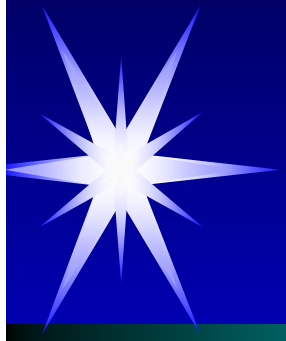

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Exploring the Night Sky

Beyond the Stars

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Beyond The Stars

- Double Stars
- Nebulae
- Star Clusters
- Galaxies

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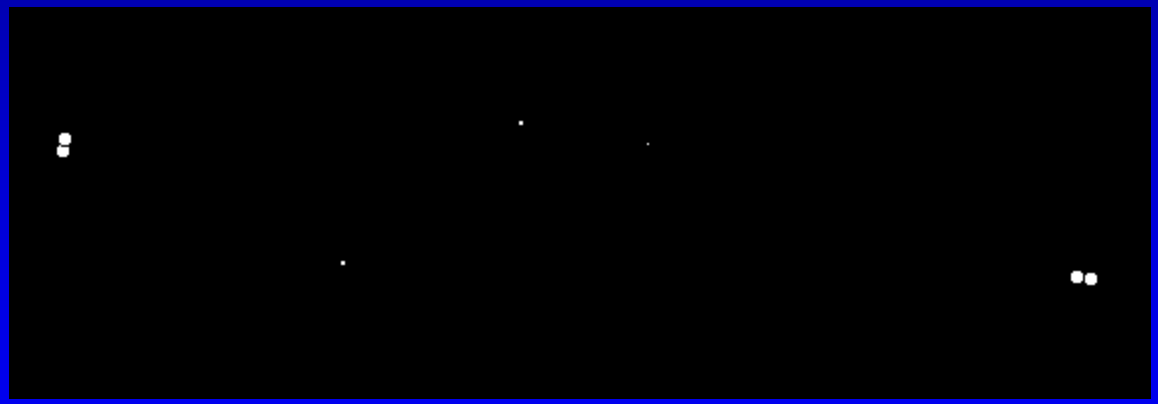
Double Stars

- **Apparent Double Stars**
  - Have no relationship, but provide good viewing
- **Physical Double Stars**
  - Single stars are, in fact, quite rare
  - Most stars have a companion
  - The process of stellar formation often produces multiple star or planetary systems
  - Usually, the component stars are quite different from each other
  - However, double stars of near-equal brightness make great viewing in telescopes or binoculars

Double Stars

Double-double (and more) Epsilon Lyre

a physically related system



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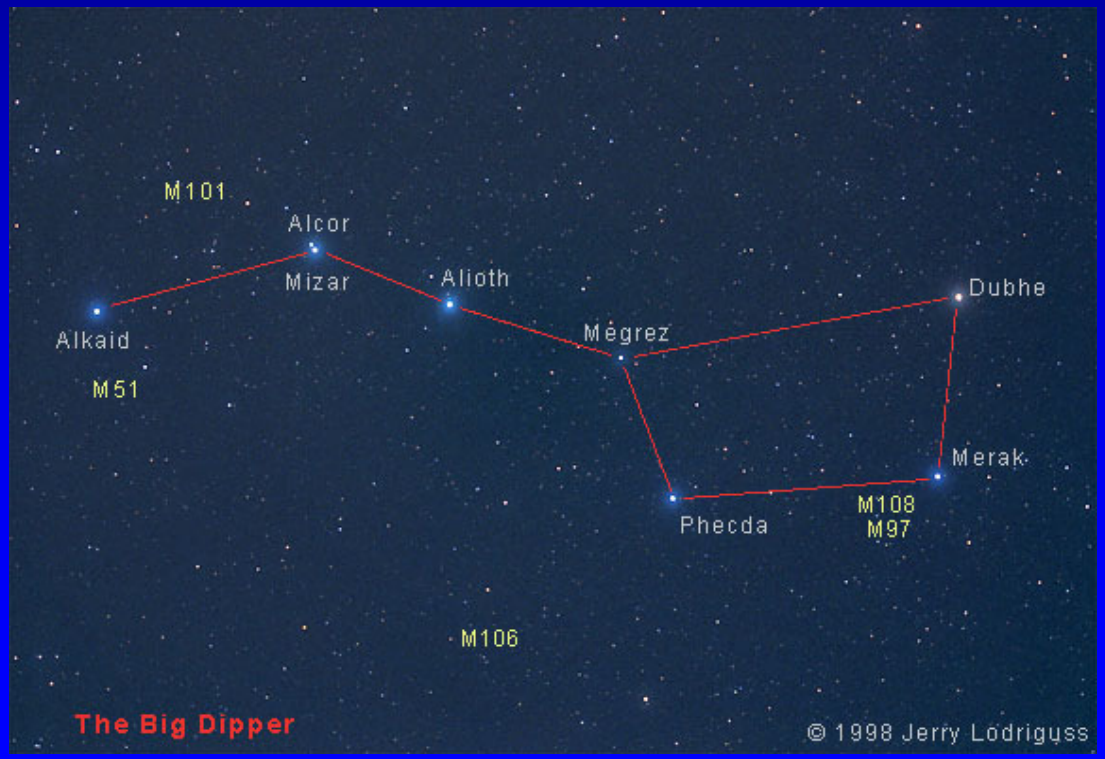
Double Stars

Mizar & Alcor in the Big Dipper



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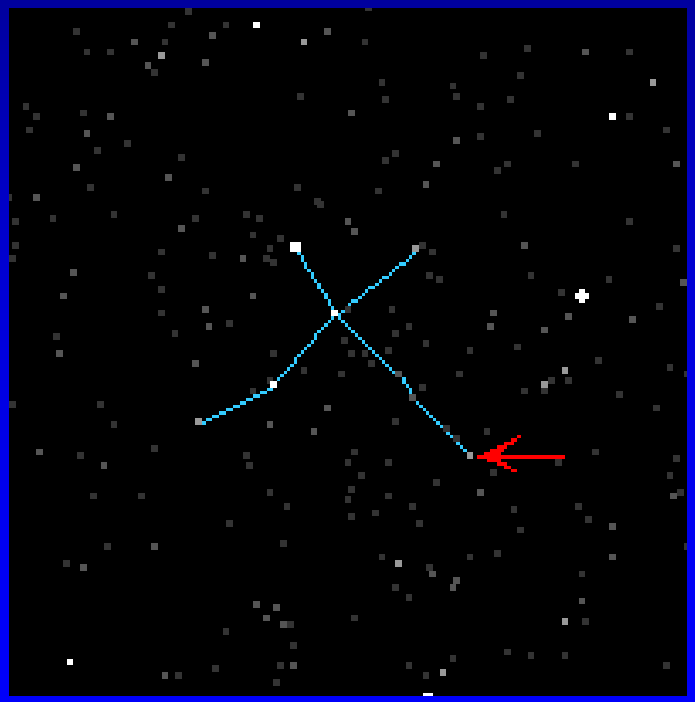
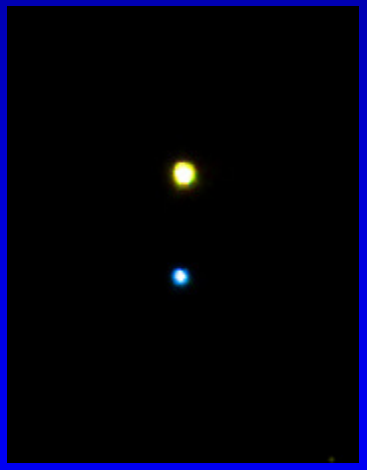
Double Stars

Albireo in Cygnus is an Apparent Double





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Nebulae

- Early astronomers called any “fuzzy”-appearing object a Nebula
- We now know some “fuzzy” objects can be star clusters or galaxies
- A true nebula is a gaseous celestial object, observed by:
  - Reflected starlight
  - Emission lines
  - Unilluminated (dark) seen as silhouetted against a bright nebula

Nebulae

Orion Nebula – reflected starlight

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Nebulae

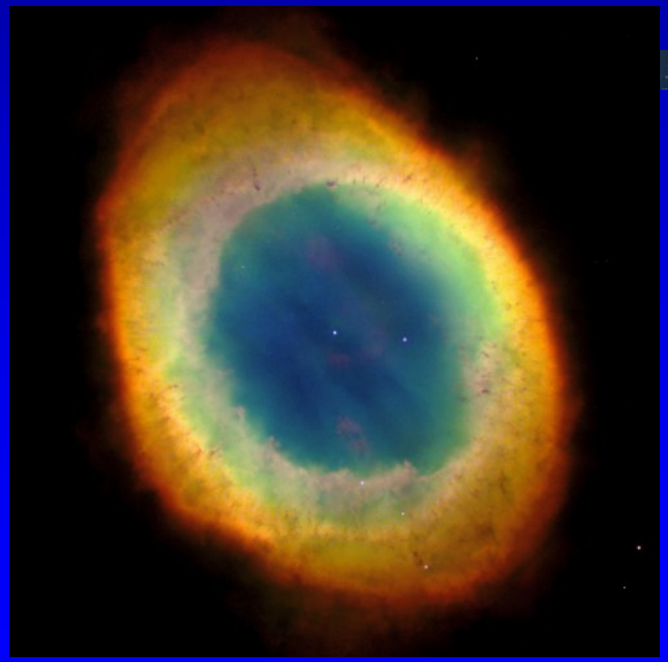
Horsehead Nebula – dark, silhouetted

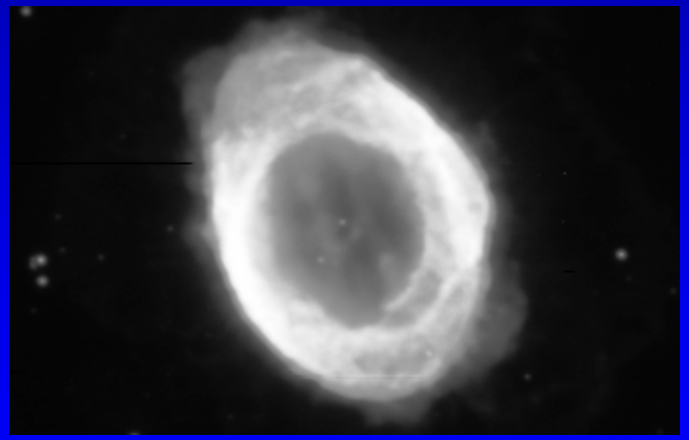
Nebulae

Crab Nebula – emission lines

Nebulae

Ring Nebula – emission lines





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Star Clusters

- Groups of hundreds to thousands of stars
- Generally have a common origin, so many of the stars are of similar brightness
- Star clusters make for great observation, with telescope or binoculars

Star Clusters

- **Open Clusters**
  - **Lie within our galaxy – generally associated with the spiral arms**
- **Globular Clusters**
  - Are spherically shaped
  - Located in a spherical halo around our galaxy

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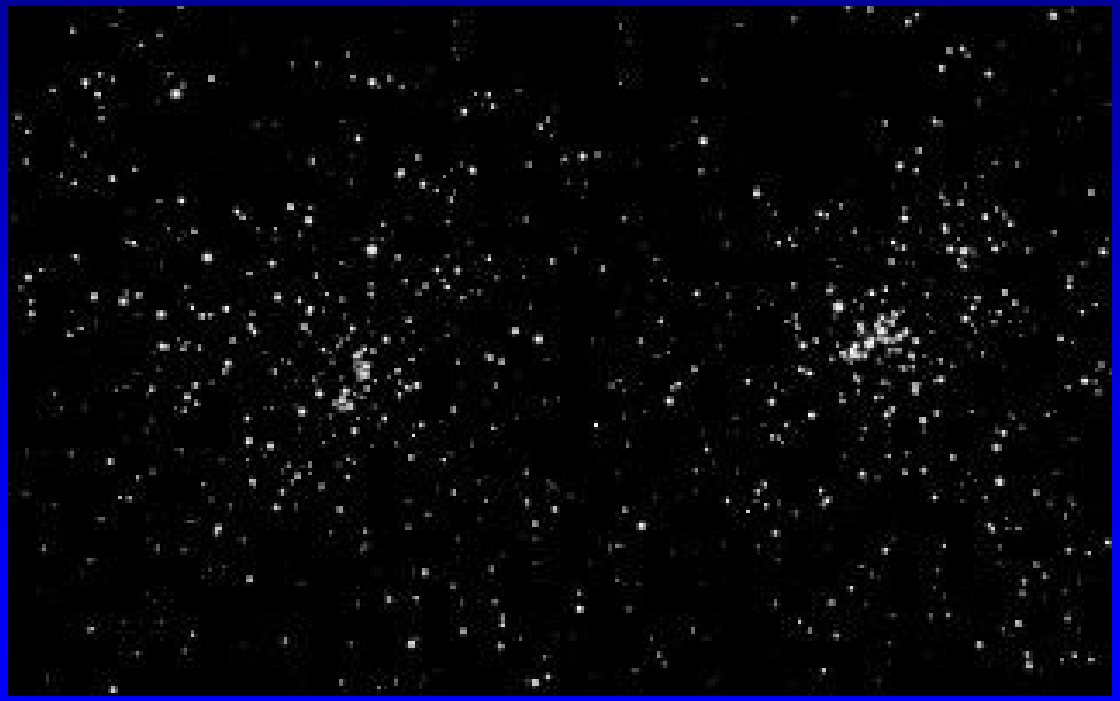
Open Clusters

H and chi – double cluster in Perseus



Open Clusters

The Pleiades and the Hyades

M45 © Royal Observatory Edinburgh/Anglo-Australian Observatory
Photograph from UK Schmidt plates by David Malin

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Globular Clusters

M13 – globular cluster in Hercules

Galaxies

- The Milky Way is our galaxy
- There are as many galaxies in the universe as stars in our galaxy
- Galaxies tend to form in groups
- Our “Local Group” includes about 45 relatively-near (within 5 million light years) galaxies
- Several galaxies in our Local Group are easily visible in binoculars or small telescopes, but many are very faint dwarf galaxies

Galaxies

The Great Nebula (old term) in Andromeda

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Galaxies

M83 is probably what our galaxy looks like