c. Suggest purchase of Westfall's *Construction of Modern Science* to provide you a reference book for background

3. Course requirements: a short, ungraded initial paper, three 6 to 8 page papers
   a. Drafts of the three main papers on indicated dates, with final versions of the papers at the end of exam period
   b. Papers play a critical role in learning in the course, and hence will insist within reason that drafts come in on time -- e.g. lose rewrite privilege otherwise, and receive little comments
   c. Short initial paper to help you sort out the three different world systems
4. Also included with syllabus: a list of key events in science, the figures responsible, and their dates to give you a panoramic overview of the 3 centuries
   a. At the end of each set of notes is a list of "select sources," the sources I have used in preparing the notes over the last 28 years; do not mistake this for an exhaustive bibliography
   b. A valuable general reference: *Dictionary of Scientific Biography*
5. Three final comments about the course
   a. Science distribution credit automatic for second semester, but not for first
   b. A lecture course, but not in sense that you sit passively taking notes on what I say
      (1) Lectures serve role of putting you in position to read and to write papers more effectively
      (2) This by putting certain things hopefully in better focus and by providing you additional background
      (3) Strongly encourage interruption and questions
      (4) Notes will be available on Trunk from each class, plus optional further readings
   c. A personal comment: there is no course I teach or have thought of teaching that I think has greater intellectual value for you
      (1) Regardless of orientation -- science, engineering, humanities -- material of this course can provide a picture of science that will be of value the rest of your lives
      (2) I intend the course to be one of the most memorable intellectual experiences of your life -- as it has proved to be for many people in it over the last 25 years

II. Astronomy, as Inherited by Ptolemy

A. The Celestial Sphere

1. The sphere of the stars: diurnal motion
   a. Picture all the stars as if on a sphere surrounding the earth -- the celestial sphere (spherical astronomy)
   b. Diurnal rotation about diameter through north and south celestial poles
   c. Each star traces a circle, in part visible with time lapse photography
   d. (The question of the distance of the stars, or any other celestial object, from the earth is the first fundamental evidence problem to note in this course!)

2. Celestial equator: the great circle midway between the two poles and perpendicular to the diameter through them
    a. Instead of longitude and latitude, the corresponding "coordinate" system for the celestial sphere has right ascension and declination
    b. Right ascension in units of hours, with 24 hours around the equator: corresponding to times when stars etc. ascend; declination in degrees, corresponding to geographical latitude
3. In addition to the diurnal motion which it shares with the stars, the sun moves about 1 deg eastward each day with respect to the stars
    a. Taking roughly 365 and 1/4 days to complete its way around the sphere
    b. North of the celestial equator for roughly half of this time, south the other half
4. The path the sun follows among the stars is called the ecliptic -- the line along which solar and lunar eclipses occur
    a. Inclined at a little more than 23 deg from equator, with intersection points called the vernal and autumnal equinoxes, and the extreme points the two solstices
    b. Celestial latitude and longitude measured with respect to the ecliptic, with a north and south ecliptic pole, and not with respect to the equator
    c. From time immemorial, ecliptic divided into 12 constellations, each 30 deg wide: the signs of the zodiac
5. The vernal equinox slowly moves among the stars, taking 26,000 years to complete its circuit
    a. Precession of the equinoxes, actually from the wobble of the spheroidally shaped earth
    b. From Aries to Pisces, soon to be entering the age of Aquarius
    c. That precession occurs was known for a long time before the pattern and rate were determined; the precise cause was first announced in Newton's *Principia*

B. Planets: "Wandering Stars"
1. The Sun is accordingly a wandering celestial body, in contrast to the "fixed stars", which stay in the same position with respect to one another
    a. Wanders at a certain average rate per day
    b. But in fact this rate not uniform: e.g. takes 94 and 1/2 days from the vernal equinox to the summer solstice, and 92 and 1/2 days from the summer solstice to the autumnal equinox
2. The Moon is another example of a celestial body that "wanders" among the stars, at a much faster rate than the sun (around 27 and 1/3 days to complete the circuit), moving north and south of the ecliptic
    a. Latitude of the moon quite complex: line of nodes itself moving with time
    b. Eclipses as the classic prediction problem in astronomy, made difficult by the non-uniform longitudinal and latitudinal motion of the moon: the 18 year Saros cycle, a repeating cycle of sequences of eclipses, discovered by the Babylonians