NSTA WEB SEMINARS

LIVE INTERACTIVE LEARNING @ YOUR DESKTOP

NSDL/NSTA Web Seminar:

Celebrating Astronomy: A Star's Story

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

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

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY
http://nsdl.org

http://www.thephysicsfront.org

NSTA WEB SEMINARS

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

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY
http://nsdl.org

comPADRE
Resources for Physics & Astronomy Education

NSTA WEB SEMINARS

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

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY
http://nsdl.org

NSTA WEB SEMINARS

Stars are made of:

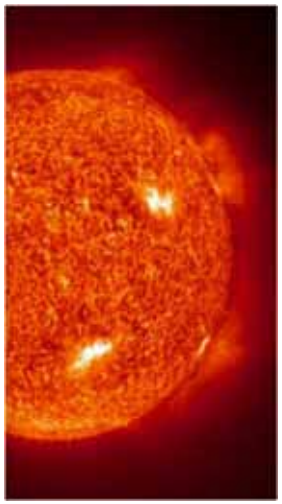
- (by mass)
- 70-80 % Hydrogen
- 20-30% Helium
- 1-2% Metals (everything else - C, N, O, Si, Ca, Fe, Zn)

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

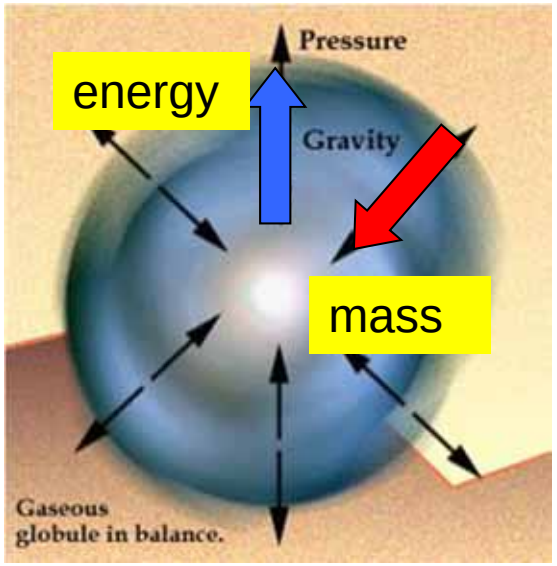
http://nsdl.org

NSTA WEB SEMINARS

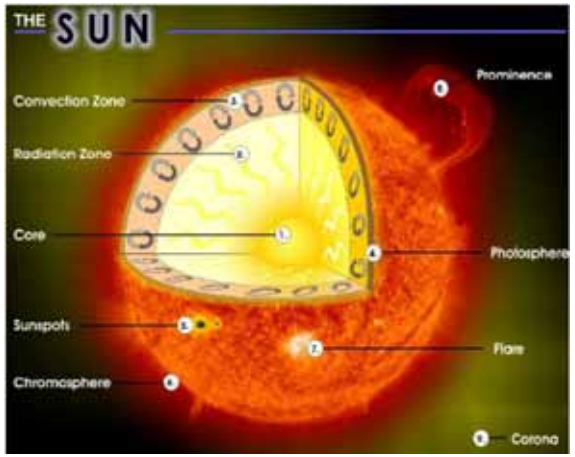
Stars….



…are massive, hot, glowing balls of gas



…lifestyles are determined by the struggle for **equilibrium** between **gravity and pressure**

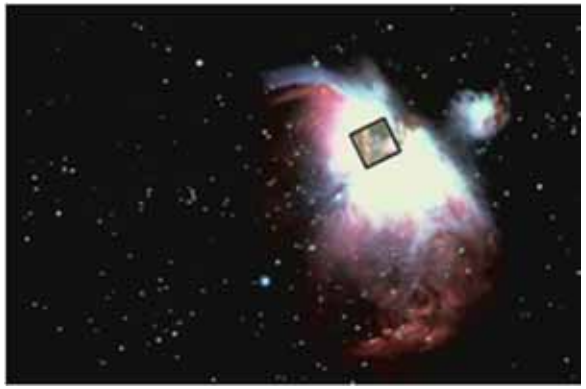
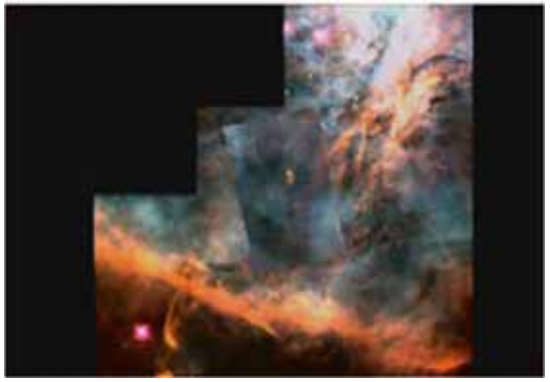
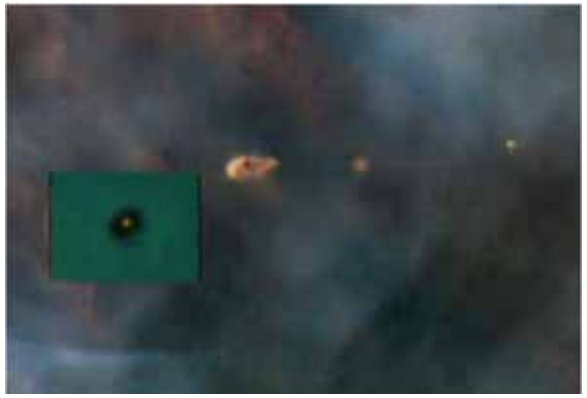
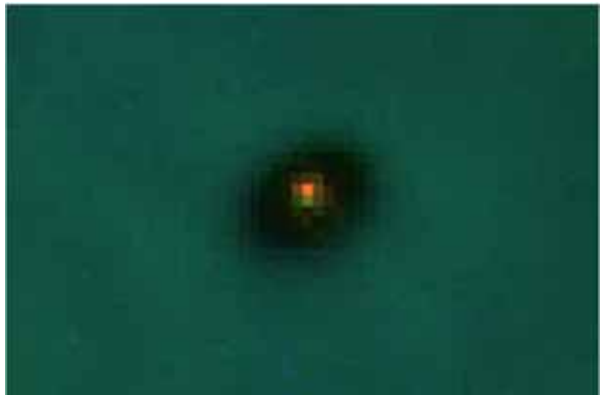


…produce their energy via nuclear fusion in their cores

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY
http://nsdl.org

NSTA WEB SEMINARS

Star Nurseries …
a star is born in the Orion Nebula

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

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

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY
http://nsdl.org

NSTA WEB SEMINARS

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

Swan Nebula

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.

- 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

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY
http://nsdl.org

NSTA WEB SEMINARS

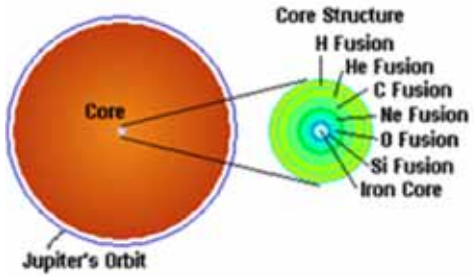
A star's initial mass determines its life

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:

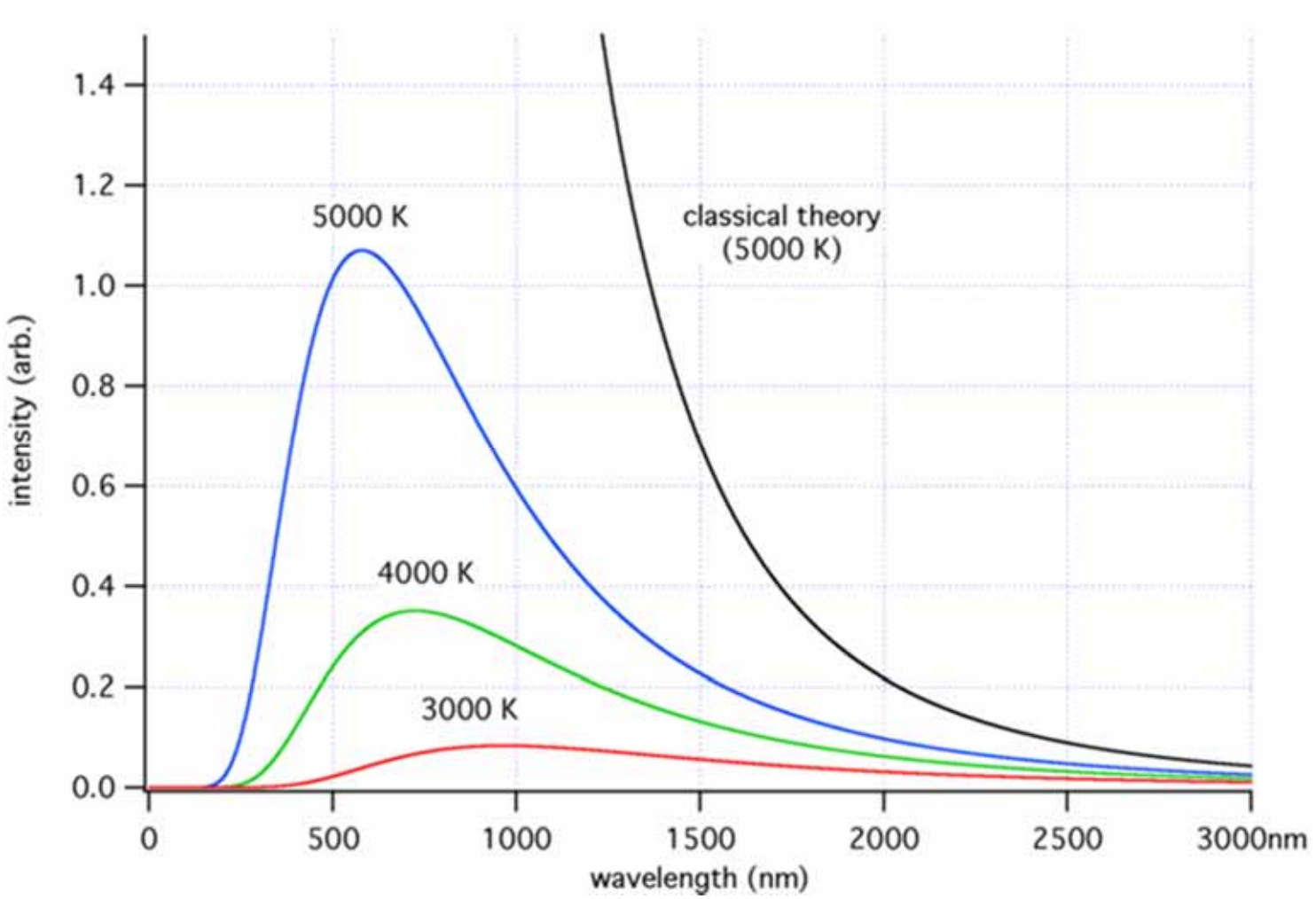
- Temperature
- Composition
- Brightness
- (and in some cases, Distance, but that's another story)

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, **$E = hc/\lambda$.** (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



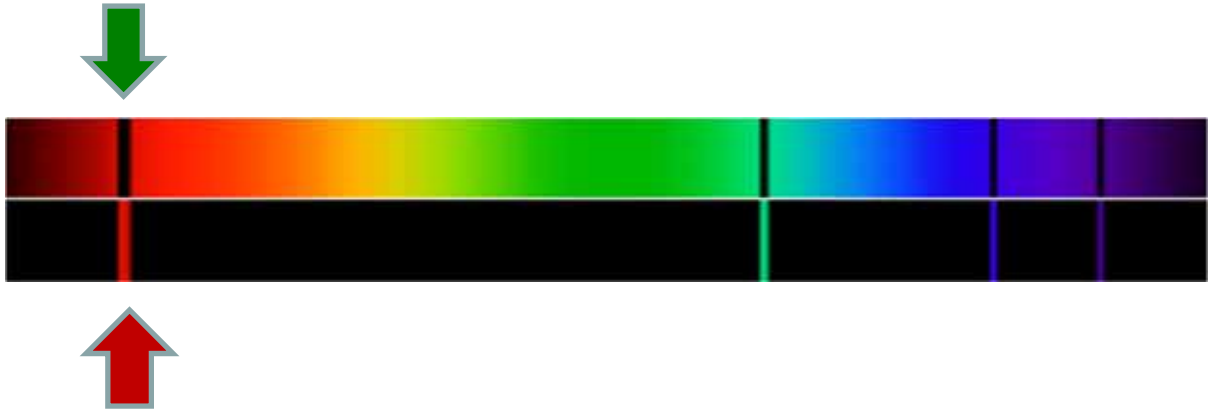
NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

http://nsdl.org

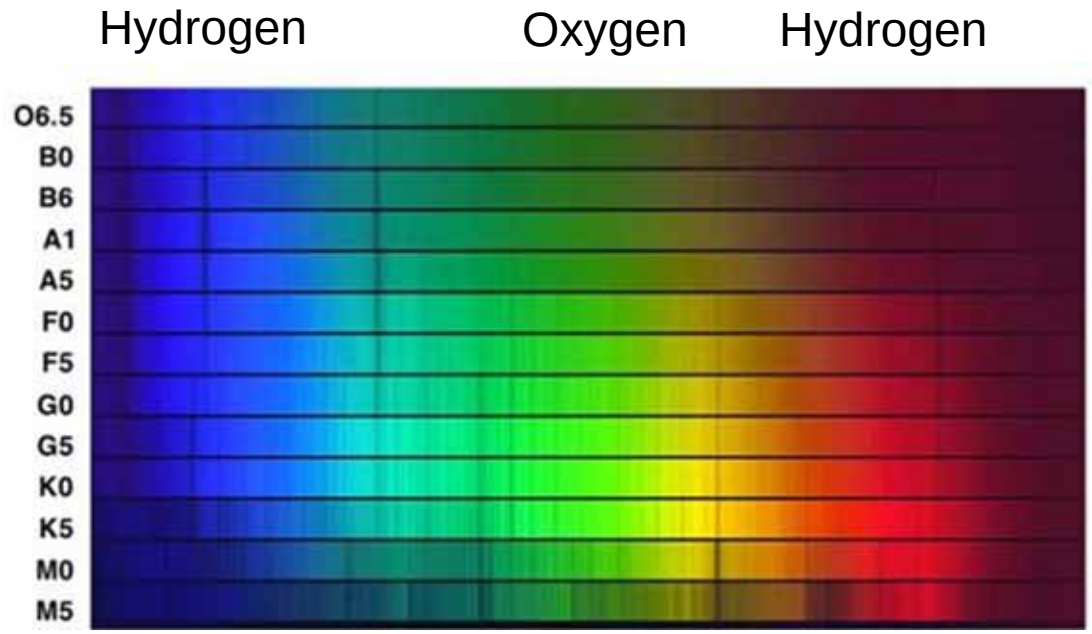
NSTA WEB SEMINARS

About light and stars

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



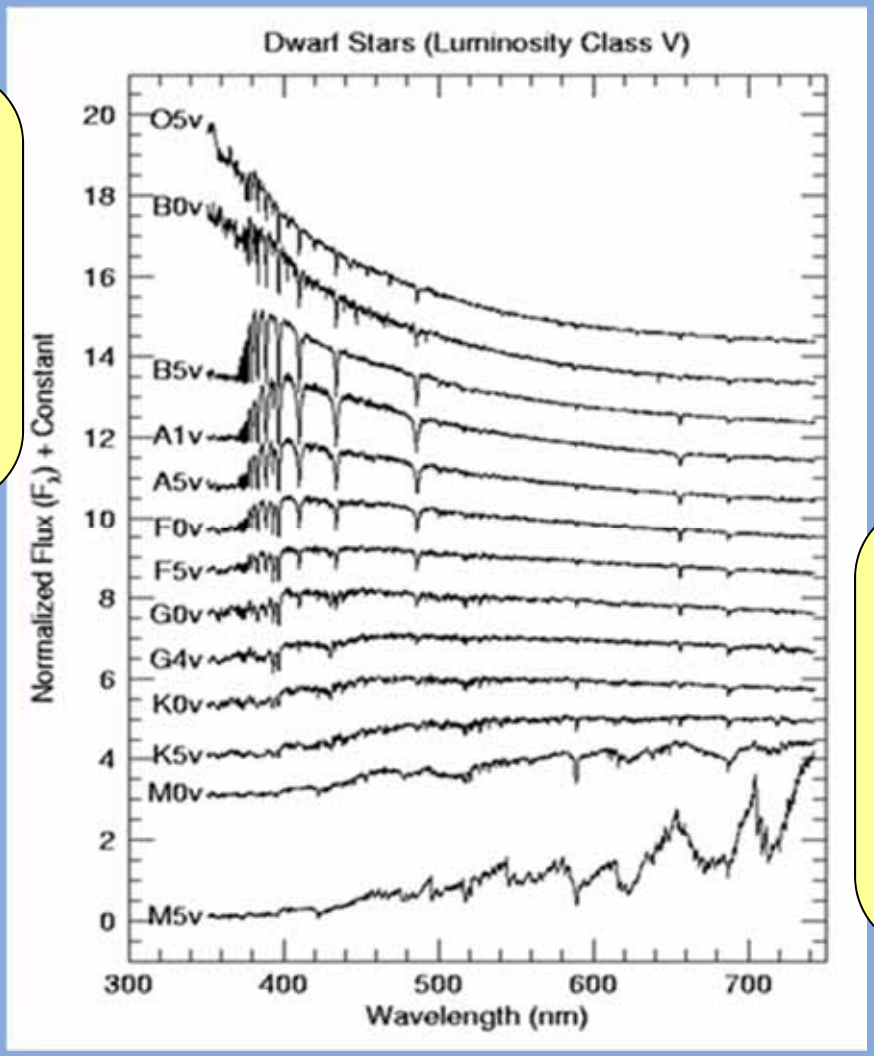
- Atoms and molecules in the hotter corona (as in the sun) emit light - so we observe an EMISSION spectrum.



Surface Temperature	Spectral lines from:
T > 10,000 K	Hydrogen
8,000 K – 10,000 K	Hydrogen and helium
T < 8,000K	Hydrogen, helium oxygen, iron, silicon, nitrogen, calcium
Coolest stars	Molecules

Profile of star spectra

The elements in the cooler layers absorb light, producing the absorption spectrum

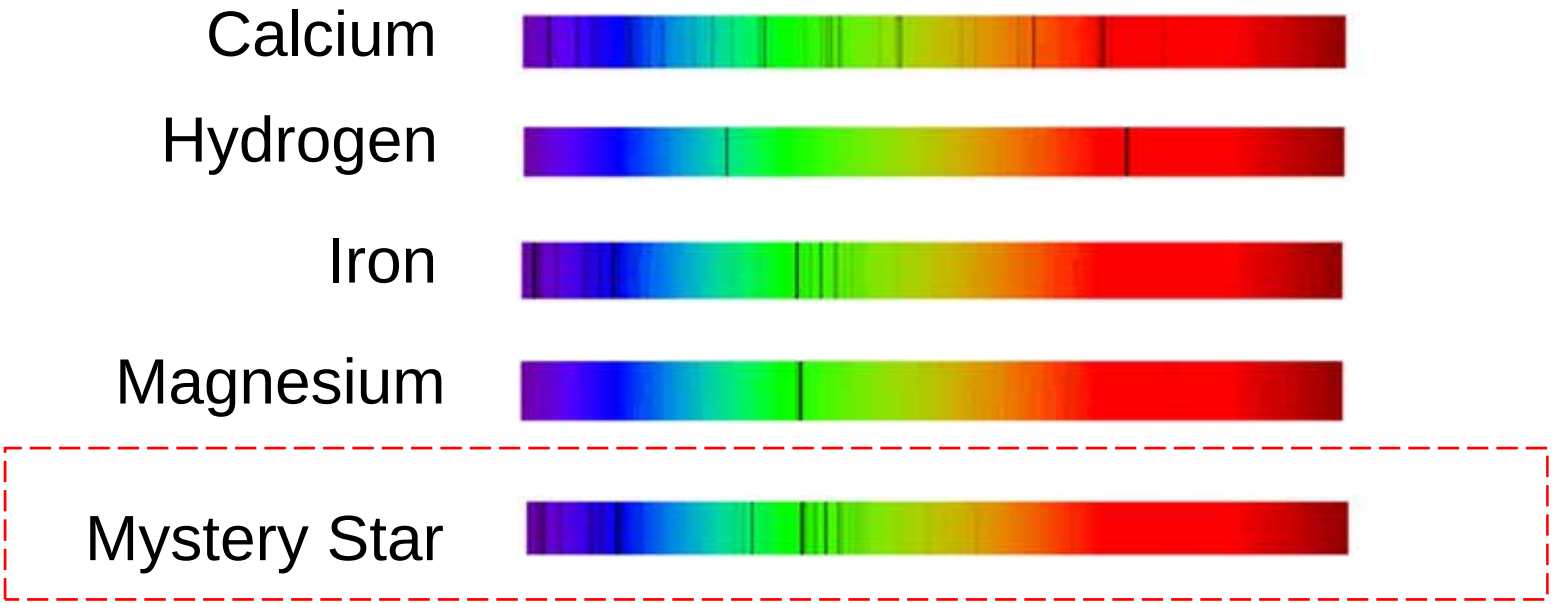


The distribution of energy emitted by a star produces a spectrum. (SED = spectral energy distribution)

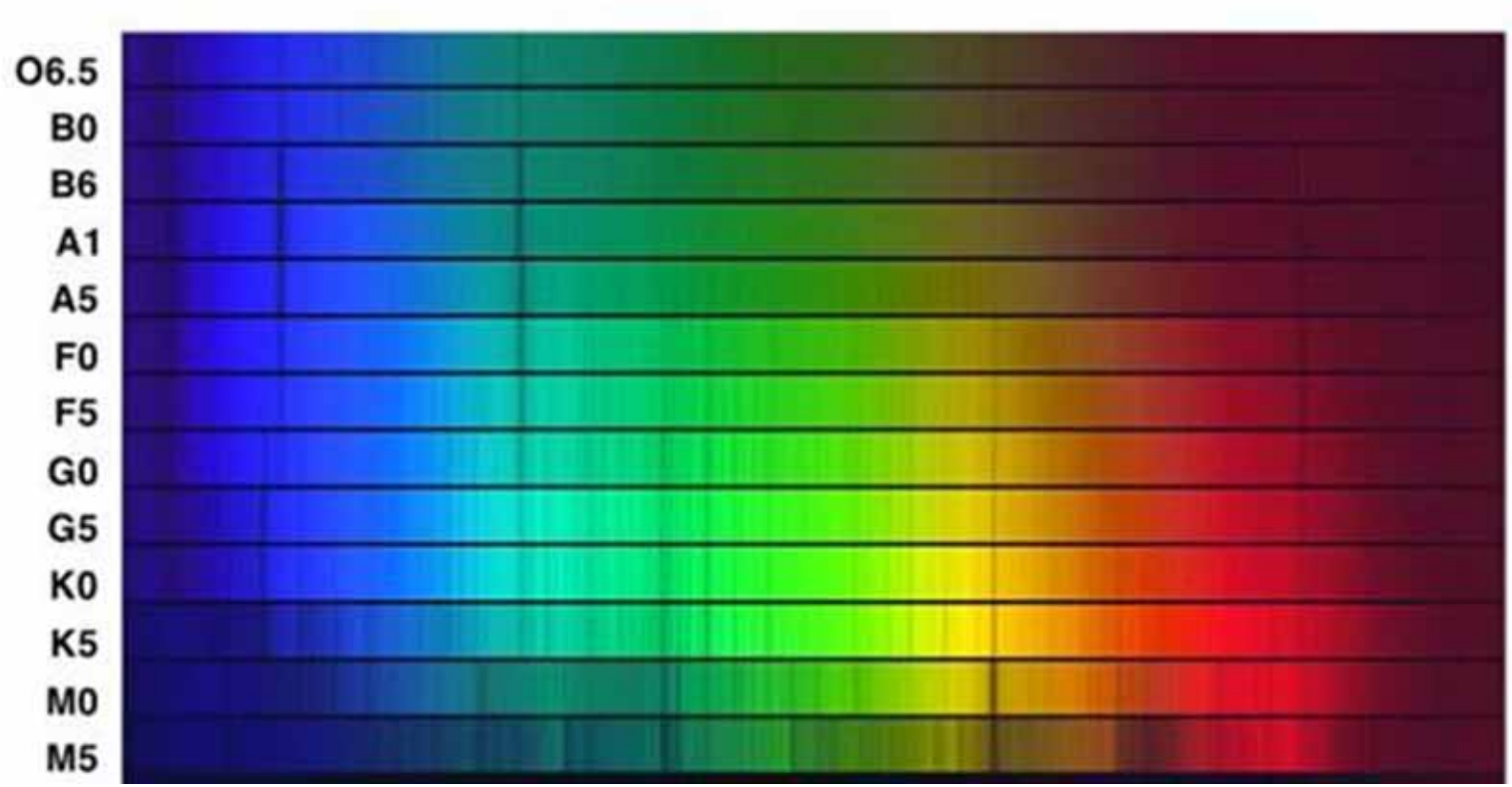
Light from the core produces a continuous spectrum

Which elements are present in the mystery star represented by the spectrum below? Stamp your answer(s)

Calcium	Hydrogen	Iron	Magnesium



Bonus: What is the mystery star's spectral type?



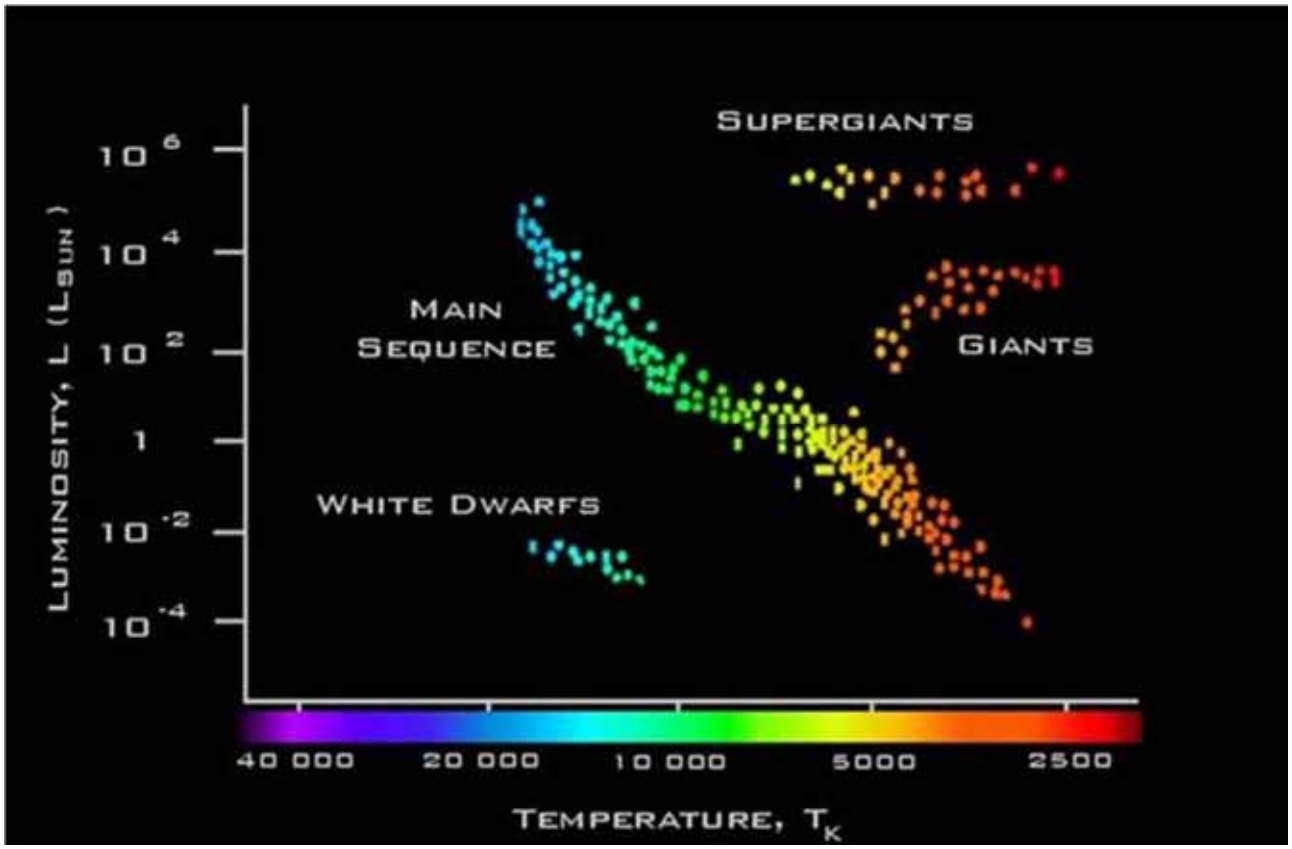
Mystery Star

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

http://nsdl.org

NSTA WEB SEMINARS

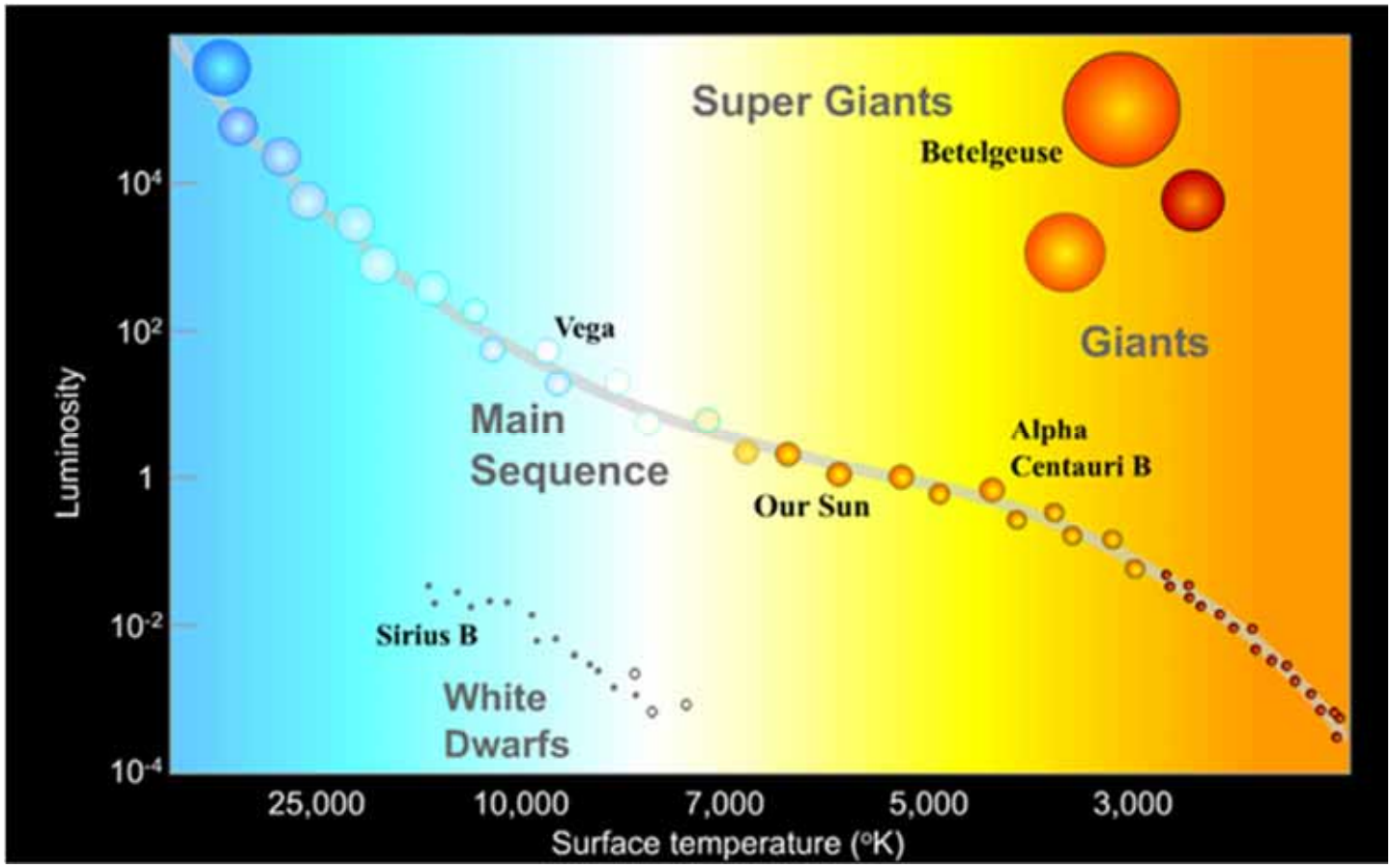
Plotting temperature against brightness, gives us an organizing diagram - The Hertzprung-Russell Diagram.



This diagram is to astronomy as the periodic table is to chemistry.

Interactive quiz: http://aspire.cosmic-ray.org/labs/star_life/support/HR_static.swf

Quiz Answers

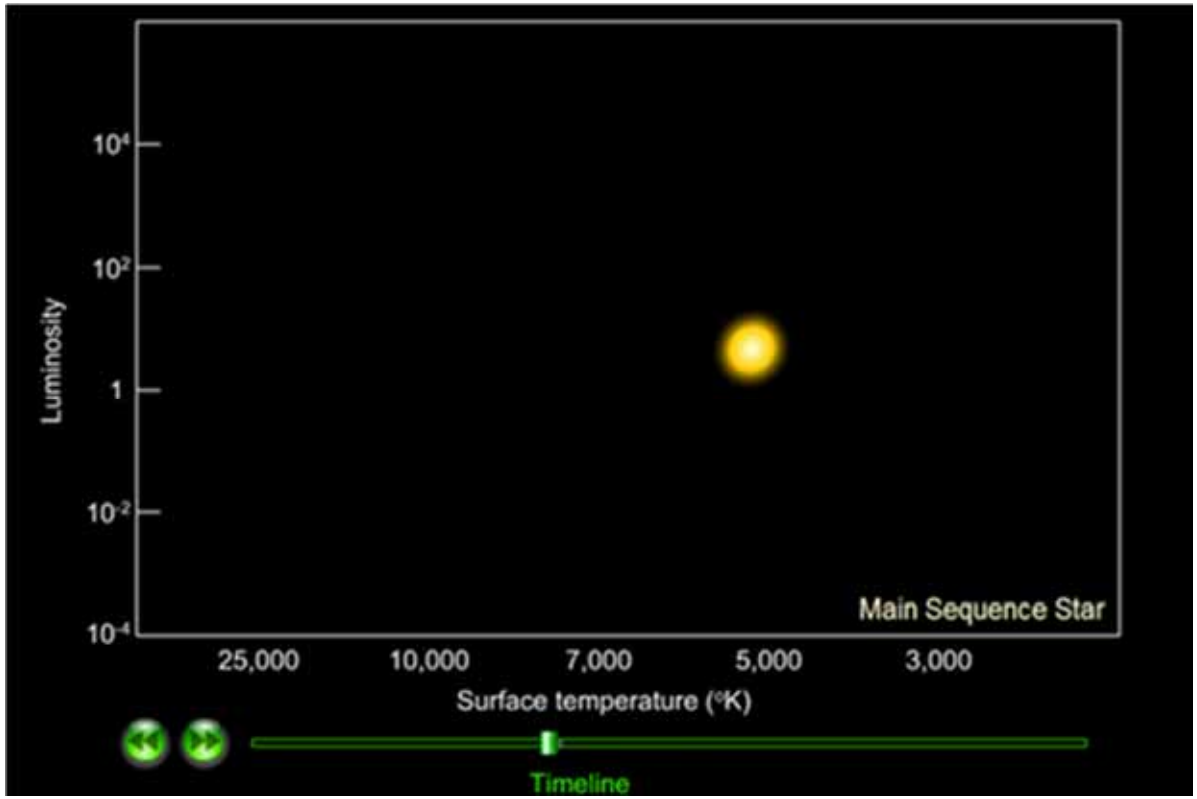


NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

http://nsdl.org

NSTA WEB SEMINARS

Simulated life cycle of a 1 solar mass star



http://aspire.cosmic-ray.org/labs/star_life/support/HR_animated.swf

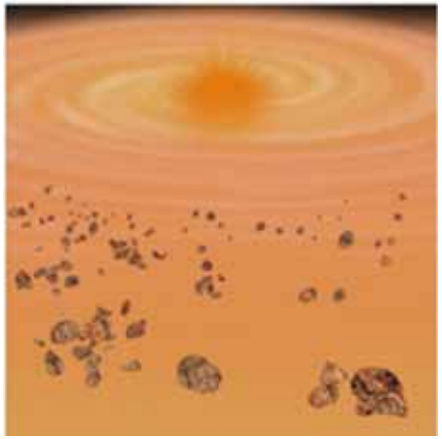
NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY
http://nsdl.org

NSTA WEB SEMINARS

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).



planetesimals

jupiters

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

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

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

http://nsdl.org

NSTA WEB SEMINARS

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.

www.teachertube.com/view_video.php?viewkey=35f9a631b9db584a264e

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

http://nsdl.org

NSTA WEB SEMINARS

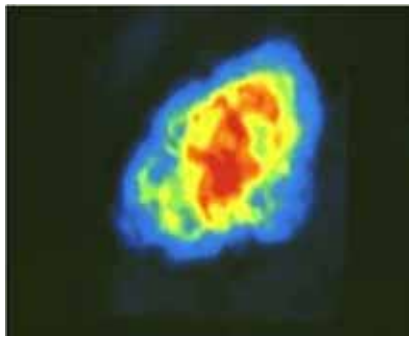
When Stars Die

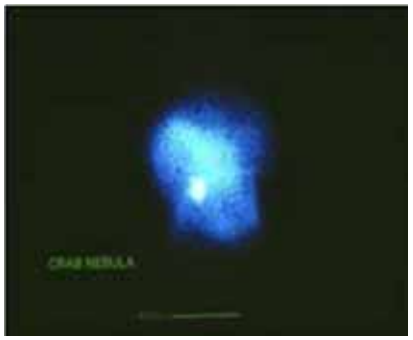

Medium sized (1-8 Msun) stars swell up, possibly engulfing planets, releasing outer layers into interstellar medium, the core becomes a white dwarf.

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

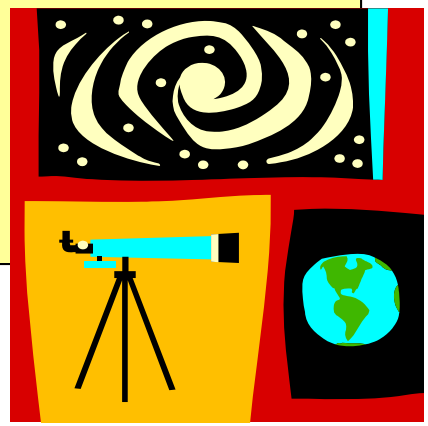
Hubble Space Telescope

http://hubblesite.org

International Year of Astronomy 2009

http://astronomy2009.us

http://astronomy2009.org



NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

http://nsdl.org

NSTA WEB SEMINARS

More about stars can also be found at:

comPADRE
Resources for Physics & Astronomy Education

http://compadre.org

ThePhysicsFront.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

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

http://nsdl.org

NSTA WEB SEMINARS

Dr. Susana Deustua
deustua@stsci.edu

THANK YOU!

Dr. Cathy Ezrailson
Cathy.Ezrailson@usd.edu

http://nsdl.org

http://www.thephysicsfront.org

NSTA WEB SEMINARS

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

NSDL

http://nsdl.org

NSTA WEB SEMINARS

http://www.elluminate.com

NSTA WEB SEMINARS

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