

**Part 2**

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**K-6 Activities and Lessons  
for Use in the  
STARLAB Portable Planetarium**

*Compiled, edited and revised  
by Joyce Kloncz and Gary D. Kratzer*

# Tips On Using STARLAB

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by Joyce Kloncz

The first time you use STARLAB is an exciting event! If you are using it as a classroom teacher or as a planetarium director, you'll want to make sure you are prepared for your students before you begin. Here are some ideas that have been used in the past for a successful STARLAB program.

1. Try to set up STARLAB a day ahead of time so you are ready and comfortable before the children come. After following the set-up directions in the front of the Set-up/Operation section, take some time in STARLAB preparing for your first visitors.
2. Find some interesting planetarium music to play when your students arrive. (A favorite of my school children is "Celestial Soda Pop" by Fresh Aire VI – Orpheus).
3. Plan some classroom management techniques for students. It is important that they know your expectations in advance. In a dark classroom like STARLAB, it's important to be consistent, but caring!! Here are some tried and true techniques:
  - Make sure there are two adults to maintain safety
  - When entering STARLAB, have two children hold the door flaps open.
  - Set a small fluorescent lantern in the doorway (available from Radio Shack).
  - The teacher should go in first, turn on the projector side lights, and have the children follow in single file.
  - Have the students sit completely around the inside edge of the STARLAB floor, "on their pockets," but not up against the STARLAB wall. This is their seat for the duration (I suggest that teachers shouldn't allow seat-changing while in STARLAB).
  - Make sure the students don't block the inflation/ventilation tube.
  - Have a red flashlight available that will help to spot any problems.
  - When leaving, the teacher should be the last one out.
4. Look through the cylinder information and decide in advance what you will do. If you are going to be taking children into STARLAB only once, plan a lesson that will be easy to do. For instance, show the Greek Mythology Cylinder and tell the stories about four easy-to-find constellations, such as Orion, Big Bear and Little Bear, and Cassiopeia. (See the Greek Mythology Cylinder section). Then show the Constellation Cylinder and with an arrow pointer, show the students where those four constellations are on that cylinder. Next, show the Starfield Cylinder and point out the same four constellations. Have children look carefully at the night sky, then close their eyes and imagine what the constellations look like. When they open their eyes, see if they can still find the constellations. With older students, have them use the star maps and arrow pointers with teams of students to find the constellations. If you can accomplish all of this, the students will have had a wonderful introduction to STARLAB.
5. When you take students in again, add some constellation stories to the ones you told the first time. If time allows, show the Earth Cylinder (see the Earth Cylinder curriculum section) or other cylinders. Try some activities from your Planetarium Activities for Student Success (PASS) volumes — see pages 36, 37 in this section for a series description. (Did you remember to send in your Product Registration form to receive these free volumes?)
6. It's important that the students realize that you are learning along with them. If they ask you questions that you can't answer, simply tell them that you'll find the answer together. Don't think that you have to know all of the answers the first time in STARLAB. Your confidence will grow each time you are in STARLAB.

# Pre- and Post-STARLAB Activities

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## Overview

Listed below are some activities which can be done by the classroom teacher either prior to or after being in STARLAB. Complete lessons follow in this K-6 section.

### Lessons for Grades K-3

1. Do the "Horizon Lesson for Primary Grades" on page 6 to show young students how the horizon goes all the way to the ground.
  - Make your own constellations from bleach-spotted tissue paper.
2. Do the "How to Make Constellations Pictures" lesson on page 17.
  - Punch the holes of one constellation through aluminum foil and a star map, then put foil on an overhead projector and have kids guess which constellation it is.
  - Punch holes through a star map in the bottom of a film can. Look at the constellation through light. (Film cans are free at film processing firms.)
3. Use the seasonal Star Maps to learn constellations on pages 38-43.
6. Do the "Circle Puzzle," "Dots Puzzle," and "Create a Constellation" lessons (pages 23-28 of PASS Volume 5, *Constellations Tonight\**) to show students how ancient Greeks and Romans came up with the constellations.

### Lessons for Grades 4-6

1. Do the "Meteoroids & Craters" experiments from PASS Volume 7, *Moons of the Solar System*, pages 25-26.
2. Do the Oobleck experiment (from *Oobleck: What Do Scientists Do?* in the GEMS series — see resource list on page 45 for purchasing information).
3. Make a Star Clock using the template on page 8 of this section (from *Earth, Moon and Stars* — GEMS).
4. Send seasonal Star Maps home with your students so that they can practice finding constellations and planets with their parents. See templates on pages 38-43.
5. Do the "What Are Your Ideas About the Earth?" worksheet to find out about students' misconceptions about our earth (from *Earth, Moon and Stars* — GEMS).
6. Make polystyrene "moon balls" to show the moon's phases. (See PASS Volume 7, *Moons of the Solar System*).
7. Encourage students to track the moon's phases and locations for a month.
8. Make a Moon Phaser (see page 9).

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#### Note

\* One set of the 12-volume PASS series is sent to you free when you return your Product Registration form. If you haven't already received a set with your system, make sure to send in your form!

Additional sets can be ordered through Learning Technologies, Inc., by calling 800-537-8703 or 617-628-1459.

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# Sample Scope and Sequence

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The following scope and sequence for elementary grades has been used successfully for many years by classroom teachers. It allows a natural growth of concept-building from year to year, spiraling on skills learned in previous years.

## Kindergarten

1. In the classroom, discuss how the early Greeks and Romans saw constellations in the sky. Do "Making Shapes" (PASS Volume 2) and "Create a Constellation" worksheets (PASS Volume 5). Tell the story of Cassiopeia, Cepheus, and Andromeda. Show a large black tag board constellation picture of the Big Dipper, Little Dipper, the "Lazy W," Orion and Canis Major. Explain how their interpretation of the "Lazy W" is just as effective as the Greek mythology story.
2. In STARLAB, ease the students' excitement about being in STARLAB for the first time. Discuss proper seating procedures and behavior expectations. Using the Greek Mythology Cylinder, tell the story of Ursa Major and Minor, Orion, Cassiopeia, Cepheus and Andromeda. Find the above constellations on the Constellation Cylinder. Put on the Starfield Cylinder and look for those constellations.
3. In STARLAB, review the above winter constellations. Use the Greek Mythology Cylinder, Constellation Cylinder and Starfield Cylinder. Show the Earth Cylinder and the Celestial Coordinates Cylinder.

## Grade One

1. In STARLAB, use the Greek Mythology Cylinder to find and tell the stories of Ursa Major and Minor, Orion, Cassiopeia, Cepheus, Andromeda, Canis Major and Minor, Gemini and Taurus. Put on the Constellation Cylinder and locate the above constellations. Tell the story of Orion's four main stars: Betelgeuse, Bellatrix, Rigel, and Saiph. Try to locate the above constellations on the Starfield Cylinder. After leaving STARLAB, hand out winter star maps and give directions on how to use them by discussing the cardinal directions (north, south, east and west). Show the picture of Orion's four main stars.
2. In the classroom, follow the Horizon Lesson (page 6 of this section) by making "bleach" constellations. Discuss day and night, the rising and setting of the sun and moon, and identify the cardinal directions of each. Using Post-its™ and fluorescent markers, make a picture of something you could see on the horizon. Collect for next week. Do the "Make a Daytime and Nighttime Sky" worksheet and the "Day and Night" puzzle sheet (PASS Volume 2). Find or make up constellations on bleach sheets. Hang familiar constellations in classroom.
3. In STARLAB, place Post-it™ pictures of the horizon where students think the horizon will be in STARLAB. Use black lights to show ultraviolet light on Post-its™. Discuss ultraviolet light in the spectrum. Show the Native American Mythology Cylinder and tell the Indian legends of Long Sash, the possum, buzzard and spider, and Big Bear and the Three Indian Braves. Put the Starfield Cylinder on and show how constellations would look from various points on the earth. Demonstrate day and night. If time allows, show the Ancient Chinese Legends or Ancient Chinese Seasons Cylinders.

## Grade Two

1. In STARLAB, using the Greek Mythology Cylinder, review the above constellations but add the stories of Leo the Lion, Auriga the Charioteer, Lepus the Hare, Draco, and the Pleiades. Look at the above constellations using the Constellation Cylinder. Hand out arrow pointers and show their locations. Look at the Starfield Cylinder and try to locate the above constellations. After leaving STARLAB, hand out star maps, and show the proper way to use them discussing the cardinal directions.

2. In STARLAB, use the Earth Cylinder to discuss the global continents. Introduce the concept of longitude by tying it in with time zones (each is 15° of longitude wide on average). Introduce latitude and determine your location's latitude. Use the Celestial Coordinates Cylinder and tie in latitude and longitude with declination and right ascension. Introduce the celestial equator. Show the moon phases on the Starfield Cylinder.
3. In STARLAB, show the Aurora Borealis slides. Using colored chalk and a piece of black construction paper, have students draw what they think the Northern Lights look like. If time allows, show the Native American Mythology Cylinder and review and introduce new stories.
4. In the classroom, make aluminum foil constellations using current star maps. Do the "Circle Puzzle" (PASS Volume 5, *Constellations Tonight*) to recognize that the constellations which they invent can be just as useful as the ancient Greek and Roman constellations. Do the "Dots Puzzle" (also PASS Volume 5).

### Grade Three

1. In STARLAB, review all of the above winter constellations using the Greek Mythology Cylinder. Introduce the spring constellations of Bootes, Virgo, and Hydra. Run back to back winter and spring star maps. Using star maps, work in groups of four to identify the constellations on the Constellation Cylinder. Put the Starfield Cylinder on and try to locate the winter and spring constellations in the night sky.
2. Do the "Red Planet Mars" lesson (PASS Volume 6) in STARLAB in which children find a "star" much like Mars. See slides of Lowell's study of Mars, and using Exobiology, create a creature that could live on Mars with its conditions of thin atmosphere, cold temperatures, and low gravity.
3. In STARLAB, review the Native American Mythology Cylinder and legends about Native American constellations. Add the legend of the lizard, snake and butterfly. Show the Earth Cylinder. Find the continents and continue the discussion of latitude and longitude and how they relate to the celestial equator. View the African Mythology Cylinder and tell stories from various groups from Africa.
4. In the classroom, make constellation viewers using film containers. Make "Star Clocks." Show the Nightstar Globes to locate constellations.

### Grade Four

1. In STARLAB, review winter and spring constellations using the Greek Mythology Cylinder. Introduce summer constellations of Aquila, Lyra, Cygnus, Scorpius, Sagittarius, Ophiuchus, Hercules, and the Corona Borealis. With the Constellation Cylinder, work in groups of four to locate winter, spring, and summer constellations. Run star maps back to back with winter and summer constellations. Try to locate the above constellations using the Starfield Cylinder.
2. In STARLAB, do "Moons of the Solar System," program (PASS Volume 7) which simulates the process Galileo used to track the four objects near Jupiter. Show slides of other moons in the solar system. Use moon balls to demonstrate phases and eclipses of the moon.
3. In STARLAB, review the Starfield Cylinder by finding winter, spring, and summer constellations. Help students to begin to understand the celestial equator, the zenith and the meridian. To show how stars would appear from the North Pole, set the projector for 90° north latitude. To show how stars would appear from the equator, set the projector for 0° latitude. Discuss the apparent magnitude of stars and do the "Brightness of Stars" worksheet 1 and 2. Follow Activity 6 in Volume 2 of the PASS series — "How Do the Stars Appear to Move?" Introduce the Ancient Chinese Seasons and Ancient Chinese Legends Cylinders and tell stories about their people.
4. In the classroom, make "Moon Phasers" (page 9).
5. In the classroom, do the "Oobleck" lesson (*Oobleck: What Do Scientists Do?* from the GEMS series).
6. In the classroom or outdoors, do "Meteors, Meteorites, and Meteoroids" lesson (PASS Volume 7, *Moons of the Solar System*).

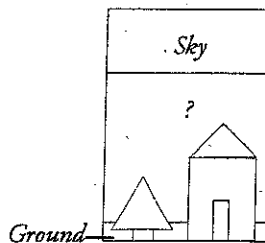
## Grade Five

1. In STARLAB, review the winter, spring, and summer constellations using the Greek Mythology Cylinder. Introduce the fall constellations of Aries, Pegasus, Andromeda, Aquarius, Pisces, and Capricorn. Using the Constellation Cylinder, work in groups of four to find these constellations, plus winter, spring, and summer constellations, using star maps and the arrow pointer. Try to locate as many constellations as possible.
2. In STARLAB, do the "Colors in Space" (PASS Volume 8) lesson, showing how reflection and absorption of colors is used by scientists to determine the composition of stars. Use the "magic cloth" and "color analyzers" to model concepts used by astronomers. Using a prism and diffraction grating, study the spectrum.
3. In STARLAB, show the Aurora Borealis slides, and sketch how they see the Northern Lights over their school. Show the Earth Cylinder to review time zones. Show the Celestial Coordinates Cylinder to discuss right ascension and declination. Review the African Mythology and Ancient Chinese Cylinders.
4. In the classroom, do "What Are Your Ideas about the Earth?" (*Earth, Moon and Stars* — GEMS) to clear up students' misconceptions about astronomy. Use Nightstar Globes to find constellations. Make boric acid crystal pictures of star fields. Make a Star Finder.

# Horizon Lesson for Primary Grades

## Purpose of Lesson

The purpose of this activity is to clear up misconceptions young children have about the horizon and the sky. They will often draw pictures like the one on the right. This activity is designed for classroom teachers who have limited access to STARLAB and/or for planetarium directors to give to classroom teachers in preparation for a planetarium visit.



## MATERIALS

- 1 large 9-foot diameter white circle cut from butcher paper
- 12" x 18" light blue construction paper (one per child)
- 12" x 18" dark blue tissue paper (one per child)
- spray bottle with diluted bleach
- newspapers to cover desk, floor, and/or outside area
- glue sticks
- Post-its™
- pencils
- tag board cut-out of a crescent moon and a sun

## Objectives

1. Students will demonstrate by modeling that the sky around us comes all the way down to the ground.
2. Students will be able to describe the horizon — that place very far away where we see the sky and ground touch.
3. Students will demonstrate by modeling that the sun, moon and stars seem to go above the horizon and sink below the horizon.
4. Using a pointer, students will identify the horizon and cardinal directions in STARLAB and on the paper circle.

## Note

Weather permitting, this activity could be done outdoors.

## Procedure

Students will make sky cards out of 2 layers of paper. Spray diluted bleach onto navy blue tissue paper. (The bleach will make spots that look like stars, so use a spray, not a stream type spray bottle.) Glue tissue paper onto blue construction paper with glue sticks. (Glue only edges of paper.)

Ask: "Where should this large circle be to represent the ground?" After deciding it goes on the floor, ask, "Where does your light blue sky card go?" Most would hold it up in the air.

Ask: "What is in between?" (Air) Discuss possibilities, but come to the conclusion that the sky is air and the air comes all the way to the ground. Have the students place their sky card so that it touches the edge of the ground paper. Discuss that this point is called the horizon.

Ask: "What do we do about all the gaps?" (Because the children are not yet sitting close together.) Tighten the circle so that the sky cards are touching with ground underneath. Redefine horizon.

Ask: "How do we know where to put the sun? Where does it rise and set?" Identify north, south, east and west and label the ground paper with magic marker. Talk about where the sun comes up in the morning and where it sets. Have a child lift and carry the sun to show it rising in the east and setting in the west.

## Procedure

Turn the sky papers around and talk about the night sky. Repeat the process with the moon and identify the horizon.

Ask: "Does the moon only appear at night? Can we ever see it in the daytime?" Of course!

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### Procedure

- Hand out Post-its™, and have the children draw an object that they would see on the horizon, such as buildings, trees, people, etc. Save these notes until the next time they go into STARLAB. Then distribute the notes and have the students place their Post-it™ on the STARLAB wall where they think the horizon is in STARLAB. Put on the Starfield Cylinder to check their answers. If incorrect, reposition their Post-it™.
  - After leaving STARLAB, come back to the ground circle and draw their object on the horizon around the edge. Use the "Do It Yourself Star Finder" (see pages 21, 22) as a guide.
  - On the blue tissue paper sky card, have students find familiar constellations with black fine line markers. Label the constellation name, again using the Star Finder as a guide.
  - On the light blue sky card, have students draw what they would see in the daytime sky: birds, planes, the sun, the moon, etc.
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### Extensions

Write a story about what you imagine the sun does at night for fun. How does it hide? What does the moon do at night? Teach perspective in art and identify the horizon. Draw landscapes. Start with an horizon line and add sky, ground, etc. Take photos of the horizon.



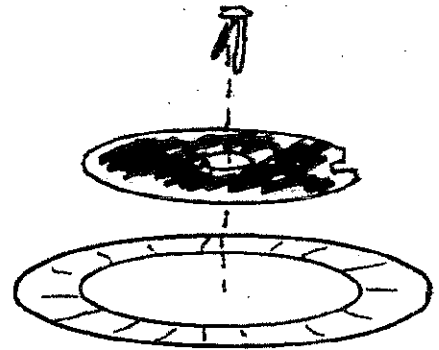
# How to Make a Star Clock

## Instruction Sheet:

### How to Make and Use a Star Clock

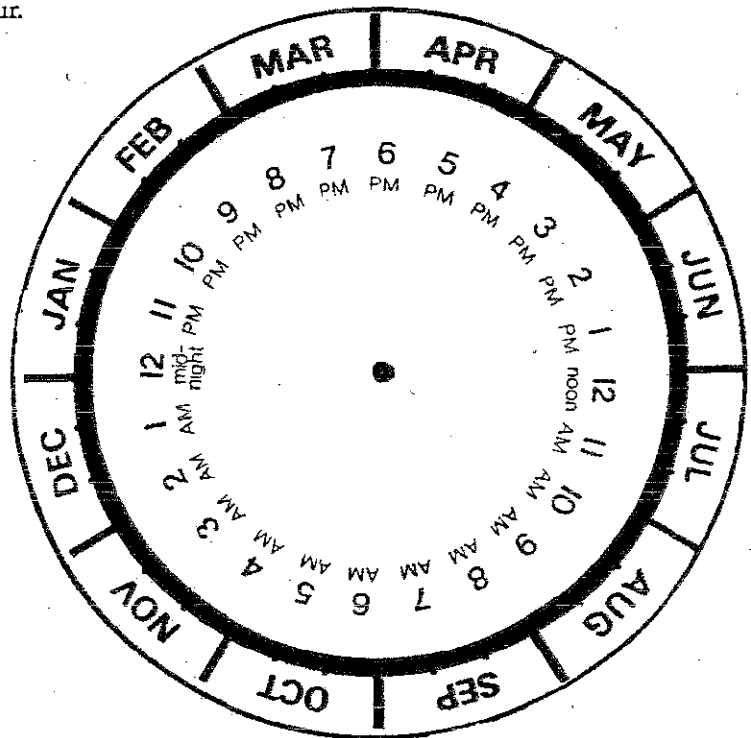
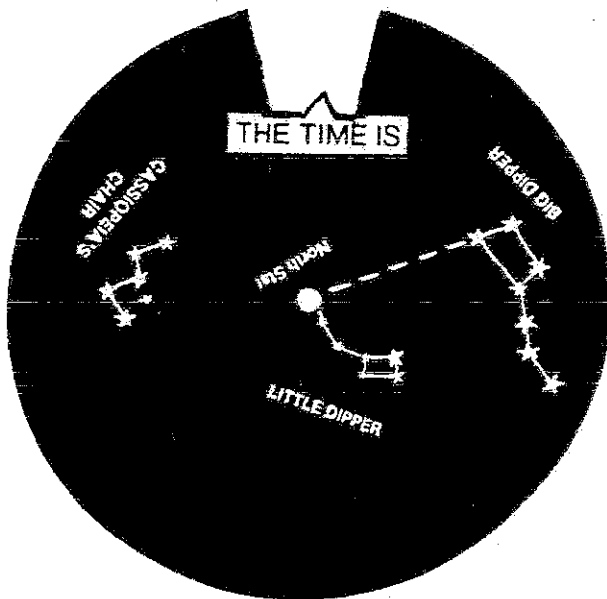
#### Indoors — Making the Star Clock

1. Cut out the two circles with a pair of scissors.
2. Cut out the notch on the small circle.
3. Use a paper punch to make a hole in the center of the small circle.
4. Place the small circle on top of the large circle. Push a large paper fastener down through the center of both circles, and spread open the fastener on the back side of the Star Clock.



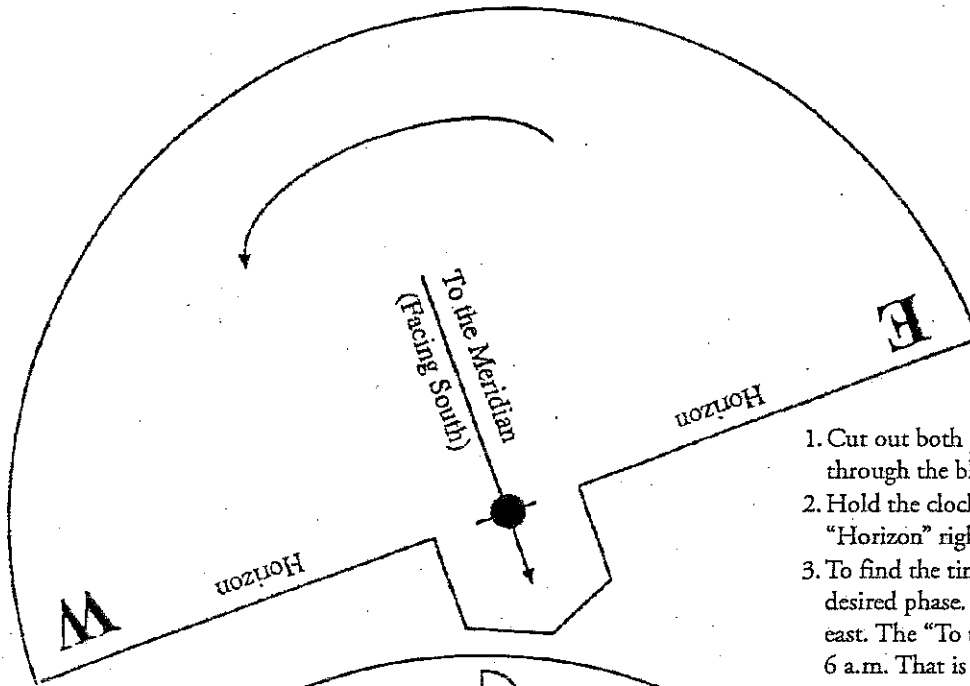
#### Outdoors — Using the Star Clock

1. Find the Big Dipper and the North Star, as shown on the face of your Star Clock.
2. Face the North Star, as shown on the front of the clock.
3. Find the current month around the outside circle of the Star Clock. Put your thumb over the current month. Hold your Star Clock so the current month, marked by your thumb, is AT THE TOP.
4. Holding the large disk firmly with the current date at the top, turn the smaller disk until its stars line up with those in the sky.
5. Read the time in the window.
6. If you are on Daylight Savings Time, add one hour.

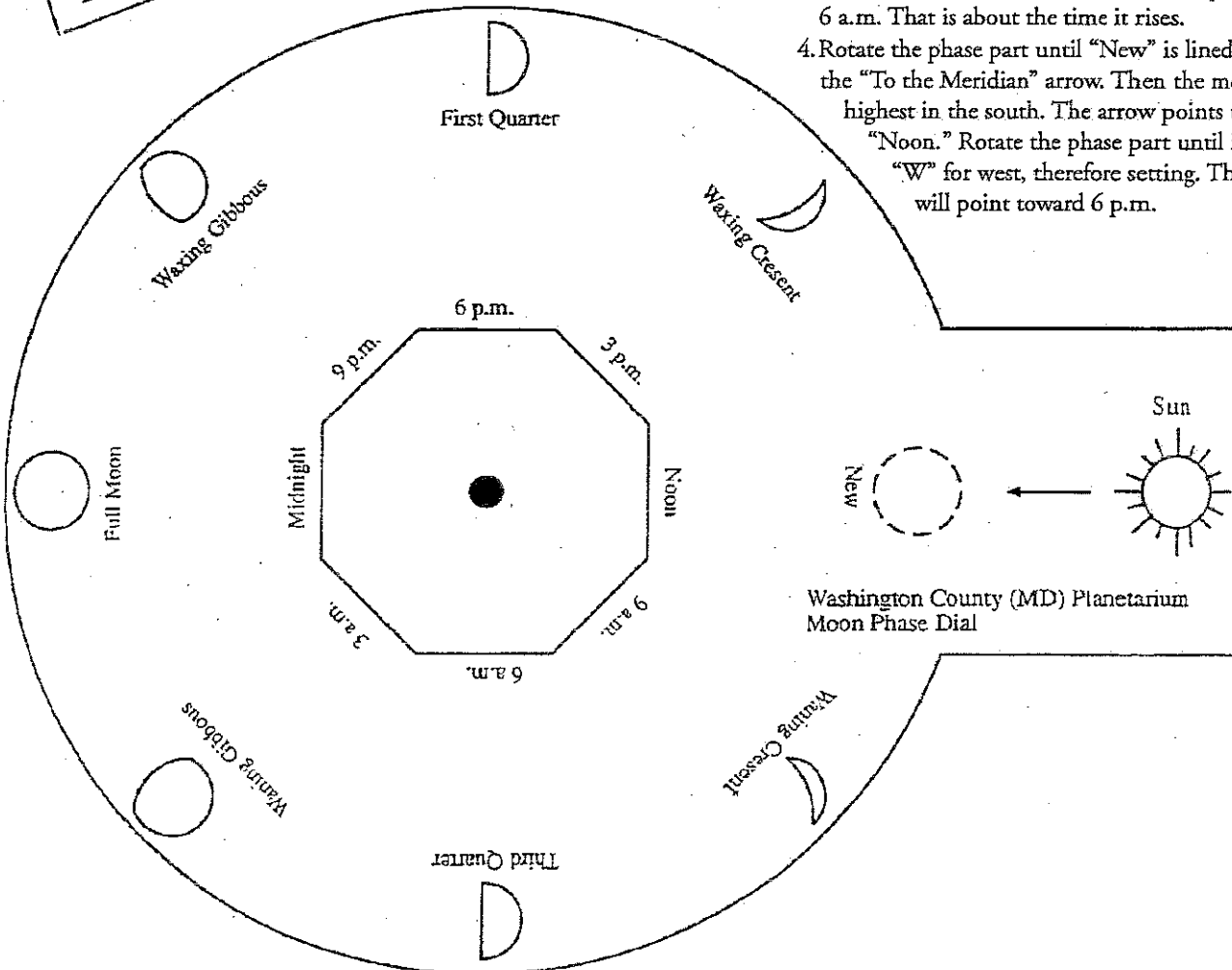


From the GEMS Teacher's Guide, *Earth, Moon, and Stars*. Reproduced with permission from Lawrence Hall of Science. Copyright © 1986 by The Regents of the University of California.

# How to Make a Moon Phaser



1. Cut out both parts and connect with a brass fastener through the black dots.
2. Hold the clock so the half-circle part has the word "Horizon" right side up.
3. To find the time that the moon rises, find the desired phase. Try "New" first. Place it at "E" for east. The "To the Meridian" arrow will point toward 6 a.m. That is about the time it rises.
4. Rotate the phase part until "New" is lined up with the "To the Meridian" arrow. Then the moon is highest in the south. The arrow points to "Noon." Rotate the phase part until it is at the "W" for west, therefore setting. The arrow will point toward 6 p.m.



Washington County (MD) Planetarium  
Moon Phase Dial

# Constructing a Moon Calendar

Contributed by Stephen Berr

## Grade Level

Elementary through middle school.

### Procedure

The following activity can be done as a class activity with each student making one page or each student making an entire calendar. The images are a photo-realistic simulation of the moon as it might be seen through a small telescope or binoculars. Each image has a number for the age of that moon in days.

1. Cut out the moon images from the attached pages along the dotted lines.
2. Paste each moon image to a separate piece of 4 x 5 inch tag board.
3. Punch two holes at the top of each tag board page.
4. Assemble all 30 tag board pages in numerical order and bind them together with the looseleaf rings or yarn. This is now the Moon Calendar.

## MATERIALS

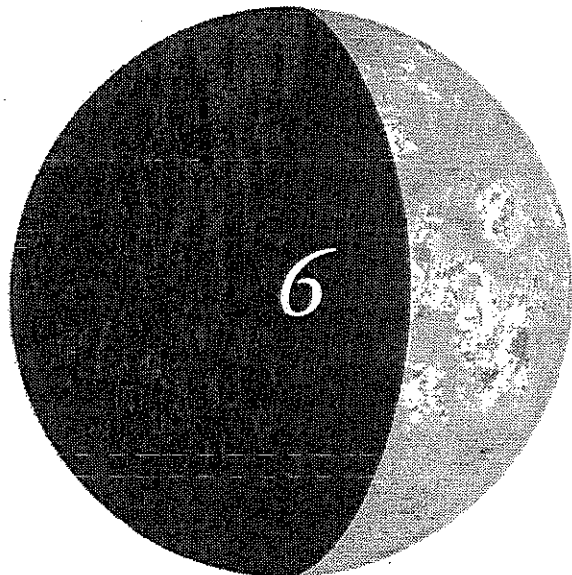
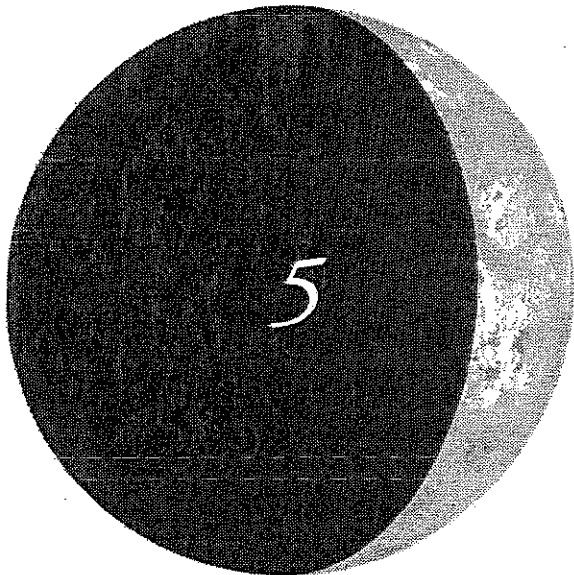
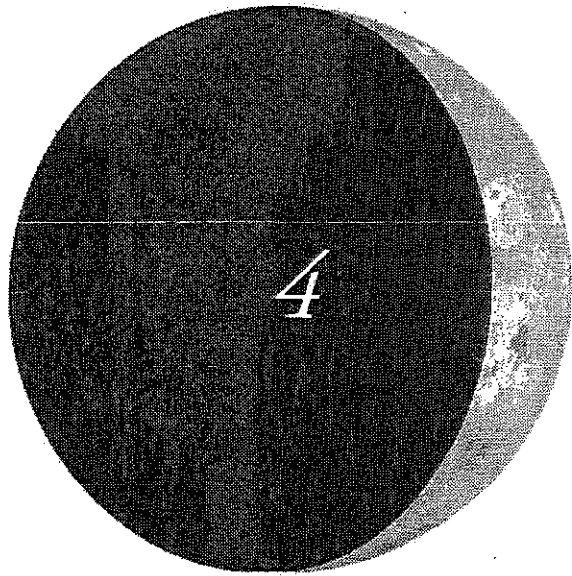
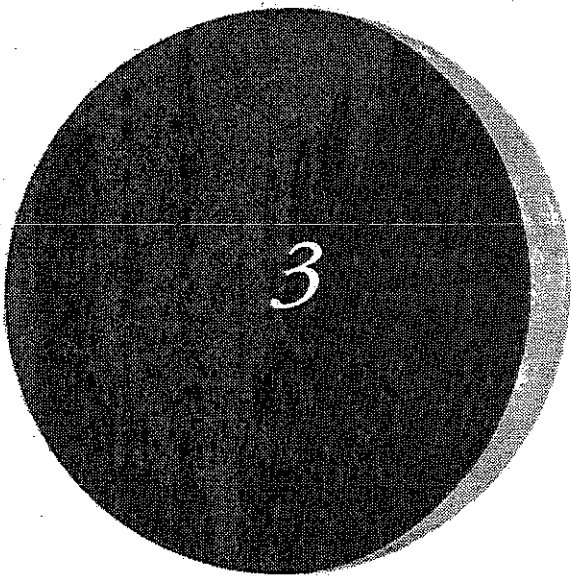
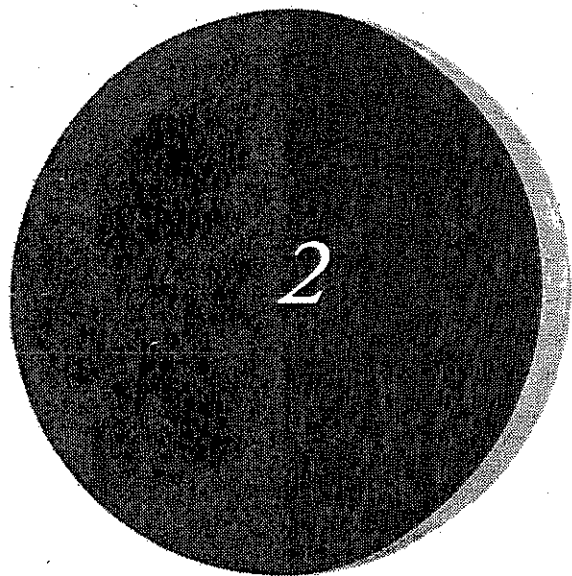
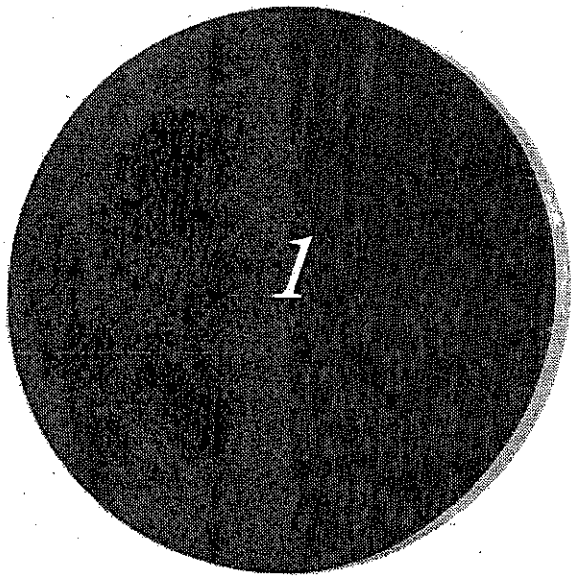
- 30 4" x 5" pieces of tagboard
- lunar images (see next 5 pages)
- 2 looseleaf rings or pieces of yarn to bind the booklet
- glue sticks
- hole punch

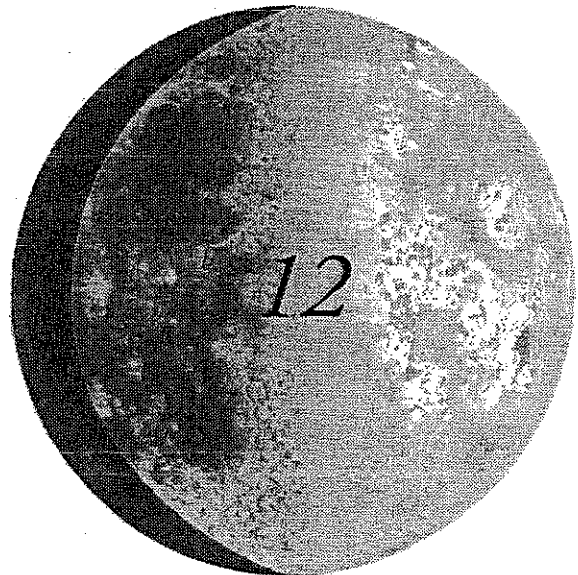
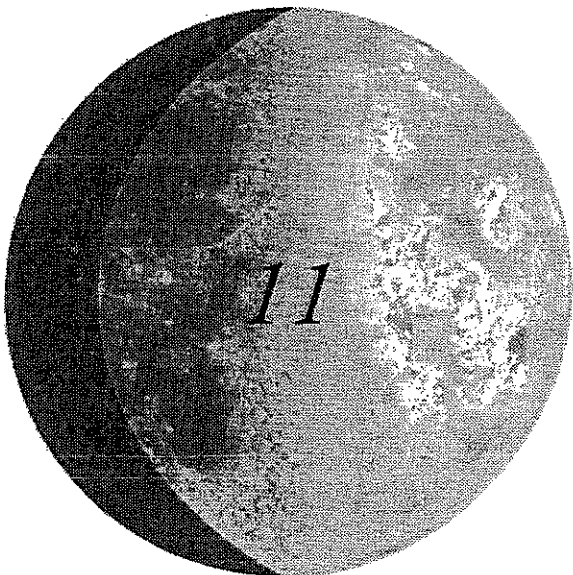
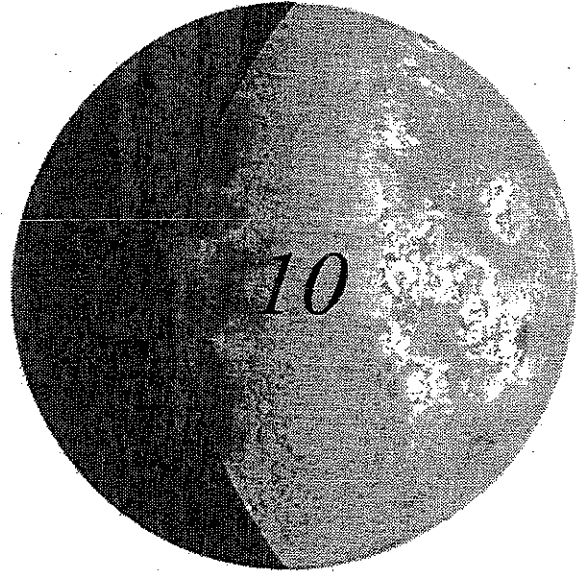
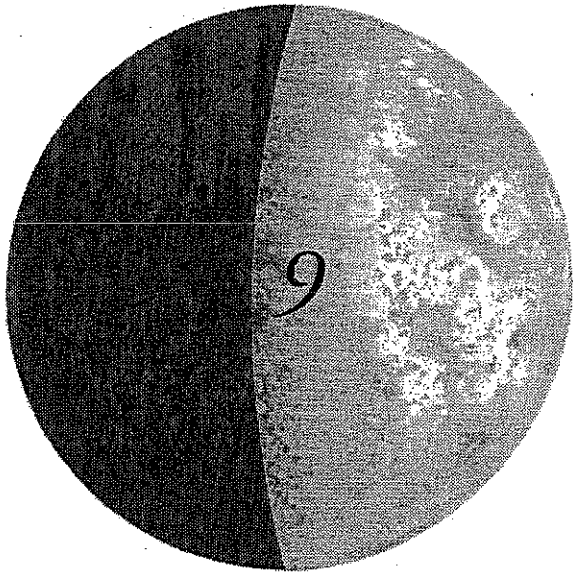
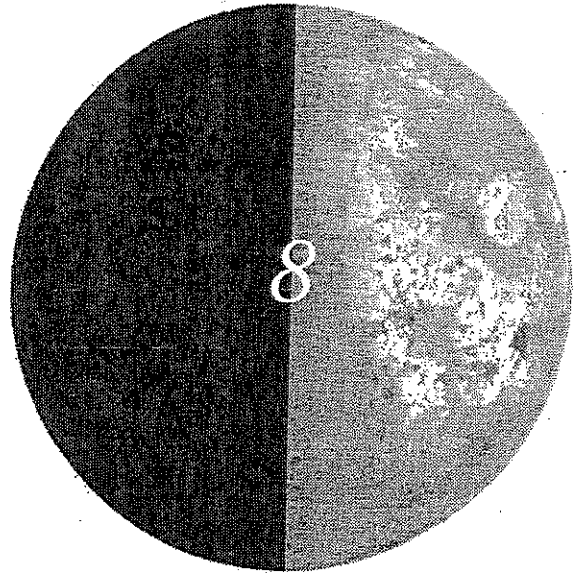
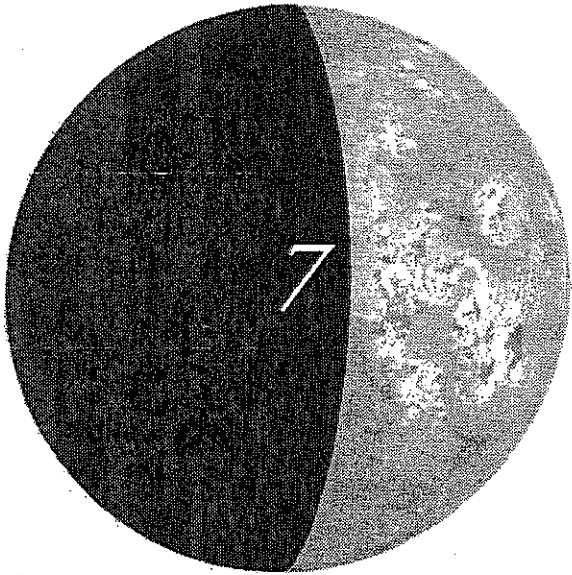
### Note

Because the moon goes around the earth in  $29\frac{1}{2}$  days and there are 30 moon phases, this Moon Phase Calendar needs to be reset to the actual new moon or full moon about every six to eight weeks.

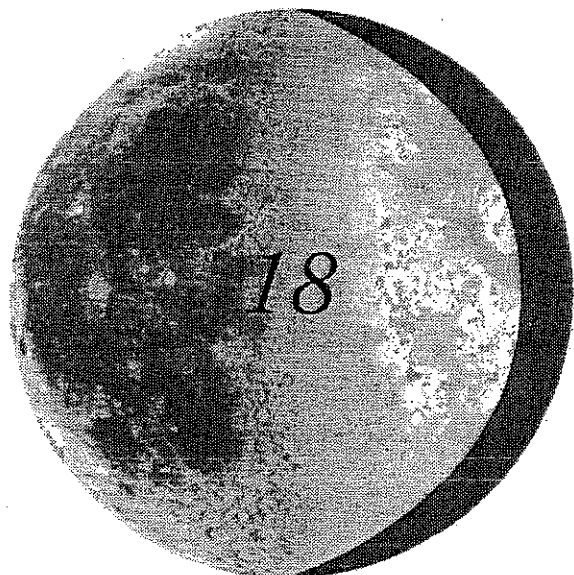
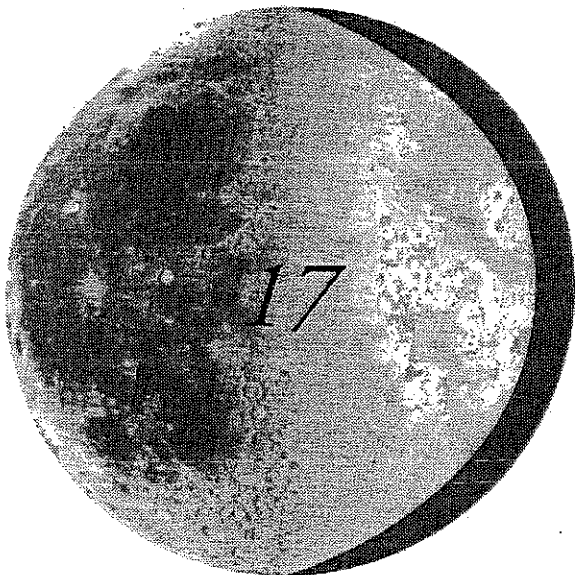
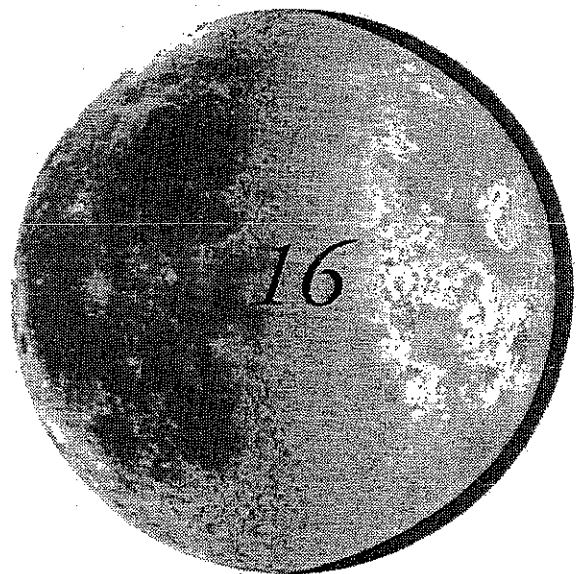
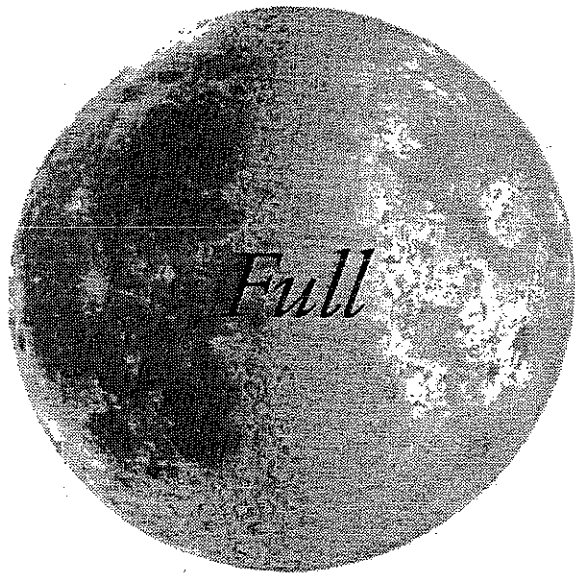
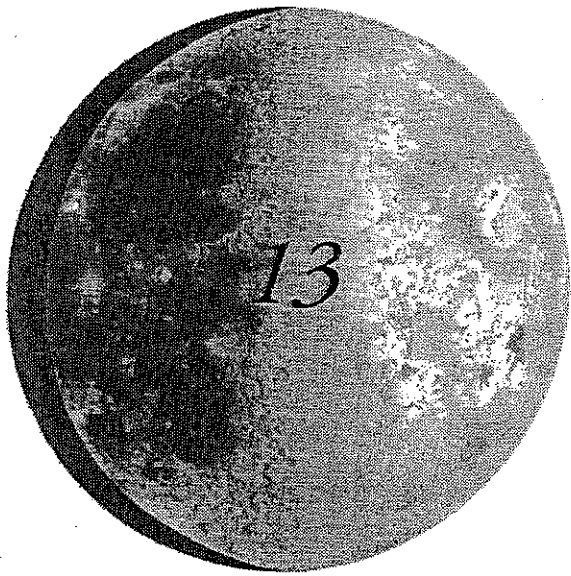
This abbreviated version of the **Constructing a Moon Calendar** activity is printed with permission from Science Kit & Boreal Laboratories. The complete laboratory kit, catalog #46590-00, is available for sale from:

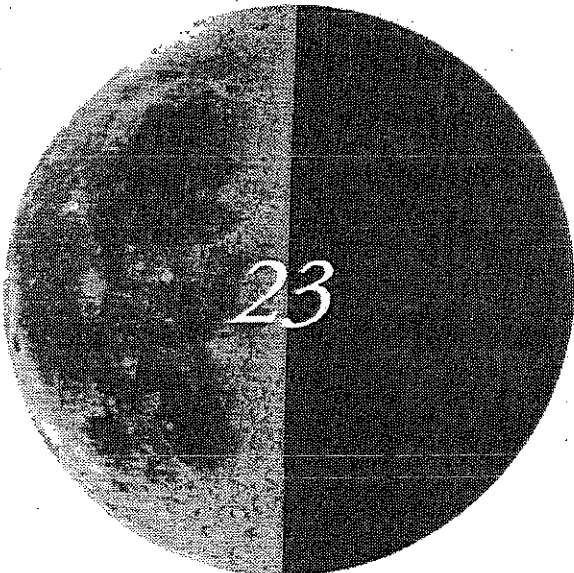
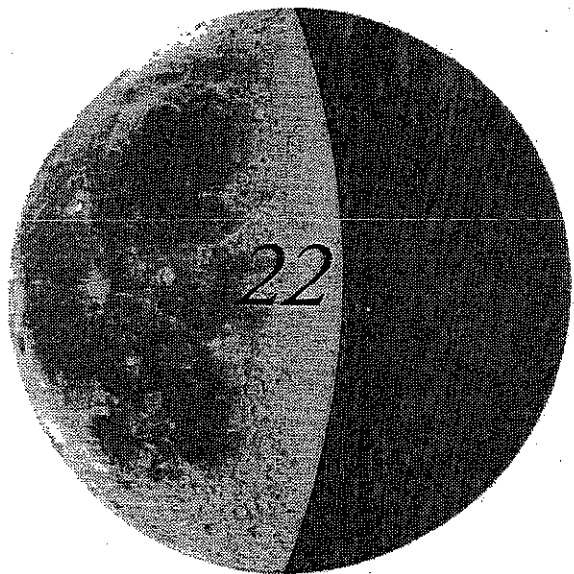
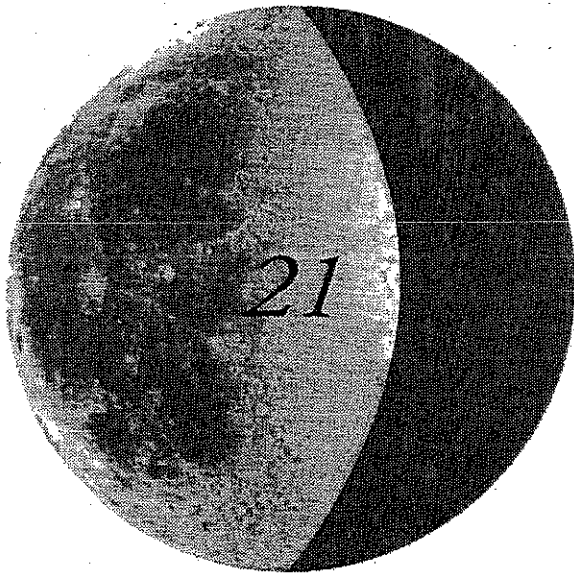
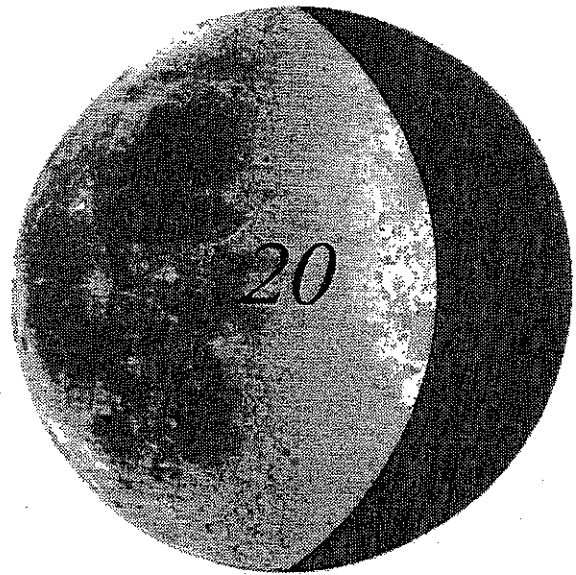
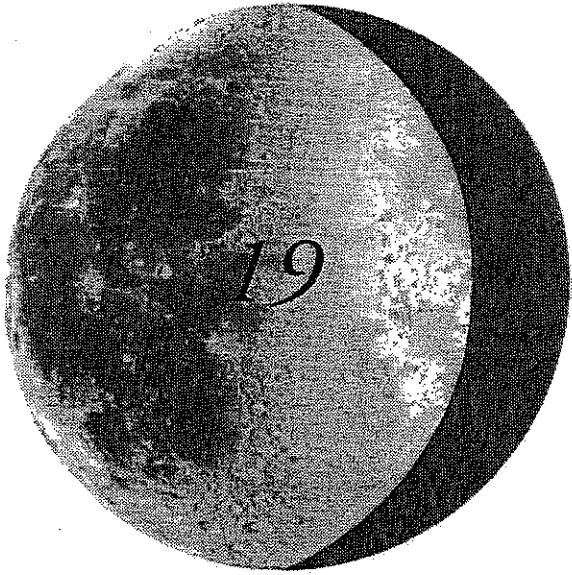
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Phone: 800-828-7777





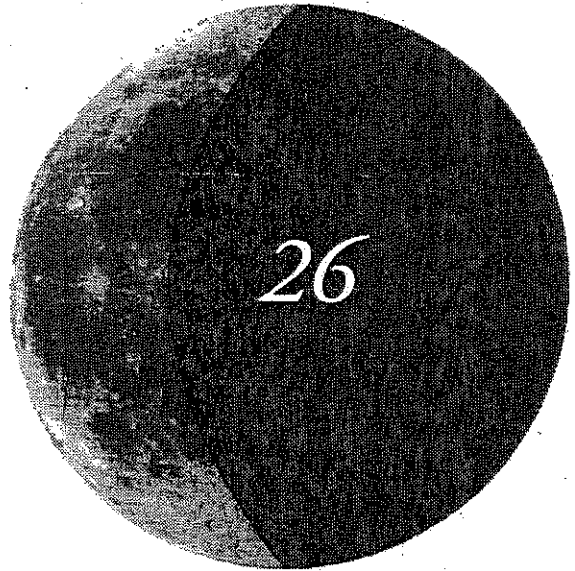








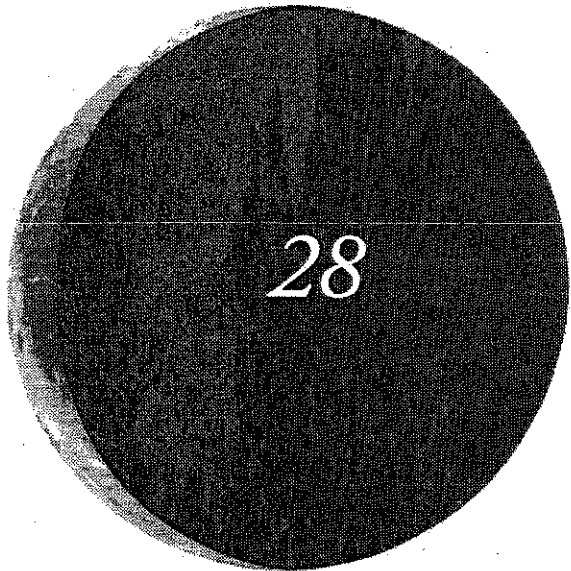
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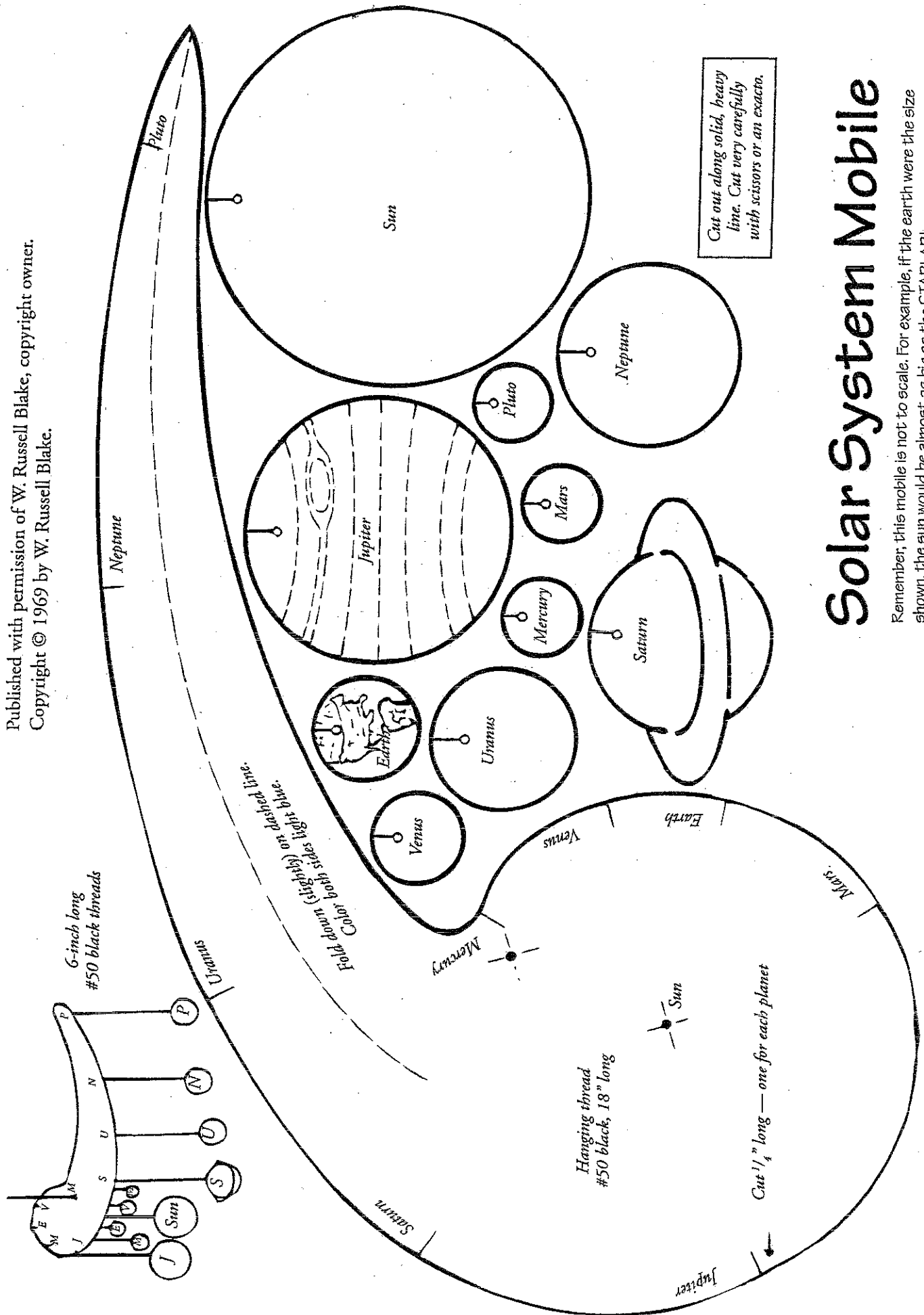
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New



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Cut out along solid, heavy line. Cut very carefully with scissors or an exacto.

# Solar System Mobile

Remember, this mobile is not to scale. For example, if the earth were the size shown, the sun would be almost as big as the STARLAB!

# How to Make Constellation Pictures

## Aluminum Foil and Film Can Planetariums

Here are two lessons that can be done before or after STARLAB use — one uses aluminum foil, the other uses film can holders. The foil constellations can be used with all grade levels, but the film can constellations should be used with older elementary ages, such as grades 3, 4, or 5, due to the fact that push pins are used.

### Objectives

Children, by making constellation pictures, will be able to distinguish between eight seasonal constellations, learn the constellations by their Greek name, identify their classmates' constellation pictures when viewed on an overhead projector, and take the constellation pictures home to review.

### Process Skills

Describing • observing • interpreting • communicating • working cooperatively

### MATERIALS

- 9" x 12" sheets of aluminum foil
- scissors
- Scotch™ Tape
- newspaper
- Styrofoam or cardboard pieces
- stick pins or push pins
- discarded film can holders
- seasonal star maps
- permanent markers

### Procedure

- Have students fold their foil in half, in half again, and in half again. Unfold the foil and cut on the fold lines. They will now have 8 small rectangles. (If the foil is all wrinkled, roll a pencil over it to smooth it out). Choose one constellation to work on first.
- Place the star map over the piece of foil and using a stick pin, poke through the stars on the star map. (Use newspaper, styrofoam or cardboard pieces to protect the table top). They may have to practice this a bit so that the pin hole is a hole, rather than a tear. Use a permanent marker to write the name of the Greek constellation on the foil. Complete all 8 pictures.
- When done, take one at a time up to the overhead projector, and have students guess which constellation they see. They can also take these pictures home and hang them in either their north, south, east or west window where they would see the constellations in the night sky. This is a good way to review the constellations they have learned in STARLAB.
- This lesson can be varied by having children use film can holders. (They are available through film processing stores, which will give them away to teachers, if they know you are using them for a school project.) Have children carefully cut out the constellation shape plus its name. Tape that small piece of paper UPSIDE DOWN on the bottom of the film can so when they look through the film can, the constellation will be right side up. Push carefully through the stars with a push pin. When done, tape the picture with its name on the side, so students don't forget its name. They can be removed later when they have learned the names. Hold the film cans to their eyes and identify which constellation they have made. Do as many film can planetariums as you can.

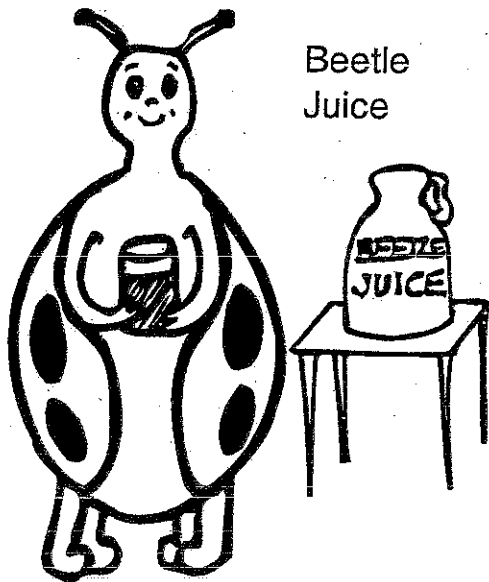
### Evaluation

Have students identify which constellations they have made by showing them and identifying them to the teacher. Take the pictures or film cans into STARLAB to identify them while viewing the Starfield Cylinder.

# How to Remember Orion's Stars

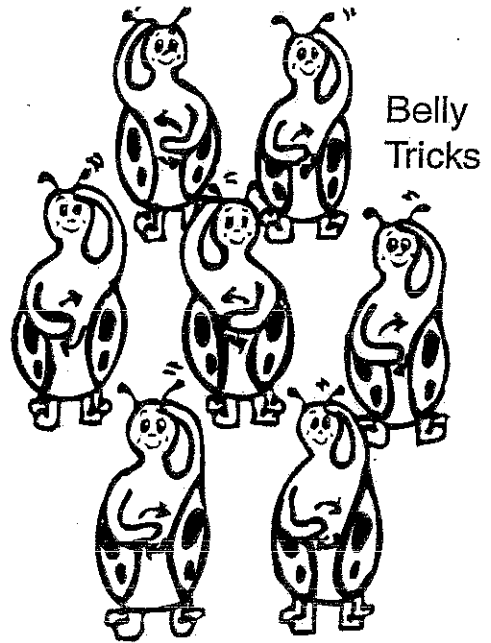
## Betelgeuse, Bellatrix, Rigel and Saiph

Tell a story about beetles drinking juice, then doing "belly tricks," then taking medicine for their bellyache ("Di-Gel" sounds like Rigel), then playing baseball and the umpire calling the beetle "Saiph."



Beetle  
Juice

*Betelgeuse*



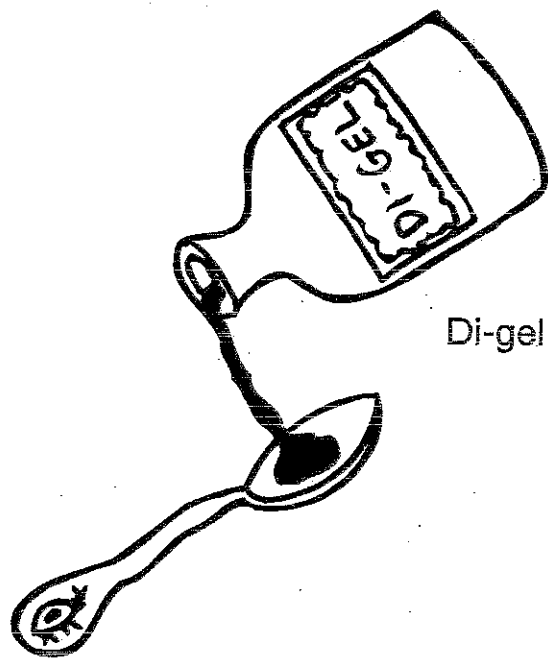
Belly  
Tricks

*Bellatrix*



SAFE!!

*Saiph*



Di-gel

*Rigel*

# How to Use a Star Finder

If a student is to become truly interested in the stars, he must be able to identify them as he looks up at the myriad of lights in the night sky. By learning to use a Star Finder in the planetarium — a controlled model of the real sky — students can develop skills to use Star Finders out of doors and competence in identifying stars and constellations.

## Objectives

Students will be able to:

1. Use a Star Finder with some degree of proficiency in locating stars both in the planetarium and in the real sky.
2. Identify specific constellations in the night sky for any specific date with the aid of a Star Finder.

## Process Skills

Describing • observing • interpreting • communicating • inferring • working cooperatively

## Background information

Share the following information with students: A representation of the real sky is provided by a Star Finder. Thus a Star Finder may be used as a tool for locating stars in the sky.

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### Procedure

#### In the classroom:

1. The teacher should duplicate or have printed enough patterns for Star Finders for each student to assemble one. The instructions for assembling and using the Star Finder are provided with the pattern.
2. Using an overhead projector with a transparency of the Star Finder students are using, point out and/or demonstrate the following:
  - A. Time and date
  - B. Proper orientation
  - C. Position of observer
  - D. Cardinal or compass points

Help children get well acquainted with four or more major constellations to be visible in the night sky on date of planetarium visits.

#### In the planetarium:

1. Set planetarium for evening of visit.
2. Distribute Star Finders to the pupils who made them and one red flashlight to every two students. Explain the necessity of working together with one student holding the red flashlight and the other working with the Star Finder.
3. Let the planetarium sun set and help students orient themselves and the Star Finder with respect to planetarium compass points (N, E, S, W). Bring the stars up so that the brightest ones are visible.
4. Students should set their Star Finders by turning the star disk until the date printed on the disk is set to correspond with the time of observing. Face south and hold the Star Finder in such a manner that the stars can be read and the south on the finder points towards the South Pole. Continue holding the finder in position and use the flashlight to locate the stars which match those in the sky. The Finder is designed for latitudes 30°N through 50°N but is useful at any northern mid-latitude.
5. After dimming the side lights enough for more stars to be seen, ask the students to use their Star Finders as above to identify a constellation and/or star as you point it out on the dome.
6. After the above step is accomplished to your satisfaction, turn the side lights down completely and let students

## MATERIALS

- STARLAB Portable Planetarium
- Do It Yourself Star Finder pattern (see pp. 21, 22)
- Starfield Cylinder
- glue sticks
- arrow pointers
- scissors
- red flashlight (for reading)

observe the "real sky." Let students use the arrow pointer to outline constellations on the dome.

7. Sum up the planetarium experience of the value of a Star Finder.
- 

### **Follow-up Activities**

1. Each student should take his/her Star Finder home and use it to locate the same asterisms and constellations in the nighttime sky that he/she observed in the planetarium.
2. Plan a night observation session with students and use the Star Finder to locate objects in the real sky. (For a star party, incorporate activities for parents.)
3. Ask several students to make a comparative study of other types of star finders and to use one or more of them. They should report results to the class.
4. Assign charts of various types to other students, with the request that they locate five stars in the sky at night and later report on their stargazing experiences.

### **Evaluation**

Point to a constellation or asterism (one or several) and ask students to locate it on their Star Finders, marking it with a circle. Evaluate each student on his performance in the post activities.

List several stars and constellations by name and ask students to use their Star Finders to determine the month each star and constellation would be visible at 10:00 p.m. and to name the general area of the sky in which the star would appear.

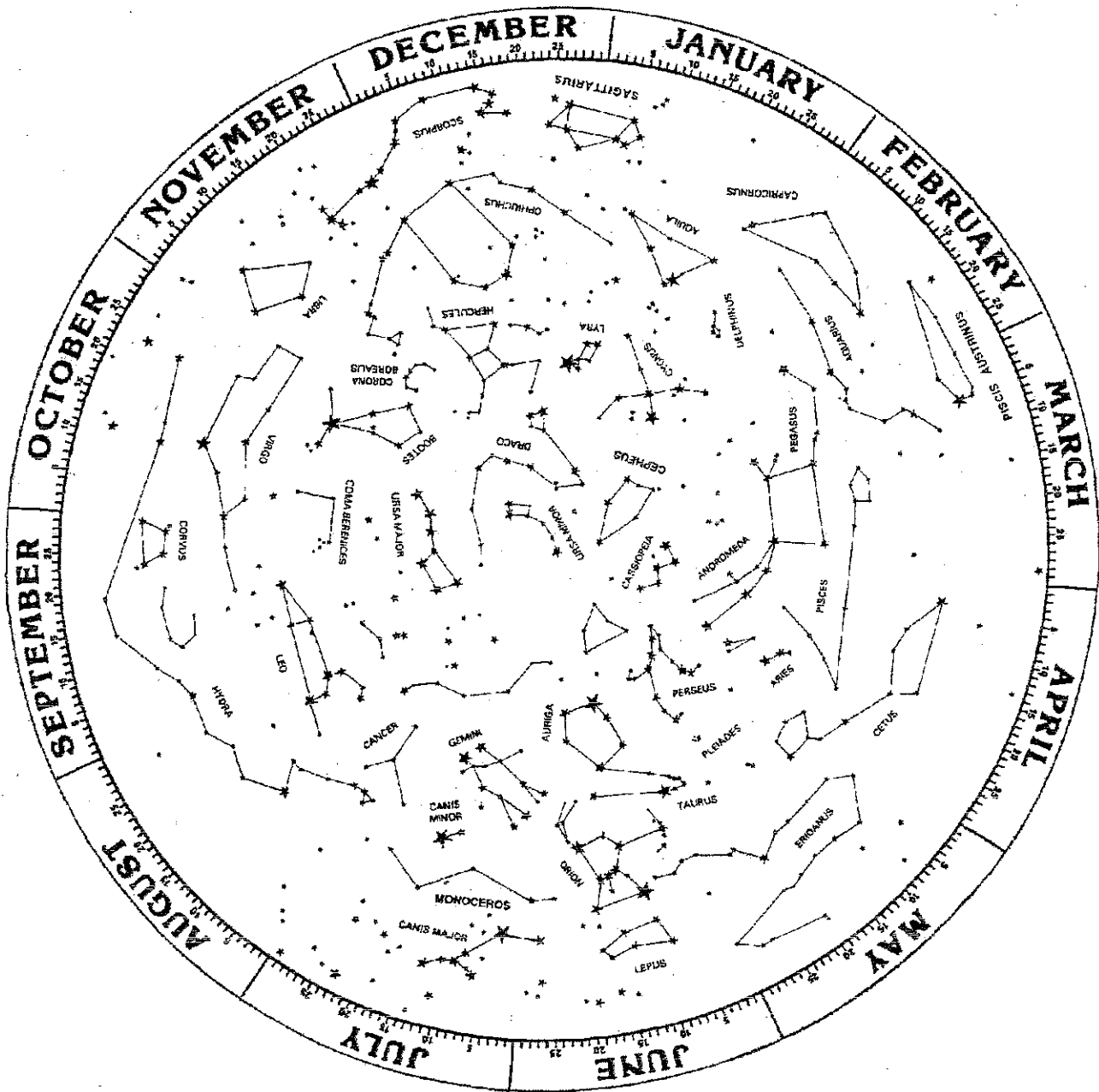
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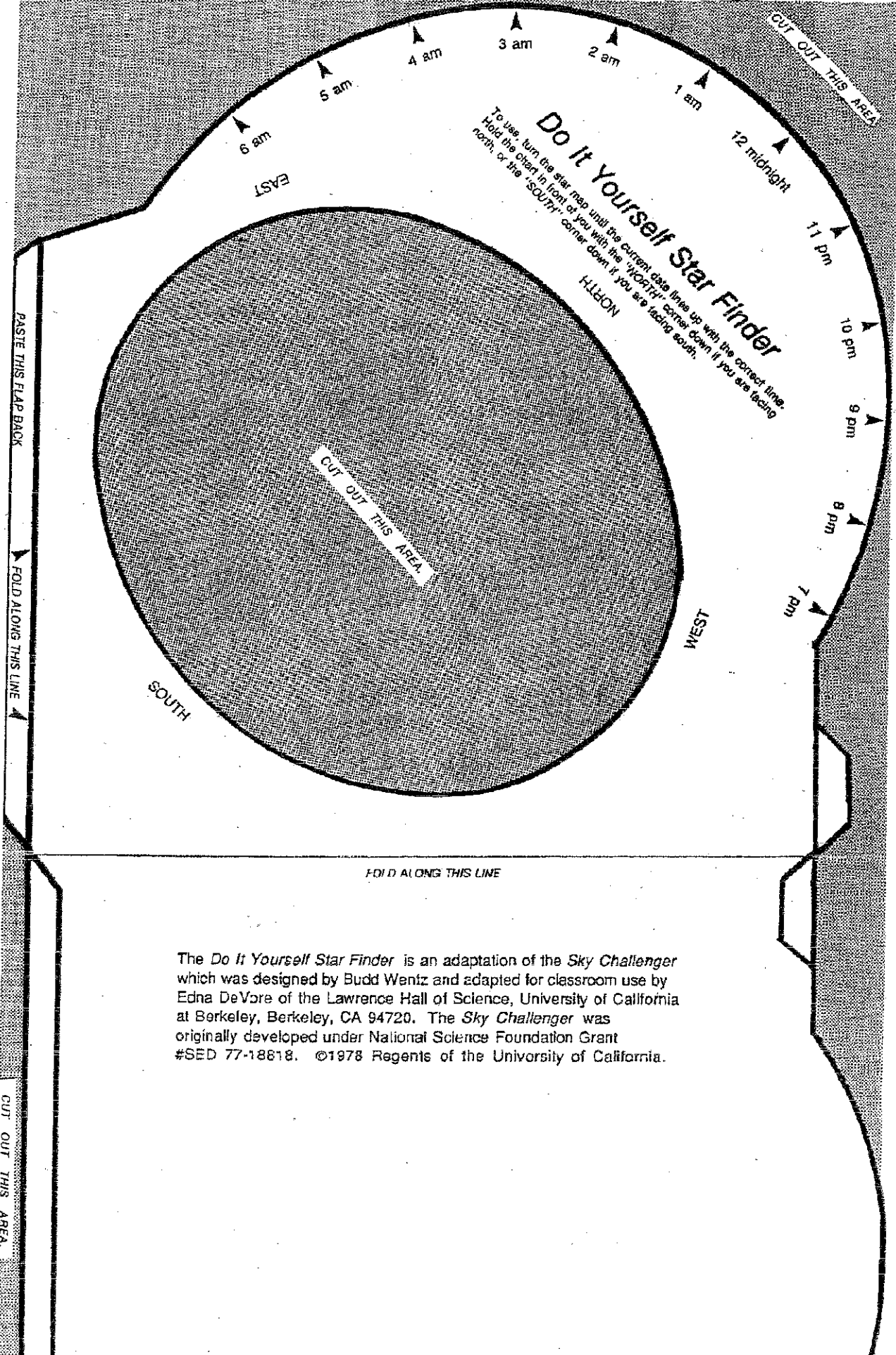
### **Note**

For Do It Yourself Star Finder pattern used in the activity, see the next two pages. These Star Finders are also available from Learning Technologies on a heavy-duty cardboard. Call toll-free 1-800-537-8703 or 1-617-628-1459 for more information.

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# How to Make a Do it Yourself Star Finder





The *Do It Yourself Star Finder* is an adaptation of the *Sky Challenger* which was designed by Budd Wentz and adapted for classroom use by Edna DeVore of the Lawrence Hall of Science, University of California at Berkeley, Berkeley, CA 94720. The *Sky Challenger* was originally developed under National Science Foundation Grant #SED 77-18618. ©1978 Regents of the University of California.

# How to Use a Dipper Finder

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Children will start feeling at home with the stars and will become interested in observing them further when they realize that they can easily find the Big Dipper on a clear night. The Big Dipper, in turn, will help them locate a very important star for finding their way, Polaris. The Dipper Finder to be made in this activity will tell them in what general region of the north sky to look for the Big Dipper at any hour of the night throughout the year. As they use it, they will see how the Dipper appears to move around the Pole Star.

## Objectives

Students will be able to:

1. Use the Dipper Finder to locate the position of the Big Dipper at selected hours and months of the year.
2. Locate the North Star (Polaris).

## Process Skills

Describing • observing • interpreting • communicating • inferring • working cooperatively

## Background information

Share the following information with students.

The Big Dipper appears to move in the sky from hour to hour.

The Big Dipper appears to change its position from month to month.

The pointer stars in the Big Dipper point toward the North Star (Polaris).

## MATERIALS

- STARLAB Portable Planetarium
- Dipper Finder pattern and instructions (see p. 25)
- Starfield Cylinder
- paper fastener
- arrow pointers
- glue sticks
- red flashlight (for reading)
- scissors

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## Procedure

In the classroom:

1. Review rotation of the earth, shape of the Big Dipper, and the usefulness of this star configuration in finding the North Star and cardinal points.
2. Ask students to construct the Dipper Finder using the materials given them.
3. Let students practice setting and orienting the Dipper Finder for various dates and hours of night until they become familiar with its operation.

In the planetarium:

1. Preset the planetarium for the date of the visit and for one hour after sunset.
  2. With side lights up, ask students to set their Dipper Finders for the date and time of the STARLAB setting and determine the approximate region of the north sky where the Big Dipper will be found.
  3. With the students, identify cardinal points, horizon, meridian, and zenith.
  4. Activate the stars, lowering the side lights until the Big and Little Dippers are visible (but maintain as much room illumination as possible). Each student should verify his predicted orientation of the Big Dipper with its position in the planetarium sky. Ask students to observe the position of the North Star (ask them this again in connection with all later observations).
  5. Using diurnal motion, advance the sky two or three hours at a time through a 24-hour period. Before each advancement, students should reset their Dipper Finders for the correct time and make a prediction on the Dipper's location. Following each advancement they should observe the position of the Dipper in relation to their prediction as well as the horizon, zenith, and other stars.
  6. Using annual motion and the ecliptic, and the same inquiry procedures as above, show the position of the sun by season and the position of the Dipper in the evening sky on the same date.
-



### Follow-Up Activities

1. Each student should take his Dipper Finder home and use it to locate the Dipper and North Star in the night sky.
2. The Dipper Finder is large enough to include more stars. Ask students to plot the Little Dipper, Cassiopeia, and Draco on their Dipper Finders from the sky at night. On the next school day, they should check their success with a star chart.
3. At upper elementary levels, guide students in using their Dipper Finders and the Big Dipper to tell the time of night (see Engelbriktsen, Greenleaf, *Let's Explore Outer Space*, pp. 24-36 for directions for using the Big Dipper as a clock in the sky).

### Evaluation

Show the Big Dipper in four different positions at 9 p.m. on the planetarium dome and ask students to use their Dipper Finders to discover the month in which each position would occur.

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### Note

For the Dipper Finder pattern used in the activity, see the next page.

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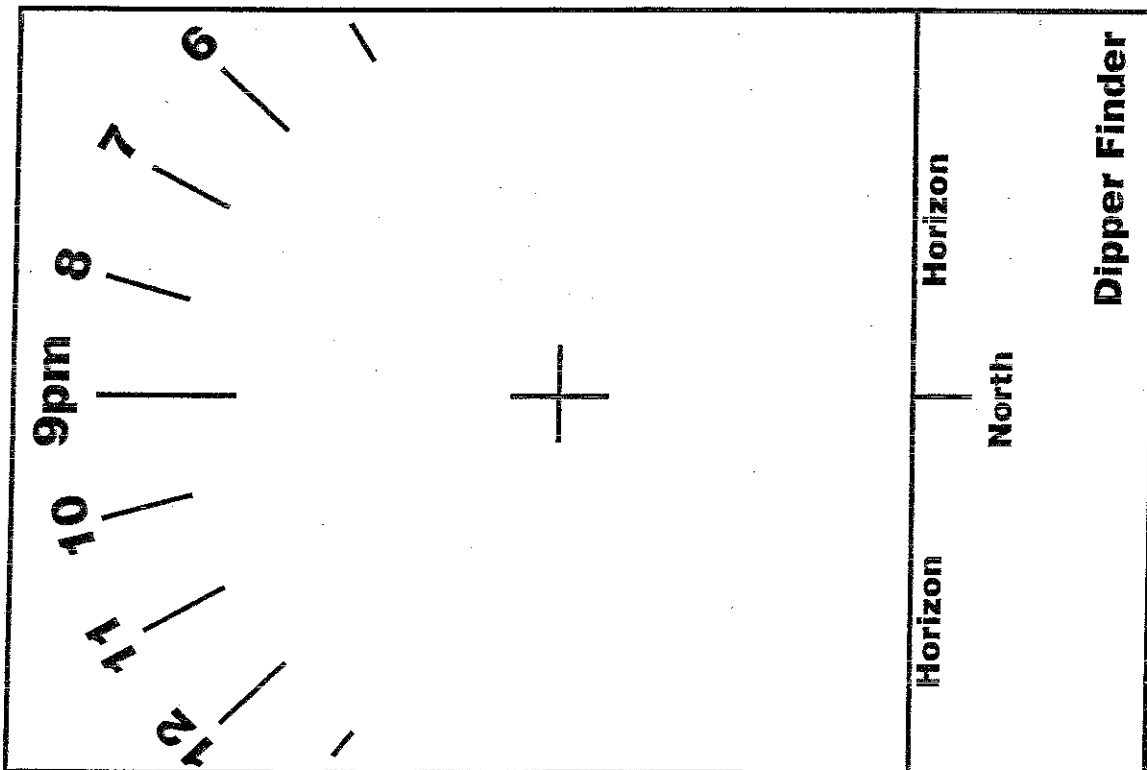
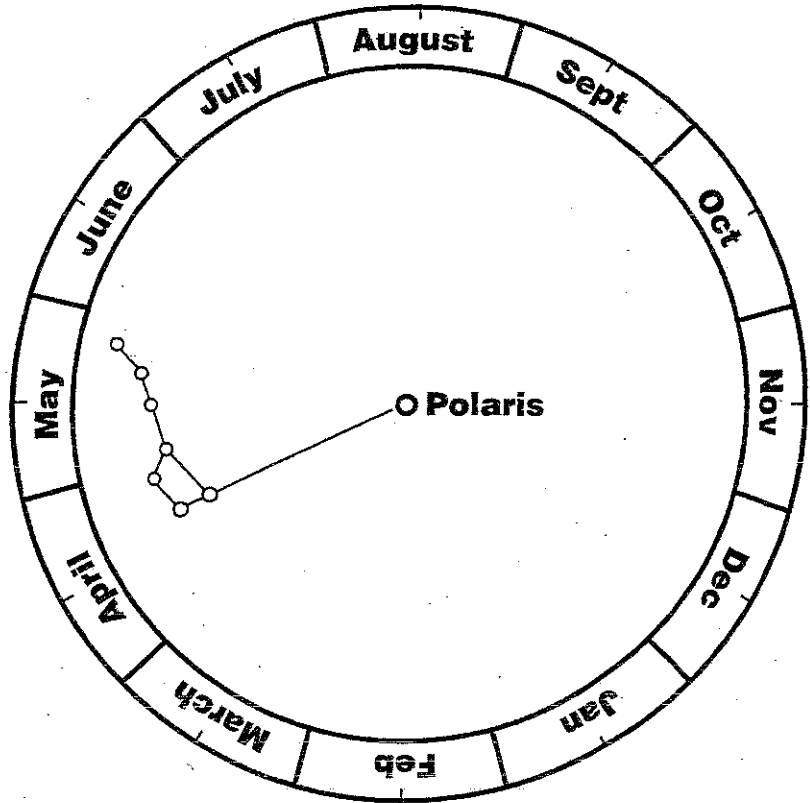
# Dipper Finder Pattern and Instructions

## Construction

1. Cut out the circle and rectangle and glue-stick both onto tag board. Trim tag board to exact size of circle and square.
2. Fasten circle to rectangle by putting paper fastener through Polaris.

## Use

1. Line up the date of observation with the time of observation. For example, if it is 10 p.m. on April 11, turn the month wheel until a point about a third of the way into the space marked "April" is aligned with 10 p.m. on the square card.
2. Hold the card up so that the north horizon on the card corresponds with the north horizon in the planetarium or real sky.



# Stars and Constellations

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## Objectives

Students will be able to:

1. Determine star colors.
2. Match hot and cool stars with proper color.
3. Explain that the sun is the closest star; other stars are very far away.
4. Determine the magnitude of various stars in the winter sky.
5. Identify Rigel, Betelgeuse, Sirius, Procyon, Aldebaran, Pollux and Castor as bright stars and identify the constellations in which those stars are located in the winter sky.
6. Find the winter and summer triangle.

## Process Skills

Describing • observing • interpreting • communicating • inferring • working cooperatively

## Background information

Share the following information with students.

1. Stars vary in color.
  - a. The color of a star is determined by its temperature.
  - b. Red stars are the coolest stars.
  - c. Blue-white stars are the hottest stars.
2. Stars vary greatly in size.
  - a. Our sun is a medium-sized star.
  - b. The red giants are the largest stars.
  - c. The white dwarfs are the smallest stars.

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## Procedure

Point out red stars (Betelgeuse in Orion, Antares in Scorpius) and blue-white stars (Rigel in Orion and Spica in Virgo). With a dimmer switch and a clear glass bulb, show how the cooler filament is red, just before the bulb goes out, and the hottest filament turned all the way up is white or bluish. Have students compare the hottest part of a bonfire (blue flame), the coolest part, (red flame), or the most efficient color on a gas stove (blue).

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3. The magnitude of a star refers to its observed brightness.
  - a. The lower the magnitude, the brighter the star.
  - b. Stars fainter than the sixth magnitude cannot be seen with unaided eyes.
4. Stars vary greatly in distance from the earth.
  - a. The sun is our closest star.
  - b. The stars are so far away that we cannot easily measure the distance in miles.
  - c. If you travel 1000 miles an hour, it would take you 3 million years to reach the nearest star excluding the sun.
  - d. The distance to stars is measured in "light years."

## MATERIALS

- STARLAB Portable Planetarium
- arrow pointers
- Starfield Cylinder
- red flashlights (for reading)

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**Procedure**

Use a star map and have students determine the magnitude of stars by putting five rays around the brightest, four rays around the next brightest, three, two, and one ray around those least bright, in order. Use the following constellations: Orion, Canis Major and Minor, Gemini, and Taurus. Show them the accepted magnitude chart of stars as found in the PASS series (Volume 2, Lesson 6) or by using a star chart.

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5. The sky is divided into areas by groups of stars known as constellations.
  - a. There are 88 constellations in the entire sky.
  - b. These can be used to locate position in the sky.
  - c. Constellations are star patterns.
    - The most familiar are the circumpolar constellations which can be seen at all times (depending on your latitude).
    - Other common constellations can be seen only during certain times of the year.
  - d. Some large, bright stars are easily seen.
    - Betelgeuse and Rigel are part of the constellation Orion.
    - Sirius is a part of Canis Major.
    - Spica is a part of Virgo.
    - Vega, Deneb and Altair form the summer triangle.
    - Betelgeuse, Procyon and Sirius form the winter triangle.

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**Procedure**

Locate the above familiar constellations using a star map. Have students work in teams, and assign each team two constellations to find. When done, use arrow pointers to locate the constellations in the dome.

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# The Motion of Stars and Constellations

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## Objectives

Students will be able to:

1. Observe that during rotation, Polaris stands still.
2. Explain why seasonal stars rise and set and circumpolar stars do not.
3. Tell which direction circumpolar stars appear to move around Polaris.

## Process Skills

Describing • observing • interpreting • communicating • inferring • working cooperatively

## Background information

Share the following information with students.

1. Northern circumpolar stars are located in the northern sky.
  - a. The North Star is always above the North Pole.
    - The North Star does not appear to move in the sky.
    - It can be found by using the guardian stars of the Big Dipper.
  - b. The circumpolar stars do not rise and set, but are always visible and revolve around the North Star.
2. Stars appear to move rapidly in the night sky due to the rotation of the earth.
  - a. Circumpolar stars revolve counterclockwise around Polaris.
    - The position of the stars changes about  $15^\circ$  each hour.
    - They make a complete revolution in a little less than 24 hours.
  - b. In the southern sky, the stars move from east to west.
    - The stars that rise in the eastern part of the sky, set in the western part of the sky.
    - This movement in the sky is similar to that of the sun.
3. The reason the stars do not come back to exactly the same place each night is due to the earth's orbit of the sun.
  - a. This motion is very slow.
    - The earth revolves around the sun in 365 and  $1/4$  days.
    - The star's apparent motion to the west is about 1 degree each day.
  - b. Constellations move to the west when observed at the same time each night.
    - Orion is seen in the southeast sky at 8 p.m. on January 1.
    - Orion is in the southern sky at 8 p.m. in the middle of February.
    - Late in March, Orion is in the western part of the sky at 8 p.m.

## MATERIALS

- STARLAB Portable Planetarium
- arrow pointers
- Starfield Cylinder
- red flashlights (for reading)

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## Procedure

Turn on the diurnal motion and see how the stars appear to rise and set. Use the information above to provide astronomy concepts to students. Watch the circumpolar stars and see how they revolve around the North Star. Use the two "guardian stars" of the Big Dipper to go up to the North Star, Polaris. Watch the stars in the southern sky move from east to west. Demonstrate night sky with daily motion.

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# **Tell Me What You Know About Stars!**

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**Note:**

This activity was contributed by Sue Reynolds Button of the Onondaga-Cortland-Madison BOCES, Syracuse, NY. For background information on the Milky Way Galaxy and the solar system, refer to *A Collection of Curricula for the STARLAB Solar System & Galaxy Cylinder*.

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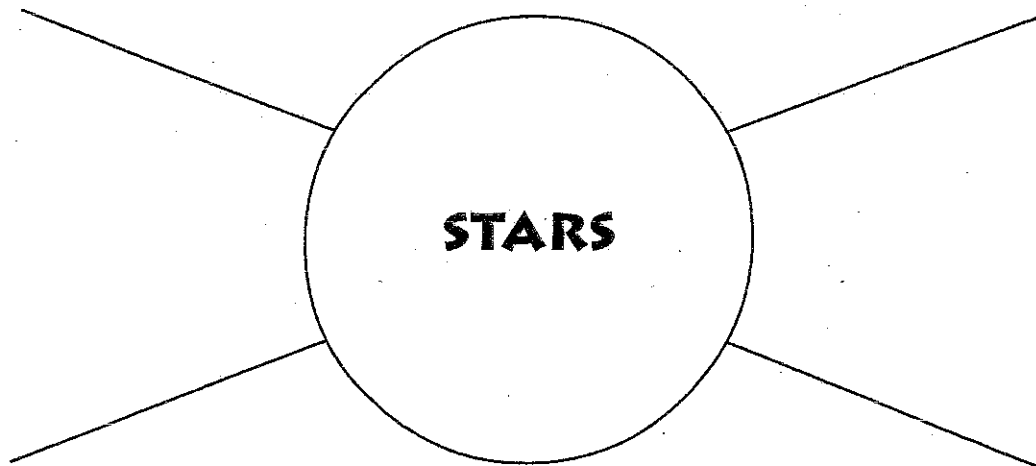
**Grade Level**

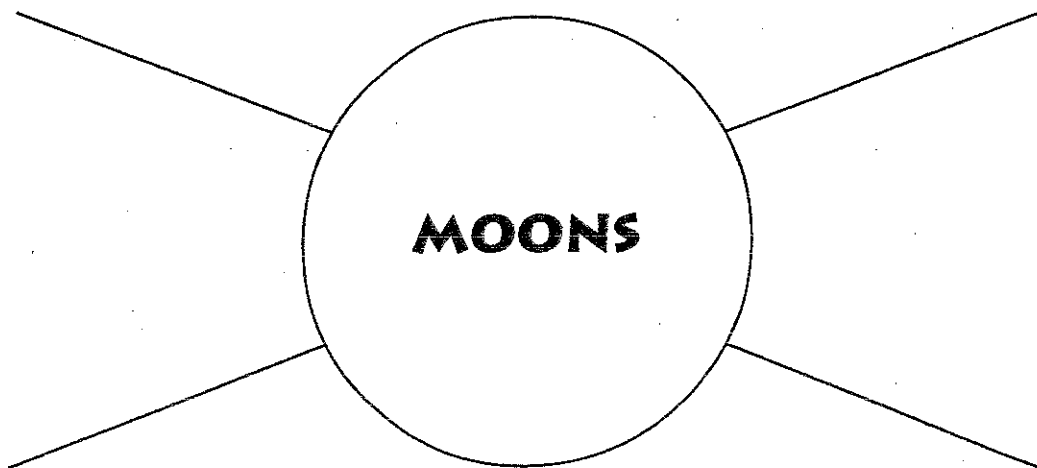
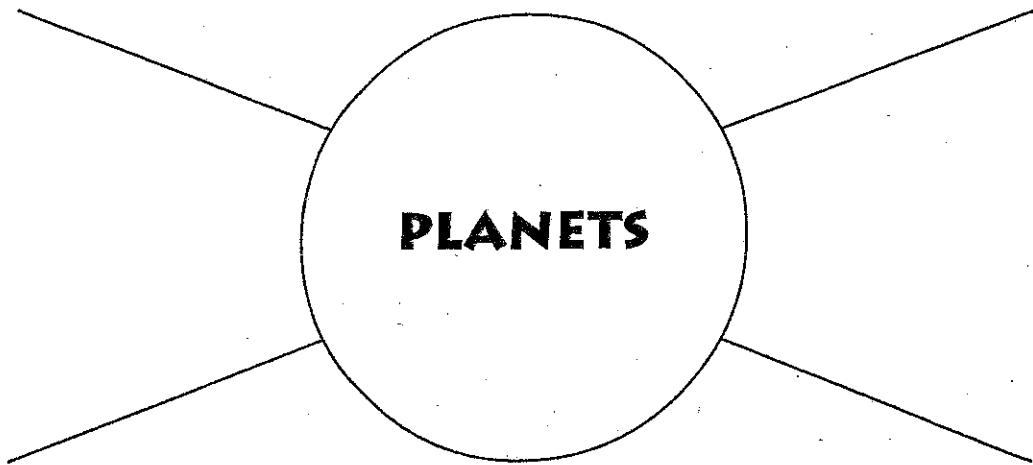
3-6

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**Procedure**

- On the Attribute Web below, have the students record some facts that they know about stars. Encourage them to think about all stars (not just one) and why they are called stars. They may use the lines-out from the center of the Web to record their thoughts. Have them write one fact on each line. If they think of more than four facts, they can add more lines to write on.
  - Have the students repeat the above procedure on the appropriate Attribute Web for planets and moons (see next page).
- 





# A Comparison of Star and Planet Attributes

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**Note:**

This activity was contributed by Sue Reynolds Button of the Onondaga-Cortland-Madison BOCES, Syracuse, NY. For background information on the Milky Way Galaxy and the solar system, refer to *A Collection of Curricula for the STARLAB Solar System & Galaxy Cylinder*.

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**Grade Level**

3-6

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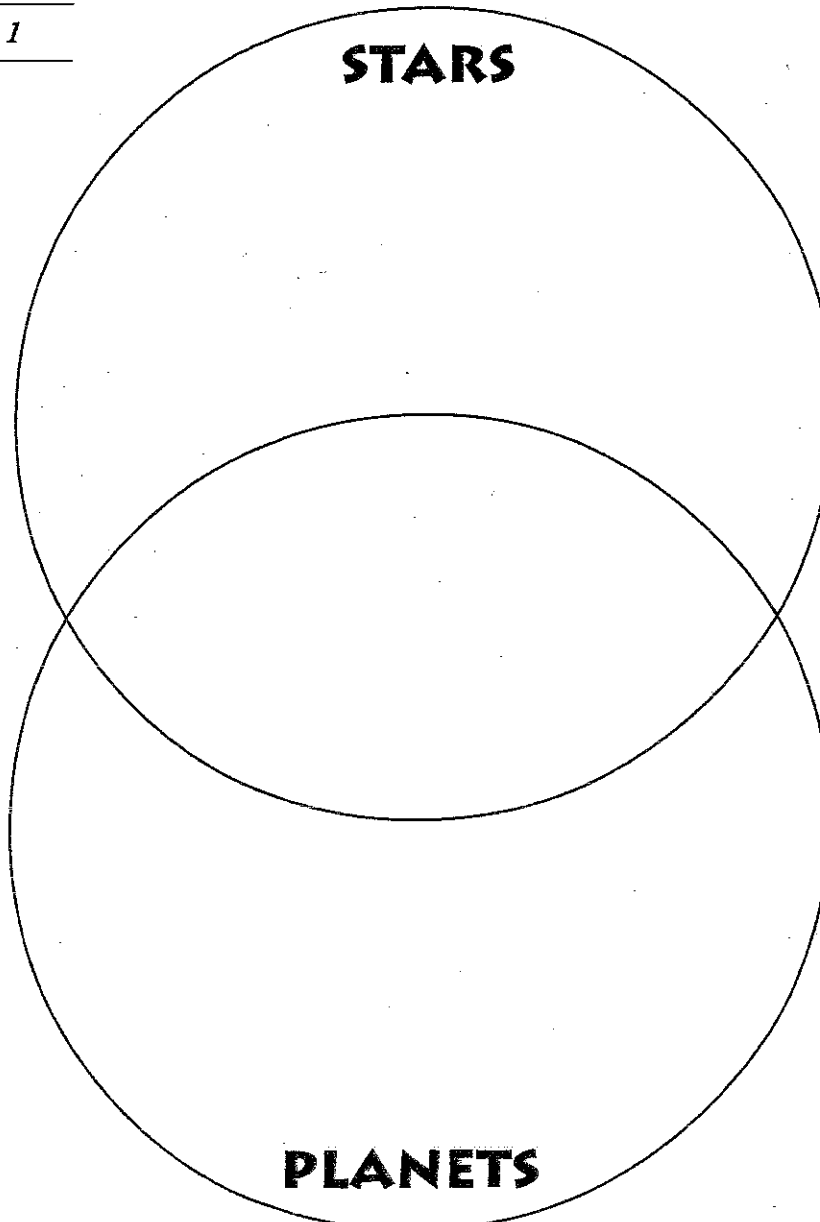
**Procedure**

Have the students use one of the two following Venn Diagrams to compare and contrast attributes — Venn Diagram 1: stars and planets (below) or Venn Diagram 2: stars, planets and moons (next page).

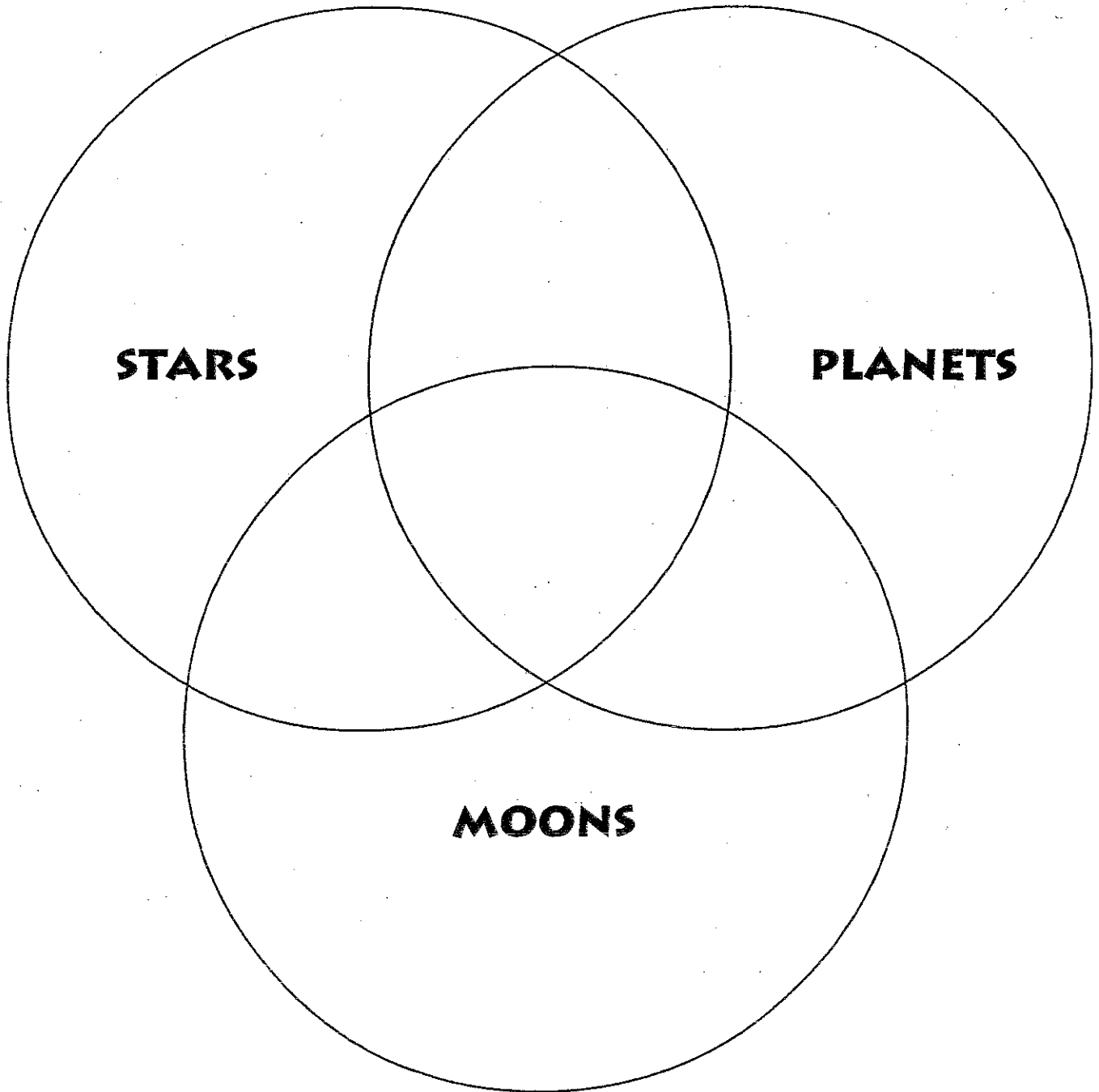
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*Venn Diagram 1*

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# People Search Activity

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## **Objective**

Content review

## **Grade Level**

5-6

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### **Procedure**

Explain the activity to your students. Using the People Search sheet (on the next page), each person is asked to move around the room until they find a person who can help them fill in the answer for one of the items in the boxes. The person who helped must sign their name once in the one box. The search continues as the student writes answers received from other students and gets their signatures in the other boxes. As a culminating activity, the teacher asks for volunteers to restate answers they collected.

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### **Note:**

This activity was contributed by Sue Reynolds Button of the Onondaga-Cortland-Madison BOCES, Syracuse, NY. For background information on the Milky Way Galaxy and the solar system, refer to *A Collection of Curricula for the STARLAB Solar System & Galaxy Cylinder*.

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# People Search Worksheet

Find someone who . . .

1. Can tell the name of our Solar System's sun	6. Knows his/her "universal address." (Ask, "Where do you live in the universe?")
2. Can compare and contrast the terms "star" and "planet."	7. Can define the term "ecliptic."
3. Can tell the number of stars in our Solar System.	8. Can explain why our Solar System's planets can never be seen in the north sky at our latitude.
4. Can name the planets in our Solar System in order (from the closest to the furthest from the sun.	9. Knows all thirteen constellations of the zodiac.
5. Can tell you the name of our home galaxy.	10. Can tell you their "sun sign" and can explain how they determined it.

# Our Universal Address

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**Note:**

This activity was contributed by Sue Reynolds Button of the Onondaga-Cortland-Madison BOCES, Syracuse, NY. For background information on the Milky Way Galaxy and the solar system, refer the *A Collection of Curricula for the STARLAB Solar System & Galaxy Cylinder*.

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**Grade Level**

4-6

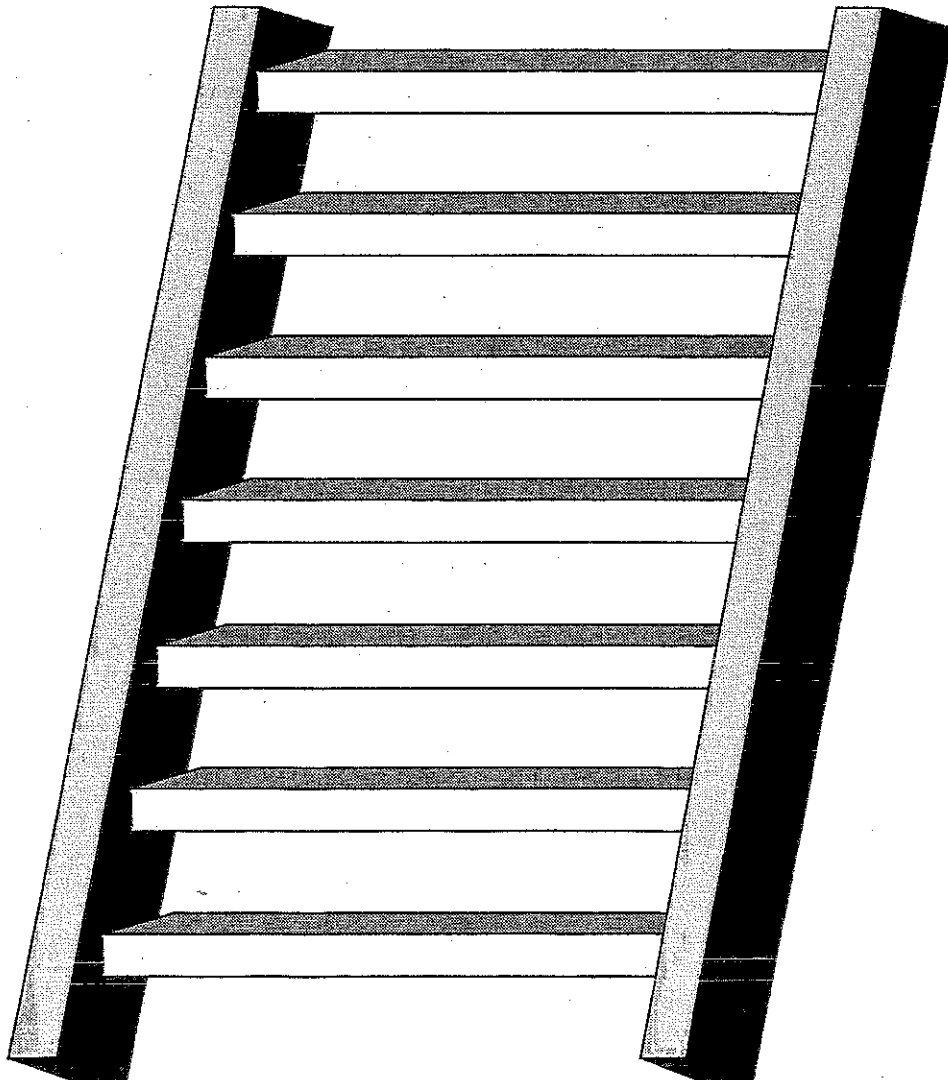
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**Procedure**

Explain the activity to your students:

"On the top rung of this ladder, write the name of something that represents the largest thing you can think of in space that can contain, inside of it, all the other categories on the ladder. It is the largest thing we can name in space and that we live in. Fill in the rest of the ladder rungs with names of objects, groups of objects that tell where we live in space. The smallest object or part will be written on the bottom rung of the ladder. We are ranking items according to size and what the item contains. Each item must contain the items that are on the rungs below it."

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# **A Summary of Planetarium Activities for Student Success (PASS)**

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*Series Editors: Cary Sneider, Alan Friedman, and Alan Gould*

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## **Series Introduction**

If you have access to a planetarium for teaching about astronomy, space science, and other subjects, this series of books is for you. Designed for both experienced planetarium professionals and teachers who will be using a planetarium for the first time, these volumes provide a wealth of field-tested strategies and practical suggestions for presenting entertaining and educationally effective programs for students.

The first four books provide a general orientation to astronomy and space science education with applications for both the planetarium and classroom settings. Each of the remaining volumes presents a complete planetarium program and related classroom activities. We hope you will find the materials useful in your work with students and teachers, as well as springboards for your imagination and creativity.

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## **Volume 1: Planetarium Educator's Workshop Guide**

Participatory planetarium programs involve students actively in the planetarium environment. The most effective programs are both entertaining and educational. This guide introduces the theory and practice of developing effective planetarium programs through a series of thought-provoking activities and discussions.

## **Volume 2: Planetarium Activities for Schools**

This volume provides a wealth of effective planetarium activities for elementary and middle school students, as well as ideas for developing new activities for students of any age.

## **Volume 3: Resources for Teaching Astronomy and Space Science**

There is a wide spectrum of resources for teaching astronomy and space science in elementary and middle schools. This annotated resource guide has the best resources that we have found, including school curricula, books, periodicals, films, videos, slides, professional organizations, planetariums, and telescopes.

## **Volume 4: A Manual for Using Portable Planetariums**

Primarily a "how-to" manual for setting up and using a portable planetarium, this guide has many suggestions useful for teaching school programs in any planetarium.

## **Volume 5: Constellations Tonight**

In this participatory version of a classic night sky planetarium program, students receive star maps and have an opportunity to use them to find constellations in the planetarium sky. Classroom activities include creating constellations and using star maps.

## **Volume 6: Red Planet Mars**

Students discover Mars three different ways during this planetarium program. They find the red planet by observing it over a period of several nights as it moves against the background stars. Then they view it through a telescope and try to map its surface. Finally they see Mars via space probes. Classroom activities involve students in modeling the solar system, and creating creatures that could survive under different planetary conditions.

## **Volume 7: Moons of the Solar System**

This program begins with observations of the earth's moon and a modeling activity that shows why the moon goes through phases and eclipses. Then the students look at Jupiter's four major moons on a series of nights and figure out

how long it takes one to circle Jupiter. Finally, the students journey through the solar system to see many moons through the “eyes” of modern spacecraft. Classroom activities involve students in performing experiments in crater formation, using moon maps, and designing lunar settlements.

### **Volume 8: Colors from Space**

What can we learn about the stars and planets from their colors? Answering this question requires a fundamental understanding of why we see color. During this program, students deepen their understanding through a series of activities in which they “travel” to an imaginary planet circling a red sun, and experiment with color filters and diffraction gratings. Related classroom activities include making secret messages that can only be decoded with color filters, and then using the same filters to view nebulae and planets.

### **Volume 9: How Big Is the Universe?**

Based partly on ideas from the short film *Powers of Ten*, this program surveys distances and sizes of things in the universe. Starting with ordinary things on earth that students are familiar with, they move to progressively more distant astronomical objects: the moon, the sun, the solar system, nearby stars, the Milky Way galaxy, and clusters of galaxies. Students use various methods to determine distance: parallax, “radar,” and comparing brightness of objects. Classroom activities include students writing their complete galactic address, making a parallax distance finder, finding the distance to the moon, and activities about the expanding universe.

### **Volume 10: Who “Discovered” America?**

Students ponder the meaning of the word discover in this program. Can one “discover” a land where people are already living? Students learn the reasons and methods by which Columbus navigated to the “New World,” and some of the impacts of his voyages on Native Americans. They also find that certain myths about Columbus are untrue. He was not, for example, alone in believing that the earth is round. Students also learn about other explorers who “discovered” America long before Columbus’s time. Classroom activities include determining the shape and size of the earth, using quadrants to determine latitude, and modeling lunar eclipses.

### **Volume 11: Astronomy of the Americas**

There are hundreds of Native American cultures, each with distinctive views of the heavens. There are also common threads in many of those cultures. In this program students visit five cultures: the Hupa people of Northern California, plains and mountain tribes that have used Medicine Wheel in Northern Wyoming, the Anasazi of Chaco Canyon in New Mexico, the Mayan people in Mexico and Central America, and the Incan people in Peru. Students observe moon cycles and changes in the sunrise and sunset positions on the horizon and learn how solar observations help Native Americans stay in tune with the harmonies of nature. Classroom activities include the Mayan and Aztec number systems, observing changes in real sunset positions, and learning how Venus can appear as either the “Morning Star” or “Evening Star.”

### **Volume 12: Stonehenge**

In this program, students learn what Stonehenge is and how it could have been used by its builders as a gigantic astronomical calendar. They also learn how astronomer Gerald Hawkins discovered one of Stonehenge’s probable functions, by actively formulating and testing their own hypotheses in the planetarium. Along the way, they learn a lot about apparent solar motion, and the creation of the research field of “archaeoastronomy.” Classroom activities include constructing a special Solar Motion Demonstrator to represent the entire yearly cycle of the solar motion.

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#### **Note**

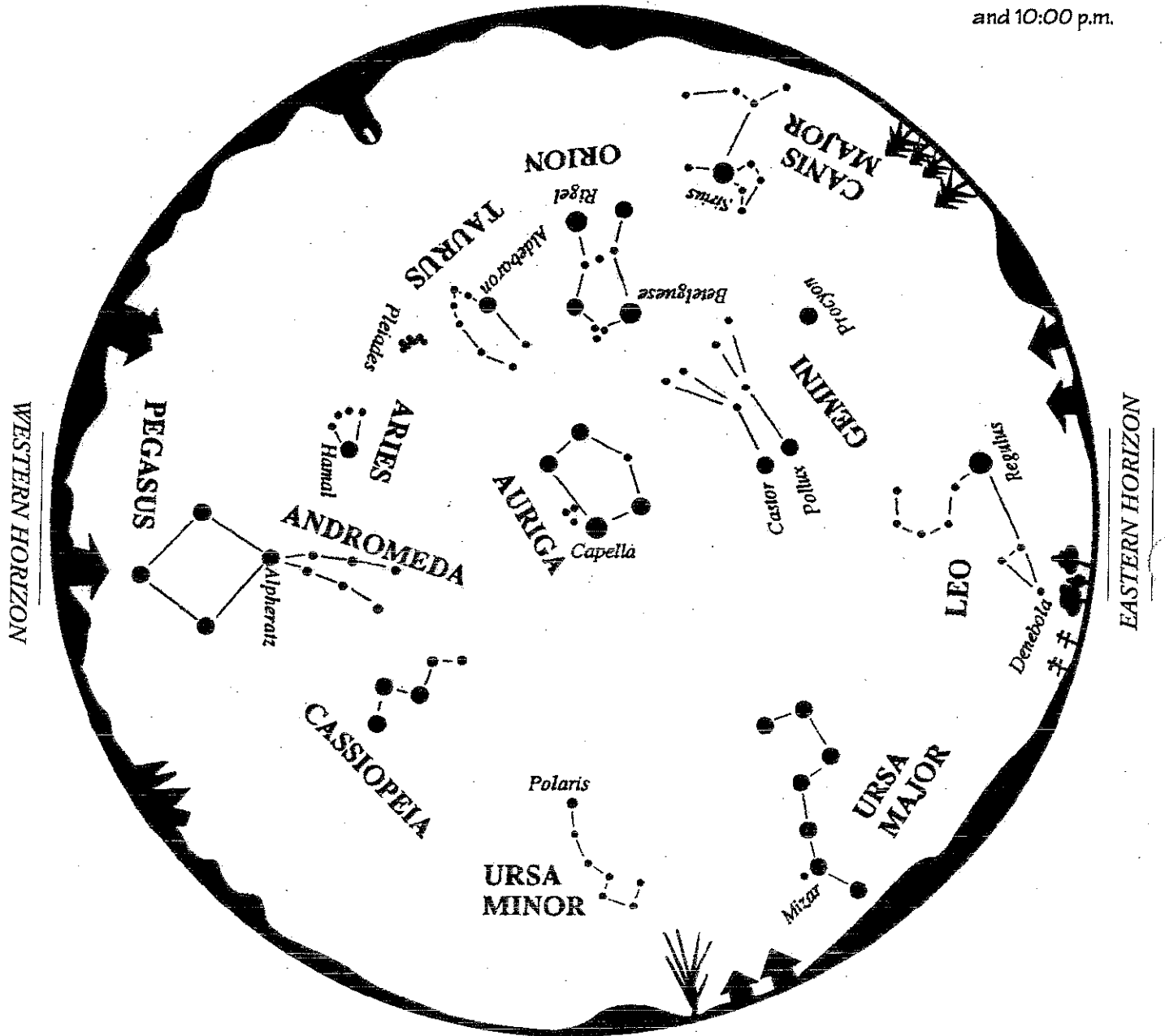
One set of this 12-volume series is sent to you free when you return your Product Registration form. If you haven’t already received a set with your system, make sure to send in your form! Additional sets can be ordered through Learning Technologies, Inc., by calling 800-537-8703 or 617-628-1459.

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# Evening Star Map for January - February

SOUTHERN HORIZON

between 9:00  
and 10:00 p.m.



NORTHERN HORIZON

To use map:

Turn the map so the direction you are facing is on the bottom.

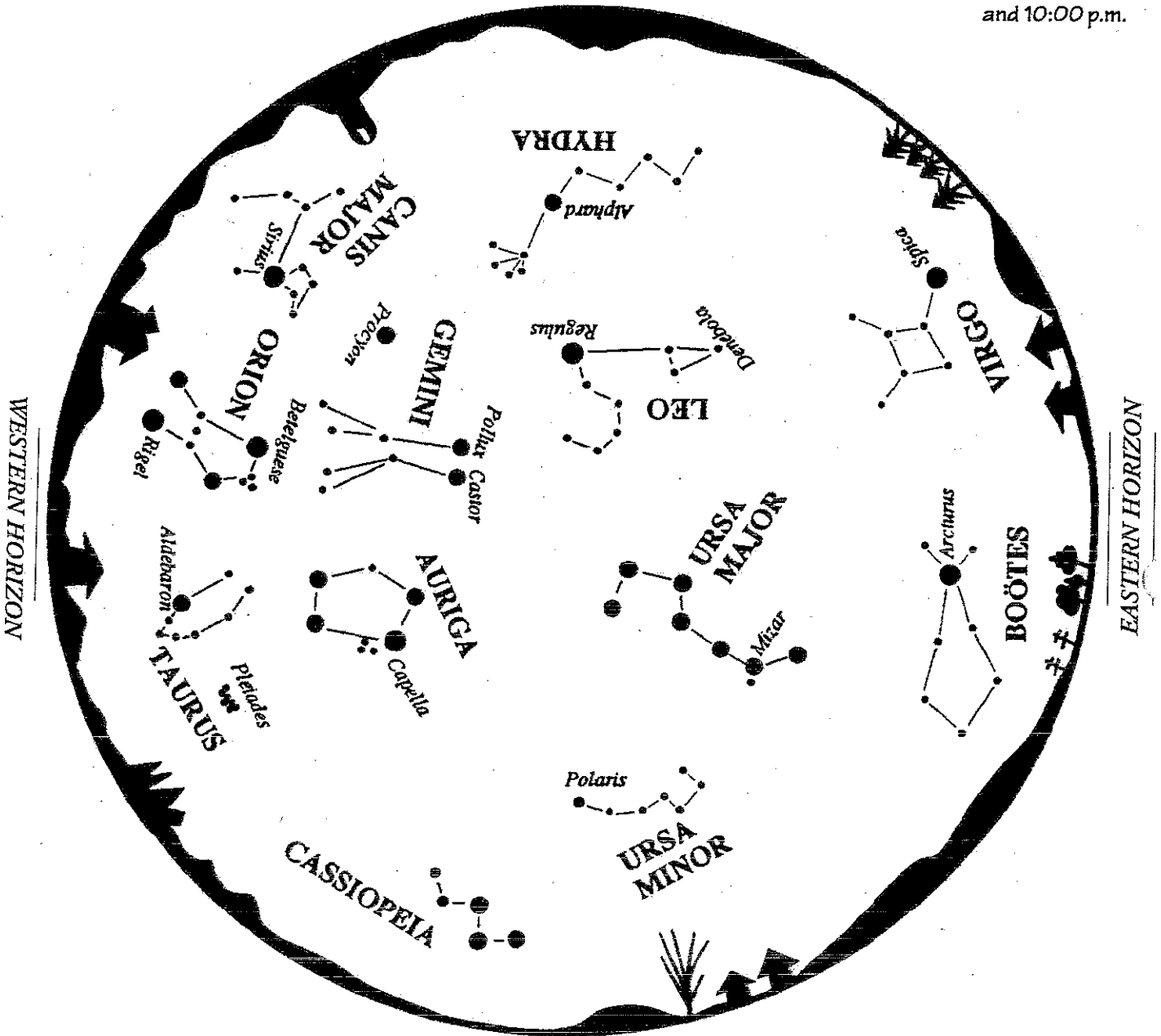
The constellations in the sky will match the constellations on the map.

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# Evening Star Map for March - April

SOUTHERN HORIZON

between 9:00  
and 10:00 p.m.



NORTHERN HORIZON

To use map:

Turn the map so the direction you are facing is on the bottom.

The constellations in the sky will match the constellations on the map.

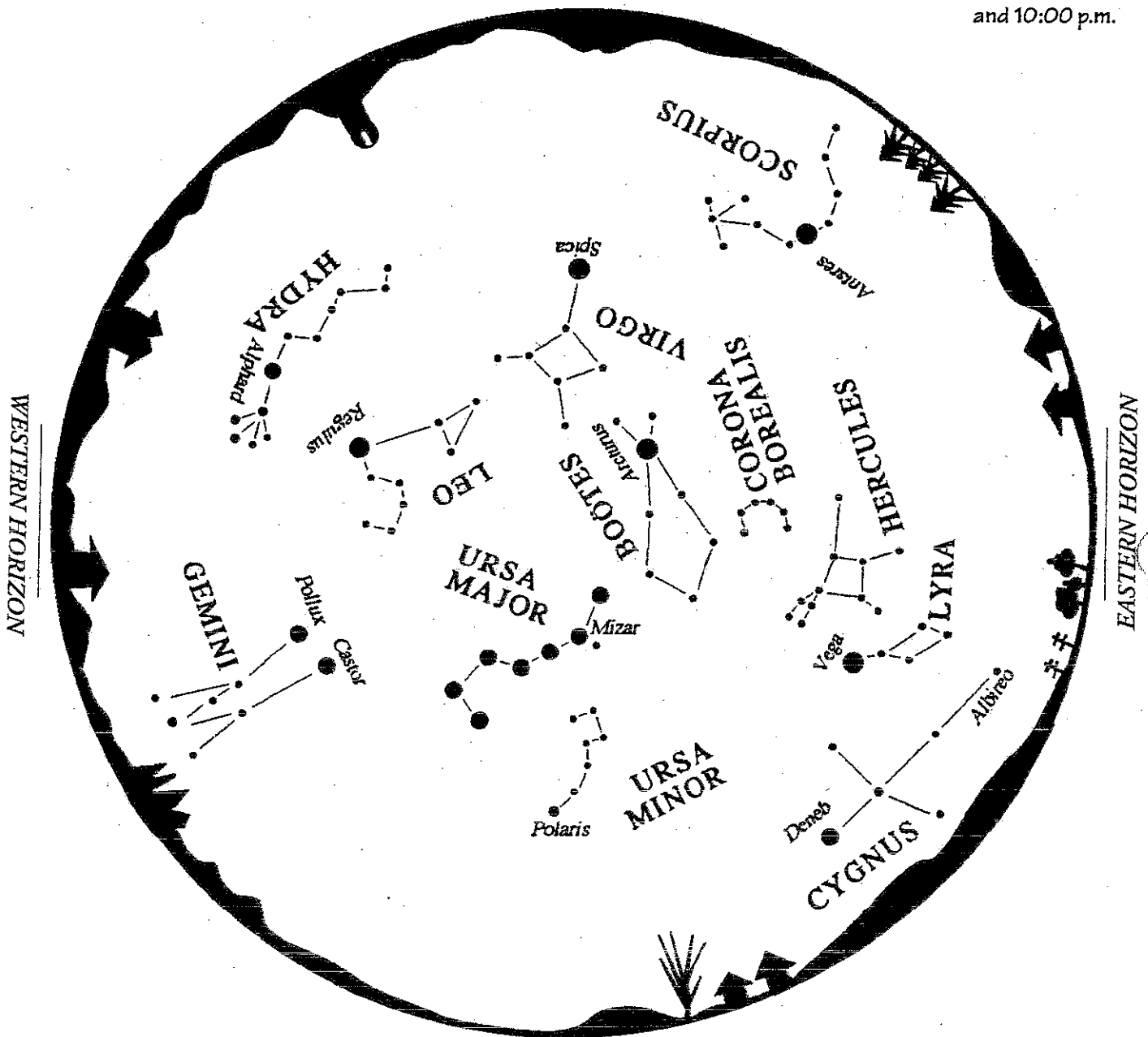
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# Evening Star Map for May - June

SOUTHERN HORIZON

between 9:00  
and 10:00 p.m.



NORTHERN HORIZON

To use map:

Turn the map so the direction you are facing is on the bottom.

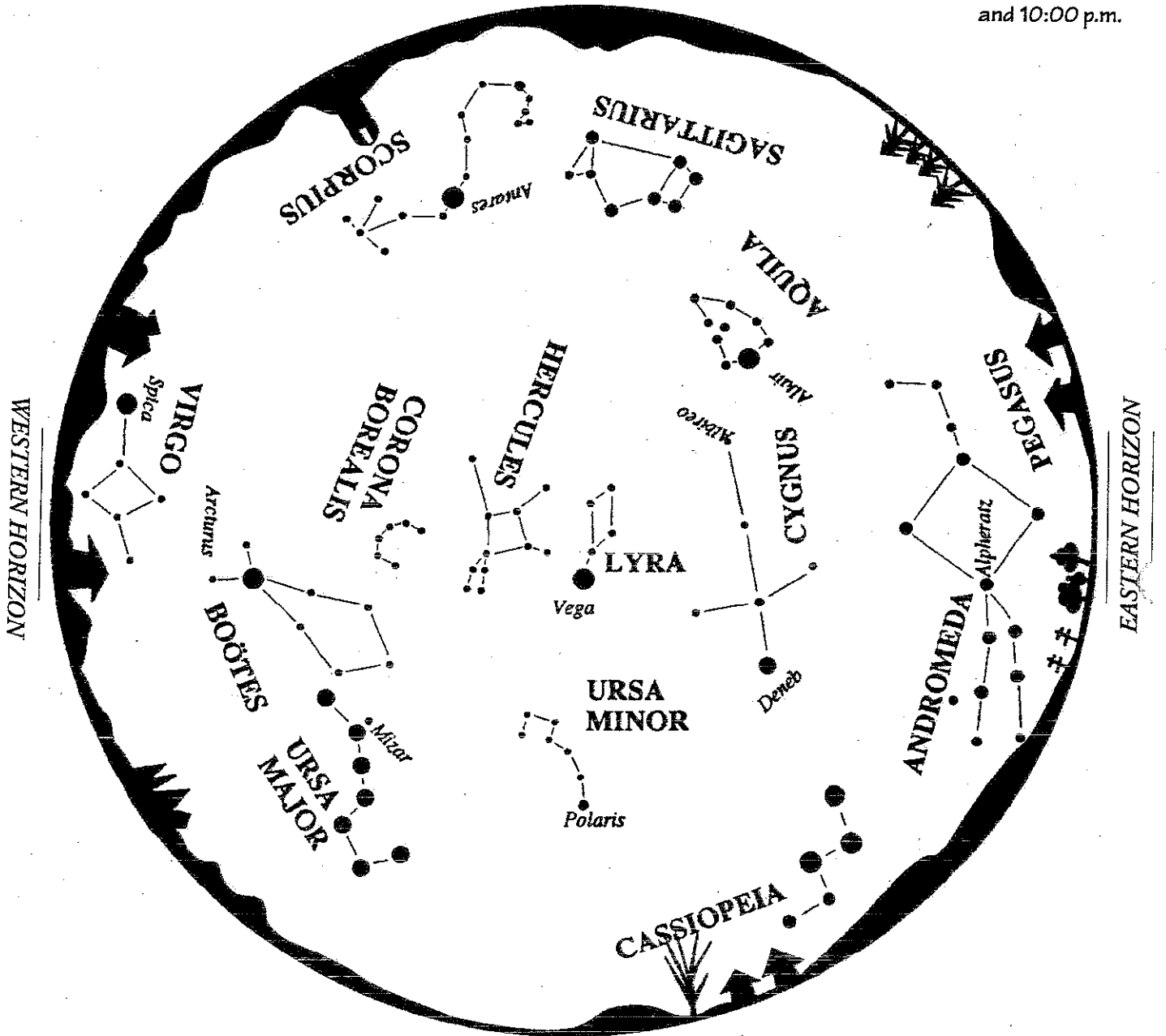
The constellations in the sky will match the constellations on the map.

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# Evening Star Map for July - August

SOUTHERN HORIZON

between 9:00  
and 10:00 p.m.



NORTHERN HORIZON

To use map:

Turn the map so the direction you are facing is on the bottom.

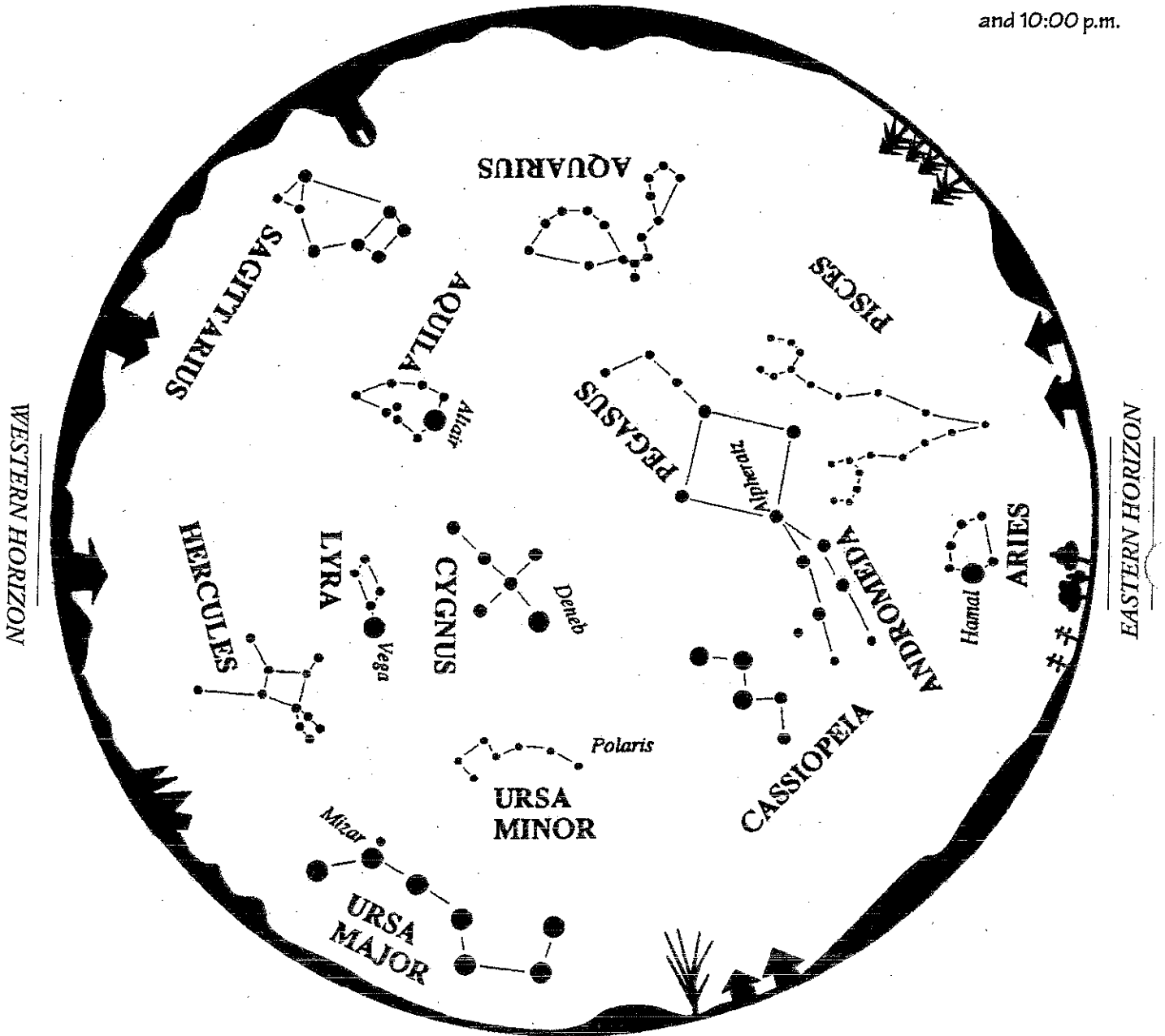
The constellations in the sky will match the constellations on the map.

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# Evening Star Map for September - October

SOUTHERN HORIZON

between 9:00  
and 10:00 p.m.



NORTHERN HORIZON

To use map:

Turn the map so the direction you are facing is on the bottom.

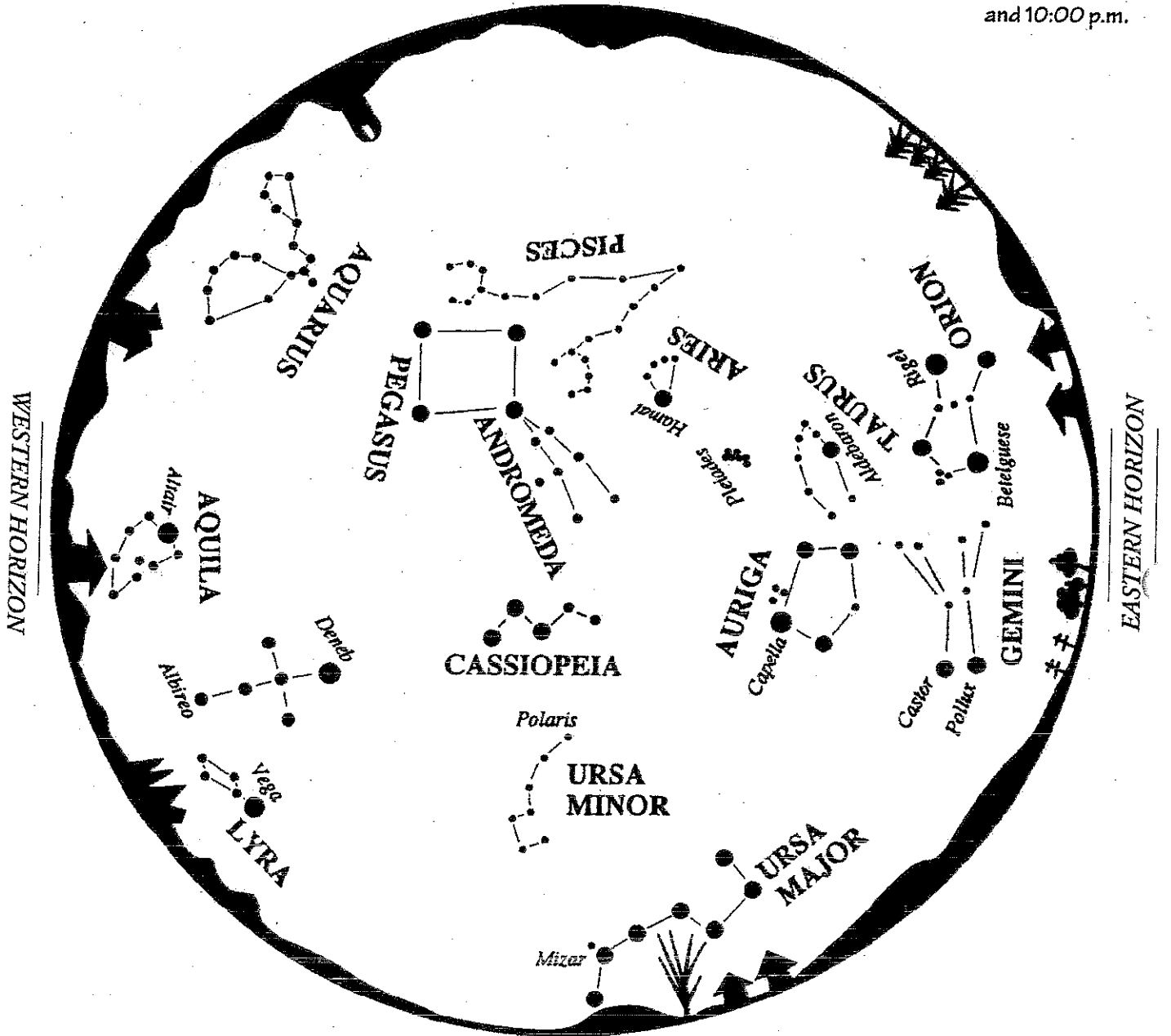
The constellations in the sky will match the constellations on the map.

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# Evening Star Map for November - December

SOUTHERN HORIZON

between 9:00  
and 10:00 p.m.



NORTHERN HORIZON

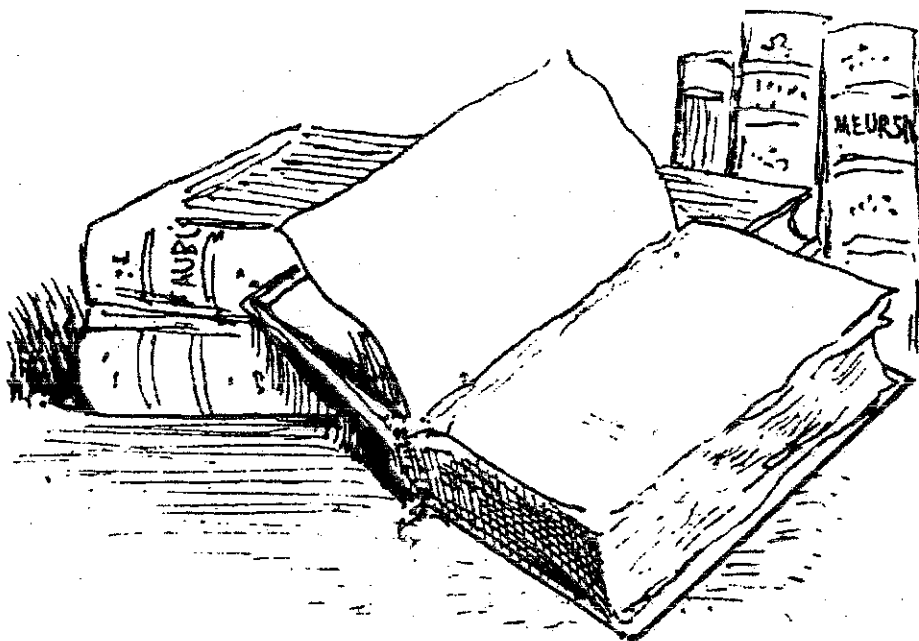
To use map:

Turn the map so the direction you are facing is on the bottom.

The constellations in the sky will match the constellations on the map.

From *Planetarium Activities for Student Success (PASS)*, Volume 5: *Constellations Tonight*. Reproduced with permission from Lawrence Hall of Science. Copyright © 1993 by The Regents of the University of California.

# K-6 Resources



# **Free and/or Inexpensive Materials to Teach Astronomy in the Classroom**

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## **The Universe in the Classroom: A Newsletter on Teaching Astronomy**

To be put on the mailing list for future issues, teachers should write on school stationery and identify the grade level they teach. This is a free, excellent classroom resource for grades 3-12.

Astronomical Society of the Pacific, Teachers' Newsletter, Dept. N, 390 Ashton Ave., San Francisco, CA 94112, Telephone: 1-800-335-2624

Also order their catalog. It is a plethora of astronomy materials.

## **Abrams Planetarium Sky Calendars**

For about \$7.50 a year, a sky calendar will be mailed quarterly, three issues per mailing. This single sheet contains a wealth of easily observed astronomical events, presented in a clear, understandable format with daily information given on a monthly calendar with a star map on the back. Contact Abrams Planetarium at the address below for current pricing.

Abrams Planetarium, Michigan State University, East Lansing, Michigan 48823

## **Science Education News**

This newsletter is free of charge and covers science education news, opportunities for fellowships, institutes, forums, and meetings, and reviews resources and reports on science education. Use school stationery.

Office of Science and Technology Education, American Assoc. for the Advancement of Science, 1333 H St. NW, Washington, DC 20005

## **NASA photographs, updates, and information sheets**

A wonderful wealth of up-to-date NASA information, including the Voyager 2 flybys. This material is free. Use school stationery.

NASA Jet Propulsion Laboratory, Attn: Teacher Resource Center, JPL Educational Outreach, 4800 Oak Grove Dr., Mail Stop CS-530, Pasadena, CA 91109

## **Free astronomy catalogs**

(Make requests on school stationery.)

Project STAR Hands-on Science Materials, Learning Technologies, Inc., 40 Cameron Ave., Somerville, MA 02144. Phone: 1-800-537-8703

Edmund Scientific, 101 E. Glouster Pike, Barrington, NJ 08007-1380

Sargent-Welch, 7300 N. Linder Ave., PO Box 1026, Skokie, IL 60077

Frey Scientific Co., 905 Hickory Lane, Mansfield, OH 44095

Optica, 4100 MacArthur Blvd., Oakland, CA 94619

## **Additional Materials**

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### **Great Explorations in Math and Science (GEMS) Series**

Created by the Lawrence Hall of Science, University of California, Berkeley. Including:

1. *Color Analyzers*, Grades 5-8.
2. *Earth, Moon and Stars*, Grades 5-9.
3. *Moons of Jupiter*, Grades 4-9.
4. *Oobleck: What Do Scientists Do?*, Grades 4-8.

Available from Learning Technologies, 40 Cameron Avenue, Somerville, MA 02144.

Phone: 1-800-537-8703 or 1-617-628-1459. Fax 1-617-628-8606.

### **Planetarium Activities for Student Success (PASS)**

A 12-volume set created by the Lawrence Hall of Science, University of California, Berkeley.

Available from Learning Technologies, Inc., 40 Cameron Avenue, Somerville, MA 02144.

Phone: 1-800-537-8703 or 1-617-628-1459. Fax 1-617-628-8606.

# Astronomy for Elementary Teachers

## Bibliography

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### Books

- Allison, Linda, *The Reasons for Seasons*, a Brown Paper Book Series, Little, Brown, and Co., Boston/Toronto/London.
- Beyer, S. L., *The Star Guide — A Unique System for Identifying the Brightest Stars in the Night Sky*, Little, Brown, & Co.
- Blum, James K., *The Stargazer's Companion*, Mallard Press, 666 5th Ave., NY, NY 10103.
- DeBrain, Jerry, and Murad, Don, *Look to the Sky*, Good Apple, Cartage, IL.
- Dickinson, Terence, *Exploring the Night Sky*, Camden House.
- Jobb, Jamie, *The Night Sky Book*, a Brown Paper Book series, Little, Brown and Co., Boston/Toronto/London.
- Krupp, E.C., *The Big Dipper and You*, Morrow Junior Books.
- Krupp, E.C., *The Moon and You*, Morrow Junior Books.
- Levy, David H., *The Sky — A User's Guide*, Cambridge University Press.
- Mayer, Ben, *Starwatch*, Perigee Books, Putnam Publishing Group.
- Menzel, D. H. and Pasachoff, J. M., *A Field Guide to the Stars and Planets*, National Audubon Society and National Wildlife Federation.
- Moeschl, Richard, *Exploring the Sky*, Chicago Review Press.
- Moore, Patrick, *Astronomers' Stars*, W. W. Norton & Co., NY/London.
- Moore, Patrick, *The Pocket Guide to Astronomy*, Simon & Schuster, NY.
- Porcellino, Michael, *Young Astronomer's Guide to the Night Sky*, TAB Books, Blue Ridge Summit, PA.
- Raymo, Chet, *365 Starry Nights*, Prentice Hall Press.
- Rey, H. A., *The Stars — A New Way to See Them*, Houghton Mifflin, Boston.
- Rey, H. A., *Find the Constellations*, Houghton Mifflin Company, Boston.
- Schaaf, Fred, *Seeing the Sky, 100 Projects Activities & Explorations in Astronomy*, John Wiley & Sons, NY.
- Whitney, Charles A., *Whitney's Star Finder*, Alfred A. Knopf, NY.



### **Tapes — Video and Cassette**

STARLAB Promotional Video, Learning Technologies, 40 Cameron Ave., Somerville, MA 02144.  
19 minutes, 1-800-537-8703.

*Tapes of the Night Sky — A Guided Tour of the Stars*, Astronomical Society of the Pacific. Available from Learning Technologies, 40 Cameron Ave., Somerville, MA 02144. 19 minutes, 1-800-537-8703 or 1-617-628-1459.

*Voyager — the Grand Tour*, (video) 19 min., Young Astronauts.

### **Magazines/Booklets**

*Astronomy* magazine, Kalmbach Publishing Co., 1027 N. 7th St., Milwaukee, WI 53233

"Backyard Astronomy," by Alan MacRobert, *Sky and Telescope* magazine. Sky Publishing Corp., PO Box 9111, Belmont, MA 02178

*Daytime Astronomy, Teachers' Guide for ESS*, Webster/McGraw Hill, Co.

*Earth, Moon, and Stars: An Astronomy Activity Guide*, GEMS Guides, by Cary Sneider, Lawrence Hall of Science, Berkeley, CA, 94720.

*The Edmund Sky Guide*, T. Dickinson and S. Brown, Edmund Scientific, Barrington, NJ 08007.

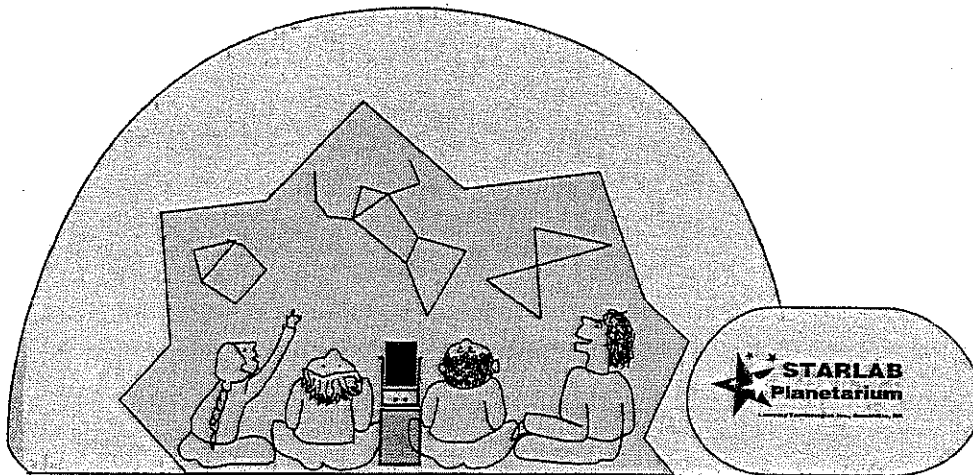
*A Look at the Planets*, NASA, Supt. of Documents, US Gov. Printing Office, Washington, DC 20402.

*Odyssey Magazine*, a magazine for children, 21027 Crossroads Circle, PO Box 1612, Waukesha, WI 53187-1612.

*Science and Children*, (contains sky chart and calendar), comes with membership in the National Science Teachers Assoc., 1742 Connecticut Ave. NW, Washington DC 20009-1171 (202-328-5800) \$52 per year for 8 issues.

# Stars & Skies,

## STARLAB Activities for Grades 4 to 6



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### An E.S.E.A. Title IV Project, 1979.

The *Stars & Skies* project was originally developed in 1979. The activities in this section have been culled from the original document and updated by Gary D. Kratzer. These activities should be especially useful to the beginning STARLAB user. The elementary section is divided according to grade level. Each section contains suggested student objectives, background information, and planetarium activities. This section also contains supplemental activities to be used as pre- or post-planetarium visits. Refer to the Appendix (located at the end of the Grades 7-9 section) includes scripts and directions for construction of support equipment.

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Revised by Gary D. Kratzer, 1997

# Elementary Grades 4-6 Objectives

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## Objectives — Grade 4

The student should be able to:

1. Identify the cardinal directions and locate the North Star in the planetarium.
2. Describe the general east to west movement of the sun, stars, and moon.
3. Observe and describe the apparent motion of the Big Dipper in relation to the North Star over a period of several hours.
4. Observe and discuss the concept that stars continually shine but may not be seen by the naked eye due to other stronger light sources.
5. Observe and describe the movement of constellations.
6. Demonstrate that constellations are merely imaginary star groupings that are not connected in any physical way.
7. Identify the circumpolar constellations, using the Constellation Cylinder within the STARLAB.

## Objectives — Grade 5

The student should be able to:

1. Compare and discuss the work of early astronomers Copernicus, Galileo, and Ptolemy.
2. Describe the phases of the moon in 5 stages (new to full).
3. Observe and discuss the major constellations not covered at previous levels, using the Constellation Cylinder within the STARLAB.
4. Describe the comparative positions of the circumpolar stars in a given 24-hour period.
5. Describe the relative positions of the circumpolar stars in different seasons of the year.
6. Demonstrate why the North Star does not appear to change its relative position in the sky.
7. Demonstrate an understanding that celestial bodies appear to move in a regular path through the universe "dome."

## Objectives — Grade 6

The student should be able to:

1. Compare and discuss the work of some early astronomers. Review 5th level astronomers and add Tycho Brahe, Kepler, and Eratosthenes.
2. Describe the relative changes in the sunrise and sunset times over a one-year period.
3. Demonstrate an understanding of the reasons for the apparent motion of the stars.
4. Demonstrate an understanding of the seasonal changes in stellar locations due to the revolution of the earth around the sun.
5. Demonstrate an understanding of the differences in stellar motion as observed from the equator versus the polar regions.
6. Identify four major stellar reference points used in locating and describing positions of other stellar bodies.
7. Identify the location and explain the Greek mythological origin of the zodiacal constellations.
8. Discuss and compare legends of the Native American with those of the Greek legends of Ursa Major, Ursa Minor, Cassiopeia, and Orion.
9. Demonstrate the use of a star finder map by locating constellations in the STARLAB sky.

# Cardinal Directions, Activity 4-1

## Objective

The student should be able to identify the North Star and cardinal directions within the planetarium.

## MATERIALS

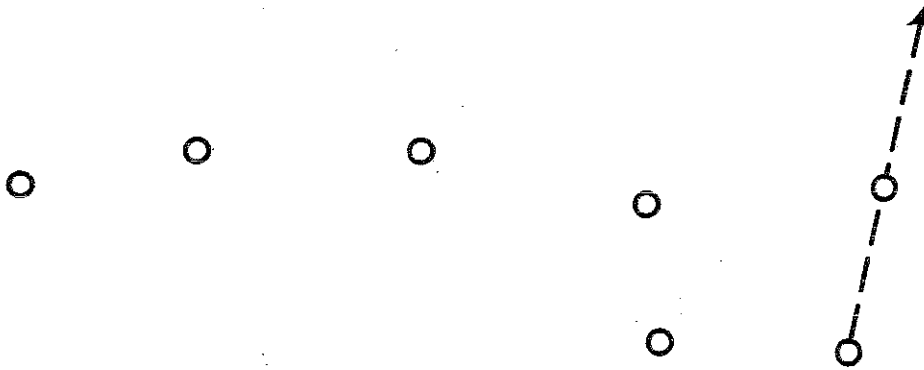
- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder

## Procedure

- Set the projector for a particular date, time and latitude.
- Have the student locate the Big Dipper (Ursa Major). Locate the two stars at the end of the cup. These are the pointer stars. (See diagram.)

## Note

If you are observing from a latitude near  $30^\circ$ , the Big Dipper will actually appear to dip below the northern horizon within a 24-hour period as it revolves around Polaris.



## Procedure

- Follow an imaginary line connecting these two stars approximately 5 times the length between the two pointer stars. Polaris (North Star) will be the moderately bright star nearest to that line.
- Have the students establish that quadrant as north. Have the students face north. Now explain that south will be behind them, east to the right and west to the left.

# Celestial Movement, Activity 4-2

---

## Objective

The student should be able to describe the general east to west movement of the sun, the moon and other stars.

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- ecliptic slide projector mount
- moon slide set
- 35 mm slide projector

---

### Procedure 1

- Set the Starfield Cylinder for 12:00 a.m. in the month of December at your home latitude. Have the students observe the constellation, Orion.
- Advance the cylinder one hour, observing the same constellation.
- Rotate the cylinder platform until Orion disappears below the western horizon and continue until it reappears on the eastern horizon. Have the students discuss the observed directional movement of the constellation. Point out that the movement is an east to west movement.
- Demonstrate the east to west movement of the sun and moon.

---

### Procedure 2

- Use the same procedure as above, substituting months for the hourly settings. Specify that the monthly observation needs to be made at the same time of night each month.
- Discuss the similarity in east-west movement.

---

### Extension Activity

Set up a slide projector on the ecliptic slide projector mount. Set the mount at the 30° setting. Use the moon slide set and demonstrate the motion of the moon by turning the swivel base from east to west. Discuss east to west movement of the

## Apparent Motion, Activity 4-3

---

### Objective

The student should be able to observe and describe the apparent motion of the Big Dipper (Ursa Major) in relation to the North Star over a period of several hours.

### MATERIALS

- STARLAB Portable Planetarium
- Projector
- Constellation Cylinder

---

### Procedure

- Have the students identify the position of the Big Dipper at a particular time. Using the pointer stars, locate and identify the North Star.
  - Set the projector for 8:00 p.m. Observe the location of the Big Dipper.
  - Turn the projector to the 9:00 p.m. setting. Discuss the change in position of the Dipper, especially noting the "handle."
  - Make several other one-hour changes. Discuss the movement.
- 

### Extension Activity

For an additional activity, select times at random and have students predict the time. Also discuss the similarities of the movement to a clock, noting that the Dipper will make one complete rotation in 24 hours.

# Stars and Light Pollution, Activity 4-4

---

## Objective

The student should be able to observe and discuss the concept that stars continually shine but may not be seen with the naked eye due to a phenomenon known as light pollution.

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- Variable Light Source (see Appendix in 7-9 section)

---

## Procedure

- Turn down the side lamps on the projector. Adjust the projector to its lowest setting. No star should be seen. Ask the students to describe what they see.
  - Slowly increase the brightness of the projector (with the Starfield Cylinder in place). Ask students to tell you when they see the first star. Continue to turn knob until the entire starfield is lighted. Discuss the concept that stars are of different brightness (called magnitude).
  - Turn the dimmer knob on projector down from full brightness about 1/2 turn. Slowly turn on the variable light source. Discuss the comparison of this light to the rising sun with the children.
  - As the Variable Light Source reaches full strength, ask the students the difference they see in the starfield in the planetarium sky. Emphasize the concept that stars make their own light and are constantly emitting light, but our eyes will only register that light if there is no other stronger light source interfering. In this case, the Variable Light Source (sun simulator) is stronger than many of the stars of lower magnitude, thereby rendering them invisible to our eye.
  - Discuss real life situations where this same thing happens.
- 

## Extension Activity

Have students observe the sky from various locations such as: urban, rural, and isolated places away from lights.

# East-West Constellation Movement, Activity 4-5

---

## Objective

The student should be able to observe and discuss the general east to west movement of constellations.

## Background

Constellation configurations do not actually move above us, but only appear to move due to the rotation of the earth and the gradual revolution of our planet around the sun.

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Constellation Cylinder

---

## Procedure

- Set the projector for 7 p.m. on a specified date and latitude. Identify any one of the constellations visible on that date. With the students, make note of the location of the constellation.
  - Now move the projector to the 8 p.m. setting and observe the changes. Continue the process for each hour (ex. 9:00 p.m., 10 p.m., etc.). Students should note the general east to west movement.
  - Select a specific time to observe. Set the projector for the first day of the month you are observing. Note the location of a selected constellation.
  - Next move the projector to the first of the following month, same time of night. Note location of the constellation. Continue this date movement for each of the 12 months. Discuss the yearly motion and compare it to the nightly motion.
-



# Star Groupings, Activity 4-6

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## Objective

The student should be able to demonstrate the concept that constellations are merely imaginary star groupings that are not connected in any physical way.

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Constellation Cylinder
- Starfield Cylinder
- white paper
- markers
- arrow pointers
- clipboards (optional)

---

### Procedure 1

- As the students sit in the planetarium ask them to observe the starfield and see if they can connect the stars to make any shapes. Have them work in pairs. Share their findings. Pass around arrow pointers, if available.
  - Put on the Constellation Cylinder and introduce the word "constellation." Point out a couple of the common constellations (Big Dipper, Cepheus). Ask students to suggest ways they think these constellations got their names.
  - Turn up the planetarium side lights. Divide the students into 4 or 5 groups. Ask each group to put a series of dots on their sheet of white paper which has been provided (do not connect yet), using the felt tip markers. Give each group a number. That number should be put on their sheet. The group should make up a name for their constellation. The number will serve to identify the group's work.
  - Have each group display their constellation. Have each student or group decide what each constellation might be. Share the ideas. Discuss the variety of answers and emphasize the concept that constellations are arbitrary configurations made up by man.
- 

### Procedure 2

- Have the students connect the stars in any pattern to form a figure of some type. This will be their "self-discovered" constellation.
  - Have the students name their constellations. You may want them to compose a mythical story to go with the figure.
  - As a class you may want to develop an entire sky map, putting each student's constellation in the sky, and use a bulletin board as your universe.
-

# Circumpolar Constellations, Activity 4-7

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## Objective

The student should be able to identify the circumpolar constellations on the constellation starfield in the portable planetarium.

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## Procedure

- Using the *Do it Yourself Star Finder*, familiarize yourself with the following constellations: Ursa Major (Big Dipper), Ursa Minor (Little Dipper), Draco, Cepheus, Cassiopeia.
- In STARLAB, ask students to identify the Big Dipper. Discuss the idea that the Big Dipper is part of the constellation Ursa Major, the Big Bear. It can be seen all year in the northern sky.
- Use the pointer stars at the edge of the Big Dipper cup to locate Polaris. Since Polaris (North Star) is at the tip of the handle of the Little Dipper, the constellation Ursa Minor, the Little Bear, is found. It can also be seen all year in the northern sky.
- Cassiopeia is located on the opposite side of the North Star from the Big Dipper. Draw a line through the pointer stars to the North Star and continue that line twice that distance to find the constellation. Nicknamed the Lazy W, Cassiopeia is found high in the autumn evening sky. In summer it is found in the northeastern sky and in winter in the northwestern sky.
- Next, move to Cepheus, who is located near his queen, Cassiopeia. The top side of the Lazy W will point to Cepheus. Cepheus is made up of rather dim (low magnitude) stars. Its shape is basically a triangle on top of a box. Cepheus is upside down in the northeastern summer evening sky. He can be found high in the autumn evening sky and low in the spring sky.
- Finally, Draco, the Dragon, appears next to Cepheus. He wraps his tail around Ursa Minor (Little Dipper). The stars between the Big and Little Dippers are the end of the dragon's tail. The main body of the dragon begins and stretches to the diamond-shaped head. The legs are very low magnitude stars, so look closely. Draco is high in the summer evening sky and low in the winter northern sky.

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Constellation Cylinder
- *Do it Yourself Star Finder* (see pp 21, 22)
- *Constellation Locator Script* (see Appendix)

## Extension Activity

Go outside at night with your students and use the *Do it Yourself Star Finder* to locate these same constellations in the real night sky.

# Early Astronomers, Activity 5-1

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## Objective

The student should be able to compare and discuss the work of early astronomers: Ptolemy, Copernicus, and Galileo.

## Background

Ptolemy, in his book, *The Almagest*, explained the geocentric (earth-centered) theory of the planetary motions. The planets were thought to rotate in circles (epicycles), the centers of which described orbits around the earth. The sun and moon, also considered planets, were believed to orbit the earth without epicyclical rotation.

Not until the year 1543 did anyone seriously challenge the idea that Earth was the center of the universe. A Polish astronomer, Nicolaus Copernicus, argued that the earth and the moon, along with the other five planets then known, all moved around the sun in circles. He also said that the earth rotates and this makes the sun and stars appear to move across the sky. Like most ideas that upset comfortable old beliefs, the idea that earth was in motion was hard to accept. It was up to other scientists later on, to prove that Copernicus was right.

Galileo advanced the idea that before explaining what happens, you must carefully observe how it happens. He used a set of lenses, developed by a Dutch spectacle maker, Hans Lippershey, to invent a telescope that made objects appear about 36 times larger. Observations with his telescope, especially the discovery of the phases of Venus, supported the ideas of Copernicus.

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## Procedure

- Class discussion in the planetarium or classroom setting should center around each of the men.
  - Student reports can be assigned. Have students write news articles, in the present tense, about the findings of these men.
- 

## Extension Activities

Students could role play and dress according to the times.

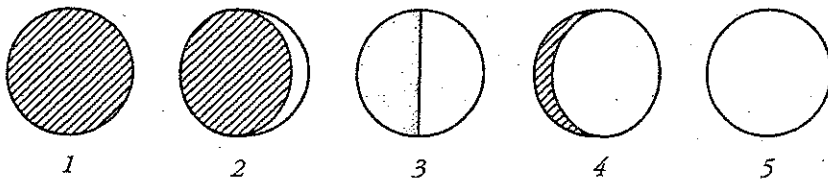
# Phases of the Moon, Activity 5-2

## Objective

The student should be able to describe the phases of the moon in five stages (new to full).

## Background

1. New moon
2. Waxing crescent
3. First quarter
4. Waxing gibbous
5. Full moon



During the revolution of the moon about the earth, the relative positions of the sun, earth, and moon change. This causes sunlight to be reflected toward the earth by different portions of the side of the moon facing us. The changing positional relationships of the sun, earth, and moon caused by the moon's orbit about the earth are responsible for the apparent changes in its shape as viewed from Earth.

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### Procedure for the classroom

For several weeks prior to obtaining the STARLAB, students should observe the moon outdoors each night and report on its appearance and position in the sky.

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### Procedure for the planetarium

- Using a star chart, set the projector for the appropriate date, time, and latitude.
  - (Optional) Set up the slide projector on its stand just to side of the entrance tube.
  - Using the STARLAB moon phases (or slide projector with moon phase slides), give students practice in identifying the different phases of the moon.
  - Demonstrate the general path the moon takes across the sky (east to westerly movement).
- 

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- moon phases

### Optional

- ecliptic slide projector mount (see Appendix for plans)
- 35mm projector
- moon phase slides

## Constellation Location, Activity 5-3

---

### Objective

The student should be able to locate the following constellations using the Constellation Cylinder: Ursa Major, Ursa Minor, Cassiopeia, Cepheus, Draco, Orion, Canis Major, Leo and Pegasus.

---

### Procedure

Review the concept of what a constellation is. Read the Constellation Locator Script while displaying the Constellation Cylinder giving ample time for students to locate the stars in the dome as you read. Use the arrow pointer to review each of the constellations. If you feel that the students are capable, you may project the entire starfield using the Starfield Cylinder and review those constellations covered.

---

### MATERIALS

- STARLAB Portable Planetarium
- Projector
- Constellation Cylinder
- Constellation Locator Script (see Appendix)
- arrow pointer

# Nightly Position of Constellations, Activity 5-4

## Objective

The student should be able to describe the comparative positions of the circumpolar constellations in a given 24-hour period.

## Background

The constellations, Ursa Major, Ursa Minor, Draco, Cassiopeia, and Cepheus, can easily be seen circling Polaris in a 24-hour period.

## MATERIALS

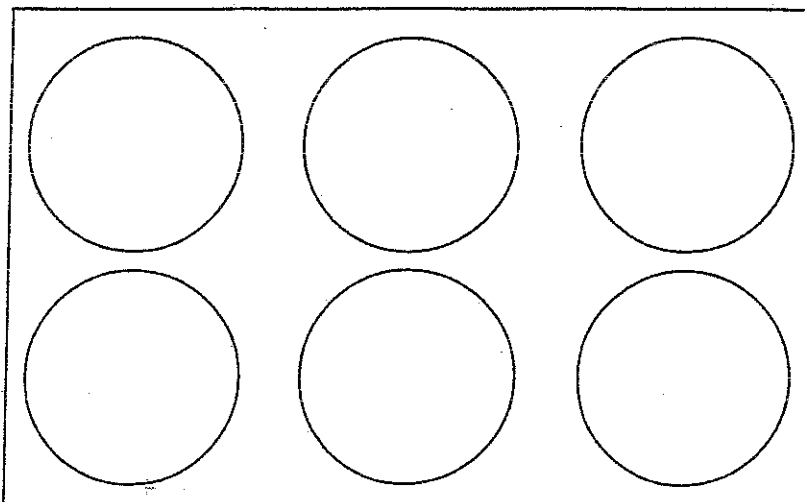
- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- Constellation Cylinder
- worksheet of circles

## Procedure

- Using standard setup procedure with the Constellation Cylinder, locate the Big Dipper (Ursa Major) and Polaris. Show students how the Big Dipper appears to rotate around Polaris. You may do this by turning the projection cylinder one complete rotation.
- Locate the other major circumpolar constellations and note the motion by turning the cylinder one complete rotation again.
- Place the Starfield Cylinder on the projector and locate the Big Dipper and Polaris.
- Give the students the worksheet of circles. Have them draw the position of the Big Dipper in the appropriate section of Circle #1.
- Move the projection cylinder through 4 hours of the night time sky. You may or may not wish to identify the particular time. Have the students again draw the position of the Big Dipper in the appropriate section of Circle #2.
- Continue this same procedure of 4 hour movements and drawing the Big Dipper in the rest of the sections of each circle. This will show the position of the Big Dipper through a 24-hour period. You may follow the same procedure for the other circumpolar constellations.

## Note

It should be emphasized that in the real sky all of the positions would not be seen due to daylight hours.



## Seasonal Position of Constellations, Activity 5-5

---

### Objective

The student should be able to describe the relative positions of the circumpolar stars in different seasons of the year.

### Background

If the circumpolar constellations are observed at the same time each night throughout the year, they will appear to make a complete rotation around Polaris (North Star).

### MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- Do it Yourself Starfinder

---

### Procedure

- Use the Do it Yourself Starfinder to become familiar with the position of the circumpolar constellations in various months of the year.
  - Have the Starfield Cylinder set for one of the fall months. Make your observation time about 9:00 p.m. for your latitude.
  - To show students the different positions of the circumpolar constellations throughout the year, simply rotate the projector month-by-month past the 9:00 p.m. observing time as indicated on the hour and date scale.
- 

## Position of the North Star, Activity 5-6

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### Objective

The student should be able to demonstrate why the North Star does not appear to change relative position in the sky.

---

### Procedure

- Using the Constellation Cylinder, have the students use the "pointer" stars of the Big Dipper to locate Polaris (North Star). Point out the rest of Ursa Minor (Little Dipper).
  - Have the students follow the movement of Ursa Minor while the projector platform is turned slowly by hand one complete rotation. The students should observe Polaris as the pivot point for the movement of Ursa Minor.
  - Have some students follow the motion of other circumpolar constellations while observing the North Star.
  - The same activities may be repeated using the Starfield Cylinder.
- 

### MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- Constellation Cylinder

# The Ecliptic, Activity 5-7

---

## Objective

The students should be able to demonstrate an understanding that celestial bodies appear to move in a regular path against the background of space.

## Background

The ecliptic is the path which the sun and planets seem to follow in the night sky or celestial sphere. It is the midpoint of a band  $16^\circ$  wide between which the twelve constellations of the zodiac are found, as well as the sun, moon and planets.

---

## Procedure

- Using the Constellation Cylinder, point out the location of the ecliptic.
  - While moving the cylinder in a slow circle, have the students observe and follow certain constellations located close to the ecliptic.
  - Using a planet slide in the projector mounted on the ecliptic slide projector mount, move the planet along the ecliptic. Discuss the movement. Point out that the ecliptic path will not always be in the same place in the sky. Relate this path to the changing daily path of the sun across the sky during the seasons.
- 

## MATERIALS

- STARLAB Portable Planetarium
  - Projector
  - Constellation Cylinder
- Optional
- 35 mm slide projector
  - ecliptic slide projector mount (see Appendix)
  - planet slides



# Studying Early Astronomers, Activity 6-1

---

## Objective

The student should be able to compare and discuss the work of Ptolemy, Copernicus, Galileo, Brahe, and Kepler.

## Background

Refer to background information from Activity 5-1.

Tycho Brahe made careful observations of the sky for twenty-seven years. He kept accurate nightly records of the positions of the planets that could be seen with the naked eye — Mercury, Venus, Mars, Jupiter, and Saturn. Brahe mapped the positions of about a thousand stars. Even though he believed that the sun revolves around the earth and that the other planets revolve around the sun, the accurate data he obtained was later useful to many astronomers. It was especially useful to Brahe's assistant, Johannes Kepler.

Johannes Kepler became an assistant to Brahe only a year and a half before Brahe died. Through study of the thousands of pages of notes Brahe left, Kepler discovered patterns and relationships. His discoveries are called Kepler's laws. They give the mathematical explanation for calculating:

- 1) The shape of a planet's orbit.
- 2) The speed of a planet at each part of its orbit.
- 3) The period of revolution of each planet.

---

## Procedure

- Conduct a class discussion in the planetarium or classroom covering each of the astronomers covered.
  - Assign written reports. Have students write news articles, in the present tense, about the findings of these astronomers.
- 

## Extension Activity

Students could role play and dress according to the times.

# Sunrise and Sunset Position, Activity 6-2

---

## Objective

The student should be able to describe the relative changes in the sunrise and sunset positions and times over a one year period.

## Background

If you got up early enough to watch the sunrise one morning each week for a whole year, you would notice an interesting pattern. On September 22 (autumnal equinox) the sun would rise due east; on December 21 (winter solstice) the sun rises from its southern-most position; on March 20 (vernal equinox) the sun again rises due east; and on June 21 (summer solstice) the sun rises from its northern-most position. If you made accurate observations from the time the sun rose due east, then moved southward, then northward, then back due east, you would find that 365 days had passed.

The yearly changes in the stars which are visible are sometimes difficult for children to understand. Remember that it is night when we are on the side of earth away from the sun, and we can only see those stars which are above us at night. Consider two times of the year; six months apart — for example, December 21 and June 21. The earth is on opposite sides of its orbit on these two dates. When you look into the sky on these two nights you are looking in opposite directions and see a different part of the sky. Therefore, the stars seen in the southern sky will change throughout the year. For the same reason, the stars which are near the North Star will appear to make a complete circle around it each year.

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- horizon worksheet (paper with horizon drawn on it)

### Optional

- ecliptic slide projector mount

---

## Procedure

- Using the Starfield Cylinder and optional ecliptic slide projector mount, set up for approximately September 22 by removing the plug covering the September sun position on the Starfield Cylinder. Repeat the procedure when observing in December, March and June. Project the sun due east just above the horizon. Rotate the cylinder to about December 22 and show the sun rising from its southern-most position along the ecliptic. Again rotate the cylinder to about March 20 and show the sun rising due east. Rotate the cylinder to about June 21 and show the sun rising at its most northern position. Finish the activity by moving the cylinder once more to September 22 and show the sun rising due east.
- Review the procedure for locating the North Star (Polaris) and have the students follow the apparent motion of the circumpolar constellations as they move around Polaris. Be sure to relate the movement to the rotation of the earth (one complete turn of the cylinder equals 24 hours).
- Have the students face the eastern horizon and locate a star or constellation. Use a star and planet finder to help. For example: if you observe the night sky on November 15 at 9:00 p.m., the constellation, Orion, will be in the eastern sky. The students should follow the constellation as it rises and sets. This motion should be related to the rotation of the earth.

---

## Extension Activities

Have the students plot the path of the sun rising throughout a year's time on a worksheet that has the horizon drawn on it. Use the sunrise-sunset time schedule to relate the days getting shorter and shorter and then longer and longer to the above activity showing the different positions of the sun rising at different times of the year.

# Apparent Motion, Activity 6-3

## Objective

The student should be able to demonstrate an understanding of the reasons for the apparent motion of the stars.

## Procedure

Demonstrate these concepts as you explain this in STARLAB.

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder

*The earth has two principal motions. Rotation is the turning of the earth on its axis.*

*Revolution is the motion of the earth in its orbit around the sun. (Care should be taken not to confuse these terms when working with children). The earth rotates on its axis once in 24 hours (rounded off). When viewed from above the North Pole, the earth turns in a counterclockwise direction. It might be less confusing to children if the earth is thought of as turning from west to east. The sun appears to rise in the east. We know that the earth is moving and the sun is "standing still."*

*Therefore, we must be moving toward the sun at sunrise or toward the east. It is important to see that sun time varies from east to west because of the earth's rotation. For example, sunrise occurs in New York long before it does in California.*

*When the earth is observed from above the North Pole, it appears as a circle. All circles contain  $360^\circ$ ; therefore it is  $360^\circ$  around the earth. We know that the earth turns once in 24 hours. By dividing the distance around the earth ( $360^\circ$ ) by the time it takes for the earth to rotate once on its axis (24 hours) we find that the earth turns  $15^\circ$  per hour. It is extremely important for children to realize that the apparent night motion of the stars is due to the earth's rotation, and not movement of the stars! Think of the stars as being stationary in space. What will a star on the eastern horizon appear to do as the earth turns toward the east? Obviously it will appear to rise. Following the same logic, it is apparent that the North Star will not appear to move since it is over the axis of the earth. The stars which are near the North Star will appear to circle the earth. The stars which are near the North Star will appear to circle it since they are seen too far above the horizon to rise and set.*

*The movement of the earth around the sun is called revolution. The earth revolves about the sun in approximately 365 and  $1/4$  days or one calendar year. While the earth is revolving around the sun, its axis points toward the North Star (Polaris). Since the axis angle never changes, the angle between the earth's axis and the sun is constantly changing; giving us our seasons and causing changes in the stars which are visible.*

## Seasonal Changes, Activity 6-4

---

### Objective

The student should be able to demonstrate an understanding of the seasonal changes in stellar locations due to the revolution of the earth around the sun.

### Background

Many constellations appear to change positions in the sky as the seasons change. If you know your constellations well, you can use them as a calendar to help tell the month of the year.

### MATERIALS

- STARLAB Portable Planetarium
- Projector
- Constellation Cylinder
- Starfield Cylinder

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### Procedure

- Locate the Big Dipper and Cassiopeia in the northern sky. Which one seems to be on top? (Cassiopeia will be on top if the projector is set for observing in May). Turn the projection cylinder month-by-month and have the students observe or chart the location of these two constellations throughout the different seasons.
  - Have the projector (with either cylinder) set for observing in August at 9:00 p.m. Locate the constellations Sagittarius, Scorpius, and Libra in the southern and western sky close to the horizon or the ecliptic. Turn the cylinder so the students will see these constellations pass from view in the west. In early November at 9:00 p.m. the constellations Capricornus, Aquarius, and Pisces will appear in the south and west along the ecliptic. Again, turn the cylinder stopping on another month and locating the constellations seen in the southern sky. In this manner, the students will observe a general east to west movement of constellations throughout different seasons of the year.
- 

## Stellar Position — Poles vs. Equator, Activity 6-5

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### Objective

The student should be able to demonstrate an understanding of the differences in stellar position at the equator versus the polar region.

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### Procedure

- Demonstrate the sky as seen from the North Pole. Tilt the projector to a latitude of  $90^\circ$  North. Locate the Big Dipper and Polaris. Turn on the daily motion switch and slowly rotate the cylinder in a complete circle. Show the students what stellar motion is like as viewed from the North Pole.
  - Show the sky as seen from the equator. Change the latitude of the cylinder to  $0^\circ$  or the equator. If the change is made slowly, the students will see familiar stars disappear to the north while new stars appear to the south. Turn on the daily motion to move the cylinder slowly in a complete circle. This will demonstrate stellar motion as seen from the equator. The North Star is due north on the horizon. The South Pole of the sky is due south on the horizon. The South Pole is hard to locate because no conspicuous stars mark it. Both points (the North and South Poles of the sky) will not appear to move.
- 

### MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder

# Stellar Reference Points, Activity 6-6

## Objective

The student should be able to identify four major stellar reference points used in locating and describing positions of other stellar bodies.

## Background

Stellar observers generally use well-known and easily identifiable astronomical features as reference points in locating other stellar features. Four common reference points are:

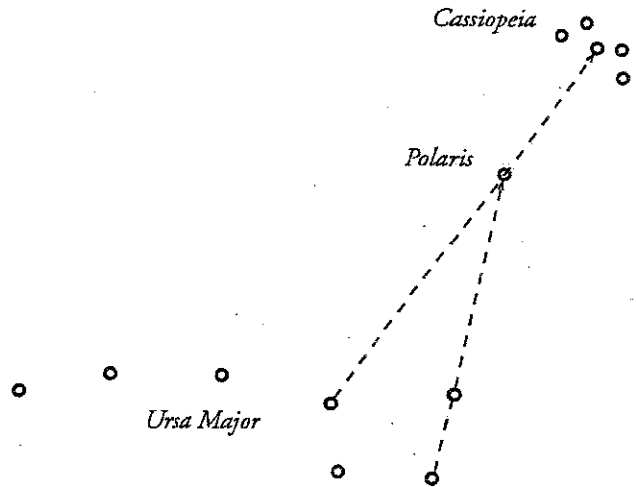
1. Polaris
2. Cassiopeia
3. Pointer stars of the Big Dipper (Ursa Major)
4. Orion's belt

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- arrow pointer

## Procedure

- Have students identify the Big Dipper (Ursa Major). Locate the 2 stars which make up the end of the cup. These two stars, called the pointer stars, are most important. Using the arrow pointer, have each student point to these stars and draw a line through them and approximately five times the distance between them to locate Polaris, the North Star.
- To reinforce the idea that all bodies seem to rotate around Polaris, slowly turn the cylinder and notice the phenomenon.
- Have students find the star which joins the handle of the Big Dipper to the bowl. Follow an imaginary line from this star through Polaris (North Star) and continue in this direction until you find the "W" or "M" shaped constellation of Cassiopeia. Again, have each student follow the location procedure. If time permits, turn the projector off, turn the cylinder a 1/4 turn, turn projector back on, and relocate Cassiopeia.
- To locate Orion (Orion the Hunter can be found in the southern sky throughout the winter), look for Betelgeuse (Beetle Juice) and Rigel (Ri-gel), the two brightest stars with the three dimmer stars of the belt halfway between the two. From the three stars forming Orion's belt, follow the line suggested by these three stars to the south-east. They lead to the very bright star, Sirius, the most apparently bright star of the night skies. Sirius is the bright star in the constellation, Canis Major or Big Dog. Canis Major is one of the two hunting dogs of Orion.



(Illustration not to scale).

# Greek Mythological Constellations, Activity 6-7

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## Objective

The student should be able to observe the location and discuss the Greek mythological origin of the zodiacal constellation.

## Background

The twelve zodiacal constellations are:

- Aries, the Ram
- Taurus, the Bull
- Gemini, the Twins
- Cancer, the Crab
- Leo, the Lion
- Virgo, the Virgin
- Libra, the Scales
- Scorpius, the Scorpion
- Sagittarius, the Archer
- Capricornus, the Sea Goat
- Aquarius, the Water Bearer
- Pisces, the Fishes

## MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- Constellations Cylinder
- Greek Mythology Cylinder
- Do it Yourself Star Finder

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## Procedure

- Locate the 12 zodiacal constellations using the Constellation Cylinder or Greek Mythology Cylinder. (The Do it Yourself Star Finder will also help).
  - Then locate the 12 zodiacal constellations on the Starfield Cylinder.
  - Optional: refer to the Constellation Locator Script.
-

## Native American and Greek Myths, Activity 6-8

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### Objective

The student should be able to discuss and compare/contrast the legends of the Native American and the Greek legends of Ursa Major, Ursa Minor, Cassiopeia, and Orion.

---

### Procedure

- Discuss and compare Native American Mythology with Greek mythological origins of selected constellations.
  - Students may be divided into groups for research and presentation of constellation origin: Native American and Greek. Presentations can be given in the STARLAB.
- 

### MATERIALS

- STARLAB Portable Planetarium
  - Projector
  - Starfield Cylinder
- Optional
- Native American Mythology Cylinder
  - Greek Mythology Cylinder

## Using a Star Finder, Activity 6-9

---

### Objective

The student should be able to demonstrate the use of a Do it Yourself Star Finder by locating a given constellation within the portable planetarium.

### Background

Follow the specific directions for the Do it Yourself Star Finder.

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### Procedure

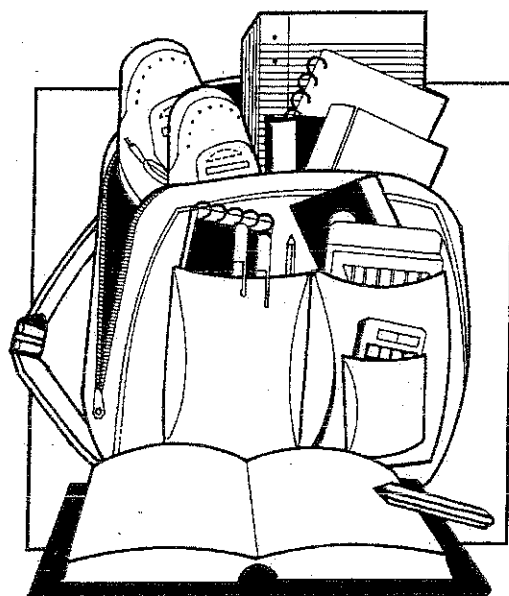
With the Starfield Cylinder in place and latitude set, hand out the Do it Yourself Star Finders. Beginning with easy-to-find constellations, have students locate them for a particular day and time of the year.

---

### MATERIALS

- STARLAB Portable Planetarium
- Projector
- Starfield Cylinder
- Do it Yourself Star Finder

# Stars & Skies, Supplemental Activities for Grades 4-6





## Jumbled Words

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At the conclusion or beginning of a group of activities or a unit on a certain subject, duplicate the following scrambled words and/or use other special vocabulary from the unit. See how many words the students can unscramble in a specified time.

nselcolatioent	(constellations)
sptlean	(planets)
nortsaomy	(astronomy)
etpeolces	(telescope)
treeom	(meteor)
mcote	(comet)
smra	(Mars)
erats	(stars)
czodia	(zodiac)

## Comparing the Size of the Planets

---

### Note

To scale down the size of the planets, you can use any unit of measurement. The smallest unit can be the smallest planet. For example, you might use 1 centimeter as 1 unit.

### Procedure

- Mark off 1 unit on a piece of paper. This represents the diameter of Mercury. Make a circle from this diameter as shown.
- Use the table below to measure the diameter of each planet.
- Cut out and label each planet.
- Discuss: Which planet is the largest? Which planet is the second largest? Which planets are about the same size as the earth? How might you compare the size of the sun with the size of each of the planets?
- Suggestion: You might make a mobile out of your planets. Make the planets out of heavy paper or back them with cardboard and hang them on a clothes hanger.

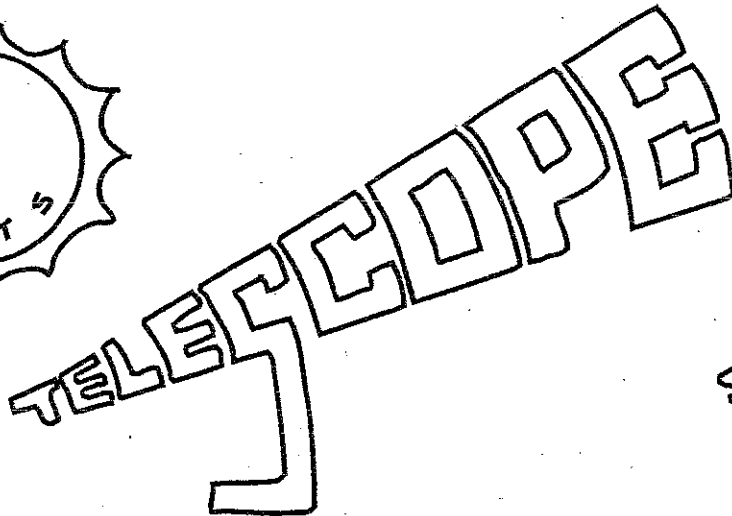
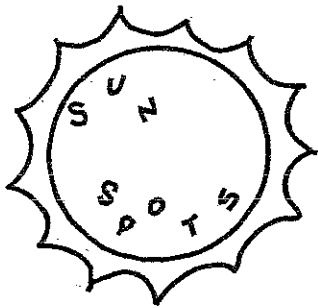
### MATERIALS

- paper
- pencil
- scissors

### Units of Diameter

Venus — $2\frac{1}{2}$	Jupiter — 29	Neptune — 9
Earth — $2\frac{3}{5}$	Saturn — 25	Pluto — 1
Mars — $2\frac{2}{5}$	Uranus — 10	Sun — 287

## Drawing Words



**Some words can be written so they show their meaning.**

---

### Procedure

- Ask the students to think about how they might draw other words about the solar system.
  - Have them try their luck using words such as the following.
- 

Constellations

Satellite

Reflecting

Orbit

Meteors

Solar System

Comet

Eclipse

Galaxy

Winter

Rotation

Summer

Mercury

Autumn

Revolution

Spring

# Word Search

## Word List

Find the following words in the puzzle below.

Moon	Rocket	Orbit
Rotate	Gravity	Phase
Sun	Month	Wax
Apollo	Astronaut	Wane
Telescope	Lunar	Seas
Rays	Tide	Crescent
Cold	Meteorite	Hot
Volcanoes	Eclipse	Crater
Satellite	Gibbous	

S	A	T	E	L	L	I	T	E	A	W	A	X	P	G
G	K	M	O	N	T	H	S	C	D	A	N	R	M	I
R	P	R	O	C	K	E	T	L	P	N	H	O	T	B
A	H	M	E	T	E	O	R	I	T	E	S	T	D	B
V	A	X	C	O	L	D	Q	P	D	L	R	A	F	O
I	S	Y	W	Z	C	R	E	S	C	E	N	T	R	U
T	E	L	E	S	C	O	P	E	L	G	S	E	A	S
Y	B	A	S	T	R	O	N	A	U	T	S	R	Y	T
L	O	R	B	I	T	M	O	O	N	G	D	R	S	I
K	S	U	N	S	V	O	L	C	A	N	O	E	S	D
A	P	O	L	L	O	S	R	C	R	A	T	E	R	E

# Making Constellation Slides

---

## Procedure

- Use processed black 35mm slides (or slides you took when you thought there was enough light) to make constellation slides. Place the black slides on a soft surface such as a magazine. Using a needle, poke small holes in the slide at locations corresponding to star positions in the constellations.
  - A shoe box makes a good projector for constellation slides made out of black construction paper. If each student made a projector and a slide you would have some good material for a quiz. Cut the end out of a shoe box and two slots on each side to allow a piece of black construction paper, with pin holes in the form of a constellation, to slide through. Place a flashlight on the inside of the box or cut out the other end of the box to allow light to pass through the pin holes.
  - Clear transparencies with the constellations drawn on them is a simple way to project the stars.
  - Have several students draw stars (small dots for small circles) hit or miss on the chalkboard so that the board is quite full of "stars" in the "sky." The students may use a piece of plain white paper and fill their "sky" full of "stars" and then exchange their paper with another student. Ask the children to see if they could join some together with a line and tell what this picture reminds them of.
- 

# Lost in Space

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## Note

The purpose of this activity is to become familiar with the facts about the universe.

---

## Procedure

- The class is to be divided into two teams of equal ability.
  - Each team elects a captain who will be responsible for giving the team answer. The first player on Team A gives a one-sentence description of where he is; for example: "I am on a planet that has four moons." The players on Team B have up to three team guesses to guess where player on Team A is. If they guess correctly, the player from Team A is captured and becomes a member of Team B. If they do not guess correctly, the first player from Team B describes where he is and the players from Team A do the guessing. The team with the most players at the end of the allotted time is declared the winner.
  - It would be helpful to the students to give them a little time to do some research on their own location. To avoid errors, the pupil who gives the description might be requested to write the correct answer to where he is lost and allow the teacher to check it, to insure that his clue description is correct.
-

## Lost on the Moon Worksheet

You are in a space crew originally scheduled to rendezvous with a mother ship on the lighted surface of the moon. Mechanical difficulties, however, have forced your ship to crash-land at a spot some 200 miles from the rendezvous point. The rough landing has damaged much of the equipment on board. Since survival depends on reaching the mother ship, the most critical items available must be chosen for the 200 mile trip. Below are listed the 15 items left intact after landing. Your task is to rate them in terms of their importance to your crew in its attempt to reach the rendezvous point. Place number 1 by the most important item, 2 by the second most important, and so on through number 15 for the least important.

- \_\_\_ Box of matches
- \_\_\_ Food concentrate (4 packages)
- \_\_\_ 50 feet of nylon rope
- \_\_\_ Parachute silk (1 large piece)
- \_\_\_ Portable heating unit
- \_\_\_ Two .45 caliber pistols (with shells)
- \_\_\_ One case dehydrated milk
- \_\_\_ Two 100 lb. tanks of oxygen
- \_\_\_ Stellar map (of the moon's constellations)
- \_\_\_ Flashlight
- \_\_\_ Magnetic compass
- \_\_\_ Gallons of water (5)
- \_\_\_ Signal flares (3)
- \_\_\_ First aid kit with injection needles
- \_\_\_ Solar-powered FM receiver transmitter

Compare your ranking with the astronauts' list supplied by your teacher, then do the following:

- Beside each item on your list, place the number that represents the difference between your ranking and the astronauts' ranking. For example, if you listed oxygen first, you would write 0 in front of oxygen on your list. If you had ranked it third you would write 2, and so on.
- After placing a score beside each item on your list, add up the individual scores to set a total score.
- The lower your score, the closer you came to surviving the return trip to the base ship.
- What is your survival score?
- Compare your score with others in your class.

Refer to the above list to answer the following questions.

1. Oxygen, water, and food concentrate are very important items. Why?
2. How would the star chart and solar-powered receiver-transmitter be useful?
3. For each one of the following items, briefly explain why it would be almost useless for your survival: box of matches, magnetic compass, flashlight, portable heating unit.
4. If you were stranded on the dark side of the moon would your ranking of items be different?
5. Which two items named in Question 3 would become important on the dark side of the moon? Why?

## **Lost on the Moon Answer Key**

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**Here's how astronauts would rank the importance of the following:**

- 15 Box of matches (little or no use on moon)
- 4 Food concentrate (4 packages) (daily food requirements)
- 6 50 feet of nylon rope (help in climbing, securing packs)
- 8 Parachute silk (1 large piece) (shelter against sun)
- 12 Portable heating unit (useful only for dark side of moon)
- 10 Two .45 caliber pistols (with shells) (Useful as self-propulsion devices)
- 11 One case dehydrated milk (nutrition source when mixed with water)
- 1 Two 100 lb. tanks of oxygen (necessary for breathing)
- 3 Stellar map (of the moon's constellations) (Principal means of finding direction)
- 13 Flashlight (useful only for dark side of moon)
- 14 Magnetic compass (useless; moon probably has no magnetic poles)
- 2 Gallons of water (5) (to replenish body loss)
- 9 Signal flares (3) (location marker when within sight of base ship)
- 7 First aid kit with injection needles (for injury or sickness)
- 5 Solar-powered FM receiver transmitter (distress signaling)

### **Answer to questions on Lost on the Moon Worksheet**

1. These meet critical body requirements and they are not found on the moon.
2. Important for determining position; means of communication with base ship.
3. Matches — will not burn on the moon.  
Magnetic compass — no known magnetic poles on the moon.  
Flashlight — sun is so bright it would be difficult to tell whether it was on or off.  
Heating unit — too much heat already.
4. Yes.
5. Flashlight for signaling and for lighting the way, and the portable heating unit because of extreme cold on dark side.

## Fun Pictures for Your Classroom

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