

Annenberg/CPB
Professional Development Workshop Guide

Reactions in Chemistry

An eight-part professional development workshop
for high school chemistry teachers

**Produced by Hadassah College, Jerusalem in collaboration with
the Educational Film Center (EFC)**

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Table of Contents

Introduction	1
About the Workshop.....	1
Workshop Components	4
Helpful Hints for Facilitators	6
Materials Needed	7
Workshop 1. Atoms and Molecules	9
Workshop 2. Macro to Micro Structures	13
Workshop 3. Energetics and Dynamics	17
Workshop 4. Theory and Practice in Chemical Systems	21
Workshop 5. Chemical Design	25
Workshop 6. The Chemistry of Life	29
Workshop 7. Chemistry and the Environment	33
Workshop 8. Chemistry at the Interface	37
Appendix	41
Reading Assignment.....	42
Activities Guides	71
Quotes	213
Credits	233

About the Workshop

Overview

Reactions in Chemistry, and further, reactions to chemistry, are the focus of this educational workshop from Annenberg/CPB. It is a multimedia workshop for chemistry teachers' professional development, consisting of video, this print guide, and a Web site.

The workshop focuses on the "four elements" of chemistry teaching:

- Chemistry as a scientific discipline
- The art of educational pedagogy
- The historical development of chemistry
- Up-to-date technological applications

The workshop features students and teachers from various secondary schools in the U.S. who are involved in classroom activities and laboratory experiments in chemistry. The workshop focuses on students' ideas about basic concepts in chemistry and their teachers' reactions to these ideas. It presents teachers' reflections about their own teaching and discussion forums on how to teach chemistry and its main difficulties. The workshop offers a source of activities, experiments, and reading resources for teachers to use in their daily work. Experts on education and university professors add dimension to the strategies of teaching chemistry.

The workshop also features experts from different disciplines that relate to chemistry. Historians present the development of scientific thinking in chemistry through examples from early times. Industrial chemists and people who use chemistry for their daily work put chemistry in the context of current everyday life by explaining the role of chemistry in what they do. Examples are the chemistry of food, medication, forensics, and composite materials. This relates the students' own experience of everyday chemistry to what they learn in the classroom.

These ideas are introduced by cutting-edge methodologies and advanced educational technologies that are currently being used in secondary schools throughout the U.S. The multimedia nature of the workshop, combining video, a Web site, and this printed guide, maximizes the possibility of extracting teaching materials and methodologies from the workshop.

Program Summaries

Workshop 1. Atoms and Molecules

Modeling Chemistry: This program deals with teaching the very first steps of chemistry. It introduces the basic building blocks—the atoms—which, through their properties of periodicity and binding, form molecules. The program offers different ways to represent these basic concepts by creating useful models in the minds of new chemistry students. It follows the development of these concepts through history and their use in modern technology.

Workshop 2. Macro to Micro Structures

Teaching for Conceptual Change: This program deals with the conceptualization of micro processes and environments. It involves teaching chemistry through macro phenomena, which can be observed, and micro processes, which occur on the molecular level and can only be imagined. Conceptual change must occur in order for students to understand chemical phenomena. Teaching for conceptual change poses a great challenge to teachers because they must create imaginary and physical models in order to help students visualize microenvironments and processes that occur within them.

About the Workshop, cont'd.

Workshop 3. Energetics and Dynamics

The Complexity of Teaching Chemistry: This program emphasizes the importance of learning about the basic principles of energetics and dynamics. The complexity of teaching concepts such as the collisions theory, reaction kinetics, and electronic energy levels is introduced using a variety of teaching strategies. These concepts are related to everyday phenomena through topics such as nuclear and solar energy.

Workshop 4. Theory and Practice in Chemical Systems

Problem Solving: This program shows how a theoretical understanding of the driving force for chemical systems can lead to further development of new technologies and to the discovery of new phenomena in practice. In teaching, this is done through the creation of a close relationship between the science and mathematics of chemical processes, through problem-solving activities. These activities, which are based on a systematic interpretation of chemistry into mathematics, make the connection between theory and practice. These basic skills form the foundation for learning about chemical systems.

Workshop 5. Chemical Design

Facilitating Laboratory Learning: This program deals with basic concepts that are required for the understanding of chemical design. The idea is brought about by experiences from everyday life, such as the stoichiometry of baking, the ingredients of soft drinks, the components of drugs, and the chromatography of markers. The tools of the chemical designer—the chemist—are found in the laboratory, and the procedure which leads to the development of new materials is based on scientific investigation. These tools are applied to chemistry teaching in the classroom and to the facilitation of laboratory learning.

Workshop 6. The Chemistry of Life

Effective Teaching Strategies: This program discusses the chemistry of the wonders of life. It starts off with the way life began and goes on to deal with the structure and function of biological molecules. It emphasizes the value of relating chemical principles to biology studies and states that living organisms are huge chemical systems in equilibrium. Thus, learning processes are based on the chemistry of life, and this program shows how effective classroom strategies aim at enhanced learning.

Workshop 7. Chemistry and the Environment

Classroom Climate: This program introduces the chemistry of the environment. It addresses selected topics such as water quality and purification, recycling, and the hole in the ozone layer. Bringing the students to awareness of these topics helps them understand important issues in the world around them. In studying chemistry, environmental studies or anything else, the classroom climate is an important issue as well, and the teacher can influence it to a great extent.

Workshop 8. Chemistry at the Interface:

Quality in Teaching: In the last program, cutting-edge technologies are presented, where chemistry is at the interface with other disciplines: tissue engineering, deciphering of the human genome, and agricultural resources for new materials. The future of technology is incorporated into the chemistry classroom, motivating the students with exciting real-world applications and contributing to teaching. The workshop ends with a discussion: What is quality in teaching and how does it influence chemistry students and teachers?

The Philosophy of *Reactions in Chemistry*

Why REACTIONS in chemistry? The dictionary definition of REACTION is: "response due to priority of priority situation" (www.babylon.com). In chemistry, though, it means chemical change: "A chemical change is a dissociation, recombination, or rearrangement of atoms." In both situations, reaction relates to something dynamic in which change is involved, either by changing our doing in response to a stimulus, or by changing and creating structures made up of atoms.

About This Workshop, cont'd.

Change is the keyword for all that relates to inservice professional development of teachers. Teachers apply to programs for professional development because they seek change: change in their teaching methods, change in the curriculum, and change in their understanding of the subject matter. The basic idea of such programs is to give the teachers the support that they need in order to create this change, on the professional level, and from the social and personal points of view.

Professionally speaking, teachers look for widening their scope of knowledge in their own discipline and in related topics; they look for new lesson plans and classroom activities for teaching and evaluating students; they want to adjust their curriculum to new educational standards; they want to gain experience in inserting new materials into their classroom teaching.

In the social and personal aspects, teachers look for support in implementing new teaching methods, devising new ways for evaluation, and strengthening their position in their own eyes and in front of their peers and students. They come to the development program in order to share their knowledge and experience, discuss their ideas, and generalize patterns of teaching according to new standards.

Chemistry is a very challenging discipline for teaching. On the one hand, it relates to almost all we do in life: to processes in our human body, to the composition of the food we eat, to the materials we use, and to the technological developments which constantly change our lives. On the other hand, it is a very complicated discipline of science. It deals with atomic structure, reaction kinetics, energetics of bond breaking and formation, and so on. All of these are processes on the microscopic scale and require a deep understanding in order to do the necessary calculations. The challenge of teaching chemistry is teaching the basics of the scientific method and training for inquiry and problem-solving skills.

A workshop for chemistry teachers' professional development should give an answer to all of these needs. In *Reactions in Chemistry*, a great deal of attention was given to these issues. The workshop is composed of video, a Web site, and print materials: a multimedia production that is aimed at engulfing the learners' different capabilities such as observing, listening, and communicating. Teachers who participate in the workshop sessions will meet, watch the program, and conduct discussions both in session and online. This collaboration is essential for developing the social aspects discussed, sharing lesson plans and information, practicing new issues about teaching, and creating new connections with other chemistry teachers. The program echoes these principles by featuring chemistry teachers and experts who discuss ideas from their own teaching experience in secondary schools and universities and contribute to the process of change.

Reflection about one's own practices in teaching is also an essential part of professional development. Teachers who participate in the workshop sessions will get a chance to review their teaching methods on their own and with their peers. They will share new ideas that come up during discussions or are featured in the video programs and try to implement these in their classrooms, guided by the print guide and Web site. The workshop sessions and the online discussions provide the support required for teachers to discuss their new experiences, examine the reasons for their failures and successes, and create the change they want in a safe and supporting environment.

Specifically, *Reactions in Chemistry* tries to give answers to difficulties that arise directly from chemistry teaching, such as problem solving, laboratory learning, addressing the invisible, materializing new concepts, and creating the connections between micro processes and macro phenomena. Everyday topics such as environmental and technological issues are harnessed to demonstrate chemistry in action; models and analogies are brought forth by scientists and teachers; new lesson plans, in the classroom and the laboratory, are presented and discussed in the program; a wealth of electronic and printed information is referred to, creating a basis for knowledge development.

In summary, *Reactions in Chemistry* aims at helping teachers improve their own teaching, by forming a multimedia, multidisciplinary learning environment, from which teachers may extract whatever they find valuable for creating change in their own teaching methods.

Workshop Components

The Web site and guide provide everything you need to know to conduct this workshop, either with colleagues or on your own. The workshop consists of activities carried out with your colleagues on-site (Workshop Sessions) and those to do on your own (Pre-Workshop Preparation and Between Sessions). See Helpful Hints for Facilitators for more information on preparing for group workshop sessions.

Pre-Workshop Preparation (On Your Own)

This guide provides reading and activities to prepare you for each workshop session.

Workshop Sessions (On-Site)

Weekly workshop sessions may be scheduled around live broadcasts, in which case you will want to begin at least 30 minutes before the scheduled broadcast. You may prefer to pre-record the programs on videocassette and schedule the sessions at a time that is more convenient for all participants. Sessions work best when scheduled for a minimum of two hours, but three hours is optimal.

Each session consists of three parts:

Getting Ready

In preparation for watching the program, you will engage in approximately 30 minutes of discussion and activity.

Watch the Workshop Video

Then you will watch the 60-minute video program. Within each program, there are opportunities to pause the tape for discussion:

- A. If you watch the programs on video, use the beaker signs to stop the video at the end of each unit, and hold a short discussion about the segment (about 10 minutes each) or immediately following the video.
- B. If you are watching a real-time broadcast, you may want to consider the questions posed while viewing the program, and discuss them later. Take notes about your own thoughts and relevant points to the questions raised, in order to carry on a 30- to 45-minute discussion after viewing (not including the summarizing discussion).

Going Further

Wrap up the workshop with an additional 30 minutes of discussion and activity.

Workshop Components, cont'd.

Between Sessions (On Your Own)

Homework Assignment

This guide provides exercises and activities that put into use practices learned in the last session, or prepare you for the next one.

Ongoing Activities

You will carry on these activities throughout the course of the workshop:

Keep a Journal

Keep a journal of thoughts, questions, and discoveries from the workshop itself, and relate them to learning experiences that take place in your own classroom.

Use the Web Site

Visit the workshop Web site at www.learner.org/channel/workshops/chemistry/ for materials and resources required for the participation in the workshop. Prepare for each workshop session by reading through the session online. Also, use the Web site to deepen your understanding, find aids for the implementation of the practices shown in the workshop, and search for links and readings to the topics that you teach.

Share Ideas on Channel-TalkChemistry

Subscribe to an email discussion list and communicate with other workshop participants online. To subscribe to Channel-Talk, visit:

<http://www.learner.org/mailman/listinfo/channel-talkchemistry>

Helpful Hints for Facilitators

Successful Workshop Sessions

These guidelines will help you conduct successful workshop sessions, particularly the Getting Ready and Going Further segments. These 30-minute, pre- and post-video group discussions will help participants better understand the video programs and enhance the workshop experience. Getting Ready prepares participants for what to focus on during the video programs and Going Further provides the opportunity to analyze and reflect on what they saw.

Designate Responsibilities

Each week, someone should be responsible for facilitating the workshop sessions. This may be a professional facilitator or a volunteer from among the participants, or you may choose to divide and rotate duties among several participants.

Prepare for the Session and Bring the Necessary Materials

The facilitator should review the entire session in the guide prior to arriving for the session, as well as reviewing the materials needed for that session. The facilitator will be responsible for bringing enough materials for the participants. If you are viewing the video programs on videocassette, the facilitator may want to preview the programs. It is highly advisable to review the program material on the Web site before the sessions, the activities and quotes from the programs, and related links and readings.

Before the First Session

You may want to photocopy this guide for all participants so they may follow along, refer back to ideas covered in the session, or have their homework assignments handy. Or, you may direct them to the Web site to print the guide themselves. Either way, you will want participants to have the guide prior to the first session, so they will come prepared. Be sure participants know to bring a notebook to each session and that there is an assignment prior to the first session (see Pre-Workshop Preparation for Workshop 1).

Keep an Eye on the Time

We have suggested the amount of time you should spend on each question or activity. While these times are merely guidelines, you should keep an eye on the clock, particularly if you are watching a live broadcast. You may want to set an alarm clock before you begin Getting Ready to ensure that you won't miss the beginning of the video. If you are watching the workshops on videotape, you will have more flexibility if your discussions run longer.

Record Your Discussions

We recommend that someone take notes during each discussion, or even better, that you tape-record the discussions. The notes or audiotapes can serve as make-up materials in case anyone misses a workshop.

Share Your Discussions on the Web

The workshop sessions serve as a starting point to share and think about the workshop ideas. Encourage participants to continue their discussions with participants from other sites on Channel-Talk.

Materials Needed

To the Facilitator

Review each session in the workshop guide or the Web site to find the materials needed for each session.

Always have the print guide handy during sessions, so that you can refer to it during viewing and discussion.

Each participant will need a notebook in which to take notes during discussions and keep a journal of thoughts, experiences, and ideas about chemistry teaching during participation in the workshop.

Work on the Web site is an integral part of this workshop. Participants should have access to a computer with a Web connection (Explorer 4.0 or Netscape 4.0 browsers) in order to fully participate in the program.

Materials Needed for Workshop 1

Bring to the workshop session a soccer ball to model C_{60} and some square pieces (4" x 4") of chicken wire to model graphite and nanotubes.

Materials Needed for Workshop 2

Bring to the workshop session several extra printouts of the Science Teaching Standards, from <http://books.nap.edu/html/nses/html/3.html>.

A concise sourcebook for further assignments, activities, and background material is *ChemSource*, version 2.1 (Orna, Mary Virginia, O.S.U.; Schreck, James O. & Heikkinen, Henry, eds.), 1998. Visit the Web site at <http://intro.chem.okstate.edu/ChemSource/chemsource.html>.

