Inquiring into Science Instruction Observation Protocol (ISIOP)

CODEBOOK

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Contents

TEACHER PRE-OBSERVATION QUESTIONNAIRE

1–12.
Science Content to be covered

This questionnaire provides the observer with background on the lesson to be observed, including the ways in which it fits into previous and future lessons. The teacher should indicate all of the content that will be addressed explicitly in the observed lesson. He or she should check all items that apply. All items are from the *National Science Education Standards* for middle school grades 5–8.

ISIOP DATA COLLECTION INSTRUMENT

Section 1—Background Information

Teacher ID	Identification number assigned to the teacher for confidentiality and database tracking. Located in header of each page.
1. Observation date	For live observations, record the date that the class observation took place. For videotaped observations, record the date the video was coded, or leave blank.
2. Class scheduled start time	Time the class was scheduled to begin. This may be slightly different from when the observation began.
3. Class scheduled end time	Time when the class was scheduled to end (which may be different from the observation end time).
4. Class ID	This is an identifier for the teacher (e.g., period 3 or block 2 or green team). This will allow the observer to see the same class on repeated visits, if necessary.
5. Student information	Total numbers of students at the beginning and end of class.
6. Instructional artifacts	The observer should note whether or not worksheets, readings, or other handouts were used in the course of the lesson; and whether or not they were able to obtain copies for use in the coding process. Artifacts can be text-based or graphically-based, such as data images, maps, animations, etc.
7. Additional notes (including physical characteristics…)	Provide either a verbal or pictorial description of the physical characteristics of the room, including the presence of scientific equipment, posters, science notebooks/ journals, and other teaching aids. Also, note the general arrangement of the student and teacher desks.

Section 2—Classroom Observation Procedure

ISIOP Data Collection Instrument pages 1-5 should be used to record the key information from the lesson that will be used in the scoring rubrics. Specifically, you will use the Lesson Event Codes and Teacher Verbal Practices Codes to fill in the Classroom Observation Sheet, and you may fill in the Observation Notes. Each observer should be familiar with the codes prior to conducting an observation, but pages 4 and 5 provide summary definitions of the Lesson Event and Verbal Practice codes for easy reference during an observation. The observer should take multiple Classroom Observation Sheets to the observation to ensure that they have enough for a series of Lesson Events. **During live observations you will need access to a stop watch to time the Lesson Events.**

Lesson Events (LE) are distinguished by discrete shifts in the lesson from one activity to another. A change in activity is defined as a point at which the organization of the class (for students) or nature of the work shifts (as indicated by the class activity)[1]. There are several pieces of information recorded about each Lesson Event (LE): an LE-unique number (i.e., 1, 2, 3, 4, etc.), start time, activity type, class organization structure, and level of student disengagement. All of this information is recorded at the top of the Classroom Observation Sheet (see p. 3 of the Data collection instrument). **Definitions and examples of LE codes are provided below and rules for coding are on pp. 7-8 of this Codebook.**

Classroom Observation Sheet and Observation Notes

Lesson Event #   Each Lesson Event is numbered sequentially in the ( ) space at the top of the Classroom Observation Sheet, p. 2 of the Instrument. If there is a change in either the way the class is organized for students or the type of class activity, this would constitute a new Lesson Event. Therefore, **two sequential Lesson Events should not be coded with the exact same class activity** AND **student class organization codes,** even if the teacher makes a distinction in the way the class is presented to the students. When deciding whether to begin a new Lesson Event, consider whether the next activity is instructionally different than the one before it. Has the primary task changed and would the teacher recognize it as a different event? If there is a clear distinction in the nature of the activity, code it as a separate Lesson Event.

    For example:
- Students determining and writing lab procedures in groups (coded as WRIT for class activity and G for class organization) would be a separate event from students performing those procedures in groups (coded as HANDS for activity and G for class organization).
- Students taking turns reading aloud to the whole class (coded as READ for class activity and W for class organization) would be a separate LE from students reading the remainder of the material silently (coded as READ for class activity and I for class organization).
- Students rotating in stations to brainstorm different ideas and writing them on the charts located at each station would be coded as WRIT for class activity and G for class organization. However, if the groups of students are then instructed to go around again and write down what was recorded at each station, this would also be coded as WRIT and G. Though the teacher made a clear distinction between these two activities, they would be coded as one Lesson Event because it was the same

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[1] American Institutes for Research (April, 2004). *Researching education as it happens. Using classroom observations to generate quantifiable data.* Paper presentation at the annual meeting of the American Educational Research Association, San Diego CA, p. 4.

type of activity and the students were still organized in small groups to do that activity.

If you are unsure whether to code the next activity as a separate Lesson Event, break apart the Lesson Events to begin with, recording all Lesson Event information in separate columns. You can then go back at the end of the lesson and aggregate if you decide the events were not distinct; it is easier to aggregate Lesson Event information after the observation than to break it apart.

Start time

This is the start time for each Lesson Event. A Lesson Event should begin when the teacher verbally says they are beginning a new activity. This is usually when the teacher begins to give instructions for the next activity. For example: Lesson Event #1 (WRIT) the students are writing lab procedures and drawing the set-up of the apparatus they will use in an experiment. Lesson Event #2 (HANDS) starts when the teacher tells students to begin working on the experiment. (for more guidance see "Overview of Lesson Event Coding Rules, on pp. 7-8 below)

Notes

At the bottom of each Lesson Event column on the Classroom Observation Sheet (Data Collection Instrument p. 2), take notes about the main science content for each Lesson Event and the activities that students are engaged in. The information you record in this space can help you remember the events when you complete the post-observation rubrics.

Observation End Time

In the space provided at the bottom of the page, note the time the instruction ended. If a teacher clearly finishes a lesson before the end of a designated class period, the end time of the observation is when the teacher ended the instruction. If a teacher then adds on additional instruction, it would not be coded because it was not as part of the intact lesson.

Lesson Event Information/Codes
[Rules on pp. 7-8 of this Codebook, codes also listed on p. 4 of the Data Collection Instrument]

Act—
Class Activity Codes

These codes are used to describe what is happening in the classroom. There are two main categories for activities—verbal or physical. These are intended to be mutually exclusive categories of activities, assuming that there will be some verbal interaction in the physical activities as well. The coder should code the predominant type of activity for each Lesson Event. Only one activity code per Lesson Event should be coded. The codes to use for Activity are summarized on p. 4 of the instrument, and should be taken to observations for reference.

Verbal Activity Codes

INST   **INSTRUCTION** occurs when the teacher provides information, activates prior knowledge from previous lesson, calls on students for "correct answer." This type of activity is dominated by dialogue from the teacher directed to the students. It could include student note taking while the teacher is providing information. INST can happen in either the classroom or field setting. If the teacher interrupts a lab experience (HANDS) to provide new information to students, such as new instructions, specific safety information, or to correct a misconception, you would code this interruption as a separate Lesson Event of INST.

DISC   **DISCUSSION** occurs when students *share* their *own ideas* with each other and respond to each others' input. This type of activity is dominated by the students directing their dialogue to each other. The teacher acts as a facilitator by, for example, prompting students to respond to each other and encouraging student to student dialogue. When classes are organized into small groups or pairs, students may record in writing the result of the discussion in order to report out or share at another time with the whole class, but the emphasis is on the exchange of ideas through dialogue, not on producing a specific written artifact. When whole-class organization is present, students must refer to and reflect on ideas that are presented by other students.

READ   **READING** occurs when students read text silently or aloud. This code should be used when the whole class is reading aloud (or silently) a passage with interspersed short discussion of the passage. (See Rule #4 on p. 8 of this codebook.) This code can also be used if students are doing readings from an electronic source (e.g., computer).

PRES   **PRESENTATION** occurs when students "report out" what they noticed in an experiment/observation, or formally present findings and/or interpretations of their findings. This occurs in a structured way, i.e. by having groups take turns explaining what they found. If the teacher asks one or two students to describe their observations as part of a larger discussion, but it is not part of an effort to hear from all groups of students, this should be coded as either INST or DISC.

WRIT   **WRITTEN** occurs when an activity is intended to produce a written artifact, drawing, or graph (from an existing data table) *without direct HANDS-ON data collection*. May or may not include some conversation between students to complete a *prescribed task*. If there is a "do now"/"journal notes"/or other type of written activity that the students automatically do at the beginning of each class, then code it as WRIT. The "writing" can be done by hand or on the computer. Do NOT use this code when students are taking notes on a lecture (use INST) or reading (use READ) or recording data (perhaps on a worksheet) from a lab (HANDS).

LIT   **LITERATURE SEARCH** occurs when students gather science information (not raw data) on the Web, or from books in the library or classroom.

ASMT   **TAKING A TEST or HOMEWORK REVIEW** occurs when the teacher provides the students with a formal assessment of their understandings, or when there is a review of material for test preparation, or when homework or other prior assessments are reviewed.

VID   **VIEWING VIDEO** occurs when Video/ film is shown in the classroom. See Rule #5 on p. 8 of this codebook.

Physical Activity Codes

MODL   **MODEL** occurs when the teacher *uses* a physical *model* of a phenomenon, such as using the globe and a flashlight to demonstrate seasons on Earth. The model is the focus of the instruction and the primary means of conveying information. If the teacher uses a model as a brief example to

demonstrate a concept as part of a discussion or instruction, then use DISC or INST because the model was not the focus of instruction. Do not use this code for computer-based models; use SIM instead.

DEMO   **DEMONSTRATION** occurs when the teacher *demonstrates actual phenomenon* for students, such as dropping different objects into unknown liquid to explore density. If the teacher uses a model to demonstrate the concept, code as MODL. If the demonstration is brief and serves as an example within a larger discussion where the demonstration is not primary, code as either INST or DISC. However, if the demonstration is the focus of the Lesson Event, accompanied by discussion of the demonstration, include the discussion or explanation within the timeframe of the Lesson Event called DEMO. If teacher walks through the steps of a lab for the students prior to them doing the lab, code this as INST, not DEMO.

SIM   **SIMULATIONS** occurs when students or teacher use computer *simulations* to explore or model phenomena. Manipulating Geographic Information Systems (GIS) to produce a new map layer would be coded here.

REP   **REPRESENTATIONS** occurs when *students manipulate representations* of phenomena (e.g., games, puzzles, models). For example, *students use* flashlights on a globe to simulate and understand seasonality. Include clean-up time as part of this activity because it is often highly variable when it starts and stops for every student.

HANDS   **HANDS-ON** occurs when students independently manipulate *phenomena in class* or manipulate *scientific instruments* and can include collecting and recording data as part of this manipulation. Also use this code when students are giving commands to a remote scientific instrument via the computer. Include clean-up time as part of this activity.

FIELD   **FIELD STUDIES** occurs when students collect data or explore *phenomena outside.* These outdoor lessons may begin with INST just like lessons that take place in the classroom. If a teacher is providing an experience, such as a guided nature walk, where there is some information provided to the students and the students are doing observations at the same time, code this entire Lesson Event as FIELD (not FIELD and INST). Include clean-up time as part of this activity.

SEC   **SECONDARY DATA** occurs when:
students collect, manipulate, download, or access raw data from existing scientific databases.

STN   **STATIONS**
This code only applies when the class activity includes rotating to different stations and the activities at these stations are different. For example, at one station students observe a demonstration and at another they do some hands-on lab work and at another they watch a simulation. If there are different stations but the students are doing similar things, like weighing different objects, use another physical activity code such as HANDS.

Org— Class Organization for Students	The coder notes the class organization for the students for each Lesson Event as follows:

Student codes
I = individual
P = interacting pair
G = small group (more than 2 and fewer than 7 students)
W = whole class

Code the type of class organization that is *actually observed*, even if it is different from what the teacher instructed the students to do. For example, if the teacher said to work in pairs but the students worked individually, you would code the class organization as "I."

Diseng— Student Disengagement	The ISIOP measures disengagement, rather than engagement, because it is easier for an observer to notice instances of specific disengaged behaviors (e.g., putting one's head on the desk, talking off-topic, etc.).For each Lesson Event, rate the overall level of student disengagement across the Lesson Event. Indicators of disengagement include:

- head down on the desk
- not looking at the teacher or class materials
- using phone or listening to iPod
- talking with another student about a topic unrelated to the class
- writing or reading non-class-related materials
- passing notes
- moving around the class—unrelated to class activity
- talking out loud in conversations unrelated to the work at hand

It is important to note that this is an overall measure across the Lesson Event. There is no need to track individual students, but consider the level of disengagement across the students for that Lesson Event. Ratings are based on the proportion of students disengaged throughout the duration of the Lesson Event. Since students can typically be disengaged for brief periods of time during any activity, it is not necessary to track individual students throughout the lesson. Rather, consider the overall level of disengagement across the classroom, not across individual students, throughout the Lesson Event.

NONE = all students were engaged for the majority of the Lesson Event
FEW = **At least one, but less than 25%** of the students were off-task for most of the Lesson Event
HALF = **about 25-50%** of the students were off-task for most of the Lesson Event
MOST = **about 50-75%** of the students were off-task for most of the Lesson Event
ALL = **about 75-100%** of the students were off-task for most of the Lesson Event
NA = can't see students to rate (**this would be used for video recorded lessons only**)

OVERVIEW OF LESSON EVENT CODING RULES

1. **One Activity Code and Class Organization Code per Lesson Event**: The coder should code the predominant type of activity and class organization for each Lesson Event and *use only one activity and one class organization code per Lesson Event*. The codebook cannot pre-specify every scenario that may appear in a class, so the observer needs to be familiar enough with the codebook so they can make reasoned, consistent judgments about what they see. Use page 5 of the data collection instrument to help guide decisions

2. **Lesson Events begin when the teacher verbally says it begins**:
   a. *(When to start the observation)*: A coder can ignore the initial time that students are finding their seats, handing in homework, etc. The first Lesson Event should start when the teacher gives a clear indication that the lesson is starting, by saying something to the effect of "ok, let's get started." Begin to code the event *the first time the teacher says* that the lesson is starting or that the students should begin working, even if there are a few minutes before teaching or student work actually begins. The only exception to this would be if the class begins with a warm-up activity where students walk in knowing what is expected of them without verbal prompting (see also #3a below).

   b. *(When to begin a new Lesson Event)*: A new Lesson Event start time occurs when the teacher verbally indicates that there will be a change in activity. As soon as a teacher announces that the students should begin doing something different, or if the teacher begins to give directions for the next activity, code this as the start time for another Lesson Event. An exception is at the beginning of class: often teachers will say briefly what students will be doing for the day and then begin giving instructions for the first activity (which will be something other than INST). Since teachers often provide background information and instruction during this initial Lesson Event, in addition to directions for the next activity, you should code the entire period of instruction, including directions as INST, beginning the second Lesson Event when the students actually begin the next activity.

   c. (*How to decide on a code for multiple activities occurring simultaneously*): Sometimes teachers will arrange the class so that multiple activities can be going on at the same time. These fall into one of three scenarios:

      i.   Scenario 1—The activities are all of the same type and thus coded with one activity code.
      ii. Scenario 2—The activities are of different types and would be coded with the STN physical activity code. This could occur with or without rotation during the observed class period.
      iii. Scenario 3—The students self-pace through a set of different activities (e.g., read something, then use a computer simulation, then write the answers to some questions).

      The start time for scenario 1 or 2 is determined in the same way as any other type of Lesson Event (see *b* above). For Scenario 3, the teacher is likely to give a verbal cue, for example, "When you're done with the reading, go ahead and work with the computer simulation," when the teacher notices some students are ready to move on. The first time the teacher gives this reminder verbal cue, you would code this as the start time for another Lesson Event; in this example, it would signal the beginning of a computer simulation Lesson Event (SIM).

   d. (*When to end the observation*): End the observation (note the end time) when the teacher verbally indicates that his or her formal instruction has ended. For example, the end time can be indicated by the teacher telling the students to put away their materials, when the teacher gives a homework assignment, when the teacher tells students that they may work on their own until the end of class, etc. It helps if you know the time that the class is scheduled to end before you begin the observation, so that when that time approaches you can anticipate these kinds of cues that the formal instruction

has been completed. Once you end the observation, do not code any more Verbal Practices, even if the teacher then continues to talk to the students.

3. **Start the observation with INST**: Most live observations (either in a classroom or field setting) will begin with instruction of some kind, so the default beginning code should always be INST unless one of the following two exceptions takes place.

   a. Exception 1—Occasionally teachers will have an established routine where students enter the room and do a written activity to warm them up for the class. In these cases, you would begin the observation with WRIT.
   b. Exception 2—In a video-recorded lesson, the videographer may not always capture the beginning of the class, starting the recording after the class orientation has taken place. In these instances, you will need to begin Lesson Event #1 with the most appropriate activity code, which may or may not be INST.

4. **Use the activity code that describes the main purpose of the activity**: Consider whether the teacher would identify each Lesson Event as the primary activity. Transient Lesson Events should NOT be coded as distinct Lesson Events. For example, if a teacher is lecturing (INST) and asks a student to read a passage from the textbook aloud to the class before continuing the lecture, this should be coded as one Lesson Event and not as two separate Lesson Events, because the read-aloud was transient and in service of transmitting information like the lecture. If there was a class discussion (DISC), then the teacher asks students to read a passage silently to themselves (READ), and then moves onto a class demonstration (DEMO), this series would constitute three Lesson Events.

5. **Cleaning up from an activity**: Include the time it takes students to clean up from an activity as part of that activity's Lesson Event. If clean up takes a disproportionate amount of time, make a note of this in the "notes" section, either on the classroom observation page, or on page 4 of the data collection instrument.

6. **Whole-class reading or video viewing**: Some teachers choose to have students take turns reading aloud an assigned reading, and interspersed between readers are brief discussions of the main points and vocabulary. You should code this type of event as READ. Do not code each student reading and the subsequent class discussions as different events. The same rule applies to watching video clips between which there are brief instructional episodes, except that this Lesson Event would be coded as VID.

7. **Don't code the time that lapses when there is a class interruption**: An interruption is defined as the time when the students' perceive an obvious break in the flow of the class activity. For example, if a lecture is interrupted by a conversation with the school's maintenance man, when the interruption begins record the Lesson Event end time, and then restart the Lesson Event once the interruption ends by recording another start time for the same Lesson Event. Or, if using a stopwatch in the observation, just stop it during the interruption then start again when instruction resumes (not as a new Lesson Event). Don't code any Verbal Practices during the interruption. Exception: if the Lesson Event is not a whole-class activity and the interruption does not disturb the flow of the students' work, then continue to record the time as if there was not an interruption, but don't code any teacher Verbal Practices until the teacher returns attention to the students.

Teacher Verbal Practices Codes
[Rules on p. 15; codes also on p. 5 of the Data Collection Instrument]

Within each Lesson Event, the frequency of each type of teacher Verbal Practice should be recorded. Each instance of a Verbal Practice is noted with a tick mark in the appropriate cell of the Classroom Observation Sheet. A tick mark will be noted for each new question prompt (which may include more than one individual question) and for each complete thought/comment. You would code utterances made to individual students as well as those made to the whole class—there is no distinction in this coding scheme. The specific types of comments and questions are listed under broader sub-categories. These sub-category headings describe the general purpose of the utterances, so you should use them to guide your selection of a specific Verbal Practice. For each Verbal Practice, a definition and bulleted examples of what a teacher would actually say are provided below.

To **GAUGE** or **EXPAND** students' thinking or knowledge. These Verbal Practices elicit students' thinking through asking students various types of questions.

(*Code*)	(*Definition*)
Solicit	Soliciting volunteers for class activity; call on students to take a turn responding; tally students' votes/choices; check on students' progress. If a teacher asks a question that fits in one of the other questioning codes below, and then solicits a series responses from students to that same question, you would code the question with the appropriate code, but each subsequent prompting as instances of solicit. In a call and response type of situation, an observer should tally all instances of soliciting different students to answer questions, even when the same question is repeatedly asked. Do not tally non-verbal prompts as these can be missed by different observers.

(*Examples*)
- Alex? (inviting a student to offer a response to a question the teacher has already asked)
- Who would like to help with…
- How many of you do "x"?
- Are you finished? (to a group of off-task students)
- Where are your data?

Fact Asking questions that require students to recall facts, terms, and definitions, OR require students to provide short, specific answers (knowing that…). These are often closed-ended questions that ask for **declarative** knowledge, as defined by Ruiz-Primo (2009)[2], and may include yes/no responses. Fact questions can also ask for simple observations.
- How many electrons are in a carbon atom?
- What is temperature?
- Who remembers the definition for pollution?
- Which layer of rocks is older…the ones on top or the ones below?
- Roger, what is the definition of igneous rock?
  Note: Count the explicit prompting of the specific student as an instance of Solicit, but the question itself as Fact.
- What did you see in the microscope?

[2] Ruiz-Primo, M. A. (2009). *Towards a framework for assessing 21st century skills*. Paper commissioned for the National Academies, Washington D.C. Retrieved May 19, 2009 from http://www7.nationalacademies.org/bose/21CentSKillUploads.html.

Procedural   Asking questions that require students to recall steps, actions, or procedures in observing phenomena or conducting investigations (knowing how to do something). These are questions that ask for procedural knowledge, or the knowledge of how to a particular procedure is carried out. Usually these questions take the form of "if-then production rules or sequence of steps." These questions can ask about motor procedures (e.g., how to use a balance to mass an object), simple application of a well-practiced algorithm (e.g., how to construct a graph), or complex procedures (e.g., how to implement a multistep procedure to find out the density of an object).

- How do we prepare our slides for viewing the onion cells?
- How do you record temperature data?
- What do you do after generating a hypothesis?
- What's the first step you are going to do when you go to the lab station?

Explain   Asking questions that require students to recall theories, models, or evidence to explain natural phenomena (knowing why or how something happens). These are questions that ask for schematic knowledge, or the knowledge of how or why something occurs. Explain questions can also probe for further elaboration of a given student response.

- When you said "this layer of rocks was below that layer of rocks," what does that tell us about their ages?
- Why is pollution so difficult to regulate?
- When you're outside and feel hot, is it because your temperature is going up?
- Why do we need to collect data in science?
- How are sedimentary rocks different from igneous rocks?
- What's your theory here?

> **Fact** vs. **Explain**
>
> **Explain** questions probe for elaboration and explanation often in response to a student's thinking. However, if a follow-up question only asks for additional factual information rather than student reasoning, the follow-up question should be coded as **Fact**. In addition, if the teacher poses a closed-ended question, such as one where students are given the options for an answer, code that question as **Fact** even if the question is explaining a phenomenon. A follow up question where the teacher asks "Why?" would be coded as **Explain**.

Apply   Encourage students to apply learning to new conditions, scenarios, or problems (what if…). These kinds of questions typically follow an initial student response because they are asking the student to apply their knowledge (that they just articulated) to a new situation.

- What do you predict will happen when we try this?
- Is that true every single day? What about the a.m. tides?
- Given what you've learned, what is the most sensible arrangement of electrons in a carbon atom?

Meta   Prompt students to evaluate the reasoning, explanations, or use of evidence in argument by themselves or others. These questions elicit students' thinking about their own or others' thinking. This code could also be used in stances where the teacher is building students' meta-awareness of the procedures

- Billy why do you agree with Keesha's explanation?
- Is the example that Rob gave the same thing or something a bit different from the example that Karl gave?
- Kayla, what evidence did you used to draw your conclusion?
- You've explained to me how you record these data; now tell me why we record data in this way.

Procedural vs. **Explain** vs. **Meta**

Procedural asks for knowledge of the steps of a procedure and **Explain** means "tell me more," but **Meta** elicits a reflection on the knowledge through questions that ask students to explain their thinking rather than the concepts.

To provide **SIGNPOSTS** to students about the progression/order of the lesson. These Verbal Practices consist primarily of statements that serve to set a coherent content story line for students, temporally connecting concepts to those learned the day before, during the current lesson, or in the near future. Note that the codes are listed in temporal order.

New and Old   Explicitly making connections between previously covered material and what is currently being discussed.

- This is similar to last week when we did…
- Yesterday Michael told us something about carbon dioxide being poisonous.

Directions   Providing the directions to students, either for activities as they are occurring, or for activities that will occur later in the same lesson. Tally each separate direction as a separate utterance, even when part of a larger set of instructions for a task, or when a teacher repeats the same direction to different groups of students.

- First, put the flask on the mesh.
- Now go to each station and write down what's there.
- When you address this question, you will need to …
- Take out your assignment from yesterday.
- You have three more minutes to complete your write-ups.
- In five minutes we will begin to clean up.

New and Old vs. **Directions**

An utterance such as "Take out the notes you took yesterday" would be an instance of **Directions,** because the teacher is not connecting the current topic to what was learned the day before, only asking students to take out the notes. On the other hand, **New and Old** makes explicit connections between the topic being addressed and something that was previously covered.

Foreshadow   Foreshadowing what will come later in the instructional experience (logistical information). This code records instances where a teacher references what will be learned in a future lesson, often connecting ideas from the current lesson to future activities.
- A little later on we will be choosing our research questions.
- Pay attention to this point because we will be coming back to it tomorrow.
- The reason we need to understand hypotheses is so that next week when you do your experiments you will be able to make them.

To provide **FEEDBACK** to students. These Verbal Practices record instances where teachers respond to students' thinking by accepting their answers, praising them for answers, or rephrasing them in some way.

Acknowledge   Repeating close to verbatim what a student said for the whole class to hear. Do not code things like "okay" or "right" that start sentences, which is more of a speech artifact.

Rephrase   Articulating a student response more clearly/logically/succinctly, often using more precise, scientific language. Teachers sometimes rephrase a student answer and seek confirmation from the student that the teacher understood what they said—this type of utterance can be in the form of a question. When a teacher is providing a definition or other that is most likely new to the student, use GIVE INFO (see below).
- That's right. The rock becomes solid. We say it solidifies.
- So you're saying that when the plant gets energy from the sun, we call that photosynthesis—is that what you meant?

Redirect   Indicating that some part of a student response is not accurate or on target and pushing for more information from the students. Can be in the form of a question.
- You have part of the answer but we need a little more information.
- OK. Stored energy. But, are you saying that is that a force?

> **Redirect** vs. **Explain**
>
> Use **Redirect** when the teacher is pressing for a more complete or correct answer to the same question. Use **Explain** when s/he is asking for further details or a deeper understanding of a concept without conveying that a previous response was incomplete.

Correct   Correcting a student's misconception or incorrect answer by providing the correct answer OR stating that the answer given was incorrect.
- No, that's not the answer.
- I think what you meant was friction, not gravity.

> **Redirect** vs. **Correct**
>
> With **Redirect**, the teacher gives the student a chance to expand on his/her answer or explain it further; with **Correct**, there is no such opportunity.

Praise   Reinforcing or encouraging creative answers, participation, persistence.
- Good answer.
- I like the way you are thinking.
- Very creative.

To **PROMPT** thinking or **REDUCE COMPLEXITY**. These Verbal Practices record instances where the teacher supports students understandings of conceptual information by explaining new information or giving them new ways to consider concepts.

Give Info Providing conceptual or procedural information, vocabulary, or definition of terms. These utterances should be tallied for conceptual information relevant to the science topics that students are learning. Irrelevant information unrelated to the topic at hand, should not be coded. One instance should be tallied for each complete thought. For vocabulary or definition of terms, you would code an instance for each different term. Giving procedural information differs from DIRECTIONS in that the teacher is providing more general information about how something is carried out, rather than explicitly telling students the steps for how they will perform a procedure.
- A crystal is an orderly arrangement of atoms.
- Your elbows and knees have hinge joints.
- To calculate density you need to divide the mass by the volume.
- In order to make a crystal you would…

Directions vs. **Give Info**

Directions provide explicit instructions about a specific task that students will carry out or the itinerary for what students will accomplish. **Give Info** provides general information about how to a procedure could be carried out that is not necessarily tied to the directions for an activity..

Rephrase vs. **Redirect** vs. **Give Info**

Use **Give Info** when a teacher is providing a definition or other information that is most likely new to the student. Use **Rephrase** when the teacher delivers a revised version of a student's response. **Redirect** implies that, in responding to a student utterance, the teacher has either indicated that the students' thinking is not complete or is pushing for more information.

Situate Providing a *conceptual* rationale for a topic or class activity. Statements contribute to a conceptual storyline and connections to broader scientific concepts and understandings. They provide students with an understanding of how or why the concept fits within a larger picture, either within the class content story line or within the scientific community.
- This idea is important to scientists because…
- We do this part of the activity because it helps us understand…

Hint Giving hints or making suggestions about things to consider related to a task or topic (general or more distal guidance to a learning target). These can also be specific hints and minimal cues to guide students' thinking towards an idea or task. These statements can be thought of as "optional" directions and in some instances could be phrased as a question.
- Maybe you could think about it this way…
- You might want to consider the range of movement in that joint. (Teacher was trying to help student distinguish between shoulder and elbow joints)
- Have you tried to put that bone on the other side?
- It begins with the letter H.
- You're going to use that same information, but look in a different place.
- You could write that on your chart.

Think Aloud   Demonstrating how he/she (the teacher) thinks about a topic, makes observations or approaches a problem.
- So let's think about this together—if we take x and do y, we get z.
- When we did that exercise I noticed that Janet…
- When we learn about something, sometimes having a picture of it in our head can help us to visualize and understand it.
- Since our chart says igneous, light in color, and large crystals, we know this could be granite or rhyolite.
- If I were asked whether this was a femur or humerus, I would probably be thinking, about the relative length of the bones in mice.

Deflect   Not providing an answer to a student's direct question but, rather, encouraging the student to find the answer for him/herself. Though this is listed as a comment, it can be stated in two parts with a comment and question. You would count a statement as deflecting if the teacher bounced the question to another student, as in the second bulleted example below.
- I don't know; what do you think?
- I don't know; what do you think Sarah? (George was the one who asked the original question to the teacher)

Summarize   Reinforcing the main points of a whole or part of the lesson by tying together multiple pieces of information. This code could be one to two specific utterances summarizing a current discussion, or they could be a set of statements describing what was learned across the lesson. In each case, each single utterance summarizing a single explicit point should be tallied.
- So what I'm hearing from everyone is…
- Today we learned …
- We learned a lot today about oxygen and carbon dioxide.

Situate vs. **Summarize**

Summarize recaps what was learned during the class session; **Situate** connects the ideas to a bigger picture.

Missed Utterance   Use this category when you could not hear what the teacher was saying. This often happens when a teacher is rotating around to groups and working with individual students. This code is useful when viewing videotaped lessons. The frequency of these missed utterances will serve as a good indicator for bias in the data collection process and should be considered as error for interpretation purposes.

VERBAL PRACTICES CODING RULES

1. **Code complete thoughts**: It often takes a teacher a few tries to get out the exact question or comment that the teacher wants to communicate to the student; therefore, you should make a tick mark for new instances/ideas/communications rather than every utterance. If a teacher repeats the same comment or question, record each separate instance. In our analysis we have found that different users tend to record whole utterances differently. Determining proper grain size takes practice. We have attempted to offer you some guidance on this in the transcripts provided as part of the training procedures. However, the observer should keep in mind that the protocol looks at the overall proportion of each type of Verbal Practice to the total number of Verbal Practices recorded. Therefore, if one observer notes fewer utterances overall relative to another observer, the proportions of each individual type of utterance may still be close across the two observer (please see procedures for calculating reliability in the training procedures described in the User's Manual). Therefore, this protocol was built on the assumption that two raters naturally differ to some extent in their understandings of the Verbal Practice codes; while it is important to record each complete thought according to the definitions above, our analysis has shown that it is the proportion of the types of utterances that is most important (please see procedures for calculating reliability in the training section of the User's Manual).

2. **Don't code everything**: The codes that are selected for this protocol indicate practices that can differentiate between teachers, based on the relative frequency with which the practices are exhibited. Therefore, not everything that a teacher may say will fit into a category on this protocol. If there is a comment or question that does not seem to fit these categories, you can ignore it but you may choose to make a note in the Observation Notes on ISIOP Data Collection Instrument p. 3.

3. **Use the code that best fits**: There are times when a teacher will make a statement like, "Tell me what you remember about bonds," and even though this is a statement, it is really meant to elicit information from a student and is more appropriately captured at a FACT question.

4. **Use of written artifacts**: If a teacher reads to the students from a handout, textbook, or other written artifact, you can code these utterances in the Verbal Practices frequency tallies.

Creating Scale Scores for Verbal Practices
For coding purposes, the Verbal Practices are grouped into sub-categories (i.e., to Gauge or Expand…) that correspond to an intuitive understanding of their purposes. However, for scoring, the items are rearranged into three factors that are based on the underlying structure of the items as determined by confirmatory factor analysis: (1) Students prompted to make sense of information, (2) teacher makes content story line explicit, and (3) teacher presents information. The assignment of codes to factors is as follows:
1. **Students prompted to make sense of information:** Solicit, Explain, Apply, Meta, Deflect
2. **Teacher makes content story line explicit:** New and Old, Foreshadow, Situate, Rephrase, Praise
3. **Teacher presents information:** Fact, Procedural, Directions, Acknowledge, Redirect, Correct, Give Info, Hint, Think Aloud, Summarize

Observation Notes
Page 3 of the Data Collection Instrument provides a space for the observer to record qualitative notes of the lesson. This section is particularly helpful in providing a record of any anomalous practices or unusual circumstances, indicators of the observed teacher's style of teaching, indicators of the quality of the instruction or teacher's understanding of the content, or anything else that may provide the context of the lesson or may not be adequately captured by the Lesson Event and Verbal Practices information. You may note any circumstances that could inform your post-observation coding (Science Content, Investigation Experiences, and Instructional Leadership sections) or future analysis including, such as any science content misconceptions.

Coding Rubric for Investigation-Related Experiences

Items 8–42. The items in this investigation-related coding rubric describe the kinds of physical and cognitive experiences that are related to doing and thinking about scientific investigations. Since scientific practices can occur during many types of class activities, a lesson does NOT need to a formal lab to be coded as having Investigation Experiences. For example, a class can focus on generating testable research questions or how to design an experiment—without actually conducting one. Or a class may focus on debating the merits of different arguments using scientific evidence/data that the students themselves did not collect. These kinds of classes would likely have items checked off in the questioning/exploration, analysis, and conclusions sections of the Investigation-Related Experiences rubric.

The items in the Coding Rubric for Investigation-Related Experiences capture the extent to which the teacher provided scientific investigation learning experiences in the lesson. If any of the items are checked, the lesson can be considered "inquiry-based" because students are engaged in the practical or reasoning skills needed to do scientific investigation. Many researchers consider "inquiry-based" lessons to be completely student directed, while others are interested in the extent to which scientific practices are included in instruction, even in instances where they are more teacher-directed. Therefore, this Science Investigation rubric is divided into two sections. Part A contains the most student-directed experiences. Part B on the other hand contains teacher directed Investigation Experiences with the least amount of student responsibility and active thinking, which are often referred to as "cookbook lab" or "simple inquiry" experiences. Further elaboration on the specific items, or examples, is provided below.

Overall Ratings in Parts A and B

Items: 12, 16, 21, 25, 30, 32, 35, 38, 42
For each general area of Investigation Experiences (bolded headings in the checklist), a rater should determine the extent to which the activities listed in an area were the focus of the lesson using the following scale:

None = 0 (none of the sub-items were checked as present)
A little = 1 (at least one item was checked and up to approximately 10% of the class time was focused on selected investigation-related activities)
Some = 2 (between about 10-50% of the class time was focused on selected activities)
A lot = 3 (at least 50% of the class time was focused on selected activities)

PART A: Student- Directed Activities

Questioning/ Exploration

8. *Students research what is already known from existing resources to generate ideas to investigate.*
The research may take place through electronic or print media, with the intent to investigate something further with the information gathered. This kind of research is different from information-seeking tasks assigned by the teacher to generate science reports.

9. *Students generate investigation questions.*
This may be led by the teacher, but the students are responsible for thinking about different questions that can be investigated. You can select this item if the students participate in a brainstorm about different questions, but then the teacher makes the final selection from that list.

10. *Teacher helps students figure out what will make a good investigation question (i.e., testable, empirical).*
In these conversations, the teacher and students discuss whether or not a particular question is one that meets a set of criteria for scientific questions. Students are encouraged to think about the research question, rather than having the question given to them by the teacher.

11. *Students make their own predictions or formulate hypotheses as part of an investigation.*
Students state their predicted outcomes to an investigation or make formal hypotheses. These are not informal questions about what students think they will happen next; rather these should be more formal instances where students discuss and/or record predictions before an experiment or demonstration.

Design

13. *Students design ways to investigate research questions, including choosing appropriate variables, techniques, and tools to gather, record, and analyze data.*
   - Choosing the right equipment or material for the task, such as a beaker or a flask.
   - Choosing which independent variables they will manipulate.
   - Choosing how they will record or analyze the data.

   The focus of this item is on student responsibility for some aspect of the investigation design. A coder can select this item if only one aspect of the investigation design is decided by the students. Not all items have to be under the students' discretion for this item to be coded as present. For example, this item could be checked if students are given an opportunity to consider the variables, tools, and equipment for an investigation but the teacher summarizes and provides students with the procedures,

14. *Teacher discusses with students the role of variables and controls in investigation designs.*
The intent of these discussions is to explain why aspects of an experiment are allowed to vary and most are not, and can include the potential for bias, confounding designs and issues with interpreting results.

15. *Students identify treatment and control variables.*
Students either choose the treatment or control variables or are prompted to identify which aspects of the experiment will vary (treatment) and which will remain the same (control).

Data Collection and Organization

17. *Students make descriptive observations.*
Observations are typically qualitative in nature. These observations can include drawing (e.g., how lab apparatus is set up). Also, code under this item basic quantitative descriptive information, such as simple frequency counts that are done without the assistance of any tools. However, frequency counts that use tools like grids to ensure systematic sampling should be coded under item 18.

18. *Students make accurate measurements using scientific tools and instruments.*
Measurements are quantitative in nature. Basic quantitative descriptive information, such as simple frequency counts that are done without the assistance of any tools, should be coded under item 17. However, frequency counts that use tools like grids to ensure systematic sampling should be coded under this item. Tools do not have to be "high tech" to count under this item (e.g., a tape measure would be included).

19. *Students access and record secondary data (existing datasets or databases) using computers.*
Secondary data is raw data that has not been directly collected by the student. It consists of scientific data that is made available to students through, for example, online data interfaces. This kind of data is organized in some format, and allow students an opportunity to manipulate or draw inferences..
   - Downloading images from the Hubble telescope.
   - Accessing bird census records through Cornell Ornithology Lab database.

20. *Students devise and use their own organizational scheme for recording data.*
    The focus of this question is on the student having to devise the method for recording the data in a systematic, organized way rather than being provided the format for organizing the data by the teacher. Additionally, if this organizational scheme is derived through whole-class or group discussion and consensus you should select this item.

Analysis

The data being analyzed does not necessarily have to have been generated by students for the items in this section to be selected.

22. *Students use mathematics to transform, organize, or interpret data.*
    Data transformation can include graphing and plotting. The analysis can take place by hand or with the aid of technology.

23. *Students use physical models or simulations to assist with the analysis and interpretation of data/evidence.*
    Physical models can include many things—globes, small-scale replications, any number of creatively constructed representations. These models can also be computer simulations. For this item to be selected, students must use the physical model to aid in their analysis and interpretation. Just looking at a model without using it to interpret data would not be included in this item.

24. *Students assess the reliability and/or validity of the knowledge generated in an investigation by critiquing methodological flaws and how well procedures were followed.*
    The focus of this question is on critical analysis of the methods that were employed to generate the data. For an activity to be considered critical analysis, there needs to be some discussion of sources of error that could have affected the results.

Conclusions/Communication/Evaluation

The results of an investigation do not have to have been generated by students for the items in this section to be selected. Critical thinking about someone else's investigation or a thought experiment is acceptable as well. These items reflect general phases of building conclusions and claims from data. Item 26 reflects building simple conclusions related only to the variables in the investigations. Item 27 reflects students' emerging understanding of the larger meaning of the investigation, such as might be presented in a discussion section of a published article. Item 28 reflects students developing presentations or revising their explanations in light of other evidence, ideas, or consideration of experimental bias.

26. *Students build logical arguments about the cause-and-effect relationships between variables.*
    These could include thinking, writing, or explicit discussion of directionality of the variables and what is reasonable and unreasonable to conclude about the inputs and outcomes of an experiment. This is more than reporting out of results—the teacher is facilitating students' formulation of their own conclusions.

27. *Students share investigation results and their own thinking/conclusions/interpretations about the meaning of those results.*
    The focus of this question is on higher order or critical thinking on the part of the student regarding the implications of findings or results from an investigation. "Sharing" could occur through class or group discussion and does not need to be a formal presentation for this to be coded. If the "sharing" is part of a formal presentation, you would select item 28 as well.

28. *Students plan and/or deliver a* presentation *of results to the class.*
    This item can be selected if, in the observed lesson, students are planning a presentation or if they are actually doing the presentation. However, for this item to be selected, a formal presentation will take place at some point in a future class period.

29. *Students evaluate and revise their explanations/predictions in light of alternative explanations posed by the teacher, other students' investigations, or other sources of existing scientific knowledge.*

For this item to be coded there will need to be some discourse that situates the students' explanations within the explanations offered by fellow students or by the broader scientific community. For example if different student-groups got different results form an experiment, and the whole class discusses these differences to reach conclusions together, this item would be selected.

PART B: Teacher-Directed Activities

Questioning/ Exploration

31. *Teacher tells the students the questions they will investigate.*
In this instance, students were NOT given the opportunity to brainstorm about questions they would like to investigate or consider different variables; they were simply given the question or purpose of the investigation by the teacher, either verbally or as part of a handout.

Design

33. *Teacher provides the variables to investigate.*
You would check this item if the teacher tells students the variables that they will need to investigate. This differs from providing the research question in that the teacher could provide the question, but give the students an opportunity to determine what variables they might investigate.

34. *Teacher provides the procedures to follow in the investigation.*
You would check this item if students have not been given an opportunity to consider or the responsibility for determining the design of an investigation; rather students are given procedures, without discussion of the reasons for the steps of the investigation.

Data Collection and Organization

36. *Students record data on worksheets or in science notebooks with a format prescribed by the teacher.*
The focus of this item is that the teacher has had responsibility for figuring out how to organize the data-collection record rather than the student.

37. *Teacher provides data for students.*
In this item the students have no responsibility for collecting, recording, or organizing the data, though they may be engaged in manipulating data (see items 22 and 23). For example, you would check this item if the teacher provides seismic readings at different locations, and students are expected to plot these data.

Analysis and Conclusion

39. *Teacher tells students the analysis procedures*
In this item, the teacher gives students the set of steps to follow for data analysis without giving them an opportunity to consider the methods for organizing, aggregating or summarizing the data. Though they may have collected the data or determined procedures for data collection, here the teacher tells them how to proceed before interpreting the results.

40. *Teacher provides data analysis for students.*
In this item, students have no responsibility for analyzing data. They may have collected or have been given data to consider, but the teacher provides them with the analysis of the data.

41. *Teacher tells the students what to conclude from an investigation.*
You would select this item if the teacher tells the students the conclusion they should draw from the data or analysis. This is often in the form of verification of existing knowledge, which includes very limited input from students about what conclusions might be drawn.

Coding Rubric for Classroom Instructional Leadership Practices

Items 43–70. These items should reflect your general impression of the skill with which the teacher provided instructional leadership and managed the classroom. Our analysis of the underlying structure of these items has shown them to align with the following four conceptual categories: **Overall Teaching style, Support for self-directed learning, Lesson organization, and Dealing with distractions**. Below is guidance for the rating categories used throughout this section of the scoring rubric. These are not absolute parameters, but should be used as general guidance.

Please rate the items according to the extent to which they describe the observed lesson:

0 = Does not describe the lesson: The item was not evident or observed at all during the course of this particular lesson.

1 = Slightly characteristic of the lesson: The item was observed once or twice during the course of the class, but it was not an integral part of the teacher's style. An attempt was made by the teacher, but it was not done clearly, coherently, or completely.

2 = Somewhat characteristic of the lesson: The practice was observed 3-4 times during the course of the class. It was done somewhat coherently, or incompletely.

3 = Very characteristic of the lesson: The practice was a clear component of the teacher's style, evident frequently during the course of the class. When present it was done clearly, coherently, and completely

Teaching Style

These items relate to how the teacher structured the social climate, and aspects of their approach for engaging and challenging the students. This includes the teachers' questioning style—whether the teacher utilized students' answers in ways that furthered understandings or helped the student and others make meaning of the concepts.

44. *The teacher projected a welcoming and engaging teaching style.*
    A teacher who rates low on this item may come across as emotionally distant, uninterested in the students, or frazzled.

45. *The teacher utilized teaching approaches to push students' thinking farther and encourage flexibility in their thinking.*
    A teacher who rates low on this item may not engage students with challenging questions or engaging activities appropriate to their skills.

53. *The teacher used adequate wait time (5 seconds or more) to allow students to formulate a response to questions.*
    "Wait time" is defined here as when a teacher asks a question and students start raising their hands, the teacher waits or employs strategies to encourage others to respond, without immediately calling on the first set of students.

60. *The teacher used formative assessment strategies to responsively pace the lesson.*
    This includes use of questioning strategies, either verbal or written, that gauge students' understanding. Teachers who responsively pace the lesson use students' responses to clarify or elaborate on ideas, as needed. A low rating would indicate that teachers do not use these strategies or that the teacher does not pace the lesson to keep the students' interest.

62. *The teacher exhibited enthusiasm, curiosity, and interest in science.*
    Consider how often the teacher made comments like "wow, that's really cool," "how interesting," "this is so much fun" when referring to scientific phenomena.

63. *The teachers' discourse and comments utilized students' thoughts, ideas, opinions, or questions as contributions to the class learning experience.*
    Consider how often the teacher solicits and uses students' input in the direction of the discussions that take place in the classroom. For example, a teacher would rate low if he or she follows a pre-determined

sequence of questions even when students are offering reasonable alternatives they would like to explore.

64. *The teacher solicited from students what they know or believe about a topic in order to understand their prior conceptions.*
For this item to be characteristic of the lesson, it could include prompting several students in the class for their prior understandings and would be done each time a new idea or science topic is introduced.

68. *The teacher asked students to expand on or clarify an idea previously offered by themselves, a peer, or other source of information.*
Consider how often the teacher pushes students to think beyond the first response that they may provide. Does this happen consistently or more sporadically?

69. *Students asked their own substantive/relevant questions of the teacher.*
This can happen in the context of a large class discussion or in a one-on-one context as the teacher is walking around the class. These questions are not, "what's the answer" type of questions but rather indicate that the students are putting ideas together and wondering about the task/science content at hand.

70. *The teacher exhibited openness to new ideas, approaches, and/or data.*
In coding this item, consider how willing the teacher was to consider input from the students, particularly atypical understandings of materials. Did the teacher ask additional questions so that students were encouraged to share their thoughts and further the class understanding? Does she acknowledge, redirect, thank the student, ask the student further questions, expand on what the student has said… or ignore, say, "No, that's wrong," etc.?

Support for Self-Directed Learning

These items relate to the way in which the teacher monitors student learning and provides opportunities for them to take responsibility for their own learning.

52. *The teacher encouraged students to work together to develop collective understandings.*

54. *The teacher encouraged students to respond to their classmates' thoughts and questions.*

57. *The teacher actively monitored individual and group progress (e.g., walking around the room to look at student work, asking for student verbal updates, etc.).*
A slightly characteristic rating, for example, could include the teacher rarely checking in with students on their progress or understanding, or consistently remaining at her desk or the front of the room when students are completing individual or group work. A somewhat characteristic rating would include a teacher who only occasionally employed strategies to check in with students.

58. *The teacher encouraged students to take responsibility for their learning by allowing them to make decisions about some aspect(s) of the class activity.*
Examples of this include allowing students to choose between several options for some aspect of an activity or suggesting students do things like take notes without "telling" them to take them. For lessons when there were not appropriate opportunities for students to make decisions, rate this item as "not observed."

61. *The teacher facilitated student self-pacing of learning activities, where appropriate.*
Did the teacher allow additional time on activities when needed? Did she provide support for students who worked faster, or encourage students to work at their own pace? If there were not appropriate opportunities for student self-pacing, code this item as "not observed."

66. *Students worked cooperatively.*
There may be instances when there were no opportunities for students to work cooperatively with a partner, in a group, or in participating in a whole class discussion. In this case, code this item as "not observed."

Lesson Organization

Lesson organization refer to the extent to which teachers explicitly organizes the lesson, key ideas for the students, and creates a physical environment that facilitates student engagement. Organizing the lesson includes explicitly stating the lesson objectives, activity goals, timeframe, or expectations. Teachers also help students organize the content by appropriately sequencing information.

43. *The teacher facilitated a learning-conducive physical environment for the majority of the students.*
For example, does the teacher ensure that all students can see the teacher or the focus of instruction? Are students arranged in the classroom in a way that is appropriate to the activity and facilitates their engagement with the lesson?

46. *The teacher stated the learning goals (ie, the science content that students would learn).*

47. *The teacher provided an overview of the activities in the lesson.*

48. *The teacher stated the performance expectations for the lesson (e.g., products, time frame).*
For this item to be characteristic, learning goals, overview of the activities, and performance expectations should be explicitly stated. In some classrooms, these organizational features may be written in the form of agendas or on a blackboard or bulletin board. If the teacher does not explicitly state them but draws students' attention to them or provides time for students to read or consider them, rate the item as "very characteristic."

49. *The teacher situated the lesson within the context of previous lessons' science content.*

50. *The teacher clearly and explicitly connected the lesson's key science ideas to one another.* These items refer to the teacher's organization of the science concepts and key ideas. For example, did the teacher explain the ways in which the science ideas within the lesson were connected to each other or to larger science ideas that have previously been explored? To what extent did the teacher explicitly present a coherent science content narrative or connect student thinking to the science ideas being presented or explored?

56. *Transitions into the lesson and/or between Lesson Events were short in duration and did not interrupt instructional flow.*
Observers should pay attention to whether the teacher had a difficult time beginning the lesson. Did the teacher say "let's begin," yet students were not engaged with the work of the lesson or Lesson Event for several more minutes? Was there a long time between Lesson Events that broke the work flow for the students? Did this happen between each Lesson Event or infrequently during the observation?

Dealing with Distractions

Distractions can include classroom interruptions due to students' disengagement from the lesson or from school activities such as loudspeaker announcements or another teacher entering the classroom. **Items 51, 59, and 65 should be reverse coded for analysis.**

51. *Two or more students exhibited distracting behavior that made it difficult for the offender or others to focus attention.*
Distracting student behaviors constitute those that make it difficult for the offender or others to focus attention due to volume of noise or movement or diverting attention to other topics/things (e.g., students talking over each other so that they can't hear one another, students wandering around the room, students having off-topic side conversations, students playing with cell phones). This category of behavior does not include occasional students calling out responses that are not either persistent and/or distracting.

54. *Students remained on task even when teachers' attention was focused elsewhere.*
In instances where the entire lesson is composed of whole class instruction, rate this item as very characteristic if the students were actively engaged in the lesson throughout.

59. *Interruptions derailed the learning goals and flow of the lesson.*
Instances where no interruptions were observed should be rated as "Does not describe the lesson."

65. *Students asked irrelevant questions of the teacher (e.g., personal, opinion, non-science or non-lesson related).*

These types of questions tend to derail the conversation from the topic at hand.

67. *Students were attentive when the teacher was speaking.*
"Attentive" does not mean "quiet" necessarily. In some classes there is a higher level of background noise, so in rating this item, consider whether or not the teacher thinks the students are attending and whether or not there is a lot of confusion on the part of the students after directions for a task has been given by the teacher (usually an indication of not paying attention).

Scoring and Interpretation

As described in the introduction to the Classroom Instructional Leadership section, the items are grouped into four sub-scales. The score on each sub-scale for an observed lesson is the mean of the item scores (note those items in the scales that should be reverse coded).

Coding Rubric for Science Content

Items 71–109. The Science Content Coding Rubric is designed to determine the overall alignment of the content present in the lesson with certain National Science Education Standards and the extent to which students are actually engaged in thinking about the science in the lesson. To complete this rubric you will need to think more globally about the content of the lesson that was **explicitly taught**, independent of any particular utterance, activity, or direction. Note that there are **2 versions** of the Science Content Coding Rubric**:** one for **Middle School (grades 6–8)** and one for **High School (grades 9–12).** Please ensure that you use the appropriate rubric for the grade band you are observing.

Within each content area, check "Yes" for each standard addressed by the observed lesson, including the content taught through in teaching aids and materials. The final item in each section asks you to rate the extent to which that topic area was addressed by the lesson. For this item, consider the extent to which the content was actually present in the lesson. Here are some things to consider:

- The content items need to be explicitly taught, rather than the intended topic of the lesson. For example, if a teacher states what the students will learn at the beginning of the lesson, but then does not explicitly address the ideas, then the content has not been taught.

- It is possible for a teacher to cover more than one general content area in a lesson and both areas may be emphasized "a lot," or one might be emphasized more than the other.

- Even though students may be engaged in an activity, a teacher might spend a significant amount of time organizing the class with only a small portion of the class devoted to actually making meaning about a particular science topic. The emphasis in this case would likely be "a little."

- Some class activities may be constructed so that they place more emphasis on how to do the activity rather than the science ideas behind the activity. For example, consider a lesson where students are building boats out of foil and testing their buoyancy. If the focus of the lesson is on whether or not the boats sink or float rather than the relationship between surface area and buoyancy, the science content was minimally addressed, and should be coded as emphasized "not at all" or "a little." Conversely, if in the same activity students are clearly measuring surface area and are prompted to think about the relationship between surface area and buoyancy, then physical science can be coded as taught "a lot."

The list of science topics is based on the National Science Education Standards and is organized into subject categories. The list is intended to be comprehensive, but may not be. Therefore, a topic that a teacher covers in a lesson may not be on the list. In these cases, use the Overall Rating in the appropriate science content area to rate the emphasis on this "other" content, and note at the bottom of the page the specific content.