



Reflections

NUMBER 31
NOVEMBER, 2010

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

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Inquiry: The Art of Asking Questions

The process of scientific inquiry has often been described as the act of questioning nature, but how do we convey the full meaning of this metaphoric description to students? In *Introductory Physical Science*, the answer is that we model the processes of inquiry by asking good, insightful questions throughout the course.

Much has been written about the meaning of inquiry in science education. *The National Science Education Standards (NSES)* (NRC, 1996), developed and published by the National Academy of Sciences, defines inquiry as:

... a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating results. Inquiry requires identifications of assumptions, use of critical and logical thinking, and consideration of alternative explanations. (NSES, page 23)

Obviously, there are many facets to inquiry!

A companion document, *Inquiry and*

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Host Site Needed for 2011 Summer Workshops

Since the Colorado School of Mines will be unable to host us next year (and since we would like to expand workshop access to other areas of the country), we are currently looking for a host site for our 2011 Summer Workshops. Characteristics of possible host sites include:

- Access to two or more classrooms (one of which does not have to be a lab);
- Use of on-site *IPS* lab equipment;
- Someone to act as an on-site facilitator (could be a workshop participant);
- Lodging and dining facilities on-site or nearby.

Selected host school(s) will be provided with tuition credits for one or more teachers from that school to attend the workshop(s). If you and your school are interested in becoming a workshop host, please contact us at 888-501-0957 or by sending an email to workshops@sci-ips.com.

Inquiry (from page 1)

the *National Science Education Standards: A Guide for Teaching and Learning* (NRC, 2000) was also created by the authors of the *NSES*. This document described five essential features of classroom inquiry:

1. Learners are engaged by scientifically oriented questions.
2. Learners give priority to evidence in responding to questions.
3. Learners formulate explanations from evidence.
4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific knowledge.
5. Learners communicate and justify their proposed explanations.

At the risk of stating the obvious, notice that each of these items justifiably concentrates an action of the learner—identifiable behaviors involving the use of evidence to formulate and justify explanations. But what triggers these behaviors? All five come in response to questions—questions posed by the teacher, the textbook, or fellow students.

The recognition of the importance of good questions has been a pillar of the *Introductory Physical Science* curriculum since its initial development, and the commitment to providing students and teachers with good questions has only intensified with the new 9th edition of *IPS*. Various types of questions found in the 9th edition *IPS* program (many of which also appeared in previous editions) are summarized in the following table.

Type	Location	Purpose	Treatment in other textbooks
Blue bulleted questions	Embedded within experiments	Encourage and guide student thought about experimental procedures and analysis	Other textbooks too often provide recipe-like instructions for labs, promoting minimal thought on the part of the student.
Comprehension Guide Questions™ (CGQs)	In the margins of most reading sections	Scaffold reading skills by allowing students to self-assess their comprehension of what they have read; may also be used as additional formative assessment questions in class	Some textbooks claim to promote reading skills, but actually place statements of key ideas in the margins rather than questions. These simply encourage students to skip readings, looking only at those statements.
Formative Assessment (FA) questions in the text	In the lighter yellow background at the ends of most sections	Quickly assess the status of student understanding, either individually or as a class	In other books, questions labeled as “formative assessment” often lack the “minds-on” aspect of <i>IPS</i> questions; they sometimes even require only the rote regurgitation of vocabulary definitions and facts.
Formative Assessment (FA) questions in the <i>Teacher’s Guide and Resource Book (TGRB)</i>	In most sections of the <i>TGRB</i> that correspond to reading sections in the textbook	Provide teachers with the flexibility to adapt or supplement the FA questions in the textbook to the current level(s) of understanding of their students	Since the <i>TGRB</i> is an entirely separate supplemental publication, more extensive guidance and teaching tools (including FA questions) can be provided than in other publishers’ “teacher’s editions” of the textbook where “teacher space” is limited.

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Additional End-of-Section questions	In the darker yellow background at the ends of most sections	Challenge students to think more deeply about what they have learned in a given section of the text	Often present in other texts, but usually lacking in a requirement for incrementally deeper thinking
Review, Application, and Extension questions (RAEs)	At the end of each chapter	Review and extend what has been learned in a chapter by applying the learnings to new situations, while using and extending the critical thinking skills developed throughout the course	Provided with some, but not all, other textbooks
Rhetorical questions	At the beginning of and within most sections	Serve to provide a framework/rationale and get students thinking about what follows; provide points for discussion	A common feature in most textbooks
Assessment items: Multiple-choice	In the <i>Assessment Package</i>	Provide high-quality questions and carefully constructed tests that gauge student understandings in an easily gradable format, allow teachers to diagnose gaps in student understanding, inform subsequent instruction, and stand up to an “open-book” test—requiring active thought rather than rote recital of facts or following the pattern of algorithmic examples	Other programs often provide a test bank of questions that require little active thought (easily judged by asking “Would this be a good question on an open-book test?”).
Assessment items: Open response	In the <i>Assessment Package</i>	Address differences in learning styles by allowing students to express their understandings in a more creative, extended, essay format	Provided with some, but not all, other textbooks
Assessment items: Authentic assessment	In the <i>Assessment Package</i>	Provide the teacher with lab tests as a way to evaluate experimental procedures and analytic skills	While often copied in other textbooks, none have achieved the quality or success of <i>IPS</i> standards such as the “Sludge Test.”

Scientific inquiry involves asking meaningful questions of nature. Inquiry-based science education involves modeling the processes of inquiry through the art of asking good, non-trivial questions at every opportunity—challenging students to become active, critical thinkers rather than passive absorbers of knowledge.

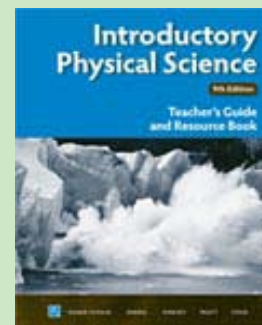
References:

National Research Council. (1996). *The National Science Education Standards*. Washington, DC: The National Academy Press.

National Research Council. (2000). *Inquiry and the National Science Education Standards: A Guide to Teaching and Learning*. Washington, DC: The National Academy Press.

IPS-9 Teacher's Guide and Resource Book and Assessment Package

The 9th Edition *Teacher's Guide and Resource Book* is now available! In addition to all of the features from previous editions—teaching tips, lab safety tips, teacher background information, formative assessment questions, answers to bulleted questions and problems in the 9th edition textbook, and sample data and analysis—the new edition also contains a CD-ROM with projectable and printable figures from the textbook. To learn more, see sample pages, or download an excerpt of the *TGRB*, visit www.sci-ips.com/p_ips9_teach.htm .



The 9th Edition *Assessment Package* will be available in Spring, 2011. While the tests in this edition's AP will be similar in format to those in previous editions—containing multiple choice and open response (essay) questions, as well as lab tests—the overall appearance of the AP has changed! In response to suggestions from teachers, the new AP will be published on CD-ROM. This will allow us to provide multiple versions of each test, with the distractors scrambled, so that different versions of the same test can be used for different classes.

For more information, visit www.sci-ips.com/p_ips9_assess.htm .

Some 7th Edition Books Are Still Available!

Copies of the 7th edition *IPS* student textbook, as well as the 7th edition *Assessment Package* are still available, but we are down to a single copy of the *Teacher's Guide and Resource Book*! These books are now out of print, so once they are gone, they're gone. If you are still using the 7th edition and need to fill in your inventory, don't hesitate! Order now!

Special closeout prices for the textbook (\$38) and *Assessment Package* (\$32) are in effect while supplies last, with additional discounts for class sets of the AP. For more information, please contact us at 888-501-0957 or by email at sales@sci-ips.com.



Have you seen our new website?

Visit www.sci-ips.com ! Some specific links with information about the 9th edition of *Introductory Physical Science* are provided below:

For *IPS-9* general information: http://www.sci-ips.com/p_ips9_txtbk.htm

To see *IPS-9* sample pages: http://www.sci-ips.com/e_sample_ips.htm

For the *IPS-9* Table of Contents: http://www.sci-ips.com/p_ips9_txtbk_toc.htm

To learn about the structure and storyline of *IPS-9*: http://www.sci-ips.com/p_ips9_storyline.htm

To download an excerpt of the book: http://www.sci-ips.com/pdf/excerpts/IPS9_text_excerpt.pdf

For information about the *Teacher's Guide and Resource Book*:

http://www.sci-ips.com/p_ips9_teach.htm

For information about the *Assessment Package*:

http://www.sci-ips.com/p_ips9_assess.htm

