Active Chemistry™

ELEMENTS

VOLUME 2 NUMBER 1 FALL 2004 - Winter 2005

An Overview

Active Chemistry is a standards-based, National Science Foundation funded, full-year curriculum that is being developed in association with leading educators, scientists, engineers, and institutions. Our goal is to improve the literacy of our student population in science. *Active Chemistry* embraces the idea that ALL students can have success in chemistry. *Active Chemistry* is strongly correlated with what we want students to know and to be able to do. It incorporates research on how people learn and what engages students intellectually.

The *Active Chemistry* Curriculum is:

- Based on a scientific inquiry approach to learning.
- Built on a problem-based learning model.
- Derived from current science education research.
- Focused on student questions and investigations.
- Centered on collaborative learning strategies.
- Designed with substantial teacher support and with the assistance of the American Institute of Chemical Engineers.

Field Teachers at Columbus, Ohio

Dawn Arnett, Titusville H.S., FL
Patricia Barker, Hollywood H.S., CA
Kristen Cacciatore, Dedham H.S., MA
Connie Celestine, Crossland H.S., MD
Ann Chatfield, Dalton H.S., GA
Jody Christophe, Lincoln H.S., PA
James Clements, Atlantic H.S., FL
Valerie Felger, DATA, TX
Gail Hermann, Quincy H.S., IL
John Paul Jones, Crestview H.S., FL
Joseph Kleinmann, Roosevelt H.S., NY
Stephanie Levens, N. Broward Prep., FL

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Field Test Training at Columbus, Ohio

As the development of the Active Chemistry curriculum enters its third year, twenty-five high school chemistry teachers traveled to Ohio State University in Columbus to participate in a two-week Field Test training. It was a diverse group and participants came from Washington state to Florida, from Los Angeles to Massachusetts. One goal of the training was to provide the teachers with direct experience with the curriculum, from the student perspective. Following the training, the teachers took the curriculum into their classrooms around the country.

A second important goal was to provide feedback to AC writers and editors for the final revision of the materials. Finally, the classroom experiences of the teachers will provide valuable data for the project evaluation team.

Arthur Eisenkraft, Project Director, led these hardworking and dedicated teachers through the two-week proceedings by introducing the AC approach and instructional methodology. Working in teams of four, all the teachers began with the same two chapters during the

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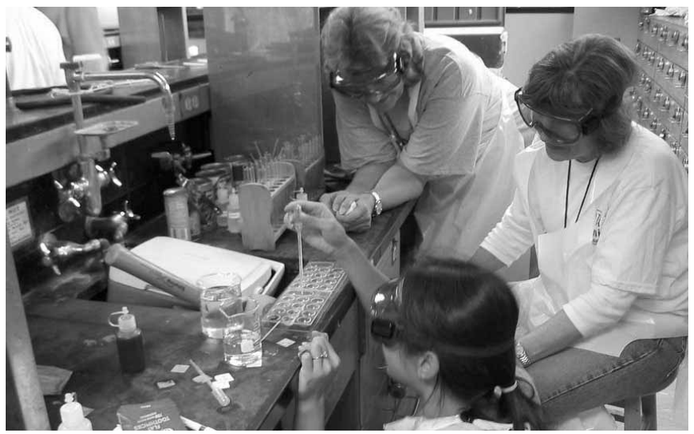

Experimenting in Columbus, Ohio

Field Test Training at Columbus, Ohio (continued)

first week: Artist as Chemist followed by The Periodic Table. Generally, mornings were spent in the classroom where various aspects of the pedagogical approach were discussed. The Celeste Laboratories were the site for afternoon lab work, the teachers meticulously went through the chapter activities, each set of activities culminating in the **Chapter Challenge**. To provide greater interaction, the teams were changed between the two chapters. With the time remaining in the second week, teams were shuffled again and, instead of everyone working on the same chapter, six teams addressed the **Challenge** and activities in six different chapters.

The entire Active Chemistry team was involved in making the training a huge success. Field Coordinator Jean Pennycook began early each morning at 8 am with warm-up activities which were designed to not only focus the group for the day's work, but also just to have fun with each other. Principal Investigator Barbara Zahm organized and participated in the video taping of classroom and laboratory sessions. PI Gary Freebury played a key role in organizing the chemicals and equipment required for the labs, while PI Darlene Schuster was invaluable in supporting the efforts of all, as well as presenting a "Comparison of Active Chemistry Challenges with Technology Standards and Engineering Design." Gary Hickernell, as Project Coordinator, made certain that not only the chip and dip bowls were refilled but also kept the copy machines at Kinko's humming throughout the night. Representing the Evaluation Team, Frances Lawrenz and Rachelle Haroldson were there to help the teachers understand the evaluation procedures, describing the data collection, its schedule, and how the Field Teachers were an important component to the curriculum development process.

In addition to the AC team members already mentioned, several members from the Active Chemistry writing teams were present. Brian Radcliffe, Kristen Cacciatore, David Barry and Carl Heltzel provided the teachers valuable insight into each of their chapters. From the host Ohio State writing team led by L. S. Fan, John Parson, Peggy Sheets, Himanshu Gupta, and Darlene Schuster were also present to work with the teachers. It was truly a two-way street of information exchange as the writers (all teachers themselves) not only led and informed, but listened to what the teachers had to say about their Active Chemistry experiences.

While the two weeks were intense, beginning at 8 am each morning and often finishing after 5 pm, there were some opportunities for diversion. These came in the form of shopping, a trip to the museum of science and technology, a Saturday evening Picnic with the Pops (and Glenn Campbell), or a trip to the Air and Space Museum in Dayton. Some chose to jog along the muddy Olentangy River. Since this group of teachers had widely varying interests, it was difficult to get the entire group together for recreation! A favorite breakfast activity in the dining halls was to guess what activities brought all the other groups to the Ohio State campus at the same time. Were they volleyball players, soccer players, bible groups, or computer whizzes? Sometimes one could fabricate some very creative groups based solely on observations.

<u>Quotes from Columbus:</u>

"Everyone on the team is amazing! I have learned so much from each of you!" "Great workshop! Thanks!" "I'm so excited to be a part of this project!" "Out of 10, I rate the training 9+" "I had a good time and feel prepared." "I learned a great deal both about the program and this type of teaching in general." "Fantastic, outstanding, life-changing!" "I had a wonderful time and I am very anxious to start teaching AC!" "A reunion of teachers next year." "A reunion would be great!" "Reunion next summer!"

Frances Lawrenz,
Active Chemistry Project
Evaluation Team Leader

Meet Rachelle Haroldson

Many of our Field Teachers have corresponded with Rachelle Haroldson, but only those who attended the Columbus Field Test Training Institute have met her. For that reason, we wanted to "bring her to life" for the rest of you. Rachelle is a new member of the Evaluation Team led by Dr. Frances Lawrenz at the University of Minnesota. Currently, she is pursuing an MA in Science Education at the university, but previously she had taught chemistry and physics in the Milwaukee school system.
The opportunity to attend the Training Institute this past summer was a valuable experience for her as she began to develop relationships with the Field Teachers, learn more about Active Chemistry and about education in general. In her words, the Active Chemistry Project "has been a great learning experience, from developing instruments to working with fun science teachers." In addition to Dr. Lawrenz, Rachelle works with Nate Wood.

Field Teachers at Columbus, Ohio (continued)

Charlotte Lum, Summit Prep. H.S., CA
Maggie Matthews, Shorewood H.S.,WA
Amy Murphy, Spain Park H.S., AL
Joshua Pretzer, Culver Academies, IN
Rosemary Riggs Roosevelt H.S., TX
Brenda Rinehart, Thompson H.S., AL
Jocelyn Roger, Squalicum H.S., WA
David Smith, Battle Creek H.S., MI
Alissa Watson, Bardstown H.S., KY
Janice Weaver, Culver Academies, IN
Melissa Wickenkamp, San Rafael H.S., CA
James Wicks, Sr., Garfield H.S., CA
Doug Yenney, Dayton H.S., WA

Additional Field Teachers

Rachel Badnowski, Southfield H.S., MI
Nora Ann Bennett, Mt. Tabor H.S., NC
Isabel Camille, Coral Gables H.S., FL
Grant Clark, Newton N. H. S., MA
Linda Craig, Butler H.S., PA
Jeanene Crenshaw, Jeff. Davis H.S., AL
Carol Durso, Haverford H.S., PA
Frances Dziuma, St. Barnabas H.S., NY
Brian Gagne, Newton N. H.S., MA
Judith Glazener, DuVal H.S., MD
Marci Harvey, W. Forsythe H.S., NC
Oscar Hernandez, Robert E.Lee H.S., TX
Angela Holcomb, Mt. Tabor H.S., NC
Solona Hollis, Miller Grove H.S., GA
Ray Hulse, Haverford H.S., PA
James Kopchains, Flushing H.S., NY
Arthur Logan, Clio Area H.S., MI
Dan Mader, Kaukauna H.S., WI
Catherine McCluskey, E. Wake H.S., NC
Mitzi Moore, International School, TX
Sharona Moss, Selma H.S., AL
Gerard Pepe, North Babylon H.S., NY
Alicia Peterson, Haverford H.S., PA
Richard Pimentel, Coachella Valley H.S., CA
Candace Purdom, Washington Co.H.S., KY
Richard Redman, Franklin H.S., CA
Veronica Riffle, Lake Ridge Acad., OH
Vince SantoPietro, Shorecrest H.S., WA
Carol Smith, Van Alstyne H.S., TX
Karen Tokos, Newton N. H.S., MA
Jane Wallace, Dalton H.S., GA
Shanan Wheeler, Churchill H.S., MI
Rodney White, Shorecrest H.S., WA
Sarah Wilson, Caldwell H.S., ID
Gail Zitchittella, Cheektowaga H.S., NY

Pilot Teacher omissions from last year

Betsy Uhing, Grand Island Sr. H.S., NE
Sarah Wilson, Caldwell H.S., ID

Development Team

Active Chemistry Principal Investigators

Arthur Eisenkraft, Ph.D.
University of Massachusetts Boston
Boston, MA

Gary Freebury
Kalispell High School, Kalispell, MT

Darlene Schuster, Ph.D.
American Institute of Chemical Engineers, Washington, D.C.

Barbara Zahm, Ph.D.
It's About Time, Armonk, NY

Active Chemistry Writing Teams: The Natural and Fabricated World

Hannah Sevian, Ph.D., *team leader*
University of Massachusetts
Boston, MA

Kristen Cacciatore
Dedham High School
Dedham, MA

David Barry, Chemistry teacher
Chelsea High School, Chelsea, MA

Arts and Leisure

Carl Heltzel, Ph.D., *team leader*
Chemistry Director
Transylvania University
Lexington, KY

Diane Johnson, ARSI Master teacher
Lewis County High School
Vanceburg, KY

Brian Radcliffe, Science Chair
Bryan Station High School
Lexington, KY

Food and Drugs

Robert Hartshorn, Ph.D., *team leader*
University of Tennessee, Martin, TN

Paul D. Dunbar
Dept. of Engineering
University of Kentucky, Paducah, KY

Stanford N. Peppenhorst
Science Chair
Germantown High School
Germantown, TN

Sustainability

L.S. Fan, Ph.D., *team leader* Chemical Engineering Chair
Ohio State University, Columbus, OH

Darlene Schuster, Ph.D. — American Institute of Chemical Engineers, NY, NY

John Parson, Ph.D.
Chemistry Assistant Chair
Ohio State University
Columbus, OH

Himanshu Gupta, Ph.D.
Dept. of Chemical Engineering
Ohio State University
Columbus, OH

Peggy Sheets, Chemistry teacher
Upper Arlington High School
Arlington, OH (Retired)

Active Chemistry Additional Support

Jean Pennycook
Pilot and Field Test Coordinator
Fresno Unified School District
Fresno, CA

Gary Hickernell
Project Coordinator
It's About Time, Armonk, NY

Active Chemistry Board of Advisors

Jerry Bell, Ph.D., Senior Scientist
International Activities Division of ACS (American Chemical Society)

Rodger Bybee, Ph.D.
Executive Director of BSCS (Biological Sciences Curriculum Study)

Marilyn Decker
Senior Program Director of Science for Boston Public Schools

Dianne Dorland, Ph.D.
President, AIChE
(American Institute of Chemical Engineers) and Dean of Engineering
Rowan University

Maria Alicia Lopez Freeman Executive Director, CSP
(California Science Project)

Mary Gromko, Ph.D.
Science Supervisor K-12 for the Colorado Springs School District 11

David Lavallee, Ph.D., *Provost*
Vice President of Academic Affairs SUNY New Paltz

Carlo Parravano, Ph.D.
Executive Director, Merck Institute for Science Education and AAAS Fellow

Harold Pratt, NSTA President and BSCS Advisory Board member

Ethel Schultz, Science Education Consultant CESAME, trustee of the Noyce Foundation

TIMELINE

Currently, fifteen chapters are being field tested in high schools throughout the country by more than fifty teachers and testing will continue throughout the 2004-2005 school year. Based on the feedback and research results from the pilot test, a final revision of the materials will be conducted in 2005. Publication will follow in the spring of 2006.

August 2004 – June 2005: Field Test (In progress)

June 2005: Revised and edit student and teacher materials based on field test results.

Spring 2006: Active Chemistry introduced at ACS/NSTA meetings.

The *Active Chemistry* NSTA Presentations 2004/2005

INDIANAPOLIS, IN
Thursday, November 4, 2004
1:00-2:00 pm

Friday, November 5, 2004
11:00-12:00 noon

SEATTLE, WA
Thursday, November 18, 2004
2:30-3:30 pm

Saturday, November 20, 2004
8:00-9:00 am

RICHMOND, VA
Thursday, December 2, 2004
3:30-4:30 pm

DALLAS, TX
Friday, April 1, 2005
8:00-9:00 am

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As the publishers of Active Physics, EarthComm, Investigating Earth Systems, and MATH Connections, all NSF funded programs, IAT has a proven track record in dissemination and implementation of NSF research-based programs. IAT has also built a Professional Development and Implementation Department to focus on facilitating successful implementations of all its programs.

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Content of Active Chemistry Pilot Chapters

Voyage Down Alimentary Canal
- Hydrolysis (sugar- starch relationship)
- Enzymes/Catalysts
- Chemical test for starch
- Increased surface area/rate of rxn
- Temperature and rate of reaction
- Acid/Bases/Neutralization/Titration
- Acid/base indicators
- Gas collection by water displacement
- Chemical test for CO2
- Charles law/gas pressure
- Stoichiometry
- Gay-Lussac's law
- Diffusion
- Osmosis, semi-permeable membrane
- Concentration
- Equilibrium
- Representing very small numbers

Grandma was a Chemist
- Oxidation
- pH/Neutralization/titration
- Osmosis
- Conductivity
- Concentration of solutions
- Acid /base Kinetic molecular theory
- Phase changes/phase diagram
- Boiling point/vapor pressure
- Crystal formation/ rate of formation
- Air pressure
- Enzymes/active site/lock and key action
- Hydrogen bonding
- Fermentation
- Denaturing a protein

Looking Good - Smelling Great
- Kinetic Molecular Theory
- Diffusion/Effusion
- Molar mass
- Graham's law
- Balancing equations
- Chemical synthesis
- Fundamental laboratory skills
- Rate of crystallization
- Experimental design
- Bonding
- Solute/solvent/solution
- Polar/nonpolar molecules
- Hydrophilic/ lypophilic
- Detergents
- Isomers/handedness/stereochemistry
- Labels and chemical content
- Chemical function of ingredients
- pH

Artist as Chemist
- Physical/chemical properties of matter
- Atomic structure
- Electron arrangement
- Organic vs inorganic
- Acid - pH/acid formation
- Physical/chemical changes
- Classification of matter
- Conservation of mass
- Percent composition
- Polarity
- Alloys and properties of metals
- Electroplating
- Bonding (ionic, covalent, metallic)
- Water of hydration
- Intermolecular forces

Cookin' Chemistry
- Heat vs. Temperature
- Organic molecules, functional groups
- Combustion
- Stoichiometry
- Energy changes in reactions
- Energy and phase changes
- Exothermic vs Endothermic Rxns
- Conservation of energy and matter
- Activation energy
- Bond energies
- Intermolecular forces
- Types of solutions
- Molar quantities
- Solution concentration
- Crystallization
- Heating and cooling curves
- Heat of fusion
- Specific heat
- Protein denaturation
- Protein structure

Ideal Toy Company
- Battery function
- Physical/chemical properties of matter
- Gas laws
- Gas production
- Decomposition reactions
- Density of gases
- Diffusion
- Redox reactions
- Energy transformations
- Kinetic Energy
- Particulate nature of matter
- Stoichiometry
- Polymers
- Thermoset vs thermoplastic

Forensics
- Acids/Bases
- Combustion reactions
- Precipitates
- Solubility
- Metals/nonmetals
- Double-displacement reactions
- Ionic, covalent compounds
- Solvents/ solutes
- Chromatography
- Atomic structure of a solid
- Solubility rules
- Polymers
- Atomic structure luminescence
- Light and chemilumenence
- Single-displacement reactions
- Redox reactions
- Significant figures
- Density

Chemical Dominoes
- Focus on energy conservation
- Chemical vs physical properties
- Enthalpy and entropy change
- Engineering design process
- Conservation of mass
- Balancing chemical reactions
- Stoichiometry
- Reactivity of metals with acids/bases
- Arrhenius definition of acids/ bases
- Energy vs wavelength
- Visible electromagnetic spectrum
- Absorption/emission in spectroscopy
- Conservation of energy
- Endothermic/ exothermic
- Reaction diagrams, effect of catalysis
- Electrochemical cells
- Electrolytes
- Enthalpy vs entropy as driving forces

Soap Manufacture
- Introduction to cleaning agents
- Structural diagram/ Lewis dot
- Structure of fats
- Structure effect on chemical properties
- Chain length, saturated vs unsaturated
- Van der Waals forces
- Acids – Bases – Arrhenius definition
- Properties and operational definition
- Neutralization
- pH, pH scale
- Hydrophilic/hydrophobic interactions
- Tetrahedral structure of carbon bonding
- Logarithms
- Experimental design

It's Water
- Naming compounds
- Ionic/molecular
- Periodic trends/classification of matter
- Solubility/precipitation reactions
- Spectral absorption
- Analysis by ion specific electrodes
- Acids/bases/pH/equilibrium
- Solubility factors
- Chemical bonding
- Electron densities
- Electrostatic forces
- Hess's law/order/disorder
- Law of thermodynamics
- Dynamic states of equilibrium, Ksp
- Suspensions/Tyndall effect
- Coagulants/anti coagulants
- Ionic equilibrium
- Human toxicity limits
- Carcinogens
- Rates of chemical reactions
- Properties of fluids

Making It Matter
- Nomenclature
- Chemical and physical properties
- Classification of matter
- Carbon compounds
- Polymers
- Organic reactions
- Addition/condensation
- Intermolecular forces
- Hydrogen bonding
- Van der Waals forces
- Crosslinking
- Social and environmental issues
- History of chemistry
- Crystalline/amorphous structures
- Flow properties (rheology)
- Polymer processing
- Natural and synthetic materials

Fuel Cells
- Energy scenario
- Sources of energy
- CO2 emissions
- Greenhouse effect/global warming
- CO2 sequestration
- Hydrogen economy
- Energy carriers
- Fuels, caloric value, flammability limits
- Hydrogen production
- Activity series of metals
- Thermochemistry
- Energy conservation
- Specific heat capacity
- Reaction kinetics
- Common ion effect
- Adsorption of gases
- Voltaic cells, electrolysis, cell potentials
- Electroplating
- Fuel cells, proton exchange membrane
- Ernst equation, basis of pH calculations
- Chemicals to power generation
- Metal – Air fuel cells

Movie Special Effects
- Electrolysis
- Element/compound
- Chemical formulas
- Chemical symbols
- States of matter
- Kinetic/potential energy
- Phase change energy
- Phase change diagram
- Properties of matter
- Gas behavior
- Melting/boiling point
- Mixtures/suspensions/colloids
- Density
- Significant Figures
- Metals/nonmetals
- Polymers
- Organic/inorganic
- Hydrocarbons
- Combustion

Periodic Table
- Trends in the Periodic Table
- Properties of Elements
- Physical/ chemical properties
- Atomic mass, isotopes
- Relative mass
- Experimental error
- Mole concept
- Scientific notation
- Law of definite proportions
- Atomic structure
- Neutron/proton/electron
- Bohr model
- Electromagnetic spectrum
- Emission spectrum
- Atomic spectra
- Ionization energy
- Electron configuration
- Predicting formulas
- Ionic and covalent bonding
- Electron dot diagrams
- Fusion/fission

Cool Chemistry Show
- Chemical and physical change
- Solution chemistry
- Reactions in solution
- Predicting ionic charge
- Naming compounds
- Writing formulas
- Ionic/molecular compounds
- Types of chemical equations
- Conservation of matter
- Predicting products
- Energy changes in chemical reactions
- Reaction rates
- Acids and bases
- pH scale
- Oxidation/reduction reactions