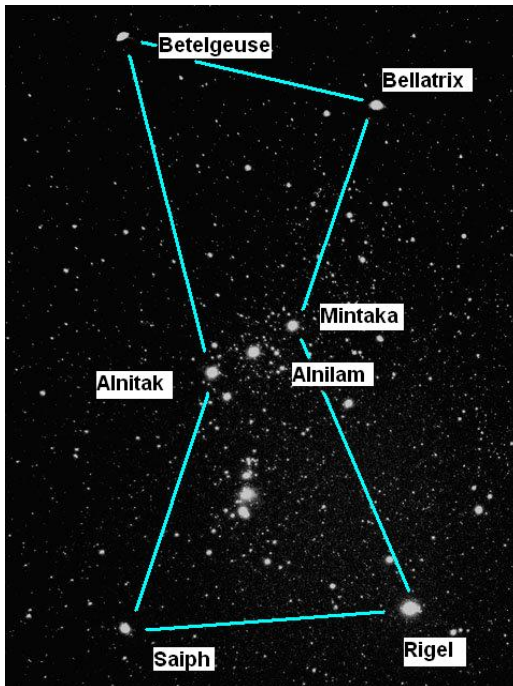


Constellations in 3D

A constellation is a pattern of stars that we see in the sky, but actually stars are spread out in space, and what we are seeing is only a geometric projection. This is much like the 2-dimensional photographs that we take, which only capture one perspective in how things actually look in space. For example, below is a photograph of the constellation Orion as it appears in the sky. The table gives the positions and distances to the brightest stars in Orion.



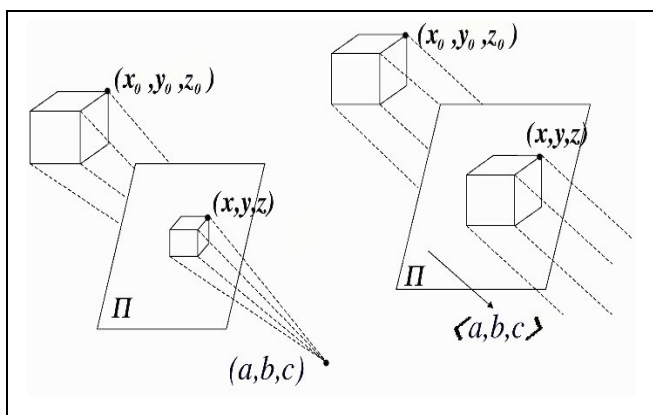
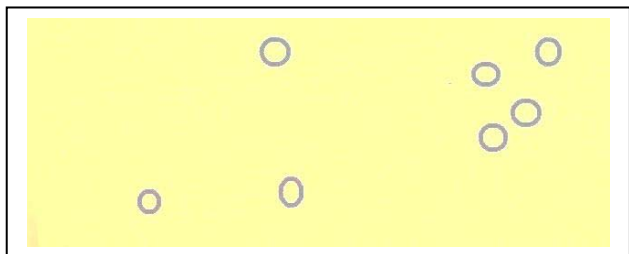
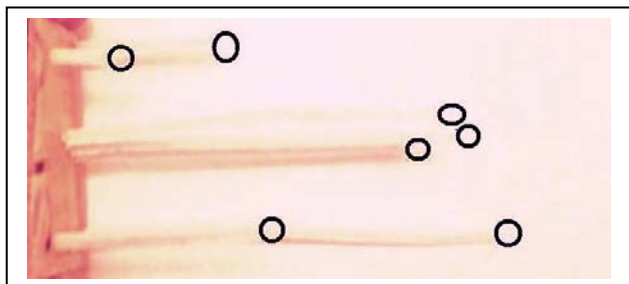
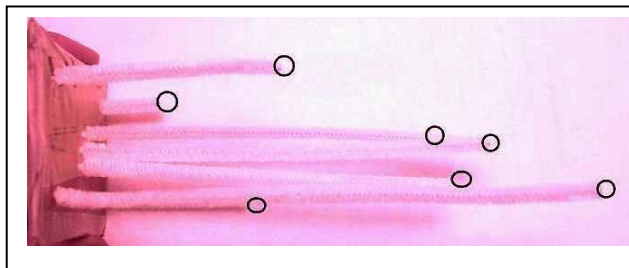
Star	R.A.	Dec.	Distance (parsecs)
Betelgeuse	5:50	+7:23	650
Rigel	5:10	-8:19	800
Bellatrix	5:20	+6:16	300
Saiph	5:43	-9:42	1800
Alnilam	5:31	-1:16	1530
Alnitak	5:36	-2:00	1470
Mintaka	5:27	-0:37	1500

- 1 - Cut out the photograph of Orion and glue it to a piece of stiff cardboard.
- 2 - Using a scale of 100 parsecs = 1 centimeter, cut 7 pipe cleaners to the lengths corresponding to the distances for each star in the table.
- 3 - On the back side of the cardboard, push the pipe cleaner through the cardboard at the location of each star so that the pipe cleaners stick out of the back of the card.
- 4 - Attach a small piece of round clay, or some other marker, to the end of each pipe cleaner to represent the corresponding star.
- 5 - With the cardboard viewed edge-on in your left hand, draw the locations of the stars on graph paper from the following perspectives. (You may also choose to take a digital photo and edit-out the pipe cleaners leaving only the stars in the picture!)

Problem 1 - Construct a bottom-view sketch by rotating the cardboard so that the bottom of the constellation faces you.

Problem 2 - Construct a side-view sketch.

Problem 3 - Construct a top-view sketch



A digital camera was used to take these pictures, from top to bottom, for Problem 1, 2, and 3.

The stars were added in an image editing program.

Students will see that the placement of the stars changes as the viewer's orientation in space changes. This will happen because stars are located 'along the third dimension' at various distances from the viewer.

Orion is an interesting constellation because the three Belt Stars are at nearly the same distance from Earth, so from different orientations, they tend to stay together as a 3-star asterism.

Astronomers call this change of appearance a 'projection effect' because we are projecting the 3-d locations of stars in space onto a 2-d viewing screen.

This figure shows two kinds of projection effects. The first is called Perspective Projection because the lines converge at a point where the viewer is located. The second is called Orthographic Projection because the image on the projection plane is a one-for-one duplicate of the original.

(Courtesy Tom Farmer, Journal of Online Mathematics "Geometric Photo Manipulation")