



Professional Learning Module

Modeling the enactment of the Formative Assessment: *Optimization Problems: Boomerangs* (Problem Solving)

This Professional Learning Module describes how a facilitator can implement, with fidelity, the Shell Center's Formative Assessment Lesson, *Optimization Problems: Boomerangs*, 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=207&subpage=problem>

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](#)

Boomerangs: the pre-lesson assessment

The pre-lesson assessment is designed to *surface* the common issues that impede student learning. It is important that students are given the opportunity to figure out how to get started on the problem without help from their teachers or peers. Guiding students toward an effective approach robs them of the opportunity to learn how to engage in CCSS Standards for Mathematical Practice *MP1* (*Make sense of problems and persevere in solving them*). The pre-lesson assessment is not graded, but is analyzed to identify common issues. These data are used to modify instruction.

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

Individual work in the light of teacher feedback questions or comments

In a problem-solving lesson, students' responses to the pre-lesson assessment are returned to them along with the feedback questions or comments that the teacher has generated. Working through the problem for the whole class will quickly sabotage the entire lesson.

Lesson Guide: pages T-4

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-4 & T-5; **Videos:** [A Teacher Listens](#), [The Importance of Homogeneous Grouping](#) & [Mini-Conference](#)

Collaborative analysis of Sample Student Responses

Students are given four 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: page T-5; **sample responses S-2, S-3, S-4 & S-5;** **slide** *Evaluating Sample Responses to Discuss P-1*;

Video: [The Power of Students Analyzing Sample Student Work](#)

Whole-class discussion of the task and Sample Student Responses

Teachers facilitate a whole-class discussion to consider the different approaches students used both in their collaborative small group work and in their analysis of the sample student responses. Teachers who have enacted the Shell Center's Formative Assessment Lessons tell us that wrapping up the lesson is 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-5 & T-6; **slides with sample responses P-2, P-3, P-4 & P-5;** **Video:** [Whole-class discussion](#)

The post-lesson assessment and/or post-lesson reflection

This component of the lesson gives students the chance to reflect on their learning during the lesson or complete a post-lesson assessment, and allows the teacher and the students to become aware of which common issues have been resolved and which still remain. As with the pre-lesson assessment, it is important to ask students to complete it individually in class, without help from peers or teachers.

Lesson Guide: page T-7; **Facilitator Notes:** [Administering the Post-Lesson Assessment](#)

Professional Learning Module

Following up on the enactment of the Formative Assessment Lesson: *Optimization Problems: Boomerangs* (Problem Solving)



Ann Shannon & Associates, LLC

This Professional Learning Module describes how to follow up on the enactment of the lesson *Optimization Problems: Boomerangs*, 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=207&subpage=problem>
Resource: [Facilitator Notes](#)

The mathematics of *Optimization Problems: Boomerangs*

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 Optimization Problems: Boomerangs](#)

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-7; **Student work:** [Boomerangs](#);

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

Write 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 beginning of the lesson to help them re-engage with the problem.

Handout: [Criteria for Feedback](#)

Analyze student responses to the post-lesson assessment or/and the post-lesson reflection

If available, participants analyze a small set of student responses to the post-lesson assessment and add these data to a copy of the *Growth Analysis Spreadsheet* in order to illustrate student growth across the pre- and post-lesson assessments. In addition, or as an alternative, participants may review students' reflections on the lesson to determine which common issues have been resolved and which still remain.

Student work: [Boomerangs](#)

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 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 Algebra 1](#)

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](#)