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Compact Compacts: Models: A Simple (and Tasty) Model for Electron Clouds

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Computer Simulation of Inorganic Qualitative Analysis

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In order to compromise between dedicating most of a semester to inorganic qualitative analysis and omitting it altogether, a computer program has been written to simulate the analysis of the Group I and Group II cations. Inorganic qualitative analysis is allotted three weeks of the General Chemistry Laboratory during the spring semester. During this short time it is hoped that two objectives can be accomplished. First, the techniques used in the analyses are introduced by requiring each student to run known samples of Group I and Group II cations and one unknown sample from each group. Second, the students become familiar with the kind of reasoning used in the analyses by running many more unknowns on the computer than is feasible in the laboratory. The major sacrifice of this approach is that little descriptive chemistry is covered.

The laboratory and computer programs follow, with some simplification, the scheme used in Hered, et al. "Basic Laboratory Studies in College Chemistry," 5th ed., D. C. Heath and Co., Lexington MA, **1976,** Part Three. At the computer terminal, the student selects an unknown by entering a 10-digit number of his own choice. The simulation program asks questions involving procedure, such as which reagent to add next or whether to use the supernate or the precipitate. The program checks each entry made and allows the student to correct wrong entries. The program tells if the correct ions were found and also checks to see if a complete but not excessive analysis for that particular unknown was performed. The same unknown may be tried again by entering the same ten digit number.

The instructor sets the number of errors allowed before an analysis is automatically terminated. He also may easily change the code for the unknowns if he wishes. The program is written in MU-BASIC on a PDP-11VO3 and requires a minimum of 4500 words of core and is available upon request.

Concentration Model

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Students in beginning chemistry and environmental studies courses often have difficulty in understanding the units which are used to describe levels of pollutants, especially trace metals, carcinogens and pesticides found in various ecosystems. This is particularly true if low levels of concentration are involved. In an attempt to assist students in visualizing these concepts we assembled models of certain concentration levels ranging from 10% by weight to 1 ppm.

The principal problem in making models was in finding a million inexpensive "particles" which could be easily seen and yet occupy a small enough space so that the models could be conveniently handled and observed by the students. The punched out pieces of paper card from computer cards was the answer to the problem, and they were easily secured from the computer center without cost. They were available in a variety of colors which made it easy to represent different components in our models.

Weights obtained by weighing large quantities of known numbers of punch outs gave an average weight of 0.719 mg per punch out. (This weight may vary according to the type of card or style of punch out.) We had to assume, also, that the only variation in the punch outs was their color. One million particles were measured by weighing 719 g of punch outs. This quantity occupied a volume of approximately 2 l. As a result, clear glass acid bottles served as convenient containers. The appropriate quantities of each colored component were weighed and thoroughly mixed to represent the different concentration levels.

Compact Compacts: Models

A simple (and tasty) model for demonstrating the electron cloud concept is suggested by **John T. Moore** of Stephen F. Austin State University Nacogdoches, TX 75962. A sugar cube is used to represent the electron as a point charge. A few simple atoms are constructed using Styrofoam balls to represent protons and neutrons in the nucleus with electrons shown as sugar cubes outside the nucleus. The class is then told that they could take that sugar cube representing the electron and change its form into cotton candy. The mass and physical state would be the same, but the form would be different. A cotton candy ball (of approximately the same weight as the sugar cube) is then shown, and the class is told that this represents an electron cloud. At this point it is quite easy to show how this electron cloud can be distorted by outside forces, shared by two atoms, or even snatched away from the atom by the ionization energy supplied by a hungry student.

A classroom visualization of ethylene Π and Π^* molecular orbitals is reported by **Fred H. Greenberg** of the State University College at Buffalo, Buffalo, New York. In the model of ethylene that is used, carbon and hydrogen are represented by 3-in. and 1-in. diameter Styrofoam spheres painted black and red, respectively. Toothpick connectors hold the spheres tangentwise in the usual atomic sequence. Simulating the lobes of the *p* atomic orbitals are four, 2-in. unpainted spheres secured tangent to the carbons and perpendicular to the ethylene sigma plane. The Π^* and Π MO's are generated during or after an explanation of their physical meaning, by spraying shaving cream from an aerosol can on the AO surfaces exterior to the carbon-carbon bond, and then in the region between the two AO's. The model is easily restored by washing away the shaving cream with water.