

Astronomy Reading Guide
Chapter 4: *Making Sense of the Universe*
Mr. Fuentes – Astronomy CN

ONE key idea for the chapter

The fourth chapter presents the *physical laws* we see in our universe that link all things, from the smallest atoms we are made of to the largest clusters of galaxies. And while this chapter might appear to be one of the least exciting, it does present the one concept that ultimately matters the most in terms of determining what kind of planet, or star, a cloud of gas and dust might become, and consequently what we can learn about them – gravity. And as with the last chapter, there is one key essay question for our midterm exam you should prepare:

How does gravity work? What does it depend upon? How can the law of gravity explain tides? How do we know?

We'll have one entire lecture on Gravity, and another discussion assignment to help you learn how to explain gravity's similarities and differences with other forces like magnetism. For now, consider:

Gravity depends upon some of these. Which ones? In what ways (i.e., does the force increase if the parameter increases? Does the force of gravity decrease? Or is there no effect on the force of gravity?)

- i) *Temperature*
- ii) *Type of matter*
- iii) *Mass of one object*
- iv) *Size of one object*
- v) *Motion (velocity)*
- vi) *Distance between objects*
- vii) *Masses of two objects*
- viii) *Rotation*
- ix) *Solid, Liquid or Gas*
- x) *Density*

You should decide the answers to this question, and for the exam essay, explain what gravity does depend upon, and what it doesn't.

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.

4.3 What keeps a planet orbiting around the Sun?

4.4 What does gravity depend upon?

4.4 How does gravity cause tides?

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

1. **Page 89 – and Figure 4.4** – The explanation for weightlessness in space is very important, and represents of the most common questions people might ask you as an astronomy student. We usually describe this motion as “zero-gravity” which is totally misleading, and has caused many people to think that there is no gravity in space. There is gravity in space – otherwise the Moon wouldn’t orbit Earth, Earth couldn’t orbit the Sun, and the Sun couldn’t orbit in the Milky Way. But if you are in orbit around an object, you are in essence falling around it constantly, and you won’t feel that force of gravity.
2. **Figure 4.5** – Illustrating Newton’s three laws of motion. If this is the only science class you’ll need to take to obtain your Associates degree, and possibly one of the only physical science classes you take for your entire college career, you should learn these three laws and understand how and where they apply. Please do remember that the three *Newton’s Laws of Motion* are **NOT** the same as the three *Kepler’s Laws of Orbits*.
3. **Page 98** – What determines the force of gravity? This section will help you the most in the text to deal with the first part of the essay question.
4. **Figure 4.19 – Page 102** - Illustrating how the Moon’s tidal force from gravity “stretches” our planet. Note how all points of the planet are pulled simultaneously towards the same direction of the Moon – but that the points on Earth *farther* from the Moon are pulled with less force. Use the lengths of the arrows and their direction to help you picture how gravity is always attractive, and decreasing with distance. How we translate those different strengths of gravity into the two high and two low tides every day is really important. Read that over.
5. **Page 103** – This special topic relates why the Moon always shows the same face towards Earth; it addresses another common misconception, that the Moon does not spin.

Three key end-of chapter resources you should look at

- Page 106 – Visual Skills Check is a great review of gravity, and a wonderful way to test your understanding of the concepts. Definitely try it!
- Page 107 – Test your Understanding Questions.
- Pages 107-108 – Quick Quiz Questions. Many of these are identical to those asked on the reading quiz at Mastering Astronomy. If you have any questions about these, please ask in class or in office hours!

Questions/Concepts YOU want to Review: