David Cox

Understanding the Universe

LENGTH OF LESSON: Two class periods

GRADE LEVEL: 6-12

SUBJECT AREA: Astronomy/Space Understanding the life cycle of stars from birth to death.

OBJECTIVES:
Students will understand the following:

1. The stages of evolution a star goes through are determined by the size of the star.
2. How the Hertsprung –Russell diagram explains star life cycles.

MATERIALS:
For this lesson, you will need:

Research materials about stars and the evolution of stars books from the library or encyclopedias.

Computer with Internet access: Groups students in no more than 3 to a computer.
A good starting point is Windows to the Universe
http://www.windows.ucar.edu/tour/link=/cool_stuff/tourstars_1a.html

http://imagine.gsfc.nasa.gov/docs/science/know_l2/stars.html

http://www.seasky.org/cosmic/sky7a01.htm

http://www.jpl.nasa.gov/stars_galaxies/

http://www.pbs.org/wgbh/nova/gamma/cosm_nf.html#bina

PROCEDURE:

1. Review with your students what they have learned about stars. In the course of discussion, determine how much they know about star evolution.

2. If students do not fully understand the terms *red giant*, *white dwarf*, *neutron star*, *supernova*, and *black hole*, have them use the research materials you have provided or the Internet to become acquainted with the terms and understand how they relate to the evolution of stars of different sizes.

3. Before continuing the activity, students should know the following three facts:

- A star the size of our sun will burn steadily for 10 billion years, then expand to a red giant, and finally collapse into a white dwarf about the size of Earth.

- A star three or four times the sun's mass will burn steadily for a shorter time, then expand into a red giant, and finally collapse, ending up as a neutron star—a super-dense star about the size of a large city.

- A star 50 times the sun's mass will burn for an even shorter time and may blow up as a supernova before collapsing and eventually shrinking to infinity, becoming a black hole.

4. Divide the class into three groups, and assign the students in each group to focus on one of the three types of stars just mentioned: a star the size of our sun, a star three or four times the sun's mass, and a star 50 times the sun's mass.

5. Have each student use her or his prior knowledge and information from research to draw a carefully labeled set of diagrams illustrating the stages in the evolution of the type of star his or her group has been assigned.

6. Display students' diagrams in the classroom so that the class can use them to compare the stages of evolution of the three different types of stars.

ADAPTATIONS:

Have each student draw a set of diagrams for all three types of stars.

DISCUSSION QUESTIONS:

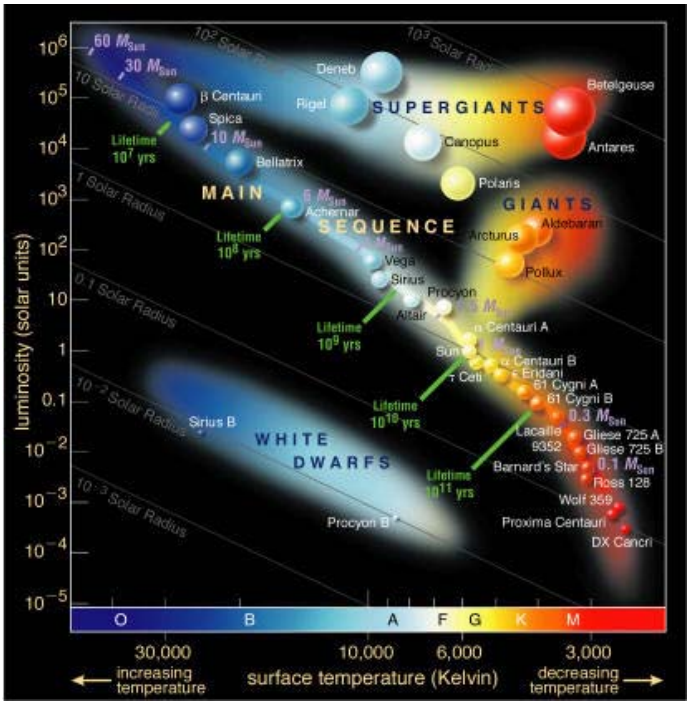
1. Discuss why some scientists were uneasy about the idea of an expanding universe?

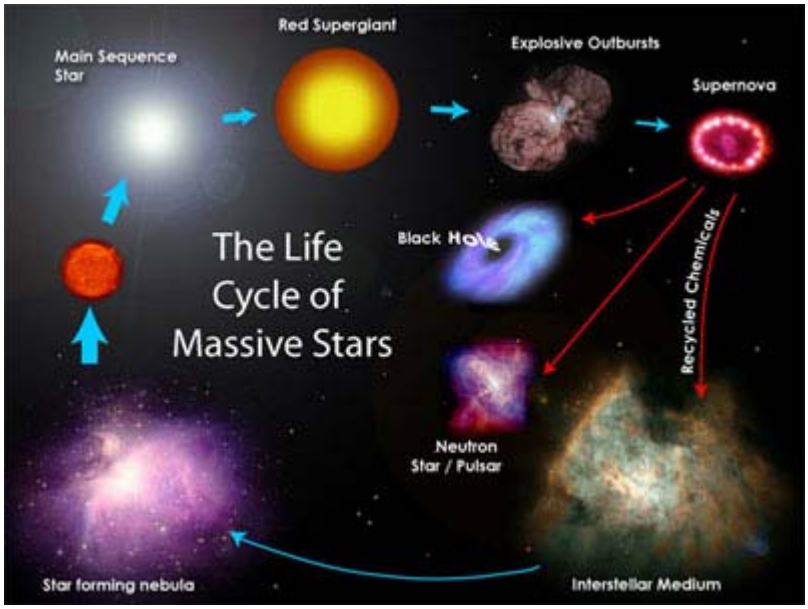
2. Astronomer Wendy Freedman's observations of Cepheid variable stars in another galaxy indicated that the age of the universe is about eight-twelve billion years. Why did her discovery cause such a debate among astronomers? What elements of her discovery still lend themselves to argument?

3. What do scientists learn by observing parts of the universe in other than the visible parts of the spectrum?

3. What materials are believed to compose dark matter, and what can we learn about the universe by examining it?

Images:





Assessment:

You can evaluate your students on their diagrams using the following three-point rubric:

Three points: diagrams carefully prepared; labels clear and correct; diagrams accurately illustrate the star's stages of evolution

Two points: diagrams adequately prepared; some labels unclear or incorrect; diagrams accurately illustrate the star's stages of evolution

One point: diagrams carelessly prepared; labels unclear and/or incorrect; diagrams reflect some inaccurate information about the star's stages of evolution

You can ask your students to contribute to the assessment rubric by determining how many diagrams will be required to illustrate the stages of evolution for each type of star.

EXTENSION:

News Flash!
Have students prepare and deliver a one- or two-minute news report announcing one of the following discoveries or topics: Cepheid variables, supernovae, dark matter, cosmic background radiation, black holes, red shift.

Science Fiction: How Real Is It?
Divide the class into groups to consider the accuracy of selected science-fiction programs or movies that depict space travel. Students should note and explain any laws of physics that appear to be ignored or altered in the programs or movies. You may prefer to choose one such program to have the students watch as a group in order to detect scientific inaccuracies.

SUGGESTED READINGS:

"Fires at Cosmic Dawn"
S. George Djorgovski, Astronomy, September 1995

"A River in the Universe"
Adam Frank, Astronomy, August, 1996

"Stellar News for Stars and Dreamers"
William J. Cook, U.S. News and World Report, January 29, 1996

WEB LINKS:

Comet Shoemaker-Levy Collision with Jupiter
This site contains wonderful pictures of the collision between the comet and Jupiter. It presents good background information, close-ups, up-to-date scientific data as well as space and ground-based observations.
http://www.jpl.nasa.gov/sl9/

The Solar System
This is a good resource for teachers and students on the solar system and individual planets. It offers pictures, animation, and references, with hypertext leading to more information.
http://www.uni-geochem.gwdg.de/

GLONASS (Russian Space Force)
This is a very interesting site to visit after students have explored other similar American sites. It takes you to Russia to learn about the Russian space force, or GLONASS. Students will immediately notice that this Russian Web site is not as colorful nor graphic-rich as American sites; it is mostly text. It is a good contrast to our sites (this could be used as a "compare and contrast" writing assignment). Click on

the English version, then to GLONASS. The introduction explains what GLONASS is and its history. Go back and click on KOI-8 version to show students have the site looks in Russian.
http://mx.iki.rssi.ru/SFCSIC/SFCSIC_main.html

VOCABULARY:

Cepheid variables
A class of giant, pulsating stars, whose brightness varies in a periodic manner, which is used to measure distance in astronomy.

Context:
Edwin Hubble was studying a distinctive kind of star called a Cepheid variable.

globular cluster
A compact, spherical-shaped cluster of stars that shares a common gravitational association.

Context:
We're looking at globular star clusters - 100,000 to 1,000,000 stars.

light-year
In astronomy, the unit of length used to measure distance i.e. the distance that light traveling in a vacuum covers in one year.

Context:
They say the star is four and a third light-years away.

red shift
The shift toward the longer wavelength, or red section, of the spectrum.

Context:
It was Hubble who recognized the significance of the red shift in the light.

spectrum
The distribution of electromagnetic radiation from a radiant source, spread out into wavelengths or frequencies.
Context:
Visible light, the rainbow of red to violet, is a small slice of a larger spectrum.

ACADEMIC STANDARDS:

Grade Level:
7-12
Subject Area:
space science

Standard: MO Strand 6 Understanding the Universe
Understands essential ideas about the composition and structure of the universe and the Earth's place in it.

Benchmarks:
Knows that current theory states that about ten billion years ago, the entire contents of the universe expanded explosively into existence from a single, hot, dense chaotic mass; our solar system formed

from a nebular cloud of dust and gas about 4.6 billion years ago.

Knows that at the beginning of the universe, stars formed out of clouds of the lightest elements and became hot as the material condensed and began releasing energy from the nuclear fusion of light elements into heavier ones in their extremely hot, dense cores; some stars eventually exploded, producing clouds of material from which other stars and planets would condense; this process of star formation and destruction continues.

Knows that the scientific account of the universe comes from studying evidence about the contents and imagining, with the help of mathematical models and computer simulations, how the contents got to be the way they are.

Know that the strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.

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Grade Level:
9-12
Subject Area:
technology

Standard:
Understands the nature of scientific inquiry.

Benchmarks:
Knows that hypotheses are widely used in science for choosing what data to pay attention to and what additional data to seek, and for guiding the interpretation of the data.

Knows that conceptual principles and knowledge guide scientific inquiries; historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.

Knows that scientists conduct investigations for a variety of reasons, such as exploration of new areas, discovery of new aspects of the natural world, confirmation of prior investigations, prediction of current theories, and comparison of models and theories.

Knows that results of scientific inquiry - -new knowledge and methods - emerge from different types of investigations and public communication among scientists; the nature of communicating and defending the results of scientific inquiry is guided by criteria of being logical and empirical and by connections between natural phenomena, investigations, and the historical body of scientific knowledge.