



3-D Constellations

Activity Guide

Adapted with permission from the activity Building Three-Dimensional Models of Constellations in *Project STAR: The Universe in Your Hands*, © 1993, 2001 by the President and Fellows of Harvard College, published by Kendall/Hunt Publishing Co., Dubuque, IA.

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Type of Activity:	Indoor classroom or drop-in station, facilitated
Set up Time:	30 – 45 minutes
Time to Do:	30 minutes
Audience age:	8 years and older
Group size:	various

What's This Activity About?

The stars appear to be painted on the dome of the sky above our heads. Those that make up the Big Dipper, Orion and other constellations appear close to each other in space - but are they really close together? This activity demonstrates that the pattern we see in the sky is just an accident of our place in space and the stars in a constellation can actually be quite distant from each other, so that the same constellation would thus look much different from a different part of the galaxy.

Materials

For each constellation model:

- Copies of constellation photographs (see pages 5-6)
- Copies of constellation charts (see pages 7-8)
- Meter stick

- Thick sewing needle or ballpoint pen (with long, exposed writing point)
- Steel washer
- Piece of corrugated cardboard about 30 cm x 30 cm (1 ft. x 1 ft.)
- Pony beads * (number equal to number of stars in constellation)
- 1-meter long pieces of black button thread * (number of pieces equal to number of stars in constellation)
- Tape

**indicates that this material is included in the AFGU toolkit. You may need to replenish these supplies. See the list of sources on page 4.*

Setting Up the Activity

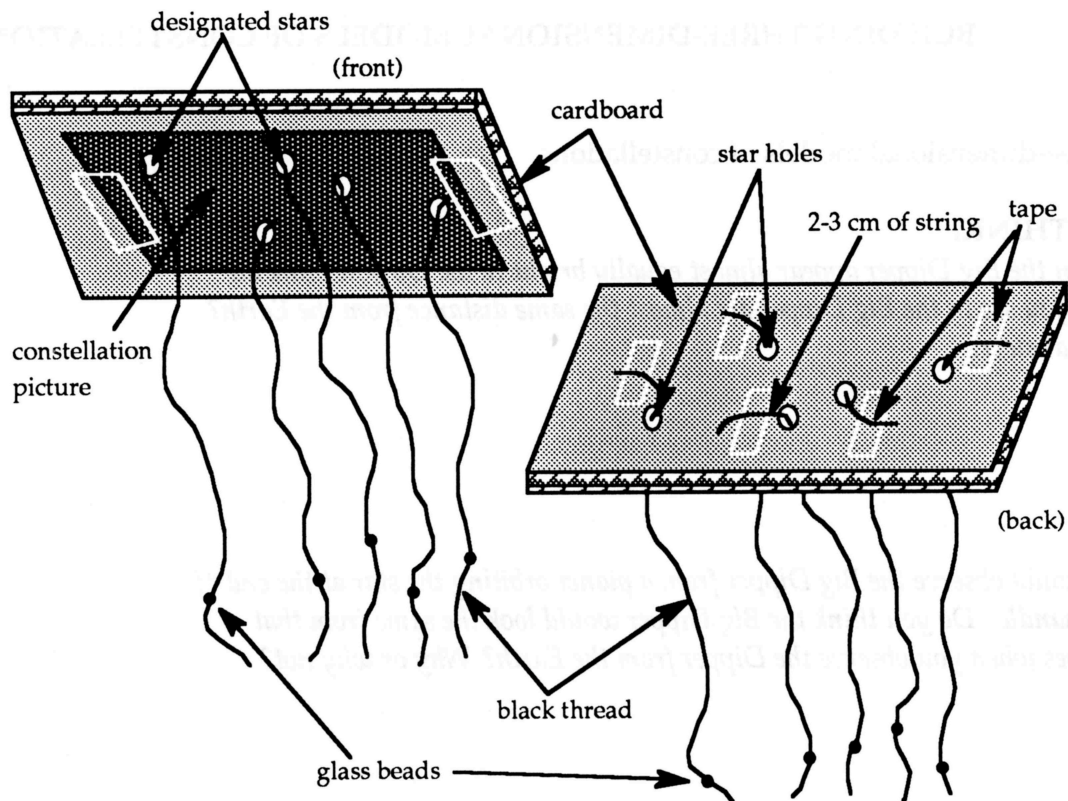
This works best with participants sitting at tables. You will need to pre-cut the lengths of thread and the pieces of cardboard. Set out one piece of cardboard, a constellation photograph, a constellation chart, a pen or needle, the appropriate number of threads and pony beads, and a ruler for each participant, as well as tape for the table to share.

Suggestions for Introducing the Activity

If possible, look at the Big Dipper or another constellation together, if not in the real sky, then in a planetarium or on a photograph. The stars in the Big Dipper appear almost equally bright to us. Do you think all the stars that you see in the Big Dipper are almost the same distance from Earth? Imagine you could observe the Big Dipper from a planet orbiting the star at the end of the Big Dipper's handle. Do you think the Big Dipper would look the same from that planet as it does when you observe the Dipper from Earth?

Doing the Activity

1. Participants should carefully tape the constellation photograph to the piece of cardboard.
2. They then place a bead on each string by first passing the thread through it, then around and through it again. By stringing the bead this way, they will be able to slide the bead along the length of the string, but it will stay in place when they let go.
3. Using the needle or pen, participants should punch holes through the photo and the cardboard at the position of each star which has a distance written next to it on the corresponding chart. They then slide a piece of thread through each hole leaving about 1 inch at the back and the rest at the front. (The front is the side with the constellation photo.) Tape the one-inch length of thread to the back of the cardboard to hold it in place. To cover up this messy side, you can tape the constellation chart over it.
4. Participants should then bring together the ends of all the strings on the front side and tie them into a tight knot around a steel washer about 56 cm (22 in) from the sheet of cardboard. Have them cut off the extra thread. This thread length is used because the camera that took the pictures of these constellations had a focal length of 56 cm. If you hold the picture at a distance of 56 cm from your eyes, the constellation will appear the same size as it does in the sky.



5. The distance to the stars on the photos is indicated on the constellation charts on pages 7 and 8. A star labeled "75 l.y." is 75 light years from the Earth. A light year is the distance light travel in one year, about 10^{13} km.
6. To make a three-dimensional model of the constellation, participants must slide the beads along the string until they are the correct scale distance from Earth. Use a scale of 2.5 cm = 100 l.y. For example, if a star is 100 l.y. away, slide the bead representing that star to 2.5 cm (1 inch) from the washer. If you have a star that is 830 l.y. away, slide that bead out 21 cm (8.3 inches) away. See the table on page 4 for the scaled distances to the stars in Orion and the Big Dipper. Participants can use the rulers to position their beads at their approximate scaled distances.
7. When the beads are positioned, participants should hold the washer with one hand and the photo upright with the other hand. They then stretch the strings and hold the washer next to an eye. Looking at the photo through the washer, they should be able to see the beads outlining the shape of the constellation. This may work better in pairs, with one partner holding up the cardboard so that it is easier for the other partner to view the constellation. As mentioned above, the scale of the photo is such that if you hold the cardboard 56 cm from your eye, your view of the constellation is the same as you would have at night looking at the constellation with your naked eye.
8. Next, they can hold the model so that they are looking at the constellation from the side. This is how the constellation would appear if you traveled many light years out into space and looked at it from the "side."

Wrap-up

You may want to have participants draw the constellation the way it would appear in a “side view.” They could indicate the direction towards the Earth with an arrow and even create a name and story for their constellations.

Return to your questions from the introduction. Are all the stars in the Big Dipper an equal distance from the Earth? Would it look the same from a planet orbiting the star at the end of the Dipper’s handle?

Complimentary activities:

- Sizing Up the Stars
- Big Dipper Star Clock
- Making & Using a Planisphere

Materials sources:

It is best to use button thread for this activity because it is thick and strong. Black is best, since it blends in with the background of the photographs. Button thread can be purchased at most sewing and craft supply stores, as can pony beads.

Scaled Distances to Stars:

	Distance from Sun in l.y. (listed on chart)	Scaled distance from washer (cm)
Big Dipper	107	2.68
	82	2.05
	75	1.88
	65	1.63
	62	1.55
	59	1.48
Orion	1400	35.00
	1200	30.00
	1100	27.50
	815 (Rigel)	20.38
	489 (Betelgeuse)	12.23
	360	9.00
	70	1.75