

“If Practicable Pass Over to the Waters of the Columbia”
(Captain Meriwether Lewis to William Clark prior to expedition)

Objectives. After completing this lesson, students will be able to

- make mathematical calculations related to the travel speed of certain stages of the Lewis and Clark expedition.
- compare their calculations with evidence from the journals of Lewis and Clark.
- describe some of the limitations of the calculations.
- describe some of the difficulties the Corps of Discovery experienced traveling over 8,000 miles through uncharted territory.

Lesson Overview.

In this online simulation, students will make mathematical calculations related to the travel speed of the Lewis and Clark expedition, with respect to variables such as current, weight of cargo, wind, type of boat, etc.

Preliminary Activities (Optional)	Introduction (10 minutes)	Online Activity (60 minutes)	Assessment (10 minutes)	Extensions (Optional)
Learn about the object of the Lewis and Clark mission; practice some math skills	Connect to previous knowledge; review mathematical formulas as necessary	Explore the factors that influenced travel time, carry out simulations, and make mathematical calculations	Questions for class discussion or written assessment	Resources for additional research

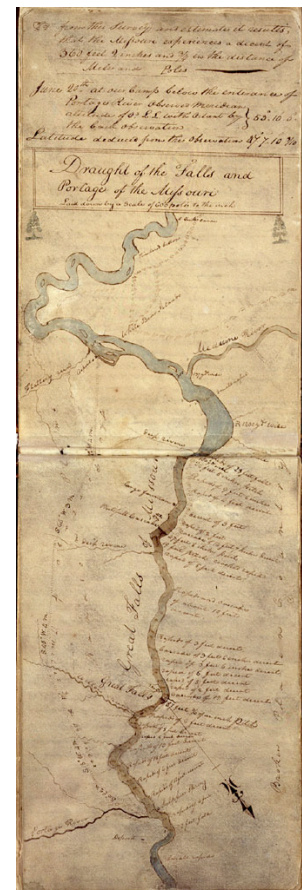
Background for the Teacher.

When Lewis and Clark began their expedition, they were equipped with some 30 tons of crates, barrels, bundles, and boxes. The bulk of that cargo consisted of food supplies, gifts and items of trade for the Native Americans they would meet along the way. Among the most important items in the cargo were those that would allow the explorers to collect information about the unknown territory they were preparing to enter. The complete journey would be some 8000 miles long, mostly by water, and the only map that Lewis and Clark had of the area through which they would travel indicated a great blank space in the middle of the continent, marked “Unknown.”

Because Lewis had the responsibility of planning and acquiring the necessary provisions for this expedition, it was important for him to estimate the total travel time, so that he could include enough supplies for their needs without carrying excess cargo. Lewis and Clark estimated the distance and duration of their expedition, using the known longitudes of their starting and ending points to estimate distance, and using the predicted velocity of the modes of transportation available to them at the time. The predicted the Corps would be traveling at approximately 45° N, where one degree of longitude is equal to approximately 49 miles, and one minute of longitude is equal to approximately 0.8 miles. Their starting point (just across the river from St. Louis, Missouri), Camp Dubois, Illinois, was known at the time of the expedition to be 89° 59' W longitude. Their expected destination, the mouth of the Columbia River, was known at the time of the time of the expedition to be 124° 4' W longitude. The difference between the starting point and the destination was 34° 5'. Thus, the total distance could be estimated to be about 1670 miles. At 10 miles per day (Lewis' slower estimate), the Corps could reach the Pacific Ocean in 167 days. If they could average 12 miles per day, they could reach the ocean in about 139 days. It could be estimated that it would take them about the same amount of time to return to St. Louis.

Among the numerous pieces of scientific and navigational data Lewis and Clark were expected to record was the current speed of major waterways. This information could, of course, prove useful to future travelers, and Jefferson had high hopes for opening this newly acquired territory up for trade. Lewis and Clark performed very simple measurements of the velocity of the Missouri River in a number of locations, comparing velocities after and before major tributaries entered. They simply dropped a stick in the water, timed its travel to a certain point, then measured the distance the stick traveled. Using the formula for velocity, $V = D/T$, they found the Missouri River current to vary from about 3 miles per hour to about 7 miles per hour. At one point, they found that their stick floated 46 poles, 6 feet in 23 seconds. One pole being equal to 16.5 feet, this would mean the current was racing at about 23 miles per hour, much faster than other figures recorded. In his journal, Clark described the river as “like a falls” about this time.

One of the most treacherous segments of the expedition proved to be the portage around the Great Falls of the Missouri, in present-day Montana. It must have been a beautiful site. At 900 feet wide and 80 feet high, Lewis called it "the grandest sight" he "ever beheld." This may have been due, as much as anything, to the confirmation the falls provided that he and Clark had chosen the right path. However, the portage that Lewis and Clark thought would be less than a mile, turned out to be much more: 18 miles, in fact, to pass the five waterfalls. Their smaller canoes were filled with supplies and



carried, dragged, and pushed as makeshift wagons. The ground was steep and rocky, and covered with prickly pear cactuses that tore at the men's moccasins, and then at their feet. They experienced alternating heat of summer and violent thunder and hail storms. Bugs, snakes, and bears were a constant threat. But somehow, amidst all the trials, Lewis and Clark managed to map their course at least as meticulously as they did other portions of their journey. They used a two-pole chain (33 feet) and a compass to plot the distance and bearing of this most famous leg of the expedition. The map that resulted (right) is one of the most widely recognized among the dozens of maps that resulted from this expedition. Once past the Great Falls, the challenge was to find Indians from whom they could buy horses to help them get over the Rocky Mountains. It took a while, but of course, they made it, and finally they would be able to travel by water with the current, instead of against it. However, as Lewis and Clark were traveling down the Columbia River, on their way to the Pacific Ocean, they came to another great falls area, which they called the long and short narrows (now covered with water as a result of construction of The Dalles Dam). By this time, the Corps was likely desperate to get to the Pacific Ocean. They did not relish the idea of another difficult portage, the memory of the 30 days it took them to get around the Great Falls still strong. Clark wrote of the surrounding lands in his journal on October 24th, 1805, "as the portage of our canoes over this high rock would be impossible with our Strength, and the only danger in passing thro those narrows was the whorls and Swills arising from the Compression of the water, and which I thought (as also our principal watermen Peter Crusat) by good Stearing we could pass down Safe, accordingly I deturmined to pass through this place notwithstanding the horrid appearance of this agitated gut Swelling, boiling & whorling in every direction." Indians lined up along the shores of the river expecting to see the white men drown, but they were disappointed. Cargo and men made it safely through what would probably be a Class 5 rapids (impassible), in river-rafting terms today.

Classroom Management Tips

1. Complete any desired preliminary activities (below) prior to beginning this activity.
2. Prior to activity, reserve computer lab as necessary.
3. Decide ahead of time how you will organize your class for the online activities. If you have enough computers, you may wish to have students work alone at a computer. Two students per computer may stimulate additional discussion and interaction. Three or more students to a computer can result in some students being left out of the activity unless you use certain strategies such as assigning each group member a task. If a projector and interactive whiteboard are available, you may wish to do this as a whole class activity, allowing students to take turns manipulating the activities with a mouse or on the whiteboard.

Preliminary Activity Ideas.

Before beginning this lesson with your students, you may wish to do one or more of the following activities.

1. Lewis and Clark Rediscovery Interactive CD. Show your class segments of this informational CD using a computer projector. (Note: The CD will need to be installed on the computer prior to use and inserted during use.) From the Main Menu, select North America 1803 for a brief slide show (5 minutes) about the events leading up to the expedition. For a brief slide show about the challenges of river travel, select Expedition from the Main Menu, then The Known from the territory choices. Click on the Expedition Case, then Technology/Daily Life to see a number of Peace Medal icons. Clicking on the first Peace Medal, near St. Louis, will launch “River Challenge.” There are many other interesting segments. Explore yourself and show other segments that you find appropriate or allow your students to explore on their own.
2. Using the Computer Calculator. Directions and a simple worksheet are included if your students are unfamiliar with using the calculator on their computers. If you plan to allow them to use the computer calculator for necessary calculations in the Interactive Web-based Activity, it is recommended that you allow some practice for students who are unfamiliar with its use prior to doing the activity. This will allow students to focus on the activity learning experience as they are doing it, rather than on how to use the computer’s calculator. (See Appendix)
3. Circa 1803. This lesson from the PBS Lewis and Clark Website will put students in the frame of mind of exploring a truly unknown territory. There is a student worksheet at <http://www.pbs.org/lewisandclark/class/pdf/Lesson1a.pdf> and an article to read at http://www.pbs.org/lewisandclark/inside/idx_cir.html .

Suggested Procedure .

1. Activate students' prior knowledge with the following questions for discussion. (5 minutes)
 - What do you think were the most important tasks or missions of the Lewis and Clark expedition? *Answers should include: to map the area, to find the most direct route to the Pacific Ocean, to open the area up for later trade and expansion, to find out about the native people of the area.*
 - How long does it take you to drive to Portland (or some destination familiar to students)? *Students should be able to give a reasonable answer to this.*
 - How long would it take you to get there if you didn't have roads or a car? *This should be more difficult for them to estimate.*
 - How would you know how much to pack for the journey? Imagine the difficult task Lewis faced as he prepared to take 40 men into unknown territory to travel some 4000 miles to the Pacific Ocean and back. There would be no hotels to stay at or restaurants to eat at if their camp provisions didn't last. The success of their journey depended largely on the planning and calculations of Captain Lewis, prior to the expedition.
 - Explain to students that in this activity, they will be asked to solve several problems related to the problems Lewis and Clark had to solve on their journey. The problems will require them to think, use some logic and math skills, and do some calculations (either on scratch paper, a hand-held calculator, or the computer calculator, as you see fit).
2. Have students do the Interactive Web-based Activity. (60 minutes) It is recommended that you preview the activity; you may wish to have students do various sections on different days. Depending on students' skills, some pre-teaching may be necessary before beginning each section.
3. Follow-up discussion questions. (10 minutes)
 - How long did Lewis and Clark *estimate* it would take them to travel to the Columbia River? Why was this estimate so far off of the time the expedition *actually* took? *278 – 334 days, a little less than one year. However, Lewis and Clark actually made several revised estimates that were a little longer, allowing for more time with Indians and time for exploring. Lewis and Clark had no way to know that some days, their travel would be slower than 10 miles per day, that they would spend more time negotiating with Indians, and that they would have to wait out two winters due to impossible travel conditions.*

- How can you measure current speed? Why was such a measurement of interest to Lewis and Clark? *Students should describe their activity of dropping an object into the river, measuring how long it takes to float a certain distance, then using the formula $V = D/T$ to calculate current speed or velocity. This was important to know for future river travel and trading.*
- What tools and skills did Lewis and Clark use to navigate and map their way around the Great Falls? Why did they record their route so meticulously? *They used a compass for measuring direction and a two-pole chain for measuring distance. They were very careful to be accurate so that others who might travel in this region after them would have useful maps to guide them.*
- As Lewis and Clark were traveling down the Columbia River, on their way, finally, to the Pacific Ocean, they came to another great falls area (known today as Celilo Falls and covered with water as a result of building The Dalles Dam), What difficult decisions were made here? Why were they difficult? What was the result? *Students should describe the decision Lewis faced about whether to take the canoes, laden with all their supplies, through the falls and risk losing everything, even their lives, or portage the canoes and all their cargo around the falls. Lewis, by this time probably desperate to get to the Pacific Ocean, opted for the more dangerous choice – shooting the rapids. Though the Indians predicted they would all drown, luck was with them. Cargo and men made it safely through what would probably be a Class 5 rapids (impassible), in river-rafting terms today.*

Extensions.

1. “Lewis and Clark Trail in the Twenty-first Century.” How have modern methods of transportation affected travel time? In this activity, you will compare the travels of Lewis and Clark to a similar voyage many modern-day families will make to follow parts of the Lewis and Clark trail. (See Appendix)
2. “The Search for Lewis and Clark,” a video from the Discovery Channel.
3. “Calculating Time and Distance on the Missouri Trail.” Here are some challenging word problems for your students, similar to those that they solved in the online activity, from the [HistoryChannel.com](http://www.historychannel.com). Find background information, problems, and extended activities at <http://www.historychannel.com/classroom/missouri/time.html>
4. “Forces of Nature: The Challenges of River Travel.” This PBS Classroom Lesson engages students in water dynamics by having them build a river and explore how forces of nature affect the river, and how those forces affected Lewis and Clark. Find a detailed lesson plan at <http://www.pbs.org/lewisandclark/class/111.html>.
5. “Are We There Yet? Delays, Delays, Delays.” In this activity, students will examine journal entries of the various events that caused delays in the expedition, and examine the events from various perspectives. (See Appendix)

Additional Resources.

Discovering Lewis and Clark. <http://www.lewis-clark.org/>

This site contains an incredible wealth of information about the expedition. Many of the content sections have photographs of various sites along the expedition. One section includes photos or drawings of the actual biological specimens collected and modern photos of the same specimens.

Lewis and Clark PBS Website <http://www.pbs.org/lewisandclark/index.html>

This is the website to accompany the PBS documentary by Ken Burns. Included is plenty of great background information, an interactive trail map, an interactive story of the expedition, and classroom resources.

Latitude/Longitude Distance Calculation. <http://jan.ucc.nau.edu/~cvm/latlongdist.html>

This website allows user to input a source and destination latitude and longitude and it will calculate the distance between the two points in statute miles, nautical miles, or kilometers.

The Journals of Lewis and Clark Online.

<http://libtextcenter.unl.edu/lewisandclark/index.html>

Oregon Benchmarks.

Math Grade 8

- Use order of operation rules, including exponents
- Develop and use strategies to estimate the results of rational number computations and judge the reasonableness of results
- Model situations, make predictions and inferences, and solve problems using linear equations and inequalities
- Solve problems involving rates and derived measurements for such attributes as speed, velocity, and density
- Construct and read drawings and models made to scale
- Interpret the concepts of a problem-solving task and translate them into mathematics
- Choose strategies that can work and then carry out the strategies chosen
- Accurately solve problems using mathematics

Math Grade 10

- Develop and use strategies to estimate the results of real number computations, determine the amount of error, and judge the reasonableness of results
- Apply the associative, commutative, and distributive properties to simplify computations with real numbers
- Approximate and interpret rates of change in graphical and numeric data
- Interpret the concepts of a problem-solving task and translate them into mathematics
- Choose strategies that can work and then carry out the strategies chosen
- Accurately solve problems using mathematics

Science Grade 8

- Summarize and analyze data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.

Science Grade 10

- Summarize and analyze data, evaluating sources of error or bias. Propose explanations that are supported by data and knowledge of scientific terminology.

(Oregon Benchmarks continued)

Social Science Grade 8

- Read, interpret, and understand how to construct geographic representations to analyze information, understand spatial relationships, and compare places.
- Represent and interpret data and chronological relationships from history, using timelines and narratives.
- Evaluate data within the context it was created, testing its reliability, credibility, and bias.
- Understand how individuals, issues, and events changed or significantly influenced the course of U.S. history post American Revolution through 1900.
- Understand how various groups of people were affected by events and developments in Oregon state history.
- Clarify key aspects of an event, issue, or problem through inquiry and research.
- Examine a controversial event, issue, or problem from more than one perspective.
- Examine the various characteristics, causes, and effects of an event, issue, or problem.

Social Science Grade 10

- Interpret and evaluate information using complex geographic representations.
- Locate and identify places, regions, and geographic features that have played prominent roles in historical or contemporary events.
- Analyze and evaluate the impact of economic, cultural, or environmental factors that result in changes to populations of cities, countries, or regions.
- Reconstruct, interpret, and represent the chronology of significant events, developments, and narratives from history.
- Understand how contemporary perspectives affect historical interpretation.
- Understand causes, characteristics, and impact of political, economic, and social developments in Oregon state history.
- Define, research, and explain an event, issue, problem, or phenomenon and its significance to society.
- Analyze an event, issue, problem, or phenomenon from varied or opposed perspectives or points of view.
- Analyze an event, issue, problem, or phenomenon, identifying characteristics, influences, causes, and both short- and long-term effects.

Appendix

This appendix includes copies of student activity guides and teaching tips for preliminary and extension activities to accompany the Interactive Web Activity “Pass Over to the Columbia.” See Teacher Lesson Plan for an overview of each activity and suggestions for how to them with your students.

Preliminary Activity – Using the Computer Calculator

Extension Activity – The Lewis and Clark Trail in the Twenty-first Century

Extension Activity – Are We There Yet? Delays, Delays, Delays

Name _____
Date _____

**Pass Over to the Columbia
Preliminary Activity**

**Using the Computer Calculator
Student Activity Guide**

There's a very handy calculator on Windows-based computers. To use it, click on the "Start" button on your computer screen, then select "Programs," then "Accessories," then "Calculator." It looks like the diagram at the right.



You can either enter numbers and functions by clicking on the appropriate buttons or by using your keyboard. Experiment to find which method works best for you. You can keep the calculator active while you are using other programs. When you want to hide it, click the "minimize" button. When you need it, just click on "Calculator" in your lower task bar.

Now try some problems.

1. $7,458 + 6,931 =$ _____

2. $13,399 - 12,070 =$ _____

3. $654 \times 520 =$ _____

(Hint: the symbol computers use for multiplication is the " * ")

4. $8,293 \div 4 =$ _____

(Hint: the symbol computers use for division is the " / ")

5. $2(8+2) - 9 =$ _____

6. $\frac{6(4+2) - 6}{10} =$ _____

Using the Computer Calculator Teaching Tips

Suggestions

- Make copies of the Student Activity Guide for your class.
- If you have access to a computer with a projector, you can do some sample problems with your class to demonstrate the basics. Then students can work independently or in pairs to complete the problems on the Student Activity Guide.
- If students work in pairs at one computer, assign one to “drive the mouse,” and the other to write answers on the Student Activity Guide. After completing half of the problems, ask them to change roles.
- If these math problems are too simple or too difficult for your students, change the problems to allow your students to practice using the computer calculator with problems more appropriate for their skill level.

For Fun

Have students make up their own problems, with answers, and challenge their classmates to solve them.

Suggested Answers to Problems

1. 14,389
2. 1,329
3. 340,080
4. 2073.25
5. 11
6. 3

Name _____
Date _____

**Pass Over to the Columbia
Extension Activity**

**The Lewis and Clark Trail in the Twenty-first Century
Student Activity Guide**

How have modern methods of transportation affected travel time? In this activity, you will compare the travels of Lewis and Clark to a similar voyage many modern-day families will make to follow parts of the Lewis and Clark trail.

1. Recall

- a) How many miles did the Corps of Discovery travel (round-trip)? _____
- b) How long did the entire Lewis and Clark expedition take? _____

2. Estimate

- a) How far (in miles) do you think it might be if you were to drive the most direct route today, starting out in St. Louis, Missouri, driving to Astoria, Oregon (where the Corps of Discovery wintered at Fort Clatsop, near the mouth of the Columbia River), and then returned to St. Louis? _____
- b) How long do you think it would take? _____

3. Map Reading

- a) Now, go online to <http://www.eduplace.com/ss/maps/pdf/uscap.pdf> to see a modern map of the United States (or your teacher may have a printed one for you to view). Use the distance scale in the legend of your map and some simple calculations to make the following estimates.
- b) How many miles would your round-trip be, from St. Louis to Astoria (the mouth of the Columbia River), driving the most direct route, according to the map scale?

- c) Assuming you drive an average of 50 miles an hour (this allows for some traffic, occasional rest stops, etc.), how long do you think it would take you to drive this round-trip route? _____

4. MapQuest

- a) Next, go online to <http://www.mapquest.com> . Look in the box labeled “Directions.” Under “START,” type St. Louis in the “City” field and type the state abbreviation for Missouri – MO in the “State” field. In the “END” section, type Astoria under “City” and type OR for Oregon in the “State” field. Click the “Get Directions” button.
- b) What is the total distance, in miles, this round-trip route would take? (Hint: MapQuest presents a one-way trip) _____
- c) How long, in hours, would this round-trip route take? _____
- d) How many days would this round-trip route take, assuming you could only drive 10 hours per day?
- e) How many hours might it take you to fly this distance, round-trip? _____

5. Compare

In the space below, explain which trip you would rather take, and why: the expedition with Lewis and Clark, or the modern-day version of the same route. How has the technology of travel changed since the Lewis and Clark expedition.

The Lewis and Clark Trail in the Twenty-first Century Teaching Tips

Suggestions

- Make copies of the Student Activity Guide for your class.
- If you have access to a computer with a projector, you can do a sample query for directions on MapQuest with your class to demonstrate the basics. Then students can work independently or in pairs to complete the problems on the Student Activity Guide.
- If students work in pairs at one computer, assign one to “drive the mouse,” and the other to write answers on the Student Activity Guide. After completing half of the problems, ask them to change roles.
- If students work in pairs at one computer, and work together to complete the problems, you may wish to have them each answer question 5 independently, in order to offer their own ideas and understanding.

Suggested Answers to Questions

- 1a. Over 8,000 miles
1b. Almost 2 ½ years (863 days)
- 2a. Answers will vary.
2b. Answers will vary.
- 3b. About 3500 miles
3c. Without stopping, about 70 hours, or about 3 days. Students may estimate more hours or days, taking into consideration the need to stop for eating and sleeping.
- 4b. 4275 miles
4c. About 62 ½ hours
4d. A little more than 6 days
4e. Answers will vary, but for a commercial flight between Portland, Oregon and St. Louis, Missouri, the total round-trip flight time is about 10 hours.

Name _____
Date _____

**Pass Over to the Columbia
Extension Activity**

**Are We There Yet? Delays, Delays, Delays
Student Activity Guide**

Introduction

As you learned in the interactive web-based activity, *Pass Over to the Waters of the Columbia*, Lewis and Clark and the Corps of Discovery faced a number of delays that dramatically increased the duration of their expedition. In this activity, you will explore journal entries of those delays and examine the events from various perspectives.

Objectives

After completing this activity, you will be able to

- Research and explain some of the causes for delays in the Lewis and Clark Expedition and some of the occurrences during those delays.
- Examine these events from more than one perspective.

Materials

- Computer with internet access

Directions

1. Work through Part 1 of the interactive web-based activity, *Pass Over to the Columbia*, paying particular attention to the part of the activity titled “Travel Time: 863 days later.....”
2. Read the summary of each of the “delays” and click on the Journal icon to read some journal entries from members of the expedition, written during those delays. Notice that Lewis and Clark were not phenomenal spellers; the journal entries are recorded just as they were originally written, spelling errors and all.
3. Optional: Read additional journal entries written during those delays. Use Table 1 below which lists the major delays, a brief summary of some events during those delays, and dates of those events. If you have access to copies of the journals, you may look up these additional dates in the appropriate volume. Or, use this website for an online version of the journals - <http://libtextcenter.unl.edu/lewisandclark/index.html>
4. Select one journal entry for one particular date. Choose another “character” in that journal entry (perhaps another member of the expedition, a Native American, or even Captain Lewis’ dog, Seaman) and consider how the events may have appeared to that character. Write a new journal entry from that character’s perspective.
5. Repeat with additional journal entries as directed by your teacher.

Table – Details of Delays

Meetings with Indians

Council Bluffs Otos and Missouriis	July 30-Aug 2, 1804
Calumet Bluff Yankton Sioux	August 28-31, 1804
Bad River, Teton Sioux	September 24-26, 1804
Arikara Villages	October 8-11, 1804
West Lemhi Pass, Lewis Shoshone Camp	August 13-15, 1805
Camp Fortunate	August 17- 24, 1805
Shoshone Camp	August 21-31, 1805
Ross's Hole, Flathead	September 4- 6, 1805
Walla Walla	October 16-17, 1805
The Dalles	April 15-18, 1806

Wintering at Fort Mandan

Fort Mandan vicinity	October 25, 1804
Begin Fort Mandan	November 3, 1804
Leave Fort Mandan	April 7, 1804

Rest and Reorganization

Camp White Fish	July 22-26, 1804
White River	September 16 -17, 1804
Traveler's Rest	September 9-11, 1805
Clearwater Canoe Camp	September 26 -October 7, 1805
Rock Fort	October 25-28, 1805

Exploring

Mouth of Yellowstone	April 25 – 27, 1804
Marias River	June 3-12, 1804
Three Forks of the Missouri	July 25-30, 1805
Beaverhead River	August 4-8, 1805
Sandy River	March 31-April 6, 1806

Portaging around Falls

Portage around Great Falls	June 13 – July 15, 1805
Portage around Celilo Falls	October 22-23, 1805
Portage around Cascades	October 31-November 2, 1805
Return journey, portage around Cascades	April 9-12, 1806

Wintering at Pacific Ocean

Arrive at estuary	November 7, 1805
Arrive at Fort Clatsop site	December 7, 1805
Leave Fort Clatsop	March 23, 1806

Waiting for Snow Melt to Cross the Rockies

Nez Perce Camp	May 14-June 10, 1806
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Are We There Yet? Delays Teaching Tips

Suggestions

- Make copies of the Student Activity Guide for your class.
- Decide how you want to group students for this activity. Will they do this individually, in pairs, or in small groups?

For Fun

- After writing their assigned journal entries, you may opt to have them work in small groups create a skit about some of the events that occurred during one day as represented in a journal entry of their choice.