Teacher's Guide $.30

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HUNTINGTON II Simulation Program — CHARGE

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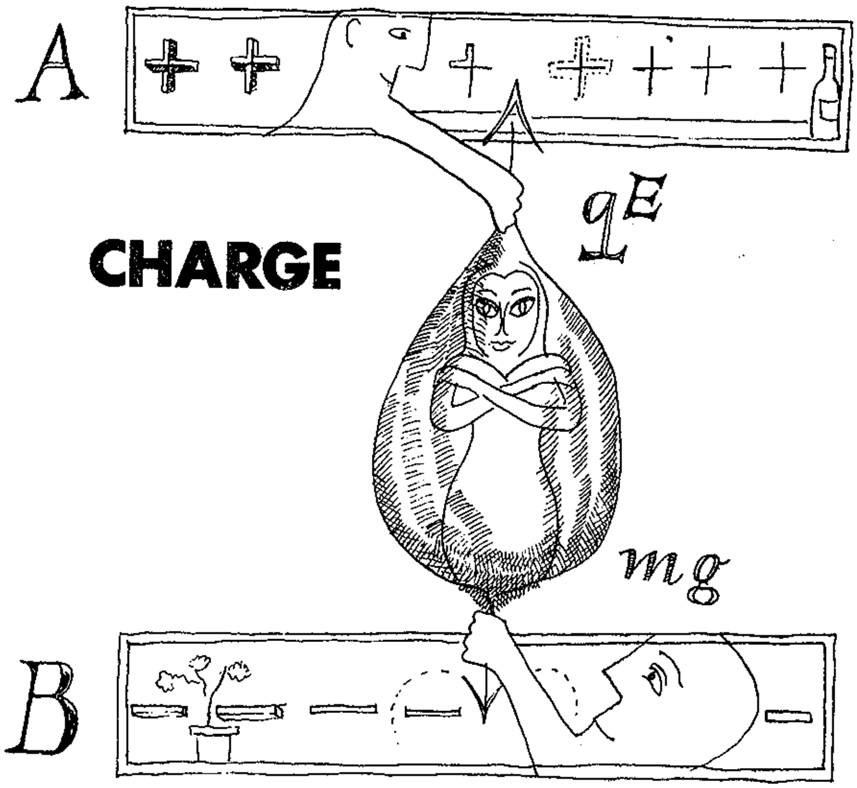
CHARGE



TEACHER'S GUIDE

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<u>HUNTING TWO COMPUTER PROJECT</u>

1 September 1971

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CHARGE

TEACHER MATERIAL

Subject Area: Physics

Specific Topic: Determination of electronic charge -- Millikan's Oil Drop Experiment

Grade Level: 11 - 12

Computer Program: *CHARGE*

Special Language Features Used: RANDOMIZE

Abstract: This simulation of a modern version of the Millikan Oil Drop Experiment is designed to demonstrate to the student the existence of a discrete unit of electrical charge.

Text References:

PSSC *PHYSICS* and *PHYSICS LAB GUIDE*
Boston: D. C. Heath, 2nd Ed., 1965.

Melissinos, A. *EXPERIMENTS IN MODERN PHYSICS*
New York: Academic Press, 1966.

Morantz, S. A. *PHYSICS*
New York: Benziger Brothers, 1969.

Shankland, R. S. *ATOMIC AND NUCLEAR PHYSICS*
New York: Macmillan and Company, 1955.

As you may have noticed, we are using a new format for the support material of CHARGE. There are now three individual parts. The first contains a description of the experiment simulated and instructions for running the computer; this comprises the student material. The second part contains guidelines, suggestions and discussion questions for classroom use. The third and final part consists of appendices on topics you might want further information on, e.g. notes on the CHARGE model or the detailed calculations for falling spheres. The "layers" referred to in Appendix V designate the level of difficulty of the explanation and calculations.

I. Goals for the CHARGE Unit

After completing CHARGE, the student should be able to:

1) Describe Millikan's Oil Drop Experiment and the success with which he determined the charge of an electron.

2) Explain how the existence of a discrete unit of electric charge was demonstrated by the results of the oil drop experiment.

3) Explain how the use of latex spheres simplifies the calculations for the experiment.

4) State the forces acting on the particle when it is balanced between the gravitational and electric fields and derive the equation for calculating the the charge on the particle.

II. Preparatory Activities

1) Describe the original oil drop experiment performed by Millikan and compare his value for the charge of an electron with the currently accepted value.

2) If you have the apparatus for any version of the oil drop experiment, set up and perform the experiment to obtain values for the charge of an electron.

3) Describe the latex sphere experiment simulated by CHARGE, the operation of the program, and the procedure for running the program.

4) Analyze in class the forces acting on the spheres and derive the equation for determining the charge. Note how the calculations for the charge are simplified by using the latex spheres.

III. Use of the Program

We suggest that the students use CHARGE in conjunction with the actual performance of some version of the Millikan oil drop experiment. This would give a student the benefit of the laboratory experience while providing him with data accurate enough to let him draw a clear-cut conclusion about the nature of the electric charge. A simple self-contained Millikan apparatus with a supply of latex spheres can be obtained from:

Macalaster Scientific Company
Route 111, Everett Turnpike
Nashua, New Hampshire 03060

(NOTE: Our experience with this apparatus has been very limited, so that this statement does not constitute a recommendation.)

The CHARGE program can be modified to simulate some other version of the oil drop experiment. This is something you may choose to do if your class is not performing the experiment with latex spheres.

IV. Follow-up Discussion Questions

1) Plot the values obtained for q on a line graph ; at what values do the points cluster? What is the smallest of these values? Are the other values for q all multiples of this value? If not, are they all multiples of some smaller number?

2) How would you account for obtaining a value of q that did not fall into any of the cluster groups?

3) How will an increase in the voltage applied affect a positively charged sphere? Why did a change in voltage fail to affect some of the spheres?

4) The existence of quarks, particles carrying a charge of 1/3e or 2/3e, has been postulated. How would the presence of quarks affect the results of the experiment?

5) When the astronauts of Apollo 15 were on the moon, they dropped a rock and a feather simultaneously and observed that both objects did indeed reach the ground at the same time. What would happen if Millikan's oil drop experiment were performed on the moon?