The NSTA Reader's Guide to A FRAMEWORK FOR K–12 SCIENCE EDUCATION

Practices, Crosscutting Concepts, and Core Ideas

Second Edition

By Harold Pratt
With contributions from Rodger W. Bybee,
Richard A. Duschl, Joseph Krajcik, and more.
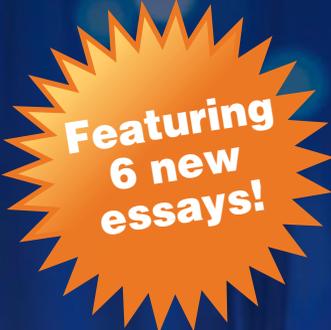
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Arlington, Virginia

The NSTA Reader's Guide to *A Framework for K–12 Science Education*
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PART IV: Understanding *A Framework for K–12 Science Education*: Top Science Educators Offer Insight

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Background

In 2012, the National Research Council published *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (*Framework*)*, which identifies key scientific ideas and practices all students should learn by the end of high school. The *Framework* serves as the foundation for new K–12 science education standards that will replace those developed in the 1990s, including the *National Science Education Standards* (*NSES*) and *Benchmarks for Science Literacy* (*Benchmarks*).

A state-led effort to develop the new science standards—called *Next Generation Science Standards* (*NGSS*)—has been managed by Achieve Inc. The process involved science experts, science teachers, and other science education partners. The first draft of the *NGSS* appeared in May 2012, and the final version was released in April 2013. NSTA recommends that the science education community fully examine the *Framework* and explore in-depth the concepts and ideas on which the new standards are built.

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* National Research Council (NRC). 2012. *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

Using This Guide

This guide is intended for many audiences—including science teachers, science supervisors, curriculum developers, administrators, and other stakeholders in science education—to help them better understand and effectively implement the new standards. As the introduction to

A Framework for K–12 Science Education (*Framework*) states, "the framework is intended as a guide to standards developers as well as to curriculum designers, assessment developers, state and district science administrators, professionals responsible for science-teacher education, and science educators working in informal settings" (pp. 2 and 4). Teachers play a key leadership role in each of these functions and will benefit from a deep understanding of the *Framework* as a stand-alone document and as a guide to the use of the *Next Generation Science Standards*.

To make the best use of this guide, the reader should have a copy of the *Framework* in hand for reference. The *Framework*, and many other National Research Council reports noted in this document, can be downloaded free of charge from the National Academies Press at *www.nap.edu*. This guide is designed to facilitate the study of the *Framework*, not replace reading it. For each chapter of the *Framework*, the guide provides

1. an overview;
2. an analysis of what is similar to and what is different from previous standards and benchmarks; and
3. a suggested action for science teachers, science supervisors, and other science educators to support understanding of the *Framework* and anticipate its impact on classrooms, schools, and districts.

Contents of the *Framework*

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The overview is not intended to be an exhaustive summary of the *Framework* chapter, but rather a brief synopsis of the key idea(s). The second section—an analysis of what is new and different—is much more effective if the reader of this guide has a copy of the *National Science Education Standards* and *Benchmarks for Science Literacy* in hand or is reasonably familiar with these documents. Much of our analysis is based on comparisons with these two important documents that were published in the mid-1990s. Other documents will also be referenced to provide additional background and reading. The third section—suggested action—contains recommendations for activities for individuals, small teams, or larger groups to explore and learn about the ideas and concepts in the *Framework*. While some will find the overview and analysis sections most insightful, others will appreciate the suggested actions and use them as guides for possible professional development ideas.

Summary

The executive summary states the purpose and overarching goal of *A Framework for K–12 Science Education* (*Framework*) is to "ensure that by the end of 12th grade, *all* students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside school; and have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology" (p. 1).

The *Framework* recommends that science education be built around three major dimensions, which are provided in the sidebar (Box S.1, p. 3)

The intent is that the *Next Generation Science Standards* should integrate these three dimensions. The early sections of the *Framework* do not communicate this intent, but it becomes clear in Chapter 9, "Integrating the Three Dimensions," and in the Chapter 12 recommendations to Achieve Inc. The early chapters are instead designed to provide an understanding of each separate dimension.

The Three Dimensions of the *Framework*

1. Scientific and Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

2. Crosscutting Concepts

- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change

3. Disciplinary Core Ideas

Physical Sciences
- PS1: Matter and its interactions
- PS2: Motion and stability: Forces and interactions
- PS3: Energy
- PS4: Waves and their applications in technologies for information transfer

Life Sciences
- LS1: From molecules to organisms: Structures and processes
- LS2: Ecosystems: Interactions, energy, and dynamics
- LS3: Heredity: Inheritance and variation of traits
- LS4: Biological evolution: Unity and diversity

Earth and Space Sciences
- ESS1: Earth's place in the universe
- ESS2: Earth's systems
- ESS3: Earth and human activity

Engineering, Technology, and the Applications of Science
- ETS1: Engineering design
- ETS2: Links among engineering, technology, science, and society

Source: NRC 2012, p. 3

Obtaining, Evaluating, and Communicating Information

By Philip Bell, Leah Bricker, Carrie Tzou, Tiffany Lee, and Katie Van Horne

The National Research Council's recent publication *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (*Framework*; NRC 2012), which is the foundation for the *Next Generation Science Standards*, places unprecedented focus on the practices involved in doing scientific and engineering work. In an effort to lend specificity to the broad notion of "inquiry," the intent behind the practices outlined in the *Framework* is for students to engage in sensible versions of the actual cognitive, social, and material work that scientists do. This article focuses on one of those practices.

Obtaining, evaluating, and communicating information

Reading and writing comprise over half of the work of scientists and engineers (NRC 2012; Tenopir and King 2004). This includes the production of various scientific representations—such as tables, graphs, and diagrams—as well as other forms of communication such as giving conference presentations and speaking to the public and other stakeholders. The reading and writing that scientists do help them better understand scientific ideas and communicate their research to their colleagues and to the public. Thus, K–12 students of science should have substantial and varied experiences with reading, analyzing, writing, and otherwise communicating science so that they too can deeply engage with disciplinary core ideas and crosscutting concepts while exploring practices associated with scientific reading and writing. This is why the "obtaining, evaluating, and communicating information" practice was included in the *Framework*.

K–12 students should learn how to conceptualize, compose, and refine different types of scientific writing from detailed scientific research abstracts to articles for a lay audience on current issues related to topics such as health and the environment to elaborate evidence-based arguments and even to proposals for funding. They should also learn how to find and understand everything from science-related newspaper articles to peer-reviewed journal articles—at reading levels that are developmentally appropriate and with use of relevant disciplinary criteria to select pieces and judge their quality. K–12 students also need practice obtaining information and evaluating it (to make personal health decisions or take informed action on environmental issues, for example). Students should learn to search and browse scientific and library databases, the internet, and print and digital media outlets (newspapers, magazines, blogs, Twitter, RSS feeds) for information they can use to inform their research and learning of science. They need to practice evaluating the information they find, learning how to judge whether information is credible and by whose criteria, as well as learning which information is necessary and useful for any given purpose.

In articulating the related learning goals, the *Framework* (NRC 2012, pp. 75–76) specifies that all students should be able to:

- Use words, tables, diagrams, and graphs, as well as mathematical expressions, to communicate their understanding or to ask questions about a system under study.
- Read scientific and engineering text, including tables, diagrams, and graphs, commensurate with their scientific knowledge and explain the key ideas being communicated.
- Recognize the major features of scientific and engineering writing and speaking and be able to produce written and illustrated text and oral presentations that communicate their own ideas and accomplishments.
- Engage in a critical reading of primary scientific literature (adapted for classroom use as appropriate) and of media reports of science and discuss the validity and reliability of associated data, hypotheses, and conclusions.

Instruction as a "cascade of practices"

The *Framework* calls for students to routinely participate in extended science and engineering investigations that engage them in authentic practices while learning about disciplinary core ideas and making connections to the crosscutting concepts. Direct participation in scientific and engineering work will support students' science learning and the scientific literacy goals of the *Framework.* We argue that it will also help students understand specific career possibilities in the sciences and in engineering.

The practices do not operate in isolation, and we argue that part of giving students opportunities to participate in authentic scientific and engineering work is ensuring that they can experience firsthand the interrelatedness of these practices—as an unfolding and often overlapping sequence, or a cascade. For example, students may begin by learning about natural resources and posing a testable scientific question (practice 1) before designing a study and collecting data (practice 3), analyzing and interpreting those data (practice 4), developing a model (practice 2), and communicating important aspects of that model to an audience (practice 8). Many such permutations exist for sequencing and overlapping the practices during investigations, depending on the type of scientific or engineering investigation underway and the specific learning goals in question.

Promoting educational equity through practices

The focus on practices can also advance an educational equity agenda. There is often an artificial distinction made in science learning experiences between what counts as science and what is not science (Calabrese Barton 1998; Warren et al. 2003). Removing this barrier allows for learners to make connections between their lives and science and engineering and allows for diverse voices to be heard (Calabrese Barton 1998, p. 389). This is particularly important for the language-intensive practice of obtaining, evaluating, and communicating information. The *Framework* describes another instructional strategy: "Recognizing that language and discourse patterns vary across culturally diverse groups, researchers point to the importance of accepting, even encouraging, students' classroom use of informal or native language and familiar modes of interaction" (NRC 2012, p. 285). These inclusive instructional

strategies allow students to leverage what they know and participate in the workof science focused on community interests and practices.

Example 1 (Prekindergarten): Beginning a science research practice with our youngest students

Young children are curious about the world around them and readily engage in informal science throughout their everyday lives. The *Framework* calls for a significant focus on providing science learning opportunities in preschool and early elementary school, so it is important to consider how young students still learning to read and write can engage in the practices of science. Through a multiyear research collaboration with two prekindergarten classrooms, the team has developed an approach to science instruction that aligns to the vision in the *Framework* by incorporating students' science-related interests and experiences while engaging them in practices, developing an understanding of core ideas, and making connections to crosscutting concepts.

During a unit early in the school year, one teacher was reflecting on all of the questions her students had been asking about the natural world and their varied interests related to the unit. Realizing that she did not have enough time to address each student's individual questions, she came up with an activity that became known as "Research Day." Students were given classroom time to do their own research using relevant nonfiction books preselected by the teachers and the school librarian, and then they drew, dictated, and shared their research findings with their peers.

In a later unit about garden ecosystems, students asked many questions about insects and other living creatures found in a garden (e.g., aphids, bees, worms, spiders, etc.), so the teachers offered another Research Day. One student, Eleanor, was immediately attracted to a book with colorful illustrations of ladybugs in a garden. A teacher came over to read the text to her, and Eleanor, satisfied with her book selection, drew a detailed picture of a ladybug surrounded by aphids on her research paper. She then dictated information about ladybugs to be written on her paper by a teacher: "Sometimes ladybugs' food runs out, and there are not enough aphids to go around. The ladybugs gather in a swarm and fly off somewhere near to survive." Here, the teacher's support of the students' individual interests allowed Eleanor to find information that provided further evidence related to Core Idea LS2 (Ecosystems: Interactions, Energy, and Dynamics) in their garden ecosystems unit: Animals depend on their surroundings for survival.

All students were given time to look through books and document their newly learned information through drawings and dictations, just like Eleanor. At the end of Research Day, the students stood in front of the class to share their research papers with their peers, describing their drawings and explaining what they learned that day. Later, the teachers compiled the research papers into a book that was displayed in the classroom. Research Day was repeated during various units throughout the year, resulting in a collection of student research that was reviewed by the students and their parents.

Example 2 (Grade 5): Using public service announcements to communicate the science behind everyday health practices

The *Micros and Me* curriculum unit focuses students on the learning of microbiology by connecting it to personally and community-relevant health issues. We incorporate inquiry investigations, such as investigating the presence of beneficial microorganisms such as yeast, sampling for microorganisms in school, and conducting student-centered investigations about hand washing and "green" cleaning. The design has two goals: (1) making science personally consequential to students' lives, and (2) connecting authentic scientific practices and content deeply with students' everyday practices. Students learn about the characteristics of life such as reproduction (LS1.B) and the structure of plant and animal cells (LS1.A). While learning about growth of "micros" (bacteria, viruses, fungi), they learn that organisms have certain requirements for life (LS1.C).

One of the central innovations in the curriculum is a *self-documentation* technique (Tzou and Bell 2010) accompanied by community-based interviews conducted by the students to elicit students' family and community-based activities related to health and illness prevention. Self-documentation is a technique where, in this case, students were given digital cameras to take home for one night to document the activities in their lives related to an open-ended prompt. However, we have also used self-documentation in other contexts where students just record in a journal or on a worksheet the activities in their everyday lives related to a prompt.

In *Micros and Me,* students investigate the following prompt: "What are ways that you and your family/community stay healthy and keep from getting sick?" We argue that because non-Western customs and ways of thinking are typically marginalized in traditional school science curricula (Ballenger and Carpenter 2004), it is particularly important—when thinking about broadening participation in science—to find ways to connect a broader range of practices to important curricular goals in science education. In *Micros and Me*, the self-documented activities are connected to a student-led research project where students synthesize information from scientific investigations in the unit, self-document home and community activities, and conduct independent internet and library research on health issues found in their community to construct an evidence-based argument in the form of a *public service announcement*, several of which are displayed in the school and the local public library.

The goal of the public service announcement is threefold: (1) to validate and leverage students' everyday activities within the context of formal science instruction, (2) to give students practice unpacking and evaluating internet and book-based research sources, and (3) to engage students in communication of scientific ideas to a public audience of their choosing. Students are asked to choose a personally relevant health activity to research (e.g., managing asthma), find at least three sources about that activity, and construct a *convincing* public service announcement aimed at persuading their friends and families to take some type of action related to the activity in question. In a public service announcement poster about *E. coli,* written in crayon, we see evidence of the student communicating scientific information in the language that is appropriate to his peer audience. The student gives four examples for avoiding the contraction of *E. coli*: ordering well-cooked meat in a restaurant, not drinking water in lakes, drinking pasteurized juice, and washing hands after using the restroom. Finally,

the student translates this information into a list in Spanish on the left side of the poster since that language is prominent in his community. This example shows how empirical and research-focused activities can be integrated with high personal and community relevance by designing instruction to include the communication practice.

Example 3 (Grade 8): Evaluating and arguing with evidence in a classroom science debate

The third example comes from a curriculum intervention study conducted in an eighth-grade physical science classroom where the teacher made extensive use of computer learning environments to support students' science investigations (Linn and Hsi 2000). This example highlights how two scientific practices—"obtaining, evaluating, and communicating information" and "engaging in argument from evidence"—can be productively sequenced to support students' conceptual learning.

It can be very productive to view science classrooms as "scientific communities writ small" where students produce, share, debate, and refine knowledge in similar ways to how practicing scientists do it. In this unit, students evaluated disparate sources of information—from their classroom experiments, various web sources and advertisements, to their own life experiences—according to scientific criteria. They identified and evaluated this information as they prepared for a classroom debate. The goal of the classroom debate is to come to a group consensus about the topic as a "scientific community."

After conducting four weeks of experiments related to the properties of light embedded in Core Ideas PS4.B and PS4.C (e.g., light intensity over distance, how light travels through space from distant stars, reflection, absorption/energy conversion), students then engaged in an eight-day debate project as a culminating activity for the light unit. They evaluated a shared corpus of evidence, searched out new evidence on the internet, developed detailed written, evidence-based arguments, and engaged in two days of whole class debate about "How Far Does Light Go?" (Bell 2004).

Figure 1 shows the kind of written arguments students authored, for various pieces of evidence in the corpus, when they were given the sentence-starter "We think this supports the theory ____ because…." In addition to this "causal prompt" scaffold, students also reflected on multiple relevant criteria related to how well the evidence fits with scientific knowledge, whether appropriate methods were used, the trustworthiness of the source,

Figure 1. Two students who analyzed evidence from a shared corpus wrote this explanation
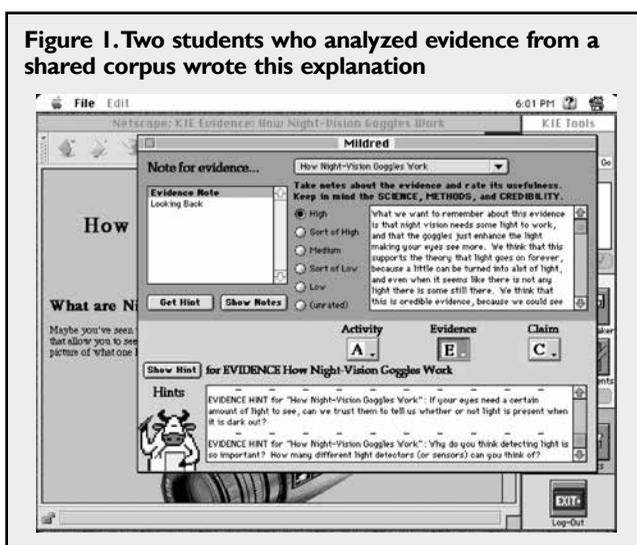
Figure 2. Two students using SenseMaker software constructed this argument to use in a classroom debate about the properties of light
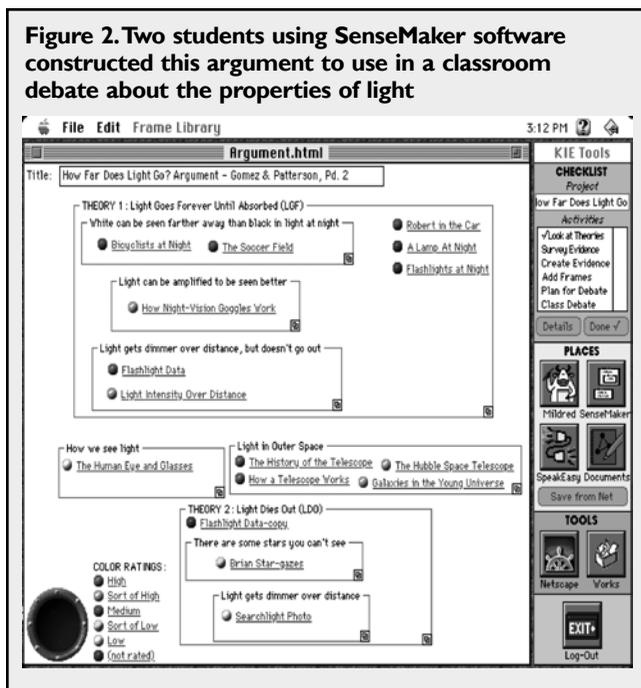
and the usefulness of the information for the debate topic. As shown in Figure 2, each pair of students created an argument map using a software tool called SenseMaker that related pieces of evidence (shown as dots) to conceptual claims (shown as boxes). These argument maps allowed for an easy comparison of students' ideas during the classroom debate. The transcript (Figure 3, opposite) highlights the kind of sense-making discussions that happened as students tried to develop a shared understanding of the physics of light.

Student 2 explains the decision to consider a certain phenomenon labeled "The Soccer Field" irrelevant, meaning that it doesn't provide any evidence that can be used to distinguish between the two alternative theories. Student 3 provides a different perspective, saying that the light is stopped at different distances, which leads student 2 to reconsider the evidence. This approach to drawing the relationships between theories and evidence allows for more focused questions to be posed to peers, and the detailed written arguments allowed students to share and refine their conceptual ideas at a deeper level (Figure 3).

Whole class sense-making conversations like this one were shown to support students' conceptual learning about light on cognitive assessments (Bell 2004). Students also developed epistemic knowledge that science is a social enterprise that progresses through the evaluation of evidence, systematic argumentation from evidence, and the collaborative debate of ideas (Bell and Linn 2002).

Example 4 (Grade 10): Communicating research investigations to scientists

This fourth example showcases the communicative practices of high school biology students who participated in contemporary infectious disease-related research. Students learned the biology behind why various pathogens make humans sick at the cellular level, as well as the science behind how and why infectious diseases are transmitted locally and globally. They learned ideas embedded in Core Idea LS1 (From Molecules to Organisms: Structures and Processes), such as cell structure and function related to the immune system, as well as ideas embedded in Core Idea LS4 (Biological Evolution: Unity and Diversity), such as viral evolution. Students had their choice of project: a local social network analysis in order to learn about

and apply constructs like herd immunity or a global epidemic modeling study in order to think about the various factors affecting the spread of infectious disease, such as seasonality and viral latency periods. As part of these projects, students read original research, communicated with scientists who conduct this type of research, and conducted their own research. Students developed products to communicate various aspects of their work to scientists and other health professionals, their teachers, and their peers. These products included: (a) a *research design plan*, (b) an *elevator speech*, and (c) an *original research paper*.

Once students selected a project, they designed a research study to conduct. Part of this involved reading published social network analysis studies involving infectious diseases or published global epidemic modeling studies (depending on students' project choice), reading background information on analysis and modeling tools, and reading background information on the disease(s) they wanted to use as a case study. Students then wrote their *research design plan* (see Figure 4, p. 88 for an example with expert feedback) where they developed the specifics of the study they wanted to conduct, including their testable question, their rationale(s) for posing that question, their hypothesis, their methods, and their thinking about how they would know if their data supported or refuted their hypothesis (and spoke to their testable question). Once students designed their studies, they forwarded their research plans to scientists and health professionals, who provided feedback (e.g., questions to ponder, challenges to students' thinking, resources to investigate, and lessons learned from their own research). Students then revised their plans based on the feedback and proceeded with their studies.

After students collected and analyzed their data, they wrote *elevator speeches* (Figure 5, p. 88) in which they clearly and succinctly explained the details of their study, including their preliminary findings. They received feedback on the text of their speeches from peers, and they then revised their speeches in preparation for a two-minute presentation to scientists and health professionals. Students answered questions based on their research and the ideas they learned in class.

Figure 3. Example 3, transcript segment

[Student 1]

Why did you put *The Soccer Field* in **Irrelevant**?

[Student 2, presenting to the class]

I put *The Soccer Field* in **Irrelevant** because . . . oh yeah—because it was the one with the flashlight and they held the light back and then the light from the car—like headlights they—it went further so it didn't—I don't think it really made a difference. Or I don't think it really supported either theory because it did go a long ways, but the light intensity wasn't as strong.

[Student 3]

For *The Soccer Field,* doesn't that kind of prove how far light keeps going if it keeps showing as its—as [the guy] keeps moving back and the light—light gets stopped like a reflection or would it stop that light because <UNCLEAR>.

[Student 2]

Well, I don't think it really supports either theory because I know that the light is still there, and it's being absorbed and it's spreading out so much that you can't see it, but the light energy is still there.

Figure 4. A sample research design plan with feedback from a scientist

3. Describe the global transmission modeling study of influenza you plan to complete. [HINT: What are you interested in investigating? This can change once you become more familiar

We are interested in investigating the differences in infection rates of influenza based on a few predefined variables such as transmission rate or ability to travel by plane and car.

> 5/15/11 10:53 PM
> **Comment [1]:** Good questions

4. What is your group's initial research question related to influenza and how it is transmitted globally?

The first question we plan to ask is what effect comes of decreasing the amount of airline travel once the disease begins. The second question we want to ask is if we increased the amount of time a disease is infectious, what effect will come concerning the spread speed of said disease.

5. What is your group's initial hypothesis? What do you think you will find?

> 5/15/11 10:54 PM
> **Comment [2]:** Both questions are well posed and can be implemented within

We feel that decreasing air travel will decrement the speed at which the virus spreads, but maybe not too much. This hypothesis comes from the multifarious ways that disease can be spread. Decreasing airline travel may seem like a good idea, but there is still sea and land travel that will allow the disease to spread. Also, we feel that as we increase the

> 5/15/11 11:03 PM
> **Comment [3]:** Very good research hyptheses.

Figure 5. An elevator speech summarizing a social network analysis study

We work together to use social network analysis to study how a disease spreads through a population. Our research question is, "Can we find certain 'hotspot' people who we can immunize in order to prevent the spread of disease and prevent an epidemic?" Right now, we have found that we can definitely isolate certain people whom we can immunize to shut down the social network system and make it harder for the disease to spread from person to person. These people who have the highest betweenness centrality and who are the most connected to everyone else.

After receiving this additional feedback on their research, students wrote an original mini-research paper in which they fused aspects of their research design plan with their data analysis. They drafted findings and crafted evidence-based arguments to make claims related to their research questions. These claims were undergirded by their data and analyses of those data. These mini-research papers were peer-reviewed and published online so that others ranging from teachers to peers to parents to others in the community could read about their work.

Conclusions

We hope this article can open up a discussion with science educators in all areas of the system—from K–12 schools to informal science institutions and afterschool learning environments—about the varied ways to provide opportunities for young people to obtain, evaluate, and communicate information in science and engineering. Substantial acts of reading, writing, and otherwise communicating should be embedded in students' science and engineering investigations. As described in the *Framework*, this supports important cognitive and social learning processes, it helps accomplish the ambitious learning goals outlined in the *Framework*, and it also allows related learning goals to be focused on (e.g., those outlined in the *Common Core State Standards* in mathematics and English language arts—science and technology). For these

reasons, it is an ideal time to engage youth in practices related to obtaining, evaluating, and communicating scientific and engineering-related information.

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National Science Teachers Association

"Science, engineering, and technology permeate nearly every facet of modern life, and they also hold the key to meeting many of humanity's most pressing current and future challenges. Yet too few U.S. workers have strong backgrounds in these fields, and many people lack even fundamental knowledge of them. This national trend has created a widespread call for a new approach to K–12 science education in the United States."

—From the Summary of *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*

A Framework for K–12 Science Education provides a broad set of learning expectations for students as they study science and engineering throughout the K–12 years. The *Framework* guides the writers of the *Next Generation Science Standards (NGSS)*; will influence curriculum, assessment, and teacher professional development decisions for years to come; and ultimately will help inspire new generations of science and engineering professionals and scientifically literate citizens.

The handy *Reader's Guide* unpacks the three key dimensions of the *Framework*—scientific and engineering practices, crosscutting concepts, and core ideas in each specific discipline—allowing teachers, administrators, curriculum developers, university professors, and others to more easily grasp how the *NGSS* differ from previous standards. Harold Pratt, a career science educator who was deeply involved in the development of the *National Science Education Standards*, offers the following for each chapter of the *Framework:*

• An overview with a brief synopsis of key ideas
• An analysis of what is similar to and what is different from the *NSES*
• A suggested action to help readers understand and start preparing for the *NGSS*

This second edition includes 10 essays by key leaders in science education, each further explaining the *Framework*. Along with discussions on topics such as scientific and engineering practices, engineering and technology core ideas, and connections in math, new essays examine the *NGSS* in relation to life, physical, and Earth and space science.

This primer is a critical companion to the *Framework* for science educators nationwide as they incorporate the *NGSS* into their teaching of science and engineering.