Astronomy Adventures

Age Range:
9+ years old

National Science Education Standards:

Unifying Concepts and Processes:
K-12: Systems, order, and organization
K-12: Evidence, models, and explanation

Earth and Space Science:
K-4: Objects in the sky
K-4: Changes in the earth and sky
K-4: Properties of Earth materials
5-8: Structure of the earth system
5-8: Earth in the solar system

Science as Inquiry:
K-12: Abilities necessary to do scientific inquiry
K-12: Understandings about scientific inquiry

Approximate Time Required for Session:

2 hours

Purpose:

- To learn about objects and bodies in our solar system.
- To learn to use a sky wheel to locate constellations.
- To learn that celestial bodies have properties and patterns of movement that can be observed and described.

Overview of Activities:

In this session, campers will have fun learning about our solar system. In Activity A: What's Up?!, you will lead a group discussion about the objects and bodies in our solar system. Using a set of Astronomer's Clues, campers will design a map of our solar system. In Activity B, campers will engage in a traditional camp favorite: star gazing. Campers will first assemble a sky wheel and learn to use this tool. They will then go on a night hike and use the sky wheel to locate constellations.

Background Information for Facilitator:

The universe is so large that scientists have yet to discover everything out there and they probably never will! There are many solar systems. Our solar system includes the sun, eight planets, five dwarf planets including Pluto, and many moons, stars, and other small bodies such as comets, asteroids, and meteoroids.

Our solar system is dominated by the sun. The sun is an average, though enormous, star that provides the light and heat necessary to maintain livable temperatures on Earth. The sun is the only star in our solar system.

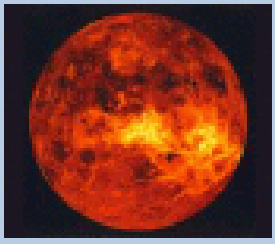
Background Information Continued:

The planets in our solar system are shown in the panels (ordered from closest to farthest from the sun). The four inner planets—Mercury, Venus, Earth, Mars—are closest to each other and the sun. They have a hard, rocky surface, and spacecrafts can land on them. The remaining planets—Jupiter, Saturn, Uranus, Neptune—are called outer planets. They are farther from the sun and each other. They are much bigger than the inner planets. These giant planets do not have solid surfaces; they are mostly composed of gases. All eight planets orbit the same sun, a star whose extreme brightness is due to its close proximity. The planets' characteristics, such as their orbit time and temperature, are indicators of their distance from the sun. For example, the Earth spins on its axis 180° every 24 hours (a day) and takes approximately 365.24 days (a year) to orbit the sun.

Our solar system is part of the Milky Way galaxy, which has a spiral shape. There are millions of stars in this galaxy. Like the sun, each star is a very, very hot ball of gas. Each star is unique; they differ in color, size, shape, age, and brightness. Some stars actually give off more light than the sun, but they are thousands of light years away from us. Stars appear to twinkle because we are viewing them through the turbulent air in the atmosphere. (Planets, however, don't twinkle because they are larger and are closer to Earth.) Believe it or not, stars have a lifecycle, just like us! Every star will explode, and yes, that includes our sun.

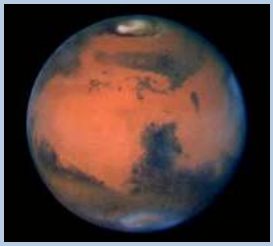
Long ago, sky watchers thought that certain groups of bright stars formed patterns that resembled outlines of animals, people, and other objects. These sky watchers named the star clusters after characters from Roman and Greek mythology. These groups of stars are called constellations. There are 88 constellations recognized by astronomers today.

Mercury



Venus

Earth

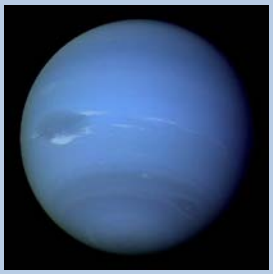


Mars

Jupiter

Saturn

Uranus



Neptune

Background Information Continued:

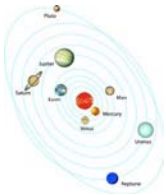
Comets, asteroids, meteoroids, and moons also occupy the night sky. Comets can be described as "dirty snowballs" that orbit the sun. The center (nucleus) is composed of ice, rock, dust, and frozen gases. When a comet gets near the sun it becomes visible, primarily because of the effect of the sun's heat and light on the center. We see a large bright light of dust and gas vapors (called the coma or atmosphere) and tails created by the solar wind.

Asteroids are small rocky bodies that orbit the sun. They are mainly found in the asteroid belt between Mars and Jupiter.

Meteoroids are dust particles or rocks from other celestial bodies. When they enter the Earth's atmosphere, they burn up! We refer to this brief streak of bright light as a "shooting star." Falling meteoroids are also called meteors. Some, called meteorites, make it all the way to the Earth's surface. Meteorites cause craters when they land, which is why the surface of many solar objects appears bumpy.

There are also many moons in our solar system. Earth has one moon. The moon appears to change shape depending on which part is illuminated up by the sun (lunar phases). The moon has a rocky surface and lots of craters because it doesn't have an atmosphere to prevent meteorite strikes.

There are also man-made objects in space, such as planes, spacecrafts, and satellites. Man-made satellites are made of metal. They are launched into Earth's atmosphere and orbit around us. They transmit information from space back to us. They tell us about the weather, let us make long distance calls, and even allow us to watch television and listen to music!



Activity A: What's Up?!

Approximate Time Required for Activity:

1 hour

Suggested Groupings:

Large groups of up to 20
Smaller groups of 4-6

Introduction:

In groups, campers will observe, identify, and discuss objects and bodies in the sky. They will then use a set of clues to construct a map of the solar system. This map will assist them on their journey into outer space!

Materials Needed:

- "Astronomer's Clues to the Solar System" sheets – found in appendix
- Envelopes (any size)
- Long sheets of paper (e.g., butcher paper)
- Scissors
- Scotch tape and/or glue or glue sticks
- Construction paper (misc colors)*
- Aluminum foil*
- Markers, crayons, colored pencils*
- Glitter*
- Other objects found in nature (e.g., rocks, dirt)*
- Flip chart paper and markers for each large group to list objects and record responses

4-H SET Abilities:

- Problem Solve
- Infer
- Draw/Design
- Compare
- Demonstrate/ Communicate

Tips!

Allow campers to gather their own natural materials from the surrounding environment to construct their map (e.g., rocks, dirt).

A key to the clues can be found in the appendix.

*This is a suggested list. Gather enough materials for campers to make their map and have fun being creative!

Tip!

Remember to encourage lots of exploration. Avoid answering questions. Ask questions to help campers discover their own answers.

Preparation:

1) Read the background information.
2) Review the activity and try to make your own map.
3) Determine the size and number of large and small groups. Assign at least one trained facilitator to each large group and if possible each small group.
4) Identify a location for the activity; you will need a large space for the large group discussions and preferably tables for the small groups to construct their maps.
5) Copy and cut out the "Astronomer's Clues to the Solar System." For each small group, place a complete set of clues (#1-13) in an envelope.
5) Gather the rest of the materials and put them in a central location. Make sure you have enough materials for each small group.
6) Put flip chart paper and a marker at each location for the large group discussions.

Introduction and Opening Questions (10 minutes):

1) Gather the campers. Explain to the campers that they are now all Astronomers and will soon be blasting off into outer space to explore! Before blasting off they will use a set of clues to design a map of the solar system to assist them on their journey. First, let's investigate what we already know about the solar system.
2) Divide campers into groups of about 20 people. Each group should have at least one trained facilitator.
3) Have campers discuss the objects or bodies that make up our solar system. The facilitator should record responses on the flip chart paper provided. Some questions to ask include:
   - What do you know about outer space?
   - If you took a trip to outer space, describe what you would see. Lead a short discussion about what they know about the objects or bodies named.

- Is there anything you would like to know more about?
- How could you find out more information?
- Has anyone looked through a telescope or been to a planetarium? Tell us what you saw or learned!

Experiencing (30 minutes):

1) From the larger group form smaller groups of 4-6.
2) Have each small group come up with a name for their space craft!
3) Give each group a large piece of butcher paper to draw/design their map and an envelope containing a set of "Astronomer's Clues to the Solar System."
4) Tell them to use the clues to construct the map. Read each clue carefully and try to figure out what the object is and where it belongs in the solar system. Each clue describes an object that should be included in the map.
5) Ask campers to select the materials they will need to make the map. They may also use materials found in nature. Remind them to think about the properties of the different objects described in the clues (e.g., size, color, texture) as they select their materials and draw/design their map.
6) Allow campers 25 - 30 minutes to design and construct the map.

Sharing, Processing, & Generalizing (20 minutes):

After each group completes their map of the solar system, gather all the small groups together to form the larger group of 20 for the rest of the activity. Have each group share the solar system map they constructed. Some questions to ask include:

- Explain what objects you included in your map.
- Describe the process that led to your group's decision about where to place the objects or bodies? How did the clues help you figure out where they should go?

Tips!

The clues will help campers determine the relative position of objects. For planets, the temperature and length of a year (how long it takes the object to orbit the sun) are key pieces of information. The longer the year and the colder the object's surface, the farther it is from the sun.

Campers may struggle with the clues. This is not a bad thing. Avoid giving them answers. The process is most important part of the activity.

Sharing, Processing, & Generalizing Continued:

- Discuss why you drew or represented each object as you did. For example: Why did you choose the color(s) you did for each object? Why did you select the material(s) you did for each object?
- Share any clues that were particularly difficult to solve. How did you figure them out?

After each group shares, ask campers:

- Compare all the maps. Discuss what is similar? What is different?
- Correct any misrepresentations or disagreements.
- Are there any remaining questions you have about objects or bodies in the sky or solar system? Discuss!

Taking it One Step Further:

1) To integrate technology and enhance the learning experience, do Activity A after observing the night sky with telescopes or binoculars. Have campers describe what they see. Some questions to ask are:
   - Compare what you can see using telescopes/binoculars with what can be seen without them.
   - Are there any objects and bodies that you cannot see with telescopes/binoculars? Why?
   - What can be learned from these technologies? Explain what you learned.
2) Take a trip to a planetarium. Discuss what new information was learned.

Activity B: Star Gazing

Approximate Time Required for Activity:

30 minutes for daytime portion
30 minutes for nighttime portion (not including hiking time)

Suggested Groupings:

Large groups of up to 20
Smaller groups of 4-6

Introduction:

All of the stars you see at night are within our galaxy – the Milky Way galaxy. In this activity, campers will learn more about stars and our galaxy. They will make a sky wheel and learn to use this tool to locate constellations. Campers will have fun applying this knowledge while on a night hike.

Materials Needed:

- Sky wheel for each camper (includes both star wheel and star holder) – found in appendix
- Scissors
- Scotch tape
- Red plastic or fabric
- Rubber bands large enough to fit around a flashlight
- Flashlights

Preparation:

1) Read the background information.
2) Review the activity and gather materials ahead of time.
3) Make a copy of the star wheel and sky holder for each camper.

4-H SET Abilities:

- Use Tools
- Infer
- Hypothesize
- Observe
- Collaborate

Tip!

To use the sky wheel:
- Rotate the star wheel until the time and date line up.
- Hold the sky wheel in front of you.
- Locate the constellation you want to find. Identify the horizon it is closest to.
- Turn the star holder so that horizon is at the bottom.
- Keep the sky wheel in the same position and lift it over your head. The view displayed is what you should see at night.

Preparation Continued:

4) Decide on the size and number of small groups.
5) Make a red-filtered flashlight for use on the night hike. Each small team (4-6 campers) will need one. Take a piece of red fabric or plastic and place it over the end of the flashlight and secure it with a rubber band.
6) You will need to allot some time during the day for campers to make the sky wheel as well as some time at night for campers to use it to locate constellations.
7) Decide on a spot for the star gazing portion of Activity B. A night hike is fun but not necessary. Any spot with a good view of the night sky will suffice.

Introduction and Opening Questions (5 minutes):

1) Explain to campers that they are going to make a sky wheel to use on a night hike.
2) Divide campers into groups of about 20 people. Each group should have at least one trained facilitator.
3) Ask Campers:
   - Have any of you made a sky wheel before? If so, ask them to share their experiences. Where were they at, what did they do with the sky wheel, how did they use the sky wheel?
   - What if we went on a night hike, how could we use the sky wheel?

Experiencing – Daytime (15 minutes):

1) In the same groups, have each camper make a sky wheel. The complete sky wheel has two components: The star wheel and the star holder.
   - First, create the initial star wheel: Cut along the black dashed line.
   - Next, make the star holder: Cut along the black dashed line that outlines the times, making an oval shaped hole in the center. Fold the bottom section

up along the dashed line and tape the edges together to form a pocket.
- Place the star wheel into the star holder. The constellations should show through the oval window.

2) After the sky wheel is made, allow campers 5-10 minutes to explore it and discover how to use it to locate constellations.

Sharing, Processing, and Generalizing I (10 minutes):

- Have campers form small groups of 4-6
- Discuss what constellations they will see on their night hike. They will need to know the date and time of the night hike.
- Discuss how the night sky would change if they went on the night hike three hours later. What about three months later?
- Ask campers to form a hypothesis about why these changes occur. Share.
- Have each camper identify on the sky wheel which constellation they want to find while on the night hike. Ask them to guess how high in the sky they think it will be.
- Remind campers to keep the sky wheel in a safe place as they will use the sky wheel while on a night hike.

Experiencing – Nighttime (20 minutes):

1) Before starting on the night hike, have campers pair up in small teams of 4-6 campers. These do not need to be the same teams formed for the daytime part of the activity.
2) Explain to campers that we are going on a night hike. During the night hike they will try to locate each of their teammates' constellations.
3) Give each small team a red-filtered flash light.
4) Take the campers on the night hike.
5) Give campers 20 minutes to investigate the night sky and find each others' constellations.

Tips!

Avoid answering questions. Ask questions to help campers discover their own answers.

Constellations closer to the center of the sky wheel will be higher in the sky than constellations closer to the horizon.

Bright light causes the pupils to contract, so illuminate the sky wheel with a red-filtered flashlight. The softer red light will preserve your night vision.

Tips!

A good book for further exploration is *Constellations: A Glow-in-the-Dark Guide to the Night Sky* by Chris Sasaki.

The program is FREE and easy to use!!

Sharing, Processing, and Generalizing II (10 minutes):

Bring small groups together to form a larger group of approximately 20 for the rest of the activity. Each large group should have at least one trained facilitator. Before hiking back to camp, ask the campers:

- Were you able to find all the constellations you looked for? If not, why do you think you were not able to find some?
- How accurate was the sky wheel? Discuss whether it was easy or difficult to find constellations using the sky wheel.
- Discuss how you might use the sky wheel in your life.
- How might you use the sky wheel if you got lost at night?
- How do you know you are looking at a star and not other objects in the sky, such as planets, planes, satellites, meteors, comets, or another galaxy?
- Discuss how what you see in the night sky at camp compares to what you see at home. Discuss what might impact the ability to see objects or bodies in the night sky.

Taking it One Step Further:

1) Learn more about the Greek and Roman mythology behind the constellations. Tell stories while sitting in front of the camp fire or even on your night hike.
2) Observe the night sky in greater detail. Download: http://files.uberdownloads.com/apps/Stellarium/index.php and use it to enhance this activity. You can use it along with the sky wheel to locate and learn more about constellations and other objects in the night sky.

Bibliography

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Astronomer's Clues to the Solar System

CLUE 1

I am made up of gases, mostly hydrogen. My light takes 8 minutes to reach Earth! I have been providing heat and light for nearly 5 billion years and scientists believe I have enough hydrogen in my core to "burn" for 5 billion more years. I am not the biggest star in the sky, but I am the only star in our solar system. What star am I? _____ Where am I in the solar system?

CLUE 2

I am bits and pieces of rock that orbit the sun. Most of us are in a large belt between the biggest planet and the planet most likely to support life (other than Earth)! Some believe I am left over from when our solar system formed – nearly 5,000 million years ago. What am I? _____ Where might you find me?

CLUE 3

I have a rocky crust and a solid metal core. I am colorful and full of green spaces, deserts, deep oceans, and fields of ice. I spin around once (rotate) every 24 hours, which is one day for me! I travel (orbit) around the sun once every 365.24 days. I have seasons because my tilt. I do not have extreme temperatures. My atmosphere is made up of mostly oxygen and nitrogen and helps keep my temperature fairly steady. I have one moon. Who am I _____ and where am I in the Solar System?

CLUE 4

I am the Greek god of the sky. I have 11 rings! It is believed my rings were formed when a large object collided with me millions of years ago. This knocked me completely on my side. I have a small rocky core. My atmosphere is composed of mainly hydrogen gas and helium that gives me my color. I have dense clouds that cover my surface, I am very cold, and I have strong winds. My day is 17.9 hours and my year is equal to about 84 Earth years. I have 27 known moons. I am _____. Where am I in the solar system?

CLUE 5

I am the smallest of my kind and have no moons. My surface is rocky and I have a lot of craters from meteorites hitting me; I don't have much of an atmosphere. It is terribly hot here during the day and extremely cold at night. My days are long (58.6 Earth days). My year is short compared to others like me (88 Earth days), which is why the Romans named me after their quick-footed messenger god. Scientists say that life cannot exist here because there is no water and the gases are not the kind living things need to survive. Who do you think I am _____ and where am I in the solar system?

CLUE 6

I am named after the ruler of the Roman gods. I am the largest of my kind. I have 1 ring. I am composed mostly of gases – hydrogen and helium. I have big storms; in fact, one has been raging for more than 300 years. I am covered by constantly moving clouds that are hundreds of miles thick and made of hydrogen gas. The temperature above my clouds is very cold and my center is very hot. My day is just 9.8 hours. My year is equal to 11.86 Earth years. I have the most known moons of all (63). Guess who I am._____ Where am I in the solar system?

CLUE 7

The Romans named me after their goddess of love and beauty. I am one of the brightest objects in the night sky because I am very close to Earth. I am also the hottest of my kind. My days are really long (243 Earth days) and it takes me 224.7 Earth days to orbit the Sun. I have a cloud layer, but because I have very little water, my clouds are made of sulfuric acid. Below my cloud layer is a very thick atmosphere mainly made up of other gases – carbon dioxide and nitrogen. I don't have any moons. Do you know who I am? _____ Do you know where I am in the Solar System?

CLUE 8

I am named after the Roman god of farming. I am the second largest of my kind. I am an amazing sight with over 1000 rings that are mostly ice. My core is made of rock and ice, but I am mostly hydrogen and helium. My temperatures are cold - normally about –185°C. Bands of clouds circle me. My winds are among the fastest in the solar system. My day is 10.2 hours and my year is equal to 29.4 Earth years. I spin so fast that the gases in my atmosphere are flung out toward my equator creating the bulge shape I am known for. I have at least 56 known moons; some say 61. Who am I? _____ Where am I in the solar system?

CLUE 9

I am named after the Roman god of the sea. I have the strongest, most frigid winds ever measured, along with fierce storms and giant hurricanes. My dark spots are thought to be gigantic storms. I have poisonous streaky white clouds of methane ice. My atmosphere contains methane, hydrogen, helium, and water. Beneath my thick, cloudy atmosphere is molten rock, water, liquid, ammonia, and methane. My outer atmosphere is one of the coldest in the solar system (-218°C), but my center is as hot as the Sun's surface (7,000°C). Many are surprised to find out that I have 5 rings! One day for me is 19.2 hours and one year is 164.79 Earth years. I also have 13 known moons. Who could I be? _____ Where am I in the solar system?

CLUE 10

I am named after the Greek and Roman god of the underworld. I am small and cold. My day is 6.4 Earth days, and my year is 248 Earth years. My orbit is different than those of the planets, so sometimes I am closer to the Sun than at other times. I have a rock core and the rest of me is about 98% nitrogen with traces of methane and carbon dioxide. When I move toward the sun, some of these materials turn from solid to gas and an atmosphere appears! I have 3 known natural satellites (moons). I used to have more status!!! Who am I? _____ Where am I in the solar system?

CLUE 11

I am often described as a "dirty snowball." As the name implies, I am made of ice, rock, dust, and frozen gases. When I get near the sun during my travels, you can see me. Some think that when I struck Earth I provided the elements necessary for the emergence of life (i.e., carbon, hydrogen, oxygen, and nitrogen). What am I? _____ Where might you see me?

CLUE 12

Because of my color, the Romans named me after their god of war. I appear bright in the night sky because I am close to Earth. I have clouds, fog, volcanoes, lava fields, canyons, craters, icecaps, and lots of dusty soil that is full of iron. Today, I don't have water flowing on my surface, but once upon a time I did. Scientists think I may have seasons and may be able to support life! I have two known natural satellites (moons). One day for me is about 24.6 hours and it takes me nearly 687 Earth days (1.9 years) to orbit the Sun. Who am I? _____ Where do you think I am in the solar system?

CLUE 13

My more common name is a "shooting star." I am made up of dust particles or rock from other bodies. Sometimes I make it through a planet's atmosphere all the way to its surface. I create craters! What is my more technical name _____ and where might you find me in the solar system?

Key: Astronomer's Clues to the Solar System

CLUE 1: SUN, CENTER OF OUR SOLAR SYSTEM

CLUE 2: ASTEROID
- ORBITS THE SUN.
- MAINLY FOUND BETWEEN THE ORBITS OF MARS AND JUPITER IN A REGION CALLED THE ASTEROID BELT.

CLUE 3: EARTH, 3RD PLANET FROM THE SUN

CLUE 4: URANUS, 6TH PLANET FROM THE SUN

CLUE 5: MERCURY, 1ST PLANET FROM THE SUN

CLUE 6: JUPITER, 5TH PLANET FROM THE SUN

CLUE 7: VENUS, 2ND PLANET FROM THE SUN

CLUE 8: SATURN, 6TH PLANET FROM THE SUN

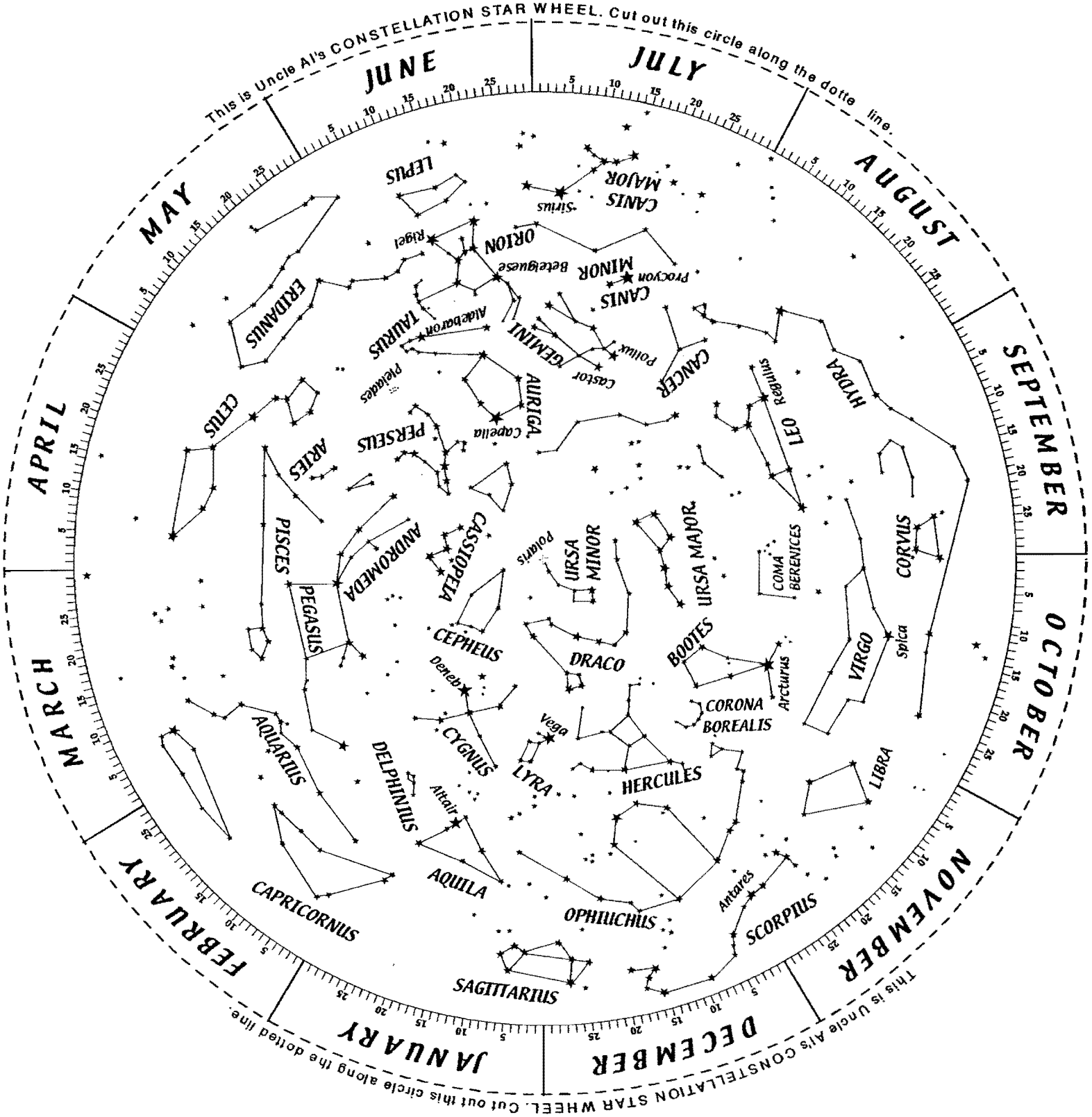
CLUE 9: NEPTUNE, 7TH PLANET FROM THE SUN

CLUE 10: PLUTO, FURTHEST (FORMER PLANET) FROM THE SUN

CLUE 11: COMET, ORBIT THE SUN

CLUE 12: MARS, 4TH PLANET FROM THE SUN

CLUE 13: METEOROID, METEORITES, METEORS
- METEOROIDS FLOAT AROUND IN THE SOLAR SYSTEM.
- SOME FALL INTO THE EARTH'S ATMOSPHERE AND WE SEE A BRIGHT STEAK OF LIGHT ACROSS THE SKY. THESE ARE CALLED METEORS.



INSTRUCTIONS FOR ASSEMBLING UNCLE AL'S STAR WHEELS

Step 1: Print out all pages. Paste them onto a file folder or any other sturdy piece of paper or cardboard.

Step 2: Cut along all the black dashed lines on the Star Wheel and Star Holder printouts. On the "Star Holder" remove the interior of the oval shape and the cardboard above the hour labels

Step 3: On the "Star Holder", fold the cardboard along the dotted line.

Step 4: Tape or staple the edges together forming a pocket.

Step 5: Take your printed and trimmed star-wheel, and place it inside your newly made STAR HOLDER.

Uncle Al's HOU Sky Wheels are based on LHS Sky Challengers created by Budd Wentz and available through LHS Museum Store.
(510) 642-1016) http://www.lhs.berkeley.edu/pass/ast110&111&121.html

Instructions for Using Uncle Al's Star Wheels

1. Align your date and time, and then look up at the sky
2. Locate the constellation you want to find on the map.
3. Turn your map so the horizon it is closest to is at the bottom.
4. The star positions in the sky should match those on the wheel!