

Gliding through the Galaxy using Transformations

Target Standard Geometry

- Apply transformations and use symmetry to analyze mathematical situations
- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Use visualization, spatial reasoning and geometric modeling to solve problems

Related Standard Representation

- Create and use representations to organize, record, and communicate mathematical ideas.
- Select, apply, and translate among mathematical representations to solve problems.

Teaching Plan

Part I: "S P A T I A L" Relationships: Constellation Comparisons

Purpose

Comparing and contrasting constellations based on their shapes and angles.

Materials

Transforming the Big Dipper activity sheet
Transforming the Big Dipper, The Game!

Scissors

Card stock or cardboard

Acetate

Small squares of acetate with the Big Dipper drawn on it or a transparency with multiple Big Dipper drawings on it.

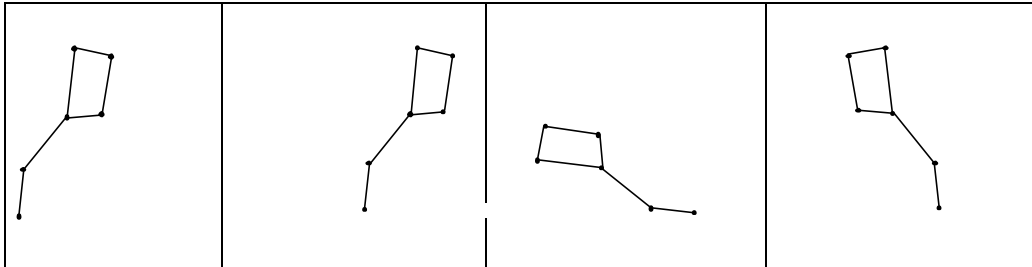
Implementation

Give students a Big Dipper shape. Ask them if they recognize any patterns? How could one create a pattern? Once the pattern is identified, the students connect the stars to form the Big Dipper. *note® discussion of constellations and origins would be appropriate here.*

Introduce transformations by having them determine how to get the Big Dipper in the various positions that represents a slide, flip and turn. You may demonstrate slide, flip, and turn with transparencies and while doing so give the students the acetate (square with a Dipper on it) and have them position the acetate into the position of the drawing in the boxes found in the **Transforming the Big Dipper** activity sheet. Write the name of the transformation type below the appropriate square. Repeat this for each image in the box. Follow this activity with **Transforming the Big Dipper, The Game!** It gives students an opportunity to sharpen their spatial abilities and enrich their geometrical terms.

TEACHER COPY

Transforming the Big Dipper



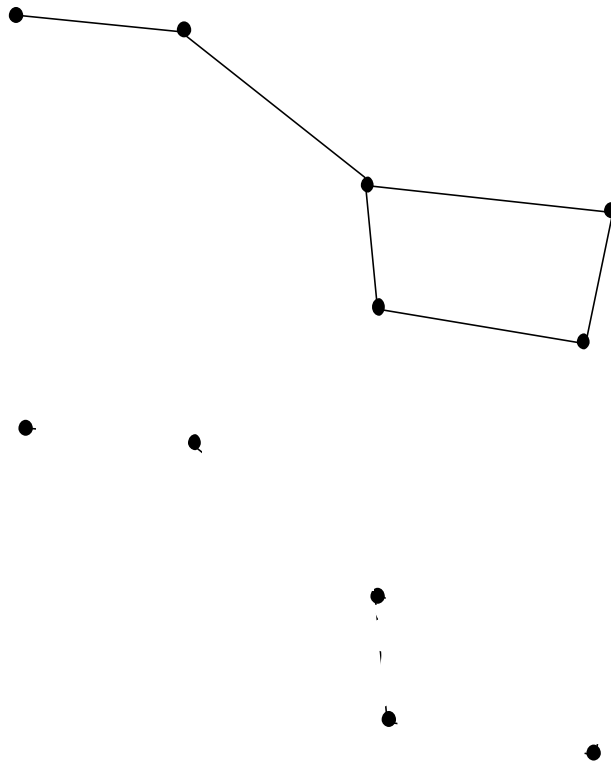
Frame 1
(Standard)

Frame 2
A. slide

Frame 3
B. rotation

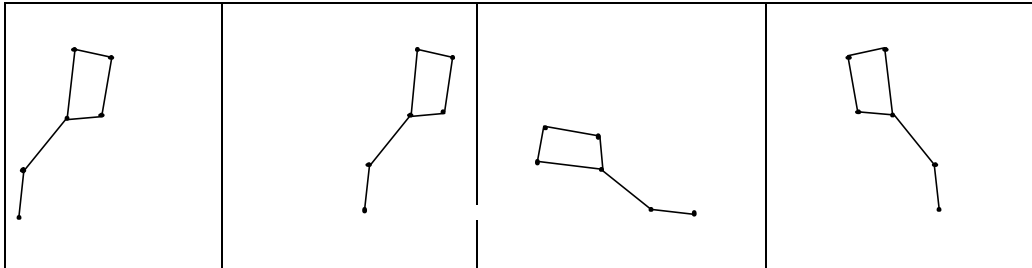
Frame 4
C. flip

Black line master of the Big Dipper to give to students and use on overhead:



Name: _____

Transforming the Big Dipper



Frame 1

Frame 2

Frame 3

Frame 4

(Standard)

A. _____

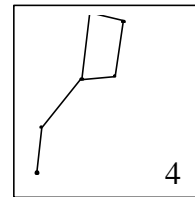
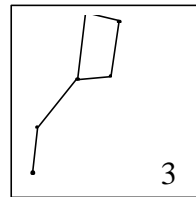
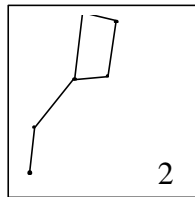
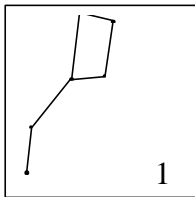
B. _____

C. _____

Transforming the Big Dipper, The Game!

Implementation

1. Photocopy the Big Dipper game board, rules, and playing cards.
2. On cardboard or card stock mount the game board on one side and the rules on the other.
3. Cut the playing cards apart.
4. Make a transparency of the four game pieces. The pieces should be the same size as the square on the game board and the Big Dippers should be congruent to the ones in the square (you may need to reduce or enlarge them).



TURN (rotate)	TURN and SLIDE	FLIP and SLIDE
SLIDE (translation)	SLIDE and TURN	SLIDE and FLIP
SLIDE (translation)	TURN, SLIDE, and FLIP	TURN and SLIDE
FLIP, SLIDE, and TURN	TURN, SLIDE, and FLIP	SLIDE and TURN
FLIP, SLIDE, and TURN	SLIDE, FLIP, and TURN	SLIDE, TURN, and FLIP
TURN, FLIP, and SLIDE	SLIDE, FLIP, and TURN	SLIDE, TURN, and FLIP
TURN, FLIP, and SLIDE	TURN and FLIP	FLIP, TURN, and SLIDE
FLIP (reflection)	FLIP and TURN	FLIP, TURN, and SLIDE

Transforming the Big Dipper, The Game! Rules

Set up:

Two, three or four people may play this game at one time.

For two players, start at spaces in opposite corners of the board.

For three players, start in any three corners.

For four players, use all four corners.

Shuffle the cards and place them in a pile face down.

Object:

The game begins with each player's transparent game piece properly positioned on the corner of the game board. The object of the game is to move the playing piece on each turn until it reaches the diagonally opposite corner of the game board and it is properly positioned on that space. This is how the game is won. On each turn, pick a card from the pile, follow the instructions, and place it face-up in a discard pile.

Moves:

A slide or translation is a motion that moves the game piece either vertical or horizontal and the distance will be one square. The Big Dipper on the playing piece must always coincide with the Big Dipper on the square.

A turn or rotation will be a quarter turn (90 degrees) in either direction. In this move, the piece will change direction, but will remain on the same game board space.

A flip or reflection will be a move that flips or reflects the game board space. Therefore, there are four possible moves.

A free space does not have a Big Dipper on that game board space. Playing pieces may land on these spaces facing in any direction. However, if a player lands on an occupied free space, the player's piece must coincide with the piece that is already there.

Moves can only take place if the Big Dippers of the game piece and the game board space look identical. Moves must be made whenever possible, even if it is considered an undesirable move. A player's chance to move is forfeit only if it is impossible to carry out the instructions on the playing card.

Part 2: Stellar Positions

Materials

Cassiopeia, “The Queen”, Sunspot Transformation, and Cepheus, “The King” activity sheets
Acetate (if students complete the Cepheus activity sheet)

Prior Knowledge

Students must have experience with transformation of figures (slides, flips, and turns) and the associated vocabulary.

Implementation

Use the following activity sheets to give students practice with geometric transformation within the context of star positions in the night sky.

1. The activity sheet **Cassiopeia, “The Queen”**, is designed to have students identify the transformation of the constellation in the star field (more appropriate for 3rd grade). *note® Cassiopeia in star field B is a flip from the standard, star field C is a rotation, and star field D is a slide.*
2. The activity sheet **Cepheus, “The King”**, is developed to introduce students to what telescope images do to a star image and challenge the students to draw the transformations compared to the star field standard. (This is more appropriate for upper grades). *note® to assist the upper grade students (using the Cepheus activity sheet) in developing their spatial and geometry ability, you may wish to give them a piece of acetate and fine point marker to help them draw the transformations.*
3. Discussion of the activity sheets and the various transformations should close this part of the lesson.

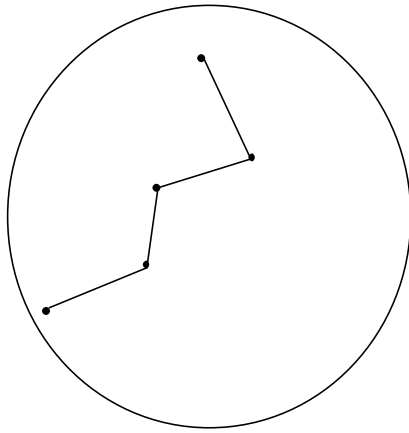
Name: _____

Cassiopeia, "The Queen"

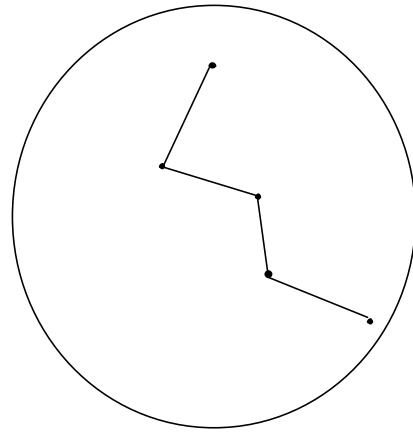
Demonstrate using transparencies that the rotation of constellations around the North Star often appears to flip constellations if you choose opposite seasons. Upon careful examination, it becomes clear that it is a rotation. In this activity you will be determining whether the constellations in the fields when compared to the criterion star field are transformed by turns, slides, or flips.

Activity Sheet: Cassiopeia

Explore the 4 star fields: Compare Star fields B, C, and D to the standard and name the type of transformation it has undergone.

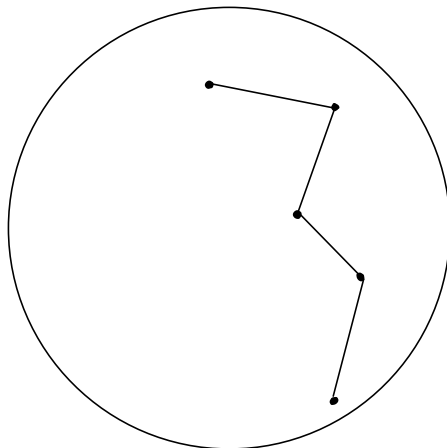


Star field A
Cassiopeia
Standard



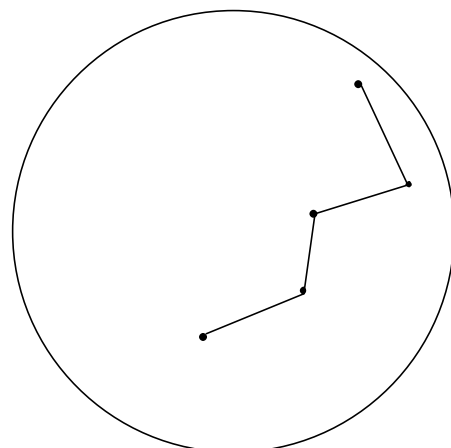
Star field B

B is _____



Star field C

C is _____



Star field D

D is _____

Name: _____

Sunspot Transformation

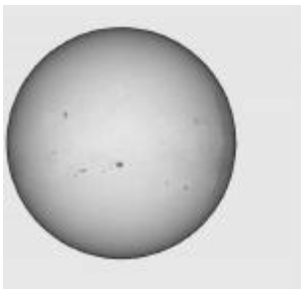
Match the Sun's picture with the view as seen from each telescope below:

Telescope 1 reflects (flips) the image

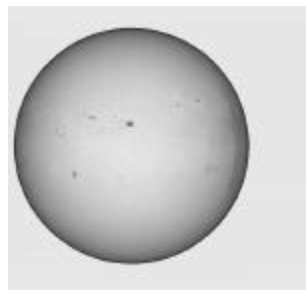
Telescope 2 rotates (turns) the image

Telescope 3 slides the image

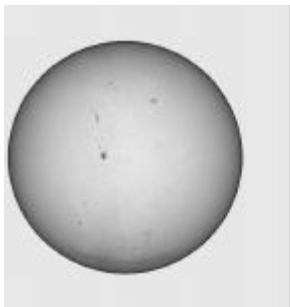
Using the sunspot pictures and the standard below, have the students identify the transformation of the solar images as taken from the telescope photos. (See the telescope key above).



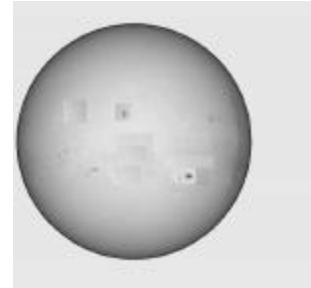
Standard sunspot image



Sunspot image 2



Sunspot image 3



Sunspot image 4

1. Sunspot image #2 came from which telescope? _____
2. Sunspot image #3 came from which telescope? _____
3. Sunspot image #4 came from which telescope? _____

Additional Resources

http://www.thursdaysclassroom.com/index_09mar00.html

http://www.thursdaysclassroom.com/index_02sep99.html

http://www.thursdaysclassroom.com/index_08june00.html

www.astro.wisc.edu/~dolan

Refracting Telescope Kit:

Learning Technologies, Inc.

40 Cameron Avenue

Somerville, MA 02144

1-800-537-8703

Cepheus, "The King"

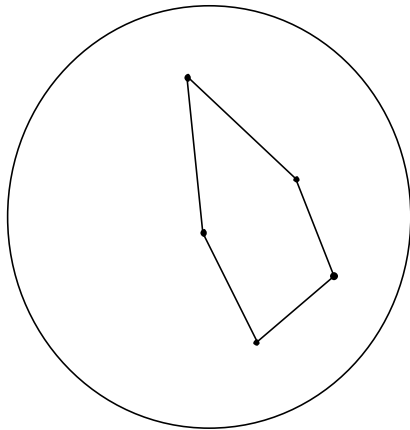
Activity Sheet: Cepheus

Using the standard star field, draw the constellation as it would look for each of the following transformations as seen when observed from the telescopes below.

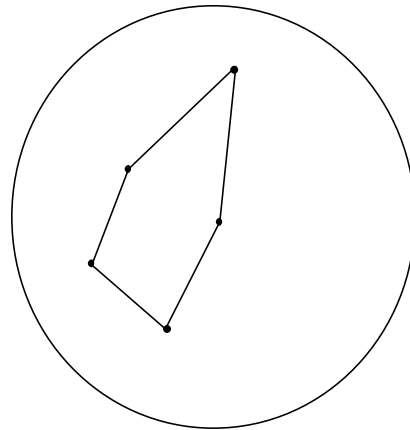
Telescope 1 reflects (flips) the image

Telescope 2 rotate (turns) the image

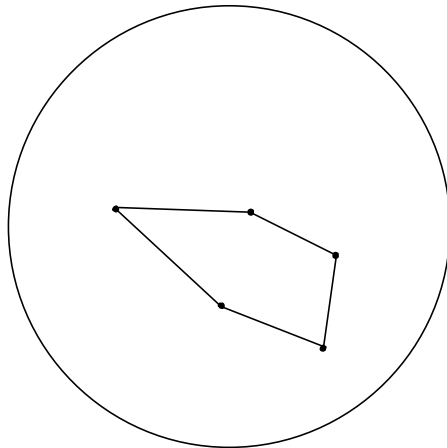
Telescope 3 slides the image



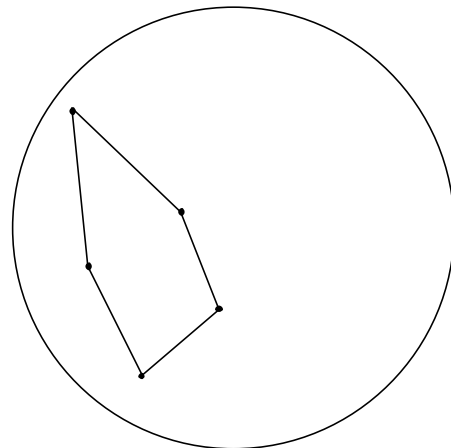
Star field A
Standard



Star field B:
Telescope 1



Star field C:
Telescope 2



Star field D:
Telescope 3

Name:

Cepheus, "The King"

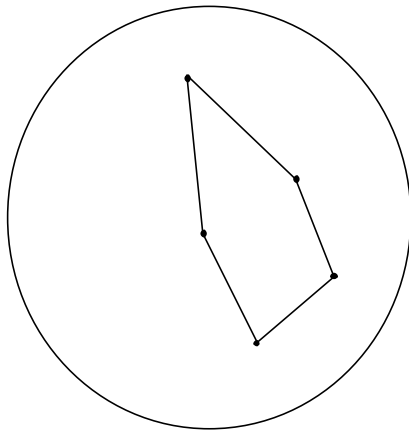
Activity Sheet: Cepheus

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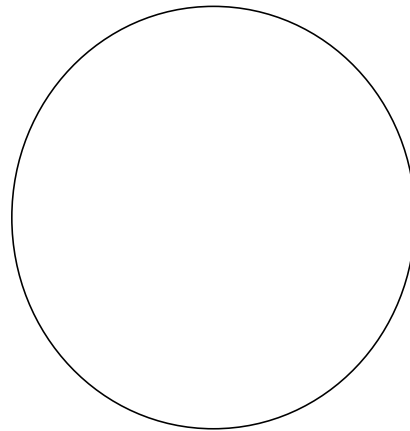
Telescope 1 reflects (flips) the image

Telescope 2 rotate (turns) the image

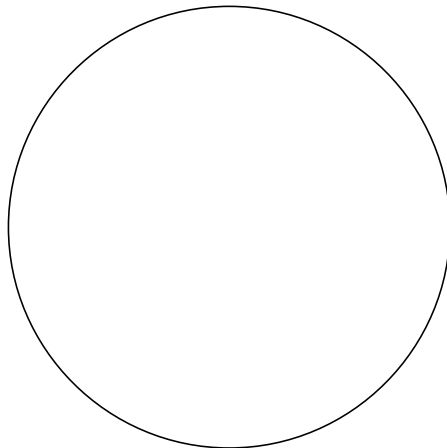
Telescope 3 slides the image



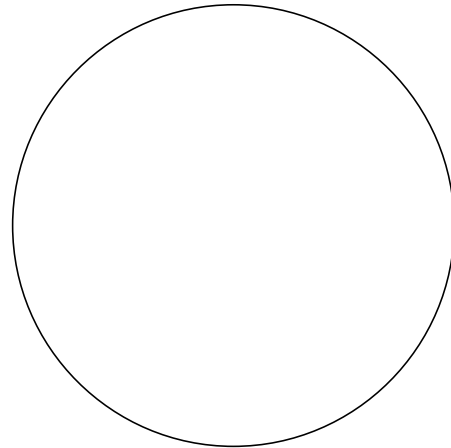
Star field A
Standard



Star field B:
Telescope 1



Star field C:
Telescope 2



Star field D:
Telescope 3

Part 3: Do Star Positions Really Occur by Flips, Turns, and Slides?

Purpose

The purpose of this activity is to have the students determine whether changes in star positions are due to flips, turns, or slides.

Materials

Seasonal Star Maps: Summer, Fall, Winter, Spring (with the Little Dipper, Big Dipper, Cepheus, and Cassiopeia)

Stellar Seasons activity sheet

Implementation

In the previous activity with transformations, the students explored the geometric transformation within the context of constellations. Posing the question, “Do star positions really occur by flips, turns, and slides?” students explore which of these geometric transformations actually occur in nature. This should be done as a teacher demonstration with a set of transparencies using the **Star Maps** of the four seasons. note→ it is the North Star (in the Little Dipper) which does not appear to move.

1. Make a transparency of the summer constellations (**Seasonal Star Map: Summer**) that include the Big Dipper, Little Dipper, Cepheus, and Cassiopeia. Project this and identify the constellations. Discuss ways to describe the directions identified on the star map. What direction is missing? (South) Ask them what season the transparency represents? Will the same stars be seen in the winter? Will the star patterns be in the same location of the sky in the winter? Discuss their ideas and have them make predictions of what the star locations might look like in the winter. Now, place the **Seasonal Star Map: Winter** transparency over the summer transparency. Observe Cassiopeia and compare its star positions in two seasons. What geometric transformation of the constellation seems to have occurred?
2. Repeat the comparison again, looking at the Big Dipper with the spring and fall star map transparencies.
3. Previously, the opposite seasonal star maps were compared. What kinds of transformations did the discussion bring forth? Continue the lesson by sequencing the star maps in order.
 - A. Project the summer star map transparency on the screen.
 - B. Hand out the **Stellar Seasons** activity sheet.
 - C. Have students draw the Little Dipper in the circle designated as summer on their activity sheet. Point out that the last star in the Little Dipper is known as the “North Star” or “Polaris.”
 - D. Point out that the North Star is the point of reference. Next, have the children draw where they think that the location of the Little Dipper will be in Fall. Repeat this for winter and spring.

note® Remind them to place these in reference to the standard seen in the summer transparency. Also remind them that they should be thinking of the positions in terms of slides, turns, and flips.

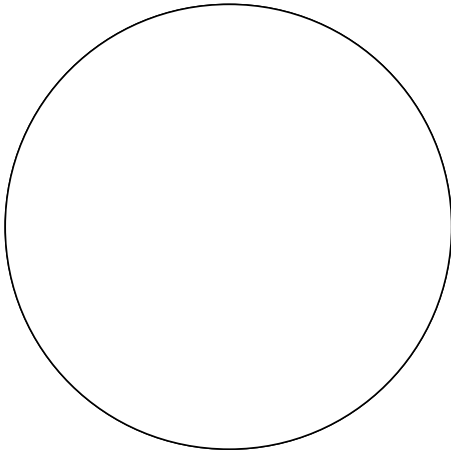
- E. Now, sequence the transparency sheets in order of the seasons starting with summer. Discuss the position changes and the transformation that occurred. At this point make sure to emphasize arguments for rotation or turns.

note ® *The purpose is have students see that there is only one transformation that accounts for all the positions. Return to the original question, “Do these changes in star positions really occur by flips, turns, and slides?” (Rotation)*

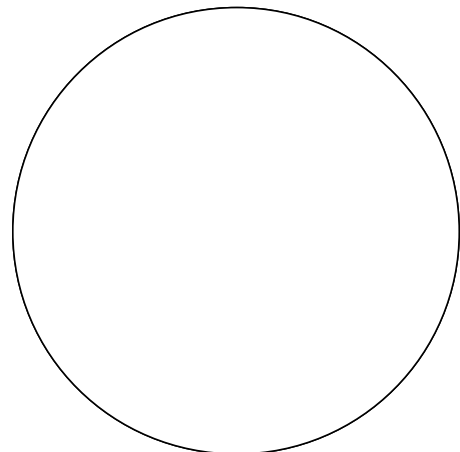
- F. Have the students write a sentence using symbols, drawings, words, or diagrams to show that the positions of the stars near the North Star are geometrically transformed through “rotation” or by turns. This should lead to a discussion of what is moving, the stars or the earth? The position change of the circumpolar stars (stars that circle the North Star) during the night is due to rotation. The seasonal change of constellations is due to the revolution of the earth.

Name:

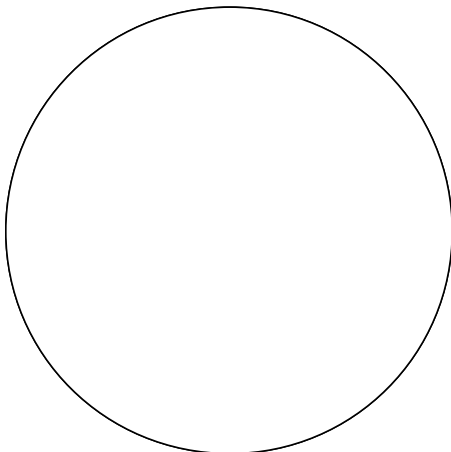
Stellar Seasons



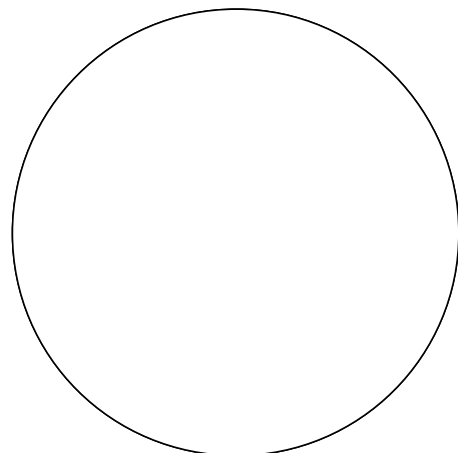
Summer



Fall

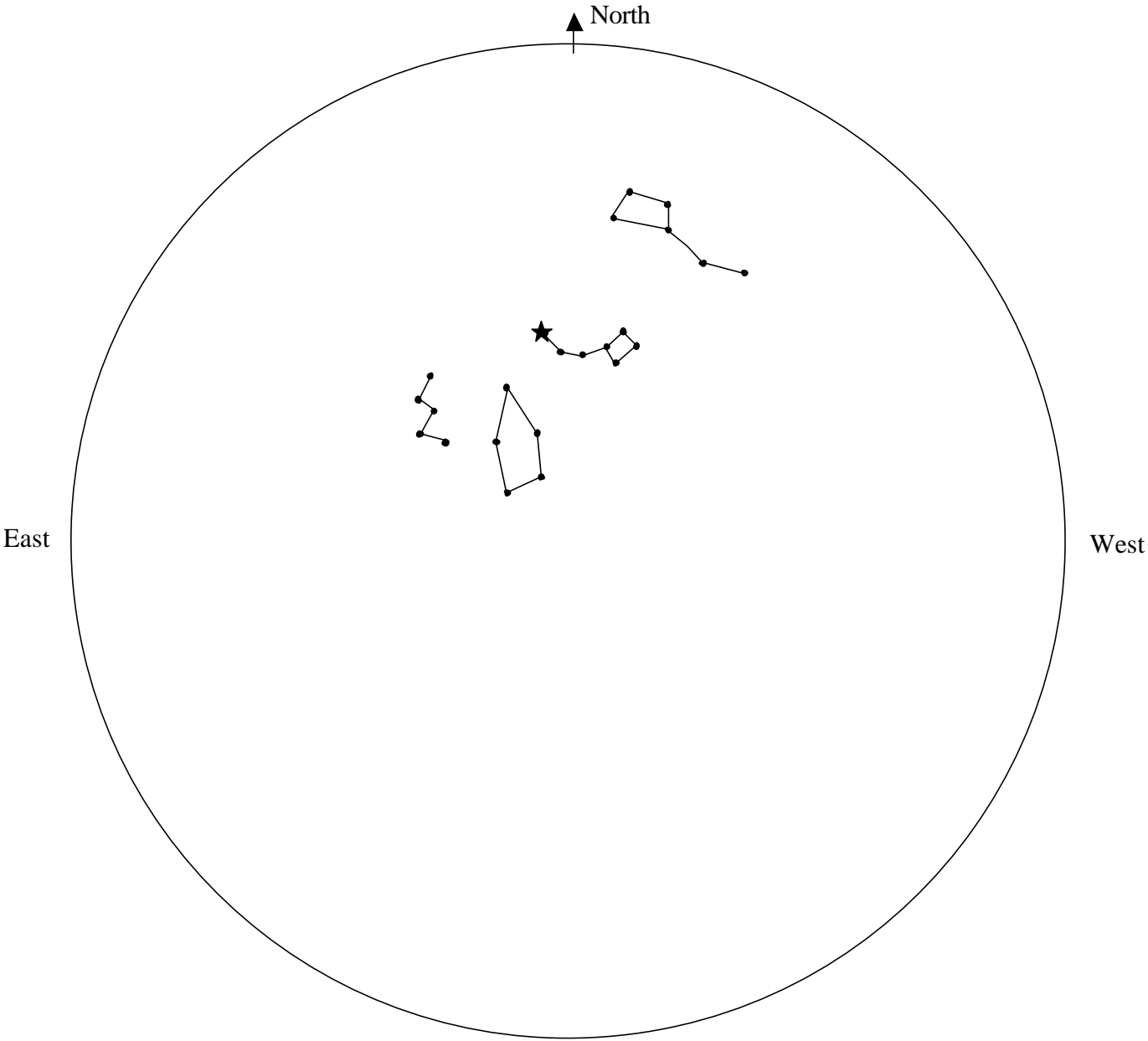


Winter

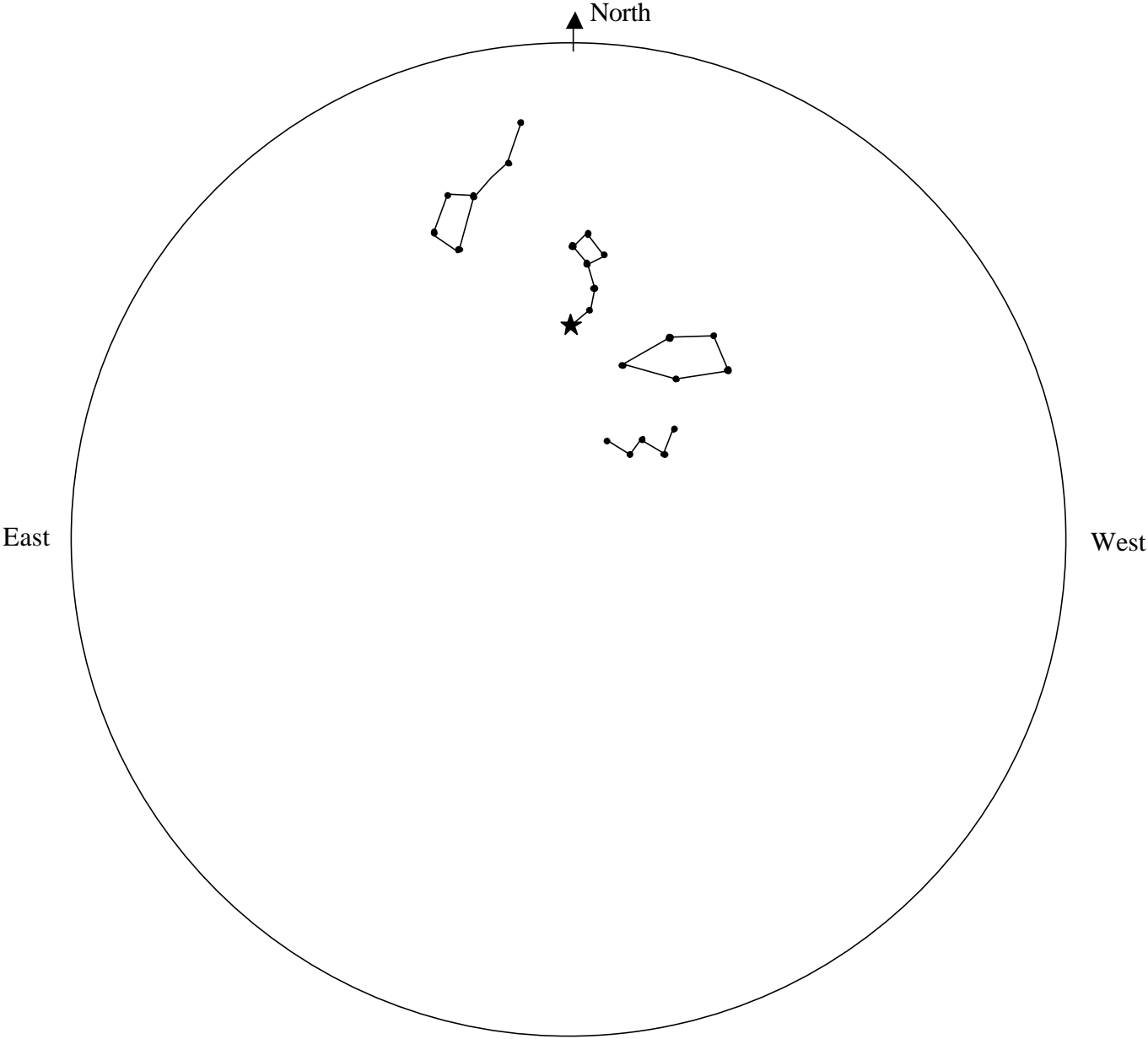


Spring

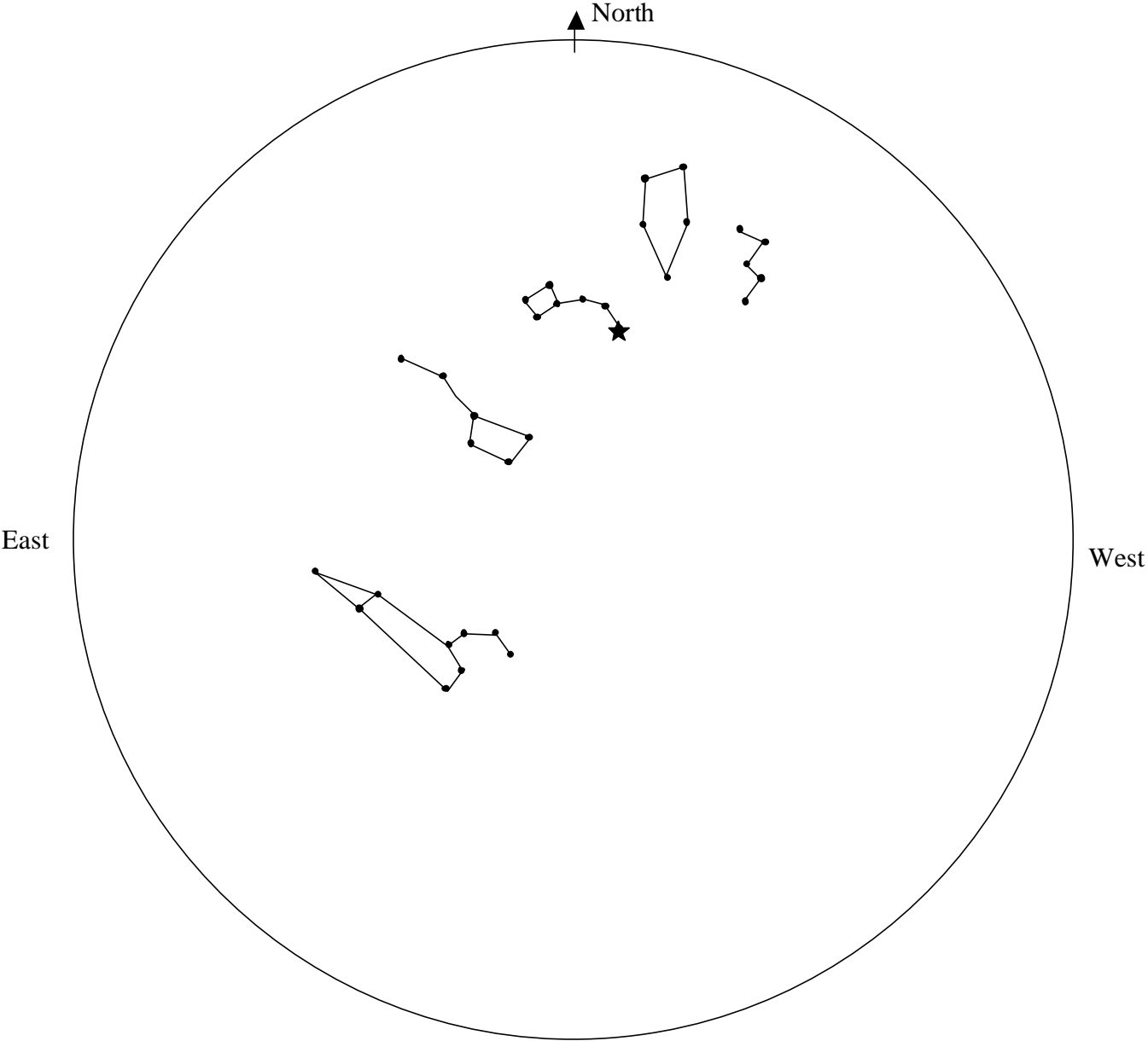
Seasonal Star Map: Summer



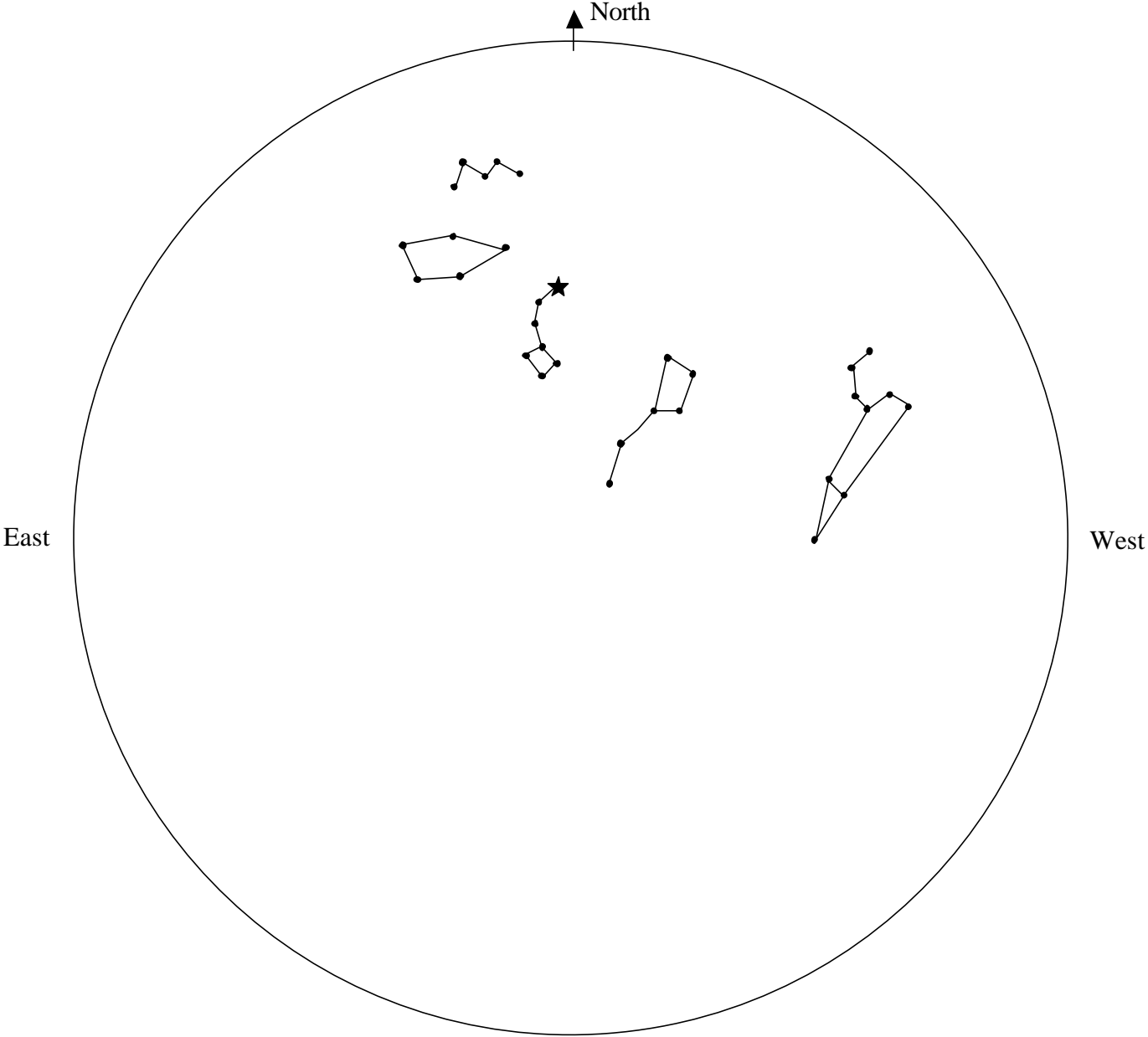
Seasonal Star Map: **Fall**



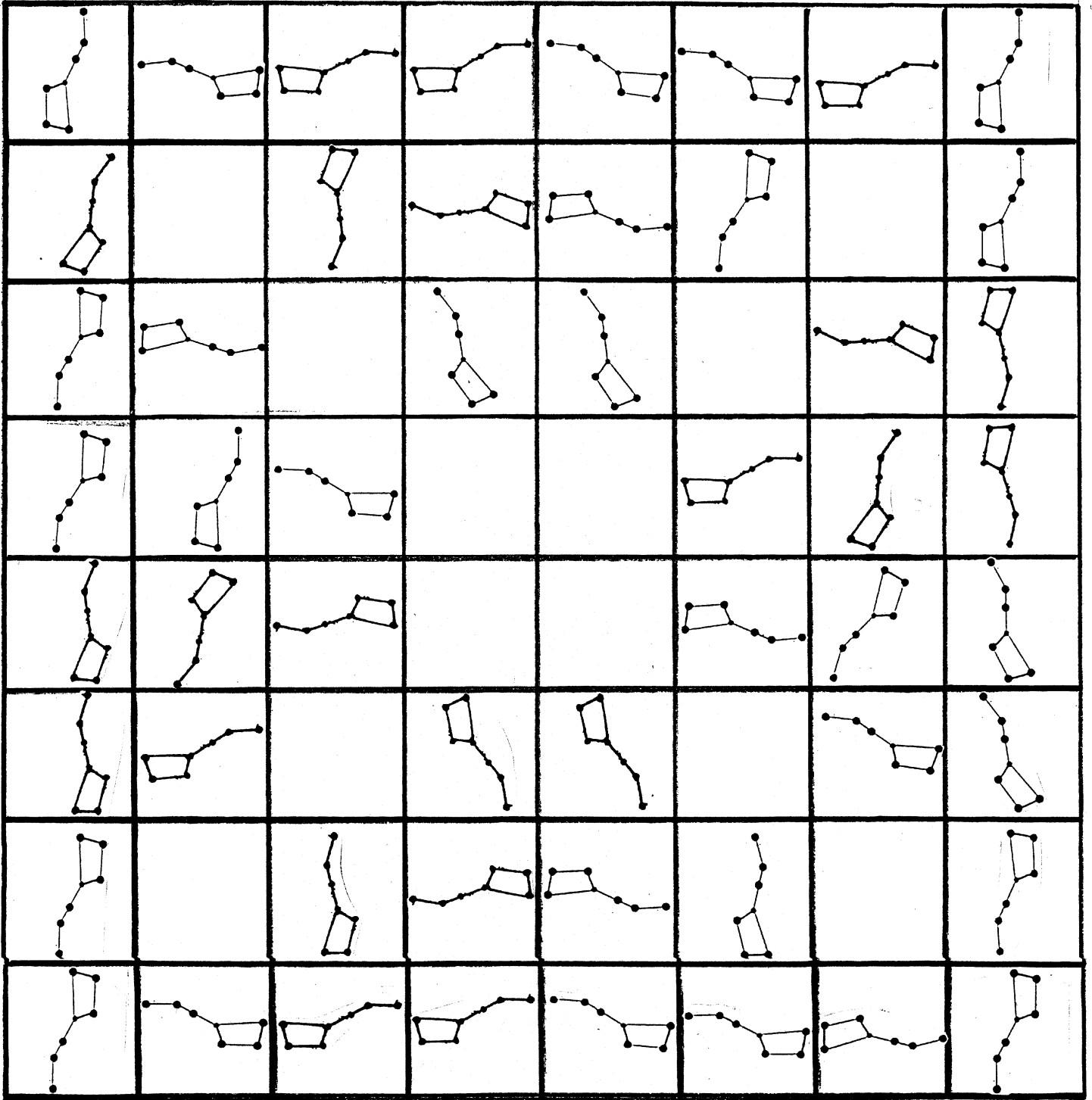
Seasonal Star Map: Winter



Seasonal Star Map: Spring



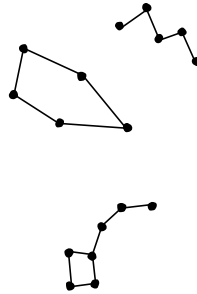
Gliding Through the Galaxy Gameboard



Assessment Page

Name _____

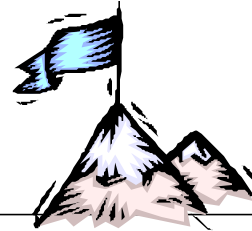
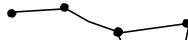
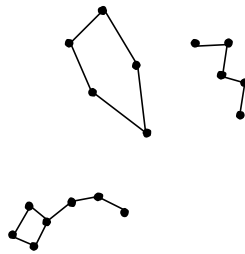
Manhattan, Kansas
3 am UT December 14



1. How is the sky different in Flagstaff as compared to Bozeman (slide, flip, and/or turn)?
2. How is Manhattan different?



Flagstaff, Arizona
3 am UT December 14



Bozeman, Montana
3 am UT December 14

