

National Aeronautics and Space Administration



# red rocks

Informal Lesson





# Red Rocks

Grades: 9-12

Prep Time: ~10 min

Lesson Time: ~50 minutes



## WHAT LEARNERS DO: Explore red rocks of Earth to explain why Mars is red.

Learners will explore Karijini Gorge in Australia and Oak Creek Canyon in Sedona, AZ searching for clues to the environments that formed the red rocks there. They will observe these rock formations at a variety of scales to gather these clues. Finally, they will apply their understanding of red rock formation to answer the question “Why is Mars red?”

### NRC FRAMEWORK/NGSS CORE & COMPONENT QUESTIONS

#### HOW AND WHY IS EARTH CONSTANTLY CHANGING?

NGSS Core Question: ESS2: Earth Systems

#### How do Earth’s major systems interact?

NGSS ESS2.A: Earth Materials and Systems

### INSTRUCTIONAL OBJECTIVES (IO)

*Learners will be able to*

**IO1: Interpret evidence in the rocks of Mars at a variety of scales to explain the presence of iron oxide and what it tells us about water in the ancient/present Martian environment.**

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*Last edited: April 25, 2018*



## 1.0 Materials

### Required Materials:

#### Please supply:

- Computer or Laptop – 1 per learner
- Supported Browsers: Chrome; Edge; Firefox; Safari

### Optional Materials:

#### From Teacher Guide

- (A) Reading Rock Evidence Worksheet
- (B) Red Rocks Evaluation Worksheet
- (C) Reading Rock Evidence Worksheet (KEY)
- (D) Red Rocks Evaluation Worksheet (KEY)

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## 2.0 Lesson Timeline

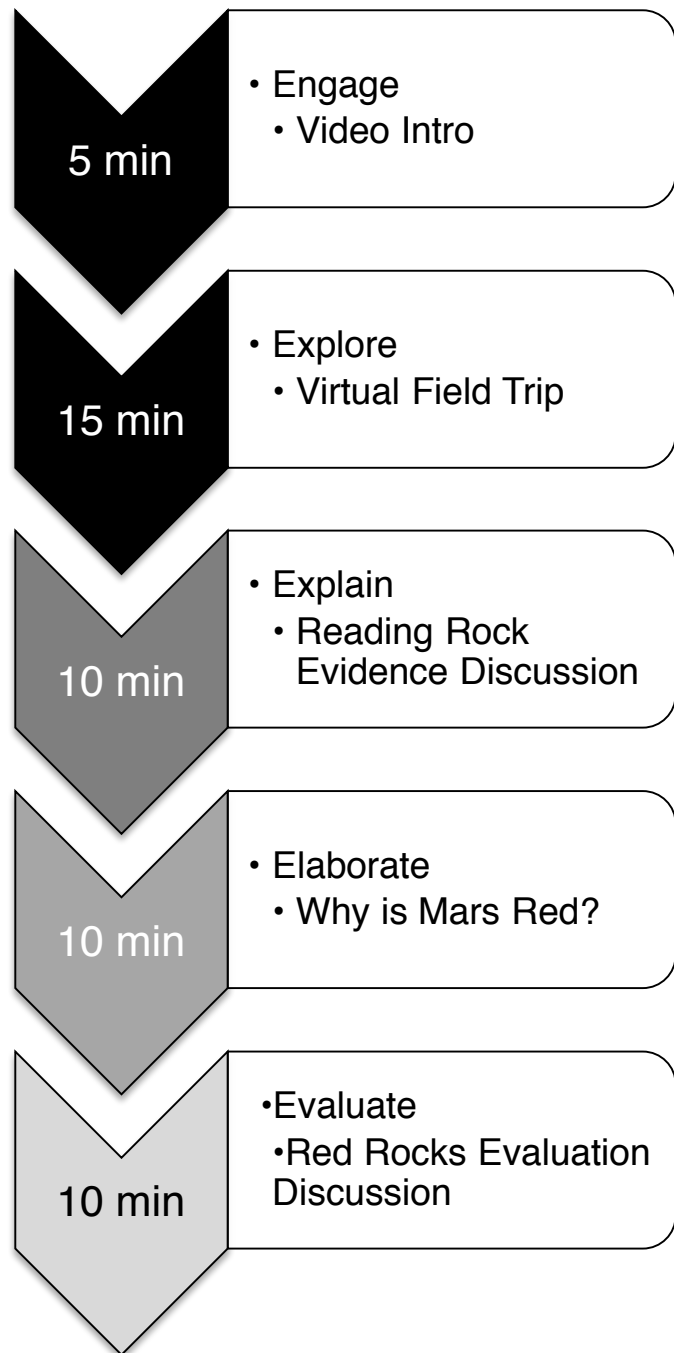
### Red Rocks Lesson Timeline:

Time:

- 50 minutes

5-E Inquiry Process:

- The arrow color represents the 5-E step learners will be primarily engaging in for that class session



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### 3.0 Vocabulary

<b>analyze</b>	consider data and results to look for patterns and to compare possible solutions
<b>cementation</b>	the process of hardening sediment through the precipitation of minerals between the pore spaces
<b>compaction</b>	the process of compressing sediment and reducing the amount of space (pore space) between the grains
<b>composition</b>	the chemical makeup of an object
<b>compound</b>	a substance formed by chemically combining two or more elements
<b>cross-bedding</b>	layers of sedimentary rock that are deposited at an angle compared to the surrounding horizontal layers
<b>data</b>	facts, statistics, or information
<b>empirical evidence</b>	knowledge gained through direct or indirect observation
<b>explanations</b>	logical descriptions applying scientific information
<b>grains</b>	small, hard particles or crystals resulting from weathering
<b>hand sample</b>	a rock sample that is typically the size of a hand, collected for further examination
<b>igneous rock</b>	rock that is formed through the cooling and solidification of magma or lava
<b>macroscopic</b>	large-scale and visible to the naked eye
<b>mesoscopic</b>	small or medium-scale; visible to the naked eye or using a low magnification hand lens
<b>microscopic</b>	extremely small scale that can only be seen with a microscope because they are so small
<b>mission</b>	a spacecraft designed to explore space, seeking to answer scientific questions
<b>observations</b>	specific details recorded to describe an object or phenomenon
<b>predict</b>	to declare what will happen based on reason and knowledge
<b>scale</b>	a comparative relation between objects such as size or distance
<b>sedimentary rock</b>	rock formed from the cementation of material deposited in oceans or on Earth's surface
<b>thin section</b>	a rock sliced so thin it allows light to pass through

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## 4.0 Procedure

### PRIOR KNOWLEDGE & SKILLS

- A. Periodic Table
- B. Chemical Bonds
- C. Compound Naming Conventions
- D. Rock Types and their Formation
- E. Observing Skills
- F. Claim, Evidence, Reasoning Cycle

### PREPARATION

- A. Visit <https://infiniscope.org/lesson/red-rocks/> for access to the digital learning experience, standards alignment documents, and additional resources.
- B. Reserve computers or tablets for Exploration Days

### STEP 1: ENGAGE (~5 minutes)

#### Set Up the “Why is Mars red?” Question

- A. Hand out or assign computers and ask students to access the Why is Mars Red? digital learning experience at <https://infiniscope.org/> and choose “**Explore**” to launch the experience.
- B. Learners will access a video introduction in the beginning of the Red Rocks VFT, setting the stage to answer the question “Why is Mars red?” and explaining why we explore Earth to understand other planets and moons.

### STEP 2: EXPLORE (~ 15 minutes)

#### Red Rocks Virtual Field Trip

- A. Allow learners to follow the Red Rocks VFT.
- 🍏 **Management Tip:** In preparation for the next group, ask learners to click the restart button located in the top toolbar under the three horizontal lines. This will ensure your next group starts at the beginning of the VFT.
- 🍏 **Educator Tip:** If students seem to be stuck in the activity, it isn’t responding in a way that seems correct, or if an error occurs, students can attempt to refresh their browser or click the “Restart” button located in the upper right corner of the screen. “Restart” will clear all of their progress and bring them back to the start screen. Hitting the browser’s “Refresh” button will not restart the activity.
- 🍏 **Educator Tip:** If you would like to analyze learner interactions in this activity, you can sign up to join the **Infiniscope Teaching Network** (<https://infiniscope.org/join/>) and

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enroll your group into the activity. By enrolling, you will gain access to the analytics of the activity by learner to see how learners progressed through the activity. You also have the ability to adopt the activity and adapt it to the specific needs of your community.

### **STEP 3: EXPLAIN** (~ 10 minutes)

#### **Reading Rock Evidence**

- A. At the conclusion of the VFT, take a few minutes to review the questions on **(A) Reading Rock Evidence Worksheet** and discuss what was found on Mars. Learners should understand that Mars does not have red sedimentary rock, but instead has sedimentary rocks with a thin layer of red dust covering the planet.
- B. Many of these questions were addressed within the Virtual Field Trip. They should be a review of concepts for the learners.

### **STEP 4: ELABORATE** (~ 10 minutes)

#### **Why is Mars Red?**

- A. After exploring Karijini Gorge and Oak Creek Canyon VFT's, learners will apply their understanding of sedimentary rocks and oxidation to the surface of Mars.

### **STEP 5: EVALUATE** (~ 15 minutes)

#### **Evaluate Evidence for Red Rock on Mars and Importance of Observational Scales**

- A. Discuss the questions found on **(B) Red Rocks Evaluation**.

## **5.0 Extensions**

1. Investigate iron ore production across the globe, the process used to separate iron and oxygen, and propose a way to use the iron oxide of Mars as a raw material for human exploration of the planet.

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**(A) Reading Rock Evidence Worksheet**

Name: \_\_\_\_\_

**Instructions:****Explain the following concepts based on what you've discovered in the Red Rocks VFT.**

1. Describe the characteristics used to identify sedimentary rocks.

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2. What can be seen at each scale?

	<b>Karijini Gorge</b>	<b>Oak Creek Canyon</b>
<b>Macroscale Observations</b>		
<b>Mesoscale Observations</b>		
<b>Microscale Observations</b>		

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**(B) Red Rocks Evaluation Worksheet**

**Name:** \_\_\_\_\_

**Answer the following questions based on the Red Rocks Virtual Field Trip.**

- 1. Explain the importance of observing at a variety of scales, microscale – macroscale.

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- 2. Why is Mars red? What evidence can you use to support your claim?

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- 3. Which iron oxide environment is similar to the environment of Mars, Karijini Gorge, Western Australia or Oak Creek Canyon, Sedona? What evidence (micro – macro) can you point to that supports your claim? Include an introduction, scientific language to clarify your claim, use formal style, and provide a concluding sentence. (Use separate paper if necessary).

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**(C) Reading Rock Evidence Worksheet (KEY)****Instructions:**

Explain the following concepts based on what you've discovered in the Red Rocks VFT.

1. Describe the characteristics used to identify sedimentary rocks.

Layering, cross-bedding, sediment, grain size, oxidation.

2. What can be seen at each scale?

	Karijini Gorge	Oak Creek Canyon
<b>Macroscale Observations</b>	<u>shows large scale layering (bedding), different colors and thicknesses of layers</u>	<u>shows large scale layering (bedding) such as cross-bedding, different colors and thicknesses of layers</u>
<b>Mesoscale Observations</b>	<u>shows fine layering, fine colored layers and thicknesses</u>	<u>shows grain size, fine layering, fine colored layers and thicknesses</u>
<b>Microscale Observations</b>	<u>shows layers and can identify the chemical composition of the individual components</u>	<u>shows individual grains and can identify the chemical composition of the individual components</u>

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**(D) Red Rocks Evaluation Worksheet (KEY)**

Answer the following questions based on the Red Rocks Virtual Field Trip.

1. Explain the importance of observing at a variety of scales, microscale – macroscale.

*Observing at a variety of scales gives additional data you cannot observe at the other scales. It provides a greater opportunity to interpret the past environment using all data that is available in the rock record.*

2. Why is Mars red? What evidence can you use to support your claim? *Oxidation of iron at the surface. Not embedded in rock, it is loose dust exposed to water and oxygen at the surface only.*

3. Which iron oxide environment is similar to the environment of Mars, Karijini Gorge, Western Australia or Oak Creek Canyon, Sedona? What evidence (micro – macro) can you point to that supports your claim? Include an introduction, scientific language to clarify your claim, use formal style, and provide a concluding sentence. (Use separate paper if necessary)

*Neither – the sedimentary rock of Mars is not oxidized, the dust is; therefore it's environment was different from both Karijini and Oak Creek Canyon. It did not have an iron-rich ocean that reacted with oxygen, nor groundwater flowing through the oxidized sedimentary rock.*

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