

NOTE: All materials are those of the
project team and do not represent KDE
endorsement.

Classroom Embedded Assessment [CEA] Title: Mars' Valles Marineris Flight

a. Targeted Performance Expectation(s)

6-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

Background PE (to draw from for CCC of energy)

6-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

[Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

b. Learning Goal(s)

1. Learners will identify evidence from video of **geoscience processes** that have shaped Mars' Valles Marineris (recognizing geoscience processes in action – DCI-“do learners know what geoscience processes are”)
 - Landslides
 - Side valleys
 - Gullies
 - Earthquake (* Note: this is beyond expectations because requires additional knowledge of Mars)
 - Deposition
2. Learners will use **crosscutting concept of energy** to explain what causes those geoscience processes to happen (both the energy source and related phenomena like gravity, freeze/thaw of water).
3. Learners will combine the video evidence with the energy causality to **generate an explanation** for how Valles Marineris and select details of its features came to be.

NOTE: All materials are those of the project team and do not represent KDE endorsement.

c. Instructional Context

Students have explored various geoscience processes on Earth (gullies from water erosion, landslides from freeze/thaw, etc.) One key idea in this prior instruction is the role of energy in geoscience processes. Includes some models of water erosion in dirt/sand or a stream table, ice freezing to break a full, closed container. Sun's energy highlighted.

Students have previous experiences with how Grand Canyon formed, with emphasis on the weathering effects of water as well as the erosion from the moving water carrying away the material.

NOTE: One key idea students will have explored is the centrality of water (moving, raining, freezing, etc.) for many geoscience processes. The Mars context for this CEA was chosen as a CONTRAST since there is currently no liquid surface water on Mars and hasn't been for many years.

This CEA used in early part of the unit, after introductory segment about “geoscience processes” (maybe 3-4 days). After this unit would be

- Rock cycle
- Plate tectonics
- Energy from interior of Earth

Weather & Climate would be the unit after this unit concludes (breaking apart “weather & climate” from other earth processes since it is complex)

d. Student Task/Prompt – see end of document for exact copy of handouts distributed to students

- **See Student Task Sheets at end.**

Scenario/Phenomenon:

4-minute narrated video flight over and through Mars' Valles Marineris (titled “Valles Marineris”)

<https://www.youtube.com/watch?v=crsqzZNUXsY>

Published Aug. 2007 by Jet Propulsion Lab (JPL)

NOTE: All materials are those of the project team and do not represent KDE endorsement.

Watch video in 2 rounds:

- A. Round 1 = watch uninterrupted. Student Task is to create an ordered list of geoscience processes that they see/hear evidence for in the video. See **Part A** of task sheet at end.
- B. Round 2 = pause at each identified geoscience process (student or teacher says “pause”). At each pause, students add to their **Part A** list if needed (use purple pen) and then fill in a 3-column-chart in a teacher-supported manner (see **Part B** of attached task sheet). In column 2 of **Part B**, students write their ideas about energy/phenomena about the geoscience process on Mars, “*What source(s) of energy are involved in ___ (this geoscience process)*”, and teacher facilitates a whole-class discussion while learners “purple-pen” their response to complete the Mars column.

PURPLE PEN NOTE: Students write their initial ideas with black/blue pen or pencil. Then during teacher-facilitated whole-class discussion, the ‘purple pens’ are used for them to add anything else they omitted the first time. This formative assessment process (called “purple penning” in this CEA) is a way for the teacher to quickly identify students’ initial ideas vs. those augmented by discussion, while simultaneously permitting students to immediately and actively add to their knowledge and thinking.

Students individually fill out the final column about energy/phenomena for Earth-based cause of the geoscience process (**Part B** of student task sheet). At this point teacher collects the student sheets to review the “on Earth” column responses.

- C. After returning student task sheets the next day, review/correct the final column of Part B as needed – students again “purple pen” their responses to add to initial thinking. Then students individually complete the final narrative prompt in **Part C** asking for explanation of Valles Marineris. Prompt,

“Construct an explanation describing how the Sun’s energy causes a geoscience process (you pick one to write about) to change the surface of Earth, using at least one example from Mars to make a comparison In your comparison, be sure to describe the specific change and the energy source causing it. “

NOTE: All materials are those of the project team and do not represent KDE endorsement.

e. Success Criteria

QUALITY INTERPRETATIONS

Part A

DCI focus: At least 3 sources of evidence of geoscience processes. If they get 4, that would be above expectations. The 5th one (the first one on the list about 'earthquake forces' forming the Valles Marineris) would be unknown to learners.

Part B

CCC (energy): Causal explanations (landslides, gullies) include BOTH weathering (water, wind on Earth due to energy from Sun heating air masses and evaporating water; could include freeze/thaw cycle) AND erosion (gravity causing landslide material to move downhill, or gravity causing water to flow downhill carrying with it mass from the weathering process)

CCC (energy): Deposition (sedimentation) on Earth includes both wind and water (larger pieces of sediment than on Mars). Energy is from the Sun.

ABOVE EXPECTATIONS

CCC (energy): Causal explanation for earthquakes includes (in the Earth) magma and plate tectonics. Interior energy due to (energy of collisions during formation of Earth + bonus: radioactivity)

Part C

Response includes: (a) one geoscience process identified; (b) Appropriately connect that geoscience process to Sun's energy, including intermediary of water (evaporation or freeze/thaw cycle) when appropriate; (c) directly or indirectly (by writing about other non-water causes) reference difference on Mars as lack of surface water as intermediary agent

QUALITY SPECTRUM OF RESPONSES in part C

Minimum expectation – geoscience process identified

Proficient expectation – able to connect geoscience process to Sun's energy and water (if appropriate)

Above expectations – able to use lack of water on Mars as comparative difference, which indirectly emphasizes importance of water on Earth.

NOTE: All materials are those of the project team and do not represent KDE endorsement.

EXEMPLARY STUDENT RESPONSE

EXAMPLE 1

Landsides happen on both Earth and Mars. On Earth, the Sun's energy can cause landslides by evaporating water, which then rains down and erodes rock and eventually the rock falls down due to gravity, which is a landslide. On Mars, there is no water to evaporate, but the Sun's energy can heat rock and expand it, which makes the rock weaken and eventually break off pieces from other rock. These broken pieces will fall due to Mars' gravity, causing a Martian landslide.

EXAMPLE 2

Gullies and canyons...

EXAMPLE 3

Wind dunes... (deposition)

Note: If a student struggles with Part C response, look at their responses in parts B and A to diagnose (purple pen) where they seem to be getting stuck.

f. Next Instructional Steps

NOTE: Hypothetical examples of what this might look like.

For task Part A DCI success criterion, put into groups of:

- (a) 3 or more geoscience processes identified
- (b) Fewer than 3

Follow-up possibilities....

- For "fewer than 3" group, offer additional geosciences phenomena (video, pictures, out on playground) and have them identify and characterize them.
- For "3 or more" group, look at their responses to parts B & C

NOTE: All materials are those of the project team and do not represent KDE endorsement.

For task Part B CCC Energy (landslides/gullies) and (deposition)

Document pattern of percentage of class with indicated elements in Part B (on Earth) in a table similar to below:

Identify weathering and erosion descriptively	Reference energy of Sun with water (evaporation or freeze/thaw)	Reference energy of Sun with wind (air mass moving)	If they got energy/water in Part B right, check if they also had strong response in C about energy
?%	?%	?%	?%

NOTE: If in instructional context the “water and weather” unit has not yet been taught, then a low understanding of relationship between wind and energy of Sun is OK – still to be taught.

The key idea that learners should know at this point in the instructional sequence is energy connected with water. If many students struggled with this, this means we need to reteach and re-engage with this concept in a variety of geoscience phenomena before moving on. Next instruction will explicitly and exclusively focus on energy for variety of geoscience phenomena. Example: video of backyard rainstorm and small gully forming. Students guided to go beyond description to “source of energy” – from moving water to why it moves (gravity) to how it got uphill (via evaporation) to energy from Sun which caused the evaporation.

IF descriptive weathering and erosion appears to be well-understood, then that is a solid foundation to build on for guiding students to think about the causative energy agents that cause weathering and erosion to happen.

g. Student Work Samples

None.

h. Reflection and Revision

None.

NOTE: Student handout pages begin on next page

NOTE: All materials are those
 of the project team and do not
 represent KDE endorsement.

Flying over Valles Marineris on Mars

Name _____

Focus Question: *How are geoscience processes on Mars the same and different from Earth?*

Part A. – Make a numbered list of geoscience processes you see or hear evidence for while watching the video flight over Valles Marineris on Mars.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Part B. – What source(s) of energy are involved in each geoscience process mentioned?

Geoscience Process (from Part A list)	<u>Energy Source – on Mars</u> (we do together with purple pens after you write your initial ideas)	<u>Energy Source – on Earth</u> (you do individually)

NOTE: All materials are those
of the project team and do not
represent KDE endorsement.

Part C.

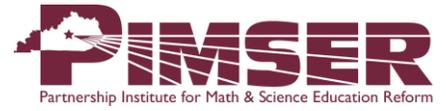
Construct an explanation describing how energy causes a geoscience process to change the surface of Earth, using at least one example from Mars to make a comparison

In your comparison, be sure to describe the specific change and the energy source causing it.

Project ASSESS (2016-18) –
sponsored by KY Dept. of
Education (KDE) MSP Program

NOTE: All materials are those
of the project team and do not
represent KDE endorsement.

UNIVERSITY OF
LOUISVILLE
CENTER FOR RESEARCH IN
MATHEMATICS & SCIENCE
TEACHER DEVELOPMENT



[page 2]