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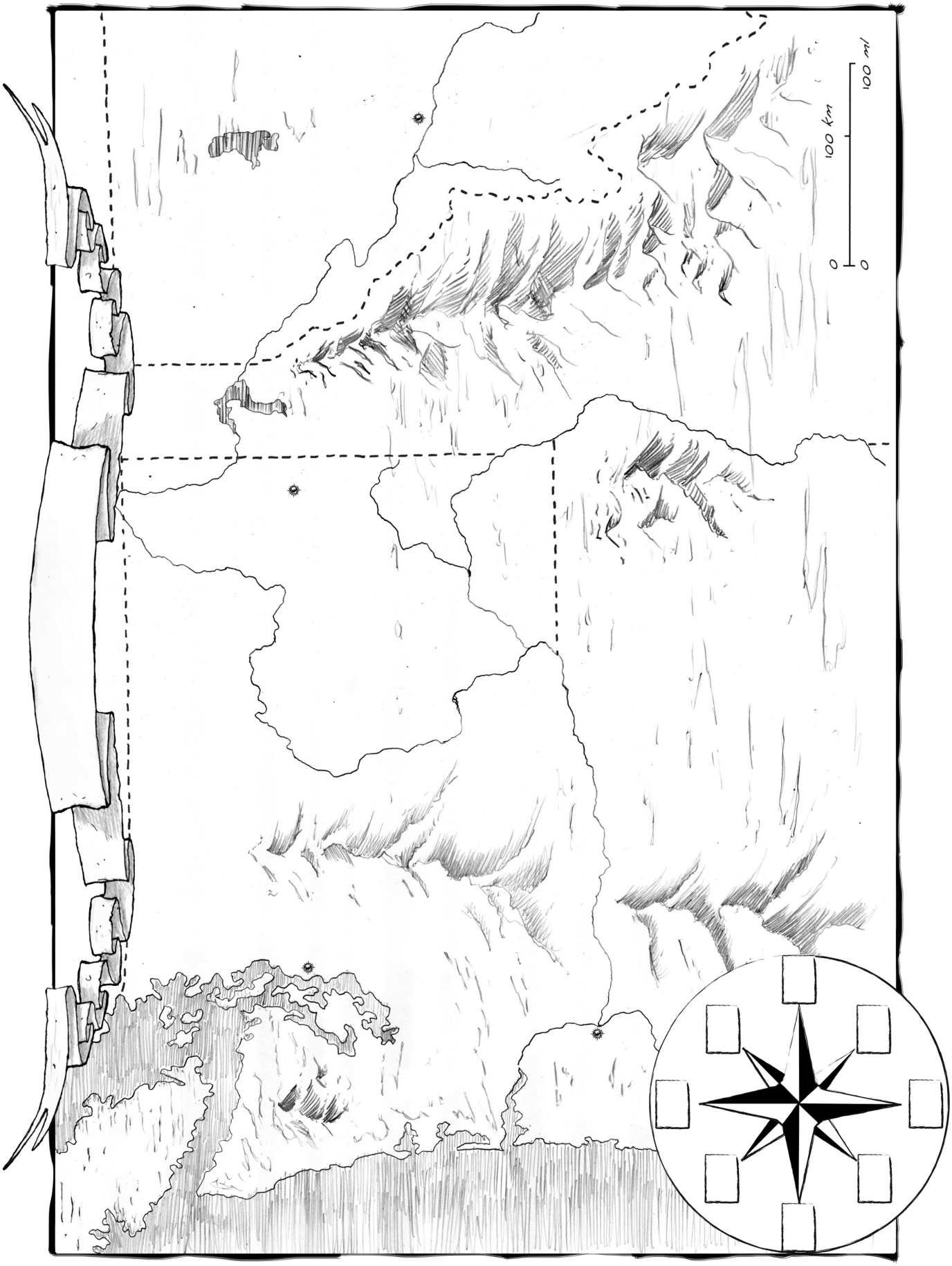
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LESSON 1: PRE-READING

OBJECTIVE

Provide an overview of the ice age and the Missoula Floods. Students will share prior knowledge and connect it to new information.

MATERIALS

- *Terra Tempo Ice Age Cataclsym!*
- Student Workbook
- Crayons/colored pencils

TIME

20-30 minutes

PROCEDURE

1. Ask students to use their copy of the book to find the answers to the following questions found in their student workbook.
    a. What is the full title of this book?
        i. Terra Tempo: Ice Age Cataclysm!
    b. What are the three main characters' names?
        i. Caleb, Jenna, Ari (be sure to distinguish between the characters names and the authors')
    c. What type of cataclysm, or disaster is this book about?
        i. The Missoula Floods
    d. Describe what you think will happen in this book.
        i. The kids go back to the ice age and witness the Missoula Flood
2. Discuss their answers.
3. Have students brainstorm what they already know and want to learn about the ice age on their KWL charts. Ask them to share out what they already know, and what they want to know. (The last column will be filled out after reading the last chapter.)

WHAT DO *I KNOW* ABOUT THE ICE AGE?	WHAT DO *I WANT* TO LEARN ABOUT THE ICE AGE?	WHAT HAVE *I LEARNED* ABOUT THE ICE AGE?

4. Have students color and personalize their Student Workbook cover

BACKGROUND: THE MISSOULA FLOODS

The great flood depicted in this story really happened! In fact, evidence suggests that this flood may have happened many times. Geologists are still working to determine exactly how many floods there were, but we can be sure that they did happen, they were the most powerful and destructive floods to have ever occurred on Earth.

Glacial Lake Missoula appears to be the source of all the water. At its peak capacity, the lake was 2,000 feet deep and contained 500 cubic miles of water. That's more than Lake Erie and Lake Ontario combined!

When the ice dam broke, it released a huge mass of water and ice and swept across parts of Idaho, Washington, and Oregon. At the breach of the ice dam, the water moved at a speed ten times the combined flow rate of all the rivers in the world today. Moving at such a high rate, the water and ice actually shook the ground as it traveled toward the Pacific Ocean. It stripped away thick soils and cut deep canyons in the bedrock underneath.

The floodwaters moved across central Washington in braided channels and massive surges of water up to 600 feet tall. The floodwaters would have reached speeds of about 65 miles per hour, draining the lake in only 48 hours. Take a moment to think about that! That's an amazing amount of water moving at incredible speeds!

When the floods subsided, the ice dam would reform and eventually the great floods would happen again. In a period of 2,000 years there may have been upwards of 40 separate flood incidents.

STANDARDS

LANGUAGE ARTS

EL.03.RE.09/ EL.04.RE.07/ EL.05.RE.07- Draw upon a variety of comprehension strategies as needed—rereading, self-correcting, summarizing, class and group discussions, generating and responding to essential questions, making predictions, and comparing information from several sources.
EL.03.RE.20- Use titles, tables of contents, chapter headings, illustrations, captions, glossaries, and indexes to locate information in the text.
EL.03.RE.25- Demonstrate comprehension by identifying answers to questions about the text.
EL.03.RE.32-Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
EL.04.RE.17- Locate information in titles, tables of contents, chapter headings, illustrations, captions, glossaries, indexes, graphs, charts, diagrams, and tables to aid understanding of grade level text.
EL.04.RE.22- Make and confirm predictions about text using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, and important words.
EL.05.RE.18-Use features of informational texts, such as formats, graphics, diagrams, illustrations, charts, maps, and organizational devices to find information and support understanding.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.

SOCIAL SCIENCES

SS.03.HS.02- Understand events from local history.
SS.03.SA.02- Gather information relating to an issue or problem.

LESSON 2: CHAPTER 1 – LOCKED DESK

OBJECTIVES

Students will define new vocabulary. Students will read and answer chapter questions, and orient and label the map.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook
- Crayons/Colored pencils
- Projector
- Map (Teacher Version)

TIME

60 minutes

OPENER

Direct students to the Chapter 1 vocabulary list in their workbooks. Read through the vocabulary list with them. Help them pronounce the words and clarify the definitions when necessary. Some definitions are missing. Tell students that as they read, they should to think about what those words might mean and create their own definitions.

1. Ranging-
2. Mancala- a type of board game
3. Age- geologic period
4. Council Crest-
5. Reverberator-
6. Portal- an entrance or doorway
7. Compass- direction finder
8. Prehistoric-
9. Paleontologist- a person who studies ancient life. They examine fossils for clues about how life has changed throughout the ages.
10. Pleistocene- a period in Earth's history about 2.5 million years ago until 10,000 years ago. This is the time of great ice ages.

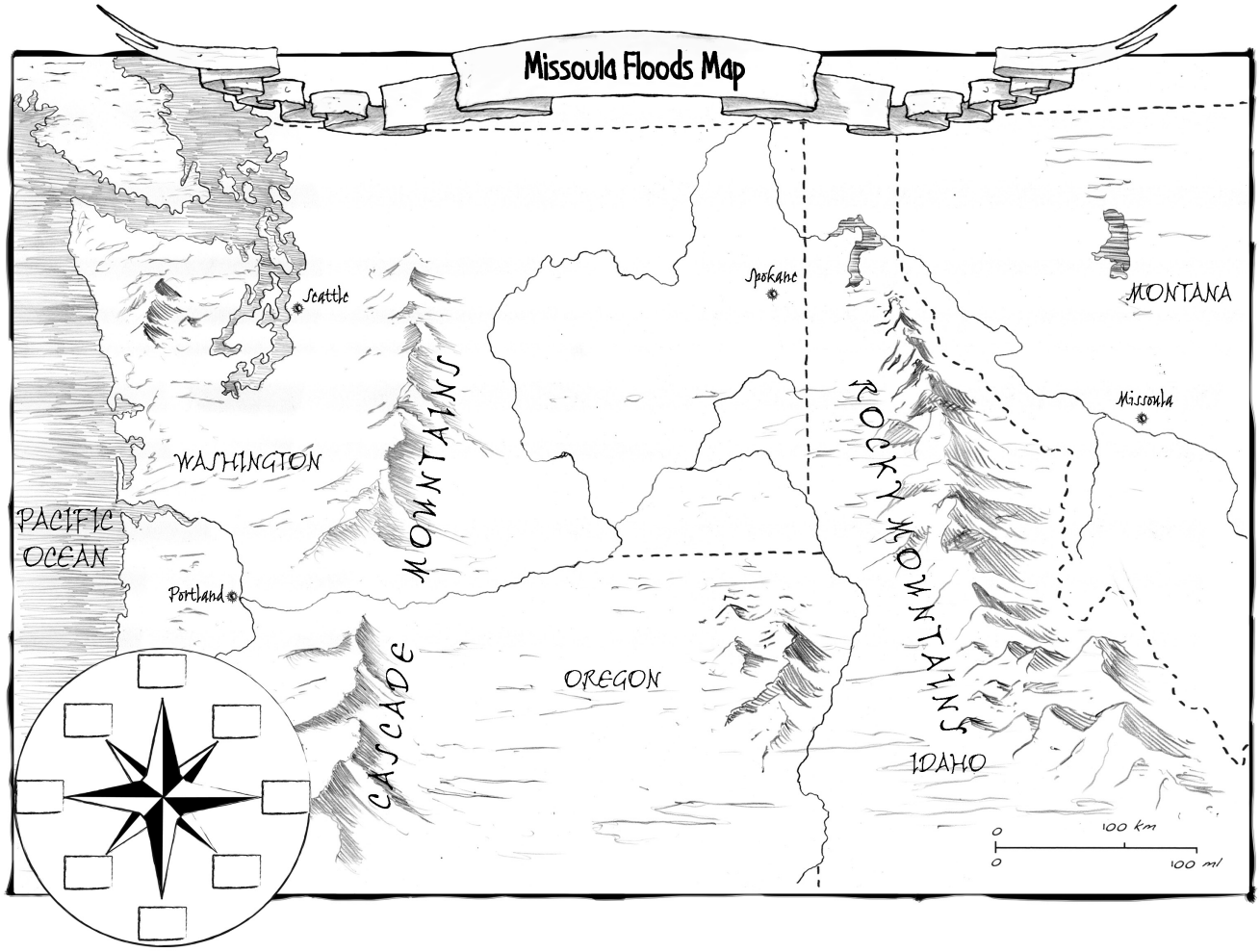
PROCEDURE

1. Read Chapter 1. (This may be done as a class, individually, in groups or pairs, etc…) N.B. If you are reading as a class, have the class try the chant!
2. Have students define the vocabulary words with missing definitions.
3. Ask students to answer the chapter questions:
    a. Whose house are the kids in when they discover the map and journal?
        i. Their Uncle Al and Aunt Maddie's house.

b. What does the journal say needs to happen in order to activate the portal?
    i. Place the magic map in the center of the reverberator and place the compass in its place on the map. When the needle points north, repeat the chant 3x.
c. Ari says his parents found a mammoth skeleton. What do you think they do for a living?
    i. They are paleontologists (see vocab list)
d. What do you think some key differences will be between modern times and the age the kids have traveled to? Give at least three examples.
    i. Different animals, no cars, no phones, etc…

4. Direct students to the ice age map in their workbooks and read over the instructions with them. Projecting the Missoula Floods map, ask students to label their own maps.

e. Label:
    i. Portland
    ii. Seattle
    iii. Missoula
    iv. Cascade Mountains
    v. Rocky Mountains
    vi. Pacific Ocean
f. Have students color or outline to distinguish:
    i. Washington
    ii. Oregon
    iii. Idaho
    iv. Montana



CLOSER

Ask students to check their neighbor's map for completeness.

BACKGROUND INFORMATION: THE PLEISTOCENE

The Pleistocene epoch is a period in time in Earth's history from 2.5 million years ago to 10,000 years ago. This is the time of the great ice ages. The weather was colder and dryer, with less evaporation occurring during the short summers. During this period great ice sheets formed over much of North America, Europe, and Siberia. In many places the ice was thousands of feet thick. There was so much water locked up in ice that ocean levels were 400 feet lower than today. The globe Caleb looks at in Uncle Al's office is a model of the Earth during the Ice Age. Though the continents are all in the same place, the shorelines looked very different than today. The rivers were much larger and there were many huge lakes that no longer exist. The ice sheets would advance and retreat 11 times during the Pleistocene, until finally they melted at the end of the period, about 10,000 years ago, leaving behind the modern landscape we live in today.

STANDARDS

LANGUAGE ARTS

EL.03.RE.04/EL.04.RE.01/EL.05.RE.01-Read aloud grade-level narrative text and expository text fluently and accurately with appropriate pacing, change in voice, and expression.
EL.03.RE.07/EL.04.03/EL.05.RE.03- Listen to, read, and understand a wide variety of grade-level informational and narrative text.
EL.03.RE.09/ EL.04.RE.07/ EL.05.RE.07- Draw upon a variety of comprehension strategies as needed—rereading, self-correcting, summarizing, class and group discussions, generating and responding to essential questions, making predictions, and comparing information from several sources.
EL.03.RE.12/EL.04.09/EL.05.RE.09- Understand, learn, and use new vocabulary that is introduced and taught directly through orally read stories and informational text as well as student-read stories and informational text.
EL.03.RE.15- Use sentence and word context to find the meaning of unknown words.
EL.03.RE.25- Demonstrate comprehension by identifying answers to questions about the text.
EL.03.RE.32-Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
EL.04.RE.11/EL.05.RE.11- Determine meanings of words using contextual and structural clues.
EL.04.RE.22- Make and confirm predictions about text using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, and important words.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.

SOCIAL SCIENCE

SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
SS.03.GE.02- Understand the purpose of maps, globes, and other geographic tools.
SS.03.GE.03- Identify major physical features and describe how they are represented on maps, globes, and other tools.
SS.03.GE.04- Identify physical characteristics of places and compare them.
SS.03.HS.02- Understand events from local history.
SS.03.SA.02- Gather information relating to an issue or problem.
SS.05.GE.01.01- Know and use basic map elements to answer geographic questions or display geographic information.
SS.05.GE.02.01- Use maps and charts to interpret geographic information.
SS.05.GE.03.03- Locate, identify, and know the significance of major mountains, rivers, and land regions of Oregon.
SS.05.GE.04.01- Identify and locate major landforms, bodies of water, vegetation, and climates found in regions of the United States.

LESSON 3: CHAPTER 2 – THUNDERBIRD

OBJECTIVE

Students will diagram the process of the flood and visualize comparative measurements to understand the scope. Students will construct vocabulary definitions and answer comprehension questions about the reading.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook

TIME

50-60 minutes

OPENER

Ask students to evaluate the maps they labeled yesterday (places they labeled in the Pacific Northwest). Ask students to predict where on the map the kids have gone. (Hint: they are going to be in the same location, Portland, but it will look different because they have traveled over 10,000 years back in time.)

PROCEDURE

1. Before reading, go over the vocabulary with students. Inform students that they will need to create the missing definitions from the information provided in the chapter.

1. Invocation- calling upon a spirit or god for help
2. Mythic-
3. Carnivore- meat eater
4. Flow rate-
5. Climate- the general weather conditions of a region, such as temperature
6. Ice Dam- when ice acts as a dam, blocking water and causing it to pool
7. Scoured-

2. Read Chapter 1. (This may be done as a class, individually, in groups or pairs, etc.) NB If you are reading as a class, have them try the chant!

3. Have students define the vocabulary words with missing definitions.

4. Ask students to answer the chapter questions:
    a. Describe how the kids escape the short-faced bear.
        i. They chant the helpful invocation they found in the journal, which summons a mythic creature called a Thunderbird.
    b. The kids are in the same geographic location as Council Crest, but over 15,000 years

earlier. What differences do you recognize? Were your predictions correct?
    i. There is no sign of the city, or human life. Instead, most of Portland is covered by water and there is a huge bear!
c. What does Ari say is happening that is causing all the water.
    i. The Missoula Floods.
d. Summarize some effects of the climate change at the end of the ice age.
    i. The climate was getting warmer so the ice turned to water. Ari says it could have been called the *the melt off age*.
e. The kids are the blinking red dot on the map. What is the name of the blinking blue dot that they are heading towards?
    i. The Wallula Gap

5. Have the students use Ari's description of the The Missoula Floods to fill in the graphic organizer.

CLOSER

Read students the information about J Harlen Bretz located in the background information section. Bretz's theory about the great flood was ridiculed and rejected by scientists. Ask students if they know of any other scientists whose ideas were originally rejected but are now accepted? Discuss what obstacles these scientists face.

THE MISSOULA FLOODS

See background information from Lesson 1.

J HARLEN BRETZ

In 1923, after studying the odd landforms of the Channeled Scablands of central Washington, geologist J Harlen Bretz published the first in a series of scientific papers in which he proposed that a huge cataclysmic flood must have carved the features he had been studying. Bretz was not able to say where the water had come from, but he was sure that a flood had occurred. Bretz's idea was met with resistance and even ridicule. Bretz was not one to back down and he continued to defend his idea until 1940 when another geologist, Joseph T. Pardee reported his findings on the giant 50-foot-high ripple marks, spaced 200-500 feet apart at the exit way of Glacial Lake Missoula. By 1950, with the help of aerial photography, evidence of the floods was overwhelming, and most geologists accepted the idea of the Great Missoula Floods.

STANDARDS

LANGUAGE ARTS

EL.03.RE.04/EL.04.RE.01/EL.05.RE.01-Read aloud grade-level narrative text and expository text fluently and accurately with appropriate pacing, change in voice, and expression.
EL.03.RE.07/EL.04.03/EL.05.RE.03- Listen to, read, and understand a wide variety of grade-level informational and narrative text.
EL.03.RE.09/ EL.04.RE.07/ EL.05.RE.07- Draw upon a variety of comprehension strategies as needed—rereading, self-correcting, summarizing, class and group discussions, generating and responding to essential questions, making predictions, and comparing information from several sources.
EL.03.RE.12/EL.04.09/EL.05.RE.09- Understand, learn, and use new vocabulary that is introduced and taught directly through orally read stories and informational text as well as student-read stories and informational text.
EL.03.RE.15- Use sentence and word context to find the meaning of unknown words.
EL.03.RE.25- Demonstrate comprehension by identifying answers to questions about the text.

EL.03.RE.30- Distinguish cause-and-effect and fact and opinion.
EL.03.RE.32-Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
EL.04.RE.11/EL.05.RE.11- Determine meanings of words using contextual and structural clues.
EL.04.RE.20- Identify and/or summarize sequence of events, main ideas, facts, supporting details, and opinions in informational and practical selections.
EL.04.RE.22- Make and confirm predictions about text using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, and important words.
EL.05.RE.21- Recognize and/or summarize sequence of events and main ideas presented in informational texts, identifying evidence that supports those ideas.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.

SOCIAL SCIENCE

SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
SS.03.HS.02- Understand events from local history.
SS.03.GE.04- Identify physical characteristics of places and compare them.
SS.05.GE.01.01- Know and use basic map elements to answer geographic questions or display geographic information.
SS.05.GE.02.01- Use maps and charts to interpret geographic information.
SS.05.GE.04.01- Identify and locate major landforms, bodies of water, vegetation, and climates found in regions of the United States.
SS.05.HS.02- Identify cause and effect relationships in a sequence of events.

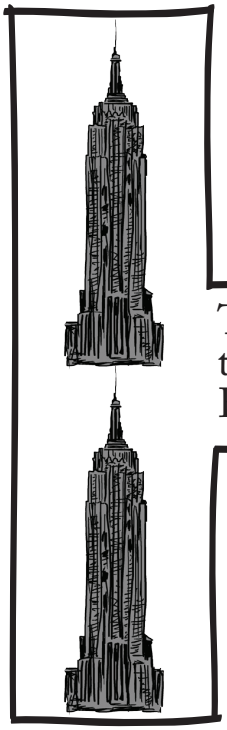
THE MISSOULA FLOODS: AKA THE BRETZ FLOODS

A MASSIVE ICE DAM BLOCKS THE CLARK FORK RIVER

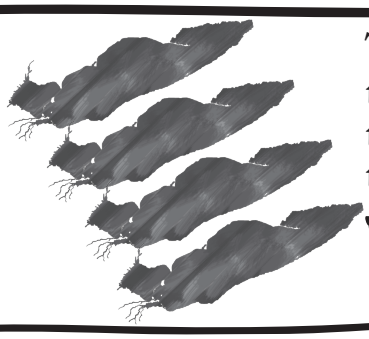
WATER BACKS UP BEHIND DAM CREATING A LAKE

THE ICE DAM BROKE LETTING ALL THE LAKE WATER OUT

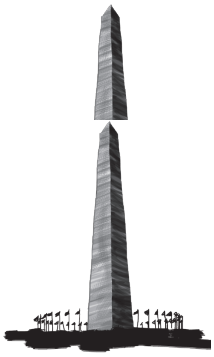
THE WATER FLOWED ALL THE WAY FROM IDAHO TO THE PACIFIC OCEAN



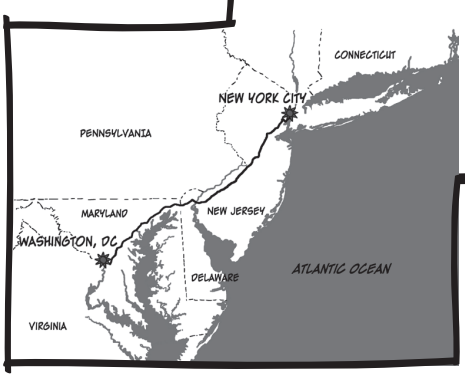
The Ice Dam was two times as high as the Empire State Building.



The water that formed the lake would be more than four times larger than Lake Erie.



When the dam broke, it let loose a wave of water 1 1/2 times the height of the Washington Monument and moving 350 times faster than the Mississippi River.



The water traveled more than twice the distance from Washington D.C. to New York City.

LESSON 4: CHAPTER 3 – THE GAP

OBJECTIVES

Students will summarize the three planetary cycles. Students will create a visual aid illustrating the third planetary cycle and how the Earth's axis works like a top.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook
- Earth top pattern
- Zodiac Dial
- Scissors
- Glue/tape
- Colored pencils/crayons
- Projector with slides: Portland, Columbia River Gorge, Wallula Gap

TIME

60-80 minutes

OPENER

Review the characters' journey from Chapter 2. Project the following slides: Portland, Columbia River Gorge, and the Wallula Gap. Have students find and mark these locations on their map.

KEY CONCEPT

As the position of the Earth rearranges the seasons change, which means the climate of Earth changes.

PROCEDURE

1. Please go over the vocabulary before reading and use as a reference during reading.

   Orbit- the path of a celestial body (such as asteroids, moons, planets, stars) or an artificial satellite as it revolves around another body
   Elliptical- a shape resembling an oval or a cross section of a cone –provide visual
   Sum- the total or result of adding
   Tilt- to lean, slope or slant
   Zodiac- an imaginary belt of the heavens within which are the apparent paths of the sun, moon, and principal planets. It contains twelve constellations and hence twelve divisions called signs of the zodiac.
   Ecliptic- a great circle on the celestial sphere representing the sun's apparent path during the year. So-called because lunar and solar eclipses can occur only when the moon crosses it.
   Equinox- either of two points on the planet at which the ecliptic intersects the celestial equator.

2. Read Chapter 3. (This may be done as a class, individually, in groups or pairs, etc.) NB This chapter is more complex and contains a higher level of difficulty than the previous chapters. We recommend reading together or in a group!

3. Ask students to answer the chapter questions:

    a. Caleb is trained in survival skills. What does he say they need to accomplish? Build a shelter, then a fire, then find water, then eat. Explain why each is important to surviving in the wild.
        i. Shelter: A shelter will protect you from the elements and provide you with a sense of security from the world outside while you sleep. The main function of a shelter is to keep you dry.

        ii. Fire: It is very important to stay warm and a fire will help you do that. Fire demands respect, because although it can keep you alive, it can also cause great harm and damage. Always make a fire ring to contain your fire and always be safe.

        iii. Water: Water is more important to the body than food. But that water must be clean, fresh water. In the story, Jenna finds water from a spring. If you are in a real survival situation, it is important that the water you drink be fresh!

        iv. Food: Though we all love to eat, food is not as important as the other things listed above. A person can live for over a month without food, whereas they can only live about a week with no water. In the story the kids live off the picnic basket contents as well as berries and rabbit.

    b. How did Uncle Al first get the map?
        i. He found the map stacked with others while preparing for a geology field trip.
    c. How does the map work, according to Uncle Al's journal entry?
        i. It works with your thoughts, wants, and needs and depends on the right timing, the right placement, and the right chant.
    d. The characters learn that the stars look different in the Ice Age because Earth has gone through changes in position, tilt, and orbit. Read the summary of the three planetary cycles and draw an illustration to represent the meaning. Then describe how these cycle changes affect the climate of Earth: (consult background info)

PLANETARY CYCLE	ILLUSTRATION	HOW WOULD THIS EFFECT EARTH'S CLIMATE & SEASONS?
Cycle 1: The orbit of Earth around the sun cycles from a circle to an ellipse about every 100,000 years. This changes the distance from Earth to the sun.	See book for examples	As the Earth gets closer to the sun, the climate gets hotter, and as it gets farther from the sun it gets cooler.
Cycle 2: The tilt of the Earth's axis cycles from 20.4 degrees to 26.2 degrees every 42,000 years. The greater the tilt, the more variation in seasons	See book for examples	The greater the tilt, the colder the winter gets and the hotter the summer gets. The smaller the tilt, the less change there is between winter and summer.
Cycle 3: Earth's axis wobbles like a top as it spins, changing the location of the pole, stars, and the view of the Zodiac constellations. This helps chart time and location. If the Earth had no wobble, the tilt of the axis would straighten to 0 degrees (think of Cycle 2).	See book for examples	If there wasn't a wobble the axis tilt would be zero and there wouldn't be seasonal changes. Some places would be in continual summer, others in constant winter!

e. What was the theory that Milutin Milankovitch put together?
   i. As the position of the earth rearranges, the amount of solar radiation the Earth receives is different, which causes the intensity of seasons to vary, thus climates change.

ACTIVITY

Earth Top is an activity to demonstrate the third planetary cycle, our current cycle, known as the precession of the equinox.

1. Cut out the Earth top pattern (coloring is optional).
2. Tape the folds on the pattern together to form a 3D diamond shaped Earth.
3. Cut small holes in the North and South Poles.
4. Finally, cut out and roll the instruction box and insert it into the holes cut at the poles. This represents Earth's axis.

DEMONSTRATE

Place your Earth Top on the planet Earth in the center of the Zodiac Dial and gently spin. When the top falls over, the zodiac sign(s) it lies on is the constellation visible to Earth at night. The constellation opposite on the dial is obscured behind the sun and will not show up in the night sky for another 6 months! For example, when Capricorn is visible, Cancer is not. Also notice the change in the North axis of the top points. This is comparable to the changing pole star, which occurs due to the Earth's top-like wobble.

DEMONSTRATE

We keep referring to a top-like wobble. Spinning a quarter can be a good demonstration of what we mean. As the quarter's spin slows down, it wobbles similarly to the Earth's wobble as it rotates in space.

CLOSER

Have students describe how spinning their Earth Top is similar to the Third Cycle. Ask students if they know which constellations are visible in the night sky, or which constellation the sun was located at when they were born—their astrological sign.

BACKGROUND

The Earth rotates around its north–south axis. While making daily rotations around its axis, Earth is also making yearly revolutions as it orbits the sun. The Earth's revolution around the sun is what makes the sun appear to move eastward. The motion of the sun is really caused by our changing point of view from Earth as Earth orbits the sun. The setting and rising of the sun is caused by Earths daily rotation around its north–south axis. As the Earth rotates away from the sun we get night, and when it circles back to face the sun we have day.

ZODIAC CONSTELLATIONS

The ancient astronomers observed shapes in the stars and described the patterns as animals, humans, half-animals, and mythical creatures. The constellations that make up the Zodiac form an imaginary belt in the sky encircling the ellipse that the earth moves along in its orbit around the sun. There are 12 constellations, which appear along the path the sun seems to follow in the sky as Earth moves around it. The constellations are usually visible for three months at a time but can vary depending on the latitude of your location.

THE FIRST CYCLE

The Earth's orbit around the sun varies from circular to elliptical every 100,000 years. This variation from circle to ellipse changes the distance between the Earth and the sun by 12,000,000 miles! The current orbit of Earth around the sun is not a perfect circle but an ellipse. Therefore, Earth's distance from the sun varies; Earth is closest to the sun in January and farthest in July. The current variation in distance between the Earth and the sun in its orbit is so small it does not affect the climate on Earth. But the other planets (excluding poor, downgraded Pluto) orbit the sun on the same plane as Earth. Think of a round cake pan. The sun sits in a hole in the middle of the pan. Imagine the planets as marbles, those marble roll around the sun on the pan but cannot move up or down. They only move around on the surface of the pan. This is called the elliptic plane! The planets exert gravitational forces upon Earth as they all orbit in their elliptic plane and cause the shape of Earth's orbit to cycle from ellipse to circle. They can change the distance from Earth to the sun by 12,000,000 miles, which would certainly affect the climate of Earth. Imagine the change to Earth being 12,000,000 miles closer to the sun!

THE SECOND CYCLE

Currently, the Earth's rotational axis is tilted 23.45 degrees (with respect to a vertical line perpendicular to the elliptic plane of the solar system). This angle varies cyclically from 20.4 to 26.2 degrees about every 42,000 years (our tilt is at the midpoint between the two extremes). A greater tilt brings more severe seasons, while a smaller tilt brings less change. If the angle of the tilt were 0 there would be no seasonal variations! This tilt also changes our view of the stars from the ground.

THE PRECESSION, THIRD CYCLE

The Earth's rotation on its axis has caused Earth's shape to diverge from a perfect sphere. It bulges around the equator. The sun and moon exert a gravitational pull or tug on the Earth's bulge, and this tug (along with the Earth's daily rotation) causes the Earth to wobble about its axis, like a top or

spinning quarter. This wobble is called the precession. If a pen were attached to the Earth's axis as it rotated it would draw a conical shape. The period of time for this conic figure is 26,000-year rotation, the Earth's axis points to a different star along the way, which becomes Earth's north star. Our current north star is Polaris. **Thuban** was the pole star in 3000 BCE, when *Terra Tempo* takes place. Keep in mind that the zodiac constellations are not oriented on the north-south axis around Earth's orbit of the sun like the pole stars, but around the middle of the orbit, like a belt. Some of that belt is obscured behind the sun while we can see others in our night sky, and as the seasons change we leave those constellations behind and proceed to the next in the cycle. If the Earth were not rotating, its axis would straighten perpendicular to the elliptical plane and the degree of the axis's tilt would be 0!

STANDARDS

LANGUAGE ARTS

EL.03.RE.04/EL.04.RE.01/EL.05.RE.01-Read aloud grade-level narrative text and expository text fluently and accurately with appropriate pacing, change in voice, and expression.
EL.03.RE.07/EL.04.03/EL.05.RE.03- Listen to, read, and understand a wide variety of grade-level informational and narrative text.
EL.03.RE.09/ EL.04.RE.07/ EL.05.RE.07- Draw upon a variety of comprehension strategies as needed—rereading, self-correcting, summarizing, class and group discussions, generating and responding to essential questions, making predictions, and comparing information from several sources.
EL.03.RE.12/EL.04.09/EL.05.RE.09- Understand, learn, and use new vocabulary that is introduced and taught directly through orally read stories and informational text as well as student-read stories and informational text.
EL.03.RE.25- Demonstrate comprehension by identifying answers to questions about the text.
EL.03.RE.30- Distinguish cause-and-effect and fact and opinion.
EL.03.RE.32-Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
EL.04.RE.20- Identify and/or summarize sequence of events, main ideas, facts, supporting details, and opinions in informational and practical selections.
EL.04.RE.22- Make and confirm predictions about text using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, and important words.
EL.05.RE.21- Recognize and/or summarize sequence of events and main ideas presented in informational texts, identifying evidence that supports those ideas.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

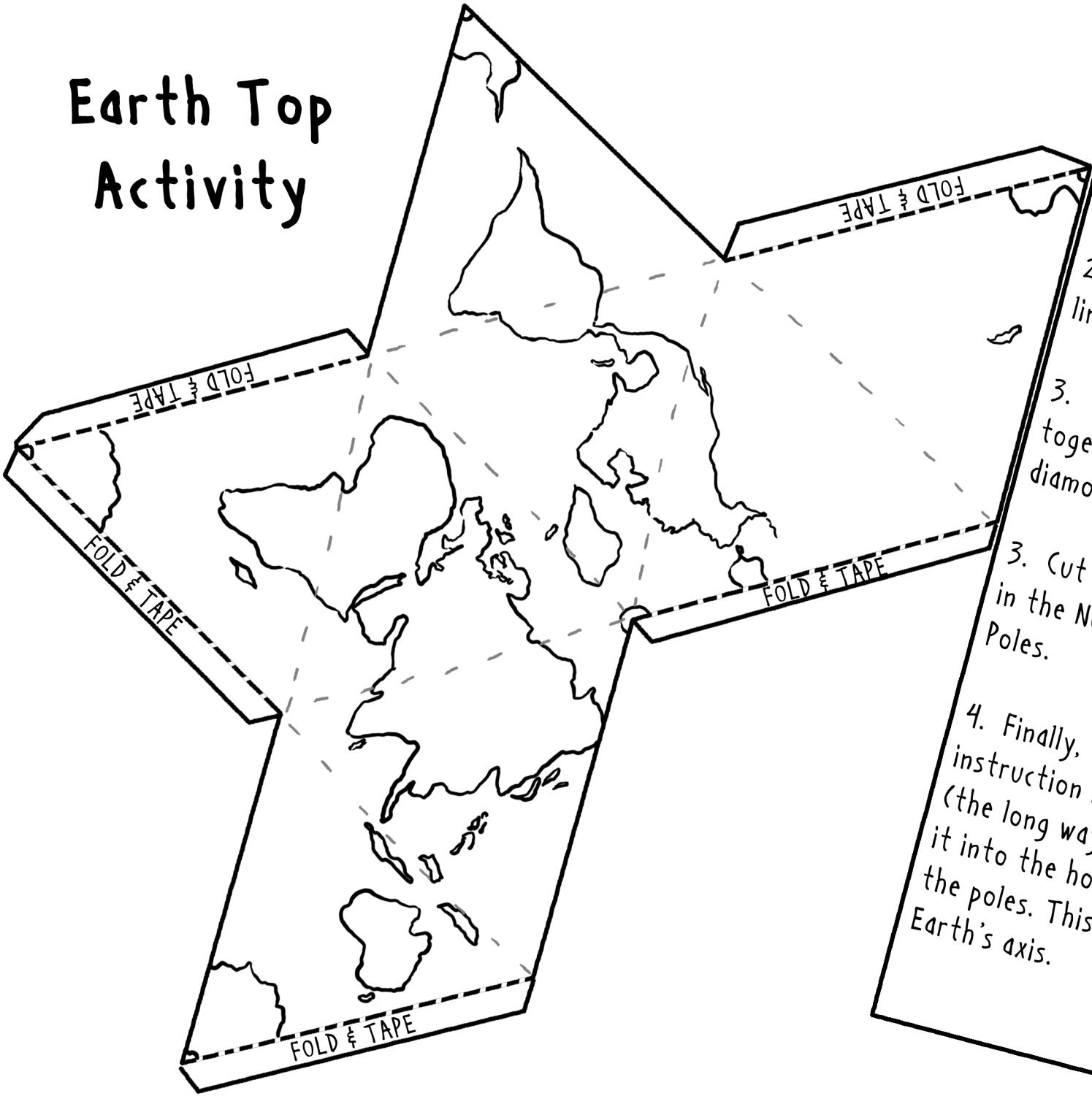
3.2P.1- Describe how forces cause changes in an object's position, motion, and speed.
3.2E.1- Identify Earth as a planet and describe its seasonal weather patterns of precipitation and temperature.
4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.
5.1E.1- Describe the Sun-Earth-Moon system.
5.2E.1- Explain how the energy from the sun affects Earth's weather and climate.

SOCIAL SCIENCE

SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
SS.03.HS.02- Understand events from local history.
SS.03.GE.04- Identify physical characteristics of places and compare them.
SS.05.GE.01.01- Know and use basic map elements to answer geographic questions or display geographic information.
SS.05.GE.02.01- Use maps and charts to interpret geographic information.
SS.05.GE.04.01- Identify and locate major landforms, bodies of water, vegetation, and climates found in regions of the United States.
SS.05.HS.02- Identify cause-and-effect relationships in a sequence of events.

Capricorn
Sagittarius
Scorpio
Libra
Virgo
Leo
Cancer
Gemini
Taurus
Aries
Pisces
Aquarius

Earth Top Activity



INSTRUCTIONS

1. Cut out the pattern.
2. Fold along all dotted lines.
3. Tape the marked folds together to form a 3D diamond shaped Earth.
3. Cut or poke small holes in the North and South Poles.
4. Finally, cut out this instruction box, roll it up (the long way!) and insert it into the holes cut at the poles. This represents Earth's axis.

LESSON 5: CHAPTER 4 – THERE'S SO MUCH WATER

OBJECTIVE

Students will describe the term *Glacial erratic*, give an example, and construct a simulation. Students will translate and interpret phrases from the Chinook language.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook
- Projector: Slides of Willamette Meteorite & Dry Falls
- Clay
- Paper plate
- Ice cube

TIME

50 minutes (extension activity additional 20-30 minutes)

OPENER

Review the Key Concept from Lesson 4. Ask students to recall the location of the characters at the end of Chapter 4.

PROCEDURE

1. Go over the definition of glacial erratic.

Glacial erratic- rocks carried by ice and deposited on material different than the rock. Ice can pick up huge amounts of material such as boulders, some large in size and weighing tons, then move them many miles

2. Read Chapter 4. (This may be done as a class, individually, in groups or pairs, etc.)

3. Ask students to answer Chapter Questions:

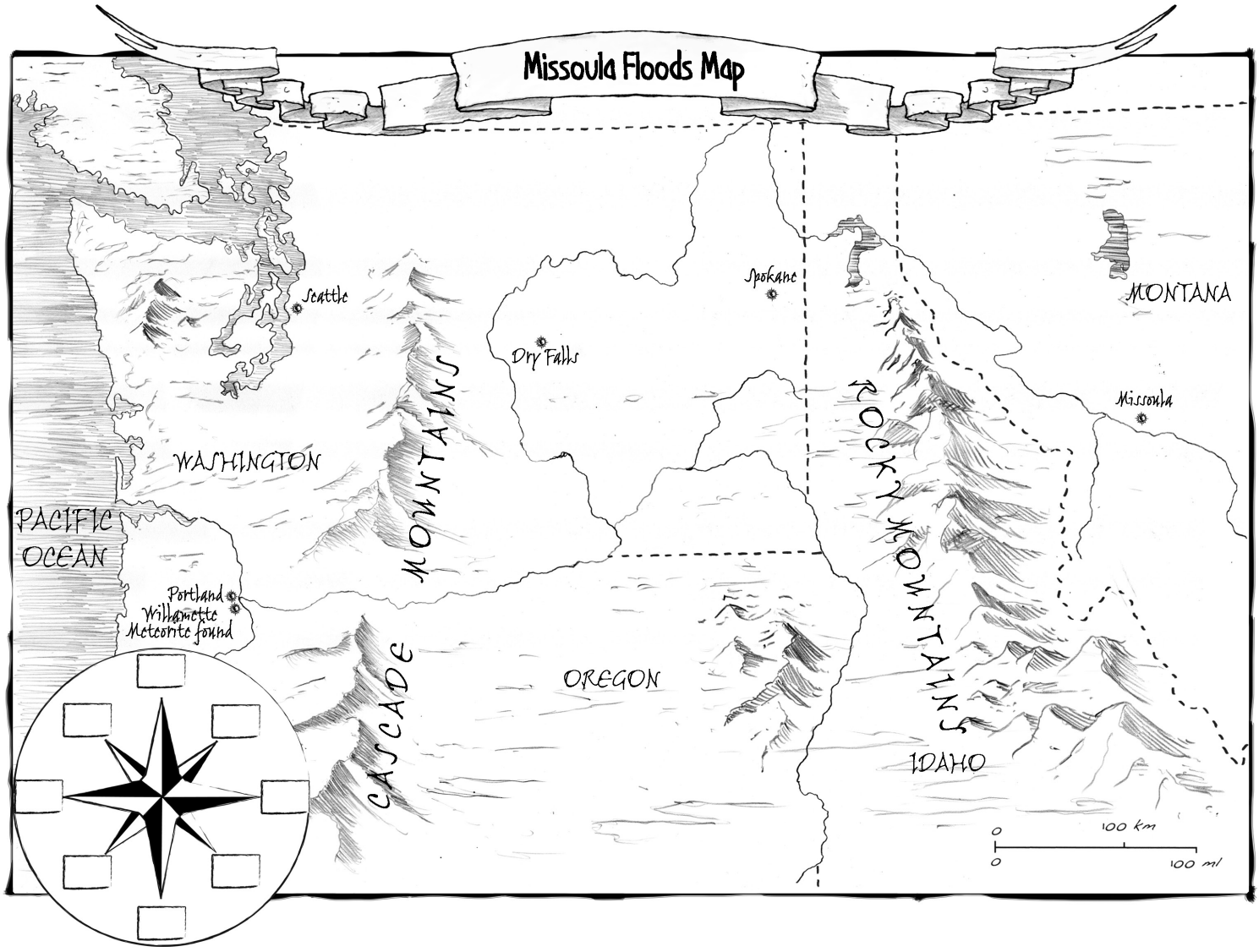
    a. What is the significance, or importance, of the Wallula Gap during the flood?
        i. The Wallula Gap was a narrow passage in the Horse Heaven Hills that caused the flood water to back up and form a really big lake.
    b. What are the three dials called and what do they do?
        i. Precessional Dial- marks time periods of 2,150 years assigned to zodiac constellations.
        ii. Month Dial- marks the lunar, or moon, month periods with zodiac symbols.
        iii. Lunar Dial- counts the days in the lunar month (28).
    c. How did the rock rafting on the iceberg get to its current location?

i. A glacier tore the rock off a mountain, and then the iceberg broke off the glacier and rafted to its present location.

d. What do you observe about the great waterfalls?
   i. There are animals caught in it and it is huge!

e. What is the name of the animal that Caleb sees munching on the tree?
   i. A Jefferson Ground Sloth (extinct).

4. Project the slide of Dry Falls. Read over the information and discuss how Ari says they were formed. Compare them to the falls in the chapter.
5. Project the Range Map and ask students to label Dry Falls on their maps, and where the Willamette Meteorite was found.



6. Project the Slide of the Willamette Meteorite. This is an example of a glacial erratic. Ask students if they can find the hidden picture of the Willamette Meteorite in one of the previous chapters.
7. ***Extension Activity***- If you are going to do the extension activity, this is a good time to do it! See directions below.

TRANSLATION ACTIVITY

- Read the background information about the Chinook language to students.
- Tell them they will be using their Chinook language dictionary to translate some of the chants the characters use.
- The first row has the chant, the second row is for the literal translation of the word, and the third row is for the student interpretation of the translation for the whole chant.

NB Translations are not exact, in the correct sentence order, or necessarily literal, but each student should come up with an idea about what they mean from the definition and the context!

Can you find the meaning of the chants? You may insert some English words into your translation to make complete sentences.

CHANT	KLATAWA	LALY	TUM TUM	WAKE	SIAH	SINAMOKST	SUN	KIMTAH
WORD MEANING	Travel	Time	The Plan, I wish	Not	Far off	Seven	Day	Behind
YOUR TRANSLATION	I wish to time travel, not far, but to seven days ago.							

CHANT	KLATAWA	LALY	TUM TUM	SIAH	HYAS	CHUCK
WORD MEANING	Travel	Time	The Plan, I wish	Far off	Many vast	Water
YOUR TRANSLATION	I wish to time travel to the distant time of much water.					

CHINOOK	ENGLISH	CHINOOK	ENGLISH
Alki	In the future	Lolo	To carry
Alta	Now	Mamook	The act of doing anything
Chako	To become	Mahsie	Thank you
Chuck	Water	Mika	You, yours, thee, thine
Cultus	Worthless	Muck a Muck	Food
Elakha	Sea otter	Nesika	We, our, ours, us
Elan	Aid, help, assistance	Olalie	Berries
Hyas	Many, vast	Polaklie	Night
Illahee	Land, home	Saghalie	Sky, heaven, celestial, uppermost
Ikpooie	To shut	Siah	Far off, distant, remote
Kawak	To fly	Sinamokst	Seven
Kimtah	Behind, after, afterwards	Skookum	Strong, powerful, potent
Killapi	To return	Sun	A day, the sun
Klatawa	Travel	Tahmahnawis	A guardian or familiar spirit, a ghost or magic
Klonas?	Who knows?	Talapus	Coyote
Kloshe	Good	Tukamonuk	One hundred
Kula Kula	Bird	Tum Tum	The plan, the heart, the will, belief, mind
Laly	Time	Tumwata	Waterfall
Lapote	Door	Wake	No, not, none

CLOSER

Have students share and compare their chant translations.

EXTENSION ACTIVITY: SEE PDF

In this activity, students will use ice and clay to construct a model of a glacier moving across the landscape and evaluate how glaciers cause glacial erratics.

1. Give students a piece of clay to flatten into a landscape. They can create land features to replicate a landscape.
2. Next distribute ice cubes and ask students to rub the ice cube across their clay land. The ice should be drawn slowly and in one direction with a little pressure. This should be repeated 7-10 times.
3. Have students place the ice cube on the paper plate to melt and ask them to answer their activity questions:
    a. Describe the changes you see in your clay landscape now that your ice/cube glacier has moved across it.
    b. Can you see any patterns, grooves, or pits that the glacier carved? If so, describe them.
    c. If your clay was really land, explain the effects this ice cube glacier had in forming the current landscape.
    d. Look at your melting ice cube. Is it pure water?
    e. What is the term used to describe the particles of clay in your ice-melt?
    f. Name a famous example of this term!

NB Ice is cold! Student may take short breaks to warm up their fingers but be sure they rest their ice on the plates and continue again in the same position and direction. Some types of clay will dissolve in water. If so, you should be able to see their color in your dissolved ice and know those particles are glacial erratics from your clay.

BACKGROUND: THE CHINOOK LANGUAGE

The language of the chants the kids use to time travel is a real language called Chinook. The Chinook language was a trade jargon used by the Native Americans and the European explorers and traders of the 19th century. The jargon existed before contact with Europeans, as a language of commerce between the peoples of the Columbia River and beyond. The many tribes of the river spoke different languages amongst themselves and had a common trade language to use when encountering a different tribe. When the Europeans arrived, elements of French and English were incorporated into the jargon so that the different nations could understand one another.

The language fell out of common usage by the 1920s, but there are hundreds of place names in Oregon, Washington, Idaho, Montana, Alaska, British Columbia, The Yukon, and Alberta that are words from the jargon.

STANDARDS

LANGUAGE ARTS

EL.03.RE.04/EL.04.RE.01/EL.05.RE.01-Read aloud grade-level narrative text and expository text fluently and accurately with appropriate pacing, change in voice, and expression.
EL.03.RE.07/EL.04.03/EL.05.RE.03- Listen to, read, and understand a wide variety of grade-level informational and narrative text.
EL.03.RE.09/ EL.04.RE.07/ EL.05.RE.07- Draw upon a variety of comprehension strategies as needed—rereading,

self-correcting, summarizing, class and group discussions, generating and responding to essential questions, making predictions, and comparing information from several sources.
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EL.04.RE.22- Make and confirm predictions about text using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, and important words.
EL.05.RE.11 Determine the meanings of words using contextual and structural clues.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

3.2P.1- Describe how forces cause changes in an object's position, motion, and speed.
3.2E.1- Identify Earth as a planet and describe its seasonal weather patterns of precipitation and temperature.
4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.

SOCIAL SCIENCE

SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
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SS.05.GE.01.01- Know and use basic map elements to answer geographic questions or display geographic information.
SS.05.GE.02.01- Use maps and charts to interpret geographic information.
SS.05.GE.03.03- Locate, identify, and know the significance of major mountains, rivers, and land regions of Oregon.
SS.05.GE.04.01- Identify and locate major landforms, bodies of water, vegetation, and climates found in regions of the United States.

LESSON 6: CHAPTER 5 – PLEISTOCENE SAFARI

OBJECTIVES

Students will choose which animals in this book are extinct and hypothesize about their modern relatives. Students will summarize information on extinct animals to create a safari guide. Students will evaluate three theories of extinction and devise their own theory.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook
- Animal PPT
- Projector
- Crayons/colored pencils

TIME

60-80 minutes

OPENER

Ask students to use their Chinook Dictionary to create a greeting.

Example: Kloshe Sun = good day

Or, ask students to translate the longer thunderbird-summoning chant Jenna uses in Chapter 4. Create your own greeting using your Chinook Dictionary or translate the thunderbird-summoning chant that Jenna uses in Chapter 4!

PROCEDURE

1. Before reading, review the meaning of Pleistocene (Lesson 2) in the title of this chapter. Ask students to predict what will happen in the chapter from the title, *Pleistocene Safari.*

   Be sure students are familiar with the term **extinct.**

2. Read Chapter 5. (This may be done as a class, individually, in groups or pairs, etc.) If you are reading together, try pronouncing the Chinook time travel chant as a class 3x! This is one of the chants students translated in Chapter 4!

3. Ask students to answer the Chapter Questions: (there are fewer questions because students are completing a safari guide for this chapter.)

   a. Explain how the characters arrive *before* the flood.
      i. They find a time travel compass on the ground that lines up with their compass, and they use a chant to take them back just before the flood.
   b. Of all the animals the characters have seen so far which is the most interesting to you? Why?
      i. Answers will vary.

4. Display the Animal PPT. There will be two slides for each animal, one with just a picture and another with animal information. Students will use their extinction chart to decide which animals are extinct and what modern animals they think are related to them, **before** you display the animal information slide!
5. Read over the three theories of extinction (in PowerPoint) and ask students to speculate about what they think happened.

THEORIES

1. Hunted to extinction.

2. Changes in the climate were too great for the mammals to adapt to. For instance: Climate change alters plants and there may not have been enough food for these large animals.

3. Disease. New climates have new types of bacteria and viruses that may have killed the large mammals off.

4. Your theory:

ANIMAL	DIED OFF	STILL ALIVE	RELATED TO...	
SABER-TOOTHED CAT	X		LION	
GIANT SHORT-FACED BEAR	X		MODERN BEAR	
JEFFERSON GROUND SLOTH	X		SLOTH	
QUENTIN'S PRONGHORN	X		PRONGHORN	
DIRE WOLF	X		WOLF	
COLUMBIAN MAMMOTH	X		ELEPHANT	
WOOLY MAMMOTH	X		ELEPHANT	
CAMELOPS	X		CAMEL	
WESTERN HORSE	X		HORSE	
ELK		X		
CHICKADEE		X		
LONG HORNED BISON	X		BISON	

ACTIVITY

Pleistocene Safari

Students will create a guide to the animals seen by the characters.

- Students will write a fact about the animal in the dialogue bubble provided. Dialogue for the elk is given as an example.
- Students must include the animal's name.
- Students may then color their guide.


HI! WE'RE ELK. WE'RE ONE OF THE LARGEST SPECIES OF DEER IN THE WORLD!
WE'RE ALSO ONE OF THE LARGEST LAND MAMMALS IN NORTH AMERICA AND EASTERN ASIA. US MALES GROW THESE MASSIVE ANTLERS, WHICH WE SHED EACH YEAR.

STANDARDS

LANGUAGE ARTS

EL.03.RE.04/EL.04.RE.01/EL.05.RE.01-Read aloud grade-level narrative text and expository text fluently and accurately with appropriate pacing, change in voice, and expression.
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EL.04.RE.12- Distinguish and interpret words with multiple meanings by using contextual clues.
EL.04.RE.22- Make and confirm predictions about text using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, and important words.
EL.05.RE.11 Determine the meanings of words using contextual and structural clues.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

3.2L.1- Compare and contrast the life cycles of plants and animals.
4.1L.1- Compare and contrast characteristics of fossils and living organisms
4.1L.1-Describe the interactions of organisms and the environment where they live.
4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.
5.2L.1- Explain the interdependence of plants, animals, and environment, and how adaptation influences survival.

SOCIAL SCIENCE

SS.03.SA.02- Gather information relating to an issue or problem…
SS.05.HS.02- Identify cause-and-effect relationships in a sequence of events.

LESSON 7: CHAPTER 6 – FLOOD PATHS

OBJECTIVES

Students will contrast the pre- and post-flood landscapes. Students will compare the water features on the flood scale with similar water-carved features. Students will evaluate the impact of the great floods on the Northwest. Students will create an Ice Age flood map and compare with modern map.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook
- Projector
- Crayons/Colored pencils

TIME

50-60 minutes

KEY CONCEPT

Water shapes the world around us, and it acts in similar fashions whether in a huge flood, ocean, river, or small stream. This is because water is scale independent.

OPENER

Ask students to share their animal extinction theories from Chapter 5. Ask students to predict what will happen next in the plot.

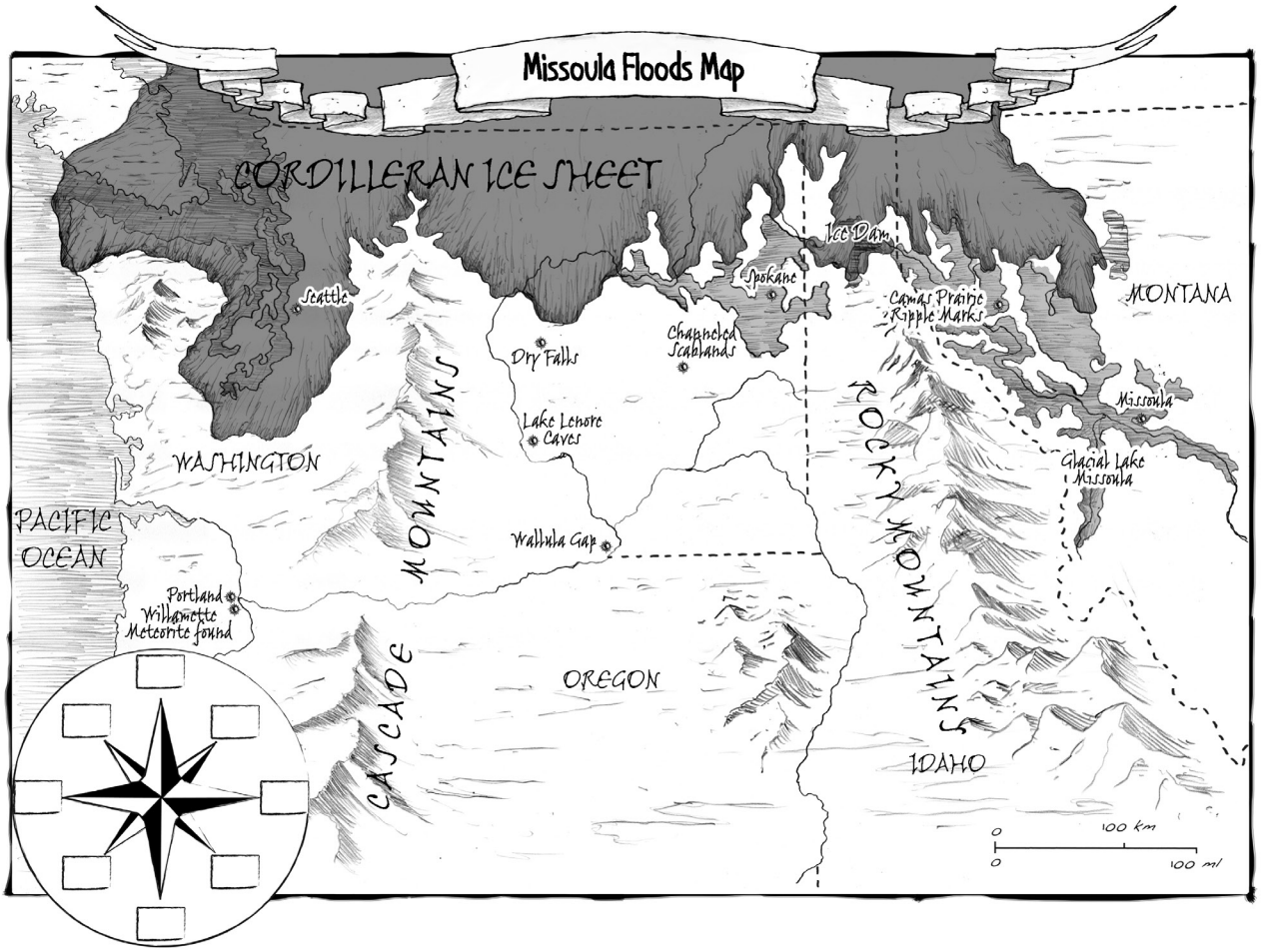
PROCEDURE

1. Read Chapter 6 (This may be done as a class, individually, in groups or pairs, etc…).
2. Instruct students to answer Chapter Questions:
    a. The first lake Jenna, Ari, and Caleb fly over is Lake Columbia. What does Ari say will happen when the ice dam breaks?
        i. The water from Lake Missoula will overflow Lake Columbia and flow across the plains.
    b. In your own words, describe the ice dam and Lake Missoula. (Remember Chapter 2 size comparisons.)
        i. Answers will vary: huge, giant, like a sea…
    c. Once the ice dam breaks and all that water is let loose, it washes across the land. Give at least three observations about the flood and its path.
        i. Many animals drown
        ii. The water created whirlpools
        iii. The water would cover the modern city of Portland
    d. When Ari says he'll never look at water the same way again, what do you think he means?
        i. Answer will vary: The water became such a powerful and force of change and destruction.
    e. How do you think the flood has impacted, or changed the Pacific Northwest? Ex:
        i. Permanently changed the shape of the land
        ii. Destroyed animals, plants, even people

iii. Altered the environment
iv. Moved sediment from Eastern Washington to Willamette Valley, making it fertile

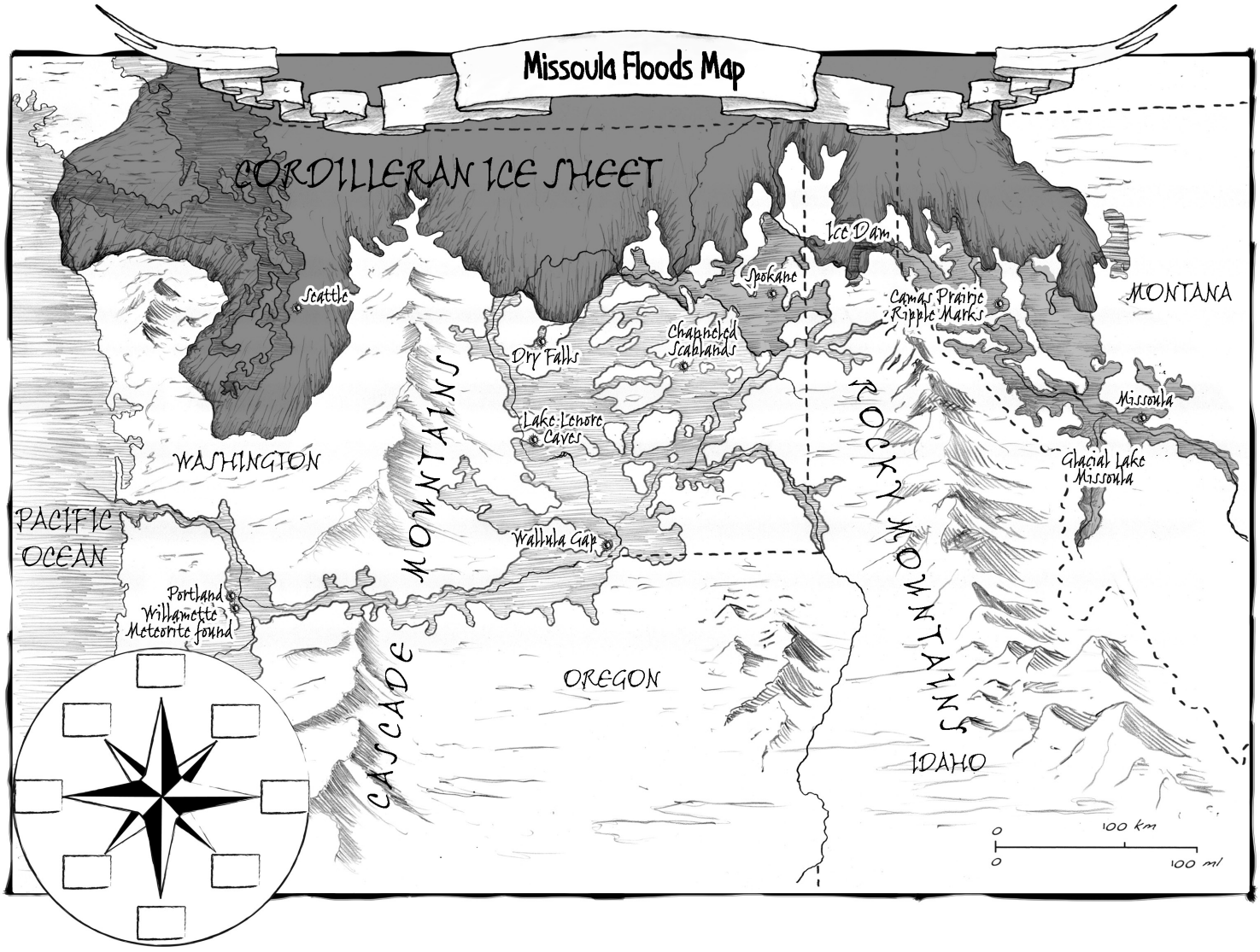
3. Instruct students to turn to their pre-flood map. Project the map under the *Imagine That* tab on the *Terra Tempo: Ice Age Cataclysm!* website. Have students label:
   i. Ice Dam
   ii. Lake Missoula
   iii. Channeled Scablands
   iv. Dry Falls
   v. Camas Prairie Ripples

GLACIAL LAKE MISSOULA STRETCHED FROM THE LAKE MISSOULA POINT ALL THE WAY TO THE ICE DAM. STUDENTS SHOULD SHADE THIS AREA.



NB They should already have Wallula Gap, Columbia River Gorge, Portland, and the Pacific Ocean labeled.

4. As students label, show them the pictures and **read** the information about the features. NB Labels will be approximate!
5. Once students are finished labeling and discussing the information in the slides, project the map under the *Range* tab.
6. Point out the Cordilleran Ice Sheet (which the ice dam was a part of) and have students label and color an approximation on their map.
7. Point out the path of the floodwaters from Lake Missoula all the way to the Pacific Ocean. If you click on the red dots it will show the locations as the characters see them.
8. Have student shade the area of the flood path on their maps.

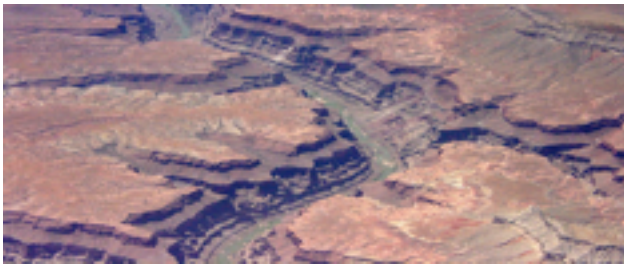


9. Ask students to answer the questions, comparing the map they began with with this Ice Age Flood map!
    a. List at least three things that exist on your Ice Age Flood map that do not exist in modern times:
        i. Cordilleran Ice Sheet
        ii. Glacial Lake Missoula
        iii. Ice Dam
        iv. Water covering much of Eastern Washington and parts of Oregon
    b. The Camas Prairie Ripples, Channeled Scablands, Dry Falls, Lake Lenore Caves, and Columbia Gorge were created or carved in part by water from the Missoula Floods. But water creates similar features whether it's from a great flood, the ocean, a river, or rain! This is because water is **scale independent.** The left-hand column shows similar features to those you labeled on your map. Draw a line connecting the pictures to the ones created during the flood and describe how they are similar and different.

ICE DAM:

In this picture I see ice blocking the flow of water and creating a pond or lake just like the Ice Dam in the Missoula Flood but on a smaller scale.

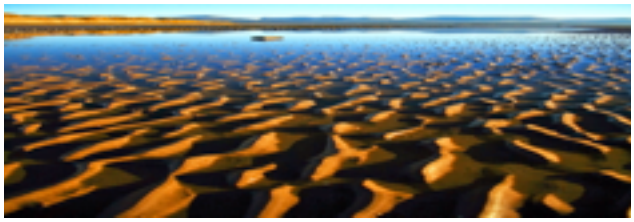
COLUMBIA RIVER GORGE:



CHANNELED SCABLANDS:

LAKE LENORE CAVES:

CAMAS PRAIRIE RIPPLES:



DRY FALLS:

CLOSER

Ask students to describe what it means when you say water is scale independent and give some examples.

BACKGROUND

THE FLOOD PATH TODAY

Do you want to embark upon an epic journey into the heart of flood country? The floods are long gone, but the scenery left behind is outstanding! A family or group of friends can have a wonderful time touring the scenery of the Missoula Flood path. Start at Glacier National Park to view the glaciers that were once part of the vast Cordilleran Ice Sheet that covered much of North America until 10,000 years ago.

The town of Missoula, Montana, is nestled in the hub of the five valleys that were once filled with water, forming Glacial Lake Missoula. You can still see the water marks high up on the mountains at the edge of town!

Sun Lakes State Park in Washington is the home to Dry Falls. There is no longer water flowing over the falls, but the views over the cliff edge are amazing! You can stand at the edge and imagine the power of the flood in full force as you look at what is left of the solid rock that was torn apart so long ago.

The Wallula Gap: Visit the Gap! This opening in the Horse Heaven Hills is accessible by road, boat, and foot! In the springtime the hills are bursting with wildflower color. The views from the top of the gap are awe inspiring.

The Columbia River Gorge: This breathtaking natural landmark is the only sea-level passage through the Cascade Mountains. The waters of the Missoula Floods expanded upon the opening already created by the Columbia River and carved the amazing cliff faces that host some of the tallest waterfalls in the country!

Portland, Oregon: No flood country trip is complete without a visit to Portland! Imagine this modern city under 400 feet of water! From Portland, you can drive south up the Willamette Valley and view the Yamhill Erratic, one of the largest of the huge boulders rafted in ice during the floods from places hundreds of miles to the east, in the Rocky Mountains.

STANDARDS

LANGUAGE ARTS

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SCIENCE

4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.
6.2E.1- Explain the water cycle and the relationship to landforms and weather.

SOCIAL SCIENCE

SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
SS.03.GE.02- Understand the purpose of maps, globes, and other geographic tools.
SS.03.GE.03- Identify major physical features and describe how they are represented on maps, globes, and other tools.
SS.03.GE.04- Identify physical characteristics of places and compare them.
SS.03.HS.02- Understand events from local history.
SS.03.SA.02- Gather information relating to an issue or problem.
SS.05.GE.01.01- Know and use basic map elements to answer geographic questions or display geographic information.
SS.05.GE.02.01- Use maps and charts to interpret geographic information.
SS.05.GE.03.03- Locate, identify, and know the significance of major mountains, rivers, and land regions of Oregon.
SS.05.GE.04.01- Identify and locate major landforms, bodies of water, vegetation, and climates found in regions of the United States.
SS.05.HS.02- Identify cause and effect relationships in a sequence of events.

LESSON 8: CHAPTER 7- COUNCIL CREST

OBJECTIVES

Students will construct a compass. Students will practice using the cardinal directions and their compass to describe locations.

MATERIALS

- Terra Tempo: Ice Age Cataclysm!
- Student Workbook
- Metal paper clip
- Strong magnet (A strong kitchen magnet usually works!)
- String
- Cup
- Pencil or pen

TIME

50-60 minutes

OPENER

Ask students to describe some of the changes caused by the flood (Chapter 6).

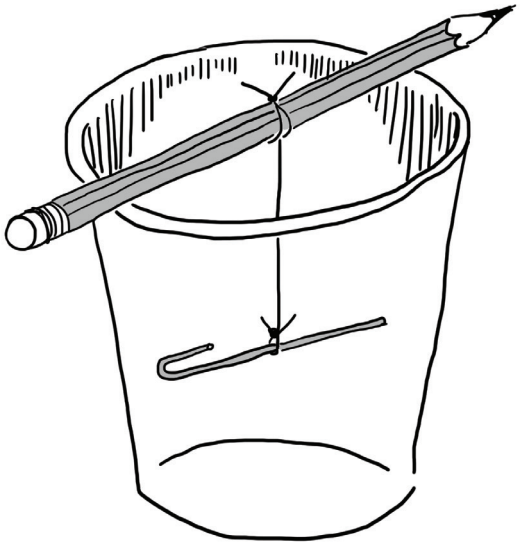
PROCEDURE

1. Read Chapter 7. (This may be done as a class, individually, in groups or pairs, etc.) If you are reading together, try pronouncing the Chinook time travel chant as a class 3x!
2. Ask students to answer the chapter questions.
    a. What do Ari, Jenna, and Caleb need in order to get home to their own time?
        i. A time travel compass and a chant.
    b. Where do the characters find the chant that will send them home?
        i. It fell out of the journal on a piece of paper.
    c. Describe how the kids build a time travel compass.
        i. They build it around a rock with special drawings by placing stones north, east, south, and west.
    d. Use your Chinook dictionary to translate the chant: *Klatawa Laly Tum Tum Killapi Illahee*
        i. I wish to time travel and return home!
3. Activity
    a. You may want to review the following vocabulary before you begin (see background for more information):
        i. Compass
        ii. Magnetic Compass
        iii. Cardinal Directions
        iv. Intermediate Directions
        v. Compass Rose

ACTIVITY: BUILD A COMPASS

The characters have Caleb's compass to help them determine directions and navigate. You will build your own compass and use it to determine directions and answer questions about location. This can be done individually, in pairs, or groups.

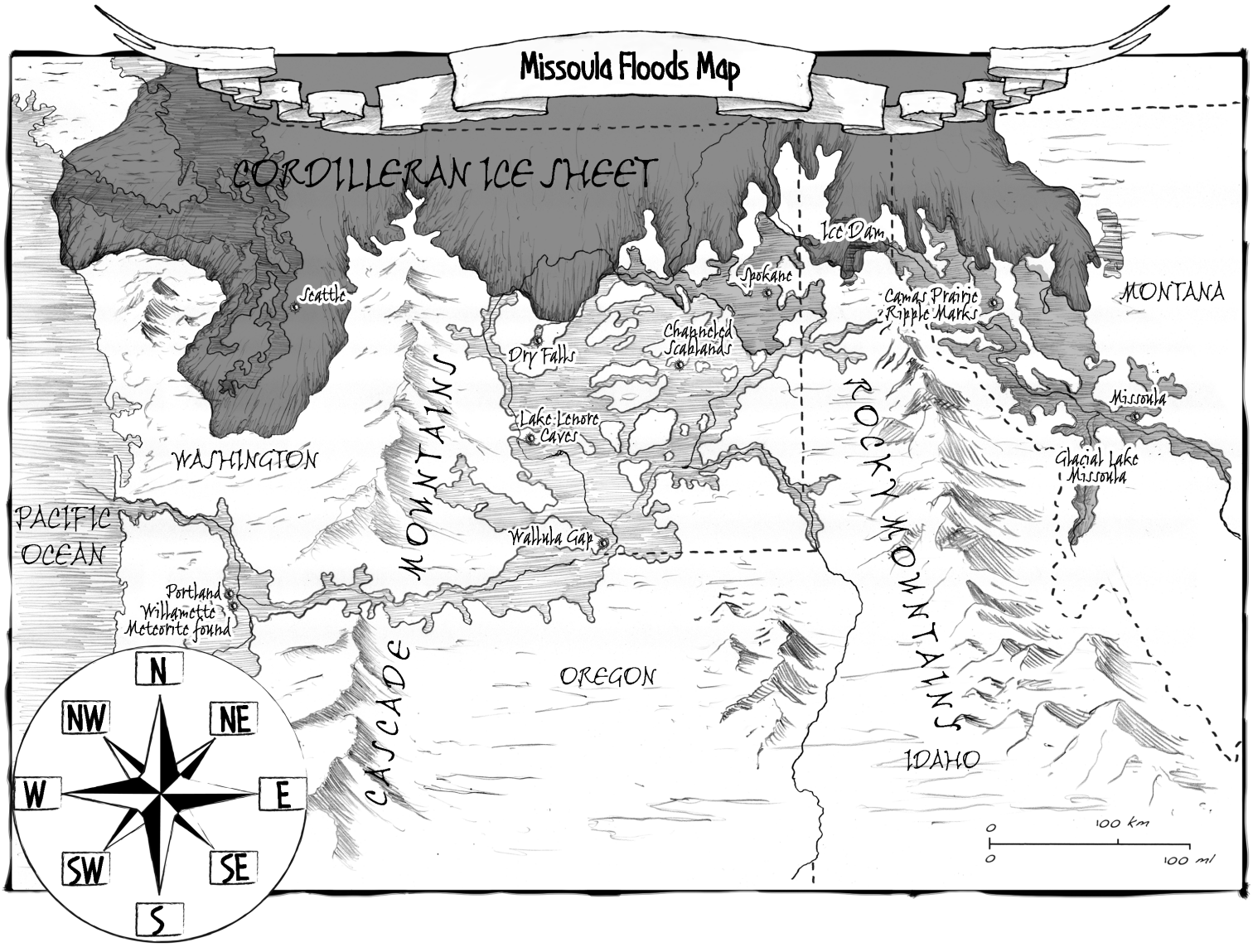
1. First unfold a paper clip so that it is as straight as possible. NB It must fit in the cup horizontally, so small paper clips might be best, or have students fold a bit of the paper clip back over the ends (this may help keep the north and south ends clear).
2. Slowly rub the straightened paper clip in the same direction along a strong magnet 30 times. This will magnetize your paper clip.
3. Put the magnet aside and tie a string from the center of a pencil to the center of the paperclip so that it is balanced and hangs evenly.
4. Place the pencil over the rim of a cup and let the paperclip hang in the center.
5. Watch as the paper clip aligns with Earth's North and South magnetic poles (once the paperclip stops swinging).
    a. To test your compass, rotate the cup and wait for the paper clip to align North/South again. If it does not point the same direction after moving the cup, your paper clip may not be magnetized and you need to repeat #2.
6. Once you have successfully built a compass, compare with others to determine with the class which direction is North, South, East, and West.
7. Draw a compass rose to mark North, Northeast, South, Southeast, Southwest, West, and Northwest. (*Suggestion: Place a piece of paper under your compass cup and mark North, then South, then East and West, but do not move the paper, only the compass*!)
8. Use your compass and compass rose to answer the following: (It may be helpful to answer these questions as a class.)
    a. Which direction is the door from your desk?
    b. Which direction is the teacher's desk?
    c. Which direction is the clock?
    d. To get to the pencil sharpener from your desk, which direction do you need to travel?
    e. What direction is the front office from your classroom?
    f. If your friend stood facing the board with their back to you, what direction would they be facing?
    g. What direction would your friend, the one facing the board, need to travel to get to you?



CLOSER

Ask students to label the compass rose on their completed Ice Age Flood map and align. (Turn the Ice Age map until North on the map's compass rose is parallel with North on the compass rose you made in class.) Use the compass to determine:

- Which direction from your desk is Seattle?
- Which direction is Missoula?



BACKGROUND

The **compass** was invented in Ancient China around 247 BCE, and was used for navigation by the 11th century. The compass was introduced to medieval Europe 150 years later, where the dry compass was invented around 1300.

A **compass** is an instrument that shows the four **cardinal directions** (North, South, East, West) and **intermediate directions** (Northeast, Southeast, Southwest, Northwest). Usually a diagram called a **compass rose** showing direction is marked on the compass.

A **magnetic compass** contains a magnet that aligns itself with Earth's magnetic poles. A compass functions as a pointer to "magnetic north" because the magnetized needle at its heart aligns itself with the lines of the

Earth's magnetic field. The magnetic field exerts a torque on the needle, pulling one end or *pole* of the needle toward the Earth's North magnetic pole, and the other toward the South magnetic pole. When the compass is held level, the needle turns until one end points toward the North magnetic pole. (Allow oscillations to end. This may take a few seconds.)

STANDARDS

LANGUAGE ARTS

EL.03.RE.04/EL.04.RE.01/EL.05.RE.01-Read aloud grade-level narrative text and expository text fluently and accurately with appropriate pacing, change in voice, and expression.
EL.03.RE.07/EL.04.03/EL.05.RE.03- Listen to, read, and understand a wide variety of grade-level informational and narrative text.
EL.03.RE.09/ EL.04.RE.07/ EL.05.RE.07- Draw upon a variety of comprehension strategies as needed—rereading, self-correcting, summarizing, class and group discussions, generating and responding to essential questions, making predictions, and comparing information from several sources.
EL.03.RE.12/EL.04.09/EL.05.RE.09- Understand, learn, and use new vocabulary that is introduced and taught directly through orally read stories and informational text as well as student-read stories and informational text.
EL.03.RE.25- Demonstrate comprehension by identifying answers to questions about the text.
EL.03.RE.32-Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
EL.04.RE.11/EL.05.RE.11- Determine meanings of words using contextual and structural clues.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

3.2P.1- Describe how forces cause changes in an object's position, motion, and speed.
3.4D.2- Describe how recent inventions have significantly changed the way people live.
4.2E.1- Compare and contrast the changes in the surface of Earth that are due to slow and rapid processes.
5.2P.1- Describe how friction, gravity, and magnetic forces affect objects on or near Earth.

SOCIAL SCIENCE

SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
SS.03.GE.02- Understand the purpose of maps, globes, and other geographic tools.
SS.03.GE.04- Identify physical characteristics of places and compare them.
SS.03.HS.02- Understand events from local history.
SS.03.SA.02- Gather information relating to an issue or problem.
SS.05.GE.01.01- Know and use basic map elements to answer geographic questions or display geographic information.
SS.05.GE.02.01- Use maps and charts to interpret geographic information.
SS.05.GE.04.01- Identify and locate major landforms, bodies of water, vegetation, and climates found in regions of the United States.

LESSON 9: CHAPTER 8 – PORT OF ORIGIN

OBJECTIVES

Students will hypothesize about what will happen once water freezes, then demonstrate and evaluate their hypothesis. Students will support the statement *friction causes heat* with a demonstration and understand how friction relates to the ice dam breaking. Students will build a model of a kolk and explain how kolks formed in the flood. Students will brainstorm and list what they have learned about the Ice Age.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook
- Clear or translucent cup
- Marker/Pen
- Access to freezer
- Water
- Empty liter soda bottle
- Glitter
- Pebbles

TIME

50-60 minutes

OPENER

Ask students to use their Ice Age map to answer:

- Which direction do Jenna, Caleb, and Ari fly from Portland to the Wallula Gap? NE
- From the ice dam which direction does Lake Missoula extend? SE
- When the ice dam breaks, which direction does the flood water travel? SW

Ask for thoughts on what will happen next to the characters.

PROCEDURE

1. Read Chapter 8. (This may be done as a class, individually, in groups or pairs, etc.)
2. Ask students to answer the chapter questions:
    a. How would you describe Uncle Al's behavior when the kids appear in modern times on Council Crest?
        i. Concerned, Suspicious, Happy…
    b. What do you think Uncle Al is talking about when he says there were greater dangers than saber-toothed cats and giant short-faced bears?
        i. Answers will vary. They might have gotten stuck!
    c. A theory about why the ice dam broke has to do with water moving through small cracks causing friction. Rub your hands back and forth together to demonstrate friction.

Explain how friction could cause the ice dam to break.

i. When one object rubs against another it causes friction and friction causes heat, even when ice rubs against ice. The heat from friction melted the ice and made large cracks appear in the ice dam, which broke the ice dam apart.

d. Why do you think Uncle Al doesn't want the kids to talk about their time travel experience, even with their mother?

i. Answers will vary. People might try to steal the map, or think they were crazy.

3. Activities!!

ACTIVITY 1: EXPANDING WATER INQUIRY

1. Fill part of a clear or translucent cup with water. When the water settles draw a line around the cup to mark how high the water rises.
2. Fill out the Inquiry Questions below.
3. Freeze.
4. Tomorrow: Compare the frozen water level to the liquid level marked with a line.
5. Complete the Inquiry (Lesson 10 opener)

INQUIRY

Question: What will happen to the water in the cup when it freezes?

a. Nothing will happen
b. It will expand higher than the line
c. It will shrink below the line.

Hypothesis: Your answer to the above question is your hypothesis.

When the water freezes_____

Test your hypothesis: Freeze the cup and answer the rest of this inquiry tomorrow.

ACTIVITY 2: KOLKS

This activity can be completed in groups or as a class demonstration.

Kolk- A kolk is like an underwater tornado that occurs in fast-moving water. It is capable of picking up and moving earth, or blasting huge boulders and rocks apart.

Gather:

a. Empty soda liter bottle with cap
b. Glitter
c. Small rock or pebbles

1. Fill the soda bottle ¾ of the way full with water.
2. Add in a generous amount of glitter. Be sure it is a color you will be able to see in the water.
3. Add the pebbles.
4. Flip it upside down so that the cap is facing down and the wider bottom part is up, and let it all settle.
5. Shake the bottle in a circular fashion to create whirlpool and underwater twister. NB You can see the twister better if you hold it up with a light source behind the bottle.
6. How this is similar to a kolk (*see uncle Al's explanation*)? Discuss.

i. Review concept: a kolk is another example of water's independence of scale.

CLOSER

Ask students to fill in the last column of their KWL charts from Lesson 1. This can be done collectively as a class, individually, or in groups.

STANDARDS

LANGUAGE ARTS

EL.03.RE.04/EL.04.RE.01/EL.05.RE.01-Read aloud grade-level narrative text and expository text fluently and accurately with appropriate pacing, change in voice, and expression.
EL.03.RE.07/EL.04.03/EL.05.RE.03- Listen to, read, and understand a wide variety of grade-level informational and narrative text.
EL.03.RE.09/ EL.04.RE.07/ EL.05.RE.07- Draw upon a variety of comprehension strategies as needed—rereading, self-correcting, summarizing, class and group discussions, generating and responding to essential questions, making predictions, and comparing information from several sources.
EL.03.RE.12/EL.04.09/EL.05.RE.09- Understand, learn, and use new vocabulary that is introduced and taught directly through orally read stories and informational text as well as student-read stories and informational text.
EL.03.RE.15- Use sentence and word context to find the meaning of unknown words.
EL.03.RE.25- Demonstrate comprehension by identifying answers to questions about the text.
EL.03.RE.32-Ask questions and support answers by connecting prior knowledge with literal information found in, and inferred from, the text.
EL.04.RE.11/EL.05.RE.11- Determine meanings of words using contextual and structural clues.
EL.04.RE.22- Make and confirm predictions about text using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, and important words.
EL.05.RE.24- Draw inferences, conclusions, or generalizations about main ideas in text, and support them with textual evidence and prior knowledge.

SCIENCE

3.1P.1- Compare and contrast the properties of states of matter.
3.2P.1- Describe how forces cause changes in an object's position, motion, and speed.
3.3S.1- Plan a simple investigation based on a testable question, match measuring tool to their uses, and collect and record data from a scientific investigation.
3.3S.2- Use data collected from a scientific investigation to explain the results and draw conclusions.
3.3S.3- Explain why when a scientific investigation is repeated similar results are expected.
Scientific Inquiry 4.3 and 5.3
5.2P.1- Describe how friction, gravity, and magnetic forces affect objects on or near Earth.

SOCIAL SCIENCE

SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
SS.03.GE.03- Identify major physical features and describe how they are represented on maps, globes, and other tools.
SS.03.HS.02- Understand events from local history.
SS.05.GE.01.01- Know and use basic map elements to answer geographic questions or display geographic information.
SS.05.HS.03- Identify cause and effect relationships in a sequence of events.
SS.05.GE.04.01- Identify and locate major landforms, bodies of water, vegetation, and climates found in regions of the United States.

LESSON 10: GRAPHIC NOVEL PART 1

OBJECTIVES

Students will analyze the parts of a story and determine them for *Terra Tempo: Ice Age Cataclysm!* Students will brainstorm their own parts of a story based on something they learned about the Ice Age (see last column of KWL chart).

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!*
- Student Workbook
- Overhead of The Art of Storytelling

TIME

50-60 minutes

OPENER

Retrieve the frozen cup of water from the previous lesson and complete the inquiry.

Observation: What has happened to the frozen water in relation to the line you drew yesterday?

Results: When the water froze it_____

Draw Conclusions: When water freezes…

Compare your results with the rest of the class's results. Has your conclusion been supported by others?

PROCEDURE

1. Instruct students that they will be making their own graphic novel to show what they have learned from reading *Terra Tempo: Ice Age Cataclysm!* But first they need to learn how to map a story.
2. Go over the following vocabulary located on their Art of Storytelling worksheet in the student workbook:
    a. Setting- where and when the story happens
    b. Characters- the players (major and minor) taking part in the action of the story
    c. Climax- the most decisive moment or major turning point in the story
    d. Plot- key events
    e. Exposition- background needed to understand the story
    f. Rising Action- a related series of incidents that build toward the climax
    g. Falling Action- the climax has finished and the story is heading towards a conclusion
    h. Denouement- the final resolution or end result of a dramatic event or narrative; the outcome
3. Together, fill out the Art of Storytelling worksheet for *Terra Tempo: Ice Age Cataclysm!* (overhead)
4. Students brainstorm their own story map about something they have learned while reading *Terra Tempo: Ice Age Cataclysm!* (consult the last column of KWL chart). This is their key event

or theme!

5. Students will fill out their own Art of Storytelling worksheet for their Ice Age graphic novel based on their key event of theme. Ex: Animal extinctions. This will be the basis for their script and cartoons.

6. Students may need assistance brainstorming for their story map. Small groups, pairs, or having students bring you their ideas is recommended.

CLOSER

Have students share some of their graphic novel ideas.

STANDARDS

LANGUAGE ARTS

El.03.LI.05- Determine significant events from the story.
El.03.WR.01- Find ideas for writing stories and descriptions through various sources, including conversations with others, and in books, magazines, textbooks, or on the internet.
EL.03.WR.02- Discuss ideas for writing, use diagrams and charts to develop ideas, and make a list or notebook of ideas.
EL.03.WR.03- With some guidance, use all aspects of the writing process in producing compositions and reports.
EL.03.WR.23- Write legibly in cursive and manuscript, leaving space between letters in a word, words in a sentence, and between words and the edges of the paper.
EL.03.WR.24- Write narratives.
EL.04.LI.04- Identify the main problem or conflict of the plot, and explain how it is resolved.
El.04.WR.01/EL.05.WR.01- Use a variety of strategies to prepare for writing, such as brainstorming, making lists, mapping, outlining, grouping related ideas, using graphic organizers, and taking notes.
EL.04.WR.05/EL.05.WR.05- Use the writing process.
EL.04.WR.21/EL.05.WR.22- Write smoothly and legibly in cursive or manuscript, forming letters and words that can be read by others.
E.L.05.LI.04- Identify the main events of the plot—their causes, and the influence of specific events on future actions.
EL.05.WR.22- Write fictional narratives.

SCIENCE

3.3S.1- Plan a simple investigation based on a testable question, match measuring tool to their uses, and collect and record data from a scientific investigation.
3.3S.2- Use data collected from a scientific investigation to explain the results and draw conclusions.
3.3S.3- Explain why when a scientific investigation is repeated similar results are expected.
Scientific Inquiry 4.3 and 5.3

SOCIAL STUDIES

SS.03.HS.02- Understand events from local history.
SS.03.GE.01- View and draw simple maps and pictures to locate, describe, and show movement along places.
SS.03.GE.03- Identify major physical features and describe how they are represented on maps, globes, and other tools.
SS.05.HS.03- Identify cause and effect relationships in a sequence of events.

ART

AR.03.CP.01/AR.05.CP.01- Use experiences, imagination, essential element and organizational principles to achieve a desired effect when creating, presenting and/or performing works of art.
AR.03.AC.01- Recognize essential elements, organizational principles and aesthetic effects in works of art.

The Art of Storytelling

Craigmore Creations

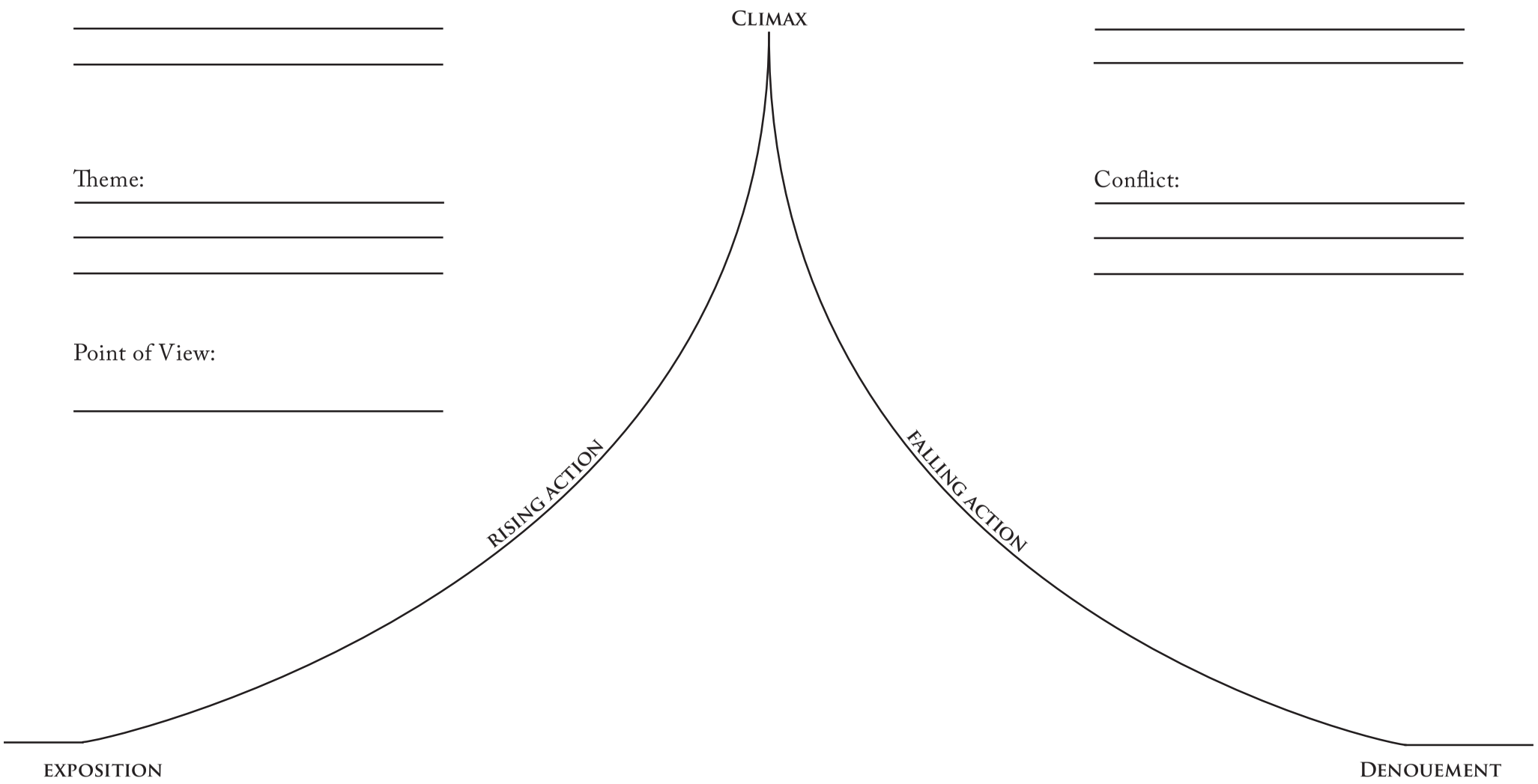
Setting:

Characters:

Theme:

Conflict:

Point of View:



Plot:

LESSON 11: GRAPHIC NOVEL PART 2

OBJECTIVES

Students will write a rough draft based on their story map and brainstorming. Students will cut out and begin sketching their story. Students will practice drawing their main characters and editing their storyboard. Students will add and edit text for their frames.

MATERIALS

- *Terra Tempo: Ice Age Cataclysm!* (use as model)
- Student Workbook
- Frame sheets to cut out
- Minimum requirements
- Scissors
- Pencils

TIME

80 minutes

OPENER

Brainstorm descriptions and answer the following:

- Main character's name:
- Two words describing your main character:
- Three words describing the setting of your story:
- Four words describing your important event or climax:
- Five words describing the importance of this event:

PROCEDURE

1. Have students share their opener with a partner. This will allow them to summarize what their story is about.
2. Instruct students to turn their opener into a paragraph describing what their story is about. Ask students to try to be descriptive and clear. This is the rough draft for their story that they will consult when drawing their frames.
3. Once students have completed their rough draft, instruct them to read over it. Is their setting and main character clear? Is the plot, or what will happen in the story, clear?
4. Next have students select and cut out blank frames. Students will be able to add and take away frames as their novel progresses.
5. Ask students to start sketching what happens in their story on their cut out frames (no need to color yet!). Have them start with what they wrote in their rough draft and on their Art of Storytelling worksheet. Consult *Terra Tempo: Ice Age Cataclysm!* as a model throughout.
6. Have students practice drawing their main characters. Be sure the main characters express what they are feeling. Check out Ari, Jenna, and Caleb in *Terra Tempo: Ice Age Cataclysm!* They do not have to tell you what they feel; you can see it on their faces and in their body language!
7. Eliminate some frames and add others to flesh out the story and meet the requirements.
8. Add text bubbles or script. As this is a rough draft, the writing can go on the back of the card. Have students look at the *Terra Tempo: Ice Age Cataclysm!* frames for inspiration. Not all frames have text, but some frames have multiple bubbles.

9. When students have their storyboard in order and completed, ask them to number their frames so they will not get confused about the order for their final.

CLOSER

Ask students to read their neighbor/group members text bubbles to help proofread.

MINIMUM REQUIREMENTS: PLEASE TAILOR FOR YOUR NEEDS

3RD GRADE OR BEGINNERS LEVEL	4TH GRADE INTERMEDIATE LEVEL	5TH GRADE ADVANCED LEVEL
1 Main Character*	2 Main Characters*	3 Main Characters*
10 frames	12 frames	14 frames
8-9 text bubbles or strips	10-11 text bubbles or strips	12-13 text bubbles or strips
Has a setting or background	Has a setting or background	Has a setting or background
Has a key event from *Terra Tempo: Ice Age Cataclysm!*	Has a key event from *Terra Tempo: Ice Age Cataclysm!*	Has a key event from *Terra Tempo: Ice Age Cataclysm!*
Color	Clear information about key event	Clear information about key event
	Color	Explains importance of event
		Color

* Main characters do not have to be people!

STANDARDS

LANGUAGE ARTS

El.03.LI.05- Determine significant events from the story.
El.03.WR.01- Find ideas for writing stories and descriptions through various sources, including conversations with others, and in books, magazines, textbooks, or on the internet.
EL.03.WR.02- Discuss ideas for writing, use diagrams and charts to develop ideas, and make a list or notebook of ideas.
EL.03.WR.03- With some guidance, use all aspect of the writing process in producing compositions and reports.
EL.03.WR.23- Write legibly in cursive and manuscript, leaving space between letters in a word, words in a sentence, and between words and the edges of the paper.
EL.03.WR.24- Write narratives.
EL.04.LI.04- Identify the main problem or conflict of the plot, and explain how it is resolved.
El.04.WR.01/EL.05.WR.01- Use a variety of strategies to prepare for writing, such as brainstorming, making lists, mapping, outlining, grouping related ideas, using graphic organizers, and taking notes.
EL.04.WR.05/EL.05.WR.05- Use the writing process.
EL.04.WR.21/EL.05.WR.22- Write smoothly and legibly in cursive or manuscript, forming letters and words that can be read by others.
E.L.05.LI.04- Identify the main events of the plot—their causes, and the influence of specific events on future actions.
EL.05.WR.22- Write fictional narratives.

SCIENCE

Will vary according to student topic

SOCIAL STUDIES

SS.03.HS.02- Understand events from local history.
SS.05.HS.03- Identify cause and effect relationships in a sequence of events.

ART

AR.03.CP.01/AR.05.CP.01- Use experiences, imagination, essential element and organizational principles to achieve a desired effect when creating, presenting and/or performing works of art.
AR.03.AC.01- Recognize essential elements, organizational principles and aesthetic effects in works of art.

LESSON 12: GRAPHIC NOVEL PART 3

Ideally students would complete their graphic novel after the Craigmore Creations Assembly/Workshop!

OBJECTIVES

Students will choose the final frames for their novel. Students will write, draw, and color their graphic novel frames. Students will position and glue their frames to make a book.

MATERIALS

- Student Workbook
- Rough draft frames
- Glue
- Colored pencil
- Frame cut outs
- Rubric

TIME

80 minutes

OPENER

Have students brainstorm titles for their novel and what they would put on the cover. Remember, before you read, when you looked at the *Terra Tempo: Ice Age Cataclysm!* cover, you met the characters and could reasonably guess what the story would be about.

PROCEDURE

1. Have students line up their rough draft frames in order on the blank pages provided for their novel in the Student Workbook.
2. Students may want to add frames, or change the frame shapes for their final. Remember once it's glued it's stuck—literally!
3. Once students have made their final decisions about their frames, have them begin their finals. Finals need to have proper spelling and grammar, as well as demonstrate their best craftsmanship.
4. Color.
5. Carefully lay out and glue the frames into your graphic novel.
6. Finally, create a title page illustration that reflects what your novel is about and give it a title.

CLOSER

Allow students to look at and read each other's work.

STANDARDS

LANGUAGE ARTS

El.03.LI.05- Determine significant events from the story.
El.03.WR.01- Find ideas for writing stories and descriptions through various sources, including conversations with others, and in books, magazines, textbooks, or on the internet.
EL.03.WR.02- Discuss ideas for writing, use diagrams and charts to develop ideas, and make a list or notebook of ideas.

EL.03.WR.03- With some guidance, use all aspect of the writing process in producing compositions and reports.
EL.03.WR.23- Write legibly in cursive and manuscript, leaving space between letters in a word, words in a sentence, and between words and the edges of the paper.
EL.03.WR.24- Write narratives.
EL.04.LI.04- Identify the main problem or conflict of the plot, and explain how it is resolved.
El.04.WR.01/EL.05.WR.01- Use a variety of strategies to prepare for writing, such as brainstorming, making lists, mapping, outlining, grouping related ideas, using graphic organizers, and taking notes.
EL.04.WR.05/EL.05.WR.05- Use the writing process.
EL.04.WR.21/EL.05.WR.22- Write smoothly and legibly in cursive or manuscript, forming letters and words that can be read by others.
E.L.05.LI.04- Identify the main events of the plot—their causes, and the influence of specific events on future actions.
EL.05.WR.22- Write fictional narratives.

SCIENCE

Will vary according to student topic

SOCIAL STUDIES

SS.03.HS.02- Understand events from local history.
SS.05.HS.03- Identify cause and effect relationships in a sequence of events.

ART

AR.03.CP.01/AR.05.CP.01- Use experiences, imagination, essential element and organizational principles to achieve a desired effect when creating, presenting and/or performing works of art.
AR.03.AC.01- Recognize essential elements, organizational principles and aesthetic effects in works of art.

GRADING

We have provided a rubric, but feel free to tailor it to your needs:

NAME: _____

	1	2	3	4	SCORE
COMPLETION	Graphic novel is incomplete. Student has not met minimum requirements.	Graphic novel is mostly complete. Student has fulfilled some minimum requirements.	Graphic novel is complete but student did not fulfill minimum requirements.	Graphic novel is complete and student fulfilled all minimum requirements.	
PRESENTATION	The artwork seems sloppy and the illustrations do not complement the story.	The artwork is ok but lacking in neatness, color, and quality. Little originality.	The artwork seems to be good quality, colorful, and neat, but there is some lack of originality.	The artwork seems to be high quality, colorful, and purposeful. The author demonstrates creativity and originality.	
ORGANIZATION/ WRITING	The writing is not well organized and details do not follow a logical order. Many grammar and spelling errors. Many words are sloppy or unreadable.	Some details are not in logical order. Story is difficult to follow. Grammar and spelling errors present that distract from story. The writing is generally readable.	Details are placed in logical order but the way they are presented makes the writing less interesting. Some errors in grammar or spelling that distract from content. Neatly written or typed.	Details in story are logically presented and keep the interest of the reader. No distracting spelling or grammar errors. Neatly written or typed.	
COMMUNICATION OF KNOWLEDGE	Information unclear. Not related to *Terra Tempo: Ice Age Cataclysm!* topics.	Key event relevant but lacking explanation or supporting details.	Relevant, but lacking one or more supporting details to demonstrate understanding.	Relevant to topics in *erra Tempo: Ice Age Cataclysm!* Gives the reader important information that demonstrates understanding.	
					TOTAL: