

Rocking the Rock Cycle (Part 1 of 3): **[Based on eHow's *Rock Cycle Game*]**

What is it?

Rocks and minerals help scientists decipher things about past periods on our Earth and other planets. The rock cycle helps us understand what conditions helped formed those rocks, which can tell us a lot about the history of a region. The Mars Rover Curiosity uses rocks to try to figure out whether or not Mars had “the right stuff” to support life. It looks for different rocks and minerals that were formed under specific conditions; conditions we know supported life here on Earth.

In this first activity, students will participate in a game to learn about the different processes that create rocks.

This activity discusses topics related to National Science Education Standards:

4-ESS1-1: *Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process*

- This activity encourages students to consider the different modes of the rock cycle, and the different types of rock that form on Earth.

Materials (per class):

Equipment, provided by NASA:

- Several sets of dice

Printables:

- Rock Cycle Printout
- Rock Cycle Station: Igneous
- Rock Cycle Station: Metamorphic
- Rock Cycle Station: Sedimentary
- Rock Cycle Station: Magma
- Rock Cycle Station: Sediment

Materials (per student):

Printables:

- Rock Cycle Game Worksheet

Artifact included in this kit:

- Mars Rover Curiosity Mineral Kit which includes:

- *Rock and Mineral Kit*: Rocks and minerals the Mars Rover Curiosity is looking for in Gale Crater.
- *Mars Rocks!* Flash Cards: information about the samples.

Recommended Speakers from Ames:

Please note that our Speakers Bureau program is voluntary and we cannot guarantee the availability of any speaker. To request a speaker, please visit <http://speakers.grc.nasa.gov>.

Margarita Marinova (Planetary Science and Exploration, Mars)

William Clancy (Planetary Science Mission, Mars Analogue Missions, Human Robotics Systems)

Jeffery Hollingsworth (Planetary Atmospheric Dynamic and Circulation of Mars)

Set-Up Recommendations:

- Print out copies of **Rock Cycle Printout**, as many as you feel appropriate for the class to use (we suggest at least 5 are printed out and posted at the different stations)
- Prepare copies of **Rock Cycle Game Worksheet** for students
- Print out at least one copy of **Rock Cycle Station: Igneous**, **Rock Cycle Station: Metamorphic**, **Rock Cycle Station: Sedimentary**, **Rock Cycle Station: Magma**, and **Rock Cycle Station: Sediment**
- Set up three stations around the room with several sets of dice at each. These stations are igneous, metamorphic, and sedimentary. Post the **Rock Cycle Station** posters at each station

Procedure:

1. Introduce the activity to students with a discussion. Different types of rocks behave differently under different conditions. Heat, pressure, erosion, etc. are some of the conditions that can be applied to rocks, and depending on what they are, they will become different types of rocks according to the Rock Cycle. In this activity, students will play games pretending to be rocks themselves. They will start at any one of the three stations, and depending on what they experience (by rolling the dice) they may move to another station.
2. Split the class into teams, or have them work individually. Pass out copies of **Rock Cycle Game Worksheet** and have them answer question 1.
3. Explain that as they play students will write down in the chart on their **Rock Cycle Game Worksheet** what rocks they become. Have students pick a first rock and write it down in the first spot under *Current Rock Type*.



4. Students will now move through the rock cycle. At each station, there should be a copy of the **Rock Cycle Printout** and **Rock Cycle Station**. Students will roll the dice, and according to the **Rock Cycle Station** sheet, they will undergo a change (pressure, heat, hurricane, volcanic eruption) and will move or stay depending on how their type of rock would respond. For example, if one student is an igneous rock, and it undergoes weathering, it will become sediment, and so that student would move to the Sediment station and roll again.
5. After several rounds, have students gather back together and compare what forms they underwent in the Rock Cycle Game!
6. End the class with a discussion. The different transformations they went through can explain how different rocks appear as they are.
7. The Mars Rover Curiosity uses these transformations to try to learn the history of the planet Mars. For example, if a metamorphic rock is discovered in the surface, scientists know it got there because of heat and pressure!

Helpful Resources:

Earth Science Explorer: Rock Cycle:

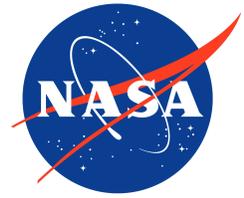
<http://www.cotf.edu/ete/modules/mseese/earthsysflr/rock.html>

Mars Rover Curiosity: Mission:

<http://mars.jpl.nasa.gov/msl/mission/>

Space.com's Mars Rover Curiosity 7 Biggest Discoveries (So Far):

<http://www.space.com/20396-mars-rover-curiosity-big-discoveries.html>



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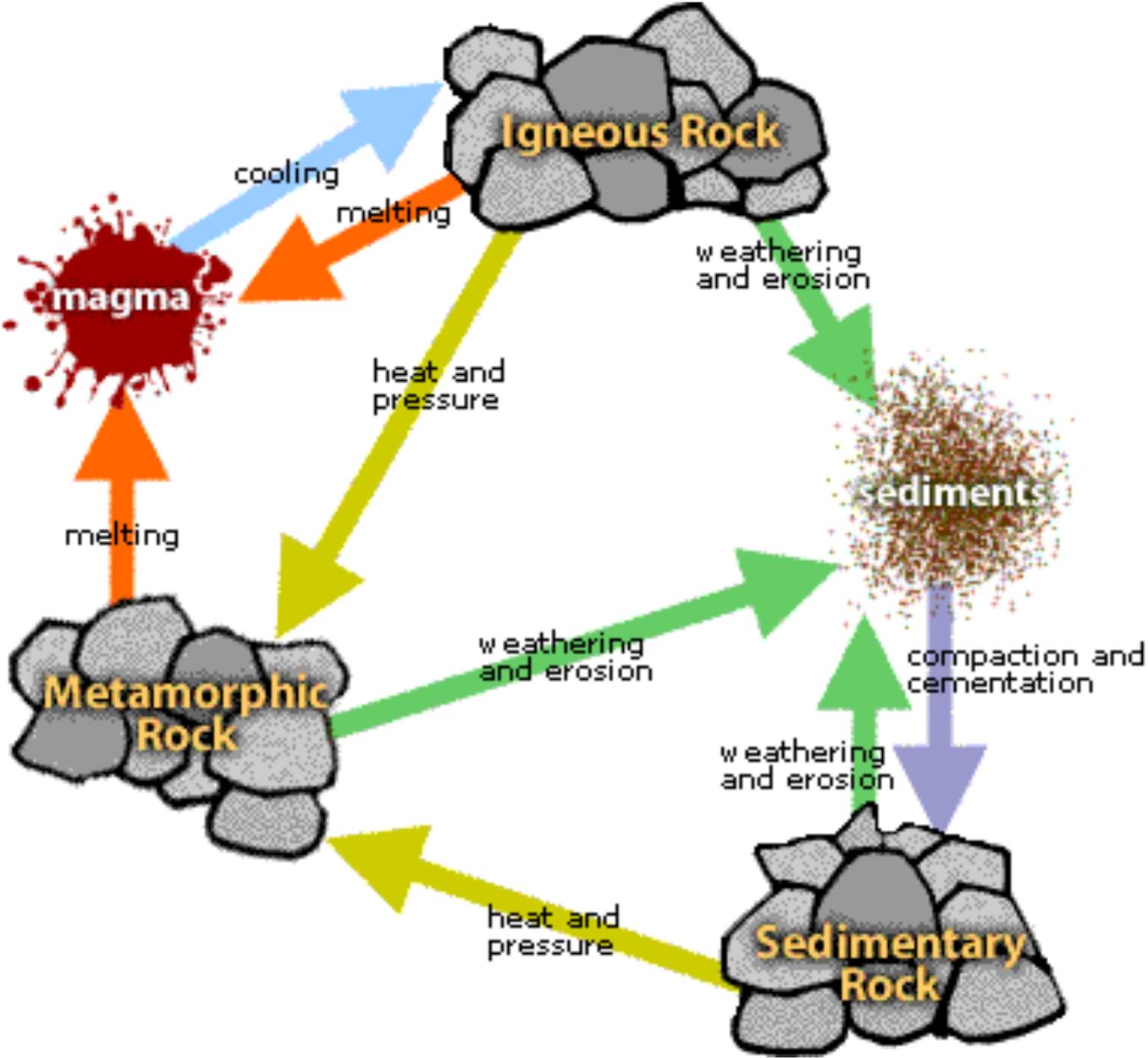
Rock Cycle Game Worksheet

1. What are the three main types of rock?

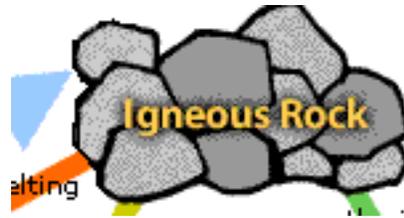
2. Using the chart below, describe how you move through the rock cycle.

Current Rock Type	Number Rolled on Die	Effect on Rock	New Rock Type

The Rock Cycle

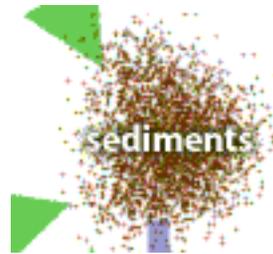


Rock Cycle Station: Igneous



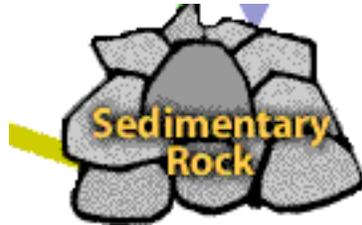
Number on Die	Effect on Rock
1	Hurricane (Weathering)
2	Buried Underground (Heat and Pressure)
3	High Heat (Melting)
4	Ocean Waves (Erosion)
5	Winter (Cooling)
6	Sunny Day (No Change)

Rock Cycle Station: Sediment



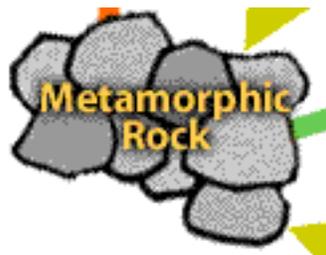
Number on Die	Effect on Rock
1	Wind (Erosion)
2	Buried Underground (Heat and Pressure)
3	Compaction and Cementation
4	Ocean Waves (Erosion)
5	Compaction and Cementation
6	Hurricane (Weathering)

Rock Cycle Station: Sedimentary Rock



Number on Die	Effect on Rock
1	Heat and Pressure
2	Wind (Erosion)
3	Heat and Pressure
4	Hurricane (Weathering)
5	Ocean Waves (Erosion)
6	Heat and Pressure

Rock Cycle Station: Metamorphic Rock



Number on Die	Effect on Rock
1	Ocean Waves (Erosion)
2	High Heat (Melting)
3	Hurricane (Weathering)
4	High Heat (Melting)
5	High Heat (Melting)
6	Wind (Erosion)

Rock Cycle Station: Magma



Number on Die	Effect on Rock
1	Ice (Cooling)
2	Heat and Pressure
3	Ocean (Cooling)
4	Wind (Erosion)
5	High Heat (Melting)
6	Hurricane (Weathering)



Rocking the Rock Cycle (Part 2 of 3):

What is it?

Rocks and minerals help scientists decipher things about past periods on our Earth and other planets. The rock cycle helps us understand what conditions helped formed those rocks, which can tell us a lot about the history of a region. The Mars Rover Curiosity uses rocks to try to figure out whether or not Mars had “the right stuff” to support life. It looks for different rocks and minerals that were formed under specific conditions; conditions we know supported life here on Earth.

In this second activity, students will use crayons to simulate the processes that create the three main types of rock: sedimentary, igneous, and metamorphic.

This activity discusses topics related to National Science Education Standards:

4-ESS1-1: Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process

- This activity encourages students to consider the different modes of the rock cycle, and the different types of rock that form on Earth.

Materials (per class):

Equipment, not provided by NASA:

- Electric Teakettle

Printables:

- Rock Cycle Printout

Materials (per team of 2 students):

Equipment, not provided by NASA:

- Crayon (1 per team)
- Foil (5” by 5” square per team)
- Plastic Knife
- Water cup (1 per team)

Printables:

- Color the Rock Cycle Worksheet

Artifact included in this kit:

- Mars Rover Curiosity Mineral Kit which includes:
 - o *Rock and Mineral Kit*: Rocks and minerals the Mars Rover Curiosity is looking for in Gale Crater.

- *Mars Rocks!* Flash Cards: information about the samples.

Recommended Speakers from Ames:

Please note that our Speakers Bureau program is voluntary and we cannot guarantee the availability of any speaker. To request a speaker, please visit <http://speakers.grc.nasa.gov>.

Margarita Marinova (Planetary Science and Exploration, Mars)

William Clancy (Planetary Science Mission, Mars Analogue Missions, Human Robotics Systems)

Jeffery Hollingsworth (Planetary Atmospheric Dynamic and Circulation of Mars)

Set-Up Recommendations:

- Print out copies of **Rock Cycle Printout**, as many as you feel appropriate for the class to use
- Prepare copies of **Color the Rock Cycle Worksheet** for students
- Set out supplies for each team of students
- Fill and plug in the electric teakettle at the front of the room

Procedure:

1. Introduce the activity to students with a discussion. Using the **Rock Cycle Printout**, start discussion with the students about the different types of rock. Where would you find sediment? What about magma?
2. Pass out copies **Color the Rock Cycle Worksheet** and have students answer question 1.
3. Split the class into teams, or have them work individually. Explain the activity they will be doing. They will be using this very special type of rock (crayon rock) to see different processes rocks go through in the rock cycle.
4. Have students unwrap their crayon. What type of rock is this most like? Is it uniform and smooth? Grainy? Different colors? After some discussion, have students write down what kind of rock they think it is in the first section of question 2 on their **Color the Rock Cycle Worksheet**.
5. Have students use their knife to “erode” their crayon rock. They should scrape a pile of crayon shavings from the crayon onto their paper plate. *Optional: students are welcome to share shaving with other students.* Explain what is happening: when rocks are exposed to different weather, wind, waves, etc. they

can erode into sediment. Have students fill out the next section on their **Color the Rock Cycle Worksheet**.

6. Have students put all of their crayon sediment onto the center of the foil square. Have them fold over the foil and press down firmly with the palm of their hand. Now the rocks are experiencing lithification – compacting and cementing sediments together. Have them open the packet. What does it look like now? Explain that they have now created sedimentary rock. Have them fill out the next section on their **Color the Rock Cycle Worksheet**.
7. Now fold the foil into a boat shape (with the sedimentary rock inside). While they are doing this, go around and fill one of their cups with hot water from the teakettle.
8. When they have their cup of hot water, have students float their boat on the water and observe their sedimentary rocks. Remove the boat when the colors have swirled together, but not completely blended. What kind of rock do they have now? Metamorphic rock! Their crayon rock has undergone metamorphism, or heat and pressure, to get to where it is now. Have them fill out the next section on their **Color the Rock Cycle Worksheet**.
9. If their water has cooled, pour more hot water into their cups and float their metamorphic rocks until they have completely blended. What has happened now? The rock has melted into magma. Have students fill out the next section on their **Color the Rock Cycle Worksheet**.
10. Now, have students remove their rocks from the water and let them cool. When magma cools, what does it create? Igneous rock! Students have now returned the rock to the type that it started in. Have them fill out the last section of their **Color the Rock Cycle Worksheet**.

Helpful Resources:

Earth Science Explorer: Rock Cycle:

<http://www.cotf.edu/ete/modules/mse/earthsysflr/rock.html>

Mars Rover Curiosity: Mission:

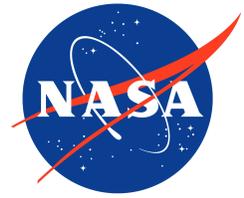
<http://mars.jpl.nasa.gov/msl/mission/>

Space.com's Mars Rover Curiosity 7 Biggest Discoveries (So Far):

<http://www.space.com/20396-mars-rover-curiosity-big-discoveries.html>

Safety:

- Please be sure the students are careful with the hot water in their cups
- Please be sure that students use caution when scraping their rocks as sometimes the crayons can break



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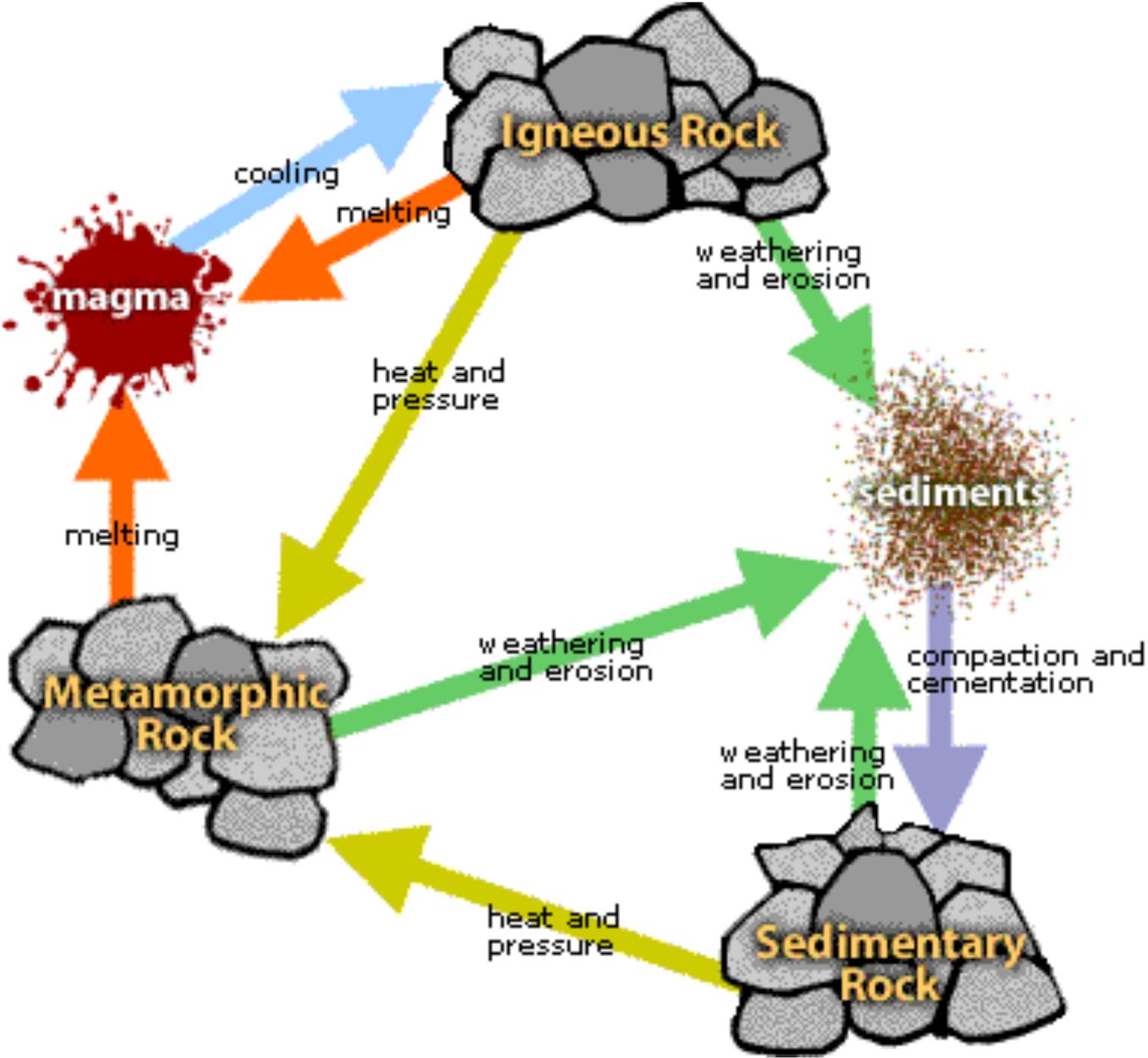
Color the Rock Cycle Worksheet

1. What are the five main types of rock?

2. Using the chart below, describe your crayon rock through the Rock Cycle.

Rock Type	Description of Rock

The Rock Cycle





Rocking the Rock Cycle (Part 3 of 3):

[Based on Bright Hub Education's *Hold a Rock Election!*]

What is it?

Rocks and minerals help scientists decipher things about past periods on our Earth and other planets. The rock cycle helps us understand what conditions helped formed those rocks, which can tell us a lot about the history of a region. The Mars Rover Curiosity uses rocks to try to figure out whether or not Mars had “the right stuff” to support life. It looks for different rocks and minerals that were formed under specific conditions; conditions we know supported life here on Earth.

In this last activity, students will create an election poster for a rock of their choice.

This activity discusses topics related to National Science Education Standards:

4-ESS1-1: *Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process*

- This activity encourages students to consider the different modes of the rock cycle, and the different types of rock that form on Earth.

Materials (per student or team):

Equipment, provided by NASA:

- Mars Rover Curiosity Mineral Kit (with Flashcards)

Equipment, not provided by NASA:

- Paper (large poster board, or small sheets)
- Coloring Pens
- Markers
- Research Materials: computer with internet access, books about rocks, etc.

Printables:

- Mars Rover Curiosity: Goals

Artifact included in this kit:

- Mars Rover Curiosity Mineral Kit which includes:
 - o *Rock and Mineral Kit*: Rocks and minerals the Mars Rover Curiosity is looking for in Gale Crater.
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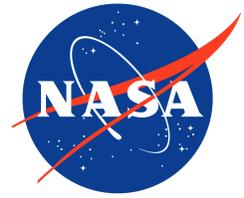
Set-Up Recommendations:

- Print out copies of **Mars Rover Curiosity: Goals**, as many as you feel appropriate for the class to use
- Connect the computers to different informational sites about rocks (some are listed in the **Helpful Resources** section)
- Set up the Mars Rover Curiosity rock samples at the front of the room
- Set out art supplies for students to use

Procedure:

1. Introduce the activity to students with a discussion. Now that we know how different rocks and minerals function in the world. We know that the Mars Rover Curiosity is looking for specific rocks and minerals to try to read the history of our red neighbor. Our class has been asked to vote on which rocks the Mars Rover Curiosity should look for! In class, we will design campaign posters to try to help decide which rocks would be best to search for.
2. Split the class into teams, or have them work individually. Pass out copies of **Mars Rover Curiosity: Goals** and let them have a chance to look at the different goals of the mission.
3. Have students (individually or in teams) come up to the front of the room and examine the different samples you have available. As they examine the rocks, write down on the board some observations they have of each rock. The mineral kit comes with flashcards about each rock and why Curiosity is looking for it. Allow students time to look at these flashcards as well.
4. After examining, ask students to pick the rock they wish to campaign for, and ask them to start researching. Their poster will need to have 4 facts about their chosen rock and two images of that rock (in a building, in nature, etc. You can choose how the students should represent the rock).
5. Allow students time to research their rock and create their poster. When they have finished, gather all of the posters at the front of the room.
6. Tell each student (or team) that they will now have to campaign for their rock. Give students a few minutes to come up with a speech and go around the room allowing students to talk about their rock.
7. After all of the speeches, have a vote! Which rock won? Why did it win?

National Aeronautics and Space Administration



Helpful Resources:

Earth Science Explorer: Rock Cycle:

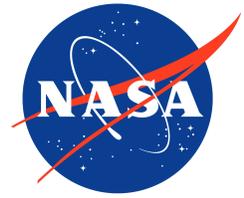
<http://www.cotf.edu/ete/modules/mseese/earthsysflr/rock.html>

Mars Rover Curiosity: Mission:

<http://mars.jpl.nasa.gov/msl/mission/>

Space.com's Mars Rover Curiosity 7 Biggest Discoveries (So Far):

<http://www.space.com/20396-mars-rover-curiosity-big-discoveries.html>



Mars Rover Curiosity: Mission Goals

Goal 1: Determine whether life ever arose on Mars

The Mars Rover Curiosity will try to determine whether or not life could have ever arisen on Mars by looking for environmental conditions that scientists know support life. We know from the two Mars Exploration Rovers (Spirit and Opportunity) that there was likely liquid water on Mars, and so Curiosity will be looking for other elements that also support life. On Earth, we know that six elements are necessary to all life: carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur. Curiosity will be looking for these elements on Mars.

Goal 2: Characterize the climate of Mars

The Mars Rover Curiosity will try to explore the history of Mars's atmosphere by looking for changes in elements in the planet's surface. A warmer, wetter, and thicker atmosphere may have provided a much more habitable surface on the planet. The rover will study the stable isotopes (isotopes are atoms of the same element that have different masses because they have a different number of neutrons in the nucleus) of carbon to try to study the history of Mars's atmosphere.

Goal 3: Characterize the geology of Mars

A record of the geological history of Mars is folded into the layers of rock found on the surface. The rover will study the rock and soil beneath the surface in order to understand the geologic processes that created and modified the Martian crust. In particular, it will look for evidence of rocks that formed in the presence of water.