Teacher Training on the Revised Math Standards

Math 9-12

Welcome

Agenda: Day 2

Time	Content
8–11:15	Part 4: Assessment & Instructional Materials • M7: Connecting Standards and Assessment
11:15–12:30	Lunch (on your own)
12:30–4	• M8: Evaluating Instructional Materials Part 5: Putting it All Together • M9: Instructional Planning

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Norms

- Keep students at the center
- Be present and engaged
- Be reflective and solutions oriented
- Challenge ideas with respect
- Monitor airtime

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Today's Goals

- Discuss the role assessment plays in the integrated system of learning
- Discuss the cycle of assessment
- Discuss the four areas of focus for standards-aligned assessments
  - Review and create Math assessment items
- Develop a process for evaluating instructional materials
- Connect standards and assessment through instructional planning

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Key Ideas

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Key Ideas

Strong Standards

Standards are the bricks that should be masterfully laid through quality instruction to ensure that all students reach the expectation of the standards.

High expectations

We have a continued goal to prepare students to be college and career ready.

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Key Ideas

Instructional Shifts

The instructional shifts are an essential component of the standards and provide guidance for how the standards should be taught and implemented.

Aligned Materials and Assessments

Educators play a key role in ensuring that our standards, classroom instructional materials and assessments are aligned.

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Part 4 : Aligned Materials and Assessment

Key Idea

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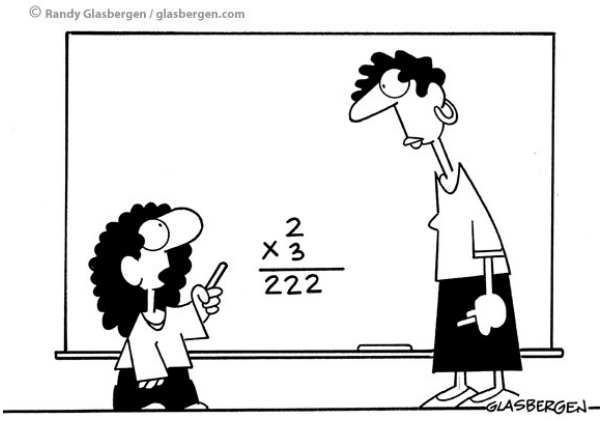
Assessing Student Understanding: EOC Mathematics

Think About it…



"What do you mean, it's the wrong kind of right?"

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Goals

- Discuss the role assessment plays in the integrated system of learning
- Discuss the cycle of assessment
- Discuss the four areas of focus for standards-aligned assessments
  - Review Math assessment items
  - Create Math assessment items

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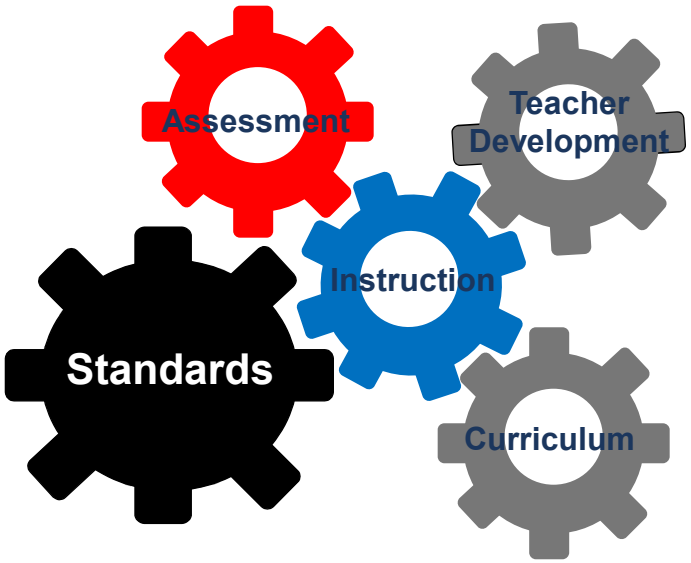
Connecting Standards and Assessment



Defining Assessment

- Assessment is the action or an instance of making a judgment about something.

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Turn & Talk

- Considering this definition of assessment, what are educators “making a judgement about” when assessing students?

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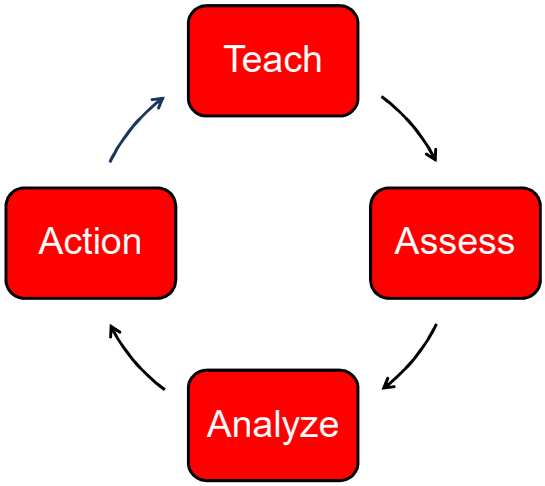
The Cycle of Assessment



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Think About It…

"The good news is that research has shown for years that **consistently applying** principles of assessment for learning has yielded remarkable, if not unprecedented, gains in student achievement, especially for low achievers."

—Black & Wiliam, 1998

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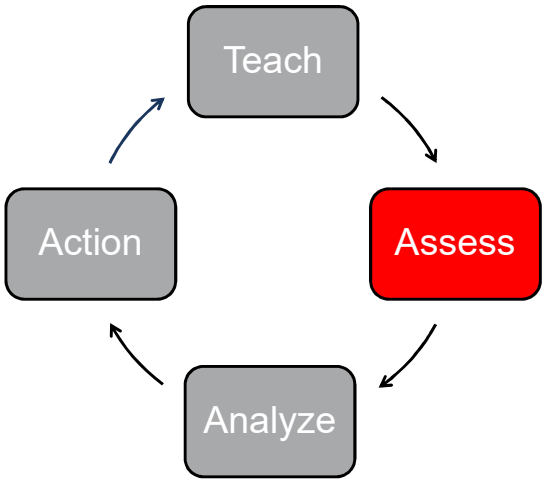
Assessment

The Cycle of Assessment



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Standards Aligned Assessments

Areas of Focus

1. Intent of the Assessment
   - Summative
   - Formative
2. Content and Structure of Assessments
3. Analysis of Assessments

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Intent of Assessments

"Benchmark assessments, either purchased by the district or from commercial vendors or developed locally, are generally meant to measure progress toward state or district content standards and to predict performance on large-scale summative tests. A common misconception is that this level of assessment is automatically formative."

-Stephen and Jan Chappuis 2012

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Formative vs Summative

How are the results used?

Formative	Summative

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Intent of Assessments

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Standards-Aligned Assessments

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Quality Assessments

Universal Design Principles:

- No barriers
- Accessible for all students
- Upholds the expectations of our state standards

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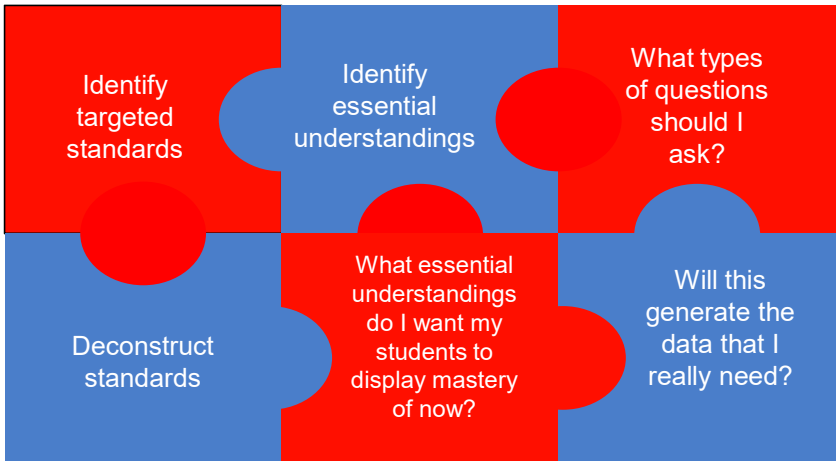
Developing a Classroom Assessment



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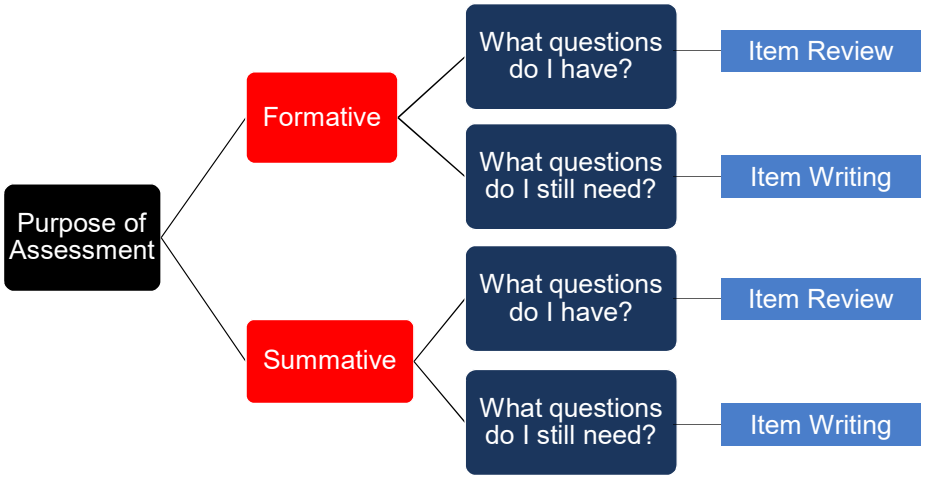
Inventory for Classroom Assessment



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Assessing an Item

Assessing an Item Activity-Math

Grade 4 Math:

Standard:

4.OA.A.3: Solve multi-step contextual problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

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Which item provides a better lens into student understanding?

Item 1: Samantha bought stickers.

- She bought 6 packs of stickers.
- Each pack has 12 stickers.
- She got 8 more stickers from a friend.

How many stickers does Samantha have in all?
A. 76
B. 78
C. 80
D. 82

Item 2: Samantha bought stickers.

- She bought 6 packs of stickers.
- Each pack has 12 stickers.
- She got 8 more stickers from a friend.

How many stickers does Samantha have in all?
A. 26
B. 64
C. 72
D. 80

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Which item provides a better lens into student understanding?

Item 1: Samantha bought stickers.

- She bought 6 packs of stickers.
- Each pack has 12 stickers.
- She got 8 more stickers from a friend.

How many stickers does Samantha have in all?
A. 76
B. 78
C. 80-Correct Answer
D. 82

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Which item provides a better lens into student understanding?

Item 2: Samantha bought stickers.

- She bought 6 packs of stickers.
- Each pack has 12 stickers.
- She got 8 more stickers from a friend.

How many stickers does Samantha have in all?

A. 26-Student adds the 3 numbers in the problem together
B. 64-Student multiplies 6 and 12 and subtracts 8
C. 72-Student Multiplies 6 and 12 but forgets to add 8
D. 80-Correct Answer

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Assessment Terminology

Item Type

- Selected response
- Open response
- Verbal
- Extended writing

Item Components

- **Stimulus** – the passage(s)
- **Stem –** the question that is asked
- **Key –** the correct answer
- **Distractor –** an incorrect answer
- **Rationale –** the reason an answer is correct or incorrect

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Examining Items: Formative vs Summative

What is the question actually asking?	Is the question aligned to the depth of the standard?	Are the answers precise?
Is the wording grade appropriate?	Is the question aligned to the standard?	Do the distractors give insight into student thinking?
Is the entire standard assessed?	Is the question precise?	Is there a better way to assess the standard?

Item Assessment Activity

You will look at five assessment items. For each provided item, think about the things we just discussed. Decide if you would keep the item, revise the item in some way, or choose to exclude it when building a classroom assessment.

Look first at the items independently. Then you may work with a partner to complete the activity.

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M3.G.GPE.A.1 (G.GPE.A.1)

Know and write the equation of a circle of given center and radius using the Pythagorean Theorem.

The equation for a given circle is

$$2x^2 + 2y^2 - 8x - 12y + 8 = 0.$$

What is the radius of the circle?

A. 2
B. 3
C. 4
D. 12

G.SRT.B.4 (M2.G.SRT.B.4)

Prove theorems about similar triangles.

Right Triangle ABC has side lengths 5, 12 and 13. If Triangle DEF is similar to ABC and has one side length 60, what are the possible missing side lengths of DEF?

A. 10 and 24
B. 25 and 65
C. 30 and 78
D. 36 and 96
E. 100 and 125
F. 144 and 156

A2.A.REI.D.6 (M1.A.REI.C.4)

Explain why the *x*-coordinates of the points where the graphs of the equations *y = f(x)* and *y = g(x)* intersect are the solutions of the equation *f(x) = g(x)*; find the approximate solutions using technology.

$f(x) = |x| - 2$ and $g(x) = -|x| + 2$

Graph *f(x)* and *g(x)*. Identify all solutions to the equation *f(x)=g(x)* on the graph.

M1.F.IF.C.7 (A1.F.IF.C.8)

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Two savings plans are represented by the functions f(x) and g(x) respectively, where x is the number of months and f(x) and g(x) represent the value of each account in dollars.

What is the average rate of change of the higher earning account after 6 months?

$f(x) = 30(1.04)^x$

x	g(x)
1	50
2	200
3	450

Write your answer in the space provided.

A2.A.APR.A.2 (M3.A.APR.A.2)

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.

Identify all zeroes for the following:

$$y = 2x^5 - 5x^4 - 3x^3 - 2x^2 + 5x + 3$$

Turn & Talk

- Share one or two “ah-ha” moments from this activity with your table partners.

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10 minute break

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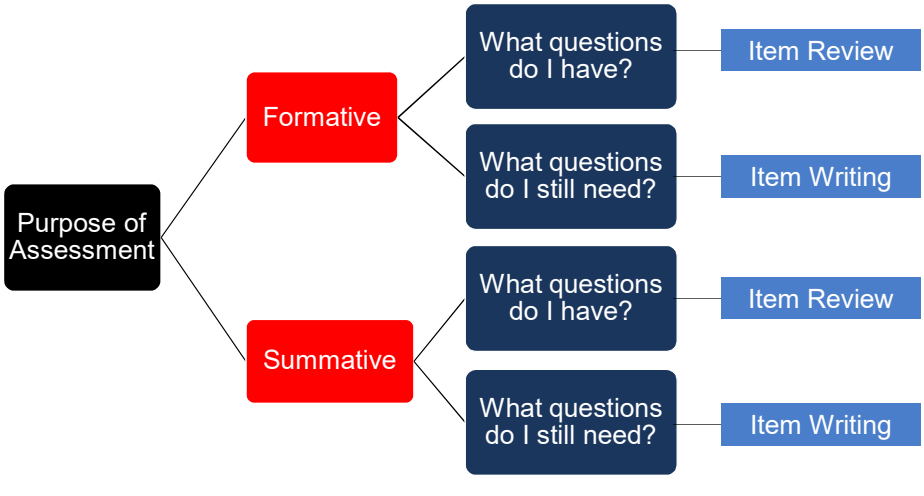
Creating Formative Items

Inventory for Classroom Assessment



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Item Writing-Formative Assessments

What is the question actually asking?	Across all items, are there questions aligned to the depth of the standard?	Are the answers precise?
Is the wording grade appropriate?	Is the question aligned to the standard?	Do the distractors give insight into student thinking?
Is the entire standard assessed in the suite of items?	Is the question precise?	Is there a better way to assess the standard?

Standards-based

Before you actually start writing items:

- Think about the *purpose* of the assessment as a whole. Is it formative or summative?
- Read the standards carefully with the assessment purpose in mind. Ask yourself: "What skills/knowledge are the standards asking the student to display?"
- Revisit the "I can" statements or "essential questions" you wrote for the standard(s). They may provide guidance as you write items.
- Brainstorm.

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Revisiting Standard A1.F.IF.C.7 (M2.F.IF.B.5a)

A1.F.IF.C.7 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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FORMATIVE Assessment

Determine if each equation will have a minimum or a maximum value. You do not have to provide any coordinates. Match the equations on the left with the correct choice on the top.

	Maximum	Minimum
$y = (x-2)^2+4$		
$y = -1(x-2)^2+4$		
$y = -2x^2 + 4x - 2$		
$y = 2x^2 - 8x + 1$		

FORMATIVE Assessment

For a quadratic function, complete the square in order to identify the zeroes.

Identify the zeroes for the following quadratic equation:

$$y = 2x^2 - 4x + 1$$

FORMATIVE Assessment

Interpret zeros and extreme values for quadratic equations in terms of a context.

A ball is thrown straight up, from 4 m above the ground with a velocity of 20 m/s. It's height is modeled by the following equation:

$$h = 4 + 20t - 5t^2$$

How long will it take the ball to hit the ground?

A. 5 seconds
B. 4.2 seconds
C. 2.2 seconds
D. 1 second

Revisiting Standard A1.F.IF.C.7 (M2.F.IF.B.5a)

Did we cover all aspects of the standard with these items? Turn and talk to a neighbor.

A1.F.IF.C.7 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Recap: Big Ideas

- Formative assessments *may* need items that scaffold in order for the teacher to diagnose what a student does/does not understand.
- Effectively writing "I can" or "Essential Questions" helps target assessment items specifically to standards.
- It is very difficult to formatively assess student understanding through a single item.
- It's important to ask yourself the 9 essential questions during item review or item writing.

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Quality Assessments

Universal Design Principles:

- No barriers
- Accessible for all students
- Upholds the expectations of our state standards

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Item Writing-Formative Assessments

What is the question actually asking?	Across all items, are there questions aligned to the depth of the standard?	Are the answers precise?
Is the wording grade appropriate?	Is the question aligned to the standard?	Do the distractors give insight into student thinking?
Is the entire standard assessed in the suite of items?	Is the question precise?	Is there a better way to assess the standard?

Item Writing-Your Turn

- You will be provided a set of standards and two options for item writing.
- Once you have finished writing items, you will post them for our gallery walk.
  - Please post the coding for the standard(s) to which your items are written.
  - You do not have to post the rationales.
- You may work with a partner.

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Selected Response

Multiple Choice	Multiple Select
Items typically have 4 answer options with 1 correct answer. It may be helpful to use the verb in standard. Most of the time the stem will be stated in a positive manner avoiding negatives. The item really should be written as a question, not a completion statement.	Students are typically asked to provide two or three correct answers to the question in the stem. Such items tend to enable students to demonstrate a full understanding of a concept, or solve problems in multiple ways. There are typically 2−3 correct answers and 5−6 answer options, depending on the grade level/standard being assessed.

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Your Turn: FORMATIVE Item Writing

Option 1	Option 2
1. Choose 3 standards. 2. Write an item to assess each standard that you would use on a formative assessment. 3. Try to write at least one multiple choice or multiple select item. Focus on writing distractors that provide instructional information.	1. Choose 1 standard. 2. Write 3 formative assessment items to the single standard that you select. Make sure that each item requires students to demonstrate a different level of understanding of the standard. 3. Try to write at least one multiple choice or multiple select item. Focus on writing distractors that provide instructional information.

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Gallery Walk

As you look at/review your colleagues items, look for similarities and differences in the items created.

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Turn & Talk

Reflect on your experience writing assessment items and discuss:

- What was challenging about this experience?
- What did you learn from this experience?
- What supports do you need to better understand the relationship between standards and assessments in this way?

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Analyzing Assessments

Standards Aligned Assessments

Areas of Focus

1. Intent of the Assessment
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2. Content and Structure of Assessments
3. Analysis of Assessments

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Analysis of Assessment

- Is the data from assessments being analyzed?
- How is it analyzed?
- On which questions did students perform well? Why?
- On which questions did students perform poorly? Why?
  - Were there issues with poorly written questions, questions not really aligned to standards, multiple correct answers, …

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Did you know…

- In general on the grade 2 stand-alone field test students performed better on writing to literary text as opposed to informational text. Why?
- In general students struggled answering assessment items around quadratics in Algebra I. Why?
- Students demonstrated better understanding in Reading: Informational Text than Reading: Literature in English I. Why?

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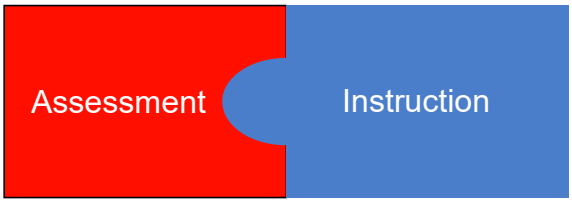
Taking Action

Action



- How is instruction changing/adapting as a result of student data?
- Are results shared with all stakeholders (including students)?
- Are assessments adapted to address weaknesses found?

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Think about it…

"The assessments will produce no formative benefit if teachers administer them, report the results, and then continue with instruction as previously planned."

—Stephen and Jan Chapuis, 2012

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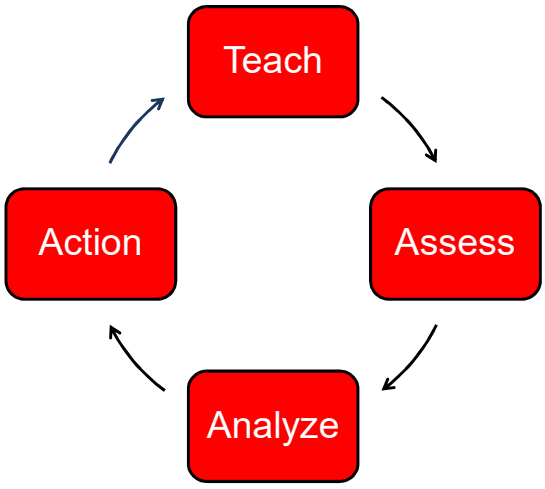
Summary

The Cycle of Assessment



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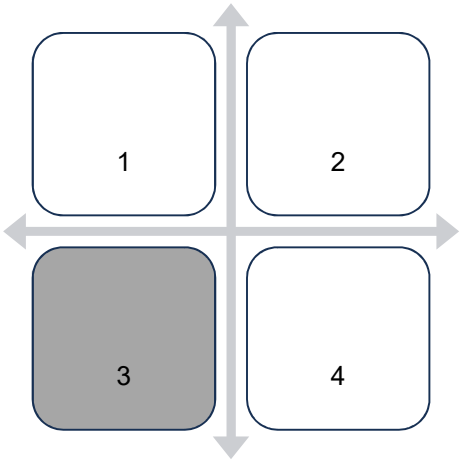
Appointments with Peers



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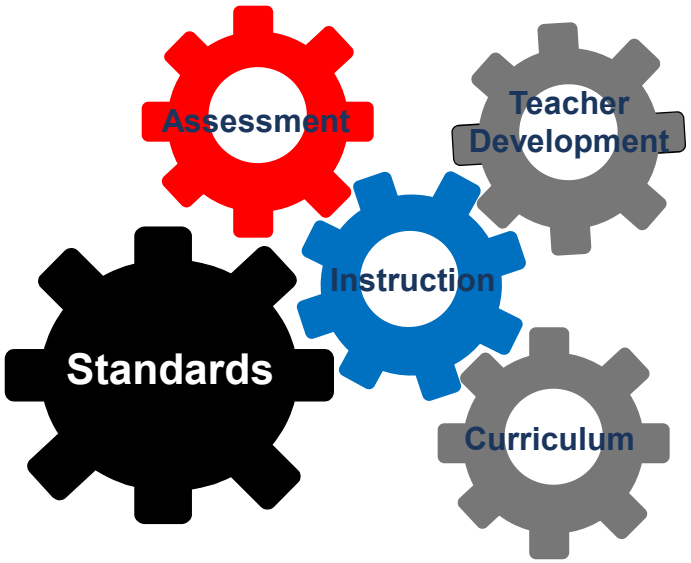
Connecting Standards and Assessment



Lunch Break: 1 hour 15 minutes

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Please Sign In!

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Module 8: Evaluating Instructional Materials

Key Question

How do we know that our instructional materials address the depth of the content and the instructional shifts of focus, coherence, and rigor of the TN State Standards?

Goals

- Examine the TEAM rubric to define what is meant by standards based materials.
- Know which key criteria to use for reviewing materials, lessons, and/or units for alignment and quality.
- Understand how the review process of instructional materials will:
  - Deepen understanding of the standards,
  - Make use of screening instruments to analyze materials to determine alignment or gaps, and
  - Result in wise decisions about how best to use the materials already on-site to teach the new standards to mastery OR effectively fill any gaps uncovered in the review process.

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Standards-based Materials and Practice

Rationale

"…teachers have a responsibility to make day-to-day instructional choices that ensure that students work with problems that engage their interest and their intellect."

—*Smarter Than We Think*

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Reflect on our Practice

When your students' work is on public display, in the hallway or shared with families, can anyone see the math?

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Reflect on our Practice

In other words:

- Are the materials and the instructional practices you are using focusing on the mathematics?
- If anyone looked at your students' work, would they be able to see the math or would they be left asking "where's the math?"

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TEAM: Activities & Materials

- Support the lesson objective
- Are challenging
- Sustain students' attention
- Elicit a variety of thinking
- Provide time for reflection
- Provide opportunities for student-to-student interaction
- Provide students with choices
- Incorporate technology
- Induce curiosity & suspense
- In addition sometimes activities are…
  - Game-like
  - Involve simulations
  - Require creating products or
  - Demand self-direction and self-monitoring
- The preponderance of activities demand complex thinking and analysis
- Texts & task are appropriately complex

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TEAM: Problem Solving

- Abstraction
- Categorization
- Predicting Outcomes
- Improving Solutions
- Generating Ideas
- Creating & Designing
- Observing & Experimenting
- Drawing Conclusions/Justifying Solutions
- Identify Relevant/Irrelevant Information

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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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Effective Mathematics Teaching Practices

1. Establish mathematics **goals** to focus learning.
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3. Use and **connect mathematical representations.**
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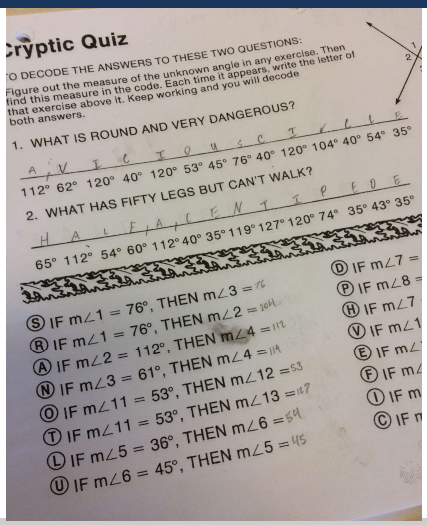
Missing Angle Activity



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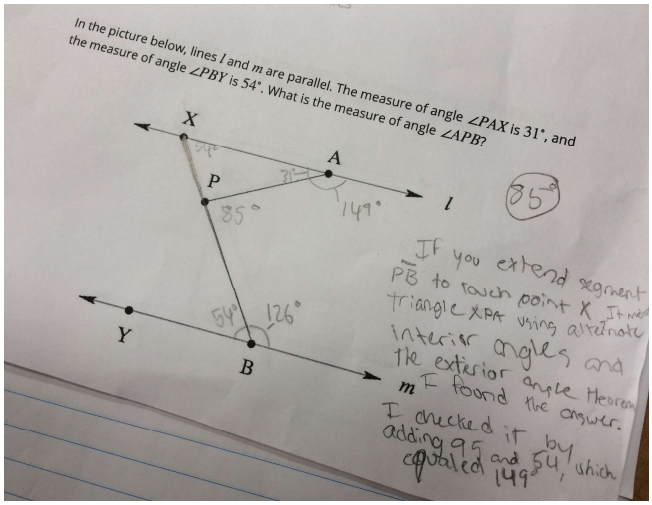
Missing Angle Activity-Angle Task



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Missing Angle Activity

- What content standard do you think these activities address?
- Where is the evidence of student understanding of the mathematical content?

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Missing Angle Activities

If a teacher was trying to addressing the depth of the **content standard 8.G.A.5** does the Cryptic Quiz accomplish this goal?

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Missing Angle Activities

8.G.A.5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.

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Missing Angle Activities

8.G.A.5. **Use** **informal arguments** to **establish** **facts** about the **angle sum** and **exterior angle** of **triangles**, about the **angles** **created** when **parallel lines** are **cut** by a **transversal**, and the **angle-angle criterion** for **similarity** of **triangles**. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*

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Criteria for Alignment and Quality

Research

"A curriculum is more than a collection of activities."

-from the Curriculum Principle in Principles and Standards for School Mathematics

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Research

A **well-articulated curriculum** will:

- Make clear the most important mathematics of the grade level.
- Specify when concepts and skills are introduced and when they should be mastered.
- Detail how student conceptual understanding of big ideas develops across units and across multiple grade levels.

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Identifying Effective Instructional Materials

- When choosing instructional materials, what should a teacher consider?
- Stop and jot some ideas.

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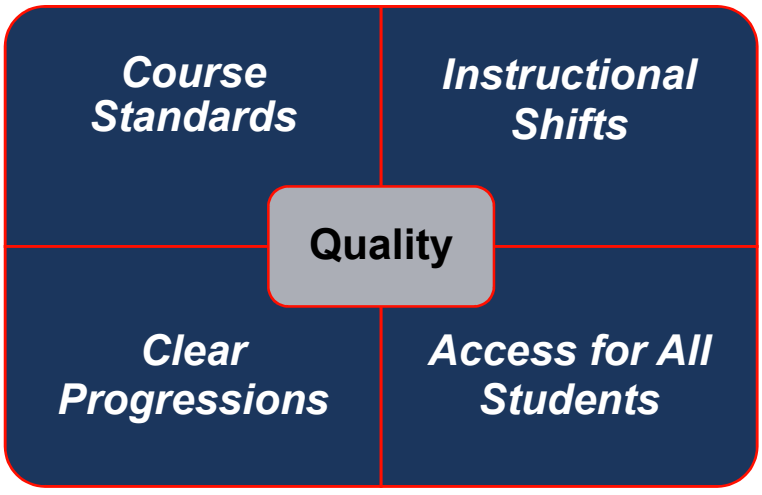
Key Criteria for Instructional Materials



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Key Criteria for Instructional Materials

- High-quality instructional materials are:
  - Aligned to the standards,
  - Connected to the content,
  - Show clear learning progressions, and
  - Are devoted to the major work of the grade/course standards (math).

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Let's Recap

- Our classroom practice and the resulting student work should always connect with all components of the Tennessee State Standards.
- Our use the high leverage teaching practices will promote the types of activities that will increase student achievement.
- Our use of specific key criteria for reviewing materials, lessons, and/or units for alignment and quality will ensure student access to the Tennessee State Mathematics Standards.

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Instructional Materials: Using a Review Process

Materials Review Instrument

- The screening instruments call for **100 percent alignment to the standards** for English language arts, math, science, and social studies.
- Once reviewers have a deep understanding of the standards, they should study the screening instrument.

Materials Review Instrument

- **Section I: Non-negotiable Alignment Criteria**
  - **Part A: Standards**
  - **Part B: Shifts**
    - **Focus**
    - **Rigor**
    - **Coherence**

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Materials Review Instrument

- **Section I: Part A**
- The instructional materials represent **100 percent alignment** with the Tennessee Math Standards and explicitly focus teaching and learning on the course standards at the rigor necessary for students to reach mastery.

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Materials Review Instrument

- **Section I: Part B**
- Instructional Shifts
  - Focus
  - Rigor
  - Coherence

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Materials Review Instrument

Part B: Non-negotiable

Focus: Instruction centers on the course standards, standards for mathematical practice, and literacy skills for mathematical proficiency.

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Materials Review Instrument

- Materials focus on the course standards. Topics from future courses and/or earlier grades/courses are clearly identified as such in the materials, and do not detract from focus.
- Materials connect the standards for mathematical practice and literacy skills for mathematical proficiency to the content standards in meaningful and intentional ways. The development of the math practices and literacy skills is well-grounded in content and not isolated.

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Materials Review Instrument

- Materials include teacher-directed materials that explain the role of the standards for mathematical practice in the classroom and in students' mathematical development. Problems and activities present opportunities for students to make use of and exhibit the math practices as they work on content.
- Materials are mathematically accurate and course appropriate.

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Materials Review Instrument

Part B: Non-negotiable

Provides learning experiences that supports coherence across and within courses and grade levels.

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Materials Review Instrument

- Connections are made within a course between clusters and domains, where these connections are appropriate and natural, as set forth by the standards.
- Content progressions between this course and other mathematics courses reflect those seen in the standards. These progression connections are clearly indicated in the materials and enhance the required learning in the course. They are clearly aimed at helping students meet the standards as written.

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Materials Review Instrument

Part B: Non-negotiable

The three aspects of rigor are given full attention: conceptual understanding, procedural fluency, and application.

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Materials Review Instrument

- High-quality problems and questions designed to invite exploration and support conceptual understanding are included for content standards and clusters that explicitly call for it. A variety of conceptual problems enable students to connect mathematical ideas and representations and transfer understandings to new situations.
- Materials support the development of fluency and include opportunities to practice algebraic manipulation and computation, appropriately apply tools, and use technology. Sometimes problems are purely procedural; none are based on non-mathematical tricks or mnemonics.

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Materials Review Instrument

- Students are given opportunity to apply mathematical knowledge and skills for standards that set a clear expectation for modeling. A variety of course-appropriate problems provide students the opportunity to apply mathematical models in a variety of contextual situations using knowledge and skills articulated in the standards prior to or during the current course.

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Materials Review: Screening Instrument

Section two examines materials and screens for usability and accessibility. By examining this section, reviewers can determine if the materials reflect best practices and are accessible for ALL students.

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Materials Review Instrument

- **Section II: Additional Alignment Criteria and Indicators of Quality**
  - **Part A: Key areas of focus**
  - **Part B: Student engagement & instructional focus**
  - **Part C: Monitoring student progress**

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Best Practices

- While our standards have undergone mostly minor revisions, it's important to review instructional materials you use to determine where you have strong alignment to standards and where you may have gaps to fill.
- **School leaders and teachers should engage in reviewing instructional materials on an ongoing basis to develop pedagogy and capacity.**

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Teacher Materials Review Process

Teachers need to review materials when:

- There is a new adoption. (This occurs annually for different subjects at the local level.)
- Current materials have gaps that may require supplemental materials.
- They are looking for supplemental instructional materials.

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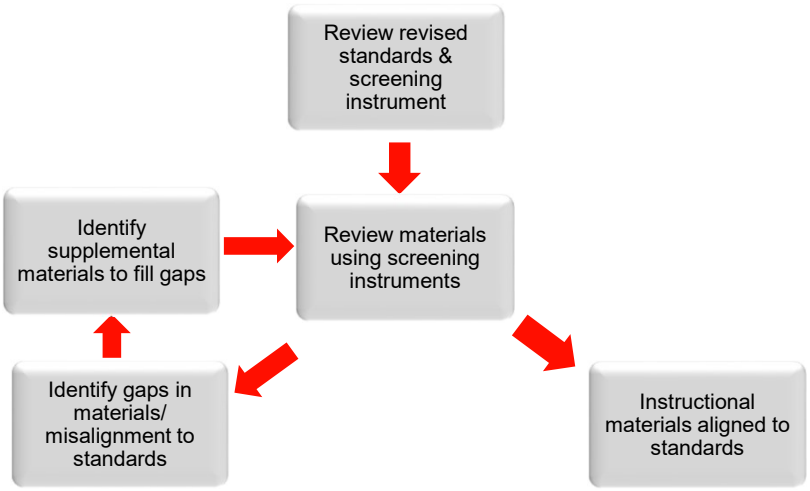
Teacher Materials Review Process



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Supplemental Materials

Let's discuss:

- What resources do you have on hand?
- Where do you find supplemental materials?
- How can you use this process to evaluate supplemental materials?

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Reviewing Materials: A Recap

As you look for materials…

1. Is it aligned to the standards?
2. Does it reflect high leverage best practices?
3. Is it accessible for ALL students?
4. Does it lead to students being able to demonstrate mastery of the standard?

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Think Back to Cryptic Quiz…

- Was it aligned to the course standards?
- Did it focus on major work of the grade?
- Could it be a part of coherent set of activities?
- What SMPs did it align to?
- Can the literacy skills be applied?
- Can ALL students access the activity?
- How do students demonstrate mastery?

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Math Standards Revisions – Potential Gaps

Grades 6-8:

- Shifted Compound Probability standard
  - Moved from seventh to eighth grade
- Revised Geometry standards
  - Removed from seventh grade: slice of 3-dimensional objects
  - Removed from eighth grade: congruency and similarity of 2-dimensional objects

Grades 9-12:

- Shifted a number of standards from Algebra II and Integrated Math III to the Additional Math Courses

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Reflect

"High-quality coherent mathematics programs help students make sense of mathematics by situating the mathematics in problem solving contexts, so that students learn the mathematics in order to answer meaningful questions in real-world or mathematical contexts. Explicit attention is paid to promoting students' conceptual understanding of mathematical content as well a mathematical thinking and reasoning practices so that the mathematics itself makes sense to students. By linking mathematical topics within and among mathematical domains, mathematics appears as a unified discipline rather than as a collection of topics."

—from *Principles to Actions*

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Module 8 Review

The review process of instructional materials will:

- Deepen understanding of the standards,
- Make use of screening instruments to analyze materials to determine alignment or gaps, and
- Result in wise decisions about how best to use the materials already on-site to teach the new standards to mastery OR effectively fill any gaps uncovered in the review process.

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Part Four

Aligned Materials and Assessments

Educators play a key role in ensuring that our standards and classroom instructional materials, and assessments are aligned.

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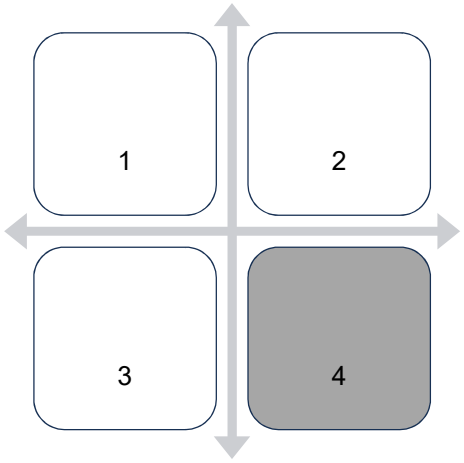
Appointments with Peers



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10-Minute Break

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Part 5: Putting It All Together

Key Idea

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Module 9: Instructional Planning

Goals

- Understand intentional instruction as a bridge between good standards and assessment
- Develop lesson planning techniques to strengthen the understanding of the relationship between standards and practice
- Create lessons based on the revised standards to be used for instruction

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Rationale

"…teachers have a responsibility to make day-to-day instructional choices that ensure that students work with problems that engage their interest and their intellect."

—from *Smarter Than We Think*

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Designing Effective Learning Experiences

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Classroom Culture

Setting Up Norms – Practice Standards

"If there's a threat of being wrong every time I raise my hand, and being wrong is a bad thing, then very quickly I decide math isn't for me, I don't like this, I'm not a smart person."

—Noah Heller, Harvard Graduate School of Education

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What are some possible norms?

We will take about three minutes to let you develop at least two norms that you would like to establish in your classroom starting next year.

Then we will chart a master list.

The next slide will serve as a stimulus for our thinking.

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Setting Up Positive Norms in the Math Classroom

- Everyone can learn math to the highest levels
- Mistakes are valuable
- Questions are important
- Math is about creativity and making sense
- Math is about connections and communicating
- Math class is about learning not preforming
- Depth is more important than speed

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What is intentional instruction?

- Standards are driving your instruction.
- What does "intentional" mean in "intentional instruction?"
- Gather evidence of learning (assessments)
  - What are your end goals? What do students need to…
    - **K**now,
    - **U**nderstand, and
    - **D**o to meet these standards?

} KUD

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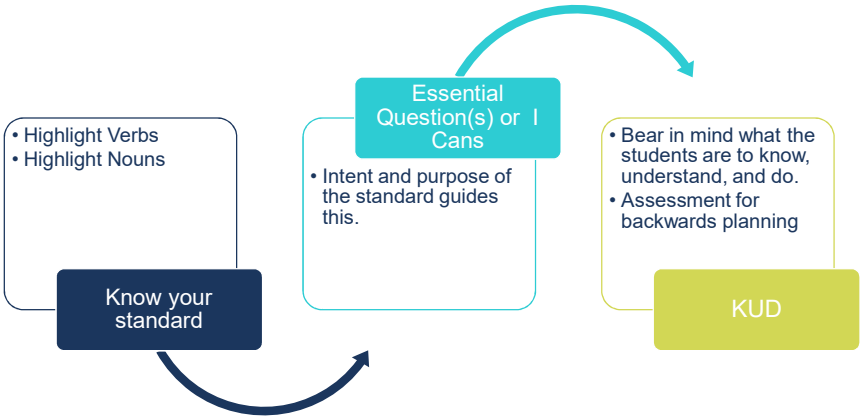
Step 1: Standard-driven Instruction



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Our Example Standard

A1.F.IF.C.7

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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Thinking Vertically

A2.F.IF.B.4 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Know and use the properties of exponents to interpret expressions for exponential functions.

For example, identify percent rate of change in functions such as $y = 2^x$, $y = (1/2)^x$, $y = 2^{-x}$, $y = (1/2)^{-x}$.

There are no assessment limits for this standard. The entire standard is assessed in this course.

M2.F.IF.B.5 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

b. Know and use the properties of exponents to interpret expressions for exponential functions.

For example, identify percent rate of change in functions such as $y = 2^x$, $y = (1/2)^x$, $y = 2^{-x}$, $y = (1/2)^{-x}$.

There are no assessment limits for this standard. The entire standard is assessed in this course.

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Standard(s) Analysis: KUD

- Know: What are the students to know? (our nouns)
- Understand: essential questions, mathematical goals
- Do: What are the students to do? (our verbs)

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Possible Results from Analysis

I CAN
explain the properties of a function by writing it in different equivalent forms.

ESSENTIAL QUESTION
How can writing a function in different equivalent forms help us with problems and in understanding the properties of the function?

A1.F.IF.C.7 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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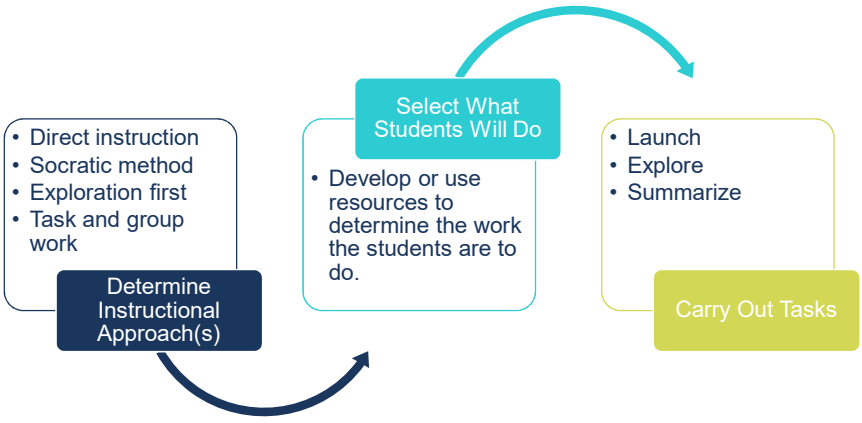
Step 2: Intentional Instruction



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Example Approach

A1.F.IF.C.7 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

We desired to use a task for group work with this standard.

We went to Illustrative Mathematics and selected the Ice Cream Temperature task.

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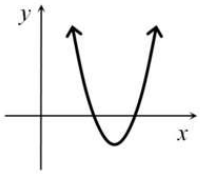
Task: Which Function?

Which of the following could be the function of a real variable x whose graph is shown below? Explain.



$f_1(x) = (x+12)^2 + 4$	$f_5(x) = -4(x+2)(x+3)$
$f_2(x) = -(x-2)^2 - 1$	$f_6(x) = (x+4)(x-6)$
$f_3(x) = (x+18)^2 - 40$	$f_7(x) = (x-12)(-x+18)$
$f_4(x) = (x-12)^2 - 9$	$f_8(x) = (24-x)(40-x)$

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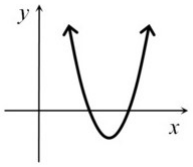
Part 1: Solutions

The graph of $f_1(x) = (x+12)^2 + 4$ has a vertex of $(-12, 4)$ which is in the second quadrant, so it does not match the graph.

The graph of $f_2(x) = -(x-2)^2 - 1$ has maximum rather than a minimum value at $x = 2$ since the leading coefficient is negative (in other words, the graph opens downward), so it does not match the graph.



The graph of $f_3(x) = (x+18)^2 - 40$ has a vertex of $(-18, -40)$ which is in the third quadrant, so it does not match the graph.

The graph of $f_4(x) = (x-12)^2 - 9$ has a vertex of $(12, -9)$ which is in the fourth quadrant, and the leading coefficient is positive (so the graph would open upward) so this could describe the function whose graph is given.

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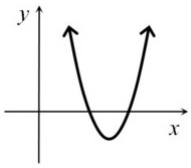
Part 2: Solutions

The graph of $f_5(x) = -4(x+2)(x+3)$ has x-intercepts of $(-2, 0)$ and $(-3, 0)$. Since the x-intercepts are both positive for the given graph, they do not match.

The graph of $f_6(x) = (x+4)(x-6)$ has x-intercepts of $(-4, 0)$ and $(6, 0)$. The x-intercepts are both positive for the give graph, so they do not match.



The graph of $f_7(x) = (x-12)(-x+18)$ has a leading coefficient that is negative and so has a maximum rather than a minimum value (at $x = 15$) and thus cannot match the graph.

The graph of $f_8(x) = (x-24)(x-40)$ has x-intercepts of $(24, 0)$ and $(40, 0)$. Since the x-intercepts are both positive for the graph and the leading coefficient is positive (so the graph would open upward), this could possibly be the equation for this graph.

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Does it align?

A1.F.IF.C.7 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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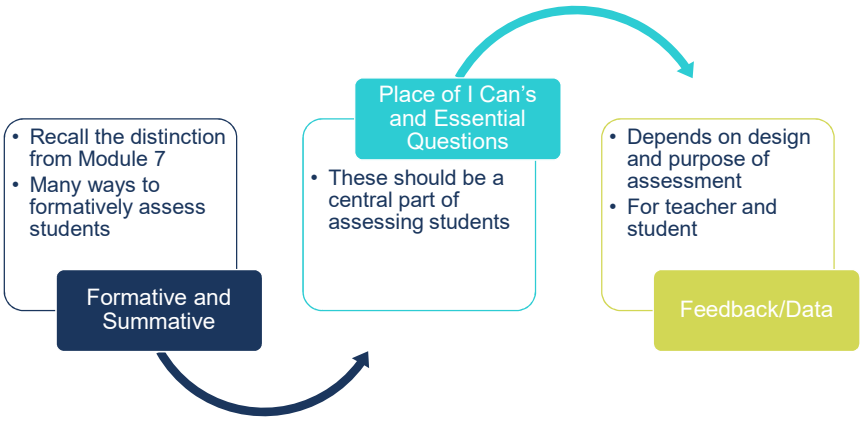
Step 3: Assessment of/for Learning



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An Example of a Simple Formative

- What was the main idea you learned today?
- What is something you are struggling with or have questions about with respect to writing quadratic functions in different ways?
- Give a short one- or two-sentence answer to:
  - **What does writing functions in different ways do for us in working with problems?**

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You Do It Now

Intentional Instruction Process

- **Step 1: Standard-driven Instruction**
  - Know your standard: Deconstruction
  - "I can" and essential questions
  - KUD – for assessment thinking
- **Step 2: Intentional Instruction**
  - Determine instructional approach
  - Select what students will do
  - Carry out tasks
- **Step 3: Assessments of/for Learning**
  - Formative – Summative
  - Place of "I can"s and essential questions
  - Feedback/data

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Your Turn

- Please take the standard you worked on in module 4 and review the intent and purpose of the standard and the "I can" and essential questions that were developed.
- Go to Illustrative Mathematics, find your standard, and select a task that you think would be a good fit for a group work approach to teaching the standard.
- Chart the task and be ready to share why it was selected.
- Develop a formative assessment that could be used for feedback and guide instruction.

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Your Turn

- Each group should share the following:
  - What task did you select and why (or what did you modify)?
  - Does the standard align exactly with what was on the site?
  - How do you think you would present this to the students?
  - What formative questions did you develop and why?

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Module 9 Review

- We brought together the concepts studies in the previous modules to plan for instruction.
- We were intentional in our instruction, using instruction to bridge the gap between standards and assessment.

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Key Ideas

Strong Standards

Standards are the bricks that should be masterfully laid through quality instruction to ensure that all students reach the expectation of the standards.

High expectations

We have a continued goal to prepare students to be college and career ready.

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Key Ideas

Instructional Shifts

The instructional shifts are an essential component of the standards and provide guidance for how the standards should be taught and implemented.

Aligned Materials and Assessments

Educators play a key role in ensuring that our standards and classroom instructional materials align.

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Districts and schools in Tennessee will exemplify excellence and equity such that all students are equipped with the knowledge and skills to successfully embark on their chosen path in life.

Excellence | Optimism | Judgment | Courage | Teamwork

Appendix

TN

Time for Telling and Visualization

Visualization and A Time for Telling

"Teachers who emphasize visual mathematics and who use well chosen manipulatives encourage higher achievement for students, not only in elementary school but middle school, high school and college."

—Sowell, 1989

"There are points of knowledge development that are indicative of a 'time for telling' or a 'readiness' for being told something."

—Schwartz and Bransford , 2013

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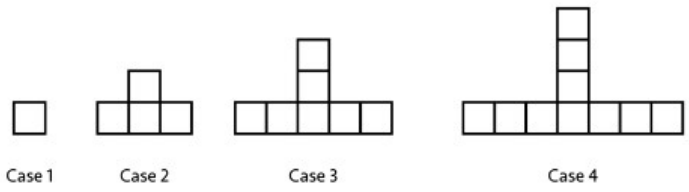
The Power of Visualization



How would you describe the growth of each case of the squares above visually?

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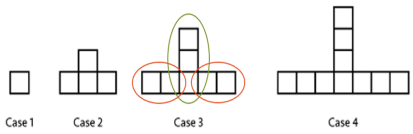
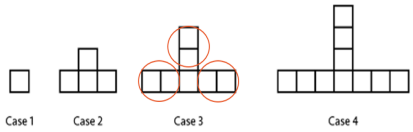
The Power of Visualization



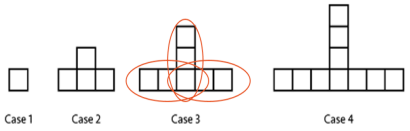
The case number in the middle and one minus the case number on each end.



The case number minus one on each end then add the middle one on the bottom.

Let n represent the case number. Which one goes where?

$3n-2, \quad 3(n-1)+1, \quad n+2(n-1)$



The case number in the middle and on each end. Which means we counted the bottom middle one twice too many times.

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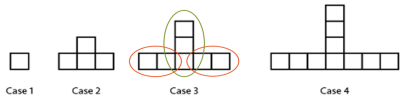
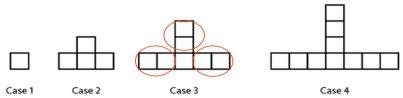
The Power of Visualization



The case number in the middle and one minus the case number on each end.



The case number minus one on each end then add the middle one on the bottom.

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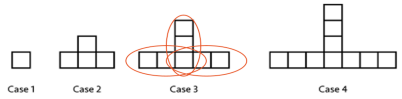
$3n-2, \quad 3(n-1)+1, \quad n+2(n-1)$



The case number in the middle and on each end. Which means we counted the bottom middle one twice too many times.

Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

How does the visualization make the meaning of the standard evident and real?
Are students now more ready to be told/hear the concepts?

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Reflection

- What were any key takeaways from this section on A Time for Telling and Visualization?
- Please first share at your tables, and then we'll share out with the whole group.

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