Solar System Formation:

I. The Objectives:
   A. Explain the Motions of Planetary Bodies: Fig 8.1
      1. Most Angular momentum is counter clockwise.
      2. Planets travel near the ecliptic plane inside Neptune’s orbit
      3. Orbits are nearly circular
   B. Nature of the planets: Table 8.1
      1. Terrestrial planets, Mercury to Mars
         a. Rocky/metallic planets
         b. Few moons
         c. No rings
      2. Asteroids in the Asteroid Belt
      3. Jovian planets
         a. Larger bodies
         b. Further from the sun
         c. Colder bodies
         d. Composed mostly of HE and H (small amounts of other materials)
         e. Lots of moons (made of rocky ice)
         f. Rings
      4. Pluto and comets
         a. Icy bodies with highly eccentric orbits
         b. Billions of bodies in Kuiper belt and Oort cloud

II. Evidence for solar systems formation
   A. Examine our solar system
      1. Only system we can study closely
      2. Assume our system is not atypical
   B. Other solar systems
1. 18 Planets discovered since 1990
2. Large planets close to star
C. Formation of other solar systems
   1. Clusters of young stars found in nebula
   2. These stars have disks and dust around them

III. Nebular Theory of solar system formation
   A. Solar system formed out of a large cloud of dust and gas
      1. Cloud comes from
         a. Primordial material - H & He
         b. Material ejected from stars
         c. Supernova material - heavy elements
      2. Assume roughly spherical
      3. Gravitationally bound
   B. Gravitational Collapse
      1. Conserved quantities during collapse?
      2. If cloud has no average angular momentum?
      3. A cloud with an average angular momentum conserves angular momentum
         \[ L_t = \sum_{i}^{all\ particles} m_i \vec{\omega}_i \times \vec{r}_i \]
      4. Positions and velocities are relative to the cloud center.
      5. \( L_t \) is absolutely conserved - as the diameter of the cloud, \( r \) shrinks, what has to expand?