Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
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Introduction

When our son John was 3, he incessantly asked, "How do you know?" At the time this seemed tiresome, at best, but in time my wife and I came to appreciate that this is THE key question in much of life, and certainly in science, and that encouraging students to ask it of authorities could be a teacher's most enduring accomplishment. The goal of this seminar was to develop materials that would encourage students to ask "How do you know?" and to provide some answers. It was hoped that these materials would foster delight in mastering the logic of inference from experimental evidence, rather than grudging submission to the authority of a text or teacher.

Discussions during the seminar meetings focused on molecular structure, bonding, and reactivity. First we discussed how the most powerful present methods for observing atoms and molecules work. These included scanning probe microscopy, which allows feeling individual particles, and x-ray diffraction and how it revealed the double-helix structure of DNA. After a discussion of how quantum mechanics provides a theory for atomic and molecular structure, we addressed the amazing fact that, in the absence of sophisticated experimental instruments and theories, 19th Century chemists were able to develop a detailed understanding of molecular architecture - an understanding so accurate that no one was surprised when, in the 20th century, molecular structure was revealed in atomic detail by x-ray diffraction. Most attention was focussed on experiments from 1780 through the first half of the 19th Century, which through analytical chemistry and quantitative observation of gases established the atomic nature of matter. In all cases we stayed as close as possible to experimental observation by working with the original reports of 18th and 19th Century chemists and physicists.

Fellows came to the seminar from varied backgrounds and with needs for curricular materials ranging from college-level second year chemistry to kindergarten-level special education. They surveyed, and incorporated in their units, experimental resources from text books, the primary chemical literature, and the world wide web. In a number of cases they developed valuable original experiments. They developed activities that would engage the students' enthusiasm and their minds - including Socratic seminars on the atomic philosophy of the ancient Greeks, use of playground swings to discover harmonic motion, close observation of familiar materials, putting the discovery of molecular genetics in a cultural human context, and graphing important scientific data that was collected nearly 200 years ago.

Some of the most imaginative, and evocative, activities are those developed for learning disabled students at both the elementary and high school levels. These have been carefully worked out, and complemented with insightful discussions of teaching goals and strategy, to be accessible to the students for whom they were designed. But they also raise fundamental scientific questions that would make them equally appropriate, in slightly modified form, for all levels of science instruction.

Thus I would encourage a science teacher at any level to survey all of these units with the goal incorporating materials and ideas in her own teaching. Often this will require only modest adjustment of presentation, because the fundamental phenomena of science are a delight and stimulus for inquisitive minds of all ages.

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