

Astronomy Reading Guide
Chapter 3: *The Science of Astronomy*
Mr. Fuentes – Topics in Astronomy SCP 140

ONE key idea for the chapter

The third chapter includes both *historical facts* about how astronomy developed as a science, and the *conceptual principles of science in general*. Both are crucial to master for our class, and for our final exam, the process of science developed and explained in this chapter will be the single most important question everyone must answer. For the midterm exam, the single MOST important idea you should learn from this chapter relates to Galileo's observations, and Kepler's Laws. Our midterm exam includes the essay question:

What did Galileo see with his telescope? Why were his observations so important? And what are Kepler's Laws. Where do they apply?

We'll have one entire lecture on Galileo's observations, and what each meant in the overthrow of the geocentric theory of the solar system. You should be able to thoroughly explain the answer to this question, in words and in pictures. In particular:

- a) *Galileo made at least six key observations of the moon, sun, three planets, and stars. For each, describe what he saw, and why it was important.*
- i) *Moon*
 - ii) *Sun*
 - iii) *Jupiter*
 - iv) *Venus*
 - v) *Saturn*
 - vi) *Stars in the Milky Way*

Note for the exam, you will be expected to explain EACH of these with at least a sentence or two. A list like the above of the observations alone, without their significance, will not be sufficient to earn a good mark on the essay.

- b) *What are Kepler's three laws in basic language. Give an example using the orbits of Earth for the first TWO laws, and compare the orbits of Earth and Mars for the THIRD law.*
- i) *Shape*
 - ii) *Speed*
 - iii) *Time*

THREE key questions for the chapter we'll discuss

You should be able to answer these questions after reading the chapter, and attending the lectures.

3.2 *How did the Greeks explain planetary motion?*

3.3 *How did Copernicus challenge the Earth-centered model?*

3.4 *How can we distinguish science from non-science?*

FIVE key passages, pages, pictures, and paragraphs you should review

1. **Page 63 – and Figure 3.11** – The explanation of the observed motion of the planets – their **retrograde** motion – from Ptolemy is presented in words and in the figure. Note the little “loop-the-loops” called epicycles, which Ptolemy used to account for the appearance that the planets presented as they occasionally reverse direction in the sky over weeks.
2. **Page 65** – Copernicus. You can read a bit about him here, but his “Copernican Model” really ignited a revolution in the thinking of people across Europe. One important note is that his model for the orbits of the planets was incorrect in one key detail, making the model no more accurate than prior Ptolemaic models.
3. **Pages 67-68 – Figures 3.13, 3.14, and 3.15** – Kepler’s Laws. Remember ours is not a mathematical class, so don’t worry about the equations presented here. Instead, recognize each of Kepler’s Laws, and how you would explain them to someone outside of class.
4. **Page 71 – Figure 3.19** depicting the difference between the Geocentric and Heliocentric theories explanation for the phases and size changes of Venus. Note that it was BOTH the change in phases and the large change in size of Venus that confirmed it had to be orbiting the Sun, and not Earth. The Ptolemaic theory did allow for Venus to change some of its phases, but NOT its size, so dramatically.
5. **Page 72 (and Figure 3.21)** – Hallmarks of Science. We have already discussed these in our exploration of why *astronomy* is a science, and *astrology* is not. Remember not everything in the world must be explained by science to be valid, useful, or important to us; concepts of love, faith, beauty, and intuition are all present in our lives, but not necessarily explained with science. But it is also important to recognize when things are not scientific, and why.

Three key end-of chapter resources you should look at

- Page 80 - Science or Non-Science?
- Page 81 – Process of Science questions #33 and #34
- Page 80 – Quick Quiz questions (some very similar to those on the midterm)

Questions/Concepts YOU want to Review: