, B. (2011). EXERCISING IN SPACE. Retrieved July 08, 2020, from https://www.nasa.gov/audience/foreducators/exploringmath/algebra1/Prob_Exercise_detail.html

Dunbar, B. (2010, May 25). Problem 28, A Study of Astronaut Radiation Dosages. Retrieved July 08, 2020, from https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/SMIII_Problem28.html

9-12 Presentation Rubric (CCSS Aligned): MyPBLWorks. (2019). Retrieved July 08, 2020, from https://my.pblworks.org/resource/document/9_12_presentation_rubric_ccss_aligned