

The Astronomy of Middle-earth: Teaching Astronomy Through Tolkien

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In his role as author of the classics "The Hobbit," "The Lord of the Rings," and "The Silmarillion," Tolkien acted as a "Sub-creator," in that he made a "secondary world which your mind can enter." The reader believes in the world while inside it because of its self-consistency - its "reality." Part of that "creation" involved crafting an astronomy for Middle-earth.

During his early years as a professor at the University of Leeds he utilized interdisciplinary and unconventional teaching methods, such as Anglo-Saxon crossword puzzles. It is therefore fitting that we take advantage of the depth and breadth of Tolkien's "sub-creation" in the interdisciplinary teaching of science in general, and astronomy in particular, to non-science majors. This involves using literary references from Tolkien's work as the springboard for class discussion or the backbone of a lab exercise.

1) "The Stars of Middle-earth" [included in this packet]

Objective 1: Students become familiar with the use of a starfinder (planisphere) and use it to discover the identity of certain stars and constellations named by Tolkien.

In the chapter "Three is Company" of "The Fellowship of the Ring" it is described that

"Away high in the East swung Remmirath, the Netted Stars, and slowly above the mists red Borgil rose, glowing like a jewel of fire. Then by some shifts of airs all the mist was drawn away like a veil, and there leaned up, as he climbed over the rim of the world, the Swordsman of the Sky, Menelvagor with his shining belt."

Students set their starfinder for 1 AM, Sept. 25 [date and time derived from Tolkien's notebooks] and identify Menelvagor, Remmirath, and Borgil. From Tolkien's own notes it is certain that Menelvagor is Orion and Remmirath is the Pleiades.

Objective 2: Students learn about the connection between star color and temperature (spectral classes – OBAFGKML). In doing so, they will narrow down their choices for Borgil. Note that there is disagreement among Tolkien scholars as to the identity of Borgil. Mars has been proposed but is largely discounted, as it is elsewhere identified as Carnil. The main debate is between Aldebaran and Betelgeuse. This author has a paper in preparation in which it is posited that based on literary and astronomical information the correct choice is clearly Aldebaran.

Objective 3: Students will learn about circumpolar constellations and create their own constellation out of known stars in order to solve the mystery of "Durin's Crown." This group of stars was depicted on the gates of Moria, and it was said to be visible even during the day reflected in the Mirrormere of Kheled-zâram in Moria. This would make the constellation circumpolar. In the book version of "The Fellowship of the Ring," Gimli, Frodo, and Sam pause to look upon its image before leaving Moria after Gandalf's death. Two of Tolkien's own sketches give different renditions of this group of seven stars.

Students first use a "blank" circumpolar map to try and find a candidate for Durin's Crown. Afterwards they compare their identification to the real constellations by using their starfinders

and/or star maps. Note that this is an open-ended activity, as there is no clear canonical identification. Many authors believe it is the Big Dipper, while others suggest Corona Borealis. This author hesitantly suggests Cepheus might be the best answer.

2) "The Line of the Evening Star" [not included in this packet]

As this lab was initially developed for an interdisciplinary science course, the first part of the lab deals with genetics and family trees, specifically studying the lineage of Elrond Half-Elven, son of Earendil [Venus].

Students can then comment on the accuracy of the following quotation:

"Elves and Men are evidently in biological terms one race [species], or they could not breed and produce fertile offspring...." Letter to Peter Hastings, Sept. 1954

[Astronomical] Objective 1: To study the apparitions of Venus over the course of a year and determine the maximum apparent elongation in degrees.

Students plot the orbital positions of Venus and Earth on polar graph paper. From this data, students translate the positions into horizon views and state whether Venus would be a Morning Star or Evening Star. The maximum elongation angle is estimated. It is important to plot the orbits of Venus and Earth to scale on the polar graph paper; it is suggested that Venus be plotted three units from the center and Earth four units.

Objective 2: To analyze a literary description of Venus for astronomical accuracy.

Students are asked to comment on the astronomical accuracy of the following excerpt: "But so bright was Rothinzil [Venus] that even at morning Men could see it glimmering in the West, and in the cloudless night it shone alone, for no other star could stand beside it." ["The Downfall of Numenor," The Silmarillion: 311]

3) "What Day is it, Mr. Frodo?" [Lab Exercise or Discussion] [included in this packet]

Objective 1: To understand the cycle of the phases of the moon and what time of day or night they are visible.

As background for this exercise, students study the phases of the moon and their apparent rising and setting times. An excellent tool, a moon phase locator, can be found at the Discovery Channel website: <http://school.discovery.com/lessonplans/programs/lightofthemoon/>.

Objective 2: To analyze the lunar chronology in a literary work.

Students will use the moon phase locator or other diagrams to visualize several passages from "The Fellowship of the Ring," then use their understanding of phases to answer Sam's concerns about the amount of time which had apparently elapsed on their journey. [Note that Tolkien calls a quarter phase a "sickle"]

Part B: Elvish stars

In “The Fellowship of the Ring” [book version], Frodo and friends spend an evening stargazing with a band of elves. According to Tolkien’s notes (and the storyline), the following scene takes place just after midnight on September 25:

“Away high in the East swung Remmirath, the Netted Stars, and slowly above the mists red Borgil rose, glowing like a jewel of fire. Then by some shifts of airs all the mist was drawn away like a veil, and there leaned up, as he climbed over the rim of the world, the Swordsman of the Sky, Menelvagor with his shining belt.”

Set the star finder for 1 AM on September 25 and answer the following questions:

- a) How might “Netted Stars” look?

- b) Find a reasonable candidate for Remmirath. Explain your choice.

- c) Based on the description in the text, find a likely candidate for Menelvagor. Explain your choice.

To identify Borgil the concept of star colors must be introduced. The hotter the star, the bluer the color, while the cooler the star the redder the color. Astronomers denote the surface temperature and color of a star by its “spectral class”. The classes (from hottest to coolest) are OBAFGKML – the order is no longer alphabetical due to historical changes in our understanding of stars. KML stars are reddish. Consulting a list of the brightest stars in the sky, note all stars which fall into these spectral classes:

KML stars:

Which of these are in the correct part of the sky?

Read the description from FOTR carefully once more – can you narrow down your choice for Borgil?

Explain your choice:

Part C: Dwarvish stars

In a later section of FOTR, the Fellowship looks in a special reflecting lake outside of Moria. In it was seen the image of a constellation sacred to the Dwarves, Durin's Crown. The image is said to be visible all the time (even in daytime), so it can never set.

What kind of constellation must the Durin's Crown be?

Tolkien scholars cannot definitively match up this constellation with a real one in our sky, but several candidates are suspected. Therefore there is no "right" answer for this part of the lab, choices which are more or less thoughtful.

- 1) Spend a few minutes comparing the two renditions of Durin's Crown (the arrangement of stars, not the actual crown picture) depicted by Tolkien himself (one diagram is an earlier model – we do not know which one is supposed to be “correct”).



What do you notice that the images have in common? How do they differ?

- 2) Using the enclosed blank star map, find one or more candidates for Durin’s Crown. Clearly mark them on the map by connecting the dots.

- 3) Compare your candidates to actual constellations on the star finder you made earlier – did you draw complete constellations, pieces of constellations, or connect stars from several constellations?

- 4) Explain your choice(s) – how would you try to convince a Tolkien scholar that you are the first person to discover the true identity of Durin’s Crown?

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What Day is It, Mr. Frodo?

Materials: diagram of moon phases, moon phase finder

Key Concepts: phases of the moon
Lunar calendars

Description:

- Teacher will discuss lunar phases and help the students construct the moon phase finders.
- Teacher will have students calculate the elapsed time between new moon and new moon, new moon and full moon, new moon and first quarter moon, based on the fact that the synodic period of the moon is 29.5 days.
- Students will read the following passages from Tolkien's "Fellowship of the Ring" and in each case will use their moon phase finders to mirror how the moon is described to appear in the sky. The phase and approximate time of day should be recorded for future use. *Note: Tolkien describes a quarter phase moon as a "sickle," whereas others commonly use that term to describe a crescent phrase.*

A) Fellowship's arrival in Lothlorien:

"Frodo lay for some time awake, and looked up at the stars glinting through the pale roof of quivering leaves. Sam was snoring at his side long before he himself closed his eyes.... Late in the night he awoke. The other hobbits were asleep. The Elves were gone. The sickle Moon was gleaming dimly among the leaves." "Lothlorien," FOTR (335)

B) Fellowship's travel down the River Anduin:

"The weather was still grey and overcast, with wind from the East, but as evening drew into night the sky away westward cleared, and pools of faint light, yellow and pale green, opened under the grey shores of cloud. There the white rind of the new Moon could be seen glimmering in the remote lakes. Sam looked at it and puckered his brows." "The Great River," FOTR (375)

C) The next night:

"The eighth night of their journey came. It was silent and windless; the grey east wind had passed away. The thin crescent of the Moon had fallen early into the pale sunset, but the sky was clear above, and though far away in the South there were great ranges of cloud that still shone faintly, in the West stars glinted bright." "The Great River," FOTR (376)

- Teacher will now read the following passage, after which the students will try and address Sam's confusion. Just how much time has passed between the first passage and the last?

D) Later that night:

"Sam sat tapping the hilt of his sword as if he were counting on his fingers, and looking up at the sky. 'It's very strange,' he murmured. 'The Moon's the same in the Shire and in the Wilderland, or it ought to be. But either it's out of its running, or I'm all wrong with my reckoning. You'll remember, Mr. Frodo, the Moon was waning as we lay on the flet up in that tree: a week from full, I reckon. And we'd been a week on the way last night, when up pops a New Moon as thin as a nail-paring, as if we had never stayed no time in the Elvish country.'" "The Great River," FOTR (379)

- After the students have drawn their own conclusions, teacher will read the continuation of the passage:

E) The solution was offered by Aragorn:

"But so it is, Sam: in that land you lost your count. There time flowed swiftly by us, as for the Elves. The old moon passed, and a new moon waxed and waned in the world outside, while we tarried there. And yestereve a new moon came again." "The Great River," FOTR (379)

Further exploration: Discuss the use of lunar calendars in other cultures (Jewish, Moslem, Tibetan, etc). The calendar systems used in Tolkien's work can also be discussed.

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