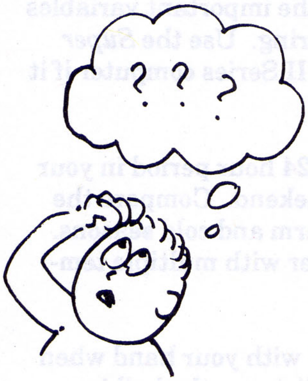
47 Laboratory Investigations
You're On Your Own

Discussion



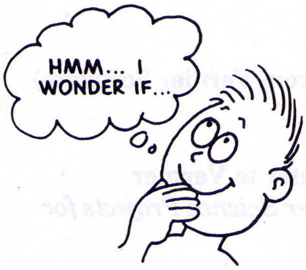
Many of the labs in this manual are intended to give you experience in performing certain specific tasks. As such, they often contain very specific directions. Sometimes you may know the "answer" to a lab before you do it. That's okay—because the answer is secondary to the important practice you gain in gathering, organizing and interpreting data.

The following labs are of the open-ended kind, and do not entail specified steps for you to follow. The purpose of these open-ended investigations is to give you experience at attempting to find the solution to problems for which the answer is *not* known. In these cases you must devise your own method. A list of such laboratory investigations is shown below.

Choose one of the investigations from the list or come up with one of your own. It is important that you define exactly what your investigation will and will not accomplish. Formulate an hypothesis. As a safety precaution, be sure to have your instructor approve your experimental procedure and/or apparatus before you begin experimenting. Acquire and organize your data—graphically, if appropriate. Specify as many factors as you can that influenced your experimental outcome. Does your experiment affirm or refute your hypothesis? Remember, some of the most famous experiments in physics had *null* results—e.g., the Michelson and Morely experiment—so do not despair if your experimental results refute your hypothesis.

Do and *enjoy!*

Investigations



- Find a relationship between the area covered by jigsaw pieces that are unconnected and the same pieces when connected. Predict the area needed to lay out pieces for a puzzle that when put together is known to have a certain area.

- Determine which factors influence the toppling speed of dominoes. What is the maximum speed for a chain of dominoes at least one meter long?

- Devise and build an accelerometer. Calibrate the accelerometer so that it measures acceleration in m/s^2. Explain its operation.

- Devise an experiment that shows how the applied force (or net force) and mass of a system are related to its acceleration.

- Devise a method to measure the free-fall acceleration.

- Predict the height of an arrow shot straight up by measuring the work required to draw the bow. How does drag affect your prediction?

- Devise a method to measure the speed of an object, such as a whiffle ball or tennis ball, as it strikes the ground.

- Find quantitative relationships among the height, speed, mass, kinetic energy, and potential energy of a projectile ejected by a physical pendulum apparatus (such as in "Releasing Your Potential" available from Arbor Scientific).

• Devise a simulation using the *Interactive Physics II* software for the Macintosh available from Knowledge Revolution.

• Devise an experiment that demonstrates: a) constant speed b) constant velocity c) constant acceleration d) variable acceleration (jerks). Use the *Super Sonic Plus* ultrasonic ranging system with an Apple II Series computer if it is available.

• Devise an experimental procedure that measures the important variables of a damped harmonic oscillator, such as a loaded spring. Use the *Super Sonic Plus* ultrasonic ranging system with an Apple II Series computer if it is available.

• Measure the vertical temperature gradient over a 24 hour period in your physics classroom during a school day and on the weekend. Compare the temperature gradients between days during both warm and cold seasons. How thermally efficient is the classroom? A computer with multiple temperature probes may be very helpful.

• Estimate the average force you exert on a baseball with your hand when you pitch it. Express your estimate in terms of the distance the ball is thrown and the time of flight—both quantities you can measure.

• Devise a simulation using the *Physics Explorer* available from Wings for Learning.

• Use the CASTLE Kit (available from PASCO) to devise an experiment that investigates the effect different numbers of bulbs have on the charging/discharging times of a capacitor.

• Use the "Millikan Oil Drop" simulation (available from Vernier Software) to investigate the charge on an electron.

• Devise an experiment in chaos. You may wish to refer to Vernier Software's book, *Chaos in the Laboratory and 13 Other Science Projects for the Apple II.*

• Use the "Pulse Mode Timing" of *Super Sonic Plus* to devise an experimental apparatus that will measure the speed of sound in a gas other than air.

• Devise an investigation using a spreadsheet program and a computer. You may wish to refer to *Wondering About Physics* by Dewey Dykstra and Robert Fuller (John Wiley and Sons, 1988). This neat little book can be used with a laser video disc entitled "Physics Vignettes...A Series of 16 Physics What If?...Video Scenarios."

• Calculate the incline of a hill, θ, which you can cycle on at constant speed as a function of the gear radii. Test your predictions by cycling on a nearby incline.

• Segments of a short span bridge are observed to deflect downwards as vehicles cross it. Likewise, rails on a railroad track are deflected as a train rolls by. Devise a technique that will enable you to measure the deflection of the roadbed or the train track.