Stars in the Sky

Fast Facts

Curriculum Area: Mathematics
Grade Level: Grade 8
Suggested Duration: 135 minutes

Stage 1 Desired Results

Established Goals

Montana Content Standards for Mathematics

Geometry 5.G.1 Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).

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

Geometry 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 American Indians, using coordinates.

Geometry 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 similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

Indian Education for all Essential Understandings Regarding Montana Indians

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

- 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

Essential Questions

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

Students will know…

- the traditional and Crow Indian names for the North Star and the Big Dipper.
- the transformation terms, translation, rotation, and reflection.

Stage 2 Assessment Evidence

Performance Tasks

1. Activity, creating a Big Dipper clock and drawing the transformations of a constellation.
2. Worksheet graphing Big Dipper on four quadrant grid.

Other Evidence

1. Participation in classroom activity
2. "Stars on the Ceiling”
3. 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. 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 is not 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 its name and that it is a constellation 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 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 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. 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 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 Questions

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 counterclockwise with the passing of each hour; No, all of the Big Dipper may not always be visible from your location, it is 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 it does not 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

Coordinate plane A plane 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 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 This 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 The y-axis.

↓ ↓
(2 , 5)

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

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 and 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.

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" (Activity 1-8)
- Make a Star Clock.
- Copies of the worksheet "Graphing the Coordinate Plane"
- McCleary, Timothy P. *The Stars We Know*. Long Grove, IL: Waveland Press, Inc., 1997.

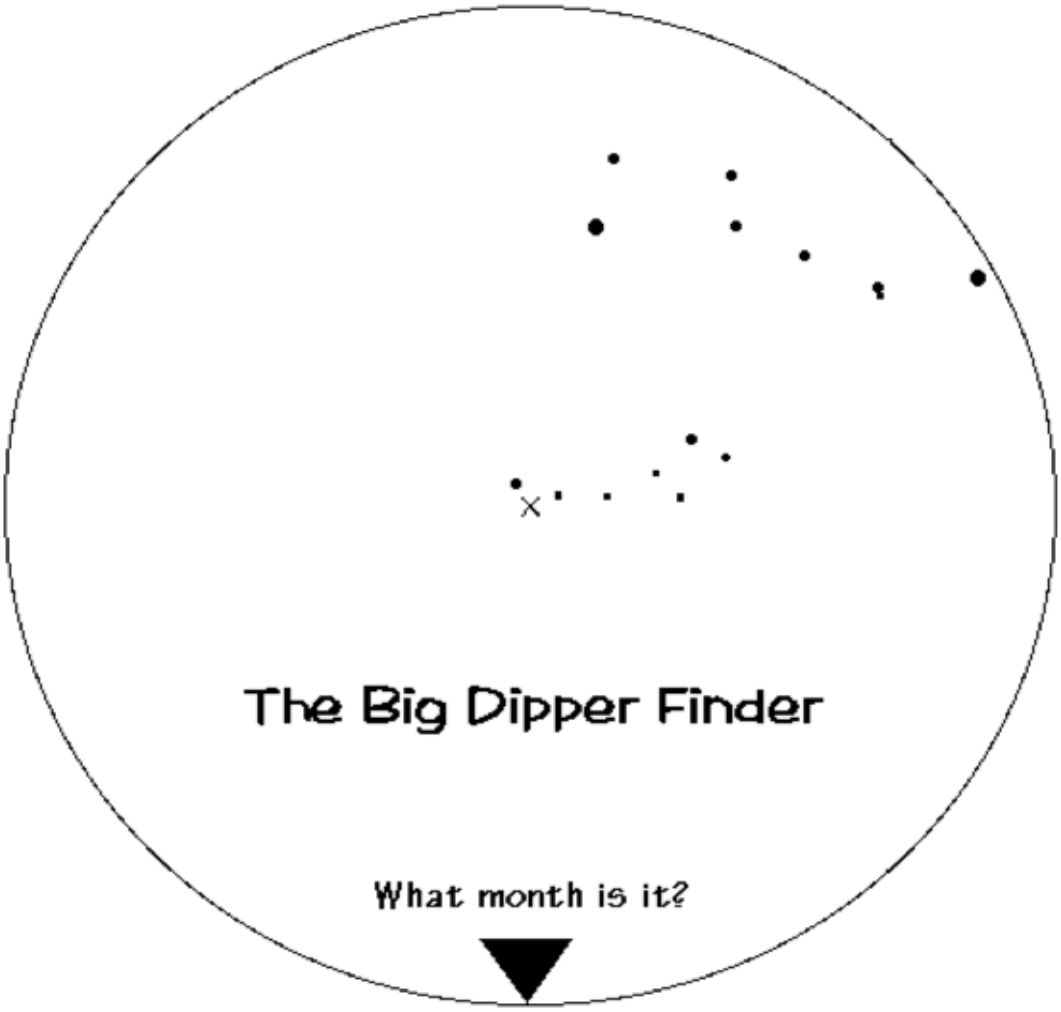
Montana Content Standards and IEFA Essential Understandings Regarding Montana Indians

Montana Content Standards for Mathematics – Grade 5

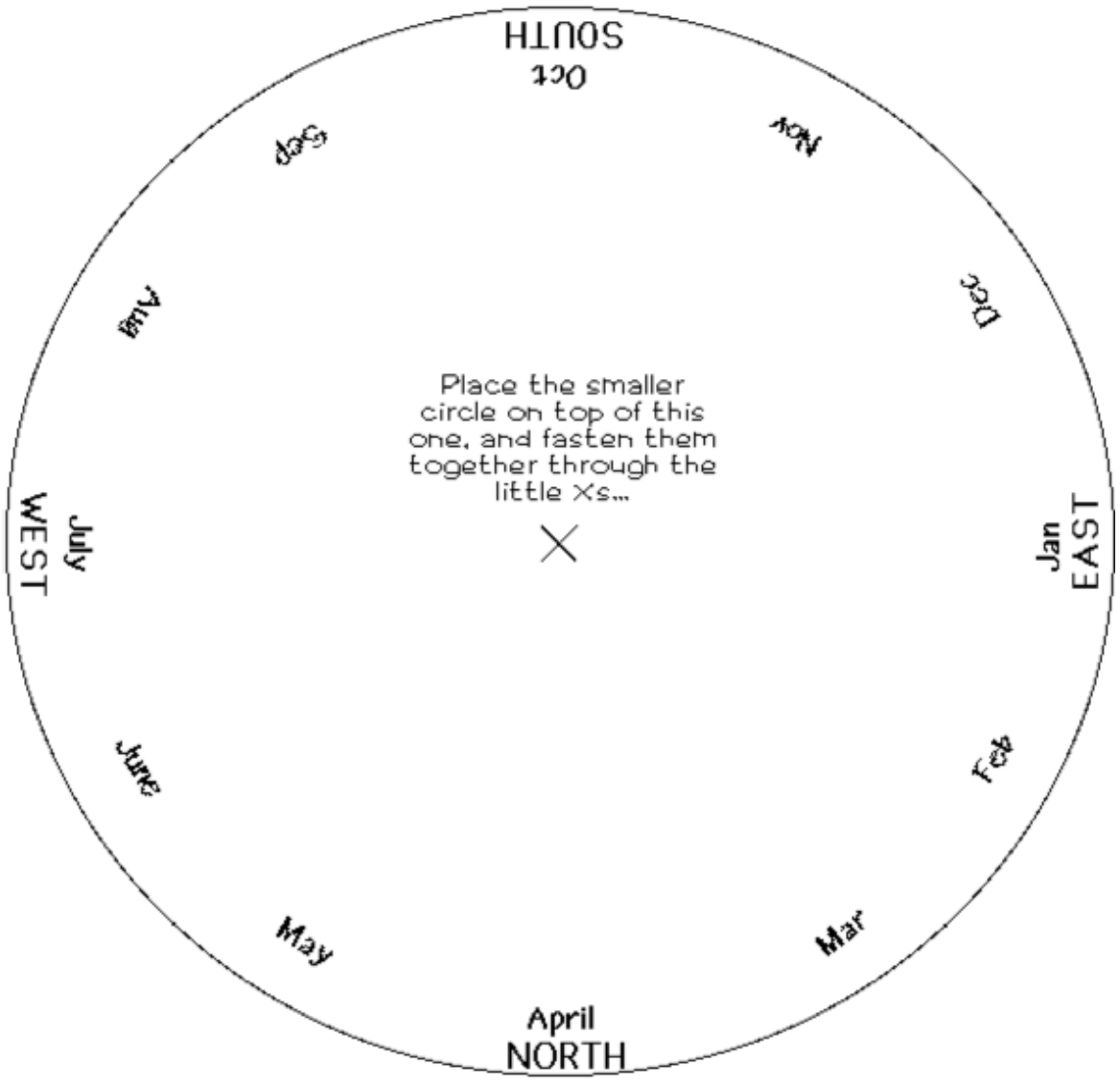
Montana Content Standards for Mathematics – Grade 8

Essential Understandings Regarding Montana Indians

The Big Dipper Clock (Small Circle Spins on Top)



The Big Dipper Clock (Large Circle on Bottom)



Graphing the Coordinate Plane

Name _____ Date _____

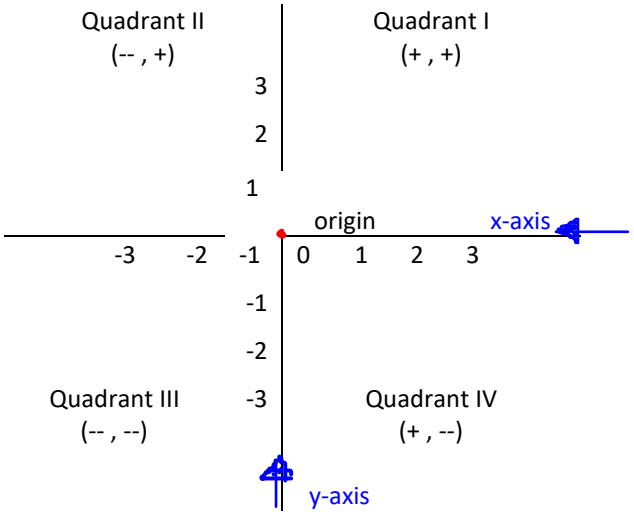
Coordinate plane - A plane formed by a horizontal number line called the x –axis and a vertical number line called the y-axis.
Quadrants -The four regions of a coordinate plane formed by the intersection of the x- and y-axis.
Origin -The point of intersection of the x- and y-axis on a coordinate plane.
Ordered pair - This 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 using a different colored pencil for each set.

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

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

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

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

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

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

7. What type of transformation occurred in each quadrant compared to **Quadrant I?** (translations, rotations, reflections, and dilations)

   Quadrant II _____

   Quadrant III _____

   Quadrant IV _____

8. How do you know what type of transformation in comparison to Quadrant I was performed?

9. What is another set of transformation that may have occurring for Quadrant II in comparison to Quadrant I?

10. Are the four constellations similar? Why or why not?

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

    1. _____ _____

Graphing the Coordinate Plane - 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. How do you know what type of transformation in comparison to Quadrant I was performed?

Multiple Responses.

9. What is another set of transformation that may have occurring for Quadrant II in comparison to Quadrant I?

Multiple Responses

- Reflection over the x and then y axis or vice versa.

10. Are the four constellations similar? Why or why not?

Multiple Responses: Yes, tow dimensional figures are similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations.

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_