

Multi-Tiered System of Supports in Mathematics

Course Enhancement Module

Part 2: Universal Math Instruction

Facilitator's Guide



Contents

	Page
Introduction to the Multi-Tiered Systems of Support in Mathematics Course Enhancement	
Module	1
Purpose.....	1
Audience.....	1
Facilitator’s Guide.....	2
Evidence-Based Materials	2
Tiered Organization	2
Opportunity to Learn.....	4
Interactive Adult Learning	4
Resources	4
Materials.....	5
In This Guide.....	5
Table of Contents	5
Handouts	5
Citation for This CEM	6
Part 2: Slides and Supporting Facilitator Notes and Text	7
Anchor Presentation Table of Contents and Handouts.....	130

This facilitator’s guide is intended for use with the following resources:

- Presentation slides
- Participant handouts

These resources are available on the Course Enhancement Modules (CEM) web page of the CEEDAR Center website (ceedar.org).

Introduction to the Multi-Tiered Systems of Support in Mathematics Course Enhancement Module

The Collaboration for Effective Educator Development, Accountability, and Reform (CEEDAR) Center developed this Course Enhancement Module (CEM) on Multi-Tiered System of Supports (MTSS) in mathematics to assist faculty at institutions of higher education (IHEs) and professional development (PD) providers in the training and development of all educators. This CEM provides information and resources about how to prepare teacher and leader candidates and current practitioners to create effective instructional environments for all students, including students with disabilities and their non-disabled classmates. This module helps educators appreciate that an effective instructional environment integrates a continuum of academic and behavioral interventions that are evidence based and accommodate the needs of each student in the class and school.

Through this CEM, participants will learn about assessment tools and intervention practices that should be integrated into a comprehensive, evidence-based math intervention program within the Response to Intervention (RtI) framework. MTSS integrates assessment and intervention within a school-wide, multi-level prevention system to maximize student achievement and reduce behavior problems. The assessment tools and intervention practices are research-based and involve multiple levels of support (including school-wide, class-wide, small-group and individual levels of support) using data-based decision making. As participants gain knowledge about how to effectively use these tools and practices, they will become proficient in using mathematics data to guide intervention decisions, matching the academic intervention to the specific skill deficit and the intensity of a student's needs. The CEM will guide participants in becoming proactive, positive problem solvers who anticipate student needs and design instruction and interventions to prevent academic failure.

Purpose

This CEM was designed to build the knowledge and capacity of educators in the selected topic. The module may be adapted and is flexible to accommodate faculty and PD provider needs. The anchor presentation and speaker notes may be used in their entirety to cover multiple course or professional PD sessions. Alternatively, specific content, activities, and handouts may be used individually to enhance existing course and PD content.

Audience

The audience is intended to be teacher and leader candidates within pre-service programs at the undergraduate or graduate levels, district teachers, practitioners, and leaders participating in in-service professional learning opportunities. The CEM could also be used for PD for current

teachers, practitioners, and leaders interested in staying abreast of current research and trends on best practices for students with disabilities and students who struggle. The facilitator's guide serves as a blueprint to support faculty and PD providers charged with providing teachers and leaders with training in a selected topic. Faculty members and state and local PD providers can conduct the training.

Facilitator's Guide

The facilitator's guide consists of anchor presentation slides with a script to support facilitators as they present the content and learning activities within the presentation. Facilitator notes and talking points are included. The speaker notes are intended as a guide for facilitators using the PowerPoint slides and may be modified as needed. Reviewing the entire guide prior to facilitating the training is highly recommended.

Evidence-Based Materials

All information and resources included in this presentation were drawn from PD products developed by U.S. Department of Education–sponsored centers and projects and other peer-reviewed, research-based, or reputable sources. These centers and projects used a rigorous process to directly link their PD products to available research evidence on MTSS in mathematics. For example, the National Center on Intensive Intervention (www.intensiveintervention.org) follows a five-step process for product development (i.e., design, production, internal review, external review, and U.S. Office of Special Education Programs approval) to develop its series of eight training modules about how to use a data-based-individualization approach to design and implement intensive academic and behavioral interventions for students with severe, persistent needs.

Tiered Organization

The learning resources are organized into four main parts:

Part 1: Introduction. Part 1 introduces participants to the essential elements of mathematics content and instructional practices that all teachers need to know in order for students to gain proficiency. The importance of science, technology, engineering, and mathematics (STEM) education is defined in terms of college and career readiness, meeting the needs of the future job market, and eliminating historical disparities in math and science education. Part 1 also describes the characteristics of students who have math disabilities, outcomes for students who struggle with math, and real-life application through case studies.

Part 2: Universal Math Instruction. Part 2 introduces participants to the concept of universal math interventions—supports for all students, including students with disabilities and English language learners (ELLs)—in the context of MTSS and instruction in the Common Core State Standards (CCSS). Instruction at the universal level should include high-quality instructional practices that are evidence based and delivered with fidelity in recognition of student strengths. Part 2 also describes the role of screening and progress monitoring at the universal level to determine whether the core curriculum instruction is effective for most students.

Part 3: Supplemental Math Interventions. Part 3 introduces participants to the process and importance of implementing supplemental interventions and using data to determine whether a particular intervention is working to improve outcomes for at-risk students in mathematics. It includes descriptions of the distinguishing features of supplemental interventions and considerations for selecting and implementing evidence-based math interventions to effectively address student skill deficits in mathematics. Part 3 also explains how to apply progress-monitoring strategies in the data-based decision-making process to determine whether the student is responding to the supplemental intervention prior to intensifying the instruction.

Part 4: Intensive Math Interventions. Part 4 introduces participants to using data-based individualization (DBI) as a framework for increasing the intensity of math interventions to accommodate the individual needs of non-responding students. It identifies strategies for intensifying mathematics instruction to adequately address a student’s severe and persistent learning needs. Part 4 explains how to use more frequent and precise progress monitoring to determine whether a student is making adequate gains in mathematics with specially designed instruction.

As illustrated in Figure 1, the parts of this CEM are framed according to level of intensity. A complete table of contents and summary of handouts for each part is included at the end of this guide.

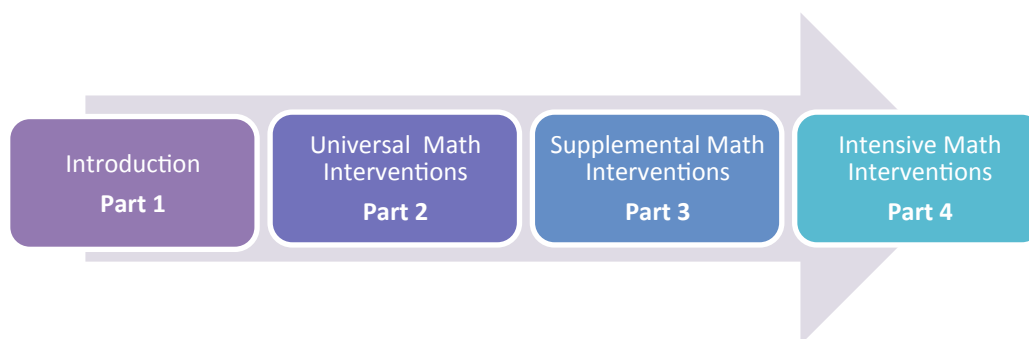


Figure 1. Multi-Tiered System of Supports in Mathematics Anchor Presentation Structure

Opportunity to Learn

Learning activities are embedded throughout each part of the anchor presentation. Each part concludes with an evolving case study in which facilitators and participants can discuss and apply the acquired knowledge of MTSS in mathematics to make data-based instructional decisions for a hypothetical student. All parts engage participants in a variety of interactive learning activities such as videos, small and whole group discussions, reflections, and handouts. Parts 2 and 3 explore interactive online tool charts that can be used to inform the selection and implementation of research-based mathematics assessment and intervention tools. Parts 2 and 4 provide concrete examples of explicit, high-quality mathematics instruction that can be applied to immediate teaching experiences. Part 3 engages students in data analysis activities that allow participants to practice graphing, calculating slope, and using slope to determine responsiveness to math interventions. All activities are optional and may be adapted to meet the needs of a particular audience.

Interactive Adult Learning

This CEM consists of interactive adult learning activities so that participants can engage with and unpack content with their peers through engaged learning. These are also activities participants can use in their own classrooms with students. Directions for each activity are provided in the section where it appears.

Resources

The following resources are provided for use in delivering the anchor presentation:

- Facilitator's guide (this document)
- Presentations
- Participant handouts, as needed
- References and slide citation charts, as needed

All of these materials may be used and adapted to fit the needs of the training context. To cite the content, please use the following statement: "These materials have been adapted in whole or in part with permission from the CEEDAR Center." The citation should be: Artzi, L., Jackson, D., & Marshall, A. (2014). *Course Enhancement Module: Multi-tiered systems of supports in mathematics*. Gainesville, FL: The CEEDAR Center. Retrieved from <http://www.ceedar.org>

Materials

The following materials are recommended for training and associated activities:

- Chart paper
- Markers for chart paper
- Scissors
- Post-it notes
- Timer
- Pens at each table
- Internet connection for website links embedded in presentations
- Calculator

Necessary materials will vary based on the content and activities selected, which will depend on the audience and the format of the course or PD session.

In This Guide

The remainder of the guide provides speaker's notes to support facilitators as they present the content and learning activities included in this anchor presentation. Reviewing the entire guide prior to facilitating the training is highly recommended.

Table of Contents

- What is Universal Instruction in MTSS?
- What Does High Quality Mathematics Instruction at the Universal Level Look Like?
- What Are Considerations for Universal Math Instruction in the Common Core State Standards?
- What is the Role of Screening and Progress Monitoring at the Universal Level?
- What is the Process for Data Based Decision Making?
- Case Study: Meet Ethan and Mr. Math

Handouts

- Handout 4: Questions for Sticky Note Carousel
- Handout 5: Investigating the Evidence for Universal Math Programs
- Handout 6: Using the Tools Chart to Evaluate Screening Tools
- Handout 7: Pick and Chips
- Handout 8: Write and Right
- Handout 9: Case Study: Meet Ethan and Mr. Math

Citation for This CEM

Permission for use is not required, but please cite as:

Artzi, L., Jackson, D., & Marshall, A. (2014). *Course Enhancement Module: Multi-tiered systems of supports in mathematics*. Gainesville, FL: The CEEDAR Center. Retrieved from <http://www.ceedar.org>

Part 2: Slides and Supporting Facilitator Notes and Text

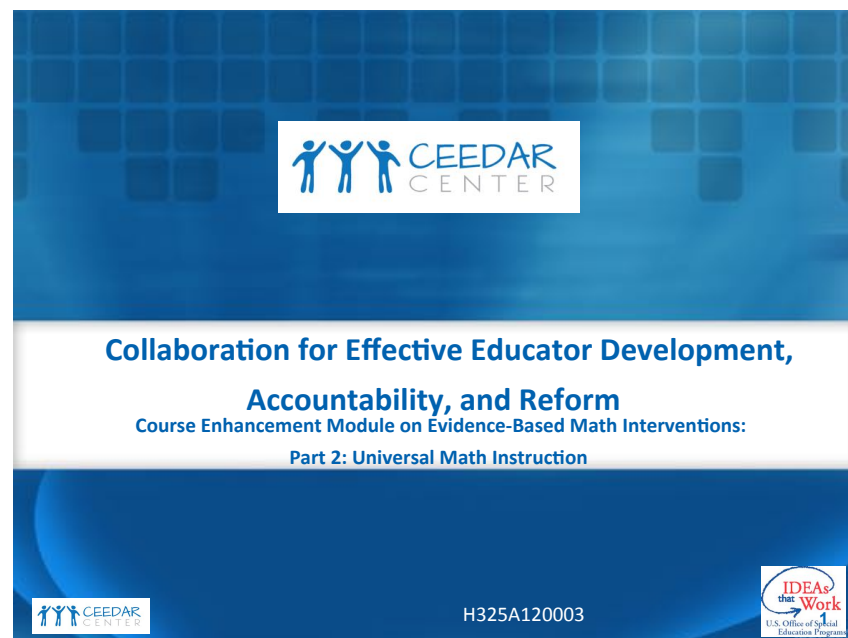
Slide 1—CEM on Multi-Tiered System of Supports in Mathematics: Part 2 (Universal Math Instruction)

In Part 2 of the CEEDAR Course Enhancement Module (CEM) on *multi-tiered system of supports in mathematics*, you will learn about the importance of implementing universal math curriculum and using data to assess if the curriculum is working to improve student outcomes in mathematics.

Speaker notes are provided for most of the PowerPoint slides included in each of the four parts of this CEM. The notes provide additional details about the information presented in a particular slide, including the context for the information presented as well as further elaboration of key points. Thus, the speaker notes are intended as a guide for the presenter who is using the PowerPoint slides and may be modified as needed. Specific citations for modules and webinars are also provided in the notes section of the slides.

Instructions for using the speaker notes:

- Text formatted in standard font is a sample script for the presenter. Although these may be read verbatim, speaker notes are intended as a guide for the presenter and may be modified as needed. Text formatted in italics is intended as directions or notes for the speaker.



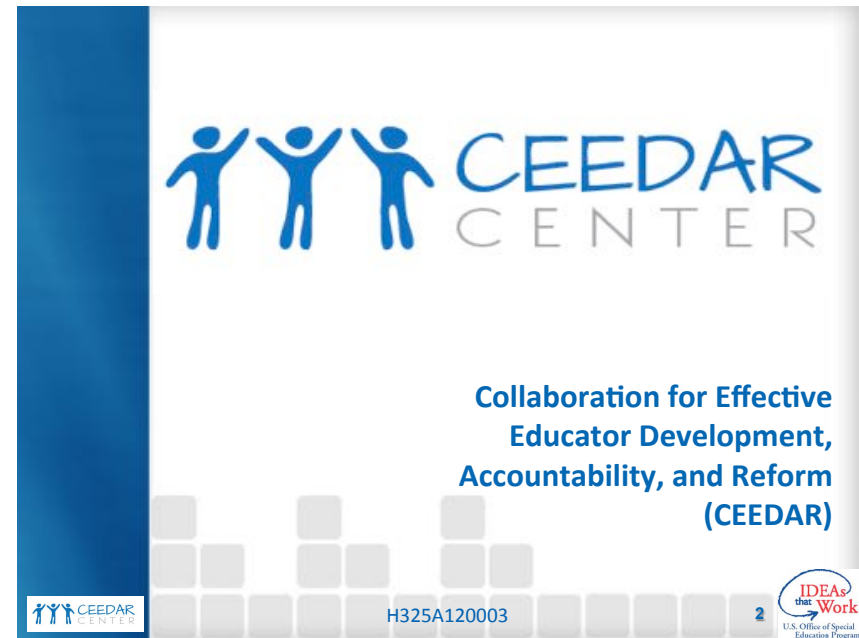
Find additional information below the slide notes in the PPT.

1

- An orange star on the slide indicates an active participant learning activity. The steps for interactive activities are described for each slide.

Slide 2

In light of many of these difficulties, CEEDAR was developed as a response.



Slide 3—Note

Give participants time to briefly view the slide.

Note

Part 2 comprises content and resources from:

- The National Center on Intensive Intervention (NCII): www.intensiveintervention.org
- Center on Response to Intervention: www.rti4success.org
- The IRIS Center for Training Enhancements. (2010). *RTI: Mathematics*. Retrieved from <http://iris.peabody.vanderbilt.edu/module/rti-math/#content>
- The IRIS Center Evidence-based Practice Summaries. Retrieved from http://iris.peabody.vanderbilt.edu/ebp_summaries/
- RTI Action Network: <http://www.rtinetwork.org>
- Understanding Language: <http://ell.stanford.edu/>
- Vocabulary Instruction and Assessment of Spanish Speakers Research Program: <http://www.cal.org/vias/index.html>
- CREATE Center: <http://www.cal.org/create/research/index.html>



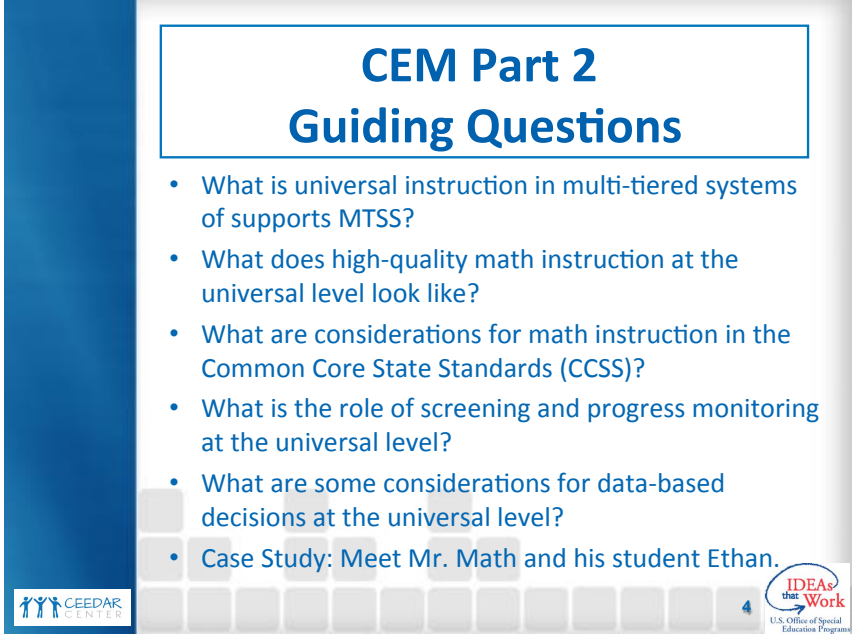
3

Slide 4—CEM Part 2 Guiding Questions

These guiding questions will be discussed in more detail in this CEM part:

- What is universal instruction in MTSS?
- What does high-quality math instruction at the universal level look like?
- What are considerations for math instruction in the Common Core State Standards (CCSS)?
- What is the role of screening and progress monitoring at the universal level?
- What are some considerations for data-based decisions at the universal level?

At the end of this CEM part, you will engage in a case study.

A graphic for a presentation slide titled "CEM Part 2 Guiding Questions". The title is in a blue box at the top. Below it is a list of six guiding questions in blue text. At the bottom left is the CEEDAR Center logo, and at the bottom right is the "IDEAS that Work" logo with the text "U.S. Office of Special Education Programs". The slide has a blue vertical bar on the left and a grid of grey squares at the bottom.

CEM Part 2 Guiding Questions

- What is universal instruction in multi-tiered systems of supports MTSS?
- What does high-quality math instruction at the universal level look like?
- What are considerations for math instruction in the Common Core State Standards (CCSS)?
- What is the role of screening and progress monitoring at the universal level?
- What are some considerations for data-based decisions at the universal level?
- Case Study: Meet Mr. Math and his student Ethan.

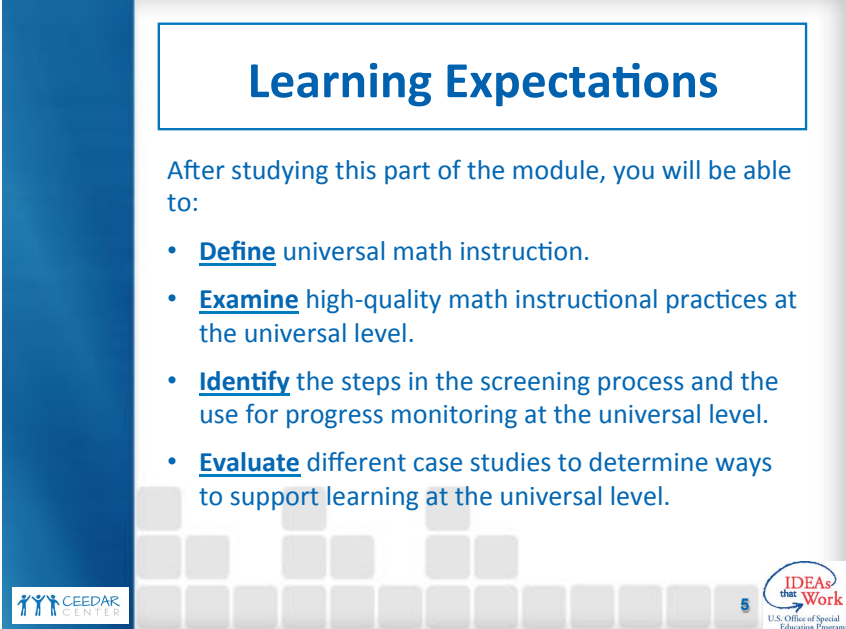
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IDEAS that Work
U.S. Office of Special Education Programs

Slide 5—Learning Expectations

These objectives will be covered in this CEM part.

Give participants a minute to read the objectives for this part.



Learning Expectations

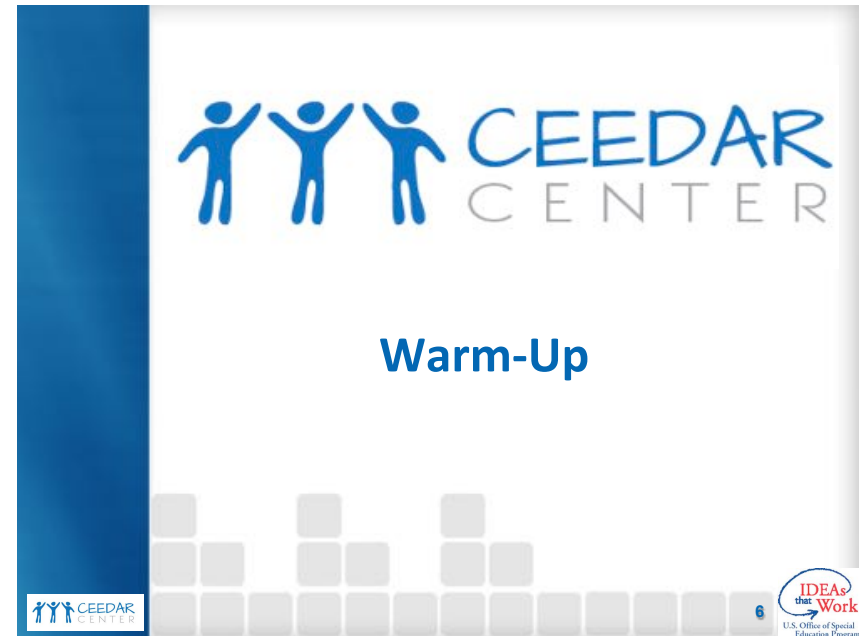
After studying this part of the module, you will be able to:

- **Define** universal math instruction.
- **Examine** high-quality math instructional practices at the universal level.
- **Identify** the steps in the screening process and the use for progress monitoring at the universal level.
- **Evaluate** different case studies to determine ways to support learning at the universal level.

  5

Slide 6—Warm-Up

In this CEM part, you will engage with the concept of universal math and how it fits into the MTSS model. Before we do that, let's take a moment to do a warm-up activity.



Slide 7—Activity: Sticky Note Carousel

Throughout Part 2, participants will engage with the content through interactive activities that they can also apply to their classroom teaching situations. These are noted with an orange star on the slide. Corresponding handouts are noted with a blue star. This first activity is called Sticky Note Carousel.

For Sticky Note Carousel:

1. *Tape the questions below (also in Handout 4) on walls around the classroom.*
2. *Give participants a thin stack of sticky notes. Students will use the sticky notes to answer the questions and then post the notes on the relevant wall (under each question).*
3. *Participants will revisit this activity at the end of Part 2. Therefore, encourage them to write their answers in blue ink so that they know which answer pertains to the warm-up activity (instead of the cool-down activity).*
4. *Discuss some of the answers as a class and reference certain answers as they arise throughout Part 2.*
5. *If there is time debrief on the activity, note that this anticipation activity helps you formatively gauge participants' pre-existing knowledge with respect to the content. Similar anticipation activities could be conducted in a math class.*

Handout 4

Interactive Activity

Activity: Sticky Note Carousel

- Use a sticky note to answer the questions posted on each wall.
- Post your sticky on the wall under each question.

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7

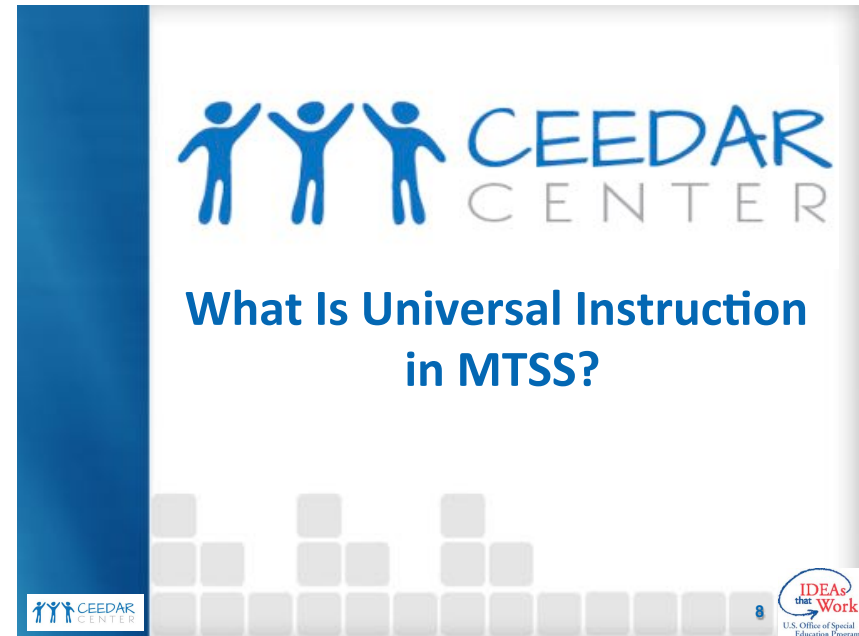
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Questions for Sticky Note Carousel:

1. What are features of high-quality universal math instruction?
2. What math skills receive focus in the Common Core State Standards—Mathematics (CCSS-M)?
3. What are universal math screeners? What makes a good universal math screener?
4. How is progress monitoring conducted at the universal level?
5. What are some considerations for data-based decision making at the universal level?

Slide 8—What is Universal Instruction in MTSS?

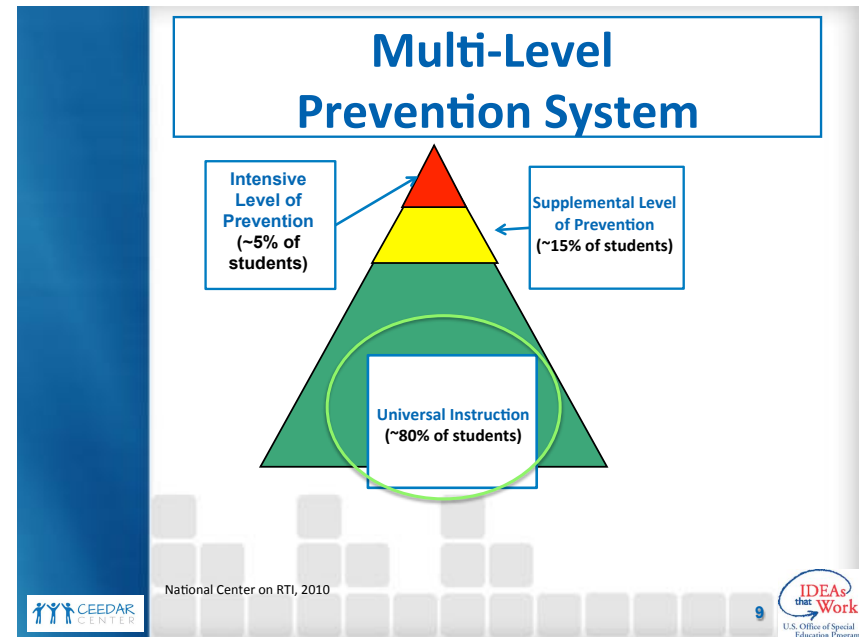
Before we talk specifically about universal math, let's discuss key characteristics of instruction at the universal level in MTSS. As we talk, remember that universal instruction is sometimes referred to as Tier I, core instruction, or primary level instruction. For the rest of the CEM, however, we will refer to it as universal instruction.



Slide 9—Multi-Level Prevention System

The triangle represents three levels of instructional intensity. The universal level includes high-quality core instruction. The supplemental level includes evidence-based intervention(s) of moderate intensity. The intensive prevention level includes individualized intervention(s) of increased intensity for students who show minimal response to secondary prevention. At all of these levels, instructional practices should be evidence based, meaning that research supports the use of the instruction.

Here in Part 2 of the CEM, we will discuss the universal level.



Slide 10—Universal Level

The focus at the universal level is on ALL students. It is delivered within the general education classrooms and is the school district's core curriculum, whether that is in the form of a complete universal program from a publisher or a district-developed program that is composed of best instructional practices. In any instance, however, instruction at the universal level should include instructional practices that are evidence based and aligned with state or district standards and national standards.

The assessments administered at the universal level of prevention are screening, continual progress monitoring (for students near the cut point for screening or those who have transitioned from more intensive levels of support), and summative assessments such as state assessments or final exams. School-based professional development (PD) is institutionalized and structured so that all teachers continually examine, reflect upon, and improve instructional practice.

Universal Level

- **FOCUS:** ALL students.
- **INSTRUCTION:** District curriculum and instructional practices that are research based, aligned with state or district standards, and incorporate differentiated instruction.
- **SETTING:** General education classroom.
- **ASSESSMENTS:** Screening, continual progress monitoring, and outcome measures or summative assessments.

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National Center on RTI, 2010

10

IDEA's that Work
U.S. Office of Special Education Programs

Slide 11—Universal Level

Give participants time to read the bullets on the slide.

Universal Level

- High-quality core math instruction (i.e., Tier I, primary level).
- Effective for approximately 75-80% of the students.
- Evidence-based or research-based high-quality instruction implemented with fidelity.
- Instruction for about 45-90 minutes per day for all students.

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National Center on RTI, 2010

11

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Slide 12—Features of Universal Instruction

The features of this MTSS level, the universal level, include high-quality evidence-based core instruction delivered with fidelity and consideration for cultural and linguistic responsiveness and recognition of student strengths. This level includes screening for all students and progress monitoring for those students who score below a determination point, or a cut score, on the universal screener. Another MTSS feature evident throughout all the MTSS levels is the process for data-based decision making. The four characteristics of universal instruction will be the focus in this CEM part.

Features of Universal Instruction

- High-quality instruction for all students
- Universal screening for all students
- Progress monitoring for some students
- Data-based decision making

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12

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Slide 13—CEM Part 2 Guiding Questions

We have discussed the first question in this CEM part. Now, we will discuss high-quality instruction at the universal level and will answer the next three questions. This discussion will be followed by the use of assessments at the universal level and then data-based decision making at the universal level. You can see how each of these Part 2 guiding questions align to one of the MTSS universal features.

CEM Part 2 Guiding Questions

- What is universal instruction in MTSS?
- What does high-quality math instruction at the universal level look like?
- What are instructional considerations for English learners in universal math?
- What are considerations for math instruction in CCSS?
- What is the role of screening and progress monitoring at the universal level?
- How should data-based decisions be made?

High-quality instruction for all students	
Universal screening for all students	
Progress monitoring for some students	
Data-based decision making	

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13

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Slide 14—What Does High-Quality Math Instruction at the Universal Level Look Like?

Universal math instruction should include evidence-based practices using a standards-aligned curriculum (Buffum, Matto, & Weber, 2012). Your school or district may use a comprehensive published math universal program or it may have conceptualized its own core universal math curriculum. According to Buffum et al. (2012), you should consider comprehensive programs as resources. However, you may need to modify the existing comprehensive program based on your students' needs or augment aspects of it for additional high-quality math instructional practices. Also, focus on implementing standards-based instruction using the relevant district standards. Therefore, we will first discuss some of the evidence-based features, or instructional practices, of high-quality math instruction before turning to discussion about the current national math standards.



Slide 15—Activity: Video Jigsaw Listening

As mentioned on the previous slide, at all MTSS levels, instructional practices should be evidence based. So let's explore this notion further. This term is important across all the MTSS levels: universal, supplemental, and intensive. It is often applied to intervention curriculum, assessments, and teaching practices. When an instructional feature or comprehensive instructional program or intervention is said to be *evidence based*, this means that there were likely a few experiments in which some students received the program or instructional feature and some students did not. If there were learning gains in the treatment group that were statistically significantly greater than in the control group, sometimes referred to as differential effects, then there is some indication that the instructional feature was helpful for student learning. When additional studies, called replications, find similar positive effects, there is better indication that the instructional feature facilitates student learning. Now let's watch a video featuring Dr. Allison Gandhi, principal researcher at the American Institutes for Research, who explains the notion of *evidence based* in more detail.

You may conduct this video activity through Jigsaw Listening. Jigsaw Listening is an activity that students/participants can then use in their teaching contexts.

For Jigsaw Listening:

1. *Students pair up and take out paper for taking notes.*



Activity: Video Jigsaw Listening

Watch as Dr. Allison Gandhi addresses the following question:
How do I know if tools and interventions are evidence based?



<http://www.rti4success.org/video/how-do-i-know-if-rti-tools-and-interventions-i-am-using-are-evidence-based>

National Center on Response to Intervention, n.d.a



15

2. *One person in each pair (half of the class) should watch the video in order to answer, “What is evidence-based practice?” The other partner should watch the video in order to answer the question, “What are considerations for selecting evidence-based tools and interventions?”*
3. *At the end of the video, partners share their responses with each other.*
4. *Debrief the content as a class. Ask: What is evidence-based practice and what should be considered in selecting evidence-based tools?*
5. *You may also debrief the activity as a class. Ask: How did this activity support students? (Students may respond that they were able to engage with a partner and discuss each of their answers with a partner before discussing as a whole class. Therefore, their partner could provide support and modelling if needed.)*

Consider different populations and student groups while exploring the evidence of a program or instructional feature.
Ask participants what subgroups they might explore further.

Slide 16—What Works Clearinghouse

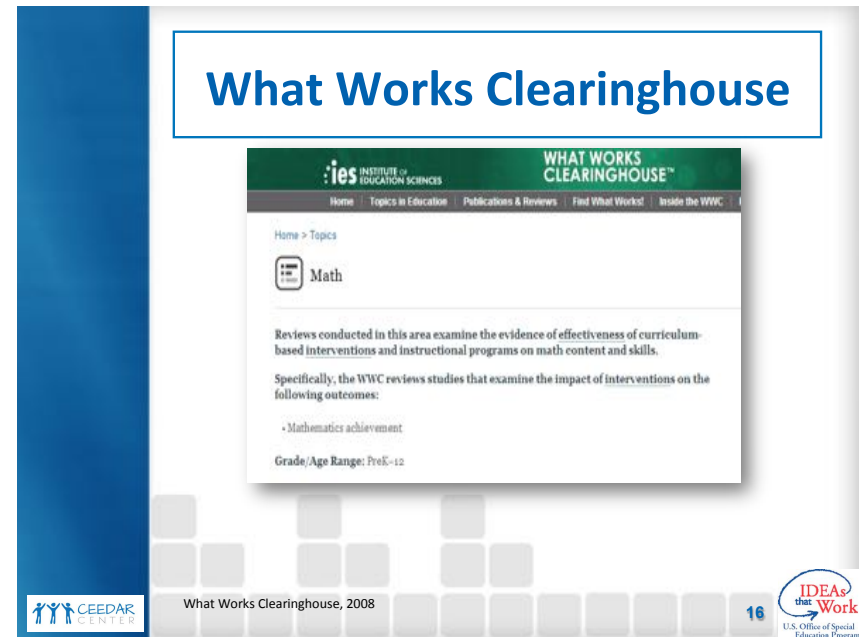
There is a list of evidence-based universal (as well as secondary and intensive) math programs and interventions on the What Works Clearinghouse (WWC) website. The WWC is part of the U.S. Department of Education's Institute of Education Sciences (IES), which was established under the Education Sciences Reform Act of 2002.

This link details WWC review procedures:

http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_procedures_v2_1_standards_handbook.pdf

Some universal program WWC research reports are summarized here:

http://iris.peabody.vanderbilt.edu/ebp_summaries/



Slide 17—WWC Effectiveness Rating Categories

There are the six WWC ratings. Understanding each rating will help you as you use the WWC website to identify universal math programs. Keep in mind that evidence should show function of the program with relevant student subgroups.

This link details WWC review procedures:

http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_procedures_v2_1_standards_handbook.pdf

Some universal program WWC research reports are summarized here:

http://iris.peabody.vanderbilt.edu/ebp_summaries/

WWC Effectiveness Rating Categories		
Rating	Evidence for Positive Effect?	Evidence for Negative Effect?
Positive effects	Strong evidence	No evidence
Potentially positive effects	Evidence	No evidence
No discernable effects	No evidence	No evidence
Mixed effects	Evidence	Evidence
Potentially negative effects	No evidence	Evidence
Negative effects	No evidence	Strong evidence

What Works Clearinghouse, 2008

17

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Slide 18—Best Evidence Encyclopedia

The *Best Evidence Encyclopedia* provides similar reports for evidence. Each program reviewed is rated for its level of evidence, and a symbol next to each program's name shows its rating. The categories of evidence of effectiveness are strong, moderate, limited (strong evidence of modest effects and weak evidence with notable effects), and no qualifying studies. Ratings are based on both the quantity and the quality of studies reviewed and consider the number of studies, the type of studies (preference for randomized or randomized quasi-experimental), sample size, and effect size.

For more information:

<http://www.bestevidence.org/math/mhs/top.htm>

The screenshot displays the Best Evidence Encyclopedia website. The main header reads "Best Evidence Encyclopedia" with the tagline "Empowering Educators with Evidence on Proven Programs". Below the header, there's a navigation bar with links: Home, About the BEE, Review Methods, Sign Up for News, Resources, and a Search bar. The main content area is titled "Mathematics / Middle and High School" and features a table with links to "Top-Rated Programs", "Key Findings", "Limited Evidence Programs", "Review Summary", "Other Programs", and "Review Methods". A sidebar on the left lists "Program Reviews" for Mathematics (Elementary, Middle/High School, Effectiveness of Technology), Reading (Beginning, Upper Elementary, Elementary, Middle/High School, English Language Learners, Struggling Readers, Effectiveness of Technology), and Science. A "Full Report" link is also present. On the right, a box titled "Best Evidence Encyclopedia Evidence Ratings" lists five categories with corresponding symbols: Strong evidence of effectiveness (yellow circle with a star), Moderate evidence of effectiveness (yellow circle), Limited evidence of effectiveness: strong evidence of modest effects (yellow circle with a star), Limited evidence of effectiveness: weak evidence with notable effects (yellow circle with a star), and No qualifying studies (N). The footer includes the CEEDAR Center logo, the text "Center for Data-Driven Reform in Education, n.d.; National Center on Response to Intervention, n.d.", and the "IDEAS that Work" logo with "U.S. Office of Special Education Programs".

Slide 19—Activity: Pairs to Squares Exploration

Now let's investigate some of the universal math programs using information from WWC or the Best Evidence Encyclopedia. *Conduct this activity using activity Handout 5. The activity, called Pairs to Squares, takes about 15 minutes to complete. Participants can keep track of this activity in their notebooks in order to draw on this when they begin teaching. For Pairs to Squares:*

1. Have participants work in the same pairs as the prior activity.
2. Each pair should pick two universal programs and explore the information on the WWC or Best Evidence Encyclopedia website.
3. After an appropriate duration of time, have partners combine with another pair (groups of four; "square the pairs") and share their findings.
4. If pair in the small groups investigated different programs, they can give a brief summary of the program. If they investigated the same universal program, they can each report their findings and discuss how their analyses were similar and different.
5. Debrief the activity with participants; noting how working in pairs, then small groups, helps provide peer scaffolding and support. They can keep these grouping structures in mind in universal math.

The graphic features a blue vertical bar on the left with a yellow starburst containing the text "Handout 5 Interactive Activity". To the right, a white box with a blue border contains the title "Activity: Pairs to Squares Exploration". Below the title is a screenshot of the "WHAT WORKS CLEARINGHOUSE" website. The website header includes "ies INSTITUTE OF EDUCATION SCIENCES" and navigation links: Home, Topics in Education, Publications & Reviews, Find What Works!, Inside the WWC. The main content area shows a search for "Math" with results for "Reviews conducted in this area examine the evidence based interventions and instructional programs on mathematics achievement." It lists "Specifically, the WWC reviews studies that examine the following outcomes:" and "Grade/Age Range: PreK-12". A sidebar on the right shows "Best Evidence Encyclopedia" and "Top Rated Programs". At the bottom, it says "Center for Data-Driven Reform in Education, n.d." and "What Works Clearinghouse, 2008". A small "CEEDAR CENTER" logo is in the bottom left, and a "19 IDEAS that Work U.S. Office of Special Education Programs" logo is in the bottom right.

Slide 20—High-Quality Math Instruction Includes:

Explicit instruction often entails initial instruction and modelling by the teacher, guided practice with the teacher, independent student practice and application, and reteaching to address misunderstandings. Although not math specific, many practices outlined by Paschler et al. (2007; IES Practice Guide) can be applied to math. These findings include space learning over time; use a sequence of content that builds understanding in meaningful ways (*see figure on slide for example of a sequence with fractions*); integrate examples with practice; combine visual and verbal descriptions; integrate abstract and conceptual representations; assess students to inform and facilitate learning; and teach students how to judge their own learning and strengthen their metacognitive skills, those skills that help them to think about their learning.

Have participants discuss these and other features.

For more information: The IRIS Center for Training Enhancements. (2010). High-quality mathematics instruction: What teachers should know.

High-Quality Math Instruction Includes:

- A mix of teacher-directed and student-centered instruction with explicit attention to math concepts by teachers and students.
- A rigorous cognitive level with a range of curricular components that build on each other in a coherent sequence.
- New math concepts introduced to students using a variety of different methods.
- Students prompted to explain thinking, practice solving problems, and reason conceptually, abstractly, and visually.
- Assessment that informs instruction.

Sequence of Skills—Common Core State Standards

Develop an understanding of fractions as numbers:

- Part/whole relationship
- Number on the number line
- Equivalent fractions
- Whole numbers as fractions
- Comparing fractions

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Center on Intensive Intervention, 2014

20
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Slide 21—Teachers Using High-Quality Math Instruction May:

Support students' math learning through modelling concepts and prompt them to expressively think aloud while they acquire and work with a new skill.

For explicit instruction, demonstrate each step related to a specific set of math problems and allow students to practice on a new set of problems using the same procedures (Baker, Gersten, & Lee, 2002; Gersten et al., 2009). Show students heuristic strategies that promote metacognitive math learning. Heuristic strategies are those that help students think about their math learning (e.g., underline key words, check work). These strategies are not math specific, but they help students attend to methods for solving math problems (Gersten et al., 2009), and these heuristic techniques are particularly supportive of students with learning disabilities.

Have participants think-pair-share ways they have seen their teachers implement these practices or have implemented these practices themselves.

For Think-Pair-Share:

- 1. Pose the question.*
- 2. Provide students a few minutes to reflect on their answers.*
- 3. Students find a partner and share together.*
- 4. Debrief answers as a whole class.*

Teachers Using High-Quality Math Instruction May:

- Relate content to prior experiences and build background knowledge when necessary.
- Explicitly instruct important concepts and how existing and requisite math skills can be used to solve problems.
- Model and demonstrate concepts and support students as they practice.
- Support students as they practice and prompt students to think aloud with respect to their math reasoning.
- Attend to students' math error patterns.
- Foster conceptual math understanding through the use of heuristic strategies.



IRIS Center, 2010; National Center on Intensive Intervention, 2014

21

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Slide 22—Teachers Using High-Quality Math Instruction May:

Develop students' math language. Academic English is the language of the classroom, of academic disciplines (e.g., science, history, and math) in texts and literature. It is often used in extended discourse related to reasoning (Schleppegrell, 2004, 2007). Unique linguistic patterns in math can be found in vocabulary, discourse, and with grammatical patterns. For example, to contend with math, one must relate math concepts to each other and work with more technical and sometimes abstract math vocabulary (see Bauman & Graves, 2010, for a discussion regarding academic vocabulary). Therefore, promoting skills connected to the language structures in math is helpful for student math learning.

Have participants think-pair-share how these practices can help promote student math learning.

Figure drawn from curriculum on <http://www.intensiveintervention.org/resources/sample-lessons-activities/mathematics>.

Teachers Using High-Quality Math Instruction Might:

- Develop math language
 - Promote word-level and text-level skills students will need to engage with and comprehend the math content.

Numerator: How many parts of the whole.

Denominator: How many parts make up the whole.

Figure from:
(National Center on Intensive Intervention, 2014)

22

Slide 23—Teachers Using High-Quality Math Instruction May:

Paivio (1990) brought forth the dual coding theory. The dual coding theory stipulates that learners draw on visual and verbal information when comprehending new information. Therefore, helping to strengthen the visual code for math concepts may help promote, facilitate, and support students' understanding, especially with more abstract concepts.

Read slide. Have participants think-pair-share ways they have seen their teachers implement these practices or have implemented the practices themselves.

Teachers Using High-Quality Math Instruction May:

- Promote visual representations:
 - Draw on visual and graphic representations for more abstract concepts.
 - Use manipulatives and multimedia.



McGraner et al., 2011; National Math Advisory Panel Report, 2008

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23

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Slide 24— Teachers Using High-Quality Math Instruction May:

At the universal level, there should be opportunities for student interactions and discussion and interaction between teacher and students using all modalities of language: reading, speaking, writing, and listening (Fuchs, Fuchs, Mathes, & Simmons, 1997; Moschkovich, 1999). Grouping configurations can be strategically applied to support math lesson objectives.

Look at the three square pictures. These pictures depict the grouping configurations: teacher-to-whole-class and independent practice. What do you notice about the level of engagement with the students in the square pictures? Do you think instruction is reaching all of them? (*Allow participants to share.*)

Now look at the circular pictures. What do you notice about the level of engagement? (*Allow participants to share.*) These grouping configurations increase student discussion and engagement with the math content. In paired work, half the class will be speaking at once.

The instructional goals of the lesson should be used to determine the grouping patterns for each class, and in turn the groupings should be supported by lesson goals and objectives.

Strategic grouping configurations can also support a gradual

The slide features a blue header with the title "Teachers Using High-Quality Math Instruction May:" in white. Below the title is a bullet point: "Enable engaged learning, including peer-mediated learning." The slide is decorated with six circular photographs showing various classroom interactions: a teacher at the front of a class, students working in pairs, and students in small groups. The slide includes the CEEDAR Center logo in the bottom left, the number "24" in the bottom center, and the "IDEAS that Work" logo with "U.S. Office of Special Education Programs" in the bottom right.

release of learning (e.g., teacher models, teacher models with students, students do it together, students do it alone), through which students' responsibility is increased as they acquire the concept (see Fisher & Frey, 2013, for discussion regarding gradual release). For example, a teacher may initially model a new math concept to the class (i.e., teacher-to-whole-class), then have students practice with a partner and confirm their answers in small groups. At the end of the lesson, when students have already engaged with the concept with their peers and acquired it through the teacher model, they may participate in an individual activity.

If there is time, conduct the noise experiment. Ask one participant to be the Noise Monitor. Pose a question to the class and call on one student. Have the Noise Monitor note the noise level. Then pose a second question and ask participants to share in pairs. Have the Noise Monitor note the noise level. Have participants discuss their feelings with respect to the noise level. Ask: Is a noisy classroom always a sign of an unmanaged class? What are additional considerations regarding peer learning? Students may respond that they should monitor the groups/pairs, that students should be held accountable for learning in form, that students may become more adept at peer learning activities as the year advances (with additional practice), that noisy activities should not be conducted when the next-door neighbor is administering an important test, etc.

Slide 25—Use Groupings Aligned to Instructional Goals

Paired instruction often includes students working in dyads. Cooperative small groups often entail small groups of students. Each student is usually held accountable for his or her learning and performance in the small group (Slavin, 2011). *Ask participants to discuss ways they may hold students accountable for learning in small groups.*

Peer tutoring and learning models show promise in the research as a way to support student learning and increase learning motivation while students practice a concept (Fuchs, Fuchs, Yazdian, & Powell, 2002; Roscoe & Chi, 2007; Saenz, Fuchs, & Fuchs, 2005). Peer tutoring should not be used as a means to teach entirely new concepts (Fuchs et al., 2002). With peer tutoring and learning, students teach each other.

Determine student groups using a variety of ways; do not always group based on math proficiency level or language proficiency level. Link your reasons for grouping and peer learning back to the needs of the lesson goals and objectives.

For more information:

http://iris.peabody.vanderbilt.edu/module/rti-math/cresource/how-can-teachers-effectively-implement-rti-formathematics/rti_math_11/rti_math_11_link_lessonplan/#content

Use Groupings Aligned to Instructional Goals

- Determine and combine grouping configurations based on instructional goals.

The diagram shows five blue boxes representing different grouping configurations: 'Cooperative, small groups', 'Paired instruction', 'Independent practice', 'Peer tutoring/learning models', and 'Whole class'. These boxes are arranged in a staggered, overlapping manner. Below the boxes is a grid of small grey squares.

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IRIS Center, 2010
25
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Slide 26—Teachers Using High-Quality Math Instruction May:

Instruction at the universal level should strive to meet the diverse needs of all students, including students with learning disabilities. At the universal level, this may include differentiation of instruction, or tailoring instruction to meet individual student needs (Tomlinson, 2000; Tomlinson & McTigue, 2006). Attention should be given to differentiation practices that are linguistically and culturally responsive, accommodations, and modifications. In universal instruction, differentiation may involve mixed instructional groupings, team teaching, peer tutoring or learning, learning centers, and accommodations to ensure that all students have access to the instructional program (Williams et al., 2014).

Consider the learning goals and universal math lesson objectives and then consider how you can help each student in class access those goals and learning objectives. How can you unlock the target math content for each child? For some students, you may need to scaffold their learning with some supports or present material in a different way. Other students will benefit from lessened support, removal of the scaffolds, or additional instructional enhancements. For example, you may observe that one student is a very visual learner. Therefore, during individual practice time, you may show that visual learner a digital image that depicts the target math concept. Differentiated instruction is NOT the same as the supplemental

Teachers Using High-Quality Math Instruction May:

- Implement accommodations to ensure that all students have access to the universal math program.

Might include:

- Co-teaching
- Mixed instructional groupings
- Peertutoring and learning
- Visual input
- Multimedia
- Manipulatives
- Scaffolds
- Learning centers

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26

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or intensive instruction that characterize the other MTSS levels. It is also NOT conducting three different kinds of lessons in one class, and math instruction should focus on the grade-level math concepts outlined by the standards.

If there is time, have participants reflect on times they have encountered differentiation, scaffolding, and removal of scaffolding in their lives. Also, have participants share ways they may differentiate math instruction at the universal level.

For more information: <http://iris.peabody.vanderbilt.edu/wp-content/uploads/2013/06/div.pdf#content>

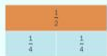
Slide 27—Supporting Students With Disabilities

Concrete graphical representations in universal instruction can provide support with more abstract math concepts. Consider also the needs of students with reading disabilities (see Jordan, 2007) as they engage with the language of math. These students may need some support with the language elements that arise in their math materials. Research shows promising effects in helping students with disabilities attend metacognitively to their math learning (think about their learning and acquisition) and heuristic strategies, or those strategies that help students think about their learning process, can help promote students' metacognitive mathematical thinking (Fuchs, et al., 2004).

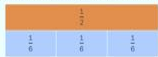
Support Learning for Students With Disabilities

Modeling:

1. Place the $\frac{1}{2}$ fraction bar in front of the student.
2. Place two $\frac{1}{4}$ fraction bars under the $\frac{1}{2}$ bar.

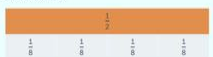


3. Explain that because $\frac{1}{2}$ and two $\frac{1}{4}$ bars are the same size, $\frac{1}{2}$ is equal to $\frac{2}{4}$.
4. Write $\frac{1}{2} = \frac{2}{4}$.
5. Provide one more example with $\frac{1}{2}$ and three $\frac{1}{6}$ bars.



Guided Practice:

1. Tell the student to take out the $\frac{1}{2}$ bar.
2. Tell the student to take out the $\frac{1}{8}$ bars.
3. Tell the student to see how many $\frac{1}{8}$ bars it takes to be equal with the $\frac{1}{2}$ bar.
4. Student response: 4.



- Use precise language to teach key concepts.
- Model, repeat, and demonstrate steps in a process.
- Provide concrete learning opportunities, including the use of manipulatives.

<http://www.intensiveintervention.org/resources/sample-lessons-activities/mathematics>

National Center on Intensive Intervention, 2014



27

For more information: National Center on Intensive Intervention. (2014). Fractions as numbers. Washington, DC: U.S. Department of Education, Office of Special Education Programs, National Center on Intensive Intervention.

Slide 28—Support Learning for Students With Disabilities

Peer assisted learning show promise in the research as a way to support student learning and increase learning motivation while students practice a concept (Fuchs et al., 2002; Roscoe & Chi, 2007; Saenz et al., 2005). Peer tutoring should not be used as a means to teach entirely new concepts (Fuchs et al., 2002).

Refer back to slide 25 for the various peer assisted learning models.

The National Center on Intensive Intervention has developed a collection of companion materials and activities intended to assist special education teachers, interventionists, and others working with students with intensive mathematics needs.

See more at:

<http://www.intensiveintervention.org/resources/sample-lessons-activities/mathematics>

Support Learning for Students With Disabilities

Feedback:

5. If correct, say, "Yes, $\frac{4}{8}$. You can see $\frac{1}{2}$ is the same as $\frac{4}{8}$. They're the same size. That means they're equivalent."
6. Have the student write the equivalent fraction: $\frac{1}{2} = \frac{4}{8}$.

Practice:

7. Repeat with $\frac{5}{10}$ and $\frac{6}{12}$.

Corrective Feedback:

Sample incorrect student response 1: " $\frac{1}{2}$ is equivalent to $\frac{3}{8}$."

Teacher feedback: " $\frac{3}{8}$ is not quite enough. Look at the tiles: $\frac{3}{8}$ is shorter than $\frac{1}{2}$. The fractions have to be the same size to be equivalent. Try it again. How many eighths are equivalent to $\frac{1}{2}$?"

Sample incorrect student response 2: " $\frac{1}{2}$ is equivalent to $\frac{5}{8}$."

Teacher feedback: Determine why the student made the error. Was it a counting error? Was it a visual/spatial error?

" $\frac{5}{8}$ is too much. Look at the tiles: $\frac{5}{8}$ is longer than $\frac{1}{2}$. The fractions have to be the same size to be equivalent. Try it again. How many eighths are equivalent to $\frac{1}{2}$?"

(Have the student demonstrate the correct procedure following the error before moving to the next problem.)

<http://www.intensiveintervention.org/resources/sample-lessons-activities/mathematics>

National Center on Intensive Intervention, 2014

- Provide repeated opportunities to correctly practice skills.
- Deliver feedback and direct error correction.
- Encourage the student to repeat the correct process when an error is made.

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28

Slide 29— Draw On Graphic Supports and Graphic Organizers

Also, while presenting information for students with math learning disabilities, consider additional formats and include visual cues. Graphic organizers, such as Venn diagrams, T-charts, word webs, and thinking maps, can help students identify concepts and make relationships among them, and teacher-prepared outlines equip students with a form for notetaking while reading dense text material. These visual representations also help support students acquiring English. These visual ways to present information help students make use of the visual representation route (as discussed in Paivio's dual coding theory) while English learners contend with the language.

Draw On Graphic Supports and Graphic Organizers

- Present information in a variety of visual formats.

Flowchart for Dividing Fractions

```
graph TD
    Start([Start]) --> Step1[Divide the dividend (first fraction)]
    Step1 --> Step2[Divide the divisor (second fraction)]
    Step2 --> Step3[Convert mixed numbers to improper fractions]
    Step3 --> Step4[Reciprocal of the divisor]
    Step4 --> Step5[Multiply the dividend by the reciprocal of the divisor]
    Step5 --> Step6[Reduce the fraction to lowest terms]
    Step6 --> End([End])
```

3/8 ÷ 1/4

Visual representation of the division $\frac{3}{8} \div \frac{1}{4}$ using three circular models. The first circle is divided into 8 equal sectors, with 3 sectors shaded blue to represent $\frac{3}{8}$. The second circle is divided into 4 equal sectors, with 1 sector shaded yellow to represent $\frac{1}{4}$. The third circle is divided into 8 equal sectors, with 6 sectors shaded blue to represent the result $\frac{6}{8}$, which simplifies to $\frac{3}{4}$.

Area Model

Area model for $\frac{3}{8} \div \frac{1}{4}$. A large rectangle is divided into 8 equal horizontal strips. The first 3 strips are shaded blue to represent $\frac{3}{8}$. The second 3 strips are divided into 4 equal vertical sections, with 1 section shaded yellow to represent $\frac{1}{4}$. The third 2 strips are shaded blue to represent the result $\frac{6}{8}$, which simplifies to $\frac{3}{4}$.

<http://www.intensiveintervention.org/resources/sample-lessons-activities/mathematics>

National Center on Intensive Intervention, 2014

29

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Slide 30—Address the Needs of English Language Learners

Before a student moves from the universal level to the supplemental level, it should be determined that the student received linguistically and culturally appropriate instruction within the universal curriculum (Sanford, Brown, & Turner, 2012).

Let's talk about considerations for English language learners (ELLs).

While engaging with this part of the CEM, keep in mind that ELL students in the U.S. are a heterogeneous group. English learners' language proficiency profiles may be different; some students may come to their schooling experience in English with strong first-language proficiency while others may not have developed their first language fully before acquiring English (Brown & Doolittle, 2011). Therefore, instructional guidelines in this CEM section should be taken as general considerations and with acknowledgement that each of your ELL students will have individual learning needs.

Let's watch a video in which Dr. Artiles, professor at Arizona State University, talks about ways to be culturally responsive to the needs of ELLs in an MTSS framework. Keep the following question in mind as you watch the video: What should educators take into consideration when instructing ELLs,

Address the Needs of English Language Learners

- Watch and listen as Dr. Alfredo Artiles talks about considerations for instruction in MTSS for English language learners (ELLs).



<http://www.rti4success.org/video/what-should-educators-take-consideration-when-instructing-english-language-learners>
Center on Response to Intervention, n.d.f

Esparza Brown & Sanford, 2011

particularly in an MTSS framework?

Debrief answers as a class.

Broadly speaking, although good, high-quality instruction is generally helpful for English learners, research also indicates that additional instructional supports are beneficial for English learners' content learning (August & Shanahan, 2006; Gersten et al., 2007; Baker et al., 2014). Some promising practices that help support their learning across disciplines in the universal level are multimodal in nature. These multimodal practices draw on multiple modes of input, including visual and nonlinguistic support. Multimedia that integrates animated visualizations, oral language, and, if with captions, written connected text, is well suited to supporting English learners content learning. Other promising practices indicated by research also help strengthen students' text-level skills such as promotion of vocabulary development and students' academic language development (see August & Shanahan, 2006).

Sanford, Brown, and Turner (2012) presented the PLUSS model of instruction, which integrates many of these aspects. They presented the PLUSS model related to reading instruction, but many of these aspects will apply if you add math next to reading:

P: Preteach critical vocabulary

L: Language modeling and opportunities for using academic language

U: Use visuals and graphic organizers
S: Systematic and explicit instruction in reading (and math) components and strategies
S: Strategic use of native language

For more information:

<http://www.rti4success.org/sites/default/files/rtiforells.pdf>

Slide 31—Use Valuable Resources

Because English learners have experience with other countries and/or languages, they will bring unique backgrounds with them to their learning situations, and these funds of knowledge can be drawn upon to promote content instruction in English (Baker et al., 2014; Echevarria, Vogt, & Short, 2013), including math. You can work with students to understand their backgrounds and find out ways to make them feel comfortable, empowered, and supported in their new learning environment.

If there is time, have participants speak in small groups about times they traveled to a new country, watched another country's TV show, or participated in a new sport. Have the groups discuss cultural elements that were new to them and how they felt navigating new cultural contexts. Have groups discuss ways they can help support students new to the schooling structures here in the United States. Also, have groups discuss ways they can find more information about a

Use Valuable Resources

- Draw on students' background experiences and home languages as learning resources.

Triángulo in Spanish and triangle in English are cognates. They look and sound alike and mean the same thing.

1 ½

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Moshkovich, n.d.; National Center on Response to Intervention, n.d.b; Understanding Language, 2010

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31

child's background and prior schooling experiences and support students with their new learning environments and in building new background.

For more information, reference CEEDAR's culturally responsive education innovation configuration at:

<http://cedar.education.ufl.edu/wp-content/uploads/2014/08/culturally-responsive.pdf>

Other resources for more information include:

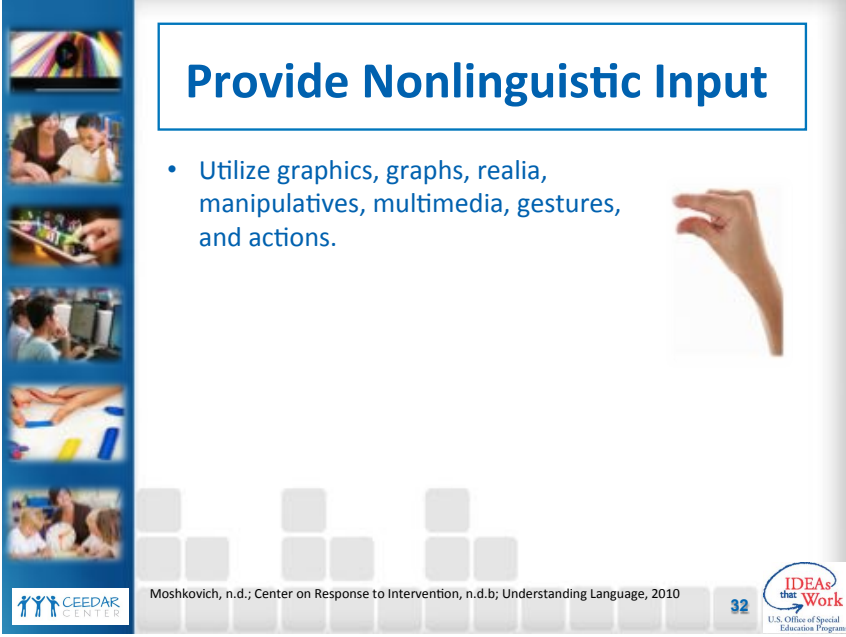
<http://www.rti4success.org/sites/default/files/rtiforells.pdf>

http://ell.stanford.edu/sites/default/files/math_learnmore_files/2.Principles%20for%20Math%20Instruction%208-14-13.pdf

http://ell.stanford.edu/sites/default/files/math_learnmore_files/4.Language%20of%20Math%20Task%20Templates%2010-4-13.pdf

Slide 32—Provide Nonlinguistic Input

Engage with slide.



The slide features a vertical sidebar on the left with six small images: a rainbow, two children, hands with blocks, a child at a computer, hands with blocks, and two children. The main content area has a title box at the top right, a bulleted list, and a hand icon. The footer includes the CEEDAR Center logo, a citation, a slide number, and the IDEA logo.

Provide Nonlinguistic Input

- Utilize graphics, graphs, realia, manipulatives, multimedia, gestures, and actions.

Moshkovich, n.d.; Center on Response to Intervention, n.d.b; Understanding Language, 2010

32

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Slide 33—Utilize All Language Modalities

Engage with slide.

Utilize All Language Modalities

- Provide varied opportunities for practice and reinforcement of math concepts in speaking, listening, reading, and writing.





Moshkovich, n.d.; Center on Response to Intervention, n.d.b; Understanding Language, 2010



33

Slide 34—Promote Academic Math Conversations

Encourage all students to engage with class math discussions. As students are in the formative stages of acquiring English, Moschkovich (n.d.) cited that instructors should focus on their math reasoning and knowledge and their utilization of math practices, instead of extensive focus on English learners' accuracy with language use or language mistakes they may make.

For more information, see:

http://ell.stanford.edu/sites/default/files/math_learnmore_files/2.Principles%20for%20Math%20Instruction%208-14-13.pdf

http://ell.stanford.edu/sites/default/files/math_learnmore_files/4.Language%20of%20Math%20Task%20Templates%2010-4-13.pdf

<http://www.rti4success.org/resource/implementing-effective-literacy-practices-instructing-english-language-learners-within>

Promote Academic Math Conversations

- Provide authentic ways for students to engage in meaningful math conversations.
- Help students actively use their academic math language.

Moschkovich, n.d.; Center on Response to Intervention, n.d.b; Understanding Language, 2010

34

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Slide 35—Support Academic Math Conversations

Model academic language for students and apply language scaffolds to help prompt students' expressive use of academic math language. Allow for some additional time as your ELL students are participating in academic math conversations (Echevarria, Vogt, & Short, 2013), especially for students in the formative stages of English acquisition. Without some additional wait time, the class conversation may have moved on before that child could participate.

As a class, brainstorm other ways to support academic math conversations.

For more information, see:

http://ell.stanford.edu/sites/default/files/math_learnmore_files/2.Principles%20for%20Math%20Instruction%208-14-13.pdf

http://ell.stanford.edu/sites/default/files/math_learnmore_files/4.Language%20of%20Math%20Task%20Templates%2010-4-13.pdf

<http://www.rti4success.org/resource/implementing-effective-literacy-practices-instructing-english-language-learners-within>

Support Academic Math Conversations

- Model academic math language for students.
- Provide sentence frames and other scaffolds to help support academic math talk.
- Allow for additional wait time in discussion.
- Speak clearly and slowly.



To compute this problem, first I ____.

Then, I _____. After that, I _____.

I know my solution is accurate because _____.

Moshkovich, n.d.; Center on Response to Intervention, n.d.b; Understanding Language, 2010

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Slide 36—Engage Students in Peer Learning

English learners benefit from engaged learning time so that they can routinely and actively practice with English. Moreover, when active, engaged learning takes place in a certain subject (in this case, math), students expressively practice the language structures that are often found in that subject's language register. Therefore, peer learning and active student engagement has been shown to be supportive for ELLs (Baker et al., 2014; Gersten et al., 2007) because it provides authentic opportunities for students to actively engage with English—the language they are acquiring—and when this occurs in math, it is also in the register of the math subject area.

At the same time, keep in mind that some learning structures of other countries may be different. A child coming from a teacher-to-whole-class lecture-style learning situation may benefit from some adaptations to support them as they begin to engage with peer learning activities.

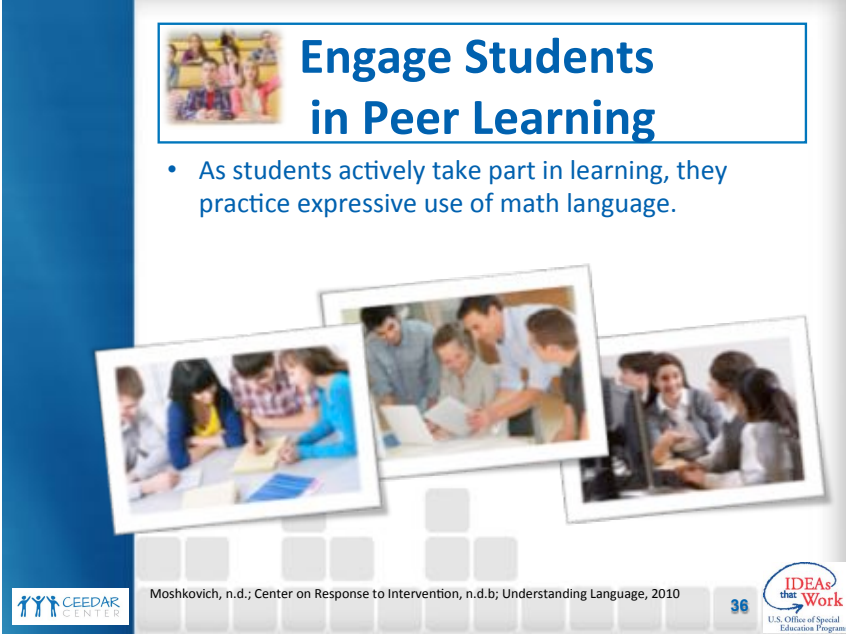
Have students share how they may help support students as they acclimate to interactive learning.

For an example of math interactive activities:

<http://www.cal.org/create/pdfs/siop-math-tip-final.pdf>

For more information, see:

http://ell.stanford.edu/sites/default/files/math_learnmore_file/2.Principles%20for%20Math%20Instruction%208-14-13.pdf



Engage Students in Peer Learning

- As students actively take part in learning, they practice expressive use of math language.

Moshkovich, n.d.; Center on Response to Intervention, n.d.b; Understanding Language, 2010

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36

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http://ell.stanford.edu/sites/default/files/math_learnmore_files/4.Language%20of%20Math%20Task%20Templates%2010-4-13.pdf

<http://www.rti4success.org/resource/implementing-effective-literacy-practices-instructing-english-language-learners-within>

Slide 37—Enhance Students' Math Vocabulary

Now let's turn to vocabulary instruction's place in universal math instruction. Universal math instruction should consist of some vocabulary instruction for all students as a way to help support their promotion of word-level elements in their math materials. Vocabulary is a key determinant in models of reading comprehension, but it is also an important component in content knowledge acquisition and academic success, and acquiring the vocabulary of a content domain is associated with success in that content (in this case, math; see Bravo & Cervetti, 2008; Schleppegrell, 2007). English is a vocabulary-rich language with a vast and ranging lexicon (i.e., universe of words; Nation, 2001). Some research suggests that children will acquire 50,000 words by the time they leave secondary school (Graves, 2006). So English vocabulary acquisition is a tall order for many school-aged children. Fostering vocabulary development across content areas can prove to be very beneficial for all students; in many cases, it will be extremely beneficial for students such as English learners and students with learning disabilities because, at times, the vocabulary level poses some challenge for these learners (see August &

Enhance Students' Math Vocabulary

- Evidence-based vocabulary instruction should:
 - Be daily and explicit.
 - Consist of definitions and contextual examples.
 - Include repeated exposure to target words over several days.
 - Engage students in active, deep processing activities with target words in reading, writing, listening, and speaking.
 - Include regular review of words that are difficult for students to acquire.

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Center on Response to Intervention, n.d.b
37
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U.S. Office of Special Education Programs

Shanahan, 2006).

Recent research suggests that vocabulary instruction that is daily and explicit and includes repeated exposure that promotes deep processing of target words can be effective for all students. These studies show that exposure can come in a variety of forms, including use of visuals, such as illustrations and graphic organizers; use of videos; paired activities between ELLs and English proficient students; group discussions; and writing activities. The goal of these vocabulary instructional components is for students to develop an understanding of word meanings to the point where they can use these and related words in their communication and as a basis for their content area learning.

With respect to the math language register, a level of depth, or quality, of word knowledge is needed for some conceptual words in order for students to grasp the math concepts (Marzano, 2004; Schleppegrell, 2007). For some conceptual words vital to math, it may not be enough for a student to have a general sense, or flavor, for the word, they may need more complete word knowledge (Marzano, 2004)—one has to understand fully what a *hypotenuse* is if one is going to apply the Pythagorean Theorem. Consider Marzano's (2004) point when choosing words for rich vocabulary instruction in math; we will talk about choosing words shortly. Because the math register is technical in nature, a characteristic of math language

regards multiple-meaning words; students may encounter new technical, or domain-specific, word meanings for word forms they already know (e.g., *table*, *operation*, *expression*, *solution*). These words may pose a challenge for language learners and students with reading disabilities. Therefore, draw their attention to the new meaning for the known word form and the way it appears in the content area (in this case, math; see Bravo & Cervetti, 2005).

Let's talk about what makes up math vocabulary. Domain-specific words are those words that are mainly found in the content areas. For math, domain-specific words are *measurement*, *diameter*, *cubic*, etc. These words are more technical in nature, conceptually key to a content area, and in many cases lower frequency (compared to words that cross-cut subject areas). Although these words are useful for students, current research (Baker et al., 2014; Gersten et al., 2007; Nagy & Hiebert, 2011) and the CCSS (2013) authors also recommend focusing on words that cut across content areas. These are called general academic words—like *identify*, *determine*, *scarcely*. They have high dispersion across the content areas, meaning that they are found across the disciplines. Words of grammatical cohesion, or connectives, also fall under this category—for example, *however*, *therefore*. These connectives join ideas and signal shifts in text, and in math understanding, these words may help students better comprehend conceptual and relational elements of math problems, math word

problems and text \book explanations (see Nation, 2001; Uccelli, Rosenthal, & Barr, 2012).

Concerning English learners, note that in some cases, they may present with different vocabulary needs from their non-English-learner peers. For example, English learners may need additional assistance with words that native speakers already know and are not part of the academic curriculum. For example, ELLs may not know words such as *bank*, *take*, *sink*, or *can*, yet textbook publishers will assume that students know these words and not include them as vocabulary targets. Teachers should provide students with a brief instruction during lessons that emphasizes the meanings of common phrases and expressions, not just single words. They can also draw attention to potentially confusing words and phrases during instruction. In other cases, some ELLs may more easily acquire words that may be more arduous for their non-ELL peers. For example, words that are shared across two languages and words that are higher frequency in the ELL's first language may present with a lessened learning challenge for the ELL student compared to a child who does not have experience with that other language. (Remember that the ELL student population is heterogeneous and the transfer effect across languages may not be as evident with ELLs who have less developed first languages.)

Formatively assessing students' vocabulary knowledge can help

shed light on the kinds of words they may need additional instructional support on. Let's now turn to some elements of strategic vocabulary instruction with respect to math.

For more information, see:

http://ell.stanford.edu/sites/default/files/math_learnmore_files/2.Principles%20for%20Math%20Instruction%208-14-13.pdf

http://ell.stanford.edu/sites/default/files/math_learnmore_files/4.Language%20of%20Math%20Task%20Templates%2010-4-13.pdf

<http://www.rti4success.org/resource/implementing-effective-literacy-practices-instructing-english-language-learners-within>

Slide 38— Robustly Instruct Judiciously Chosen, Useful Words

Choose words and phrases for rich vocabulary instruction very carefully. A prudent selection of words for rich instruction is critical because rich vocabulary instruction, instruction that prompts students' deep processing of word meanings (see Beck & McKeown, 2002; Coyne, McCoach, & Kapp, 2007), although effective, is also time intensive. Accordingly, only a handful of words should be taught at a time. Some authorities recommend teaching about eight to 10 words per week; others suggest two to three words per day.

Think about selecting those words that students would be less likely to acquire through their own means or the words that

Robustly Instruct Judiciously Chosen, Useful Words

- Present a few key domain-specific and general academic words and phrases in child-friendly language and apply the word to its use in math.

Equivalent
When something is equivalent it is the same or equal.

Equivalent
Are these apples equivalent? Use the word equivalent in your answer.

Equivalent
Equivalent fractions are equal. They are the same amount.

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38

need the intensive instructional target. At the same time, remember that it may be better to richly instruct math conceptual words that students need depth of knowledge for in order to accrue math content (Marzano, 2004).

You may choose general academic words that are frequent in texts, domain-specific words that are conceptually important to the math content, and other general academic words that students will need to know in order to better understand the domain-specific word. In order to *measure* something, for example, students must *evaluate* the *length*. Therefore, teaching high-utility general academic words like *evaluate* as well as some important domain-specific vocabulary like *measurement* and *length* can help students develop deeper conceptual understandings of the math measurement content (Baker, et al., 2014; see Marzano & Marzano, 1988, for discussion of mega-cluster approach to word selection).

Have participants look at the vocabulary picture cards and discuss elements that are present on the cards and how they might enhance the instruction.

Slide 39—Apply Embedded Instruction With Richer Approaches

In addition to intensive rich vocabulary instruction, other words can also be targeted through brief parenthetical explanations or through meanings and/or translations provided at the bottom or margin of a page (sometimes called glosses). This less robust approach is what Coyne et al. (2007) call embedded instruction (see also Graves et al, 2014). Words that may be well served through embedded instructional means may be those that are more concrete, more easily mentally imaged, and more easily defined (see August et al., 2012).

Let's look at how rich vocabulary instruction might work in tandem with less-robust embedded vocabulary instruction within the context of a math lesson. In this lesson on fractions, the words *determine*, *denominator*, and *common* are crucial for students to understand in order to complete the math activity. *Determine* and *common* are also words that are higher-frequency in school text (see Zeno, Ivenz, Millard, & Duvvuri, 1995) and therefore, knowing those words will be useful for students beyond math. The domain-specific word, *denominator*, is certainly not nearly as frequent as the general academic words, but it is a conceptually integral word for one to work with fractions. Here *convert* is a good candidate for embedded instruction because it is more easily defined and slightly more concrete. It is also a cognate with Spanish, *convertir*; it sounds and looks similar and means the same thing

Apply Embedded Instruction With Richer Approaches

- Use grade-appropriate math materials to find high-frequency words/phrases or words/phrases conceptually important to the subject of math. Richly instruct a few high-utility words. Provide embedded explanations (or marginal glosses) for a few words that are more concrete and easily defined through parenthetical means.

Using Fraction Bars to Determine Least Common Denominator

Each bar has a number, 1-9, at the beginning, and each of its multiples is listed (up to 9) on the bar.

3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	

$3 + 3/4 =$

Rich Instruction

- determine
- common
- denominator

1. Select the fraction bars for 3 and 4. Line them up next to each other.

2. By looking at the fraction bars, determine the LCM, which is 12.

3. Convert each fraction to a new fraction with the denominator 12.

a. $2/3 = 7/12 \rightarrow 12 \div 3 = 4 \rightarrow 4 \times 2 = 8 \rightarrow 2/3 = 8/12$

b. $3/4 = 7/12 \rightarrow 12 \div 4 = 3 \rightarrow 3 \times 3 = 9 \rightarrow 3/4 = 9/12$

Convert, or change, each fraction into a new fraction.

Lesson from National Center on Intensive Intervention, 2014

39

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across both languages.

Slide 40—Help Students Become Adept Independent Word Learners

In tandem with rich instruction and embedded support for high-utility vocabulary, you can promote strategies that help students become better independent word learners. This will be a key skill for them, as the majority of vocabulary they will acquire will be through more independent means (see Graves, August, & Mancilla-Martinez, 2013). While word learning strategies are often discussed in the context of reading instruction, these techniques may also be useful for students as they engage with math texts. Consider the grade-level universal math content and materials to help inform you about the language structures that might be targeted for this instruction.

The word learning strategies highlighted in prior research and supported in the CCSS include: structural analysis, or analysis of word parts, sometimes also referred to as morphology instruction (Bauman et al., 2002; Deacon et al., 2010; Goodwin & Ahn, 2010; Kieffer & Lesaux, 2007); contextual analysis (Bauman et al., 2002), or drawing students' attention to the context clues in the text; and promotion of students' use of word reference materials (Graves, 2006). Promoting students' awareness of cognates, or words that are shared across both languages, can be particularly supportive for English learners

Help Students Become Adept Independent Word Learners

- Promote student use of word learning strategies when encountering unknown words.

When you come across an unknown word:
Examine, Infer, Check.



Examine. Inspect the word and surrounding text. Look for clues **inside** the word and look for clues **outside** of the word in the surrounding text.

1. Look for word parts you might know. **Morphology**
2. Think about whether the word looks similar to a word in your other language. **Cognate/Analogous**
3. Find clues to the word's meaning in the surrounding text. **Context Clues**

Infer. Try to determine the word's meaning.

Check. If you need, check the word's meaning with a word reference source (e.g., dictionary, thesaurus, etc.). **Word Reference: Dictionaries, Thesaurus**

(Carlo et al., 2004; Dressler & Kamil, 2006).

Although these are four distinct word learning strategies, they also work together as one attends to a text and language through metacognitive means (Baker et al., 2014). For example, the context of the surrounding text can help a reader determine word parts from a word and whether that word is a cognate. The learner will need the context of surrounding text to determine which dictionary meaning entry they should ultimately choose. Graves (2006) recommends devising an approach to word learning strategies.

For more information, see:

<http://www.rti4success.org/resource/implementing-effective-literacy-practices-instructing-english-language-learners-within>

Slide 41—Word Learning Strategy: Structural Analysis

Structural analysis is the analysis of word parts such as roots, prefixes, and suffixes. A prefix is a group of letters that goes in front of a word. In addition to teaching students the meanings of these word parts, students can also practice with word and sentence deconstruction and reconstitution activities with respect to the parts such as building affixed words (Graves, 2006). Drawing on an ELL's funds of knowledge with their language background, you may also directly translate word parts across languages (e.g., "ly" in English is "mente" in Spanish), and point to the word parts that are the same across both languages ("re" in English is "re" in Spanish; Graves et al., 2013).

Word Learning Strategy: Structural Analysis

- Focus on key word parts (prefixes, suffixes, and roots) that appear frequently in math materials.

The diagram shows the word 'recalculate' broken down into its components: 're' (again), 'com' (recompute), 're' (remeasure), and 'calculate'. It also shows 'recalculate' broken down into 're' (again) and 'calculate'. Below this, the word 'recalculate' is shown with a picture of a boy calculating, and the word 'recalculating' is shown with a picture of a boy calculating. The text 'The boy recalculates the addition problem three times.' is written below the pictures. To the right, the word 're-measured' is shown with a picture of a boy measuring, and the text 'The mom re-measured the boy. She measured the boy a second time.' is written below the picture.

Triangle is a Latin word.
"Tri" in Latin means "three" in English.
"Ang" in Latin means "bend" in English.
Triangle = three bends.

re
again

recompute
remeasure
recalculate

re
again

recalculate

recalculating

The boy recalculates the addition problem three times.

41

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Slide 42—Word Learning Strategy: Structural Analysis

Draw students' attention to context clues as they arise in math materials and texts. Name the kind of clue (e.g., a pivot, definition). For frequent kinds of context clues, you may have students actively find illustrations for the clue or make note of the clue (Bauman et al, 2002; Graves, 2006; Graves et al, 2013).

Word Learning Strategy: Contextual Analysis

- Draw attention to context clues as they arise in math materials and texts. Have students actively find illustrations for the clue. Name the clue. Some common clues are:

Context Clue	Example
Definition	A diameter is a part of a line that goes through the center of the circle with endpoints on the circle.
Example	The Earth is a sphere.
Pivot	John has four apples, but Sandy only has two.



42

Slide 43—Word Reference Material Skills

Help students attend to the unique text features of their dictionaries, bilingual dictionaries, or digital dictionaries. With technology today, many digital pages have hyperlinked meanings of translations for key vocabulary; books may have those same scaffolds in the margins—an element called marginal glosses (Blachowicz & Fisher, 2002). Research indicates that students benefit from support in how to make use of these scaffolds and that includes understanding when to look up a word and go back to read the page or word problem a second time with the new known word meaning (Nation, 2001).

Word Reference Material Skills



Reinforce students' use of headwords and ways to determine the correct word sense in a multiple-meaning dictionary entry.



Facilitate students' use of hyperlinked words and marginal glosses with digital texts.

Emphasize rereading text after a word meaning is determined.



43

Slide 44—Word Learning Strategy: Cognate Awareness Analysis

Cognates are words that sound and look similar across two languages and have similar meanings; research studies have generally found positive effects regarding instruction that fosters this kind of awareness for English learners (see Carlo et al., 2004). You may point out cognates that are encountered in the math content and record the word; students may individually search for cognates in their math materials. Applying contrastive analysis, or analysis related to the word differences across both languages, can help promote students' cognate awareness (Graves, August, & Mancilla-Martinez, 2013). Also, help support students understanding related to false cognates, or those words that look alike across two languages, but do not mean the same thing.

Word Learning Strategy: Cognate Awareness Analysis

- Draw students' attention to words that are similar across both languages.
- Contrast across both languages.

English Word	Spanish Word	Differences
calculate	calcular	te → ar
problem	problema	a added to Spanish word
fraction	fracción	tion → cion

- Find these words in math materials.



44

Slide 45—Enhance Environment With Math Language and Concepts

The picture on the right portrays a classroom without environmental enhancements or print. What do you think of this classroom? How would you like to be a student learning there? If a student, any student, looks around, there are no cues to help reinforce the math language or concepts encountered in the lessons—they just look up to see a drab yellow wall.

You can enhance the classroom's physical classroom environment with the language of math and math concepts. Adding pictures to the word wall also helps increase visualization. Other bulletin boards may include important sentence frames to help support students participate in math conversations or engage in peer learning or may graphically show certain math concepts. You can also explicitly show students the environmental print in your math classroom and draw on those assets in your instruction as reinforcers and scaffolds (Harmon et al., 2009).

At the same time, keep the walls and bulletin boards organized. If they are too busy, students may become overstimulated or confused when attempting to engage with the environmental print.

Enhance Environment With Math Language and Concepts

- Post academic math language around the classroom. Use visuals, graphic support, and color coding to promote visualization.

45

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Have participants look at each bulletin board example and think-pair-share about ways to improve each one.

Slide 46—Activity: Explore the Instructional Quality

Now let's take some time to explore one of the universal math programs from the WWC for some of these math instructional features that we discussed in these last two CEM sections. On the same worksheet as the last activity, Handout 5, explore one universal math program for some of the instructional practices we discussed for all students as well as those elements of differentiation.

Have participants work in either the same small group as the last activity or in their pair from the last activity. They should do Part 3.

Handout 5
Interactive Activity

Activity: Explore the Instructional Quality

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Home > Topics

Math

Reviews conducted in this area examine the effectiveness of research-based interventions and instructional programs.

Specifically, the WWC reviews studies that have the following outcomes:

- Mathematics achievement

Grade/Age Range: PreK-12

Best Evidence Encyclopedia
Empowering Educators and Leaders to Boost Student Achievement

Home | What Works | Research | Practice | News | About

Mathematics: Middle and high school

Topic	Findings
Classroom Management	Classroom Management
Classroom Organization	Classroom Organization
Classroom Climate	Classroom Climate
Classroom Structure	Classroom Structure
Classroom Culture	Classroom Culture
Classroom Environment	Classroom Environment
Classroom Resources	Classroom Resources
Classroom Processes	Classroom Processes
Classroom Products	Classroom Products

Center for Data-Driven Reform in Education, n.d.; What Works Clearinghouse, 2008

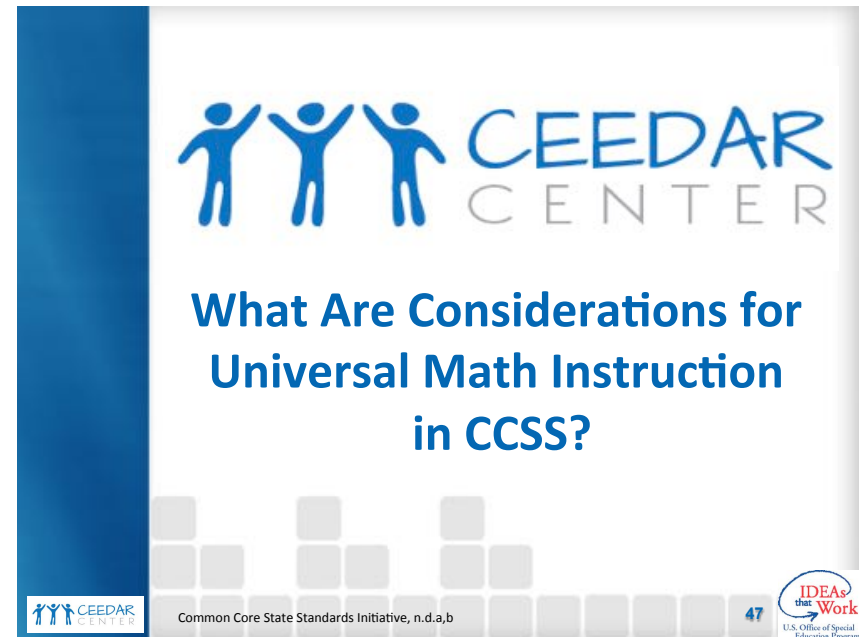
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46

Slide 47—What Are Considerations for Universal Math Instruction in CCSS?

While discussing math at the universal level, it is important to note that the instruction should be informed by and aligned to the national standards. The CCSS-M were briefly discussed in CEM Part 1. However, this section will dive deeper into instructional considerations with respect to the CCSS-M. In doing so, we will explore the various elements of the CCSS-M.

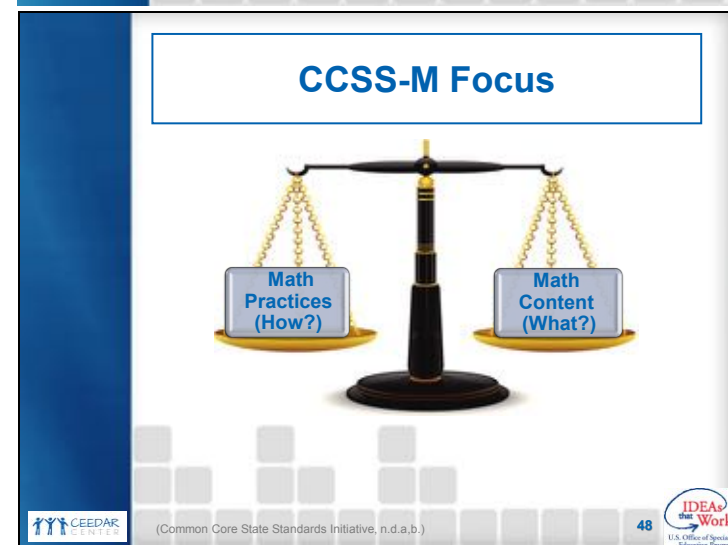


Slide 48—CCSS-M Focus

The CCSS-M places an equal weight on the math content and the math practices.

According to the CCSS-M (n.d.a):

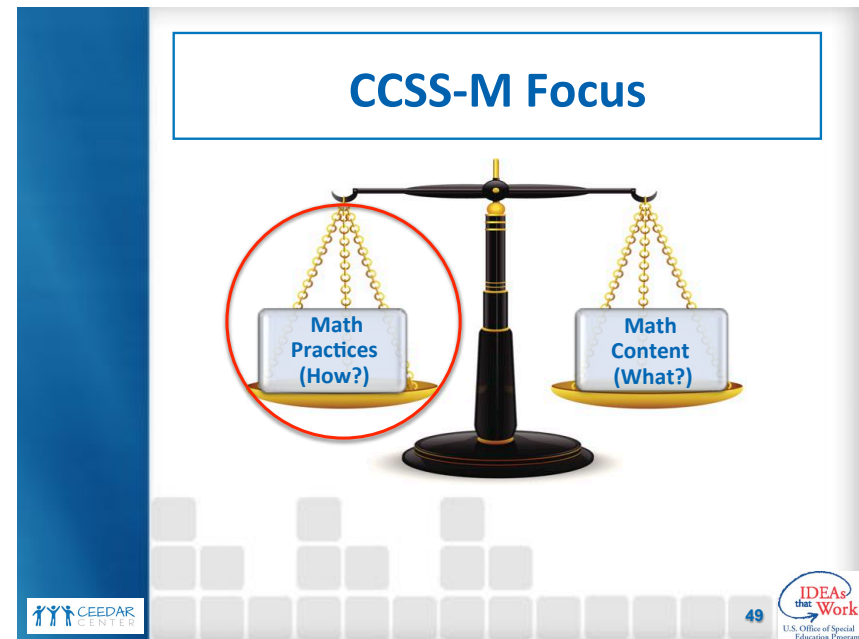
“The Common Core State Standards for Math actually include two types of standards: the content standards and the standards for mathematical practices. The content standards define the specific skills that are to be mastered at each grade level. For example, multiplication, division, and fractions are all



content standards for 3rd grade. The standards for mathematical practices, however, outline *how* students go about doing the math. They are skills, based on the NCTM process standards, which students should utilize on a daily basis, regardless of the content being taught.”

Slide 49—CCSS-M Focus

First, we will explore the math practices highlighted in the CCSS-M.



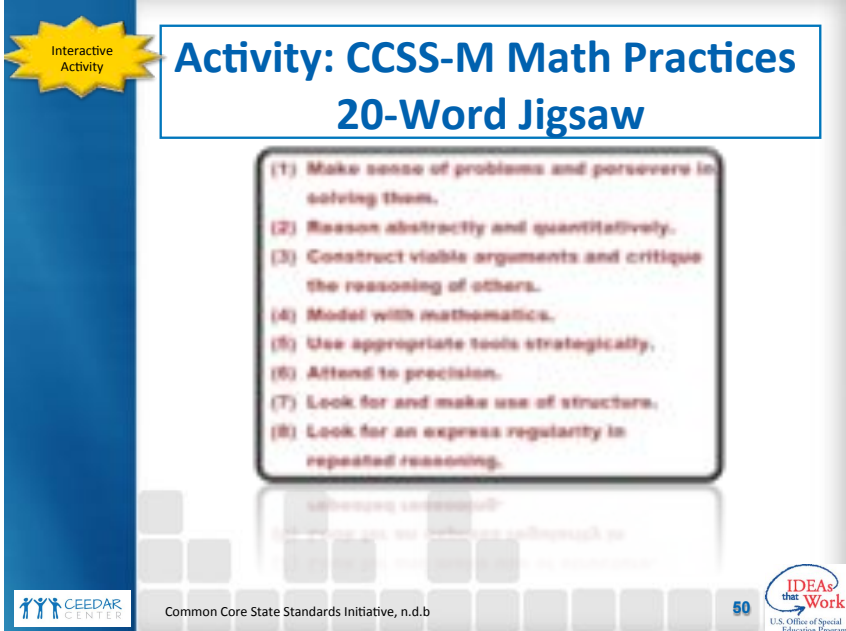
Slide 50—Activity: CCSS-M Math Practices 20-Word Jigsaw

These eight practices are a framework for how students should engage with math. They are overarching and apply across the K-12 curriculum.

According to the CCSS-M (n.d.b):

“The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important “processes and proficiencies” with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council’s report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy).”

Have students jigsaw these eight math practices.



The slide features a blue vertical bar on the left with a yellow starburst icon containing the text "Interactive Activity". The main title, "Activity: CCSS-M Math Practices 20-Word Jigsaw", is in a blue box at the top right. Below the title is a list of eight math practices in a rounded rectangle. At the bottom, there are logos for CEEDAR Center, Common Core State Standards Initiative, and IDEA's that Work, along with the number 50.

Interactive Activity

Activity: CCSS-M Math Practices 20-Word Jigsaw

- (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 an express regularity in repeated reasoning.

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50

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There are two options for a jigsaw activity provided: 1. the 20-Word Jigsaw and 2. the Graffiti Wall Jigsaw.

For the 20-Word Jigsaw (Option 1):

- 1. Ask each participant to take out a sheet of paper.*
- 2. Split participants into eight groups.*
- 3. Assign each group a math practice.*
- 4. Give them time to explore the math practice on the CCSS-M site. Each group should then come up with a story that is less than 20 words that adequately captures the essence of that math practice. Tell them to each write their 20-word story because they will be teaching that practice to other students who have not explored it.*
- 5. Have participants regroup into a second group that includes one student from each original group. If students are appropriately grouped then the eight group members should each have a unique math practice.*
- 6. Each participant teaches their new group about the math practice and shares the original group's 20-word story.*
- 7. Debrief group answers with a "Whip Around the Room" (go around the room by group and have each group share out their 20-word stories). Discuss the final 20-word stories as a class.*
- 8. Debrief the interactive activity. Ask students how this might help support student learning. Students might say that there was peer support in the jigsaw groups, but that all students were held accountable because they had to teach the content to their second groups. Students might say that the 20-word*

story helped them attend to the most important pieces in their explanation.

For the Graffiti Wall Jigsaw (Option 2):

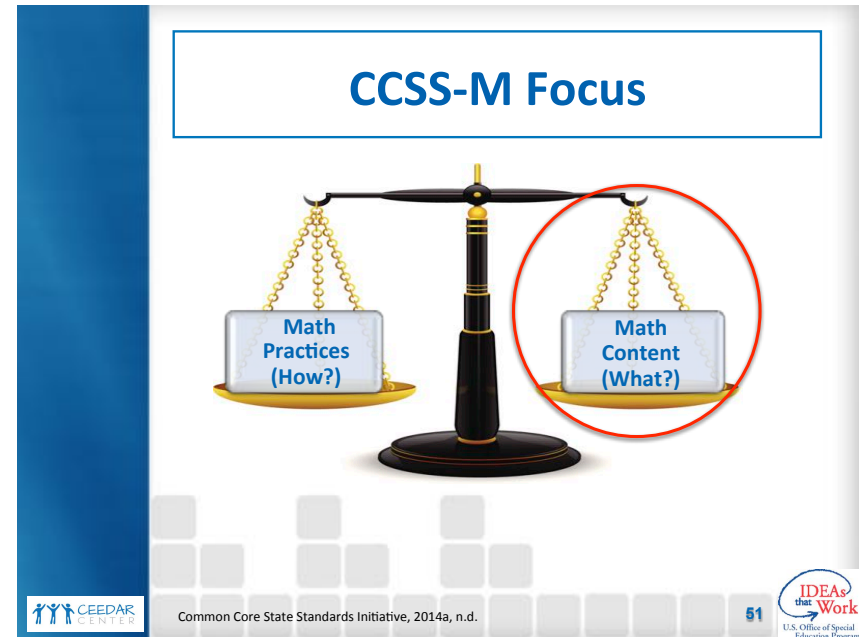
- 1. Give each group a piece of chart paper.*
- 2. Split participants into eight groups.*
- 3. Assign each group a math practice.*
- 4. Give them time to explore the math practice on the CCSS-M site. Each group should then talk about a piece of graffiti (a picture) that adequately captures their math practices. They can draw their graffiti on chart paper. The other group members conceptualize a caption for their graffiti.*
- 5. Have participants regroup into a second group that includes one student from each original group. If students are appropriately grouped then the eight group members should each have a unique math practice.*
- 6. With your call, each group rotates to each of the graffiti posters. The participant who was in the first group that made the poster explain the math practice and how their graffiti captures the essence of the practice.*
- 7. At the end, debrief the content with the class.*
- 8. Debrief the activity. Ask participants how this might help support student learning. Participants might share that there was peer support in the jigsaw groups, but that all students were held accountable because they had to teach the content to their second group and there were specified jobs in the first group. Participants might say that the graffiti wall helped them*

visualize their learning with the image.

This is the explanation of the CCSS-M math practices drawn from: <http://www.corestandards.org/Math/Practice/>

Slide 51—CCSS-M Focus

Now we will turn to the math content highlighted in the CCSS-M. Keep in mind, however, that math practices are still relevant while discussing the math content of the CCSS-M. We will talk about that more in this CEM section.



Slide 52—Math Content Domains Across Grades

First let's look at the math content domains. This chart shows the CCSS-M math content domains by grade.

For more information:

<http://www.corestandards.org/other-resources/key-shifts-in-mathematics/>

Math Content Domains Across Grades	
Grades	Skills
K-2	Concepts, skills, and problem solving related to addition and subtraction.
3-5	Concepts, skills, and problem solving related to multiplication and division of whole numbers and fractions.
6	Ratios and proportional relationships and early algebraic expressions and equations.
7	Ratios and proportional relationships and arithmetic of rational numbers.
8	Linear algebra and linear functions.

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62

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Slide 53—Big Idea and Essential Understandings

The CCSS-M standards are organized around domains and clusters. Domains are overarching concepts like number and place value. Within each standard cluster, there are overarching standards and then sub-standards. The National Council for Teachers of Math (NCTM; 1991) calls these big ideas and essential understandings. Big ideas are sometimes also called enduring understandings. These big ideas have worth that is broader than the lesson, and they state the importance for the math concept and skill. Big ideas can consist of sub-units or standards, and these are what NCTM refers to as “essential understandings.” Essential understandings are more specific, and build toward the big idea. Taken together, big ideas and essential understandings often frame a unit or lesson at the universal level (NCTM, 1991).

For more information:

<http://www.corestandards.org/Math/Content/introduction/how-to-read-the-grade-level-standards/>

The diagram illustrates the hierarchy of mathematical concepts. At the top, a box labeled "Big Idea and Essential Understandings" contains the title "Big Idea and Essential Understandings". Below this, a blue box labeled "Big Idea" contains the text: "Generalize place value understanding for multi-digit whole numbers." Below the blue box, a larger box labeled "Essential Understandings" contains three specific understandings: "Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. For example, recognize that 700 = 70 × 10 by applying concepts of place value and division.", "Read and write multi-digit whole numbers using base ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.", and "Use place value understanding to round multi-digit whole numbers to any place." The diagram uses arrows to show the flow from the Big Idea to the Essential Understandings. The slide number 53 is visible in the bottom right corner.

Big Idea and Essential Understandings

Big Idea

Generalize place value understanding for multi-digit whole numbers.

Essential Understandings

Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. For example, recognize that 700 = 70 × 10 by applying concepts of place value and division.

Read and write multi-digit whole numbers using base ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Use place value understanding to round multi-digit whole numbers to any place.

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63

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Slide 54—Activity: AHA! Listening

Consider the math domains we just discussed as you view Dr. Fuchs' video. In this video, Dr. Fuchs, professor at Vanderbilt, discusses certain considerations for math instruction within MTSS. Think about the similarities and differences across math and reading.

Conduct this activity through AHA! Listening.

For AHA! Video Listening:

1. *Participants listen to the video while noting a few new considerations or things that struck them as they watched the video.*
2. *Allow pairs or groups of students to share their ideas.*
3. *Debrief as a class.*

Interactive Activity

Activity: AHA! Listening

Watch and listen as Dr. Lynn Fuchs talks about considerations with respect to math instruction.



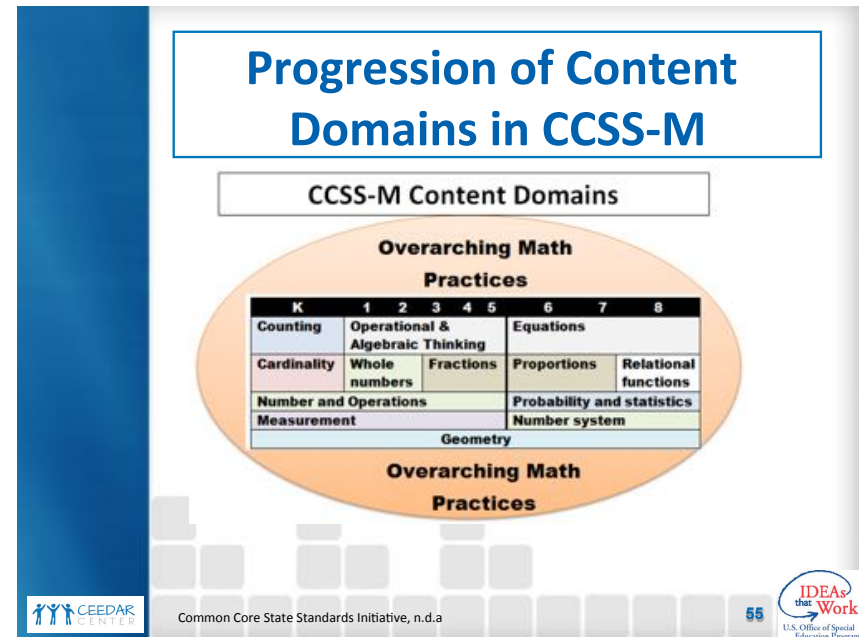
Grades	Skills
K-2	Concepts, skills, and problem solving related to addition and subtraction.
3-5	Concepts, skills, and problem solving related to multiplication and division of whole numbers and fractions.
6	Ratios and proportional relationships and early algebraic expressions and equations.
7	Ratios and proportional relationships and arithmetic of rational numbers.
8	Linear algebra and linear functions.

<http://www.rti4success.org/video/there-lot-information-about-rti-reading-how-it-different-math>
Center on Response to Intervention, n.d.c.

54
U.S. Office of Special Education Programs

Slide 55—Progression of Content Domains in CCSS-M

Now that we have discussed the content domains, also consider that in the CCSS-M, content domains are situated within the eight math practices we discussed in the prior section. This is a vital shift in the CCSS-M: The eight math practices, represented here by the surrounding orange circle, carry across all the grades.

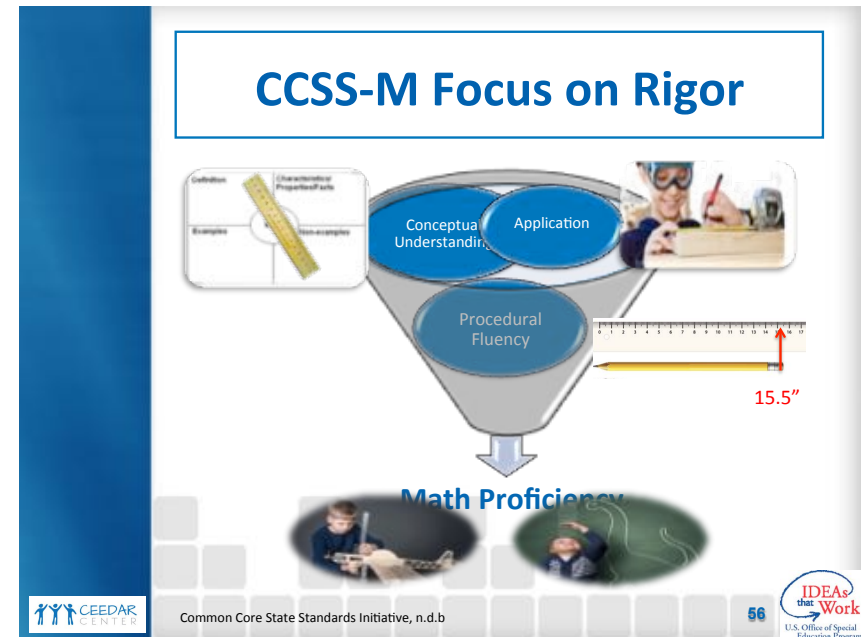


Slide 56—CCSS-M Focus on Rigor

Another important shift to note with respect to the CCSS-M is the emphasis on rigor.

According to the CCSS-M (n.d.b):

“Rigor refers to deep, authentic command of mathematical concepts, not making math harder or introducing topics at earlier grades. To help students meet the standards, educators will need to pursue, with equal intensity, three aspects of rigor in the major work of each grade: conceptual understanding, procedural skills and fluency, and application. *Conceptual understanding*: The standards call for conceptual understanding of key concepts, such as place value and ratios. Students must be able to access concepts from a number of perspectives in order to see math as more than a set of mnemonics or discrete procedures. *Procedural skills and fluency*: The standards call for speed and accuracy in calculation. Students must practice core functions, such as single-digit multiplication, in order to have access to more complex concepts and procedures. Fluency must be addressed in the classroom or through supporting materials, as some students might require more practice than others. *Application*: The standards call for students to use math in situations that require mathematical knowledge. Correctly applying mathematical knowledge depends on students having



a solid conceptual understanding and procedural fluency.”

So, conceptual understanding includes understanding math concepts, operations, symbols, and diagrams. These understandings help a student connect new math knowledge to previous knowledge. Look at this slide. In order to measure something, the boy needs to know what a ruler is. Procedural fluency entails carrying out math procedures and knowing how to flexibly apply the procedures in the most efficient way. So to measure, the boy must know how to line up the ruler and where to mark. He also needs to understand the units of measurement. Application refers to the use of math when math knowledge is needed. Here the boy and his teacher work together to measure the wood; they are authentically applying the math concept.

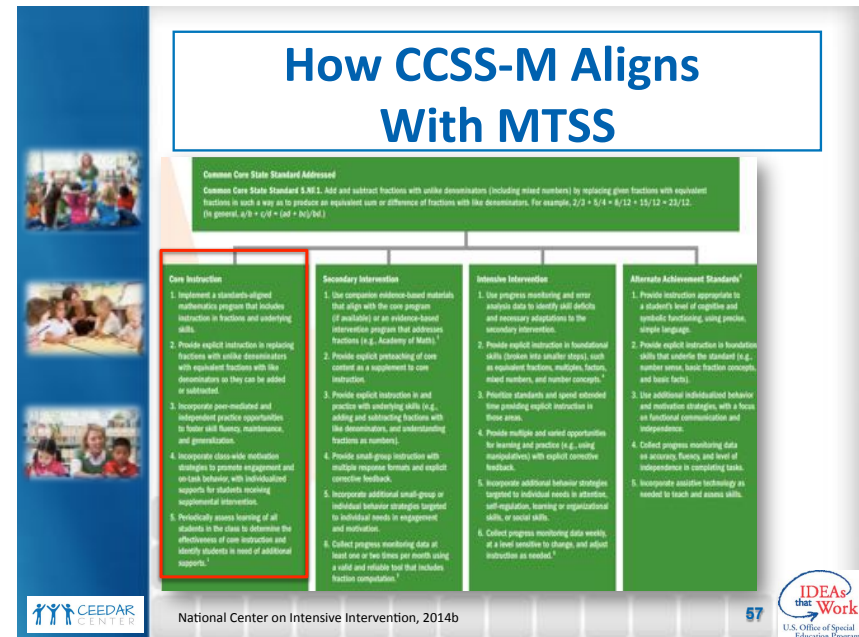
When conceptual understanding, procedural fluency, and application work together, math proficiency increases. For example, the boy will gain a depth of math proficiency with respect to measurement and will be able to apply that understanding flexibly and efficiently across a variety of contexts.

Give participants a minute to discuss the graphic on this slide. Ask participants to think of another math concept and talk together about the conceptual understanding, procedural fluency, and application needed to gain proficiency with that concept.

Slide 57—How CCSS-M Aligns With MTSS

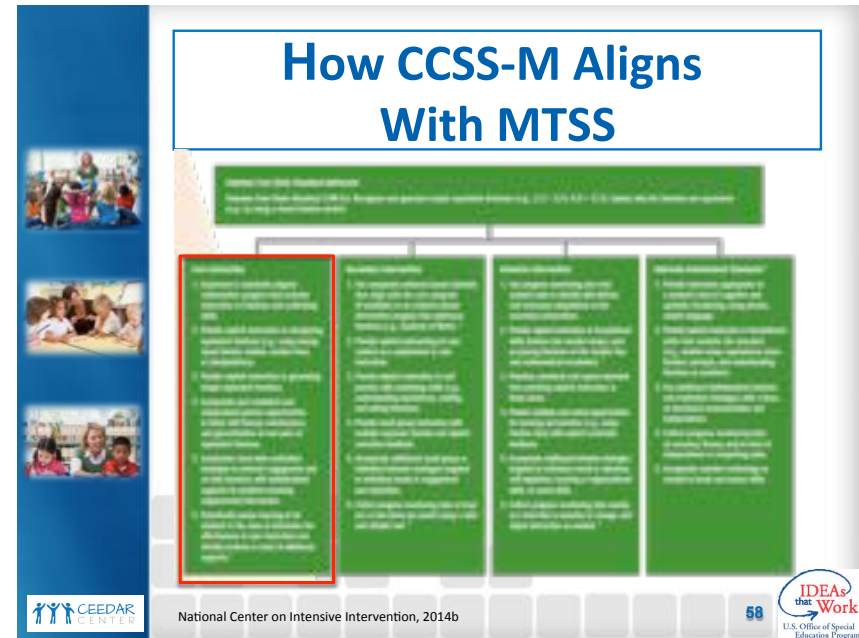
Now with respect to MTSS, note that the progression of supports provided at each MTSS level can and should be aligned with the grade-level CCSS-M standard, or the standards that inform the universal math program. As you move along the MTSS continuum, the supports increase, but the standard is retained.

In this CEM part we are focused on the universal level, which is sometimes called core, Tier I, or primary). However, you can take the CCSS-M grade-level standard and apply it through the different MTSS levels. The learning supports increase, but the CCSS-M standard does not change (like moving to a below-grade standard). MTSS is focused on supports that unlock each grade-level standard for all students, so all students access and acquire the grade-level content.



Slide 58—How CCSS-M Aligns With MTSS

Here is the same chart of progressions that is indexed to another CCSS-M standard. Again, note that the same grade-level content standard carries through all the MTSS levels.



Slide 59—Activity: Explore in Relation to CCSS-M

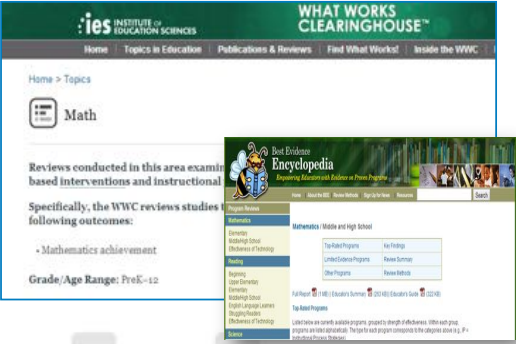
On the same worksheet as the last activity, Handout 5, explore the same universal math program (from the prior activity). However, this time determine the ways in which that universal math program aligns with the CCSS-M. Consult the CCSS-M when needed. Consider both math practices and content domains. Consider the CCSS-M focus on rigor. What elements does the universal program meet? Are there any that it does not seem to meet? How would you address those aspects in your universal math instruction?

Have students work in either the same small groups as the last activity or in their pair from the last activity. They should complete the last part of that activity page.

Handout 5

Interactive Activity

Activity: Explore in Relation to CCSS-M



Center for Data-Driven Reform in Education, n.d.; What Works Clearinghouse, 2008

69

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Slide 60—CEM Part 2 Guiding Questions

We have now answered the first four questions for Part 2 of the CEM. Now, we will discuss the use of assessments at the universal level. After that, we will look at data-based decision making.

CEM Part 2 Guiding Questions

- What is universal instruction in MTSS?
- What does high-quality math instruction at the universal level look like?
- What are considerations for math instruction in the CCSS?
- What are instructional considerations for English learners in universal math?
- What is the role of screening and progress monitoring at the universal level?
- How should data-based decisions be made?

High-quality instruction for all students	
Universal screening for all students	
Progress monitoring for some students	
Data-based decision making	

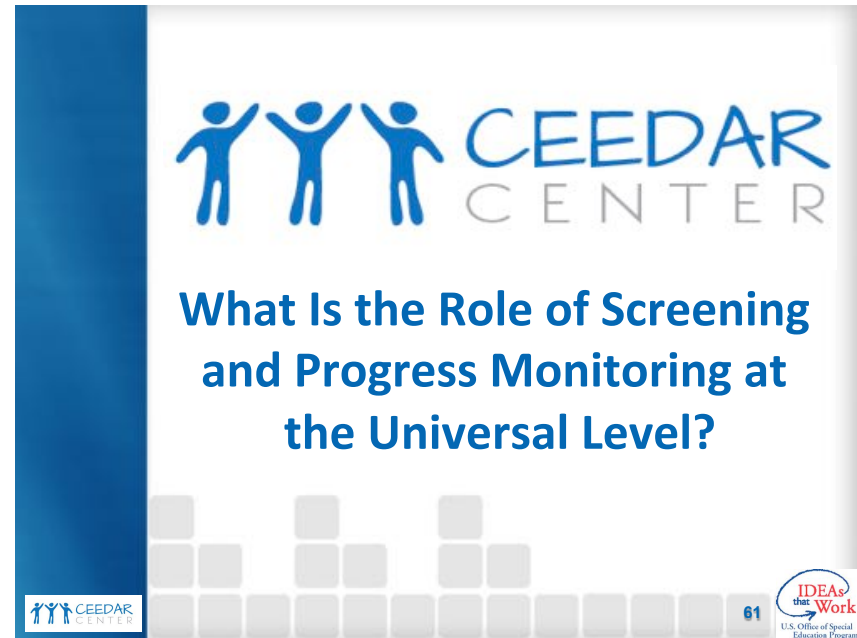


60

Slide 61—What Is the Role of Screening and Progress Monitoring at the Universal Level?

Now that we have discussed some key curricular considerations, we will discuss how universal screening is implemented at the universal level. Screening can answer these questions:

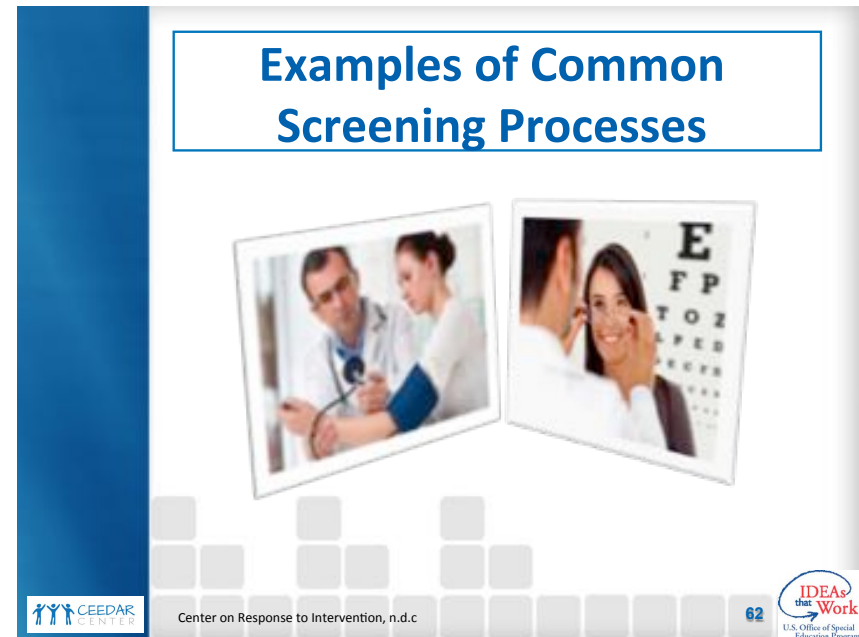
- Is our core curriculum and instruction effective?
- Which students need additional assessment and instruction?



Slide 62—Examples of Common Screening Processes

The screening process is not unique to education. In fact, standardized screening processes, such as blood pressure screenings and vision screenings, are common in many other fields. In all cases, the purpose is to identify indicators that predict if more testing or further intervention is needed; these screeners are designed to be efficient and cost effective. How many of you have participated in blood pressure screenings? These measures do not actually indicate if you have heart problems. Instead, the results of these cost-efficient and brief assessments indicate when more information is needed. Additional assessments (that are most likely more expensive and invasive) are needed to confirm the presence of a problem. All of us have had eye exams, probably beginning in school. This very cheap screening process provided school nurses with sufficient data to refer a child for further assessment. Without this type of standardized eye screening in schools, many children may not have received appropriate vision supports until much later in their schooling. The major goal of all of the screening processes is to identify and address potential problems early in order to prevent bigger problems in the future.

Depending on time available, you may want to provide the following more in-depth explanations of other types of screening.

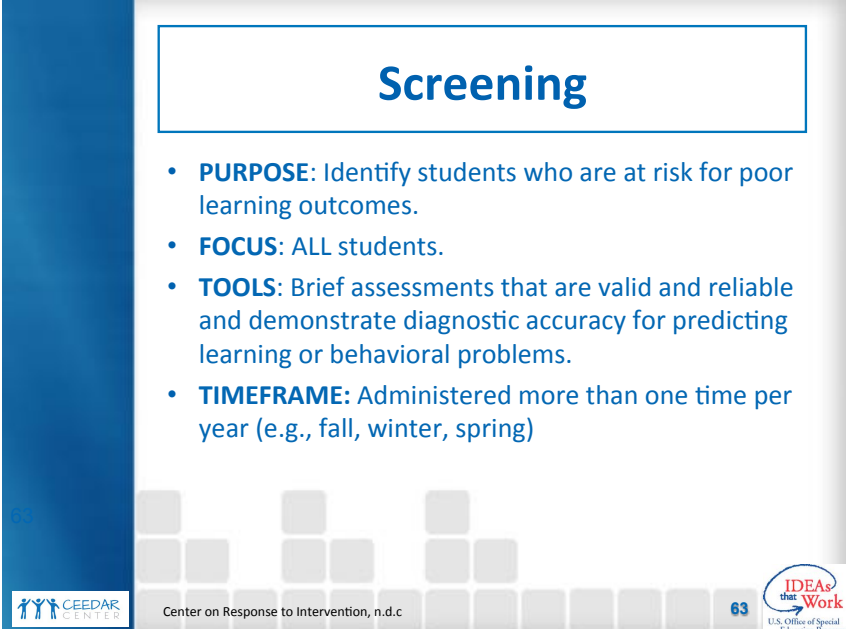


For more information, see:

<http://www.rti4success.org/essential-components-rti/universal-screening>

Slide 63—Screening

Implement screening to identify students at risk for poor learning outcomes; identify students who need additional assessment (i.e., progress monitoring) and instruction (i.e., secondary or intensive); and provide data on the effectiveness of the core instruction and curriculum. The focus for screening is on all students, not just students we believe are at risk. Students may slip through the cracks unless there is a systematic process for screening in place. Screening is not a diagnostic test; it is a brief, reliable, and valid assessment to identify which students may need additional assessments. The tools should demonstrate diagnostic accuracy for predicting learning in math. In other words, they should accurately identify who could be at risk.



Screening

- **PURPOSE:** Identify students who are at risk for poor learning outcomes.
- **FOCUS:** ALL students.
- **TOOLS:** Brief assessments that are valid and reliable and demonstrate diagnostic accuracy for predicting learning or behavioral problems.
- **TIMEFRAME:** Administered more than one time per year (e.g., fall, winter, spring)

Center on Response to Intervention, n.d.c

63

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Slide 64—Universal Screening

Now you will hear from several principals about why they believe screening is important and how they implement screening in their schools.

Conduct this activity through AHA! Listening.

For AHA! Listening:

1. *Students listen to the video while noting a few new considerations as they watch—things that struck them while watching the video.*
2. *Allow pairs or groups of students to share their ideas.*
3. *Debrief as a class.*



Universal Screening

[Video 1: Principal Perspectives](#)



<http://www.youtube.com/watch?v=HaHWoN-LVFc>
National Center on Response to Intervention, 2012c



Slide 65—Screening Process

As mentioned in the video, regular screening is necessary throughout the year for ALL students. Through screening at the middle or end of the year, you may catch students who were doing well at the beginning of the year but are struggling as the demands increase. Struggling students are identified by implementing a two-stage screening process. The first stage, universal screening, is a brief assessment for all students conducted at the beginning of the school year; however, many schools and districts use it two or three times throughout the school year. For students who score at or below the cut score on the universal screener, a second stage of screening is then conducted to more accurately predict which students are truly at risk for poor learning outcomes. This second stage involves additional, more in-depth testing or short-term progress monitoring to confirm a student's at-risk status (Compton et al., 2010).

Screening Process

- Two-stage screening process:
 - Stage 1:** Universal screening for all students.
 - Stage 2:** More in-depth testing or progress monitoring for students who score at or below the cut score.
- Should be an educationally valid outcome.



Center on Response to Intervention, 2010

65

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Slide 66—Common Mathematics Screeners

These are some examples of math screeners. You may have different screeners to assess different outcome measures. No one screener can screen for all areas, so different screeners may be necessary for different outcome areas.

Consider both reliability and validity when choosing screeners. Reliability asks if the assessment produces similar scores across conditions and situations? Reliability is not a particular problem if the tool has good psychometric properties. Validity asks: Does the test measure what you want to assess? Think of validity as the degree of evidence behind the function of a measure for a specific student; it is variable across different contexts. Therefore, validity may be a problem if assessment results could be influenced by students' language, cultural, and experiential backgrounds.

Choose age-appropriate outcome measures that capture student ability. It is important that the screener you choose has strong classification accuracy, meaning the screening tool is able to accurately classify students into at-risk and not at-risk categories. For example, in reading, in order to have good classification accuracy, screeners must target reading or reading-related skills that are pertinent to the grade and time the screen is administered (Jenkins, Hudson, & Johnson, 2007, p. 585). Gersten et al. (2005) found the following three brief,

Common Mathematics Screeners		
Domain	Measures	Grades
Early numeracy	• Oral Counting • Next Number • Number Identification • Quantity Discrimination • Missing Number	K-1
Computation	• M-CBM • Math Computation • Number Facts	1-8
Concepts and applications	• Math Concepts and Applications • Concepts • Concepts/Applications	2-8

Center on Response to Intervention, 2010

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timed assessments were reliable predictors of first graders at risk for mathematics difficulty: (1) quantity discrimination, (2) missing number identification, and (3) number identification fluency. In Grades 4 through 8, use screening data in combination with state testing results (Baker, Gersten, Flojo, et al., 2002; Gersten et al., 2011).

Slide 67—Center on RTI Screening Tools Chart

The National Center on Intensive Intervention (NCII) has developed a screening tools chart that can be accessed through the Center on Response to Intervention website at <http://www.rti4success.org/screeningtools>. The tools chart does not recommend tools but provides users with a consumer report on available tools, similar to what you may find when searching for consumer goods such as a car. We will look at the process for using the tools chart, recommended in the user's guide. We will also look in depth at the columns, which include both indicators of valid tools and efficiency factors to consider.

When possible, demonstrate the most updated version of the tools chart on the website (<http://www.rti4success.org/screeningTools>) instead of using the following screenshots.

[illegible]

Slide 68—Tips for Using the Tools Chart

Read slide.

Tips for Using the Tools Chart

1. Gather a team.
2. Determine your needs.
3. Determine your priorities.
4. Familiarize yourself with the content and language of the chart.
5. Review the data.
6. Ask for more information.

68

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68

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Slide 69—NCRTI Screening Tools Chart

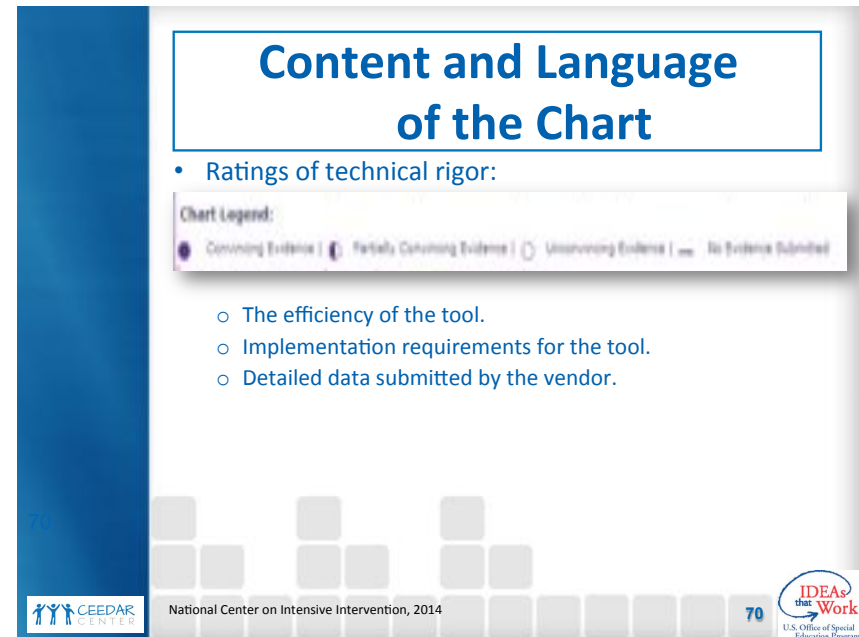
Screening involves brief assessments that are valid, reliable, and evidence based. They are conducted with all students or targeted groups of students to identify students who are at risk of academic failure and, therefore, likely to need additional or alternative forms of instruction to supplement the conventional general education approach. The tools chart includes a large amount of information designed to assist you in selecting a tool that is most appropriate for use in your classroom, school, or district. The best tool is not going to be the same for every user and is not determined by any single element on the chart. Users of the chart should review all of the different elements of the chart while making a decision.

NCRTI Screening Tools Chart										
Tool	Area	Classification Accuracy Rating	Generalizability	Reliability	Validity	Intergroup Reliability, Accuracy, and Discrimination Index for Diverse Populations	Efficiency			
							Administration & Scoring Time	Scoring Time	Scoring Method	Scoring Method
AS Assessable Screening Tool	Mathematics	1	Moderate Low	1	1	—	Group 35–40 Minutes	Computer Scored	Yes	Yes
AS Adults	Mathematics	1	Moderate High	1	1	—	Group 50 Minutes	Yes	Yes	Yes
AS Adults	Mathematics – Curriculum- Based Measurement	1	Moderate High	1	1	—	Group 2 Minutes	Yes	Yes	Yes
AS Adults	Mathematics Concepts and Applications	1	Moderate Low	1	1	1	Individual Group 11–13 Minutes	Yes	Yes	Yes
AS Adults	Test of Early Numeracy – Meaning Number	1	Broad	1	1	—	Individual 2 Minutes	Yes	Yes	Yes
AS Adults	Test of Early Numeracy – Number Identification	1	Broad	1	1	—	Individual 2 Minutes	Yes	Yes	Yes
AS Adults	Test of Early Numeracy – One-Counting	1	Moderate Low	1	1	—	Individual 2 Minutes	Yes	Yes	Yes

Slide 70—Content and Language of the Tools Chart

There are four main areas on which tools are evaluated: ratings of technical rigor; efficiency; implementation requirements (e.g., cost, training needs); and the data submitted by the vendor (e.g., reliability data, validity data). The ratings of technical rigor are represented with rating bubbles, similar to the symbols used in Consumer Reports. A full bubble indicates convincing evidence, and an empty bubble indicates unconvincing evidence.

The first area that is presented is the ratings of technical rigor. For each of these standards, the TRC reviewed data submitted by developers of the tools and gave a rating of *convincing*, *partially convincing*, *unconvincing*, or *no evidence*. If using the tools chart online, you can click on the name of the standard in the column heads of the chart to view a definition of the standard and a rubric describing the specific criteria used by the TRC to rate tools on that standard.



Slide 71—Content and Language of Chart

The tools chart offers an Implementation Table for each tool, which can be accessed by clicking on the name of the tool. The implementation table includes the following information:

- Cost of the tool
- Training required to implement the tool
- Level of staff expertise required to administer the tool
- Where to go for training and technical support
- How scores are reported

All of this information is provided by the vendor.

Content and Language of the Chart

Tool or Outcome	Type of Validity	Age or Grade	Cost	Coefficient
Letter Writing System (LWS)	Concurrent	K	1000.00	0.47
Letter Writing System (LWS) - Teacher Edition	Probitive	K	100.00	0.51
Letter Writing System (LWS) - Student Edition	Probitive	K	100.00	0.73
Letter Writing System (LWS) - Parent Edition	Probitive	K	100.00	0.84
Letter Writing System (LWS) - Teacher Edition - Spanish	Concurrent	K	1000.00	0.50
Letter Writing System (LWS) - Student Edition - Spanish	Concurrent	K	1000.00	0.48
Letter Writing System (LWS) - Parent Edition - Spanish	Probitive	K	100.00	0.87
Letter Writing System (LWS) - Teacher Edition - Spanish - Spanish	Probitive	K	100.00	0.73
Letter Writing System (LWS) - Student Edition - Spanish - Spanish	Probitive	K	100.00	0.89
Letter Writing System (LWS) - Parent Edition - Spanish - Spanish	Probitive	K	100.00	0.73
Letter Writing System (LWS) - Teacher Edition - Spanish - Spanish	Probitive	K	100.00	0.82
Letter Writing System (LWS) - Student Edition - Spanish - Spanish	Probitive	K	100.00	0.51
Letter Writing System (LWS) - Parent Edition - Spanish - Spanish	Probitive	K	100.00	0.40
Letter Writing System (LWS) - Teacher Edition - Spanish - Spanish	Probitive	K	100.00	0.40
Letter Writing System (LWS) - Student Edition - Spanish - Spanish	Probitive	K	100.00	0.36
Letter Writing System (LWS) - Parent Edition - Spanish - Spanish	Probitive	K	100.00	0.30

Slide 72—Disaggregated Data in the Screening Tools Chart

The disaggregated data column is useful for determining whether the assessment has been tested with various subgroups such as English learners. When you click on a bubble in this column, you can look at how the data were disaggregated and if there were any meaningful differences between subgroups. As you can see from this screenshot, several products have horizontal lines in that column, meaning that there is no information regarding disaggregated data. This is because the vendors who submitted the information about the assessment did not provide information regarding disaggregated data. All of the information in the screening tools chart is based on what the vendors send to NCRTI. As more people request information that is not currently available, vendors will be encouraged to submit more information in the future.

Disaggregated Data in the Screening Tools Chart

Disaggregated Reliability, Validity, and Classification Data for Diverse Populations

Data are disaggregated when they are calculated and reported separately for specific sub-groups.

Technical Standard 5: Disaggregated Reliability, Validity, and Classification Data for Diverse Populations

Rating	Rating defined
Full bubble: Convincing evidence	At least two of the three types of data (classification, reliability, and validity) are disaggregated for at least 1 group AND meet the criteria for convincing or partially convincing.
Half bubble: Partially convincing evidence	One of the three types of data is disaggregated for at least 1 group AND meets the criteria for convincing or partially convincing.
Empty bubble: Unconvincing evidence	One or more of the three types of data are disaggregated for at least 1 group, but all of the disaggregated data meet the criteria for unconvincing.
Dash: No evidence provided	None of the data are disaggregated for diverse groups.

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72

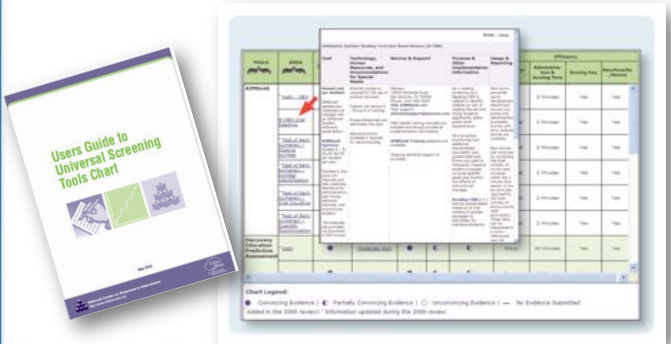
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Slide 73—Ask for More Information

The tools chart provides publisher contact information in the pop-ups found in the second column. For more information about how to use the tools chart, there is a user guide.

http://www.rti4success.org/tools_charts/supplementalcontent/screening/universalscreeningusersguide.pdf.

Ask for More Information



Users Guide to Universal Screening Tools Chart

Universal Screening Tools Chart

Chart Legend:

- Emerging Evidence
- ◐ Partially Compromising Evidence
- ◑ Significantly Compromising Evidence
- ◒ No Evidence Submitted

Updated during the 2010 review



National Center on Intensive Intervention, 2014



73

Slide 74—Activity: Reviewing the Tools Chart

Allow 10-15 minutes for teams or tables to look more closely at the screening tools chart, either online if computers are available or using printed copies. The participants will use Handout 6. The time for this team activity will depend of the needs of the group. If time allows, consider having two or three teams share their tool and the evidence they found that supports its validity and reliability.

Handout 6

Interactive Activity

Activity: Reviewing the Tools Chart

Review Screening Tools Chart

- What screening tools in math have high classification accuracy, reliability, and validity?
- What evidence exists for their reliability and validity?
- Which tools are most efficient?

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74

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Slide 75—Identifying Students as At Risk

With screeners, success depends on accurate identification of the students identified as at risk. This is essential for preventing costly identification errors. Perfect screening would result in 100% accurate identification of true positives (i.e., those who need additional support) and true negatives (i.e., those who do not need additional support), but there is no perfect screening tool.

A cut score is a score on a screening test that divides students who are considered potentially at risk from those who are considered not at risk. Cut scores may also be referred to as cut-points or targets, depending on the tool. They are determination points.

Identifying Students as At Risk

Success in MTSS depends on accurate identification of students who are at risk for poor learning outcomes.

Clinical Decision Making Model

		Outcome	
		At risk	Not at risk
Screen	At risk	True Positive	False Positive
	Not at risk	False Negative	True Negative

True Positive – students correctly identified at risk
False Positive – students incorrectly identified at risk
False Negative – students incorrectly identified not at risk
True Negative – students correctly identified not at risk

National Center on Intensive Intervention, 2010

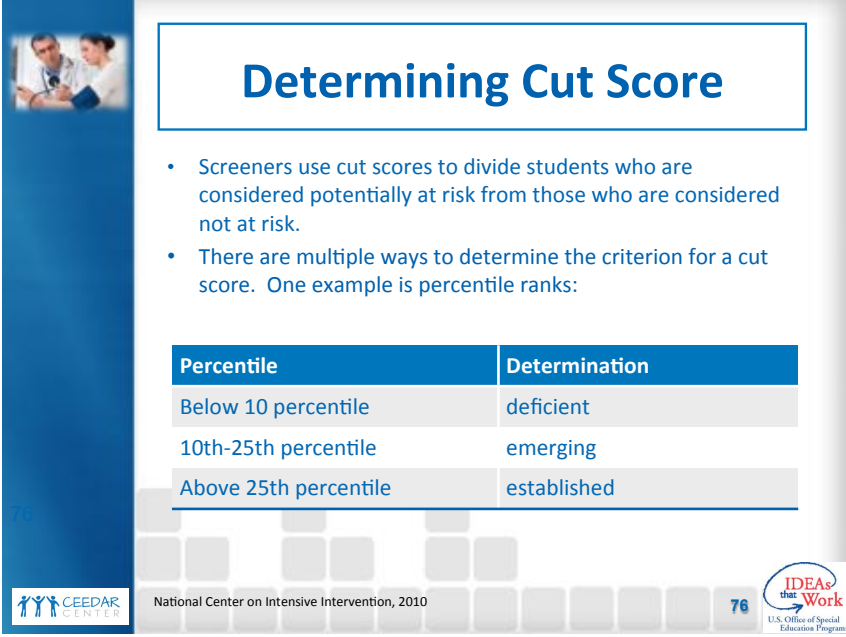
75

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Slide 76—Determining Cut Score

It is important to remember that cut scores used to identify students as at risk may not be the same ones you use to identify students for supplemental support. Your choice of cut score will affect classification accuracy (i.e., sensitivity and specificity). Cut scores are often set to over-identify students as at risk to mitigate false negatives. Think about the blood pressure check. You would rather be falsely over-identified through that screener as at risk for heart disease. When your doctor will follow up with subsequent tests, it will become clear that you are, in fact, not at risk. However, if the heart screener, the blood pressure check, had criteria set at too rigorous of a level and, therefore, under-identified people, then some of those with heart disease would be missed with the screener. That is why it is important to enact a two-staged procedure with screening—the second stage of screening will help shed better light on those students who are truly at risk versus the students who were over-identified.

Concerning English learners, Brown and Doolittle (2008) suggest that it can be helpful to compare an English learner to his or her true peers as a way to examine the instructional program provided to a group of similar students. An ELL's true peers are other students who share similar characteristics, including similar language proficiencies and cultural and experiential backgrounds. The purpose of this comparison is to



Determining Cut Score

- Screeners use cut scores to divide students who are considered potentially at risk from those who are considered not at risk.
- There are multiple ways to determine the criterion for a cut score. One example is percentile ranks:

Percentile	Determination
Below 10 percentile	deficient
10th-25th percentile	emerging
Above 25th percentile	established

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National Center on Intensive Intervention, 2010

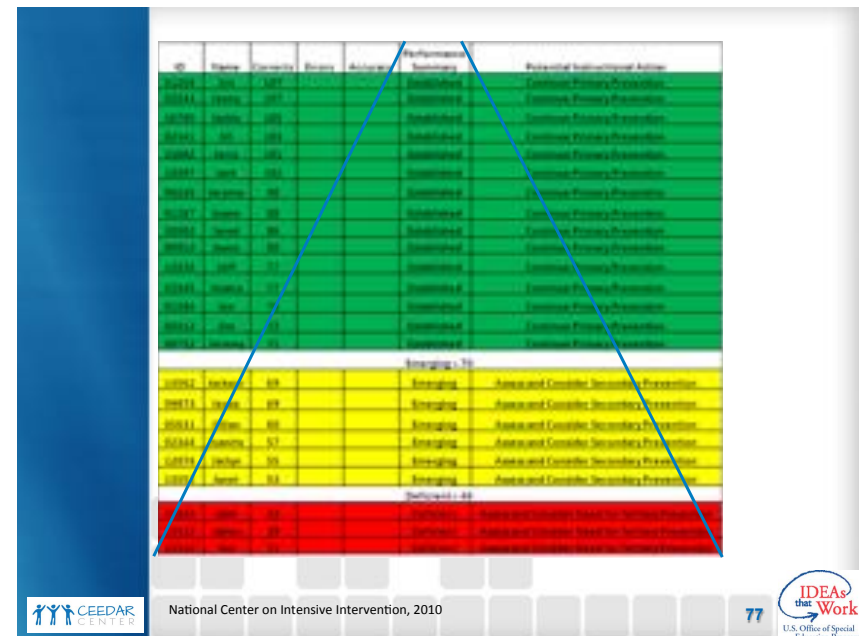
76

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identify whether a lack of progress may be specific to the one student or if there may be a problem with the instructional program given to a group of students.

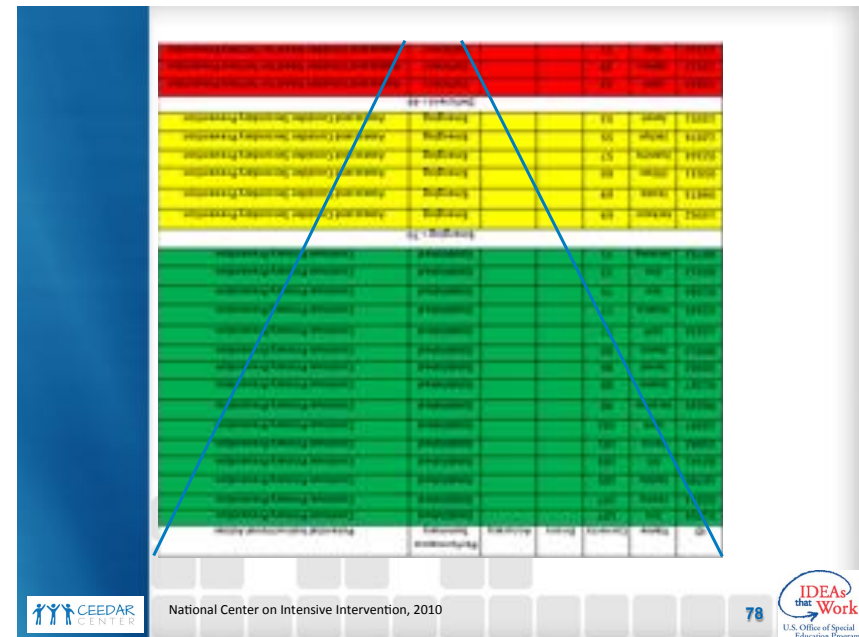
Slide 77

This type of data representation is what is often associated with the triangle. In fact if you turn this upside down (*click for animation*), you will see where the triangle graphic originates.



Slide 78

Students who score below the cut score, perhaps those students in the yellow and red, should now have their progress monitored. This enables you to understand their performance at a deeper level. It also helps to ensure classification accuracy because screeners often over-identify students at risk to mitigate false negatives. Progress monitoring will help you determine those students who were falsely identified as at risk by the screener.



Slide 79—Progress Monitoring in Universal Instruction

For those students who are indicated to be at risk (i.e., scored below the cut score), you will want to enact a second stage of screening. This may be in the form of progress monitoring for a brief period. Note that progress monitoring is also used to track student growth once they start receiving supplemental or intensive instruction, but here, progress monitoring can be used as the second stage of screening. Progress monitoring as a way to track student progress in the other MTSS levels will be explained in more detail in CEM Part 3, but let's touch on it here in the context of a second screening stage.

As with screening, the Center has developed a progress-monitoring tools chart that can be accessed through the Center on Response to Intervention's website at <http://www.rti4success.org/progressmonitoringtools>.

Progress Monitoring in Universal Instruction

- Students identified through the universal screening are monitored to assess their risk status.

Title	Area	Reliability of the Reliability Performance of the Level Score C	Validity of the Reliability Performance of the Level Score D	Production Validity of the Stage of Improvement D	Interdependent Reliability and Validity Area D
KAPYmath	M-CBM	●	●	●	●
KAPYmath	Math Computation	●	●	●	●
KAPYmath	Math Concepts and Applications	●	●	●	●
KAPYmath	Oral Reading Fluency (R-CBM)	●	●	●	●
KAPYmath	Test of Early Literacy - Letter Naming Fluency	●	●	●	●
KAPYmath	Test of Early Literacy - Letter Sound Fluency	●	●	●	●
KAPYmath	Nonsense Word Fluency	●	●	●	●
KAPYmath	Test of Early Literacy - Phonics, Spelling, Punctuation, Grammar, Vocabulary	●	●	●	●
KAPYmath	Test of Early Numeracy - Missing Number	●	●	●	●
KAPYmath	Test of Early Numeracy - Number ID	●	●	●	●
KAPYmath	Test of Early Numeracy - Oral Counting	●	●	●	●
KAPYmath	Test of Early Numeracy - Quantity Discrimination	●	●	●	●
KAPYmath	Cognitive-Based Measurement in Reading (CBM-R)	●	●	●	●
KAPYmath	Letter Sound Fluency	●	●	●	●
KAPYmath	Measurement in Reading (CBM-R)	●	●	●	●
KAPYmath	Measurement in Reading - Basic Fluency	●	●	●	●
KAPYmath	Measurement in Reading - Advanced Fluency	●	●	●	●

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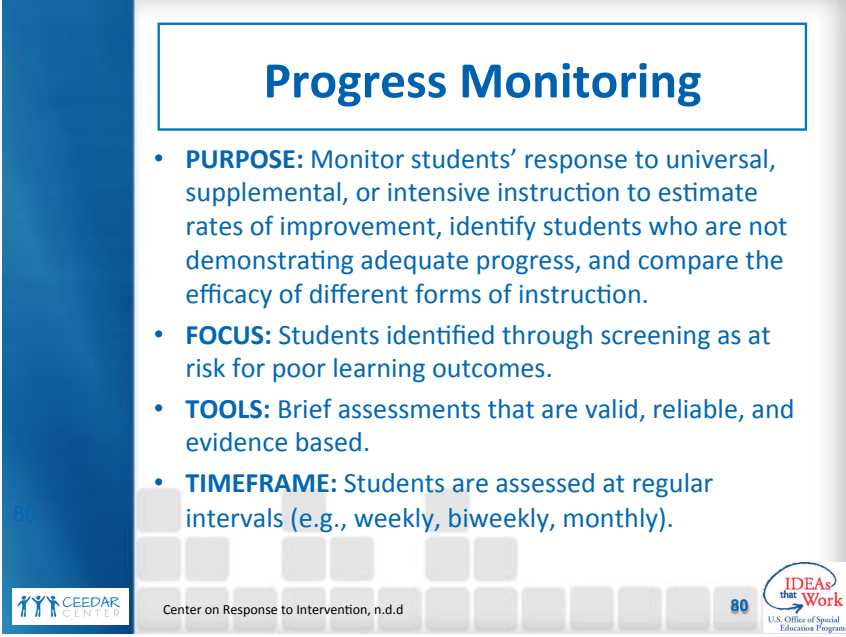
National Center on Intensive Intervention, 2014a

79

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Slide 80—Progress Monitoring

The timeframe for progress-monitoring assessment is dependent on the tools being used and the typical rate of growth for a student. Progress monitoring can be used any time throughout the school year. With progress monitoring, students are assessed at regular intervals (e.g., weekly, biweekly, monthly) to produce accurate and meaningful results that teachers can use to quantify short- and long-term student gains toward end-of-year goals. CEM Part 3 will discuss progress monitoring in supplemental instruction in more detail. However, progress monitoring can also be used as a second screening stage for students who score below the cut score, or determination point. That will help to shed light on whether they are making sufficient progress in universal math instruction.

The slide features a blue header bar with the title "Progress Monitoring" in white. Below the header, there is a list of four bullet points in blue text. At the bottom of the slide, there is a footer area containing the CEDAR Center logo on the left, the text "Center on Response to Intervention, n.d.d" in the middle, and the "IDEAS that Work" logo on the right, which includes the number "80" and the text "U.S. Office of Special Education Programs".

Progress Monitoring

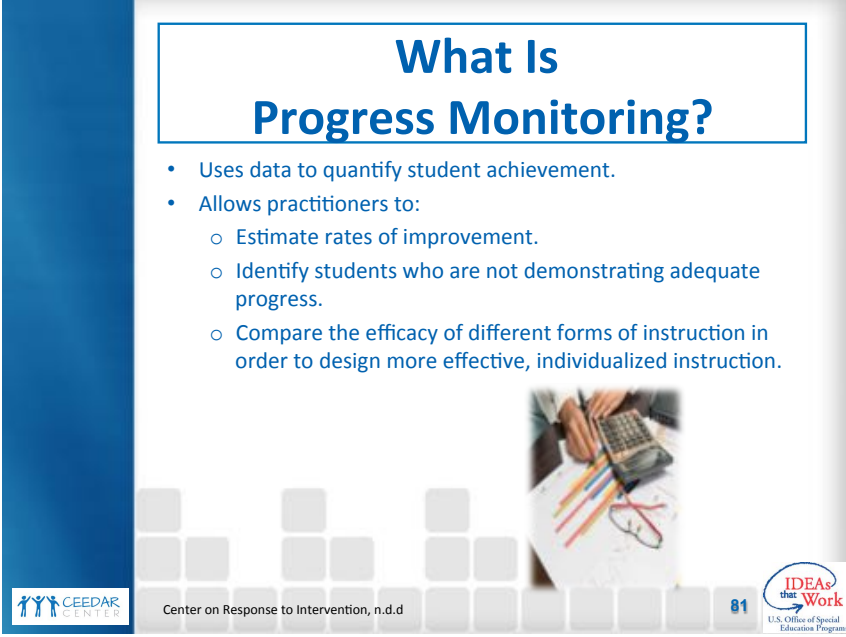
- **PURPOSE:** Monitor students' response to universal, supplemental, or intensive instruction to estimate rates of improvement, identify students who are not demonstrating adequate progress, and compare the efficacy of different forms of instruction.
- **FOCUS:** Students identified through screening as at risk for poor learning outcomes.
- **TOOLS:** Brief assessments that are valid, reliable, and evidence based.
- **TIMEFRAME:** Students are assessed at regular intervals (e.g., weekly, biweekly, monthly).

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80
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Slide 81—What Is Progress Monitoring

Progress-monitoring data can be used to estimate student improvement, compare the efficacy of different interventions, and identify students who are and are not responding to instruction. Progress monitoring is an example of a standardized formative assessment. Although teachers can use the data to make decisions about what is or is not working, they are not considered to be diagnostic assessments. Progress-monitoring tools can either be mastery measures or general outcomes measures. When used as a progress-monitoring tool, they address very different questions: 1) Has the student learned the skill? and 2) Can the student generalize and maintain the learned skills, respectively? No progress-monitoring tool is perfect. Participants must take into account their needs and priorities as well as the technical adequacy of the tool when selecting progress-monitoring tools.



What Is Progress Monitoring?

- Uses data to quantify student achievement.
- Allows practitioners to:
 - Estimate rates of improvement.
 - Identify students who are not demonstrating adequate progress.
 - Compare the efficacy of different forms of instruction in order to design more effective, individualized instruction.

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81

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Slide 82—Progress-Monitoring Tools Should Be:

Progress-monitoring tools are brief assessments that are reliable and evidence based and use repeated measures that capture student ability. The measures should show evidence that allows you to draw conclusions about their validity with respect to students. They should be measures of age-appropriate outcomes. No one progress-monitoring tool can monitor all outcome areas. Different tools may be necessary for different areas. Progress monitoring will be highlighted in CEM Part 3.

Progress-Monitoring Tools Should Be:

- Brief assessments.
- Repeated measures that capture student learning over time.
- Measures of grade-, age-, or instructionally appropriate outcomes.
- Reliable, presenting evidence to make valid inferences.

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82

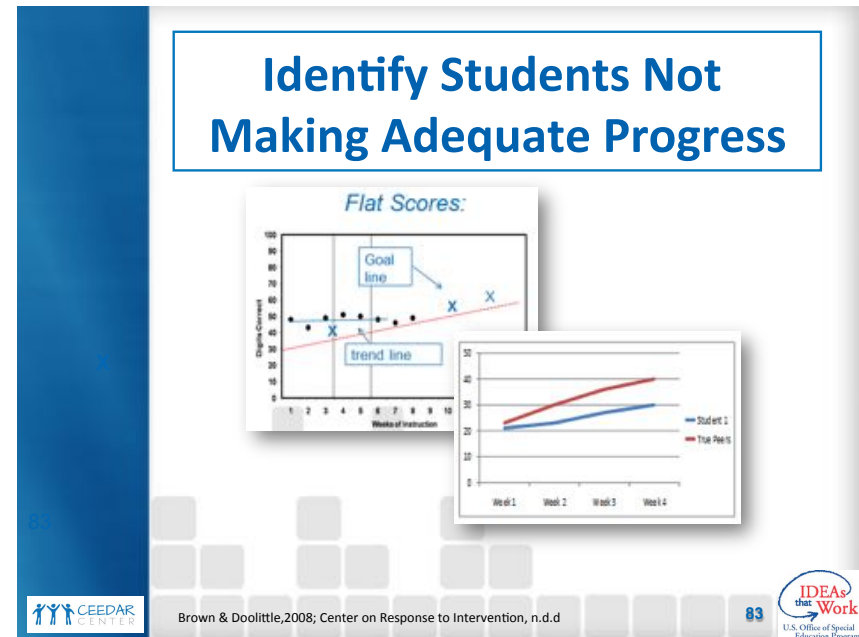
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Slide 83—Identify Students Not Making Adequate Progress

With progress monitoring, you can see improvement by looking at trend lines in comparison to a goal line. In the first example, we see that this trend line is flatter than the goal line. The student is not benefitting from the instruction, and, therefore, the teacher needs to make a change in the instructional program. That kind of trend line is called a flat score.

The second example shows student who is an English learner compared to a truer peer. We see that the student representing the blue line has not made as much progress as his or her true peers. Therefore, we can assume that we need to make adjustments in that student's instructional program but may not need to make adjustments for the others. What would you do if the student were making the same progress as his or her true peers, but none were on track? In that case, the instructional program should be adjusted for all students in the group. Comparing a student to his or her true peers should never excuse a teacher from adjusting instruction when students are not making sufficient progress.

Remember, you should never lower the goal because a student is an English learner. Below-grade-level performance should not be considered normal or something that will resolve itself when oral language proficiency improves. If the trend line is flatter than the goal line, the instructional program should be changed or adjusted to increase a student's scores so the scores match or surpass the goal line. When an ELL student is



not making progress, the instructional program itself must be examined to determine the match between the curriculum and the student's current level of English language proficiency (Brown & Doolittle, 2008).

Slide 84—Activity: Pick and Chips

Have participants discuss elements of progress monitoring in universal instruction (as a second screening stage) through the activity Pick and Chips.

For Pick and Chips:

- 1. Group participants into table groups. Have each group cut out the cards from Handout 7 or have them pre-cut. Do the same procedure with the chips.*
- 2. Put the cut cards in the middle of the table and pass a chip out to each member.*
- 3. One member picks a card and reads the question to the table members.*
- 4. Then, each person responds and puts the chip in the center. Each person can also react to the answers previously heard, but every group member should respond.*

After about 10 minutes for activity, debrief answers as a class. Ask participants how this may help support learning. Responses may note that the chips force each participant to engage with the conversation, but that the group provides a scaffold.

Handout 7
Interactive Activity

Activity: Pick and Chips

- Pass a “chip” out to each group member.
- One member picks a card and reads it to others at the table.
- Each person reacts to the card and can agree or disagree with any of the comments they previously heard. After a member responds, he or she should put his or her chip in the middle.
- When all chips are in the middle, have another person pick a new card.

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84

Slide 85—CEM Part 2 Guiding Questions

Again, more specific methods for progress monitoring will be highlighted in CEM Part 3 when the supplemental level of instruction is discussed. Now let's turn to the process for data-based decision making and what that looks like at the universal level.

CEM Part 2 Guiding Questions

- What is universal instruction in MTSS?
- What does high-quality math instruction at the universal level look like?
- What are considerations for math instruction in the CCSS?
- What is the role of screening and progress monitoring at the universal level?
- How should data-based decisions be made?

High-quality instruction for all students

Universal screening for all students

Progress monitoring for some students

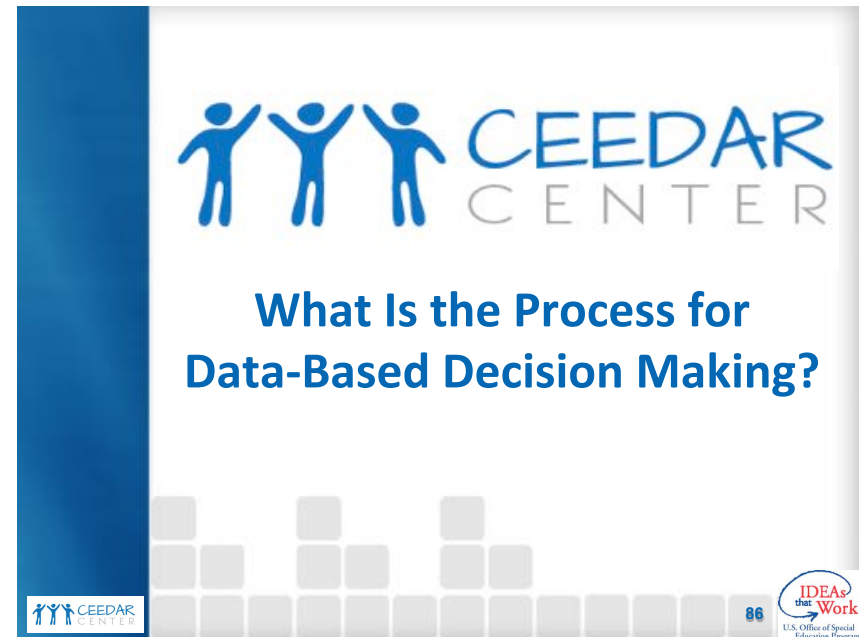
Data-based decision making

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85

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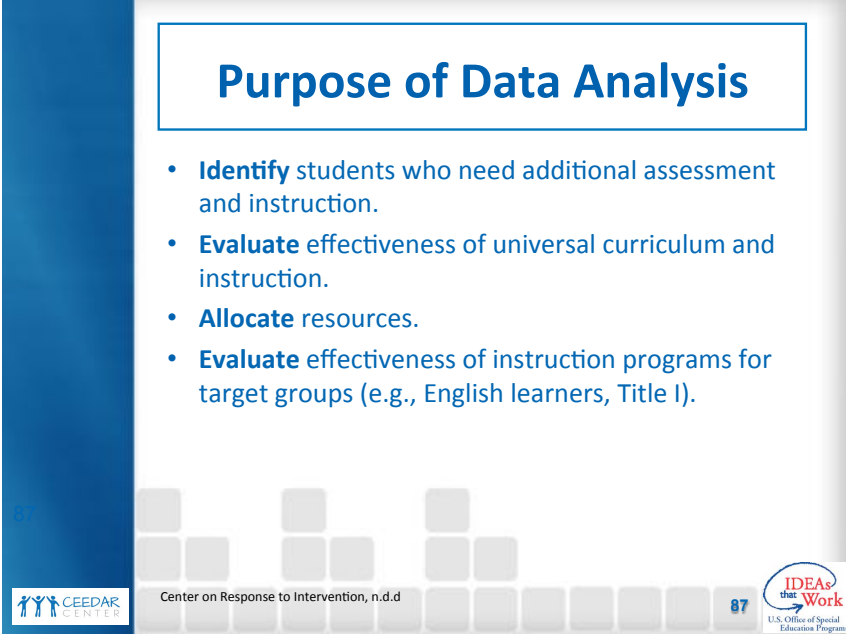
Slide 86—What Is the Process for Data-Based Decision Making?



Slide 87—Purpose of Data Analysis

Read slide.

Because MTSS is a framework for providing services, the outcomes you are concerned with could vary, and could include things such as academic achievement, behavior, graduation, or post-school outcomes. Sites (state, district, schools) typically identify the outcomes students are expected to achieve, and then screen to see which students are not likely to achieve those outcomes.



Purpose of Data Analysis

- **Identify** students who need additional assessment and instruction.
- **Evaluate** effectiveness of universal curriculum and instruction.
- **Allocate** resources.
- **Evaluate** effectiveness of instruction programs for target groups (e.g., English learners, Title I).

87

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Slide 88—Levels of Data Analyses

Read the slide.

Identify what you are looking for at all levels of analysis (e.g., district, school, grade, class, students) and levels of prevention (e.g., efficacy, struggling students).

Levels of Data Analyses

Data analyses should occur at the:



District Level



School Level



Grade Level



Class Level



Student Level

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Slide 89—Routines and Procedures for Data-Based Decision Making

Teams should establish routines and procedures for conducting data reviews, establish decision-making processes, and establish explicit decision rules for assessing student progress. This is an important task for district teams to accomplish so that there is some consistency across schools. Collaborative teams may include grade-level teams, subject-specific teams, vertical teams that are across grade levels but “share common learning outcomes developed across consecutive years” (Buffum et al., 2012, p. 34), and teams that are interdisciplinary.

Routines and Procedures for Data-Based Decision Making

- Teams should establish:
 - Routines and procedures for conducting data reviews.
 - Decision-making processes.
 - Explicit decision rules for assessing student progress.





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89

Slide 90—Conducting Data Reviews

It is important to develop routines and procedures for how your team will review data. Establishing these routines and procedures will help build consistency and trust among the school data teams.

Read slide.

Conducting Data Reviews

- Conduct data reviews at logical, predetermined intervals.
- Schedule data reviews prior to the beginning of instruction.
- Use established meeting structures.
- Involve relevant team members.

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Slide 91—Data-based Decision Making

As a team, determine the steps are you going to follow in order to use the screening data to make decisions? Ongoing evaluation of the selected routines and procedures is necessary to ensure they are culturally and linguistically responsive and lead to the desired outcome.

Data-Based Decision Making

- Articulate routines and procedures in writing.
- Implement established routines and procedures with integrity.
- Ensure routines and procedures are culturally and linguistically responsive.

91

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Slide 92—Establishing Routines and Procedures

In thinking about establishing routines and procedures for data-decision making, consider clarifying the following points in writing prior to implementation. Articulating routines and procedures in writing helps ensure and assess whether established routines and procedures are being implemented with integrity.

Establishing Routines and Procedures

Consider clarifying in writing:

What are you looking for?

How will you look for it?

How will you know if you found it?

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Slide 93—Examples of Explicit Decision Rules

Teams may also consider articulating in writing specific decision rules. They may want to define what happens when certain things occur:

- More than 80% of students are above cut score.
- Less than 80% have reached the cut score: Do we strengthen the core instruction and curriculum? Do we add an intervention?
- Lack of progress is evident: What do you do? Do you make a plan?
- Student progress varies by target group (e.g., Title I, special education, low SES)

Decision rules should be established at all levels, including class, grade, and school.

Examples of Explicit Decision Rules

Also articulate in writing:

What happens when:

- * More than 80% of students are above the cut score
- * Less than 80% have reached the cut score
- * Lack of progress is evident
- * Student progress varies by target group (e.g., Title I, special education, low SES)

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93

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Slide 94—Activity: Write and Right

Have participants discuss considerations of data teams through the activity Write and Right.

For Write and Right:

- 1. Use one handout set per group of three.*
- 2. Pass each piece of paper out to each group member. Each person reacts to the prompt at the top of the page (they will each have different prompts).*
- 3. Then each member passes the page to the right when you call on the groups to do so.*
- 4. The member adds his or her thoughts in the next box and can also react to the previous response.*
- 5. When everyone in the group has added thoughts to the prompt, take a few minutes to discuss each one as a group, noting overarching themes in the answers.*
- 6. Debrief the overarching themes as a class.*
- 7. Debrief the whole activity as a class. Ask participants how this activity may support learning. Some answers may mention that it integrates writing, and provides peer modelling and support.*

Handout 8

Interactive Activity

Activity: Write and Right

- Each group member reacts to the prompt at the top of the page.
- Then pass the page to the right.
- The second person adds his or her thoughts in the next box and can also react to the current response.
- When everyone in the group has added their thoughts to the prompt, take a few minutes to discuss each one as a group, noting overarching themes in the answers. Be ready to share.





94

Slide 95—Case Study: Meet Ethan and Mr. Math

In this section, you will meet Ethan, who is struggling with universal math instruction. This case study will illustrate the various topics that we talked about in Part 2 of the CEM. While participants engage with the next set of slides, have them answer the questions on Handout 9 at relevant points.

Handout 9

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**Case Study:
Meet Ethan and Mr. Math**



Bear Lake Elementary School

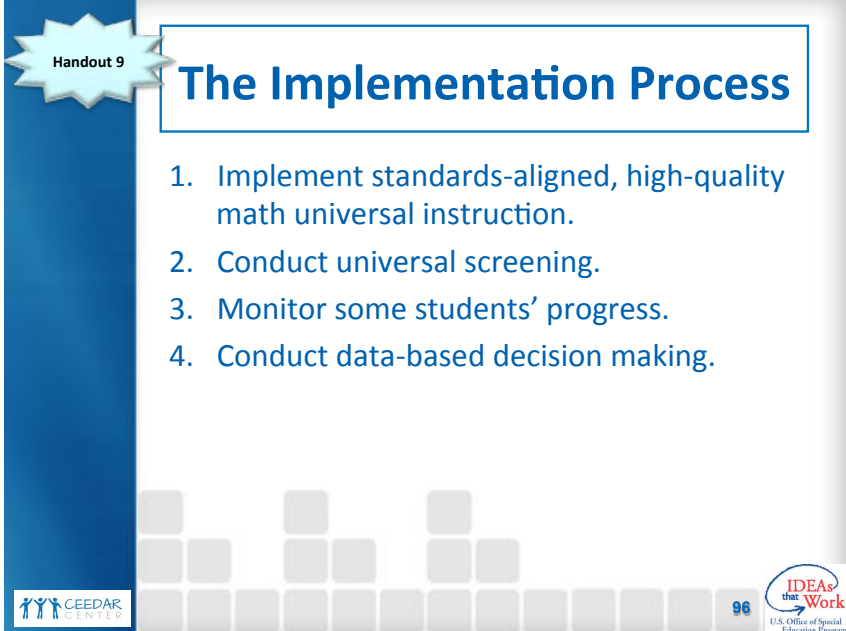
National Center on Response to Intervention National Center on Student Progress Monitoring

95 **IDEAS that Work**
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Slide 96—The Implementation Process

This is the 4-step implementation process of a universal program as discussed in this CEM section. It includes: implementing standards-aligned high-quality math instruction at the universal level with attention to students diverse needs, including students with math and reading disabilities and English language learners; conducting universal screening for all students; monitoring the progress of some students who performed below determined targets on the screening measure, and conducting data-based decision making with school teams.

Now let's look at the case study of Mr. Math and his student Ethan



Handout 9

The Implementation Process

1. Implement standards-aligned, high-quality math universal instruction.
2. Conduct universal screening.
3. Monitor some students' progress.
4. Conduct data-based decision making.

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Slide 97—The Universal Math Curriculum

During the 50-minute mathematics period, Mr. Math uses a CCSS-M-aligned math curriculum that was adopted by Bear Lake’s principal. The principal enacted the curriculum after reviewing WWC data, journal articles, and reports on evaluations from U.S. Department of Education.

Handout 9

The Universal Math Curriculum

- During the 50-minute mathematics period, Mr. Math uses a CCSS-M-aligned math curriculum that was adopted by Bear Lake’s principal.
- The principal enacted the curriculum after reviewing What Works Clearinghouse data, journal articles, and reports on evaluations from U.S. Department of Education.





Slide 98—While Teaching, Mr. Math Draws On:

However, Mr. Math also makes sure to draw on certain math instructional practices.

Read slide.

Handout 9

While Teaching, Mr. Math Draws on:

- Explicit instruction of key concepts.
- Modeling.
- Heuristic strategies.
- Student think-alouds.
- Peer learning, with various student groupings informed by instructional goals.
- Realia, visuals, and use of multimedia.
- Differentiation of instruction, including providing scaffolds and removing them when students are ready.
- Targeting a mix of key general academic and domain-specific vocabulary, word learning strategies, and math language structures to help promote understanding of the “math language.”

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Slide 99—While Teaching, Mr. Math:

While teaching Mr. Math attends to the learning needs of all students at the universal level.

Handout 9

While Teaching, Mr. Math:



- Explicitly models concepts, provides students opportunities for practice and application or concept, and provides explicit feedback and error correction for students.
- Fosters academic math conversation and provides some language-based scaffolds, like sentence frames.
- Uses gestures and nonlinguistic support, like graphics.
- Provides additional wait time and tries to speak clearly.
- Draws on multimedia videos, computer programs, and manipulatives to help illustrate some key concepts.

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Slide 100—Mr. Math and Screening

Read slide.

Note that Mr. Math will also screen his students in December and again in April. These are consistent timeframes set forth by the Bear Lake principal.

Handout 9

Mr. Math and Screening

- Bear Lake screens all students in September.
- Mr. Math implemented a screener for all students.
- He chose a few screeners to target key skills in the second grade math content.
- Mr. Math consulted the Center on RTI tools chart and determined that the validity, reliability, and efficiency of the screener fit his context and student population.



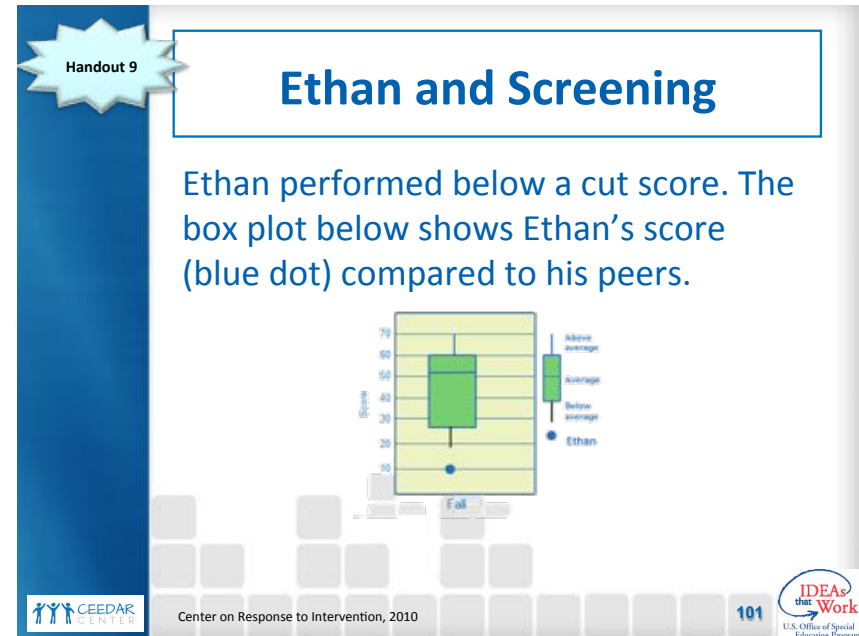
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100

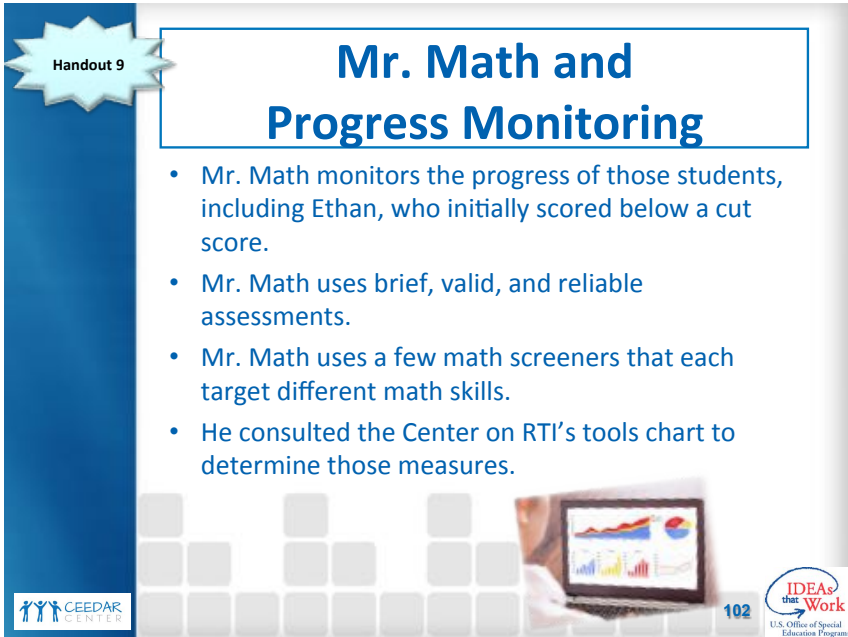
Slide 101—Ethan and Screening

On the math screener that Mr. Math Administered, Ethan performed below the cut score and also performed below his peers.



Slide 102—Mr. Math and Progress Monitoring

For the students who scored below the cut score, Mr. Math monitors their progress for about 8 weeks.



Handout 9

Mr. Math and Progress Monitoring

- Mr. Math monitors the progress of those students, including Ethan, who initially scored below a cut score.
- Mr. Math uses brief, valid, and reliable assessments.
- Mr. Math uses a few math screeners that each target different math skills.
- He consulted the Center on RTI's tools chart to determine those measures.

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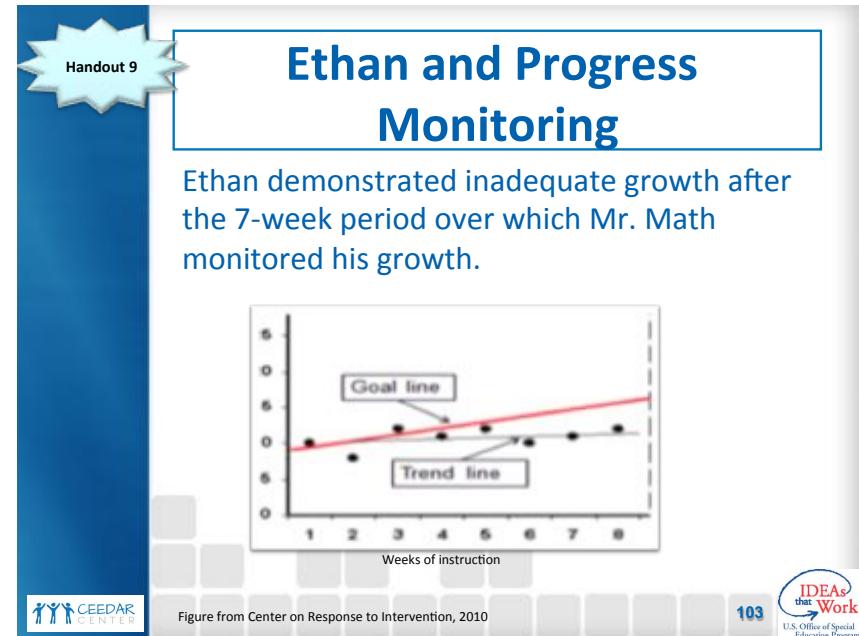
102

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The handout features a blue vertical bar on the left with a starburst containing the text 'Handout 9'. The main content area has a white background with a blue border. At the bottom, there is a keyboard graphic and a laptop displaying a bar chart. Logos for CEEDAR CENTER, IDEA 102, and IDEAS that Work are also present.

Slide 103—Ethan and Progress Monitoring

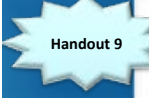
This slide shows the graph from one of the Math screeners Mr. Math gave. For all the screeners, Ethan's trend line is flat. He is not making progress.



Slide 104—Data-Based Decision Making at Bear Lake

Read slide.

The Bear Lake data team also consulted their previously developed plan for how they will systematically analyze the data. They previously determined in writing the decisions rules and specifications for determining whether students will benefit from some additional supplemental support in math. Therefore, they looked to these written decision rules to help them determine the course of action for Ethan.

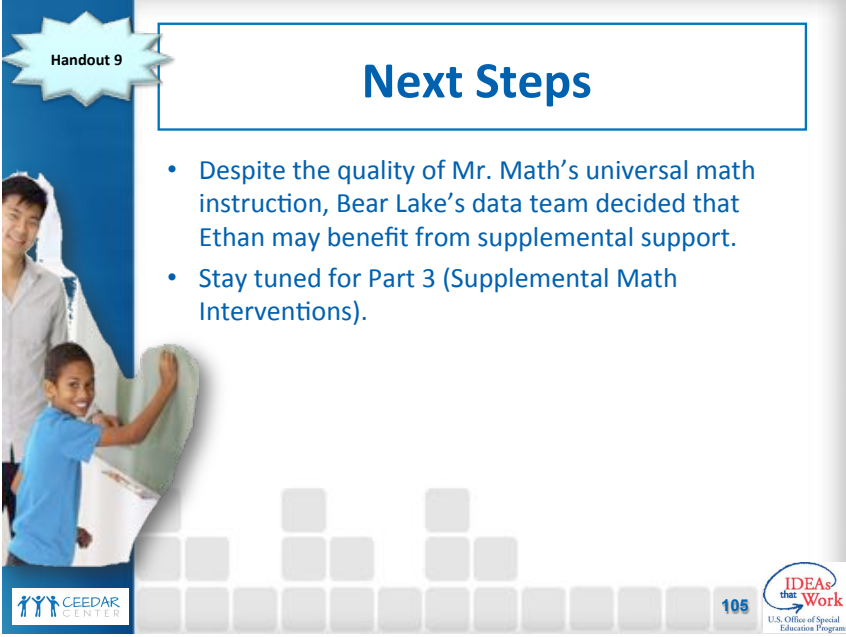
Handout 9

Data-Based Decision Making at Bear Lake

- Mr. Math and the other members of the second-grade Bear Lake data team review the data for the students they were monitoring.
- They consult district and school data at the same time point in previous years.
- They consider both growth and level of performance level.



Slide 105—Next Steps



Handout 9

Next Steps

- Despite the quality of Mr. Math's universal math instruction, Bear Lake's data team decided that Ethan may benefit from supplemental support.
- Stay tuned for Part 3 (Supplemental Math Interventions).

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The slide features a blue starburst in the top left corner containing the text 'Handout 9'. To the left of the main content area is a photograph of a male teacher and a young student working together on a large green heart-shaped poster. The main content area has a white background with a blue border at the top. Below the title 'Next Steps', there are two bullet points. The bottom of the slide has a decorative pattern of grey squares of varying sizes. In the bottom left corner is the CEEDAR CENTER logo, and in the bottom right corner is the IDEA logo with the number 105.

Slide 106—Activity: Concentric Circles

Use the Concentric Circles activity to have participants share each part of their reaction to the case study.

Rotation 1: Do you think the proper universal curriculum was enacted at Bear Lake Elementary? Do you think Mr. Math's instruction was sufficient at the universal level? What did you like? Do you have suggestions for improvement?

Rotation 2: (after the outside circle rotated one position to a new partner) What did you think of Mr. Math's assessment procedures at the universal level? Do you think he enacted appropriate procedures with Ethan?

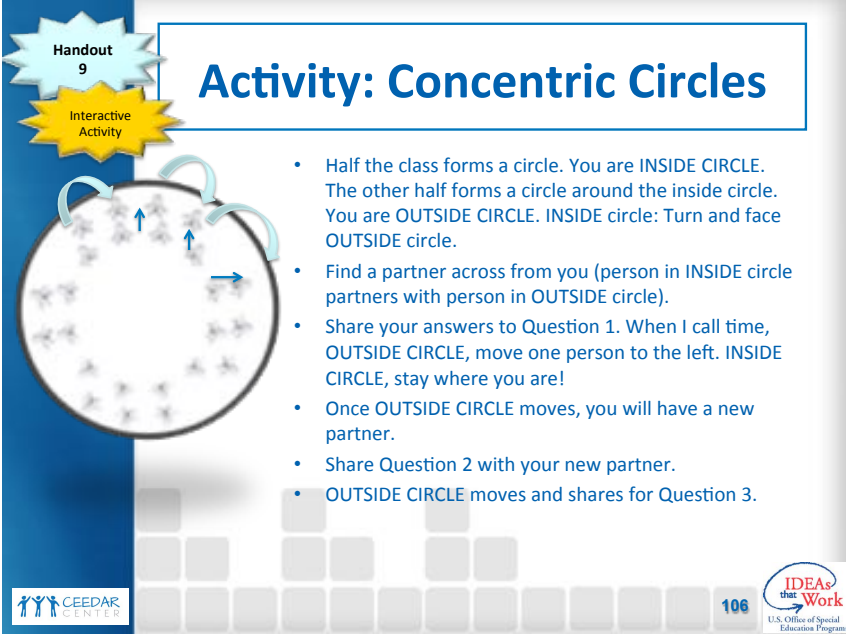
Rotation 3: (after the outside circle rotate one more position to a new partner) Do you think the Bear Lake data team enacted appropriate procedures for data-based decision making? Do you have any ideas for additional considerations? Do you think they made the proper decision regarding Ethan?

For Concentric Circles (also called Inside/Outside Circle):

1. Half the class forms a circle. They are the INSIDE CIRCLE The other half forms a circle around the inside circle. They are the OUTSIDE CIRCLE.

2. INSIDE circle, turn and face OUTSIDE circle.

3. Each participant should have a partner across from them



Handout 9

Activity: Concentric Circles

- Half the class forms a circle. You are INSIDE CIRCLE. The other half forms a circle around the inside circle. You are OUTSIDE CIRCLE. INSIDE circle: Turn and face OUTSIDE circle.
- Find a partner across from you (person in INSIDE circle partners with person in OUTSIDE circle).
- Share your answers to Question 1. When I call time, OUTSIDE CIRCLE, move one person to the left. INSIDE CIRCLE, stay where you are!
- Once OUTSIDE CIRCLE moves, you will have a new partner.
- Share Question 2 with your new partner.
- OUTSIDE CIRCLE moves and shares for Question 3.

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106

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(person in INSIDE circle partners with person in OUTSIDE circle).

4. Have participants share their answers to question 1. Do you think the proper universal curriculum was enacted at Bear Lake Elementary? Do you think Mr. Math's instruction was sufficient at the universal level? What did you like? Do you have suggestions for improvement?

5. When you call time, OUTSIDE CIRCLE, moves one person to the left. INSIDE CIRCLE, stays where they are!

6. Once outside circle moves, participants will have a new partner.

7. They share question 2 with your new partner. What did you think of Mr. Math's assessment procedures at the universal level? Do you think he enacted appropriate procedures with Ethan?

8. When you call time, OUTSIDE CIRCLE, moves one person to the left. INSIDE CIRCLE, stays where they are!

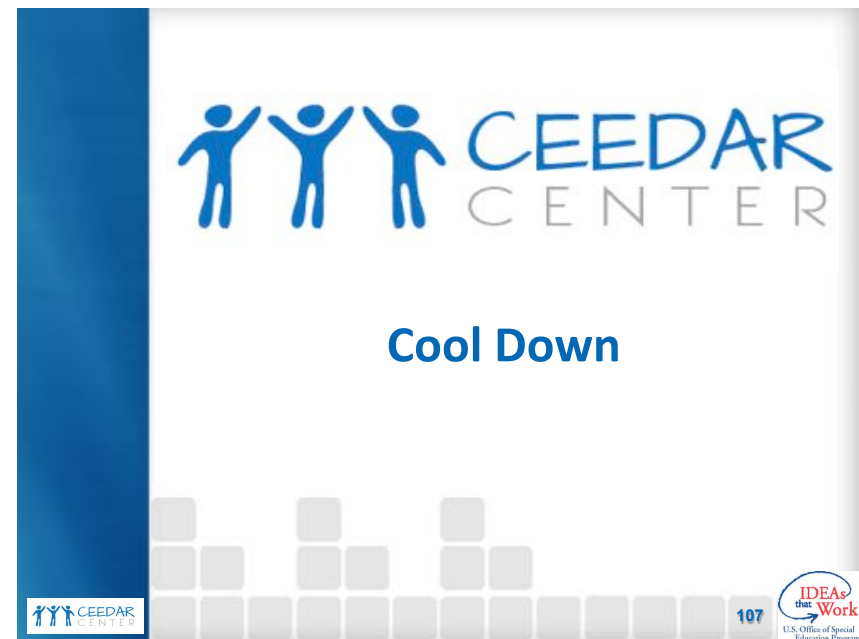
9. Once outside circle moves, participants will have a new partner.

10. They share question 3 with your new partner. Do you think the Bear Lake data team enacted appropriate procedures for data-based decision making? Do you have any ideas for additional considerations? Do you think they made the proper decision regarding Ethan?

After the Concentric Circles activity debrief the answers to all three rotation questions as a whole group. Also, discuss how concentric Circles might help support engaged student learning. For example, students are paired with a partner and had the opportunity to work with a few partners through the activity.

Slide 107—Cool Down

Take some time at the end of the session to go back to the warm-up activity and revisit the answers to the questions posted on the wall.



Slide 108—Activity: Sticky Note Carousel Revisit

Debrief the answers that people wanted to change and the additional answers.

Handout 4

Interactive Activity

Activity: Sticky Note Carousel Revisit

- Go back to the sticky notes posted on the wall at the start of the module.
- Write on at least three more sticky notes using black ink. You can:
 - Modify an existing answer (and post the sticky on top of the answer you want to change).
 - Add a new answer.

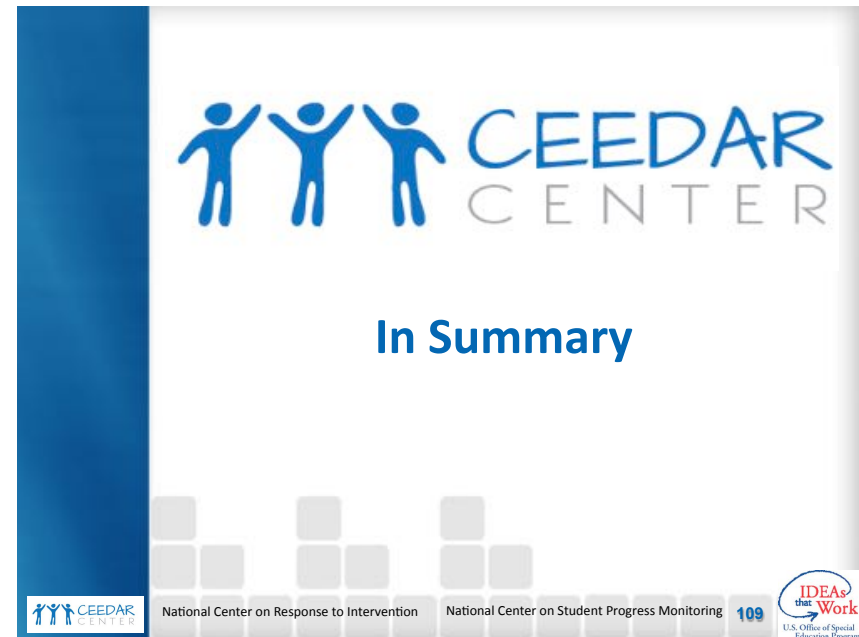


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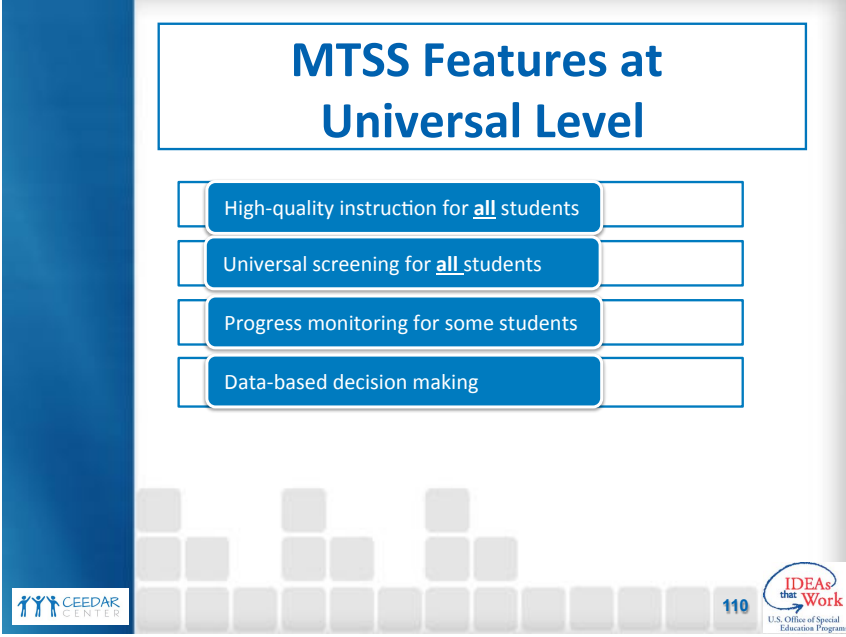
Slide 106—In Summary



Slide 110—MTSS Features at Universal Level

To review, in universal instruction, attention should be on fidelity of implementation, with consideration for cultural and linguistic responsiveness and recognition of student strengths as well as the use of high-quality instruction with evidence-based practices.

The next CEM part will discuss considerations for math instruction and assessment at the supplemental level.

The slide features a blue vertical bar on the left. The main content area has a white background with a blue border at the top containing the title. Below the title are four blue buttons with white text, each followed by a white rectangular box. At the bottom, there is a decorative pattern of grey squares and two logos: the CEDAR Center logo on the left and the IDEA logo on the right, which includes the text '110' and 'U.S. Office of Special Education Programs'.

MTSS Features at Universal Level

High-quality instruction for <u>all</u> students	
Universal screening for <u>all</u> students	
Progress monitoring for some students	
Data-based decision making	

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Slide 111—Disclaimer

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111

Anchor Presentation Table of Contents and Handouts

Part 1: Introduction (4 subparts)

- ✧ Why Is Mathematics Education So Important?
- ✧ Characteristics of Successful Math Programs, Teachers, and Students
- ✧ How Mathematical Thinking Develops
- ✧ Multi-Tiered Systems of Support

Part 2: Universal Math Instruction (6 subparts)

- ✧ What is Universal Instruction in MTSS?
- ✧ What Does High Quality Mathematics Instruction at the Universal Level Look Like?
- ✧ What Are Considerations for Universal Math Instruction in the Common Core State Standards?
- ✧ What is the Role of Screening and Progress Monitoring at the Universal Level?
- ✧ What is the Process for Data Based Decision Making?
- ✧ Case Study: Meet Ethan and Mr. Math

Part 3: Supplemental Math Interventions (6 subparts)

- ✧ What Are Supplemental Interventions?
- ✧ The Implementation Process
- ✧ The Importance of Choosing Evidence-Based Math Interventions and Implementing Them With Fidelity
- ✧ Research-Based Activity: Evaluating an Evidence-Based Math Intervention Program
- ✧ Measuring Student Progress
- ✧ Case Study: Following Ethan

Part 4: Intensive Math Interventions (10 subparts)

- ✧ What Are Intensive Math Interventions?
- ✧ Data-Based Individualization: The Foundation of Intensive Intervention
- ✧ The Implementation Process
- ✧ DBI Step 1: Secondary Intervention Delivered With Greater Intensity
- ✧ DBI Step 2: Progress Monitoring
- ✧ DBI Step 3: Diagnostic Assessment
- ✧ DBI Step 4: Adaptation
- ✧ Intensive Intervention in Mathematics
- ✧ DBI Step 5: Continued Progress Monitoring, Analysis, and Adaptation
- ✧ Case Study: Following Ethan

Handouts

Part 1

- ✧ Handout 1: A Guide to 8 Mathematical Practice Standards
- ✧ Handout 2: Creating Baselines and Goal Lines
- ✧ Handout 3: Concrete-to-Representational-to-Abstract (C-R-A) Instruction

Part 2

- ✧ Handout 4: Questions for Sticky Note Carousel
- ✧ Handout 5: Investigating the Evidence for Universal Math Programs
- ✧ Handout 6: Using the Tools Chart to Evaluate Screening Tools
- ✧ Handout 7: Pick and Chips
- ✧ Handout 8: Write and Right
- ✧ Handout 9: Case Study: Meet Ethan and Mr. Math

Part 3

- ✧ Handout 10: The Implementation Process for Supplemental Math Interventions
- ✧ Handout 11: Selecting Evidence-Based Supplemental Math Intervention Programs
- ✧ Handout 12: Worksheet for Identifying Intervention Program Effectiveness
- ✧ Handout 13: Calculating Slope and Determining Responsiveness to Intervention
- ✧ Handout 14: Supplemental Math Intervention Case Study at Bear Lake

Part 4

- ✧ Handout 15: The Five Steps in the Implementation Process of Intensive Math Interventions (DBI)
- ✧ Handout 16: Case Study at Bear Lake: Determining Response at the Intensive Level (Ethan)

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