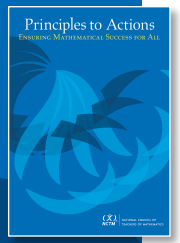

Principles to Actions

Effective Mathematics Teaching Practices

The Case of Jamie Bassham and the Missing Function Task

Algebra 2

This module was developed by Melissa Boston and Stephen Miller at the University of Pittsburgh. Video courtesy of Hamilton County School District and the Institute for Learning.

These materials are part of the ***Principles to Actions Professional Learning Toolkit: Teaching and Learning*** created by the project team that includes: Margaret Smith (chair), Victoria Bill (co-chair), Melissa Boston, Fredrick Dillon, Amy Hillen, DeAnn Huinker, Stephen Miller, Lynn Raith, and Michael Steele.

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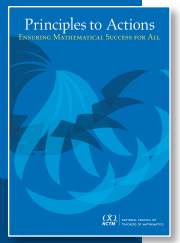


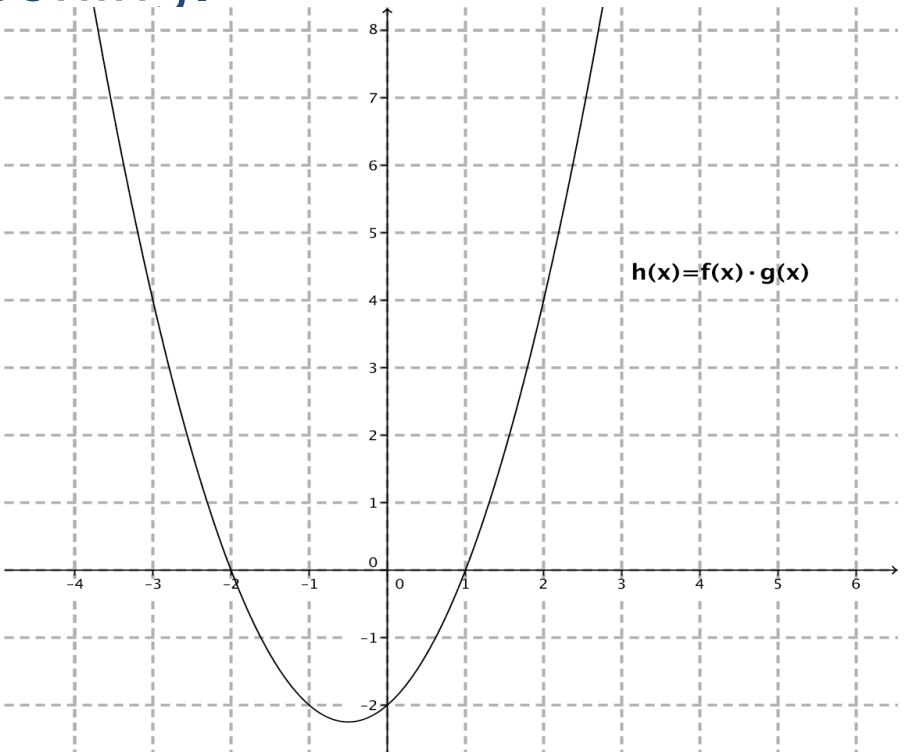
Overview of the Session

- Solve and Discuss the Missing Function Task
- Watch the video clip and discuss what the teacher does to support her students engagement in and understanding of mathematics
- Discuss the effective mathematics teaching practice of *pose purposeful questions*

The Missing Function Task

If $h(x) = f(x) \cdot g(x)$, what can you determine about $g(x)$ from the given table and graph? Explain your reasoning.

x	f(x)
-2	0
-1	1
0	2
1	3
2	4



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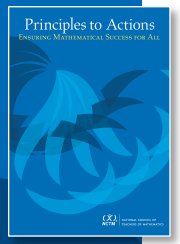
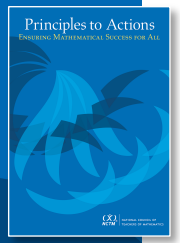


Learning Goals

Create two or three mathematical learning goals for this lesson. Be ready to share these goals.



Missing Function Task Video Context

School: Tyner Academy, Chattanooga, TN
Principal: Carol Goss
Teacher: Jamie Bassham
Class: High School Algebra 2
Size: 16 students

At the time the video was filmed, Jamie Bassham was a teacher at Tyner Academy in the Hamilton County School District. The lesson occurred in an Algebra 2 class. The "Missing Functions" task occurs within a sequence of related tasks on "Building Polynomial Functions" created by the Institute for Learning, University of Pittsburgh.

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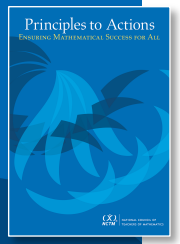
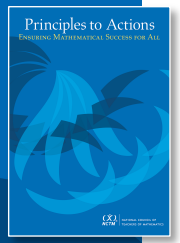


Ms. Bassham's *Mathematics* Learning Goals

Students will:

1. Explore the meaning of multiplying functions by use of tables and graphs.
2. Develop an understanding that the x-intercepts of a quadratic function (when they exist) consist of the x-intercepts of the two linear functions whose product defines it.



Connections to the CCSS Content Standards

Arithmetic with Polynomials and Rational Expressions (A-APR)

Understand the relationship between zeros and factors of polynomials

3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common core state standards for mathematics*. Washington, DC: Authors.

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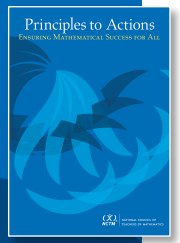

Connections to the CCSS Content Standards

Building Functions F-BF

Building a function that models a relationship between two quantities

1. Write a function that describes a relationship between two quantities.★

1.B Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*

★Mathematical Modeling is a Standard for Mathematical Practice (MP4) and a Conceptual Category, and specific modeling standards appear throughout the high school standards indicated with a star (★).

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common core state standards for mathematics*. Washington, DC: Authors.

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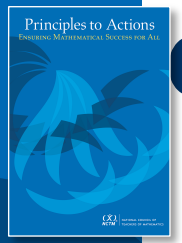

Connections to the CCSS Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. **Look for and make use of structure.**
8. Look for and express regularity in repeated reasoning.

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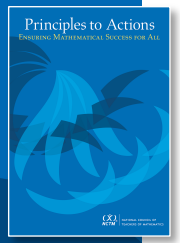
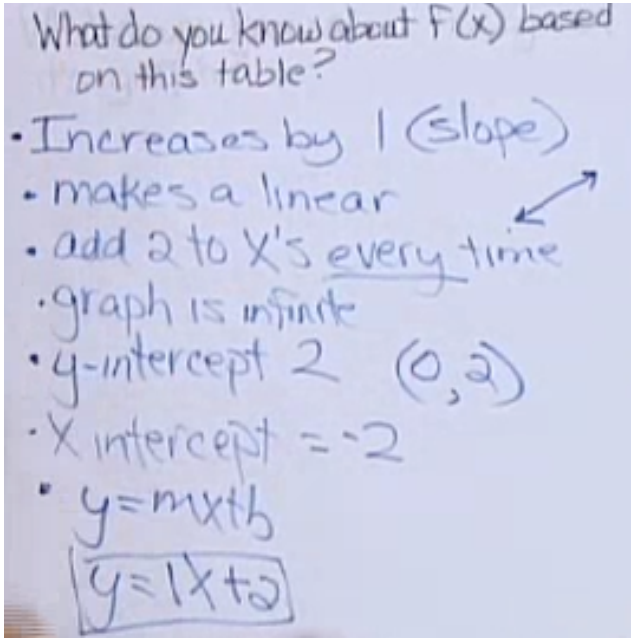


Missing Function Task
The Context of Video Clip

Prior to the clip, students have created this chart:



The Video Clip begins with groups of four students working together as the teacher moves among the groups asking questions. At the end of the clip, students discuss their work and ideas.

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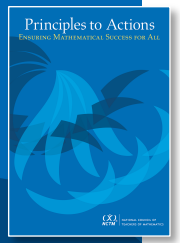

Lens for Watching the Video Clip - Time 1

As you watch the video, make note of what the teacher does to support student learning and engagement as they work on the task.

In particular, identify any of the *Effective Mathematics Teaching Practices* that you notice Ms. Bassham using.

Be prepared to give examples and to cite line numbers from the transcript to support your claims.

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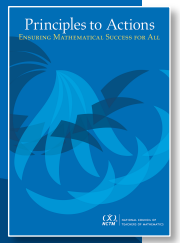

Effective
Mathematics Teaching Practices

1. Establish mathematics **goals** to focus learning.
2. Implement **tasks** that promote reasoning and problem solving.
3. Use and connect mathematical **representations.**
4. Facilitate meaningful mathematical **discourse**.
5. Pose purposeful **questions**.
6. Build **procedural fluency** from conceptual understanding.
7. Support **productive struggle** in learning mathematics.
8. **Elicit and use evidence** of student thinking.

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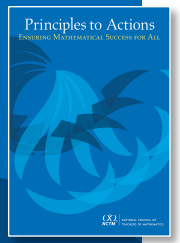

Pose Purposeful Questions

Effective Questions should:

- Reveal students' current understandings;
- Encourage students to explain, elaborate, or clarify their thinking; and
- Make the mathematics more visible and accessible for student examination and discussion.

Teachers' questions are crucial *in helping students make connections and learn important mathematics and science concepts. Teachers need to know how students typically think about particular concepts, how to determine what a particular student or group of students thinks about those ideas, and how to help students deepen their understanding.* (Weiss and Pasley, 2004)

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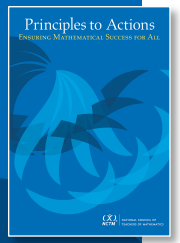
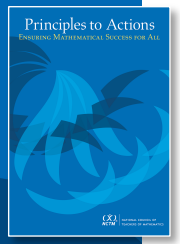


Lens for Watching the Video Clip - Time 2

As you watch the video this time, pay attention to the questions the teacher asks. Specifically:

- What do the questions reveal about students' current understandings?
- To what extent do the questions encourage students to explain, elaborate, or clarify their thinking?
- To what extent do the questions make mathematics more visible and accessible for student examination and discussion?



Pose Purposeful Questions: Teacher and Student Actions

What are teachers doing?

- Advancing student understanding by asking questions that build on, but do not take over or funnel, student thinking.
- Making certain to ask questions that go beyond gathering information to probing thinking and requiring explanation and justification.
- Asking intentional questions that make the mathematics more visible and accessible for student examination and discussion.
- Allowing sufficient wait time so that more students can formulate and offer responses.

What are students doing?

- Expecting to be asked to explain, clarify, and elaborate on their thinking.
- Thinking carefully about how to present their responses to questions clearly, without rushing to respond quickly.
- Reflecting on and justifying their reasoning, not simply providing answers.
- Listening to, commenting on, and questioning the contributions of their classmates.

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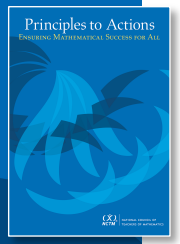


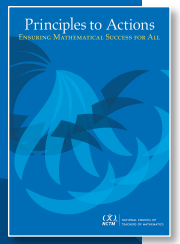
Characteristics of Questions That Support Students' Exploration

Assessing

- Based closely on the work the student has produced
- Clarify what the student has done and what the student understands about what they have done
- Provide information to the teacher about what the student understands

Advancing

- Use what students have produced as a basis for making progress toward the target goal
- Move students beyond their current thinking by pressing students to extend what they know to a new situation
- Press students to think about something they are not currently thinking about



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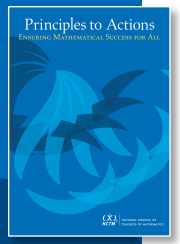
Stay & listen

Walk away



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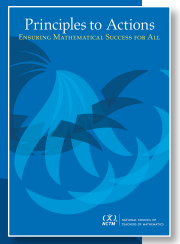

What have you learned and how do these ideas apply to your classroom work?

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