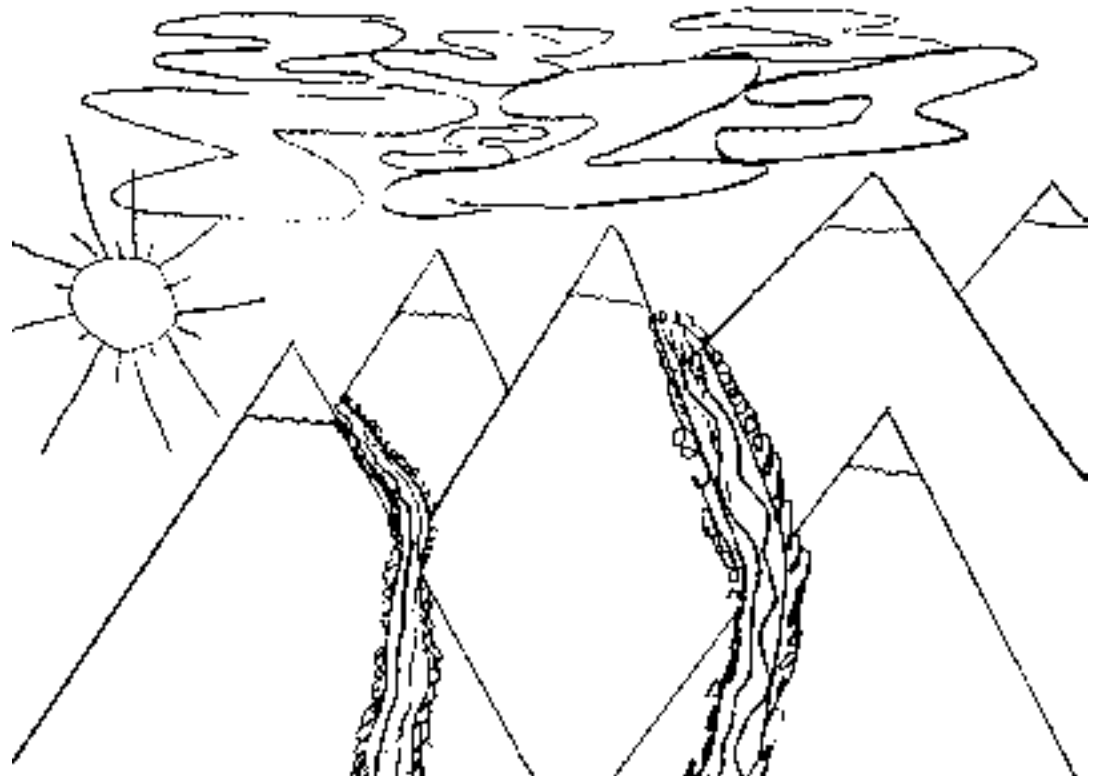




# Unit 2: Mountains and Mountain Building *Backbone of the World*



Mountains and Erosion  
Student Artwork by  
Chris Daley

## Mountains and Mountain Building Teacher Background Information

*Included below is the text from the St. Mary Visitor Center Exhibits in Glacier National Park. The exhibits were created in collaboration with the four tribes to tell visitors to the park what the mountains mean to them.*

*All mountains are sacred to the Blackfeet, Kootenai, Salish, and Pend d'Oreille Tribes. The mountains are part of who we are and who we will be.*

*The Blackfeet, Kootenai, Salish, and Pend d'Oreille have spiritually and culturally important sites among the mountains. Sometimes we leave special objects in the mountains and at times trails may be closed. Please respect our cultures - leave items in the mountains and obey signs.*



### At Home In This Place DVD Content

Play Videos:  
[Blackfeet - It's Like Being Home](#)

#### Blackfeet

- Mountains are significant to us because they provide knowledge.
- Mountains have a future value to us; we don't know what will be revealed in the future.
- All mountains have animal, bird, and water spirits. Roots, herbs, and plants have healing medicine and provide spiritual passage for vision quests.
- "Backbone of the World" is the Blackfeet name for the Rocky Mountains in Glacier National Park. The sacred water flows three directions at Triple Divide Mountain.
- Ninastako (Chief Mountain) in Blackfeet, means "the mountain that stands apart."



### At Home In This Place DVD Content

Play Audio:  
[Kootenai- The Place Where They Danced](#)

[-We Ask That You Walk Lightly](#)

#### Kootenai

Glacier is significant to the people because so many of our physical and spiritual needs can be attained today in a relatively compact area between the high peaks and lower lakes and streams, as it always was for our ancestors. Medicinal plants and spiritual guidance can be attained here.



### At Home In This Place DVD Content

Play Videos:  
[Salish & Pend d'Oreille- I Can Almost Hear our Ancestors](#)

#### Salish and Pend d'Oreille

The west side of Glacier National Park is part of the traditional homeland of the Pend d'Oreille people, and to the east, along the Rocky Mountain Front south of Glacier, lived the Tuñáxn. The Salishan tribes call the entire Rocky Mountains Sntx<sup>w</sup>eyčń - the Backbone. The highest peaks, the ones that are only rock, are called X<sup>w</sup>čx<sup>w</sup>čut. The elders say these places should be respected and kept pristine for all generations to come.



## Unit 2- Mountains and Mountain Building Lesson 1

### *Oral Histories and Glacier National Park*

#### **Materials:**

- *At Home In This Place* DVD
- [Student Reading, Unit 2](#)
- Paper
- Pencil
- Colored pencils



Triple Divide Pass and Peak, Clay Parcels photo (Glacier NP Digital Image Library).

#### **Lesson At A Glance**

Students read and compare/contrast the cultural stories about creation of land formations with “A Geological Story of Glacier National Park.” The teacher will lead a discussion about story telling, oral history, and different explanations for the same phenomena.

#### **Objectives**

Students will be able to:

- Explain the importance of oral history and cultural stories.
- Compare and contrast it to a story their family tells over and over again.
- Use language arts and artistic skills to produce their own stories of environmental phenomena in their community.
- Speculate creatively and scientifically about natural phenomena in their lives.
- Consider compatibilities between Western science and Native knowledge.
- Realize there are multiple perspectives for the same landscapes.

#### **Time Required**

50 minutes (may need additional time to write their own stories).

#### **Vocabulary**

Environment, mountain, oral history, phenomena.

## Teacher Preparation/ Background

Review the definitions for oral history and origin story.

- An oral history is a historical account recorded in the memories, legends, stories, songs, art, and languages of people who did not create written histories. Oral histories are passed from one generation to the next and are as valid as written histories. Indigenous languages are the key to the survival of oral histories, as they can seldom be translated accurately into other languages.
- Origin story – An origin story is a people’s account of their own creation and beginning. Origin stories are part of tribes’ oral histories. They do not always concur (agree) with archaeological or academic theories about the origins of humankind, or human migrations. However, this does not mean that such stories are not true or do not have value and importance.

Percy Bullchild in *The Sun Came Down: The History of the World as My Blackfeet Elders Told It*, writes,

All of this story is true, because we Natives preserved our history in our minds and handed it down from generation to generation, from time unknown, orally. From the time human life began. It isn’t any different from the stories our white friends tell about such as King Arthur of the Round Table and Joan of Arc, there are many other stories of the white legends that are written too. Some of these stories may sound a little foolish, but they are very true. And they have much influence over all of the people of this world, even now as we all live. (3)

This activity is designed to get students thinking about story telling and the importance of oral histories and origin stories. It should also get them to speculate creatively and scientifically about natural phenomena in their environment. It is best to have students choose phenomena that they have often wondered about. This is a warm-up writing activity and topics need not be limited to mountain building.

## Procedures



**At Home In This Place**  
DVD Content

Play Videos:  
[Blackfeet - It's Like Being Home](#)



**At Home In This Place**  
DVD Content

Play Audio:  
[Kootenai- The Place Where They Danced](#)

[-We Ask That You Walk Lightly](#)



**At Home In This Place**  
DVD Content

Play Videos:  
[Salish & Pend d'Oreille- I Can Almost Hear our Ancestors](#)

1. Share the information each tribe contributed to the St. Mary Visitor Center Exhibit: [Wisdom in Spoken Words](#), as well as the unit introduction about the importance of the Rocky Mountains to the four tribes and to their oral history creation stories. Show the videos from each tribe: “It’s Like Being Home,” “The Place Where They Dance,” and “I Can Almost Hear our Ancestors.” Discuss the connection each video relates about the stories and the area that is now Glacier National Park.
2. Have the students do the [Student Reading for Unit 2](#) (use whatever works best - homework, silent reading, group reading, or teacher reading out loud). The Glenbow Museum, Canada, as part of their Niitsitapiisini- Our Way of Life, virtual exhibit has a [video link for Okotoks, Alberta](#) where one of the largest rock fragments associated with the Napi story is located.
3. Use the questions and vocabulary at the end of the reading for discussion. Then have students speculate creatively and scientifically about natural phenomena in their lives.
4. Have them use language arts and artistic skills to produce their own stories about environmental phenomena in their community. Have them illustrate their story with colored pencils.

**Reflection/Assessment** Editing partners should practice reading their stories to each other, make constructive suggestions for revision, and rewrite a final draft.

Those students who feel secure enough should tell their stories without the paper. Others could read their story to the class or have the teacher read the story for them. How did it feel to share their story- easy, hard, scary?

**Writing and Art Extension**

All stories and illustrations could be collected and bound into a book by one or two of the students who would like to create a cover and table of contents. What might the cover of that book look like? Would students like to design a cover for one of the stories?

**Action Project/ Field Trip Extension**

- [Ranger-Led Field Trips and Service Learning Projects](#) in Glacier National Park. Earth Science and Forest Processes field trips about park geology.
- [Self-Guided Field Trips](#) as well as [Fd Tours](#) - various concession operated - in Glacier National Park.
- [Glacier Institute](#) - geology and other education programs.
- Flathead CORE - [outdoor education guide for field trips in the Flathead](#).

**Additional Resources**

- [Before There Were Parks: Yellowstone & Glacier Through Native Eyes-](#) MT PBS video, 30 minutes.
- Listen to the Blackfeet, Salish , Pend d'Oreille and Kootenai stories on the "Audio" portion of the "At Home in This Place" DVD.
- [Land of Many Stories; The People and Histories of Glacier National Park](#) MT Historical Society Footlocker - available for loan from [Glacier](#), has the CD "Blackfeet Legends of Glacier National Park" by Jack Gladstone.
- [Montana Skies Blackfeet Astronomy](#)- MT OPI-Indian Education For All, has Blackfeet speaker telling Blackfeet stories about the night sky and constellations.
- Contact the Tribal Culture Committees and request a native speaker to visit your classroom.
- [Flathead Geoscience Education Project](#)-investigating the geological history of the Flathead Indian Reservation through a combination of modern geological research, tribal knowledge and oral histories.
- [Glacier National Park Conservancy Bookstores](#) - variety of books specific to Glacier National Park.
- [Flathead Community of Resource Educators Website](#) - Flathead education resource providers, education trunk list.



Napi Student Artwork  
by Mandy Horn

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**MT Content Standards** Unit 2: Lesson 1

## Montana Common Core Standards—English Language Arts

CCRA.SL.1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCRA.SL.2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

## Standards for Literacy in History/Social Studies, Science, and Technical Subjects

CCRA.RH/ST.1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCRA.RH/ST.2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

CCRA.RH/ST.4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

CCRA.RH/ST.7. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

CCRA.RH/ST.8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

CCRA.RH/ST.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

CCRA.WHST.3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.

CCRA.WHST.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCRA.WHST.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

CCRA.WHST.7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

CCRA.WHST.9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

## Montana Standards for Science

Science 1.1.6. Identify, compare, explain... how observations of nature form an essential base of knowledge among the Montana American Indians.

## Montana Standards for Social Studies

Social Studies Standard 3. Students apply geographic knowledge and skills (e.g., location, place, human/environment interactions, movement, and regions).

Social Studies Standard 4. Students demonstrate an understanding of the effects of time, continuity, and change on historical and future perspectives and relationships.

Social Studies Standard 6. Students demonstrate an understanding of the



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**MT Content Standards** impact of human interaction and cultural diversity on societies.  
**Continued**

Indian Education for All Seven Essential Understandings Regarding  
Montana Indians

Essential Understanding 1 —tribal diversity

Essential Understanding 3 —importance of oral traditions

Essential Understanding 6 —history is subjective



## Unit 2- Mountains and Mountain Building Lesson 2

### *The Work of Water* - INSTRUCTIONAL WORK OF WATER VIDEO

#### **Materials:**

- Trough-one can be built from 2' x 10's nailed together
- Clay from a stream bank or recycled potters clay
- Soil -garden or used potting soil
- Sand
- Small sized gravel from the schoolyard or aquarium gravel
- Several ping pong ball-sized rocks of different shapes
- A two-quart juice pitcher with a narrow spout
- A transparent container to collect runoff materials
- Optional: toy houses; Glacier raised relief map/eye dropper/food coloring for extension activity



Middle Fork Flathead River  
spring high water, NPS photo.

#### **Lesson At A Glance**

Students construct a river model. Then use a watering can or hose to observe the role water has in causing weathering, erosion, deposition and sculpting the landscape.

#### **Objectives**

Students will be able to:

- Construct a river model and observe the role water, erosion, and sedimentation can have in shaping the landscape.
- Describe how sedimentary rocks form.



<b>Time Required</b>	Two class periods -one to construct the model and one to observe erosion and deposition. Additional time to let sediments settle to see layers. Can be multi-day with students doing exploratory play.
<b>Vocabulary</b>	Banks, confluence, course, delta, drainage, excavates, mouth of the river, meanders, river source, sediment, terracing, topographical features, transports, tributaries.
<b>Teacher Preparation/ Background</b>	This activity gives the students a hands-on experience with the way water excavates, transports, and deposits material. Be familiar with erosion and background information on rivers and rocks. View the <a href="#">instructional video</a> which shows one version of how to make a river model of erosion and water flow. Perhaps a sand box or other outdoor version would work just as well. Could older students build something? There are also models available through science stores and local Conservation Districts. Decide which you will use and obtain the materials. You will need to identify a place for students to go outdoors to create/use the stream model. For the science extension, it will be necessary to obtain a Glacier raised relief map. (An excellent river dynamics digital student resource to consider obtaining in advance is the Confederated Salish & Kootenai Tribes' <a href="#">Explore the River Interactive DVD</a> -limited copies available for free from CSKT for educators.)
<b>Procedures</b>	<ol style="list-style-type: none"> <li>1. Review with the Unit 2 Student Reading how stream erosion is one of the major agents shaping the topographical features in the environment. Be sure to relate the formation of the ancient sedimentary rocks comprising Glacier's mountains to this activity.</li> <li>2. Take the students and materials outside and guide them in constructing a river model.</li> <li>3. Arrange the trough so that the lower end hangs over the transparent glass cake pan.</li> <li>4. Mold a bedrock base of clay in the bottom of the trough.</li> <li>5. Have students sprinkle layers of gravel, sand, and soil along the length of the trough making sure that there is a top layer of soil.</li> <li>6. Push rocks down into the soil near the center and along the course of the trough.</li> <li>7. As an added touch the students may want to place little twigs and pine trimmings along the course to represent trees.</li> <li>8. When the model is complete, slowly pour water (or trickle water from a hose) into the top center of the trough. Allow the water to percolate gently until it begins to make its own bed down the center of the trough. Rocks in the way will create meanders in the river bed. There is no need to overdo the water. When the cake pan is nearly full of water with its sediment load allow it to settle naturally.</li> <li>9. At this point you may wish to casually teach a little river nomenclature. Point out and discuss the source, the banks, tributaries, confluence, meanders, the course, delta, and the mouth of the river. Add any other vocabulary and information that you are comfortable with.</li> <li>10. Allow the contents of pan to sit for several hours or until the next day. Point out how the different materials have separated themselves into sedimentary layers.</li> </ol>

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**Reflection/Assessment** If possible, leave these materials out so that the students can continue to experiment with them. Practicing their vocabulary and naming formations. Finally, save this model for further activities with the unit on Glaciers and Glaciation.

**Science Extension**  
[Watch the Video on how to do this Triple Divide Science Extension](#)

- Take the small Glacier relief map and locate Triple Divide Peak to the south of St. Mary Lake. Suppose that for some reason you needed to dispose of some water on top of Triple Divide Peak. Where would that water go? Use an eye dropper to deposit water on the map until it finds its way down the three drainages into the Pacific Ocean, the Atlantic Ocean and into Hudson Bay.

**Writing Extension**

- For a writing and research assignment you might invite the students to write a story about a trip in a canoe, or as a drop of water or a stick, that begins at the top of Triple Divide. Which drainage would you take? What would you see and what would happen along the way? Where would you finally end up?”

**Action Project/ Field Trip Extension**

- [Ranger-Led Field Trips and Service Learning Projects](#) in Glacier National Park. Earth Science and Forest Processes field trips about park geology.
- [Self-Guided Field Trips](#) and [Guided Tours](#) - various concession operated.
- [Glacier Institute](#) - geology and other education programs.
- Flathead CORE - [outdoor education guide for field trips in the Flathead](#).
- Confederated Salish & Kootenai Tribal Natural Resources Dept., [River Honoring](#)- contact the Tribes for updates.
- [Flathead Conservation District](#) , [Flathead Audubon](#) , [Whitefish Lake Institute](#)- variety of related education/outreach projects.

**Additional Resources**

- [Explore the River, Interactive DVD](#) - Confederated Salish & Kootenai Tribes, The DVD explores in detail the hydrology, habitat, fish, and Salish and Pend d’Oreille culture and history and their current efforts to restore the Jocko River.
- [Flathead Community of Resource Educators Website](#) - contains a resource link to the [Flathead Watershed Sourcebook](#) - information on cultural and natural history of the Flathead watershed and [traveling trunks](#).
- [Flathead Lake Biological Station](#)- field research and education facility of the University of Montana located at Yellow Bay on Flathead Lake.
- [Montana Watercourse](#) - education trunks, water monitoring, and other water education programs and materials.
- [Project Wet](#) - water education activities and teacher workshops.
- [Glacier National Park Conservancy Bookstores](#) - books specific to Glacier.

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**MT Content Standards** Unit 2: Lesson 2

Montana Common Core Standards—English Language Arts

CCRA.SL.1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCRA.SL.4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

Montana Standards for Science

Science 1.1.4. Use (create, analyze) models that illustrate simple concepts and compare those models to the actual phenomenon.

Science 1.1.6. Identify, compare, explain ... how observations of nature form an essential base of knowledge among the Montana American Indians.

Indian Education for All Seven Essential Understandings Regarding Montana Indians

\*Essential Understanding 1 —tribal diversity

\*Essential Understanding 3 —importance of oral traditions

\*Essential Understanding 6 —history is subjective

\* If connect lesson with Unit 2 stories and additional resources listed from the Confederated Salish & Kootenai Tribes



## Unit 2 -Mountains and Mountain Building Lesson 3

### *Erosion and Preservation of the Water Table-* INSTRUCTIONAL VIDEO

#### **Materials:**

- Two large trays
- A watering can with a sprinkling spout
- A fresh square of sod
- A bucket of sandy loam



Spring Flooding Middle Fork of Flathead River, NPS photo.

#### **Lesson At A Glance**

Teacher will demonstrate or have students take turns, pouring water on different ground covers to observe which holds the sediments in place better.

#### **Objectives**

Students will be able to:

- Investigate why ground cover is of primary importance in reducing the rate of erosion in a natural environment.
- Create a model that shows the role of vegetation in retarding (slowing down) erosion and preserving the water table.
- Research local flooding events.

#### **Time Required**

50 minutes

#### **Vocabulary**

Agricultural activities, ecosystem, vegetation, water table.

#### **Teacher Preparation/ Background**

View the instructional video on how to set up the activity so that students can pour water on different ground covers. Be familiar with erosion and [Glacier soils](#). Gather all the ground cover/soil materials needed. Identify a space to conduct the activity outside or inside (without creating a mess). Consider incorporating research and tie in [annual flooding events](#), as well as the historic 1964 flood. (Starting on p. B59 of this [USGS report](#) is information and photo of the 1964 flood and Divide Creek at St. Mary, MT in Glacier National Park).

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**Procedure**

1. Place the two trays so that one end is slightly higher than the other.
2. Put the clump of sod on one tray and an equal pile of sandy loam on the other tray.
3. Let the watering can rain for a period of time on each earth sample.

**Reflection/Assessment**

Invite the students to discuss what happened and why. At the end of the activity have the group examine the two specimens for retained water content. How does vegetation retard erosion and preserve the water table?

Many tribes in Montana followed a yearly cycle of movement, directed by the seasons. How were annual flooding events less of an impact on livelihoods at that time than how we are living today? What do the trees and plants, forests and meadows of Glacier National Park and other vegetated areas do for the ecosystem? Discuss how human activities such as logging, fire management, agricultural activities and development in the surrounding ecosystem can help or hinder the goals (preservation and protection of natural and cultural resources) of Glacier National Park.

**Science Extension**

Can they make accurate predictions of what would happen with changes to the amount of ground cover? Changes in the terrain? Changes in the speed and amount of water added?

**Action Project/ Field Trip Extension**

- [Eco-enrichers](#)- science lesson on plant and animal contributions to soil.
- [Ranger-Led Field Trips and Service Learning Projects](#) in Glacier National Park. Earth Science and Forest Processes field trips about park geology.
- [Self-Guided Field Trips](#) and [Guided Tours](#) - various concession operated
- [Glacier Institute](#) - geology and other education programs.
- Flathead CORE - [outdoor education guide for field trips in the Flathead](#).
- Confederated Salish & Kootenai Tribal Natural Resources Dept., [River Honoring](#)- contact the Tribes for updates.
- [Flathead Conservation District](#) - spring Flood Awareness Days, riparian projects, [Symphony of Soils](#) video, and traveling Rolling Rivers Trailer.
- [Flathead Audubon](#) and [Whitefish Lake Institute](#) -education/outreach.

**Additional Resources**

- [Explore the River, Interactive DVD](#) - Confederated Salish & Kootenai Tribes, The DVD explores in detail the hydrology, habitat, fish, and Salish and Pend d'Oreille culture and history and their current efforts to restore the Jocko River.
- [Flathead Community of Resource Educators Website](#) - link to the [Flathead Watershed Sourcebook](#) - information on cultural and natural history of the Flathead watershed and [traveling trunks](#) dealing with water.
- [Project Wet](#) - water education activities, trunks and teacher workshops.
- [Soil Science Society of America](#) - educational materials kit.
- [Crown of the Continent Research Learning Center](#) - soils of Glacier NP.

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**MT Content Standards** Unit 2: Lesson 3

Montana Common Core Standards—English Language Arts

CCRA.SL.1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCRA.SL.4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

Montana Standards for Science

Science 1.1.4. Use (create, analyze) models that illustrate simple concepts and compare those models to the actual phenomenon.

Montana Standards for Social Studies

Social Studies Standard 3. Students apply geographic knowledge and skills (e.g., location, place, human/environment interactions, movement, and regions).

Social Studies Standard 4. Students demonstrate an understanding of the effects of time, continuity, and change on historical and future perspectives and relationships.

Social Studies Standard 6. Students demonstrate an understanding of the impact of human interaction and cultural diversity on societies.

Indian Education for All Seven Essential Understandings Regarding Montana Indians

\*Essential Understanding 1 —tribal diversity

\*Essential Understanding 3 —importance of oral traditions

\*Essential Understanding 6 —history is subjective

\* If connect lesson with Unit 2 stories and additional resources listed from the Confederated Salish & Kootenai Tribes





## Unit 2 -Mountains and Mountain Building Lesson 4

### *Formation of Mountains and Faults-* INSTRUCTIONAL FAULTS VIDEO

#### Materials:

- [Student Reading, Unit 2, A Geological Story of Glacier NP](#)
- An assortment of various colors of 12 inch felt squares
- Several 30 quart garbage bags
- A bucket of clean sand
- Several sheets of balsa wood, or a similar material (graham crackers can work), in various thicknesses and colors
- A utility knife
- Standard building blocks or 2” x 4” end cuts of various lengths
- [Glacier NP Student Resource Guide](#)
- [Digital Image Library](#) has an assortment of Glacier pictures



Fault in diorite sill, Danny On photo (Glacier NP Digital Image Library).

#### Lesson At A Glance

Stations are set up around the classroom for teacher to demonstrate and then for students to rotate through in small groups. Video and photos are available of mountains in Glacier NP for students to look at from the [Student Resource Guide CD](#) or other source.

#### Objectives

Students will be able to:

- Simulate with simple models geologic mountain building processes.
- Define geologic terms.
- Recognize the effects that weathering/erosion have on the mountains.
- Consider compatibilities between Western science and Native knowledge.
- Realize there are multiple perspectives for the same landscapes.

#### Time Required

50 minutes

#### Vocabulary

Rifting (other vocabulary defined in Student Reading).

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## Teacher Preparation/ Background

Make sure you and students are familiar with the basic geology of Glacier NP, especially the vocabulary. For handouts, you can use the geologic story from the Student Reading Unit 2 and from the [Rocks and Glaciers](#) section of the park's website. There are also three levels of explanations on the Glacier NP website: [mountains](#) (short & basic); [geologic formations](#) (longer and includes thrust fault, stromatolites), and the [resource guide on geology](#) (longer and more detail). Have available student access to a variety of photos and maps of Glacier NP. (If you don't have internet, a free CD of the park's [Student Resource Guide](#). Watch the [Instructional Faults Video](#) and obtain the materials to set up the four stations in your classroom. Create instruction cards for each station. This activity is designed to give students hands-on experience with some of the concepts involved in the geologic explanations for the formation of mountains.

## Procedures

1. Discuss their homework (Student Reading, Unit 2) and have them work in small groups to share their answers for the "Checking for Understanding" questions. Did the students notice similarities between the Native knowledge and Western Scientific perspectives of how the mountains got their shapes?
2. Watch [Glacier's Geologic Story video](#) to further explore the geologic perspective.
3. Demonstrate each of the stations and point out the instruction card for the geologic concept being modelled. Identify and define any new vocabulary.
4. Have students rotate through each station and do the activities and discuss the dynamics that they demonstrate. Encourage them to experiment as long as they show interest and do appropriate activities. Don't be too concerned about proper technical language. The students should feel free to apply their own vocabulary to facilitate communication skills. When appropriate, supply technical vocabulary and nomenclature but not to the point where students become hesitant to discuss the dynamics.

### Station 1 - Deposition and down- warping

Ask a student to inflate a garbage bag, leaving about a third of the available air space unfilled, and tie the end tightly so that no air can escape. Lay the bag flat on the table and slowly pour sand in the center of the bag. The weight of the sand deposited like sediment will cause the surrounding area of the bag to rise while the center sinks. Pour the sand on several different areas of the bag. Facilitate student discussion of how this deposition on a shallow sea floor might affect the surrounding area.

### Station 2 - Sedimentary Layering and Folding

Take a stack of felt squares and begin to lay them in successive layers on the table. If the presenter is familiar with the rock formations of Glacier Park, they may wish to lay down a succession of colors that correspond to the colors of formations in the park. Any series of earth tones will do just fine. You may want to cap your felt sandwich with a layer of blue or green to represent water or vegetation. Facilitate student discussion of the sediments that make up the materials for mountain building.

Push the edges of the felt layered sandwich together as far as you can. This is an example of mountain formation by folding; even materials as soft as

## Procedures Continued

felt can only be folded so far before they are compacted as tightly as they can be. Certainly a great deal of folding was involved in the making of our mountains.

Some limited magma intrusions filled in space between rock layers and moved up through faults to form sills and dikes. Invite students to make suggestions about how they can demonstrate the intrusion of sills and dikes into your layered model.

### Station 3 - Fault Blocking and Overthrust Slip

Make a short stack of balsa wood squares (could also use graham crackers and frosting). Have a student make an oblique cut through the materials. Have them push these layers together to demonstrate folding. The layers will pile up, shuffle, or even overturn. This is what happens in fault blocking dynamics when harder materials are compressed by plate tectonics.

### Station 4 - Rifting

Pile several layers of various length building blocks together as if you were building a brick wall. Make sure that the bottom run is composed of your two longest blocks. Pull the two bottom blocks apart slowly until the upper layers collapse into the gap. This is known as rifting. Rifting occurs when subsurface intrusions spread the surface materials to the point of collapse, when tectonic plates pull apart, or in rare cases when surface materials happen to slough or slide across subsurface materials. The North Fork and

Folding due to horizontal pressure.



Fold has developed into a thrust fault.



Thrust has over-riden younger rocks.



<b>Procedures Continued</b>	Flathead Valleys are actually a kind of rift valley that has been partially re-filled with sedimentary materials.
<b>Reflection and Assessment</b>	<p>Making pudding is a good activity that can be used to illustrate the role of Plate Tectonics in mountain building. Have the class make a pot of chocolate pudding. After the pudding is done, pour it in a shallow glass cake pan to cool. When almost cool, carefully use a sharp knife to cut the film that formed on top of the pudding into two equal portions. Carefully tilt the pan so that half of the pudding film slides up and over the other half of the pudding. The film represents the lighter continental crusts colliding and forming folded mountains. Even if the mountains collapse into a heap, the pudding can still be eaten by a hungry class.</p> <p>See if students can identify geologic concepts they learned in the pudding activity.</p>
<b>Extension</b>	As a review and a treat have the students bake a layer cake using mixtures of food color to represent the various sedimentary layers comprising the Glacier National Park rock formations. Instead of putting frosting on top, spray a large layer of whipped cream on a clean piece of stiff paper. Place the cake on top of the whipped cream. Place the edge of the stiff paper on the edge of a baking sheet. Lift the back edge of the paper slowly until the cake slides over onto the baking sheet. Cut and serve the cake and top it with the whipped cream conveyor surface. This little procedure gives a rough impression of how the Lewis Thrust Fault may have operated. It may be healthier, though not as much fun, to make a large hero sandwich with the class, using ingredients that suggest the appropriate and corresponding sedimentary layers in the park. Either activity will make a lasting impressions on the students.
<b>Action Project/ Field Trip Extension</b>	<ul style="list-style-type: none"> <li>• Ask a local geologist to come and speak to the class about the geology of your area.</li> <li>• <a href="#">Ranger-Led Field Trips and Service Learning Projects</a> in Glacier National Park. Earth Science and Forest Processes field trips about park geology.</li> <li>• <a href="#">Self-Guided Field Trips</a> in Glacier National Park.</li> <li>• <a href="#">Glacier Institute</a> - geology and other education programs.</li> <li>• Flathead CORE - <a href="#">outdoor education guide for field trips in the Flathead</a>.</li> <li>• <a href="#">Guided Tours in Glacier National Park</a>- various concession operated.</li> </ul>
<b>Additional Resources</b>	<ul style="list-style-type: none"> <li>• <a href="#">Flathead Community of Resource Educators Website</a> - contains a resource link to the <a href="#">Flathead Watershed Sourcebook</a> - which contains cultural and natural history of the Flathead watershed.</li> <li>• <a href="#">Glacier National Park Conservancy Bookstores</a> - books specific to Glacier.</li> </ul>

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**MT Content Standards** Unit 2: Lesson 4

## Montana Common Core Standards—English Language Arts

CCRA.SL.1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCRA.SL.2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCRA.SL.4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

## Standards for Literacy in History/Social Studies, Science, and Technical Subjects

CCRA.RH/ST.1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCRA.RH/ST.2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

CCRA.RH/ST.4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

CCRA.RH/ST.6. Assess how point of view or purpose shapes the content and style of a text.

CCRA.RH/ST.7. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

CCRA.RH/ST.9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

## Montana Standards for Science

Science 1.1.4. Use (create, analyze) models that illustrate simple concepts and compare those models to the actual phenomenon.

Science 1.1.6. Identify, compare, explain ... how observations of nature form an essential base of knowledge among the Montana American Indians.

## Montana Standards for Social Studies

Social Studies Standard 3. Students apply geographic knowledge and skills (e.g., location, place, human/environment interactions, movement, and regions).

Social Studies Standard 6. Students demonstrate an understanding of the impact of human interaction and cultural diversity on societies.

## Indian Education for All Seven Essential Understandings Regarding Montana Indians

\*Essential Understanding 1 —tribal diversity

\*Essential Understanding 3 —importance of oral traditions

\*Essential Understanding 6 —history is subjective