INTERRELATED SCIENCE
a pre-college approach

This scheme proposes to:
1. Enroll students in an interrelated science program for three years.
2. Keep students in contact with three different science teachers every week of each year.
3. Challenge students with related science lessons in the biology, chemistry, and physics areas every week.

The main purposes of this scheme are to:
1. Instill a genuine operational understanding of the interrelatedness of the three main areas of science.
2. Prepare students for advanced placement and college level science courses with the operations of all three sciences fresh in their minds.
3. Foster an extended period of caring between the students and all of their science teachers.

In general, each student will receive the same number of contact days with each of the three teachers as in the traditional hierarchical tract of biology-chemistry-physics. A significant difference exists in the spatial delivery of the lessons involved.

In a five day week a student will attend three classes with the major teacher for that year. He will attend one day each with the other two supporting teachers. Refer to diagram 1.

To illustrate, assume that chemistry is the major theme for the freshman year. A student will attend chemistry on Monday-Wednesday-Friday. On Tuesday he will attend biology, and on Thursday he will attend physics. Since the theme for the year is chemistry, both the biology and the physics teachers will present lessons related to the unit being studied in chemistry each week. It is imperative that the chemistry teacher establish the general outline for the year in advance. However, the chemistry teacher assumes no responsibility in preparing, delivering, or measuring the success of the supportive biology and physics lessons. The biology and physics teachers are tasked only to present related lessons, not reinforcing or adjunct lessons.

Similar formats exist for the remaining years, with physics for the sophomores and biology for the juniors as the major themes. In this plan, the senior year is reserved for an elective advanced placement course in one of the sciences. However, the whole scheme could be projected forward one year to encompass only the sophomore, junior, and senior years. Conceivably earth science could be worked into this plan and should be.

The essence of the interrelated curriculum is that connections exist between the sciences and that the duty of the student is to learn how to
recognize those connections and make use of them simultaneously. The responsibility of the science faculty is to ensure that students do not fallaciously perceive that biological phenomena exist separate from chemical and physical realms, and vice versa for each of the other disciplines. That simply is not the case. Teaching from the perspective that students will logically blend the lessons learned separately into a matrix of understanding, at some unspecified later date is illogical and academically irresponsible.

No real hierarchical order for studying science exists. If anything resembling a hierarchy of learning exists, it is in the teaching of science, not in the learning of science. In the traditional tract of biology—chemistry—physics is an intimation that chemistry requires a more mature cognitive state (i.e., is harder to understand than biology) and that physics requires an even more mature and disciplined mind (i.e., is even harder than chemistry). This is not only false but also reflects an intentional deception. Nothing inherent in physics makes it more difficult than chemistry. A similar situation exists for chemistry and biology. Indeed, a biology student at any age would benefit from knowledge of Heisenberg’s Uncertainty Principle and Bohr’s Atomic Theory.

That present courses are taught this way is a reflection of the students’ cognitive and developmental abilities at the various age levels, not in the subject matter itself. Any of the three sciences can be taught effectively at any of the three grade levels. Naturally, the older students will be more receptive to the more difficult concepts and lessons within any given subject, because of their own state of mind and learnedness, not because the subject matter can only be taught to older students.

That chemistry and physics students need a higher degree of math ability (than the younger biology students typically have) is a bogus argument. Simply teach the younger students chemistry and physics lessons which do not require the more complicated math operations. You never hear the argument that chemistry students cannot be successful without a solid background in biology. Nor, do you ever hear a similar wail about physics students needing a solid chemistry background.

Indeed, if anything close to resembling a hierarchy of science learning exists it should be rearranged more like chemistry-physic-biology or physics-chemistry-biology. Unlike chemistry and physics, a sophisticated understanding of biological phenomena does require a background in the other areas.

For example, whether light travels as particles or as waves can be imagined, explained, demonstrated, and even tested with relatively simplistic models and exercises without any references to green leaves or even dead leaves. Similarly, the effects that light energy traveling in any form will have on an organic molecule with a central magnesium atom can be imagined, explained, demonstrated, and even tested with relatively simplistic models and exercises, without any references to green leaves or even dead leaves. However, to truly understand the life-sustaining process of
photosynthesis does require a conceptual understanding of light energy, heat conduction and convection, electron transfer systems, chemical bonds, molecular rearrangements, and a host of other events, many learned in physics and chemistry lessons.

That an amazingly complex process such as photosynthesis can be reduced, as it is in many introductory biology courses, into a simplistic formular calling for carbon dioxide and water to mix in the presence of a chlorophyll molecule and light energy to produce sugar and evolve oxygen gas as a by-product is a gross concession on the biologists' part to an unfair state of curriculum affairs. It does serve to affirm that any of the sciences can be taught effectively at any level. It is a shocking waste of teacher and student energy that the whole process will have to be re-taught and re-learned later in a more correct context, after the student has received the "higher levels" of understanding from the other sciences.

Fewer college students will take chemistry than take biology, and nationwide even fewer will take physics. Considering this it is a debatable issue as to whether offering more than one chemistry or physics course in secondary schools is even a wise use of resources. In addition to the technological demand to produce more chemists and physicists (and ecologists), especially American ones from American universities, it is uncontestable that we must produce more adults who are biologically, chemically, and ecologically literate if we are to preserve a way of life that we know to be desirable; if we are to preserve life at all. In order to exist in the next century, an average non-scientist (perhaps a college graduate) must be competent in biological and ecological principles. Indeed, he must not only understand but practice wise stewardship of the living planet. His understanding of ecological principles must be more than academic.

To this end, pre-college biology should be taught as an interrelated course with the physical sciences, to include chemistry, physics, and earth science. College preparatory programs must ensure that the bulk of their graduates are well trained in biology and adequately prepared for college level chemistry, physics, and earth science. All of this preparation will have little meaning if the student cannot relate the roles of these sciences to his daily life and to the enterprises of humanity. Given the present state of world affairs in the environment, government, economics, agriculture, technology, and education it is probably time that we abandon teaching the separate disciplines of science and aggressively approach science education from the holistic perspective of teaching and learning about the interrelatedness of science, technology, and society (STS).

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