

NARST NEWS

NATIONAL ASSOCIATION
FOR RESEARCH
IN SCIENCE TEACHING

*Organized to
improve science teaching
through research*

Lawrence C. Scharmann, Editor
Center for Science Education
Kansas State University, Manhattan, KS

Volume 34 (1) March, 1992

PRESIDENT'S COLUMN

Russell H. Yeany

THE CANYON IN THE COMMONS

Once upon a time, there were two cousins, one named Qual and the other called Quant. Qual, the younger of the two cousins, viewed the world in what one would label as descriptive and narrative terms. While, Quant perceived the world in more mathematical or numerical terms. Together they were able to interpret the events and issues in their lives with great understanding. They were looked to as a source of explanations about how and why things worked. They were the source of all the understanding in the community.

Then one day a small crevice appeared in the commons area of the community. Qual and Quant were called upon to examine and explain the occurrence. Quant measured and calculated while Qual observed and recorded the process. As Qual stood on one side and Quant on the other, the crevice grew wider. They observed, described and recorded, and measured, timed and calculated the event. All the townspeople waited for the two cousins to provide an explanation of what was happening. Half of them stood on one side with the remaining half on the other. Everyone felt satisfied that Qual and Quant together would help them to understand the origin and significance of the rapidly widening crevice.

After a time, the separation and distance between the cousins was so great that they could not communicate! Nevertheless, each carried on with their tasks using their individual approach to the problem. After a time, they drew back from the two edges of the crevice which was by now a great canyon isolating the two halves of the community. Each cousin began to ponder the cause and significance of the event they had just witnessed. Half of the townspeople gathered around each cousin with anxious and eager expectations. But, neither Qual nor Quant could reach a satisfactory explanation. Each felt frustrated in their attempts to reach an understanding. Neither felt confident enough to attempt to provide an interpretation to the townspeople. Each realized that they alone could not provide an explanation of the event. Each felt a critical need for the other's input.

The townspeople sensed the problem and decided that they needed to devise a means to get Quant and Qual together. They began to build a bridge across the new canyon. Much time passed and many attempts at bridging the gap failed. Each side held meetings to discuss the situation. Some argued that, without a bridge, we will never again understand our world. Others argued that it was impossible to build a bridge and that they would simply understand the world within limiting constraints of either cousin's way of understanding. Some even concluded that the two cousins were better off being separated and, that the one on the other side didn't really contribute to the understanding anyway.

Life continued on each side of the canyon. What had once been a single community with townspeople who had a rich and whole understanding of life as provided through Quant and Qual was now two distinct communities whose members had limited perspectives provided by one or the other of the cousins. All activities on either side of the canyon ran parallel to activities on the other side; but none crossed over. After a time, Quant and Qual became more confident in their own ability to provide understanding to their communities. Each began to dismiss the importance of the other's way of gaining this understanding. Each community named their town Right and the community on the other side of the canyon Wrong.

Many years passed and Quant and Qual grew old. In their old age, each began to develop a desire to make contact with the other. Finally, each cousin bid farewell to their townspeople and began a long journey around the canyon to the almost forgotten community on the far side. With great surprise but immediate joy, they met at the mid point of their journeys. They had conquered the canyon that had separated them for too long.

Qual and Quant spent much time rejoining their perspectives and ways of interpreting issues and events. They each became whole in their understanding of these issues and events. They talked of how they now knew that they had failed to provide a rich and whole understanding for the townspeople of their respective communities. They lamented the failed attempts to build a bridge. And, they cried.

FROM THE JRST EDITOR

TWO SPECIAL ISSUES OF JRST SLATED

Call for Papers Announced

Issue One

Special Issue of the *Journal of Research in Science Teaching* on: Teaching and Learning Biological Evolution. Editors: Catherine Cummins, Sherry Demastes, Mark Hafner

The teaching of evolution is a controversial and difficult task, but evolution is the unifying theme of biology. This special issue will deal with current research and theory in the teaching and learning of evolution. Topics can include, but are not limited to:

1. Alternative conceptions.
2. Successful teaching strategies.
3. The study of student's evolutionary conceptual frameworks.

AAAS's *Project 2061* and the National Research Council's *Fulfilling the Promise* both stress the importance of evolution as a central theme in science education reform. As Dobzhansky (1973) has said, no biological phenomenon makes sense unless viewed in the light of evolution. The issue does not seek to repeat works answering creationist arguments such as those produced by NSTA and the National Academy of Sciences. We will welcome papers representing a diversity of research methods.

Time Line

Manuscripts Due:	December 1, 1992
Reviews Returned:	February 15, 1993
Revisions Due:	March 31, 1993
Publication Date:	Early 1994

Send manuscripts to: Dr. James H. Wandersee, Associate Editor, *Journal of Research in Science Teaching*, 223-F Peabody, Louisiana State University, Baton Rouge, LA 70803.

Issue Two

Special Issue of the *Journal of Research in Science Teaching* on: Reading, Writing, and Science Understanding. Editors: Larry D. Yore, William G. Holliday, and Donna E. Alvermann

Focus

Learning science through the activities of science reading

and writing calls for a complex, interrelated process of meaning making and problem solving rather than a simplistic, unidirectional process of meaning taking and rote recitation. This 1994 Special Issue of *JRST* is intended to stimulate collaborative, interdisciplinary inquiries that will contribute to a better understanding of how print-based language arts (reading and writing) influence science learning. This early call for papers is provided to encourage researchers to conduct investigations targeted specifically for this 1994 special issue.

Possible Topics

1. Relationships between metacognition and cognition involving the print-based language arts and the sciences.
2. Conceptual change, composition, and comprehension in science.
3. Problem solving, reading, and writing in science.
4. Effective use of text-processing and text-production in the science classroom.
5. Enhancement projects directed toward improving scientific literacy that include the print-based language arts.
6. Comprehension or composition instruction in science.

Time Line

Manuscripts Due:	March 31, 1993
Reviews Returned:	May 21, 1993
Revisions Due:	August 31, 1993

Manuscripts should be limited to about 30 double-spaced, typed pages including tables, figures and references. Other information for contributors can be found on the inside back cover of *JRST* or it can be obtained from the *JRST* Editorial Office Secretary, 223-E Peabody, Louisiana State University, Baton Rouge, LA 70803. Six (6) copies of each manuscript should be submitted to Special Issue Editor, Dr. Larry Yore, Department of Social and Natural Sciences, University of Victoria, Box 3010, Victoria, BC V8W 3N4, CANADA.

ANNOUNCEMENTS

USE NARST MONOGRAPHS FOR CLASSROOM INSTRUCTION SAYS TOBIN

The two most recent NARST monographs numbers 3 and 4, make excellent textbooks for graduate level classes. The monograph written by William Cobern (*World View Theory and Science Education Research*) examines the implications for science teaching of world view. I used the text in a summer class containing high school teachers, full-time masters degree students, and doctoral students in mathematics and science. The content of the book provided students with a

theoretical framework for examining what happens in science classrooms.

The interpretive research monograph edited by James Gallagher (*Interpretive Research in Science Education*) also provided students with excellent materials from which they could advance their understandings of interpretive research. We have used the monograph as a text in both a doctoral level course and one at the masters degree level. Teachers wanting to plan their own classroom research will find the monograph useful.

Copies of each monograph are available from the Executive Secretary, Dr. John Staver, (Address on back cover).

INSTRUCTIONAL MATERIAL IN THE HISTORY & PHILOSOPHY OF SCIENCE AND SCIENCE TEACHING AVAILABLE

The journals and conference proceedings produced in conjunction with the International Conference *The History and Philosophy of Science in Science Education*, held in Tallahassee, Florida in 1989, make excellent texts for courses in the history and philosophy of science and science teaching. The readings are particularly useful for graduate level courses. The following materials are still available at the following costs:

- | | |
|--|---------|
| 1. Interchange, vol 20. | \$10.00 |
| 2. Synthese, vol 80. | \$10.00 |
| 3. Studies in the Philosophy of Education, vol. 10. | \$10.00 |
| 4. Science Education, vol 74 | \$10.00 |
| 5. The History and Philosophy of Science in Science Teaching, vol. 1. (358 p) | \$15.00 |
| 6. More History and Philosophy of Science in Science Teaching, vol. 2. (404 p) | \$15.00 |

All six publications can be obtained for a package cost of \$55.00.

Send a check made payable to Florida State University to:

Kenneth Tobin
203 Milton Carothers Hall
Florida State University
Tallahassee, FL 32306

Information about the Second International History, Philosophy and Science Teaching Conference (May 11-15, 1992) can be obtained from:

Skip Hills
Faculty of Education
Queen's University
Kingston, Ontario
CANADA K7L 3N6

STS Series in *Theory Into Practice*

Theory Into Practice, the education journal published by the Ohio State University College of Education, has recently completed two special issues that may be of interest to NARST members.

Science-technology-society (STS) is the topic of a series of two thematic issues of the education journal, *Theory Into Practice*. The first of the two issues, dated Autumn 1991, focuses on STS "challenges" and is available now. The second of the series, dated Winter 1992, will focus on STS "opportunities" and is scheduled for publication in February.

Guest edited by M. Eugene Gilliom, Stanley Helgeson, and Karen Zuga, the two-part series explores the role of the schools in developing in students an understanding of the relationships among science, technology, and society. In the first issue, the authors review the historical antecedents of this emerging field, consider how various disciplines can contribute to its study, and discuss factors influencing the teaching of STS. Articles in the second issue examine the opportunities for new initiatives created by the need to work across traditional boundaries. Both issues offer critiques of current trends and reflect the complexity involved in the development of this curriculum area.

Copies (\$6.00 each) may be ordered from the College of Education Business Office, 174 Arps Hall, 1945 N. High Street, Columbus, OH 43210.

NARST Membership Renewal/Application Form 1992

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Research Interests (List up to three codes from the list of research interests below):

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- | | | |
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| 01 affective factors | 11 middle school science education | 21 teacher knowledge and beliefs |
| 02 alternative frameworks | 12 physics education | 22 Other _____ |
| 03 biology education | 13 policy issues | |
| 04 chemistry education | 14 problem solving | |
| 05 conceptual change | 15 quantitative methods | |
| 06 elementary science education | 16 science curriculum | |
| 07 equity issues | 17 science learning | |
| 08 gender issues | 18 science teacher education | |
| 09 geology education | 19 science teaching | |
| 10 interpretive methods | 20 secondary science education | |

Research Matters - to the Science Teacher

A Guide to Assessing, Selecting, and Using Science Textbook Visuals

William G. Holliday, University of Maryland, Center for Science Education, College Park, MD

Science learning materials rely heavily on visuals to communicate important information to students trying to understand complicated ideas and solve difficult problems. Thus it's important for teachers to select materials--including but not limited to textbooks--that contain effective visuals and, in turn, to use them effectively.

Line drawings, diagrams and photographs can elaborate, clarify, and make memorable the text that they accompany (1, 3, 6, & 7). This visual type is called iconic because the spatial relations depicted in these two-dimensional visuals represent many of the actual spatial realities of concrete three-dimensional things, for example, a physical object's position, orientation, shape, and size. Typical examples appear in some middle school-earth science textbooks to show how glaciers formed. Such line drawings illustrate glaciation by showing V-shaped valleys that fill with ice and snow and form glaciers, which carve out land and produce today's U-shaped glaciated valleys.

Illustrations showing the glaciation process accenting important relevant visual characteristics capture for students the method by which glaciers produced some of today's mountainous landscapes. Adjacent to the illustration is a prose description of important abstract points--including a discussion of how ice, water, and rock combine with gravity and friction to sculpt. This description includes definitions of terms and explains some of the implicit abstractions suggested in the visual. Thus, the two text media complement one another (2).

A second useful type of illustration found in textbooks and elsewhere is called schematic. Schematic visuals function as summarizers of information, whereby essential concepts are presented in a quickly read format (4). For example, diagrams can be a powerful tool for summarizing the relationships between photosynthesis and respiration. These two related concepts contain numerous difficult-to-learn biochemical cycles--information that students must disentangle, segregate, group and compare. Research and classroom experience suggest that students who learn such cycles from diagrams rather than from prose do better on some school tests (9).

Tables and charts, too, are powerful summarizers of important information (4 & 5). Consider, for instance, the periodic table which is used as a unifying theme in some chemistry textbooks. Tables and charts are also useful summarizers of information not central to author's purposes, freeing additional textbook space for adequate explanations of truly important concepts. A good example is the one-page table found in chapter one

of the nation's best-selling school text, *Modern Biology*, which lists the names and accomplishments of 20 major "contributors to biological knowledge." In earlier versions, the authors ramble on, page after page, using up valuable space. This technique of boxing information can be used to convince recalcitrant buyers that their favorite material has been covered while providing greater text space to explain other information of central importance (8).

Some Characteristics and Uses of Effective Visuals

Because visuals are so important, their selection is also important. The following 18 characteristics and uses of effective visuals are presented for science teachers' use in selecting, assessing, and using science textbook visuals including iconic (such as line drawings and photographs of objects), schematic (such as flow charts and circuit drawings), and additional summarizing visual types (such as tables and charts).

These 18 statements about visuals are presented with questions and are derived from often-cited research studies. Each is supported by three research references in order of apparent value. The page number(s) are given for easy reference. Each question contains an example found in some middle and senior high school science textbooks.

Good Textbook Visuals:

1. *Portray Accurate Spatial Relations.* Do the visuals portray accurate and realistic spatial relations (e.g., the earth and sun's relative sizes and separating distances) among illustrated objects and their parts? (8, p. 75; 2, p. 641; 7 p. 725; 6, p. 61)
2. *Don't Distract Students' Attention.* Do visuals (e.g., colorful photographs not directly related to the science of the textbook) distract students who are unclear about what should be learned? (8, p. 108, p. 118, p. 172; 1, p. 129; 6, p. 107)
3. *Are Appealing to Students.* Do visuals (e.g., photos of erupting volcanos) add to a textbook's appeal or attractiveness without adding unreasonable publication costs? (1, p. 127; 8, p. 24, p. 130)
4. *Spark Interest Curiosity and Inquiry Attitudes.* Are selected visuals (e.g., photographs of inquisitive and enthusiastic chemists working in their laboratory) designed to spark interest, curiosity and inquiry attitudes without interfering with learning tasks central to the teacher's goals? (8, p. 26, p. 119, p. 122; 2, p. 660)
5. *Relate to the Science.* Are the visuals (e.g., large photos of amusement park rides with no apparent connection to the science described in the textbook) necessary and relevant to higher-order learning, or are they merely flashy devices used to sell science textbooks? (8, p. 73, p. 74, p. 124; 6, p. 107)
6. *Illustrate Difficult-to-Image Information.* Do the visuals illustrate some information (e.g., drawings representing stages of glaciation) that is very difficult to describe using just

sentences? (2, p. 650; 8, p. 119; p. 160; 2, p. 651, p. 657)

7. *Highlight, Reintegrate, Reinforce and Rehearse*. Are the visuals (e.g., schematic drawings of nitrogen and oxygen biological cycles) highlighting, reiterating, reinforcing and helping student rehearse important information for easier learning? (8, p. 126, p. 129; 2, p. 657; 6, p. 122)

8. *Focus Students' Attention*. Are questions and other adjunct learning aids (e.g., arrows illustrating the flow of fluids around airplane wings) used to selectively focus students' attention on important information (e.g., temperature and heat of water changing energy states)? (4, p. 523; 5; 8, p. 135)

9. *Summarize and Contrast Information*. Do selected visuals used to help students summarize information (names and historical contributions made by scientists), segregate and compare contrasting points of view (e.g., Lamarck and Darwin's conceptions of how evolution works) and discriminate between highly similar yet different concepts (e.g., differing kinds of vertebrate hearts)? (8, p. 185; 2, p. 666; 7, p. 715)

10. *Customize Visuals*. Are the visuals (e.g., contrasting vascular and non vascular plants) designed according to the goals of the authors--for example, using drawings to highlight structures, photographs to provide a sense of realism, and charts to compare two sets of variables? (6, p. 13; 8, p. 173; 7, p. 715; 9, p. 384)

11. *Reference Visuals in Text*. Are the visuals (e.g., charts describing properties of mixtures) reasonably juxtaposed to relevant text and referenced in the science textbook for easy location? (2, p. 650, p. 651; 6, p. 107)

12. *Help Students Remember*. Are important objects (e.g., the human ear--see 6, p. 72-75) and their parts used to illustrate and increase the chances of students remembering the concrete concepts and subsequently solving problems in their working or short-term memories? (8, p. 88, p. 176; 2, p. 653)

13. *Help Students Organize Information*. Are visuals (e.g., end-of-chapter summarizing diagrams) used to help students organize and learn important information presented in the text (8, p. 192; 2, p. 660; 7, p. 725)

14. *Help Low-ability Students*. Do selected visuals (e.g., drawing of mechanical systems, drawings of concrete objects adjacent to their verbal labels) help students with low-spatial or verbal abilities by providing compensating illustrated information? (8, p. 135, p. 169; 2, p. 658, p. 665)

15. *Help High-ability Students*. Do selected visuals (e.g., drawings of growth hormones differentially placed on vascular plant stems) help students with high-spatial or verbal abilities by providing them with opportunities to capitalize on their exceptional perceptual and learning abilities? (i, p. 137, p. 181; 2, p. 658)

16. *Understand Graphic Conventions*. Do the visuals contain reasonable graphic conventions (e.g., shadings illustrating motions, left-to-right and top-to-bottom orientation patterns used in circuit diagrams) that are familiar to the students? (i, p. 74, p. 142, p. 161; 2, p. 653)

17. *Place Visuals in Textbook*. Do visuals (e.g., pulley systems) and their placement specifically facilitate readers'

eye movements alternating between reading the text and inspecting the accompanying visual, resulting in increased chances of comprehension? (2, p. 652; 8, p. 130; 3, p. 13)

18. *Orchestrate Textbook Visuals*. Are selected visuals (e.g., drawings, photographs and texts describing the movement of blood through the heart) orchestrated in combination and used to present selected important concepts increasing students' chances of higher-order learning? (8, p. 118, p. 140; 2, p. 648, p. 652; 7, p. 725)

More To Learn?

Readers interested in learning additional technical information about visual learning research are encouraged to read the reviews and original works cited in the references.

Remember, there are no magic formulas or panaceas concerning the selection and use of instructional visuals.

William G. Holliday is Professor of Curriculum and Instruction at the University of Maryland at College Park.

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Research Matters - to the Science Teacher

Creating a Multicultural Learning Environment In Science Classrooms

Alejandro J. Gallard, Science Education, Florida State University, Tallahassee, FL 32306

Introduction

Most science teachers do not need to be reminded that creating a learning environment for today's science students is an increasingly complex problem. We are faced with dramatic changes in student demographics. As an example, *Newsweek* (1991) reported that:

... more than 5 million children of immigrants are expected to enter US public schools during the 1990s. About 3.5 million schoolchildren are from homes where English is not the first language. More than 150 languages are represented in schools nationwide. (p. 57)

The wide assortment of languages, customs and experiences, associated with today's immigration movement, are very different from what has been experienced in past like movements. Yesterday's immigrants were European and constituted a large part of the minority population in the US. For these immigrants the teaching styles, images in textbooks, teachers and schools encountered in the US were extensions of those which characterized their homelands. In contrast, today's immigrants emanate from such places as the Caribbean, Latin America, Mideast and Southeast Asia. For these people, the traditional images associated with education differ markedly from those which apply to white, European, cultures. However, the images encountered in present classrooms derive from white, European traditions (Beane, 1988). Because the present anthropological, linguistic and sociological context is so diverse, it becomes vital for science teachers to address the different languages, customs, and experiences (multiperspectives) that students bring to science classrooms.

The multiperspective change our classrooms' populations have undergone have a substantial impact on science teachers striving to create a classroom environment in which all students can learn. According to Tobin (1991) learning in science:

... is regarded as an interpretive process of making sense of experiences in terms of extant knowledge. The heart of the learning process is the negotiation of meaning. Learners must be given opportunities to make sense of what is learned by negotiating meaning; comparing what is known to new experiences, and resolving discrepancies between what is known and what seems to be implied by new experiences.

Therefore, learning is a result of students making sense of the world they live in. This process is complicated if a student's basis for making sense is radically different from how others in the classroom are making sense. For instance, a Caucasian, middle class American student and a Hispanic migrant student may read the same textual information on plants. Because of the Caucasian's experiences, he may focus on plants as aesthetics extensions of his home or school when constructing meaning. On the other hand, the migrant Hispanic student will interpret the information in light of his fieldwork experience. In both instances construction is correct because it has been determined by the learners' cultural context. However, the Caucasian's efforts at making sense may more closely resemble what a science teacher who has not had any fieldwork experience may consider as correct responses. This includes the languages that both students use to make sense and as they communicate what they have learned to others as well. The implication is that students need to work in a classroom environment that enables and encourages them to use their cultural tools. These tools include language, cognitive referents which include myths, personal beliefs and metaphors, images, preferred learning styles, and the time and space to apply extant knowledge to problem-solving situations.

It is important for us as science teachers to realize that a student's knowledge is a result of her/him interacting and making sense of the culture in which she/he lives. Even though students have immigrated to the US, their cultural experiences are an important component of this extant knowledge. Thus, it becomes incumbent on us as science teachers to find ways that students may use their knowledge, or views of the world, in ways that draw on their prior cultural experiences. Staying with our example of a student with fieldwork experience we could have him share with his classmates his knowledge about plants to include the vocabulary he uses to distinguish plant parts or even plants themselves.

One's own words, based on personal experiences to describe, interpret and understand science phenomena is referred to by Cobern (1991) as a way of looking at the world which is based on

... the foundational beliefs, i.e., presupposition about the world that support both common sense and scientific theories-that is a world view. (p. 7) A world view defines the self. It sets the boundaries of who and what I am. It also defines everything that is not me, including my relationships to the human and non-human environments. (p. 9)

Thus, a student's world view, of which language plays a major role, is the major source of cognitive tools she/he brings to science classrooms as she/he goes about trying to make

sense of the science that is being taught.

Making sense is a critical factor to consider; because interpretation of a science lesson will be in accord with each individual student's world view, students can interpret the same science phenomena in many different ways. Cobern (1991) offers the following excellent illustration of how varied interpretation may be.

Three men went to see Niagara Falls. One was an Indian from India, one was a Chinese, and one an American. On seeing the falls, the Indian, as a matter of course, thought of his god, manifested in this grandeur of nature. The Chinese simply wished to have a little hut beside the falls, where he might invite a friend or two, serve tea, and enjoy conversation. The American, however, on viewing the falls, immediately asked himself what could be done to make the most of such an enormous amount of energy (p. 50).

The Role of Communication

In the US, the use of a language other than English for instructional purposes has been of great controversy. Researchers such as Cummins (1981, 1986), Cuevas (1984), Hakuta (1986), Ramirez (in press), and Walsh (1991) have demonstrated that students' use of their primary language in the classroom adds to their ability to learn and excel in the English language. These authors are referring to limited English proficient students attending bilingual classrooms where teaching and learning is in the student's native language and English.

A major reason that limited English proficient students eventually excel in English, by using their primary language, is that these students are provided the opportunities to develop major conceptual understandings of what they are trying to learn as opposed to trying to learn vocabulary words that are detached from real contexts.

Conceptual understanding begins when direct experiences are discussed in terms of language that is the everyday language of the student. Once experiences are understood in this way the language of science can be added; the language of science is then connected through everyday language, and to the student's direct experiences. Thus, it seems that we need to create and maintain science classrooms that are rich in opportunities for students to use their native language as they attempt to make sense of the world.

It is important for us to keep in mind that "communication is culture bound. Students with different cultural norms are at risk if teachers have little knowledge, sensitivity, or appreciation of the diversity in communication styles" (Taylor, 1987, p. 1). Perhaps student communication, in our science classrooms, is a matter of whether we stress learning (as learning

previously has been defined) or vocabulary accumulation. Cummins (1981) refers to this as the difference between a classroom environment that emphasizes context-embedded versus context-reduced communication.

Context-embedded communication derives from interpersonal involvement in a shared reality that reduces the need for explicit linguistic elaboration of the message. Context-reduced communication, on the other hand, derives from the fact that this shared reality cannot be assumed and thus linguistic messages must be elaborated precisely and explicitly so that the risk of misinterpretation is minimized. (p. 11)

The notion of context-embedded communication seems to fit neatly with making sense of science phenomena through diverse, multi-sensory experiences and working in cooperative groups. Students in a context-embedded classroom would have an opportunity to explore science in a manner that emphasizes conceptual understanding and not vocabulary expertise.

In many cases integrating a student's culture into school activities has been confined to activities such as celebrating Cinco de Mayo, Black History Month, or the Chinese New Year. Such activities are often designed to assist students in the majority culture to better understand the cultures of minority groups. However, "neat multicultural activities" fail to meet the learning needs of culturally diverse students, in science classrooms. Lessons that acknowledge cultural differences must be a daily part of the science curriculum; such lessons should not be reserved for special enrichment activities. In order to meet the learning needs of culturally diverse students, we must provide, in every lesson we plan to teach, regular opportunities for all students to make sense of their experiences in ways that are personally meaningful. Science activities planned in this manner will necessitate the use of all the languages students bring into the classroom. This would be especially important for limited English proficient students. A way of facilitating the use of many languages is through cooperative grouping with classmates who speak the same language thus providing them with opportunities to negotiate meaning. After students have used their own experiences to construct new meanings they should then be provided opportunities to negotiate meaning in English.

The idea of facilitating cultural experiences that are familiar to minorities of color or language should not be limited to the classroom but extended to the whole school. For example, when working with Hispanic students, Lucas, Henze, and Donato (1990) recommend (1) valuing the students' cultures, (2) setting high expectations, (3) emphasizing parental involvement, (4) offering courses in three modes for: students who do not speak English; beginning English speakers; and fluent English learners.

The Milieu of Science Teaching and Learning

We also need to think of ways that facilitate students examining science knowledge in historical, social and multicultural contexts; activities that integrate a science curriculum associated with scientific advances identified with non-Western cultures, or comparing science in different cultures. For example instead of introducing the contributions of George Washington Carver only during Black History month, his scientific contributions should be key elements when such topics as botany, agribusiness or biotechnology emerge in the classroom.

If the suggestions are initiated, the students' multiperspectives become the basis for not only teaching but the whole of the school's culture. Pugh (1990) summarized these points by suggesting that teachers consider the following:

1. Science is not free of cultural influence.
2. Science textbooks are not free of racism.
3. History and development of science should not be solely attributed to European cultures.

The ideas mentioned by Pugh center around the notion that in science and science teaching there is no written rule that a particular view directly and easily connects into the life experiences of all students.

Summary

Perhaps one of the most difficult issues for a science teacher to deal with is developing ways to encourage learning through facilitating students' use of extant knowledge, which includes culture, and language, in a multi-cultural setting. Adding to the complexity of a multi-cultural classroom is the notion that the discipline of science has its own culture and language, and so does the science teacher. The key to comprehending this milieu is to understand that learning, which is the process of making sense, is culture dependent. Specifically, if we provide students with opportunities to make sense of science phenomena through diverse, multi-sensory incidents, learning will take place. Thus, students would be able to use their experiences, which include language and culture, as they interpret science phenomena. Students would then be able to compare what they know to these new experiences and find ways to make sense of them.

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Suggested Readings

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1992 ELECTION RESULTS

The results of the 1992 election of officers and executive board members are now final. The NARST leadership team extends its thanks to all the candidates for their participation and offers its congratulations to the newly elected officers and board members. Please extend congratulations to your colleagues whom the members have chosen to lead NARST over the next three years:

President-Elect: Kenneth G. Tobin

Research Coordinator: Audrey Champagne

Executive Board: Richard Duschl

Executive Board: Cheryl Mason

FROM THE EXECUTIVE SECRETARY

In his text entitled the *Complete Problem Solver* (2nd edition), John Hayes (1989) defined a problem as, "Whenever there is a gap between where you are now and where you want to be, and you don't know how to find a way to cross that gap, you have a problem." (p. xii). Grayson Wheatley utilized Hayes' definition of a problem to define problem solving as what you do when you don't know what to do. Colleagues, I have a problem. I have considered all sorts of ways to ignore my problem, such as 1) reading scholarly journals and books; 2) preparing a manuscript for possible publication; 3) playing 18 holes of golf; 4) jogging four miles; or 5) taking the family on a vacation. Moreover, I have contemplated several possible courses of action that I could take after sharing my problem, such as: 1) changing my address; 2) changing my FAX number; 3) changing my office phone number; or 4) obtaining an unpublished home telephone number. But, none of these will bring a resolution to the problem; thus, I have decided to take the direct approach and leap straight into the gap. Colleagues, the time has come to increase the NARST membership dues.

The Executive Board met in October and spent an entire weekend discussing issues central to the continuing growth and vitality of NARST. Among the issues discussed was an increase in the annual membership dues. The current annual dues structure has been in place for at least five years. Regular members pay \$54, student and emeritus members receiving *JRST* pay \$30; student members not receiving *JRST* pay \$14; emeritus members not receiving *JRST* pay nothing. Under a proposal approved unanimously by the Executive Board, the annual dues structure would become:

Regular member	\$90.00
Student member with <i>JRST</i>	\$46.00
Student member without <i>JRST</i>	\$14.00
Emeritus member with <i>JRST</i>	\$46.00
Emeritus member without <i>JRST</i>	-----

An analysis of three factors provided the impetus for the Executive Board's action. The first factor relates to the 1992 budget and cash reserves. The Executive Board approved an operating budget for 1992 that contains a projected \$7,000 deficit. I anticipate closing out the 1991 budget with approximately \$15,000 cash in reserve, but this cushion will quickly disappear without increased revenues. A combination of higher sales of NARST monographs and books, an increase in membership, and greater participation in the 1992 Annual Meeting could shrink but not totally remove the deficit.

The second factor centers on our contract with John Wiley & Sons, publishers of the *Journal of Research in Science Teaching*. The publishing agreement expires at the end of 1992; thus, it must be renegotiated in the coming year. The publisher has demonstrated a commitment to NARST by not

increasing the charge to NARST members when it could have done so at certain points under the present contract. However, the Executive Board expects that Wiley and Sons will have to increase charges to NARST members by a substantial amount under a new contract. Moreover, the Executive Board could not delay its action, as a dues increase must be voted on and approved by the membership. Assuming that members vote to increase dues, the earliest that a new dues structure can be implemented is fiscal 1993, which begins January 1, 1993. Thus, the Executive Board had to act in advance of a new contract for publishing *JRST*. It is likely that the NARST membership will also vote on a dues increase in advance of a new *JRST* contract.

The third factor focuses on the sources of revenue and the costs of operating NARST in the 1990s. NARST has three principal sources of revenue: membership dues; sales of books and monographs; and its Annual Meeting. In preparing the budget for 1992, I adhered to the philosophy that normal operating expenses should come from dues and sales; the Annual Meeting should, in a worst case scenario, pay for itself. According to 1992 budget projections, receipts for the Annual Meeting should exceed expenses by about \$3,700. Thus, the Annual Meeting, should pay its own way. Further, the actual deficit is centered in the area of normal operating expenses.

As I stated earlier, the Executive Board examined the present financial situation at length during its recent meeting and unanimously approved the new membership dues structure. The Board further recommended that NARST members be informed early on through *NARST News*, thereby allowing members to reply with suggestions, comments, and concerns. I suggest that members do this in two ways. First, take the time to call, write, or FAX your reply to me using the information at the close of this message. Second, come to the Annual Meeting, discuss the issues with your colleagues, and attend the NARST business meeting, which is scheduled for 11:00 a.m. - 12 noon, Tuesday, March 24, 1992. Please note that this time slot lies in the middle of the Annual Meeting, not at the end, thereby providing ample time for discussion. After the close of the Annual Meeting, I will mail ballots to all NARST members who have paid their 1992 dues. Please use the information provided below to reply regarding an increase in dues:

Dr. John R. Staver
NARST Executive Secretary
Center for Science Education
219 Bluemont Hall
Kansas State University
Manhattan, KS 66506
PHONE: (913) 532-6294
FAX: (913) 532-7304

NARST News

NARST News is the quarterly newsletter of the National Association for Research in Science Teaching, produced as a means for the NARST leadership team to communicate with members. Moreover, individual members, special interest groups and regional, national and international associations, can announce items of interest. First priority will be afforded to regular NARST News features; other items will be published as space permits and on a first-received basis. Copy submitted in other than printed form should be through one of the following alternatives: 1) as a **Wordperfect** text file on a five inch floppy MS-DOS computer disk; 2) as a **Wordperfect** text file on a 3 1/2 inch Macintosh disk; 3) FAX copy to (913) 532-7304; or 4) through **BITNET** (LSCHARM@KSUVM). News and/or other contributions will be accepted up to 3 weeks prior to the first day of the month of quarterly publication. Late items will be considered for publication in subsequent newsletters.

Send contributions to the return address below.

NARST Membership Information

I am interested in becoming a member of the National Association for Research in Science Teaching (NARST).

- Please send me information about NARST.
 Please send a NARST Membership Application form.

NAME: _____

ADDRESS: _____

City	ST	ZIP
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Country

Please send membership/information requests to:

Dr. John Staver, Executive Secretary
NARST, Bluemont Hall
Kansas State University
Manhattan, KS 66506-5334

NARST NEWS

Lawrence C. Scharmann
Editor
Center for Science Education
Kansas State University
Manhattan, KS 66506-5334

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KAREN MURPHY
6610 LINCOLN AVE
DES MOINES IA 50322