Astronomy 141 -- Winter 2012
In-Class Quiz 4 Study Guide

Properties of Stars
- Luminosity: total energy output from a star
- Colors of stars and relation to Temperature
- Spectral Classification
- Spectral Sequence is a Temperature Sequence
- Main Spectral Types: O B A F G K M L

The Hertzsprung-Russell Diagram:
- Plot of Luminosity vs. Temperature for stars.
  - Main Sequence Stars
  - Giant Stars
  - Supergiant Stars
  - White Dwarfs

The Lives of Stars
- Star shine because they are hot
- The primary source of energy in stars in nuclear fusion
- Main Sequence stars generate energy via Hydrogen fusion into Helium
- The Main Sequence is a mass sequence:
  - Low-mass = cool and low-luminosity
  - High-mass = hot and high-luminosity
- How does a star's main-sequence lifetime depend on its mass?
  - Larger Mass = Shorter Life.
  - Smaller Mass = Longer Life.
  - What are typical lifetimes for O-stars, M-stars, & the Sun?
- How might a star's main-sequence lifetime affect the possibility of life arising on planets around it?

- What happens when a star runs out of Hydrogen for fusion in the core?
- Low Mass stars (M < 4 Msun)
  - Star becomes a red giant
  - Loses its envelope
  - Remnant core becomes a White Dwarf
- Intermediate-Mass Stars with 4 < M < 8 Msun
  - Star becomes a red supergiant
  - Loses its envelope
  - Remnant core becomes a White Dwarf
- High-Mass Stars with M > 8 Msun
  - Star becomes a red supergiant
  - Burns through a succession of nuclear fusion fuels up through Iron
  - Catastrophic collapse of the Iron Core causes a supernova explosion
  - Remnant core becomes either a neutron star or a black hole

- Supernovae
  - Heavy elements beyond Iron are created in the supernova explosion
  - Explosion debris seeds interstellar space with heavy elements

Habitable Zones around Stars
- Likely place to look for life is on rocky planets in the habitable zones of low-mass stars
- Basic requirements for life in a planetary context
  - Stable source of energy: long-lived low-mass star
  - Raw materials for Complex chemistry
  - Location for life to emerge (solid surface)
  - Benign environmental conditions (low UV radiation)
- Where is the Sun's habitable zone today?
- HZs get wider and farther from the star as its luminosity increases
- Other factors affecting habitability
  - Tidal Locking – important for red dwarfs where HZ is close to the star
  - Dangerous superflares from red dwarfs
  - UV radiation hazard from high-mass main-sequence stars
- Around which types of main-sequence stars are we most likely to find potentially life-bearing rocky planets?

The Solar Neighborhood
- What are the nearest stars to the Sun?
- Local space is very empty and stars are very far apart
- Could the Alpha Centauri system harbor habitable planets?
- About half of nearby stars are in binaries or triples
- The average distance between stars locally is about 6 light years
- The distribution of stars is dominated by low-mass stars
- Stars like the Sun are relatively rare
- About 75% of nearby stars are red dwarfs (M-type stars)
- The Milky Way is our Galaxy
  - It is a flattened disk of stars with a central bulge
  - It is nearly 100,000 light years across and 1000ly thick
- There are nearly 200 billion stars in the Milky Way

Extrasolar Planetary Systems
- Searches for planets around other stars
  - Astrometric Wobble Method
  - Doppler Wobble (RV) Method
  - Planetary Transit Method
  - Gravitational Microlensing Method
- Which techniques are the most successful?
- What types of planet are each technique most sensitive to?

Properties of Extrasolar Planetary Systems
- We find many Jupiter-sized planets close to their parent stars
- What are the prospects for finding Earth-like planets?
- We find many planets on eccentric orbits
- We tend to find planets around metal-rich stars

Finding Earths (The Pale Blue Dot)
- What are the challenges of finding very small planets like Earth?
- What does the spectrum of the Earth look like?
- What do we learn about a planet from its thermal infrared spectrum?
- What are the features of the reflection spectrum of the Earth?
- What are the important Spectroscopic Biomarkers of life?
- What can we learn from variability in the brightness of an exoEarth?

Intelligent Life in the Universe
- What are the criteria we think define "intelligent" beings?
- What is the encephalization quotient (EQ)?
- How long did it take for intelligence to emerge on Earth?
- How do we define "advanced technology"

The Drake Equation
- Roughly how many stars are there in the visible Universe?
- What is the Drake Equation?
- What factors in the Drake Equation are known from observations?
- What factors in the Drake Equation are conjectural?
- What does the Drake Equation imply about the number of civilizations in our Galaxy at any given time?
- What does the Drake Equation imply about the average distance between civilizations in our Galaxy at any given time?
- What is the main limitation of the Drake Equation?