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Reflections

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New Science Standards Are Coming

Harold Pratt

As many of you have probably read, new national science standards, called the *Next Generation Science Standards* (*NGSS*) are being developed with a scheduled release in the spring of 2013. A second and last public draft will be released in early December 2012 (at a date to be announced) for review by anyone who goes online to read the draft and complete the associated survey. To stay apprised of the release, which will be available for only a few weeks, and other information about the upcoming standards, go to **www.achieve.org**.

The *NGSS* are being developed by Achieve, a non-profit education reform organization, in partnership with 26 partner states, the American Association for the Advancement of Science, and the National Science Teachers Association.

The development of the new standards is the second of a two-step process that began when the National Research Council, the operating arm of the National Science Academies and the group that developed the *National Science Education Standards* (*NSES*), released *A Framework for K-12 Science Education*★ in July 2011. The 380-page *Framework* laid out a detailed set of specifications for the content and design of the *NGSS*. This included three major dimensions of the outcomes expected of all students—"Scientific and Engineering Practices," "Disciplinary Core Ideas," and "Crosscutting Concepts" that are to be integrated in all the standards.

Anyone interested in studying the *NGSS* should start with a careful reading of the *Framework*. It spells out the goals of the standards and the purpose behind the integration of the three dimensions, in addition to providing a detailed explanation of each of the dimensions. Answers to questions about elements in the *NGSS* can usually be answered by reading the *Framework*. This reading, in turn, will be aided by using NSTA's *Reader's Guide to the Framework*.★★

The Scientific and Engineering Practices stated in *NGSS* and listed here replace and expand on the "Abilities of Inquiry" in the 1996 *National Science Education Standards*.

1. Asking questions (science) and defining problems (engineering)

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NEXT GENERATION SCIENCE STANDARDS (from page 1)

2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating and communicating information

The Crosscutting Concepts dimension includes the following unifying ideas:

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

The Core Disciplinary Ideas include the usual disciplines of Life Sciences, Physical Sciences, Earth and Space Sciences and a new, fourth discipline, Engineering, Technology and the Applications of Science. Note the inclusion of the engineering elements in the first and sixth practices above. The *Framework* discusses practices common to both science and engineering.

Of interest to *IPS* users is the content of the middle-level physical science Core Disciplinary Ideas included in the *NGSS* public release of May 2012.

- Chemical Reactions
- Structure and Properties of Matter
- Energy
- Forces and Motion
- Interaction of Forces
- Waves and Electromagnetic Radiation

See NEXT GENERATION SCIENCE STANDARDS on page 4

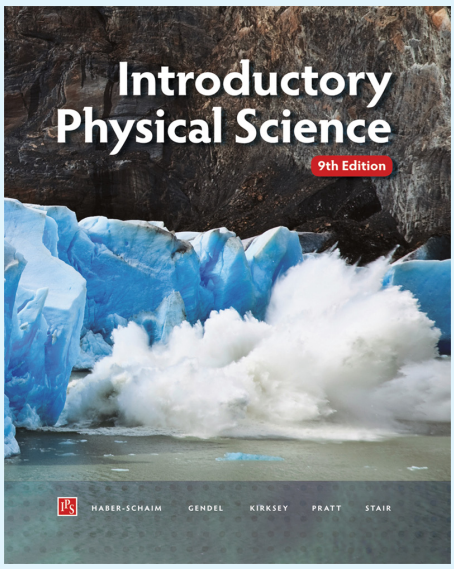
2013 *IPS* National Workshops

In July of 2013, Science Curriculum Inc. will offer three different *IPS* workshops on the Colorado School of Mines campus in Golden, CO. The workshops will cover Chapters 1-6, 7-11, and 12-16, respectively, of the 9th Edition of *IPS*. The dates for the workshops are as follows:

***Introductory Physical Science* – Part 1** (Chapters 1–6: Properties of Matter)	July 14–19, 2013
***Introductory Physical Science* – Part 2** (Chapters 7–11: Atoms and Molecules)	July 21–26, 2013
***Introductory Physical Science* – Part 3** (Chapters 12–16: Energy and Forces)	July 21–26, 2013

A workshop registration form can be downloaded at **http://www.sci-ips.com/e_workshops.htm**. For questions or additional information, please contact us toll-free (888-501-0957) or by email (**workshops@sci-ips.com**).

Now your students can have their own *IPS* ebook!



The Ninth Edition of *Introductory Physical Science* is now available through the iTunes Bookstore to schools and students in the United States, Canada, Switzerland, Norway, Netherlands, Denmark, Finland, Sweden, Great Britain, Ireland, France, Germany, Italy, Spain, and Australia.

For the low, current introductory price of $14.99 (in the U.S.), you and your students can purchase the *IPS* ebook for use on the iPad, iPhone, and iPod Touch. In addition, schools can enroll in Apple's **Volume Purchase Program**.

The *IPS* ebook offers both convenience and useful tools not available with the print version of the textbook! With an *IPS* ebook, students can:

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For more information, visit **http://www.sci-ips.com/e_ebookinfo.htm** .

To purchase the ebook in the U.S., visit **https://itunes.apple.com/us/book/introductory-physical-science/id549155537?mt=11 .**

TEACHERS: If your students are interested (and it is acceptable within your school), please feel free to print and distribute this page so students can get their ebook before the introductory price expires in January!

NEXT GENERATION SCIENCE STANDARDS (from page 2)

An innovative characteristic of the *NGSS*, called for in the *Framework*, is the integration of the three dimensions in all of the standards. The architecture of a standard consists of four components—a set of performance expectations in the upper box and a set of three "foundation boxes" below the performance expectation—one each for the practices, disciplinary core ideas, and crosscutting concepts. (For brevity, the example shown below has only one performance expectation, along with the practices, core ideas, and crosscutting concepts related to that expectation. A full standard would have several of the elements in each box.)

MS.PS-SPM.a. Structure and Properties of Matter

Students who demonstrate understanding can:

a. **Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits.** [Clarification Statement: Examples of atoms combining can include Hydrogen (H_2) and Oxygen (O_2) combining to form hydrogen peroxide (H_2O_2) or water (H_2O).] [*Assessment Boundary: Restricted to macroscopic interactions.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Developing and Using Models	PS1.A: Structure and Properties of Matter	Patterns
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems. • Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs.	• All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. Graphs and charts can be used to identify patterns in data.

The content in the foundation boxes was derived from the specifications in the *Framework*. In the example, the performance expectation in the top box may appear to be a specific instructional objective. It has been written by the development team at Achieve to guide assessment of the content in the foundation boxes. It is important to keep in mind that standards serve as guides to shape curriculum, instruction, and assessment, but they do not dictate specific instructional strategies or activities.

Based on a premise familiar to *IPS* teachers, the *Framework* discusses the integration of the dimensions when it states...

> *students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry and the discourse by which the ideas are developed and refined. At the same time they cannot learn or show competence in practices except in the context of specific content…Furthermore, crosscutting concepts have value because they provide students with connections and intellectual tools that are related across different disciplinary content… (page 218)*

To affect local schools in about half of the states, *NGSS* or a version of it must be adopted by the respective state legislatures. In the balance of the states, adoption is the prerogative of local districts or schools. These policy steps take time. As a result, *NGSS* may not affect many schools for two or more years. Nevertheless, you may find it interesting and advisable to go online in December to review the public draft. This will probably be the only opportunity to see *NGSS* until it is released in the spring. (Achieve's policy in the past has been to leave the draft on the web for only three weeks.)

- ⋆ *A Framework for K-12 Science Education* can be read and a free pdf version downloaded at **http://www.nap.edu/catalog.php?record_id=13165** .
- ⋆⋆ The *Reader's Guide to the Framework* can be read and a pdf version downloaded at **http://www.nsta.org/store/product_detail.aspx?id=10.2505/9781936959778&lid=ngss**.

Harold Pratt was a staff member and writer for the National Science Education Standards. *He currently consults with NSTA during the review and feedback phase of the development of the* Next Generation Science Standards.