Science Formative Assessment

Volume 2

50 More Strategies for Linking Assessment, Instruction, and Learning

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Contents

Preface

HOW THIS BOOK FITS WITH THE OTHER TWO BOOKS IN THIS SERIES

In the last decade, a great many books have been published on formative assessment. These books, usually intended for a general audience, address the importance of formative assessment, the research that supports it, how it is used formally and informally, and they also include examples. Most of these books provide only a few science examples and are seldom authored by science specialists. When science examples are included, they rarely contain examples of appropriate phenomena that provide explanatory power for core disciplinary ideas. In 2008, the first edition of *Science Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning* was published (Keeley, 2008). Finally, science teachers had a formative assessment resource they could use that was science specific and authored by an experienced and well-respected leader in science education. Instead of a one-size fits all generic approach across all subject areas, *Science Formative Assessment* was designed to specifically address formative assessment considerations in science and include examples that reflect the nature of science teaching and learning.

The first book provided 75 formative assessment classroom techniques, referred to by the acronym FACTs, which science educators could use to elicit common, research-based misconceptions about the natural world throughout a cycle of instruction. These FACTs promote thinking and mirror practices used by scientists to make sense of the natural world. As assessments *for* learning, they ultimately help teachers build a bridge between where students are to where they need to be in their scientific understanding. These 75 FACTs have been used by thousands of K–12 teachers, university faculty, and professional developers, in the U.S. and internationally, to both inform and transform teaching and learning in science.

A mathematics version, *Mathematics Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning*, co-authored by

Page Keeley and Cheryl Rose Tobey, was published in 2011. Many of the same FACTs that are included in the *Science Formative Assessment* (Volume 1) book are included in the mathematics version. FACTs that were science-specific were replaced with mathematics-specific FACTs, as well as some new FACTs that can be used across disciplines. Twenty new FACTs were added, and 50 FACTs from the science version were repeated with mathematics examples. Not counting the overlap in strategies, these two books provided educators with a total collection of 95 FACTs.

This third book is the second volume of science FACTs. *Science Formative Assessment: 50 More Practical Strategies Linking Assessment, Instruction, and Learning* provides several new science FACTs and includes science examples of some of the FACTs included in the mathematics volume. Now, teachers have an extensive collection of 125 science FACTs and a combined collection of 138 science and mathematics FACTs in all.

PURPOSE AND NEED

Why so many formative assessment strategies teachers can use to inform their teaching and promote learning? Good teachers have a repertoire of purposeful and effective strategies they use to move students' learning forward, while at the same time, understanding where their students are in their thinking at any point during a cycle of instruction. They do not use the same strategies over and over until students tire of them. For example, K-W-L is an effective strategy to find out what students know (the K in K-W-L) about a topic and want to know (the W in K-W-L) about a topic before they begin an instructional unit or lesson. But if a teacher uses this same strategy every time he or she begins a lesson or unit, eyes will eventually roll, and students will think, "Oh, no, not another K-W-L again." Having a rich and robust repertoire of strategies brings variety to instruction and motivates and engages learners.

Having a lot of strategies (FACTs) to pull from is not enough. Teachers need to know how, when, and for what purpose to use a FACT. They need to know what stage in an instructional cycle a FACT is best used. Should it be used for elicitation or to check whether students have grasped and can apply the concept or practice? Is it helpful in bringing misconceptions to the surface? Teachers need to know in what format the FACT should be used. Should it be used individually at first, and then in a small-group format? Which FACTs work well in a whole-class discussion format? Teachers need to connect the FACT to a learning goal and think about how students will get feedback to know how they are moving toward the intended outcome of a lesson. The description of each FACT provides information on how the FACT promotes learning, how it informs instruction, how it should be implemented, modifications for different types of learners, and caveats to be aware of when using the

FACT. This information is specific to each FACT and will help teachers use the strategy effectively. However, it is important to take the time to gain a broader understanding of science formative assessment in general, and how it inextricably links instruction, assessment, and learning. For this reason, I strongly suggest you read Chapters 1–3 in *Science Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning* (Keeley, 2008, 2015) as a companion to this book, as this important information is not repeated in this volume.

AUDIENCE

The primary audience for this book is K–12 teachers who teach science and pre-service teachers preparing to teach science; however, many of the formative assessment techniques described in this book can be used in other disciplines besides science. College instructors can also use the techniques in this book. Professional developers, instructional coaches, mentors, and anyone who works with teachers can benefit from using the formative assessment classroom techniques to design, facilitate, and monitor adult learning.

ORGANIZATION

Chapter 1 opens with a classroom snapshot and describes the important link between assessment and learning. It describes the big idea of formative assessment and breaks it down into five key strategies. The chapter further elaborates on two major ways to use the formative assessment techniques in science—as an elicitation strategy and to support productive science talk. It concludes with considerations for next steps and provides a table of all 138 FACTs in the three books in this series.

Chapter 2 describes the link to state standards, including the *Next Generation Science Standards* (NGSS Lead States, 2013). Table 2.1 lists the grade-level examples included in Chapter 3 that illustrate how a FACT is used and the concept and core idea targeted by the example. Table 2.2 shows how the scientific and engineering practices are linked to the 50 FACTs in Chapter 3.

Chapter 3 is the heart of the book. It includes a collection of 50 FACTs. The FACTs are arranged in alphabetical order so they can be easily located by name. Each section uses a common format, with a brief description of the FACT, how the FACT promotes student learning, how it informs instruction, how to develop and use the FACT, a content specific example of using the FACT in science, general attributes, links to the *Next Generation Science Standards,* modifications for different types of learners, caveats to be aware of, uses in other disciplines besides science, and a brief example

of how it is used in another discipline. Space is provided at the end of each section for you to record notes on how you used the FACT and considerations for further use.

There is also an Appendix with an annotated list of resources that can be used with the FACTs, as well as resources to extend your learning about science formative assessment and effective instruction.

FACT 9

CONFIDENCE LEVEL ASSESSMENT (CLA)

Description

Confidence Level Assessment (CLA) is used to assess students' level of confidence on a particular task or assessment item. CLAs can be used to determine students' readiness to proceed with a task. CLAs can also be used to assess students' confidence in their answer choice(s) on formative assessment items such as probes or from question banks. The information can be quickly scanned by the teacher to inform next steps in supporting students' learning related to completing the task, understanding of disciplinary content or practices, and readiness for summative assessment.

How This FACT Promotes Student Learning

Confidence Level Assessments (CLAs) provide students with a metacognitive opportunity to self-assess the extent to which they feel confident in completing their task or how confident they are in their answer choices on assessment items. It is important for students to have confidence in their ability to undertake a task, as well as confidence in their answers and ways of thinking. Uncertainty or lack of confidence is a self-assessment feedback signal to the student that he or she may need additional help with completing a task or understanding the content of a lesson.

How This FACT Informs Instruction

Confidence Level Assessments help the teacher identify areas where students feel they can proceed with a task or understand the content that has been taught. High confidence in the ability to complete a task is an indication that the teacher can proceed with the lesson or activity. Low confidence indicates a need to further prepare students for the task at hand. CLAs prior to a task can be used to assign small groups so that there is at least one person in a group who is confident in proceeding and can help others. For example, after teaching the concept of an eclipse, the teacher might use CLAs to ascertain how confident students are in developing a model they can use to demonstrate and explain the difference between a lunar and a solar eclipse.

Confidence Level Assessments also indicate the extent to which students believe their answers to a formative assessment probe or set of formative assessment questions are correct. Low confidence levels may signal the need for additional instruction to advance students' learning. Medium and high confidence levels on correct answer choices can be an indication of readiness for summative assessment. High confidence in a wrong answer

to a conceptually based question is a signal to the teacher that the student may have a strongly held misconception that cannot merely be corrected, but may need to be addressed through instructional strategies that support conceptual change.

Design and Administration

Establish a confidence scale such as 0 to 3: 0—no confidence and/or simply a guess with no understanding; 1—low confidence; 2—medium confidence; 3—high confidence. When using CLAs with tasks or activities that are part of the day's lesson, ask students to hold up fingers (closed fist, 1 finger, 2 fingers, 3 fingers) to indicate how confident they are in being able to move into the task, activity, or lab. If students are being prepared for a task, activity, or lab investigation that will commence the next day, use *Confidence Level Assessments* as an exit slip and have the students describe why they feel confident or unconfident, and what they need in order to proceed with the task. This added writing piece provides additional formative information the teacher can use to prepare students for the lesson.

If CLAs are used with formative assessment items, such as probes, banks of assessment items, or benchmarking practice tests, have students indicate next to their answer what their confidence level is in their answer choice(s) using the 0–3 ranking levels or whatever scale you wish to use. Figure 3.10 is an example of a chart that can be posted in the classroom for use with CLAs.

Connection to the *Next Generation Science Standards*

This FACT can be used to formatively assess students' confidence in a task or assessment that targets the disciplinary core ideas and cross-cutting

Figure 3.10 Indicators of Confidence

Confidence Level	*Indicator of Confidence*
0	I have no confidence. I cannot proceed with the task on my own. I don't know enough to answer this or I guessed at the answer.
1	I am slightly confident. I can proceed with the task with some help. I know something that helped me answer this but I'm not sure about my answer.
2	I am confident. I can proceed with the task. I know something that helped me answer this and I can support my answer choice.
3	I am very confident. I can proceed with the task and I can help others. I definitely know the answer to this question and I can explain the answer to others.

concepts, including how confident they are in connecting a cross-cutting concept to a core idea. It is particularly helpful in determining how confident students are in connecting a scientific or engineering practice to a core idea or cross-cutting concept in preparation for demonstrating an NGSS performance expectation.

General Implementation Attributes

Ease of Use: High **Time Demand:** Low **Cognitive Demand:** Medium

Modifications

This FACT can be combined with the *Human Scatterplots* technique when used with formative assessment probes (Keeley, 2008, 2015). The *y*-axis represents the answer choices and the *x*-axis represents a continuum of confidence.

Caveats

Even though students may indicate the highest level of confidence in a correct answer choice or in their readiness to proceed with a task, it is still important to check for their understanding before they assist or explain a concept to others.

Use with Other Disciplines

This FACT can also be used with tasks and assessments in mathematics, social studies, language arts, health, foreign languages, and visual and performing arts. For example in foreign languages, students can be given menus in the language they are learning and indicate how confident they are in ordering items from a menu.

My Notes