

# Web sites and Worksheets

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## Introduction

Astronomy is a practical subject by nature. Unfortunately for teachers, many of the practical activities require specialised equipment or night viewing. I have gathered a set of sites from the internet that allow teachers to show many practical aspects of the subject in class. These sites are mainly interactive simulations which allow the students to gather data and/or change limits to determine relationships. Along with this, there are some basic worksheets to help guide students through the sites and achieve the desired outcomes from the syllabus.

## Worksheets

Below is a list of the worksheets that are included in this paper. They are being added to continually as well as being amended as students use them and new ideas come up.

Stellar Parallax	Stellar Parallax 2
Stellar evolution	Binary Stars
Eclipsing Binaries	Stellar Classes
Colour and temperature	

## Other interesting websites

This is a list of websites that I have come across to do with physics but are not necessarily only to do with astrophysics and are not all simulations. They do however have good information and simulations related to the physics syllabus.

<http://www.coc.cc.ca.us/departments/ASTRO/Default/links3.htm>

A series of information sites from asteroids, meteors, the sun and more: a good source of information for teachers and students alike.

[http://es.rice.edu/ES/humsoc/Galileo/Student\\_Work/Astronomy95/telescope\\_design.html](http://es.rice.edu/ES/humsoc/Galileo/Student_Work/Astronomy95/telescope_design.html)

How to make a cheap and functional telescope

<http://jersey.uoregon.edu/vlab/>

An excellent simulation site. It has applets for all areas of physics – many for year 11 physics. It also has a tools area that has graphing and spreadsheets.

<http://www.astrophysik.uni-kiel.de/pershome/supas086/launcher/launcher.html>

A site that allows you to launch a rocket and look at different configurations such as, number of stages, where the rocket is launched from etc. An excellent resource for the Space core.

<http://instruct1.cit.cornell.edu/courses/astro101/>

A site that has lecture notes to accompany the simulations used in the worksheets. Information for teachers or eager students.

[http://www.explorescience.com/activities/activity\\_list.cfm?categoryID=3](http://www.explorescience.com/activities/activity_list.cfm?categoryID=3)

multimedia activities that use shock wave. These activities are wave based.

# Stellar Parallax

<http://instruct1.cit.cornell.edu/courses/astro101/java/parallax/parallax.html#example>

The above website shows a simulation of stellar parallax.

From the description answer the following questions:

- 1) What criteria must the star fit for using this method?
- 2) What happens to the position of the star as the Earth orbits through the year?
- 3) This motion happens over a period of a year, how can astronomers measure this movement?
- 4) What is proper motion and how can this be corrected?

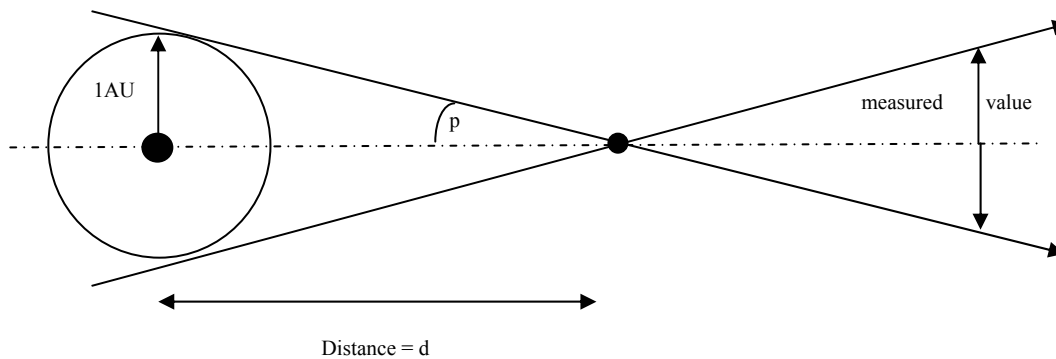
Start the simulation

- 1) Describe the motion of the star as seen from Earth
- 2) Where in orbit around the Sun is the Earth when the star is seen to be; at the bounds and in the middle of the bounds?
- 3) Measure the distance between bounds. Use this and other information to calculate the distance to this star.

*camera used is 35 mm.*

$\frac{\text{distance to star}}{\text{Earth's diameter}} = \frac{\text{camera focal length}}{\text{star's shift in photo}}$
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Use the diagram below to help you relate your measurements to the actual distance of the star.



- 4) Calculate the angle of parallax using the following relation  

$$p = 1/d$$
- 5) Give reasons for the distance that you have calculated being so small.

## Stellar Parallax

[http://www.astro.washington.edu/labs/parallax/parallax\\_distance.html](http://www.astro.washington.edu/labs/parallax/parallax_distance.html)

The above website shows photos of star fields taken 6 months apart. Follow the instructions to determine the distance of the two stars shown.

Answer the following questions:

- 1) What is meant by the term "blinking" in relation to the star photos?
- 2) Why is this useful in helping to locate the star of interest?
- 3) Calculate twice the parallax angle of star A.
- 4) What is the parallax angle for star A?
- 5) Do the same for star B.
- 6) Answer the three questions on the website.
  1. How accurate are your distances? (Measure the parallaxes a few times; do you get the same distance each time? Is it worse for one star than the other?)
  2. Which star is closer?
  3. Based on their relative apparent brightnesses, which star is intrinsically the brightest? Explain

Follow the link to the stellar parallax lab. Use the information on the page to answer the four questions stated.

**Question 1:** How long do you have to wait for a star to undergo its maximum parallactic displacement?

**Question 2:** How can the observation of stellar parallaxes in general be used as evidence against a geocentric view of the cosmos?

**Question 3:** How far, in parsecs, is an object that has a parallax  $p$  of 1 arc-second? How far is it, in light-years?

**Question 4:** How far, in parsecs, is an object that has a parallax  $p$  of 0.1 arc-seconds? How far is it, in light-years?

## *Stellar Classes*

[http://jersey.uoregon.edu/vlab/prf/PRF\\_plugin.html](http://jersey.uoregon.edu/vlab/prf/PRF_plugin.html)

Determine the characteristics of each of the stellar classes.

In the bottom right hand corner, several classes are listed.

The scale on the right is the temperature. This can be change to see the effect.

By selecting "draw limits of integration", the colour index will be displayed.

By selecting "star data" the real radiation obtained is superimposed.

By right clicking the mouse on the curve, the wavelengths at any point will be displayed.

Go through each star in the list and fill in the table of characteristics below.

Set the temperature to 18 000 K.

<b>Star type</b>	<b>Peak wavelength</b>	<b>Colour Index</b>	<b>Appearance colour</b>
O5V			
O7 - BOV			
O7 - B III			
B3 - 4V			
B5III			
B6V			
B9III			
A1-3V			

Determine a generalised view of characteristics shared by different spectral classes.

## *Stellar Evolution*

<http://instruct1.cit.cornell.edu/courses/astro101/java/evolve/evolve.htm>

The above website shows a simulation of stellar evolution. It allows you to follow the evolution of stars of different masses

*From the description answer the following questions:*

- 1) How do stars on the main sequence of the HR diagram generate energy?
- 2) How are higher temperatures within the core of a star achieved?
- 3) What is the determining factor of how far a star will evolve?

*Start the simulation*

- 1) Using the following initial stellar masses, write down the sequence of steps that the star follows and note the relative amount of time spent in each step.
  - (a) mass =  $m_{\odot}$  (Solar mass)
  - (b) mass =  $1.5 m_{\odot}$
  - (c) mass =  $0.63 m_{\odot}$
  - (d) mass =  $15 m_{\odot}$
  
- 2) What is the minimum limit of the mass of a star to become a supernova?

## *Binary Stars*

<http://instruct1.cit.cornell.edu/courses/astro101/java/binary/binary.htm>

The above website shows a simulation of stellar parallax.  
You will need to know the following definitions to work the simulation.

<b>Mass 1 or Mass 2</b>	The mass of each of the two stars.
<b>Separation</b>	The distance between the two stars in solar radii.
<b>Eccentricity</b>	Eccentricity of the orbit
<b>Inclination angle</b>	Angle of the orbital plane of the stars to our line-of-sight. <ul style="list-style-type: none"> <li>• 0° - face on</li> <li>• 90° - edge on</li> </ul> <p>Note that this is opposite from the Eclipse simulation - we'll fix this in the future.</p>
<b>Node angle</b>	Angle of the major axis as measured in the orbital plane (see privileged view)

- 1) Set the parameters as follows.

$m_1 = 1$   
 $m_2 = 1$   
 $a = 0.7$   
 $e = 45$   
 $i = 45$   
 $w = 0$

- 2) Describe the view from Earth in terms of motion and position of the two planets.  
3) How does this convert to the graph?  
4) Explain the effect on the motion if the masses are changed? Try the following combinations:

$m_1$	$m_2$
1	2
2	1
4	1
1	8

- 5) Explain what the spectra is telling you about the stars in this system. Relate your description to the positions of the stars in their orbits.  
6) How can the period of the stars be determined?  
7) Define spectroscopic binary stars.  
8) Using Kepler's Law, how can the mass of the system be determined?

## *Colour and Stellar Temperature*

<http://zebu.uoregon.edu/nsf/planck.html>

*Using the applet titled: Blackbody Radiation and Stellar Temperature*

1. Define black body radiation.
2. Why is a star considered an ideal black body?
3. Set the thermometer on the left to 8 000 K. Sketch the black body radiation curve that results.
4. Select the red, blue and visual filters. In the box along side these, the colour index and colour ratios are displayed.
5. Set the temperature to each of the following values. Record the colour index for each.
6. Graph colour index versus temperature.
7. Determine a relationship between temperature and colour index.
8. What is colour index used for?

*Using the applet titled: Total energy emitted and Temperature*

1. The area under the curve represents energy output. Set the left thermometer to 10 000 K and the right thermometer to 5 000 K. Describe the area under each curve.
2. Set the thermometers to each of the values listed below. Estimate the area beneath each curve by adding the boxes enclosed.
3. Graph T versus Intensity. Describe the curve.
4. Graph  $T^4$  versus Intensity. Describe the curve.
5. What is the relationship between intensity (energy) and temperature?
6. What law relates these two quantities together?

## *Eclipsing Binary Stars*

<http://instruct1.cit.cornell.edu/courses/astro101/java/eclipse/eclipse.htm>

The above website shows a simulation of eclipsing binary stars.

- 1) Define an eclipsing binary.
- 2) What do the axes of the graph represent?
- 3) Set the values as follows:
  - Star 1 type A
  - Star 2 type F
  - angle = 10
  - separation = 10
- 4) Describe the shape of the graph.
- 5) Relate the features of the graph to specific positions in the orbit of the two stars.
- 6) Change the values to see the effect that each of the following has:
  - Star Type - eg: What happens when the types are the same?
  - Separation - separate the stars by differing amounts and make a general observation.
- 7) What effect does the angle of inclination have on the graph? Can you put forward an explanation for this?