Lifetime of Stars—3 Oct

- How are giants and dwarfs related?
- Does the sun have a finite life or does it last forever?
- Clues
  - H-R diagram
  - Mass is related to luminosity
  - Fuel consumption rate

Pleiades & M15

- Stars in a cluster were born at the same time. They are at the same distance.
  - Study a cohort of thousand-tuplets. How are they different? What is their lifetime?
- What are differences between the Hertzsprung-Russell diagrams of M15 and the Pleiades? (For M15, plot is apparent magnitude.)

Differences between M15 & Pleiades

- All stars in Pleiades are on the main sequence. Some in M15 are not.
- Main sequence ends at color -0.2 for Pleides and +0.4 for M15.
- M15 has more stars.
Mass-Luminosity Relation

- Reading the plot
  - Absolute magnitude of the sun is about 5.
  - Mass of the sun is 1.
  - Mass = 10^{0.4 \cdot \text{Lum}}

- What is the mass of a star with 1000 times the luminosity of the sun?

1. What is the absolute magnitude of such a star?
   - A. -2.5
   - B. 0
   - C. 2.5
   - D. 5
   - E. 7.5

2. What is the mass?
   - A. 1.2
   - B. 16

Lifetime of Stars

- Lifetime = Amount of fuel / Rate of consumption
  - Lifetime of a tank of gas for a car
  - For a star
    - Amount of fuel = mass
    - Rate of consumption = luminosity
  - Lifetime = mass / luminosity
  - Stars have a finite life. The sun will not live forever!

Lifetime of Stars

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- Life of sun is 10^8 years
- O3 stars
  - Lifetime is 1/600 of sun’s
  - O stars have a lot more mass than the sun. Why is their life so short?
- M0 stars have a long life.

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<tbody>
<tr>
<td>O3</td>
<td>-6</td>
<td>25000</td>
<td>40</td>
<td>1/600</td>
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<tr>
<td>G2 (sun)</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>M0</td>
<td>10</td>
<td>1/100</td>
<td>0.3</td>
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Pleiades & M15

3. Why does M15 not have any main sequence stars with B-V = 0.2?
   - A. They were not born in M15.
   - B. They died already.
   - C. They became redder main-sequence stars.
Pleiades & M15

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4. Why are there so few giants in the Pleiades?

5. How are giants related to main sequence stars?