

Professional Learning Module

Modeling the enactment of the Formative Assessment: *Proofs of the Pythagorean Theorem* (Concept Development)



Ann Shannon & Associates, LLC

This Professional Learning Module describes how a facilitator can implement, with fidelity, the Shell Center's Formative Assessment Lesson, *Proofs of the Pythagorean Theorem*, so that participants understand how to enact, in their own classrooms, this lesson that is compatible with the Common Core State Standards (CCSS). Resources for each component of the module are included as page numbers in the *Lesson Guide*, and as links to additional professional learning tools such as handouts and videos.

Shell Center's Lesson Guide: <http://map.mathshell.org/materials/lessons.php?taskid=419&subpage=concept>

Framing the lesson

Teachers frame the lesson so that students know what to expect throughout the entire process, from the pre- to the post-lesson assessment. Participants learn what it means to *frame* a lesson, why it is important, and what might go wrong if it is neglected.

Handout: [Framing a Formative Assessment Lesson](#)

Proving the Pythagorean Theorem: the pre-lesson assessment

The pre-lesson assessment is designed to *surface* the common issues that impede student learning. We have found it important to ask students to complete it individually in class, without help from other students or their teacher. Coaching students to the right answers can keep common issues hidden and hinder student success. The pre-lesson assessment is not graded, but is analyzed to identify student errors. These data are used by teachers to develop feedback questions or comments, and to modify instruction.

Lesson Guide: page T-2; assessment S-1 & S-2; **Facilitator Notes:** [Administering the Pre-Lesson Assessment](#)

Whole-class interactive introduction

For successful enactment of the introduction it is important to follow the *Lesson Guide's* suggestions exactly. Replacing the whole-class discussion with a mini-lesson will quickly sabotage the entire lesson.

Lesson Guide: page T-4; slides P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11 & P-12

Collaborative small-group work

For this component of the lesson, students are organized into small groups and are asked to plan a joint solution to the problem. This gives students an opportunity to engage in CCSS Standards for Mathematical Practice [MP1](#) (*Make sense of problems and persevere in solving them*), [MP2](#) (*Reason abstractly and quantitatively*) and [MP3](#) (*Construct viable arguments and critique the reasoning of others*). These opportunities are enhanced when teachers give students feedback, allow them to struggle productively in homogeneous pairs, and mini-conference so as to scaffold student learning.

Lesson Guide: pages T-5

Collaborative analysis of *Sample Methods to Discuss*

Students are given three sample student responses to various aspects of the problem that they have been grappling with, and are asked to analyze them. This component of the lesson creates a powerful context to engage in CCSS Standards for Mathematical Practices [MP3](#) (*Construct viable arguments and critique the reasoning of others*) and [MP6](#) (*Attend to precision*).

Lesson Guide: pages T-5 & T-6; *Sample Methods to Discuss* S-3, S-4, S-5 & S-6; slides P-13, P-14, P-15 & P-16;

Videos: [A Teacher Listens](#), [The Importance of Homogeneous Grouping](#) & [Mini-Conference](#)

Whole-class discussion of *Sample Methods to Discuss*

This is the most difficult part of almost any lesson. Teachers who have enacted the Shell Center's Formative Assessment Lessons tell us that this is the part of the lesson where they feel the most vulnerable, and the part where they find the *Lesson Guide's* specific advice on what they might say to their students most useful.

Lesson Guide: pages T-6 & T-7; slides P-14, P-15 & P-16; **Video:** [Whole-class discussion](#)

Proving the Pythagorean Theorem (revisited): the post-lesson assessment & sharing prepared feedback

Students are given back their pre-lesson assessments and their teachers' feedback questions and comments before being asked to complete the post-lesson assessment. The post-lesson assessment gives students the chance to demonstrate growth across the pre- and post-lesson assessments. We have found it important to ask students to complete it individually in class, without help from other students or their teacher.

Lesson Guide: page T-7; assessment S-7 & S-8; slides P-17 & P-18; **Facilitator Notes:** [Administering the Post-Lesson Assessment](#)

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Following up on the enactment of the Formative Assessment Lesson: *Proofs of the Pythagorean Theorem (Concept Development)*



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This Professional Learning Module describes how to follow up on the enactment of the lesson *Proportion and Non-proportion Situations*, and how to facilitate the professional learning opportunities that are afforded by Formative Assessment Lessons.

Shell Center's Lesson Guide: <http://map.mathshell.org/materials/lessons.php?taskid=419&subpage=concept>

Resource: [Facilitator Notes](#)

The mathematics of *Proofs of the Pythagorean Theorem*

Participants reflect on the lesson to determine its mathematics. They consider its alignment to the CCSS and reflect upon how the lesson presents students with an opportunity to learn.

Lesson Guide: page T-1; **Handout:** [The Mathematics of Proofs of the Pythagorean Theorem](#)

Analyze student responses to the pre-lesson assessment

Participants analyze a small set of student responses to the pre-lesson assessment to identify and name the 3 to 5 most important common issues evident in the student work. Participants record these data in a copy of the *Growth Analysis Spreadsheet*.

Lesson Guide: pages T-3, T-8, T-9 & T-10; **Student work:** [Proving the Pythagorean Theorem](#);

Spreadsheet: [Growth Analysis Spreadsheet](#); **Handout:** [How to use the Student Analysis Growth Spreadsheet](#)

Writing feedback questions and comments that will move the learner forward

Using the *Criteria for Feedback* handout, participants practice developing 3 to 5 feedback questions that are designed to encourage students to think more deeply about the common issues and move their learning forward. This written feedback is shared with students at the end of the lesson, just before they begin the post-lesson assessment.

Handout: [Criteria for Feedback](#)

Analyze student responses to the post-lesson assessment

Participants analyze a small set of student responses to the post-lesson assessment and add these data to their copy of the *Growth Analysis Spreadsheet* in order to illustrate student growth across the pre- and post-lesson assessments.

Student work: [Proving the Pythagorean Theorem \(revisited\)](#)

Modifying subsequent instruction

Assessment is not formative until it is used to modify subsequent instruction. The formative assessment lessons are designed to reveal evidence about student learning. Here participants use all of the evidence—the evidence revealed during the lesson and that collected from the assessments—to modify subsequent instruction so that it better promotes student learning and is compatible with the CCSS.

When to enact this lesson in your classroom

Deciding when to enact a Formative Assessment Lesson can be a challenge. Many lessons fit well about two-thirds of the way through a compatible unit of instruction, but would also work well as part of a review. The *Course Outline* provides a suggestion for when to enact this lesson.

Resource: [A Course Outline for Geometry](#)

Link the structure of the lessons to the theory of formative assessment

The Big Idea and the Five Strategies studied earlier convey the interpretation of formative assessment that underpins the Shell Center's lessons. Participants consider how the structure of the lessons maps on to the theory.

Handout: [Big Idea of Formative Assessment](#); **Handout:** [Five Strategies of Formative Assessment](#)