her or his seat and then plots and analyzes those very numbers.

I've performed half a dozen such experiments with those MIT freshmen who chose our nearest equivalent to "Physics for the Citizen." Another such experiment was done with visiting high school science teachers, who acted then as students. In it the student measures the amplitude and period of a pendulum versus time, and its period versus amplitude, height and the composition of the bob. The rulers and clock need to be very large so as to be readable from anywhere in an auditorium seating hundreds of students, and the tick when the bob interrupts a light beam needs to be loud. This large scale allows even a distant observer to feel a strong, unmediated interaction with the experiment.

The students take down the numbers they are directed to observe and then analyze, plot and write up the results as homework.

Since many students need to be taught the most basic basics—for example, to interpolate ruler readings between marks separated by 10 centimeters—it probably would be good to repeat one or more of the experiments after grading to teach how results can be sharpened by care. A difficulty may be lack of experience with experiments and data analysis on the part of many recitation instructors or other graders, and inability of lecturers to omit material to make way for the very time-consuming process of learning to take and analyze data.

Of course, real laboratories are much better, but to be good they require much more teaching talent and time per student than do lecture demonstrations. It is unrealistic to expect first-rate physics laboratories to be required of most students at most US institutions.

Fortunately, the experience of handling equipment is probably not necessary for fairly good science citizenship. As a feasible substitute, we can try merely(!) to teach what it is to make reliable observations and to carry out clear analyses of numbers, with the equipment itself manipulated only by the lecturer.

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Onsager's Outside-In Intuition

Another counterintuitive notion!

Graham R. Fleming and Peter G. Wolynes (May 1990, page 36) mention a 1976 conference at which Lars Onsager argued that in the process of electron solvation "the solvent far from a *localized* electron would relax to equilibrium faster than the solvent near the electron, and so the solvation structure around the electron would form from the outside in! . . . We shall never know exactly how he came to this counterintuitive notion about solvation dynamics because he died shortly after the meeting" (italics added).

The conference was the 1976 International Conference on Electrons in Fluids, and the particular remark referred to by Fleming and Wolynes is on page 1819 of the refereed proceedings[1]: "Let me argue for the proposition that the 'snowball' forms from the outside in. If we regard the *trap formation* as a process of dielectric relaxation around a *delocalized* electron, this will proceed at a rate given by the longitudinal relaxation time $\tau_L = \tau_D \epsilon_\infty / \epsilon_0$ in the distant part of the fluid (outside the counteracting region of localization), and the *equilibrium* polarization in the immediate vicinity is established last" (italics added). Joshua Jortner replied that this was similar to a proposal that the *initial step* in electron localization was the fast response of the polar medium to a large polaron in an *extended* state, involving the buildup of the long-range polarization field. In the vernacular this was known as an electron's "digging its own hole."

Some of us preferred a model in which a delocalized electron suddenly becomes localized by an inelastic event in an already existing defect (trap) in the local structure of the fluid. The resulting jolt of charge-dipole torque then causes solvent rearrangement near the center of charge. The rearrangement rapidly spreads outward, and then more gently washes back inward as the final adjustment that achieves equilibrium with the bulk liquid. The idea of the back-inward phase of the relaxation was inspired by Onsager's remark. It is an attempt to take into account the enormous resistance of the bulk liquid structure to a sudden, drastic rearrangement in a local section of it.

Onsager was intuitive, and the molecular dynamics simulators got the quotation wrong! If they continue their elegant work they might find the back-inward phase of the liquid rearrangement around a suddenly introduced charge.

The word "counterintuitive" simply means that someone is wrong.

Reference

1. Can. J. Chem. **55**, 1795–2277 (1977).

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FLEMING AND WOLYNES REPLY: No one disputes Lars Onsager's level of intuition. We use the term "counterintuitive" to mean "against the naive intuition of ordinary mortals." Gordon Freeman is correct that Onsager's original suggestion dealt with the localization of the electron. Our memory was clouded since Onsager's contemporaneous work with Joseph Hubbard suggests the same set of time scales for localized charges.

As to the scientific facts, we feel it is likely that the outside-in formation picture holds for some solvents. Indeed, a lot of the analytical work in this area described in our article suggests this. The current molecular dynamics results for water suggest that in this liquid formation of the structure occurs in the anti-Onsager way around localized charges: inside first, outside last. Nevertheless, as we also pointed out, the current molecular dynamics calculations do not include the polarizability of the water directly and thus cannot be considered definitive. It is not altogether out of the question that the outside-in picture will be vindicated in the last analysis by molecular dynamics.

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Emigré Scientist Aid: Threat to Civil Rights?

In his letter to the editor (October, page 121) Alexander Kaplan proposes a program involving a combination of Federal funding and university support to create research positions that would be open to immigrant scientists only. He has in mind Soviet emigrés in particular, but would also include immigrant scientists from Eastern Europe and China.

Let's be honest. What Kaplan wants is discrimination based on national origin! His proposed program would violate the Equal Opportunity Act, which is one of the great cornerstones of American civil rights legislation. The research positions he wants to create would be open to Soviet emigrés but not to American blacks or American women. Soviet