



Assessing for Learning Facilitator's Guide



WORKSHOP I: INTRODUCTION TO FORMATIVE ASSESSMENT

**A Professional Development Curriculum from the
Institute for Inquiry®**

The first in a set of five workshops for teacher professional development

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You can download your own copy of this guide at www.exploratorium.edu/ifi/assessing. A wealth of background material, for this and the other guides in the series, can be found at www.exploratorium.edu/ifi/library.

In order to access these materials, you will need Macromedia Flash Player 5 or higher and Adobe Acrobat Reader 4 or higher, available for free downloading at www.exploratorium.edu/ifi/help. These plug-ins may require additional memory.

**You can download any of the
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A screenshot of the Exploratorium's "Workshops" website. The header reads "Workshops professional development experiences for educators" and "Institute for Inquiry". The main content area features a large image of hands holding a globe. Below this, there are sections for "Workshop Schedule" (See a current schedule of Institute for Inquiry offerings.), "Workshop Brochure" (Download information about our workshop offerings.), and "Lead your own Workshops" (A series of facilitator's guides published on the Web for professional developers working with teachers.). Under "Lead your own Workshops", there are two sub-sections: "Fundamentals of Inquiry" (Five workshops designed to introduce teachers to inquiry teaching) and "Assessing for Learning" (Available Fall 2006). The footer includes "ABOUT THE INSTITUTE | WORKSHOPS | LIBRARY" and the Exploratorium logo with "site index", "sponsors", and "help" links.

Introduction to Formative Assessment

Welcome

Welcome to *Introduction to Formative Assessment*, the first workshop in the ASSESSING FOR LEARNING curriculum. The five workshops in this series introduce formative assessment and offer ways for teachers to begin applying elements of formative assessment in their own classrooms.

This five-part curriculum is designed to be presented in sequence and in its entirety. To help facilitators review key concepts that pertain to the entire curriculum, each workshop guide contains a section on Formative Assessment Basics.

Created by British educator and author Wynne Harlen in collaboration with the staff of the Exploratorium Institute for Inquiry in San Francisco, this curriculum has been offered to science educators and professional developers at the Exploratorium since 1996.

In 2000 the National Science Foundation asked that the Institute for Inquiry make these workshops available to even more educators. The result is a series of guides that provide step-by-step instructions and access to support materials online so that professional developers and teacher educators can present these workshops on their own.

Lynn Rankin
Director
Institute for Inquiry

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Acknowledgments

ASSESSING FOR LEARNING is based on original work by British educator and author Wynne Harlen in collaboration with the Exploratorium's Institute for Inquiry in San Francisco. Formerly Director of the Scottish Research Council, Dr. Harlen has spent the last thirty years involved in research on assessment and student learning in primary science education. Her books, including *The Teaching of Science in Primary Schools*; *Primary Science: Taking the Plunge*; and *Teaching, Learning, and Assessing Science 5–12*, are used by educators throughout the world. Since 1996 she has been the primary presenter of a five-day series of workshops on formative assessment at the Institute for Inquiry. The core ideas and activities from those workshops, as well as Dr. Harlen's original drafts of this document, form the basis for these guides.

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ABOUT THIS WORKSHOP

- **The Workshop in Context**
- **Workshop Overview**

The Workshop in Context

ASSESSING FOR LEARNING

Introduction to Formative Assessment is the first of five workshops in the ASSESSING FOR LEARNING curriculum. The workshops in this curriculum are designed to be used sequentially so that participants work step-by-step toward a full understanding of formative assessment. All five workshops take as their starting point the Formative Assessment Basics, introduced on page 9 of this guide and available in each of the five facilitator guides in this series.

The ASSESSING FOR LEARNING curriculum consists of the following workshops:

Workshop

I

Workshop I: Introduction to Formative Assessment

Participants discover the purpose of formative assessment and find out how it differs from summative assessment (about 2 hours).

II

Workshop II: Assessing Process Skills

Participants learn how to observe and interpret students' use of the process skills of science (about 3 hours).

III

Workshop III: Effective Questioning

Participants identify questions that are useful for eliciting students' ideas and for encouraging the use of science process skills (about 2 hours).

IV

Workshop IV: Assessing Science Ideas

Participants create indicators of development for specific scientific ideas and consider the nature of feedback that helps student learning (about 2 hours).

V

Workshop V: Student Self-Assessment

Participants investigate the value of students assessing their own and their peers' work and explore ways to communicate goals and criteria to students (about 2 hours).

How to Use the Curriculum

This curriculum is designed to be presented in sequence and in its entirety. If you decide to present less than the full curriculum, it's important to communicate this to participants, so they aren't left with the impression that they have been introduced to all the main ideas related to formative assessment. For example:

- Doing only Workshop I would be a good introduction to formative assessment, but would not offer teachers any practical strategies to implement in the classroom.
- Doing Workshops II, III, IV, or V alone would offer classroom strategies, but without the overview of formative assessment to put those strategies in context.
- Doing Workshop I followed by one of the other workshops would provide an overview of formative assessment and a single strategy to implement it, but would give an incomplete picture of formative assessment practice.

Workshop Overview

A Quick Summary

Introduction to Formative Assessment is the first in a set of five guides in the ASSESSING FOR LEARNING curriculum. The guides are designed to help facilitators plan and present professional development workshops for educators interested in developing an understanding of formative assessment and how to begin to apply it in their classroom.

This workshop is the starting point for considering the meaning and purpose of assessment. It helps participants distinguish between formative and summative assessment and lays the conceptual foundation for subsequent workshops in the ASSESSING FOR LEARNING curriculum.

Because the word “assessment” may mean different things to different people, this workshop begins by helping participants develop a common understanding of the term. Beginning this way not only helps prevent miscommunication as the workshop proceeds, it also models the approach of using learners’ ideas as a starting point for learning.

How the Workshop Works

This workshop takes about two hours and is designed to be led by two facilitators. While it is possible for one facilitator to lead the workshop, we suggest that two work together. There are a number of presentations in the workshop, and having two facilitators allows you to divide responsibility for different sections.

Typically, planning takes about four hours, not including the time necessary to prepare materials. In this guide, we list materials for 36 participants. For fewer participants, quantities of materials and other workshop logistics can be adjusted as needed.

We recommend 12 to 36 participants for our workshops. Having fewer than 12 does not allow for the lively group interaction that is such an important component of the workshop. Having more than 36 makes

whole-group discussions unwieldy and can necessitate an additional facilitator.

In this workshop, participants begin by reading four short classroom vignettes and deciding which, in their view, involve assessment. If

they believe a vignette does involve assessment, they consider a number of questions about the assessment: What information was gathered? By whom? About whom? Who used the information and how? Answering these questions helps participants make distinctions between different types of assessment, particularly between formative and summative assessment.

The focus of the workshop then shifts to formative assessment—the type of assessment that’s used to help students learn and teachers teach. A brief presentation addresses the purpose of formative assessment and is followed by a description of the use of formative assessment in the classroom.

Goals

- To help teachers develop an understanding of formative and summative assessment and the different purposes they serve in the classroom.
- To help teachers understand the characteristics of formative assessment and the role it plays in supporting student learning.

To conclude, the facilitator presents a brief survey of relevant research findings and reviews the workshop's take-home messages.

About the Take-Home Messages

The take-home messages are brief statements that convey the central pedagogical ideas encountered during the workshop. By introducing the messages early on, facilitators set the context for what is to follow, and inform participants of the purpose and content of the workshop. This transparency of purpose is an important initial step in establishing an atmosphere of trust between facilitators and learners. Such trust is critical in creating a climate in which learners feel comfortable expressing opinions and considering new ideas.

Understanding of the messages deepens as the workshop progresses, and as participants become intellectually engaged in building new ideas based

on their firsthand experiences and their conversations with each other. The take-home messages are revisited at the end of the workshop as a way to summarize and reinforce the understandings participants have constructed.

Take-Home Messages

- **Formative assessment, assessment *for* learning, is different from summative assessment *of* learning.**
- **For formative assessment to take place, teachers must gather and interpret evidence of students' thinking, and then use that evidence to make decisions that further student progress toward instructional goals.**
- **Assessment is only formative when teachers use the information they've gathered to make instructional decisions.**

FORMATIVE ASSESSMENT BASICS

- **The Inquiry Connection**
- **The Formative Assessment Cycle**
- **Additional Resources**

The Inquiry Connection

Formative Assessment and Learning Science through Inquiry

From their earliest years, children develop ideas about the world that make sense to them, but don't necessarily correspond to the scientific view. How do we help children develop their ideas into more scientific ones?

Experience and research show that merely teaching "correct" scientific ideas does not necessarily change students' understanding. Change is more likely to happen when students test their scientific ideas for themselves. Teaching through inquiry helps students test their existing ideas about scientific phenomena, consider alternative ideas, and gradually develop an understanding that is more consistent with evidence and with the scientific view of how things work. But students often need help with this process. Formative assessment gives teachers the means to help students express their ideas and rigorously test them.

In general, when students engage in science inquiry, they go through the following phases:

- They begin by observing and exploring materials, and they raise questions about their observations.
- They choose a question to investigate, and then plan and do an investigation to try to answer their question.
- During the course of the investigation, they come up with ideas to explain what they're seeing, and find ways to test those ideas.
- Finally, they interpret the results of their investigations and communicate those results to others.

In order to help students have productive inquiry experiences in which they express and test ideas that can lead to new scientific understanding, teachers need to check in and offer guidance in every phase of the process. To do their investigations, students must be able to ask questions that can be investigated. And in order for students to draw conclusions based on evidence, they need to be able to plan systematic investigations to gather that evidence. The teacher's role in this process is to find out how the student is doing in each phase, and help them make progress.

To know how students are doing, teachers need a way to "get into students' heads" and understand how they're thinking. Each of the above phases of inquiry is an entry point for the teacher to carry out assessment that will provide information on how students understand science concepts, and on how effectively they are using the process skills of science (such as observing, questioning, planning, interpreting and communicating). The teacher can then use this information to determine what next steps students need to take in order to increase their understanding of science concepts and improve their ability to use the process skills of science. The teacher can then guide students in ways that will help them take next steps in learning.

Ideas about Formative Assessment

"Ideas about assessments have undergone important changes in recent years. In the new view, assessment and learning are two sides of the same coin. . . . When students engage in assessments, they should learn from those assessments."

National Research Council, *National Science Education Standards*. (Washington, DC: National Academy Press, 1996), pp. 5–6.

But of course it is the students who do the learning—and the more they are aware of the learning goals of their activities, the more they are able to recognize for themselves how to make progress. Part of the teacher's role, then, is to share goals with students, provide them with skills and opportunities for assessing their own progress, and help in deciding their next steps. All these aspects of teaching—gathering information about students' learning, interpreting it in terms of their progress, using it to decide next steps, feeding back to students how to move forward, and helping students understand

Assessment and Inquiry

"Assessments have become more sophisticated and varied as they have focused on higher-order skills. Rather than simply checking whether students have memorized certain items of information, new assessments probe for students' understanding, reasoning, and use of that knowledge—the skills that are developed through inquiry."

National Research Council, *National Science Education Standards*.
(Washington, DC: National Academy Press, 1996, p. 6.)

the goals of their work and assess their own progress—are encompassed in the concept of formative assessment, and form the basis for the ASSESSING FOR LEARNING curriculum.

While formative assessment is essential when teaching science through inquiry, this powerful teaching strategy can also be applied effectively to all science teaching approaches (as well as any other curricular topic). Because formative assessment involves periodically checking students' current understanding during—rather than after—instruction, it provides useful information which allows teachers to tailor their teaching to a single student's, or a whole class's, specific needs. Using assessment to inform teaching is important in any instructional approach. However, it is critical to inquiry, in which students are raising questions and designing investigations to test their own ideas. Teachers must assess progress at every step of the investigation in order to ensure that their investigations are sound enough for students to draw useful conclusions that help them more fully develop their scientific ideas.

The Formative Assessment Cycle

Overview

Assessment is part of every teacher's job. The type of assessment teachers are most familiar with—in which they examine students' work in order to determine grades, write evaluations, compare levels of achievement, and make decisions about promotion—is called *summative assessment*.

In doing *formative assessment*, teachers also examine and evaluate students' thinking—but in this case, they do so in order to make pedagogical decisions for the purpose of helping students get closer to learning goals. Teachers use the information they gather about student work to determine what students need to do next that will help them progress toward the goals of the lesson.

The value of this kind of assessment is attested to not only by individual teachers who have used it effectively in their classrooms, but also by a significant body of research, as the sidebar at right, "Research on Formative Assessment," indicates.

The Formative Assessment Cycle

It's useful to think of what teachers (and students) do in formative assessment as a cycle of events, as shown in the diagram on the next page and on page M6. If you follow the diagram clockwise, you'll be able to see how the process can bring students ever closer to the learning goals.

Before instruction begins, the teacher decides what the learning goals will be. These goals, shown at the top of the diagram, can be scientific attitudes, conceptual ideas about science content, or science process skills, since all are important in science instruction.

The teacher also chooses an initial learning activity

Research on Formative Assessment

"In a review of research on assessment and classroom learning, Black and Wiliam [Black, P. J., and D. Wiliam. 1998. 'Assessment and Classroom Learning.' *Assessment in Education*. 5 (1) 7–74, 1998.] identified and analyzed 250 studies comparing classrooms where formative assessment was and was not practiced. This revealed striking evidence that, on almost every kind of academic measure, students whose teachers systematically applied formative assessment techniques outperformed similar students who did not receive such treatment. These differences were significant, both statistically and educationally.

"There was also evidence that the gain was greatest for lower-achieving students. This exhaustive study leaves the reader convinced that the improvement of formative assessment practices in United States classrooms might be the closest thing to the elusive 'magic bullet' that education reformers might find."

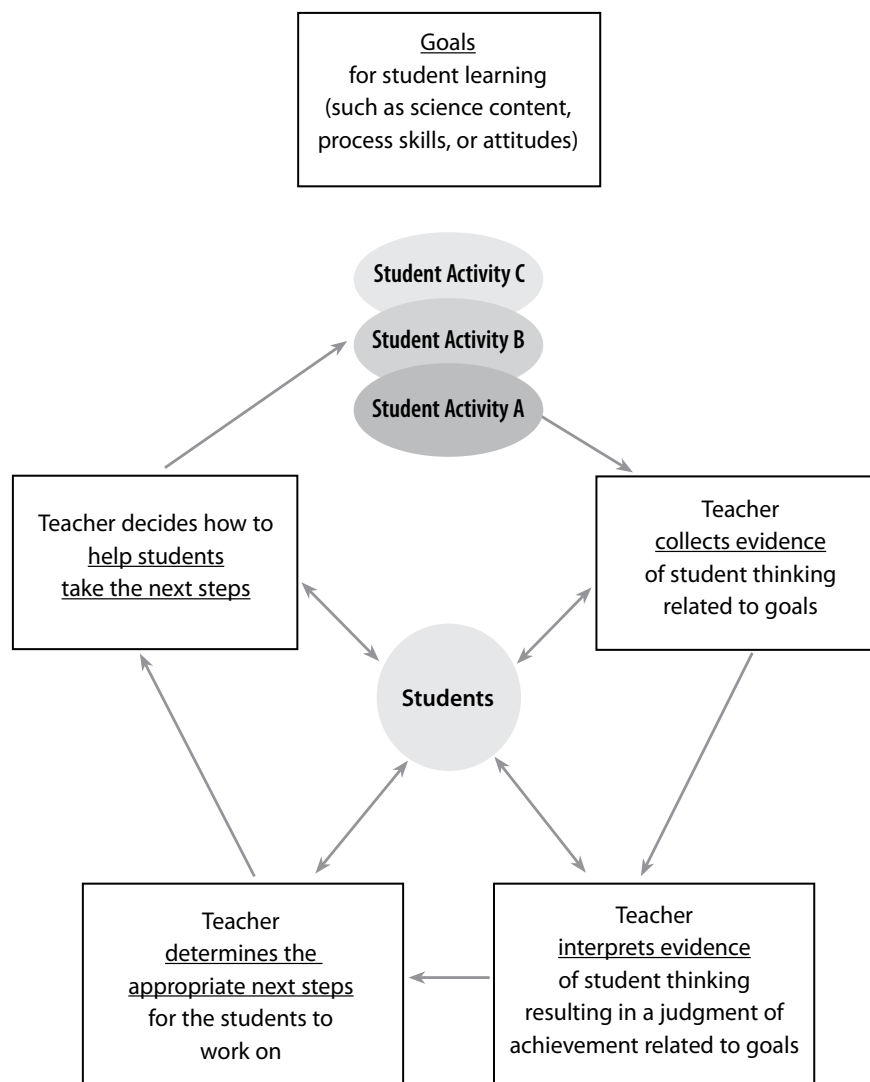
Wynne Harlen. *Enhancing Inquiry through Formative Assessment*. (San Francisco: Exploratorium, 2003) pp. 7–8.

(represented in the diagram as Activity A) meant to begin the process of helping students achieve the learning goals. Although the teacher can have plans for subsequent activities students might do to reach these goals, it's important to remain flexible. Information gathered and interpreted in the course of formative assessment may suggest ways of modifying plans so they more effectively address goals.

Teacher Collects Evidence Relating to Goals.

During the initial activity (Activity A), the teacher collects evidence of students' thinking in relation to the goals. The teacher can gather evidence in many ways, such as by watching students as they work, by

Formative Assessment Cycle



questioning them, or by asking them to communicate their understanding through writing or drawing.

Gathering evidence should be an integral part of any lesson. Lessons may already include opportunities to elicit the use of certain process skills or the application of specific scientific ideas, or the teacher may need to

plan something especially for this purpose. Planning may involve deciding, for instance, what questions to ask in order to encourage the kinds of thinking and learning intended in a particular activity.

Lesson preparation that includes plans for eliciting student thinking in relation to the learning goals has

"One teacher, in planning a lesson on simple circuits, decided to have the students draw on the whiteboard all the circuits they tried to construct, both those that did and those that didn't work. This form of communication gave her an immediate picture of the way the students' ideas were developing and enabled her to work with those who were unsure and needed help understanding what is essential in a complete circuit."

Wynne Harlen. *Enhancing Inquiry through Formative Assessment*. (San Francisco: Exploratorium, 2003) p. 22.

a double benefit. First, it ensures that students use and develop process skills and scientific ideas; and second, it gives teachers opportunities to assess the development of those skills and ideas. In this way, teaching and assessment are closely intertwined.

Teacher Interprets Evidence. Once evidence of student work has been gathered, the teacher needs to interpret that evidence to find out how students are progressing toward their learning goals. In order to do this, the teacher considers more than just the extent to which the student has reached the learning goal, but also the student's experience, past achieve-

A classroom teacher asked her students to draw a picture of a crayfish, label the parts, and describe the function of each. She wanted to see how her students used their process skills of close observation, and to elicit their understanding of structure and function. One student's drawing labeled only the legs, but distinguished between those used for movement and those used for feeding. Despite the fact that the student's work was incomplete, the teacher saw it as an indication that he had observed very closely and understood issues of structure and function. For the teacher, this was a sign of improvement, since the student had not been able to focus well in previous observations.

—Institute for Inquiry

ments, recent progress, and the effort the student has made. The teacher's interpretation is then student-referenced, allowing the teacher to match next steps with the needs of the individual student.

Teacher Determines Appropriate Next Steps. The process of interpreting evidence leads the teacher to arrive at a judgment about where students are in relation to the learning goals. In the diagram, the phrase "judgment of achievement" in the lower right-hand box refers to what the teacher thinks a student knows in relation to goals, and not how well the student is doing.

Once this judgment has been made, the teacher determines the developmental steps students need to take next in order to increase their understanding of scientific ideas, improve their science process skills, or enhance their scientific attitudes.

In a third-grade classroom, students were investigating the effects of water on plant growth: they had given different amounts of water to similar plants in various places around the room. The teacher decided that the next step was to have her students think about how to choose which condition to keep the same (such as the location of the plants) in order to make their experiment a "fair test."

—Institute for Inquiry

Teachers are accustomed to drawing on their experience to decide what would help students who show varying degrees of mastery. But there are also a number of sources that can help teachers consider the developmental progression of certain scientific ideas and process skills. For more information, see the Additional Resources on page 16.

It is this iterative process that distinguishes formative assessment from other kinds of assessment. Here, information about student achievement is gathered

In order to help her students plan for a “fair test,” a third-grade teacher asked her students how they could tell if differences in plant growth were due to differences in the amount of water each plant received, or to where the plant was located. The students responded by deciding that it would be important to keep all the plants in the same place. That way, they reasoned, they could test for the effect of watering without being confused by the effects of light or heat from different locations.

—Institute for Inquiry

and interpreted and used to help make the next instructional decision.

Teacher Decides How to Help Students Take Next Steps. Once teachers determine what students need to do to continue progressing towards the learning goals, they must then decide how best to facilitate that next step.

For instance, if a teacher is trying to help further develop students’ conceptual ideas, useful strategies include helping students test their existing scientific ideas, providing access to more scientific ideas than they currently have, and enhancing communication and reflection. Teachers can help students design experiments and investigations to test their ideas. They can give students reference materials, or introduce them to alternative, more scientific ideas and support them in thinking about those ideas. And they can set up situations in which students work together

to create explanations of scientific phenomena they encounter in experiments and investigations.

About the Student’s Role in the Formative Assessment Cycle

Students are at the center of the Formative Assessment Cycle because they play a central role in formative assessment. Every action a teacher takes during the cycle involves interactions with students.

In addition to teachers evaluating and supporting student progress toward learning goals, students can also take action on their own behalf. When students know about the goals of instruction, they can give the teacher evidence about their own understanding in relation to those goals. The more students can take on the role of self-assessment, the more they can move toward being able to decide their own next steps.

Student Self-Assessment

“Student participation is a key component of successful assessment strategies at every step. If students are to participate effectively in the process, they need to be clear about the target and the criteria for good work, to assess their own efforts in light of the criteria, and to share responsibility in taking action in light of the feedback.”

National Research Council. *Classroom Assessment and the National Science Education Standards*. (Washington, DC.: National Academy Press, 2000) p. 1.

Additional Resources

These resources can provide valuable information about formative assessment to facilitators and participants alike.

- ❑ Black, Paul, and Dylan Wiliam. "Inside the Black Box: Raising Standards through Classroom Assessment." Online article available at www.pdkintl.org/kappan/kbla9810.htm.
- ❑ Black, Paul, Christine Harrison, Clare Lee, Bethan Marshal, and Dylan Wiliam. *Working Inside the Black Box: Assessment for Learning in the Classroom*. London: King's College Department of Education & Professional Studies, 2002. Particularly useful for Workshops III, IV, and V.
- ❑ Harlen, Wynne. "Encouraging and Handling Children's Questions." Chapter 13 in *The Teaching of Science in Primary Schools*. London: David Fulton Ltd., 2000. Particularly useful for Workshop III.
- ❑ Harlen, Wynne. *Enhancing Inquiry through Formative Assessment*. San Francisco: Exploratorium, 2003. This monograph sets out research evidence and theoretical points to make the case for using formative assessment in inquiry science teaching. Available online at www.exploratorium.edu/ifi/resources/harlen_monograph.pdf.
- ❑ Harlen, Wynne. *Teaching, Learning & Assessing Science 5–12*. London: Sage Publications, 2006. This book presents a theoretical rationale for why science should be taught in constructivist ways. Chapters 7–12 offer an explanation of the role formative assessment plays in that type of teaching.

In addition to the resources above, the publications listed below can offer support for teachers interested in further information on science education standards and the developmental progression of science ideas and process skills at different grade levels.

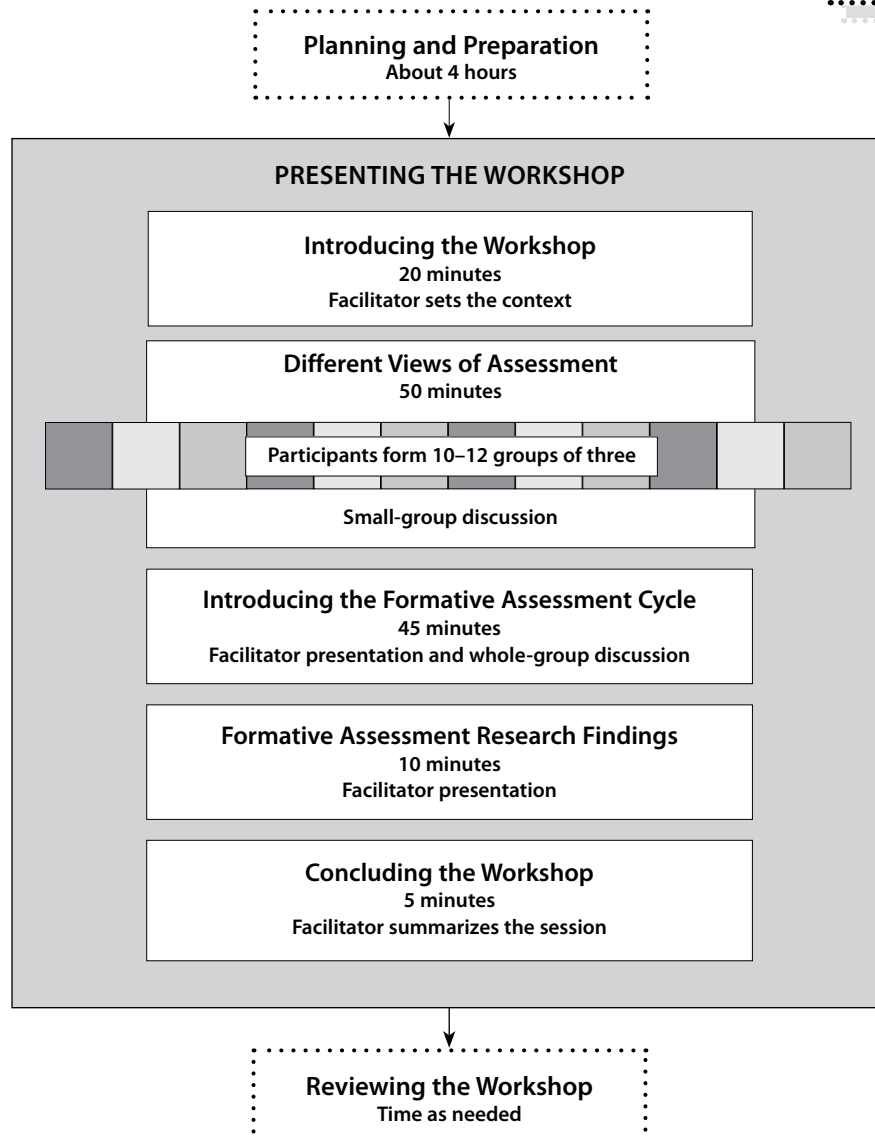
- American Association for the Advancement of Science. *Atlas of Scientific Literacy*. Washington, DC: American Association for the Advancement of Science and the National Science Teachers Association, 2001.
- American Association for the Advancement of Science. *Benchmarks for Science Literacy*. New York: Oxford University Press, 1993.
- National Assessment of Educational Progress (NAEP). "The NAEP Science Achievement Levels." National Center for Education Statistics (NCES), 2002. <http://nces.ed.gov/nationsreportcard/science/achieveall.asp>.
- National Research Council. *National Science Education Standards*. Washington, DC: National Academy Press, 1996.

PLANNING AND PREPARATION

- **Workshop at a Glance**
- **Essential Planning Steps**
- **Charts, Overheads, and Handouts**
- **Materials**

Workshop at a Glance

Facilitators needed: 1–2
Participants accommodated: 30–36
Time to present the session: About 2 hours



Essential Planning Steps

Overview

The *Introduction to Formative Assessment* workshop requires a good deal of planning and preparation. Below you'll find step-by-step instructions, divided into three categories: Before the Workshop, On the Day of the Workshop, and After the Workshop.

If two facilitators will be presenting the workshop, it's important to go over these steps together, arriving at a shared understanding of workshop goals. There's a lot to do, including reading through this entire guide, preparing to lead discussions, trying the workshop yourselves as if you were participants, arranging for an appropriate space, and preparing charts and handouts.

You'll also want to set aside time after the workshop to talk with your co-facilitator about what went well and what could be improved for subsequent workshops.

Before the Workshop

1. Read this guide all the way through. It is essential for you to read through this guide before doing any of the other planning steps. You may want to flag sections that don't make immediate sense to you, coming back to them as the goals of the workshop become clearer.

2. Become familiar with the formative assessment content. Review the Formative Assessment Basics section (see page 9). This is the foundation of the entire curriculum.

3. Prepare materials. Gather and organize all materials (see the complete list on pages 22–23).

- Prepare the handouts, charts, and overheads, and organize them in the order in which you will use them

during the workshop. Masters start on page 44.

They are identified with the letter *M* and numbered in order of use.

- Study the Additional Resources on page 16, deciding what you might want to copy for distribution at the end of the workshop. Note that the article “Inside the Black Box,” by Paul Black and Dylan William (available online at www.pdkintl.org/kappan/kbla9810.htm) will be especially helpful as you prepare to facilitate the Formative Assessment Research Findings section of this workshop.

4. Do the workshop as learners. Meet with your co-facilitator, if there is one, and go through the workshop as if you were participants.

Do all the same tasks workshop participants will be asked to do. This will help you better understand the kinds of responses they will give, the kinds of problems that could come up, and the kinds of questions people may ask.

Planning Time Needed

Approximately 4 hours, plus time to gather and prepare materials and equipment

An Important Note from the Institute for Inquiry

This workshop is the result of many years of development with educators across the country. While its format may seem adaptable, using it in ways other than those described here will not only change the participants' experience, but the outcome as well. We recommend becoming familiar with the planning and presentation of the workshop and experiencing its intended results before considering any adaptation.

5. Go over the workshop as facilitators. Go through the workshop again, this time as facilitators. If there will be more than one facilitator, decide which sections and tasks each facilitator will be responsible for.

6. Familiarize yourself with each step. Be sure you understand the purpose of each section and each discussion. Keep the take-home messages (M1) in mind as your overall guide. These messages express the pedagogical ideas participants should take away from the workshop.

A Note about Scripts

Many of the steps in this guide contain scripted information, set in *italic type* and marked with gray arrows. The scripts are intended to illustrate one way of presenting information and instructions to workshop participants. While the content of the scripts is crucial, the exact wording is not. After thoroughly familiarizing yourself with the scripts and noting the important points, you may decide to convey the information in your own words rather than reading the scripts to participants word for word.

- Review the description of the formative assessment cycle, which begins on page 33. Practice displaying and describing the diagram (M6) before presenting it. In order to make the diagram clear to participants, you'll have to be clear about it yourself.

- It's especially important to become thoroughly familiar with handout M2: "Classroom Vignettes," so that you'll be comfortable referring to the four vignettes throughout the workshop.

- Review the presentation of chart and handout M5: "Key Points about Assessment," paying special attention to the box on page 34 that gives examples from the vignettes of these key points.

- Review the presentation of chart and handout M10: "Research Findings about Formative Assessment," paying special attention to the box on page 37 that suggests how best to present these findings.

7. Be prepared to set the context. Setting the context for the workshop is crucial. The facilitator who introduces the workshop should study the script in Steps 2, 3, and 4 of Introducing the Workshop (see page 25), and practice presenting this information.

8. Plan time and space carefully.

- You'll need a space large enough for 30–36 participants (10 to 12 teams of three people each) to work together comfortably.

- Create a detailed schedule for facilitators to refer to during the workshop. Note the beginning and ending times for each step (e.g., Introductions and Set Context, 9:00–9:05; Describe assessment and outline structure of workshop, 9:05–9:10).

- Prepare a simplified version of the schedule for participants, which you can post at the beginning of the workshop. A sample schedule is shown below.

Sample Schedule for Participants

9:00–9:20	Introducing the Workshop
9:20–10:10	Different Views of Assessment
10:10–10:55	Introducing the Formative Assessment Cycle
10:55–11:05	Formative Assessment Research Findings
11:05–11:10	Concluding the Workshop

On the Day of the Workshop

1. Prepare the room. Set up your equipment and put handouts, charts, and overheads where you'll have access to them when you need them.

2. Watch your schedule. Refer to the schedule you created (see Step 8, above) to keep the workshop on track.

After the Workshop

You and your co-facilitator (if there is one) should take some time to reflect on your experiences. Issues of logistics, communication, outcomes, and expectations can be addressed at this point. The Facilitation Review (page 40) will allow you to assess the results of your work and identify successes and challenges that can help guide subsequent workshops.

Charts, Overheads, and Handouts

Masters begin on page 44, are identified by the letter *M* (for Master), and are numbered in order of use. Note that some masters will be used for both a handout and a chart or overhead.

Charts or Overheads	Master Available on Page
You can prepare these as either large charts or overheads. If you have access to a copy machine that can enlarge to poster size, enlarge these masters 400% to create charts that are 34" x 44". Otherwise, hand-copy facsimiles onto chart paper or poster paper approximately the same size.	
<input type="checkbox"/> Take-Home Messages (for Introducing the Workshop; reuse in Concluding the Workshop)	M1
<input type="checkbox"/> Classroom Vignettes Grid (for Different Views of Assessment)	M4
<input type="checkbox"/> Key Points about Assessment (for Different Views of Assessment)	M5
<input type="checkbox"/> Formative Assessment Cycle (for Introducing the Formative Assessment Cycle)	M6
<input type="checkbox"/> Research Findings about Formative Assessment (for Formative Assessment Research Findings)	M10

Handouts	Master Available on Page
Photocopy these 8½" x 11" handouts, one for each participant.	
<input type="checkbox"/> Take-Home Messages (for Introducing the Workshop; reuse in Concluding the Workshop)	M1
<input type="checkbox"/> Classroom Vignettes (for Different Views of Assessment)	M2
<input type="checkbox"/> Classroom Vignettes Activity Sheet (for Different Views of Assessment)	M3
<input type="checkbox"/> Key Points about Assessment (for Different Views of Assessment)	M5
<input type="checkbox"/> Understanding the Formative Assessment Cycle (for Introducing the Formative Assessment Cycle)	M7
<input type="checkbox"/> Sound Activity Vignette (for Introducing the Formative Assessment Cycle)	M8
<input type="checkbox"/> Comparing Formative and Summative Assessment (for Introducing the Formative Assessment Cycle)	M9
<input type="checkbox"/> Research Findings about Formative Assessment (for Formative Assessment Research Findings)	M10

Materials

☐ Marking pens for facilitators to record on chart M4: “Classroom Vignettes Grid”

☐ Overhead projector (optional) and marking pens for transparencies

PRESENTING THE WORKSHOP

- **Introducing the Workshop**
- **Different Views of Assessment**
- **Introducing the Formative Assessment Cycle**
- **Formative Assessment Research Findings**
- **Concluding the Workshop**

Introducing the Workshop

Overview

In this opening section, facilitators talk about the workshop's purpose, describe how participants will work together, and introduce the take-home messages, the central pedagogical ideas of the workshop.

Letting everyone know what they will be doing and why helps build trust and demonstrates your respect for the participants as learners. A respectful atmosphere is essential for fostering a free and open exchange of ideas.

Note that giving participants handouts of selected charts and overheads during the workshop makes it easier for participants to refer to the information displayed. This is especially important when the charts or overheads are long and complicated.

7 Steps ♦ 20 Minutes

1. Ask participants to introduce themselves (10 minutes). Begin the workshop by introducing the facilitators and asking the participants to introduce themselves.

2. Set the context. Say:

► *This is the first workshop in a series of five that deal with formative assessment. It will help you begin to think about some of the ideas and practices of formative assessment and the benefits it can offer to you and your students.*

We're going to begin today by talking about formative and summative assessment; then we'll focus on formative assessment.

We'll be discussing ideas and thinking about what they mean for your practice in the classroom. And while you won't come away with specific class-

room activities, you will gain an understanding of formative assessment and some ideas that can be applied to your work with students.

3. Describe the main reasons for doing assessment in the classroom. Tell participants:

► *In the classroom, there are two main reasons for doing assessment:*

*(1) to aid learning (assessment **for** learning) and*

*(2) to report on if, and how effectively, learning has occurred (assessment **of** learning)*

Different kinds of assessment have certain things in common—gathering evidence, interpreting that evidence, and using the interpretation in some way. But how each of these things is carried out is determined by the purpose of the assessment.

4. Describe what will happen in this workshop.

Tell participants:

► *Today, we'll begin by looking at our own views of what assessment is and how it's used. We'll read four classroom vignettes and respond to questions about them. We'll discuss our ideas in small groups, and then with the whole group.*

Following that, we'll talk about the purpose of formative assessment and then discuss the formative assessment cycle, which outlines the process of formative assessment in the classroom. We'll share our own experiences of formative assessment, both as teachers and learners, and then close by talking about research findings that show the importance

Materials Reminder

During this part of the workshop, facilitators will need to:

- Post chart M1 and distribute handout: "Take-Home Messages"

of formative assessment to student learning.

5. Post chart M1: “Take-Home Messages” and distribute the corresponding handout. Read the take-home messages aloud. Then tell participants:

► *Throughout the workshop, you’ll be working to develop your own understanding of the pedagogical ideas these messages express.*

6. Explain how the workshop relates to your

district’s goals, standards, and other professional-development activities for science education. Tell participants why you chose to present this workshop. Explain how it fits with other professional-development experiences they’ve had and how it relates to district and state standards.

7. Tell participants that the workshop will take a little more than two hours. If you’ve planned a break, let people know that as well.

INTRODUCTION TO FORMATIVE ASSESSMENT
CHART OR OVERHEAD & HANDOUT

Take-Home Messages

- Formative assessment, assessment *for* learning, is different from summative assessment, assessment *of* learning.
- For formative assessment to take place, teachers must gather and interpret evidence of students’ thinking, and then use that evidence to make decisions that further student progress toward instructional goals.
- Assessment is only formative when teachers use the information they’ve gathered to make instructional decisions.

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M1

Different Views of Assessment

Overview

The activities in this section are meant to highlight the idea that different kinds of assessments are done in different ways for different purposes. Reading and discussing examples from the classroom helps broaden people's ideas about the range of ways one carries out assessment in general and prepares participants to focus on formative assessment in particular.

After introducing the workshop, ask participants to form groups of three. Together, they'll read and discuss four classroom vignettes that describe science activities. Then, you'll ask for each group's responses to questions on the activity sheet (M3) and you'll record them on the large grid (M4).

Note on the Use of the Word "Judgment"

All assessments involve gathering information, making a judgment about it, and using that information for some purpose (such as assigning grades, informing instruction, and so on). In this section, the word "judgment" refers purely to what the teacher thinks the student knows in relation to the learning goals, not how well she thinks the student is doing. Although the word judgment may only seem applicable to summative assessments in which grades are assigned, all assessments include a judgment: that is, based on the evidence, they are what the teacher thinks the student knows at that time.

7 Steps ♦ 50 Minutes

1. Ask participants to form groups of three. They'll be working in small teams for this part of the workshop.

Before beginning the activity, be sure to post chart M4:

"Classroom Vignettes Grid." You'll be using it to record participant responses.

2. Introduce the activity.

Participants will be reading and discussing four classroom vignettes. Tell people:

► A useful way to begin examining formative assessment is first to think about assessment in general. To do this, we'll be reading and discussing some short classroom vignettes in which assessment might be happening.

There are different kinds of assessments done in different ways for different purposes. For instance, formative assessments are done during instruction to help in making instructional decisions, while summative assessments are done after teaching is completed, for the purpose of assigning grades or marks.

Despite these differences, all assessments involve three things:

- Gathering information
- Making a judgment about it, and
- Using that information for some purpose (such as assigning grades, informing instruction, and so on)

At this point, it may be useful to comment on the use of the word "judgment." You might say something like this:

Materials Reminder

During this part of the workshop, facilitators will need to:

- Distribute handout M2: "Classroom Vignettes"
- Distribute handout M3: "Classroom Vignettes Activity Sheet"
- Post chart M4: "Classroom Vignettes Grid"
- Post chart and distribute handout M5: "Key Points about Assessment"

INTRODUCTION TO FORMATIVE ASSESSMENT HANDOUT

Classroom Vignettes

■ Vignette A: Decomposition
A fifth-grade teacher embarking on a unit about decomposition wanted to help his students realize that some plant material is cycled through decomposition and incorporated into other plant material.

Before beginning, however, he decided to find out what his students knew and thought about the processes involved.

To find out, he arranged the students in groups, gave them some leaves, and asked them to discuss what they knew about how leaves changed throughout a year. What would these leaves have looked like in the spring? What will they look like in the fall? What will they look like by next spring?

Then he asked each group to produce a series of drawings showing how their leaves looked now, what they might have looked like before, and what they would look like in the fall and next spring. The students were asked to annotate their drawings with explanations of the changes they depicted.

■ Vignette B: Fertilizer I
In a fifth-grade class, students were involved in investigating the effect of various fertilizers on the growth of different kinds of seedlings. Some students planted lettuce seedlings, some nasturtium, some cabbage, and others used various kinds of tomato seedlings.

One group set up their trials very carefully, using the same soil before mixing in equal amounts of fertilizer, filling identical pots, and planting seedlings of the same size in them. However, the teacher noticed that they watered their seedlings without taking care to use the same amount of water for each one.

As they clearly were aware that they needed to keep things the same for fair comparisons, the teacher asked them if they thought it mattered that they'd watered their plants with different amounts of water. They said it wouldn't make any difference because any extra water would just go to the bottom of the pots and drain away.

The teacher realized that this had implications for their understanding of how fertilizers work, as the students

did not seem to realize that the fertilizers could be washed away.

She asked them to investigate separately what happens when small amounts of fertilizers are put in water. They observed that the fertilizers dissolved and realized that the amount of water was a variable that had to be controlled for a fair test. They also advanced their ideas about how plants could be affected by fertilizer.

■ Vignette C: Fertilizer II
At the end of their investigations of fertilizers, the teacher held a discussion with the whole class about how to report their work so that others could understand what had been done, what had been found, and how it could be explained. The students ended up with a list of points that made a good report of an investigation. The teacher wrote these in large print on a chart and pinned it to the wall. While the students wrote their reports of their investigation, they were reminded to pay attention to the points listed. When they presented their reports to each other, they used the list to make constructive comments about how the reports (their own and others) could be improved.

■ Vignette D: Camouflage
At the end of a unit on camouflage in animals, a teacher asked her fourth-grade students to write down answers to the following questions to see how they were able to apply the ideas she hoped they had grasped.

1. Brown bears are found in the mountains in Canada and white bears in the Arctic. Why do you think you don't find white bears in the mountains and brown bears in the Arctic? Think of as many reasons as you can.
2. Many kinds of "big cats" such as tigers and leopards have stripes and blotches on their coats.
 - a. Write down as many ways you can think of that this helps these animals.
 - b. Write down as many ways you can think of that this might not help these animals.
3. Some fish have darker colors on their backs than on their undersides. Can you think of a reason for this?

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M2

- Although the word “judgment” may only seem applicable to summative assessment, all assessments include judgments—made by the teacher and based on available evidence. In this workshop, when the word is used in relation to formative assessment, it does not refer to a judgment of good or bad, but of what a teacher thinks a student knows in relation to learning goals.

3. Have participants read and discuss vignettes (25 minutes). Distribute handouts M2: “Classroom Vignettes” and M3: “Classroom Vignettes Activity Sheet.” Ask participants to read and discuss the vignettes, and to record their views on their activity sheets. Tell people:

- This exercise will help you express your views about assessment.

In our small groups of three, we'll read and discuss the vignettes on handout M2, using the questions on handout M3 as discussion points. Fill out the

activity sheet with your answers, and then we'll reconvene as a whole group to talk about each vignette.

We'll probably find that we all have different ways of understanding assessment, and there will be differences of opinion as we answer the questions. We want to hear, briefly, the reasons for these differences of opinion.

When you consider the questions on your activity sheets, it's especially important to focus on question 5, “Who used [the assessment] and why?” Let's take 25 minutes to work.

- Use the time while people are working to post chart M4: “Classroom Vignettes Grid” if you have not yet done so. You'll be recording people's responses to the vignettes on this grid.
- After 20 minutes, warn people that they have five minutes left. Also, remind them to work on question 5 (“Who used it and how?”) if they have not yet done so.

INTRODUCTION TO FORMATIVE ASSESSMENT HANDOUT

Classroom Vignettes Activity Sheet

Read Vignettes A–D. Answer these questions for each:

1. Does what is described include assessment?
2. If so, what information was gathered?
3. If so, by whom was it gathered?
4. About whom was it gathered?
5. Who used the information and how?

	A Decomposition Vignette	B Fertilizer I Vignette	C Fertilizer II Vignette	D Camouflage Vignette
1. Is there assessment?				
2. What information was gathered?				
3. By whom?				
4. About whom?				
5. Who used it and how?				

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M3

4. When groups are done, ask them to report out (15 minutes). To begin, address the group as a whole. Explain that you will be asking for answers to the questions on the activity sheet and recording responses on the large grid posted in front of the room.

- Explain that reading the vignettes and charting responses is meant to bring up some key points about assessment, which you will introduce soon.

5. Record the group's responses. As groups report out, record their responses on chart M4: "Classroom Vignettes Grid" posted in front of the room. Note that you only need to summarize the responses in one or two words—such as "yes, if . . ." or "no"—as you fill in the grid.

Acknowledge that differences of opinion are to be expected for each item on the grid. They can be charted or just verbally acknowledged.

Feel free to ask questions or make comments as you work. These asides will help prepare participants to understand the ideas on chart M5: "Key Points about Assessment," which the group will go over at the end of this section.

- **Begin by asking one group to answer question 1 ("Is there assessment?") for all four vignettes.** Record their responses on the posted grid. Then ask if any other group has different responses and the reasons for the differences.

When taking responses for question 1, note that there may be some disagreement about whether assessment is being carried out in Vignettes A (Decomposition) and D (Camouflage). If this is the case, you can point out that while evidence is gathered in both, it remains to be seen how that evidence will be used for the purposes of assessment. In A, for instance, the teacher could use the evidence as a pre-assessment of students' thinking

that will help shape upcoming lessons. In Vignette D, the information could be used to assign grades.

- **When question 1 is done, ask another group to respond to question 2 ("What information was gathered?") for all four vignettes.** Record their responses on the posted grid. Then ask if any other group has different responses and the reasons for the differences.

When taking responses for question 2, encourage participants to also consider when the information was gathered, asking in Vignette A (Decomposition) if people think there might be a benefit to assessing students' thinking at the beginning of a topic. (This relates to the first item on chart M5: "Key Points about Assessment.")

Classroom Vignettes Grid				
	A Decomposition Vignette	B Fertilizer I Vignette	C Fertilizer II Vignette	D Camouflage Vignette
1. Is there assessment?	Yes/No	Yes	Yes	Yes/No
2. What information was gathered?				
3. By whom?				
4. About whom?				
5. Who used it and how?				

M4: "Classroom Vignettes Grid" with some typical responses

Then, in order to make the point that assessment involves more than just written information (the third item on the "Key Points about Assessment" chart), ask *"In what form was the information collected?"* about Vignettes B or C (Fertilizer I and II), if this has not yet come up.

Key Points about Assessment

1. Assessment does not take place only after learning. Assessments can be done at any time during instruction—at the beginning and during, as well as at the end.
2. Finding out learners' ideas at the start of a topic involves assessment.
3. Written answers or other artifacts are not necessary for assessment to take place. Assessments can be based on observations, conversations, and on other information such as drawings.
4. Assessment involves gathering information, making a judgment about it, and using the information for some purpose.
5. Assessment information can be used for the purpose of helping students in the process of learning as well as for gauging what students have learned.
6. Assessments can be carried out by students as well as by teachers.

Surrounding Text Boxes:

- Top Left:** Note that in Vignette A (Decomposition), assessment happened at the beginning of instruction; in Vignette B (Fertilizer I), it happened during instruction; and in Vignette D (Camouflage), it happened after instruction.
- Middle Left:** We saw this in Vignette A (Decomposition), when the teacher began by asking groups to discuss what they knew about leaves before they did their drawings.
- Bottom Left:** You can see a good example of this in Vignette B (Fertilizer I), when the teacher's observations of student actions led to her decision about how to take next steps.
- Top Right:** All assessments—whether formative or summative—contain these three steps.
- Middle Right:** In Vignette B (Fertilizer I), for example, the teacher evaluated student understanding as the work was being carried out, and designed next steps to address the problems that arose. In Vignette D (Camouflage), evaluation happened at the end of the process and helped gauge what the students learned.
- Bottom Right:** There's a good example of this in Vignette C, where students did a self-assessment at the end of their project.

Handout Footer: INSTITUTE FOR INQUIRY: www.exploratorium.edu/ifi | © Exploratorium | exploratorium | M5

When facilitating Step 6, you can use M5: “Key Points about Assessment,” and the boxed text above, to help give examples from handout M2: “Classroom Vignettes.”

- Ask another group to respond to question 3 (“By whom?”) then move on to question 4 (“About whom was the information gathered?”) for all four vignettes. Record their responses on the posted grid. Then ask if any other group has different responses and the reasons for the differences.

If nobody mentions it, you can point out that in Vignette A (Decomposition), information was gathered about the whole class; in Vignette B (Fertilizer I) information was gathered about a single group; and in Vignette D (Camouflage), information was gathered about individual students.

- When question 4 is done, ask another group to respond to question 5 (“Who used the information and how?”) for all four vignettes. Record their responses on the posted grid. Then ask if any other group has different responses and the reasons for the differences.

If nobody mentions it, you can add that either the teacher or the students can use the information to help improve student learning (Vignettes A, B, and C), or the teacher could use the information after instruction—perhaps for the purpose of giving a grade (Vignette D).

6. Summarize the main ideas of the vignettes (5 minutes). Distribute handout M5: “Key Points about Assessment.” Then, referring to the chart, go over the points one by one, noting appropriate examples from the vignettes as described in the box on the previous page.

7. Reinforce main ideas about assessment. Conclude this section by saying:

- *All assessments involve gathering information, making judgments about it, and then using that information for some purpose, whether it’s to make an instructional decision or to assign grades.*

Simply gathering evidence is not, in itself, assessment. In these cases:

- *Vignettes B and C were examples of formative assessment. So was Vignette A if the information was used to help shape the upcoming lessons. In these vignettes, information was gathered during instruction and served the purpose of helping improve student learning.*
- *Vignette D, on the other hand, was an example of summative assessment. In this vignette, information was gathered after instruction and could be used to assign a grade or mark.*

Then go on to the next section.

Introducing the Formative Assessment Cycle

Overview

This section is the heart of the workshop. Here, you'll be introducing the formative assessment cycle and then presenting a new classroom vignette that illustrates formative assessment. As participants analyze the vignette, they'll begin to compare formative and summative assessment.

8 Steps ♦ 45 Minutes

1. Introduce formative assessment (10 minutes).

Say:

- *We've just read vignettes describing both formative and summative assessment. Now we'll focus more deeply on formative assessment, which has the purpose of helping learning.*

Tell participants that formative assessment is part of teaching, and that it could be called "assessing for learning." Explain that teachers need to plan how they can gather information about student thinking in relation to the learning goals, and once they have that information ask themselves, "How do I help students take next steps?"

2. Introduce the Formative Assessment Cycle. Post chart M6: "Formative Assessment Cycle" and distribute handout M7: "Understanding the Formative Assessment Cycle." Indicating chart M6, tell participants:

- *This diagram represents the formative assessment cycle. Understanding this diagram and what it represents is the heart of this workshop. We'll spend most of the workshop looking at how the formative assessment cycle works by considering several examples from the classroom. Having multiple examples of teachers using the cycle is meant to*

help reinforce an understanding of what formative assessment looks like in practice.

We'll go over this cycle once in general, and then again using specific examples from a classroom. After this, you'll go through the cycle yourself using another classroom example.

3. Explain the formative assessment cycle (10 minutes). Ask participants to refer to the chart on display (and on their handouts). Then using the "Explaining the Formative Assessment Cycle" box on page 33, explain the cycle to participants using the boxed scripts provided. Begin with "Goals" at the top and move clockwise around the diagram.

4. Demonstrate the formative assessment cycle in practice (10 minutes). Once again, go over the Formative Assessment Cycle, this time relating it to the Fertilizer I vignette (Vignette B) read earlier. Tell participants:

- *Let's take a look at how the cycle works using the Fertilizer I vignette from our previous activity.*

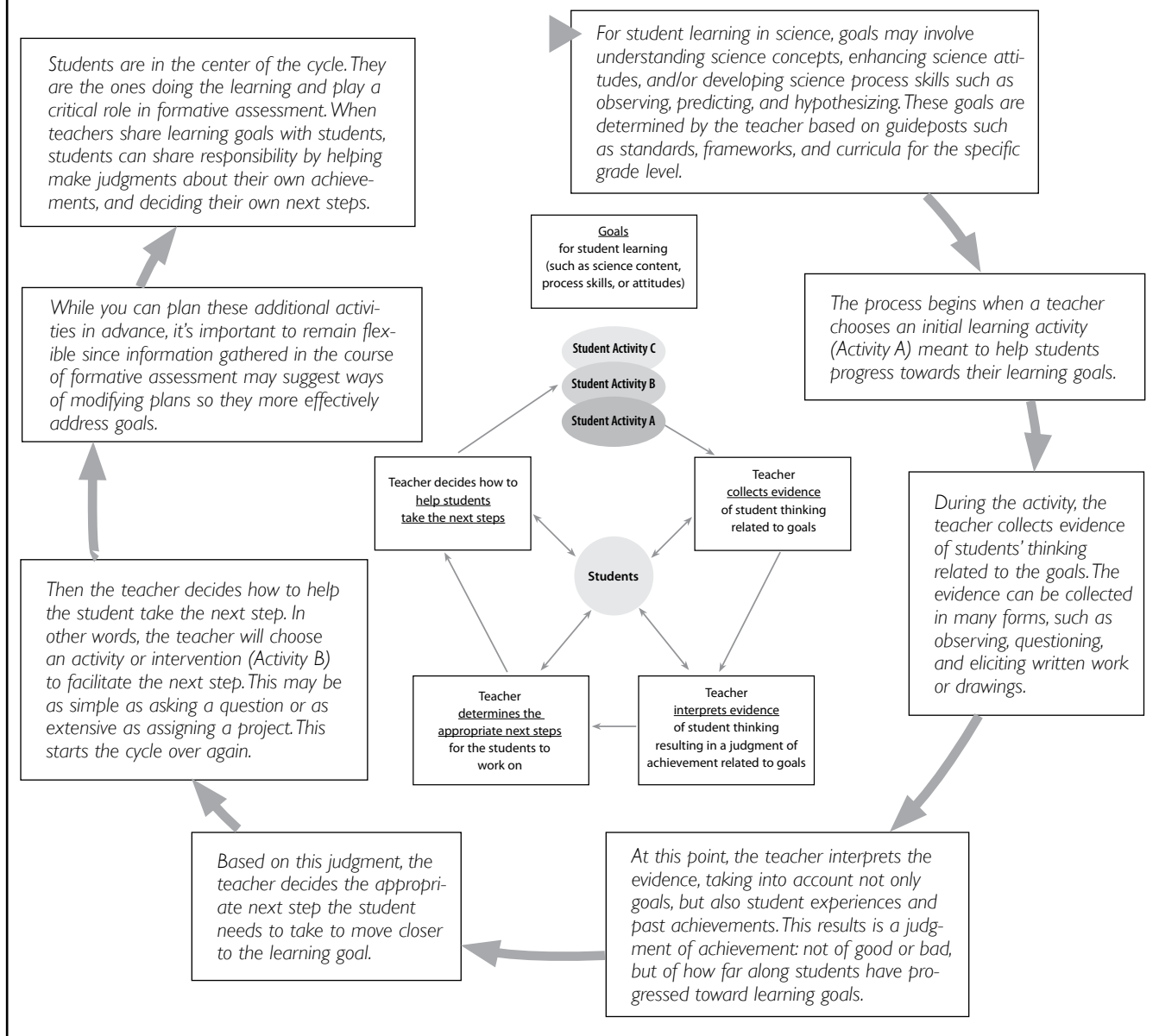
Refer to the "Formative Assessment in Action" box on page 34. Use the boxed scripts to help as you explain the process.

Materials Reminder

During this part of the workshop, facilitators will need to:

- Post chart M6: "Formative Assessment Cycle"
- Distribute handout M7: "Understanding the Formative Assessment Cycle"
- Distribute handout M8: "Sound Activity Vignette"
- Distribute handout M9: "Comparing Formative and Summative Assessment"

Explaining the Formative Assessment Cycle



The boxed scripts will help you explain the formative assessment cycle to participants (see Step 3).

5. Distribute handout M8: "Sound Activity Vignette" and ask participants to read it. Tell people:

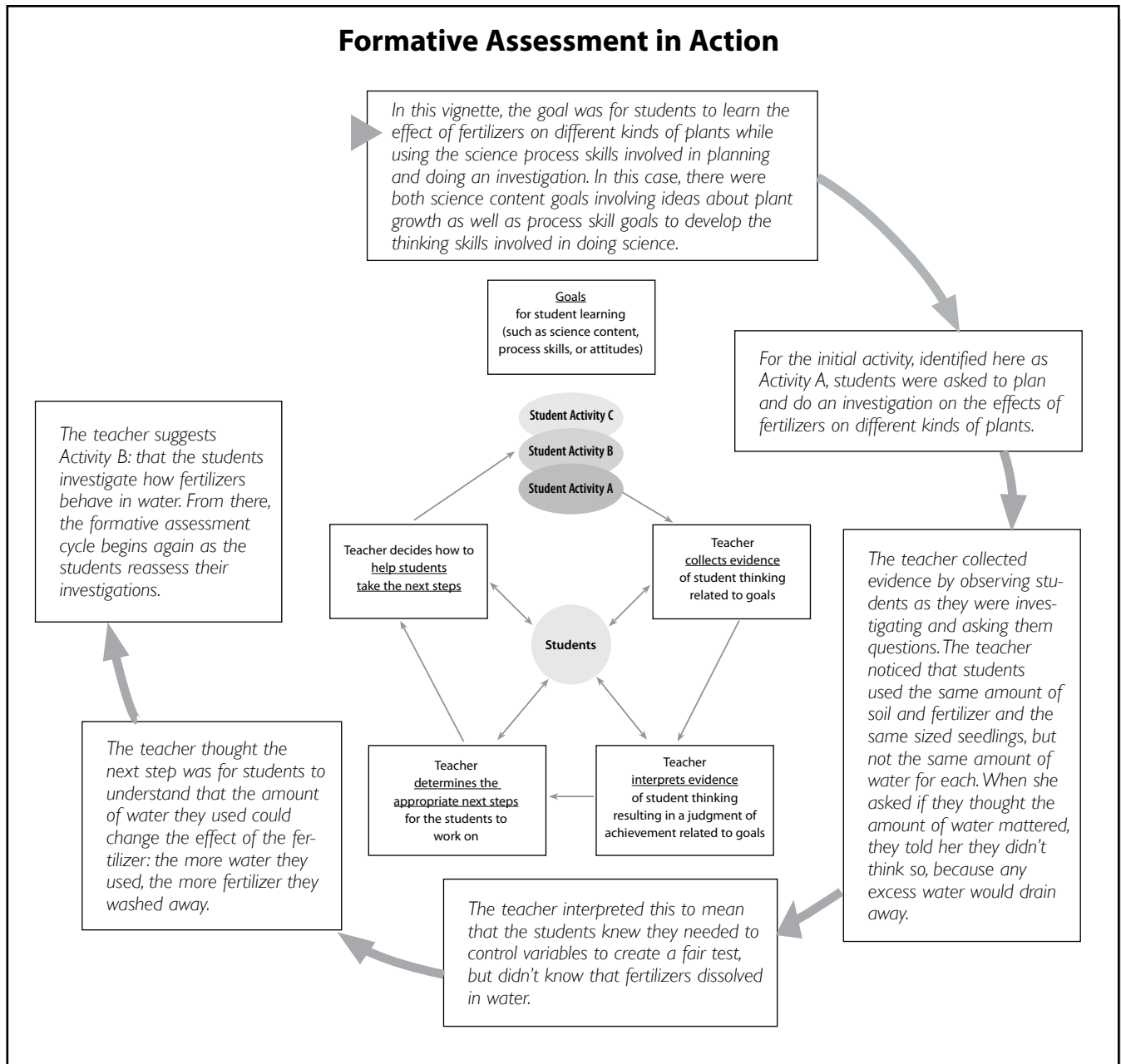
- We've just seen how the steps of the formative assessment cycle look in the fertilizer vignette.

Now I'd like you to try to find the steps in another classroom vignette about an investigation on sound. Like the fertilizer vignette, this example has both

science content and science process skill goals for teaching. See if you can find where the teacher goes through the steps of the cycle for both kinds of goals.

This vignette is meant to help you recognize the steps of the cycle during a lesson. It is not meant to show ideal examples of teaching.

Formative Assessment in Action



Using the Fertilizer I vignette, these boxed scripts will help you explain formative assessment in action (see Step 4).

As people read, be sure chart M6: "The Formative Assessment Cycle" is still displayed. Remind people that they can also refer to their own copy of handout M7: "Understanding the Formative Assessment Cycle," which was distributed earlier.

Circulate while people read the vignette. When most people seem to have gone through it once, give a one-minute warning before moving on to the next step.

6. Use the following prompts to elicit responses to handout M8: "Sound Activity Vignette."

After participants have finished reading, ask the questions listed in the box on the next page and take responses. After each response, ask the group if there are other responses or if people agree or disagree. That way, if a participant gives a response related only to a process skill goal or a content idea goal, other participants can

offer responses related to the goal not mentioned.

- Note that the possible responses listed in the box below include both the process skill and science content goals that are likely to come up. Use these sample responses to help you field responses by identifying

how the vignettes illustrate specific points on the cycle.

7. Summarize the formative assessment cycle as illustrated by handout M8: “Sound Activity Vignette.” Remind participants that this is an example

Questions and Sample Responses to M8: “Sound Activity Vignette”	
<p>1 <i>What were the teacher’s goals?</i></p> <p>Participant responses may include these observations:</p> <ul style="list-style-type: none"> • Process Skill Goals—The teacher wants students to do a self-directed investigation based on their own questions and be able to communicate their findings to one another. • Science Content Goals—The teacher wants students to understand what affects the pitch and volume of a sound, and that sound travels through different objects in different ways. 	<p>2 <i>What kinds of evidence did the teacher collect?</i></p> <p>Participant responses may include these observations:</p> <ul style="list-style-type: none"> • Evidence Related to Process Skill Goals—The teacher observed many groups recording information in non-systematic ways. • Evidence Related to Science Content Goals—The teacher observed that when students presented their findings, no one addressed the idea of volume or loudness.
<p>3 <i>What did the evidence tell the teacher?</i></p> <p>Participant responses may include these observations:</p> <ul style="list-style-type: none"> • Interpretation of Evidence Related to Process Skill Goals—Students needed help recording their observations in a way that let them compare the pitches of sounds to each other so they could more easily see relationships and draw conclusions. • Interpretation of Evidence Related to Science Content Goals—There was no indication that students understood what affected the volume or loudness of sounds, one of the teacher’s goals. 	<p>4 <i>What did the teacher decide to do as a result of her interpretation of the evidence?</i></p> <p>Participant responses may include these observations:</p> <ul style="list-style-type: none"> • Next Steps for Helping Students Develop Their Science Process Skills—The teacher taught a brief lesson that showed a way of comparing the pitches of sounds and systematically recording the information • Next Steps for Helping Students Develop Their Science Content Understanding—The teacher taught a brief guided lesson on the topic of sound volume because the students had not yet shown that they understood it.

of formative assessment because the teacher considered student learning goals, collected evidence to determine to what extent the goals were being met and, based on that information, decided what intervention would help move students toward the learning goals.

8. Contrast formative and summative assessment (5 minutes). Distribute handout M9: “Comparing Formative and Summative Assessment.” Tell people:

► *This handout compares and contrasts formative*

and summative assessment. Looking at the similarities and differences can help further clarify formative assessment

Read the text aloud point by point. Then conclude by explaining:

► *In summative assessment, the judgment is communicated to the student as a grade or mark and the assessment is over. But in formative assessment, the judgment is used by the teacher to decide next steps for the student, and the cycle repeats.*

Comparing Formative and Summative Assessment

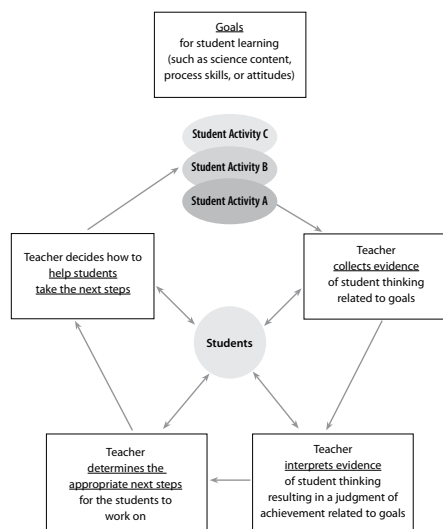
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M9

Formative Assessment Cycle

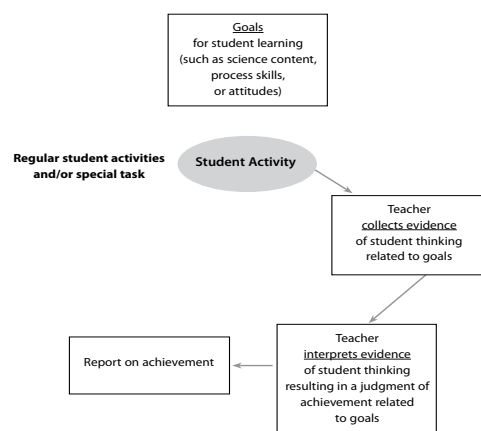


■ Both formative and summative assessment begin with goals, student activities, and collecting evidence related to the goals.

■ In summative assessment, all students are evaluated according to common criteria so results can be compared; the resulting information is used to report what has been learned up to a particular point in time.

■ In formative assessment, the information the teacher acquires about students is interpreted by also considering the students' effort and past achievement and is used to adapt the next learning experiences in ways that will help the students progress toward the goals.

Summative Assessment Model



■ While summative assessments are usually thought of as tests used for assigning grades, these same kinds of tests could be used formatively to diagnose what would help students progress toward their goals. Conversely, formative information could be used summatively through using portfolios and other means.

INTRODUCTION TO FORMATIVE ASSESSMENT

HANDOUT

Formative Assessment Research Findings

Overview

In this part of the workshop, facilitators offer summaries of research findings about the effectiveness of formative assessment. For information, read the article “Inside the Black Box” at www.pdkintl.org/kappan/kbla9810.htm. This article summarizes results from more than 250 studies and makes a strong, research-based case for using formative assessment to improve student learning.

2 Steps ♦ 10 Minutes

1. Tell participants that research supports the effectiveness of formative assessment. Remind people that formative assessment helps students learn, and so can be effective in raising levels of achievement.

Mention that evidence from research suggests that improving formative assessment practice

can lead to considerable gains in learning.

2. Present research findings. Post chart M10: “Research Findings about Formative Assessment” and distribute the corresponding handout. Go over each point, reading the corresponding script below. Be sure to point out that people can find more information by going to the Web address at the bottom on the handout.

Materials Reminder

During this part of the workshop, facilitators will need to:

- Post chart and distribute handout M10: “Research Findings about Formative Assessment”

INTRODUCTION TO FORMATIVE ASSESSMENT

CHART OR OVERHEAD & HANDOUT

Research Findings about Formative Assessment

- There is firm evidence that improving formative assessment practice can raise levels of student achievement.
- Current teaching practice lacks many of the features that research shows are central to a positive impact on achievement.
- Assessment is only formative when it reflects the aims of learning and is used in making decisions about next steps in learning.
- Feedback can help students take part in deciding how to improve their performance. Effective feedback focuses on their work and is not judgmental.
- Students can learn to self-assess so that they can understand the purposes of their learning and how to improve it.

For more information, read “Inside the Black Box” at www.pdkintl.org/kappan/kbla9810.htm

INSTITUTE FOR INQUIRY:
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exploratorium M10

Certain features, such as the questions teachers ask students, how teachers give feedback on student work, and use of student self-assessment, have been shown to be particularly effective. (These features will be addressed in upcoming workshops.)

The main feature of formative assessment is that instructional decisions are made based on the information gathered. The information that is gathered can be very specific to the learning goals. That’s what “reflect the aims of learning” means. Unlike multiple-choice tests or other large-scale assessments, you can tailor the collection of information to tell you what a student knows.

Giving students relevant feedback that helps them understand how they can improve their work encourages them to take steps in that direction. Research has shown that when teachers give judgmental feedback, such as saying “good job” or assigning a score for the work, and then make suggestions for improvement, students don’t look further than the judgment and ignore suggestions for improvement.

The boxed scripts will help you explain the information on M10: “Research Findings about Formative Assessment” (see Step 2).

Concluding the Workshop

Overview

This final section offers an opportunity to summarize the workshop and review the take-home messages.

4 Steps ♦ 5 Minutes

1. Spend a few minutes summarizing the main features of the workshop. Tell participants:

- *Today, we had a chance to read both formative and summative assessment vignettes, learn about the formative assessment cycle, think about our own personal experiences of formative assessment, and review research evidence about the effectiveness of formative assessment in raising levels of student achievement.*

2. Post chart M1: “Take-Home Messages” and review each point. Tell participants:

- *As we noted at the beginning of the workshop, the main pedagogical ideas that emerged from the work we’ve done are expressed in the take-home messages.*

3. Distribute additional resources. If you have other resources prepared for participants to take, distribute them now.

4. Thank participants and bring the workshop to a close. As appropriate, let people know about upcoming workshops, and when and where they will take place.

Materials Reminder

During this part of the workshop, facilitators will need to:

- Post chart M1: “Take-Home Messages”
- Distribute any additional materials you have prepared.

REVIEWING THE WORKSHOP

- **Facilitation Review**

Facilitation Review

Overview

It's a good idea to set aside some time after the workshop to get together with your co-facilitator (if there was one) and reflect on what worked and what didn't work. You can think and talk about your own facilitation and the workshop design, and consider what adjustments you can make for subsequent workshops. You'll also want to consider how the group's understanding of formative assessment developed during the workshop.

If you were the sole facilitator, take some time to consider the questions below and jot down notes for use when you present the workshop again.

4 Steps ♦ Time as needed

1. Acknowledge what you did well, and reflect on the goals. Start by taking a few minutes to talk about what went well during the workshop. Share any insights you gained about good facilitation strategies. Identify some things you did that helped groups get over difficult spots. Also, ask yourselves what you might do differently next time to improve the workshop.

2. Go through the workshop from beginning to end. Discuss not only how you facilitated different parts of the workshop, but also what participants did, and what they learned in each part of the workshop:

- Were all participants fully engaged in all parts of the workshop? Were there some steps that seemed particularly difficult for any of them? What could you do to encourage more active participation or help participants through difficult spots?

- Did participants develop their own understanding of the take-home messages? If so, how did they demonstrate their understanding? If not, what could you do differently to help them arrive at an understanding?
- Were participants inspired to consider applying some of their new ideas in their own classrooms?

3. Review the logistics of the workshop.

- Did you remain on schedule?
- Did you ever feel rushed to complete a step or did you finish early?
- What adjustments could you make that would be helpful?
- How did the distribution and cleanup of materials go?
- Is there anything you could do next time to make the workshop run more smoothly?

4. Consider how you worked together with your co-facilitator.

- Were you able to transition smoothly from one part of the workshop to the next?
- Were you able to transition smoothly between the roles of primary and secondary facilitator?
- Did you communicate effectively with each other during the workshop?
- What could you do to improve transitions and communication?

MORE FROM THE INSTITUTE FOR INQUIRY

- **About the Exploratorium Institute for Inquiry**
- **More Workshops on the Web**

About the Exploratorium Institute for Inquiry

The Exploratorium is San Francisco's innovative museum of science, art, and human perception. Here, hundreds of interactive exhibits engage visitors in seeking answers to the questions that emerge as they play and experiment with all kinds of intriguing phenomena.

The process of discovery and exploration is at the foundation of the Exploratorium Institute for Inquiry (IFI), a group of scientists and educators dedicated to developing and promoting inquiry-based science learning.

For more than thirty years, we have been educating teachers, administrators, and professional developers about the theory and practice of inquiry-based learning. Our workshops emphasize both the impor-

tance of engaging learners in firsthand experience with materials and phenomena, and the necessity for learners to play an active role in building new knowledge. Our work is shaped and refined by our own knowledge and experience, and by the invaluable input of teachers and professional developers working in the field.

For more information contact

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Since 1969, the Exploratorium has been bringing hands-on learning to visitors from around the world. Filled with hundreds of interactive exhibits, the museum offers programs for the public as well as for science and education professionals.

More Workshops on the Web

In addition to the ASSESSING FOR LEARNING curriculum, the Exploratorium also offers a series of five FUNDAMENTALS OF INQUIRY workshops. You can find more information at www.exploratorium.edu/ifi/workshops.

The FUNDAMENTALS OF INQUIRY curriculum is organized into these three areas:

Elements of Inquiry

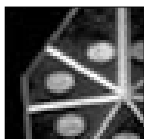
Three workshops that serve as building blocks for an immersion into inquiry by focusing on various hands-on approaches and process skills related to inquiry learning.



Workshop I: Comparing Approaches to Hands-On Science

Participants discover that different approaches to hands-on teaching support different goals for learning (about 3.5 hours).

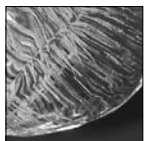
Preview the workshop at www.exploratorium.edu/ifi/comparing



Workshop II: Process Skills

Participants identify the tools needed to carry out inquiry—the process skills—and examine the role of these skills in learning (about 3.5 hours).

Preview the workshop at www.exploratorium.edu/ifi/skills



Workshop III: Raising Questions

Participants examine the kinds of questions learners ask about phenomena and find out how to turn “noninvestigable” questions into “investigable” ones (about 3.5 hours).

Preview the workshop at www.exploratorium.edu/ifi/questions

Immersion in Inquiry

In this workshop, participants plan and conduct an investigation that illustrates how deep conceptual content—in this case, about stream flow and erosion—can be learned through a carefully orchestrated science inquiry process. At the same time, the activity illuminates the process of inquiry itself.



Workshop IV: Stream Table Inquiry

Participants experience inquiry firsthand, learning scientific process and content through an extended investigation (about 6 hours).

Preview the workshop at www.exploratorium.edu/ifi/streamtable

Connections to the Classroom

This last workshop focuses on helping participants make connections between what they have experienced in the previous workshops and what they can do in their classrooms to incorporate more science inquiry.



Workshop V: Subtle Shifts: Adapting Activities for Inquiry

Participants examine how current classroom activities can be modified to incorporate elements of inquiry (about 3 hours).

Preview the workshop at www.exploratorium.edu/ifi/subtleshifts

REPRODUCIBLE MASTERS

		Page
• Take-Home Messages	chart or overhead & handout	M1
• Classroom Vignettes	handout	M2
• Classroom Vignettes Activity Sheet	handout	M3
• Classroom Vignettes Grid	chart	M4
• Key Points about Assessment	chart or overhead & handout	M5
• Formative Assessment Cycle	chart or overhead	M6
• Understanding the Formative Assessment Cycle	handout	M7
• Sound Activity Vignette	handout	M8
• Comparing Formative and Summative Assessment	handout	M9
• Research Findings about Formative Assessment	chart or overhead & handout	M10

Take-Home Messages

- **Formative assessment, assessment *for* learning, is different from summative assessment, assessment *of* learning.**
- **For formative assessment to take place, teachers must gather and interpret evidence of students' thinking, and then use that evidence to make decisions that further student progress toward instructional goals.**
- **Assessment is only formative when teachers use the information they've gathered to make instructional decisions.**

Classroom Vignettes

■ Vignette A: Decomposition

A fifth-grade teacher embarking on a unit about decomposition wanted to help his students realize that some plant material is cycled through decomposition and incorporated into other plant material.

Before beginning, however, he decided to find out what his students knew and thought about the processes involved.

To find out, he arranged the students in groups, gave them some leaves, and asked them to discuss what they knew about how leaves changed throughout a year. What would these leaves have looked like in the spring? What will they look like in the fall? What will they look like by next spring?

Then he asked each group to produce a series of drawings showing how their leaves looked now, what they might have looked like before, and what they would look like in the fall and next spring. The students were asked to annotate their drawings with explanations of the changes they depicted.

■ Vignette B: Fertilizer I

In a fifth-grade class, students were involved in investigating the effect of various fertilizers on the growth of different kinds of seedlings. Some students planted lettuce seedlings, some nasturtium, some cabbage, and others used various kinds of tomato seedlings.

One group set up their trials very carefully, using the same soil before mixing in equal amounts of fertilizer, filling identical pots, and planting seedlings of the same size in them. However, the teacher noticed that they watered their seedlings without taking care to use the same amount of water for each one.

As they clearly were aware that they needed to keep things the same for fair comparisons, the teacher asked them if they thought it mattered that they'd watered their plants with different amounts of water. They said it wouldn't make any difference because any extra water would just go to the bottom of the pots and drain away.

The teacher realized that this had implications for their understanding of how fertilizers work, as the students

did not seem to realize that the fertilizers could be washed away.

She asked them to investigate separately what happens when small amounts of fertilizers are put in water. They observed that the fertilizers dissolved and realized that the amount of water was a variable that had to be controlled for a fair test. They also advanced their ideas about how plants could be affected by fertilizer.

■ Vignette C: Fertilizer II

At the end of their investigations of fertilizers, the teacher held a discussion with the whole class about how to report their work so that others could understand what had been done, what had been found, and how it could be explained. The students ended up with a list of points that made a good report of an investigation. The teacher wrote these in large print on a chart and pinned it to the wall. While the students wrote their reports of their investigation, they were reminded to pay attention to the points listed. When they presented their reports to each other, they used the list to make constructive comments about how the reports (their own and others) could be improved.

■ Vignette D: Camouflage

At the end of a unit on camouflage in animals, a teacher asked her fourth-grade students to write down answers to the following questions to see how they were able to apply the ideas she hoped they had grasped.

1. Brown bears are found in the mountains in Canada and white bears in the Arctic. Why do you think you don't find white bears in the mountains and brown bears in the Arctic? Think of as many reasons as you can.

2. Many kinds of "big cats" such as tigers and leopards have stripes and blotches on their coats.

a. Write down as many ways you can think of that this helps these animals.

b. Write down as many ways you can think of that this might not help these animals.

3. Some fish have darker colors on their backs than on their undersides. Can you think of a reason for this?

Classroom Vignettes Activity Sheet

Read Vignettes A–D. Answer these questions for each:

1. Does what is described include assessment?
2. If so, what information was gathered?
3. If so, by whom was it gathered?
4. About whom was it gathered?
5. Who used the information and how?

	A Decomposition Vignette	B Fertilizer I Vignette	C Fertilizer II Vignette	D Camouflage Vignette
1. Is there assessment?				
2. What information was gathered?				
3. By whom?				
4. About whom?				
5. Who used it and how?				

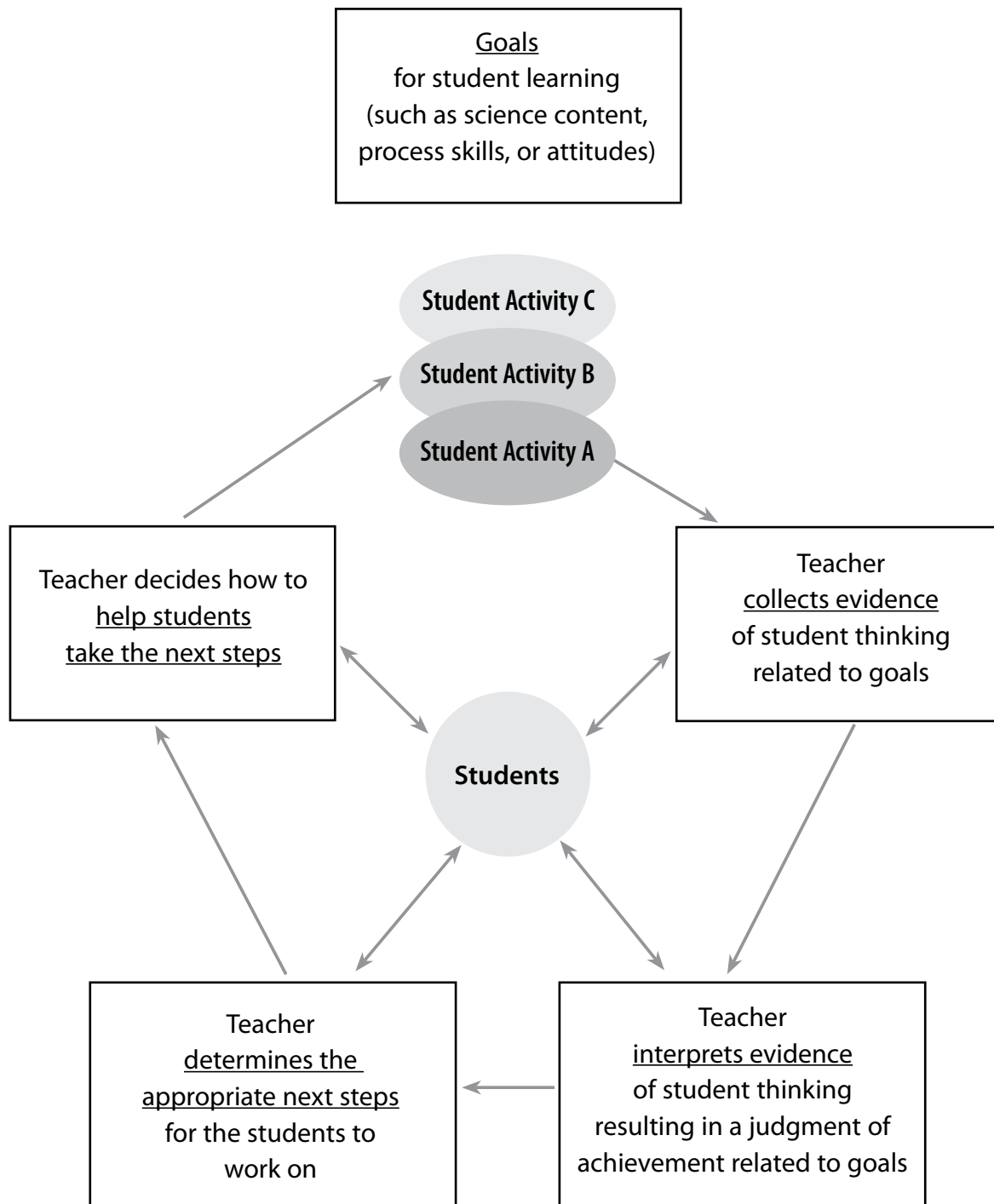
Classroom Vignettes Grid

	A Decomposition Vignette	B Fertilizer I Vignette	C Fertilizer II Vignette	D Camouflage Vignette
1. Is there assessment?				
2. What information was gathered?				
3. By whom?				
4. About whom?				
5. Who used it and how?				

Key Points about Assessment

- 1. Assessment does not take place only after learning. Assessments can be done at any time during instruction—at the beginning and during, as well as at the end.**
- 2. Finding out learners' ideas at the start of a topic involves assessment.**
- 3. Written answers or other artifacts are not necessary for assessment to take place. Assessments can be based on observations, conversations, and on other information such as drawings.**
- 4. Assessment involves gathering information, making a judgment about it, and using the information for some purpose.**
- 5. Assessment information can be used for the purpose of helping students in the process of learning as well as for gauging what students have learned.**
- 6. Assessments can be carried out by students as well as by teachers.**

Formative Assessment Cycle



Understanding the Formative Assessment Cycle

■ Teacher chooses the *goals for learning* (content, process skills, and/or scientific attitudes).

■ Teacher chooses the *initial learning activity* (Activity A) meant to help students progress toward the learning goals.

■ Teacher *collects evidence* of student thinking in relation to the goals during the activity (evidence can be gathered through observing, questioning, or eliciting students' written work or drawings).

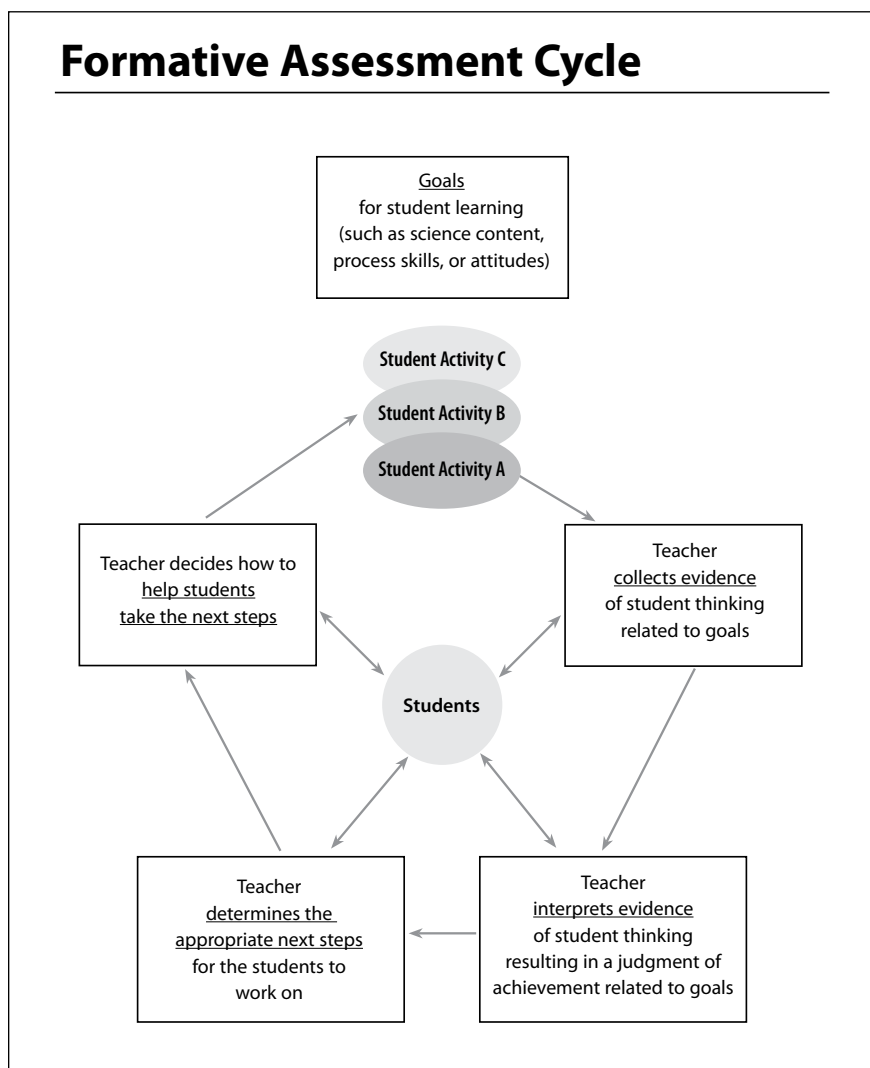
■ Teacher *interprets the evidence* by considering it in relation to some criteria of achievement of the learning goals as well as the students' effort and previous work.

■ Teacher arrives at a *judgment of achievement* based on the evidence. This is not a judgment of good or bad, but of how far along the students have progressed towards the learning goals.

■ Teacher decides the *next developmental step*—one that will help students progress toward the learning goals.

■ Teacher decides how to *help students take the next step* (Activity B), which could simply be asking a question, choosing an appropriate activity from the curriculum, or designing an entirely new activity. Then the cycle continues.

Formative Assessment Cycle



The center of the cycle highlights interactions with *students* because

■ students are the ones doing the learning

■ the more that students understand the goals of instruction, the more they are able to provide evidence for the teacher of their progress towards the goals and participate in deciding their own next steps towards the goals.

Sound Activity Vignette

In this vignette, a teacher uses formative assessment in her second-grade classroom during a unit on sound. As you read the vignette, refer to the formative assessment cycle to follow the teacher through each step as she formatively assesses both her students' process skills and ideas.

A teacher was planning a unit on sound for her second-grade class. She had both process and content goals for her students.

- She wanted her students to be able to do a self-directed investigation based on their own questions and communicate their findings to each other.
- She wanted her students to understand what affected the pitch and volume of a sound, and to learn that sound could be changed by the material it moved through.

To help her students progress towards these goals, she planned to begin by having them explore the materials in a sound kit, raise questions about what they noticed, and then try to answer their questions by doing investigations. Finally, the teacher planned to have the groups share their findings with each other. With some facilitation, the teacher thought this activity could support both her process and content goals.

Her students got started and, based on the questions they raised, were doing a good job investigating. During the investigations, however, the teacher noticed several groups recording observations about pitches in such terms as “pretty high pitched” or “kind of low pitched,” or in onomatopoeic “bings” and “bongs.”

The teacher’s interpretation of this was that students were recording information in an unsystematic way that would make it difficult for them to understand what was responsible for making sounds higher or lower. She decided that they needed to consider ways to compare pitches of sounds with each other. She decided to stop the class for a moment and model

a way of recording information she thought would be helpful for those groups who were not being systematic.

She told the class that she wanted to share with them an investigation she was personally interested in. She asked them to pay close attention to how she was recording her observations because she thought that seeing a model of using this process skill in an investigation might help them develop the skill on their own.

Her question was whether all four legs of her chair would have the same pitch if struck with a pencil (the back legs happened to be longer than the front ones). She struck two legs that had different pitches, then wrote on the board, “Leg A sounds higher pitched than leg B.” She told the class that by recording how the sound from one object compared with another, she could begin to consider what differences in the objects might be responsible for the different sounds. Then she asked the students to return to their investigations.

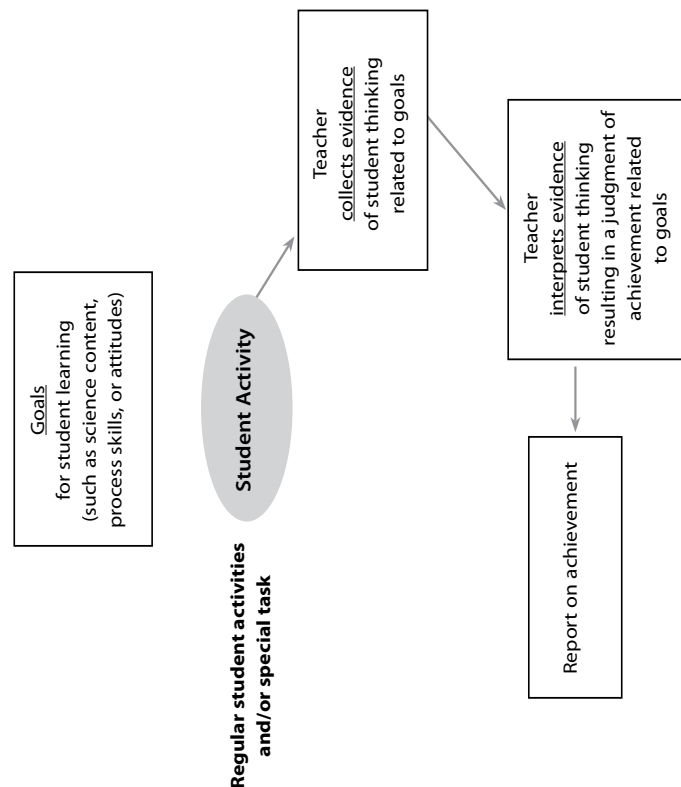
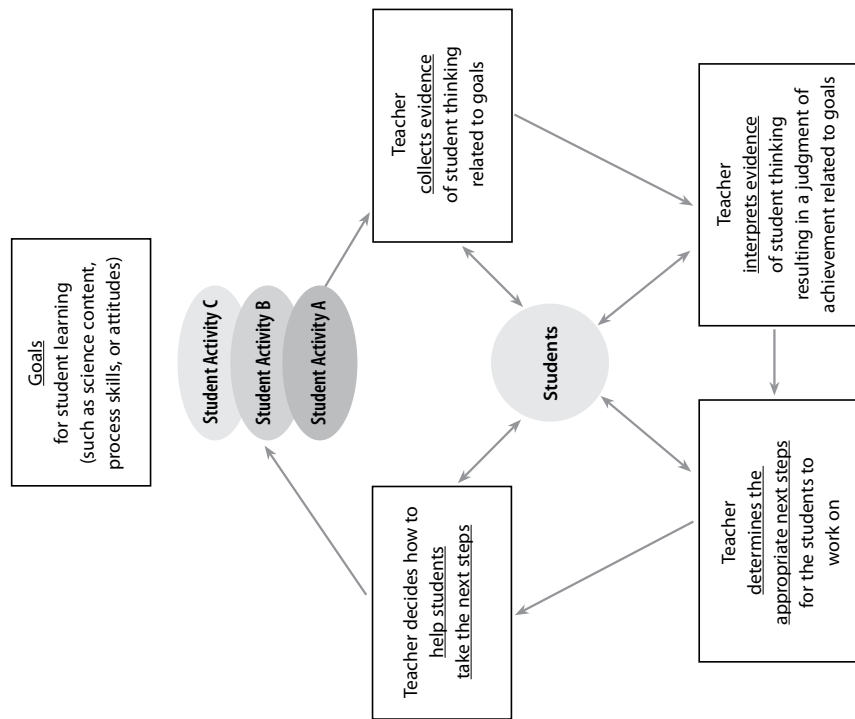
The students completed their investigations successfully and presented their findings to each other. As the teacher listened to their sharing out, she interpreted that they had adequately understood what affected the pitch of a sound, and how different objects changed sounds in different ways. No group, however, had investigated what affected the volume or loudness of a sound. She thought they still needed some experience with this idea, so she decided to present a guided activity from her kit that dealt with the concept of volume.

* * * *

In this case, the teacher’s interventions were presented to the whole class, although they could have been directed to individual students or groups. This is a good example of formative assessment because the teacher considered her goals, collected evidence to determine to what extent they were being met, and—based on that information—decided next steps to move her students further toward her goals.

Comparing Formative and Summative Assessment

Formative Assessment Model



- Both formative and summative assessment begin with goals, student activities, and collecting evidence related to the goals.
- In summative assessment, all students are evaluated according to common criteria so results can be compared; the resulting information is used to report what has been learned up to a particular point in time.

- In formative assessment, the information the teacher acquires about students is interpreted by also considering the students' effort and past achievement and is used to adapt the next learning experiences in ways that will help the students progress toward the goals.

- While summative assessments are usually thought of as tests used for assigning grades, these same kinds of tests could be used formatively to diagnose what would help students progress toward their goals. Conversely, formative information could be used summatively through using portfolios and other means.

Research Findings about Formative Assessment

- There is firm evidence that improving formative assessment practice can raise levels of student achievement.
- Current teaching practice lacks many of the features that research shows are central to a positive impact on achievement.
- Assessment is only formative when it reflects the aims of learning and is used in making decisions about next steps in learning.
- Feedback can help students take part in deciding how to improve their performance. Effective feedback focuses on their work and is not judgmental.
- Students can learn to self-assess so that they can understand the purposes of their learning and how to improve it.

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