# AST 120 Activity 8
# Aristotle's Physics

---

| Name | Full | Partial | None |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

This activity is designed to demonstrate the reasonableness of Aristotle's physics as a *qualitative* description of how things move in everyday life.

1. Pick up the steel ball, hold it above the floor, and then let go of it. What does it do?

2. How, if at all, would the ball behave if you did this experiment at a different location on the (spherical) Earth?

3. Based on the two previous questions you can conclude that dropped objects always fall _____.

   (a) toward the North Celestial Pole

   (b) toward the South Celestial Pole

   (c) toward the center of the Earth

   (d) toward a point in the Indian Ocean somewhere West of Australia

4. In the two sphere model of the universe, to which Aristotle adhered, the Earth lies at the center of the Celestial Sphere. The Celestial Sphere, in turn, forms the boundary of the entire universe. Therefore, the center of the Earth is also the . . . ?

5. Now pick up the steel ball and the wadded piece of paper towel. Hold them at the same height above the floor and then drop them at the same time. Which object hits the floor first?

6. Based on this one observation you can conclude that _____.

   (a) lighter things fall faster than heavier things

   (b) heavier things fall faster than lighter things

   (c) all things fall at the same rate regardless of their weight

7. Based on his own observations and on theories of previous Greek philosophers, Aristotle concluded that all matter in the sublunary sphere (below the Moon) was composed of four basic elements: earth, air, fire, and water. Write these elements in order from heaviest to lightest.

8. Heavier elements are pulled down more by gravity, lighter elements are pulled down less. So if the elements were allowed to "settle out" (instead of being mixed up), which of the four elements would we expect to find closest to the center of the universe? Which would be closest to the sphere of the Moon?

9. Aristotle concluded that the natural motion of all elements was to move to its proper place in the universe. Describe the natural motions of earth and fire with respect to the center of the universe.

10. Notice you have two pennies and a graduated cylinder full of water on your table. Pick up the two pennies. Hold one just above the graduated cylinder and hold the other at the same height above the table, but not above the cylinder. Drop both pennies at the same time, making sure that one penny falls into the cylinder and the other falls outside of it. Which penny falls faster?

11. Based on this one observation you can conclude that an object falling through a relatively dense medium (like water) will fall _____ than if that object was falling through a relatively less dense medium (like air).

    (a) slower

    (b) faster

    (c) at the same rate

12. Now that we have looked at natural motions, it is time to look at what Aristotle called *violent* motions. These are motions that are caused by one body pushing on another (in contrast to the natural motions caused by innate tendencies like gravity). There should be a large book on your table. Give the book a gentle, continuous push to make it slide slowly across the table. Then remove your hand from the book. What happens?

13. If you push the book across the table with greater force the book will _____.

    (a) move more slowly

    (b) move faster

    (c) not move at all

    (d) move at the same rate as before

14. Aristotle's rule for violent motion can be expressed in the form of a proportionality as[1]

$$\text{speed} \propto \frac{\text{force}}{\text{resistance}} \rightarrow s \propto \frac{F}{R}.$$

    Suppose you push an object with a force of 20 pounds and the object moves at a speed of 13 feet per second. If, without changing the resistance on the object, you pushed the same object with a force of 60 pounds what would the speed of the object be according to Aristotle's theory?

15. Suppose you push an object with a force of 20 pounds and the object moves at a speed of 13 feet per second. If you pushed the same object with a force of 20 pounds, but doubled the resistance on the object, what would the speed of the object be according to Aristotle's theory?

16. Suppose you push an object with a force of 20 pounds and the object moves at a speed of 13 feet per second. If you pushed the same object with a force of 60 pounds *and* doubled the resistance on the object what would the speed of the object be according to Aristotle's theory?

17. What would happen if an object was pushed within a vacuum (with no resistance at all)? Explain why, on the basis of his theory of motion, Aristotle was forced to conclude that a vacuum could not exist.

[1] Aristotle didn't really define his theory of motion in this algebraic way (algebra had not been invented yet). But this simple formula encapsulates Aristotle's basic idea.

18. Give the book on your table another shove. Once the book leaves your hand, are you still exerting a force on it? According to Aristotle's theory, must *something* be exerting a force on the book? Explain why or why not.

19. We saw above that Aristotle concluded that a vacuum could not exist. So what must happen when an object (enclosed in, say, air) moves? The object vacates a certain region of space, so what must happen in the space previously occupied by the object?

20. Explain how Aristotle might use the answer to the previous question to explain why the book continues to move even after it leaves your hand (or why an arrow continues to fly through the air even after it has left the bow, etc.). Do you find this explanation satisfying?

21. Now let us consider the motion of the stars, sun, moon, and five planets. Is their natural motion the same as that of the four sublunary elements? If not, how is it different?

22. Based on your answer to the previous question, would it be reasonable for Aristotle to conclude that these heavenly bodies are not made of earth, air, fire, or water? Explain why or why not.