



Color Magnitude Diagrams and World Wide Telescope - Matthew Rickert

Purpose

To allow students to explore some of the possibilities that free software World Wide Telescope (WWT) has to offer, to let them use it to create color magnitude diagrams and to solidify their prior understanding of the stellar life cycle while at the same time providing them the opportunity to analyze data and determine the relative ages of star clusters.

Overview

Students will use the free software World Wide Telescope (WWT) to simulate collecting stellar data and to create a color magnitude diagram. Students will then be able to use their diagrams and their prior understanding of stellar evolution to identify the relative stellar ages of stars. Finally, students will have the opportunity to freely explore their own interests in astronomy through the use of WWT

Student Outcomes

Students will be able to:

- use software to collect data
- appreciate how computers can make monotonous tasks easier
- analyze graphs, in conjunction with prior knowledge, to come to conclusions

Standards Addressed

NGSS HS-ESS1-3

Time

two or three 50 min class periods

Level

High school astronomy

Materials and Tools

- Computers (with internet connections and capable of running windows, although in the future, with the development of the html version of WWT, it is possible that any computer with an internet connection will work), ideally 1 per 2 people, but 1 per 5-6 can also work
- Software - World Wide Telescope (WWT) - this is a free program available at: <http://www.worldwidetelescope.org>
- Software - a graphing/spreadsheet program, ideally Microsoft Excel
- [WWT Student Spreadsheet](#) (download and distribute an electronic version for each groups' computer)



Reach for the Stars is a GK-12 program supported by the National Science Foundation under grant DGE-0948017. However, any opinions, findings, conclusions, and/or recommendations are those of the investigators and do not necessarily reflect the views of the Foundation.

- [CMD Project Directions](#) (print copies for each group)
- [CMD Project Discussion Questions](#) (print copies)
- [Combined Data spreadsheet](#) (for teacher use)
- [Exploring WWT Worksheet](#) (print copies for day 3)
- [WWT Discussion](#) PowerPoint slides
- [Student Participation Rubric](#)
- Computer projector (optional)

Preparation

- Make sure the software and computers work, download required software and spreadsheet
- Print out the handouts

Prerequisites

Students should already have covered the life cycle of the star. It is also useful if they have been introduced to H-R and/or color-magnitude diagrams (CMD)

Background

- Remember the life cycle of stars. Particularly, remember the order in which they evolve: main sequence, red giant, white dwarf.
 - Think about which of these are brighter, and which are dimmer, and what their dominant color might be.
- Some familiarity with excel (or whatever graphing program you decide to use) will be very useful, but not required

Teaching Notes

- Prior to the lesson:
 - cover stellar evolution
 - give a brief intro to WWT, just showing the students what it is and what it is capable of, it is useful to do this by just giving a demonstration using a computer projector and a single computer
- Day 1:
 - present to the students their objective: to collect stellar measurements and to create a color-magnitude diagram (CMD) for a specific cluster of stars, if you have not yet covered what a CMD (or H-R diagram) is, then it would be good to present a short introduction to what it is
 - Break the class into groups, and assign each group a star cluster
 - Hand out the CMD Project Directions, and show the students how to make their diagrams (see the attached handout), it is useful to again give a brief demo using a computer projector. They will fill in answers on the WWT Student Spreadsheet (electronically) and on the CMD Project Discussion Questions worksheet.
 - Let the students work, walk around helping them, and ensuring their participation (if needed tell the students that you will be grading them based on their participation, see the attached rubric)
- Day 2:

- if needed, give the student's time to finish their diagrams
- collect each group's data and fill in the Combined Data Spreadsheet; display the combined CMD diagram and lead a discussion on the similarities and differences between each group's diagrams, what would cause the differences, eventually lead the discussion to stellar evolution, and have the students identify main sequence, red giants, and white dwarfs and finally try to get the students to order the clusters according to their age
- Day 3: (this last day can be removed if needed)
 - if needed, finish up the discussion from day 2
 - hand out the "Exploring WWT" worksheet and let the students explore WWT on their own (if you have any problems during the prior two days, or have some students that finish early, you can always hand out this worksheet early)

Assessment

- During class, students' participation can be formally evaluated via the attached rubric
- The students' completed diagrams will be turned in and can be graded
- See the attached packets that can be collected and graded
- After combining all the groups' diagrams, present a diagram that combines that of all the groups, and ask students to identify the main sequence, red giants, and white dwarfs. Also have the students identify the oldest and youngest star clusters. Show them other CMD diagrams, and again have them order the star clusters in the order of their age- this can be assessed formally through a quiz, or informally through the use of hand raising, i-clickers, etc

Additional Information

As of 4/2014, WWT is only available for PC. However, an online version is being developed, so check their website at: <http://www.worldwidetelescope.org> to see if the online version is available