Indian Education Division
Montana Office of Public Instruction
opi.mt.gov

Mathematics – Geometry
Grade 8
Geometric Transformations Through Montana American Indian Tribal Seals

Overview

Tribal seals represent the sovereignty of each tribal nation of Montana. By studying a tribal seal, math students have a unique opportunity to learn about and apply mathematical concepts while gaining knowledge about and understanding Montana's diversity. Specifically, the Chippewa Cree Tribe has a unique heritage and identity that is represented in their tribal seal. Chippewa and Cree are two distinct tribes, but the tribe refers to themselves as Chippewa Cree. The seal is used to represent the Chippewa Cree Tribe as a governmental and independent, sovereign nation with its own government. The symbols used in the seal represent traditional stories, values, traditions, and customs from the Chippewa Cree people (as told by Lloyd C. Top Sky).

Using the Chippewa Cree tribal seal, students will describe, define, and construct rigid motion transformations (translations, reflections, and rotations) using the coordinate plane. They will identify and apply rigid motion transformations (translations, reflections, and rotations) in a variety of cultural contexts. Finally, students will understand that sequences of transformations (translations, reflections, and rotations) produce congruent figures and will demonstrate this understanding in an original piece of work.

Timeframe: Eight class periods (one is optional)

Math Domain: Geometry

Montana Mathematics Grade Level Curriculum Organizer for Grade 8, pp.s 23-27:
http://www.nwmteducationalcoop.org/units/coop/docs/MTCOGrade8.pdf

Strategies & Practices

Critical Area (for instructional focus): Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

Mathematical Practice (for student focus):

1. **Make sense of problems and persevere in solving them.** Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends.
2. **Reason abstractly and quantitatively.** Mathematically proficient students make sense of quantities and their relationships in problem situations**.**
3. **Construct viable arguments and critique the reasoning of others.** Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments.

4. **Model with mathematics.** They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts, and formulas. They can analyze those relationships mathematically to draw conclusions.
5. **Use appropriate tools strategically.** Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software.
6. **Attend to Precision.** Mathematically proficient students try to communicate precisely to others.
7. **Look for and make use of structure.** Mathematically proficient students look closely to discern a pattern or structure.

Standards

Montana Common Core Standards for Mathematics and Mathematical Practice

Math Clusters for Geometry: Understand congruence and similarity using physical models, transparencies, or geometry software.

Math Standards for Geometry:

8.G.1 Verify experimentally the properties of rotations, reflections, and translations from a variety of cultural contexts, including those of Montana Indians:

a. Lines are taken to lines, and line segments of the same length
b. Angles are taken to angles of the same measure
c. Parallel lines are taken to parallel lines

8.G.2 Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence that exhibits the congruence between them.

8.G.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures from a variety of cultural contexts, including those of Montana Indians using coordinates.

8.G.4 Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two-dimensional figures, describe a sequence that exhibits the similarity between them.

Montana Common Core Standards for Speaking and Listening

SL.8.1c Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.

SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Indian Education for All Essential Understandings

EU1: There is great diversity among the 12 tribal Nations of Montana in their languages, cultures and histories and governments. Each nation has a distinct and unique cultural heritage that contributes to modern Montana.

EU3: The ideologies of Native traditional beliefs and spirituality persist into modern day life as tribal cultures, traditions, and languages are still practiced … each tribe has its own oral histories, which are as valid as written histories.

EU7: Under the American legal system, Indian tribes have sovereign powers, separate and independent from the federal and state governments. However, the extent and breadth of tribal sovereignty is not the same for each tribe.

Learning Objectives

In this lesson, students will . . .

- Recognize that symbols can be used to represent individuals, groups, or cultures.
- Understand the symbols in the Chippewa Cree seal represent this tribal nation's values, traditions, and customs.
- Describe the effects of dilations, transformations, translations, reflections, and rotations on two-dimensional figures, and describe what an image and a pre-image are.
- Identify the three kinds of rigid motion transformations (translations, reflections, rotations) in pictures.
- Explain the transformations in the Chippewa Cree seal and infer how they are connected to the meaning of the symbols.
- Construct the three kinds of rigid motion transformations (translations, reflections, rotations) on a coordinate plane.
- Formulate generalizations about the coordinates in each of the transformations.
- Design a seal, representative of self, applying the three rigid transformations.
- Describe how a sequence of transformations leads to congruent figures; for example, two reflections lead to a rotation which leads to a congruent figure.
- Create a generalization and justify reasonings through verbal discussions, demonstrating understanding, and using appropriate vocabulary (linear, non-linear, model, interpret, initial value, functional relationship, qualitative, etc.).

Assessment

Formative Assessment:

- Day 1: Completion and accuracy of worksheet and classroom responses/discussions.
- Day 2: Use of formal definitions in describing transformations and classroom responses/discussions
- Day 3: Demonstration will serve as informal assessment. Written generalization (rule) for reflections across *x*-axis and *y*-axis and coordinates on a plane. Students should be able to explain that when reflecting across the *y*-axis, the *x*-coordinate of the image is the opposite of the corresponding x-coordinate from the pre-image. The *y*-coordinates remain the same. Students should be able to explain that when reflecting across the *x*-axis, the *y*-coordinate of the image is the opposite of the corresponding *y*-coordinate from the pre-image. The *x*-coordinates remain the same. Possible homework: perform reflections of a figure within a plane, noting coordinates of pre-image and image.

- Day 4: Demonstration will serve as informal assessment. Written generalization (rule) for translation and coordinates on a plane. Possible homework: perform translations of a figure within a plane, noting coordinates of pre-image and image.
- Day 5: Demonstration will serve as informal assessment. Written generalization (rule) for rotations and coordinates on a plane. Possible homework: perform rotations of a figure around the origin or another point, noting coordinates of pre-image and image.
- Day 6: Demonstration will serve as informal assessment. Written generalization (rule) for dilations and coordinates on a plane. Possible homework: perform dilations of a figure using different scale factors, noting coordinates of pre-image and image.
- Day 7 (optional, recommended): Demonstration on a geometry drawing utility will serve as informal assessment. Students will write the formal definitions of reflections, rotations, and translations.
- Day 8: Final Assessment: create a family seal; analyze Chippewa-Cree tribal seal.

Summative Assessment:

- Performance Assessment – creation of student seal and summary through explanations.
- Students should also be able to respond thoughtfully and accurately to the following Essential Questions:
    - How are transformations represented in the flags and seals of Montana Indians?
    - Which transformations create congruent figures in the Chippewa Cree seal?
    - How does the Chippewa Cree Nation's seal represent the cultural heritage and sovereignty of the tribe?

Materials and Resources

- ✓ Graph paper, protractors, compasses, rulers
- ✓ Information on the Chippewa Cree tribal seal: Montana Tribal Flags and Seals You can print a brochure for each pair of students. Click here for a larger version of their tribal seal.
- ✓ Copies of worksheet "A Study of the Chippewa Cree Tribal Seal (Day 1)", "Transformations of the Chippewa Cree Tribal Seal (Day 2)", and "Creating a Seal (Day 8, Final Assessment)"
- ✓ Coordinate grid paper or copies for each student of the grid worksheet for Days 3, 4, 5, 6. This grid was found at Printable Graps (PDF) (http://www.printmefree.com/Graphs.aspx) Graph Paper #17. A software tool, such as GeoGebra may be used in place of the coordinate grid paper.
- ✓ Images and descriptions of Montana tribal flags and seals:
  montanatribes.org
  Crossing Boundaries Through Art: Seals of Montana Tribal Nations
- ✓ Optional: geometry drawing utility (GeoGebra, Sketchpad, etc.)

Teacher Preparation

Review the information listed above on tribal seals and tribal flags.

Instructional Plan

Day One: Introduction to the Chippewa Cree Tribal Seal

1. Show the students images of the eight Montana tribal nation flags using the Montana Tribes Web site. Look under "Resources." State the objective: Students will discuss and understand that Montana Indian nations have a distinct and unique cultural heritage that is represented in *modern* Montana. Each is a sovereign nation (EU 7).

2. Have the students do an initial look at the flags. Ask students to observe and comment on what they notice or see in the flags.

3. Teacher and students will review geometric figures and their properties. Ask them to look again at the tribal flags, and apply prior knowledge of geometry terms and concepts to viewing the flags.

4. Pull up larger image of the Chippewa Cree Tribe's flag. In pairs, students will read the description of the flag and seal under "The Chippewa Cree Tribe" in the Montana Tribal Flags and Seals document. They will complete the attached worksheet, "A Study of the Chippewa Cree Tribal Seal (Day 1)."

5. Lead a class discussion about the seal of the Chippewa Cree flag and the geometric figures represented, discussing both the traditional symbols and the modern use of the seal. Have the students pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas (SL.8.1.c).

Day Two: Transformations

1. Discuss the basic definitions for the following words and a context for using each word. Students will use these words throughout the lesson when presenting claims and findings.

   - *pre-image* – The original figure prior to a transformation occurring.
   - *image* – The new figure produced after a transformation has occurred.
   - *transformation* – A change made to the location or size of a figure.
   - *rigid motions* – Transformations that maintain the size and shape of a figure after a change has been made to the location of the figure. These include reflection, rotation, and translation.
   - *reflection* – A basic rigid motion that moves a figure across a line, that is, the figure is *flipped* over a line of reflection, creating a mirror image, maintaining the same size and shape.
   - *rotation* – A basic rigid motion that moves a figure around a fixed point some number of degrees, maintaining the same size and shape.
   - *translation* – A basic rigid motion that *moves* a figure *along* a given vector, maintaining the same size and shape.
   - *dilation* – The result of a figure growing or shrinking, maintaining the same shape but different size.
   - Other vocabulary that may need review: *linear, non-linear, model, interpret, initial value, functional relationship, qualitative, congruent figures.*

2. Using the image of the Chippewa Cree Seal found on the "Transformations of the Chippewa Cree Tribal Seal (Day 2)" worksheet, students will work in pairs to identify transformations in the Chippewa Cree Tribal Seal. Use transparencies or tracing paper to trace a figure's pre-image. Use the traced pre-image to perform translations, reflections, and rotations (one of each) on the seal to align with a new image. *Example: Trace one of the rays onto the transparency. Slide the transparency in a set direction by a set distance along a line segment until the tracing aligns with another ray on the seal.* Pay special attention to the idea that the length of the line segments and the measures of the angles do not change between figures, leading to congruent figures.

3. Lead a class discussion for each pair of students to explain their reasoning for the transformations they identified and performed in the last activity. Students (pairs) should demonstrate at least one transformation to the rest of the class and justify their reasoning. Students should present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation (SL.8.4).

Day Three: Reflections

1. Review the definitions shared in yesterday's lesson.

2. Have each student use a coordinate plane to represent one of the Sacred Pipes from the Chippewa Cree Seal by plotting and connecting the points A(2, 2) to C(8, 8) and B(3, 3) to D(2, 4). [The coordinate grid, Grid Page for Days 3—5, found at the end of this lesson can be used, or use any coordinate grid paper or software tool such as GeoGebra.]

3. Ask students to reflect the pre-image of the Sacred Pipe across the *y*-axis, labeling the points A'B'C'D' and their coordinates.

4. Have the students compare the pre-image and image coordinates when reflected over the *y*-axis and make a generalization. (What happens to the coordinates?)

5. Ask students to reflect the image A'B'C'D' of the Sacred Pipe across the *x*-axis, labeling the points A''B''C''D'' and their coordinates.

6. Have the students compare the pre-image (A'B'C'D') and images (A''B''C''D'') coordinates when reflected over the *x*-axis and make a generalization. (What happens to the coordinates?)

7. Have the students compare figure ABCD to A"B"C"D" and make a generalization about the coordinates.

8. Divide the class into 2 groups of students. One group will reflect A"B"C"D" over the *y*-axis. The other will reflect ABCD across the *x*-axis, labeling the points $A_1B_1C_1D_1$ and the coordinates.

9. Have the students compare all four images and their coordinates and make a generalization about the coordinates. (When you reflect across the *x*-axis, what happens to the coordinates? When you reflect across the *y*-axis, what happens to the coordinates? S*tudents should notice that the pre-image and the image are always mirror images of each other over the line of reflection and the corresponding points of the pre-image and the image is always equidistant to the line of reflection.*)

10. Provide students with another coordinate plane and have them create an isosceles triangle, representing the teepee on the seal, with A(3,0), B(0,5), C(-3,0). Ask them to reflect the isosceles triangle over the *x*- and *y*-axis, checking to see if their generalizations of reflecting over each axis hold true.

11. Possible homework: Perform reflections of a figure within a plane, noting coordinates of pre-image and image.

Day Four: Translations

1. Review definitions shared in previous lessons.

2. Have each student use a coordinate plane to represent one of the feathers from the Chippewa Cree Tribal Seal by plotting and connecting the points A(2, 1) to B(3, 3) to C(2, 5) to D(1, 3) back to A(2, 1). [The coordinate grid, Grid Page for Days 3—5 found at the end of this lesson can be used, or use any coordinate grid paper or software tool such as GeoGebra.]

3. Ask students to translate the pre-image of the feather 4 units left and 3 units down, labeling the points A'B'C'D' and their coordinates.

4. Have the students compare the pre-image and image coordinates when translated and make a generalization. (What happens to the coordinates?)

5. Ask students to translate A'B'C'D' of the feather 1 units down and 3 units right, labeling the points A''B''C''D'' and their coordinates.

6. Have the students compare the pre-image (A'B'C'D') and images (A''B''C''D'') coordinates when translated and make a generalization. (What happens to the coordinates? What do you notice about the number of units translated and the coordinates?)

7. Ask students to complete one more translation to check their generalization. *(Students should notice the distance between the corresponding points of the pre-image and the image is the same as the length of the vector and the image moves in the same direction the vector points.)*

8. Lead a class discussion, asking students to justify their generalizations.

9. Possible homework: Perform translations of a figure within a plane, noting coordinates of pre-image and image.

Day Five: Rotations

1. Review translations and reflections.

2. Provide each student with a coordinate grid and a piece of tracing paper. [The coordinate grid, Grid Page for Days 3—5 can be used, or use any coordinate grid paper or software tool such as GeoGebra.]

3. Instruct all students to draw a right, scalene triangle with coordinates A(3, 1), B(6, 1), and C(3, 2) on the coordinate grid.

4. Have the students place tracing paper over the coordinate grid and trace the shape, the *x*-axis, and the *y*-axis.

5. While holding the tip of the pencil on the origin, have the students rotate tracing paper 90° about the origin, until the axes match up, *x*-axis with *y*-axis and *y*-axis with *x*-axis. Use a writing utensil to make points at the new triangle.

6. Have the students lift up the paper and draw in the new triangle, label it A'B'C' and its coordinates.

7. Have the students compare the pre-image and image coordinates and make a generalization. (What do you notice about the coordinates?)

8. Have the students place the tracing paper back on the plane and ask students to rotate A'B'C' 90° about the origin. Ask them to mark the new points, draw in the new figure, and label A"B"C" and their coordinates.

9. Have the students compare A"B"C" and its coordinates to both of the other figures and make a generalization, noticing now that they have actually rotated ABC 180°. Ask them to make a generalization about that as well.

10. Have the students place the tracing paper back on the plane and have them rotate A"B"C" 90° about the origin. Ask them to mark the new points, draw in the new figure, and label A'''B'''C''' and their coordinates.

11. Have the students compare A"'B"'C'" and its coordinates to the other three figures and make a generalization. *(Students should notice the corresponding points of the pre-image and the image are always equidistant to the center of rotation.)*

12. Students will then complete independent practice of rotation by completing the same steps as above, using a new coordinate plane, tracing paper, and a plane figure. Extension activities may be rotations about another point other than the origin.

13. Possible homework: Perform rotations of a figure around the origin or another point, noting coordinates of pre-image and image.

Day Six: Dilations

1. Review translations, reflections and rotations. These are examples of **rigid motion transformations**. A rigid motion transformation is one in which the pre-image and image both have the exact same size and shape.

2. Share with the students that a **non-rigid transformation** is one in which the pre-image and image both have the same shape, but not the same size.

3. Provide each student with graph paper and a piece of tracing paper. [For this activity, use graph paper or software tool such as GeoGebra.]

4. Have each student use a coordinate plane on graph paper to represent the tipi from the Chippewa Cree Seal by plotting and connecting the points A(-8, -8) to B(-4, -3) to C(-5, 0) to D(-3, -2) to E(-1, 0), to F(-2, -3) to G(2, -8) and back to A(-8, -8). Suggest that they can trace their tipi figure in a color of their choice.

5. Ask students to dilate by a scale factor of 2 (This can be done by simply multiplying each set of coordinates by the scale factor of 2). Have them trace this in a different color than the pre-image. The coordinates of the image should be as follows: A'(-16, -16), B'(-8, -6), C'(-10, 0), D'(-6, -4), E'(-2, 0), F'(-4, -6), G'(4, -16), A'(-16, -16).

6. Ask students to complete one more dilation of the original tipi with a scale factor of 1/2, labeling the dilated points as A", B", etc. Have them trace this in a 3rd color and name the coordinates.

7. Share that dilations that increase the size of a pre-image are called *enlargements*, whereas dilations that decrease the size of a pre-image are called *reductions*. Lead a class discussion about *scale factors* as they relate to reductions (0 < Scale Factor < 1) and enlargements (Scale Factor > 1).

8. Possible homework: Perform dilations of a figure using different scale factors, noting coordinates of pre-image and image.

Day Seven: GeoGebra Exploration (optional)

1. If a Geometry drawing utility has not been used with the students for this unit, introduce students to one, such as Geometer's Sketchpad, Cabri, or GeoGebra. You can download GeoGebra for free. There are many tutorials on the this web site or there is a free self-paced course in the Course Catalog on Teacher Learning Hub that introduces this mathematics software to mathematics teachers.

2. Demonstrate the drawing utility on the teacher computer while projecting with a LCD.

3. Have students working individually or in pairs on the drawing utility on an individual computer or device during the demonstration.

4. Encourage Free Play. Have students play with the free hand tools, point, compass, and segment. Use the selection arrow and text tool. Demonstrate how to undo objects.

5. Demonstrate how to construct a polygon. Perform a reflection of the polygon over a line. Demonstrate the "click and drag" and how to change the color of the image. Show a reflection over a line that intersects the figure and a reflection over a line that does not intersect the figure by dragging the pre-image or image.

6. Ask students to describe what they notice about the pre-image and the image as they click and drag points and sides of the pre-image or the image. Does it match the generalization made it previous lessons?

7. If students have a difficult time seeing the pre-image and the image are always equidistant to the line of reflection, have them construct a segment from a point on the pre-image and the corresponding image point. Construct the point of intersection between this segment and the line of reflection. Measure the distance from the pre-image point to the point of intersection between the segment and the line of reflection, and measure the distance from the image point and the point of intersection between the segment and the line of reflection. From this construction, the students should see that the segment and the line of reflection are perpendicular to each other. This should lead students to writing a more formal definition for reflection. *A reflection over a line is a transformation in a plane where each point of the original figure (pre-image) has an image that is the same distance from the line of reflection as the pre-image point. The line of reflection is the perpendicular bisector of the segment joining every point and its corresponding image point.*

8. Perform a rotation of the constructed polygon around a marked point (center of rotation) by a fixed angle. Demonstrate how to use the "click and drag" and how to change the color of the image.

9. Ask students to describe what they notice about the pre-image and the image as they click and drag points and sides of the pre-image or the image.

10. If students have a difficult time seeing that the pre-image and the image are always equidistant to the center of rotation, have them construct a segment from a point on the pre-image to the center of rotation and the corresponding image point to the center of rotation. Measure the distance from the pre-image point to the center of rotation, and measure the distance from the corresponding image point to the center of rotation. From this construction, the students should see that these segments are equal in length. Have students measure the angle formed by the segments drawn from the center of rotation to the pre-image and image points. Students should notice that this angle is equal to the angle of rotation they determined during the construction of the rotation. This should lead students to writing a more formal definition for a rotation. *A rotation is a transformation in a plane that moves every point around a fixed point (usually the origin) in a given direction by a given angle measure.* Rotations > 0° are counterclockwise. Rotations < 0° are clockwise.

11. Demonstrate a translation by a marked vector. Demonstrate the "click and drag" and change the color of the image.

12. Ask students to describe what they notice about the pre-image and the image as they click and drag points and sides of the pre-image or the image. (Students should notice the distance between the corresponding points of the pre-image and the image is the same as the length of the vector and the image moves in the same direction the vector points.)

13. If students have a difficult time understanding that the distance between the corresponding points of the pre-image and the image is the same as the length of the vector, have them construct a segment from a point on the pre-image to the corresponding image point and measure the length of the segment. Measure the length of the vector. This should lead students to writing a more formal definition for a translation. *A translation is a transformation in a plane that moves every point in the pre-image the same distance in the same direction.*

14. Show how to hide objects that the students don't want seen but are necessary for the construction of the transformation.

Day Eight: Assessment

See attached worksheet, "Creating a Seal (Day 8, Final Assessment)," for the complete instructions. Each student will create a seal that represents her/himself and uses all four of the transformations (reflections, translations, rotations, dilations), demonstrating understanding of each one. A Final Assessment Rubric is attached as well and should be provided to the students in advance of starting their seal and explanations.

Extension Activities and Additional Resources

Additional work could be done with the geometry drawing utility. Students might choose to create their final assessment family seal with a software tool.

Throughout the year, similar lessons could be done with one or more of the Montana Tribal Flags and Seals.

Worksheets

A Study of the Chippewa Cree Tribal Seal (Day 1) and Answer Key

Transformations of the Chippewa Cree Tribal Seal (Day 2) and Answer Key

Grid Page for Days 3—5

Creating a Seal (Day 8, Final Assessment) and Final Assessment Rubric

A Study of the Chippewa Cree Tribal Seal (Day 1)

Name: _____ Period: _____

Directions: Use the printed information to complete the following questions.

1. On what reservation do many of the Chippewa Cree Peoples live?

2. The bear paw tracks have two meanings. What do the bear paw tracks represent?

3. Who were the last two official chiefs and how are they represented in the seal?

4. Why are there nine eagle feathers?

5. What traits of the Chippewa Cree are symbolized through the eagle?

6. The fifteen sun rays are representative of whom and what are they trying to achieve?

7. List as many geometric figures and/or symbols as you see represented in the Chippewa Cree Seal and identify their properties.

8. What is an example of a symbol from this seal that is also used in other tribes' seals or flags? Why do you think that symbol is used by more than one tribe?

A Study of the Chippewa Cree Tribal Seal (Day 1)

Directions: Use the printed information to complete the following questions.

1. On what reservation do many of the Chippewa Cree Peoples live?

   Rocky Boy's Indian Reservation

2. The bear paw tracks have two meanings. What do the bear paw tracks represent?

   Bear paw tracks represent the Bear Paw Mountains where the Chippewa Cree now make their present home. Also, the bear is a sacred animal of the tribe.

3. Who were the last two official chiefs and how are they represented in the seal?

   Chief Rocky Boy and Chief Little Bear are represented by the sacred pipes. (Pipes were used to formalize agreements and in prayer.)

4. Why are there nine eagle feathers?

   The nine eagle feather represent the nine elected chiefs of the Chippewa Cree Business Committee.

5. What traits of the Chippewa Cree are symbolized through the eagle?

   The eagle represents strength, wisdom, bravery, and honor – all elements conceived from the bird that represents the thunder and lightning of the sacred sky.

6. Whom do the fifteen sun rays represent, and what are they trying to achieve?

   The sun's rays represents the fifteen Sacred Grass Dance Chiefs who are active in preserving the culture of the Chippewa Cree Tribe.

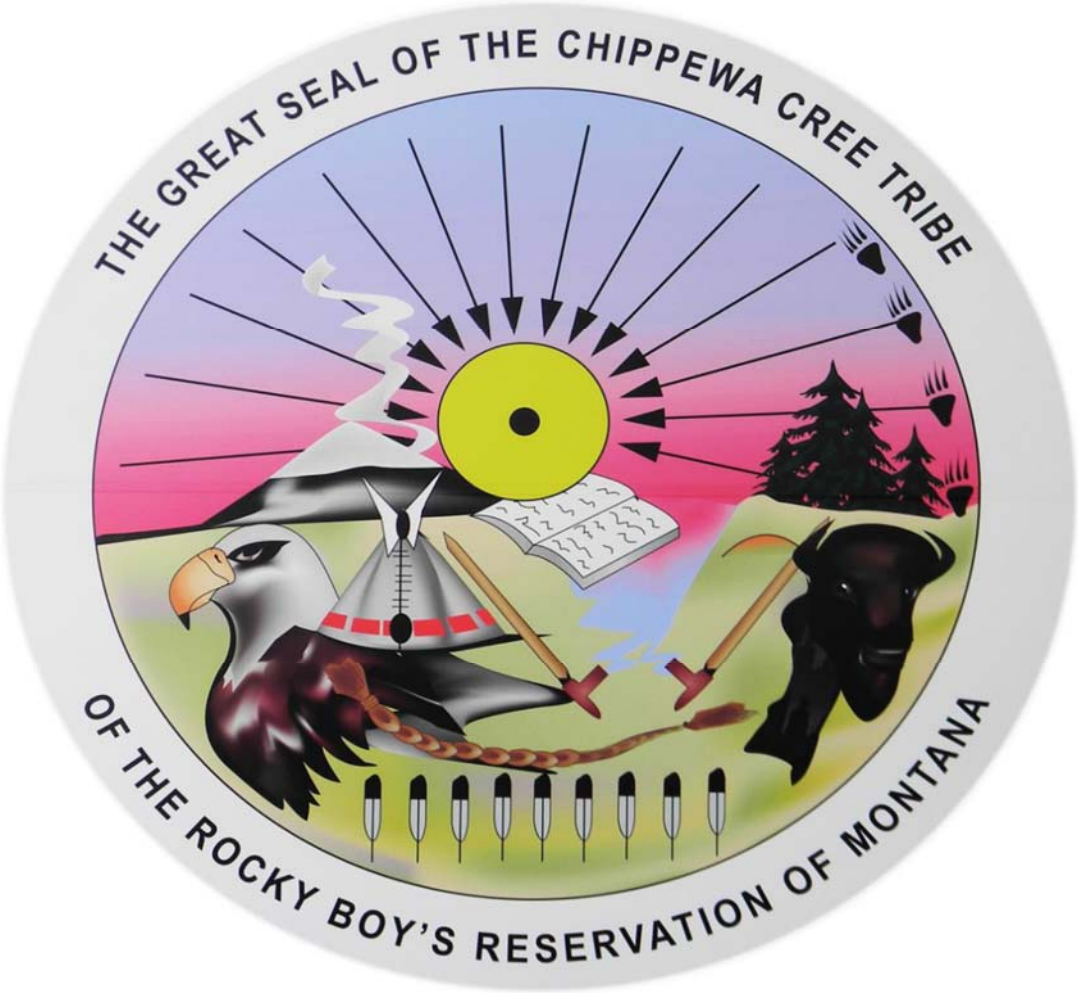
7. List as many geometric figures and/or symbols as you see represented in the Chippewa Cree Seal and identify their properties.

   Answers may vary and could include geometry terms such as circles, rays, line, cone,etc. and symbols such as eagle, sun, feathers, tipi, buffalo, bear paw tracks, book, sacred pipes, braid of sweet grass, mountains, trees, etc.

8. What is an example of a symbol from this seal that is also used in other tribes' seals or flags? Why do you think that this symbol is used by more than one tribe?

   Answers could include feathers (representing strength and wisdom), buffalo (symbol of survival and economy), etc. Many symbols on the seals represent the environment and a tribe's traditional way of life.

Transformations of the Chippewa Cree Tribal Seal (Day 2) Name: _____



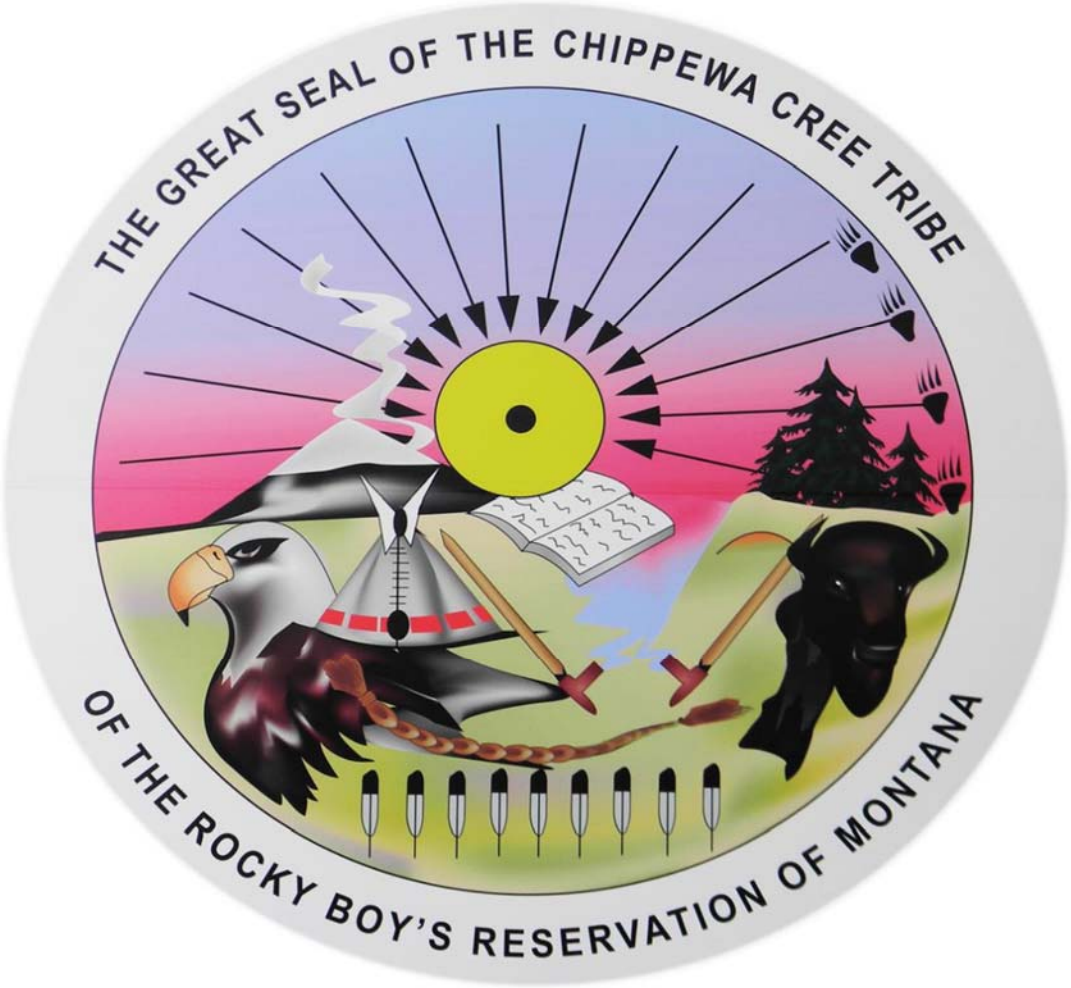
1. What examples of reflections do you see?

2. What examples of rotations do you see?

3. What examples of translations do you see?

4. What example of dilations do you see?

Transformations of the Chippewa Cree Tribal Seal (Day 2) (*Answer Key)*



1. What examples of reflections do you see?

   Answers may vary and may include the sacred pipes reflected over a vertical line, one side of the tipi to the other, each arrow with the one opposite it, etc.

2. What examples of rotations do you see?

   Answers may vary and may include the arrows rotated around the circle, the alternating bear paws rotated a certain angle, etc.

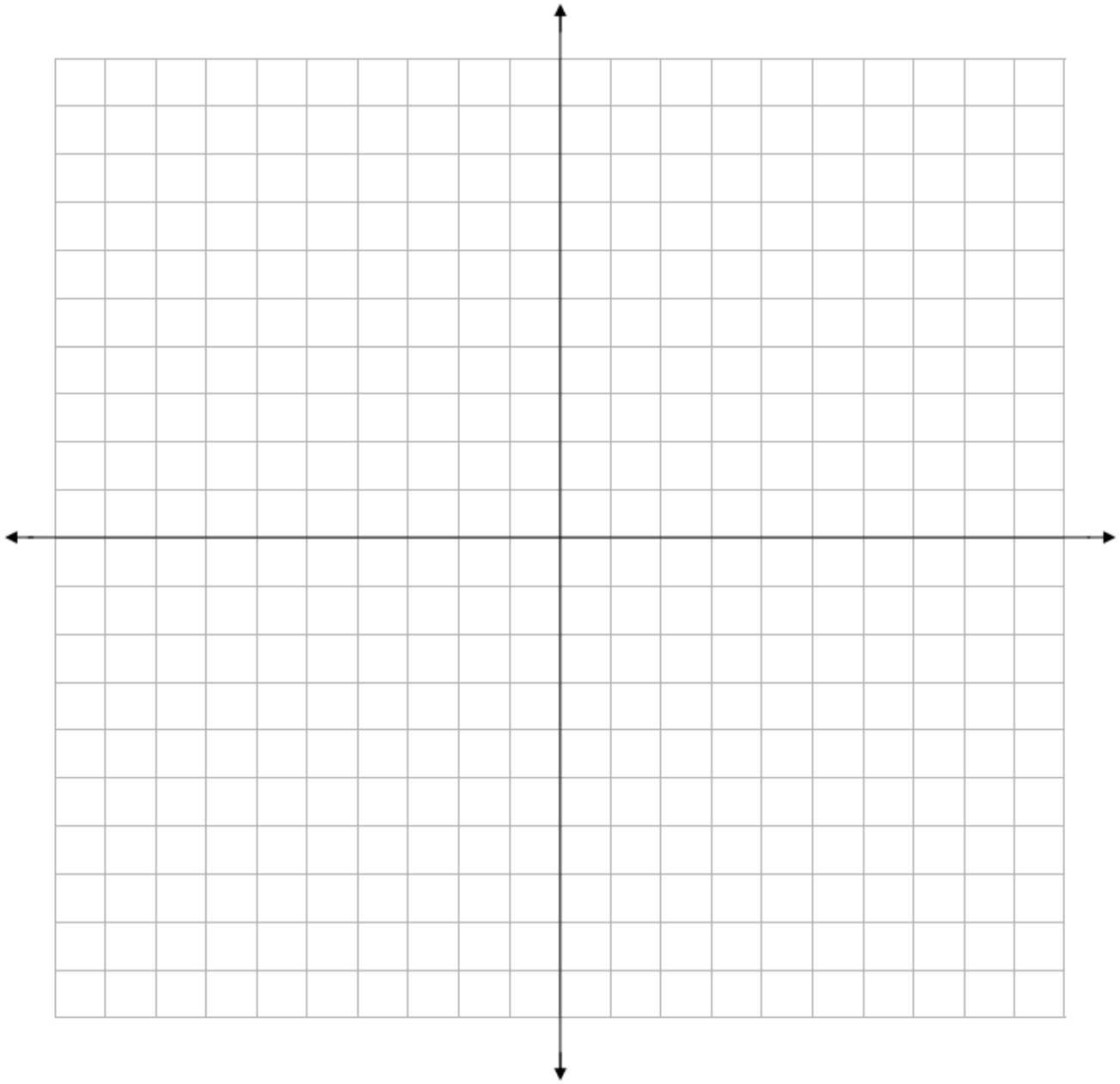
3. What examples of translations do you see?

   Answers may vary and may include the feathers translated, etc.

4. What example of dilations do you see?

   Answers may vary and may include the inner circle and the outer circle representing the sun. Some students may note that the evergreen trees may be dilations of one another although the shapes do not seem exactly the same comparing the larger to the smaller trees.

Grid Page for Days 3—5



Creating a Seal (Day 8, Final Assessment)

Name: _____

As your final assessment, you will be using your knowledge of transformations and Montana Indian Tribal Seals to create your own seal.

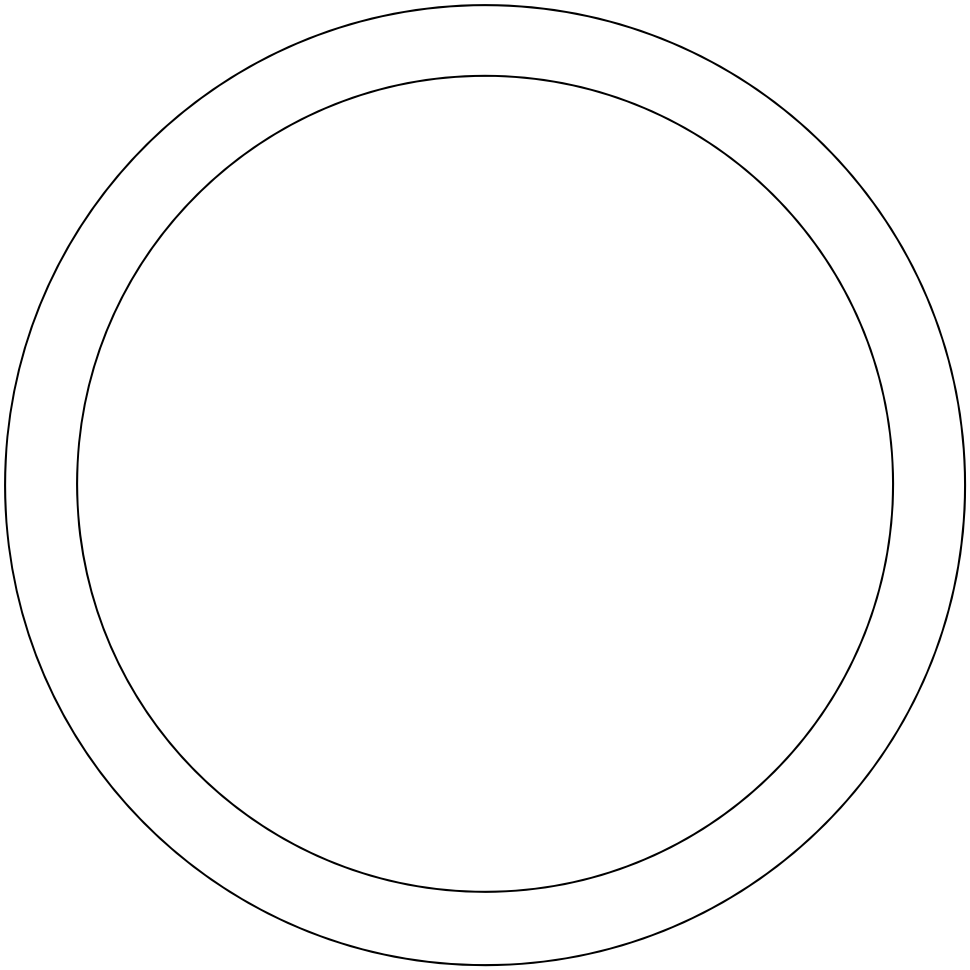
Your seal must include:

- At least five symbols that represent you, your family, or your community. Attach an explanation of each of the five symbols to your final piece.
- At least one example of each of the types of transformations: reflections, translations, rotations, dilations.
- Color (which may be symbolic, aesthetic, or both.)

Attached to your final piece, you must include:

- An explanation of how the Chippewa Cree Tribal Seal is used to show sovereignty
- A description of three symbols chosen on the Chippewa Cree Tribal Seal and the meanings for each symbol
- A description of transformations used on the Chippewa Cree Tribal Seal

Use the circle below to create a rough draft of your seal.



Final Assessment Rubric
Transformations and Montana American Indian Tribal Seals

NAME: _____ Period:_____ Date: _____

Your seal completed	_____ /4
Five symbols representing you, your family, or your community	_____ /5
Explanations of *each* of your five symbols	_____ /5
One example of a dilation in your seal	_____ /2
One example of a translation in your seal	_____ /2
One example of a reflection in your seal	_____ /2
One example of a rotation in your seal	_____ /2
Color in your seal	_____ /2

Subtotal: _____

An explanation of how the Chippewa Cree Tribal Seal indicates sovereignty	_____ /2
Descriptions of *three* Chippewa Cree Seal symbols	_____ /3
The meaning of *each* of these three symbols	_____ /3
One example of a dilation in Chippewa Cree Seal	_____ /2
One example of a translation in Chippewa Cree Seal	_____ /2
One example of a reflection in Chippewa Cree Seal	_____ /2
One example of a rotation in Chippewa Cree Seal	_____ /2

Subtotal: _____

Total points: **_____/40**