Modeling the Nearby Stars in Three Dimensions

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Abstract:

My astronomy and earth science students build a physical model of the nearby stars in order to learn the core concepts of stars, constellations, light, and the electromagnetic spectrum as well as the science and engineering practice of modeling and crosscutting concepts of scale, proportions, and coordinates. We create a hanging platform from foamcore and draw on it a diagram showing light years distance as concentric circles (1 light year = 5 cm) and right ascension (celestial longitude) as radiating spokes. The 30 star systems within 13 light years are constructed from wooden balls painted appropriate colors for their stellar classes and hung from the platform with black string with labels attached. To find the correct position, sin and cosine functions are used to determine the horizontal and vertical distances from the central ball representing Sol. Using this model, students can compare the distribution and frequency of stars, learn the scale of our galaxy, plan a future interstellar voyage, create works of poetry and art, and discuss stellar astronomy, exoplanets, and astrobiology.

The Nearby Stars

The stars near us are not particularly remarkable or exciting. They constitute a group of average stars that are typical of the spiral arms of the Milky Way Galaxy. Until recently, they tended to get ignored in most astronomy or earth science textbooks, which focused on distant, exotic stars like red supergiants or black holes.

Yet all that has changed with the recent discovery of exoplanets (planets orbiting stars outside our solar system). The closest star system, Alpha Centauri, is now known to have at least one planet the size of the Earth orbiting the second star. At least one planet is confirmed around Epsilon Eridani, and a recent study suggests there could be as many as five planets orbiting Tau Ceti. Suddenly our stellar neighborhood has become a lot more interesting.

In order to help my physics and astronomy students get a grasp for stellar coordinates, constellations, star names, and star classes, I started developing a crowning activity for our unit on the stars. We built a three-dimensional model of nearby space out to 13 light years from our sun. Our first attempt was crude and inaccurate and we had a very difficult time finding data on the closest stars (it was easy to find tables listing the brightest stars, but not the closest). Over the years and several iterations, this activity has become more accurate and complete.

Creating a 3D model of the nearby stars does take several days of class time and has to be well justified. With the new emphasis in the Next Generation Science Standards on science and engineering practices and crosscutting concepts, this activity becomes even more useful. It provides opportunities to discuss the nature of models and how they are used (and their limitations) as well as the crosscutting concepts of scale and proportion. It teaches the core concepts of stars and constellations, light and the electromagnetic spectrum, and coordinate systems.

Preparation and Materials:

This model will cost about $50 for materials the first time you build it, but it can be stored and re-used many times. After several attempts of hanging the stars from the ceiling of my classroom (which didn't do my ceiling any good), I hit on the idea of creating a hanging platform. I have installed eyebolts in my ceiling from which the platform hangs. In other rooms with ceiling tiles, the model can be hung from loops of stiff wire bent into hooks placed over the dividers between the tiles. The platform itself is made from four pieces of foamcore taped together with clear packing tape and stiffened with cardboard packing tubes or PVC pipe (whatever is handy). On the underside, I have drawn a diagram showing the radial distance out from the center with a scale of one light year equals five cm, going out to 15 light years (75 cm radius). A radial spoke was drawn every ten degrees around. I labeled zero degrees as the Vernal Equinox and labeled each radial spoke (longitude line) and light year circle. (Note: Usually the longitude dimension [called Right Ascension] is measured in hours, minutes, and seconds. This is too cumbersome for most students, so I convert it to degrees.) On the topside, I glued and taped some small scrap lumber or wooden lathing pieces into which I screwed eyebolts, one for each corner. Each corner was then hung from a ceiling eyebolt with strong cord or thin nylon rope and the whole thing leveled with a carpenter's level. The platform was set to hang at just above 2 m from the floor.

The stars themselves were made from wooden balls of various sizes ranging from small beads for planets (painted green), slightly larger balls for brown dwarfs (brown), slightly larger (1 cm diameter) balls for red dwarfs (painted red), slightly larger for orange K-type stars, about 1.5 cm diameter for yellow dwarfs (type G stars), and about 2 cm diameter for F and A stars (yellow-white and blue-white). Look at the list of materials on this page to see how many of each color of star will be needed, but be sure to check for updated lists of the nearby stars; new discoveries are still happening. For binary or trinary systems, the stars are attached to each other by thin wooden dowels and glued. For the Alpha Centauri trinary system, the A and B stars were glued to each other but Proxima Centauri was on a short dowel about 0.5 cm away from the other two. For confirmed exoplanets, my students glued the small green beads around the circumference of the star balls. All the star systems were tied onto strong black thread or string and labels were attached to each system. Initially, the string was cut to be 2 m long for stars with negative declinations and 1 m long for stars with positive declinations.

A final piece of apparatus to be prepared is a simple quadrant made from a meter stick with a protractor taped with its center on the 50 cm mark and a small weight (such as a rubber stopper) hanging on a 10 cm string from the protractor's center. This will be used to verify that the angles and distances in the model are correct.

Hanging the Stars:

Stars are located in three-dimensional space using a polar coordinate system similar to longitude and latitude and elevation on the Earth's surface. The distances to stars are measured in light years, or the distance light takes to travel in one year. Have your students do some calculations to find how many kilometers this is. Light travels close to 300,000 km per second, which puts one light year at about 6 trillion km. The closest star to us (Proxima Centauri) is about 4.2 light years away. Another measure of distance is the parsec, or the distance of a star that has a parallax angle of one arcsecond (about 3.26 light years). My students created a video lesson plan on how stellar parallax can be used to find the distance to nearby stars. You can find this lesson plan listed in the "On the Web" box at the end of this lesson. The other two coordinates are called Right Ascension (celestial longitude, measured to the right of the vernal equinox) and Declination (latitude north or south of the celestial equator).

The first star to hang is our sun, or Sol. It must be hung directly from the center of the model 1.0 m down from the platform. Poke a hole through the center and thread the black string up through the platform, then use masking tape to secure the string on top.

For our first few attempts, I had my students use the quadrant to find the correct positions for the stars. This proved to be very inaccurate, as the quadrant was hard to hold in place. I finally decided the best answer was to use trigonometry to calculate the horizontal and vertical distances using the model's scale. To find the position of a star, we used the sin and cosine functions (see the diagram). For example, for the Alpha Centauri system, which is 4.3 light years away, we multiplied this by our model's scale of one light year equals 5 cm. This gave us a radial distance of 21.5 cm, which is the hypotenuse of a right triangle. The horizontal distance is found by the formula: cos(theta) = adjacent / hypotenuse, where theta is the declination angle, the horizontal distance is the adjacent side, and the radial distance is the hypotenuse. With the horizontal distance in our model known, the students measured that distance out from the center on the underside of the platform along the correct Right Ascension angle and poke a hole in the foamcore at the correct point.

To find the vertical distance, we used the sin function in the same way. If the declination angle is greater than zero (north latitude), you will need to subtract the distance from 1 m to find how far it will hang from the platform. For stars with negative declinations you will need to add the vertical distance to 1 m. Thread the black string of each star through the hole you've created, then use a meter stick to find how far it should hang down. If it is a southern star, you will need to stack two meter sticks on top of each other. Once you've gotten the star at the right vertical distance from the top, secure the string to the top of the model with masking tape. Then take the quadrant and verify that the star is hanging at the correct distance and declination angle as measured from Sol.

Using Student Teams:

You will need to demonstrate the first few stars to show how to calculate the distances and hang the stars. Then divide your class into small teams of 3-4 students and assign them to hand three star systems at a time, then trade off with another team. One person can do the calculations, one can measure the distance out and make the hole, one can hang the star, and the final one can verify its position. Doing this, it will take about one class period to hang the platform and Sol and about three class periods to hang the stars.

While one team is hanging stars, the other students need to be working on enrichment and application assignments. One of these is the Interstellar Voyage

Proposal (see the sidebar), where they must write up an executive summary of a proposed trip to one or more of the stars in our model. They must choose the route (and justify why they are visiting those stars), design the space ship, decide how the crew will be chosen and kept alive (will this be a generational ship or use hibernation to freeze the crew?), how the ship will propel itself, and how hazards such as space debris will be avoided. They can use science fiction stories or novels as source materials or look at serious proposals such as the Bussard ramjet, solar sails, Orion, or the Daedulus spaceship designs.

Another activity is to answer a series of questions that cause them to calculate the scale and proportions of our model. For example: using the scale for stellar distances and comparing it to the actual size of the sun, how big should the stars in our model actually be? (It works out to about the size of a small molecule, such a benzene). The Earth would be about the size of a proton at the scale of our model. Have them also consider how big the model would be if it included the entire Milky Way galaxy, which is 100,000 km across (about 5 km in diameter in our model). A final interesting question is to have them calculate how many human lifetimes it would take to build an accurate model of the whole galaxy, given that there are about 200 billion stars in the Milky Way and it took the students in the class so many class hours to build the model out to 13 light years with 30 star systems.

An additional set of questions can be asked comparing the different classes of main sequence stars. If they count up the numbers of each type of star, they will see that there are no O or B type stars in our neighborhood, one A type (Sirius), one F type (Procyon), three G types (Sol, Alpha Centauri A, and Tau Ceti), and so on. By far the most common type of stars is the red dwarf. Have students estimate the total number of brown dwarfs that are likely to exist within 13 light years of us, and ask why we only know of a few so far. In fact, since the last time my students created this model (January, 2013), a new binary brown dwarf system has been discovered only 6.5 light years away. You can also look at the distribution of single stars compared to multiple star systems, and have students extrapolate from this model to the rest of our galaxy.

Part of the fun of this model is being able to gather around it and look at how the constellations change as you move through it and to get a feel for the distribution of stars. It can be a starting point for many discussions on stellar astronomy. You can lead in to a unit on exoplanets, including how they are discovered, and the search for extraterrestrial intelligence (SETI) and astrobiology. They can investigate the biographies of astronomers who discovered these nearby stars, whose names are often not found in astronomy textbooks, and look up the various systems used to name stars.

Finally, students can use their new knowledge to investigate art, poetry, and literature about the stars. They can evaluate the accuracy of examples, such as Robert Frost's "Choose Something Like a Star," or try their hand at creating their own star-inspired art. Humans have been star-struck since the dawn of our species, and this activity can help to kindle an appreciation for the majesty of the night sky and inspire students to continue their studies of astronomy.

(End of article)

Note: This article will need short sidebar articles on the following topics: Naming Stars and Stellar Classes. It will need a diagram of the star platform and hanging (see the attached) and a table of the nearest stars out to 13 light years (to be provided).

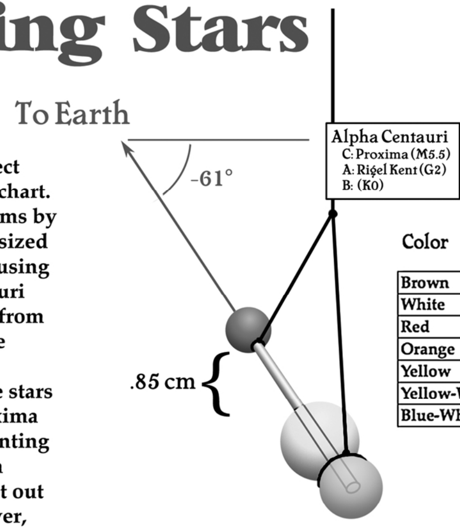
Sidebars:

Naming Stars:
To the ancient Greek and Arabic peoples, the stars were given common names that we still use, such as Bellatrix (the warrior woman) and Zubenelgenubi (the southern claw). With the invention of telescopes, many new stars could be seen and a new system was needed. Johann Bayer developed a system using the constellation name and Greek letters (alpha, beta, gamma) in order for the brightest stars, such as Beta Orionis for the second brightest star in Orion. Not even that system was enough, so John Flamsteed developed one based on constellation and numbers for stars' positions, such as 51 Pegasi or 61 Cygni. Some observatories developed their own star catalogs, such as the Bonner Durchmusterung (Bonn sampling) and other catalogs bear the names of the lead astronomer, such as Wolf, Ross, Lalande, or Gleise. Finally, modern lists have been complied such as the Henry Draper (HD) catalog at Yale University with stellar spectra or the Hipparcos targeting list (HIP).

Stellar Classes:
Not all stars are the same, and their differences are mainly due to size and age. Larger stars fuse their hydrogen fuel faster and die sooner, but give off more light and are hotter and more bluish in color. Cooler stars fuse slower, last longer, and are more reddish based on their peak output wavelengths. A diagram comparing the luminosity of a star with its temperature or color was developed independently by Ejnar Hertzsprung and Henry Norris Russell and is today called the H-R Diagram. It is a useful way of comparing stars. According to temperature and color, stars are divided up into eight categories: O type stars are huge, hot, electric blue stars that live fast, die young, and go out in a blaze of glory. They are rare but can be seen for great distances, which is why they spiral arms of galaxies appear bluish. B type stars are a little cooler and less bluish, A type stars are smaller still and bluish-white. F type stars are cooler and yellow-white. G type stars are considered dwarfs, like our sun. They are yellowish and last about 10 billion years before running out of hydrogen in their cores (compared with only a few million years for an O type star). K type stars are smaller and orange, and M type stars are small, dim, and red. Recently, a new category of stars called brown dwarfs (types L, Y, and T) have been identified. They are too small for hydrogen fusion, but do have short-lived helium fusion in their cores. They can only be discovered in infrared wavelengths. Objects smaller than brown dwarfs are considered planets.

Building Stars

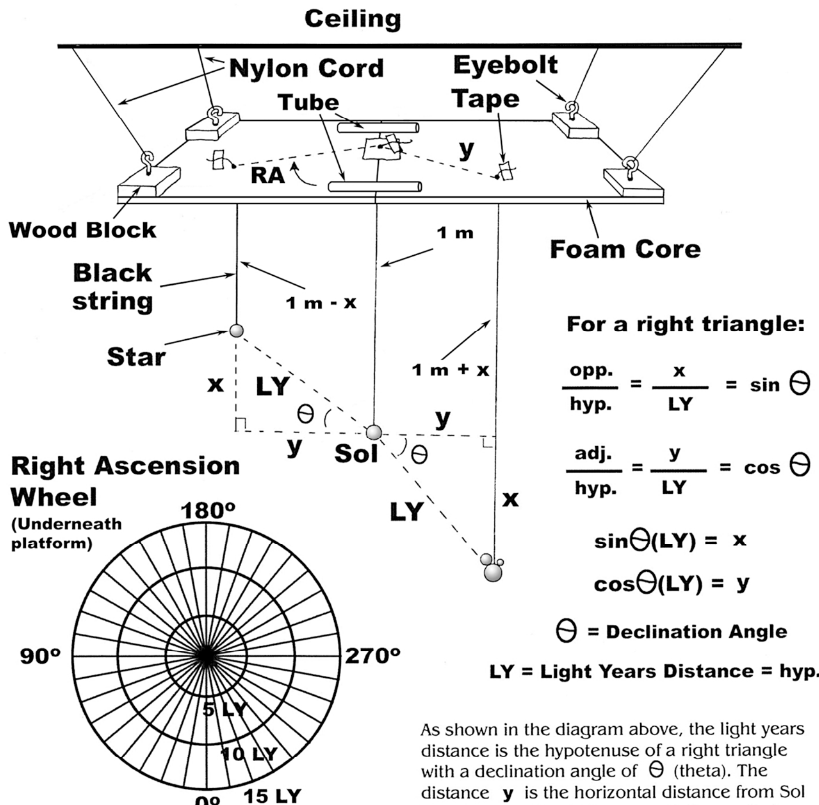
Paint the balls the correct colors according to the chart. Construct the star systems by gluing the appropriate sized wooden balls together using dowels. Proxima Centauri should be .85 cm away from Alpha Centauri A at the scale of our model. Use black string to hang the stars from the platform. Proxima Centauri should be pointing toward Sol (Earth) at an angle of 61°. Finally, cut out the labels, fold them over, and attach them with tape.



Color	Size	Number Needed
Brown	0.5 cm	7
White	0.5 cm	2
Red	0.75 cm	25
Orange	1.25 cm	5
Yellow	1.5 cm	3
Yellow-White	1.75 cm	1
Blue-White	2.0 cm	1

Building the Star Systems for the 3D Model
203x127mm (200 x 200 DPI)

Hanging Stars



Description:

Finding the exact location of a star when hanging it in the star model can be a challenge as it requires measuring the distance, the Right Ascension, and the declination angle all at once. A simpler way of locating the stars uses the idea of right triangles and trigonometry. Even though the math is more difficult, this method is ultimately easier and faster.

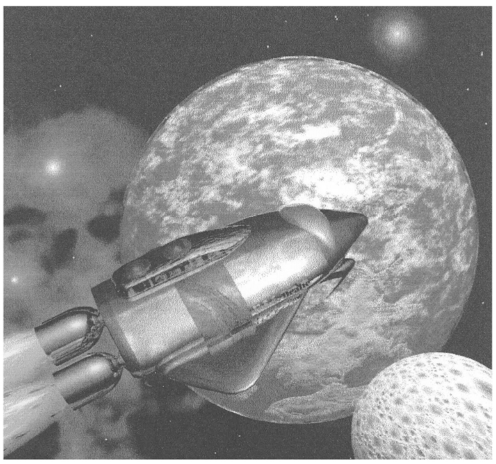
As shown in the diagram above, the light years distance is the hypotenuse of a right triangle with a declination angle of Θ (theta). The distance **y** is the horizontal distance from Sol to a star, and the distance **x** is the vertical distance that is either added or subtracted from **1 m** (the distance Sol is hanging from the foam core false ceiling of the model). First measure the Right Ascension around on the guide circle, then use the functions above to find **x** and **y**. Measure the **y** distance out along the guide angle and poke a hole in the foam core. Then use the **x** distance to determine the length of the star's string from the ceiling, adding a few inches to tape it down.

Instructions for Hanging Stars in the Model
217x254mm (200 x 200 DPI)

Interstellar Voyage Proposal

Name: ______________________________________ **Date:** _____________ **Period:** ___

Instructions: It is the year 2348 AD and you are the Project Director to build the first interstellar space ship, the *U. N. S. Brahe*. You are responsible for all aspects of planning, building, crew selection, etc. for this mission and you must present a proposal to the United Nations asking for funding. It will cost over $500 billion to build, and you must justify the expense and describe this ship and its objectives fully before your proposal will be approved. Here are some items you should address in your proposal:



1.) *Mission Objectives:* What route will you take and which star systems will you visit and why? Will your first propority be to seek out new worlds, or will it be purely to study stars? How long will your mission take (assume you can go no more than 10% of the speed of light and that you will be making a round trip)? What is your mission profile? What benefits will this misison bring to Earth?

2.) *Propulsion Design:* What type of engine will you use? Will it be a chemical rocket, an ion drive, a fusion drive, a Bussard ramjet, a light sail, or some other propulsion system? How will you carry your fuel, if required? How will you shield your ship from the radiation of your drive?

3.) *Crew Safety:* How will your crew quarters be designed to maintain the safety of the crew? How will you protect your ship from space debris and cosmic rays? How will the crew move around the ship, and what kind of facilities will they have for food, recreation, sleep, etc. How will you keep them alive for the long duration (several centuries) of this mission? Will you put them into hybernation or cryogenic sleep? Or will you create a multi-generation ship to support an entire population of people? Since muscle and bone tissue lose mass in free fall, you will need to create artificial gravity by spinning a portion or all of your ship, or by constant acceleration then deceleration.

4.) *Crew Selection:* How will you select and train your crew for this mission? What nationalities, ethnic groups, genders, ages, psychological profiles, etc. will you choose? What kind of training will they need? What sort of specialties will be necessary for the success of this mission? How many people will you take?

5.) *Construction:* How and where will you build this ship? In earth orbit or on the ground or moon? How long will it take to build and how much will it cost? How will you house the construction crews and how will you transport materials to the building site? What kind of redudant systems will you use, in case of an emergency, if the primary systems fail?

You will write up an executive summary of your proposal which answers all these questions. In addition, you will draw out your final design, showing all the points mentioned with everything completely labeled and described. You will be graded on your creativity and vision as well as the technical and scientific accuracy of your proposal.

Instructions for the Student Interstellar Voyage Proposal
203x254mm (200 x 200 DPI)

Questions on the Nearby Stars Model

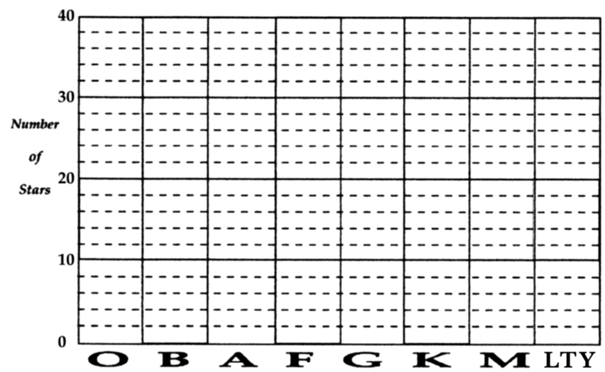
Name: ______________________________ **Date:** __________ **Period:** ____

Instructions: From the model of the nearby stars we have constructed and the table you have been given, answer the questions below on a separate sheet of paper.

1.) In the table at right, create a bar chart showing the number of each class of star from the Nearby Stars Table. Note: Use only the main sequence stars. Remember that red dwarfs are Class M, our sun is Class G, etc.

2.) Is there a relationship between color, mass, and abundance of stars for the nearby stars? Do you think this relationship holds for main sequence stars in the galaxy as a whole? Why or why not?

Frequency Diagram of the Nearby Stars



3.) What percent of the nearby stars are in multiple star systems (binary or trinary)? Why are such systems less likely to have planets?

4.) Scientists consider single stars similar in mass and age to our sun to be the best candidates for habitable planets. Why would red dwarf stars and large stars such as Sirius be less likely candidates for life-bearing planets? Of the stars in our model, which ones would be the best choices?

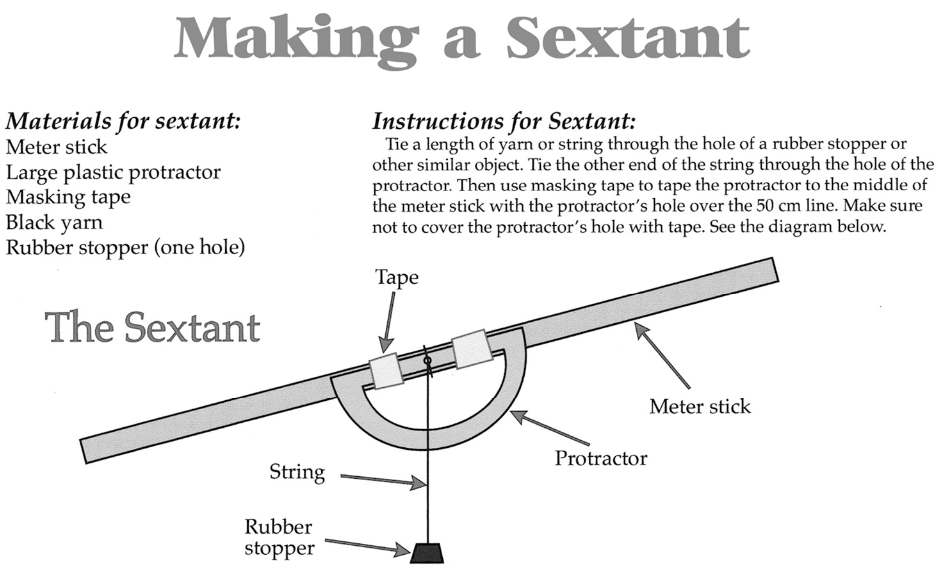
5.) Are the nearby stars randomly distributed throughout the sky (are the distancs between them all the same)? How could you explain this?

6.) Our Milky Way galaxy is about 100,000 light years in diameter and contains about 200 billion stars. At the scale we used for our model (1 light year = 5 cm), how big would our model have to be to include the entire galaxy?

7.) Our sun has a diameter of 1,391,980 km. A light year (the distance light travels in one year) is 9,460,730,472,580.8 km. If we were to make the scale of the distances to the stars match the size of the stars, then how big would one light year have to be in our model? We set our sun to be 1.5 cm in diameter.

8.) There are 7 brown dwarfs in our model (those which have been discovered so far as of 2013). Given the distribution of stars in your chart, do you expect more brown dwarfs to be discovered within 15 light years of Earth? Justify your answer based on the chart.

Comparing the Scale and Star Distribution of the Model
193x254mm (200 x 200 DPI)



Making a Sextant

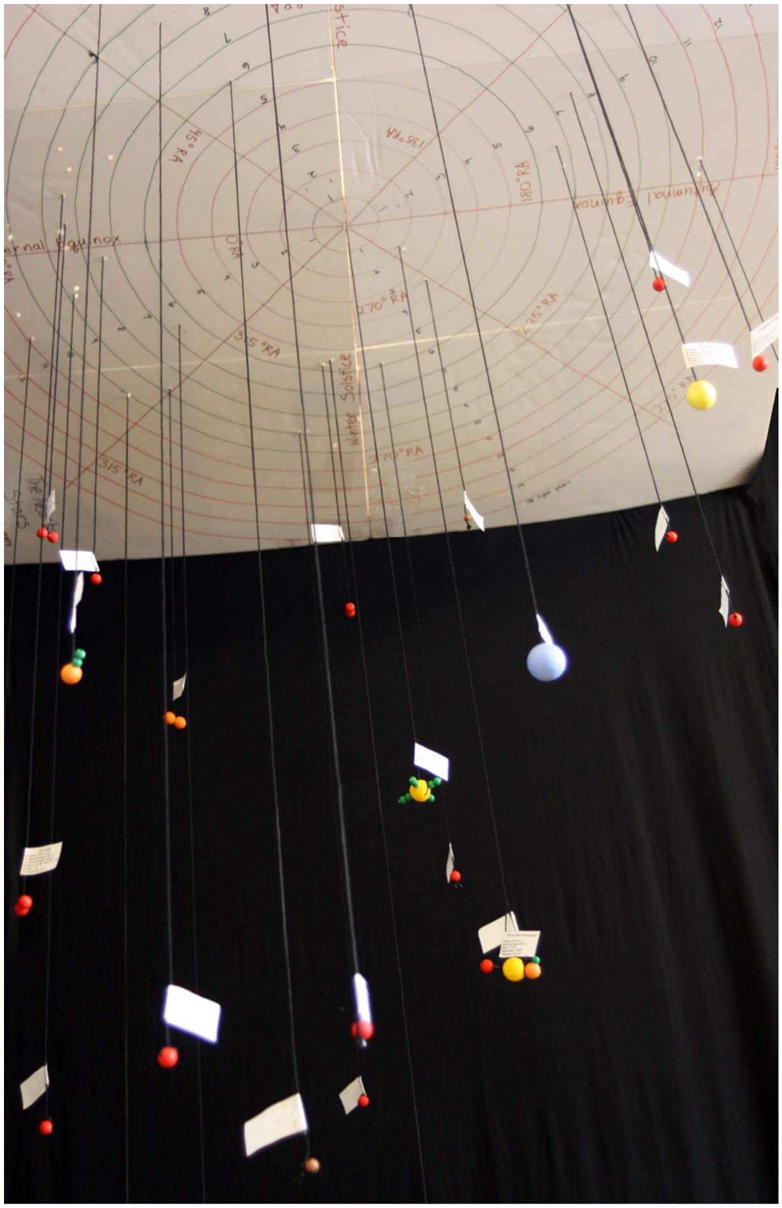
Materials for sextant:

Meter stick
Large plastic protractor
Masking tape
Black yarn
Rubber stopper (one hole)

Instructions for Sextant:

Tie a length of yarn or string through the hole of a rubber stopper or other similar object. Tie the other end of the string through the hole of the protractor. Then use masking tape to tape the protractor to the middle of the meter stick with the protractor's hole over the 50 cm line. Make sure not to cover the protractor's hole with tape. See the diagram below.

Building a Simple Sextant
203x127mm (200 x 200 DPI)



A View from Underneath the Star Model
131x203mm (200 x 200 DPI)

		The Nearby Stars to 15 Light Years (as of 2013)					
System	**Most Common Name**	**Other Names**	**Distance**	**Model Distance**	**Right Asc.**	**Declination**	**Spectral Class**
			(Light Years)	(1 LY = 5 cm)	(in Degrees)	(in Degrees)	
1	Sol	The Sun	0	0	N/A	N/A	G2V
2	Proxima Centauri	Alpha Centauri C	4.22	21.1	210°	-61°	M5.5V
2	Alpha Centauri A	Rigel Kent	4.39	21.95	210°	-61°	G2V
2	Alpha Centauri B	Gliese 559 B	4.39	21.95	210°	-61°	K0V
3	Barnard's Star	Gliese 699	5.94	29.7	270°	+5°	M5V
4	WISE 1049-5319 A		6.52	32.6	150.8°	- 53.3	BD (L8)
4	WISE 1049-5319 B		6.52	32.6	150.8°	- 53.3	BD (L9/T0)
5	Wolf 359	Gliese 406	7.8	39	165°	+7°	M6V
6	Lalande 21185	Gliese 411	8.31	41.55	165°	+36°	M2V
7	Sirius A	Alpha Canis Majoris A	8.6	43	101°	-17°	A1V
7	Sirius B	Gliese 244 B	8.6	43	101°	-17°	WD
8	UV Ceti A	Luyten 726-8 A	8.73	43.65	25°	-18°	M5.5V
8	UV Ceti B	Gliese 65 B	8.73	43.65	25°	-18°	M5.5V
9	Ross 154	Gliese 729	9.69	48.45	283°	-24°	M4.5V
9	Ross 248	Gliese 905	10.33	51.65	355°	+44°	M6V
10	Epsilon Eridani	Gliese 144	10.5	52.5	53°	-9°	K2V
11	Lacaille 9352	Gliese 887	10.73	53.65	347°	-36°	M2V
12	Ross 128	Gliese 447	10.89	54.45	177°	+1°	M4.5V
13	Luyten 789-6 A	EZ Aquarii A	11.08	55.4	340°	-15°	M5.5V
13	Luyten 789-6 B	Gliese 866 B	11.08	55.4	340°	-15°	M5V
13	Luyten 789-6 C	GJ 866 C	11.08	55.4	340°	-15°	M7V
14	Procyon A	Alpha Canis Minoris A	11.41	57.05	115°	+5°	F5V
14	Procyon B	Gliese 280 B	11.41	57.05	115°	+5°	WD
15	61 Cygni A	Gliese 820 A	11.41	57.05	317°	+39°	K5V
15	61 Cygni B	GJ 820 B	11.41	57.05	317°	+39°	K7V
16	Struve 2398 A	Gliese 725 A	11.6	58	279°	+60°	M4V
16	Struve 2398 B	GJ 725 B	11.6	58	279°	+60°	M5V
17	Groombridge 34 A	Gliese 15 A	11.64	58.2	5°	+44°	M2V
17	Groombridge 34 B	GJ 15 B	11.64	58.2	5°	+44°	M6V
18	DX Cancri	GJ 1111, Giclas 51-15	11.83	59.15	127°	+27°	M6.5V
19	Epsilon Indi A	Gliese 845 A	11.83	59.15	331°	-57°	K5V
19	Epsilon Indi B	Gliese 845 B	11.83	59.15	331°	-57°	BD (T1)
19	Epsilon Indi C	GJ 845 C	11.83	59.15	331°	-57°	BD (T6)

A Table of the Nearby Star Systems
228x172mm (200 x 200 DPI)

System	Most Common Name	Other Names	Distance	Model Distance	Right Asc.	Declination	Spectral Class
			(Light Years)	(1 LY = 5 cm)	(in Degrees)	(in Degrees)	
20	Tau Ceti	Gliese 71	11.9	59.5	26°	-16°	G8V
21	Luyten 372-58	GJ 1061, RECONS 1	12.06	60.3	53°	-45°	M5.5V
22	Luyten 725-32	Gliese 54.1, YZ Ceti	12.12	60.6	18°	-17°	M5V
23	Luyten's Star	Gliese 273	12.39	61.95	112°	+5°	M3.5V
24	SO 0253+1652		12.59	62.95	44°	+17°	M6.5V
25	Kapteyn's Star	Gliese 191	12.78	63.9	78°	-45°	M1V
26	SCR 1845-6357 A		12.84	64.2	281°	-64°	M8.5V
26	SCR 1845-6357 B		12.84	64.2	281°	-64°	BD (T5.5)
27	Lacaille 8760	Gliese 825	12.87	64.35	320°	-39°	M0V
28	Kruger 60 A	Gliese 860 A	13.07	65.35	337°	+58°	M3V
28	Kruger 60 B	GJ 860 B	13.07	65.35	337°	+58°	M6V
29	DENIS 1048-39		13.17	65.85	162°	-40°	M9V
30	Ross 614 A	Gliese 234 A	13.43	67.15	98°	-3°	M4.5V
30	Ross 614 B	GJ 234 B	13.43	67.15	98°	-3°	M7V
31	Wolf 1061	Gliese 628	13.91	69.55	248°	-13°	M3.5V
32	Wolf 424 A	Gliese 473 A	14.05	70.25	189°	+9°	M5.5V
32	Wolf 424 B	GJ 473 B	14.05	70.25	189°	+9°	M7V
33	CD -37° 15492	Gliese 1	14.22	71.1	1°	-37°	M4V
34	van Maanen's Star	GJ 35, Wolf 28	14.37	71.85	12°	+5°	WD
35	Luyten 1158-16	Gliese 83.1	14.57	72.85	30°	+13°	M8V
36	Luyten 143-23	Gliese 3618	14.6	73	161°	-61°	M5.5V
37	LP 731-58	Gliese 3622	14.76	73.8	162°	-11°	M6.5V
38	BD +68° 946	Gliese 687	14.77	73.85	264°	+68°	M3.5V
39	CD -46° 11540	Gliese 674	14.8	74	263°	-47°	M3V

There are 57 stars in 39 systems within 15 light years of Earth, although more are likely to be discovered (especially brown dwarfs).
Model Distance is in centimeters using a scale of 1 light year equals 5 cm.
Right ascension is usually given in hours, minutes, and seconds but has been converted to degrees here.
BD = Brown Dwarf
WD = White Dwarf

A Table of the Nearby Star Systems, Continued
228x151mm (200 x 200 DPI)