

Three Chemistry Curricula for All Students

by John L. Roeder

When *ChemCom* (*Chemistry in the Community*) made its debut two decades ago, it marked an effort by the American Chemical Society to reach out with a program to educate all students about the chemistry relevant to their lives. It was a departure from the traditional high school chemistry course that was taken only by "better" students who felt qualified or were encouraged to take it. *ChemCom* was pitched as a course for students who otherwise might not study chemistry -- at all. It was chemistry *for* all.

ChemCom has now been joined by two additional curricula designed to teach chemistry to all students: *Active Chemistry*, developed by those who had already produced *Active Physics* to teach physics to all (Arthur Eisenkraft at It's About Time, subsidiary of HerffJones); and *Living by Chemistry*, developed by Angelica Stacy with Jan Coonrod and Jennifer Claesgens at the University of California, Berkeley, and published by the Key Curriculum Press.

Active Chemistry is organized similarly to the earlier *Active Physics*, consisting of 11 chapters, each introduced with a challenge to be met after the students have completed the seven to nine activities in the chapter. Each activity begins with a "What Do You Think?" question designed to elicit student thinking about the topic to be covered and to inform the teacher about these thoughts. The activities then continue with sections headed "Investigate" (corresponding to the "For You to Do" in *Active Physics*), "Chem Talk," "What Do You Think Now?" "Chem Essential Questions," "Reflecting on the Activity and the Challenge," "Chem to Go," and "Inquiring Further." The 11 chapters are titled as follows: 1) "Fun With the Periodic Table," 2) "Movie Special Effects," 3) "Artist as Chemist," 4) "Chemical Dominoes," 5) "Ideal Toy," 6) "Cool Chemistry Show," 7) "Cookin' Chem," 8) "CSI Chemistry," 9) "It's Alimentary," 10) "Soap Sense," and 11) "H2Woes." Spread among these 11 chapters are 89 activities. Their connection to "standard" chemistry topics is indicated in the table comparing all three curricula below.

Living by Chemistry is divided into five modules, each of which is divided into three or more groups of lessons, 117 in all. Like the *Active Chemistry* activities, the *Living by Chemistry* lessons have a consistent organization of the following elements: "Chem Catalyst" (similar to "What Do You Think?"), "Activity" (like "Investigate"), "Making Sense" (like "Chem Talk"), Check-in (an application of the activity), and "Homework" (like "Chem to Go"). The topics of the modules are A) "Alchemy," B) "Smells," C) "Weather," D) "Toxins," and E) "Fire." Their connection to "standard" chemistry topics is also indicated in the table comparing all three curricula below.

Meanwhile, *ChemCom* marks the beginning of its third decade with the publication of its fifth edition. The seven chapters, each divided into three or four sections, retain the same titles of the fourth edition: 1) "Water: Exploring Solutions," 2) "Materials: Structure and Uses," 3) "Petroleum: Breaking and Making Bonds," 4) "Air: Chemistry and the Atmosphere," 5)

"Industry: Applying Chemical Reactions," 6) "Atoms: Nuclear Interactions," and 7) "Food: Matter and Energy for Life." The project for the "Petroleum" chapter is changed from that in the fourth edition for students to develop their own ad for an automobile, and the project for the "Air" chapter is changed to interviewing students about Riverview's new bus idling policy. This last project would be especially relevant in New Jersey, which has recently passed a law restricting the idling of vehicles. Sections on energy alternatives to petroleum (3D), radiation and climate (4B), acid deposition and other air pollution (4C,D), and nuclear energy (6D) all complement these chapter projects to imbue students with the importance of chemistry in providing energy and protecting our environment.

The first four chapters are referred to as the "core-four." Their connection to "standard" chemistry topics is also indicated in the table comparing all three curricula below.

Topic	<i>Active Chemistry</i>	<i>ChemCom</i>	<i>Living by Chemistry</i>
Atomic structure	1	1B8, 3B6, 6A	A III
Chemical periodicity	1.1,2,6,7	2A4-10	A II
Chemical bonding and molecular structure	1.7,8	1B4-7, 3A6-10, 4C4	A V, B III-2-5, B IV-4,5
Inorganic nomenclature	6.3	1B9-10	D III-2
Moles and percentage composition	3.5; 4.3	2C5-10	C IV-3
Chemical reactions: writing/balancing eqs.	3.6; 4.2,4; 6.4,8; 8.6	2C1-4	D II, III
Stoichiometry	3.5; 4.3; 11.5,6		D III-3,4
Solutions	6.1, 10.7	1C1-8	D I
Acids and bases	3.2; 6.7; 10.7	1C9, 4C5-10	D IV
Redox; electrochemistry	3.3; 4.6; 5.1	2B8-9	5C1-6
Chemical reactions: rates and equilibria	3.6; 6.6; 11.4	5B1-3, 4D7	D III-1
Energy in chemical reactions	4.7; 6.5	3B6,7, 4B6	E
Gases	5.3-7; 9.3,5	4A	C
Organic chemistry	2.9; 10, 11.1	3C, 7BCD	B
Nuclear chemistry	1.9	6	A IV

Table indicating coverage of "standard" chemistry topics by *Active Chemistry*, *ChemCom* (5th ed.), and *Living by Chemistry*. Numbers for *Active Chemistry* and *ChemCom* refer to chapters, with numbers after the decimal point referring to activity numbers for *Active Chemistry* and letters after the number for *ChemCom* referring to chapter section and number of subsection. Letters for *Living by Chemistry* refer to the modules as indicated in the text, with Roman and Arabic numerals following to indicate the section within the module. Clearly, the more references to a topic, the greater the coverage; and when an entire section or chapter is cited, the coverage is more systematic. One such topic is atomic structure and chemical periodicity, the

topic of the first chapter of *Active Chemistry* and the first module of *Living by Chemistry*. Another systematically treated topic is gases -- in chapter 5 of *Active Chemistry*, the first section of chapter 4 of *ChemCom*, and the third module of *Living by Chemistry*.

(Editor's Note: It would not be proper for me to publish a piece about a curriculum in whose development I played a part without acknowledging it. Although I have published many articles about the *Active Physics* program, I have never run a review because of my coauthorship of the chapter on sound and light ("Let Us Entertain You"), at least the initial version. The same is true for *Active Chemistry*, where I authored the chapter on atomic structure and periodicity (again, the initial version). I have also made no secret of my concern that *ChemCom* lacks a systematic discussion of the distribution of atomic electrons in energy sublevels (the first section of chapter 3 states only that there is a maximum of two electrons in the first "shell," eight in the second, and that noble gas atoms are unreactive because of filled shells). Chapter 1 of *Active Chemistry* fully accounts for the periodic table in terms of electrons in *s*, *p*, *d*, and *f* sublevels.)