

# Constellation Puzzle

**Program Type:** Demonstration or Classroom Program

**Audience Type:** Grade 1–5

**Description:** Students learn how people have used star patterns to map the sky by completing a constellation puzzle and learning stories from different cultures.

**Topics:** Stars, constellations, patterns, culture, Earth's place in the universe

**Process Skills Focus:** Critical thinking, predicting, observing, using models, communicating ideas.

## LEARNING OBJECTIVES

*For Next Generation Science Standards alignment, see end of outline.*

- Constellations are groups of stars that form an image or represent a story.
- Skywatchers map the sky using constellations and stories.
- Different cultures view the sky differently and tell unique stories.

## TIME REQUIRED

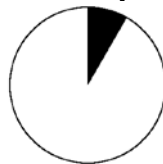
**Advance Prep**



**10 minutes**

Add 30 min if need to cut puzzle pieces

**Set Up**



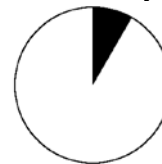
**5 minutes**

**Activity**



**30 minutes**

**Clean Up**



**5 minutes**

## SITE REQUIREMENTS

- Standard size classroom
- Desks or tables

## PROGRAM FORMAT

<u>Segment</u>	<u>Format</u>	<u>Time</u>
Introduction	Large group discussion	5 min
Constellation Puzzle	Small group activity	15 min
Wrap-Up	Large group discussion	5 min

## SUPPLIES

Permanent Supplies	Amount	Notes
Scissors	1/student	
Projector (optional)	1	
Screen (optional)	1	
Document camera (optional)	1	

Major Consumables	Amount	Notes
Story handouts (Maya, Greek, and Navajo sheets)	1 set/group	At the end of the document
Puzzle cutouts	1/group	At the end of the document, print on cardstock
Story image overlays	1 set	At the end of the document, print on plastic sheets

## ADVANCE PREPARATION

- Print one puzzle and story sheet for each group.
- If children are too small to cut pieces out accurately, cut out the puzzle pieces ahead of time.

## SET UP

- Place materials in a convenient location for students to collect during the activity.
- Prepare the document camera and projector.

## INTRODUCTION

5 minutes

*Let students speculate before offering answers to any questions. The answers given are provided primarily for the instructor's benefit.*

Suggested script is shaded. Important points or questions are in **bold**. Possible answers are shown in *italics*

Today, we are going to talk about stars and constellations. **What is a constellation?** *A grouping of stars that some cultures believe forms a shape or image.*

**A constellation is a group of stars in the night sky that looks like a shape or is connected to a story. It also refers to the region of the sky that contains these stars.**

Have you ever seen a constellation? Can you name a few constellations? *Leo the Lion, Cassiopeia the Queen, Orion the Hunter, Taurus the Bull...*

**Does anyone know what constellations are used for?** *To map the sky, to tell apart the seasons or times of year, to indicate a special event such as a ceremony or time to plant or harvest, to tell stories, to see pictures in the sky, and for navigation (tell direction).*

The constellations that most of us are familiar with are the ones that scientists use today. These constellations are based on ancient Greek stories, but other cultures have different constellations with their own stories. For example, one culture may see a set of stars as a hunter, while another culture sees the same stars as a turtle carrying the world on its back.

## SMALL GROUP ACTIVITY

### Constellation Puzzle

30 minutes

This puzzle includes the most visible constellations around the North Star. These are just a few of the 88 official constellations recognized by International Astronomical Union (IAU)—an organization of space scientists from

around the world. Astronomers use constellations to make a map of the stars and name different sections of the sky.

Many cultures use constellations to create maps of the sky and track the stars throughout the year. The constellations often have stories attached to them. Sometimes, the stories of more than one constellation are connected and help us remember how the constellations fit together like a puzzle.

So, what better way to learn about which stars go where than to actually make the sky into a puzzle of constellations?

Give each group of 2–3 students a set of the constellation puzzle pieces printed on cardstock and scissors. [If kids are too young to cut them out on their own, do this step ahead of time. It can be time consuming, so it is a great activity for older students.]

Do you recognize any of these constellations? The names used by scientists are on the back. Most of these names are the same as the Ancient Greek names.

Cut out the pieces and see if you can put your puzzle together.

Students cut out the pieces along the lines.

Students mix up the pieces and then put the puzzle together.

Once most or all of the groups have completed the puzzle, show the students the completed puzzle in front of the room with a document camera and projector. If you do not have a document camera, you can gather around one group's table and look at their puzzle.

Place the relevant cultural image overlay on top of the puzzle while sharing the stories below.

Want to learn some of the stories in the stars?

Let's start with one of the Greek stories that inspired the scientific names.

*Greek Story:* **Andromeda** (an-drom-e-da) was a princess and the daughter of King **Cepheus** (see-fee-us) and Queen **Cassiopeia** (cas-ee-o-pee-ah) in Northern Africa. Cassiopeia bragged that Andromeda was more beautiful than the sea nymphs, relatives of Poseidon and the other sea gods. Insulted, Poseidon sent a sea monster to terrorize the kingdom. To stop the monster, Andromeda's parents would have to sacrifice their daughter. So, Andromeda was tied to a rock on the shore. As she waited for the monster, the hero Perseus flew by on his winged horse, Pegasus. He fell in love with Andromeda, and rescued her. That is why the constellations of Cepheus, Cassiopeia, Andromeda, and Pegasus are all next to each other.

But other cultures have stories and constellations that are different than the Greek stories. Let's learn about a constellation from a Native American tradition.

*Diné/Navajo Story:* Navajo people, who call themselves Diné, are originally from Northern Arizona, Utah, Colorado, and New Mexico. For the Diné, the area around the North Star is one constellation with three parts. The **Female Revolving One** (the IAU constellation called Cassiopeia) is considered to be a mother, or grandmother, who shows strength, motherhood, and regeneration. She reflects stability and peace and also provides food and nutrition for her family. The **Male Revolving One** (the Big Dipper part of the IAU constellation Ursa Major) is considered to be a warrior, leader, and father (sometimes grandfather). He provides for and protects his family and community. The **Central Fire** (the North Star or Polaris) connects these two. Like the fire in a traditional Navajo home (hogan), the North Star acts as the center of the sky that other stars move around. The central fire adds stability, security, peace, warmth, and light. This constellation helps people navigate (by locating the North Star) and track time as the Male and Female Revolving Ones rotate around their fire during the year.

The Maya peoples of Mexico and Central America have been keen observers of the sky for centuries. As part of their observations, they track the movements of the Milky Way, the dense band of stars that crosses the sky.

*Maya Story:* Maya people associate the Milky Way with several things, many of which focus on how the Milky Way connects the worlds of Earth and Sky. In particular, the Milky Way is often seen as the World Tree—a tree that has its roots in the underworld, its trunk in the middle world, and its branches in the highest layer of the sky. The symbol of a World Tree looks a bit like a cross or lower-case “t.”

The association between the World Tree and the Milky Way comes from several cultural and astronomical connections. First, the Milky Way touches the horizon—where earth and sky meet—crosses the sky and then reaches the horizon in the opposite direction. Second, closer to the equator, where Maya people traditionally live, the Milky Way connects with the Southern Cross. (The Southern Cross is not visible in Oregon but is located below the horizon past Orion and Canis Major). The cross is also a symbol for the connection between worlds and the World Tree. Third, the Milky Way cuts across the sky in different places at different times of the year. When you compare the Milky Way’s path at the same time of the night at the equinoxes (March and September) and the solstices (June and December), the paths make a cross, reinforcing the symbolism of the World Tree.

Give one story sheet to each group of students.

Have students put the puzzle together again, this time thinking about how certain constellations go together in the stories.

Inquire about how the students felt using the stories to build a picture of the sky.

**Was it easier to put together the puzzle with the stories?**

**Will you be able to use these stories to remember the constellations and which ones are close to one another?**

## WRAP-UP

5 minutes

*Ask for student observations. There is no correct answer. Let students guide the discussion and present their hypotheses before discussing explanations.*

**Now that you've learned more about the night sky, why do you think that people from lots of cultures, including scientists, use constellations?**

*Constellations help map the sky by relating one constellation to another through a story. Constellations help us find stars and other things that we are looking for. Constellations help us track how the sky changes or rotates throughout the day and year.*

What did you learn about the sky that you didn't know before and you thought was interesting?

What do you want to learn more about?

Where can you go to look at the stars? How many constellations do you think you can find? Do you have someone you can ask about constellations or star stories?

## CLEAN UP

- Clean up paper scraps and return materials.

## OPTIONAL EXTENSIONS

- Have students research other constellation stories from diverse cultures. Ask them to illustrate a story and share it with the class.
- Coordinate a Star Party or participate in one hosted by a local astronomy group or science center. Portland area residents can check out the Rose City Astronomers website (<http://www.rosecityastronomers.net/>) under the "Observing" pull-down menu.
- Have students research what the sky looked like on a specific day in history or on the day they were born.

## BACKGROUND INFORMATION

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Stars appear to rotate around the North Celestial Pole—an imaginary point in the sky where the Earth's axis of rotation is pointed. Polaris—the North Star and the end of the handle of the Little Dipper—is very close to the pole. This means that it appears to stay still as the other stars rotate around it. Consequently, Polaris is always in the northern sky. The constellations closest to Polaris are visible (above the horizon) throughout the entire year at this latitude (Oregon is in the range of 42–46 degrees north). Major constellations that are always visible include Ursa Major (which includes the Big Dipper), Ursa Minor (which includes the Little Dipper), Cassiopeia, Cepheus, and Draco. Other constellations are visible for only a few months every year.

The Big and Little Dippers are not actually officially constellations. They are **part** of two constellations known as Ursa Major and Ursa Minor, respectively. There are 88 official constellations recognized by the International Astronomical Union. In this activity, we have only included 19 of the most recognizable constellations visible around 45 degrees north.

## RESOURCES

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Greek constellation stories

<http://www.comfychair.org/~cmbell/myth/myth.html>

International Astronomical Union constellation information

<http://www.iau.org/public/themes/constellations/>

Make your own star wheel (planisphere)

[www.lawrencehallofscience.org/sites/default/files/pdfs/starwheels/NorthStarwheel.pdf](http://www.lawrencehallofscience.org/sites/default/files/pdfs/starwheels/NorthStarwheel.pdf)

Spanish version of a star wheel

<https://docs.google.com/file/d/0Bx6nTKcFyOzBaTM2empZcW9EU0k/edit>

Video on how to use a star wheel

[www.youtube.com/watch?v=RzzxsoCgl2k](http://www.youtube.com/watch?v=RzzxsoCgl2k)

An interactive sky map for exploring the stars and planets by Neave Planetarium

<http://neave.com/planetarium/>



A website and widget that creates a sky map for specific times, dates, and places.

<http://www.wolframalpha.com/widgets/view.jsp?id=dbb4e34a68c5b97c287c953d74fe1d5e>

**Books:**

*Follow the Drinking Gourd* by Jeanette Winter—A story about how African Americans escaping slavery used the stars to find their way.

*Sharing the Skies: Navajo Astronomy—A Cross-Cultural View* by Drs. Nancy Maryboy and David Begay—A beautifully illustrated book sharing both Navajo and Greek constellation stories.

*Sq' Baa Hane' Story of the Stars: Educational Activities Weaving NASA Science and Navajo Knowledge*

[https://astrobiology.nasa.gov/uploads/filer\\_public/d7/fd/d7fdeb5d-549c-4248-b219-02e3e125b56e/storystars-2.pdf](https://astrobiology.nasa.gov/uploads/filer_public/d7/fd/d7fdeb5d-549c-4248-b219-02e3e125b56e/storystars-2.pdf) —A set of lesson plans for teachers aimed at inspiring people to learn about space science and Navajo traditional knowledge about the stars.

*Tales of the Shimmering Sky: Ten Global Folktales with Activities* retold by Susan Milord—Lovely stories and activities about the sky.

*The Power of the Stars: How Celestial Observations have Shaped Civilization* by Bryan Penprase —Concise explanation of constellation lore from around the world, organized by cultures.

*The Stars* by H. A. Rey—A beautifully illustrated guide to observing constellations by the author of the original Curious George books.

**GLOSSARY**

<b>Constellation</b>	A traditional or recognizable group of stars in the night sky, or the region of the sky containing them.
<b>North Star (Polaris)</b>	A star in the constellation of Ursa Minor that's just about perfectly above the Earth's North Pole. This star appears to move very little as the Earth turns.
<b>Star</b>	A hot sphere of plasma (hot, dense gas) held together by its own gravity. It is so hot that it produces light.

## NEXT GENERATION SCIENCE STANDARDS

### Practices

1. Asking questions and defining problems
2. Developing and using models

### Crosscutting Concepts

1. Patterns
4. Systems and system models
6. Structure and function

### DCIs

	Disciplinary Core Idea	K	1	2	3	4	5	MS	HS
<b>Physical Science</b>									
PS1	Matter and Its Interaction	n/a	n/a		n/a	n/a			
PS2	Motion and Stability: Forces and Interactions		n/a	n/a		n/a			
PS3	Energy		n/a	n/a	n/a				
PS4	Waves and Their Applications in Technologies for Information Transfer	n/a		n/a	n/a		n/a		
<b>Life Science</b>									
LS1	From molecules to organisms: Structures and processes			n/a					
LS2	Ecosystems: Interactions, Energy, and Dynamics	n/a	n/a			n/a			
LS3	Heredity: Inheritance and Variation of Traits	n/a		n/a		n/a	n/a		
LS4	Biological Evolution: Unity and Diversity	n/a	n/a			n/a	n/a		
<b>Earth &amp; Space Science</b>									
ESS1	Earth's Place in the Universe	n/a	✓		n/a		✓		
ESS2	Earth's Systems		n/a						
ESS3	Earth and Human Activity		n/a	n/a					
<b>Engineering, Technology, and Applications of Science</b>									
ETS1	Engineering Design								

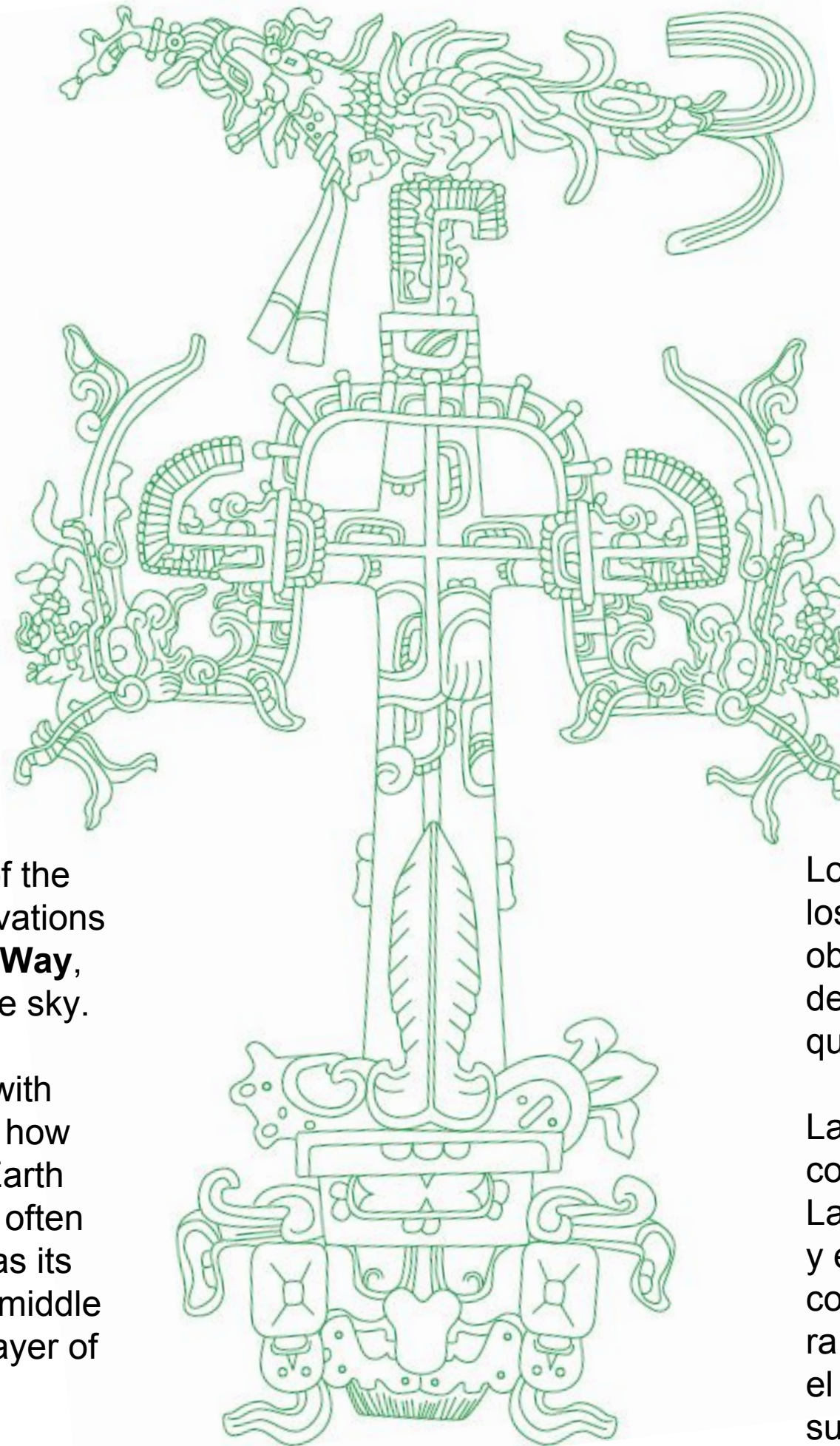
**Thank you to NASA for making the *Lenses on the Sky* project possible!**

*The material contained in this activity is based upon work supported by the National Aeronautics and Space Administration (NASA) under grant award Number NNX15AB03G. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of NASA.*

*Thank you also to the Indigenous Education Institute for allowing us to use images from their book *Sharing the Skies: Navajo Astronomy—A Cross-Cultural View* by Drs. Nancy Maryboy and David Begay as the inspiration for the Diné constellation illustrations.*

# Maya

# Maya



The Maya have been keen observers of the sky for centuries. As part of their observations they track the movements of the **Milky Way**, the dense band of stars that crosses the sky.

Maya people associate the Milky Way with several things, many of which focus on how the Milky Way connects the worlds of Earth and Sky. In particular, the Milky Way is often seen as the **World Tree**—a tree that has its roots in the underworld, its trunk in the middle world, and its branches in the highest layer of the sky.

Los mayas han sido grandes observadores de los cielos durante siglos. Como parte de sus observaciones, han seguido los movimientos de **La Vía Láctea**, la densa franja de estrellas que cruza el cielo.

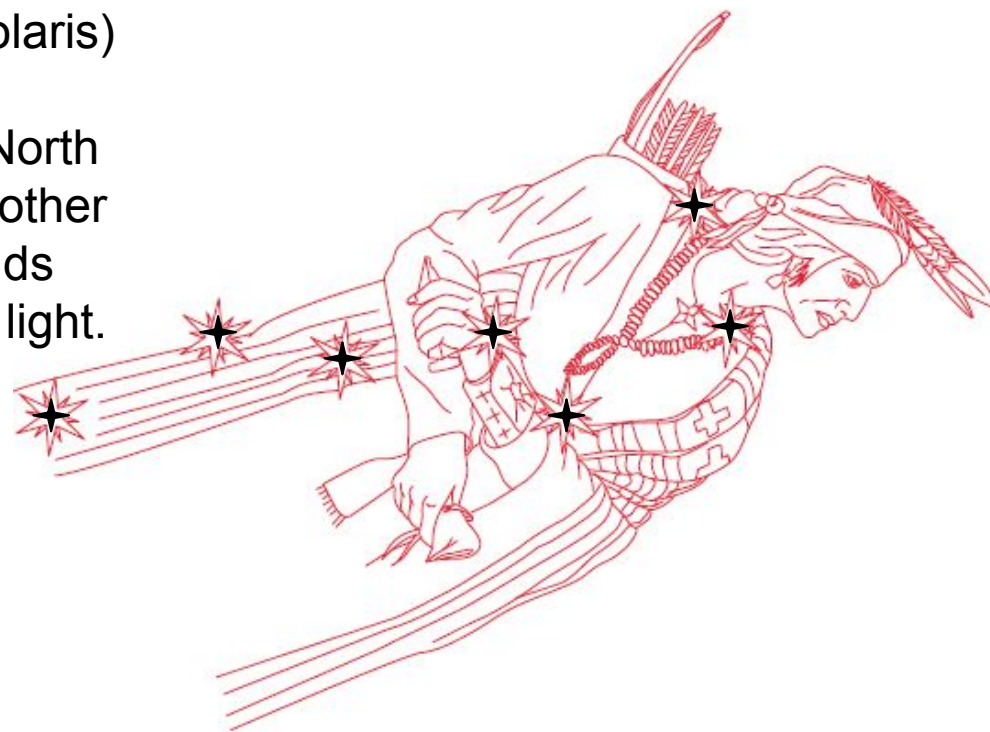
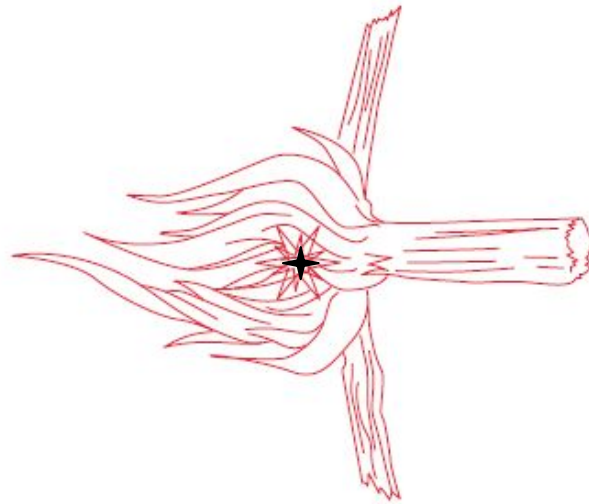
La gente maya asocia La Vía Láctea con varias cosas, y muchas de ellas se enfocan en cómo La Vía Láctea conecta los mundos de la Tierra y el Cielo. La Vía Láctea es vista en particular como el **Árbol Mundial**, un árbol que tiene sus raíces en el mundo subterráneo, su tronco en el mundo medio, y sus ramas en la capa superior del cielo.

# Navajo

For Navajo (Diné) people, the area around the North Star is one constellation with three parts. The **Female Revolving One** (called Cassiopeia by the International Astronomical Union) is considered to be a mother, or grandmother, who shows strength, motherhood, and regeneration.

The **Male Revolving One** (the Big Dipper) is considered to be a warrior, leader, and father (or grandfather). He provides for and protects his family and community.

The **Central Fire** (the North Star or Polaris) connects these two. Like the fire in a traditional Navajo home (hogan), the North Star acts as the center of the sky that other stars move around. The central fire adds stability, security, peace, warmth, and light.



# Navajo

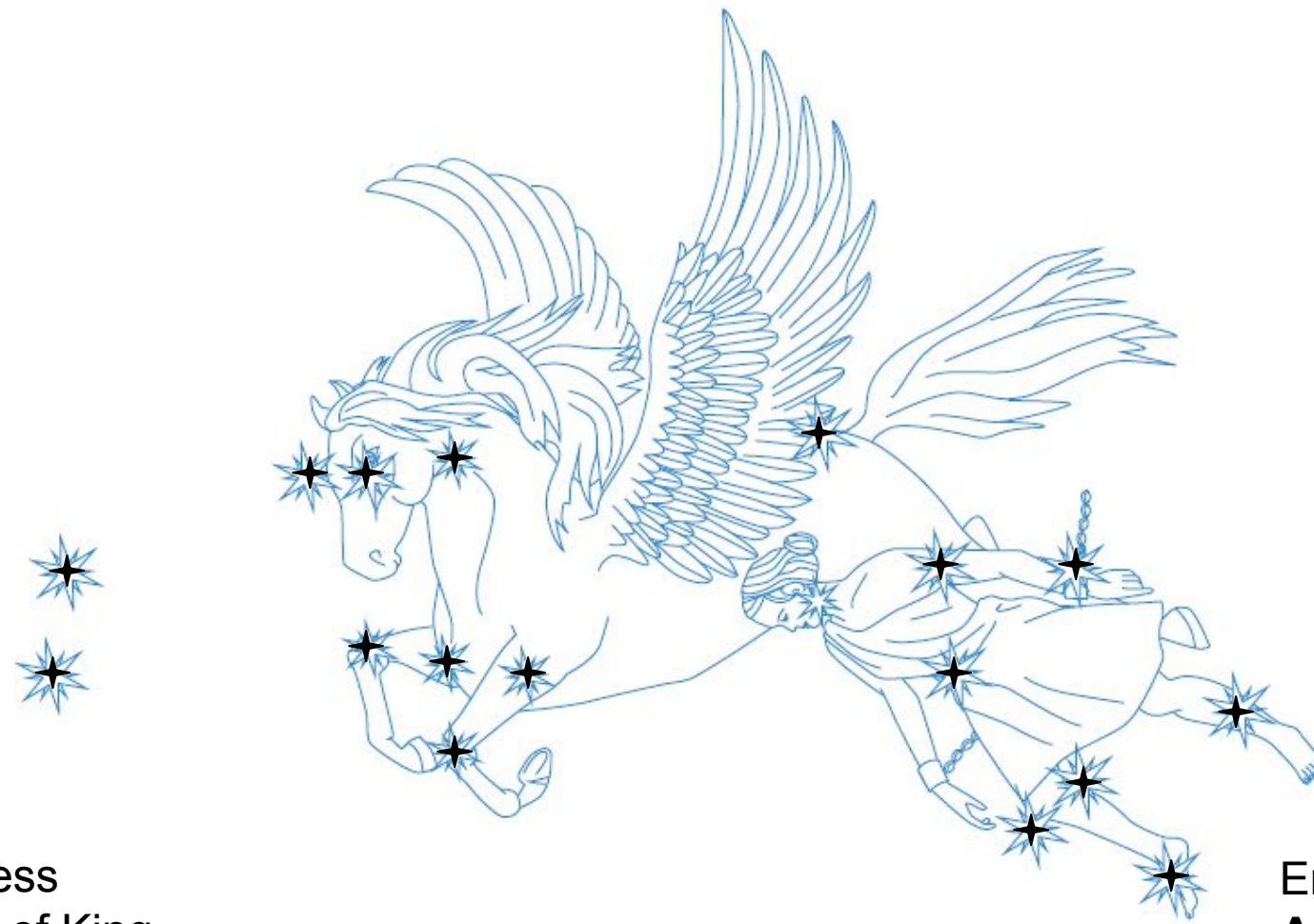
Para el pueblo Navajo (Diné), el área alrededor de la Estrella del Norte es una constelación de tres partes. **La Parte Rotatoria Femenina** (conosida como Cassiopeia por la Unión Astronómica Internacional) es considerada una madre o abuela que muestra fortaleza, maternidad y regeneración.

A **la Parte Rotatoria Masculina** (la Osa Mayor) se le considera un guerrero, un líder y un padre o abuelo. Ampara y protege a su familia y comunidad.

**El Fuego Central** (Polaris, o la Estrella del Norte) conecta a ambos. Tal como el fuego en un hogar navajo tradicional (hogan), la Estrella del Norte actúa como el centro del cielo alrededor del cual giran las otras estrellas. El fuego central añade estabilidad, seguridad, paz, calor y luz.

# Greek

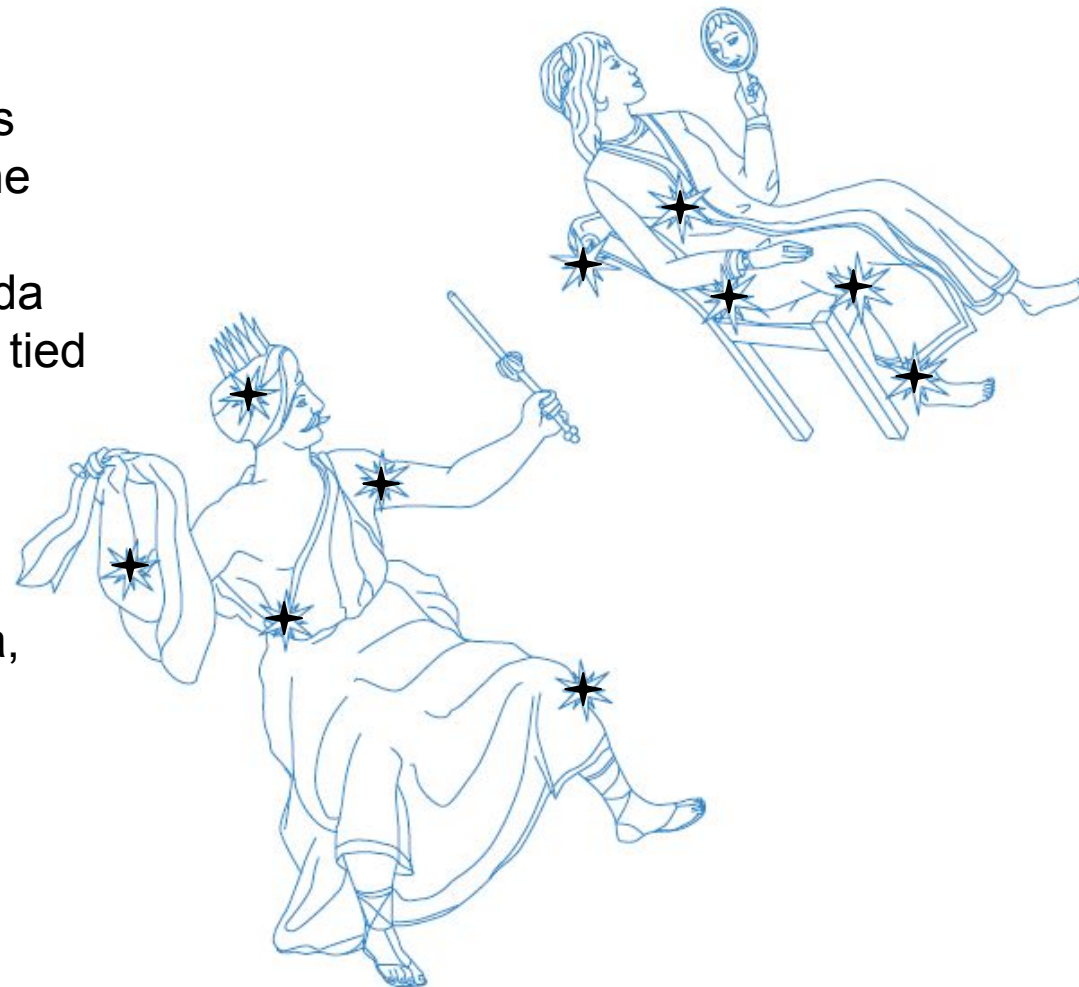
# Griego



In ancient Greek stories, princess **Andromeda** was the daughter of King **Cepheus** and Queen **Cassiopeia**.

Cassiopeia bragged that Andromeda was more beautiful than the gods. Insulted, the gods sent a sea monster to terrorize the kingdom. To stop the monster, Andromeda had to be sacrificed. So Andromeda was tied to a rock on the shore.

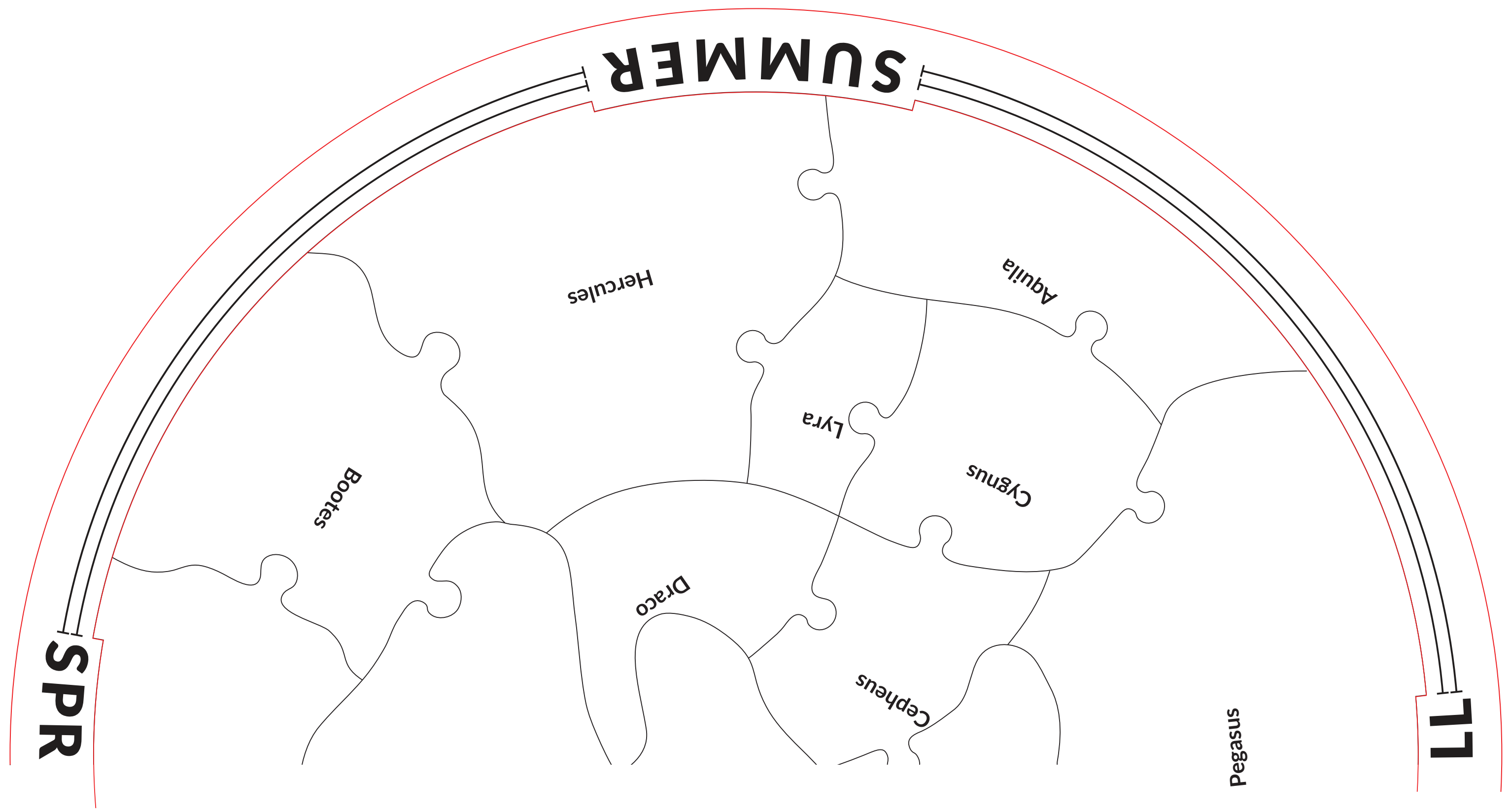
As she waited for the monster, the hero Perseus flew by on his winged horse, **Pegasus**. He fell in love with Andromeda, and rescued her.



En la antigua Grecia, la princesa **Andrómeda** era la hija del Rey **Cepheus** y de la Reina **Cassiopeia**.

Cassiopeia presumía que Andrómeda era más bella que los dioses. Los dioses se ofendieron y enviaron un monstruo de agua para aterrorizar al reino. La única forma de detener al monstruo era sacrificar a Andrómeda, por lo que fue atada a una roca a la orilla del mar.

Mientras Andrómeda esperaba al monstruo, el héroe Perseus pasó volando en su caballo con alas, **Pegasus**. Se enamoró de Andrómeda y la rescató.



**SUMMER**

Aquila

Cygnus

Lyra

Hercules

Draco

Cepheus

Bootes

**SPR**

**11**

Pegasus





