3-D MODEL OF THE BIG DIPPER

grades K–8

Objective

To demonstrate that stars and constellations are not arranged in a flat, 2-D pattern.

Introduction

Constellations are not what they seem. Although the stars all appear to be about the same distance from Earth, some are actually much farther away than others. The flat patterns the stars appear to form are an illusion. The stars in a constellation actually form three-dimensional patterns that look different from different angles.

This activity lets students construct a 3-D model of the pattern of stars known as the Big Dipper. They will see that the stars seem to form a flat pattern shaped like a dipper only when viewed from one direction—our viewpoint on Earth. Viewed from other locations in outer space, the pattern formed by these stars would look completely different.

Background Reading for Educators

The 3-D Universe, available at
http://www.amnh.org/education/resources/rfl/pdf/du_x04_3d.pdf

Materials for Part One

Black construction paper

An 8.5 x 11-inch piece of rigid cardboard or foam core board
(the top of a shoebox works well)

Black thread

Aluminum foil,
cut into seven 6-inch squares

Tape

Ruler

Copy of the Big Dipper map (pg. 5)

Developed with the generous support of
The Charles Hayden Foundation

Procedure

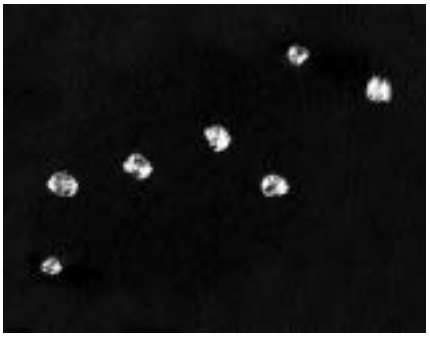
Part One: Introducing the Big Dipper

1] Copy the map of the Big Dipper (pg. 5) for each student in the class. Hold the map in front of the class.
Ask: Do the students recognize this star arrangement? Have they ever picked it out in the night sky? Do all the stars look the same distance away?
Explain: These stars form a pattern that many people recognize as the Big Dipper. The Big Dipper is part of the constellation Ursa Majoris, also known as the Big Bear. Though the stars in the Big Dipper seem to form a flat pattern, they are actually all different distances from Earth.

2] Show the class a finished mobile before they start making their own. Explain that they are going to build a mobile that will demonstrate what the Big Dipper might look like from different places in outer space.

Meg Carlough/AMNH

Completed Big Dipper mobile as seen from a side view.



Meg Carlough/AMNH

Big Dipper as viewed from below the mobile.

Part Two: Making the Mobile

3] Place the map of the Big Dipper over the black piece of construction paper. Poke a hole through each star so that the construction paper has a pattern of holes in the shape of the Big Dipper.

4] Tape the black construction paper to the cardboard or the foam. Poke holes through the cardboard where the "stars" appear on the construction paper. Hold it up for the class.
Ask: Can they make out the shape of the Big Dipper?
Explain: This is a 2-D view of the stars since it is on a flat piece of paper.

5] Cut seven two-foot-long pieces of thread.

6] Cut a six-inch square of foil and tape the end of one piece of string to it. Crumple the foil into a ball around the string, making the ball as tight as you can. Here is your first star! Repeat this six times until you have seven foil-ball stars on strings.
Explain: The foil balls represent the stars in the Big Dipper. The mobile will be hung above your head, so the closest stars to you will hang from the longest pieces of string. The chart will tell you how long each piece of string should be.

7] Poke the free end of one thread through the hole for Star no. 1 (the first star on the end of the handle). Use your Big Dipper map to find the name of this star: Alkiad. Find Alkiad in the chart below. In the right-hand column of the chart, you'll see that its string length is zero. Pull the string all the way up so the star is touching the background. Tape the thread in place on the backside of the board.

Chart for String Length

Star Name	**Distance from the Earth** in light years	**String Length** in inches
1) Alkiad	123	0
2) Mizar	78	$9\frac{1}{8}$
3) Alioth	80	$8\frac{5}{8}$
4) Mergez	81	$8\frac{1}{2}$
5) Phecda	83	$8\frac{1}{8}$
6) Merak	79	$8\frac{7}{8}$
7) Duhbe	123	0

8] Repeat this for the second star in the handle, Mizar. In the chart above you will find that Mizar needs a string length of $9^1/_8$ inches. Pull the string up through the hole, using a ruler to ensure that the string length from star to cardboard is $9^1/_8$ inches. Do the same for the rest of the five stars. Be careful not to let the strings get tangled together as you work.

Part Three: Hang and View the Mobile

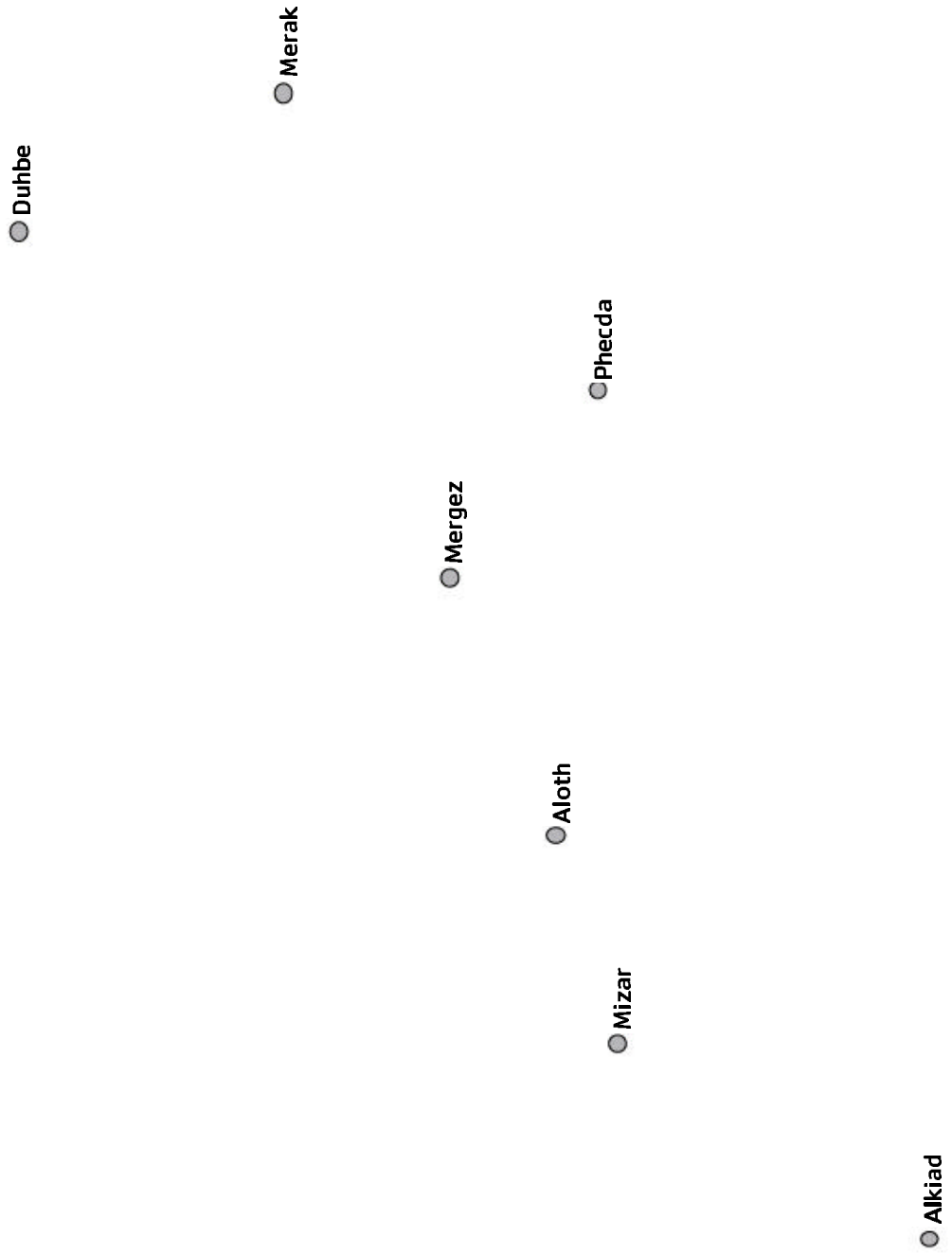
9] To hang your mobile, poke four new holes through the cardboard, each about an inch in from the four corners. Now cut two more pieces of string, each about two feet long. Pull one piece of thread down through one corner hole and then pull it up through the nearest corner hole. Tie the two ends together, then repeat for the other two holes. Tie the two loops together so the board hangs flat.

10] Hang the mobile from a nail in a doorway, or tape it to the ceiling.

11] Have your class view the mobile from straight underneath.
Ask: Can they make out the shape of the Big Dipper?
Explain: This is the view that we have from Earth. The stars are different distances away, but from straight below the stars form the shape of a dipper.

12] Walk around the model and look at the shape the stars make.
Ask: Can they see the shape of the Big Dipper any longer? Does the formation resemble a dipper at all?
Explain: From the side you can clearly see that some stars are closer to the Earth and some stars are further away. The stars seem to form a flat, two-dimensional pattern only when seen from Earth. They actually form a three-dimensional pattern that looks different from different angles.

BIG DIPPER MAP



This activity is from OLogy, the American Museum of Natural History's Web site for kids, http://www.ology.amnh.org