Research overwhelmingly supports the use of inquiry in the classroom (see Resources), so why isn't everyone using it? One of the biggest challenges to the more widespread use of inquiry is the difficulty teachers have in identifying appropriate activities. Selecting inquiry resources is a difficult task for at least two reasons. First, it is likely that many teachers in schools today have had little opportunity to study or practice the inquiry process, especially those teaching in general fields or out of field. Second, many teachers feel that there are many facets to the inquiry process and that remembering all of them is difficult. A succinct but comprehensive tool is needed to evaluate inquiry materials.

In 1999, the Council of State Science Supervisors began an initiative called Networking for Leadership, Inquiry and Systemic Thinking, or NLIST. Funded by NASA, a group of leading science educators from across the country convened to design a systemic plan to facilitate inquiry in science teaching on a national scale. As a first step, NLIST produced a definition of "science as inquiry," based upon the short descriptions of inquiry found in the National Science Education Standards (NSES), which were in turn built upon current ideas and research from within the science education discipline. After months of work reviewing and synthesizing current literature with the NSES and the work of Project 2061, this definition of inquiry was established:

Inquiry is the process scientists use to build an understanding of the natural world. Students can learn about the world using inquiry. Although students rarely dis-
cover knowledge that is new to humankind, current research indicates that students engaged in inquiry build knowledge new to themselves.

Student inquiry is a multi-faceted activity that involves making observations; posing questions; examining multiple sources of information to see what is already known; planning investigations; reviewing what is already known in light of the student's experimental evidence; using tools to gather, analyze and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.

As a result of participating in inquiries, learners will increase their understanding of the science subject matter investigated, gain an understanding of how scientists study the natural world, develop the ability to conduct investigations, and develop the habits of mind associated with science.

The next step was to construct a rubric that educators could use to evaluate instructional materials according to the principles of inquiry laid out in the Definition of Inquiry. The result was the Rubric for Evaluating Essential Features of Classroom Inquiry in Instructional Materials. Due to its grounding in the Standards, the rubric reflects the spirit of inquiry as expressed by the NSES.

Understanding the Rubric
From the beginning, this Rubric was visualized as an online product to be widely shared among science educators. According to the Definition, science as inquiry provides four learning outcomes for students: content knowledge, understanding of how scientists work, ability to conduct investigations, and habits of mind associated with science. The four sections of the Rubric are based upon these four outcomes. Each section contains descriptors, or characteristics, that materials should have in order to support learners as they work toward these outcomes (see page 24).

The first section, Section A, deals with content. If an instructional resource fails to address relevant science content, then it is of little use, regardless of its strength in the area of inquiry. The three descriptors in Section A assure that content aligns with applicable standards, that the material provides adequate opportunity for learners to develop content knowledge, and that content is accurate.

Secondly, the Definition of Inquiry holds that learners should understand how scientists conduct their work. This understanding gives students an overview of the inquiry process, and context for interpreting the many research studies that are presented and misrepresented in the press. For example, through understanding the nature of experimentation, students should understand that science rarely establishes the cause of phenomena, but that through observation and experimentation two types of phenomena can be found to be closely related or dependent in part upon one another. Section B of the Rubric explores how well a material provides opportunities for learners to understand that science is based upon questions, and that different questions lead to different kinds of investigations; and that scientists use tools, mathematics, evidence, logic, communication, and collaboration in the inquiry process.

Section C of the Rubric establishes that an inquiry activity should provide opportunities for students to conduct investigations themselves. The five subsections here, with their descriptors, provide a framework of the inquiry process, encouraging students to participate in each step of an investigation and to acquire the related skills.

Finally, Section D deals with ways of thinking, or "habits of mind," that should accompany and result from the inquiry process. This section provides descriptions of how a material might promote skepticism, openness (the flexibility to consider new explanations although an opinion may have already been formed), curiosity, and honesty (emphasizing that conclusions must be based upon evidence). Without these four habits of mind, an instructional material fails to tap the power of inquiry-based learning. Other habits of mind, such as creativity, are also associated with science as inquiry, but these four characteristics leant themselves to description in this rubric.

Four variations are provided for each descriptor, ranging from I (little or no alignment with the Definition) to IV (reflecting a high level of independent inquiry immersion for learners). A full-scale inquiry project, such as an advanced science fair project conducted independently by a student, will reflect Variation III's or IV's on each descriptor. However, it is unlikely that all material will align with Variation IV on each descriptor. For example, Mrs. Smith plans for her seventh grade students to practice their skills of observation within the context of an inquiry and may wish to select an activity that aligns strongly with Variation III or IV in the C2 and C3 areas of the Rubric.

Further, it is important to acknowledge that the Level Variation IV's for the entire Rubric represent an ideal accumulation of inquiry skills that instructional materials might facilitate. The levels that run across any particular descriptor are not
Rubric for assessing instructional materials

A. Increase their understanding of the science subject matter investigated
A1. Content
A1a. The material provides content aligned with national, state, or local standards.
A1b. The material provides opportunity to develop enduring understanding of subject matter content.
A1c. The material contains accurate content.

B. Gain an understanding of how scientists study the natural world
B1. Understanding of how scientists work
B1a. The material provides an opportunity to learn how different kinds of questions based on prior scientific knowledge suggest different kinds of investigations.
B1b. The material provides an opportunity to learn that scientists conduct investigation for a variety of reasons.
B1c. The material provides an opportunity to learn that scientists use a variety of tools, technology, and methods to extend the senses.
B1d. The material provides an opportunity to learn that mathematics is essential in scientific inquiry.
B1e. The material provides an opportunity to learn that scientists use evidence, logic, and current scientific knowledge to propose explanations.
B1f. The material provides an opportunity to learn that scientists collaborate and communicate with each other in a variety of ways to reach well-accepted explanations.

C. Develop the ability to conduct investigations
C1. Posing scientifically oriented questions
C1a. The material provides an opportunity to ask questions that can be answered through scientific investigations.
C2. Designing and conducting investigations
C2a. The material engages learners in planning investigations to gather evidence in response to questions.
C2b. The material engages learners in conducting the investigation.
C2c. The material engages learners in the use of analytical skills.
C3. Proposing answers
C3a. The material engages learners in proposing answers and explanations to questions.
C4. Comparing explanations with current scientific knowledge
C4a. The material engages learners in the consideration of alternative explanations.
C4b. The material engages learners in linking explanations with scientific knowledge.
C5. Communicating and justifying results
C5a. The material engages learners in communication of scientific procedures and explanations.
C5b. The material engages learners in appropriately responding to critical comments.
C5c. The material engages learners in raising additional questions.

D. Develop the habits of mind associated with science
D1a. The material promotes the questioning of assumptions (skepticism).
D1b. The material presents science as open and subject to modification based on communication of new knowledge and methods (openness).
D1c. The material promotes longing to know and understand (curiosity).
D1d. The material promotes respect for data (honesty).
intended to represent a seamless continuum or developmental level for a particular grade level, but the degree of alignment at which instructional materials models a particular facet of science as inquiry. One particular strength of this rubric is that each of the Variations presents concrete strategic ideas about how a material can help learners develop their inquiry skills. For example, if Mr. Brown wants his eighth grade students to develop their ability to ask questions, and he knows that they are typically able to take a general question and sharpen it so that it is then suitable for investigation (C1a, Level Variation II), then he might select an activity that allows an opportunity to select a question from a provided list, or to propose questions of their own (C1a, Level Variation III).

A Rubric descriptor for inquiry is provided on page 24. The full Rubric can be found at www.inquiryscience.com/inquiry/resources/samplerubric.htm. Although the Rubric is still undergoing reliability testing and final editing, NLIST welcomes teachers, media specialists, curriculum directors, and administrators to use the Rubric.

Applying the Rubric
An educator in any position who has limited knowledge of inquiry may use the Rubric’s list of descriptors to develop an understanding of the desired characteristics of inquiry materials. Educators who need to learn more about inquiry include administrators, media specialists, policy makers, and developers of educational materials, in addition to teachers themselves.

Another need that most educators have is the implementation of standards. Because this Rubric is based upon national standards, it will help teachers select materials that will meet standards. Further, teachers desiring to focus on specific inquiry skills (such as observation in the case of Mrs. Smith above) may use the Rubric to identify materials that emphasize that particular skill.

A third application is the formal selection or adoption of educational materials, such as textbooks or online resources. Although applying the Rubric to a textbook or website as a whole would be difficult because it is designed for evaluating a single inquiry activity, the principles it contains can be used to ensure that the spirit of inquiry is carried at least on a general level if not in every single activity.

Finally, anyone who develops science materials, such as software designers, textbook authors, and teachers, may use the Rubric to identify the characteristics needed for inquiry materials and enrich existing materials to make them more inquiry-friendly.

Summary
In the face of today’s information explosion, students must acquire the ability to conduct disciplined inquiries based on their own questions. It is no longer possible for educated adults to know everything about a topic, but it is essential that they know how to discover answers to questions that are relevant in their personal and professional lives. Scientific inquiry is one essential tool for discovering answers. With this overarching goal in mind, the Council of State Science Supervisors, in conjunction with funding from NASA, has outlined the NLIST systemic vision, which is generating products to help increase the effectiveness of all the elements in the educational system. The Rubric is a product that can help bring the NLIST vision to life.

In the months to come, the next phase of NLIST will generate a plan for the professional development of educators as related to science inquiry. Be sure to visit www.inquiryscience.com/inquiry/resources/resources.htm to keep abreast of these products as they become available.

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Resources
Inquiry has been shown to

- increase comprehension and achievement in science,
- foster the development of thinking skills,
- improve students ability to make observations
- improve students’ attitudes toward science, and
- promote scientific literacy.

Below is a collection of selected research that supports the use of inquiry in the classroom and describes barriers to its implementation.


