Indian Education for All

Model Teaching Units

Mathematics ~ Grades K-6

Developed by Montana Educators and the Office of Public Instruction

Montana
Office of Public Instruction
Denise Juneau, State Superintendent

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Mathematics Model Teaching Units Grades K-6

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Published 2010

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Mathematics Model Teaching Unit

Counting 1:1 Correspondence

Created by Jennifer La Fromboise-Wagner(Blackfeet)

Grade K - Duration: 30 minutes

Stage 1 Desired Results

Established Goals:

Number Sense and Operation Mathematics Content Standard 1: A student, applying reasoning and problem solving, will use number sense and operations to represent numbers in multiple ways, understand relationships among numbers and number systems, make reasonable estimates, and compute fluently within a variety of relevant cultural contexts, including those of Montana American Indians.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

Understandings:	Essential Questions:
• Build the foundation for number sense using 1 to 1 correspondence. • Learn information relating to the Blackfeet tribe.	• How did you know there was _____? • How did you know what Blackfeet manipulative you counted? • Why do you have to touch each manipulative? • Why do you have to practice counting manipulatives?
Students will be able to… • Count objects 1-10 using 1 to 1 correspondence. • Recall the Blackfeet manipulatives that were used.	*Students will know…* • What manipulative they have counted by announcing it at the end (ex. "6 Blackfeet Flags"). • To count each manipulative once and in a way/order as to not recount them. • They have counted a number set by pointing 1 to 1 and saying each number word for each manipulative. • By practicing the 1 to 1 correspondence it will help with number sense. • Some knowledge about the Blackfeet Indians.

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Stage 2 Assessment Evidence

Performance Tasks:

- Classroom written work in the form of a drawing or words, if applicable.
  What is your favorite number?
  What is your favorite Blackfeet manipulative?

Other Evidence

- Classroom observations during the lesson, free choice time, or other classroom routines where counting appears.
- Classroom conversations with a student or whole group discussions.
- Asking questions for self-evaluation: Do you like to count? Do you think you are a good counter? Why/Why not?

Stage 3 Learning Plan

Learning Activities:

Introduce the lesson:

"We are going to learn our numbers from 1-10 by counting manipulatives using 1 to 1 correspondence. To do this we will be using manipulatives that have pictures and information relating to the Blackfeet Tribe that is one of the 12 tribes of Montana. Each day we will learn our numbers, a new manipulative and how it relates to the Blackfeet Indians. It is important to remember the information or the name of the manipulative because you will be asked questions throughout the lesson. Also remember we are learning numbers and counting as well. So by the end we will be able to count using 1 to 1 correspondence."

Follow these steps for each day you introduce a number:

1) Show a copy of the manipulative you are going to count for that day. Using the definition sheet, tell about the manipulative. Have students repeat the name of the manipulative. Ask for 1 or 2 thoughts about the manipulative
2) On the second day review the previous manipulatives. Ask "What have you learned about the Blackfeet Indians?" Record it on chart paper and save for the remaining days to review and reflect.
3) Practice counting to the next number being taught that day.
4) Introduce the number for the day. Discuss what they know about that number and record it on a different chart paper. Save for the remaining days to review and reflect. Have children go look for and count objects in the room relating to that number. Give them a few minutes to find something to count. Call back to group to discuss what they found/counted. Add these to the chart paper for the number of the day.
5) Model 1:1 counting with the number and manipulatives for the day. Model ways to organize their counting, touching the manipulatives, arranging them in lines or piles, or by counting left to right and top to bottom. Tell them that organizing what they count helps so they don't count the manipulatives twice.

6) Hand out the amount of manipulatives for the day and have students practice counting at the table or desk. After they count, have them say out loud the number counted and the name of the manipulative, ex. 5 Blackfeet lodges, etc. Have them count to a neighbor while you are going around observing and helping.
7) Pick up the manipulatives.
8) Come together as a group to recall the number and manipulatives for the day. Ask one of the essential questions: How did you know there was _____? How did you know what Blackfeet manipulative you counted? Why do you have to touch each manipulative? Why do you have to practice counting manipulatives? Check for understanding or any confusion.
9) On the last day, have a class discussion regarding all the Blackfeet manipulatives they have learned. Then do the Performance tasks listed in the assessment section.

*Information: Provide practice time for counting with other manipulatives or objects as the day goes on. Look for opportunities to develop number sense by asking questions like: How many drumsticks would you need for 6 drums? Do we have enough Blackfeet Flags for every person? Etc.

Resources:
Web sites:
- www.opi.mt.gov/IndianEd/
- http://97.74.249.201/
- www.nctm.org
- www.bps.k12.mt.us
- www.glenbow.org/blackfoot/
- www.glenbow.org/exhibitions/online/blackfoot/

Books:
Ewers, John Canfield. (1967) *The Blackfeet: Raiders on the Northwestern Plains.* University of Oklahoma Press

Materials/Resources Needed:

- Definitions of Blackfeet manipulative material: see attached.
- Blackfeet manipulative material: see attached
- Make enough copies (cardstock paper) for class to count numbers 1-10.
- Cut out manipulatives then laminate.
- Put in baggies or containers for organization.
- Chart paper to record class responses.

Blackfeet Manipulative
Definitions

Painted Lodge- The designs relate to the stars (top), visions (middle), and the earth (bottom). The ear flaps have the Big Dipper on one side, the Pleiades on the other side and a butterfly (cross) on the back. The bottom has mountains or hills and stars. The middle is only for those who have had visions for a painted lodge. Not every Blackfeet has a painted lodge. They are often called painted teepees.

Lodge poles- The lodge poles are the structural support for the lodge coverings. A regular lodge uses about 22 poles per lodge. A Blackfeet lodge uses 4 main poles for the foundation, unlike other tribes which use three. They are often called teepee poles.

Pegs- The pegs anchor the lodge to the ground. They can be made of birch. They are shorter than buttons and thicker. The end is sharpened and peeled. The top can be peeled to show stripes for decoration or identification.

Buttons- The buttons hold the lodge together in the front, above and below the door. They can be made of willow. They are peeled on the bottom and can have stripes on the top for decoration or identification.

Parfleche- A rectangular suitcase made from animal skins (rawhide) and decorated with geometric designs. They have a strap at the top for hanging.

Blackfeet Reservation shape- This is the current shape of the Blackfeet Reservation. This is a result of treaties made from 1851 to 1896. The reservation is located in Montana next to Glacier National Park.

Chief Mountain shape- A mountain in the Rocky Mountains, which is a ceremonial and spiritual place for the Blackfeet people and used by the Blackfeet people.

Eagle feather- Eagle feathers are used to adorn many ceremonial objects. It is illegal for anyone to sell eagle feathers.

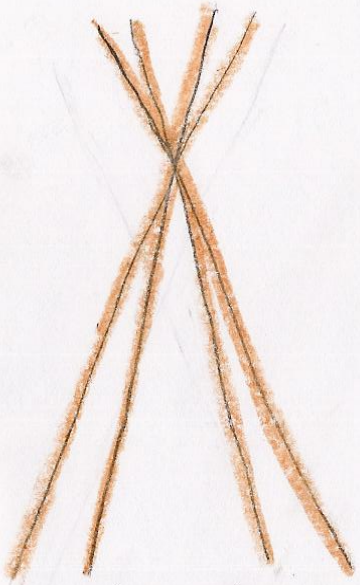
Hand drum- A small handheld drum made of animal skin stretched over a round wood frame. It is used by members of the tribe to sing honor songs for individuals who have accomplished great deeds. Blackfeet also use songs for courting, traveling, good luck, lullabies, and praise.

Drumstick- A drum stick is a stick with buckskin at the top to use with a hand drum to sing honor songs. Songs are a significant part of the Blackfeet culture and life.

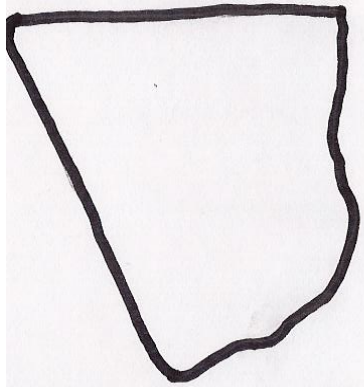
eagle feather

button

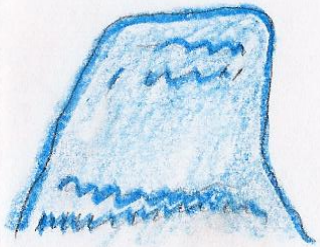
peg



lodge poles



Blackfeet Reservation



Chief Mountain

hand drum

drum stick

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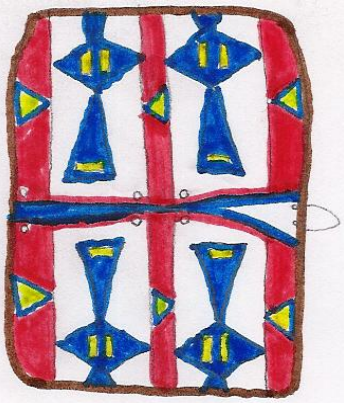
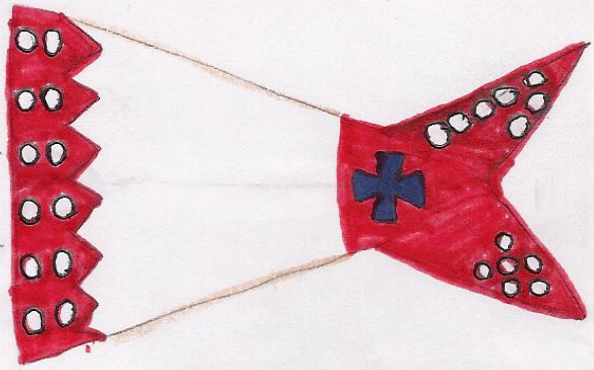


parfleche



painted lodge (rear)

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Mathematics Model Lesson

Geometry & Blackfeet Portraits

Created by Jennifer LaFromboise-Wagner (Blackfeet)

Grade K - Duration: 1 hour

Stage 1 Desired Results

Established Goals:

Geometric Reasoning Mathematics Content Standard 3: A student, applying reasoning and problem solving, will understand geometric properties, spatial relationships, and transformation of shapes, and will use spatial reasoning and geometric models to analyze mathematical situations within a variety of relevant cultural contexts, including those of Montana American Indians.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

Understandings:	Essential Questions:
• Gain an awareness that geometry helps to represent and make sense of the world. • See portraits of Blackfeet Indians that were used in advertising for the Great Northern Railway.	• How many sides does a _____ have? • How many angles does a _____ have? • What shape does this look like to you? Why? • How are a square and a rectangle the same or different? • Can you use your finger to trace a _____over this part? • Is this similar (kind of the same) to a _____? • What shape does the top, middle, or bottom of the _____ remind you of?
Students will be able to… • use their knowledge of basic shapes to identify basic shapes in portraits of Blackfeet Indians. • replicate an aspect of a Blackfeet Indian portrait by using their knowledge of basic shapes.	*Students will know…* • strategies to help identify shapes. • strategies to create shapes. • how Blackfeet Indians looked and dressed in the 1920s. • they can see basic shapes in portraits. • by using basic shapes they can recreate a picture or object. • two shapes put together can create a different shape.

Stage 2 Assessment Evidence

Performance Tasks:

- Classroom task of creating a replica of one aspect of the portrait. Created on paper.

Geometry and Blackfeet Portraits (continued)

Other Evidence:

- Participation in identifying shapes from portrait. Evident from shapes drawn on their portrait paper.
- Participation in classroom discussions regarding lesson.
- Teacher observations during the lesson.

Stage 3 Learning Plan

Learning Activities:

Introduction-5 minutes

"We have finished learning about shapes, how to identify them, and how to draw them. We are now going to use that knowledge we have to locate those shapes in portraits. We will also use those shapes to make a replica of the portrait, meaning we will copy the portrait the best we can!"

"The portraits we are going to be using are famous! They are old portraits painted in the early 1900s and they are of Blackfeet Indians. What makes these portraits famous is that they were used as advertisements for the Great Northern Railway, the railroad that travels through the Blackfeet Reservation. They were painted by a German artist named Winold Reiss (Vee-nold Rice). They are very vivid with detail and show the Blackfeet's use of shapes in their clothing and lodges."

"I am excited to get started, aren't you? Ok, let me model for you what you will need to know in order for you to do a great job!"

Model Expectations-20-25 minutes

1) Introduce the portrait of Double Steel and Two Cutter. "These women of the Kainah (Blood) Blackfeet were well known for their beadwork."

2) Display so all students can see the portrait.

3) Use the strategy called think aloud. Say "I am going to look and think for 1 minute before I do anything."

4) After 1 minute, say "I am going to look for triangles first. I know a triangle has three sides or three points. Oh I see one; I will trace it with my marker."

5) Continue on with square, rectangle, and circle; using the same strategy of think aloud.

6) Once the obvious shapes are traced, say "How can I find more shapes?" "I think her hair on the side looks like a triangle; let me trace it with my finger to see." Or "Her forehead looks like a triangle if I make a line where her eyebrows are." "I will trace it with my marker."

7) Continue on with square, rectangle and circle; using the same strategy of thinking aloud and using background knowledge of shapes.

8) Say "I have found enough shapes to try to create a replica of this portrait. The part I want to replicate is the head of woman on the right, Two Cutter."

9) Using a white paper hold it the same direction as the example. Think aloud again say "She is on the right in the example so I will find that on my paper. Her head is toward the top of the page, so I will find that on my paper. Now I see triangles on each side of her head and one in the middle for her forehead." (While saying this start to draw what you are saying. Use positional language while drawing.)

10) Although it does not look exactly like the portrait it is similar looking and we used shapes that we identified and it made it easier to replicate it

*Call attention to the strategies: think aloud and using the background knowledge of the shapes.

Locate Shapes-10-15 minutes

"Now you have seen me model what you need to do, so try using the strategies; especially when you feel stuck. Here is your portrait. It is titled "The Drummers." Song is a very important part of Blackfeet culture therefore drummers who know songs for celebration, ceremony and other aspects of Blackfeet culture are looked upon with great respect. According to Reiss, this portrait features three important Blackfeet drummers: Buffalo Body; Heavybreast; and Sure Chief. Remember to think about how to help yourselves before calling on me. If you are still stuck I will give assistance but will not draw for you."

1) Hand out portraits.
2) Walk around the tables as they are working. Write down any observations you might hear or see about their understanding of the lesson, or if they used any strategies. Help students only if they have tried to help themselves first.
3) Monitor their time verbally or with a timer so they will have enough time to create a replica.
4) Collect all sheets and use for assessment.

Create a replica-15-20 minutes

"It is time to use the knowledge you have about creating shapes and the position of where you located the shapes in the portrait to create a replica. Choose a part of the portrait and copy it. Remember to use the strategies of thinking aloud, visualizing where the shape is located and how it looks, and your background knowledge of creating shapes. Try to help yourselves before asking for my help. If you just can't get it I will assist you, but not draw it for you."

1) Hand out white paper.

2) Walk around tables as they are working. Write down any observations you might see or hear about their understanding of the lesson and/or if they used the strategies. Help students only if they have tried to help themselves first.

3) Monitor their time verbally or with a timer.

4) Collect all replicas, use for assessment, and display them in the room along with the original Winold Reiss portrait.

Since fine motor skills are still being developed, be careful with comments relating to their replicas. Focus on facts like position, size and direction of shapes. Also comment on if you noticed them using any of the strategies.

- Find time at the end of the lesson or later during the day to look at all the other portraits that were painted for the calendar.

- Find times in the year to try this lesson again to see if students improve on creations and on the use of the strategies.

Resources:

- www.winold-reiss.org
- www.gngoat.org/portraits.htm
- www.nctm.org
- http://standards.nctm.org/document/chapter3/goem.htm

Materials/Resources Needed:

- 2 -Winold Reiss Portraits of Blackfeet Indians (at the end of this lesson)

- Winold Reiss, *Double Steel and Two Cutter*
  No date, pastel, charcoal, gouache on cardboard
  Collection of Glenbow Museum, Calgary, Canada, 79.2.1

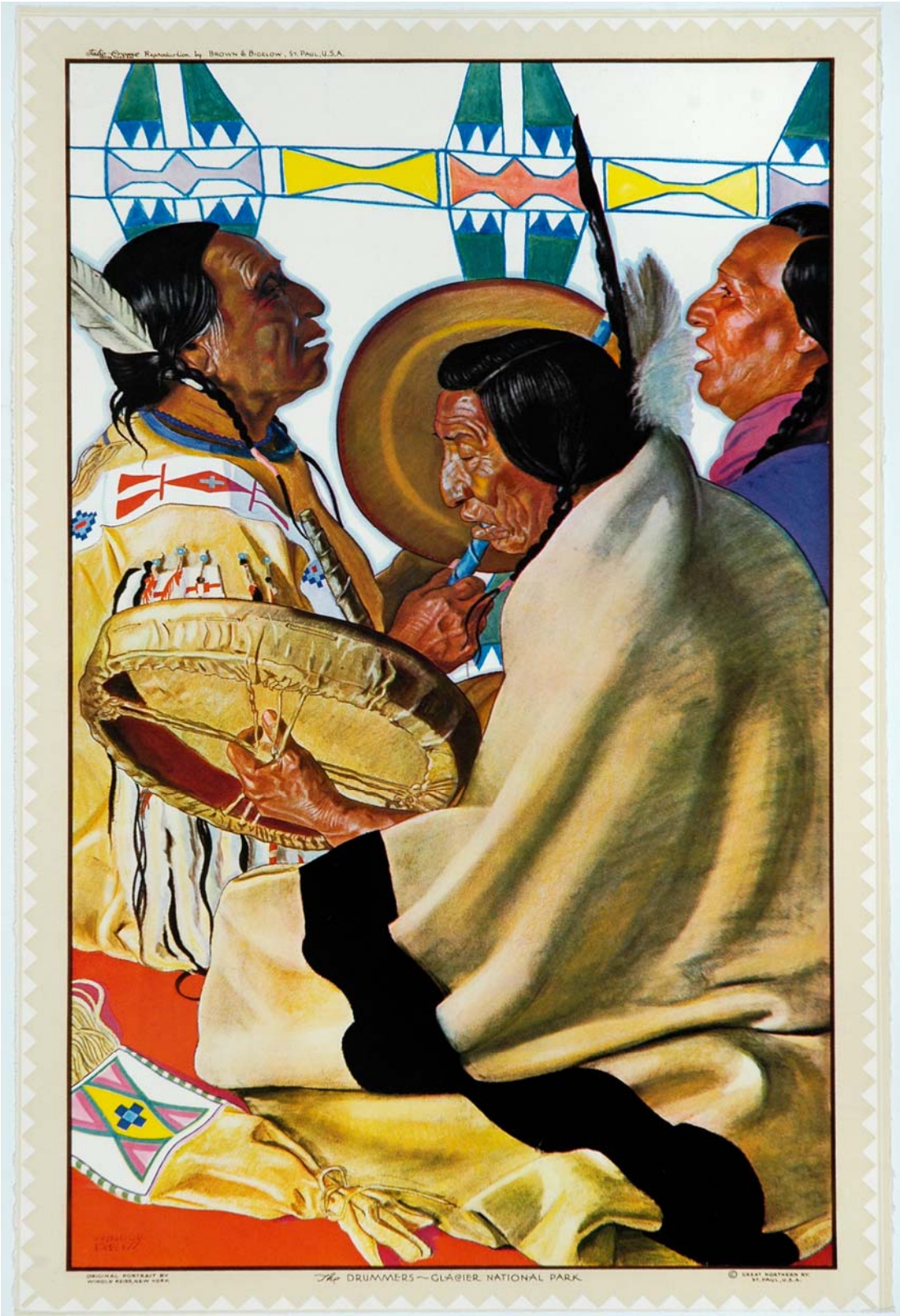
- Winold Reiss, *The Drummers*
  1933, lithograph poster
  Montana Historical Society, Haynes Foundation Collection, 1980.61.221

- White paper

- Pencils, markers, crayons and/or highlighters

Double Steel and Two Cutter

The Drummers



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Mathematics Model Teaching Unit

Shapes in the Blackfeet Language

Created by Samantha Grant

Grade Kindergarten – Approximate Duration: 60 minutes

Stage 1 Desired Results

Established Goals:

Geometric Reasoning Mathematics Content Standard 3: A student, applying reasoning and problem solving, will understand geometric properties, spatial relationships, and transformation of shapes, and will use spatial reasoning and geometric models to analyze mathematical situations within a variety of relevant cultural contexts, including those of Montana American Indians.

- **3.1 Two-Dimensional Attributes**: Describe, compare, and analyze attributes of two-dimensional shapes.

IEFA: Essential Understandings 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

Understandings:	Essential Questions:
Students will understand: ● That the rectangle, circle, square, triangle and rhombus can be given two names, one in the Blackfeet (Pikuni) language and one in English. ● The Blackfeet language is unique to the Pikuni and different from all other tribes.	● How are these shapes the same? ● How are these shapes different? ● How many sides do the shapes have? ● How many corners do the shapes have? ● How do we say these shapes in English? ● How do we say these shapes in Blackfeet (Pikuni)?
Students will be able to… ● Say and identify the shapes in English. ● Say and identify the shapes in the Blackfeet (Pikuni) language. ● Make the shapes on the geoboard with rubber bands.	*Students will know…* ● How the shapes look and are able to identify them. ● How to say the shapes in English and in Blackfeet (Pikuni). ● How to make the shapes on a geoboard as well as the circle on the back of the geoboard. ● The Blackfeet (Pikuni) is one of many Native American Languages.

Stage 2 Assessment Evidence

Performance Tasks: Student will practice and recite the shapes in English and Blackfeet. They will practice the shapes by forming them on a geoboard and by using the circle on the back of the geoboard.
Other Evidence: Students will participate in identifying and saying the names of the shapes in English and Blackfeet (Pikuni). Teacher will observe the students making the shapes on the geoboard and saying the shape in English and Blackfeet (Pikuni).

Stage 3 Learning Plan

Learning Activities: Have materials prepared before lesson and on the tables!

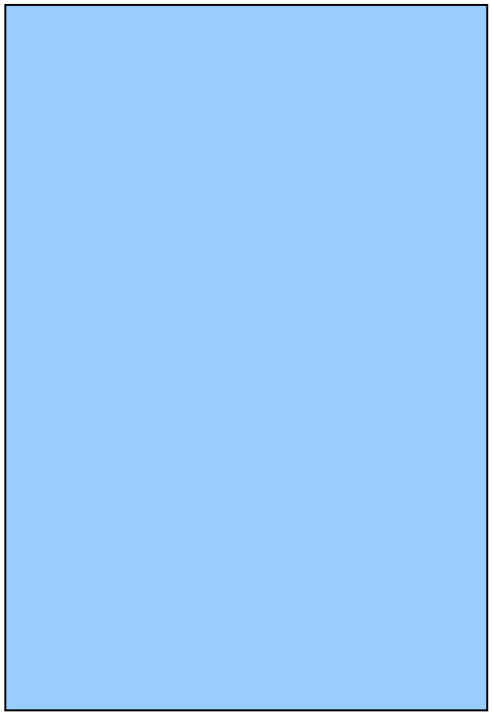
1. 15 minutes: Identify square, circle, rectangle, triangle, and rhombus in English. Show the students pictures of these shapes and have the student identify them. Pass out pattern blocks and attribute blocks of each shape for students to touch and examine.
2. 15 minutes: Identify square, circle, rectangle, triangle, and rhombus in the Blackfeet (Pikuni) Language. Show the pictures of each shape with the Blackfeet (Pikuni) language and English translation on it. Teacher says the shapes in Blackfeet (Pikuni) and has the students repeat it. Talk about how many sides and corners each shape has. How are the shapes alike? How are the shapes different? Emphasize that the Blackfeet (Pikuni) language is the one of many different Native American Languages.
3. 30 Minutes: Students will go to their tables and make the shapes on the geoboards, the students will use the back of the geoboard to make circles. Observe each student and ask them to identify the shape in English and Blackfeet (Pikuni) language. Display the shapes for each student to refer back to.
4. The teacher can go over these shapes in English and the Blackfeet (Pikuni) language everyday during math or calendar. This activity can be a math center with the pictures.

Materials/Resources Needed: Pattern Blocks, attribute blocks, pictures of each shape in English and Blackfeet (Pikuni), geoboards and rubber bands.

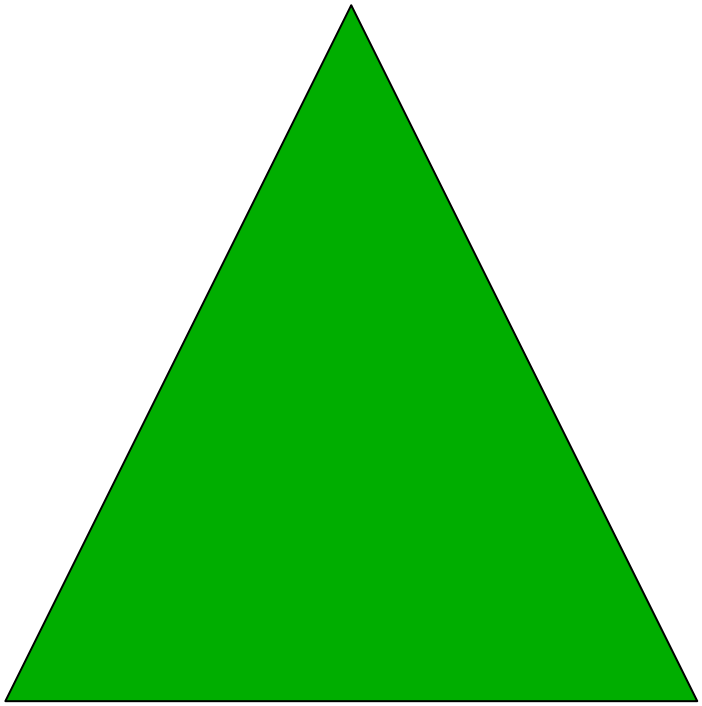
Website: Pattern block template (if teacher doesn't have pattern blocks)
http://www.mathwire.com/index.html
Go to website, click on A-Z list on top of page, choose P-R, scroll down to pattern block template and print the page out. Teachers can make circles on a word document if none are available.
* Teachers are welcomed to download activities to use in the classroom.

If geoboards are not available the teacher can use string, straws, clay and other object for students to form the shapes.

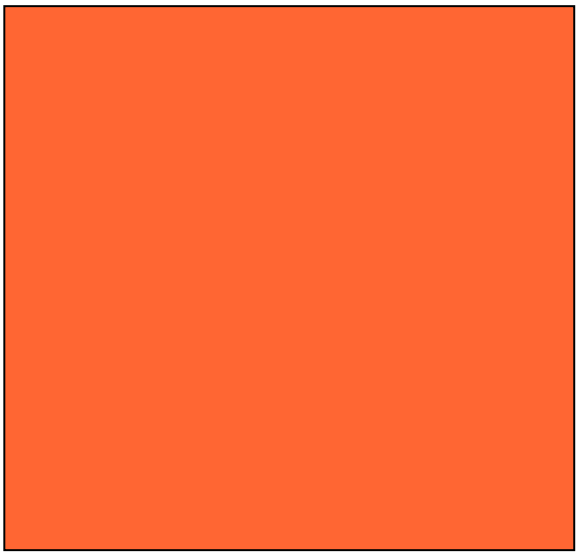
Shapes in Blackfeet: Rectangle: Is-i-nap-innoyi, Triangle: No-toy-ii, Square: A-tak-saa-kssin, Circle: O'taki, Rhombus: II-taa-wa-ko-mo-tsi-iop (Shapes with the Blackfeet name attached at bottom of lesson). **How to say the shapes phonetically, according to Calvin Weatherwax, in Blackfeet: Rectangle: Is-e-nap-in-no-yee, Triangle: no-to-yee, Square: Ah-duc-suc-sin, Circle: OOh-tah-kee, Rhombus: E-tah-wah-ko-mo-tsee-yiop Contact Information on pronunciation of the Blackfeet** shape words: Browning Public School district # 9 Native American Studies (406) 338-2715 or Blackfeet Community College Native American Studies (406) 338-5441.



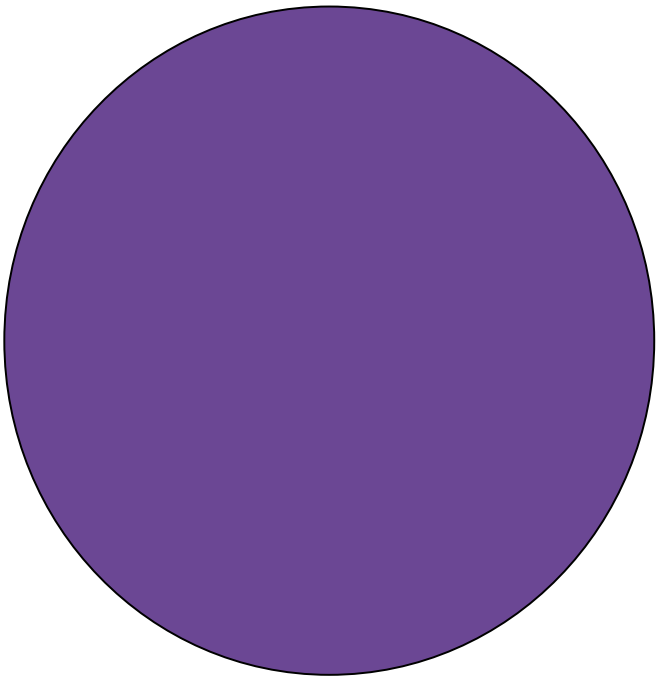
Is-i-nap-innoyi
(Is-e-nap-in-no-yee)
rectangle



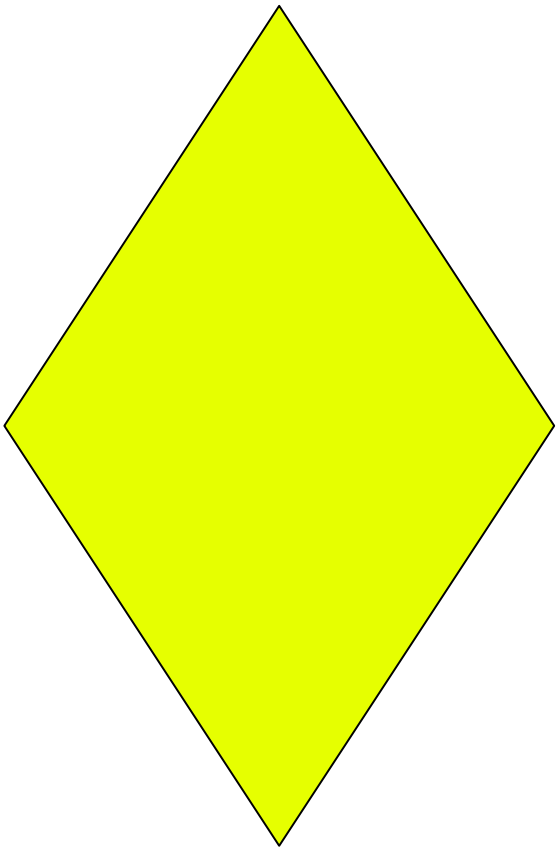
No-toy-ii (no-to-yee) Triangle



A-tak-saa-kssin (Ah-duc-suc-sin) square



O'taki
(OOh-tah-kee)
circle



II-taa-wa-ko-mo-tsi-iop
(E-tah-wah-ko-mo-tsee-yiop)
rhombus

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Mathematics Model Teaching Unit

Probability and Data Analysis

Created by: Theodora Blackweasel Weatherwax

Grade 1: Duration 2 - 45 minute sessions

Stage 1 Desired Results

Established Goals:

Data Analysis Mathematics Content Standard 2: A student, applying reasoning and problem solving, will use data representation and analysis, simulations, probability, statistics, and statistical methods to evaluate information and make informed decisions within a variety of relevant cultural contexts, including those of Montana American Indians.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

Understandings:	Essential Questions:
• Blackfeet children played tossing a hoop as a competition for skill and as a social game. • How to predict, collect data, and gather information. • How to make a graph from the information that is collected.	• How many times out of 10 do you predict that you will be able to catch the hoop with a stick? • What skills are you developing through this data collection? • Do you know of other Native American games?
Students will be able to…	Students will know…
• recognize the uniqueness of games that Blackfeet children played by age and social skills.	• how to play the Blackfeet game "Ring the Stick." • how to collect and display data using a line plot.

Stage 2 Assessment Evidence

Performance Tasks:

- Students will play the traditional Native American game of Ring the Stick.
- Students will collect and tally the results of the games.
- Students will organize collected data and display data using a line plot.

Other Evidence:

- Teachers will assess students' social skills as they play the game.

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Stage 3 Learning Plan

Learning Activities:

1. Introduce the game of Ring the Stick and discuss that it is a game played by Blackfeet children. It is a game that is used in competition. (see attachment A)

2. Have the materials available for students to play the game in groups of 3 to 4.

3. On a piece of paper, have students make a prediction as to how many times they will be able to catch the hoop on the stick.

4. Have students toss the hoop 10 times and record the number of catches by tallying on their paper.

5. Once all students have finished, make a class line plot by having the numbers 1 through 10 on the x-axis. Each student will put an X on the number of times they caught the hoop.

6. Display the line plot and review how many were right on their original prediction and record that information.

Materials/Resources Needed:

- A piece of rawhide or hard piece of plastic, string, hoop, graph paper and pencils
- Blackfeet Children Games, published by Montana Art Council, Blackfeet Community College. By calling the Community College at (406) 339-5411, you can request a copy of the game rules.

Attachment A:

Ring the Stick:

Attach a hoop of any size to a stick. However, the older the child the smaller the hoop should be. Rawhide or sinew was originally used for this but string may be used. Starting from having the hoop flat on the ground, swing the hoop upward and as it comes down try to catch it on the stick. If competing against others, decide on a number of times to catch the hoop on the stick and then take turns until there is a winner.

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Mathematics Model Teaching Unit

Buffalo Runner

Created by: Brenda Harrold

Grade 2: Lesson Duration 1 hour

Stage 1 Desired Results

Established Goals:

Number Sense and Operation Mathematics Content Standard 1: A student, applying reasoning and problem solving, will use number sense and operations to represent numbers in multiple ways, understand relationships among numbers and number systems, make reasonable estimates, and compute fluently within a variety of relevant cultural contexts, including those of Montana American Indians.

- **1.5 Length, Time, and Temperature:** Select and apply appropriate standard units and tools to measure length, time, and temperature within relevant scientific and cultural situations, including those of Montana American Indians.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

Understandings:	Essential Questions:
• Each tribe is unique in its culture, language and hunting rituals. (Blackfeet Tribe) • Vocabulary: (Blackfeet language) buffalo jump cliff = piskun buffalo runner = ahwa waki raven = Omuk-may-sto	• What was the job of the buffalo runner? • Why was it important for the buffalo runner to be fast? • What measurement would be best to use to measure how far you can run in 10 seconds?
Students will be able to… • use a stopwatch to measure 10-second intervals. • observe and mark the starting and stopping point of the runner. • measure how fast they can run in 10 sec.	*Students will know…* • the importance of the buffalo runner's job. • how to determine who is the best for the buffalo runner position. • how to measure the distance between two points. • how to start/stop a stopwatch to measure 10 second intervals.

Stage 2 Assessment Evidence

Performance Tasks:

- Observation of students timing, running, and measuring.
- Measurement of student's 10-second run to the nearest foot.

Other Evidence:

- Compiling of students information and making a class bar graph.

Stage 3 Learning Plan

Learning Activities:

1. Read aloud The Buffalo Jump written by Peter Roop and illustrated by Bill Farnsworth.

2. Discuss what units of measurement you would use to measure how far someone can run both long and short distances. If you haven't already measured out the string with one-foot intervals marked, you could have the students do that now. This takes a little longer, but will give them practice measuring in one-foot increments with a ruler and ownership in making their measuring string.

3. Demonstrate how to cooperatively measure distances by laying the 10-foot strings end to end and repeating the process over until you reach your measurement. Also demonstrate how to time the runners. If you don't have a stopwatch you can teach kids how to time by saying: 1--1000, 2—1000, …up to…10--1000.

4. Divide the class into groups of three. They will each take turns being the "runner", "timer", and "referee".

   - Mark off a starting line and have the "runner" line up behind the line.
   - The timer will give a signal to the runner to start and start the time.
   - The referee will follow the runner.
   - When 10 seconds are up the timer says or signals the runner to stop.
   - The referee marks off the spot the runner reached in 10 seconds.
   - The group then works together with their yarn to measure the distance of the runner.
   - The runner then writes down their name and the distance they ran in 10 seconds on a sticky note.
   - Repeat the process until everyone has ran and measured.

5. Collect the sticky notes and use them to make a bar graph on the board. You could extend this activity by showing the class average and/or mode.

6. Discuss who would be a good buffalo runner and why?

Teacher Notes:

Background knowledge: To start the drive a buffalo runner would wear a wolf or buffalo skin as a disguise. The buffalo runner would get the attention of the lead cow and try to lure it closer. The curiosity of the new animal would make the lead cow follow it bringing the herd with her. As the lead cow got closer the buffalo runner would begin to move quickly away. When the buffalo herd moved closer to the cliff, the buffalo runner would discard the calf robe and run or jump to safety. Additional runners circled in the back and sides of the herd to frighten them towards the cliff by shouting, waving arms, and shooting arrows. As the buffalo stampeded towards the cliff they could not stop the momentum and by the time they realized their demise, it was too late.

Materials/Resources Needed:

Background—(Blackfeet Tribes) Buffalo Tracks- Educational and Scientific Studies from Head-Smashed-In Buffalo Jump: http://www.head-smashed-in.com/BuffaloTracks.pdf
This website has a virtual 360° view of the Head-Smashed-In Buffalo Jump.

- **The Buffalo Jump**

written by Peter Roop
and illustrated by Bill Farnsworth

- One ten-foot piece of string/yarn per student. Mark off 1-foot intervals with a piece of tape or a marker. This can be done either ahead of time or have students do it.
- One-stop watch or timer (to the second) per group off three. You could also teach students how to count…1-1000, 2-1000, etc.)
- Pack of sticky notes these would work best to make a graph later
- Roll of tape or something to mark where the runner starts and stops
- One pencil per group.
- A large area for running and measuring 50-100 yards.

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Mathematics Model Teaching Unit

Pow wow Trails

Created by: Angel Greenley

Grade 3

Stage 1 Desired Results

Established Goals:

Number Sense and Operation Mathematics Content Standard 1: A student, applying reasoning and problem solving, will use number sense and operations to represent numbers in multiple ways, understand relationships among numbers and number systems, make reasonable estimates, and compute fluently within a variety of relevant cultural contexts, including those of Montana American Indians.

- **1.2 Estimation and Operations**: Estimate sums, differences, products, and quotients when solving problems. Add, subtract, multiply (three-digit by two-digit factors), and divide (two-digit dividends by one-digit divisors) to solve problems. Demonstrate fluency with basic facts.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

IEFA Essential Understanding 3: The ideologies of Native traditional beliefs and spirituality persist into modern day life as tribal cultures, traditions, and languages are still practiced by many American Indian people and are incorporated into how tribes govern and manage their affairs.
Additionally, each tribe has its own oral histories, which are as valid as written histories. These histories pre-date the "discovery" of North America.

Understandings:	Essential Questions:
• Pow wows are an important part of some Native American lifestyles. • Some families travel many miles across the state to attend different pow wows.	• What are the different reasons that families travel on the pow wow circuit? • What is the history of pow wows in Native American culture?
Students will be able to… • calculate the miles traveled on the pow wow circuit. • locate different towns of Montana on the map.	*Students will know…* • pow wows are still in existence and that families use them as a time of gathering and sharing with other families and friends. • pow wows are a source of competition and there are many different types of contests at each pow wow.

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Stage 2 Assessment Evidence

Performance Tasks:

- Students will complete a table that calculates the distance traveled on a particular pow wow circuit.

Other Evidence:

- Students will track the pow wow circuit on a map of Montana.

Stage 3 Learning Plan

Learning Activities:

1. Introduce the history of powwows and the different competitions held within a pow wow. Some American Indian families travel from pow wow to pow wow on what is called the "pow wow circuit" in Montana, using the time to camp and compete.

2. Today we are going to trace a circuit that will take us throughout the state of Montana. We will mark the places of the pow wows on a map, compute the miles traveled, the amount of gas used, and the total money spent on gas. Pow wows are typically held on the weekends, but people traveling the circuit do not go home between each celebration. Instead they travel from one town to the next. That is how we will find out the miles traveled.

3. Give students a map of Montana and introduce the circuit to be traveled. Ask students to locate each town on the map and trace the main highways between the cities. Start at your own town and travel from there. Students will need to fill in your town in the first cell of the table and the last stopping point of the table.

4. There are 3 options for finding the mileage – choose whichever one is appropriate for your class (or have different students use different methods)
    a. Give the mileage information on a piece of paper
    b. Have students use the internet and Google maps (www.google.com) and have them fill in the table on their own.
    c. Use a map and using the scale, figure the mileage on their own

5. Have students complete the table. As they find the mileage between each town, have them look at the map so they can see the distance on the map in relation to the mileage reported. Also, at each stop, have students choose one competition to research and give a brief description of the event. Each powwow needs to have different competitions, so that students become more familiar with the competitions.

6. Once students have found the mileage, go to the next step of computing the amount of gas used on the trip.

7. The final step is to compute the amount of money spent on gas using a rounded amount. (For students that need differentiation, you can change the price of gas.)

Materials/Resources Needed:

- Your Guide to Understanding and Enjoying Pow Wows – available at www.opi.mt.gov/IndianEd
- Student worksheet
- Map of Montana

Name: _____

Starting Town	Stopping Town	Total Miles Traveled	Subtotal of Miles Traveled	Competition Entered and Description
Great Falls	Bozeman			
Bozeman	Havre			
Havre	Billings			
Billings	Custer			
Custer	Arlee			
Arlee	Great Falls			

The car you are traveling in gets 20 miles to the gallon. The gas tank holds 10 gallons. How many miles can you travel on one tank of gas? _____

Gas costs $3.00 per gallon. What will the total cost of gas be for your powwow trip? _____

Explain how you got your answer. _____

_____

_____

Answer Key: (answers are based on leaving from Great Falls, MT)

Starting Town	**Stopping Town**	**Total Miles Traveled**	**Subtotal of Miles Traveled**	**Competition Entered and Description**
Great Falls	Bozeman	188 miles	188 miles	
Bozeman	Havre	301 miles	489 miles	
Havre	Billings	247 miles	736 miles	
Billings	Custer	55 miles	791 miles	
Custer	Arlee	422 miles	1213 miles	
Arlee	Great Falls	191 miles	1404 miles	

The car you are traveling in gets 20 miles to the gallon. The gas tank holds 10 gallons. How many miles can you travel on one tank of gas? **200 miles**

Gas costs $3.00 per gallon. What will the total cost of gas be for your pow wow trip? **Approximately $210.00**

Explain how you got your answer. **You need to get gas every 200 miles. When you fill a tank, it costs $30. There are 7 groups of 200 in the total miles, so you will need to fuel up 7 times. 7 x $30 = $210**

Dances:

Men's Traditional Dance: A traditional dance where war parties dance out the story of the battle or hunters dance their story of tracking an enemy or prey.

Men's Fancy Dance: Relatively new dance where dancers have colorful outfits

Men's Grass Dance: Popular dance where the outfits feature a colorful fringe, replacing the grass dancers originally tucked into their belts.

Sneak-up Dance: Follows the definite pattern of drum rolls. Dancers shake their bells and make gestures of either following or seeking out the enemy.

The War Dance: Demonstration of dancing ability and is a major contest dance category

Traditional Women's Dance: Consists of remaining stationary and bending the knee with a slight up and down movement of the body.

Women's Fancy Shawl Dance: Outfit consists of a decorative knee-length cloth dress, beaded moccasins with matching leggings, a fancy shawl, and various pieces of jewelry.

Jingle Dress Dance: The dress is made from cloth with hundreds of metal cones or jingles covering it.

Team Dancers: Three or four members make up a team and they all dance in the same style.

Owl Dance: Can be considered as the Indian version of the waltz.

Round Dance (Friendship Dance): Dance of friendship and is performed by all ages. Everyone is encouraged to dance.

The Crow Hop: Developed in the 1900s and done with a specific rhythm of the drum beat

Intertribal Dance: Everyone is welcome to dance in the Intertribal Dance – even tourists. Dancers move around the arbor sunwise – clockwise.

The Blanket Dance: Means of gaining contributions from the audience for certain causes.

Dropped Eagle Feather Dance: To most Native Americans, the eagle feather is sacred. So when a feather falls from the dancer's outfit, the powwow must stop and a special ceremony must be performed.

Honoring Veterans: Veterans are honored because they were willing to give their lives so people could live.

Definitions were taken from *Your Guide to Understanding and Enjoying Pow Wows* which can be found at www.opi.mt.gov/IndianEd.

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Mathematics Model Teaching Unit

I'm Beading: Northern Cheyenne Bead Work

Created by: Jessica Cox

Grade 4: Duration 1 hour

Stage 1 Desired Results

Established Goals:

Algebraic and Functional Reasoning Mathematics Content Standard 4: A student, applying reasoning and problem solving, will use algebraic concepts and procedures to understand processes involving number, operation, and variables and will use procedures and function concepts to model the quantitative and functional relationships that describe change within a variety of relevant cultural contexts, including those of Montana American Indians.

- **4.1 Patterns and Relations:** Describe, extend, and make generalizations about geometric or numeric patterns.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

IEFA Essential Understanding 2: There is great diversity among individual American Indians as identity is developed, defined and redefined by entities, organizations and people. A continuum of Indian identity, unique to each individual, ranges from assimilated to traditional. There is no generic American Indian.

Understandings:	Essential Questions:
• Students will understand how to create a complex pattern. • Students will be able to connect complex patterns to Northern Cheyenne moccasin beading. • Students will see real-world relationships between patterning in class and beaded artwork.	• What is a pattern? Give a dictionary definition and explain its meaning in your own words. • Are there many ways for patterns to be created? • What do you think a complex pattern is? • What does symmetry mean? Can anyone give me an example of something in this room that is symmetrical? • Why do you think the Northern Cheyenne wore moccasins? • Why do you think Northern Cheyenne decorated their moccasins with patterns?

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Students will be able to…	*Students will know…*
• create a complex pattern. • relate the pattern to Montana Indian beaded art, specifically Northern Cheyenne. • view various forms of beaded artwork on the Internet, Smart Board, or through books.	• Montana Indians were the first people to live in Montana. • Montana Indians live amongst us today and many still enjoy making traditional clothing and beading. • Northern Cheyenne Indians of today continue to make beaded moccasins for decoration and Pow wow regalia. • the uses and needs of Northern Cheyenne beaded moccasins. • the many uses of patterning. • the aesthetics of symmetry.

Assessment Evidence

Performance Tasks:

- Students will create a pattern shown on either the overhead projector or Smart Board. They will be given an Excel Spreadsheet handout, which shows the colors and numbers of beads for each row. Students will follow teacher facilitation to begin gluing their beads onto the grid paper, but will need to follow spreadsheet directions and the picture provided on the overhead to complete the pattern.
- Students will find the dictionary or math text glossary definition for the word "pattern." This definition will be copied down and discussed with the class.
- Students will show lines of symmetry upon completion of their beading pattern.

Other Evidence

- Students will answer "Essential Questions" as a pre-assessment.
- Students are proficient with math vocabulary (pattern, symmetry).

Stage 3 Learning Plan

Learning Activities:

- "Today you will learn how to create a symmetrical beading design used by the Northern Cheyenne for designing moccasins. You will use your knowledge about patterns to help you create this complex design. The Northern Cheyenne tribe used various types of beading. One of the types is called a 'lazy stitch,' which you will learn about today."

- "I would like each of you to use a dictionary or your math textbook glossary to look up the word pattern (write the word on the board, Smart Board, or overhead projector). According to the definition, what is a pattern? How would you describe a pattern in your own words? Do you think patterns can be created in many ways? Can anybody tell me what a complex pattern might be? (A complex pattern is a pattern that is more complicated to create. This type of pattern does not always follow a "rule.")

- "What does symmetry mean?" Either after receiving the correct answer or giving the answer, ask students to find something in the classroom that is symmetrical. If students have difficulty, use faces and bodies to explain… "If you draw a line from the middle of your forehead to the middle of your chin, you may find that the right side of your face looks just like the left side of your face. If you were to fold one side over the other, they would match up almost perfectly. Try this idea with your whole bodies. Did you know that symmetry is attractive to look at? Most people like the look of a symmetrical design as opposed to a non-symmetrical design."

- Can anybody think of a symmetrical pattern that they know of or does anybody see a symmetrical pattern in the room? Not only will we learn to create a complex pattern, but we will learn how to create it with symmetry."

- "Why do you think the Northern Cheyenne Indians wore moccasins? (To protect their feet and keep them warm) Why did they decorate them with symmetrical patterns?" (To show which tribe they were from, to trade with other people, because they are attractive to view, for decoration and today they are used in Powwows.)

- Place an overhead transparency of the colored pattern on the overhead, or use a Smart Board to project the picture. Have students look at the pattern to follow exactly. Do line one together, as a group, walking through each bead color step by step. Move onto line two together. Ask students if they have any questions about following these steps to complete their pattern. Allow students to work alone or in groups to complete.

- Upon completion, have students find lines of symmetry from their pattern. Assessment should be through participation and teacher observation.

Variation 1	Variation 2	Variation 3
Use food coloring to dye ***noodles*** red, dark blue, blue, green, red, and pink. Do at least two days in advance to be sure students have enough noodles for the project. Macaroni noodles may be the best. Small groups of three or four students will most likely be easiest when using noodles. Glue onto chart paper.	Use actual colored ***beads***. Glue onto chart paper.	Use ***colored pencils*** for each bead color and have students color in the appropriate areas on their grid sheets. This is the easiest variation and takes very **little preparation.**

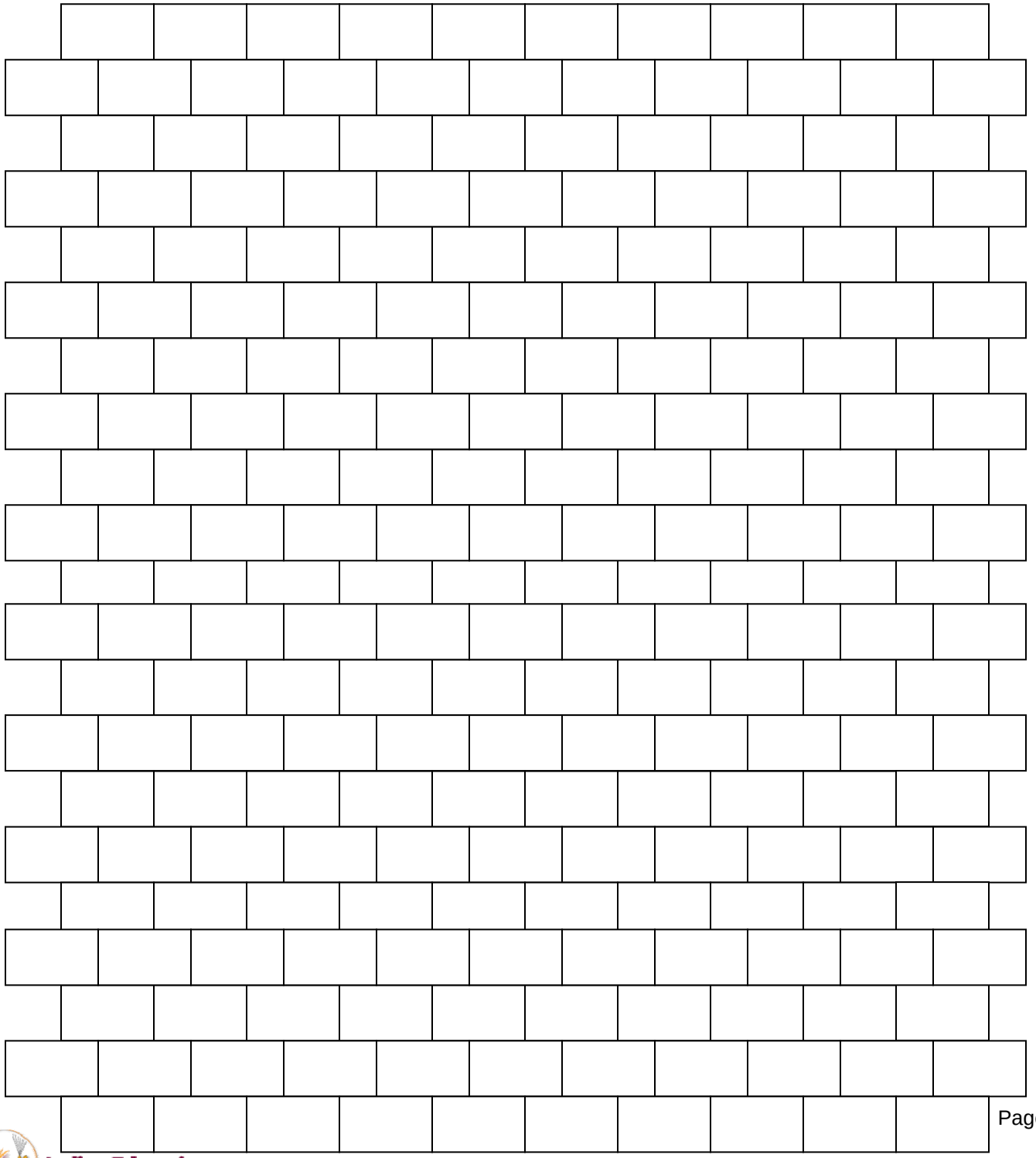
Variation 1 Materials	Variation 2 Materials	Variation 3 Materials
• Green colored noodles • Blue colored noodles • Light blue colored noodles • Red colored noodles • Pink colored noodles • Brick grid sheet (one copy per student): attached • Glue stick • Overhead of Northern Cheyenne beaded work, or project this on a Smart Board: *attached* • Overhead transparency of Cheyenne beading story, I'm Beading Moccasins by Jeannette Howlingcrane: *found at www.rci.rutgers.edu/~semurray/**moccasins**.pdf*	• Green colored beads • Blue colored beads • Light blue colored beads • Red colored beads • Pink colored beads • Brick grid sheet (one copy per student): *attached* • Glue stick • Overhead of Northern Cheyenne beaded work, or project this on a Smart Board: *attached* • Overhead transparency of Cheyenne beading story, I'm Beading Moccasins by Jeannette Howlingcrane: *found at www.rci.rutgers.edu/~semurray/**moccasins**.pdf*	• Colored pencils • Brick grid sheet (one copy per student): *attached* • Overhead of Northern Cheyenne beaded work, or project this on a Smart Board: *attached* • Overhead transparency of Cheyenne beading story, I'm Beading Moccasins by Jeannette Howlingcrane: *found at www.rci.rutgers.edu/~semurray/**moccasins**.pdf*

Teacher Resources:

Division of Indian Education. (2007). Montana Indians: Their History and Location. Montana Office of Public Instruction. Retrieved PDF version June 21, 2007, from http://www.opi.state.mt.us/

Name_____

Directions: Begin your beading by following the brick-style grid below. Use the correct color noodle (bead) for each box below. Pay close attention to your patterns as you move down your grid. Have fun!



Row	Dark Blue	Green	White	Blue	Pink	Red	Total
1	4	2	2	2	0	0	10
2	5	4	2	0	0	0	11
3	4	0	2	4	0	0	10
4	2	2	2	2	2	1	11
5	2	0	2	2	2	2	10
6	2	0	2	4	2	1	11
7	2	0	2	2	2	2	10
8	2	2	2	2	2	1	11
9	2	2	2	2	2	0	10
10	2	2	2	4	1	0	11
11	4	2	2	2	0	0	10
12	4	4	2	1	0	0	11
13	4	2	2	2	0	0	10
14	2	2	2	4	1	0	11
15	2	2	2	2	2	0	10
16	2	2	2	2	2	1	11
17	2	0	2	2	2	2	10
18	2	0	2	4	2	1	11
19	2	0	2	2	2	2	10
20	2	2	2	2	2	1	11
21	4	0	2	4	0	0	10
	57	30	42	51	26	14	220

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Mathematics Model Teaching Unit Estimating the Area of a Reservation

Created by Bonnie Spence

Grade 5 – Approximate Duration: 90 min

Stage 1 Desired Results

Established Goals:

Number Sense and Operation Mathematics Content Standard 1: A student, applying reasoning and problem solving, will use number sense and operations to represent numbers in multiple ways, understand relationships among numbers and number systems, make reasonable estimates, and compute fluently within a variety of relevant cultural contexts, including those of Montana American Indians.

- **3.4 Angles, Surface Area, and Volume**: Measure and compute angles, perimeter, area, surface area, and volume including the use of formulas and choosing appropriate units.

IEFA: Essential Understanding 4: Reservations are lands that have been reserved by the tribes for their own use through treaties, statutes, and executive orders and were not "given" to them. The principle that land should be acquired from the Indians only through their consent with treaties involved three assumptions:
I. Both parties to treaties were sovereign powers.
II. Indian tribes had some form of transferable title to the land.
III. Acquisition of Indian lands was solely a government matter not to be left to individual colonists.

Understandings:	Essential Questions:
Students will understand… • the concept of area. • how to find area of figures on a grid. • that reservation borders are not necessarily straight. • how to use a grid to estimate area of an irregular shape. • that estimates can vary. • that the average of a data set can be used to represent class data.	• Why are the figures formed by reservation boundaries often irregular shapes? • How can the area of an irregular shape be estimated? • How does finding the area of an irregular shape differ from finding the area of shapes such as triangles or rectangles?

Students will be able to…	*Students will know…*
• describe the area of shapes in square units. • find the area of shapes on a grid to the nearest half square unit. • use a grid to estimate the area of irregular shapes. • choose the best measure of central tendency to represent a set of data. • find the approximate area in square miles of Flathead Reservation.	• the definition of area. • that area is described in square units. • that different shaped figures can have the same area. strategies for estimating area.

Stage 2 Assessment Evidence

Performance Tasks: Area Worksheet, Estimated Area of Reservation: Result and Description of Method, Final Individual Performance Task, Design Your Own Boundaries Worksheet (with figure drawn on grid paper and turned in).

Other Evidence: Participation in class discussions. Individual questioning of students. Observation of student methods for grid placement and counting strategies.

Stage 3 Learning Plan

Learning Activities:

1. Review concept of area

- Ask students to define area.

  If students describe the concept of area using real world references such as the area around their desk, an area rug, or the quiet area of a library, question student responses to clarify their understanding. Ask students who say the "space" inside a shape, ask what type of shape. "Can it be the space inside a box?" "Is the area around your desk only on the floor or all around you from floor to the top of your head?" Questioning their ideas and asking them to justify and clarify will help lead students to think about the concept of area and develop the understanding that area is the "space" inside a two dimensional figure, not a three-dimensional figure.

  If students give a formula such as length times width, explain that the formula is one method for finding area of a rectangle, but ask, "Why?" "Where does it come from?" (Formulas come from recognized patterns. In a rectangle, multiplying the length and width is a fast way of counting the number of square units covering the inside of the rectangle.) At www.mathopenref.com/rectanglearea.html you can use an interactive tool to show how the formula represents the number of square units in the grid covering a rectangle.

  Some students may confuse perimeter with area. Make the distinction between linear measurement (length of a line segment as one single dimension) and area (which is two dimensions). Draw a figure on the board and have students identify where the area is in contrast to the perimeter. Using a pipe cleaner bent into any shape polygon, you can show that area only exists when there is a two dimensional figure.

Unbend the pipe cleaner into a single line segment to show that perimeter is a single length; ask students where the area is now? (Area only existed when there was a two dimensional figure.) The measurement of the perimeter still exists as a single length represented by the line segment of the "unbent" pipe cleaner, but the area cannot be represented by a single length.

Note that area of two dimensional figures is measured in square units due to the ease of counting squares and their ability to tessellate (fit together in a plane with no gaps or overlaps). This provides a consistent measuring tool for describing area. The units can be square centimeters, square inches, square yards, square kilometers, etc…

- Explain that today we will be looking at several different shaped figures and trying to determine the area of each figure.

2. Hand out Area Worksheet

- Read Question 1 aloud and ask students to answer Question 1.
- Have students share their predictions and reasoning with whole class or in small groups.
- Read through the remainder of the worksheet aloud and ask students to complete Question 2.
- students to share a variety of methods and strategies for determining the area of each figure. (Examples: Forming one square unit using two half squares, Extending figures F and G to form rectangles, counting the squares in the rectangle and then dividing the result by 2)

3. Display map of Montana Indian Reservations

- Read aloud and discuss the information about Indian reservations on "Background Information on Indian Reservations" document. (See Attached)
- Look at the map and ask students, "What do you notice about the shapes formed by the boundaries of the reservations?" (irregular shapes, curved edges) "Why do you think the shapes are irregular?" (Some border mountains, land that was sold or taken may follow geographic details such as rivers, roads, etc. which are not always straight.) "How might this make it difficult to find the exact area of each shape represented by the reservation boundaries?" (Cannot match a square grid exactly to count squares)

4. Handout map of Flathead Reservation and overhead transparency with grid.

- Assign students partners.
- Explain that each pair's task is to determine, as closely as possible, the number of square units in the area of the figure formed by the boundary lines of the Flathead Reservation. One square unit is defined as one square on the transparency grid. They may use a variety of strategies and materials to complete this task.
- Make available vis-à-vis pens, tape (for holding grid in place over map), scissors, glue sticks.
- They should be prepared to present their findings and share their method with the class.
- Ask students to complete the task with their partner.

5. Compile the class data.

- Have partner pairs share their results and the method they used to obtain it.
- Record each pair's results on the board.
- Ask why the values vary. (All are estimates.)
- Based on the data, discuss which estimate students think best represents the figure's area and why.

- Ask students to come up with one value that they will use to be the "average" area of the figure. Students may chose to find the arithmetic average (mean) by adding all the values and dividing by the number of estimates listed. Once complete have students compare this to the list on the board to be sure they agree it is a good average estimate. If the data has one particularly low or high estimate, it can affect the mean. A low value will bring the mean value down and a high value will raise the mean value. If there any of these "suspicious" values, such as one that is so far off from others, the class might want to use another method. Other methods might include choosing the most frequently occurring value (mode) or considering an extreme low or high estimate as an error in the counting of squares and recalculate the average (mean) without this value.

6. Calculate the approximate area of Flathead Reservation in square miles.

- Explain that each square unit on the map represents approximately 52 square miles in actual area. (Adjust value if map is printed at different scale than current printed document of approximately 1 cm = 7.2 miles.)
- Ask students to brainstorm with their partners how they could use this information with the chosen class average to estimate the number of square miles within the Flathead Reservation boundary. (52 times the number of squares)
- Complete the calculation and compare to land base estimates of nearly 1942 square miles.

7. Handout individual performance task, Design Your Own Boundaries.

- Read through assignment directions with students
- Have students complete the task in class or as an at-home assignment. The assessment allows for struggling students to complete a near rectangle shape with alteration of only one side of the figure. Encourage more advanced students to consider more realistic shaped boundaries like those appearing on the Montana Reservations map. You may also suggest they try different approaches to confirming the total area for their justification in Question 2.

8. Turn in completed designs.

- Post designs for students to see the variety of irregular figures that can have the same estimated area.

9. Contrast finding the area of irregular figures to known shapes such as rectangles and triangles.

- Ask how finding the area of irregular figures like those represented by Reservation lands compares to finding the area of rectangles and triangles. Allow students to share ideas and observations. Students should notice that for many of the rectangles and triangles they were able to easily cover the area with full or half squares due to the straight edges on the boundary of the figures. In the case of some triangles, they can be rearranged or be duplicated and arranged to form another shape such as a rectangle or parallelogram which makes it easier to count the squares inside. For the figures with irregular borders, some of the area can be broken into familiar shapes that are easier to count (like rectangular regions) but then the pieces with curved edges are harder to judge if they are half or a fourth of a square unit. With curved pieces you cannot as easily tell if they fit together to make a whole square unit. With straight lines it was often more obvious if the pieces fit and you could many times get an exact area versus an estimate.

Materials/Resources Needed:

- Copies of "Area Worksheet" for each student
- One copy of Montana Indian Reservations map for display (*Montana Indian Reservations map*, Indian Education for All, Montana Indians, Their History and Location, January 2007, p. 5; or www.opi.mt.gov, *Montana Reservation Information Map*, Resources, Background and Other Info link to PDF)
- Background information on history of reservations
- Copies of the Flathead Reservation map, one for each pair of students (Indian Education for All, Montana Indians, Their History and Location, January 2007, p. 22; www.opi.mt.gov)
- Copies of "Design Your Own Boundaries Worksheet" for each student
- 1-cm squares grid printed on overhead transparencies, one for each pair of students (free online grid paper available at www.incompetech.com)
- vis-à-vis pens or wipe-able markers
- tape
- scissors
- glue sticks
- one pipe cleaner or segment of bendable wire

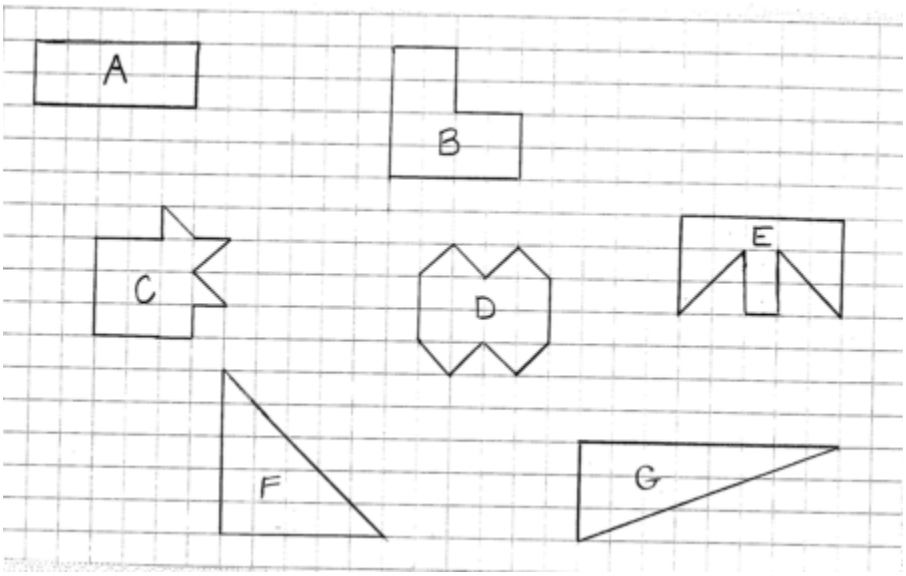
Area Worksheet **Name: _____**

1. Look at the figures A-G shown below.

a. Which figure appears to have the greatest area? _____

b. Which figure appears to have the least area? _____

c. Which figures might be equal in area? _____



If ___ is 1 unit long, then ☐ is one square unit in area.

The area of a figure is measured in square units.

2. For each figure shown above, determine whether the area of each figure is less than, equal to, or greater than 12 square units.

Figure A _____ Figure B _____

Figure C _____ Figure D _____ Figure E _____

Figure F _____ Figure G _____

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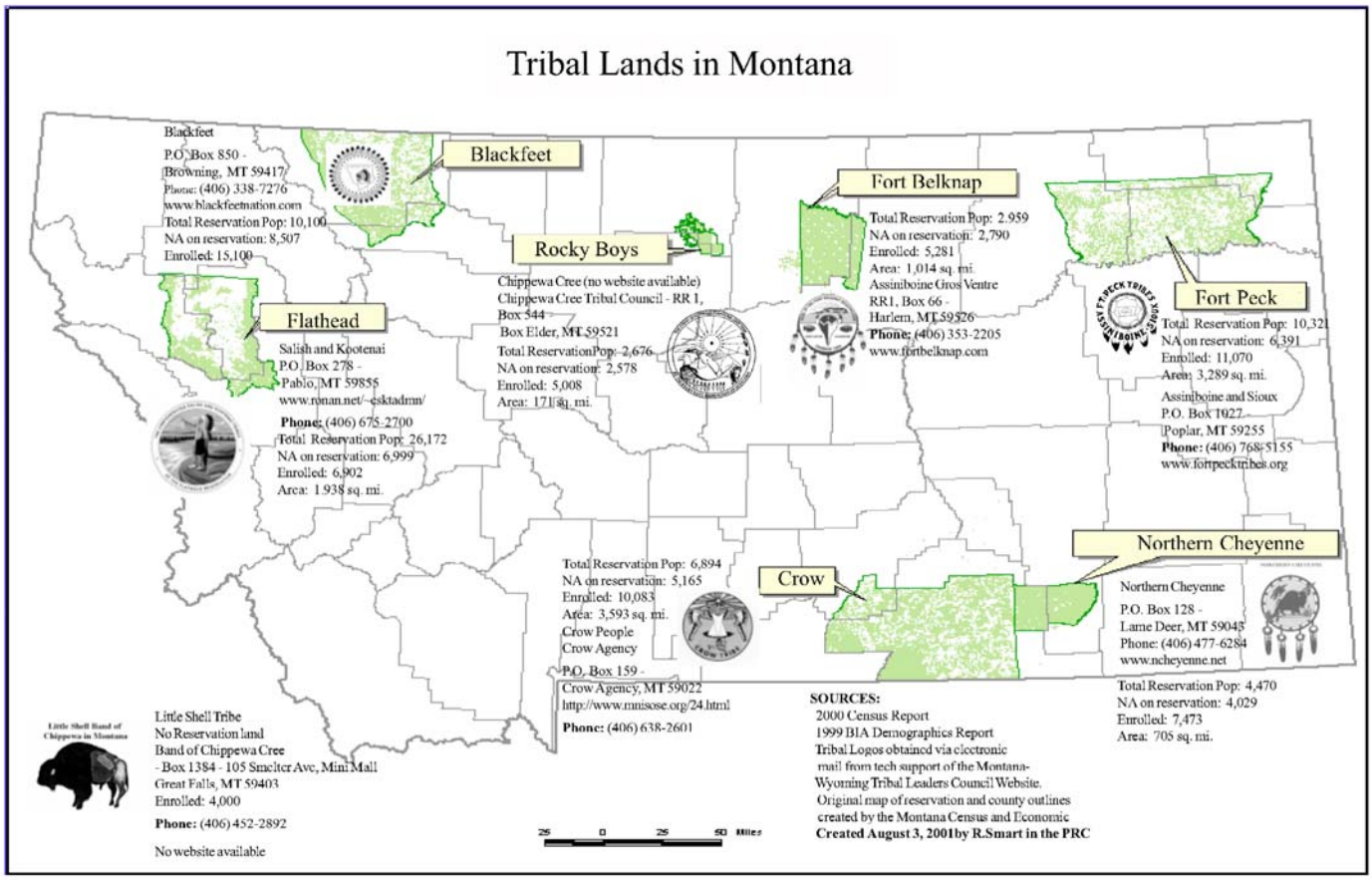


http://opi.mt.gov/pdf/indianed/resources/triballands.pdf

Background Information on Indian Reservations

(Excerpts from OPI's Indian Education for All document, *Montana Indians, Their History and Location,* pages 2 and 3).

The First Best Place

Long before Montana became known as the "last best place," Indian nations and Indian people knew this area as "the first best place." Before there was a state called Montana, several tribal nations called this area "home." In addition to the tribal nations that are currently located in the state, the Mandan, Hidatsa, Arikira, Nez Perce, and Shoshone, among many others, also have historical roots in this territory.

Indian people lived here, raised their families here, taught their children here, and knew this land and its seasons intimately. They knew their homeland was extraordinary and that the terrain could be both generous and unforgiving. This is a sacred place. Their stories are tied to this land. Their histories, religions, and philosophies are connected to this location. Their contemporary lives are still united with the landscape of this locale. This place remains, to the tribes and tribal citizens who live within the boundaries of what is now known as Montana, the first best place to live and carry on their way of life and traditions.

Indian Reservations

The introduction to the saga of this state, and indeed the nation, is focused on the land. Conflicts, battles, and struggles over land possession ensued when very different and inconsistent value systems and cultures collided. The issue of who would control and define the terms of "ownership" guided much of the relationship, and clashes, between tribal nations, the federal government, state government and individual Euro-Americans.

During the late 1800s, the fledgling U.S. Government and the established tribal nations located in this area entered into treaties that created, among other things, boundaries for each of their respective citizens. The premise that land could be acquired from the Indian nations only with their consent through the negotiated terms of treaties involved three assumptions: 1) that both parties to the treaty were sovereign powers; 2) that the Indian tribes had some form of transferable title to the land; and 3) that the acquisition of Indian lands was solely a government matter not to be left to individual colonists/settlers.

It is under these three assumptions that treaties were constructed. As such, treaties created a system whereby, in theory, tribes reserved portions of their homeland for themselves. Hence, the term "reservations." It was not land that was "given" to them. In fact, tribes ceded particular tracts of their homeland to the U.S. Government for settlement by U.S. citizens, which were called "homesteads," as well as for railroads and for gold exploration and other resources needed by this new government. The reality, of course, is that there were very few negotiated treaty terms. The U.S. Government "negotiated" with the tribes under coerced conditions in order to establish a larger land base for itself, states, and its citizens.

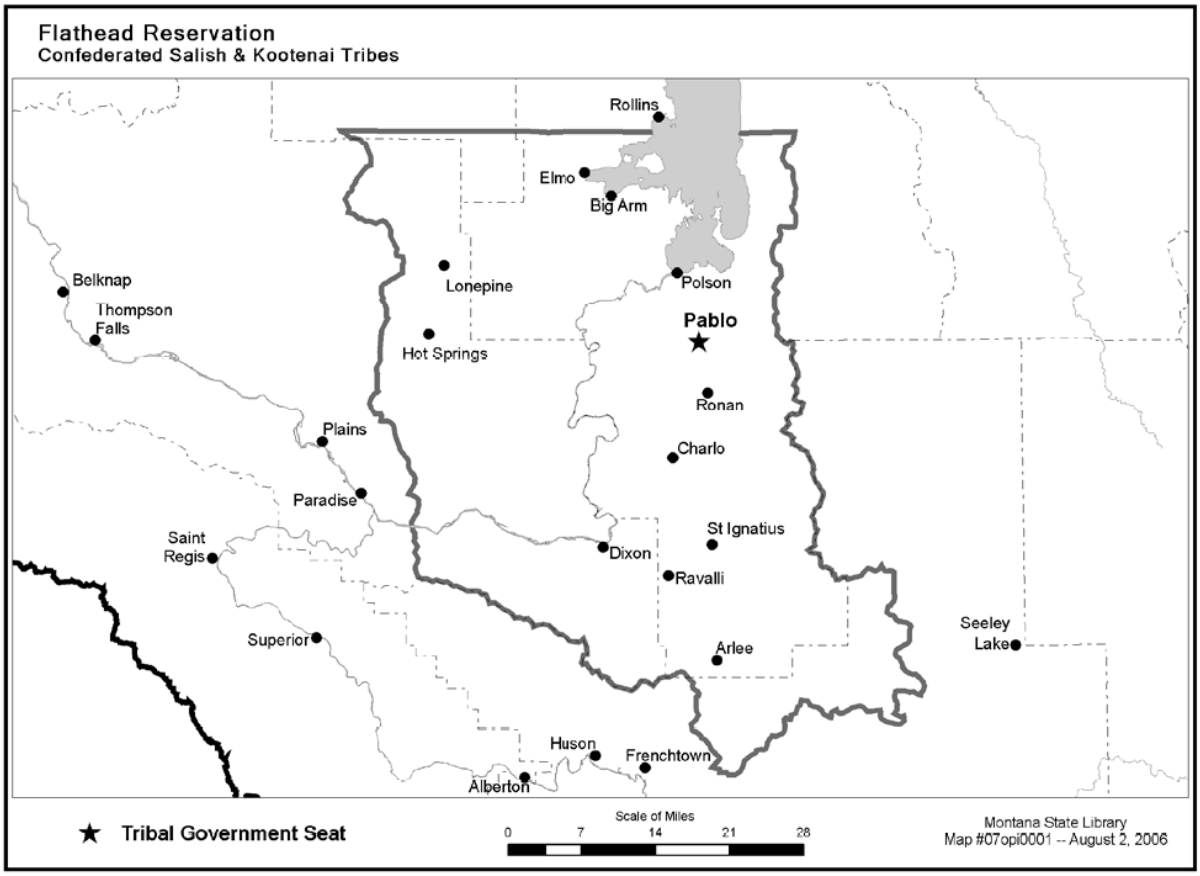
And now, the rest of the story. It was said by Mahpiya-Luta, or Red Cloud, an Oglala and Brule' (Lakota Sioux): "They made us many promises, more than I can remember, but they only kept one; they promised to take our land, and they took it." The U.S. Government did not keep its promises. The terms of the treaties were broken - in every instance. The negotiated reservations of land continued to shrink as more and more immigrants discovered this first best place. Indian people were left with very few choices; they learned to live with new neighbors, their different way of life, and their contrasting worldviews.

The story of Montana, at its beginning, is one simply about survival for tribal people. Each tribe has its own stories about the U.S. Government's failed attempts to "fix the Indian problem" through policies that were meant to assimilate their people into an American way of life, and, in some cases, terminate tribal governments and cultures entirely. Tribes have their own stories about surviving the slaughter of the bison - their primary food source. And today, they still acknowledge the destruction brought on by disease epidemics. Still, they remain. Still, they govern themselves through their sovereign status as nations within a nation. Still, they tell their own stories that tie them to this first best place. The brief histories in this publication, written by tribal people, tell a part of their stories.

The Contemporary Landscape

Twelve tribal nations eventually came to rest within the boundaries of Montana. Eleven of these nations reside within their reserved homelands - reserved either through treaties or executive order. One, the Little Shell Band of Chippewa, is "landless," but it currently seeks federal recognition and to establish its own land base. These tribal nations govern seven reservations that comprise nine percent of Montana's land base. There are also many Indian people, from all of the tribes, who live off-reservations in towns and cities across Montana.

Indian people, whether they live on or off reservations, contribute economically, culturally, socially, and politically to Montana's landscape and history. Each tribe has its respective government that establishes services for its citizens. Each tribal government, as does any government, continues to assert its sovereignty to create a better future for its members. Tribes and tribal citizens continue to play a vital role in the chronicles of Montana."


Flathead Reservation
Confederated Salish & Kootenai Tribes
Rollins
Elmo
Big Arm
Belknap
Thompson Falls
Lonepine
Polson
Pablo
Hot Springs
Ronan
Plains
Charlo
Paradise
St Ignatius
Saint Regis
Dixon
Ravalli
Seeley Lake
Superior
Arlee
Huson
Frenchtown
Alberton
Tribal Government Seat
Scale of Miles
0 7 14 21 28
Montana State Library
Map #07opi0001 -- August 2, 2006

Design Your Own Boundaries **Name: _____**

Use 1 cm grid paper to complete the question below. One small square represents 1 square mile.

1. Draw an irregular figure that…
- **could represent a reservation of land with an approximate area of 39 square miles.**
- **is a figure that shows the boundaries of a particular region. It does not have any open sides.**
- **have one or more sides that are not straight line segments.**

2. Justify how you know your area is approximately 39 square miles.

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Area Worksheet Answer Key

1. a.-c. Student responses will vary.
Revisiting after Question 2 will reveal: **a.** F b**.** A **c.** B, D, & G

2. Figure A; less (10), Figure B: equal, Figure C: less (10.5), Figure D: equal, Figure E: less (11), Figure F: more (12.5), Figure G: equal

Design Your Own Boundaries Answer Key

1. Check students' sketches.

2. Answers will vary. Justifications may include counting of whole and partial squares to form wholes, rearranging of squares to form full squares or a more familiar geometric shape, or possibly enclosure of shape in a larger familiar geometric shape of close to but greater area than original.

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Mathematics Model Teaching Unit

Geometric Beadwork

Created by: Jessica Cameron

Grade 5: Duration 1 – 60 minute lesson

Stage 1 Desired Results

Established Goals:

Geometric Reasoning Mathematics Content Standard 3: A student, applying reasoning and problem solving, will understand geometric properties, spatial relationships, and transformation of shapes, and will use spatial reasoning and geometric models to analyze mathematical situations within a variety of relevant cultural contexts, including those of Montana American Indians.

- **3.2 Congruence and Similarity**: Use spatial reasoning to determine congruence, similarity, and symmetry of objects in mathematics, art, science, and culture, including Montana American Indians.
- **3.3 Transformations including Dilations:** Define, identify, and execute transformations including translations, rotations, reflections, and dilations with appropriate technology.

IEFA Essential Understanding 3: The ideologies of Native traditional beliefs and spirituality persist into modern day life as tribal cultures, traditions, and languages are still practiced by many American Indian people and are incorporated into how tribes govern and manage their affairs.
Additionally, each tribe has its own oral histories, which are as valid as written histories. These histories pre-date the "discovery" of North America.

Understandings:	Essential Questions:
• The importance of dance to some Native American people. • The variety of geometric concepts applied to regalia. • The definition of regalia- Magnificent attire; finery http://dictionary.reference.com/browse/regalia	• How is dance an important part of some Native Americans' culture? • What mathematical terms can be used to describe the designs on regalia? • How many lines of symmetry does your figure have? • What makes lines of symmetry or a reflection appealing to the eye?
Students will be able to… • acknowledge that dance is an important tradition of some Native Americans'culture. • identify lines of symmetry. • identify a reflection.	*Students will know…* • how to identify lines of symmetry and reflections on regalia and other forms of art. • how to design beadwork on paper. • how to form lines of symmetry. • how to form a reflection.

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Stage 2 Assessment Evidence
Performance Tasks: • Students will design a piece of "beadwork" on graph paper and be able to identify at least 2 lines of symmetry and 1 reflection, in which every point of the geometric figure is moved the same distance in the same direction. They will also answer the 4th Essential Question on the back of the paper: "What makes lines of symmetry or a reflection appealing to the eye?" **Other Evidence:** • Check for understanding after reading the book by asking a variety of questions. You may start by asking if anyone has ever been to a Powwow and generate some talk on regalia.
Stage 3 Learning Plan
Learning Activities: • Read *Jingle Dancer* by Cynthia Leitich Smith to the class to bring about awareness of powwows. • Check for understanding after reading the book by asking a variety of questions. You may start by asking if anyone has ever been to a Powwow and generate some talk on regalia. Then ask the following Essential Questions: How is dance an important part of some Native Americans' culture? (each tribe has its own unique traditions that they are still able to express today through dance); What mathematical terms can be used to describe the designs on regalia? (e.g. symmetrical, reflections, translations) • Go to http://www.nmai.si.edu/exhibitions/identity_by_design/IdentityByDesign.html • Throughout the Web site there are several different designs that show symmetrical bead work. Click on a few photographs and look at each one individually. Display using a projector if possible. If no projector is available, print several pictures to pass around the class or have a community member share some regalia or other beadwork with the class. • Discuss lines of symmetry and identify any translations you may find. When discussing the patterns, be sure to use the appropriate term for the outfits, "regalia." • Hand out graph paper. • Using an overhead, show the students how to count over from the top to find the middle box. Start with one color there, and then design off of that, using that as your starting point. Design a simple example for them to get started. (See example below) • Have the students begin their own designs. The students can be very creative, just remind them that they need to show two lines of symmetry and one reflection. • When finished, have them bring the paper to you and show you where their lines of symmetry are and their reflection, which answers the 3rd Essential Question: How many lines of symmetry does your figure have? (must be able to show you at least 2 lines)

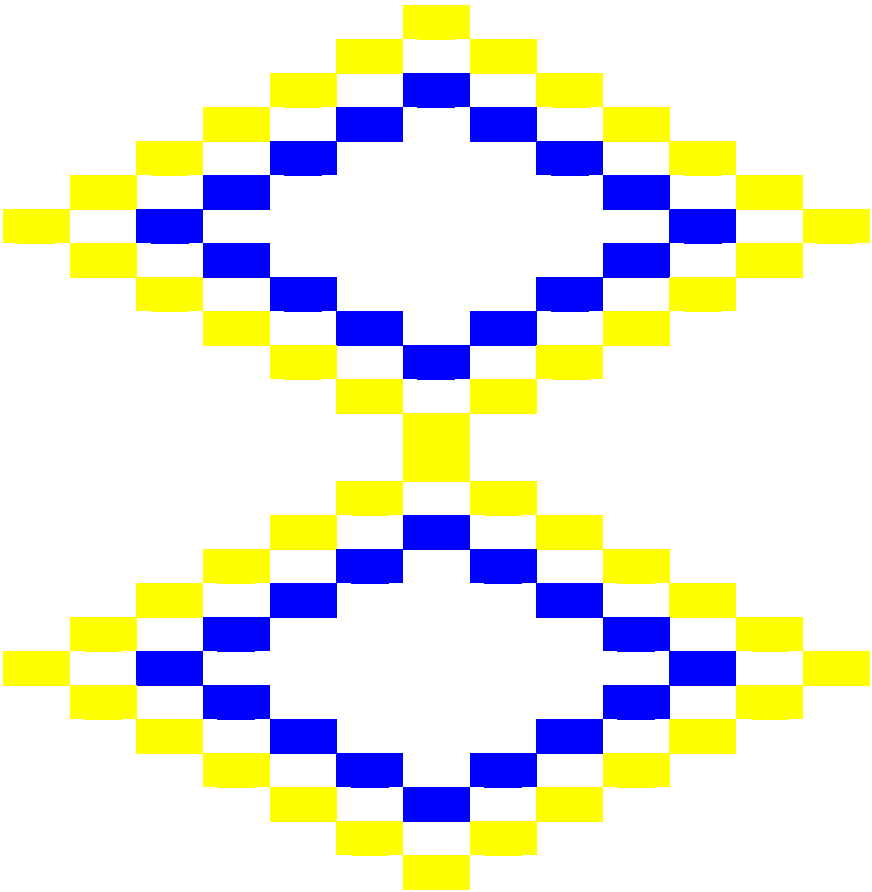
- Have it be worth 4 points; 1 point for each line of symmetry, 1 point for a reflection and 1 point for answering the 4th Essential Question on the back of their paper: What makes lines of symmetry or a reflection appealing to the eye? (e.g. they are even).

Resources:

Smith, Cynthia Leitich Smith. **(Muscogee Creek)** ***Jingle Dancer.*** Illustrated by Cornelius Van Wright and Ying-Hwa Hu. New York: Morrow Junior Books, 2000. ISBN 0-688-16241-X

- http://www.nmai.si.edu/exhibitions/identity_by_design/IdentityByDesign.html
- http://dictionary.reference.com/browse/regalia

Materials/Resources Needed:
- Internet access with overhead OR printed pictures of regalia OR a community member that has access to beadwork or regalia.
- Graph paper
- Coloring tools



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Mathematics Model Teaching Unit

Graphing Native American Populations

Created by: Jessica Cameron

Grade 5: Duration 1 - 60 minute lesson

Stage 1 Desired Results

Established Goals:

Data Analysis Mathematics Content Standard 2: A student, applying reasoning and problem solving, will use data representation and analysis, simulations, probability, statistics, and statistical methods to evaluate information and make informed decisions within a variety of relevant cultural contexts, including those of Montana American Indians.

- **2.2 Evaluating Data and Making Conjectures:** Interpret, analyze, and evaluate data using mean, median, range, and quartiles to identify trends and make decisions and predictions about data within scientific and cultural contexts, including those of Montana American Indians.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

IEFA Essential Understanding 4: Reservations are lands that have been reserved by the tribes for their own use through treaties, statutes, and executive orders and were not "given" to them. The principle that land should be acquired from the Indians only through their consent with treaties involved three assumptions:
I. Both parties to treaties were sovereign powers.
II. Indian tribes had some form of transferable title to the land.
III. Acquisition of Indian lands was solely a government matter not to be left to individual colonists.

IEFA Essential Understanding 5: Federal policies, put into place throughout American history, have affected Indian people and still shape who they are today. Much of Indian history can be related through several major federal policy periods:
Colonization Period 1492 -
Treaty Period 1789 - 1871
Allotment Period 1887 - 1934
Boarding School Period 1879 - - -
Tribal Reorganization Period 1934 - 1958
Termination Period 1953 - 1988
Self-determination 1975 – current

Understandings:	Essential Questions:
• The number of enrolled members of each tribe living on the reservation compared to those living off of the reservation.	• How many enrolled members of each tribe live on the reservations? • How many enrolled members of each tribe live off of the reservations? • What is the total population of each of the tribes represented both living on or off of the reservation? • What is the total Native American population in the state of Montana given the information you have?
Students will be able to… • design a graph using appropriate labels, key, scale, and title. • compare populations of the reservations for those living on, off, or combined.	*Students will know…* • the populations of the Blackfeet, Crow, Flathead, Ft. Belknap, and Northern Cheyenne Reservations. • how to correctly input data into a graph using appropriate labels, key, scale, and title.

Stage 2 Assessment Evidence

Performance Tasks:

- Finished product will be a complete double bar graph representing five reservations and their enrolled member population that live on the reservation and the number of enrolled members living off of the reservations.
- On the back of the graph, students will answer the Essential Questions from above. Refer to Reservation Populations (attached at the end of this lesson) for answers.

Stage 3 Learning Plan

Learning Activities:

- Download the publication at http://www.opi.mt.gov/pdf/IndianEd/Resources/MTIndiansHistoryLocation.pdf
- Share with the students on a projector or make copies for groups to share as you read through it.
- As you read through the information, stop periodically and check for understanding by asking questions about the population, history, land amount, or other interesting facts of a tribe you've just read about.
- Upon completing the reading, discuss populations on and off of the reservation and talk about why they would leave the reservation. This information can be found in *Montana Indians: Their History and Location* (http://www.opi.mt.gov/pdf/indianed/resources/MTIndiansHistoryLocation.pdf), under the section titled "Montana's Urban Indians", pages 62-65. (i.e. jobs are hard to come by on the reservation.)
- Handout the graph paper and a copy of reservation populations (below) to each student.
- Explain to the students that they are going to design a double bar graph comparing those living on and those living off of the reservations. Let them know they are going to need to use 2 coloring tools, one for each group.

- The finished product will be a finished double bar graph representing the 7 reservations and their enrolled member population that live on the reservation and the number of enrolled members living off of the reservations.

- On the back of the graph, have students answer the Essential Questions from above. Refer to Reservation Populations for answers.

Resources:
- http://www.opi.mt.gov/pdf/IndianEd/Resources/MTIndiansHistoryLocation.pdf
- http://www.opi.mt.gov/IndianEd/

Materials/Resources Needed:
- Copies of the OPI publication if unable to display on a projector.
- Copies of reservation populations (below) for each student.
- Graph paper
- Coloring tools
- Rulers
- Pencils

Background Knowledge
Students will need to know…
- How to make a double bar graph using appropriate labels, key, scale and title.
- The locations of the Montana reservations.

Reservation Populations

Blackfeet Reservation

Enrolled members living on or near the Blackfeet Reservation	8,485	
Enrolled members living off the Blackfeet Reservation	6,633	
Total number of enrolled Tribal members		15,118

Crow Reservation

Tribal members living on or near the Crow Reservation	7,153	
Enrolled members living off the Crow Reservation	3,180	
Total number of enrolled Tribal members		10,333

Flathead Reservation

Enrolled members living on or near the Flathead Reservation	4,244	
Enrolled members living off the Flathead Reservation	2,717	
Total number of enrolled Tribal members		6,961

Fort Belknap Reservation

Enrolled members living on or near the Fort Belknap Reservation		5,771
Enrolled members living off the Fort Belknap Reservation	1,532	
Total number of enrolled tribal members		7,303

Northern Cheyenne Reservation

Enrolled members living on or Near the Northern Cheyenne Reservation		4,199
Enrolled members living off the Northern Cheyenne Reservation	3,175	
Total number of enrolled tribal members (approximate)		7,374

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opi.mt.gov

Mathematics Model Teaching Unit

Graphing Old Man's Journey

Created by Bonnie Spence

Grade 5 – Approximate Duration: 60 minutes

Stage 1 Desired Results

Established Goals:

Number Sense and Operation Mathematics Content Standard 1: A student, applying reasoning and problem solving, will use number sense and operations to represent numbers in multiple ways, understand relationships among numbers and number systems, make reasonable estimates, and compute fluently within a variety of relevant cultural contexts, including those of Montana American Indians.

- **1.6 Proportional Reasoning:** Understand and apply proportional relationships to model real world situations and to solve problems involving rates, ratios, proportions, percents, and direct variation.

Algebraic and Functional Reasoning Mathematics Content Standard 4: A student, applying reasoning and problem solving, will use algebraic concepts and procedures to understand processes involving number, operation, and variables and will use procedures and function concepts to model the quantitative and functional relationships that describe change within a variety of relevant cultural contexts, including those of Montana American Indians.

- **4.1 Representing and Generalizing Patterns:** Create and use tables, graphs or diagrams, symbolic expressions, and verbal descriptions to represent, analyze, and generalize a variety of patterns involving numbers and operations.
- **4.5 Linear Modeling**: Identify and compute rate of change/slope and intercepts from equations, graphs, and tables; model and solve contextual problems involving linear proportions or direct variation using cultural contexts, including those of Montana American Indians.

IEFA: Essential Understanding 3: The ideologies of Native traditional beliefs and spirituality persist into modern day life as tribal cultures, traditions, and languages are still practiced by many American Indian people and are incorporated into how tribes govern and manage their affairs.

Additionally, each tribe has its own oral histories, which are as valid as written histories. These histories pre-date the "discovery" of North America.

Understandings:	Essential Questions:
Students will understand… • that oral histories exist that may differ from the histories they are familiar with. • how to represent rate with line graphs.	• To what extent does a graph tell a story? How does it differ from oral or written stories? • How can you use a graph to interpret the events of a story?

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Students will be able to…	*Students will know…*
• represent portions of the Blackfeet creation myth with a line graph. • use a line graph to represent change over time. • explain the connection between rate and steepness of a line. • construct and interpret a line graph.	• the features of line graphs. • a graph can be a visual representation of a story. • that in a line graph using time versus distance, a steeper line represents a faster rate while a flatter line represents a slower rate.

Stage 2 Assessment Evidence

Performance Tasks: Line Graphs Worksheet

Other Evidence: Participation in class discussion, oral justifications, individual questioning of students

Stage 3 Learning Plan

Learning Activities: Students listen to a Blackfeet creation story. Using portions of the story, students learn how to represent rates and frequencies with line graphs and histograms.

BACKGROUND (Essential Understanding 3)

Tribal languages, cultures, and traditions are alive and well throughout Indian country. Indigenous languages are still spoken, sacred songs are still sung, and rituals are still performed. It is not important for educators to understand all of the complexities of modern day contemporary American Indian cultures, however, educators should be aware of their existence. They should also understand the ways cultures might influence much of the thinking and practice of American Indians today.

These histories and traditions may be private, to be used and understood only by members of that particular tribe. Educators should be aware of this issue when asking students about their histories, ceremonies, and stories.

Educators should also be consistent with policies surrounding "religious/spiritual activities" and ensure that Native traditions and spirituality are treated with the same respect as other religious traditions and spirituality.

Each tribe has a history, as valid as any other belief, which can be traced to the beginning of time. Many tribal histories place their people in their current traditional lands in Montana. For example, educators should respect these beliefs when teaching about "the history of mankind," particularly regarding the Bering Strait Theory. Many tribal histories will be told only orally as they have been told and passed down through generations.

Some tribes may only tell certain stories during certain times of the year, and this knowledge should be respected in classrooms.

1. Warm-Up Activity

Arrange students in a circle or line to play "telephone". The first person whispers a phrase into the ear of the second person, with each repeating what he or she heard. The last person to receive the message states the message out loud to the group. A comparison of the original message is made to the final message which has usually been altered through the oral process. Start with the phrase, "The old woman wandered down a dusty road that wound around a bend and crossed a rippling stream before heading up the hill to her home among the cliffs."

After the activity, compare the original message to the final one. Were all the details still intact? Was the main message still communicated?

Ask students what they think would have happened if you wrote the message on a piece of paper and then passed it to each person, having them read it or copy it. (It would most likely remain close to the original.)

2. Introduce the concept of storytelling.

- Ask students about their experiences with storytelling. Ask if any of them listen to stories passed on through generations in their families, or listen to special stories during holidays. Some may relate to family gatherings where the recalling of events that occurred in the past are retold year after year, like remember the time when the bridge washed out…or when Dad surprised us with… Is the story always told exactly the same and with the same detail? (Some details may be enhanced or deleted depending on the story teller, thus altering the versions. Some persons may use effects such as their voice tone, volume, pausing to emphasize certain parts of the story.)
- Explain to students that oral storytelling is an important tradition in Native American cultures. Even though the details may vary among Story Tellers, these oral stories communicate what some people feel are the highest truths from their tribal histories. Tell students you will be reading an oral story from the Blackfeet Indians that was eventually recorded and published in a book in 1953. Explain that a myth (preferably called a creation story) is "a traditional story accepted as history that serves to explain the world view of a people" (wordnet.princeton.edu)
- Ask that while you read, students to try to visualize the story, especially the activities that take place during the story.

3. **Read aloud to students the Blackfeet story, "The Creation"** (found at www.opi.mt.gov/pdf/IndianEd/Resources/MTIndiansHistoryLocation.pdf)
4. **Handout Line Graphs Worksheet.**
5. **Direct students to look at the graph in Question 1.**

- Discuss the axes. Ask what the horizontal axis represents. (time) Discuss how to read the horizontal axis since there are no intervals given. (Read from left to right, further right, more time has passed) Ask what the vertical axis represents (distance traveled). Again ask how to read the distance since no units are given. (As you move up the vertical Old Man has traveled more total distance). For students having difficulty with these concepts you may want to label the horizontal axis with increments in hours and the vertical with miles.
- Contrast the first two segments of the line graph. Read aloud or have students read to themselves parts *a* and *b* of the story. Then ask why the graph changes and what the changes represent. Guide students to understand that Old Man starts walking at a constant speed. If students misinterpret segment *a* as increasing speed since the line is directed upward, have them make stair steps on the graph by repeatedly following the horizontal grid lines of the graph paper by going right 1 segment and then up vertically as much as needed

to reach the line. This way they can see that for each equal segment of time, he is traveling the same distance since the vertical segments in this section are all equal in length. Then contrast this to the steepness of segment *b* where Old Man is crossing the river. Ask students why the line segment is not as steep. (Crossing a river takes longer and he must walk slower through the water.)

- Continue comparing the remainder of the segments and aligning them with Old Man's actions, speed, and distance. Allow students to share observations and conclusions about the graph. Be sure to point out the relationship between the times Old Man is stopped and the flat horizontal segments *c* and *e*. In both these, time continues to pass, but his total distance remains unchanged while he is stopped, so it does not increase or decrease.
- Ask students to brainstorm the advantages/disadvantages of using a graph to represent Old Man's journey. (Advantages include: It is a quick visual reference that shows his pace without having to read through the story. Disadvantages include: It is one person's interpretation of the Old Man's distance and time. There is no set number of miles or time that he traveled related in the story. Many of the details of the story such as what he was creating or saying during that time are not communicated.)

6. Direct students to look at the graph in Question 2.

- Ask students to choose one of the graphs that best represents the Old Man's speed as he takes a Big Horn sheep up the mountain and an antelope down the mountain. Re-read the corresponding paragraphs of the story aloud if desired.
- Discuss students' choices and allow students to share justifications for their choice or their elimination of the other two graphs. (Graph A is the best choice) Most students will be able to eliminate Graph C since the distance decreases as time passes. Some may choose Graph B because its shape "looks" like a steep mountain. Use this opportunity to talk about your walking rate as you climb a mountain (it is slower) than when you descend a mountain (faster, thus Old Man descends the same distance in less time with Graph A)

7. Assign Question 3 to be completed individually.

- Graphs to Question 3 will vary since no specific units are designated for time or distance. The idea is for students to understand the overall shape of the graph without being focused entirely on the units of measure.

8. Turn in Line Graphs Worksheet.

- Check for key characteristics in students' graphs: walking should show a line going up, high hill walking should be less steep of a line going up, resting should show a flat line, and sliding down should be a line going down. Since sliding indicates a faster pace than climbing, it should be steeper than the uphill climb.

9. Share information about other tribes' stories.

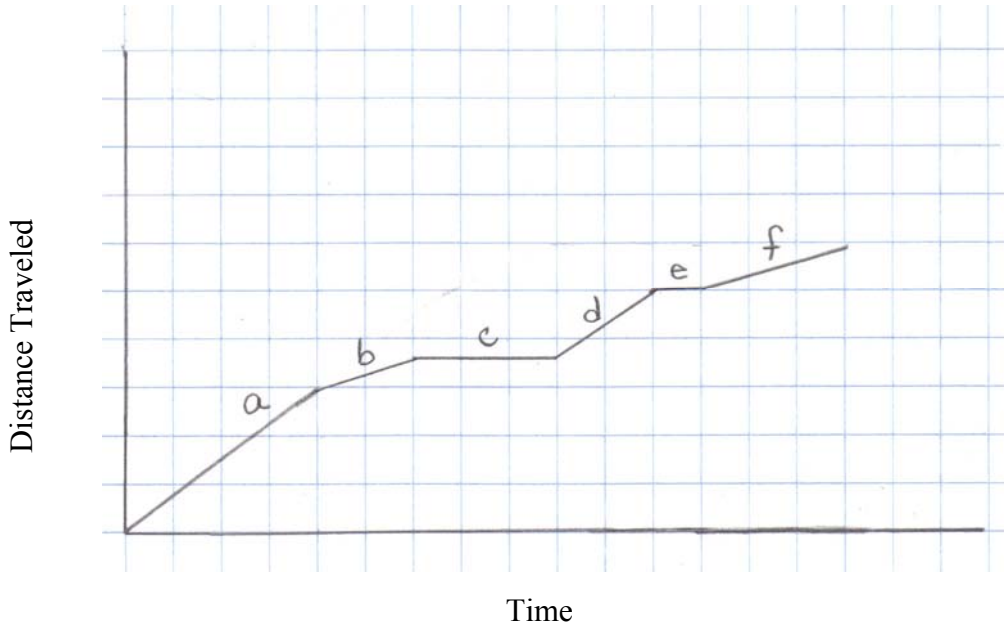
- Discuss that Old Man's Journey is one of many stories told by Native Americans. Salish and Pend d'Oreille tribes' oral histories tell of their placement in the Montana region through a story of the coyote. Many of the Coyote stories contain what may be considered fairly precise descriptions of the geological events of the last ice age (*Montana Indians, Their History and Location* p. 24)
- **Materials/Resources Needed:**

Copy of "The Creation" (www.opi.mt.gov/pdf/IndianEd/Resources/MTIndiansHistoryLocation.pdf Blackfeet Reservation, document pages 8-10)
Copies of Line Graphs Worksheet (one for each student)
Graph paper for each student
Ruler or straight edge for each student

Line Graphs Worksheet **Name: _____**

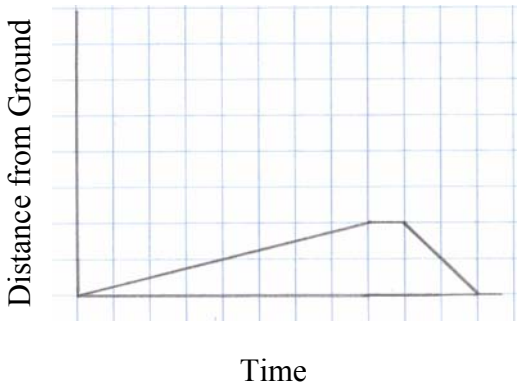
1. Study the line graph below. Discuss as a class the relationship between the story and the labeled segments of the graph.

Old Man's Travels



2. As the story progresses, Old Man leads a Bighorn sheep up a mountain and then later leads an antelope down from the mountain to the prairie. Study the three graphs below to determine which graph best represents his trip on the mountain.

Graph A: Mountain Trip



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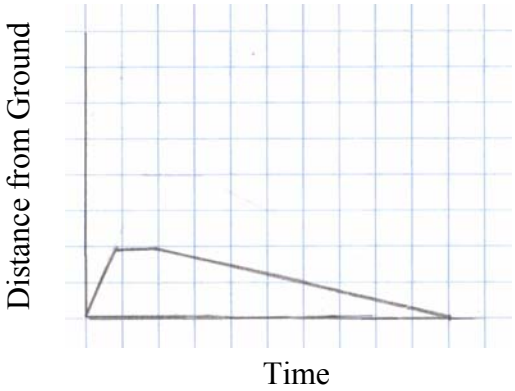
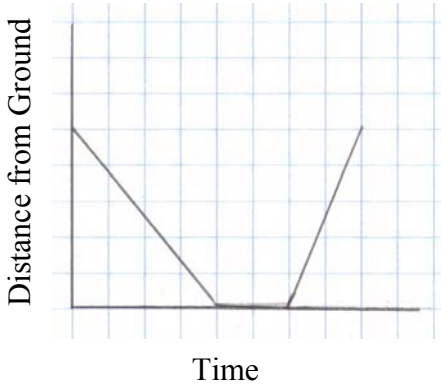
Graph B: Mountain Trip



Graph C: Mountain Trip



Which graph did you choose? _____

Why? Justify your choice. _____

_____

_____

_____

3. On graph paper, create a line graph to represent Old Man's distance above the ground during the following portion of the story. Be sure to include a title and labels on the horizontal and vertical axes.

> When he awoke from his sleep, he traveled farther north until he came to a high hill. He climbed to the top of it and there he sat down to rest. As he gazed over the country, he was greatly pleased by it. Looking at the steep hill below him, he said to himself, "This is a fine place for sliding. I will have some fun." And he began to slide down the hill. The marks where he slid are to be seen yet, and the place is known to all the Blackfeet tribes as "Old Man's Sliding Ground".

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Mathematics Model Teaching Unit

Making a Star Quilt

Created by Erin Glennie

Grade 6: Duration 2 - 50 minute periods

Stage 1 Desired Results

Established Goals:

Geometric Reasoning Mathematics Content Standard 3: A student, applying reasoning and problem solving, will understand geometric properties, spatial relationships, and transformation of shapes, and will use spatial reasoning and geometric models to analyze mathematical situations within a variety of relevant cultural contexts, including those of Montana American Indians.

- **3.1 Properties of Solids and Figures**: Define, classify and compare properties of solids and plane figures, including lines and angles.
- **3.4 Angles, Surface Area, and Volume**: Measure and compute angles, perimeter, area, surface area, and volume including the use of formulas and choosing appropriate units.

IEFA Essential Understanding 1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures, histories and governments. Each Nation has a distinct and unique cultural heritage that contributes to modern Montana.

Understandings:	Essential Questions:
• The Assiniboine and Sioux tribes of northeastern Montana mark important events through a Star Quilt Ceremony. • When making a Star quilt, precision in cutting or folding is crucial. • Geometric principles are involved.	• What is the background of the Star quilt? • How will the look of a quilt be affected if you don't use accurate measuring in your cutting or folding?
Students will be able to…	Students will know…
• use research skills to learn about the traditions of the Assiniboine and Sioux Star Quilt Ceremony. • explain what a person might see at a Star Quilt Ceremony. • review geometric properties, i.e. parallel and perpendicular lines, parallelograms (specifically a rhombus), symmetry, supplementary and complementary angles, etc. • construct a Star quilt block by folding paper into rhombi, and piecing them together.	• the importance of precise and accurate angle measurement when folding the pieces of the quilt. • how to fold a rhombus to be used as a pattern. • the meaning of the Star quilt and the ceremony where it is presented.

Stage 2 Assessment Evidence

Performance Tasks:

- Create a Star quilt block by using rhombus pattern. Use this to trace and cut the number of rhombi needed to complete each quilt (pre-plan the size and difficulty level desired). Place the pieces as desired before gluing.
- Present/display individual quilt blocks.

Other Evidence:

- Oral discussion of geometric vocabulary used for this project.
- Neatness/accuracy in constructing the quilt block.
- Verbal response to the Essential Questions.

Stage 3 Learning Plan

1. The students will begin this lesson by researching the importance of a traditional Star Quilt Ceremony. Direct them to find out why star quilts are given, what they represent, and who might be the lucky recipient. If you are short on time, the teacher should provide them with the important information. *See attached Resource Page*.

2. Bring in or show pictures of Star quilts to show the students how beautiful the colors and details are. The teacher can refer to the quilt(s) when reviewing the geometric principles involved in making the quilt. After showing a star quilt, ask the following questions:
   a. What are some geometric shapes that you see in the star quilt? (rhombi, triangles)
   b. What basic shape was used to construct the star? (rhombi)
   c. What do you know about a rhombus? (parallelogram with 2 consecutive equal sides)

3. Review/introduce the basic geometric terms evident in a star quilt:
   a. What are parallel lines? Can you find an example of parallel lines?
   b. Does the star quilt have a line of symmetry? (yes)
   c. How many lines of symmetry does it have? (8)
   d. Use the pattern to draw in all of the lines of symmetry.
   e. Does the star quilt have rotational symmetry? (yes)

4. Look at several examples of quilts to view color options and difficulty levels. Some students may want to limit theirs to 3 colors.
   http://www.art.mt.gov/folklife/folklife_quilt.asp
   http://americanindian.si.edu/education/files/quilts.pdf
   http://www.montanaquilts.com/st_book.htm

5. Have students select colors to be used for the quilt blocks. Provide each with a straightedge, scissors, glue, and a template to piece the quilt.

6. Demonstrate how to fold paper into a rhombus (directions found on **resource page**). At this point your students could use a protractor to measure the angles. You could also label the interior angles and discuss concepts such as vertical, supplemental and complementary angles.

7. Trace and cut as many rhombi needed to fill in the planned Star quilt. Begin piecing on background paper (before gluing) and mention to students the importance of precise cutting.

8. When satisfied with appearance, begin gluing onto background paper. For those who finish early, they could look at adding more detail (such as a border).

9. Have students present quilt blocks and explain why they chose the colors they did or something they learned during the lesson.

Teacher's Resources

Materials/Resources Needed:

To fold a rhombus:

1. Depending on how big/elaborate you want your quilt to turn out, use scratch paper to make your pattern.
2. Make a perfect square by folding and cutting (a 4" x 4" or smaller is suggested). Make sure you can see your diagonal fold.
3. Hold your bottom left vertex (where your diagonal starts) and bring the bottom right vertex to the diagonal; crease and leave folded.
4. Fold your top left vertex down to the diagonal; crease and leave folded. (Is it looking like a kite?)
5. Fold outside vertices into the diagonal to form a rhombus. This will be your basic pattern for creating the star quilt. You may adjust the size if desired.

Similar lesson plan offered through Simms Integrated Math (Level 2), Copyright date 2003, by Kendall/Hunt Publishing Company.
http://www.kendallhunt.com/samples/157.pdf

Extension Ideas:

1. Since traditionally the Star quilt is associated with the Assiniboine and Sioux tribes, students could research other tribal customs and compare/discuss.
2. Students could make an actual quilt square to display.
3. Complete area and perimeter activities, i.e. find both, look for a relationship of the perimeter and area of the rhombus pattern to the finished quilt.

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Integrated Science/Math Model Teaching Unit

Stars in the Sky

Created by Ann-Marie Sukut

Grade 6 – Approximate Duration 135 minutes

Stage 1 Desired Results

Established Goals:

Geometric Reasoning Mathematics Content Standard 3: A student, applying reasoning and problem solving, will understand geometric properties, spatial relationships, and transformation of shapes, and will use spatial reasoning and geometric models to analyze mathematical situations within a variety of relevant cultural contexts, including those of Montana American Indians.

- **3.3 Transformations including Dilations:** Define, identify, and execute transformations including translations, rotations, reflections, and dilations with appropriate technology.

MT Science Standard 4 Benchmark 5: Describe and model the motion and tilt of earth in relation to the sun and explain the concepts of day, night, seasons, year and climatic changes.

IEFA: Essential Understanding 3: The ideologies of Native traditional beliefs and spirituality persist into modern day life as tribal cultures, traditions, and languages are still practiced by many American Indian people and are incorporated into how tribes govern and manage their affairs.
Additionally, each tribe has its own oral histories, which are as valid as written histories. These histories pre-date the "discovery" of North America.

Understandings:	Essential Questions:
Students will understand… ● why the Crow Indian tribe named specific stars and constellations. ● how the Crow Indians used constellations to tell time and seasons. ● how to plot and transform geometric figures using constellations. ● circumpolar constellations.	● How are constellations identified and used by the Crow Indians? ● How are geometric figures represented on a coordinate grid?
Students will be able to… ● identify the Crow Indian names for specific constellations. ● explain circumpolar constellations. ● identify seasons/months of the year using constellations.	*Students will know…* ● the traditional and Crow Indian names for the North Star and the Big Dipper. ● the transformation terms, translation, rotation and reflection.

- identify and draw a geometric shape in a variety of transformed positions.
- use integers to plot figures in a four quadrant grid.

Stage 2 Assessment Evidence

Performance Tasks: Activity, creating a Big Dipper clock and drawing the transformations of a constellation. Worksheet graphing Big Dipper on four quadrant grid.
Other Evidence: Participation in classroom activity "Stars on the Ceiling". Individual Questioning

Stage 3 Learning Plan

Learning Activities:

1. Display the "Understandings" for the lesson.

2. Make a ceiling model of the North Star and Big Dipper.

- Using black paper construct a large circle, at least 10 feet in diameter and attach it to the ceiling.
- Identify the cardinal directions, North, South, East and West in your classroom.
- Make signs of the cardinal directions and place them on the edge of the black circle.
- Cut out small 3 inch circles in a bright color such as yellow or use the glow-in-the-dark stars that can be purchased in many stores.
- Use the attached "Big Dipper Finder" to help position circles or stars (representing the North Star and Big Dipper) on the ceiling using adhesive poster putty.
- The North Star (last star on the handle of the Little Dipper) should mark the center of your circle on the ceiling. (It isn't necessary to place all the stars of the Little Dipper on the ceiling for this activity.)
- Next, line up the two stars that make up the end of the ladle of the Big Dipper (opposite of the handle) with the North Star. Place the remaining stars of the Big Dipper on the ceiling, but be sure the handle of the Big Dipper angles away from the North Star.
- Make labels to place on the ceiling during the lesson for the stars using both the common and Crow Indian names (Big Dipper or Seven Stars and Polaris/North Star or Star That Does Not Move). (McCleary 1997, p 24-25)

3. Warm up Activity – Crow names for the Big Dipper and the North Star.

- As students enter the room, the teacher should be seated under the dot/star on the ceiling model that represents the North Star, looking up.
- When all students are seated proceed by telling them that like all Native American cultures, the Crow Indians have their own language and names for items in nature, including some of the stars.
- Point out the Big Dipper on the ceiling, and ask students if they know the name of this constellation. (Most likely many of the students will be able to identify it, but if not, tell them it's name and that it is a constellation that is visible in the night sky from where they live.) Tell them that the Crow call the Big Dipper, "Ihaka Sáhpua, The Seven Stars" (McCleary, 1997, vii).
- Inform the students that this constellation is very important to the Crow Indians. Its name the "Seven Stars" is said to represent seven brothers who were led by a war party leader and that this constellation often brought war parties together. It is important to tell them that there are many versions to this story, some of them very complex. This lesson is based on one of the versions.
- Next point to the star in the center of the ceiling model and tell the students that they have probably heard of this star by the name "Polaris" or the "North Star", but that the Crow refer to this star as "Ihkaxachíissee, The

Star That Does Not Move." This star may very well have been the war party leader mentioned with the "Seven Stars" (McCleary, 1997, vii).

● Open a discussion as to why the Crow might have used this name. (Answers may vary and students may even refer to the fact that early sailors used this star as well, because it seemed to remain in one place in the sky at all times of the year.)

●Place the labels for these stars on the ceiling.

4. Introduce the term "circumpolar" in order to connect the importance of the Big Dipper.

●Ask the students if they have ever heard the term circumpolar. (Allow them to make educated guesses based the root parts of the word.) *It means to be located or found in one of the polar regions.*

● Explain to the students that there are some constellations that are circumpolar, meaning that they seem to rotate around the north (or south) pole so they are visible in the Northern (Southern) Hemisphere throughout the year. The Big Dipper is a circumpolar constellation that seems to rotate around the North Star.

● Help students understand that because the Big Dipper is visible at all times throughout the year it served two purposes for the Crow. One was for directional orientation and the other was a way to calculate the passing of time. (McCleary 1997, pg 24-25)

5. An example of when the Crow would use the stars for location or calculating time?

● At one time there were three political divisions among the Crow Indians; the Mountain Crow, the River Crow and the Kicked in the Bellies. During most of the year, especially winter, these three groups consisted of several individual villages and were scattered throughout central and southern Montana and northern Wyoming. But for special occasions, such as the planting of Sacred Tobacco, Sun Dances, or a fall buffalo hunt the various villages would come together. The stars were used as a gauge to tell the families when they should gather in these larger groups. The Crow people were clever observers of the sky and used the stars to find direction and to know where they were at night. (McCleary 1997, p 3)

6. Directional orientations using the Big Dipper

●Using the ceiling model, point out ladle and the handle of the Big Dipper.

1. Explain to students that they can use the Big Dipper to locate the North Star. Show the students how to find the North Star on the ceiling model. The two stars at the far edge of the Big Dipper's ladle are often called the "pointer stars". The North Star can be found by extending the line connecting these pointer stars away from the direction of the handle. Ask students how knowing where this star is can help them when traveling East. (Sample answers might be that they would always want to keep this star on their left shoulder and then they could guarantee they are heading east.) Have a student model this using the ceiling model in the classroom by standing on the southern side of the North Star and walk east.

7. A way to calculate the passing of time during the night, months, and seasons.

● To help students understand how some constellations were helpful in tracking time of day, as well as months or seasons of the year, explain that constellations move through the sky during each night, which is the passage of hours, and also start in a little different position each night, which is the changing of months and seasons.

● Explain how the Crow Indians used the stars of the Big Dipper to measure time and seasons of the year. The location of the bowl or handle of the Big Dipper indicates time of night. During each month of the year, the bowl starts in a different place around the North Star. (For example: at dusk during mid summer, the bowl should be west of the North Star.) From this point, the Big Dipper moves counter clockwise around the North Star and is back in its original position in 23 hours and 56 minutes. This four minute lapse of time allows for the positional change of the Big Dipper with each passing month. (McCleary 1997, p 122)

● To help students understand this movement of the Big Dipper, have each student stand below the North Star and turn slowly counter clockwise watching how the North Star stays in one place while the other stars appear to move around it. Point out that this is how the stars would appear to move at the North Pole.

8. Handout "Big Dipper Clock" activity.

● Cut out the two circle patterns

● Placing the smaller circle over the larger one, fasten the two circles together by inserting a brass fastener through the two circles where they are marked with an X.

● Discuss how the finder works. They should hold the large disk so that NORTH is at the bottom. Then place the arrow towards the correct month. This should show the position of the constellation at its darkest hour (approximately 4 a.m.).

(Extension Activity)

Simulate how students should use the finder at home. In the evening students should face North and find the Big Dipper and Polaris. Next, they should hold the large disk so that NORTH is at the bottom. Then they should turn the small circle until its stars match those in the sky. They can then read the month in the window opening. Is that the correct month? Or how about moving the little circle so that the arrow points to the current month. Do the Dippers on the Finder match the orientation in the sky? They should repeat this activity after an hour or so and describe any differences. If possible, repeat this activity a third time after another hour has passed.

Discussion:

Could the students find the Big Dipper? Polaris? Did the Dipper appear to move around Polaris? Could it be used as a clock? (Yes during the night as the constellation moves counter clockwise with the passing of each hour) (No, all of the Big Dipper may not always be visible from your location (it's certainly not visible during the day*); when might it still be a useful clock?* (When sailing, camping etc…)

9. Connecting the constellation the Big Dipper to geometry.

● Review with students the transformation terms rotation, reflection and translation (slide).

● Cut a circular sheet of tracing paper the same size as the Big Dipper Finder (You may want to undo the brass fastener and attach the tracing paper so that is doesn't move.)

● Using the tracing paper, cover the Big Dipper and trace. Move the top circle half way around the bottom circle (180°) and trace again. Remove the tracing paper and ask students which form of transformation took place? (rotation)

● Have students use the tracing paper and create an example of a reflection and as translation.

10. Make connection between identifying transformations and graphing them on a four quadrant graph.

● Hand out "Graphing the Coordinate Plane" worksheet and graph paper.

● Introduce vocabulary

<u>Coordinate plane</u> – a plane that is formed by a horizontal number line called the x –axis and a vertical number line called the y-axis.

<u>Quadrants</u> – the four regions of a coordinate plane that are formed by the intersection of the x- and y-axis.

<u>Origin</u> – the point of intersection of the x- and y-axis on a coordinate plane.

<u>Ordered pair</u> – identifies the location of a specific point on a coordinate plane.

The first number in an ordered pair represents how far to move left or right along the x-axis.

The second number in an ordered pair represents how far to move up or down along the y-axis.

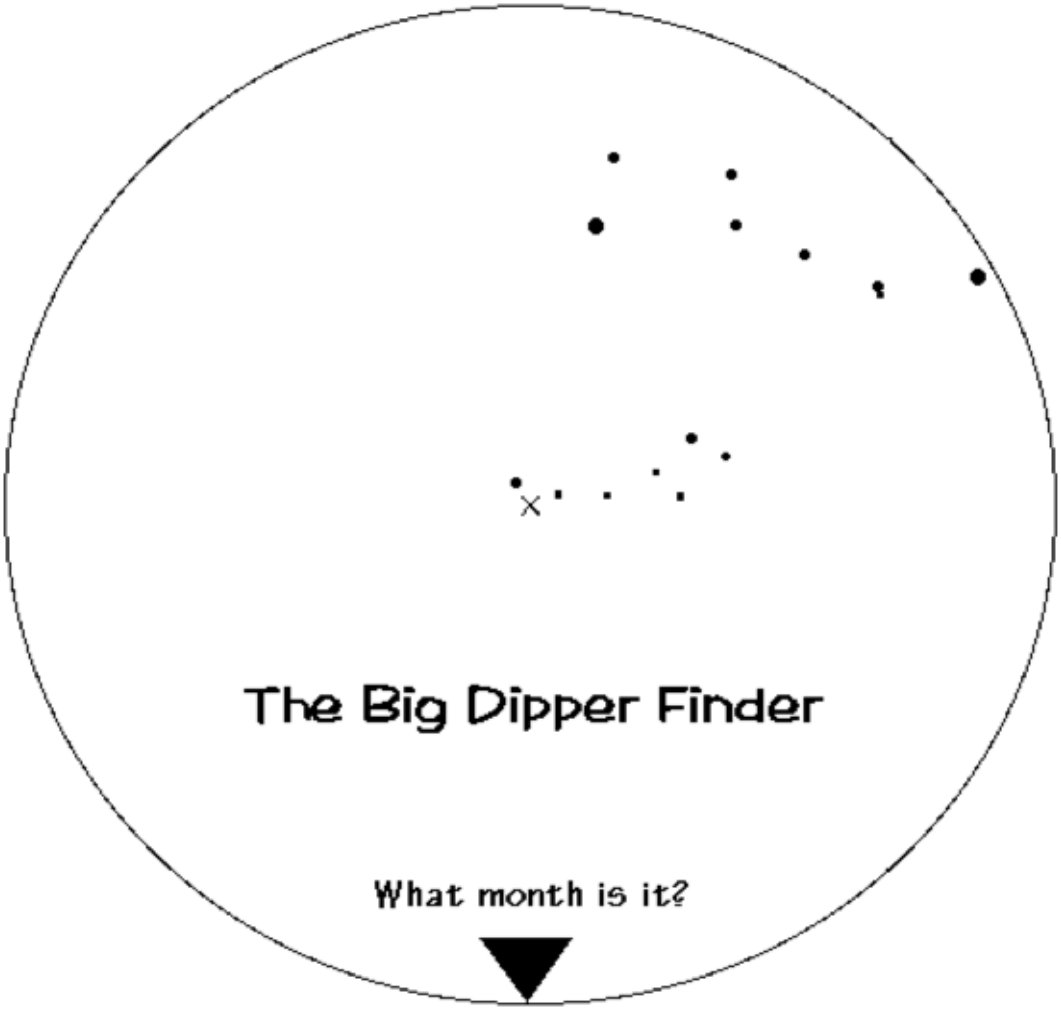
↓ ↓
(2 , 5)

The ordered pair (0,0) describes the <u>origin</u>.

11. Guide students to set up graph paper following the directions on the worksheet.
12. Ask students to plot each set of coordinate points for problem #1 through 4.
13. Monitor students work.
14. Have students finish problem #5 through #8
15. Turn in worksheet and graph paper.

Summary: Although viewing the stars in the sky on a clear night can be a breathtaking site, it is important to remember that throughout history those distance balls of fiery gases have been guiding many different cultures as they have traveled. It is also because of this celestial scene that people have been able to record and document time. The movement of the stars represents a real life situation that involves math and specifically geometry. You now can apply graphing coordinate points to your physical world.

The Big Dipper Clock
(Small Circle Spins on Top)



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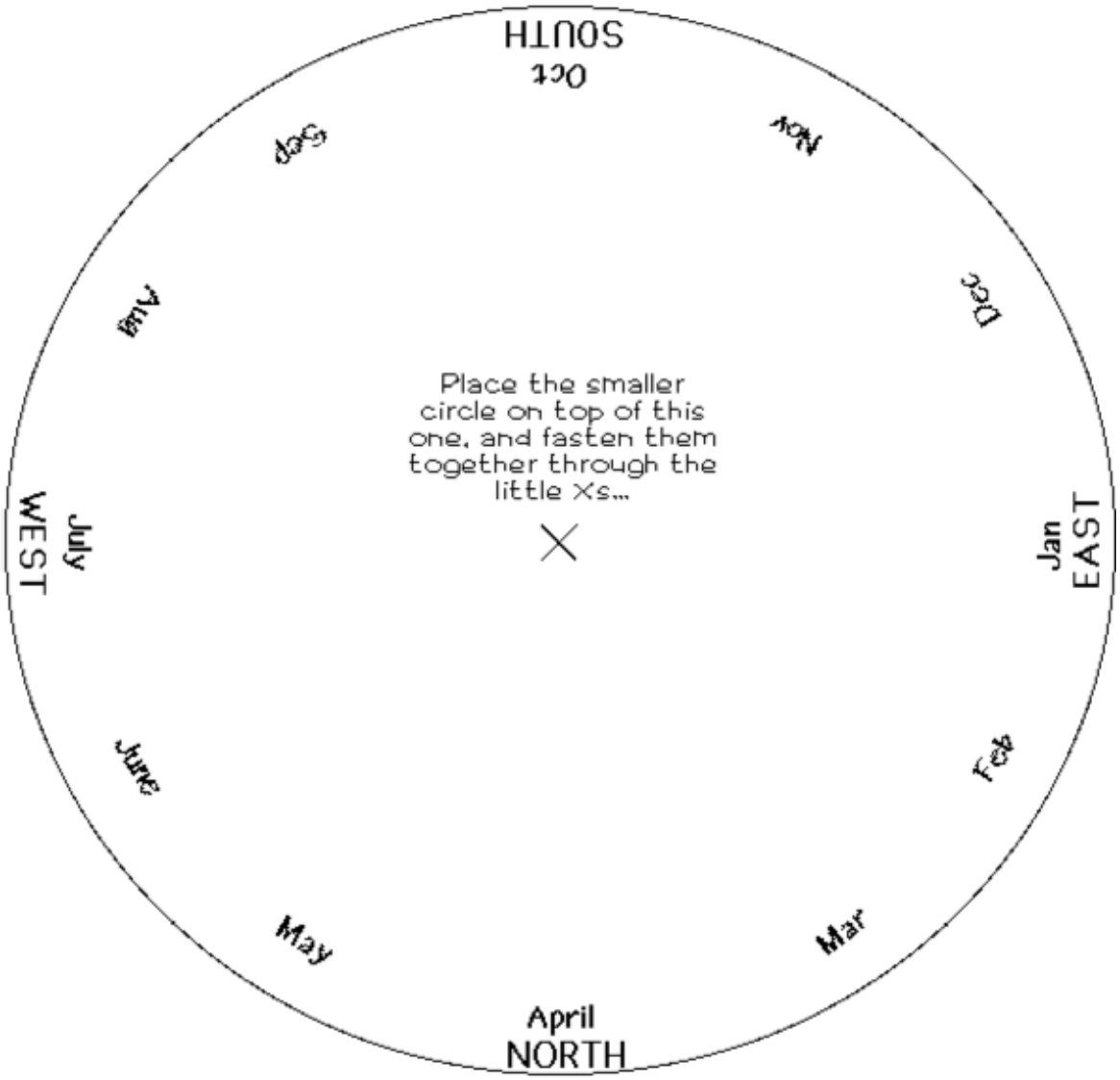
The Big Dipper Clock
(Large Circle Spins on Bottom)



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Name _____

Date _____

"Graphing the Coordinate Plane"

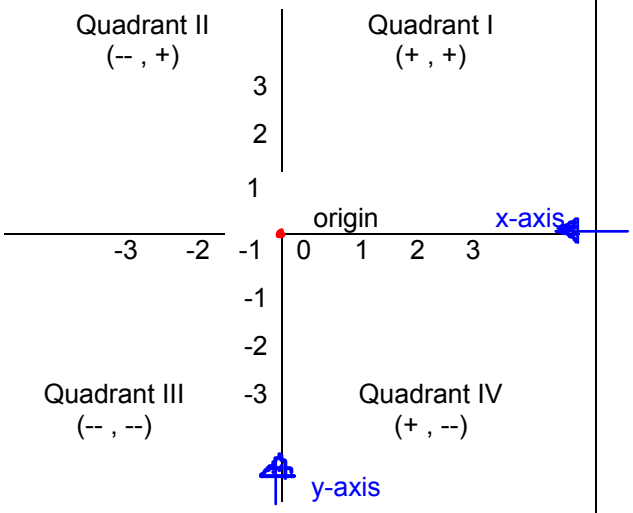
Coordinate plane – a plane that is formed by a horizontal number line called the x –axis and a vertical number line called the y-axis.
Quadrants – the four regions of a coordinate plane that are formed by the intersection of the x- and y-axis.
Origin – the point of intersection of the x- and y-axis on a coordinate plane.
Ordered pair – identifies the location of a specific point on a coordinate plane.

The first number in an ordered pair represents how far to move left or right along the x-axis.

The second number in an ordered pair represents how far to move up or down along the y-axis.

↓ ↓
(2 , 5)

The ordered pair (0, 0) describes the origin.



Directions: On a piece of graph paper, draw and label the x- and y-axis using 12 digits in each direction from the origin. Graph the following sets of ordered pairs.

1.	2.	3.	4.
A. (11, 2)	A. (-2 , 11)	A. (-11, -2)	A. (11 , -2)
B. (9, 1)	B. (-1 , 9)	B. (-9, -1)	B. (9 , -1)
C. (7, 2)	C. (-2 , 7)	C. (-7, -2)	C. (7 , -2)
D. (5, 3)	D. (-3 , 5)	D. (-5, -3)	D. (5 , -3)
E. (5, 5)	E. (-5 , 5)	E. (-5, -5)	E. (5 , -5)
F. (2, 6)	F. (-6 , 2)	F. (-2, -6)	F. (2 , -6)
G. (1, 3)	G. (-3 , 1)	G. (-1, -3)	G. (1 , -3)

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5. Draw segments connecting the coordinate points from each set in the order they are given.

6. Name the constellation sketched in all 4 quadrants using two different names?

_____ _____

7. What type of transformation occurred in each quadrant compared to **Quadrant I?**

Quadrant II _____

Quadrant III _____

Quadrant IV _____

8. Give two names for the star that could be used to label the origin (0, 0).

_____ _____

KEY

5. Draw segments connecting the coordinate points from each set in the order they are given.

6. Name the constellation sketched in all 4 quadrants using two different names?
__Big Dipper__ OR __Seven Stars__ OR __Ihaka Sáhpua__

7. What type of transformation occurred in each quadrant compared to **Quadrant I?**

Quadrant II _____rotation_____

Quadrant III _____rotation_____

Quadrant IV _____reflection_____

8. Give two names for the star that could be used to label the origin (0, 0).
North Star / Polaris OR _The Star That Does Not Move_ OR _ Ihkaxachíissee_

Materials/Resources Needed:
- Black paper (from rolls works best)
- Brightly colored dots or glow-in-the-dark stars.
- Printed labels of the cardinal directions.
- Printed labels that name the North Star/Star That Doesn't Move and Big Dipper/Seven Stars
- Poster putty
- Brass fasteners or pencils for center of Big Dipper Clock
- Copies of the "Big Dipper Clock Activity" (http://hea-www.harvard.edu/ECT/the_book/Chap1/Chapter1.html)
Eyes on the Sky Feet on the Ground. Smithsonian Astrophysical Observatory, 1996
- Copies of the worksheet "Graphing the Coordinate Plane"
- McCleary, Timothy P. The Stars We Know. Waveland Press, Inc., Long Grove, Illinois, 1997. (This book may be purchased on line or ordered through a local book store.)