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Simple Experiments to Show Atmospheric Pressure

L. Begeman
Iowa State Teachers College

Geological Survey, Washington, D.C., at very nominal prices. These maps should be selected with care and only those secured which show distinctly the various principles discussed. I would suggest maps illustrating the following: wind work, cycles of erosion, ages of valleys, river deposits, ground water, continental glaciation, mountain glaciation, vulcanism, shore lines, lakes, and topographic evidences of unequal erosion.

The most important single aid for vitalizing physiography is the laboratory and the field work. To do this work well requires more than the regular period of 45 minutes. The administrator should so organize the program that a double period is available. The laboratory should be a thorough check on the text book work and it needs most careful supervision to see that the pupil is not wasting time. In the field work there are serious problems for the teacher. He should first scout over the home region and discover good locations that will emphasize the physiographic principles discussed in class. A variety of locations are necessary as different phases of the subject are dealt with. The writer is sure that there are very few localities where illustrations of most of these principles cannot be found. If time is limited it might be possible to have the pupils excused from afternoon classes on two or three occasions during the semester. The value of the well planned, well organized field trip cannot be over estimated. Herein lies the teacher's great opportunity to gain and hold the interest of the pupil.

In one short article it is impossible to offer to teachers any extended suggestions for laboratory work. The value of topographic map work is inestimable. Each physiographic principle should be followed by a carefully planned lesson on the topographic maps to see if the pupils have the important facts well fixed in their minds. I suggest the following check-up exercise on wind work maps. The Geological Survey maps showing wind work are as follows:

Atlantic, N. J., Kinsley, Kan., Lakin, Kan., Larned, Kan., Moses Lake, Wash., Ocean City, Md., Pratt, Kan., Sandy Hook, N. J., and Toleston, Ind.

Prepare a tabulation with vertical and cross columns. In the left-hand marginal column write the names of the map sheets listed above. Enter the following headings for the vertical columns: sand dunes; depressions; shape; average height; length; location; source of sand. Then fill in the blanks.

E. J. CABLE

SIMPLE EXPERIMENTS TO SHOW ATMOSPHERIC PRESSURE

General Science

The teacher of general science in a small high school often lacks complete laboratory equipment, yet many experiments can be conducted with simple, inexpensive, and readily available material. For the demonstration of atmospheric pressure, try the following experiments:

1. Use a common glass tumbler completely filled with water. Cover it with a square piece of paper held in close contact with the water. Invert the tumbler quickly while holding the paper in position with the palm of the hand. Finally remove the hand from the paper. Let the pupils explain why the water remains in the tumbler.

2. Boil two tablespoonsful of water contained in a pint chemical flask, for about two minutes. Protect the flask from the flame with a square of wire screen. Remove the flask and quickly tie over its mouth a piece of sheet rubber, such as dentists use. Allow the flask to cool. The rubber will be forced down into the neck of the flask due to atmospheric pressure and will finally burst with a loud report. The purpose of boiling the water is to generate steam which drives out some of the air and a partial vacuum is created when the steam condenses. Encourage the class to explain the phenomenon.

3. Boil water in a flask as in (2). Immediately insert in the flask a one hole rubber stopper carrying a glass tube of any convenient length. Then invert the apparatus with the end of the glass tube dipping in a dish of water. As the flask cools the water will rush into the flask with a hissing noise. From this experiment the teacher can point out that at sea level the flask would have filled with water even if its height had been increased to approximately thirty-four

ft. above the water level in the dish. This value is obtained by multiplying the average barometric reading at sea level, or thirty inches, by the relative density of mercury, or 13.6. The pupils should be led to solve this problem.

4. Pour a pint of water into an empty gallon varnish can and boil for about five minutes. Immediately cork the can tightly and cool it either by pouring cold water on it or by allowing it to stand. The can will soon collapse. Require the pupils to calculate the total amount of force exerted on one side of the can, assuming a total vacuum inside. The experiment is striking and is admirably adapted to demonstrate the difference between the concepts of "pressure" and "force" as used in applied mechanics. Atmospheric pressure is 14.7 pounds per square inch.

5. Repeat (2) through the boiling process, then quickly insert a solid rubber stopper. After it has cooled for about fifteen minutes balance the flask on a beam balance. Then remove the stopper to admit air, replace the stopper, and notice which side of the balance is the heavier. This experiment strikingly shows that the weight of even as small a volume of air as the flask holds is sufficient to register itself on a common beam balance. Since a cubic foot of air weighs approximately one thirteenth of a pound, have the pupils calculate the weight of air in the school room. They will be surprised at its great weight and will then appreciate why a moving mass of air such as a high wind or a tornado can be so destructive.

L. BEGEMAN

COCKROACHES FOR LABORATORY STUDY

Biology

Teachers of high school biology are often handicapped by a lack of living material. This is particularly true in the teaching of insects. Most texts in biology use the grasshopper as a type of insect, largely, I suppose, because of its familiarity to the average pupil. In this latitude, however, grasshoppers do not commonly hatch until late in May and are then too small for favorable study. Plenty of adult specimens may be obtained in September, but they are then nearing the end of their life-cycle, and do not thrive well under laboratory conditions.

I have found the Australian roach, Periplaneta australasiae, to be superior to the grasshopper as a laboratory type for insect study. It is hardy in captivity and may easily be kept alive and active in the laboratory throughout the year. No particular effort is required to take care of this animal, it will eat almost anything, especially starches and sugars, and will endure starvation for long periods. The females in particular are voracious feeders; the males will eat but little in captivity even after prolonged starvation.

For laboratory study each student should be given a pair of the roaches, male and female, in a clean, quart Mason jar, The females may be distinguished by their broad abdomens and more robust appearance. The lid of the jar should be perforated to supply air, and a bit of paper placed in the jar for the animals to hide under. I usually place a small stick slantwise in the jar as the female likes to fasten her egg-cases to this support. The eggs are then easily accessible by simply removing the stick.

Sufficient water may be supplied to the roaches by letting a few drops fall inside the edge of the jar each day. Do not place any receptacle containing water in the cage, as the roaches drown easily even in shallow water. The animals should be transferred to a clean jar about every two weeks.

Each pupil should be required to keep a record of his observations on the animals throughout the semester. These notes should include general behavior of the animals, amount and kind of food eaten, response to stimuli such as is shown for example by the antennae, number of egg-cases laid in a given time and any other thing which may catch the pupil's interest. One of my captive females laid thirteen egg-cases in ninety days.

The young roaches usually hatch from the egg-capsule about forty or fifty days after laying. If the pupil succeeds in hatching some of the eggs, much interesting information

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