

Reading Guide: Newton and Locke

Recommended Order of Reading

Week 11:

1. Dewitt, ch. 20 (Required; a quick and good introduction to Newton's three laws of motion and the idea of universal gravitation.)
2. PS, pp. 104-106 (Required; another nice introduction to Newton with more emphasis given to Newtonian theory's relationship to the theories of Copernicus, Kepler, and Galileo.)
3. PS, 2.15, 2.17 (Required; excerpts from Newton's *Principia*)
4. PS, 2.14, 2.16 (Recommended; in both of these readings, Newton presents many important thoughts pertaining to scientific methodology and reasoning.)
5. SEP: ["Newton's Views on Space, Time, and Motion"](#)

Week 12 (**READING DUE MONDAY; TEST ON FRIDAY!**):

1. PS, 2.18 (Required; excerpt from Newton's *The System of the World*)
2. PS, 3.4 (Required; excerpt from Locke's *Essay Concerning Human Understanding*)

Newton's *Principia* (2.15: "Space, Time, and the Elements of Physics")

In his *Mathematical Principles of Natural Philosophy* (the "*Principia*"), Isaac Newton completes an entirely new physics and dynamics. Newton's system gives a truly unified science of motion; the principles and causes that lead objects around us to fall to the earth are the exact same as those which lead planets in their orbits. Newton's physics also builds off of the dynamics of Galileo insofar as it makes the idea of a moving earth more palatable and intuitive.

1. Develop a basic understanding of each of the following terms as Newton defines them in the first part of this reading. Try to connect these terms with concepts that we have and work with in our sciences today: "quantity of matter", "quantity of motion", "inherent force of matter", "impressed force", "centripetal force", "gravity"
2. Pay particular attention to Newton's discussion of the projectile and lead ball starting on p. 168 and going up to Definition 6. Do your best to envision the thought experiment that Newton is presenting here. What is going on with the lead ball, and what does this teach us?
3. Newton makes the following statement on p. 169: "This concept [of the center as having some cause] is purely mathematical, for I am not now considering the physical causes and sites of forces." What does that statement tell you about Newton's attitude toward / philosophy of scientific theories?
4. At the end of this first section, Newton writes, "let the reader beware of thinking that by words of this kind I am anywhere defining a species or mode of action or a physical cause or reason, or that I am attributing forces in a true and physical sense to centers (which are mathematical points) if I happen to say that centers

attract or that centers have forces." What does Newton mean here? Who does Newton's comments about "mathematical points" remind you of?

5. Describe the differences between absolute time and relative time, absolute space and relative space, absolute motion and relative motion.
6. Illustrate the difference between these same concepts by summarizing in your own words Newton's ship example.
7. Why, according to Newton, do we tend to use the relative versions of these concepts rather than the absolute versions?
8. Which concepts should we use, according to Newton, if we want to study the concepts in accord with the words that we actually use in everyday life?
9. What is the purpose for which Newton "composed the following treatise"?

Newton's *Principia* (2.17: "General Scholium")

1. According to Newton, what happens with a feather and a bit of gold in a perfect vacuum? Why is this important to his discussion here?
2. Why should we believe that the motions of the planets and moons cannot have mechanical causes? And what does Newton mean by this (i.e., what does he mean that they do not have mechanical causes)?
3. What does Newton mean that he doesn't feign hypotheses? In general, what is Newton's attitude toward the theory of gravitation, and the causes of gravity?

Newton's *The System of the World* (2.18)

This is an especially enjoyable reading in my opinion. Here you can see Newton applying all three of his laws of motion in order to convince the reader of the idea of universal gravitation. This is a very famous and often cited reading. Enjoy!

1. Newton begins by stating the problem with which he is initially concerned: the problem of "circular motion in free spaces." What is the problem exactly?
2. In the second part of this reading, Newton offers a solution to this problem. He does this through a thought experiment (we saw this same thought experiment in reading 2.14 -- the lead ball -- but the version of the thought experiment given here is much more detailed). Make sure that you read this carefully and don't read on until you can give a nice summary of the thought experiment in your own words as well as an explanation of how this solves the problem in question.
3. In the part labeled "5" and that labeled "9", we can clearly see that Newton isn't entirely original with his theory. A large part of what he is doing is taking valuable insights from previous thinkers and synthesizing these into a general system (this fact is known throughout the study of science as the "Newtonian synthesis"). What is not original to Newton in these two passages? And who is he taking these things from?
4. What is so different about Mercury and Venus's respective orbits according to Newton?
5. How can one tell that the "earth describes about the sun [...], by a radius from the one to the other, areas exactly proportional to the times"?

6. How does Newton's second law of motion show that all falling bodies, regardless of mass, accelerate to the earth at the same rate (and thus, if released at the same time, hit the earth at the same time)? (Section 19).

NOTE: Watch [this video](#) for a fun and historic experiment testing Newton's idea (which ultimately is an idea that comes from Galileo).

7. Which of his three laws of motion is Newton invoking in the last two paragraphs of this reading?

Locke's *Essay Concerning Human Understanding* (3.4)

This is also a very enjoyable reading, and it includes a lot of material that people today need to hear and take to heart. As the introductory blurb clarifies, Locke is here concerned with convincing his reader that humans are magnificently ignorant of potentially a vast number of things. He summarizes two out of three "causes of ignorance" in this reading.

1. KEY QUESTION: While this reading is interesting and fun in and of itself, the primary reason that I've assigned it is because of its affinity with the thoughts of Newton. How are the thoughts of Newton reflected in those of Locke? That is, what do Newton and Locke both emphasize? Where precisely did you notice Newton emphasizing these things?