NSDL/NSTA Web Seminar:

Celebrating Astronomy: A Star’s Story

Thursday, September 25, 2008
6:30 p.m. to 8:00 p.m. Eastern time
Agenda:

1. Introductions
2. Tech-help info
3. Web Seminar tools
4. Presentation
5. Evaluation
6. Chat with the presenters
Supporting the NSDL Presenting Team is...

For additional Tech-help call:
Elluminate Support,
1-866-388-8674 (Option 2)

Jeff Layman
Tech Support
NSTA
jlayman@nsta.org
703-312-9384

http://nsdl.org
We would like to know more about you…

http://nsdl.org
How many NSTA web seminars have you attended?

A. 1-3
B. 4-5
C. More than 5
D. More than 10
E. This is my first web seminar

Use the letters A-E located at the top left of your actual screen to answer the poll.
How many NSTA web seminars have you attended?

A. 1-3
B. 4-5
C. More than 5
D. More than 10
E. This is my first web seminar
Where are you now?

Note:
Alaska & Hawaii
Not to scale
www.50states.com
What grade level do you teach?

A. Elementary School, K-5.
B. Middle School, 6-8.
C. High School, 9-12.
D. I teach college students.
E. I am an Informal Educator.
NSDL/NSTA Web Seminar:
Celebrating Astronomy: A Star’s Story

Thursday, September 25, 2008
Today’s NSDL experts:

Dr. Susana Deustua, Researcher, Space Telescope Science Institute & Co-chair of the U.S. International Year of Astronomy

Dr. Cathy Ezrailson, Assistant Professor of Science Education University of South Dakota

http://nsdl.org

http://www.thephysicsfront.org
To begin our celebration of the International Year of Astronomy 2009, let’s investigate:

- Star birth and formation
- Stellar classification
- Star spectra
- Planet formation
- When stars die
- More resources

http://nsdl.org
Test your star power

Which do you think is the most common element (by mass) found in stars?

A. Helium
B. Hydrogen
C. Carbon
D. Silicon

Sagittarius Star Cloud, Center of the Milky Way Galaxy

http://nsdl.org
Stars are made of:

- (by mass)
- 70-80 % Hydrogen
- 20-30% Helium
- 1-2% Metals (everything else - C, N, O, Si, Ca, Fe, Zn)
Stars are massive, hot, glowing balls of gas that produce their energy via nuclear fusion in their cores. Their lifestyles are determined by the struggle for equilibrium between gravity and pressure.
Star Nurseries …
a star is born in the Orion Nebula

Hayden Planetarium, American Museum of Natural History
http://haydenplanetarium.org/movies/ava/S0801starform.mpg

http://nsdl.org
What physical factors do YOU think most influence how stars are formed?

Consider:

- Mass of the initial gas cloud
- Temperature of the gas
- Speed of cloud rotation
- Other factors…

Type your responses in the chat
A massive cloud can form thousands of stars ranging in mass from about 100 x the mass of the sun to about 1/100th of a solar mass.

Swan Nebula

The most important factor in how a star evolves and eventually dies is its initial mass.

- Smaller individual clumps may form single stars, binary stars, multiple star systems, planetary systems

- A star’s life and death depend on:
  - how much fuel (mass) they have available
  - how quickly they expend their energy
A star is born…

From collapsing cold clouds of interstellar gas and dust… clouds rotate as they collapse … conserving angular momentum … forming the smaller clumps that will become stars

Orion Nebula
A star’s initial mass determines its life

**High Mass Stars**
- Bright
- Burn “fuel” rapidly (hundreds of millions of years)
- Have very short lives
- Example: Rigel in the Orion Constellation

**Low Mass Stars**
- Less bright
- “Burn” for billions of years
- Have very long lives
- Examples: Sun, brown dwarfs
Let’s pause for questions from the audience....
Classifying stars

We classify stars based on their spectra, which provide us with information on:
- Temperature
- Composition
- Brightness
- (and in some cases, Distance, but that’s another story)
About light and energy

• Light is a particle and Light is a wave.
• A photon’s energy is proportional to its frequency \( E = h \nu \) or inversely proportional to its wavelength, \( E = \frac{hc}{\lambda} \). (\( h \) is the Planck’s constant).

• Electrons in atoms and molecules
  – Absorb light when they jump from lower to higher energy levels.
  – Emit light when they jump from higher to lower energy levels.
About light and energy and stars

[Graph showing intensity vs. wavelength for different temperatures (3000 K, 4000 K, 5000 K) and classical theory (5000 K)].

http://nsdl.org
About light and stars

• Atoms and molecules in the cooler outer layers absorb light - so we observe an **ABSORPTION** spectrum.

• Atoms and molecules in the hotter corona (as in the sun) emit light - so we observe an **EMISSION** spectrum.
<table>
<thead>
<tr>
<th>Surface Temperature</th>
<th>Spectral lines from:</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &gt; 10,000 K</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>8,000 K – 10,000 K</td>
<td>Hydrogen and helium</td>
</tr>
<tr>
<td>T &lt; 8,000K</td>
<td>Hydrogen, helium oxygen, iron, silicon, nitrogen, calcium</td>
</tr>
<tr>
<td>Coolest stars</td>
<td>Molecules</td>
</tr>
</tbody>
</table>
The distribution of energy emitted by a star produces a spectrum. (SED = spectral energy distribution)

Light from the core produces a continuous spectrum.

The elements in the cooler layers absorb light, producing the absorption spectrum.
Which elements are present in the mystery star represented by the spectrum below? Stamp your answer(s)

<table>
<thead>
<tr>
<th>Calcium</th>
<th>Hydrogen</th>
<th>Iron</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
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<td></td>
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</tbody>
</table>

Calcium

Hydrogen

Iron

Magnesium

Mystery Star

Bonus: What is the mystery star’s spectral type?
Mystery Star
Plotting temperature against brightness, gives us an organizing diagram - The Hertzprung-Russell Diagram.

Interactive quiz: http://aspire.cosmic-ray.org/labs/star_life/support/HR_static.swf
Quiz Answers
Simulated life cycle of a 1 solar mass star

http://aspire.cosmic-ray.org/labs/star_life/support/HR_animated.swf
Let’s pause for questions from the audience....
How do **planets** form around stars?

Planets form around stars from accretion of smaller bits (**planetesimals**) after the central star forms, or from a clump orbiting the main star (**jupiters**).

http://atropos.as.arizona.edu/aiz/teaching/a204/images/planetesimals.mov

http://atropos.as.arizona.edu/aiz/teaching/a204/images/ring_formation.mov

http://nsdl.org
When Stars Die

**Very massive (> 10 Msun) stars** die in energetic explosions - supernovae - producing black holes or neutron stars and release almost all their atmosphere into the interstellar medium.

When Stars Die

Medium sized (1-8 Msun) stars swell up, possibly engulfing planets, releasing outer layers into interstellar medium, the core becomes a white dwarf.

We think Low mass (< 1 Msun) stars also puff out, and eventually become white dwarfs. We do know they are very long lived -- longer than the universe is old.
Astronomy is a dynamic science. New discoveries add to our knowledge of the universe and our own solar system.

- New images brought to use by the Hubble Space Telescope show that star formation is more complex and violent than anyone had believed.
- Supersonic jets of particles and dense clots of dust warp glowing gas into a variety of fantastic shapes.
More about stars can be found at…

The Astronomy Center
http://www.compadre.org/Astronomy

Hubble Space Telescope
http://hubblesite.org

International Year of Astronomy 2009
http://astronomy2009.us
http://astronomy2009.org

http://nsdl.org
More about stars can also be found at:

http://compadre.org

http://www.thephysicsfront.org

Let’s interact with a final simulation from The Physics Front:

http://www.fourmilab.ch/yoursky

For further discussion, go to our blog at:

http://southdakotascienceeducation.blogspot.com

http://nsdl.org
THANK YOU!

Dr. Susana Deustua
deustua@stsci.edu

Dr. Cathy Ezrailson
Cathy.Ezrailson@usd.edu

http://www.thephysicsfront.org
Go to http://nsdl.org and click on the K-12 audience page to:

- Download our Seminar Resource List
- Find resources from archived seminars

Learn about new tools and resources, discuss issues related to science education, find out about ways to enhance your teaching at:

http://expertvoices.nsdl.org/learningdigitalK12
NSTA: How to Maximize Your NSTA Conference Experience
October 8, 2008

NSDL: Beyond Penguins and Polar Bears: Physical Science from the Poles
October 29, 2008

http://learningcenter.nsta.org
National Science Teachers Association
Dr. Francis Q. Eberle, Executive Director
Frank Owens, Associate Executive Director
Conferences and Programs
Al Byers, Assistant Executive Director e-Learning

NSTA Web Seminars
Flavio Mendez, Senior Director
Jeff Layman, Technical Coordinator
Content expert and Moderator
Live Web Sessions (5)
Asynchronous discussions over 5 week period
Course Materials
  – SciPack
  – SciGuide
  – Journal Articles
  – e-Book

Energy begins Sept. 30
8:00-9:30 p.m. Eastern

$322.50 (Member) | $367 (Nonmember)
Web Seminar Evaluation:

Click on the URL located on the Chat Window