Science Classroom Observation Guide

Introduction

The Science Classroom Observation Guide describes four major components of effective science classrooms. The guide provides both "potential indicators" of practices that can be ***observed*** in effective classrooms, as well as descriptions that articulate how these practices ***evolve*** with time to develop into those most effective in supporting student learning in science. The guide describes a research-based approach to effective science teaching that can be used by administrators and teachers to develop a shared understanding of quality science classrooms and to collaboratively identify targets for growth. The four major components of the guide include:

1. **Classroom Culture is Conducive to Learning Science**
An effective science classroom that is respectful and equitable is critical to ensure that each and every student has the opportunity to learn. In these classrooms, teachers and students collaboratively contribute to the flow of the lesson, both listening to each other and questioning each other. Every effort is made to ensure each student is accessing the science content and focusing on learning. In addition, a culture of evidence is an essential attribute of an effective science classroom. In this setting, discourse among students or between teachers and students includes exchanging and challenging ideas and supporting and defending those ideas with evidence.

2. **Science Content is Intellectually Engaging**
An effective science lesson focuses on science content that is important for students to know, and represents science as a dynamic body of knowledge generated by investigation and modified based on evidence. Lessons ask students to think about their prior ideas and experiences and learn by questioning and examining their ideas in light of new observations and experiences. Students interact purposefully with the intended science content within each component of the lesson to develop a scientifically accurate understanding of the scientific concepts and the supporting facts and terms.

3. **Instruction Fosters and Monitors Student Understanding**
Effective science instruction strategically uses questioning, discussion, direct experience, and direct explanation to help students think about the concepts to promote understanding. This discourse also provides a dynamic way to monitor student understanding over time. In this way, student responses drive instructional decisions to challenge current thinking and deepen understanding. These decisions may lead to small, but critical, insertions of significant focus questions or to major redesigns of activities to provide additional experiences required to address ideas revealed by students.

4. **Students Organize, Relate, and Apply Their Scientific Knowledge**
Learning occurs when students think, question, and reflect at appropriate junctures throughout a lesson. In effective science classrooms, students take responsibility for doing the intellectual work to clarify, monitor, and revise their ideas based on scientific reasoning and evidence. As students take ownership of their new, more scientifically accurate ideas they more easily recognize the purpose for the content beyond the immediate lesson, identify connections to real-world contexts, and apply their learning to new contexts.

Organization of the Guide

Each of the four major components of the guide is subdivided into multiple subsections, containing "Potential Indicators" and "Levels of Quality". The "Potential Indicators" are representative of the features you might ***observe*** in a classroom. The specific indicators likely to be present during the course of a lesson, depends on the lesson's purpose and the position of that lesson within the unit sequence. A single lesson is highly unlikely to include every indicator. Moreover, there are certainly additional relevant indicators not included on the list. The listed indicators are provided as a guide. The "Levels of Quality" synthesize the potential impact of the listed indicators within each subsection. They outline how improvements in each category might ***develop and evolve*** as changes in practice are implemented and refined over time.

Companion Formats

Two forms of the guide follow the introductory pages. The full guide includes both the potential indicators and levels of quality descriptors. It is important that users explore and understand the content of the full guide to develop a ***deep understanding*** of effective science instruction. This extended form is particularly effective in supporting pre- and post-observation discussions and reflection on instructional effectiveness. The abbreviated form serves as a ***companion*** document that can be used for recording field notes and gathering evidence during the actual observation. Use of the abbreviated form in isolation – or as a superficial "checklist" – is unlikely to benefit teachers or students.

Potential Uses

1) *Building a Common Vision for Science:* Careful study and analysis of the guide can be used to help build consensus among teachers and administrators within a school or across a district about effective science teaching and learning.
2) *Developing a Reflective Practice:* Following a science lesson, the guide can promote teacher reflection on their actions and behaviors, as well as those of students. This reflection can identify areas for personal growth and result in improved instructional effectiveness.
3) *Deprivatizing Practice:* The guide can support teacher collaboration around effective instruction. Together, teachers can target specific components from within the guide. Subsequent dialogue among teachers can focus on evidence of student learning and effective instruction gathered through observation. Such insights can be used to inform curriculum implementation or professional development planning.

Formal Teacher Evaluation: A Caution

The NCOSP Science Classroom Observation Guide is not intended for formal teacher evaluation. Establishing a culture of trust and respect, where observations are used to support teacher learning and growth, is essential for the guide to support instructional improvements. Multiple cycles of observation, reflection, and discussion over time – months and years – are necessary before lasting changes in practice takes root. Every effort must be made to ensure teachers are given the opportunity to take risks and make mistakes while on their path to instructional effectiveness. Using the guide for punitive measures could undermine the trust needed for observations to be open, honest, and productive.

Citations

Bransford, J.D., Brown, A.L., & Cocking, R.R. (1999) *How people learn*. Washington, DC: National Academy Press.

Horizon Research Inc. (2000) *Inside the classroom observation and analytic protocol*. Retrieved August 11, 2006 from http://www.horizon-research.com/instruments/clas/cop.php

Landel, Carolyn, Warren, Shannon, Evenson, Marion, and Tjoelker, Cindy. Science Classroom Observation Guide: A tool to for administrators to collaboratively reflect on effective science instruction." *In preparation.*

Minstrell, J., Anderson, R., Lenssen, E. (2007). "Constructing Understanding in Science Protocol" (CUSP). Unpublished document; adapted with permission of the author.

Kraus, P., Minstrell, J. (2007). "Diagnostic Learning Environments" (DLE). Unpublished document; adapted with permission of the author.

Teachers Development Group (2007). "Best Practices in Teaching Science: Teacher Reflection Tool." Institute Notebooks. Organization information available at: http://www.teachersdg.org/.

Weiss, Iris R. et al (2003). *Looking Inside the Classroom – A Study of K-12 Mathematics and Science Education in the United States*. Horizon Research Inc., Chapel Hill, NC., found at http: www.horizon-research.com, August, 2003.

1. Classroom Culture is Conducive to Learning Science

A. Ideas, questions, and contributions are exchanged respectfully.

Potential Indicators	Level 1	Level 2	Level 3
☐ Students and teachers interact respectfully. ☐ Students interact collegially. ☐ Students and teachers jointly decide what science related idea will be discussed or investigated. ☐ Students listen actively and ask for clarification when they don't understand.	Evidence of negative climate. Teachers and students may put down each other or express negative criticism of a personal nature.	Evidence of positive and courteous classroom norms of interaction used by both teachers and students.	Students and teachers support and encourage individuals to share, develop, and respectfully challenge ideas in a non-personal manner.

B. Discussions are based on scientific evidence.

Potential Indicators	Level 1	Level 2	Level 3
☐ Students use supporting and refuting evidence to inform reflection and discourse. ☐ Student rely on their own thinking and logical arguments to evaluate ideas. ☐ Students explain, question, and debate their own understanding. ☐ Student use observations and evidence to challenge ideas, assumptions, and inferences. ☐ Students differentiate between personal ways of knowing and scientific ways of knowing.	Student talk is largely social or procedural. Students make claims but do not support them with evidence. Students challenge individuals, not ideas.	Talk mostly focused on science concepts and issues of the lesson. Talk occasionally includes explanation. Student may invoke concepts but few make connections between inferences and their observations.	Talk is very focused on science concepts and issues of the lesson. Explanation and justification of ideas are prevalent. Students draw on past observations and experiences to support their claims and inferences.

C. Science content is made accessible to each student.

Potential Indicators	Level 1	Level 2	Level 3
☐ Content and instruction adjusted based on the knowledge and skills of each student. ☐ Explanations/clarifications are clear, accurate, and accessible to each student. ☐ Spoken and unspoken messages communicate that each student is capable of learning science. ☐ Each student actively participates in thinking and learning. ☐ Each student experience challenge that ultimately leads to new insights. ☐ Each student experiences scientifically productive disequilibrium.	Science content accessible to only a small percentage of students. Many students feel that they can not learn science.	Students are participating in thinking and learning, but instruction doesn't provide differentiated support for students with different background knowledge.	Teacher uses a variety of instructional strategies to involve students in the lesson. Classroom culture clearly communicates that both teacher and students believe everyone will learn science.

2. Science Content is Intellectually Engaging

A. Science content is significant, accurate, and worthwhile.

Potential Indicators	Level 1	Level 2	Level 3
☐ Science content is explicit and apparent to students. ☐ Science content is primarily focused on big ideas supported by relevant concepts, facts, and terms. ☐ Science content is within the bounds of an agreed upon body of knowledge. ☐ Science content is accurate. ☐ Science content is developmentally appropriate and scaffolded appropriately. ☐ Science is portrayed as a dynamic body of knowledge that changes based on the best available evidence.	Content is focused on minutia, vocabulary, or trivial facts disconnected from a large unifying idea. Content is either well above or below grade level. Science portrayed as unchanging.	Teacher identifies the big ideas, but instruction remains focused on facts and terminology. Science activities are formulaic, procedural, or confirmatory.	Students understand the learning target and the relative importance of facts and concepts in understanding the big idea. Teachers and students purposefully engaged in scientific inquiry to develop accurate understanding of those ideas.

B. Science content builds on students' prior ideas or experiences.

Potential Indicators	Level 1	Level 2	Level 3
☐ Students reveal their preconceptions about the science content, the underlying related concepts, or the nature of science. ☐ Students reveal their underlying thinking and reasoning and the source of their preconceptions. ☐ Students recognize links between their preconceptions or previously learned science concepts and the activities or experiences in the science lesson.	Science concepts in the lesson are presented without reference to preexisting student ideas. There is no explicit opportunity for students to link their own ideas with that of the lesson.	Activities or experiences may relate to students' ideas but instruction does not help students recognize this relationship.	Activities or experiences are clearly discussed as they relate to students' ideas and conceptions. Students frequently make connections between their own ideas and the science content as they move through the lesson.

C. Science content is intentionally connected to the classroom activities and experiences.

Potential Indicators	Level 1	Level 2	Level 3
☐ Student actions and interactions focus on understanding important and relevant science content. ☐ Students generate and explore relevant questions about the science content of the lesson. ☐ Students can articulate the intended science content of lesson, activity, or experience.	No connections made between the science concepts and the activities or experiences in the lesson. Students can not articulate the purpose of the activities or experiences.	Activities used to demonstrate a science idea, but students are not intellectually engaged in the underlying principles or ideas OR just accept the ideas as facts without questioning them.	Students intellectually engage in the activities to develop their understanding of the science concepts. Activities are selected and structured to provide evidence for students to resolve discrepancies and develop scientific concepts in a logical way.

3. Instruction Fosters and Monitors Student Understanding

A. Instruction fosters students' emerging understanding of science content.

Potential Indicators	Level 1	Level 2	Level 3
☐ Students are confronted with evidence that conflicts with or challenges their initial ideas as opportunity for productive disequilibrium. ☐ Questions enhance the development of students understanding of key concepts connected to the lesson. ☐ Clear and accurate explanations and clarifications are provided at appropriate points. ☐ Opportunities are provided for students to build on their present understanding as they develop new understandings. ☐ Student generated questions are pursued based on their relevance to the intended science content and their potential to deepen student understanding	Student comments or questions are mostly not allowed. When raised, they are largely to clarify procedures, terminology, or repeat information. Teachers questions do not seem to be leading anywhere OR primarily seek factual recall or procedures. Teacher responses focus on whether student statements are correct or not.	Teachers questions are directed toward knowledge of scientific concepts, but do not typically build on student responses. Some student comments or questions focus on clarification of specific concepts or address key ideas. Occasionally students request an explanation to develop understanding. Explanations are often provided without allowing sufficient time for students to come to the idea themselves.	Teacher questions are goal-oriented, following student ideas or guiding investigations and discussions. Student questions are frequently reflected back to that student or others in the class. Teacher follows student questions or comments with another question. Teacher and students questions ask for inferences or justifications, address key ideas, and clarify concepts and applications.

B. Instruction monitors students' emerging understanding of science content.

Potential Indicators	Level 1	Level 2	Level 3
☐ Student ideas are recognized, even when they were vaguely articulated. ☐ Responses to student questions or comments address the scientific idea expressed in their thinking and relate it to the focus of the lesson. ☐ Learning experiences are modified or added to ensure students develop the necessary science content knowledge.	The teacher does not use formative assessment data to monitor student learning or adjust instruction.	The teacher gathers information about student thinking but modifications to instruction based on that information are not discernable.	The teacher uses multiple strategies for assessing student learning. Teacher uses knowledge of students changing ideas to adjust instructional continuously. Adjustment may include simply posing additional guiding questions or designing investigations that relate to the models students are constructing of the intended science concepts.

4. Students Organize, Relate, and Apply Their Scientific Knowledge

A. Students make sense of the intended scientific ideas and concepts.

Potential Indicators	Level 1	Level 2	Level 3
☐ Students work on answering scientific questions or problems and objectively communicate their findings. ☐ Students clarify their own ideas, observations, reasoning, models and explanations of core science concepts. ☐ Students self-monitor the accuracy of their understanding and revise their ideas based on scientific reasoning and evidence. ☐ Students recognize changes in their initial ideas and cite experiences that led to them. ☐ Students describe the difficulties they confronted in developing new and more accurate understanding.	Students look to outside sources and knowledge authorities (e.g. teacher) for “the answer”. Students make no effort to reconcile their own ideas with the scientific concepts experienced through the lesson.	Students address scientific questions or problems to collect evidence. The ideas they learned through activities or experiences are seen as confined to the school or classroom setting. The ideas from the lesson do not dislodge or extend their initial ideas.	Students rely on their own skills to work through learning challenges rather than turn to the teacher for “the answer” or affirmation. Students take full responsibility for their learning and are confident in their abilities to learn science. Students willingly change their original ideas in the face of compelling evidence.

B. Students reflect on their new understanding of the science content.

Potential Indicators	Level 1	Level 2	Level 3
☐ Students engage in private think time to reflect on the content within the lesson. ☐ Students reflect critically on their own and each others’ processes, reasoning, and explanations. ☐ Students discuss what they do and don’t understand about the intended content.	Students do not participate in thinking about or reflecting on their learning.	Students are given some opportunities where the teacher tells them how their learning has grown based on scoring rubrics or test results.	Students are active participants in monitoring and evaluating their learning through discussions and written work.

C. Students make connections between the science content in the current lesson and prior experiences in and out of school.

Potential Indicators	Level 1	Level 2	Level 3
☐ Students articulate a purpose for the content beyond the immediate lesson. ☐ Students make multiple connections to what they already know or to applications in real world contexts. ☐ Students apply what they learn beyond the context of the original problem. ☐ Students connect the science ideas to everyday life.	Students do not make connections between the science content and any real world context or application. Science is seen as irrelevant to their daily or future lives.	Students make connections between the science content in the current lesson and prior lessons or even prior classes, but the science is still isolated or disconnected from the world outside of school.	Students make multiple connections between what they know and have learned. They see applications of the key idea to a real context. Connections might be made by the teacher or by the students. Students draw upon their learning for actions and decisions they make.

Abbreviated Science Classroom Observation Guide

Classroom Culture is Conducive to Learning Science

A. Ideas, questions, and contributions are exchanged respectfully.

Observation Notes

- ☐ Students and teachers interact respectfully.
- ☐ Students interact collegially.
- ☐ Students and teachers jointly decide what science related idea will be discussed or investigated.
- ☐ Students listen actively and ask for clarification when they don't understand.

B. Discussions are based on scientific evidence.

- ☐ Students use supporting and refuting evidence to inform reflection and discourse.
- ☐ Student rely on their own thinking and logical arguments to evaluate ideas.
- ☐ Students explain, question, and debate their own understanding.
- ☐ Student use observations and evidence to challenge ideas and inferences.
- ☐ Students differentiate between personal and scientific ways of knowing.

C. Science content is made accessible to each student.

- ☐ Content and instruction is adjusted based on the background knowledge and skills of each student.
- ☐ Explanations and clarifications are clear, accurate, and accessible to each student.
- ☐ Spoken and unspoken messages communicate that each student is capable of learning science.
- ☐ Each student actively participates in thinking and learning.
- ☐ Each student experiences challenge that ultimately leads to new insights.
- ☐ Each student experiences scientifically productive disequilibrium.

Science Content is Intellectually Engaging

A. Science content is significant, accurate, and worthwhile.

Observation Notes

- ☐ Science content is explicit and apparent to students.
- ☐ Science content is primarily focused on big ideas supported by relevant concepts, facts, and terms.
- ☐ Science content is within the bounds of an agreed upon body of knowledge.
- ☐ Science content is accurate.
- ☐ Science content is developmentally appropriate and scaffolded appropriately.
- ☐ Science is portrayed as a dynamic body of knowledge that changes based on the best available evidence.

B. Science content builds on students' prior ideas or experiences

- ☐ Students reveal their preconceptions about the science content, the underlying related concepts, or the nature of science.
- ☐ Students reveal their underlying thinking and reasoning and the source of their preconceptions.
- ☐ Students recognize links between their preconceptions or previously learned science concepts and the activities or experiences in the science lesson.

C. Science content is intentionally connected to the classroom activities and experiences.

- ☐ Student actions and interactions focus on understanding important and relevant science content.
- ☐ Students generate and explore questions about the science in the lesson.
- ☐ Students can articulate the intended science content of lesson, activity, or experience.

Instruction Fosters and Monitors Student Understanding

A. Instruction fosters students' emerging understanding of science content.

Observation Notes

- ☐ Students are confronted with evidence that challenges their initial ideas as opportunity for productive disequilibrium.
- ☐ Questions enhance the development of students understanding of key concepts connected to the lesson.
- ☐ Clear and accurate explanations/clarifications are provided at appropriate points.
- ☐ Opportunities are provided for students to build on their present understanding as they develop new understandings.
- ☐ Student generated questions are pursued based on their relevance to the science content and their potential to deepen student understanding.

B. Instruction monitors students' emerging understanding of science content

- ☐ Student ideas are recognized, even when they were vaguely articulated.
- ☐ Responses to student questions or comments address the scientific idea expressed in their thinking and relate it to the focus of the lesson.
- ☐ Learning experiences are modified or added to ensure students develop the necessary science content knowledge.

Students Organize, Relate, and Apply Their Scientific Knowledge

Observation Notes

A. Students make sense of the intended scientific ideas and concepts.

- ☐ Students work on answering scientific questions or problems and objectively communicate their findings.
- ☐ Students clarify their own ideas, observations, reasoning, models and explanations of core science concepts.
- ☐ Students self-monitor the accuracy of their understanding and revise their ideas based on scientific reasoning and evidence.
- ☐ Students recognize changes in their initial ideas and cite experiences and/or evidence that led to them.
- ☐ Students describe the difficulties they confronted in developing new and more accurate understanding.

B. Students reflect on their new understanding of the science content.

- ☐ Students engage in private think time to reflect on the content within the lesson.
- ☐ Students reflect critically on their own and each others' processes, reasoning, and explanations.
- ☐ Students discuss what they understand and don't understand about the intended content.

C. Students make connections between the science content in the current lesson and prior experiences in and out of school.

- ☐ Students articulate a purpose for the content beyond the immediate classroom lesson.
- ☐ Students make multiple connections to what they already know or to applications in real world contexts.
- ☐ Students apply what they learn beyond the context of the original problem.
- ☐ Students connect the science ideas to everyday life.