Physics Lesson Plan - 1

Syllabus

I. Lot of homework, only 2 hours of class so a lot needs to be done at home
II. Tips for Home Experiments
    A. No distractions, get down to it
    B. Follow the instructions carefully. Don't be creative or witty. There's too many
    C. May need to come up with the objective AFTER conducting the experiment

Summary of Chapter 1 and Other Observations

I. Placing Physics among other studies
    A. Physics is ***the study of the basic nature of matter and the interactions that govern its behavior***.
    B. It is a branch of natural science (as opposed to the social sciences, e.g.). Science is natural philosophy, which is a branch of philosophy.
    C. Aristotle divides philosophy into the practical sciences (politics, ethics, economics) and the theoretical (metaphysics and mathematics). Since physics deals with understanding reality rather than understanding how to act (practical), it is a theoretical discipline. However, since it deals with changeable things insofar as they are changeable, it is less certain than the other theoretical disciplines. Biology and chemistry are in this same category.
    D. Aristotle divides the natural sciences by the object of their study:
        1. Object exists with matter
        2. Object doesn't exist with matter

        And by how they study this object (method):
        1. Studies object through matter
        2. Studies object not through matter

        Metaphysics belongs in group 2.2, Mathematics in group 2.1, and Physics in group 1.1. It is absurd for a science to be in group 1B.
    E. Aristotle believed (opposed to both the later Empiricists and Idealists) that the universe is governed by general laws that, although they may elude man, are ultimately understandable. This is opposed to principles of chaos, chance, or skepticism. Physics lays out the most general laws about the material universe.
II. Scientific Method
    A. Collect facts → Make generalizations → Develop hypothesis → Test predictions with experiments → Rework hypothesis → Test new predictions
    B. Example: Double slit experiment, 1801 Thomas Young:
        1. Light casts sharp shadows, which is a characteristic of particles (Newton)
        2. Hypothesis: light is made of particles

3. Double slit experiment showed interference pattern like waves
4. Rework hypothesis: Light is a wave?

C. The scientific method follows the general process:
1. Make a theory to explain observations
2. Make observations to disprove the theory

D. Why test predictions of a hypothesis?

E. Why do tests need to be repeatable?

F. Emergence: animal behaviors, consciousness. Real science is non-reductionistic. There are aspects of the universe which can only be understood on their specific level and cannot be reduced to simpler elements.

III. Mathematics

A. *The Unreasonable Effectiveness of Mathematics in the Natural Sciences*, Eugen Wigner, 1960

B. Sometimes science proceeds with deduction as part of the scientific method.

C. Math is shorthand for so much of reality. Size, speed, color, quantity of objects, weight. Because computers only speak math, if something can be modelled on a computer, it is mathematical.

D. Not "unreasonable" because God loves math. Actually God loves order (not god of Homer or Islam).

IV. Why Should We Trust Science?

A. Covid, pharmaceuticals, evolution, IVF, cloning, nuclear bomb, the pill, abortifacients, "the narrative" (flat earth, moon landing, hollow earth)

B. Covid response was not "the science." Administrative malfunction/government

C. **Response**: Science and technology have advanced as our ethics have degraded

D. **Objection**: Science can never be certain. It's always changing its theories.

E. **Response 1**: Science doesn't radically change its theories. So many facts to be reconciled. Very few theories explain ALL the data. These theories are continually being tweaked, but not totally overhauled. Examples: Galileo overthrew Ptolemny's system, but Einstein did not overthrow Newton.

F. **Response 2**: Although it can't be certain, probability theory makes it unreasonable to reject science out of hand. 99.9% certainty is enough: Loaded die

G. The scientific method mimics how we intuitively think, but sharpens and formalizes it. The method can lead to *conclusions* which contradict our common sense, but the *method* itself IS common sense. It is applied to both common and uncommon events. A good theory is the most sensible explanation of the facts. The outlandishness of science does not come from its theories but from its facts.

V. Limits of Science

A. Theology vs Science: student debate

B. Science studies material and efficient causes (per definition above)

C. Science studies means, not ends