Appendix A

Summary of Nine Studies Examining the Effects of the Foundational Approaches in Science Teaching Program

Summary of Nine Studies Examining the Effects of the Foundational Approaches in Science Teaching (FAST) Program

Aspect of study	Description of methods and findings, by study
	Study 1: An examination of the effects of FAST on Hawai‘i students' biology achievement, interest in science, and cognitive preference
Reference	Tamir and Yamamoto (1977)
Design	Comparison-group posttest-only design
Sample	614 high school biology students spread across the four grades, 36% of which had studied FAST for one year and 31% of which had studied it more than one year
Instru-ments	Achievement was measured using final Grade-9 science grades and expected biology grades; interest was measured used a researcher-developed questionnaire item on hobbies and intended college majors; and cognitive preference was measured using a researcher developed 40-item questionnaire on preferences among four modes of attending to information in biology.
Analyses	χ^2 and analysis of variance
Statisti-cally sig-nificant findings	Findings on interest in science hobbies and class grades favored FAST students at statistically significant levels. Significant differences on intended college majors were not found. On the cognitive-preference instrument, FAST students showed significantly less preference than non-FAST students for recall.
Cautions in interpret-ing find-ings	Reliability for two of the cognitive-preference variables was somewhat low.
	Study 2: Comparison of FAST and non-FAST Hawai‘i students' performance on measures of science achievement, process skills, and creative thinking
References	Young (1993) and CRDG (2000)
Design	Randomized posttest control-group, with a pretest serving as a covariate
Sample	Of 7th-grade students in a private school, 130 were randomly assigned to FAST classes and 123 were assigned to the control group
Instrument	The Comprehensive Test of Basic Skills (CTBS) science subtest; posttests included the pretest measure plus the verbal and figural batteries of the Torrance Tests of Creative Thinking and the Stanford Achievement Test science subtest
Analyses	Multivariate analysis of covariance, followed by univariate analyses of variance

Findings	After adjusting the scores with the CTBS covariate, a statistically significant multivariate *F* value was found. Univariate analyses showed significant differences between FAST and non-FAST students on the CTBS and on the Torrance Verbal Originality and Figural Elaboration subtests. These results were interpreted to show that statistically significant differences were not found on the Stanford scores because the instrument measures recall, which FAST does not emphasize, whereas the CTBS scores showed significance because the instrument measures some higher-level cognitive processes, which FAST does emphasize. Results on the Torrance subtests were speculatively interpreted to show the effects of observe phenomena in detail and actively processing information.
Cautions in interpret-ing find-ings	None

Study 3: Comparison among FAST and non-FAST Hawai‘i seventh-graders on laboratory skills and knowledge of science

Reference	Young (1982)
Design	Posttest-only comparison-group
Sample	Random samples of 25 FAST classes and 25 non-FAST classes in Hawai‘i public schools, stratified by student ability level and school socioeconomic level. Compared with the FAST classes in the sampling strata, students in about half the non-FAST classes showed superior reading and mathematics achievement.
Instru-ments	The Laboratory Skills Test, a locally developed instrument that measures student performance on laboratory tasks (six items), science-process skills (e.g., observing, predicting, and providing evidence) (four items), and knowledge and understanding of science (four items), with a total-instrument reliability (KR_{20}) of .93 and content validity established by expert review (Young, 1982); and the Comprehensive Test of Basic Skills science subtest.
Analyses	*T*-tests
Findings	Statistically significant results favoring FAST were found for both instruments.
Cautions in interpret-ing find-ings	None

Study 4: Comparison of FAST and non-FAST students on laboratory skills, science process skills, and understanding of science	
Reference	CRDG (2000) (study conducted in 1988)
Design	Posttest-only comparison-group with a covariate
Sample	Intact groups of 6th-graders (FAST *N* = 38 and non-FAST *N* = 47) and 7th-graders (FAST *N* = 58 and non-FAST *N* = 83)
Instru-ments	Three instruments were used, including (a) the Laboratory Skills Test (LST), a results examined on the three subscales (see Study No.3 above); (b) the Performance of Process Skills (POPS) Test, a 21-item instrument measuring science process skills; and (c) the Fukuoka, Ishikawa, and Nakayama (FIN) test, also a measure of science process skills. Results on the California Achievement Test (CAT) total battery were collected for use as the covariate in the statistical analyses.
Analyses	A multivariate analysis of variance (MANOVA) was conducted to examine the significance of the tests overall, followed by univariate analyses of covariance (ANCOVA).
Findings	The MANOVA showed a statistically significant overall *F*. In the subsequent ANCOVAs, statistically significant differences were found on the three LST subtests for Grade 6; for Grade 7, statistically significant differences were found on the LST laboratory skills and process skills subtests but not on the third LST subtest. No significant differences were found on the POPS or FIN tests.
Cautions in interpreting findings	Information about the validity and reliability of the POPS and FIN instruments was not given.

Study 5: Comparison of FAST students' performance on the California Assessment Program with non-FAST students' performance in the same district	
Reference	CRDG (2000)
Design	Two annual posttest-only studies in which a small group of FAST schools and a small group of non-FAST schools in a California district were compared with state standards
Sample	FAST students: 472 in six schools in the first year and 254 in three schools in the second; non-FAST students: 360 in four schools in the first year and 366 in three schools in the second
Instrument	A statewide student science assessment briefly used in California in the late 1980s
Analyses	In *t*-tests, the means of FAST schools in a district were compared with "expected high scaled scores" for the schools; the means for the non-FAST schools in the district were compared likewise. (The scores that the state expected for the schools varied among the schools because of school demographics.)

Findings	In first of the two years, the results for the FAST schools were greater than the expected school results at a statistically-significant level ($p < .10$), but no differences were found for the non-FAST schools. In the second of the two years, FAST schools' results were not significantly different from the expected scores, but the non-FAST schools' results were significantly *below* the expected scores ($p < .01$).
Cautions in interpret-ing find-ings	Generalizations are complicated by the fact that the size of the district and of the sample were not given. It is unknown why the number of FAST and non-FAST schools varied among years or what the implications of these differences are for the results.

Study 6: Comparison of the performance of Slovakian FAST students on the Third International Mathematics and Science Study with the performance of students nationwide

Reference	Pauls, Young, and Lapitkova (1999)
Design	Posttest-only with a "comparison-group" consisting of all students, including FAST students
Sample	333 students (ages 13–14) in FAST schools in Slovakia, with a "comparison group" of 7,524 students in 145 Slovakian schools
Instru-ments	From the 1995 Third International Mathematics and Science Study, results on a total of 14 items, each addressing one of four science topics, were examined.
Analyses	Comparisons of percentages correct between FAST students and Slovakian students
Findings	FAST students outscored the group of all Slovakian students on all four topics. Only item percentages were reported, with no aggregation. For the present article, averages of item percentages correct for each of the four areas were calculated, and these averages in turned were averaged. The results showed overall averages (rounded to the whole number) of 48% for all students and 77% for FAST students (with standard errors of percentages, similarly averaged, of .56 and 2.28, respectively).
Cautions in interpret-ing find-ings	Results reflect nationwide reporting with no adjustments for incoming 10^{th} graders who may not have been instructed with FAST in their middle school years. Possible effects of student demographics or school resources were not accounted for. The percentages for the group of all students apparently include the results for the FAST students, thereby falsely inflating the "comparison group" results.

Study 7: Comparison of FAST and non-FAST students on cognitive preference, science-activity preference, and achievement	
Reference	Dekkers (1978)
Design	Posttest-only comparison of FAST students with students instructed in the Australia Science Education Project (ASEP)
Sample	101 FAST high-school students and 88 ASEP high-school students
Instrument	The Science Cognitive Preference Inventory developed by Tamir (see the description of Study 1 above); the 30-item Activity Preference in Science judging preference for reading activities, designing experiments, or discussion activities, with a test-retest correlation of .62
Analyses	Analyses of variance
Findings	The results on cognitive preferences showed FAST students with significantly higher scores on preferences for recall, with the highest scores for both curricula in questioning; results on science activities showed that FAST students' scores were significantly higher than ASEP students in laboratory work, discussion, and field work but not in reading or project work.
Cautions in interpreting findings	Reliabilities (Cronbach's alpha) for the cognitive-preference test were low.

Study 8: An examination of FAST student performance relative to standards set for the Connecticut Academic Performance Test	
Reference	CRDG (2000)
Design	Post-test only for each of three years (1995, 1996, and 1998)
Sample	All 10th graders (*N* unreported) in a Connecticut district in which students had been instructed with FAST during their middle school years
Instruments	Criterion-referenced, standards-based annual statewide test
Analyses	Comparison of mean scores with the "state goal" for each of three years
Findings	Scores from the FAST district were greater than the state goal in each of the three years. For two of the three years, the percentages of the district's students above the state goal were 52% and 61%, respectively; the statewide percentages for these two years were 32% and 34%. (The percentages for the third year were unavailable.) In one of the three years, scores in science (compared with the results for tests given in four other subjects) were the only ones that improved.

Cautions in interpreting findings	The results reflect district-wide reporting with no adjustments for incoming 10th graders who may not have been instructed with FAST in their middle school years. Analyses were limited to comparisons of percentages, with no reports of statistical significance tests, confidence intervals, effect sizes, and so forth. Possible effects of student demographics or school resources were not accounted for.

Study 9: Comparison of South Carolina FAST students' pre/posttest scores

Reference	CRDG (2000)
Design	Pre/posttest
Sample	45 6th-graders and 45 7th-graders randomly selected from students classified as average or above-average on the CTBS and by teacher judgment
Instrument	Comprehensive Test of Basic Skills science subtest
Analyses	*T*-tests between FAST student posttest means and the expected means, as specified in norms tables
Findings	Significant differences favoring FAST were found for both grades.
Cautions in interpreting findings	The *t*-test comparison with the norm group is unconventional.

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Appendix B
Inquiry Science Observation Guide

A Manual for Observing and Coding Teachers' Questioning Behaviors in Inquiry Science Classrooms

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Preface

This is a guide for collecting and coding observation data on the extent to which K–12 inquiry science teachers implement the steps of inquiry science programs in their classrooms, with an emphasis on teachers' use of questioning strategies in Foundational Approaches in Science Teaching (FAST) classes. FAST is a middle school program that has been implemented over the past 25 years in a majority of American states and several foreign countries. The guide includes a technical manual with a summary of the development procedures and validity study results and an administration manual that (a) describes data collection procedures and (b) gives the observation coding instrument and all the instructions necessary for using it.

Inquiry Science Observation Guide

I. Technical Manual

Project Background

In a National Science Foundation project (No. REC0228158), researchers and curriculum developers at Curriculum Research & Development Group, University of Hawaiʻi at Mānoa, developed instruments to investigate the degree to which teachers implemented the Foundational Approaches in Science Teaching (FAST) program in their classrooms. The two-year study was expected to be the pilot phase for a later five-year study, in which the FAST program would be disseminated and studied in a substantial number of sites nationwide. The second phase was not funded, but the project team hopes to use the instruments in future projects. Furthermore, the instruments can be used by other researchers who are studying the implementation of inquiry science programs.

One of the methods developed in the project is the protocol for observing and coding implementation that is given in this guide. Although observations are expensive, no other method provides a firsthand record of teacher behaviors with as little potential for bias and as great a potential for wide and deep coverage. The instrument is designed to code low-inference teacher behaviors. It is intended primarily to examine the extent to which observed teachers question students during science investigations (Taum & Brandon, 2005a, 2005b) and to document the extensiveness of student-teacher interaction following teachers questions. Teacher questioning is the heart of the inquiry method that the teachers use when guiding students during their investigations. The coded behaviors reflect some validity characteristics suggested by Evertson & Green (1986), including a focus on behaviors that (a) teachers learn in the FAST professional development training, (b) address key aspects of teacher questioning, and (c) are mutually exclusive.

The observation results for a designated behavior (e.g., teachers' use of probing, follow-up responses to students' comments about a student science investigation during teacher-student interaction) are analyzed as the percentage of all the teacher and student behaviors coded in a designated time period (e.g., an entire investigation or all the investigations recorded for the teacher). The advantages of this method over conducting ratings of the degree of implementation—a method that is common in observational studies of program implementation—are that (a) frequencies and percentages provide a precise record of the extensiveness of implementation of teachers' questioning behaviors and the teacher-student interaction following questions and (b) it avoids the central-tendency errors and the leniency errors that sometimes occur with conducting and analyzing ratings.

In this section of the guide, we provide technical background about the development of the protocol and about analyses of the validity of data collected and coded with it. A full description of the development and the validity studies is found in the final project report (Brandon et al., 2007).

Development and Validation of the Inquiry Science Observation Code Sheet

Description of the Development

The core of the guide is the Inquiry Science Observation Code Sheet (ISOCS). It is shown in Part II of this guide. The schema for the ISOCS originated from multiple written sources, including the FAST student book, FAST teacher's guide, and in-depth discussions between the

FAST program developers, educational researchers and evaluators, and FAST teachers. From these sources, aspects of FAST deemed critical for program success were identified. Teacher behaviors that an observer would expect to see occurring in a FAST classroom, with an emphasis on the questioning strategies used to promote student discussions, were drawn from the FAST Instructional Guide (Pottenger & Young , 1992). These three types of strategies are *lifting questions*, *clarifying questions*, and *summarizing questions*.

The development of the instrument, from early conceptualization to the collection and analysis of validation data, occurred over approximately a two-year period. Development occurred in about 40 iterations, varying in degrees from minor to major modifications in both items and design. The coding language was refined, coding procedures were revised, and the most reliably observed teacher behaviors—believed to be essential for program success—were identified. After the focus on questioning was established and videotaped observations were conducted, the first author worked closely with two graduate students and, later, two coders to expand the observation of questioning strategies, to include descriptors that provided data on the context within which the questions were asked, and to provide a structure for recording the sequence of the activities as it is manifested in the classroom.

Collecting Videotaped Classroom Observations for Trying Out the ISOCS and Analyzing Psychometric Characteristics

To try out our observation procedures and to analyze the psychometric characteristics of the data that were collected with them (i.e., aspects of validity, including reliability), the research team videotaped 19 public and private middle school science teachers on the four major Hawaiian islands during one school year. Teachers were asked to complete the first fourteen physical science (PS) investigations in FAST 1 and were advised that five of these lessons would be videotaped (PS 4, 7, 10, 12, 13). Some FAST 1 Ecology lessons were recorded as well.

Part-time employees were hired on each island and briefly trained as videographers. They were provided video cameras, boom and lavaliere microphones, digital cassette tapes, watches and camera battery replacements, and battery rechargers. The teachers recruited for taping were asked to keep the videographers apprised of their progress through the investigations and to inform them when they anticipated teaching the next target lesson.

Guidelines and checklists, which outlined the details that should be considered when conducting classroom videos, were developed for the videographers. They are given in Part II (Administration Manual). Each videographer was provided the guidelines to insure that all data were collected in a uniform manner and that details were not overlooked. The videographers also were given a checklist to follow when preparing to record a lesson. It includes items showing the necessary equipment, as well as back-up supplies such as AA and watch batteries, and also a section for recording the camera battery charging history. The videographers were asked to complete logs to keep track of taping schedules and a classroom set-up and comment sheet to complete following each taping for the purpose of providing coders and researchers with a full picture of the classroom during taping.

Not all of the targeted lessons were taped from the pool of 19 teachers because of unanticipated conflicts such as scheduling issues, communication problems, and faulty equipment and because some teachers did not teach all the targeted investigations. By the end of the year, the videographers had recorded a total of 135 FAST investigations, collecting from zero to five investigations from a total of 16 teachers. The videos were transferred to DVDs for coding (one

DVD per class period). The quality of each, defined as the extent to which teachers were visible and audible, was checked by reviewing a brief segment within every five-minute interval of every DVD; 91 DVDs were identified as being of 100% acceptable quality, and 16 were identified as being of 75% acceptable quality, resulting in a total 107 total DVDs deemed suitable for coding. Those DVDs that were deemed less acceptable that 75% were not coded.

A DVD labeling system was developed. (See Part II.) Information recorded on the labels included teacher number (which replaced the teacher's name), the lesson or investigation number (i.e., PS 4, 7, 10, 12, or 13), the class period, the date, and the videographer's initials.

Coder Training and Instrument Refinement

The research team trained coders and tried out the ISOCS over several months. The coding team originated with eight individuals. All the coders participated in a face-to-face, 16-hour training session that was conducted over a five-day period; they completed eight hours of DVD home-viewing as well. The instrument was refined during this period, as it was over the following weeks, when coders viewed and coded videotapes of three teachers during each of the three lesson phases (Introduction, Investigation, and Summary), for a total of nine observed classroom periods. Videotaped observations of teacher behaviors were first coded individually and then discussed within the larger coder group. The first author facilitated the discussions, in which the goal was to reconcile codes between the results for members of coder pairs.

The coding process involved three general steps: a) viewing the DVDs, b) coding observed teacher behaviors, and c) reconciling differences within pairs of coders. In the first step, the coders previewed the entire lesson for the purpose of establishing a broader sense of the progression of how the lesson unfolded. In the second step, the coders were advised to carefully record any observable activities shown on the ISOCS. In the final, most time-consuming step, the coders identified and discussed differences in their codes until consensus was reached on all codes.

Reconciliation between coders was the most demanding aspect of the entire coding process. It was during this time in which pairs of coders worked to rectify any differences between their codes. The reconciliation process often required a concurrent review of the DVD, with references to the exact time and code discrepancies. A third coder (one of the graduate students who had helped developed early drafts of the instrument) was available to assist if there were unresolvable coding differences between the two coders. The entire process took approximately four to six hours per FAST investigation.

The eight individuals hired to code recordings included four who had teaching experience, one with a background in curriculum design, a mechanical engineer, and a film festival project manager. As one might anticipate, it was found that teaching background and knowledge affected the coding. For example, those with preservice or inservice teaching experience tended to focus more on student behaviors while viewing the DVD-ROMs and struggled to concentrate on the teachers' use of questions, while the non-educators appreciated the simplified instructions to observe only the teachers and not the students.

Throughout the training process, coders were encouraged to provide feedback about the feasibility of the code sheet. Most of the revisions were minor, such as redefining a word or phrase to insure a universal definition among coders. Redundancies across activities, discrepancies between other activities, and unclear definitions were identified within the larger group of coders once they began familiarizing themselves with the Code sheet.

As the eight-member group continued to meet to discuss their individual codes, it became apparent that some of the coders were having difficulty limiting their codes to those described on the coding instrument. Eventually only two of the eight coders remained, both from the experienced teaching group. These coders conducted the final round of coding, providing the data that we used for conducting validity studies.

Validity (Including Reliability) Findings

The validity data collected in the videotapes were analyzed in several ways. We describe the results of these analyses in brief here; a full description is given in the final project report (Brandon et al., 2007). We analyzed data for 9 of the 16 teachers who had been videotaped during the study.

Content validity. Content validity evidence for an observation instrument such as the ISOCS is found in the extent to which it can be shown that the data collected with the instrument are relevant to the measurement task, are representative of the target content domain, and exhibit technical quality. Evidence for these characteristics of content validity is found chiefly in our description of the procedures for developing the instrument, as given briefly in this guide and provided in full in the final project report (Brandon et al., 2007). Evidence for technical quality is found in the results of our reliability studies, as well (Brandon et al., 2007), which showed (a) a correlation of .99 between the two primary coders' total number of choices per code and (b) a correlation of .53 between the two coders' total number of codes assigned to each teacher. The second correlation is a more fine-grained analysis than the first; therefore, its results are the more meaningful of the two, suggesting a moderate relationship among coders.

Consensus analyses, which examined the extent to which the coders agreed on their initial codes before reconciliation, showed a range from 5% agreement (Code B12) to 50% for teacher probing (Code D8). The percentage of agreement for student comments in response to the teacher's initial question (code C3) was 42, and the percentage agreement for teacher follow-up was 26 (Code D6).

The agreement percentages reported here are not high. However, they cannot be readily compared with typical results for observations in which events are recorded in time periods (e.g., one code for, say, every five minutes). Recording discrete, brief, low-inference behaviors and events might initially be more fraught with the possibility of error than counts of low-inference behaviors in time blocks because only one instance per block is observed in the latter method, whereas the ISOCS requires that all instances be observed and recorded exactly. Clearly, the reconciliation process is essential for collecting ISOCS data. It is noteworthy that, except in eight cases of discrepant results between codes, reconciliation was necessary because of errors of omission, not because errors of commission—that is, one of the two coders did not observe the event or behavior that the other had coded.

Concurrent validity. To collect concurrent validity evidence, we correlated some of the results of the ISOCS with the results for another measure of implementation that was prepared during the project—the Inquiry Science Questioning Quality (ISQQ) method. ISQQ results were generated for the nine teachers who were sampled for the ISOCS validity studies. We correlated teacher quality ranks from the ISQQ with (a) the percentage that student comments constituted of all the codes for teachers and (b) the percentage that the teachers' use of follow-up statements and of probing questions constituted of all the codes for the teacher. The Spearman's rho correlations were .52 and .45, respectively. Confidence intervals for these correlations are substantial, of course, because of the low *N* of teachers whose results were correlated; nevertheless, we believe that these correlations show a relationship between the two sets of results, thus supporting the validity of the ISOCS data.

Criterion-related validity. Of the teachers for whom observation data were collected and coded, six were administered the Inquiry Science Student Assessment (another instrument that was developed in the grant project [Brandon et al., 2007]). The correlation between teacher-student question-response exchanges (coded as the percentage of the total number of observed behaviors) and mean multiple-choice score on the 10 items that discriminated the most among students (as established in IRT analyses) was .96. This correlation is only suggestive because of the small number of teachers for which we have both ISOCS and student achievement results; nevertheless, its extraordinary magnitude provides evidence of the validity of the observation data.

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II. Administration Manual

Video Recording Equipment List

•1 camera and battery
•Bracket (to hold boom microphone and teacher receiver)
•Boom microphone
•Wireless receiver with battery (for teacher's microphone)
•Wireless transmitter lapel microphone with battery (for teacher)
•Headphones
•Y cable
•2 power adaptors (to recharge battery pack)
•Wireless controller ("remote controller", not used while taping)
•Spare batteries for:
 1) Boom microphone (9 volt 303/357)
 2) Teacher transmitter (9 volt)
 3) Camera (gray 7.4v, battery pack BP 508/512)
•Tapes (Digital Video Cassettes 60-90)—ensure that there is a sufficient number for the session
•Permanent felt tip pen
•Tripod

Video Recording Instructions

1. *Day prior to taping*: Check
   a. batteries.
      i. Charge all camera batteries.
      ii. Make sure that there are spare batteries in the camera bag.
         (1) 9 volt (wireless microphones receivers)
         (2) v 13 GA (microphone batteries)
   b. equipment list.
2. *Confirm with teacher*:
   a. Name and location of school (prior to first visit to the school).
      i. Map
   b. Beginning and ending time of FAST class
      i. Allow at least 30 minutes for set up prior to start of class.
3. *Attire*
   a. Wear comfortable clothing appropriate for a school setting.
4. *Time sheets*
   a. Record the time when you leave your home.
   b. Record the time that you arrive at the respective school.
   c. Record the time when you return to your home.
5. *Mileage log*
   a. Record the mileage to and from the school where you will be videotaping.
6. *Arriving at the school*
   a. Be sure to park in a visitor stall, or somewhere that is legal. The University will not pay for citations or towing fees.
   b. Go directly to the office to pick up a visitor's badge.

i. You will need to sign in as a guest or visitor when you arrive.
ii. You will need to sign out and return your badge when you leave.
c. Use the rest room prior to beginning videorecording.

7. *Camera set-up*
a. First set up the tripod.
b. Place the camera on the tripod and secure it tightly.
c. Attach the bracket to the top (foot) of the camera.
d. Attach the "boom" microphone to the bracket.
e. Attach the microphone receiver to the bracket.
f. Insert the "Y" cord into the red input adaptor on the camera.
g. Connect the boom microphone and microphone receiver into the "Y" cord.
h. Give the teacher his/her wireless microphone.
i. Test the camera by pressing the record button.
ii. Check that the battery is fully charged.
iii. Check that there is a new cassette tape in the camera.
iv. Check to make sure that the teacher's microphone is audible.

8. *While filming, do's and don'ts*
a. Be respectful of the teacher at all times, as you are a guest in his/her classroom.
b. Remind the teacher prior to the beginning of class of the signals that you will give if:
i. You can not hear he/she through the headsets (microphone not on).
(1) Raise your hand to get the teachers attention and point to your ear.
ii. Students are not speaking loud enough.
(1) Raise your thumb towards the ceiling.
c. Don't speak to the students while class is in session (the camera is already a distraction for many of the students).
d. Don't nod, sneeze, whisper, or make sounds that might interfere with the teacher and students voices.
e. Be sure that your cell phone is silenced or off.
f. Thank the teacher for allowing you to tape she and her students before you leave.
g. Record how the classroom is set-up (prior to leaving the class).
h. How students are seated (i.e. in groups of 2-4 at desks; working in pairs at lab stations, etc.).

9. *Camera packing*
a. Write the teacher's name, school, class period, and date on the cassette immediately after removing it from the camera.
b. Remove the batteries from the camera.
i. Place those that need to be recharged in the Zip-lock labeled "Re-charge."
c. Disassemble the camera , bracket, microphones, and tripod and place everything back into the bag as it was when you took it out.
d. Be sure not to leave any equipment behind.

10. *Written summary of videotaped session*

a. Record (write down) any unusual circumstances that occurred during the taped session (i.e. unexpected disruptions; loud noises that might have interfered with audio clarity; missing or broken equipment, etc.).

11. *Sending completed videotaped lessons to the research office*

a. Once a complete series (PS 4; PS 7; PS 10; PS 12; PS 13) of taping is completed, send the labeled cassettes in the pre-supplied postage paid priority mailing boxes.

Video Recording Log

Date	Time	Teacher	School	Contact #	PS #

FAST Classroom Setup and Comments

Teacher name: __________________________ *Date* ___________
*FAST Investigation no.:*___*Class period:* ___ *Videotaper name:* ______________

Describe or draw the classroom layout, including location of teacher's desk, student desks or tables, camera placement (where camera is set up), and location of students who didn't sign consent forms and can't be videotaped.

Describe or draw how the students are seated (i.e., number of students working in each group; working at desks or at lab stations).

Describe anything unusual that happened during the class (e.g., problems with lab equipment; fire drill; classroom management issues; accidents).

Describe any problems with the recording equipment (e.g., battery ran out during class, teacher microphone cut out in the middle of taping).

Did you stop and restart recording on the same tape (yes/no)?

Are there teacher handouts for the videotaped class (yes/no)?

Labeling Videotapes and DVD-ROMs

Put the following information on both a label on the tape and the spine label for the tape case. Also label any handouts that you collect for a class the same way you label the corresponding tape.

Txx – NNzz – Pervv mm/dd/yy ii (camn)

where

- •xx is a unique teacher number for
- •NN is identifier (Physical Science) or EC (Ecology)
- •zz is the number of the investigation (i.e. 4 or 10)
- •vv is the class period (i.e. 7 or D)
- •mm/dd/yy is the date

General Coding Guidelines

The Inquiry Science Observation Code Sheet (ISOCS) is designed to measure teachers' use of questioning strategies while teaching FAST. The ISOCS is divided into four columns beginning with a teacher initiated question, followed by the activity related to the question, next by the student response, and lastly with a teacher follow-up response.

The purpose of observing and coding teacher behaviors is to identify and record specific activities that occur during FAST lessons. There are three questioning strategies identified in the code sheet. Coding requires that the observer first identify the type of question initiated by the teacher (Column A, "lifting," "clarifying," "summarizing") and complete the entire string sequence by identifying Columns B, C, and D. Column B lists activity option codes which are used to identify the context in which the initial teacher-asked question in Column A was presented. Column C offers four options for describing how a student responds to the teacher question. The last Column, D, provides possible teacher follow-up responses to those noted in the previous column that are made by a student. The definitions for each of the codes are shown beginning on p. 19.

Tips for Coding

1. The instrument is most likely to be used for coding a subset of FAST investigations (Physical Science [PS] 4, 7, 10, 12, 13 and Ecology [Eco] 8, 9, 10, 11, 23, 24, 25). The coder should review the investigation to be viewed and coded in the student book before beginning the viewing and coding process.

   PS 4 - Mass and The Sinking Straw (p. 16)
   PS 7 - Floating and Sinking Objects (p. 28)
   PS 10 - Density and Objects (p. 37)
   PS 12 - Buoyancy of Liquids (p. 41)
   PS 13 - Balloons in Water (p. 46)

   ECO 8 - Soil and Roots (p. 194)
   ECO 9 - Absorption and Percolation of Water in Soil (p. 197)

ECO 10 - Capillarity of Water in Soil (p. 206)
ECO 11 - Evaporation of Water from Soil (p. 209)
ECO 23 - Plants and Water (p. 265)
ECO 24 - The Case of the Leaky Leaves (p. 266)
ECO 25 - Transpiration (p. 271)

2. Do not start coding until the relevant lesson phase (Introduction, Investigation, or Summary) has begun. For example, if the teacher is having conversations with a student before the class begins, do not begin coding.

3. Only code observable activities. By *observable* we mean audible–that the teacher can be heard using a questioning strategy or responding to a student.

4. Do not code beyond the end of the lesson (e.g., do not code homework instructions or plans for study hall).

5. Do not code activities until students are actually instructed to begin the activity. Occasionally a teacher will announce that students will be working on a specific activity during the class period, but because of time constraints or other reasons, the activity does not begin.

Inquiry Science Observation Code Sheet

Instructions: When viewing DVD-ROM recordings of inquiry science class periods, note the beginning time (as indicated on the DVD player) of each instance of a teacher-initiated question (Column A) and write the code (A1, A2, and A3) for the type of question. Then record the string of codes for the remaining activities as they occur until the teacher-student interaction ends or the teacher asks another clarifying, lifting, or summarizing question (Column A).

A	B	C	D
The teacher begins the interaction with a . . .	***. . .about. . .***	***. . .and responds to the student's(s'). . .***	***. . .by. . .***
A1. . . clarifying question [about meaning]. . . A2. . .lifting question [generalizing, correlating, contrasting, comparing]. . . A3. . .summarizing question [conclusion]. . . .	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. . . B10. . .safety issues. . . B11. . .data. . . B12. . .vocabulary words [by definition]. . . B13. . .student's prior knowledge or experiences. . . B14. . .new information outside of school. . .	C1. . .[no response] C2. . .activity (students working together in groups). . . C3. . .comment. . . C4. . .question. . .	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.

ISOCS Definitions

Code	Label	Definition
A1	Clarifying question	A questioning strategy that elicits the meaning of unfamiliar terms or the rephrasing of disconnected, unclear statements to ensure common understanding (e.g., Can you be more specific? What do you mean by "things"? Can you say that in another way? Can you give us an example?).
A2	Lifting question	A questioning strategy that "lifts" a discussion by moving it from narrow to broad, from specific to general, or from concrete to abstract (e.g., Are heat and light connected in some way? From the two lists can you find a common property? How would you define life? What problem have we found in this?).
A3	Summarizing question	A questioning strategy in which the teacher asks a student to restate what he or she said in a succinct summary (e.g., How can we put what you have just stated on the board? Can you give us the main idea of what you are saying?).
B1	making connections with previous investigations	Teacher makes a connection between new information being introduced to students and what students have already learned in earlier investigations..
B2	the problem (book)	An inquiry starting from given conditions to investigate or demonstrate something
B3	Summary/ Key questions (book)	Questions taken directly from the FAST book used to direct student inquiry and challenge their understanding
B4	Challenge questions (book)	Questions taken directly from the FAST book used to direct student inquiry and challenge their understanding
B5	predictions/ hypotheses	A student is asked to state that a specific investigation, event, or outcome which will happen in the future.
B6	tools/ equipment	Materials, devices, or implements used to carry out a particular function.
B7	procedures (book-activity)	An established or official prescribed method of doing an activity.
B8	the investigation (science experiment)	Carrying out a systematic or formal inquiry about scientific phenomena or hypotheses.
B9	observations	A student is asked to record, discuss, or define an action or process through close viewing or monitoring
B10	safety issues	The teacher addresses issues about the prevention of personal injury or property damage.

Code	Label	Definition
B11	data	Information collected by individual or groups of students, relating to a science experiment.
B12	vocabulary words (by definition)	New words that are discussed and defined by the class.
B13	student's prior knowledge or experiences	Ideas/concepts that have been addressed and assumed to have been learned in an earlier class period
B14	new information outside of school	Teacher makes a connection between new information being introduced to students and what students already know outside of school.
C1	no response	Student does not respond to teacher question.
C2	activity	Students are working together on an activity either in pairs or in small groups.
C3	comment	A student remark expressing an opinion or reaction
C4	questions	A sentence worded or expressed to obtain information
D1	no response	Teacher does no respond to student by saying anything aloud.
D2	non-verbal acknowledgment	Teacher nods or provides some other body gesture to student, without saying anything aloud.
D3	verbal acknowledgment	Teacher verbally (e.g. "Okay") confirms student's comment or question.
D4	repeating	Saying a word or sentence again in the same way.
D5	rephrasing	A verbal expression presented in an alternative way.
D6	using a follow-up statement	A teacher response to a student comment or question.
D7	goal-oriented redirecting	A carefully tailored teacher response to a student's comment or question, with a clearly stated objective.
D8	probing (clarifying) further	Teacher verbally responds to student by asking the student to further explore or examine his or her comment or question.

Appendix C

Variables Covered on the Inquiry Science Teacher Questionnaire, Inquiry Science Observation Code Sheet, and Inquiry Science Student Assessment and the Items Addressing the Variables

Variables Covered on the Inquiry Science Teacher Questionnaire, Inquiry Science Observation Code Sheet and the Items Addressing the Variables[a][a]

Variable	Item
Category A. Inquiry science classroom implementation level	
A1. The extent to which the inquiry science teacher circulates and engages with students about their investigations	•Q-A18. When you teach FAST to your focus grade, how frequently do you: l. circulate and interact with students during the lab portion of the investigation? [Never, Rarely, Sometimes, Often, Always]
A2. The extent to which the inquiry science teacher addresses the relevance of the investigation to students' lives	•Q-A18. When you teach FAST to your focus grade, how frequently do you: h. discuss how everyday situations directly relate to investigations? w. connect new information with students' personal lives (interests, home environment, community, culture, etc.)? x. connect current events and other subjects with current science concepts, skills, and investigations? [Never, Rarely, Sometimes, Often, Always] •O-B13. An activity addressing the teacher's question about students' prior *activities* or knowledge of experiences •O-B14. An activity addressing the teacher's question about new information outside of school [Observed occurrences recorded]
A3. The extent to which the inquiry science teacher has students develop, share, discuss or record their hypotheses, predictions, analyses, or findings	•Q-A18. When you teach FAST to your focus grade, how frequently do you:: b. have students write the problem or activity at the beginning of the investigation? f. ask students to make predictions about the investigation? k. encourage students to collaborate within their groups? n. have students share their predictions with the class? o. have students share their data or findings with the class? r. have students engage in discussions among themselves about investigations? [Never, Rarely, Sometimes, Often, Always] •O-B5. An activity addressing the teacher's question about predictions/hypotheses [Observed occurrence recorded]

[aa]*Q* = Inquiry Science Teacher Questionnaire, *O* = Inquiry Science Observation Code Sheet , and *S* = Inquiry Science Student Assessment. Response options are shown in brackets.

Variable	Item
A4. The extent to which the inquiry science teacher facilitates class discussions about differences among the small groups' findings	•Q-A18. When you teach FAST to your focus grade, how frequently do you: p. have students recognize discrepancies among groups' results? s. challenge students to consider the effects of errors on groups' results. [Never, Rarely, Sometimes, Often, Always]
A5. The extent to which the inquiry science teacher presents a data table summarizing the small groups' results.	•Q-A18. When you teach FAST to your focus grade, how frequently do you: t. prepare a class data table which includes each group's results and discuss findings with the entire class? [Never, Rarely, Sometimes, Often, Always]
A6. The extent to which the inquiry science teacher introduces or re-views science concepts or asks students to define or review science concepts	•Q-A18. When you teach FAST to your focus grade, how frequently do you: c. review relevant concepts and skills that were learned in previous lessons? [Never, Rarely, Sometimes, Often, Always] •O-B1. An activity addressing the teacher's question about how the investigation is connected to a previous investigation •O-B2. An activity addressing the teacher's question about the problem that the investigation addresses [Observed occurrences recorded]
A7. The extent to which the inquiry science teacher demonstrates or reviews the cor-rect use of science tools or equipment	•Q-A18. When you teach FAST to your focus grade, how frequently do you: a. demonstrate the use of a new instrument? [Never, Rarely, Sometimes, Often, Always] •O-B10. An activity addressing the teacher's question about safety issues [Observed occurrence recorded]

Variable	Item
A8. The extent to which the inquiry science teacher introduces, monitors, or reviews students' preciseness, carefulness, or procedures	•Q-A18. When you teach FAST to your focus grade, how frequently do you: g. check to ensure that students understand new procedures before beginning investigations? i. check students' designs for safety before allowing them to conduct their investigations? j. monitor small group progress during investigations? [Never, Rarely, Sometimes, Often, Always] •O-B4. An activity addressing the teacher's question about a "Challenge" (from the student book) •O-B6. An activity addressing the teacher's question about tools/equipment •O-B7. An activity addressing the teacher's question about procedures •O-B8. An activity addressing the teacher's question about the investigation (i.e., the experiment) •O-B9. An activity addressing the teacher's question about observations/data collection [Observed occurrences recorded]
A9. The extent to which the inquiry science teacher has students analyze, synthesize, and evaluate data	•Q-A18. When you teach FAST to your focus grade, how frequently do you: m. discuss variations in the data with the students in the summary phase of the investigation? u. compare and contrast students' explanations of findings? [Never, Rarely, Sometimes, Often, Always] •O-B11. An activity addressing the teacher's question about data analysis [Observed occurrence recorded]
A10. The extent to which the inquiry science teacher has students work on science vocabulary.	•Q-A18. When you teach FAST to your focus grade, how frequently do you: d. use new vocabulary words? e. ask students to identify and define words? [Never, Rarely, Sometimes, Often, Always] •O-B12. An activity addressing the teacher's question about vocabulary words [Observed occurrence recorded]
A11. The extent to which the inquiry science teacher engages students in dialogue by asking questions	•Q-A18. When you teach FAST to your focus grade, how frequently do you: q. use the "Key Questions" from the FAST student book to guide class discussion? v. question students as they conduct their investigations? y. use questioning strategies to respond to students' questions about investigations? [Never, Rarely, Sometimes, Often, Always] •O-A1. The teacher asks a clarifying question (meaning) •O-A2. The teacher asks a lifting question (generalizing, correlating, contrasting, comparing) •O-A3. The teacher asks a summarizing question (conclusion) [Observed occurrences recorded]

Variable	Item
A12. The extent to which the inquiry science teacher has students ask questions during investigations.	•Q-A18. When you teach FAST to your focus grade, how frequently do you: z. have students ask questions about the scientific phenomena addressed during investigations? [Never, Rarely, Sometimes, Often, Always]
A13. The number of inquiry science investigations that the teacher has completed during the studied period	•Q-A16. Please check each FAST 1 investigation that you teach, or will teach, to your focus grade. (Check all that apply.) [All PS, E, and RS investigation numbers]
A14. The extent to which students engage in the inquiry science investigation	•O-C1. The students do not respond to the teacher's question •O-C2. The students are engaged in an activity in groups •O-C3. A student makes a comment •O-C4. A student asks a question [Observed occurrences recorded]
A15. The extent to which the inquiry science teacher acknowledges, repeats, or rephrases students' comments or questions	•O-D1. The teacher does not respond to the students •O-D2. The teacher acknowledges the student non-verbally •O-D3. The teacher acknowledges the student verbally •O-D4. The teacher repeats the student's statement or question •O-D5. The teacher rephrases the student's statement or question [Observed occurrences recorded]
A16. The extent to which the inquiry science teacher uses follow-up statements to students' comments or questions	•O-D6. The teacher uses a follow-up statement [Observed occurrence recorded]
A17. The extent to which the inquiry science teacher uses goal-oriented redirection in response to students' comments or questions	•O-D7. The teacher uses goal-oriented redirecting [Observed occurrence recorded]

Variable	Item
A18. The extent to which the inquiry science teacher uses probing strategies in response to students' comments or questions	•O-D8: The teacher probes (for clarification) further [Observed occurrence recorded]
A19. The extent to which the inquiry science teacher uses summary/key questions to engage students in classroom discussion	•O-B3. An activity addressing the teacher's question about the Summary/Key questions (from the student book) [Observed occurrence recorded]
A20. The extent to which the inquiry science teacher customizes inquiry science classes	•Q-A19. How often do you supplement the teaching of FAST in your focus grade with written materials other than the FAST 1 books? •Q-A20. How often do you customize FAST 1 investigations in your focus grade in any way? [Never, Rarely, Sometimes, Often, Always]
A21. The extent to which students teach students in inquiry science classes	•Q-A8. To what extent do you agree with each of the following statements? h. I think that having students teach other students is an effective way to enhance learning in my FAST classes. [Strongly disagree, Disagree, Agree, Strongly agree] •Q-A9. Indicate the frequency of each of the following situations in your classes or school: b. Students teach other students in FAST classes. [Never, Rarely, Sometimes, Often, Always] •Q-A24. What percentage of the students in your focus grade teach each other in FAST classes? [0-25%, 26-50%, 51-75%, 76-100%]

Variable	Item
Category B. Inquiry science teacher characteristics	
B1. The inquiry science teacher's age	•Q-C15. What is your year of birth?
B2. The inquiry science teacher's salary	•Q-C4. What is your current annual salary? [$20,000 or below, $20,0001 to $30,000, $30,001-$40,000, $40,0001 to $50,000, $50,0001 to $60,000, $60,0001 or above]
B3. The inquiry science teacher's gender	•Q-C16. What is your gender? [Male, Female]
B4. The inquiry science teacher's highest degree	•Q-C9. For each of the items below, indicate whether you hold the following degrees or certificates. a. Bachelor's degree? b. Postbaccalaureate certificate? c. Master's degree? d. Doctoral degree? [Yes, No]
B5. The inquiry science teacher's undergraduate and graduate major and minor fields of study	•Q-C9. For each degree or certificate held, record your major and minor fields of study. If you completed more than one degree or certificate at a level, or had a double major or minor, please provide information for all fields of study at that level.
B6. The number of undergraduate or graduate science classes that the inquiry science teacher has taken	•Q-C10. How many undergraduate science courses (not including social science courses) have you taken? •Q-C11. How many graduate science courses (not including social science courses) have you taken?
B7. The inquiry science teacher's type of certification	•Q-C13. In each of the following subjects, please indicate whether or not you hold a teaching license from the state where you teach. a. mathematics b. science c. English d. social studies [Yes, No] •Q-C14. What type of teaching certificate do you hold from the state where you teach? [Regular or standard certificates, probationary, temporary, provisional, or emergency certificate, Other, I am not certified]

Variable	Item
B8. The number of years that the inquiry science teacher has taught in K–12 schools	•Q-C2. Including this year, how many years have you been employed as a K-12 teacher (not counting professional leaves, maternity leaves, and so forth)?
B9. The number of years the inquiry science teacher has taught K–12 science	•Q-C3. Including this year, how many years have you taught K-12 science (not counting professional leaves, maternity leaves, and so forth)?
B10. The inquiry science teacher's training in FAST 2 or 3	•Q-B1. Please check if you have been trained in either of the following: a. FAST 2 b. FAST 3 [Yes, No]
B11. The grades in which the teacher is teaching inquiry science classes	•Q-A1. In what grades are you teaching the FAST 1 program? (Check all that apply) [Grade 5, 6, 7, 8, 9, 10[
B12. The inquiry science teacher's science teaching capabilities	To be addressed in a future study: The extent of the inquiry science teacher's pedagogical science-content knowledge The extent of the inquiry science teacher's science content knowledge The inquiry science teacher's overall teaching quality before taking inquiry science training The inquiry science teacher's self efficacy
B13. Teacher attitude toward teaching science	•Q-A8. To what extent do you agree with each of the following statements? d. Teaching science is an ideal job for me. f. I am deeply committed to teaching inquiry science classes. [Strongly disagree, Disagree, Agree, Strongly agree]
B14. The extent to which the inquiry science teacher has high expectations of students	•Q-A8. To what extent do you agree with each of the following statements? a. The more I expect of my students, the better they will do in their FAST classes. b. Ultimately, teachers are responsible for how much their students learn about science. c. Sometimes teachers expect too much from their students. e. It is important for teachers to have high expectations of all students in inquiry science classes. g. As a teacher, I cannot do much for a student who is doing poorly. j. I feel responsible when my FAST students do not learn as much as I think they can. [Strongly disagree, Disagree, Agree, Strongly agree]

Variable	Item
B15. The extent to which the inquiry science teacher participates in science activities outside of the classroom	•Q-B6. To what extent do you: a. read science magazines, science journals, or science books outside of the classroom? b. attend science teaching conferences or meetings outside of school? c. hold leadership positions in science teaching organizations? [Never, Rarely, Sometimes, Often, Always] •Q-C12. How many hours have you spent in science-teacher professional development classes (other than FAST) over the past five years? •Q-B3. If you are a member of any mathematics or science organizations outside of your school, give their names or descriptions here.
B16. The extent to which the inquiry science teacher is proficient with computers and the Internet	•Q-C1. How proficient are you in: a. sending e-mails? b. using the Internet? c. using CDs or DVDs in a computer? [Do not use, Not at all proficient, A little proficient, Fairly proficient, Proficient] •Q-B6. To what extent do you: d. use a computer in your classroom? e. access the Internet in your classroom? f. use the Internet to help enhance your teaching and learning? [Never, Rarely, Sometimes, Often, Always]
B17. The extent to which the inquiry science teacher plans lessons	•Q-C8. In general, how important is it to you that you spend time planning FAST lessons? [Not at all, A little, Somewhat, Very] •Q-A9. Indicate the frequency of each of the following situations in your classes or school: c. I have sufficient time in my school schedule to plan my FAST curriculum. f. I have sufficient time to set up all my FAST classes. m. I have sufficient time to formally assess my FAST students' learning. [Never, Rarely, Sometimes, Often, Always]
B18. The number of the inquiry science teacher's inquiry science classes and the length of each	•Q-A11. How many FAST 1 classes do you teach in your focus grade each week? (If the number per week varies, enter the average number.) •Q-A13. What is the total length (in minutes) of all the FAST 1 classes that you teach to your focus grade each week?
B19. The extent to which the inquiry science teacher participates in school decision making	•Q-A4. To what extent does your department or school decide the FAST 1 investigations that you teach? •Q-A5. If you answered "Sometimes," "Often," or "Always" to Question 4, to what extent do you participate in deciding the FAST 1 investigations that you teach? [Never, Rarely, Sometimes, Often, Always]

Variable	Item
B20. The extent to which the inquiry science teacher provides students with extra assistance	•Q-A9. Indicate the frequency of each of the following situations in your classes or school: d. I usually have time outside of class to help my FAST students learn science. [Never, Rarely, Sometimes, Often, Always] •Q-A21. How frequently do you provide students in your focus grade with: a. extra tutoring? b. extra lab time? c. after-school help? [Never, Rarely, Sometimes, Often, Always]
B21. Teacher integration of inquiry science with other subjects	•Q-A10. Do you integrate the teaching of any other subjects into your FAST 1 classes in your focus grade? [Yes, No] If yes, enter the subject here.
B22. The extent to which the inquiry science teacher assigns homework	•Q-A15. What is the percentage of FAST 1 investigations for which you assign homework in your focus grade? [0-25%, 26-50%, 51-75%, 76-100%]

Variable	Item
B23. The extent to which the inquiry science teacher has opportunities to obtain colleagues' assistance, advice, and encouragement	•Q-A3. How often do you ask for and receive assistance in teaching FAST from other teachers in the school? [Never, Rarely, Sometimes, Often, Always] •Q-B4. How frequently do science teachers in your school meet as a group? [I am the only science teacher in the school (skip to Question 6), Never, Rarely, Sometimes, Often, Always] •Q-B5. If you did not check a for the previous item, indicate how frequently science teachers meeting as a group discuss: a. classroom management or disciplinary issues. b. inquiry science teaching methods. c. science content issues. d. administrative issues. e. staff development issues. [Never, Rarely, Sometimes, Often, Always] •Q-A9. Indicate the frequency of each of the following situations in your classes or school: a. Collaborating with fellow teachers at my school gives me access to new ideas and knowledge. e. The collaboration I have with fellow teachers at my school, ultimately improves my students' learning. j. Science teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies. l. The collaboration I have with fellow teachers at my school improves my teaching [Never, Rarely, Sometimes, Often, Always] •Q-B2. In the past 12 months, how frequently have you participated in the following activities? a. Observational visits at other schools. b. Collaborative research with other professionals. c. Collaboration with other teachers on issue of instruction. d. Mentoring or coaching other teachers. e. Being mentored or coached by other teachers. [Not at all, Occasionally, Often]
Category C. Inquiry science student characteristics	
C1. Inquiry science students' performance on inquiry science outcome measures	See Appendix F for multiple-choice, extended (i.e., written) response, and performance-assessment items.
C2. Inquiry science students' behavior in school and perseverance in science class	•Q-A22. What percentage of the FAST students in your focus grade are well behaved •Q-A23. What percentage of the FAST students in your focus grade show perseverance in learning science? [0-25%, 26-50%, 51-75%, 76-100%]

Variable	Item
C3. Inquiry science students' confidence to pass	•S-Part 3 No. 1: Using the scale above, *how confident are you* that you will **pass science class** ***at the end of this year?*** •S-Part 3 No. 3: *How confident are you* that you will get **a grade better than a C**? •S-Part 3 No. 5: *How confident are you that you will get* **an A?** •S-Part 3 No. 2: *How confident are you* that you will pass science at the end of this year with **a grade better than a D?** •S-Part 3 No. 4: *How confident are you* that you will get **a grade better than a B**? [1 = Not confident at all; 6 = Completely confident]
C4. Inquiry science students' self-confidence in science ability	•S-Part 4 No. 1: Even if the work in science is hard, I can learn it. •S-Part 4 No. 11: If I have enough time, I can do a good job on all my science work. •S-Part 1 No. 7: I can do almost all the work in science class if I do not give up. •S-Part 1 No. 23: I can learn science. •S-Part 1 No. 25: I can figure out how to do difficult work in science. •S-Part 2 Sec. 2 No. 2: I can master the skills taught in science class this year. [1 = Not at all true; 2, 3, & 4 = Somewhat true; 5 = Very true]
C5. Inquiry science students' epistemic beliefs	•S-Part 1 No. 4: I can't change how smart I am in science. •S-Part 1 No. 8: How well I do in science depends on how smart I was when I was born. •S-Part 1 No. 16: A person smart in science, was born smart in science. •S-Part 4 No. 14: I have to be really smart to do well in science. •S-Part 1 No. 2: I learn well in science when I work with a lab group. •S-Part 2 Sec. 2 No. 6: Working with my classmates helps me learn science. •S-Part 4 No. 12: My classmates help me understand what I'm not getting in science class. •S-Part 4 No. 16: Discussion with classmates in science class makes it easier for me to understand the concepts •S-Part 1 No. 19: I can learn science from our science investigations. •S-Part 4 No. 7: I really learn by doing science investigations. •S-Part 4 No. 13: Carrying out science investigations really helps me learn. •S-Part 4 No. 25: I cannot learn from science investigations. [1 = Not at all true; 2, 3, & 4 = Somewhat true; 5 = Very true]

Variable	Item
C6. Inquiry science students' science anxiety	•S-Part 1 No. 10: I get really uptight during science tests. •S-Part 1 No. 12: Taking science tests does not scare me. •S-Part 1 No. 21: Science makes me feel uncomfortable and nervous. •S-Part 1 No. 24: My mind goes blank and I am unable to think clearly when doing science. •S-Part 2 Sec. 2 No. 3: Just thinking about science makes me feel nervous. •S-Part 4 No. 5: Science makes me feel uneasy and confused. •S-Part 4 No. 10: I almost never get uptight while taking science tests. •S-Part 4 No. 17: I have usually been at ease during science tests. •S-Part 4 No. 20: I get a sinking feeling when I think of trying hard science assignments. •S-Part 4 No. 24: I am afraid of doing science assignments when I know they will be graded. •S-Part 4 No. 26: I have usually been at ease in science classes. [1 = Not at all true; 2, 3, & 4 = Somewhat true; 5 = Very true]
C7. Inquiry science students' self-efficacy toward science learning	•S-Part 2 No. 5: How sure are you that you can make appropriate observations during a science investigation? •S-Part 2 No. 2: How sure are you that you can make appropriate predictions (hypotheses) about what will happen during a science investigation? •S-Part 2 No. 6: How sure are you that you can collect accurate data during a science investigation? •S-Part 2 No. 7: How sure are you that you can clearly record results from a science investigation? •S-Part 2 No. 1: How sure are you that you can correctly follow directions to complete a science investigation? •S-Part 2 No. 4: How sure are you that you can make accurate measurements during a science investigation? •S-Part 2 No. 3: How sure are you that you can use laboratory equipment correctly? •S-Part 2 No. 8: How sure are you that you can correctly complete necessary mathematical calculations in a science investigation? •S-Part 2 No. 9: How sure are you that you can communicate results in the form of a data table or graph? •S-Part 2 No. 12: How sure are you that you can describe how the science investigation is related to everyday life? •S-Part 2 No. 11: How sure are you that you can identify sources of error that might affect the results of a science investigation? •S-Part 2 No. 10: How sure are you that you can draw correct conclusions from the results of a science investigation? [0 = No chance; 100 = Completely certain]

Variable	Item
C8. Inquiry science students' understanding of the nature of science	•S-Part 3 Sec. 2 No. 11: Science knowledge is not good or bad. •S-Part 3 Sec. 2 No. 12: When you follow the scientific way of doing something, you get the right answer. •S-Part 3 Sec. 2 No. 3: Scientists always get the same results. •S-Part 3 Sec. 2 No. 4: All good scientists work in the same way. •S-Part 3 Sec. 2 No. 8: Sometimes things that scientists thought were right turn out to be wrong. •S-Part 3 Sec. 2 No. 7: Scientific knowledge can change over time. •S-Part 3 Sec. 2 No. 9: Many different kinds of people can be good scientists. •S-Part 3 Sec. 2 No. 6: All people can learn to be good scientists. •S-Part 3 Sec. 2 No. 2: Scientists never try to show that other scientists are wrong. •S-Part 3 Sec. 2 No. 5: Scientists are always right. •S-Part 3 Sec. 2 No. 1: Scientific knowledge can be useful away from school. •S-Part 3 Sec. 2 No. 10: Scientific knowledge is only useful to scientists. [1 = Not confident at all; 6 = Completely confident]
C9. Inquiry science students' understanding of the value of science	•S-Part 1 No. 9: Science is boring. •S-Part 1 No. 14: I like to do science work. •S-Part 1 No. 15: I like completing science investigations. •S-Part 1 No. 20: I look forward to science class. •S-Part 2 Sec. 2 No. 9: What I learn in my science class is interesting. •S-Part 4 No. 2: I find science interesting. •S-Part 4 No. 18: Science is a lot of fun. [1 = Not at all true; 2, 3, & 4 = Somewhat true; 5 = Very true]

Variable	Item
C10. Inquiry science students' motivation to learn science	•S-Part 1 No. 11: It is important to me that the other students in my science class do not think I am stupid. •S-Part 2 Sec. 2 No. 8: It is very important to me that I do not look stupid in my science class. •S-Part 2 Sec. 2 No. 4: One reason that I do my science work is so that the teacher knows that I am not stupid. •S-Part 1 No. 13: One reason that I might not participate in science class is to avoid looking stupid. •S-Part 4 No. 6: One of my main goals in science class is to avoid looking like I can't do my work. •S-Part 1 No. 18: An important reason I do my science work is to master challenging concepts. •S-Part 2 Sec. 2 No. 7: I like science class work that I'll learn from even if I make a lot of mistakes. •S-Part 1 No. 6: I like the work in my science class best when it really makes me think. •S-Part 4 No. 22: An important reason why I do my work in science class is because I want to get better at it. •S-Part 4 No. 9: An important reason I do my science work is because I like to learn new things. •S-Part 4 No. 8: I would feel successful in science if I got better grades than most of the other students. •S-Part 1 No. 17: I want to do better than other students in my science class. •S-Part 4 No. 27: It is important to me that the other students in my science class think I am smart. •S-Part 1 No. 5: I can show students in my science class that I am smart. •S-Part 4 No. 23: I like to show my teacher than I am smarter than the other students in my science class. •S-Part 1 No. 22: Our teacher calls on smart students more than other students. •S-Part 4 No. 21: Our teacher lets us know which students get the highest scores on tests. •S-Part 1 No. 3: Our teacher makes it obvious when students are not doing well on their work. •S-Part 4 No. 4: Our teacher points out those students who get good grades as an example to all of us. •S-Part 2 Sec. 2 No. 5: Only a few students do really well in science class. •S-Part 4 No. 3: Our teacher really wants us to enjoy learning new things in science. •S-Part 4 No. 19: Our teacher tells us why the ideas we are learning are important. •S-Part 2 Sec. 2 No. 10: Our teacher really thinks it is very important to try hard. •S-Part 4 No. 15: Our teacher thinks mistakes are okay as long as we keep trying to learn the material. •S-Part 2 Sec. 2 No. 1: Our teacher gives us time to really explore and understand new ideas. •S-Part 1 No. 1: Our teacher wants us to really understand the concepts, not just to memorize facts.

Variable	Item
C11. Inquiry science students' overall achievement levels	To be addressed in a future study
C12. Inquiry science students' parental assistance with student homework	To be addressed in a future study
C13. Inquiry science students' participation in science and mathematics activities outside of school	To be addressed in a future study
Category D. School resources for, and constraints on, inquiry science implementation	
D1. The *availability* of facilities, equipment, and materials in inquiry science classes' science labs	•Q-A6. How much science class equipment are you required to share with other teachers? [None, A little, Some, Very much, All] •Q-A7. Do you have your own FAST classroom that no one else uses at any time? [Yes, No]] •Q-A17, Part 1. What science equipment and materials do you have in the focus grade classroom(s) where you teach your FAST 1 classes, and to what extent are the equipment and materials adequate? Please rate the availability and adequacy of the equipment and materials listed below. To what extent are these available? a. Flat top tables; b. Running water; c. Heat sources; d. Safety stations; e. Balances; f. Standard laboratory glassware; g. Thermometers; h. Overhead projector; i. Computer; j. Video projector; k. FAST student books; l. FAST teacher guide; m. Other science books [Never, Rarely, Sometimes, Often, Always]

Variable	Item
D2. The *adequacy* of facilities, equipment, and materials in inquiry science classes' science classrooms	•Q-A17, Part 2. What science equipment and materials do you have in the focus grade classroom(s) where you teach your FAST 1 classes, and to what extent are the equipment and materials adequate? Please rate the availability and adequacy of the equipment and materials listed below. If these are available and you use them, are they adequate? a. Flat top tables; b. Running water; c. Heat sources; d. Safety stations; e. Balances; f. Standard laboratory glassware; g. Thermometers; h. Overhead projector; i. Computer; j. Video projector; k. FAST student books; l. FAST teacher guide; m. Other science books [Never, Rarely, Sometimes, Often, Always] •Q-A9. Indicate the frequency of each of the following situations in your classes or school: g. My school has adequate funding for FAST books and materials. [Never, Rarely, Sometimes, Often, Always]
D3. The school leadership's support for inquiry science program implementation	•Q-A8. To what extent do you agree with each of the following statements? i. My principal supports teaching FAST in my school. [Strongly disagree, Disagree, Agree, Strongly agree] •Q-A9. Indicate the frequency of each of the following situations in your classes or school: k. I have assistants to help manage my inquiry science laboratories. [Never, Rarely, Sometimes, Often, Always]
D4. The number of inquiry science teachers in the school	•Q-A2. How many other teachers at your school teach any part of FAST 1, FAST 2, or FAST 3 (enter zero for none)?
D5. The school's support for teacher professional development.	•Q-A9. Indicate the frequency of each of the following situations in your classes or school: h. My school ensures that I have sufficient opportunities for professional development in teaching science. i. My school has adequate funding for teacher professional development. [Never, Rarely, Sometimes, Often, Always]
D6. The school's ability grouping policy	•Q-A14. How are the FAST 1 students in your focus grade grouped? [Each class is homogeneously grouped (i.e., all students have similar ability levels),Each class is heterogeneously groups (i.e. has students of all ability levels), Some classes are homogeneously groups and some are heterogeneously grouped]
D7. The number of students in the inquiry science teachers' classes	•Q-A12. What is the total number of FAST 1 students that you teach in your focus grade?
Category E. District, community, and state resources for and constraints on inquiry science implementation	

Variable	Item
E1. The average class size	Data to be collected from www.schoolmatters.com
E2. The distribution of students' ethnicities, gender, special education status, and primary languages	Data to be collected from www.schoolmatters.com
E3. The school's per-pupil expenditure	Data to be collected from www.schoolmatters.com
E4. The community socio-economic status	Data to be collected from www.schoolmatters.com
E5. The number of students in the school	Data to be collected from www.schoolmatters.com
E6. Whether the school is public or private	•Q-C5. Are you currently teaching at a public or private school? [Public, Private]
E7. Grade levels served in the school	•Q-C6. Please check the grade levels that are served in your school (check all that apply): [K-12]
E8. The average student daily attendance throughout the school	Data to be collected from www.schoolmatters.com
E9. The school's geographic location	Data to be collected from www.schoolmatters.com

Appendix D

Inquiry Science Teacher Questionnaire

University of Hawai`i
Curriculum Research & Development Group

Inquiry Science Teacher Questionnaire

This questionnaire is about the University of Hawai`i Foundational Approaches in Science Teaching (FAST) program. The purpose of the questionnaire is to collect information about FAST 1 in your classroom and about the conditions that might affect how you teach FAST 1. The information you provide will help improve the program.

This questionnaire will take you a half an hour at most to complete. Please answer the questions to the best of your knowledge. There are no right or wrong answers. All responses are confidential, and your participation is voluntary. The only reason we request your name is to keep track of who has not yet completed a questionnaire. All the information collected with this questionnaire will be summarized in aggregate. No individuals' responses will be analyzed or reported separately. Only the researchers will see the responses.

As soon as you complete and submit the entire questionnaire, we will send you $30 in bookstore gift certificates.

Note: There are three sections to this questionnaire. If you are unable to complete all three sections in one sitting click the *Pause* button located at the bottom of each page. You will be prompted to enter your e-mail address and will be e-mailed a new link that will allow you to continue where you left off.

Thank you very much for your time!

Your name: ____________

School name: ____________

Today's date (mm/dd/yy): ____________

Are you teaching any part of FAST 1 this year: ○ Yes ○ No

Did you teach any part of FAST 1 last year: ○ Yes ○ No

Reset | Submit | Pause

Inquiry Science Teacher Questionnaire

Section A. Questions About FAST in Your Classroom

Answer the questions for the most recent year that you taught FAST (this year *or* last year).

1. In what grades are you teaching the FAST 1 program ? (Check all that apply.)

- [ ] 5
- [ ] 6
- [ ] 7
- [ ] 8
- [ ] 9
- [ ] 10

2. How many other teachers at your school teach any part of FAST 1, FAST 2 or FAST 3 (enter zero if none): [ ]

	Never	Rarely	Sometimes	Often	Always
3. How often do you ask for and receive assistance in teaching FAST from other teachers in the school?	○	○	○	○	○
4. To what extent does your department or school decide the FAST 1 investigations that you teach?	○	○	○	○	○
5. If you answered "Sometimes", "Often", or "Always" to Question 4, to what extent do **you** participate in deciding the FAST 1 investigations that you teach?	○	○	○	○	○

	None	A little	Some	Very much	All
6. How much science class equipment are you required to share with other teachers?	○	○	○	○	○

7. Do you have your own FAST classroom that no one else uses at any time? ○ Yes ○ No

8. To what extent do you agree with each of the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree
a. The more I expect of my students, the better they will do in their FAST classes.	○	○	○	○
b. Ultimately, teachers are responsible for how much their students learn about	○	○	○	○

science.				
c. Sometimes teachers expect too much from their students.	○	○	○	○
d. Teaching science is an ideal job for me.	○	○	○	○
e. It is important for teachers to have high expectations of all students in inquiry science classes.	○	○	○	○
f. I am deeply committed to teaching inquiry science classes.	○	○	○	○
g. As a teacher, I cannot do much for a student who is doing poorly.	○	○	○	○
h. I think that having students teach other students is an effective way to enhance learning in my FAST classes.	○	○	○	○
i. My principal supports teaching FAST in my school.	○	○	○	○
j. I feel responsible when my FAST students do not learn as much as I think they can.	○	○	○	○

9. Indicate the frequency of each of the following situations in your classes or school:

	Never	Rarely	Sometimes	Often	Always
a. Collaborating with fellow teachers at my school gives me access to new ideas and knowledge.	○	○	○	○	○
b. Students teach other students in FAST classes.	○	○	○	○	○
c. I have sufficient time in my school schedule to plan my FAST curriculum.	○	○	○	○	○
d. I usually have time outside of class to help my FAST students learn science.	○	○	○	○	○
e. The collaboration I have with fellow teachers at my school ultimately improves my students' learning.	○	○	○	○	○
f. I have sufficient time to set up all my FAST classes.	○	○	○	○	○
g. My school has adequate funding for FAST books and materials.	○	○	○	○	○
h. My school ensures that I have sufficient opportunities for professional development in teaching science.	○	○	○	○	○

i. My school has adequate funding for teacher professional development. ○ ○ ○ ○ ○

j. Science teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies. ○ ○ ○ ○ ○

k. I have assistants to help manage my inquiry science laboratories. ○ ○ ○ ○ ○

l. The collaboration I have with fellow teachers at my school improves my teaching. ○ ○ ○ ○ ○

m. I have sufficient time to formally assess my FAST students' learning. ○ ○ ○ ○ ○

We would like you to answer the rest of the questions in Section A of this questionnaire in light of **one grade only**, which we will call the **focus grade**. If you teach more than one grade, and one of them is Grade 6, that will be the focus grade for this questionnaire. If you teach more than one grade but not including Grade 6, the **lowest of those grades** will be the focus grade. Please enter your focus grade here: [ ]

Please be sure to answer the rest of the questionnaire in light of what you have done or plan to do this year in this grade.

10. Do you integrate the teaching of any other subjects into your FAST 1 classes in your focus grade? ○ Yes ○ No

a. If yes, enter the subject (s) here: [ ]

11. How many FAST 1 classes do you teach in your focus grade each week? (If the number per week varies, enter the average number.) [ ]

12. What is the total number of FAST 1 students that you teach in your focus grade? [ ]

13. What is the total length (in minutes) of all the FAST 1 classes that you teach to your focus grade each week? [ ]

14. How are the FAST 1 students in your focus grade grouped?

- ○ Each class is homogeneously grouped (i.e., all students have similar ability levels).
- ○ Each class is heterogeneously grouped (i.e., has students of all ability levels).
- ○ Some classes are homogeneously grouped and some are heterogeneously grouped.

15. What is the percentage of FAST 1 investigations for which you assign homework in your focus grade?

- 0-25%
- 26-50%
- 51-75%
- 76-100%

16. Please check each FAST 1 investigation that you teach, or will teach, to your focus grade. (Check all that apply.)

- PS1. Liquids and Vials
- PS2. Sinking a Straw
- PS3. Graphing the Sinking-Straw Data
- PS4. Mass and the Sinking Straw
- PS5. Sinking Cartons
- PS6. Volume and the Sinking Cartons
- PS7. Floating and Sinking Objects
- PS8. Introduction to the Cartesian Diver
- PS9. Density and the Cartesian Diver
- PS10. Density of Objects
- PS11. Density of Liquids
- PS12. Buoyancy of Liquids
- PS13. Balloons in Water
- PS14. Submarine Project
- PS15. Bubbles in Gases
- PS16. Density of Gases
- PS17. Weather Balloon Project
- PS18. Boiling Water
- PS19. Heating Ice in a Balloon
- PS20. Freezing, Melting, Boiling, and Condensing of Pure Substances
- PS21. Freezing, Melting, Boiling, and Condensing of Mixtures
- PS22. Identifying Unknown Substances
- PS23. A Torricelli Tube and a Fountain
- PS24. Syringe-and-Fluid Systems
- PS25. Flask-and-Fluid Systems
- PS26. Fluids and Partial Vacuums
- PS27. Height of Liquid Columns in a Torricelli Tube
- PS28. Moving Fluids Project
- PS29. Heating a Liquid-Gas System
- PS30. Heating a Gas System
- PS31. Pressure of Gas in a Liquid-Gas System: A Demonstration
- PS32. Cooling a Liquid-Gas System
- PS33. Dew Point Project
- PS34. Predicting Temperature
- PS35. Heat Project
- PS36. Measuring Heat
- PS37. The Calorie, a Unit of Heat
- PS38. Exchange of Heat between Hot and Cold Water

- ☐ PS39. Exchange of Heat between Metal and Water
- ☐ PS40. Specific Heat and the Identification of Unknown Substances
- ☐ PS41. Solar Heating Project
- ☐ E1. Seeds with Hard Coats
- ☐ E2. Scarifying Seeds
- ☐ E3. Propagating Plants
- ☐ E4. Oral Scientific Reports
- ☐ E5. Written Scientific Reports
- ☐ E6. Soil Composition
- ☐ E7. Comparing Soils
- ☐ E8. Soil and Roots
- ☐ E9. Absorption and Percolation of Water in Soil
- ☐ E10. Capillarity of Water in Soil
- ☐ E11. Evaporation of Water from Soil
- ☐ E12. Water Vapor in the Air
- ☐ E13. Measuring Relative Humidity
- ☐ E14. Water Droplets in the Air
- ☐ E15. Major Gases in the Air
- ☐ E16. The Trace Components of Air
- ☐ E17. Weather Situations
- ☐ E18. Weather Maps
- ☐ E19. Climate
- ☐ E20. Raindrops
- ☐ E21. The Rain Walk
- ☐ E22. Water under the Ground
- ☐ E23. Plants and Water
- ☐ E24. The Case of Leaky Leaves
- ☐ E25. Transpiration
- ☐ E26. Care of an Animal in the Laboratory
- ☐ E27. The Initial Survey
- ☐ E28. Ecological Changes in a Small Area
- ☐ E29. The Physical Environment of the Class Study Area
- ☐ E30. Mapping the Class Study Area
- ☐ E31. Methods of Sampling Populations
- ☐ E32. The Ecology of the Class Study Area
- ☐ RS1. Evidence of Air Pollution in the Community
- ☐ RS2. Air Pollutants
- ☐ RS3. Effects of Air Pollutants
- ☐ RS4. A Community Pollution Inventory
- ☐ RS5. Air Pollution and the Physical Environment
- ☐ RS6. Air Pollution Control
- ☐ RS7. Air Pollution in the Future
- ☐ RS8. The Water Cycle
- ☐ RS9. Uses of Water
- ☐ RS10. Distribution of Water

- ☐ RS11. Local Issues
- ☐ RS12. Testing Water Quality
- ☐ RS13. Purifying Water
- ☐ RS14. Managing Water Resources
- ☐ RS15. Planning for the Future: A Simulation

17. What science equipment and materials do you have in the focus grade classroom(s) where you teach your FAST 1 classes, and to what extent are the equipment and materials adequate? Please rate the **availability** and **adequacy** of the equipment and materials listed below.

	To what extent are these **available**?					If these are available and you use them, are they **adequate**?				
	Never	Rarely	Sometimes	Often	Always	Not at all	Somewhat	Mostly	Completely	Do not use
a. Flat top tables	○	○	○	○	○	○	○	○	○	○
b. Running water	○	○	○	○	○	○	○	○	○	○
c. Heat sources	○	○	○	○	○	○	○	○	○	○
d. Safety stations	○	○	○	○	○	○	○	○	○	○
e. Balances	○	○	○	○	○	○	○	○	○	○
f. Standard laboratory glassware	○	○	○	○	○	○	○	○	○	○
g. Thermometers	○	○	○	○	○	○	○	○	○	○
h. Overhead projector	○	○	○	○	○	○	○	○	○	○
i. Computer	○	○	○	○	○	○	○	○	○	○
j. Video projector	○	○	○	○	○	○	○	○	○	○
k. FAST student books	○	○	○	○	○	○	○	○	○	○
l. FAST teacher guide	○	○	○	○	○	○	○	○	○	○
m. Other science books	○	○	○	○	○	○	○	○	○	○

18. When you teach FAST to your focus grade, how frequently do you:

	Never	Rarely	Sometimes	Often	Always

a. demonstrate the use of a new instrument.

b. have students write the problem or activity at the beginning of the investigation.

c. review relevant concepts and skills that were learned in previous lessons.

d. introduce new vocabulary words.

e. ask students to identify and define words.

f. ask students to make predictions about the investigation.

g. check to ensure that students understand new procedures before beginning investigations.

h. discuss how everyday situations directly relate to investigations.

i. check students' designs for safety before allowing them to conduct their investigations.

j. monitor small group progress during investigations.

k. encourage students to collaborate within their groups.

l. circulate and interact with students during the lab portion of the investigation.

m. discuss variations in the data with the students in the summary phase of the investigation.

n. have students share their predictions with the class.

o. have students share their data or findings with the class.

p. have students recognize discrepancies among groups' results.

q. use the "Key Questions" from the FAST student book to guide class discussion.

r. have students engage in discussions among themselves about investigations.

s. challenge students to consider the effects of errors on groups' results.

t. prepare a class data table which includes each group's results and discuss findings with the entire class.	○	○	○	○	○
u. compare and contrast students' explanations of findings.	○	○	○	○	○
v. question students as they conduct their investigations.	○	○	○	○	○
w. connect new information with students' personal lives (interests, home environment, community, culture, etc.).	○	○	○	○	○
x. connect current events and other subjects with current science concepts, skills, and investigations.	○	○	○	○	○
y. use questioning strategies to respond to students' questions about investigations.	○	○	○	○	○
z. have students ask questions about the scientific phenomena addressed during investigations.	○	○	○	○	○

	Never	Rarely	Sometimes	Often	Always
19. How often do you supplement the teaching of FAST in your focus grade with written materials other than the FAST 1 books?	○	○	○	○	○
20. How often do you customize FAST 1 investigations in your focus grade in any way?	○	○	○	○	○

21. How frequently do you provide students in your focus grade with:

	Never	Rarely	Sometimes	Often	Always
a. extra tutoring?	○	○	○	○	○
b. extra lab time?	○	○	○	○	○
c. after-school help?	○	○	○	○	○

	0-25%	26-50%	51-75%	76-100%
22. What percentage of the FAST students in your focus grade are well behaved?	○	○	○	○
23. What percentage of the FAST students in your focus grade	○	○	○	○

show perseverance in learning science?

24. What percentage of the students in your focus grade teach each other in FAST classes?

When you are finished with Section A, click "submit"

Reset Submit Pause

Inquiry Science Teacher Questionnaire

Section B. Questions About Science Activities at Your School

1. Please check if you have been trained in either of the following:

	Yes	No
a. FAST 2	◯	◯
b. FAST 3	◯	◯

2. In the past 12 months, how frequently have you participated in the following activities?

	Not at all	Occasionally	Often
a. Observational visits at other schools.	◯	◯	◯
b. Collaborative research with other professionals.	◯	◯	◯
c. Collaboration with other teachers on issues of instruction.	◯	◯	◯
d. Mentoring or coaching other teachers.	◯	◯	◯
e. Being mentored or coached by other teachers.	◯	◯	◯

3. If you are a member of any mathematics or science organizations outside of your school, give their names or descriptions here.

4. How frequently do science teachers in your school meet as a group?

◯ a. I am the only science teacher in the school. (Skip to question 6.)
◯ b. Never
◯ c. Less than once a month
◯ d. About once a month
◯ e. Less than once a week and more than once a month
◯ f. At least once a week.

5. If you did not check *a* for the previous item, indicate how frequently science teachers meeting as a group discuss:

	Never	Rarely	Sometimes	Often	Always
a. classroom management or disciplinary	◯	◯	◯	◯	◯

issues.

b. inquiry science teaching methods.	○	○	○	○	○
c. science content issues.	○	○	○	○	○
d. administrative issues.	○	○	○	○	○
e. staff development issues.	○	○	○	○	○

6. To what extent do you:

	Never	Rarely	Sometimes	Often	Always
a. read science magazines, science journals, or science books outside of the classroom?	○	○	○	○	○
b. attend science teaching conferences or meetings outside of school?	○	○	○	○	○
c. hold leadership positions in science teaching organizations?	○	○	○	○	○
d. use a computer in your classroom?	○	○	○	○	○
e. access the Internet in your classroom?	○	○	○	○	○
f. use the Internet to help enhance your teaching and learning?	○	○	○	○	○

When you are finished with Section B, click "submit"

Reset Submit Pause

Inquiry Science Teacher Questionnaire

Section C. Questions About Your Background and Experience

1. How proficient are you in:

	Do not use	Not at all proficient	A little proficient	Fairly proficient	Proficient
a. sending e-mails?	○	○	○	○	○
b. using the Internet?	○	○	○	○	○
c. using CDs or DVDs in a computer?	○	○	○	○	○

2. Including this year, how many years have you been employed as a K-12 teacher (not counting professional leaves, maternity leaves, and so forth)? ______

3. Including this year, how many years have you taught K-12 science (not counting professional leaves, maternity leaves, and so forth)? ______

4. What is your current annual salary?

- ○ $20,000 or below
- ○ $20,001 to $30,000
- ○ $30,001 to $40,000
- ○ $40,001 to $50,000
- ○ $50,001 to $60,000
- ○ $60,001 or above

5. Are you currently teaching at a public or private school?

- ○ Public
- ○ Private

6. Please check the grade levels that are served in your school (check all that apply):

- ☐ Kindergarten
- ☐ 1st grade
- ☐ 2nd grade
- ☐ 3rd grade
- ☐ 4th grade
- ☐ 5th grade
- ☐ 6th grade
- ☐ 7th grade
- ☐ 8th grade
- ☐ 9th grade

- ☐ 10th grade
- ☐ 11th grade
- ☐ 12th grade

7. In what year did you begin teaching at your current school? [ ]

8. In general, how important is it to you that you spend time planning FAST lessons?

- ○ Not at all
- ○ A little
- ○ Somewhat
- ○ Very

9. For each of the items below, indicate whether you hold the following degrees or certificates. For each degree or certificate held, record your major and minor fields of study. If you completed more than one degree or certificate at a level, or had a double major or minor, please provide information for all fields of study at that level.

a. Bachelor's degree? ○ Yes ○ No If yes, record your major field(s) of study: [ ]

If yes, record your minor field(s) of study: [ ]

b. Postbaccalaureate certificate? ○ Yes ○ No If yes, record your major field(s) of study: [ ]

c. Master's degree? ○ Yes ○ No If yes, record your major field(s) of study: [ ]

d. Doctoral degree? ○ Yes ○ No If yes, record your major field(s) of study: [ ]

10. How many undergraduate science courses (not including social science courses) have you taken?
Write the number here: [ ]

11. How many graduate science courses (not including social science courses) have you taken?
Write the number here: [ ]

12. How many hours have you spent in science-teacher professional development classes (other than FAST) over the past five years? Write the number here: [ ]

13. In each of the following subjects, please indicate whether or not you hold a teaching license from the state where you teach.

	Yes	No
a. mathematics	◯	◯
b. science	◯	◯
c. English	◯	◯
d. social studies	◯	◯

14. What type of teaching certificate do you hold from the state where you teach?

- ◯ regular or standard certificate
- ◯ probationary, temporary, provisional, or emergency certificate
- ◯ other
- ◯ I am not certified

15. What is your year of birth? [ ]

	Male	Female
16. What is your gender?	◯	◯

When you are finished with Section C, click "submit"

Thank you for your time in completing this questionnaire

[Reset] [Submit] [Pause]

Appendix E

Tables of Results on the Inquiry Science Teacher Questionnaire Items

Tables of Results on the Inquiry Science Teacher Questionnaire Items[a]

Table E-1.
Results About the Extent to Which the Inquiry Science Teacher Circulates and Engages With Students About Their Investigations (Variable A1)

Item	*N*	*M*	*SD*	SE_M
A.18.l. How frequently do you circulate Availability and interact with students during the lab portion of the investigation?	79	4.71	0.6	0.06

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-2.
Results About the Extent to Which the Inquiry Science Teacher Addresses the Relevance of the Investigation to Students' Lives (Variable A2)

Item	*N*	*M*	*SD*	SE_M
A.18.h. How frequently do you discuss how everyday situations directly relate to investigations?	79	4.08	0.76	0.09
A.18.w. How frequently do you connect new information with students' personal lives (interests, home environment, community, culture, etc.)?	79	3.70	0.82	0.09
A.18.x. How frequently do you connect current events and other subjects with current science concepts, skills, and investigations?	79	3.72	0.83	0.09

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

[a]Each item is identified by item number within questionnaire section number.

Table E-3.
Results About the Extent to Which the Inquiry Science Teacher Has Students Develop, Share, Discuss or Record Their Hypotheses, Predictions, Analyses, or Findings With the Entire Class or in Small Groups (Variable A3)

Item	*N*	*M*	*SD*	SE_M
A.18.b. How frequently do you have students write the problem or activity at the beginning of the investigation?	79	4.29	0.94	0.11
A.18.f. How frequently do you ask students to make predictions about the investigation?	79	4.51	0.64	0.07
A.18.k. How frequently do you encourage students to collaborate within their groups?	79	4.66	0.53	0.06
A.18.n. How frequently do you have students share their predictions with the class?	79	4.18	0.87	0.10
A.18.o. How frequently do you have students share their data or findings with the class?	79	4.48	0.71	0.08
A.18.r. How frequently do you have students engage in discussions among themselves about investigations?	79	4.13	0.76	0.09

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-4.
Results About the Extent to Which the Inquiry Science Teacher Facilitates Class Discussions About Differences Among the Small Group Findings (Variable A4)

Item	*N*	*M*	*SD*	SE_M
A.18.p. How frequently do you have students recognize discrepancies among groups' results?	79	4.33	0.69	0.08
A.18.s. How frequently do you challenge students to consider the effects of errors on groups' results?	79	4.06	0.79	0.09

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-5.
Results About the Extent to Which the Inquiry Science Teacher Presents a Data Table Summarizing the Small Groups' Results (Variable A5)

Item	*N*	*M*	*SD*	SE_M
A.18.t. How frequently do you prepare a class data table which includes each group's results and discuss findings with the entire class?	79	4.33	0.80	0.09

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-6.
Results About the Extent to Which the Inquiry Science Teacher Introduces or Reviews Science Concepts or Asks Students to Define or Review Science Concepts (Variable A6)

Item	*N*	*M*	*SD*	SE_M
A.18.c. How frequently do you review relevant concepts and skills that were learned in previous lessons?	79	4.51	0.62	0.07

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-7.
Results About the Extent to Which the Inquiry Science Teacher Demonstrates or Reviews the Correct Use of Science Tools or Equipment (Variable A7)

Item	*N*	*M*	*SD*	SE_M
A.18.a. How frequently do you demonstrate the use of a new instrument?	79	4.23	0.82	0.09

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-8.
Results About the Extent to Which the Inquiry Science Teacher Introduces, Monitors or Reviews Students' Preciseness, Carefulness, or Procedures (Variable A8)

Item	*N*	*M*	*SD*	SE_M
A.18.g. How frequently do you check to ensure that students understand new procedures before beginning investigations?	79	4.42	0.78	0.09
A.18.i. How frequently do you check students' designs for safety before allowing them to conduct their investigations?	79	4.56	0.80	0.09
A.18.j. How frequently do you monitor small group progress during investigations?	79	4.67	0.52	0.06

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-9.
Results About the Extent to Which the Inquiry Science Teacher Has Students Analyze, Synthesize, and Evaluate Data (Variable A9)

Item	*N*	*M*	*SD*	SE_M
A.18.m. How frequently do you discuss variations in the data with the students in the summary phase of the investigation?	79	4.56	0.64	0.07
A.18.u. How frequently do you compare and contrast students' explanations of findings?	79	4.09	0.79	0.09

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-10.
Results About the Extent to Which the Inquiry Science Has Students Work on Science Vocabulary (Variable A10)

Item	*N*	*M*	*SD*	SE_M
A.18.d. How frequently do you introduce new vocabulary words?	79	4.32	0.78	0.09
A.18.e. How frequently do you ask students to identify and define words?	79	4.06	0.97	0.11

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-11.
Results About the Extent to Which the Inquiry Science Teacher Engages Students in Dialogue by Asking Questions (Variable A11)

Item	*N*	*M*	*SD*	SE_M
A.18.q. How frequently do you use the "Key Questions" from the FAST student book to guide class discussion?	79	3.97	0.99	0.11
A.18.v. How frequently do you question students as they conduct their investigations?	79	4.24	0.77	0.09
A.18.y. How frequently do you use questioning strategies to respond to students' questions about investigations?	79	4.15	0.77	0.09

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-12.
Results About the Extent to Which the Inquiry Science Teacher Has Students Ask Questions During Investigations (Variable A12)

Item	*N*	*M*	*SD*	SE_M
A.18.z. How frequently do you have students ask questions about the scientific phenomena addressed during investigations?	79	4.04	0.85	0.10

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-13.
Results About the Number of Inquiry Science Investigations That the Teacher Has Completed During the Studied Period (Variable A13)

Item	*N*	*M*	*SD*	SE_M
A.16. Please check each FAST 1 investigation that you teach, or will teach, to your focus grade. (Check all that apply.)				
•Physical science	79	16.25	7.93	0.89
•Ecology	79	7.48	7.37	0.83
•Relational studies	79	1.86	3.51	0.40

Table E-14.
Results About the Extent to Which the Inquiry Science Teacher Customizes FAST (Variable A20)

Item	*N*	*M*	*SD*	SE_M
A.19. How often do you supplement the teaching of FAST in your focus grade with written materials other than the FAST 1 books?	79	3.29	0.88	0.10
A.20. How often do you customize FAST 1 investigations in your focus grade in any way?	79	3.33	0.93	0.10

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-15.
Results About the Extent to Which Students Teach Students in FAST (Variable A22)

Item	*N*	*M*	*SD*	SE_M
A.8.h. I think that having students teach other students is an effective way to enhance learning in my FAST classes.	79	3.35	0.53	0.06
A.9.b. Students teach other students in FAST classes.	79	3.59	0.74	0.08

Note. Item A.8.h. was answered on a 1–4 scale, where *1* = strongly disagree, *2* = disagree, *3* = agree, and *4* = strongly agree, and Item A.9.b. was answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-16.
Results About the Extent to Which Students Teach Students in FAST (Variable A22)

Item	0-25%	26-50%	51-75%	76-100%
A.24. What percentage of the students in your focus grade teach each other in FAST classes?	16.46	26.58	41.77	15.19

Table E-17.
Results About the Inquiry Science Teacher's Age (Variable B1)

tem	*N*	%
C.15. What is your year of birth?		
•1950 or before	15	18.52
•1951 to 1960	19	23.46
•1961 to 1970	16	19.75
•1971 to 1980	29	35.80
•1981 or after	2	2.47

Table E-18.
Results About the Inquiry Science Teacher's Salary (Variable B2)

Item	*N*	%
C.4. What is your current annual salary?		
•$20,000 or below	1	1.2
•$20,001 to $30,000	10	12.4
•$30,001 to $40,000	34	42.00
•$40,001 to $50,000	14	17.3
•$50,001 to $60,000	13	16.1
•$60,001 or above	9	11.1

Table E-19.
Results About Teacher Gender (Variable B3)

Item	*N*	%
C.16. What is your gender?		
•Male	31	39.24
•Female	48	60.76

Table E-20.
Results About the Inquiry Science Teacher's Highest Degree (Variable B4)

Item	*N*	%
C.9. For each of the items below, indicate whether you hold the following degrees or certificates. For each degree or certificate held, record your major and minor fields of study. If you completed more than one degree or certificate at a level, or had a double major or minor, please provide information for all fields of study at that level.		
a. Bachelor's	79	100.0
b. Postbaccalaureate certificate	22	27.85
c. Master's	46	58.23
d. Doctorate	2	2.53

Table E-21.
Results About the Inquiry Science Teacher's Undergraduate and Graduate Major and Minor Fields of Study (Variable B5)

Item	*N*	%
C.9.a. Teacher's undergraduate major field of study:		
•Biology	7	10.29
•Chemistry	3	4.41
•Economics	0	0.00
•Education	28	41.18
•English	4	5.88
•History	1	1.47
•Mathematics	1	1.47
•Physics	3	4.41
•Psychology	2	2.94
•Other	19	27.94
C.9.a. Teacher's undergraduate minor field of study:		
•Biology	1	3.03
•Chemistry	1	3.03
•Economics	0	0.00
•Education	6	18.18
•English	2	6.06
•History	2	6.06
•Mathematics	2	6.06
•Physics	0	0.00
•Psychology	2	6.06
•Other	17	51.52
C.9.c. Teacher's graduate major field of study:		
•Biology		
•Chemistry	0	0.00
•Economics	1	1.61
•Education	0	0.00
•English	43	69.35
•History	2	3.23
•Mathematics	0	0.00
•Physics	1	1.61
•Psychology	0	0.00
•Other	15	24.19

Table E-22.
Results About the Number of Undergraduate or Graduate Science Classes That the Inquiry Science Teacher Has Taken (Variable B6)

Item	*N*	*M*	*SD*	SE_M
C.10. How many undergraduate science courses (not including social science courses) have you taken?	79	13.63	17.75	2.09
C.11. How many graduate science courses (not including social science courses) have you taken?	79	4.96	8.16	0.95

Table E-23.
Results About the Inquiry Science Teacher's Type of Certification (Variable B7)

Item	*N*	%
C.13.a. Please indicate whether or not you hold a mathematics teaching license from the state where you teach?	21	27.58
C.13.b. Please indicate whether or not you hold a science teaching license from the state where you teach?	53	67.09
C.13.c. Please indicate whether or not you hold an English teaching license from the state where you teach?	24	30.38
C.13.d. Please indicate whether or not you hold a social studies teaching license from the state where you teach?	53	67.09
C.14. What type of teaching certificate do you hold from the state where you teach?		
•a regular or standard certificate	62	78.48
•a probationary, temporary, provisional, or emergency certificate	5	6.33
•another certificate	1	1.27
•no certification	11	13.92

Table E-24.
Results About the Number of Years that the Inquiry Science Teacher Has Taught in K–12 Schools (Variable B8)

Item	*N*	*M*	*SD*	SE_M
C.2. Including this year, how many years have you been employed as a K-12 teacher (not counting professional leaves, maternity leaves, and so forth)?	79	12.08	8.53	0.96

Table E-25.
Results About the Number of Years the Inquiry Science Teacher Has Taught K–12 Science (Variable B9)

Item	*N*	*M*	*SD*	SE_M
C.3. Including this year, how many years have you taught K-12 science (not counting professional leaves, maternity leaves, and so forth)?	79	9.72	8.00	0.90

Table E-26.
Results About Teacher Training in FAST 2 or 3 (Variable B10)

Item	*N*	%
B.1. Please check if you have been trained in either of the following:		
•FAST 2	28	34.6
•FAST 3	53	65.4

Table E-27.
Results About the Grades in Which the Teacher is Teaching FAST (Variable B11)

Item	*N*	%
A.1. In what grades are you teaching the FAST 1 program? (Check all that apply.)		
•Grade 5	2	2.53
•Grade 6	36	45.57
•Grade 7	45	56.96
•Grade 8	16	20.25
•Grade 9	1	1.27
•Grade 10	1	1.27

Table E-28.
Results About the Teacher Attitude Toward Teaching Science (Variable B13)

Item	*N*	*M*	*SD*	SE_M
A.8.d. Teaching science is an ideal job for me.	79	3.28	0.80	0.09
A.8.f. I am deeply committed to teaching inquiry science classes.	79	3.44	0.57	0.06

Note. Answered on a 1–4 scale, where *1* = strongly disagree, *2* = disagree, *3* = agree, and *4* = strongly agree.

Table E-29.
Results About the Extent to Which the Inquiry Science Teacher Has High Expectations of Students (Variable B14)

Item	*N*	*M*	*SD*	SE_M
A.8.a. The more I expect of my students, the better they will do in their FAST classes.	79	3.32	0.61	0.07
A.8.b. Ultimately, teachers are responsible for how much their students learn about science.	79	2.78	0.59	0.07
A.8.c. Sometimes teachers expect too much from their students.	79	2.72	0.68	0.08
A.8.e. It is important for teachers to have high expectations of all students in inquiry science classes.	79	3.29	0.70	0.08
A.8.g. As a teacher, I cannot do much for a student who is doing poorly.	79	3.41	0.52	0.06
A.8.j. I feel responsible when my FAST students do not learn as much as I think they can.	79	2.91	0.66	0.07

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, and *4* = often, and *5* = always.

Table E-30.
Results About the Extent to Which the Inquiry Science Teacher Participates in Science Activities Outside of the Classroom (Variable B15)

Item	*N*	*M*	*SD*	SE_M
B.6.a. To what extent do you read science magazines, science journals, or science books outside of the classroom?	79	3.41	0.94	0.11
B.6.b. To what extent do you attend science teaching conferences or meetings outside of school?	79	2.66	0.90	0.10
B.6.c. To what extent do you hold leadership positions in science teaching organizations?	79	1.56	0.87	0.10
C.12. How many hours have you spent in science-teacher professional development classes (other than FAST) over the past five years?	77	41.04	61.61	7.02

Note. Items B.6.a, B6.b, and B.6.c were answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-31.
Results About the Extent to Which the Inquiry Science Teacher Participates in Science Activities Outside of the Classroom (Variable B15)

Item	*N*	%
B.3. If you are a member of any mathematics or science organizations outside of your school, give their names or descriptions here.		
•Science organizations	30	37.97
•Mathematics organizations	5	6.32

Table E-32.
Results About the Extent to Which the Inquiry Science Teacher is Proficient With Computers and the Internet (Variable B16)

Item	*N*	*M*	*SD*	SE_M
C.1.a. How proficient are you in sending e-mails?	79	3.78	0.50	0.06
C.1.b. How proficient are you in using the Internet?	79	3.78	0.47	0.05
C.1.c. How proficient are you in using CDs or DVDs in a computer?	79	3.54	0.71	0.08
B.6.d. To what extent do you use a computer in your classroom?	79	4.35	0.85	0.10
B.6.e. To what extent do you access the Internet in your classroom?	79	4.16	1.02	0.11
B.6.f. To what extent do you use the Internet to help enhance your teaching and learning?	79	3.95	0.96	0.11

Note. Items C.1.a., C.1.b., and C.1.c. were answered on a 1–5 scale, where *1* = do not use, *2* = not at all proficient, *3* = a little proficient, *4* = fairly proficient, and *5* =proficient, and Items B.6.d., B.6.e., and B.6.f. were answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-33.
Results About the Extent to Which the Inquiry Science Teacher Plans Lessons (Variable B17)

Item	*N*	*M*	*SD*	SE_M
A.9.c. I have sufficient time in my school schedule to plan my FAST curriculum.	79	3.16	1.10	0.12
A.9.f. I have sufficient time to step up all my FAST classes.	79	3.32	1.02	0.11
A.9.m. I have sufficient time to formally assess my FAST students' learning.	79	3.35	0.92	0.10
C.8. In general, how important is it to you that you spend time planning FAST lessons?	79	3.66	0.57	0.06

Note. Items A.9.c., A.9.f., and A.9.m were answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always, and Item C.8. was answered on a 1–4 scale, where *1* = not at all, *2* = a little, *3* = somewhat, and *4* = very much.

Table E-34.
Results About the Number of FAST Class Periods Taught Per School Day, the Number Per Investigation, and the Length of Each (Variable B18)

Item	*N*	*M*	*SD*	SE_M
A.11. How many FAST 1 classes do you teach in your focus grade each week? (If the number per week varies, enter the average number.)	79	6.92	6.48	0.73
A.13. What is the total length (in minutes) of all the FAST 1 classes that you teach to your focus grade each week?	79	324.24	340.31	38.53

Table E-35.
Results About the Extent to Which the Teacher Participates in School Decision Making (Variable B19)

Item	*N*	*M*	*SD*	SE_M
A.4. To what extent does your department or school decide the FAST 1 investigations that you teach?	79	2.65	1.55	0.17
A.5. If you answered "Sometimes", "Often", or "Always" to Question 4, to what extent do you participate in deciding the FAST 1 investigations that you teach?	79	2.33	2.21	0.25

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-36.
Results About the Extent to Which Teachers Provide Students With Extra Assistance (Variable B20)

Item	*N*	*M*	*SD*	SE_M
A.9.d. I usually have time outside of class to help my FAST students learn science.	79	2.82	1.00	0.11
A.21.a. How frequently do you provide students in your focus grade with extra tutoring?	79	3.11	0.86	0.10
A.21.b. How frequently do you provide students in your focus grade with extra lab time?	79	2.92	0.94	0.11
A.21.c. How frequently do you provide students in your focus grade with after-school help?	79	3.01	0.95	0.11

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-37.
Results About the Teacher Integration of FAST With Other Subjects (Variable B21)

Item	*N*	%
A.10. Do you integrate the teaching of any other subjects into your FAST 1 classes in your focus grade?		
•Yes	50	63.29
•No	29	36.71

Table E-38.
R*esults About the Extent to Which the Inquiry Science Teacher Assigns Homework (Variable B22)*

Item	*N*	%
A.15. What is the percentage of FAST 1 investigations for which you assign homework in your focus grade?		
•0–25%	43	53.09
•26–50%	17	20.99
•51–75%	14	17.28
•76–100%	7	8.64

Table E-39.
Results About the Extent to Which the Inquiry Science Teacher Has Opportunities to Obtain Colleagues' Assistance, Advice, and Encouragement (Variable B23)

Item	*N*	*M*	*SD*	SE_M
A.3. How often do you ask for and receive assistance in teaching FAST from other teachers in the school?	79	2.38	1.09	0.12
A.9.a. Collaborating with fellow teachers at my school gives me access to new ideas and knowledge.	79	3.63	0.94	0.11
A.9.e. The collaboration I have with my fellow teachers at my school ultimately improves my students' learning.	79	3.42	0.99	0.11
A.9.j. Science teachers in this school regularly observe each other teaching classes as part of sharing and improving instructional strategies.	79	2.06	0.88	0.10
A.9.l. The collaboration I have with fellow teachers at my school improves my teaching.	79	3.53	0.97	0.11
B.2.a. Observational visits at other schools.	79	1.14	0.35	0.04
B.2.b. Collaborative research with other professionals.	79	1.53	0.60	0.07
B.2.c. Collaboration with other teachers on issue of instruction.	79	2.13	0.59	0.07
B.2.d. Mentoring or coaching other teachers.	79	1.77	0.77	0.09
B.2.e. Being mentored or coached by other teachers.	79	1.43	0.57	0.06
B.4. How frequently do science teachers in your school meet as a group?	79	3.67	1.54	0.17
B.5.a. If you did not check a for the previous item, indicate how frequently science teachers meeting as a group discuss classroom management or disciplinary issues?	79	2.16	1.31	0.15
B.5.b. If you did not check a for the previous item, indicate how frequently science teachers meeting as a group discuss inquiry science teaching methods?	79	2.30	1.40	0.16
B.5.c. If you did not check a for the previous item, indicate how frequently science teachers meeting as a group discuss science content issues?	79	2.75	1.54	0.17
B.5.d. If you did not check a for the previous item, indicate how frequently science teachers meeting as a group discuss administrative issues?	79	2.54	1.55	0.17
B.5.e. If you did not check a for the previous item, indicate how frequently science teachers meeting as a group discuss staff development issues?	79	2.44	1.44	0.16

Note. Items A.3., A.9.a., A.9.e., A.9.j., A.9.l., B.4., B.5.a., B.5.b., B.5.c., B.5.d., and B.5.e. were answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always, and Items B.2.a., B.2.b., B.2.c., B.2.d., and B.2.e. were answered on a 1–3 scale, where *1* = not at all, *2* = occasionally, and *3* = often.

Table E-40.
Results About the Inquiry Science Students' Behavior in School and Perseverance in Science Class (Variable C2)

Item	0-25%	26-50%	51-75%	76-100%
A.22. What percentage of the FAST students in your focus grade are well behaved?	1.27	6.33	31.65	60.76
A.23. What percentage of the FAST students in your focus grade show perseverance in learning science?	2.53	21.52	44.30	31.65

Table E-41.
Results About the Availability of Necessary Lab Equipment for Inquiry Science Classes (Variable D1)

Item	*N*	*M*	*SD*	SE_M
A.6. How much science class equipment are you required to share with other teachers?	79	2.86	1.16	0.13
A.7. Do you have your own FAST classroom that no one else uses at any time?				
•Yes	53	67.09	—	—
•No	26	32.91		
A.17. What science equipment and materials do you have in the focus grade classroom(s) where you teach your FAST 1 classes, and to what extent are the equipment and materials adequate? Please rate the availability of the equipment and materials listed below.				
a. Flat top tables	79	4.58	1.09	0.12
b. Running water	79	4.56	1.12	0.13
c. Heat sources	79	4.22	1.38	0.16
d. Safety stations	79	3.89	1.56	0.18
e. Balances	79	4.68	0.82	0.09
f. Standard laboratory glassware	79	4.62	0.85	0.10
g. Thermometers	79	4.59	1.01	0.11
h. Overhead projector	79	4.68	0.94	0.11
i. Computer	79	4.57	0.94	0.11
j. Video projector	79	3.42	1.63	0.18
k. FAST student books	79	4.35	1.32	0.15
l. FAST teacher guide	79	4.86	0.59	0.07
m. Other science books	79	4.42	1.07	0.12

Note. A.6. was answered on a 1–5 scale, where *1* = none, *2* = a little, *3* = some, *4* = very much, and *5* = all. A.7. was answered on a 1-2 scale, where *1* = yes and *2* = no. A.17. was answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-42.
Results About the Adequacy of Inquiry Science Classes' Science Labs (Variable D2)

Item	*N*	*M*	*SD*	SE_M
A.9.g. My school has adequate funding for FAST books and materials.	79	3.54	1.15	0.13
A.17. What science equipment and materials do you have in the focus grade classroom(s) where you teach your FAST 1 classes, and to what extent are the equipment and materials adequate? Please rate the adequacy of the equipment and materials listed below.				
a. Flat top tables	79	3.45	0.84	0.10
b. Running water	79	3.51	0.86	0.10
c. Heat sources	79	3.23	0.96	0.11
d. Safety stations	79	2.97	1.14	0.13
e. Balances	79	3.44	0.82	0.09
f. Standard laboratory glassware	79	3.58	0.73	0.08
g. Thermometers	79	3.51	0.82	0.09
h. Overhead projector	79	3.72	0.63	0.07
i. Computer	79	3.51	0.80	0.09
j. Video projector	79	3.22	1.11	0.14
k. FAST student books	79	3.49	0.89	0.11
l. FAST teacher guide	79	3.78	0.62	0.07
m. Other science books	79	3.31	0.84	0.10

Note. A.9.g. was answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always. A.17. was answered on a 1–5 scale, where *1* = not at all, *2* = somewhat, *3* = mostly, *4* = completely, and *5* = not at all.

Table E-43.
Results About the School Leadership's Support for Inquiry Science Program Implementation (Variable D3)

Item	*N*	*M*	*SD*	SE_M
A.8.i. My principal supports teaching FAST in my school.	79	3.51	0.55	0.06
A.9.k. I have assistants to help manage my inquiry science laboratories.	79	1.59	1.03	0.12

Note. Item A.8.i. was answered on a 1–4 scale, where *1* = strongly disagree, *2* = disagree, *3* = agree, and *4* = strongly agree, and Item A.9.k. was answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-44.
Results About the Number of Inquiry Science Teachers in the School (Variable D4)

Item	*N*	*M*	*SD*	SE_M
A.2. How many other teachers at your school teach any part of FAST 1, FAST 2, or FAST 3? (enter zero if none)	79	2.68	3.31	0.38

Table E-45.
Results About the School's Support for Teacher Professional Development (Variable D5)

Item	*N*	*M*	*SD*	SE_M
A.9.h. My school ensures that I have sufficient opportunities for professional development in teaching science.	79	3.72	1.05	0.12
A.9.i. My school has adequate funding for teacher professional development.	79	3.51	0.55	0.06

Note. Answered on a 1–5 scale, where *1* = never, *2* = rarely, *3* = sometimes, *4* = often, and *5* = always.

Table E-46.
Results About the School's Ability Grouping Policy (Variable D6)

Item	*N*	%
A.14. How are the FAST 1 students in your focus grade grouped?		
•Homogeneous	7	8.86
•Heterogeneous	60	75.95
•Some classes homogeneous and some classes heterogeneous	12	15.19

Table E-47.
Results on the Number of Students in the Inquiry Science Teachers' Classes (Variable D7)

Item	*N*	*M*	*SD*	SE_M
A.12. What is the total number of FAST 1 students that you teach in your focus grade?	79	63.05	42.82	4.82

Table E-48 .
Results About Whether the School is Public or Private (Variable E6)

Item	*N*	%
C.5. Are you currently teaching at a public or private school?		
•Public	54	68.35
•Private	25	31.65

Table E-49.
Results About the Grade Levels Served in the School (Variable E7)

Item	*N*	%
C.6. Please check the grade levels that are served in your school (check all that apply):		
•K–6	3	3.75
•K–8	18	22.50
•K–9	2	2.50
•K–12	7	8.75
•1–8	1	1.25
•4–6	1	1.25
•5–6	1	1.25
•5–8	2	2.50
•6	1	1.25
•6–7	1	1.25
•6–8	23	28.75
•6–9	1	1.25
•6–12	5	6.25
•7	1	1.25
•7–8	7	8.75
•7–9	4	5.00
•7–10	1	1.25
•10–12	1	1.25

Appendix F

Inquiry Science Student Assessment

FAST 1—Student Science Achievement Test

First Name ______________ **Last Name _________________**
Date____________________ **Teacher____________________**

Directions: This is a test of your scientific knowledge. <u>You will have 45 minutes to complete the questions.</u> Circle or write your answer(s) directly on this sheet.

---

1. A glass of water at 60°C is placed in a room next to a glass of water that is 10°C. The temperature of the room is 20°C at all times. If the two glasses were left in the room overnight, the temperature for both glasses of water the next day would be approximately

A. 20°C.
B. 35°C.
C. 50°C.
D. 70°C.

---

2. Air is made up of many gases. Which gas is found in the greatest amount?

A. Hydrogen
B. Carbon Dioxide
C. Nitrogen
D. Oxygen

---

3. The primary source of energy for the Earth's water cycle is the

A. wind.
B. sun's radiation.
C. earth's radiation.
D. sun's gravity.

---

4. One day when the temperature was just below 0^{O}C, Peter and Ann made snowballs. They put a thermometer into one of the snowballs and it showed 0^{O}C. They tried to make the snowball warmer by holding it in their hands. What do you think the thermometer in the snowball showed after two minutes?

A. above 0^{O}C because the snow melts
B. above 0^{O}C because the hands are warm
C. the same because the melting point of snow is 0^{O}C
D. the same because the outdoor temperature in 0^{O}C

5. Why do areas in the middle of a large continent generally have more extreme differences in temperature than areas near the coastline?

- **A.** There are generally more clouds near the oceans.
- **B.** Landlocked areas are usually at lower altitudes than coastline areas.
- **C.** Coastlines are usually surrounded by mountains that block air masses.
- **D.** Oceans change temperature slowly and regulate the temperature of nearby land.

6. Frank wants to do an experiment to test how much water lettuce plants need to grow best. Which variable should he change while holding the others constant?

- **A.** the temperature
- **B.** the amount of light
- **C.** the amount of water
- **D.** the amount of soil

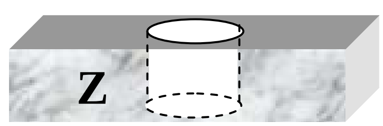
7. Sandy has three objects: a stone, a glass ball and a piece of iron. The objects are of all the same mass (250 g). The specific heat for the glass is 0.16 cal/g/^{o}C, for the stone is 0.15 cal/g/^{o}C and for the iron is 0.1 cal/g/^{o}C. She heats the objects in an oven for one hour. She places the objects each into separate cups filled with the same amount of water. Which object will heat up the water more? Why?

- **A.** The stone because it would be the biggest if they are the same mass.
- **B.** The glass because it has the largest specific heat.
- **C.** The iron because it is a metal.
- **D.** The stone because it holds heat better.

8. Block Z floats on water. Suppose Maya made a hole in it. She then placed it in water, block Z will ___________. (Pictures are actual size.)

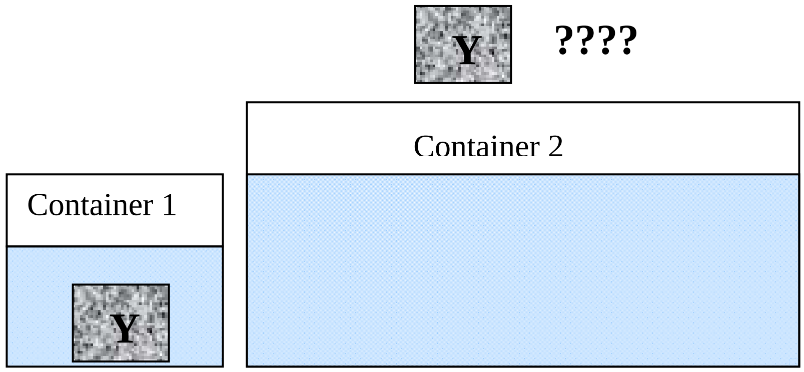
- **A.** sink.
- **B.** float.
- **C.** subsurface float.
- **D.** Not sure

Float

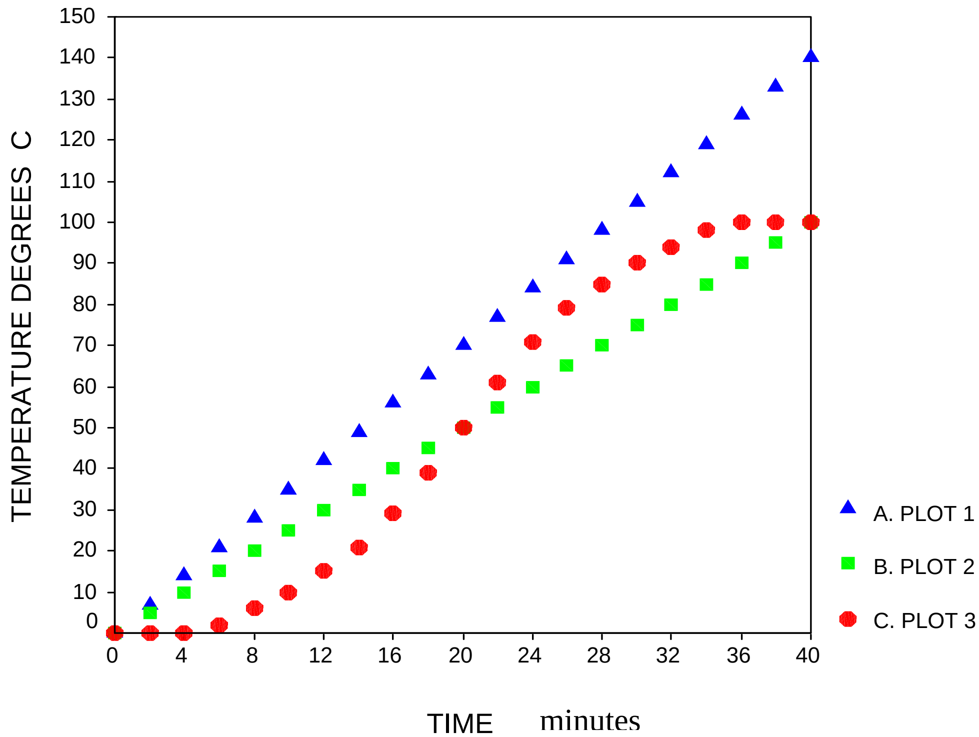


?

9. Block Y sinks in the water in Container 1. When block Y is put in a big container with more water (Container 2), block Y will _______________.



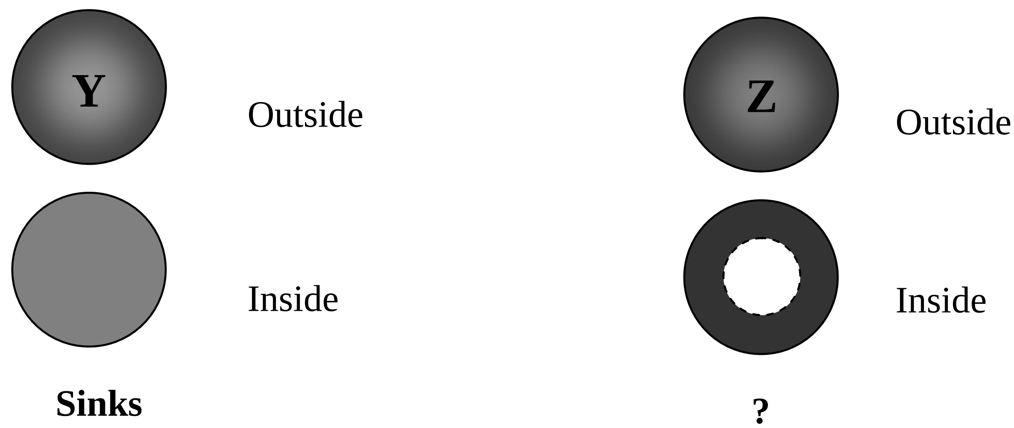
A. sink.
B. float.
C. subsurface float.
D. Not sure



10. Kay heats up a beaker with water and ice. She graphed the data on the chart above. She takes the temperature of the water until the water boils. If she plots the temperature versus time, which graph would most likely be hers?

A. PLOT 1
B. PLOT 2
C. PLOT 3

11. Ball Y and ball Z have the **SAME** mass and volume. Ball Y is solid; Ball Z is hollow in the center (see the pictures below). Ball Y sinks in water. When placed in water, ball Z will_______________.



- **A.** sink.
- **B.** float.
- **C.** subsurface float.
- **D.** Not sure

---

12. Maria has objects of the same mass but of different sizes and shapes. She dropped them from a second story balcony. She measured how long it took for each one to reach the ground. Which of the following is most likely the question she wanted to answer?

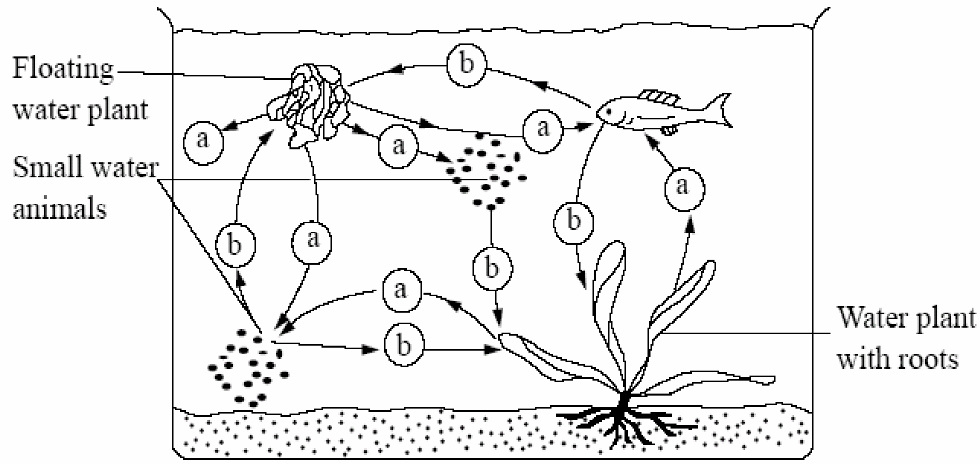
- **A.** How does height affect the force of gravity?
- **B.** How does gravity affect objects of different densities?
- **C.** How does mass and weight affect falling objects rate of fall?
- **D.** How does size and shape affect falling objects rate of fall?

---

13. Mrs. Rich's class is across the state from Mr. Young's class. Both classes recorded the temperature (C^o) and rainfall (cm) for the exact same weeks, **BUT** the classes got different readings. Which of the following would **NOT** contribute to the difference in the readings?

- **A.** One class is at a higher altitude than the other class.
- **B.** One class is next to the ocean and the other class is not.
- **C.** One class measured in the morning and the other in the afternoon.
- **D.** One class had a different recording chart than the other class.

14. The diagram below shows an example of interdependence among aquatic organisms. During the day the organisms either use up or give off (a) or (b) as shown by the arrows.



Choose the right answer for (a) and (b) from the alternative given.

A. (a) is oxygen and (b) is carbon dioxide.
B. (a) is oxygen and (b) is carbohydrate.
C. (a) is nitrogen and (b) is carbon dioxide.
D. (a) is carbon dioxide and (b) is oxygen.

15. Machine X and Machine Y are each used to clear a field. The table shows how large an area each cleared in 1 hour and how much gasoline each used.

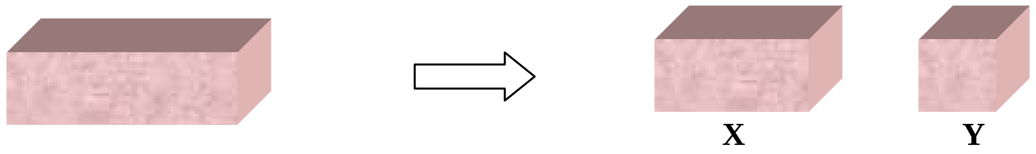
	Area of field cleared in 1 hour	Gasoline used in 1 hour
Machine X	2 acre	3/4 liter
Machine Y	1 acre	1/2 liter

Part 1) Which machine is more efficient in converting the energy in gasoline to work? (Circle one of the options below)

A. Machine X
B. Machine Y

Part 2) Explain your answer.

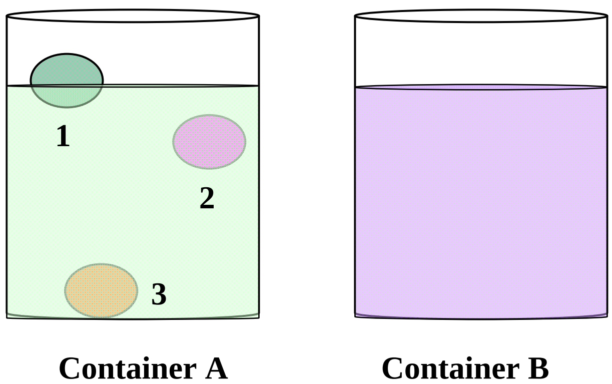
16. Rich cut a wood block into two unequal parts. Part X is 2/3 of the original one and part Y is 1/3 of the original one. Which of the following relationships is correct?



A. The volume of X is the same as the volume of Y.
B. The mass of X is the same as the mass of Y.
C. The density of X is the same as the density of Y.
D. The weight of X is the same as the weight of Y.

---

17. There are three different objects with the same size and shape floating, subsurface floating or sinking in container A below. Which of these three objects would you use to see if the liquid in container B is more or less dense than the liquid in container A? Explain your answer in as much detail as you can.



18. Jami fills a container with 100 mL of water and places it into the freezer. The water in the container freezes at 0°C. A second container filled with 90 mL of water is placed in a second freezer. At what temperature does this second container of water freeze?

A. -10°C
B. -1° C
C. 0° C
D. 10°C

---

19. Taylor dissolves 2.0 grams of salt in water. He then tries to get the salt back by evaporating the water. How would the mass of salt recovered compare with the initial mass of salt?

A. It would be the less, because some of the salt evaporates with the water.
B. It would be the same, because salt does not evaporate with water.
C. It would be the more, because a chemical change occurred.
D. It would be the same, because salt does not dissolve in water.

---

20. Tomas places a solid plastic ball into an unknown liquid. Which of the following factors would have the **GREATEST** effect on whether the plastic ball sinks or floats?

A. the color of the liquid
B. the color of the ball
C. the temperature of the liquid
D. the temperature of the ball

---

21. Willy heats up 25 mL of water from 10^0C to 15^0C. How much energy did it take to heat the water?

A. 5 degrees
B. 5 calories
C. 25 calories
D. 125 calories

---

22. Animals are made of up many atoms. What happens to the atoms after an animal has died?

A. The atoms stop moving.
B. The atoms recycle back into the environment.
C. The atoms split into simpler parts and then combine to form other atoms.
D. The atoms no longer exist once the animal has decomposed.

23. Which statement best describes the relationship between the total amount of water vapor the atmosphere can hold and the temperature of the atmosphere?

A. The amount of water vapor is not related to air temperature.
B. The amount of water vapor increases as the air temperature increases.
C. The amount of water vapor increases as the air temperature decreases.
D. The amount of water vapor decreases as the air temperature increases.

24. Carlos filled a can with crushed ice and sealed it. He then massed the sealed can and found its mass to be 365 g. He melted the ice by warming the can. No water vapor escaped and no air entered the can. He massed the can again. What is the **best** prediction of the mass?

A. The mass would be less than 365 g.
B. The mass would be 365 g.
C. The mass would be more than 365 g.
D. It is impossible to predict without more information.

25. Juan and Alice measure the temperature of boiling water. They find the temperature to be about 100^oC. They measure the boiling point of a solution of half water and half Ethyl Alcohol. What will the boiling point of the solution be?

A. The boiling point temperature will be above 100^oC.
B. The boiling point temperature will be around 100^oC.
C. The boiling point temperature will be below 100^oC.
D. There is not enough information to tell.

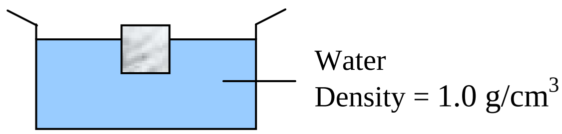
26. Whenever scientists carefully measure any quantities many times, they expect that

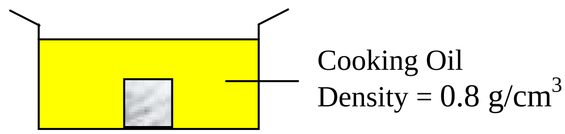
A. all of the measurements will be exactly the same.
B. only two of the measurements will be exactly the same.
C. all but one of the measurements will be exactly the same.
D. most of the measurements will be close but not exactly the same.

27. People take rides in hot air balloons. What is the best reason why hot air balloons rise?

A. Because the stream of hot air pushes the balloon up.
B. Because the smoke in the hot air lifts the balloon up.
C. Because the hot air inside the balloon is less dense than the cooler outside air.
D. Because the cooler outside air is less dense than the hot air inside of the balloon.

28. The density of water is 1.0 g/cm^3 and the density of cooking oil is 0.80 g/cm^3. Erin put a plastic block into each of the two liquids. The plastic block floated in water but sank in cooking oil. Please estimate the density of the plastic block.





A. The density is less than 0.80 g/cm^3.
B. The density is greater than 0.80 g/cm^3 but smaller than 1.0 g/cm^3.
C. The density is greater than 1.0 g/cm^3.
D. There is not enough information to tell.

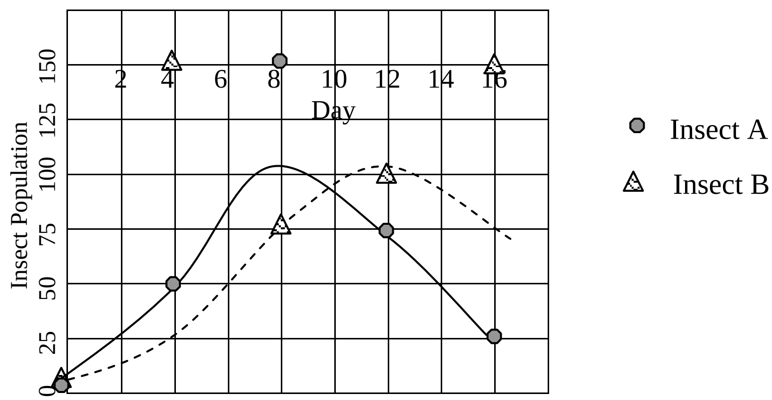
---

29. Describe the water cycle. Explain how it works. Use words and pictures to answer.

30. Kenya collected this data about Insect A and Insect B in the **same quadrat** on different days.

Insect Population					
	Day 0	Day 4	Day 8	Day 12	Day 16
Insect A	5	50	100	75	25
Insect B	5	25	75	100	75

Insect populations versus days



A. State a relationship about Insect A and Insect B. Explain your answer, using the data.

B. Based on the data, predict the population of Insect A and Insect B at day 20. Explain your prediction using the data.

FAST 1 STUDENT SURVEY

First Name _______________ Last Name ___________________
Date___________________ Teacher______________________

Part 1: There are not right or wrong answers. Please tell us how true these statements are for you. Your teacher will not look at these answers.

	Please tell us how true these statements are for you.	Not at all true		Somewhat true		Very True
1	Our teacher wants us to really understand the concepts, not just to memorize facts.	1	2	3	4	5
2	I learn well in science when I work with a lab group.	1	2	3	4	5
3	Our teacher makes it obvious when students are not doing well on their work.	1	2	3	4	5
4	I can't change how smart I am in science.	1	2	3	4	5
5	I can show students in my science class that I am smart.	1	2	3	4	5
6	I like the work in my science class best when it really makes me think.	1	2	3	4	5
7	I can do almost all the work in science class if I do not give up.	1	2	3	4	5
8	How well I do in science depends on how smart I was when I was born.	1	2	3	4	5
9	Science is boring.	1	2	3	4	5
10	I get really uptight during science tests.	1	2	3	4	5
11	It is important to me that the other students in my science class do not think I am stupid.	1	2	3	4	5
12	Taking science tests does not scare me.	1	2	3	4	5
13	One reason that I might not participate in science class is to avoid looking stupid.	1	2	3	4	5
14	I like to do science work.	1	2	3	4	5
15	I like completing science investigations.	1	2	3	4	5
16	A person smart in science, was born smart in science.	1	2	3	4	5
17	I want to do better than other students in my science class.	1	2	3	4	5
18	An important reason I do my science work is to master challenging concepts.	1	2	3	4	5
19	I can learn science from our science investigations.	1	2	3	4	5
20	I look forward to science class.	1	2	3	4	5
21	Science makes me feel uncomfortable and nervous.	1	2	3	4	5
22	Our teacher calls on smart students more than other students.	1	2	3	4	5
23	I can learn science.	1	2	3	4	5
24	My mind goes blank and I am unable to think clearly when doing science.	1	2	3	4	5
25	I can figure out how to do difficult work in science.	1	2	3	4	5

Part 2

On a scale from ***0*** (**no chance**) to ***100*** (**completely certain**), how sure are you that you can perform each of the ***science investigation activities*** below? Remember that you may use ***any*** number between 0 and 100.

0	10	20	30	40	50	60	70	80	90	100
No Chance										**Completely Certain**

How sure are you that you can…

1. _____ correctly follow directions to complete a science investigation?
2. _____ make appropriate predictions (hypotheses) about what will happen during a science investigation?
3. _____ use laboratory equipment correctly?
4. _____ make accurate measurements during a science investigation?
5. _____ make appropriate observations during a science investigation?
6. _____ collect accurate data during a science investigation?
7. _____ clearly record results from a science investigation?
8. _____ correctly complete necessary mathematical calculations in a science investigation?
9. _____ communicate results in the form of a data table or graph?
10. _____ draw correct conclusions from the results of a science investigation?
11. _____ identify sources of error that might affect the results of a science investigation?
12. _____ describe how the science investigation is related to everyday life?

	Please tell us how true these statements are for you. There are no right or wrong answers.	Not at all true		Somewhat true		Very True
1	Our teacher gives us time to really explore and understand new ideas.	1	2	3	4	5
2	I can master the skills taught in science class this year.	1	2	3	4	5
3	Just thinking about science makes me feel nervous.	1	2	3	4	5
4	One reason that I do my science work is so that the teacher knows that I am not stupid.	1	2	3	4	5
5	Only a few students do really well in science class.	1	2	3	4	5
6	Working with my classmates helps me learn science.	1	2	3	4	5
7	I like science class work that I'll learn from even if I make a lot of mistakes.	1	2	3	4	5
8	It is very important to me that I do not look stupid in my science class.	1	2	3	4	5
9	What I learn in my science class is interesting.	1	2	3	4	5
10	Our teacher really thinks it is very important to try hard.	1	2	3	4	5

Part 3

Directions: Using the scale from 1 (*not confident at all*) to 6 (*completely confident*), answer the questions below.

1	2	3	4	5	6
Not confident at all					**Completely confident**

1	Using the scale above, *how confident are you* that you will **pass science class *at the end of this year?***	1 2 3 4 5 6
2	*How confident are you* that you will pass science at the end of this year with **a grade better than a D?**	1 2 3 4 5 6
3	*How confident are you* that you will get **a grade better than a C**?	1 2 3 4 5 6
4	*How confident are you* that you will get **a grade better than a B**?	1 2 3 4 5 6
5	*How confident are you that you will get* **an A?**	1 2 3 4 5 6

We are interested in what you know and believe about science and scientists. On a scale of 1 –10, please tell us how true you believe these statements are about science.

1	2	3	4	5	6	7	8	9	10
Not at All True				Somewhat True				Very True	

1	Scientific knowledge can be useful away from school.	1	2	3	4	5	6	7	8	9	10
2	Scientists never try to show that other scientists are wrong.	1	2	3	4	5	6	7	8	9	10
3	Scientists always get the same results.	1	2	3	4	5	6	7	8	9	10
4	All good scientists work in the same way.	1	2	3	4	5	6	7	8	9	10
5	Scientists are always right.	1	2	3	4	5	6	7	8	9	10
6	All people can learn to be good scientists.	1	2	3	4	5	6	7	8	9	10
7	Scientific knowledge can change over time.	1	2	3	4	5	6	7	8	9	10
8	Sometimes things that scientists thought were right turn out to be wrong.	1	2	3	4	5	6	7	8	9	10
9	Many different kinds of people can be good scientists.	1	2	3	4	5	6	7	8	9	10
10	Scientific knowledge is only useful to scientists.	1	2	3	4	5	6	7	8	9	10
11	Science knowledge is not good or bad.	1	2	3	4	5	6	7	8	9	10
12	When you follow the scientific way of doing something, you get the right answer.	1	2	3	4	5	6	7	8	9	10

Part 4

	Please tell us how true these statements are for you. There are no right or wrong answers.	Not at all true		Somewhat true		Very True
1	Even if the work in science is hard, I can learn it.	1	2	3	4	5
2	I find science interesting.	1	2	3	4	5
3	Our teacher really wants us to enjoy learning new things in science.	1	2	3	4	5
4	Our teacher points out those students who get good grades as an example to all of us.	1	2	3	4	5
5	Science makes me feel uneasy and confused.	1	2	3	4	5
6	One of my main goals in science class is to avoid looking like I can't do my work.	1	2	3	4	5
7	I really learn by doing science investigations.	1	2	3	4	5
8	I would feel successful in science if I got better grades than most of the other students.	1	2	3	4	5
9	An important reason I do my science work is because I like to learn new things.	1	2	3	4	5
10	I almost never get uptight while taking science tests.	1	2	3	4	5
11	If I have enough time, I can do a good job on all my science work.	1	2	3	4	5
12	My classmates help me understand what I'm not getting in science class.	1	2	3	4	5
13	Carrying out science investigations really helps me learn.	1	2	3	4	5
14	I have to be really smart to do well in science.	1	2	3	4	5
15	Our teacher thinks mistakes are okay as long as we keep trying to learn the material.	1	2	3	4	5
16	Discussion with classmates in science class makes it easier for me to understand the concepts.	1	2	3	4	5
17	I have usually been at ease during science tests.	1	2	3	4	5
18	Science is a lot of fun.	1	2	3	4	5
19	Our teacher tells us why the ideas we are learning are important.	1	2	3	4	5
20	I get a sinking feeling when I think of trying hard science assignments.	1	2	3	4	5
21	Our teacher lets us know which students get the highest scores on tests.	1	2	3	4	5
22	An important reason why I do my work in science class is because I want to get better at it.	1	2	3	4	5
23	I like to show my teacher than I am smarter than the other students in my science class.	1	2	3	4	5
24	I am afraid of doing science assignments when I know they will be graded.	1	2	3	4	5
25	I cannot learn from science investigations.	1	2	3	4	5
26	I have usually been at ease in science classes.	1	2	3	4	5
27	It is important to me that the other students in my science class think I am smart.	1	2	3	4	5

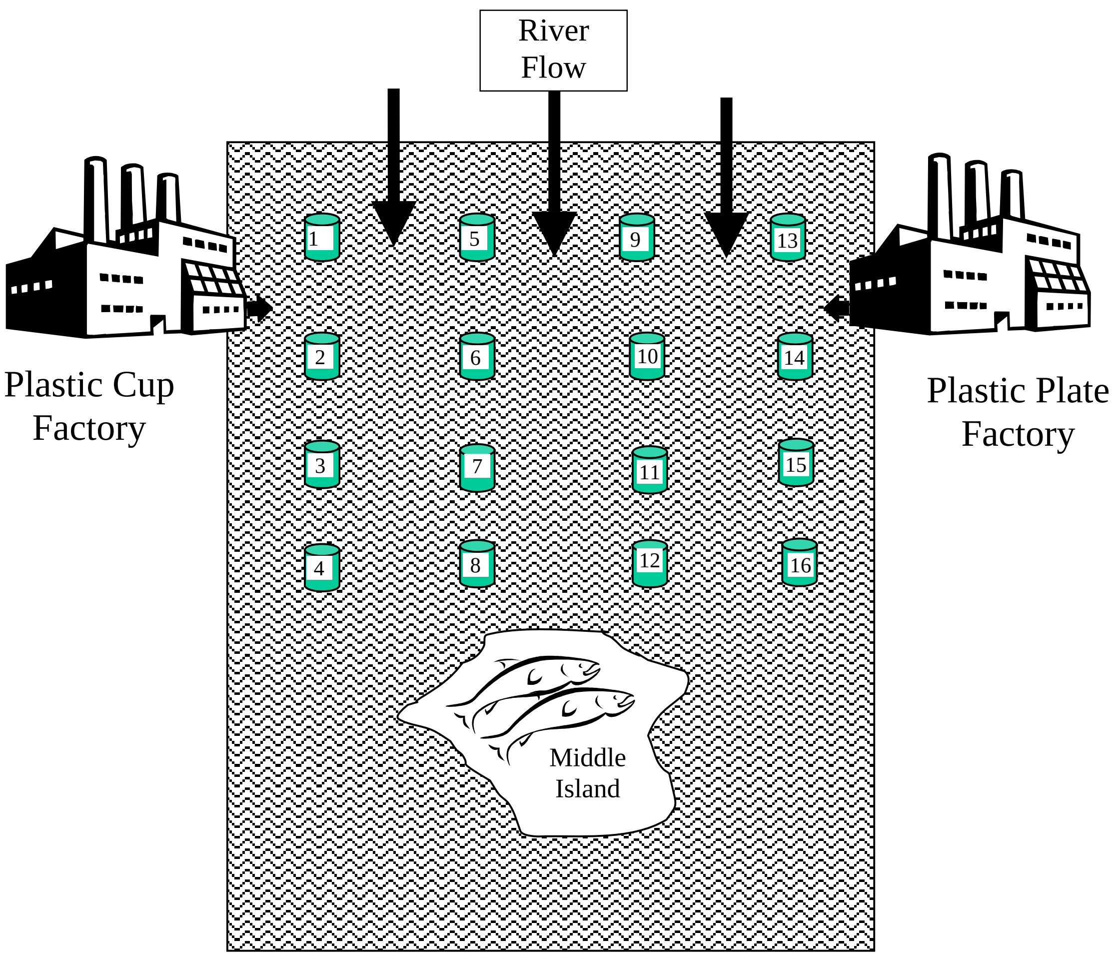
GROUP WORK

Fish Deaths in Rocky River

Your Name________________ Teacher______________ Date______
Group Member Name _______________________
Group Member Name _______________________
Group Member Name_______________________

Instructions: You are going to find out if either of two factories (or none) are polluting Rocky River enough to kill fish. You will start working in a group and then finish by yourself.

On one side of Rocky River there is a plastic cup factory. On the other side of the river there is a plastic plate factory. Both factories put pollution into the river, but usually not enough to kill fish. One day, students found dead fish downriver below the factories on Middle Island. Your job is to find out if either of the factories (or none) are putting enough toxic levels of pollution into the river to kill the fish.



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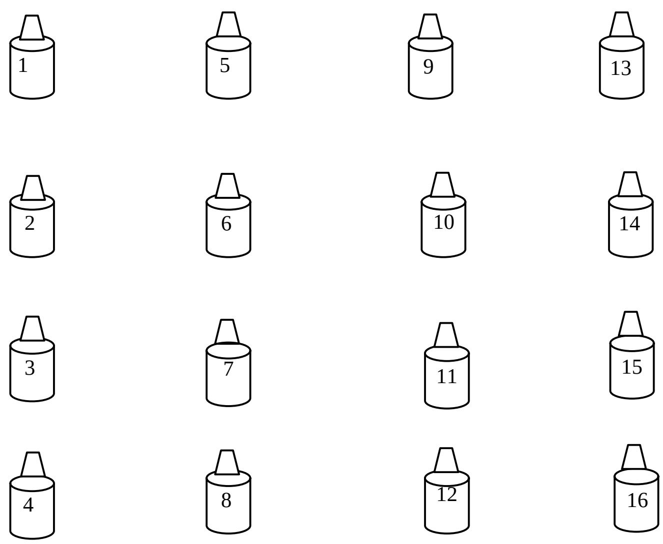
GROUP WORK

Instructions: One student read aloud, others follow along.

Getting Ready: Make sure your group has the following equipment

- ☐ Four Chemplates (plastic tray with 13 wells)
- ☐ 16 numbered Rocky River water samples (do not drink)
- ☐ One oval shaped bottle with pollution tester (green liquid; do not drink)
- ☐ 5 Known polluted water samples (your teacher has these; do not drink)
- ☐ 2—Data Collection Sheets (place the Chemplates there)
- ☐ Paper towels
- ☐ Goggles
- ☐ Aprons

Organize the 16 Rocky River Water Sample Bottles like this



Put a Chemplate on the Data Collection Sheets…Notice how they fit!

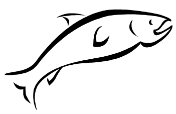
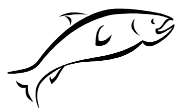
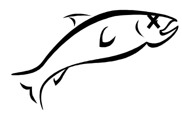
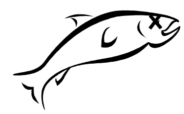
GROUP WORK

<u>Part I: Testing Known Polluted Water Samples</u>

Working as a group and using only one Chemplate…

1. Find the 5 known polluted water samples from *not polluted* to *extremely polluted*.
2. Place a Chemplate on the Data Collection Sheet.
3. Place 5 drops of each Known Polluted Water Sample into its own Chemplate well.
4. Add 1 drop of pollution tester to the sample.
5. Record the color in the table below.

<u>Note: Fish die in *somewhat polluted*, *very polluted* and *extremely polluted* water.</u>

					
Sample	Not Polluted	Tiny Bit Polluted	Somewhat Polluted	Very Polluted	Extremely Polluted
Color					

1. Discuss in your group why you need this information? Write down your own answer.

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GROUP WORK

Part III: Testing Rocky River Samples

There are 16 possible sites to test the river water. You can only test 4 sites.

1. Discuss in your group which 4 sites you would test.
2. Record in the table below, which 4 sites you think your group should test and why you should test those sites.

Site	Rationale: Why should you test the site?

Part IV: Results from Rocky River Samples

Place 5 drops of each Rocky River Water Samples your group selected into a clean Chemplate well. Add one drop of Pollution Tester. Make a scientific data table below to record your findings. Every student should make his or her own scientific data table.

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INDIVIDUAL WORK

Part V: Conclusions from Rocky River Samples

Now using your own data table and working by yourself:

1) Are either of the factories polluting the river enough to kill the fish (none, one or both)? Circle your answer.

None	Plastic Plate Factory	Plastic Cup Factory	Both Plate and Cup Factory

2) Using the evidence you collected, explain how you know which factories, if any, are polluting enough to kill the fish. Use evidence from your data table to support your answer.

3) Looking at the river map and your data, do the data that you collected make sense? How do you know?

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INDIVIDUAL WORK

Part VI: Testing Additional Samples (Working by yourself)

1. In order to further support your own answer, which three additional samples would you test? Why?

Site	Rationale: Why should you test this site?

2. Test your sites using empty ChemPlate wells by yourself? Present your results in a scientific data table.

3. Look at the river map, your old data and this new data. Do these results make sense? Why or Why not?

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INDIVIDUAL WORK

Part VII: New Conclusions

Using the new evidence you collected, do your new results support your original conclusion? Why or Why not?

Part VIII: Next Steps

You have tested water from the river and have made your conclusions. What is the next thing that you want to know about the fish deaths in Rocky River? Write a question and then explain why you want to know this.

Question:

Explain why you want to know the answer to this question:

Stop Thank You