TAKING UP SPACE
LIVING ON MARS

Subject: Biomimicry

Grade Level: 6-10

Topic: Life Science, Engineering Design

Time: 90-120 minutes

Learning Objectives

Students will:

- identify environmental challenges of living on Mars.
- analyze how organisms survive extreme conditions on Earth.
- explain how structure relates to function in biological adaptations.
- apply biomimicry principles to design a Mars survival solution.
- communicate their ideas through models, diagrams, or presentations.

Materials

images/videos of Mars environment, images/videos of extremophiles (tardigrades, cacti, penguins, desert beetles, etc.), *Extremophiles Information Sheet*, chart paper or whiteboard, paper, markers, scissors, tape, recycled building material (cardboard, foil, plastic bottles, etc.), internet access or printed research sheets, optional, clay, hot glue (supervised)

Procedure

Engage: To promote student curiosity, Show images or short video clips of Mars. *Ask: Would you survive on Mars? Why or why not? What makes Mars difficult for humans?* Make a class list of Mars challenges. *Ask: How could nature help us solve these problems?*

🌐 *What Will Life On Mars Be Like?*

🌐 NASA's Newly Released Images Of MARS #107

Challenges students should list:

- thin atmosphere (low oxygen)
- extreme cold
- high radiation
- dust storms
- limited liquid water
- reduced gravity

Explore: Help students build an understanding by having students conduct some simple research. Divide students into groups of 3-4. Each group researches 1) One Mars challenge and 2) one Earth organism that survives a similar challenge. Use *Extremophiles Information Sheet* to provide examples. Each group answers:

- What problem does this organism face?
- What adaptation helps it survive?
- How does it structure relate to its function?

Students create a quick poster or slide summarizing findings.

Explain: Have students begin to show what they have learned by having each group present their findings. Have a discussion. *Ask: How do adaptations improve survival? What patterns do we notice? How is biomimicry?*

Elaborate: Have students use their new knowledge to design a tool, habitat feature, suit component or life - support system for Mars inspired by a biological adaptation. Some examples could be:

- A radation shied inpired by a tardigrade.
- A water-harvesting system inspired by desert beetles
- A solar panel that tracks the sun like a sunflower
- A habitat insulation system inspired by penguins
- A dust-resistant surface inspired by lotus leaves

Students use the engineering design process to build rough prototypes OR create presentation boards. Designs must include:

- The Mars problem/challenge
- The biological inspiration
- How structure helps function
- Why it would work

Assessment

Evaluate: Evaluate student learning by having students host a "Mars Innovation Fair." Students present designs and answer:

- What problem does it solve?
- What organism inspired it?
- Why is this sustainable?

Peers provide feedback:

- Is the biological connection clear?
- Would this realistically help on Mars?
- How could it be improved?

Students complete a short written reflection:

- What did you learn from nature?
- Why is biomimicry important for space exploration?

Extension Activities

- Explore farming on Mars using plant tropisms.
- Compare Mars habitats to Antarctic research stations.
- Create a digial 3D habitat model.
- Research real NASA biomimicry technologies.

NGSS Alignment

Middle School

MS-LS1-1 - Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

MS-LS4-4 - Construct an explanation based on evidence that describes how genetic variations of traits increase some individuals' probability of surviving and reproducing in a specific environment.

MS-ETS1-1 - Define the criteria and constraints of a design problem.

MS-ETS1-2 - Evaluate competing design solutions using a systematic process.

MS-ETS1-3 - Analyze data from tests to determine similarities and differences among design solutions.

High School Alignment (Grades 9–10 Extension)

HS-LS1-2 - Develop and use a model to illustrate the hierarchical organization of interacting systems within multicellular organisms.

HS-LS4-3 - Apply concepts of statistics and probability to support explanations that organisms with advantageous traits increase in proportion over time.

HS-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions.

HS-ETS1-2 / HS-ETS1-3 - Design and evaluate solutions to complex real-world problems.

Differentiation

For Middle School:

- Provide structured research sheets.
- Offer specific organism options.
- Focus on clear problem-solution connection.

For High School:

- Require justification using scientific principles.
- Include constraints (materials, cost, energy).
- Incorporate trade-off analysis.

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