The brightest stars in the sky

Go outside some evening this winter and locate the familiar constellation pattern of Orion the Hunter. Surrounding Orion are the northern hemisphere constellations, and scattered throughout this area of our night sky are many of the brightest stars we see during the year. In fact, eight of the twenty-five brightest stars in our sky are located within the constellations surrounding Orion (see Figure 1). Also within this group are two of the closest stars, Sirius at 8.6 light years and Procyon at 11.4 light years.

Not only are these particular stars among the brightest in our skies, but they also demonstrate a diversity of colors. Interestingly, there is a relationship between the color of a star, its temperature, and its brightness. The temperature of a star determines its surface color and luminosity (the star's actual output of energy, which we see as how bright it appears). In general, cool stars such as Betelgeuse are reddish; medium temperature stars such as our Sun are yellow-orange; and hotter stars, such as Sirius and Rigel, are blue or blue-white (see Figure 1). The hottest stars, logically, are also be the brightest stars. However, the size of the star and its distance from the Earth play important roles in how bright the star appears.

The brightness of a star can be described in two ways—apparent magnitude and absolute magnitude. *Apparent magnitude* is based on how bright the star appears to be when compared to other stars in the sky. This is why the Sun appears to be the brightest star during the day, and Sirius appears to be the brightest star at night. On the other hand, *absolute magnitude* is a measure of how bright the star is when compared to other stars, and this comparison is done as if all the stars were the same specific distance from the Earth. Using a standard magnitude scale, a star differs in brightness by a factor of approximately 2.5 for each whole number difference. For example a first magnitude star is about 2.5 times dimmer than a 0 magnitude star, a second magnitude star is about 2.5 x 2.5 times dimmer, and so on down the line. The dimmest star we can see with the unaided eye is a sixth magnitude star, but this is only possible under excellent viewing conditions. Negative values are used for the very brightest objects.

Look at the bright stars surrounding Orion. Some, such as Sirius at 8.6 light years (l.y.) away and Aldebaran (60 l.y.), are relatively close as star distances go, while others such as Betelgeuse (1400 l.y.) and Rigel (1400 l.y.) are quite distant. Yet they all appear to be about the same brightness, albeit different colors and temperatures.

It turns out that cool stars can appear to be bright if they are very large, similar to the red super-giant, Betelgeuse. With an estimated radius of 241,401,600 kilometers, the relatively dim light from this red star is spread out over a very large surface area, which increases its apparent brightness considerably. By comparing the distance and apparent brightness of Betelgeuse to that of Aldebaran, another cool red star, it can be concluded that Betelgeuse must be larger

FIGURE 1 **Some of the brightest stars**

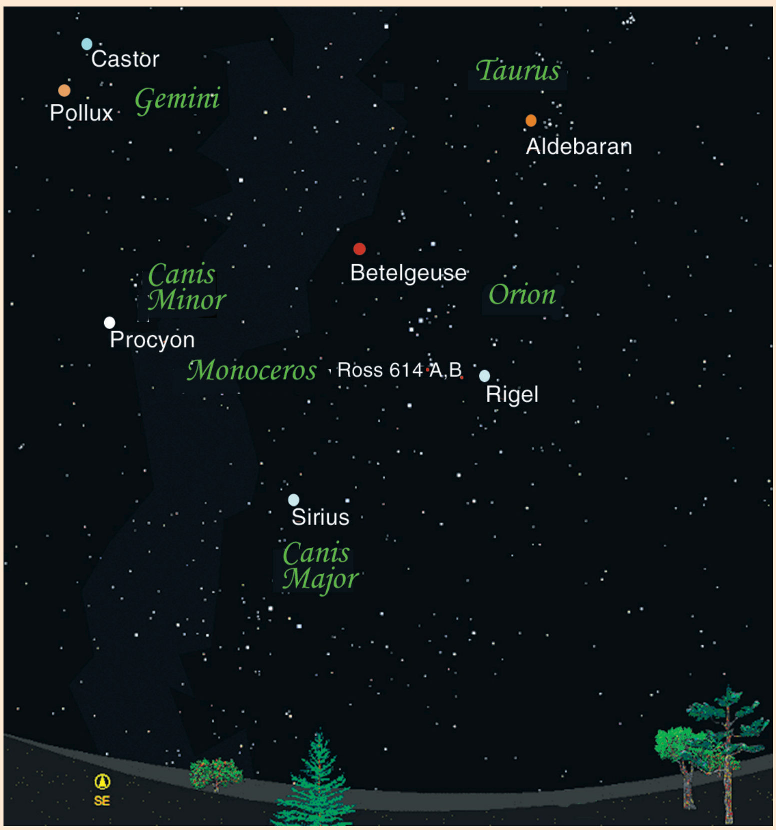

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FIGURE 2 **Some bright star facts**

Name	Distance light years	Apparent magnitude	Absolute magnitude
Sun	8 (light minutes)	-26.72	4.8
Sirius	8.6	-1.46	1.4
Capella	41	0.08	0.4
Rigel	1,400	0.12	-8.1
Procyon	11.4	0.38	2.6
Betelgeuse	1,400	0.50	-7.2
Aldebaran	60	0.85	-0.3
Pollux	40	1.14	0.7
Castor	49	1.57	0.5

than Aldebaran because it is about 35 times further away from the Earth.

Stars may also appear to be bright, regardless of their size, if their distance from Earth is not too great. Our Sun, for example, is less than 1,609,344 kilometers in diameter, but it appears to be the brightest because it is the closest to Earth. Sirius is approximately twice the diameter of the Sun and is the seventh nearest star at a distance of about 8.6 light years, yet it is the second brightest star. This is due to its temperature rather than its proximity to the Earth. Put the Sun at the same distance from Earth as Sirius, however, and the it would not be visible to us at all.

Distance not only plays an important role in apparent brightness, it is also a measure of how long it has taken the light from a star to travel to the Earth. The light year as a distance unit is based on how far light will travel in one year at the speed of light. The speed of light is 299,338 kilometers per second and, in one year, light can travel nearly 9,656,064,000,000 kilometers. In other words, the light you see from the Sun took eight minutes to travel the approximately 149,668,992 kilometers to Earth, while the light from Sirius takes nearly nine years to arrive. Light from Betelgeuse, as a comparison, takes nearly 1,400 years to make the trip to Earth.

Here is a neat way to consider the idea of light years, distance, and travel time and, in a way, to personalize a star. Using the table provided in Figure 2, or the Internet resources for constellations and their stars, find a star that has the same light year distance as your students' age. For example show your 11-year old sixth graders the star Procyon some evening this winter and point out that the light from that star that is currently reaching their eyes left Procyon's surface the year that they were born and has been traveling through space for the last 11 years.

Two special stars

To the east of Orion are the bright stars, Procyon and Sirius. Between these two bight stars and their respective constellations are two very faint stars that make up part of the constellation Monoceros the Unicorn. These very dim stars, Ross 614 A and B, are indicated by red dots in Figure 1. Light from Ross 614 A and B left the stars' respective surfaces exactly 100 "Scope on the Skies" columns ago in 1990, the same year I wrote my first Scope on the Skies column.

Visible planets

- Mercury is visible over the western horizon at sunrise during the last half of January.
- Venus rises about two hours before the Sun and is visible over the eastern horizon at sunrise.
- Earth is visible under your feet.
- Mars rises about three hours before the Sun and is over the southeastern horizon at sunset.
- Jupiter rises at about sunset and is visible all night.
- The planet Saturn rises before sunset and is visible all through the night.

Moon phases

January	
New Moon	1/02
First quarter	1/10
Full Moon	1/18
Third quarter	1/25

Celestial events

- 1/04 Earth reaches perihelion (minimum distance from the Sun)
- 1/04 Quadrantids meteor shower
- 1/27 Moon occultation of Mars

Internet resources

Quadrantids meteor shower—*www.comets.amsmeteors.org/meteors/showers/quadrantids.html*
Launch of STS-107—*science.ksc.nasa.gov/shuttle/missions/sts-107/mission-sts-107.html*
Spacehab—*www.spacehab.com/mission/107/missions_107.htm*
Measuring time and distance—*www.physics.syr.edu/courses/CCD_NEW/seti/tutorial/measure/part5.html*
Monoceros the Unicorn—*www.dibonsmith.com/mon_con.htm*
The constellations and their stars—*www.astro.wisc.edu/~dolan/constellations/constellations.html*