CETP Core Evaluation


A National Science Foundation Project

Classroom Observation Handbook

September, 2002

Frances Lawrenz
Douglas Huffman
Karen Appeldoorn

carei
The College of Education & Human Development
UNIVERSITY OF MINNESOTA

TABLE OF CONTENTS

INTRODUCTION

This handbook is part of a set of four handbooks describing instruments that may be useful in evaluations of K-16 science and mathematics education projects. These books are: Classroom Observation Handbook, K-12 Survey Handbook, Higher Education Survey Handbook, and Handbook for Evaluation of Activities and Assessments. This particular handbook and an accompanying set of videotapes and guide were designed as educational tools for K-16 classroom observers using the Classroom Observation Protocol (COP). The COP and guide were developed as part of the Collaboratives for Excellence in Teacher Preparation (CETP) Program Core Evaluation Project. The National Science Foundation (NSF) designed the CETP Program to significantly improve the science, technology, engineering and mathematics (STEM) preparation of future K-12 teachers. Approximately 25 Collaboratives were funded by NSF across the country from 1993 - 2000. The CETP Core Evaluation Project was funded after the CETP program had been in operation for several years. The goal of the CETP Core Evaluation is to provide data about the CETP program as a whole using data from the individual projects. The development of the CETP Core Evaluation is a joint effort between the CETP Core staff and the members of the individual CETPs. More information about the CETP Core Evaluation Project as well as copies of the COP and other instruments are available on our Web site (http://education.umn.edu/carei/cetp).

The COP and this handbook were constructed through the selection of items from several classroom observation forms. Items selected were those that had been shown to be predictive of standards-based instruction and positive student outcomes. Sources used included Horizon Research, Inc. (1999); the Arizona Collaborative for Excellence in Teacher Preparation (ACEPT, 2000); Evaluation of the Long Term Effect of Teacher Enhancement project (1999); the Constructing Physics Understanding Evaluation project (2001) and the Systemic Initiatives Evaluation project (2001). Although the COP was intended for use in observing mathematics and science classrooms as part of the CETP Core Evaluation, it may be easily adapted for use in other settings.

The COP is a criterion-referenced instrument for describing and rating classroom activities in K-16 STEM settings. To effectively and reliably use the instrument, the observer must have enough rating experience so that he or she understands the standards-based criteria underlying every item. The protocol has several parts. First is a description of the general demographics of the classroom including items such as type of course, numbers of students, and adequacy of the physical environment. The next part describes the instruction in terms of purpose (with interviews of the teacher) and in terms of the major activity occurring in each five-minute interval of the observation. The type of activity is coded along with the level of student cognitive activity and engagement. The last two sections are evaluative ratings of the lesson and its overall quality. It is important that all sections be completed to provide an accurate 'snapshot' of the classroom being observed.

In addition to this introduction, this handbook includes the COP, the annotated guide to the COP, a teacher interview protocol, a sample outline for daylong COP training, and lesson ratings including brief descriptions explaining the coding for each lesson and an elaborated description for the first video clip (Surface Area and Volume - 8^{th} grade).

References

American Association for the Advancement of Science. (1993). *Benchmarks for scientific literacy: Project 2061.* NY: Oxford University Press.

American Association for the Advancement of Science, Project 2061. (2001). *Atlas of science literacy.* Washington, DC: Author.

Horizon Research, Inc. (1999). *Local systemic change core evaluation data collection manual.* Chapel Hill, NC: Author.

Huffman, D. & Michlin, M. (2001). *Using computers to construct physics understanding: The impact of CPU on high school physics.* Evaluation report available from The Center for Applied Research and Educational Improvement, University of Minnesota.

Johnson, D. W. & Johnson, R. T. (1991). Cooperative learning and classroom and school climate. In Fraser, B. J. & Walberg, H. J. (Eds.), *Educational environments: Evaluation, antecedents and consequences* (pp. 55-74). Elmsford, NY: Pergamon Press, Inc.

Lawrenz, F. & Huffman, D., Lavoie, B. (2001). *Long term effects of teacher enhancement – scope, sequence, & coordination (SS&C).* Evaluation report available from The Center for Applied Research and Educational Improvement, University of Minnesota: http://education.umn.edu/CAREI/Programs/default.html.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (1995). *Assessment standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles & standards for school mathematics*. Reston, VA: Author.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

Newmann, F. M. & Associates. (1996). *Authentic achievement: Restructuring for intellectual quality*. San Francisco, CA: Jossey-Bass Publishers.

Newmann, F. M., Secada, W. G., & Wehlage, G. G. (1995). *A guide to authentic instruction and assessment: Vision, standards and scoring*. Madison, WI: Wisconsin Center for Education Research.

O'Sullivan, C. Y., Reese, C. M., & Mazzeo, J. (1997). *NAEP 1996 science report card for the nation and states*. Washington, DC: National Center for Educational Statistics.

Robitaille, D. F. (1993). *Curriculum frameworks for mathematics and science.* Vancouver: Pacific Educational Press.

Salish I Research Project. (1997). *Secondary science and mathematics teacher preparation programs: Influences on new teachers and their students. Instrument package & user's guide.* Washington DC: United States Department of Education and Office of Educational Research and Improvement.

Sawada, D., Piburn, M., Falconer, K., Turley, J., Benford, R., & Bloom, I. (2000). *Reformed teaching observation protocol (RTOP)* (ACEPT Technical Report No. IN00-1). Tempe, AZ: Arizona Collaborative for Excellence in the Preparation of Teachers.

Sawada, D., Piburn, M., Falconer, K., Turley, J., Benford, R., Bloom, I, & Judson, E. (2000). *Reformed teaching observation protocol (RTOP) training guide* (ACEPT Technical Report No. IN00-2). Tempe, AZ: Arizona Collaborative for Excellence in the Preparation of Teachers.

Statewide Systemic Initiatives Evaluation (SSI) - NSF (National Science Foundation). (2000). Information available from The Center for Applied Research and Educational Improvement, University of Minnesota: http://education.umn.edu/CAREI/Programs/default.html

Williams, T. & Levine, D. (Eds.). (1996). *United States third international mathematics and science study technical report.* National Center for Educational Statistics, U.S. Department of Education, Washington, DC: U.S. Government Printing Office.

CETP – CORE EVALUATION CLASSROOM OBSERVATION PROTOCOL

I. Background Information

A. Observer

1. Name: _____

2. CETP: _____ Institution Name: _____

3. Date of Observation: _____

4. Length of observation: _____(minutes)

5. Was the teacher informed about this observation prior to the visit? O Yes O No

B. Teacher/Faculty

1. Name: _____

2. CETP Teacher? O Yes O No

3. Gender: O Male O Female

4. K-12: Licensure/certification_____

OR College Rank: (*Check one*.)

O Instructor/Adjunct Faculty
O Assistant Professor
O Associate Professor
O Full Professor
O TA: primary responsibility?_____
O Other:_____

II. Classroom Demographics

A. What is the total number of students in the class at the time of the observation?

O 15 or fewer O 26–30 O 61-100
O 16–20 O 31–40 O 101 or more
O 21–25 O 41–60

B. Was a paraprofessional or teaching assistant in the class?
O Yes O No

C. 1. Grade Level (K-12)_____
OR
2. Student Audience (majority of students. *Check any that apply*):
(a) O Prospective teachers: (1) O Elementary (2) O M.S. (3) O H.S.
(b) O Liberal Arts Majors
(c) O Mathematics/Science Majors

D. Subject Observed/Descriptive Course Title: _____

E. Scheduled length of class_____(minutes)

III. Classroom Context

Rate the adequacy of the physical environment for facilitating student learning.

1. Classroom resources: (from "sparsely equipped" to "rich in resources")	1	2	3
2. Room arrangement: (from "inhibited interactions among students" to "facilitated interactions among students")	1	2	3

IV. Class Description and Purpose

A. Classroom Checklist

Please fill in the types of instruction (*not* the instructor's actual activities, in case they are correcting papers or something noninstructional), student engagement, and cognitive activity used in each five-minute portion of this class in the boxes below. There may be one or more strategies used in each category during each interval. For example, SGD, HOA, and TIS often occur together in a five-minute period, but SGD and L do not.

Type of Instruction

L	lecture/presentation	CL	cooperative learning (roles)
PM	problem modeling	LC	learning center/station
SP	student presentation (formal)	TIS	teacher/faculty member interacting w/ student
LWD	lecture with discussion	UT	utilizing digital educational media and/or technology
D	demonstration		
CD	class discussion	A	assessment: Please describe.
WW	writing work (if in groups, add SGD)	AD	administrative tasks
RSW	reading seat work (if in groups, add SGD)	OOC	out-of-class experience
HOA	hands-on activity/materials	I	interruption
SGD	small group discussion (pairs count)	OTH	other: Please describe.

Student Engagement

LE	low engagement, 80% or more of the students off-task
ME	mixed engagement
HE	high engagement, 80% or more of the students engaged

Cognitive Activity

1	**Receipt of Knowledge** (lectures, worksheets, questions, observing, homework)
2	**Application of Procedural Knowledge** (skill building, performance)
3	**Knowledge Representation** (organizing, describing, categorizing)
4	**Knowledge Construction** (higher order thinking, generating, inventing, solving problems, revising, etc.)
0	**Other** (e.g., classroom disruption)

Time in minutes

	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
Instruction												
Student												
Cognitive												

	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120
I												
S												
C												

B. In a few sentences, describe the lesson you observed and its purpose.
Include where this lesson fits in the overall unit of study, syllabus, or instructional cycle.
Note: This information needs to be obtained from the teacher/faculty member.

V. Ratings of Key Indicators

In this section, you are asked to rate each of a number of key indicators as descriptive of the lesson in five different categories, from 1 (not at all) to 5 (to a great extent). Note that any one lesson may not provide evidence for every single indicator; use DK, "Don't Know," when there is not enough evidence for you to make a judgment. Use N/A, "Not Applicable," when you consider the indicator inappropriate given the purpose and context of the lesson.

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	1 2 3 4 5 DK N/A
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	1 2 3 4 5 DK N/A
3. Students were reflective about their learning.	1 2 3 4 5 DK N/A
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	1 2 3 4 5 DK N/A
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/faculty member and students.	1 2 3 4 5 DK N/A
6. The lesson promoted strongly coherent conceptual understanding.	1 2 3 4 5 DK N/A
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	1 2 3 4 5 DK N/A
8. The teacher/faculty member displayed an understanding of mathematics/science concepts (e.g., in her/his dialogue with students).	1 2 3 4 5 DK N/A
9. Appropriate connections were made to other areas of mathematics/science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	1 2 3 4 5 DK N/A

For the following questions, select the response that best describes your overall assessment of the *likely effect* of this lesson in each of the following areas, from 1 (no effect) to 5 (great effect).

10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation	1 2 3 4 5 DK N/A
11. Students' understanding of important mathematics/science concepts	1 2 3 4 5 DK N/A
12. Students' capacity to carry out their own inquiries	1 2 3 4 5 DK N/A

VI. Capsule Description of the Quality of the Lesson

In this final rating of the lesson, consider all available information about the lesson, its context and purpose, the complete instructional cycle, and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the lesson you observed. Keep in mind that this rating is ***not*** intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the lesson. Please provide a brief rationale for your final capsule description of the lesson in the space provided.

❍ Level 1: Ineffective Instruction

- O Passive "Learning"
- O Activity for Activity's Sake

❍ Level 2: Elements of Effective Instruction

❍ Level 3: Beginning Stages of Effective Instruction (Select one below.)

O Low 3 O Solid 3 O High 3

❍ Level 4: Accomplished, Effective Instruction

❍ Level 5: Exemplary Instruction

Please provide your rationale for the capsule rating:

ANNOTATED GUIDE TO THE CETP CLASSROOM OBSERVATION PROTOCOL

The CETP Classroom Observation Protocol (COP) should be used to record and rate observations of mathematics and science lessons or class/lab periods for the CETP Core Evaluation. *Terminology in the COP is intended to be used flexibly in order to fit both K-12 and higher education settings*. The function of this guide and accompanying videotape is to explain the items contained in the COP so that observers will provide consistent information and procedures.

Section I: Background Information
Record in this section the information about the classroom observer and the science/mathematics K-12 teacher or higher education institution faculty member.

In item I-B-4, the licensure/certification refers to the K-12 teachers, whereas college rank refers to the college or university course instructor/professor.

Section II: Classroom Demographics
This section contains questions relating to the numbers of students, their grade level, and the length of the class. It also asks about the presence of paraprofessionals or TAs.

Item II-C-1 is to be completed by observers of K-12 classrooms whereas item II-C-2 is intended for observations in institutions of higher education. The latter item (II-C-2) contains several choices: a) refers to students in teacher preparation programs, b) means students with liberal arts majors, and c) is self-explanatory.

The classroom observer will also conduct a short interview with the teacher/faculty member in order to obtain contextual information about the observed lesson (see IV-B). This interview may take place either prior to or immediately following the observation. See the teacher interview section of this handbook for suggestions about the interview process.

Section III: Classroom Context
Rate each element of the physical environment in terms of how adequately each facilitated student learning. For example, a college biology laboratory that had little to no equipment for student use would be rated "Sparsely equipped." A K-12 classroom designed for 28 students with flexible seating and only 24 students in the class would "Facilitate interactions among students."

Section IV: Class Description and Purpose

For Section A, it is important that you familiarize yourself with the definitions of the types of instruction prior to observing the lesson. The definitions are included below; please include other strategies or categories as needed by using the "Other" option. More than one code may be assigned for each 5-minute interval; SGD, HOA, and TIS often occur together.

Type of Instruction:

L *lecture/presentation*: Teacher talks almost all the time. If students participate verbally, their interaction is minimal with questions and responses that are either very short or obvious answers.

PM *problem modeling*: Teacher demonstrating or modeling how to solve a new problem.

SP *student presentation*: e.g., student lecture, demonstration.

LWD *lecture with discussion*: Teacher talks most of the time. This differs from lecture in that students participate by answering questions that generally require more than a one-word answer. This differs from class discussion in that there is almost no student-to-student communication.

D *teacher demonstration*: Teacher shows how something works or how to do something. This differs from Problem Modeling in that it involves the use of some type of equipment or materials.

CD *class discussion*: Almost all student-to-student talk in full class setting.

WW *writing work*: Writing individually on worksheets, lab write-ups, journal entries, or other writing assignments, or combined with SGD.

RSW *reading seatwork*: Reading their textbooks or other written material.

SGD *small group discussion*: Students (2 or more) engage in conversation with each other about subject matter in small groups.

HOA *hands-on activity/materials*: Students participate in an activity that involves manipulating materials.

CL *cooperative learning*: Structured SGD with individual roles, group accountability, and group processing.

LC *learning center/station*: Students working at various stations related to particular topics. This may occur in elementary classrooms or in laboratory classes.

TIS *teacher interacting with student(s)*: Teacher moving among individuals or groups of students and talking to them.

UT *utilizing digital educational media and/or technology*: e.g., unique use of computers, calculators, videotapes, or other types of technology, not adding, multiplying, viewing overhead projections, or word processing.

A *assessment*: e.g., quiz, think aloud, problem set. Specify type and how it is used.

AD *administrative tasks*: Teacher and students take care of nonacademic business, i.e., taking attendance, collecting homework, etc.

OOC *out-of-class experience*: e.g., field trips, interactions with other classrooms, concerts.

I *interruption*: e.g., visitor, unexpected announcements, student disruption.

OTH *other*: e.g., something not included in the above codes. This should be described.

Student Engagement: This asks for a subjective judgment as to whether:

- the percentage is somewhere between 20% and 80%.
- most (80% or more) are off-task
- most (80% or more) of the students are engaged in the task

Cognitive Activity:

1 ***Receipt of knowledge*** – Students are involved in the rote reception of information. This generally includes listening to a lecture, going over homework, or watching the teacher verify a concept through demonstration. The key feature of this category is that students are receiving information but not significantly doing anything with the information.

2 ***Application of procedural knowledge*** – Students apply their knowledge. This typically involves students using what they have learned, doing worksheets, practicing problems, or building skills. The key feature of this category is that students are taking information and applying it or practicing.

3 ***Knowledge representation*** – Students manipulate information. This is usually a step beyond application. In knowledge representation activities students will typically re-organize, categorize, or attempt to represent what they have learned in a different way. For example, students might take the data from a lab activity and represent it graphically. The key feature here is the reorganization or representation of information.

4 ***Knowledge construction*** – Students create new meaning. This typically involves creating new understandings or making new connections. Students might be generating ideas, or solving new problems. For example, students might be using the results of three different labs and generating patterns that hold true in all three cases. The key feature of this category is that students generate new knowledge or meaning.

0 ***Other*** – This category includes activities not included above, e.g., classroom disruptions. These should be described.

Information in IV-B is to be obtained from two sources: a planning document and the teacher (see the teacher interview section of this document). The information from a lesson plan, syllabus, or course outline provides a context within which each lesson has a particular place. The description of the goal of the lesson and its fit within an instructional cycle or course syllabus should be obtained from an interview with the teacher/faculty member.

Section V: Ratings of Key Indicators

This section contains 12 questions to be rated by the observer. Do *not* feel that you have to complete these items during the actual observation period. However, you should be familiar with the questions so that you can jot down notes that will facilitate your rating at the end of the class. For most items, a valid interpretation can be rendered only after observing the entire lesson. Something occurring during the last five minutes of the lesson can change the interpretation of earlier observed events.

Each of the items is to be rated on a five-point scale ranging from 1 to 5. A number 1 indicates that characteristic *never* occurred. If it occurred at all, even once, a 1 should not be used. A rating of 5 means that the characteristic occurred to a great extent, whereas the numbers 2-4 indicate a continuum from a single event to frequent occurrence. Use DK when there is not enough evidence for you to make a judgment and N/A if you consider the indicator inappropriate given the purpose and context of the lesson.

The rest of this section provides clarification of the items. Although most observations will be of science and mathematics classes, some observations of science or mathematics teaching methods classes may also occur. You should consider the items broadly.

(1) This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.
Divergent thinking is an important part of mathematical and scientific reasoning. A lesson that meets this criterion would not insist on only one method of experimentation or one approach to solving a problem. A teacher who valued alternative modes of thinking would respect and actively solicit a variety of approaches and understand that there may be more than one answer to a question. An example of a classroom situation rated 5 would be where the teacher and students identify exceptional characteristics of a problem and actively construct alternative methods for investigation. A 1 would be assigned where the teacher presents statements and problem solutions as absolutes.

(2) Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.
Conceptual understanding can be facilitated when relationships or patterns are represented in abstract or symbolic ways. Developing theories from data would also be an element of abstraction. Not moving toward abstraction can leave students overwhelmed with trees when a forest might help them locate themselves. An example of a 5 would be students developing a formula or describing what would happen in different situations, based on what they were learning in a specific context. A methods class example would be developing theories about pedagogical content knowledge. Identifying patterns would be a 2. For a rating of 1, patterns would not be pointed out or developed by the students.

(3) Students were reflective about their thinking.
Active reflection is a metacognitive activity that facilitates learning. It is sometimes referred to as "thinking about thinking." Teachers can facilitate reflection by providing time and suggesting strategies for students to evaluate their thoughts throughout a lesson. A review conducted by the teacher may not be reflective if it does not induce students to *re-examine* or *re-assess* their thinking. An example of a 5 would be where students explain how they came to believe something. A methods class example would be where students think about how they came to believe certain things about mathematics and science students. An example of a 1 would be where students say what they think but don't explain how or why they think it.

(4) The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.
A cornerstone of reformed teaching is taking into consideration the prior knowledge that students bring with them. The term "respected" is pivotal in this item. It suggests an attitude of curiosity on the teacher's part, an active solicitation of student ideas, and an understanding that much of what a student brings to the mathematics or science classroom is strongly shaped and conditioned by their everyday experiences. A rating of 5 would be given where the teacher elicits the students prior conceptions and makes the students aware that these are prior conceptions. Then the teacher uses these conceptions as the basis for the lesson. A rating of 1 would be given where the teacher is unconcerned about the students pre-existing ideas, doesn't ask about them nor deal with them when they come up in class discussions.

(5) Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson) and between teacher/faculty member and students.
A lesson where a teacher does most of the work or most of the talking is not reformed. In contrast, a lesson where students work together cooperatively, exchanging ideas related to the activity, and where the teacher/faculty member moves among the groups in a facilitative manner reflects reformed teaching. An example of a 5 would be where students are working in true cooperative groups where they engage in intellectual discussions which are assisted at times by thought-provoking questions from the teacher. There is also clear rapport and respect among the teachers and students. An example of a 1 would be classrooms where there is no group work or it is individuals sitting next to each other perhaps sharing equipment but working independently. Some sharing of ideas would move the rating to a 2.

(6) The lesson promoted strongly coherent conceptual understanding.
The word "coherent" is used to emphasize the strong interrelatedness of mathematical and/or scientific thinking. Concepts do not stand on their own two feet. They are increasingly more meaningful as they become integrally related to and constitutive of other concepts. Strongly coherent conceptual understanding could also be representative of a methods class that shows the relatedness of pedagogical understandings. An example of a 5 would be when a concept is presented in a variety of ways so all aspects can be understood and also when it is related to other topics (from previous class periods or other subjects) and to real world settings. An example of a 1 would be when a teacher describes a concept without including relationships or connections.

(7) Students were encouraged to generate conjectures, alternative solution strategies, and/or different ways of interpreting evidence.
Standards-based teaching shifts the balance of responsibility for mathematical or scientific thought from the teacher to the students. An informed teacher actively encourages this transition. An example of a 5 would be where the teacher encourages students to find more than one way to solve a problem and the lesson is devoted to discussing and critiquing these alternate solution strategies. An example of a 1 would be when a teacher allows only a single way to think about or solve a problem.

(8) The teacher/faculty member displayed an understanding of mathematics/science concepts (e.g., in her/his dialogue with students).
This indicates that a teacher could sense the potential significance of ideas as they occurred in the lesson, even when articulated vaguely by students. A solid grasp would be indicated by an eagerness to pursue students' thoughts even if seemingly unrelated at the moment. The grade-level at which the lesson was directed should be taken into consideration when evaluating this item. For a methods class this could mean displaying an understanding of pedagogical content knowledge as well. A rating of 5 would be assigned when a teacher facilitates a student's understanding of a fine point within a concept or about a relationship of the concept to other areas of knowledge. The teacher understands the concept so well that any path students take to or from that concept would be recognized. A 1 would be assigned when a teacher presents information algorithmically or makes mistakes.

(9) Appropriate connections were made to other areas of mathematics/science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.
Connecting mathematical and scientific content across the disciplines and with real world applications tends to generalize it and make it more coherent. An example of a 5 would be a

physics lesson on electricity that connects the role of electricity with biological systems or with the wiring systems of a house. Another example would be a mathematics lesson on proportionality that is connected with the nature of light by referring to the relationship between the height of an object and the length of its shadow (see also #6). An example of a 1 would be a lesson where no connections are made and topics are just presented as separate entities.

(10) Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.
Mathematics and particularly science knowledge changes as new information becomes available through investigation and experimentation. New technological developments can change what we are able to perceive, e.g., electron microscopes compared to simple magnification. Therefore what is accepted as fact at one point in history may not hold true in more recently accepted paradigms of thought. An example of a 5 would be a lesson that supports the idea that knowledge is tentative, and encourages "out-of-the-box" thinking and active investigatory activity. An example of a 1 would be a lesson that presents concepts as factual and never changing and where information is not presented for critical scrutiny and where no "investigation" is allowed. It is possible that a methods class could be designed to accomplish this and then the session should be rated. If it is not a purpose of the class, N/A should be chosen.

(11) Students' understanding of important mathematics/science concepts.
A 5 rating would be assigned to a lesson that presents important or key concepts in a variety of ways. The teacher encourages student questioning that allows in depth understanding and assesses student understanding frequently in both formal and informal ways. A 1 would be given where the concepts are taught only in a didactic fashion or the concepts covered are below the level of the student and trivial (or unconnected to major ideas in science and mathematics), and where student understanding is rarely assessed or assessed inappropriately. It is possible that a methods class could be designed to accomplish this type of understanding, in which case the session should be rated. If it is not a purpose of the class, N/A should be chosen.

(12) Students' capacity to carry out their own inquiries.
A lesson that promotes frequent interaction among students and where that interaction results in planning and performing inquiry independently would be rated a 5 for this item. A 1 would be assigned to a situation where the teacher planned all activities and the students just followed detailed instruction, i.e., where no inquiry occurred. A methods class would be rated highly if the lesson increased to a great extent students' capacities to be reflective practitioners.

Section VI: Capsule Description of the Quality of the Lesson

Synthesize all the available information about the lesson and select a capsule rating that best describes the overall quality of the lesson you observed. Provide a brief rational for the selected capsule rating as well. If a methods class is observed, you should interpret the terms within the descriptions broadly. For example, the lesson might be rated as to its likelihood to enhance students' understanding of mathematics or science pedagogy. The rest of this section provides detailed explanations of the capsule ratings.

Level 1: Ineffective Instruction

There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is *unlikely* to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science. The lesson was characterized by either (select one below):

Passive "Learning"
Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher/faculty member or textbook; material is presented in a way that is inaccessible to many of the students.

Activity for Activity's Sake
Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

Level 2: Elements of Effective Instruction

Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Level 3: Beginning Stages of Effective Instruction (Select one below.)

Low 3 *Solid 3* *High 3*

Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher/faculty member may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Level 4: Accomplished, Effective Instruction

Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher/faculty member presentations, discussions with each other or the teacher/faculty member, reading). The lesson is well-designed and the teacher/faculty member implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance

most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

Level 5: Exemplary Instruction

Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher/faculty member presentations, discussions with each other or the teacher/faculty member, reading). The lesson is well-designed and artfully implemented with flexibility and responsiveness to students' needs and interests. Instruction is *highly likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

TEACHER INTERVIEW

Interviewing the teacher you plan to observe is an important step in the classroom observation process. It allows you to establish the context and goal(s) of the lesson being observed as well as other important background and clarifying information. This interview should occur prior to the observation and should follow prescribed steps to help the observer obtain accurate and unbiased information. You may also want to ask some clarifying questions after conducting the observation. Suggested interview questions are included at the end of this document; however you should feel free to modify them to fit your needs. Please make sure that the questions do not lead the teacher to change plans for the lesson.

Making the appointments

First, be sure that you have permission from the school district or institution to interview and observe the teachers or faculty members and their students. Usually an evaluator or coordinator will have already done this for you but it's good to check.

Second, call or meet with the teacher or faculty member to explain the purpose of your visits and to schedule time for the interview and observation. This would also be a good time to tell the teacher that you would like to have a copy of an assessment and a lesson plan or activity used with the class so that these documents will be available at the interview or observation. Although it would be ideal to walk into the classroom unannounced, you want to pick a time when there is an observable lesson rather than an exam, movie, field trip or other such activity. The interview should take about 10 minutes and should take place prior to the observation whenever possible. The interview *must* take place before completing the final ratings of the lesson.

The interview

During the interview, remind the teacher to fill out a survey and to have her or his students fill out student surveys as well, half Form A and the other half Form B. Ask your interview questions and use prompts to facilitate the questioning process. Collect the two artifacts or plan to collect them at the observation. Depending on the procedures at your CETP, you may also be giving the teacher the packet of surveys. Lastly, see if there are any questions about the process. Reassure the teacher that all responses will be confidential. After the interview you should complete section IV-B on the COP.

The classroom observation

Arrive at the classroom several minutes ahead of the scheduled time. Ask the teacher where you should sit and make sure you can see both the teacher and the students. You may wish to fill out the questions on classroom demographics and context right away so that you can be ready to do the five-minute ratings as the class begins. However, you will have adequate time during the observation to fill out the information if the context isn't immediately clear.

Complete the COP shortly after your observation. It is very important that you provide a rationale for section VI at the end of the document. This rationale should be at least a paragraph in length and provide reasons for your opinions.

If the surveys were filled out before your observation, be sure to collect them before you leave. Otherwise leave the surveys with the teacher and make sure arrangements have been made to pick them up.

Suggested interview questions

1. What are you trying to accomplish with this particular lesson?
2. Where does this lesson fit within the unit: at the beginning, middle or end?
3. How much time will you spend with this topic or unit?
4. What are the important concepts you're teaching in this lesson?
5. How much do your students already know about these concepts?
6. What activities have you designed into this lesson?
7. Describe the objectives for each activity.
8. Is there anything in particular that I should know about the group of students I will be observing?
9. Is there anything else you think I should understand in order to observe the lesson?
10. Do you have any questions about this data collection process?

Potential questions to be used following the observation

1. Were there any ways in which the lesson was different from what you had planned?
2. What are the next steps for this class?

IDEAS FOR DAY LONG COP TRAINING

Starting the session

Setting - Participants should be in small groups of three to five. The physical setting should allow for easy viewing of the videotapes as well as promote small group discussion.

It is important to begin the session by assessing the prior knowledge of the participants. Ask about their experiences with classroom observations. What was the purpose of these observations? What sort of forms/guidelines/data gathering devices were used? Following this discussion, develop the idea of evaluative observation including coding of student activity, engagement, and cognitive level as well as holistic and descriptive ratings.

What should observers look for when observing classes?

Brainstorm some ideas about what constitutes a standards-based science or mathematics lesson. Next have everyone write their own description of a lesson. Have the participants pair up and compare their descriptions, noting similarities and differences. Each pair should make a list of these to share with the whole group.

Background information

Briefly discuss the history of classroom observation and describe the various types and related instruments.

Introduce the Classroom Observation Protocol

Make sure everyone has a copy of the COP Handbook. Page through the handbook pointing out its various parts. After this general introduction, continue by showing the beginning of Tape I. Participants should follow along in their handbook. Tie the different components of the form into the list of generated ideas gathered at the beginning of the session as well as the different descriptions each group suggested. Stop the tape after the section on student engagement. Another alternative would be to show the whole tape first and then go through it a second time stopping after each section.

Instructional strategies

Begin Tape I again where the narrator says, “Identifying the type of instructional strategy that’s occurring is more complex.” Go through the category examples slowly asking for questions about definitions. You may need to stop the tape between strategies. Talk about cognitive level and student engagement where appropriate and tie them into the rating scales discussed above.

Practice rating lessons

First lesson - Play the first practice lesson on Tape II; have everyone watch the videotape carefully and fill out the rating form individually.

Discussion of ratings - After the participants have finished their ratings, have them share their ratings within groups. Point out that there are several sections of ratings, that is, the five-minute coding, the 12 Key Indicators, and the Capsule Description (holistic rating). Begin by discussing the Capsule Description. Try to have the groups reach consensus on this rating. Compare the ratings across groups (how many 1s, 2s, etc.).

Then consider the first two groups of ratings (the five-minute coding and the 12 Key Indicators). What is the sequence of activities? What is the cognitive level? Again, have each group agree on a single rating for each item and then share their decisions with the whole group. Discuss differences but monitor the time spent as there will be more opportunity for discussion later. The idea is not to change people's opinions so much as to have them understand what the scales show in consensus. For instance, you might think the class was a 2, but if everyone else thinks it's a 3, you need to figure out how to adjust your ratings.

Continue by showing the next lesson and follow the same general format as before. You should modify the format based on the needs of the participants. Sometimes you might just discuss particular activities/types of instruction after a practice lesson or just the holistic rating. At other times you might choose just the evaluative items or even a subset of them. Another idea would be to get the holistic rating and then discuss changes to make the lesson go up or down one rating point.

Ending the session

Go back to the classroom descriptions written at the beginning. Have the participants individually consider how they might change it now to show an ideal class in light of the session discussions. Afterward, discuss what was changed within small groups and then have each group share what they learned.

For CETP participants, have them discuss in groups how what they have learned will help them be more consistent data collectors for the core, and what they will do to make sure they are consistent. They should then share with the whole group.

For professional development/inservice participants, have them discuss in small groups how they could use what they have learned to help improve instruction at their school. They should brainstorm ideas, discuss them, and then share with the whole group.

DESCRIPTIVE RATINGS FOR PRACTICE LESSONS

This section contains thirteen lesson ratings and accompanying explanations that go along with the twelve practice lessons on Tape II. The first lesson, Surface Area and Volume, has an expanded justification of its ratings as well.

1. Surface Area and Volume – Mathematics, 8th grade

Context:
This is an eighth grade mathematics class (~25 students) on surface area and volume. These are "regular" mathematics students who have been studying surface area and volume in their textbooks. In this lesson they were to have brought in an object from home to measure.

Time in minutes:

	0-5	5-10	10-15
Instruction	LWD, PM	SGD, HOA, TIS, WW	SP
Student Engagement	HE	HE	HE
Cognitive Activity	1	2	3

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	2
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	3
3. Students were reflective about their learning.	3
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	3
6. The lesson promoted strongly coherent conceptual understanding.	3
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	2
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	3
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	3
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	2
11. Students' understanding of important mathematics/science concepts.	3
12. Students' capacity to carry out their own inquiries.	2

Capsule Description of the Quality of the Lesson

- *Level 2: Elements of Effective Instruction*

> Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science.

Justification:

This lesson is a two because of the algorithmic nature of the lesson. The first five minutes are LWD with PM but the type of questions asked of and input received from the students is mostly recall hence the one in cognitive activity. In the second five minutes the students are working with their object and the teacher is interacting with the groups. The questions the teacher asks the students in the groups are unlikely to encourage inquiry, for example, "What is the formula?" "What would that be in decimals?" Mostly the teacher appears to be checking on answers and providing encouragement such as "right," "good." The students are applying what they know so the level of cognitive activity goes up. The last five minutes is SP with some teacher introduction and interruption.

Expanded descriptive justification of the rating:

This expanded description begins by explaining the holistic 1-5 rating at the end of the COP. The lesson is rated a 2 "elements of effective instruction." The lesson has a mix of instructional styles in it. The instructor has attempted to make the lesson more concrete and relevant by having the students bring in objects (cans) from home to measure. Although this is a good idea, not all students have objects and the lesson is not designed in a way that requires the use of concrete objects. The lesson is more the manipulation of formulas and numbers than the solving real world problems. Students are not required to relate the physical size of the objects with the volumes they calculate nor are different sorts of volumes calculated. The instructor has also attempted to structure group work so that the students would be engaged in dialogue about the mathematics content. Some students do actually talk to each other but much of the work is completed independently. Discussion does not appear to be building deep knowledge about the concepts but rather to be the exchange of simple measurements or in some cases the discussion of formula manipulation or correct arithmetic. The implementation of the lesson is reasonable. The instructor is in control of the class and the students are mostly on task. He controls the class more with discipline than interest, however. In other words the students remain on task because he is "on top of them" rather than that they are involved in the content. The student presentation at the end of the class provides insight into student understanding and commitment. The students appear to have been engaged in the lesson and they are engaged in relatively higher order thinking as they present the logic they used in calculating their volumes. The instructor is presenting mathematics as having one correct answer (e.g., what is the answer and you should all be checking the answer using this formula) and as algorithmic (e.g., the example of the letter rule to show order of operation).

Going back to the beginning of the COP and considering the individual five-minute ratings, the lesson has three five-minute segments. The lesson begins with problem modeling and lecture with

discussion. The level of cognitive activity during these five minutes is low (coded a one) because students are passive recipients of knowledge. Then in the next five minutes the lesson moves to small group discussion, with hands on materials and teacher interacting with students. These categories are obvious from the one teacher-student interchange, the students with actual cans to measure and the students who are talking to each other. The level of cognitive activity is higher now (coded a 2) than during lecture because the students are applying knowledge both in terms of calculations and in talking to each other about them. The last section of the class involves the student presentations. This should continue for five minutes to actually be coded but the tape stops before enough time is provided. The presentations, however, are at a much higher level of cognitive activity for the students doing the presentations. They are actually organizing and synthesizing information (coded a 3). The students watching are passive recipients but assumedly all the students did actually perform the cognitive activity necessary to do a presentation. The actual level of engagement of the students is difficult to determine from the video clip but it appears that at least 80% of the students are engaged for the whole lesson so it is coded Highly Engaged for each of the five-minute segments.

The individual evaluative ratings of the lesson provide insight into its various components.

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving. (Coded a 2) The teacher does show some evidence of valuing alternative modes of thinking by having the students present and by having the students talk with each other about how to solve the problem. On the other hand the instructor makes it clear that there is only one right answer, and he expects the students to use the approach he showed at the beginning of the lesson.

2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so. (Coded a 3) Elements of abstraction include formulas so obviously these were included in this lesson. The student presentation also required that the students use the representations and talk about them. It is not coded higher because the students were not engaged in developing the abstractions.

3. Students were reflective about their thinking. (Coded a 3) The student presentation and the opportunity for the students to talk to one another about what they were thinking as they calculated the area bring this rating up. More explicit attention to having the students think about how and why they thought particular ways would have brought the rating up.

4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein. (Coded a 3) Bringing in a real world object and having the students use it provides an atmosphere where prior conceptions might come out. The instructor asked for questions when the lesson began which might have been an opportunity for students to express prior knowledge. When in groups the students were allowed some time to try their own ideas out. This was quite limited however.

5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students. (Coded a 3) The students did work together in groups and the teacher interacted with the students. There appeared to be a reasonable level of rapport both among the students and between the teacher and the students. A more structured feel to the collaborations such as having them be

mutually dependent rather than just working alongside each other and talking occasionally would have resulted in a higher score.

6. The lesson promoted strongly coherent conceptual understanding. (Coded a 3) The instructor talked about the relationships of volume to other mathematics and science concepts. Additionally the students brought in real objects to help show the relationship of the formulas to other areas. The lesson would have been coded higher if the instructor had tied the formulas more into other mathematical concepts and to other areas such as science.

7. Students were encouraged to generate conjectures, alternative solution strategies, and/or different ways of interpreting evidence. (Coded a 2) The students did work in groups where they could generate conjectures. Also the student presentations included their solution strategies. These were not particularly strong examples of generating conjectures, however. A higher code would have been given if the lesson explicitly forced the students to do this.

8. The teacher/instructor displayed an understanding of mathematics/science concepts (e.g., in her/his dialogue with students). (Coded a 3) The instructor appeared to understand the mathematics concepts despite a mistake in the order of operations. He could understand what the students were asking about and somewhat direct them to better understand the concepts. He was fairly rote and algorithmic in the understandings he displayed.

9. Appropriate connections were made to other areas of mathematics/science, to other disciplines and/or to real-world contexts, social issues, and global concerns. (Coded a 3) The students were dealing with a real world object that at least moved them out of the textbook. More direct references to other disciplines and to more practical real world uses of the formulas would have resulted in a higher code.

10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation. (Coded a 2) Although the lesson had some opportunity for the consideration of mathematics as dynamic, it was generally portrayed as formulaic and algorithmic.

11. Students understanding of important mathematics/science concepts. (Coded a 3) Volume and surface area are important mathematics concepts and the students did gain some understanding of these. The lack of explicit connections to other concepts and applications keep the code lower.

12. Students capacity to carry out their own inquires. (Coded a 2) The student presentations provided some experience with inquiry as did the measuring of a real world object but it was very limited. The students were given the question to investigate ("What is the volume?") and the methods for measuring as well as the way to calculate the results. This is not very likely to increase their capacity to carry out their own inquiries.

2. Graphing – Mathematics, 2nd grade

Context:
This is a second grade mathematics class with 24 students. The lesson is on graphing, grouping, classifying, comparing, and contrasting. The students are usually ability grouped for mathematics but this is a homeroom mathematics class so all abilities are there together.

Time in minutes:

	0-5	5-10	10-15
Instruction	LWD	LWD, HOA	LWD, HOA
Student Engagement	HE	HE	HE
Cognitive Activity	3	2	2

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	2
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	3
3. Students were reflective about their learning.	3
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3-4
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	2
6. The lesson promoted strongly coherent conceptual understanding.	3
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	2
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	3
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	2-3
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	2
11. Students' understanding of important mathematics/science concepts.	3
12. Students' capacity to carry out their own inquiries.	2

Capsule Description of the Quality of the Lesson

- *Level 3: Beginning Stages of Effective Instruction (Select one below.)*

  - *Low 3* O *Solid 3* O *High 3*

Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher/instructor may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the

lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:
This is a low 3 because although it has the form of a standards-based class, it does not quite have the "spirit." The class is very stiff. The teacher asks some good inquiry oriented questions, e.g., "What do you know about graphing?" but goes directly to a "correct" answer. The hands-on nature of the activity is good but the students are not constructing their own knowledge so much as she is telling them. The first five minutes are LWD and a 3 cognitive activity level because the students at this grade level are being asked to organize and describe information in their own words that they had learned previously. This also allows the teacher to obtain information about the students' prior knowledge. She doesn't really tie it into the lesson, however. The second five minutes are considered LWD, PM or D, and HOA because the teacher is lecturing in terms of giving specific directions and problem modeling/demonstrating by moving her M&Ms around on the blackboard. The students are also providing information. The last five minutes is when she is asking the students to consider what they have learned. This is primarily LWD and somewhat metacognitive and therefore a 3 on the cognitive scale.

3. Lines and Angles – Mathematics, 4th grade

Context:
This is a fourth grade mathematics class. The students are studying geometry concepts, particularly lines and angles. They are using protractors and learning vocabulary. The lesson is in two parts

Time in minutes:

	0-5	5-10	10-15
Instruction	D, LWD	LWD, OTH, TIS	L
Student Engagement	HE	HE	HE
Cognitive Activity	2	2	1

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	2
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	3
3. Students were reflective about their learning.	2
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	3
6. The lesson promoted strongly coherent conceptual understanding.	2
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	3
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	3
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	2

10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	2
11. Students' understanding of important mathematics/science concepts.	2
12. Students' capacity to carry out their own inquiries.	2

Capsule Description of the Quality of the Lesson

- *Level 2: Elements of Effective Instruction*

  Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:

This lesson is somewhat difficult to rate because the innovative use of motion as a way of learning is strong while the mathematics presented is weaker. Many misconceptions about lines and angles seem to be apparent in the lesson. Hence the rating of 2. The teacher begins the lesson with LWD and D as she shows students how to make angles. She is also asking students to recall prior information and to understand mathematics representations in a different medium, e.g., how to make a ray with your body, so the cognitive activity level is a 2. The second five minutes is coded TIS, LWD and O. It could be coded just O and then explained. The level of cognitive activity is a 3 because the students have to make new representations. The third five minutes is the students back in a normal classroom with L perhaps a little LWD toward end but the predominate type of instruction for the five minutes is lecture. The question at the end about why we want to measure angles is good and brings out discussion.

4. Physics of Sound and Frequency – Science, high school

Context:

This is a high school physics class. The lesson is on beat frequency. Students have been studying the Doppler effect in the past few classes and have completed a lab on closed pipes. They will continue the next week working with open pipes.

Time in minutes:

	0-5	5-10	10-15
Instruction	L, D	D, LWD	L, D
Student Engagement	ME	HE	HE
Cognitive Activity	1	2	2

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	3
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	3
3. Students were reflective about their learning.	2

4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	2
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	1
6. The lesson promoted strongly coherent conceptual understanding.	3
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	2
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	4
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	3
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	3
11. Students' understanding of important mathematics/science concepts.	3
12. Students' capacity to carry out their own inquiries.	2

Capsule Description of the Quality of the Lesson

● *Level 3: Beginning Stages of Effective Instruction (Select one below.)*

O *Low 3* ● *Solid 3* O *High 3*

Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher/instructor may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:

This lesson is rated a Solid 3 because it is effective but not yet accomplished. The demonstrations provide a good opportunity for inquiry but the instructor doesn't capitalize on them. It is also somewhat difficult to follow and rate since different activities often occur in the same five-minute segment. The first five minutes of D and L are interesting but at a low cognitive level. There is little evidence of what the student engagement actually was, so it was arbitrarily marked as HE based on the one scan of the class. The second five minutes was a mix of several different things but generally L with some D and some LWD. The amount of student talk is quite minimal, however. Students were asked to do problems and were asked questions based on the demonstrations so the cognitive level was higher, but the teacher still went directly to the "correct" answer. The last five minutes is also a mix of things beginning with the demonstration with the pipes and lecturing on how to do a problem. This might be best characterized by all three, L, D and LWD, but L and LWD are mutually exclusive categories so one would have to be picked. Because both the second and third five-minute segments contained both L and LWD, one was marked L and one LWD. It would be possible to consider the last section PM, but it would be a stretch since the teacher is more solving a problem than presenting a model for how to solve problems. The questions in this section also make the students apply knowledge from the demonstration so a cognitive activity level of 2.

5. Weights and Measures – Science, 1-3rd grade

Context:
This is a mixed-age class with 25 students in grades one through three. The children have been studying the concept of measurement, using units such as time, and making comparisons, for example, how much, how many, and so on. The children have been measuring weight and previously weighed themselves. This lesson is on comparing weights.

Time in minutes:

	0-5	5-10	10-15
Instruction	LWD, D	LC, SGD HOA, TIS, WW	LWD
Student Engagement	HE	HE	HE
Cognitive Activity	2	2	3

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	3
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	N/A
3. Students were reflective about their learning.	4
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	4
6. The lesson promoted strongly coherent conceptual understanding.	3
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	3
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	3
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	3
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	4
11. Students' understanding of important mathematics/science concepts.	3
12. Students' capacity to carry out their own inquiries.	4

Capsule Description of the Quality of the Lesson

● *Level 3: Beginning Stages of Effective Instruction (Select one below.)*

O *Low 3* O *Solid 3* ● *High 3*

Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher/instructor may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the

lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:
This lesson was rated a High 3 because it is effective but still has room for improvement. The teacher had the correct elements but didn't quite pull them off with competent style. The first five minutes is LWD with D and a cognitive activity level of 2. Because of the age of the students, the questions asked at the beginning do require them to consider what they know and how to represent it. They are also asked to make predictions. The second five minutes involves SGD, HOA, TIS, and LC. Additionally WW could be included since the students are shown writing in their books. The questions the teacher is shown as asking are not encouraging the students to think deeply, although the tape does not show her talking very much. The last five minutes, when she is summarizing the lesson, she asks about comparing versus exact weights, suggests a real world application and has the students reflect on their own learning.

6. Machines – Science, upper elementary

Context:
This is an upper elementary classroom of 24 students. These students have been working in groups to design and build parts of a larger "Rube Goldberg" machine that will move a marble in a given time. In this lesson students are testing their individual machines to see if the results fit with their predictions. They have to decide whether they need to make changes and also where their machine should fit in the total design.

Time in minutes:

	0-5	5-10	10-15
Instruction	SP	LWD, D	LWD
Student Engagement	HE	HE	HE
Cognitive Activity	3	4	4

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	5
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	N/A
3. Students were reflective about their learning.	3
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	5
6. The lesson promoted strongly coherent conceptual understanding.	2
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	4
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	2
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	2

10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	4
11. Students' understanding of important mathematics/science concepts.	2
12. Students' capacity to carry out their own inquiries.	5

Capsule Description of the Quality of the Lesson

- *Level 4: Accomplished, Effective Instruction*

  Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher/instructor presentations, discussions with each other or the teacher/instructor, reading). The lesson is well designed and the teacher/instructor implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

Justification:

This lesson was rated a 4 because it exemplified effective instruction. Although the class appears to be somewhat chaotic, the elements of effective instruction are in place and there is a strong emphasis on getting the children to hypothesize and inquire. The first five minutes were LWD and SP as the teacher had each of the groups describe the part of the machine they had built and where they thought it would fit into the group machine that they were building. The cognitive activity level was 3 since students were presenting their own ideas. The second five minutes they are estimating times and then seeing how long it actually takes the marble to travel through their part of the machine. Then they are trying to change the times so that the whole machine will take the appropriate amount of time. She is asking questions about how could we change this, what could be done, etc. This is LWD and D with a cognitive activity level of 4. This continues into the last five minutes but with no demonstration.

7. Properties of Water – Science, 6th grade

Context:

This is a sixth grade science classroom with 15-18 students. This lesson is in the middle of the second day spent studying the physical characteristics of water.

Time in minutes:

	0-5	5-10
Instruction	LWD, D	CD, D
Student Engagement	HE	HE
Cognitive Activity	2	3

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	3
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	2
3. Students were reflective about their learning.	2
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3

5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	3
6. The lesson promoted strongly coherent conceptual understanding.	2
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	3
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	3
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	2
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	2
11. Students' understanding of important mathematics/science concepts.	2
12. Students' capacity to carry out their own inquiries.	2

Capsule Description of the Quality of the Lesson

- *Level 2: Elements of Effective Instruction*

  Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:

This is one of four video clips taken from the Annenberg tapes of science classrooms and as such it is available commercially. The clips were selected because they either did not have, or only had small sections of, nonclassroom activity. The clips were coded and rated by both the Core Evaluation Project team and the staff at Horizon Research. Horizon Research developed the capsule rating and trains observers for Local Systemic initiatives across the country.

This lesson was rated a 2. There were substantial problems in how the three parts of the lesson hung together, which limited the extent to which the lesson could further students thinking. There were missed opportunities to develop students' thinking, primarily by failure to encourage more student interaction and to move discussions toward greater closure before shifting to another activity. The lesson is only 10 minutes long. The first five minutes includes LWD and D with the students at a cognitive level of 2. The second five minutes includes some different activities, but the predominate activity is CD where the students are talking to each other and critiquing their ideas. This discussion doesn't take place for the full five minutes and does include some teacher talk, but it does appear to be full class, student-to-student interaction. The cognitive activity level would be a 3.

8. Crickets – Science, 9th grade

Context:
This is a ninth grade science class and the second day of a lesson using cricket behavior observations as a way to learn how to design and carryout scientific investigations. There are about 20 students in the class.

Time in minutes:

	0-5	5-10	10-15	15-20
Instruction	L, SGD, TIS	SGD, WW, TIS, A	SGD, LWD, TIS	SGD
Student Engagement	ME/HE	ME/HE	HE	HE
Cognitive Activity	2	2	2	2

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	3
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	2
3. Students were reflective about their learning.	2
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	5
6. The lesson promoted strongly coherent conceptual understanding.	3
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	3
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	4
9 Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	3
10 Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	3
11 Students' understanding of important mathematics/science concepts.	2
12 Students' capacity to carry out their own inquiries.	3

Capsule Description of the Quality of the Lesson

- *Level 2: Elements of Effective Instruction*

  Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:
This is one of four video clips taken from the Annenberg tapes of science classrooms and as such it is available commercially. The clips were selected because they either did not have, or only had small sections of, nonclassroom activity. The clips were coded and rated by both the Core Evaluation Project team and the staff at Horizon Research. Horizon Research developed the capsule rating and trains observers for Local Systemic initiatives across the country.

This lesson was coded a 2. The class lacked enthusiasm and intellectual involvement in the process; it appeared that they were going through the motions of what the teacher expected of them, but the students were not invested in what they were doing. Students were not experiencing the truly investigative nature of science, but rather a prescribed, vocabulary-focused version set up by the teacher. There was evidence that the students are not "getting it"; many seemed unclear about the notions of variable, hypothesis, controls, etc. This lesson does not fit easily into the five-minute time frames. You could either break up the first five minutes into L and then SGD with TIS or code it one way or the other. The third five minutes is also somewhat of a split with LWD as well as SGD. The cognitive activity level is a 2 throughout since the students appear to be applying specific rules.

9. Optics – Science, 11th and 12th grade

Context:
This is a physics class of 11th and 12th grade students (~20) who are studying optics. This lesson is during the third day spent on this topic.

Time in minutes:

	0-5	5-10	10-15
Instruction	L (2 min) SGD, HOA, TIS	SGD, HOA, TIS	SP
Student Engagement	HE	HE	HE
Cognitive Activity	1 / 4	4	3

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	5
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	5
3. Students were reflective about their learning.	4
4 The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	4
5 Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	5
6 The lesson promoted strongly coherent conceptual understanding.	4
7 Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	5
8 The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	5

9 Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	5
10 Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	5
11 Students' understanding of important mathematics/science concepts.	5
12 Students' capacity to carry out their own inquiries.	4

Capsule Description of the Quality of the Lesson

- *Level 4: Accomplished, Effective Instruction*

  Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher/instructor presentations, discussions with each other or the teacher/instructor, reading). The lesson is well-designed and the teacher/instructor implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

Justification:

This is one of four video clips taken from the Annenberg tapes of science classrooms and as such it is available commercially. The clips were selected because they either did not have, or only had small sections of, nonclassroom activity. The clips were coded and rated by both the Core Evaluation Project team and the staff at Horizon Research. Horizon Research developed the capsule rating and trains observers for Local Systemic initiatives across the country.

Although this lesson begins abruptly with the review of the "If I DO, I DI" learning aid for the formula, it is rated a 4. There is excellent group dynamics and questioning by the teacher to get at student understanding. Directions on the design task are unclear to students. Thus a number of students are trying to remember the actual workings of the eye from biology class instead of examining the different design options. It is not until the teacher visits a couple of groups that he clarifies for the students that they are to use the formula to prove their eye design and that they are to come up with as many eye designs as possible. There is a great wrap up. The fifteen minutes don't split well into five-minute segments. The first five minutes includes both L and SGD with HOA and TIS. The bulk of the time is SGD as is the second five minutes. The last five minutes is primarily SP even though there are a few instances of other activities like the summary. Since the students are reflecting on their own understanding and developing models, the cognitive level is high.

10. Chemical Reactions – Science, 9th grade

Context:

This is a ninth grade class of 15-20 students who are in the first day of a unit studying chemical reactions.

Time in minutes:

	0-5	5-10
Instruction	SGD, HOA, TIS	LWD
Student Engagement	HE	HE
Cognitive Activity	3	3

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	3
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	3
3. Students were reflective about their learning.	2
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	4
6. The lesson promoted strongly coherent conceptual understanding.	2
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	3
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	3
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	3
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	3
11. Students' understanding of important mathematics/science concepts.	3
12. Students' capacity to carry out their own inquiries.	2

Capsule Description of the Quality of the Lesson

- *Level 3: Beginning Stages of Effective Instruction (Select one below.)*

  - *Low 3* O *Solid 3* O *High 3*

  Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher/instructor may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:

This is one of four video clips taken from the Annenberg tapes of science classrooms and as such it is available commercially. The clips were selected because they either did not have, or only had small sections of, nonclassroom activity. The clips were coded and rated by both the Core Evaluation Project team and the staff at Horizon Research. Horizon Research developed the capsule rating and trains observers for Local Systemic initiatives across the country.

This lesson was rated a low 3 assuming the teacher's purpose was to introduce/practice observation skills. Further assuming that this was early in the school year, the class was just beginning to study chemical reactions and properties. The teacher was weak in her questioning technique, and lacking in constructive criticism; she praised the students for just about everything

they said, whether or not it was significant. Having the students generate "What if…" questions at the end was good. The ten minutes began with a brief L but was mostly SGD, HOA and TIS. The last five minutes was LWD. The cognitive activity level was a 3 since the students were trying to analyze and create explanations.

11. Statistics - Educational Psychology, college juniors, seniors and graduate students

Context:

This is an introductory level statistics course for graduate students and selected juniors and seniors. This lesson is the first class period of the term.

Time in minutes:

	0-5	5-10	10-15	15-20
Instruction	SGD	LWD	LWD	WW
Student Engagement	HE	HE	HE	HE
Cognitive Activity	2	2	1	3

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	5
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	4
3. Students were reflective about their learning.	2
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	5
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	5
6. The lesson promoted strongly coherent conceptual understanding.	4
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	4
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	5
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	5
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	3
11. Students' understanding of important mathematics/science concepts.	2-3
12. Students' capacity to carry out their own inquiries.	3

Capsule Description of the Quality of the Lesson

- *Level 4: Accomplished, Effective Instruction*

  Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher/instructor presentations, discussions with each other or the teacher/instructor, reading). The lesson is well-designed and the teacher/instructor implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most

students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

Justification:
This 18-minute lesson was rated a 4 because it exemplifies accomplished instruction. The instructor begins the class with the students gathering demographic data within the class. This allows them a real world context for the use of the material that will be covered in class. These data are used as a basis for the next section of the class. She also uses the question to have the students explore their feelings about statistics. This class does not break up conveniently into five-minute sections. The first five minutes or so is a mix of a brief section of L then a long section of SGD then the beginning of LWD, which continues for about five minutes, and then a two minute SGD followed by more LWD. This continues until the end of class with a brief period of WW. The predominant activity for the first five minutes is SGD so that is the code used. The level of cognitive activity is a 2 because the students are being asked to collect information. The second five-minute section of class was coded LWD since the instance of SGD was only two minutes long. The level of cognitive activity was 2 since the students were asked about the types of data they were recording. The next five minutes is coded LWD. A large section of the LWD was listing the different statistical words the students knew. This is recall and so was coded as a 1. The final segment of the class was WW which required the students to organize information so was coded a 3.

12. Secondary Science Methods - Curriculum and Instruction, post baccalaureate

Context:
This is the second semester of science methods in a post-baccalaureate teacher licensure program. These preservice teachers are working toward 5-12 licensure. Most are life science majors. Classes are held one afternoon a week for two and a half hours. Students are familiar with group work and with each other. This lesson has several components; the component presented here has the students role-playing and reflecting.

Time in minutes:

	0-5	5-10
Instruction	L	TIS, SGD, HOA
Student Engagement	HE	HE
Cognitive Activity	1	4

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	5
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	3
3. Students were reflective about their learning.	4
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	5
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	5
6. The lesson promoted strongly coherent conceptual understanding.	4

7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	4
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	4
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	3
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	4
11. Students' understanding of important mathematics/science concepts.	4
12. Students' capacity to carry out their own inquiries.	4

Capsule Description of the Quality of the Lesson

- *Level 4: Accomplished, Effective Instruction*

  Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher/instructor presentations, discussions with each other or the teacher/instructor, reading). The lesson is well-designed and the teacher/instructor implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

Justification:

This lesson was coded a 4 because it exemplified accomplished instruction. The class begins with a lecture section where the instructor explains that the class will be an example lesson of what sort of teaching the students would be expected to do. He expects the students to think about it both as a lesson and how they would use this as a lesson and its strengths and weakness. This setting up is L with a cognitive activity level of 1. The instructor continues with the setting up of the sample lesson and then the students participate in the lesson. The sample lesson is well set up with the instructor having a list of ideas and questions about isopods that the pretend students had generated. This shows the use of student input and real world examples and of investigating questions of interest to the students themselves. The sample lesson includes SGD, HOA and TIS. The lesson as it is would have a fairly high cognitive level. However, since the real students are not only doing the experiment but also thinking metacognitively about it, the cognitive level is a 4.

13. Changing Planet—Proportions - Science, college nonscience majors

Context:

This is an introductory science course for nonscience majors called "This Changing Planet." The course is taught by various instructors. Students have three lecture sessions and one laboratory session per week during which they work in cooperative groups. This lesson is on probability.

Time in minutes:

	0-5	5-10
Instruction	L	L, PM
Student Engagement	HE	HE
Cognitive Activity	1	2

Ratings of Key Indicators:

1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	1
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	2
3. Students were reflective about their learning.	1
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	2
5. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students.	3
6. The lesson promoted strongly coherent conceptual understanding.	3
7. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	1
8. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in her/his dialogue with students).	5
9. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns.	2
10. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	2
11. Students' understanding of important mathematics/science concepts.	3
12. Students' capacity to carry out their own inquiries.	2

Capsule Description of the Quality of the Lesson

- *Level 3: Beginning Stages of Effective Instruction (Select one below.)*

  - *Low 3* O *Solid 3* O *High 3*

  Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher/instructor may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

Justification:

This short lesson was coded a 3 because it contained some elements of effective instruction. There is a lack of coherence in the activities and insufficient use of the outcomes of the small group work. The class begins with a lecture with the instructor describing how to answer a prior problem and then talking about several administrative points. Then the students are asked to consider a probability problem briefly in small groups. Then the students are back into lecture with the instructor doing a problem. This could be considered problem modeling since he is talking about a model for how to do an entire set of probability problems. The cognitive activity level for this section is a 2 because it includes the students thinking about how to apply what they know about probability when they are in their small groups.