



Reflections

NUMBER 22
OCTOBER 2006

A NEWSLETTER PUBLISHED BY SCIENCE CURRICULUM INC.

Publisher of *Introductory Physical Science (IPS)* and *Force, Motion, and Energy (FM&E)*
Thoughtful Curricula Developing Thinking Students

200 UNION BLVD., SUITE G-18 LAKEWOOD, CO 80228 888-501-0957 WWW.SCI-IPS.COM

The False Dichotomy of Chemical and Physical Changes

H. Graden Kirksey

A long time ago people observed changes in matter and attempted to classify them as either "chemical" or "physical." Perhaps this classification made sense then, but does it now?

If the temperature or pressure of a sample of water is changed, its characteristic properties also change. Heating water changes its density, viscosity, refractive index, and other characteristic properties. And if heated above its boiling point, water changes to steam. If the water sample is returned to its initial temperature, the steam condenses and the characteristic properties return to their initial values. But if carbon is burned to form a gas, one cannot get the original carbon back by returning the gas to the original temperature and pressure of the carbon.

There seems to be something important and fundamentally different about these changes. A long time ago someone called one a physical and the other a chemical change. Labeling these changes caused others to think that they understood what happens when water is heated and carbon burned. They probably thought, "Permanent changes affect the chemical nature of matter, but those that can be reversed affect only the physical nature of matter." It may have made sense at the time, but how does labeling and classifying changes help students to know and understand what happened?

Consider another change in water. Copper(II) sulfate and sodium chloride, both white salts, dissolve in water to form respectively blue and colorless solutions. What caused the changes in colors? Was dissolving a chemical or physical change? Are the original solid substances recovered if the solvent evaporates? Deciding whether dissolving is a chemical or physical change becomes "word play" or "definition nitpicking." Such distinctions distort and obscure the learning of science.

Later investigators helped us to understand these changes. The concept of atomicity was enlightening. Chemical composition became a laboratory challenge. Chemical reactions were carefully and laboriously studied. Testable explanations were posited to explain the chemistry of heating water, burning carbon, and dissolving salts. Subsequently, these explanations were tested. The practice of classifying changes into chemical and physical categories began to fade away.

Many scientists realized decades ago that classifying changes of matter as either chemical or physical may have worked in a former time, but new knowledge made these categories irrelevant. Medicine came to a similar conclusion after seeing that not all diseases are caused by foreign substances entering the body. For example, does a foreign material cause sickle cell anemia or

continued on page 2

Chemical and Physical Changes *from page 1*

Huntington's disease? As more was learned about the Kuiper Belt beyond Neptune, astronomers have met to decide what is and is not a planet. Sadly, Pluto was released from the planet team without a change in any of Pluto's properties. This is the fate of labels and rules in science—they change because our knowledge increases and not because nature changes.

None of the editions of **Introductory Physical Science** have classified changes and properties of matter as either chemical or physical, nor will they. The authors are aware that many state standards insist on identifying changes as either chemical or physical. State achievement tests have questions requiring students to distinguish between chemical and physical changes. But do chemists classify changes and properties in their laboratories?

Teaching arbitrary categories, like chemical or physical changes, has never been a part of the *IPS* curriculum. No *IPS* student has been taught a difficult scientific concept by “dumbing it down” to their level, or a useless concept because it appears on state

standards, or one that he or she must relearn correctly at a later date.

IPS students are treated as mature learners while in the middle school, and the authors are vigilant to ensure that only sound science is presented in the *IPS* course. *IPS* students perform laboratory experiments to:

1. measure characteristic properties of solids, liquids, and gases;
2. separate mixtures by use of distillation, solvent extraction, and paper chromatography;
3. separate compounds into their constituent elements by use of electrolysis and chemical reactions; and
4. synthesize chemical compounds.

These processes, regardless of whether they might be classified as physical or chemical, are used to develop the fundamental and useful ideas of mixtures, pure substances, elements, and compounds. Students can use these ideas for many years in future study and everyday life.

DID YOU KNOW? Teacher Resource Articles Are Available Online

Our textbook authors, as well as other science educators from across the country, often contribute thoughtful and enlightening resources on everything from budget-saving equipment ideas and state-mandated testing to lab notebook grading tips and science theory. You can find these articles published in our **Reflections** newsletter and in **eTips**, as well as online in our archived library of resource articles.

“Mole Day and the Meaning of the Mole” and “The Enormous Size of Avogadro’s Number” are two new resources in the SCI article collection, both contributed by H. Graden Kirksey, co-author of *IPS* and *FM&E*. Find these and others online at www.sci-ips.com/articles.html.

Start Planning Now for Summer 2007!

For more than twenty years, science teachers have come together at Colorado School of Mines in Golden, Colorado, to learn new teaching techniques and to expand their knowledge of the **Introductory Physical Science (IPS)** curriculum. In recent years, workshops for **Force, Motion, and Energy (FM&E)** and how to write good science test questions have been added. Quality science teaching has always been a cornerstone of the SCI philosophy; we take pride in the way these workshops enlighten and bring together pre-service, beginning, and experienced *IPS* and *FM&E* instructors from across the country.

“I was initially interested in the course to learn

about the program and to find out why it is the program of choice in one of our local private schools,” says Joanne Aronson, a Florida educator who attended the Golden *IPS* workshop this past summer. As a result of her attendance, she says she “learned new ways to teach concepts that I currently teach and met interesting individuals from around the country with different perspectives on science education.”

Aronson now incorporates the *IPS* philosophy into her physical science and chemistry classes, and she is eager for another “rewarding experience” next summer. Indeed, many workshop attendees come to both *IPS* and *FM&E* programs, sometimes more than

continued on page 3

Summer Workshops *from page 2*

once! The collaboration of people with different perspectives, coupled with the straight-from-the-source feedback from our author-instructors, have inspired positive feedback from even the most experienced *IPS* teachers.

Most teachers know the importance of ongoing professional development, and SCI knows that cost often plays a role in determining whether or not teachers are able to attend workshops. To support you in your development goals, we happily credit five percent of your school's purchase of copyrighted SCI materials over the past three years toward the tuition costs for SCI-approved national or regional workshops. More information on *IPS* and *FM&E* workshops, as well as our "Writing Meaningful Assessment Questions for Science Courses" workshop, can be found both online at

www.sci-ips.com/events.html

and in upcoming issues of *Reflections*. Watch for your application in January's issue! We're already looking forward to another great summer session!

2007 Workshop Dates

Introductory Physical Science I
(Chapters 1-5) July 8-13, 2007

Introductory Physical Science II
(Chapters 6-10) July 15-20, 2007
(To register for this workshop, you must have taken a Chapter 1-5 workshop.)

Force, Motion, and Energy
July 15-20, 2007

Constructing Tests for Science Courses Workshop
July 8-13, 2007

Meet Your School Services Coordinator — Tasha King

Welcome back to another productive, albeit harried, semester of science education! We at Science Curriculum Inc. are busy helping new and experienced *IPS* and *FM&E* instructors prepare for a new semester with our school-year resource publications, the newsletter you're reading now as well as *eTips*—our by-email science teaching tips. We're growing and expanding with new teacher resources and new people to support our huge community of *IPS* and *FM&E* instructors. From my perspective, as one of those aforementioned "new people," it's definitely an exciting time to be involved.

As your School Services Coordinator, I encourage you to make contact and send along your curriculum

questions, product inquiries, workshop interest, and teaching tips. I'm eager to meet the *IPS* and *FM&E* community and, being a recent journalism graduate, look forward to communicating with you throughout the school year in our publications. It's my goal to provide you with the best quality teaching support and urge you to let us know how we might be able to do that in our newsletter, on the web, and on the phone. If you have any suggestions, give me a call at 888-501-0957 or send a quick email to

office@sci-ips.com

I look forward to hearing from you and getting into my first full school year on the Science Curriculum team. Enjoy your fall semester!

What Did You Miss in the Most Recent Issue of *eTips*?

SCI eTips for Teachers is sent bimonthly and exclusively by email. In September we detailed tips for improving students' science reading skills, as well as build-your-own-pegboard instructions. Don't miss out on next month's issue! Sign up for our free distribution list now by visiting

www.sci-ips.com/newsletter.html

Looking for Resources for Teaching Physical Science?

The SCI website has information on *IPS* and *FM&E* textbooks, teacher's guides, assessment packages, test analysis software, educational films and more to aid you in your classroom! For more information on our products, be sure to check our website:

www.sci-ips.com



SCIENCE CURRICULUM INC.

200 Union Blvd., Suite G-18

Lakewood, CO 80228-1845

Reflections

A NEWSLETTER FOR SCIENCE TEACHERS

***Visit the SCI booth at the
following meetings and conventions:***

Baltimore, MD (NSTA) November 2–4, 2006

Denver, CO (CAST) November 16–17, 2006

St. Louis, MO (NSTA) March 29–April 1, 2007