Orion in 3D

Grade: 6 **Unit:** Space

Curriculum Outcome: 302-13 Identify constellations in the night sky

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Orion in 3D

Names _____& _____

For this activity we are going to construct a three dimensional model of a constellation in the sky. The constellation that we are using is called Orion and in doing this activity we will be able to observe the differences in constellations when looking at them in 3-Dimensions compared to a 2-Dimensional view.

Step 1: First take the picture of Orion that is provided below (Figure 1) and notice that there is a labelled x-axis (horizontal) and y-axis (vertical). You should measure the distance along the x axis for each star, in millimetres. Record these measurements in Column B of Table 1, overleaf.

Step 2: Measure the distance down from the top axis along the Y axis, in millimetres, to each star. This information will tell you how long to cut the strings from which you will hang each star. Record the data in Column D of Table 1.

Figure 1 - The Constellation Orion, as viewed from Earth in 2008

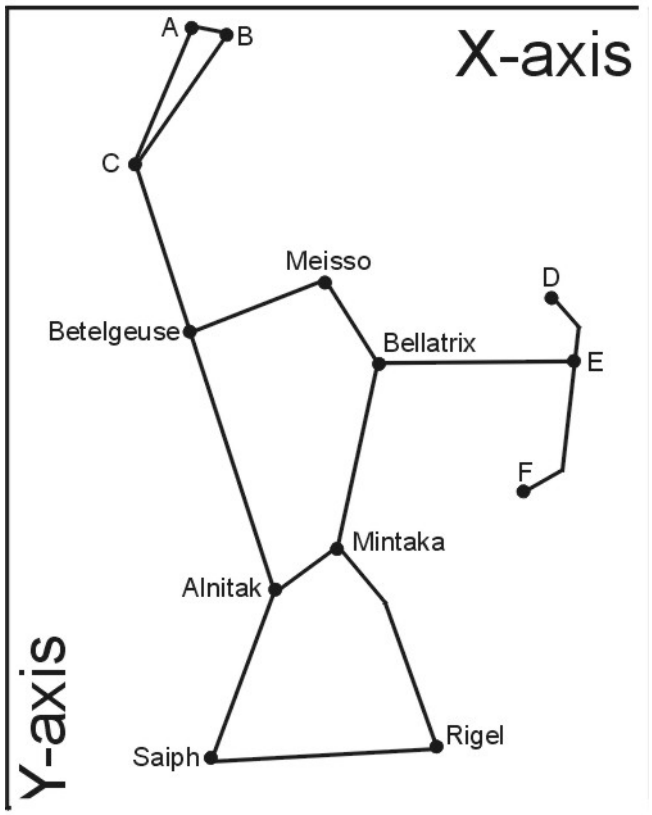


Table 1 - Enter your measurements in this table

Star name *Column A*	**Distance along X axis (mm)** *Column B*	**X axis (column B) times 3 (mm)** *Column C*	**Distance along Y axis (mm)** *Column D*	**Y axis (column D) times 3 (mm)** *Column E*
A				
B				
C				
D				
E				
F				
Bellatrix				
Betelgeuse				
Meisso				
Alnitak				
Mintaka				
Saiph				
Rigel				

Step 3: Next, multiply each of the measurements in columns A and C by three, and record the results in the remaining columns in the Table. You need to do this to make the model larger than the drawing in Figure 1, by a factor of three. The final model will, therefore, be three times larger.

Step 4: Note that the cardboard that has been given to you has an X-axis marked. Begin marking points along the X-axis for each star, and label each mark with the name of the star. Use small, neat lettering. Make a small hole in the card at each point – be careful with the sharp object!

Step 5: Start stringing the stars. Cut out a 30 cm long piece of thread for each star.

Step 6: Tape one end of each piece of thread to a ~10cm by 10cm piece of foil. Crumple the foil into a ball around the string to represent the star. Crumple each as tightly as possible. Do this for every star.

Step 7: Now you can hang the stars. Use the scaled values for the Y axis from the table (Column E) to work out how far the star should hang along the Y axis (how far below the card). You will be hanging the stars from a paperclip punched through the hole you have made along the x-axis (Fig 2) – make sure you account for the length of the paperclip (Fig 3)! When the star is hanging, check its distance from the Y-axis with a ruler. Do this for every star.

The constellation is now in 2-D!

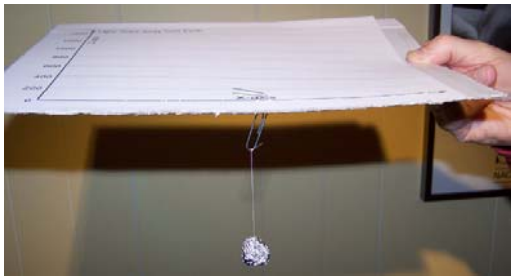


Figure 2. Star hanging from paperclip along X axis.

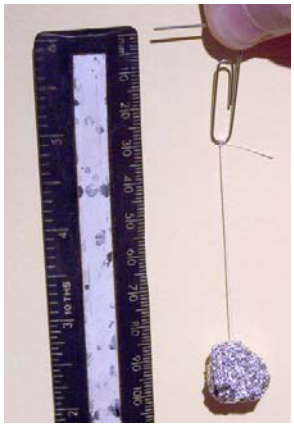


Figure 3. The length the star hangs below the card (Y-axis)

To get the constellation in 3-D you should notice that there are markings along the Z-axis of the card. This scale represents the distance the stars are from Earth, measured in light years. One light year is the distance a light photon would travel through space – a very large distance! Table 2 (below) indicates how far each star in Orion is from Earth, in light years.

Step 9: From the threaded point along the X axis, measure the distance along the Z axis that corresponds to the distance each star is from Earth. Make a new hole at each point and thread the string through the new hole, while making sure you keep the string at the same length (Y-axis). Once you have done this you can tape the thread permanently to the card. The model is now complete – the stars are arranged in 3D, as they are in space!

Table 2 - Distance of stars in Orion, from Earth (in light years).

Star	Distance of stars from Earth (in Light Years)
A	700
B	200
C	600
D	300
E	200
F	1300
Bellatrix	300
Betelgeuse	400
Meisso	1000
Alnitak	900
Mintaka	800
Saiph	600
Rigel	600

Teachers Guide – Orion in 3D

Grade Level: 6

Unit: Space

Specific Curriculum Outcome (SCO):
302-13 identify constellations in the night sky

Objective: Illustrate that a constellation is a two dimensional representation of a three dimensional arrangement of stars using a simple construction method.

Materials Needed:

- thread
- aluminum foil
- rulers
- cardboard grids
- scissors
- tape
- calculators
- 13 paperclips per student group

Introduction: Begin this activity by asking the students if they know any constellations. Create a list through the discussion and see how many different ones they can name. Show pictures of some of the constellations on the list so that students who might not know the names can recognize what they look like.

The type of model that this exercise constructs is a small scaled down version that approximates some of the elements of the original constellation. Astronomers use models all the time to study the stars because almost everything that astronomers are interested in are located far from Earth – the concept of scaling can be introduced – if you have a map you can show them that scaling is common. A map scale of 1:50,000 means the map is 50,000 times smaller than the real landscape.

Our view from Earth can make the universe seem like a two dimensional dome over the planet. To get a sense of how objects we see from Earth are distributed in three dimensions, astronomers depict the skies as scaled models. Introduce the idea that constellations may be three dimensional and look different from different angles. While we see tiny pieces of light that look like they are similar in size, it is possible for them to be hundreds of thousands of light years away from each other in the third dimension (distance).

In this activity, students will start out with the well known constellation, Orion, and model how it looks from Earth by making a two dimensional model. Then they will reconsider their models as scientists, using actual data for the distances of each star, from Earth. This will allow the students to reconstructing their models in three dimensions, to reflect the actual arrangement of stars in space. Introduce the model building activity to the students. Go through the activity handout step by step. Question how the 2D arrangement might appear if observed from a different angle, i.e., from a planet in a different solar system.

The activity is recommended for students working in pairs.

Task Instructions: This is a shortened and annotated copy of the student handout for teachers

Step 1: First you will take the picture of Orion that is provided and notice that there is a labelled x-axis (horizontal) and y-axis (vertical). You should measure the distance along the x axis for each star, in millimetres. Record these measurements in Column B of Table 1, overleaf.
This will show how far to place the stars along the X axis of the cardboard.

Step 2: Measure the distance down from the top axis along the Y axis, in millimetres, to each star. This information will tell you how long to cut the strings from which you will hang each star. Record the data in Column D of Table 1.
This will govern how long the thread will hang beneath the card – along the Y axis – when it is scaled up..

Table 3 - Enter your measurements in this table

Star name *Column A*	**Distance along X axis (mm)** *Column B*	**X axis (column B) times 3 (mm)** *Column C*	**Distance along Y axis (mm)** *Column D*	**Y axis (column D) times 3 (mm)** *Column E*
A	24	72	2	6
B	29	87	4	12
C	16	48	20	60
D	71	213	38	114
E	74	222	46	138
F	68	204	63	189
Bellatrix	48	144	46	138
Betelgeuse	29	87	42	126
Meisso	42	126	31	93
Alnitak	35	105	76	228
Mintaka	43	129	70	210
Saiph	26	78	98	294
Rigel	57	171	97	291

Step 3: Next, multiply each of the measurements in columns A and C by three, and record the results in the remaining columns in Table 1. You need to do this to make the model larger than the drawing in Figure 1, by a factor of three. The final model will be three times larger.
The picture would be too small to build a workable model from. The increased ratio will make it larger and easier to work with.

Step 4: Note that the cardboard that has been given to you has an X-axis marked. Begin marking points along the X-axis for each star, and label each mark with the name of the star. Use small, neat lettering. Make a small hole in the card at each point – be careful with the sharp object!
This will define the holes through which the threads will be strung. The students might want to use pencil so that they can erase if they make mistakes. Obvious care should be taken with sharp implements.

Step 5: Start stringing the stars. Cut out a 30 cm long piece of thread for each star. *Rigel is very close to 300mm slong the Y axis, so it might be worth advising students to cut this piece a little longer.*

Step 6: Tape one end of each piece of thread to a ~15cm by 15cm piece of foil. Crumple the foil into a ball around the string to represent the star. Crumple each as tightly as possible. Do this for every star. *The*

dimensions of the piece of foil are not at all critical. You could use a Styrofoam ball pierced on a paper clip instead.

Step 7: Now you can hang the stars. Slide each piece of thread through a hole you prepared along the X axis.

Step 8: Use the scaled values for the Y axis from the table (Column E) to work out how long the thread should be for each star. Once they are at the correct length, use a pen to mark the thread at the hole and temporarily tape the thread to the card using Scotch tape. Do this for every star.

The constellation is now in 2-D – and should look like a bigger version of the constellation in Figure 1!

To get the constellation in 3-D you should notice that there are markings along the Z-axis. This scale represents the distance the stars are from Earth, measured in light years. One light year is the distance a photon would travel through space – a very large distance! Table 2 (below) indicates how far each star in Orion is from Earth, in light years.

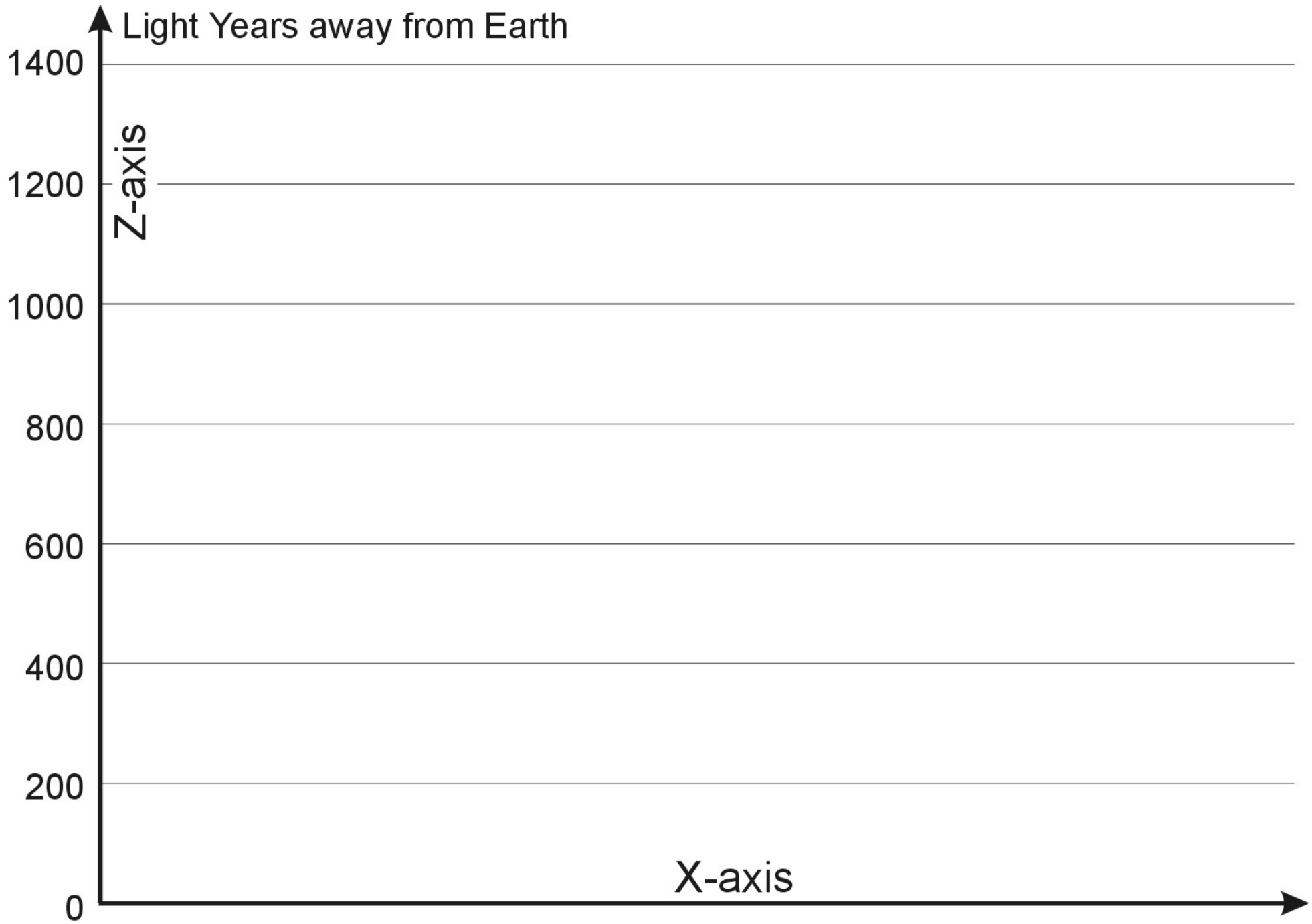
Step 9: From the point along the X axis, measure the distance along the Z axis that corresponds to the distance each star is from Earth. Make a new hole at each point and thread the string through the new hole, while making sure you keep the string at the same length (Y-axis). Once you have done this you can tape the thread permanently to the card. The model is now complete – the stars are arranged in 3D, as they are in space!
It will look like Orion from one angle, but not from every other angle, unlike a 2D picture.

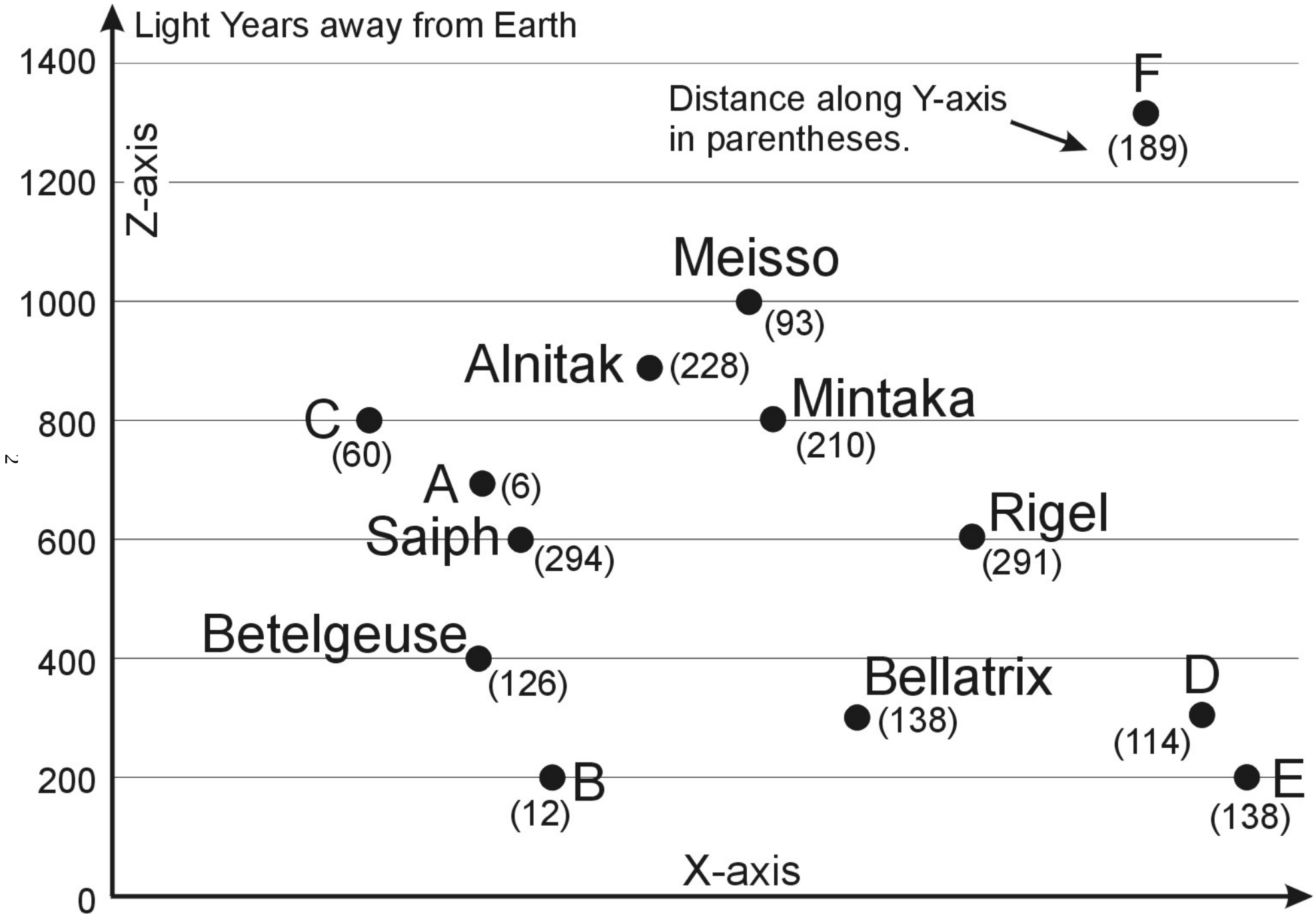
Annotated Templates

Find overleaf an unmarked template for Xeroxing onto card, or taping to a piece of card. There is also an annotated template. Each birlce marks the position of a star along the X and Z axes. The numbers in parentheses correlate to the distance each string would hang along the Y axis beneath the cardboard, in millimetres. These dimensions have been scaled by 3 from the diagram in Figure 3. Student projects can be evaluated based on this annotated answer sheet.

References

This activity is based on work by the American Museum of Natural History and data from the National Aeronautics and Space Administration (NASA).


Light Years away from Earth
1400
1200
1000
800
600
400
200
0
Z-axis
X-axis


Light Years away from Earth
1400
1200
1000
800
600
400
200
0
Z-axis
Distance along Y-axis
in parentheses.
F
(189)
Meisso
(93)
Alnitak
(228)
Mintaka
(210)
C
(60)
A
(6)
Saiph
(294)
Rigel
(291)
Betelgeuse
(126)
Bellatrix
(138)
D
(114)
B
(12)
E
(138)
X-axis