The Development of the Inquiry Science Observation Code Sheet (ISOCS)

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The Inquiry Science Observation Code Sheet (ISOCS) was developed to measure teachers' use of questioning strategies in classrooms using the Foundational Approaches to Science Teaching (FAST) program. The code sheet is only one piece of a larger data collection guide, the Inquiry Science Observation Guide (ISOG), an in-depth, comprehensive manual that includes information about observation data collection ranging from videotaping to coder training. The purpose of the guide is for collecting rich information about the quality of FAST program implementation (Ruiz-Primo, 2005).

In this paper we introduce the FAST program, describe the development of the ISOCS instrument, explain the coder training and data collection process, describe coding procedures, and present some preliminary analyses of the reliability of the coded data including lessons learned along the way.

FAST: The Program

FAST is an interdisciplinary middle school science program developed at the Curriculum Research & Development Group (CRDG), University of Hawai'i at Mānoa that is aligned with the National Science Education Standards (CRDG, 1996; Rogg & Kahle, 1997). It consists of three inquiry courses entitled, "FAST 1: The Local Environment," "FAST 2: Matter and Energy in the Biosphere," and "FAST 3: Change Over Time." For the research described here, we focused only on FAST 1, physical science (PS) lessons 4, 7, 10, 12, and 13. Each lesson (called an *investigation*) occurs in three inquiry phases: Introduction, Investigation, and Interpretation.

According to the FAST curriculum developers, the program is designed to focus on students taking on roles as "practicing scientists" working together in research teams, with the majority of time spent working on laboratory experiments. The program was carefully designed, with each science investigation following a specific sequence that is driven through inquiry. The sequence was intended to promote constant retesting of hypotheses and conclusions, emphasizing the influence of new findings on previous explanations (Young & Pottenger, 1992). Reflecting back and considering that the FAST program was developed in the late 70's, it is clear that the FAST developers were early pioneers in promoting the importance of student driven inquiry in science classrooms.

As defined by the National Research Council (2001), inquiry occurs through engagement in an activity, with a clear understanding of the task at hand, the ability to draw from a bank of previously learned knowledge, and a willingness to take risks in making predictions about possible solutions to a problem or question. According to the National Science Education Standards (NSES):

> The instructional activities of a scientific inquiry should engage students in identifying and shaping an understanding of the question under inquiry. Students should know what the question is asking, what background knowledge is being used to frame the question, and what they will have to do to answer the question." (NRC, p. 144)

There are many goals that can be met through students engagement in laboratory experiences or investigations, including (a) mastery of subject matter, (b) developing scientific reasoning, (c) understanding the complexity and ambiguity of empirical work, (d) developing practical skills, (e) understanding the nature of science, (f) cultivating interest in science and interest in learning science, and (g) developing teamwork abilities

(NRC, 2005). Although all of these goals are unlikely to be covered in any single investigation, multiple goals are likely to be met across carefully designed laboratory experiments.

The FAST teacher is viewed as a facilitator or research director and is described as "a colleague who stimulates and facilitates. . .probing into problems" (Young & Pottenger, 1992, p. 7). The role of facilitator is to guide students towards understanding new information, which requires identifying what students already know through teacher-student dialogue and using questioning techniques that are likely to engage students in meaningful conversations. For a teacher to successfully facilitate a lesson, she must understand the content of the material and the goals of the lesson so that she can ask questions that will promote maximum engagement of students.

There are two types of FAST facilitators—directive and non-directive (Young & Pottenger, 1992). A directive facilitator uses questioning techniques that include clarifying, extending, focusing, lifting, and summarizing, whereas a non-directive facilitator uses techniques such as planning a strategy, stating the problem clearly and precisely, suggesting a problem-solving approach, accepting and clarifying communication, withholding judgment, accepting feelings, keeping the discussion focused, and summarizing and clarifying direction (Young & Pottenger, 1992). The former technique demands a solid foundation in content knowledge, compared with the latter, which relies more on pedagogical techniques—the ability to lead open-ended discussions—that are not dependant on knowing the content. It is important to distinguish the difference between both techniques, as the ISOCS is modeled on three of the five directive questioning techniques described in the Instructional Guide—those which the developers felt were the three most important for observers to identify.

The Code Sheet

The ISOCS is a checklist sign instrument (Galton, 1988) designed for identifying and recording teacher behaviors during a set period of time, typically a lesson block or class period. Observation instruments of this type are intended to record the incidence of a list of low-inference behaviors (Evertson & Green, 1986), with collected data reflecting frequencies and patterns of the described behaviors, save any ratings.

Through the collaborative efforts between the authors of this paper, the FAST curriculum designers, FAST teachers, and other researchers, the Inquiry Science Observation Code Sheet was developed over a one-year period. We reviewed FAST program materials, including the Instructional Guide, the student book, and the Teacher's Guide. We prepared a "map" that clearly outlined each of the 88 investigation in FAST 1, highlighting both teacher and student activities, but decided that the map was far more intricate than necessary for the proposed (budgeted) project and that it would be more practical (feasible) identifying those variables that cut across the five investigations selected for data collection. We reviewed an observation protocol and teacher log developed at the Stanford Educational Assessment Laboratory, with whom Curriculum Research & Development Group collaborated on another NSF project about the FAST program (No. ESI 0095520) and examined the FAST Classroom Observation Instrument (COI), a research instrument based on the Instrument for the Observation of Teaching Activities that has been used to collect observation data in previous studies of the FAST program. Finally, we maintained continuous and close collaboration with both FAST developers throughout the instrument development process, while the senior FAST curriculum developer was concurrently crafting a monograph on inquiry using the FAST program (Pottenger, 2005). The lead instrument developer served as the primary liaison between coders and the broader research team and many revisions were made resulting from meetings in which discrepancies between coders or within the instrument were identified. Modifications of the instrument were then presented to the research team and open to further discussion and suggestions.

During this period, revisions and modifications were made weekly and occasionally daily. The initial development processes might best be described as pursuing a moving target while the instrument continued to be fine-tuned. Early drafts included more than 60 items describing teacher behaviors, ranging from formal lecture and direct instructional teaching strategies, to teacher guided and facilitated instructional practices, as well as other research-based good teaching practices (see Appendix A), which were largely formulated with the Center for Research on Education, Diversity and Excellence (CREDE) Five Standards for Effective Pedagogy in mind (Tharp et al., 2000). Two part-time graduate assistants and the senior author tested these items with a sample of videotaped FAST classes and refined the instrument over a period of four months. Eventually they transformed it into a 31-item classroom observation tool, as seen in Appendix B, that shows three types of questions in the first column—clarifying, lifting, and summarizing (Column A)—with four columns of activities (Columns B–E) following.

Column A lists the type of teacher-initiated question used to begin a discussion; Column B lists 14 different activities in which students can be engaged in, allowing for multiple activities to occur simultaneously; Column C is for noting a student’s response, ranging from no response to a comment or question; Column D lists possible teacher responses to the student; and Column E is for identifying whether a teacher is actively moving throughout the classroom, making contact with individual groups, or addressing the class as a whole. Each coding sequence begins with a teacher question from Column A, noted by the inquiry start time in minutes and seconds, and is followed by “strings” of activities using Columns B–E.

Collecting Data for Developing the ISOCS

Throughout the 2004–05 school year, FAST 1 physical science lessons were taped in the classrooms of a sample of 16 public- and private-school teachers on four islands in Hawai‘i. The purpose of the taping was to collect data for piloting and validating our instruments. Part-time employees were hired on each island and were trained in how to videotape lessons. The videotapers were provided video cameras and other equipment (e.g. boom and lavaliere microphones, digital cassette tapes, watch and camera battery replacements, and a battery recharger). The teachers were asked to keep the videotapers apprised of their progress through the investigations and to inform them when they anticipated teaching the next targeted lesson (i.e., PS4, PS7, PS10, PS12, and PS13). Not all lessons were taped from the pool of 16 teachers because of unanticipated conflicts such as scheduling, miscommunication, or faulty equipment. By the end of the year, the videotapers had recorded a total of 135 FAST investigations, collecting from zero to five investigations per teacher. The videos were transferred to DVDs for coding (one DVD per class period) and following quality checks for each—to determine the visibility of the teacher and audio quality—91 DVDs were identified as 100% acceptable and 16 were 75% acceptable, leaving a remaining 107 total DVDs to be coded.

Coder Training

A total of eight individuals were hired and trained to use the ISOCS. It was believed by the instrument developers that the group of coders would be imperative to the revision process, but for many of them, modifications to the instrument became an overwhelming challenge. The backgrounds of coders were broadly diverse, ranging from a veteran science teacher to others with little or no previous experiences working with a science curriculum or any practical teaching experience. There were two reasons for our broad coder recruitment criteria. First, there were hundreds of hours of videotapes to observe and code; we needed to recruit as many coders as possible. Second, we believed that a multifaceted team of observers with disparate views and beliefs toward education (e.g., careers in business, engineering, and the film industry) might prove to be a valuable resource, extending the coders' insights and capabilities beyond what trained and experienced teachers and educators might offer.

By the third month of coding, participation by those individuals from non-education backgrounds slowly began to fade. The two remaining coders both had some formal teacher training and classroom teaching experience; one teacher had experience teaching science. This suggests that the coders who did not have any formal pedagogical or content training courses in education were not well-suited for coding classroom observations. Thus, our second reason for recruiting many coders proved faulty, because the differences among coders' insights and perspectives were too great for sustaining efficient and reliable coding. These findings suggest that too much diversity can counteract, complicate, and slow the process of training coders and conducting classroom observations. We believe that it is essential to narrow the selection criteria of possible coders to include those with the pertinent pedagogical and content background knowledge and experiences, thereby ensuring that the instrument objectives can be attained.

The Coding Process

Over an eight-month period, the two remaining part-time coders observed, coded, and reconciled the 107 DVD recorded investigations. Each coder independently viewed and coded each DVD, later reconvening to identify those codes that matched, were close to matching, and were not a match. The pair discussed their differences until reaching consensus on an observed string of codes, resulting in a reconciled, observed teacher behavior.

On average, coders took approximately 3–6 hours to complete the coding process for a single DVD, beginning with (a) the first viewing, (b) coding observed behaviors, and (c) reconciling codes with a partner. The purpose of the first viewing was to allow the coders to learn about (a) the teacher's intended activities during the lesson and whether she conducted the activities as intended, (b) any unusual situations that may have occurred and interfered with the taping (e.g., a fire drill, student emergency, and so forth), and (c) whether the DVD was audible and the teacher was on camera (observable) for the majority of the taped lesson.

During the second viewing, observed teacher behaviors were coded. Coders recorded the minute and second at which teachers asked any of the types of questions shown in Column A of the ISCOS and then recorded "strings" of activities in Columns B–E that ended with the next teacher-initiated question. Initially, this stage of the coding was time consuming, because it required that the DVD be paused while matching observed behaviors with ISOCS codes. Over time, the codes became familiar to the coders, which sped up the coding process.

The final stage of coding involved two coders comparing their individual codes, first identifying similar recorded start times (e.g., 12:44 for one coder and 12:42 for the second coder) and then comparing the strings of codes (e.g., A3, B8, C1, D2, E2 for one coder and A2, B3, B8, C1, D2, E1 for the second coder). The coders also recorded relevant notes that proved helpful in expediting the reconciliation process. This process resulted in one set of codes for each teacher, indicative of instruction led by the three specified teacher initiated questioning strategies: clarifying, lifting, and summarizing.

Preliminary Analyses of ISOCS Data

To date we have conducted three types of preliminary analyses of the codes for the purposes of demonstrating code reliability. These include a correlation analysis, a one-way analysis of variance (ANOVA), and a review of the differences in patterns and percent agreement between the two coders. A total of 20 code sheets on seven teachers from the two coders, as shown in Table 1, were randomly selected for these analyses. As seen in the table, the number of codes recorded for each teacher and for each investigation varied considerably. For some teachers, there were as few as a single code string, and for others there were more than 100.

Table 1
Nineteen Randomly Selected Raw Data Code Sheets

Teacher no./ investigation no.		Total number of raw codes (*N*) and percent (%) of matched codes against total number of raw codes				Total number (*N*) of matched codes within 1 minute
		Coder 1		Coder 2		
		N	%	*N*	%	
3	PS 4	29	59%	33	52%	17
20	PS 10	42	19%	33	24%	8
21	PS 4	36	92%	50	66%	33
9	PS 12	12	83%	36	28%	10
7	PS 10	33	58%	55	35%	19
3	PS 7	110	81%	162	55%	89
3	PS 12	55	87%	128	37%	48
16	PS 13	65	65%	90	47%	42
8	PS 10	9	78%	12	58%	7
3	PS 13	13	85%	15	73%	11
1	PS 12	8	88%	12	58%	7
7	PS 7	120	45%	76	71%	54
5	PS 10	12	42%	29	17%	5
2	PS 10	25	44%	18	61%	11
13	PS12	24	(75%)	33	(55%)	18
16	PS 10	21	(52%)	19	(58%)	11
5	PS 7	56	(41%)	34	(68%)	23
6	PS 4	16	(38%)	16	(38%)	6
2	PS 4	31	(48%)	23	(65%)	15

Correlation Analysis

The purpose of the correlation analysis was to determine whether the coders' perceptions of the number of codable activities were consistent across the lessons shown in Table 1. Pearson's *r* between the two coders' number of codes across the 19 lessons =

.79 ($p < .01$). This finding shows that each coder's identification of codable activities was consistent across lessons and suggests internal consistency within each coder.

In Figure 1, a scatter plot of each coders' individually (pre-reconciled) recorded codes is shown. The plot shows the clear relationship between the two coders' number of codes per lesson. Note the four outliers in the scatter plot. Removing these outliers reduces Pearson's *r*, changing it from .79 to .57 ($p<0.05$).

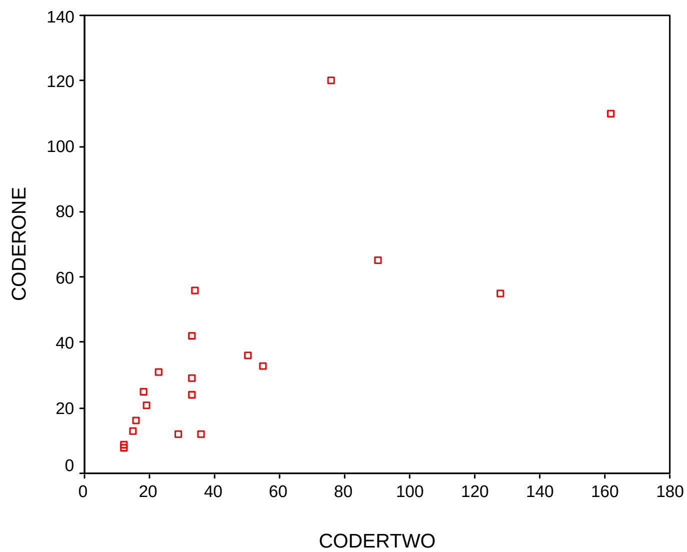

Figure 1
Two Coders total number of raw codes

ANOVA

The purpose of the one-way ANOVA was to determine whether the two coders' total number of codes per lesson varied at statistically significant levels between coders' mean total scores. The mean total number of codes for Coder 1 was 27.4 (st. dev. = 20.6), and the mean total number of codes for Coder 2 was 42.6 (st. dev. = 37.9). The results of the ANOVA showed no statistically significant difference ($F = .31$; $p = .58$). This finding suggests that the two coders identified similar numbers of codable activities per lesson—another sign of reliability.

Comparison of Coder Patterns and Percent Agreement

Despite the finding of a strong correlation between total numbers of codes and the finding of no statistically significant difference between the total number of coders' codes across lessons, both of which suggest reliable results, we found systematic differences among the two coders' results. We compared the two coders' pre-reconciled code sheets, categorized by the recorded times that indicated when an activity string (i.e., A-E) was observed to have begun. Starting times within a one-minute period were identified as matches (e.g., 12:22 and 12:07). The shaded cells in Table 1 indicate the higher percentage of the two coders' codes. For example, in Row 1 for Teacher 3, PS4, Coder 1 recorded 29 codes while observing the DVD independently and Coder 2 recorded 33 codes. The total number of codes that both individuals agreed upon is 17. The percentages represented for each coder were calculated by dividing matched codes by the total number of individual codes (e.g., 17 ÷ 29 = 59%). As seen in Table 1, Coder 1 systematically recorded fewer codes per lesson than Coder 2, who tended to observe and record more, at times recording twice as many codes as Coder 1. Of the results for the19 investigations shown in Table 1, 12 of Coder 2's total number of recorded codes are greater than Coder 1's, one is the same, and six are less than Coder 1. There are at least three reasons for this. First, perhaps Coder 1 focused less on coding the details of the lessons—that is, on recording fewer sub-strata codes—and instead paid closer attention to the teacher's initial questioning strategies. Second, Coder 1 might have not coded behaviors that warranted coding. Third, the differences in the frequencies of recorded codes between coders might be due to the fact that the instrument was modified and refined repeatedly during the development of the codes. Recall that the ISOCS went through approximately forty iterations before reaching its current version.

The next step in analyzing codes was to compare the two coders' individual code strings (e.g. A1, B3, C4, D2, E1) in the pool of codes with matching start times that we show in Table 2. As seen in the table, there are some consistencies in codes between coders, but there also are clear differences between the coders' choice of codes. There are a number of reasons that might explain differences between coding strings. First, as indicated previously, the definitions were changed and fine-tuned throughout the instrument development process. For either coder, it may have been difficult to replace earlier, loosely defined understandings of words and concepts and adopt or, minimally, accurately interpret the new definitions. Second, recognizing that the coding process was quite laborious, coders were encouraged to record observable behaviors using the style and techniques with which they felt most comfortable, for the reason that this approach might help simplify the reconciliation process. Because of this lack of uniformity in data recording procedures, Coder 2 tended to weigh on the side of caution when coding, working from a *more is better* perspective for the reason of expediting the reconciliation process. Note Rows 7 and 8 in Table 2, beneath column headings *Coder 1* and *Coder 2*, where Coder 2 has recorded two separate beginning times (Row 7, 1:48 and 3:28; Row 8, 35:30 and 35:55) compared with Coder 1, who included some matching but fewer codes (D8 in Row 7; D8, D3 in Row 8), as an extension of a single time stamp.

Table 2
Samples of Individual Coder's Pre-reconciled Codes

Row no.	Teacher No./Investigation No.		Time stamp	Coder 1	Time stamp	Coder 2
1	T3	PS12	19:45	A2, **B9**, B11, **C3**	19:52	A1, **B9**, **C3**, D6
2	T20	PS10	15:20	A2, **B5**, **C3**, D6, E2	15:27	A1, **B5**, **C3**, D4, E1
3	T20	PS10	33:55	**A2**, **B11**, **C3**, D4	33:42	**A2**, **B11**, **C3**, D6, E2
4	T21	PS4	1:23	A3, **B1**, B11, **C3**, **D8**	1:24	A2, **B1**, B9, **C3**, **D8**
5	T7	PS10	19:12	**A1**, **B3**, **C3**, **D8**, C3, **D6**	19:14	**A1**, **B3**, B12, B7, **C3**, **D8**, **D6**, C4, D6
6	T3	PS7	15:31	**A3**, **B3**, **B11**, C1, D8	15:50	**A3**, **B3**, **B11**, C3, D6
7	T3	PS12	2:38	**A2**, **A3**, B2, **B11**, **C3**, **D8**	1:48 3:28	**A2**, **A3**, B3, **B11**, **C3** **D8**
8	T16	PS13	35:30	A1, B5, **C3**, **D4**, D6, D7, **D8**, **D3**	35:30 35:55	A2, B7, **C3, D4,** C3 **D8**, **C3**
9	T8	PS10	11:33	**A1**, A2, B9, **B11**, **C3**, **D8**, C3, D6	11:36	**A1**, B3, **C3**, D6, A1, **B11**, **D8**
10	T1	PS12	36:38	A1, B5, **C3**, **D6**, D8, **C3**, **D6**, C3, D6	37:15	A2, B11, **C3**, D3, **D6**, **C3**, **D6**, E1

To identify the differences between coders, each section (i.e., A-E) was summed and totaled by matches and non-matches (see Table 3). These results were then analyzed to identify the percent agreement for each section. Note in Column E, which is about the teacher's circulation throughout the room, there is no agreement between coders; the greatest percent agreement is in Column C (student responses), and the other three columns (A, *teacher initiated questioning strategy*; B, *activity students are working on*, and D, *teacher's response to student*) do not reflect a significant percent agreement between coders. These results suggest that there are still revisions necessary to work through in improving the instrument, which is consistent with what the coders and lead instrument developer concluded following the completion of coding all DVDs.

Table 3
Non-matched and Matched Codes

	A	B	C	D	E	Total
Non-match	12	13	8	16	4	53
Match	12	18	20	19	0	69
Total recorded	24	31	28	35	4	121
Percent agreement	.50	.58	.71	.54	.00	.57

What Next?

Several issues were raised but not completely resolved over the months of developing and revising the instrument. Upon completion of all DVD codings, the first author met with the coders to discuss their reflective thoughts, suggestions, and any concerns they had about the instrument and coding process. The discussion resulted in a list of nine questions and concerns:

1) When is the right time to record the start time, the beginning, middle, or end of the teacher generated question?

2) Are the teacher responses listed in column D hierarchical?

3) When the activity in column B changes as a result of a student question midway through a discussion, how should the shift from teacher to student-initiated questioning be recorded?

4) How did the non-sequential viewing of physical science investigations (i.e. PS4, PS7, PS10, PS12, and PS13) influence coding?

5) Should future DVD audio and teacher visibility quality checks be conducted by trained coders, instead of by a graduate assistant?

6) Is it important to note how frequently a teacher asks the same question to different groups, or should an identical question across groups be considered one question?

7) How important is it to record lesson phases (i.e. Introduction, Investigation, and Interpretation)?

8) Is it important to note whether or not a teacher is circulating throughout the room while facilitating a lesson (Column E)?

9) In the words of the coders, "Until the bitter end, A1, A2, and A3 remained ambiguous" and were often used interchangeably when coding.

Based on this list, there is obviously room for improving the Inquiry Science Observation Code Sheet instrument. Despite the weekly and eventually bi-weekly meetings with coders to discuss challenges throughout the coding process, the instrument development team was unable to anticipate some of the coders' concerns. This is in part because some of the challenges did not arise until coders actually began using the observation instrument. Smaller challenges, such as difficulty in interpreting definitions, and larger issues such as devising a systematic method for recording the complex, often simultaneous multiple activities occurring in the classroom served as reminders to the research team about the theoretical verses pragmatic application that must be carefully considered when designing observation instruments.

Throughout the instrument development period, an ongoing list of "lessons learned" was kept. There were many challenges encountered, ranging from inadequate audio resulting from temperamental Y-cables or haphazardly connected microphone hook-ups or dead or dying batteries, to missing data, data not collected as a result of teachers either not teaching one of the five required project investigations or not informing the project team in advance to arrange for the investigation to be videotaped. We were reminded of the often-learned lesson that researchers need to anticipate unforeseen circumstances when collecting classroom observation data. If the goal is to tape five lessons over the course of the school year, researchers probably should aim for seven or eight to improve the odds of collecting five. Without consistent data from individuals as well as across teachers (i.e., a broad distribution including the Introduction, Investigation, and Interpretation phases), it will be very difficult to analyze the actual quality of the data and perhaps more importantly, to draw any significant conclusions about teacher performance using inquiry. Because FAST is a sequence-built curricula, what one teacher is doing in PS 4 (Physical Science, Investigation 4), can not be compared with what another teacher might be doing in PS 13, especially if there are no videos to observe between these earlier and later lessons.

The development that is continuing on the ISOCS requires addressing these concerns. Just as students learn new information and gain new skills over time, the development of a classroom observation instrument is also an on-going process which requires continual building of both conceptual and practical knowledge and experiences.

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Appendix A
Inquiry Science Observation Guide:
Activities Targeted in SCUP-I Project Observations, Categorized By Teaching Standard

Lesson phase*			Inquiry mode		Inquiry mode process descriptors			
INT	INV	INTER	Category	***Authoritative inquiry***	A	B	C	D (use when applicable)
X	X	X	1	Teacher directs student (s) ______(A)_____ to _____(B)____ relating to ______(C)_____. (Also *D*, when applicable)	1A1. individually 1A2. in a small group	1B1. record 1B2. discuss 1B3. define 1B4. read relevant materials to whole class	1C1. observations 1C2. predictions/hypotheses 1C3. procedures 1C4. data: 1C4a. differences 1C4b. relationships 1C4c. quality of data 1C5. explanations 1C6. science terms	1D1. with evidence or examples 1D2. does not apply
X	X	X	2	***Descriptive inquiry*** Through _____(A)_____, the teacher ______(B)_____ science ______(C)_____. (Also *D*, when applicable)	2A1. direct instruction 2A2. questioning 2A2a. rhetorical 2A2b. interactive	2B1. introduces or provides an overview of 2B2. reviews 2B3. demonstrates 2B4. collects 2B5. compares/contrasts	2C1. concepts(idea) 2C2. procedures(task) 2C3. tools/equipment 2C4. investigation (activity) 2C5. problem 2C6. goal 2C7. -related safety issues 2C8. data: 2C8a. differences 2C8b. relationships 2C8c. quality 2C9. explanations 2C10. terms	2D1. new information 2D2. previously learned information 2D3. investigation 2D4. unit 2D5. does not apply
X	X	X	3	***Socratic inquiry*** Teacher questions students through ____(A)_____ and responds to student _____(B)_____ by _____(C)_____ the comment or question. (Also *D*, when applicable)	3A1. clarifying 3A2. lifting 3A3. summarizing 3A4. other:	3B1. comment 3B2. question	3C1. repeating 3C2. rephrasing 3C3. using a follow-up statement 3C4. goal-oriented redirecting 3C5. acknowledging 3C6. probing	3D1. clarifies understanding of science concept 3D2. provides correct answer 3D3. leaves open-ended 3D4. does not apply
	X	X	4	Teacher circulates throughout the room.	4A1.managing: 4A1a. task-based 4A1b. procedure-based 4A3. concept-based discussion			
X	X	X	5	Teacher makes new information relevant to students' previous experiences ______(A)______.	5A1. outside of school 5A2. relating to other subject areas			
		X	6	Teacher uses ______(A)_____ questions to engage students in conversations.	6A1. summary/key 6A2. challenge 6A3. other			

* INT = introduction or review phase; INV = investigation phase; INTER = summary and challenge phase.

Pilot-test version of 3/29/07

Appendix B
Inquiry Science Observation Code Sheet

	TEACHER INITIATED QUESTIONING STRATEGY		ACTIVITY		STUDENT RESPONSE		TEACHER FOLLOW-UP RESPONSE		TEACHER-STUDENT PROXIMITY
	***A* Code**		***B* Code**		***C* Code**		***D* Code**		***E* Code**
The teacher begins inquiry using	A1 clarifying question (meaning) A2 lifting question (generalizing, correlating, contrasting, comparing) A3 summarizing question (conclusion)	***about***	B1 making connections with previous investigations B2 the problem (book) B3 Summary/ Key (book) B4 Challenge (book) B5 predictions/hypotheses B6 tools/equipment B7 procedures (book-activity) B8 the investigation (science experiment) B9 observations/data collection B10 safety issues B11 data analysis B12 vocabulary words (by definition) B13 student's prior knowledge or experiences B14 new information outside of school	***and responds to the student(s)***	C1 no response C2 activity (students working together in groups) C3 comment C4 question	***by***	D1 no response D2 non-verbal acknowledgment D3 verbal acknowledgment D4 repeating D5 rephrasing D6 using a follow-up statement D7 goal-oriented redirecting D8 probing (clarifying) further	***while***	E1 facilitating a discussion with or between students w/o circulating. E2 facilitating a discussion with or between students while circulating.

DVD #_______ Teacher#_______ PS#_______ Videotaping date_________________ Reconciliation date_________________
Coders initials_______, _______

START TIME	*Small group (sg) or whole class (wc)*		***A* CODES**		***B* CODES**		***C* CODES**		***D* CODES**		***E* CODES**
		The teacher begins inquiry using		***question about***		***and responds to the student(s)***		***by***		***while***	