Why Space Biology & An Introduction to the NASA Twin Study

Worksheet
Student Materials

Name:_____
Period:_____
Date:_____

Instructions:
On a computer?
💾 Save this document as **Last name -First name -period# -spacebio** .

You may type or use speech-to-text for your response in the answer boxes. Please use **complete sentences** in your final response, but you can use bullet points to outline your ideas first. Please avoid editing the prompts! You don't want to lose information.

ENGAGE

Before you start this section, you will learn a little bit about the National Aeronautics and Space Administration (NASA) and why biology is important for NASA. Watch NASA's "We are Going" video as an introduction to the topic.

👀 **Watch the NASA "We Are Going" (4 min)** video [https://youtu.be/vl6jn-DdafM?si=yigfcQWRJ4rtVU82]

Reminder: Get a template for your vocabulary book from your teacher if you have not already!

EXPLORE- GOING TO SPACE!	
👀 **Watch NASA Explorers: Artemis Generation (11 min)** **OR** **Yo Soy Artemis (6 min, Español)**	https://plus.nasa.gov/video/nasa-explorers-season-5-episode-1/ https://plus.nasa.gov/video/yo-soy-artemis/
🖍️ Where are people planning on traveling to in space? Have we reached that destination yet?	Answer:
1. 🔗 Check out this website	Answer:

https://www.nasa.gov/image-of-the-day/ and look at the pictures. 2. 🖼️ Pick 1-2 pictures and include a link and screenshot in your answer. Describe what you are seeing. 3. 💖 What do you like about the pictures? 4. 📖 Click on the "Read More" arrow and read the short article. Share at least two (2) facts that fascinated you. 5. 👥 Share your fact with a partner and write down your partner's favorite fact.	
🖍️ What interested you about what NASA has done or is working on?	Answer:
👀 **Watch the video on the Inspiration4 Mission (3 min)** **Or 📖 Read the article**	https://youtu.be/D38W150h9a4 https://www.spacex.com/launches/inspiration4/
🖍️ Would you ever want to go to space? Explain why or why not.	Answer: TEACHER NOTE - Good opportunity to incorporate FlipGrid if you choose to.
🖍️ What problems can you think of if you had to live in space for a long time?	Answer:

EXPLAIN - SPACE BIOLOGY VS ASTROBIOLOGY

As you have read and watched the videos about space missions, you have learned about various reasons why people aim to travel to space. Some are fascinated by just having the chance to experience space, but many are interested in making new discoveries about the universe we live in. In this section, you will learn the difference between space biology and astrobiology in detail.

Answer the questions in the boxes as you read/watch the resources provided. Make sure to read instructions carefully. You can alwa ys do more if you have time.

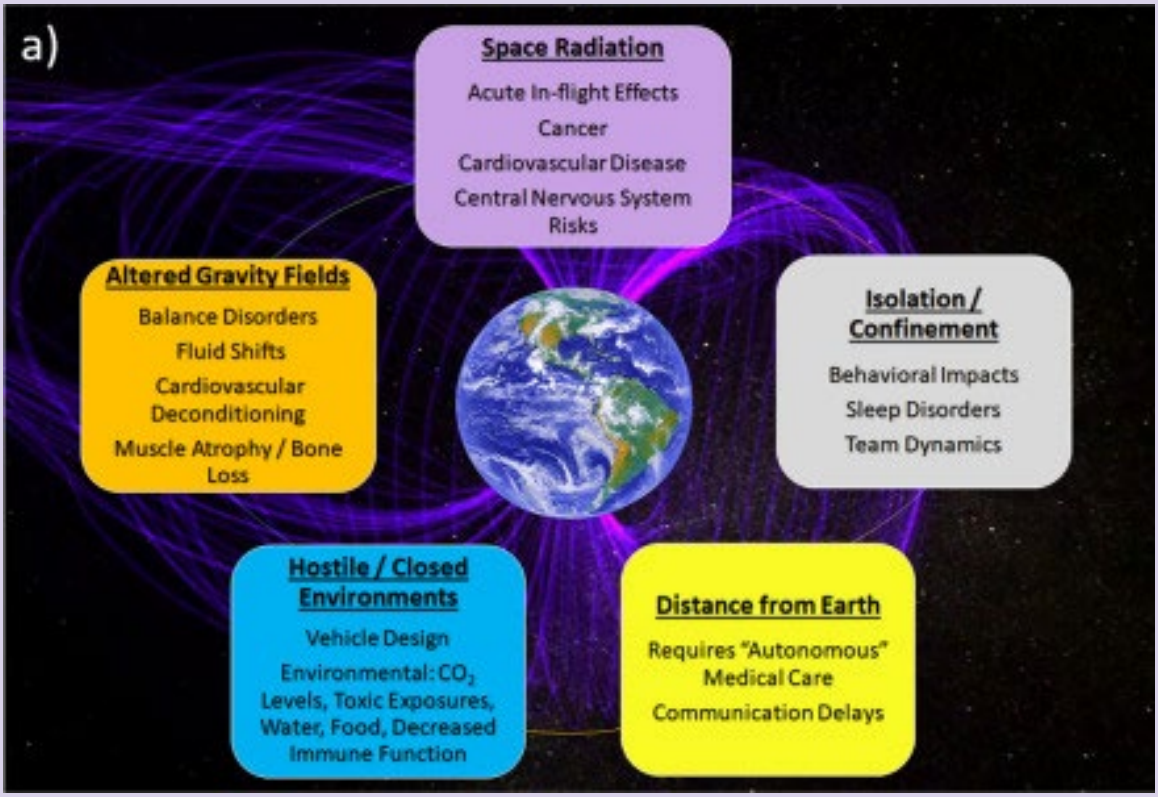
1. 📖 **Read** about the difference between astrobiology and space biology from NASA's website HERE.	https://science.nasa.gov/biological-physical/stories/space-biology-and-astrobiology-whats-the-difference/
🖍️ Write a definition for astrobiology and space biology in your own words. *You can look up any words you don't yet know to figure out their meaning. Work with a partner to come up with a good definition you all understand.*	Astrobiology : Space Biology :
🖍️ Do you think astrobiology or space biology is more interesting? Why? *Answering with "neither", "none", or a similar response will not be accepted.*	Answer: TEACHER NOTE Good opportunity to incorporate FlipGrid if you choose to.
2. Astrobiology	**Choose (Read & Watch) then respond to the questions in each column.**
📖 **Read about how did life form** Read a section of Issue #7 of *Astrobiology: The Story of our Search for Life in the*	👀 **Watch** "Astrobiology Case Study: E•NIG•MA" (9 min) • https://youtu.be/DGTPPy2fNyc?si=dQ1

Universe comic. • Read Pg 20 - 33 (or printed page numbers 18-31) https://astrobiology.nasa.gov/uploads/filer_public/e2/24/e2247808-b5c6-4e49-b2f0-4ce9c89fc43b/issue7_mobile.pdf	qd1vgRYETuGFn **Tips**: • Turn on captions using the CC button on the bottom right of the video. • Click on the settings button ⚙ to change languages or adjust speed.
🖍 List **5 key ideas** you learned from the comic. Answer:	🖍 List **5 key ideas** you learned from the video. Answer:
	🖍 What surprised you about astrobiology? Why was it surprising? Answer:
🖍 What makes up living things based on what you know now?	Answer:
🖍 Why are proteins important for understanding life?	Answer:

3. Space Biology	
👀 **Watch** TED-Ed "Could we survive prolonged space travel?" - Lisa Nip (5 min) • https://youtu.be/upp9-w6GPhU?si=2ycHVzzpCQuAx_CE	**Tips**: • Turn on captions using the CC button on the bottom right of the video. • Click on the settings button ⚙ to change languages or adjust speed.
🖍 What does "adaptation" mean? How long would it take for humans to adapt naturally?	Answer:
🖍 What does Lisa Nip mean by "gene therapy"? Why would this process be helpful?	Answer:
🖍 What challenges were mentioned in the video about space travel? Why are they a problem?	Answer:
👀 **Watch** "Introduction to Omics: 360 Degree View of You" - NASA Video (5 min) • https://youtu.be/m7X6mugpijQ?si=Z4	If you want a visual of what omics look like, see this NASA poster.

wTdta4BXUjo714	(https://www3.nasa.gov/sites/default/files/atoms/files/omics_poster.pdf)
🖍 From the "Introduction to Omics: 360 Degree View of You" video, how did they define "Omics"?	Answer:
🖍 What did they say "omics" is similar to a puzzle?	Answer:
🖍 What is the purpose of the Twin Study mentioned in the video?	Answer:
🖍 What is the benefit of studying omics?	Answer:

Here is a figure of the core concepts of space biology. It shows the 5 main hazards of spaceflight in different colored squares. Use this figure to answer the next questions.



"The five main hazards of spaceflight and the space exposome" CC by 4.0 / Cropped from original from Patel ZS, Brunstetter TJ, Tarver WJ, Whitmire AM, Zwart SR, Smith SM, Huff JL. Red risks for a journey to the red planet: The highest priority human health risks for a mission to Mars. NPJ Microgravity. 2020 Nov 5;6(1):33. doi: 10.1038/s41526-020-00124-6. PMID: 33298950; PMCID: PMC7645687. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7645687/

🔎 **Use the figure above to answer the questions below. You can use outside resources to research.**

🖍️ Looking at the figure, what are the 5 main hazards of spaceflight?	Answer:
🖍️ Choose a hazard and explain why it is dangerous on a Google slide.	Answer:

Copy-paste the link in the answer box. Make sure your share settings are "Public".	

EXPLAIN - NASA TWIN STUDY	

You have learned a little about NASA's missions and the research done in space biology. Now you will use what you learned to understand one of NASA's most significant human studies in space: the Twin Study. Have fun and explore the amazing science!

Use your vocabulary books to keep track of new words. Work with a partner to come to a conclusion about what these new words could mean and ask for help when you need it.

👀 **Watch these 2 videos** "NASA's 4-year Twin Experiment Takes Us Closer To Mars Than Ever Before" **AND** "Three Key Findings from the NASA Twins Study"	https://youtu.be/ZVRft7r8-Ds https://www.youtube.com/watch?v=hU0cD3kWnKY
🖍️ Why did NASA use twins in their research? Are there any limitations to this?	Answer:
🖍️ Describe at least 3 things scientists found out from the study?	Answer:
🖍️ What happens to gene expression in space?	Answer:
🖍️ What are telomeres? What happened to them in the study?	Answer:
🖍️ Were any of the changes in Astronaut Scott Kelly permanent?	Answer:

📝 Why was this research important? Optional resource: Twin Study Results at a Glance Poster (https://www3.nasa.gov/sites/default/files/thumbnails/image/pinwheel_041119_me-01_0.png)	Answer:
📖 **Read** the official NASA news article about the Twin Study HERE (https://www.nasa.gov/humans-in-space/nasas-twins-study-results-published-in-science-journal/)	**Recommended**: You can use this video series "OMICS: Exploring Space Through You" to help you define each omics term. https://youtube.com/playlist?list=PLiuUQ9asub3TReMNgv6kDFwNsRuCWAVcw&si=NRiBJ1ETAM1wLMP0
📝 **Define** these omics terms and add them on your vocabulary book: • Gene • DNA • RNA • Gene expression • Genomics • Epigenomics • Metabolomics • Proteomics • Transcriptomics • Microbiomics **Attach a link** to your vocabulary book if it is digital. Make sure the share settings are set to "**Public**".	(Make sure share settings are "Public") Link to Vocabulary Book:
APPLY & SHARE YOUR KNOWLEDGE Before starting the next section, check in to make sure you understand what to do.	**DUE DATE** _____
💼 Make a product to explain why space biology and omics research is important for future human space travel. Your product can be a slide presentation,	Upload your product as a URL link or picture if it is a physical object. Link or Image:

artwork, song, or any way to creatively teach someone about what you have learned. Your content MUST include the following: • What are the 5 hazard of space • Reasoning for why omics-related research is needed (use 3 omics terms) • Use supporting details from the NASA Twin Study or other provided resources to strengthen your reasoning • Why (or why not) you would want to go to space • Proper citations Audience: Peers, teacher, school community Presentation: May be in-class or a video recording. Aim for 5-8 minutes.	

Hooray you have completed the assignment! 🎉👏

For your interest!	
Hispanos de la NASA (en Español)	https://plus.nasa.gov/playlist/hispanos-de-la-nasa-2/
Astrobiology Comics	https://astrobiology.nasa.gov/resources/graphic-histories/
NASA Twin Study Full Research Paper	https://www.science.org/doi/10.1126/science.aau8650
Explore the Open Science Data Repository (OSDR) where scientists share all their omics data	https://osdr.nasa.gov/bio/repo/search?q=&data_source=cgene,alsda&data_type=study
Newsletters from Gene Lab	https://genelab.nasa.gov/newsarchive

AUTHOR

Stephanie Tsai, Saddleback High School (Santa Ana, CA)
Edited by GL4HS Staff