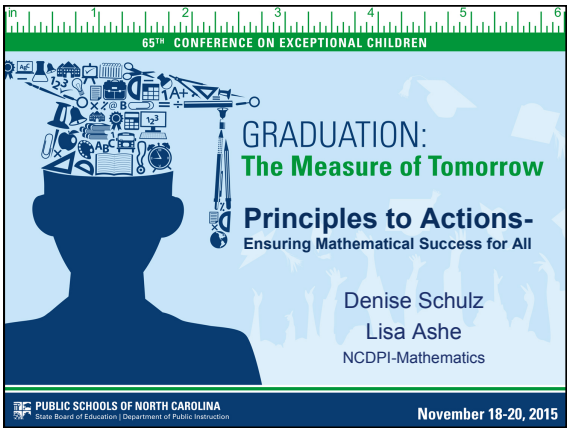


Welcome
"Who's in the Room?"

Beliefs about Teaching and Learning

Students	Teachers	Family

Sort the Beliefs

Productive Beliefs

Unproductive Beliefs

Principles to Actions pg. 11

Beliefs About Teaching and Learning Mathematics

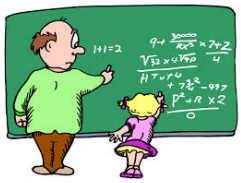
Beliefs about teaching and learning mathematics	
Unproductive beliefs	**Productive beliefs**
Mathematics learning should focus on practicing procedures and memorizing basic number combinations.	Mathematics learning should focus on developing understanding of concepts and procedures through problem solving, reasoning, and discourse.
Students need only to learn and use the same standard computational algorithms and the same prescribed methods to solve algebraic problems.	All students need to have a range of strategies and approaches from which to choose in solving problems, including, but not limited to, general methods, standard algorithms, and procedures.
Students can learn to apply mathematics only after they have mastered the basic skills.	Students can learn mathematics through exploring and solving contextual and mathematical problems.
The role of the teacher is to tell students exactly what definitions, formulas, and rules they should know and demonstrate how to use this information to solve mathematics problems.	The role of the teacher is to engage students in tasks that promote reasoning and problem solving and facilitate discourse that moves students toward shared understanding of mathematics.
The role of the student is to memorize information that is presented and then use it to solve routine problems on homework, quizzes, and tests.	The role of the student is to be actively involved in making sense of mathematics tasks by using varied strategies and representations, justifying solutions, making connections to prior knowledge or familiar contexts and experiences, and considering the reasoning of others.
An effective teacher makes the mathematics easy for students by guiding them step by step through problem solving to ensure that they are not frustrated or confused.	An effective teacher provides students with appropriate challenge, encourages perseverance in solving problems, and supports productive struggle in learning mathematics.

Principles to Action, pg. 11

Beliefs About Teaching and Learning Mathematics

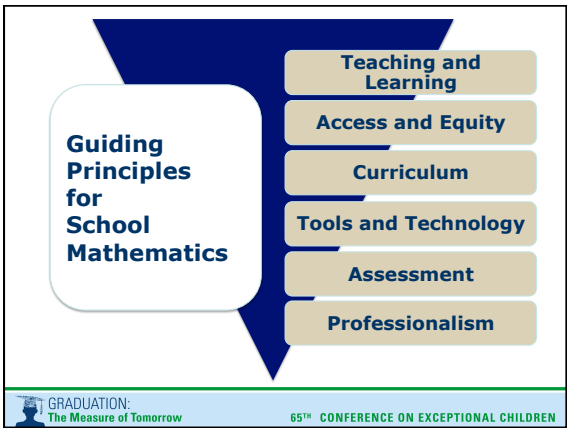
Examine the comic strip.
What do you see?

"Teachers' beliefs influence the decisions they make about the manner in which they teach mathematics."



"Students' beliefs influence their perception of what it means to learn mathematics and how they feel toward the subject."

Principles to Actions, pg. 10-11



Mathematics Teaching Practices

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

GRADUATION: The Measure of Tomorrow — 65TH CONFERENCE ON EXCEPTIONAL CHILDREN

Mathematics Teaching Practices

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

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What do you notice?

Principles to Actions
Mathematics Teaching Practices

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

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COMMON CORE STATE STANDARDS INITIATIVE

Common Core State
Standards for Mathematical Practice
(Referred to as Math Practice Standards)

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

Common Core Standards Initiative, 2012
http://www.corestandards.org

Math Goals	What might be the math learning goals?
Tasks & Representations	What representations might students use in reasoning through and solving the problem?
Discourse & Questions	How might we question students and structure class discourse to advance student learning?
Fluency from Understanding	How might we develop student understanding to build toward aspects of procedural fluency?
Struggle & Evidence	How might we check in on student thinking and struggles and use it to inform instruction?

How Many Colored Pencils?

There are 6 tables in Mrs. Potter's art classroom. There are 4 students sitting at each table. Each student has a box of 10 colored pencils.

- How many colored pencils are at each table?
- How many colored pencils do Mrs. Potter's students have in total?

How Did You Solve the Problem?

Share your representation with the other people at your table.

Tasks & Representations

What representations might students use in reasoning through and solving the problem?

Different Representations should:

- Be introduced, discussed, and connected.
- Be used to focus students' attention on the structure of mathematical ideas by examining essential features.
- Support students' ability to justify and explain their reasoning.

Lesh, Post, & Behr, 1987; Marshall, Superfine, & Canty, 2010; Tripathi, 2008; Webb, Boswinkel, & Dekker, 2008

Use and connect mathematical representations.

Because of the abstract nature of mathematics, people have **access** to **mathematical ideas** only through the **representations** of those ideas.

(National Research Council, 2001, p. 94)

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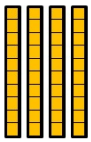
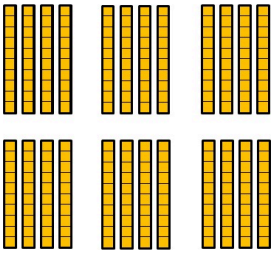
A Possible Solution:

a. There are 4 students each with ten pencils at each table.

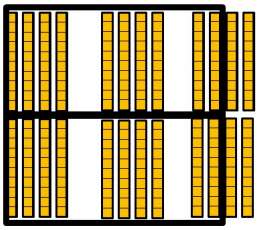


There are 10, 20, 30, 40 pencils all together.

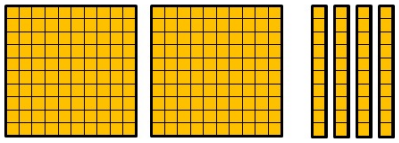
b. There are 6 tables with 4 boxes with ten pencils each.



We can combine the 4 boxes from 2 tables to get 8 boxes, and then take 2 from one table to get 10 boxes. We can do this twice.



This means there are 2 groups of 10 boxes which is 200 pencils, with 4 groups of ten pencils in addition to that.



So there are 240 pencils all together.

Another Possible Solution:

a. Each student has a box of 10 pencils, which is one group of 10. There are 4 students at each table, so there are 4 groups of 10 pencils or 4×10 pencils at each table. We also know that the "4" in the number 40 means "4 tens" so we know there are 40 pencils at each table.

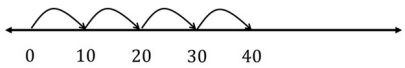
b. First, there are 4×10 pencils at each table. Since there are 6 tables, and 40 pencils at each table, there are 6×40 pencils in total. This 40 arose as 4 groups of 10, or, 4×10, so there are

$$6 \times (4 \times 10)$$

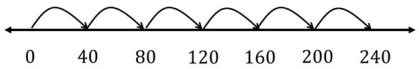
pencils in total. By the associative property of multiplication, this is also $(6 \times 4) \times 10 = 24 \times 10$ pencils. 24 tens is 240, so there are 240 pencils in total.

Another Possible Solution:

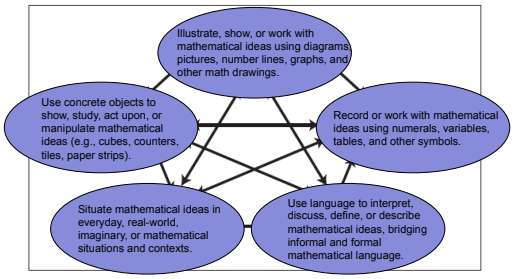
a. There are 40 pencils at one table.



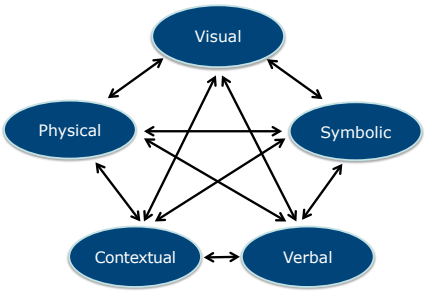
b. There are 240 pencils all together.



Use and connect mathematical representations.



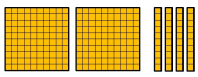
Important Mathematical Connections *between* and *within* different types of representations



Principles to Actions (p. 25) (Adapted from Lesh, Post, & Behr, 1987)

How are these solutions connected?

This means there are 2 groups of 10 boxes which is 200 pencils, with 4 groups of ten pencils in addition to that.



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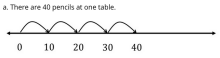

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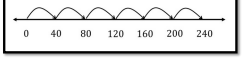

Proficient problem solvers frequently use representations to solve problems and communicate results.

Boaler, *What's Math Got To Do With It?*, 2015

Recommendations for Implementation

- Select visual representations that are appropriate for students and the problems they are solving (Woodward et al., 2012).
- Teach students that different algebraic representations can convey different information about an algebra problem (Star et al., 2015).
- Make **explicit connections** between **representations**.
- Strengthen students' **representational competence** by:
  1. Encouraging purposeful selection of representations.
  2. Engaging in dialogue about explicit connections among representations.
  3. Alternating the direction of the directions made among representations.

(NCTM, 2014).

Fluency from Understanding

How might we develop student understanding to build toward aspects of procedural fluency?

Procedural Fluency should:

- Build on a foundation of conceptual understanding.
- Over time (months, years), result in known facts and generalized methods for solving problems.
- Enable students to flexibly choose among methods to solve contextual and mathematical problems.

Baroody, 2006; Fuson & Beckmann, 2012/2013; Fuson, Kalchman, & Bransford, 2005; Russell, 2006

How does this task develop a foundation of conceptual understanding for building toward procedural fluency?

Research Shows:

- "Students who use memorization as their primary strategy are the lowest-achieving students in the world."
- "Students who were achieving at high levels were those who had worked out that numbers can be flexibly broken apart and put together again."

Boaler, *What's Math Got To Do With It?*, 2015

Compression of Concepts

Boaler, *What's Math Got To Do With It?*, 2015

"Fluency builds from initial exploration and discussion of number concepts to using informal reasoning strategies based on meanings and properties of the operations to the eventual use of general methods as tools in solving problems."

Principles to Actions (NCTM, 2014, p. 42)

Build procedural fluency from conceptual understanding.

A rush to fluency undermines students' confidence and interest in mathematics and is considered a cause of mathematics anxiety.

(Ashcraft 2002; Ramirez Gunderson, Levine, & Beilock, 2013)

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Struggle & Evidence

How might we check in on student thinking and struggles and use it to inform instruction?

Productive Struggle should:

- Be considered essential to learning mathematics with understanding.
- Develop students' capacity to persevere in the face of challenge.
- Help students realize that they are capable of doing well in mathematics with effort.

Black, Trzesniewski, & Dweck, 2007; Dweck, 2008; Hiebert & Grouws, 2007; Kapur, 2010; Warshauer, 2011

Support productive struggle in learning mathematics.

The struggle we have in mind comes from solving problems that are within reach and grappling with key mathematical ideas that are comprehendible but not yet well formed.

(Hiebert, Carpenter, Fennema, Fuson, Human, Murray, Olivier, & Wearne, 1996)

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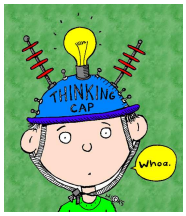
Shopping Trip Task

Joseph went to the mall with his friends to spend the money that he had received for his birthday. When he got home, he had $24 remaining. He had spent 3/5 of his birthday money at the mall on video games and food. How much money did he spend? How much money had he received for his birthday?

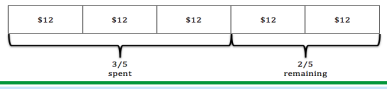
Principles to Actions pg. 51

How Would You Approach This with Students?



Teacher A:

- Tells students to draw a rectangle and shows them how to divide it into fifths to represent what Joseph had spent and what he had left.
- Then, guides students step by step until they have labeled each one-fifth as worth $12.
- Finally, she tells the students to use the information in the diagram to figure out the answers to the questions.



Teacher B:

- Asks students to write down two things that they know about the problem and one thing that they wish they knew because it would help them make progress in solving the problem.
- Initiates a discussion in which several ideas are offered for what to do next.
- Encourages students to consider the various ideas that have been shared as they continue working on the task.

How do these approaches differ?

What have students learned?

- Teacher A wants students to be successful in answering, and begins to direct the work.
- Teacher B resists the temptation to step in, but instead supports students in considering what they know and what they need to figure out.
- Students in these classrooms have very different opportunities to learn.

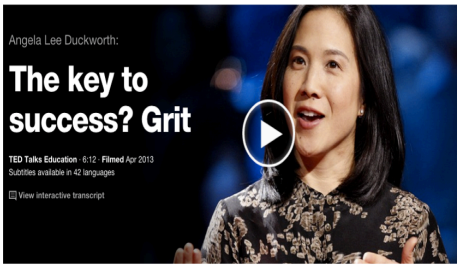
"Teachers greatly influence how students perceive and approach struggle in the mathematics classroom. Even young students can learn to value struggle as an expected and natural part of learning."

Principles to Actions, pg. 50

Fixed vs. Growth Mindset

- Fixed: those who believe intelligence is an innate trait; believe that learning should come naturally
- Growth: those who believe intelligence can be developed through effort; likely to persevere through struggle because they see challenging work as an opportunity to learn and grow

Principles to Actions, pg. 50



What is the central message about productive struggle and student learning?

Math Goals	What might be the math learning goals?
Tasks & Representations	What representations might students use in reasoning through and solving the problem?
Discourse & Questions	How might we question students and structure class discourse to advance student learning?
Fluency from Understanding	How might we develop student understanding to build toward aspects of procedural fluency?
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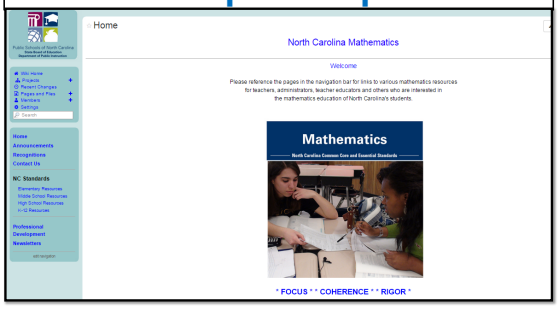
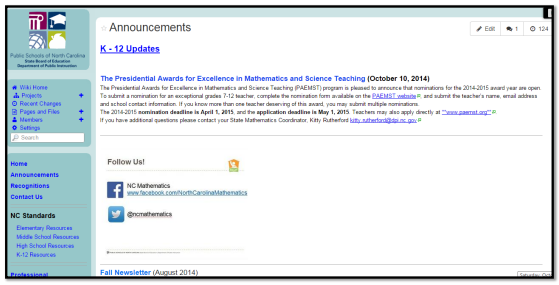
DPI Elementary Math Updates

maccss.ncdpi.wikispaces.net



Announcements



Standards

Instructional Resources

Assessment

Parent Information

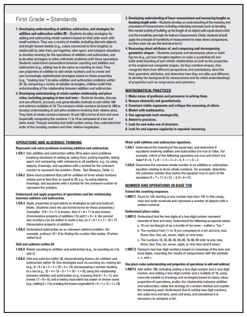
Standards

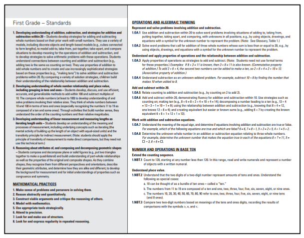
- K-5 Standards in Word format
- Major Work of the Grade
- One-page layouts
- Unpacking Documents
- Overview and Critical Areas
- Standards for Mathematical Practices
- Progressions

Major Work

First Grade	
Major Clusters	**Supporting/Additional Clusters**
Operations and Algebraic Thinking • Represent and solve problems involving addition and subtraction. • Understand and apply properties of operations and the relationship between addition and subtraction. • Add and subtract within 20. • Work with addition and subtraction equations. **Number and Operations in Base Ten** • Extend the counting sequence. • Understand place value. • Use place value understanding and properties of operations to add and subtract. **Measurement and Data** • Measure lengths indirectly and by iterating length units.	**Measurement and Data** • Tell and write time. • Represent and interpret data. **Geometry** • Reason with shapes and their attributes.

North Carolina Standard Course of Study: One Page Layouts





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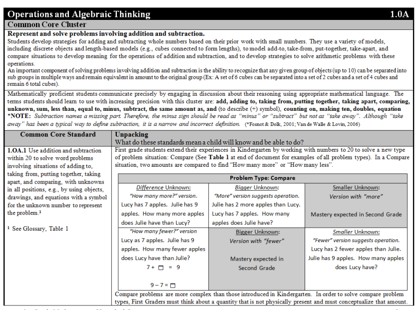
Unpacking Document



Operations and Algebraic Thinking **1.0A**

Common Core Cluster

Represent and solve problems involving addition and subtraction.
Students develop strategies for adding and subtracting whole numbers based on their prior work with small numbers. They use a variety of models, including discrete objects and length-based models (e.g., cubes connected to form lengths), to model add-to, take-from, put-together, take-apart, and compare situations to develop meaning for the operations of addition and subtraction, and to develop strategies to solve arithmetic problems with these operations.
An important component of solving problems involving addition and subtraction is the ability to recognize that any given group of objects (up to 10) can be separated into sub groups in multiple ways and remain equivalent in amount to the original group (Ex: A set of 6 cubes can be separated into a set of 2 cubes and a set of 4 cubes and remain 6 total cubes).

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **add, adding to, taking from, putting together, taking apart, comparing, unknown, sum, less than, equal to, minus, subtract, the same amount as, and** (to describe (+) symbol), **counting on, making ten, doubles, equation**
***NOTE:** *Subtraction names a missing part. Therefore, the minus sign should be read as "minus" or "subtract" but not as "take away". Although "take away" has been a typical way to define subtraction, it is a narrow and incorrect definition.* (*Fosnot & Dolk, 2001; Van de Walle & Lovin, 2006)

Common Core Standard	Unpacking What do these standards mean a child will know and be able to do?
1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.[1] [1] See Glossary, Table 1	First grade students extend their experiences in Kindergarten by working with numbers to 20 to solve a new type of problem situation: Compare (See **Table 1** at end of document for examples of all problem types). In a Compare situation, two amounts are compared to find "How many more" or "How many less".

Problem Type: Compare

Difference Unknown:	*Bigger* Unknown:	Smaller Unknown:
"How many more?" version. Lucy has 7 apples. Julie has 9 apples. How many more apples does Julie have than Lucy?	*"More" version suggests operation.* Julie has 2 more apples than Lucy. Lucy has 7 apples. How many apples does Julie have?	*Version with "more"* Mastery expected in Second Grade
"How many fewer?" version Lucy as 7 apples. Julie has 9 apples. How many fewer apples does Lucy have than Julie? 7 + □ = 9 9 – 7 = □	Bigger Unknown: *Version with "fewer"* Mastery expected in Second Grade	*Smaller* Unknown: *"Fewer" version suggests operation.* Lucy has 2 fewer apples than Julie. Julie has 9 apples. How many apples does Lucy have?

Compare problems are more complex than those introduced in Kindergarten. In order to solve compare problem types, First Graders must think about a quantity that is not physically present and must conceptualize that amount.

1st Grade Mathematics ● Unpacked Content page 5

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The Measure of Tomorrow

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Instructional Resources

- Building the Language of Mathematics
- K-2 Instructional and Assessment Tasks
- Lessons for Learning
- Units
- Building Conceptual Understanding and Fluency Through Games
- AIG Lessons
- Professional Development
- Webinars
- Teaching Math to Young Children
- Navigation Alignment
- Internet Resources

GRADUATION:
The Measure of Tomorrow

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Building Mathematical Language

First Grade			
Operations and Algebraic Thinking	**Number and Operations in Base Ten**	**Measurement and Data**	**Geometry**
Represent and solve problems involving addition and subtraction. add, adding to, taking from, putting together, comparing, unknown, sum, less than, equal to, minus, subtract, the same amount as, counting on, making ten, doubles, equation **Understand and apply properties of operations and the relationship between addition and subtraction.** add, subtract, unknown addend, order, first, second, **Add and subtract within 20.** addition, putting together, adding to, counting on, making ten, subtraction, taking apart, taking from, equivalent, sum, unknown, equal, equation, counting all, counting on, counting back **Work with addition and subtraction equations.** equation, equal, the same amount/quantity as, true, false, addition, putting together, adding to, counting on, making ten, subtract, taking apart, taking from, sum, unknown	**Extend the counting sequence.** number, zero, one, two…thirteen, fourteen…nineteen…one hundred twenty **Understand place value.** ones, tens, bundle, left-overs, singles, groups, compare, greater than, less than, equal to, <, >, = **Use place value understanding and properties of operations to add and subtract.** ones, tens, add, subtract, reason, more, less	**Measure lengths indirectly and by iterating length units.** compare, measure, order, length, height, more, less, longer than, shorter, than, first, second, third, gap, overlap, about , a little less than, a little more than **Tell and write time.** time, hour, half-hour, about, o'clock, past, analog clock, digital clock **Represent and interpret data.** Data, how many more, how many less, least, same, different, category, question, collect	**Reason with shapes and their attributes.** shape, closed, open, side, attribute, feature, two-dimensional, rectangle, square, trapezoid, triangle, half-circle, and quarter-circle, three-dimensional, rectangular prism cube, cone, prism, cylinder, partition, equal shares, halves, fourths, quarters, half of, fourth of, quarter of From previous grades: circle, rectangle, hexagon, sphere From previous grade: circle, hexagon, cube, cone, cylinder, sphere

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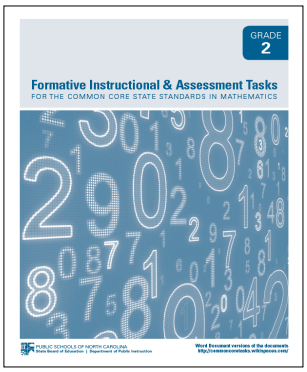

K-2 Tasks & 3-5 Tasks

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First Grade Tasks

NC Department of Public Instruction

Click on each cluster header to obtain specific tasks. Tasks are also provided as compiled documents for your convenience.

Operations and Algebraic Thinking	**Compiled Document**
Represent and solve problems involving addition and subtraction. (1.OA.1 - 1.OA.2)	1.OA Tasks (Word)
Understand and apply properties of operations and the relationships between addition and subtraction. (1.OA.3 - 1.OA.4)	1.OA Tasks (PDF)
Add and subtract within 20. (1.OA.5 - 1.OA.6)	
Work with addition and subtraction equations. (1.OA.7 - 1.OA.8)	
Number and Operations in Base Ten	
Extend the counting sequence. (1.NBT.1)	1.NBT Tasks (Word)
Understand place value. (1.NBT.2 - 1.NBT.3)	1.NBT Tasks (PDF)
Use place value understanding and properties of operations to add and subtract. (1.NBT.4 - 1.NBT.6)	
Measurement and Data	
Measure lengths indirectly, and by iterating length units. (1.MD.1 - 1.MD.2)	1.MD Tasks (Word)

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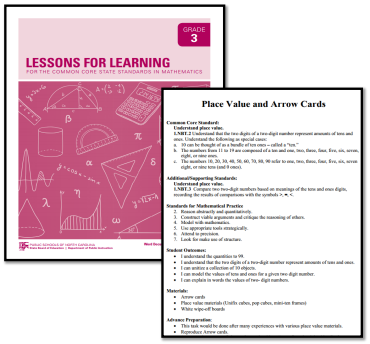

K-8 Lessons for Learning

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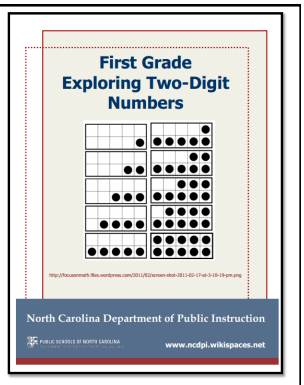
K-5 Grade Level Unit or Collection of Lessons



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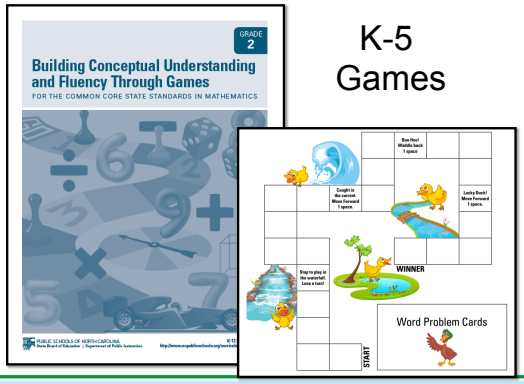

K-5 Games

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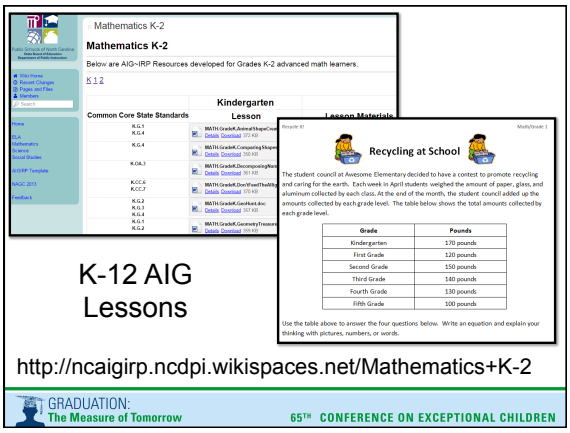

K-12 AIG Lessons

http://ncaigirp.ncdpi.wikispaces.net/Mathematics+K-2

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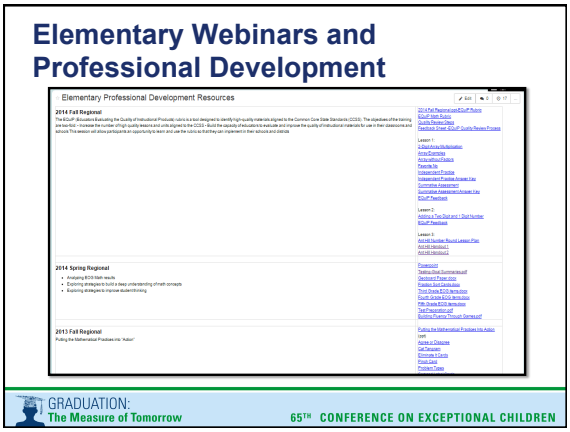

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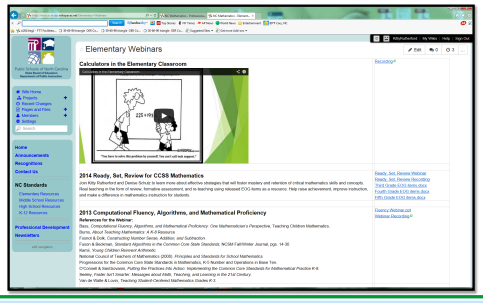
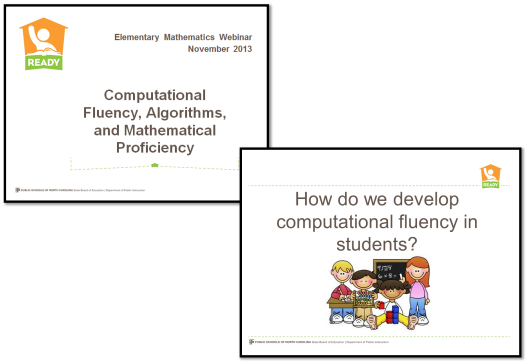
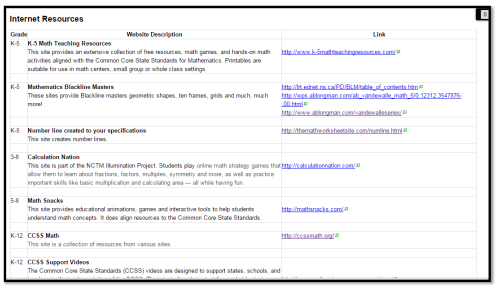
Elementary Webinars



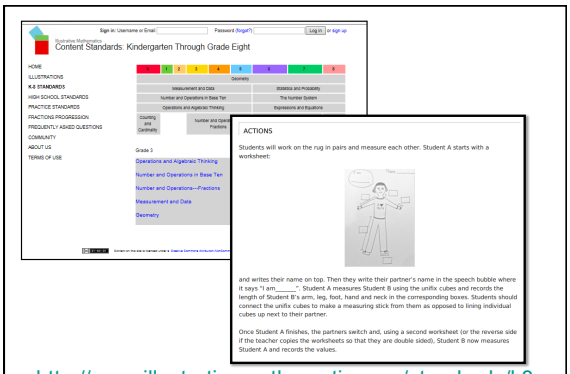


Internet Resources

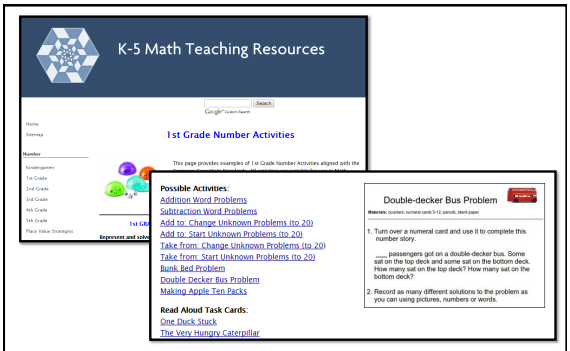


Internet Resources

Grade	Website Description	Link
K-5	**K-5 Math Teaching Resources** This site provides an extensive collection of free resources, math games, and hands-on math activities aligned with the Common Core State Standards for Mathematics. Printables are suitable for use in math centers, small group or whole class settings.	http://www.k-5mathteachingresources.com/
K-5	**Mathematics Blackline Masters** These sites provide Blackline masters geometric shapes, ten frames, grids and much, much more!	http://st.ednet.ns.ca/PD/BLM/table_of_contents.htm http://wps.ablongman.com/ab_vandewalle_math_6/0,12312,3547876-/00.html http://www.ablongman.com/vandewalleseries/
K-5	**Number line created to your specifications** This site creates number lines.	http://themathworksheetsite.com/numline.html
3-8	**Calculation Nation** This site is part of the NCTM Illumination Project. Students play online math strategy games that allow them to learn about fractions, factors, multiples, symmetry and more, as well as practice important skills like basic multiplication and calculating area — all while having fun.	http://calculationnation.com/
5-8	**Math Snacks** This site provides educational animations, games and interactive tools to help students understand math concepts. It does align resources to the Common Core State Standards.	http://mathsnacks.com/
K-12	**CCSS Math** This site is a collection of resources from various sites.	http://ccssmath.org/
K-12	**CCSS Support Videos** The Common Core State Standards (CCSS) videos are designed to support states, schools, and	



http://www.illustrativemathematics.org/standards/k8



http://www.k-5mathteachingresources.com/

http://learnzillion.com

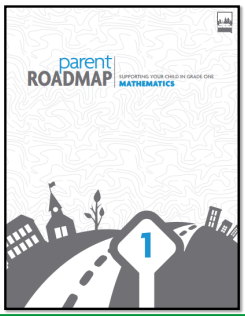
Assessment

- K-2 Instructional and Assessment Tasks
- Mid-Year Benchmark Assessment Standards
- Released K-2 Assessments
  - 2012-2013
  - 2013-2014
  - 2014-2015
- Balanced Assessment in Mathematics (internet resource)

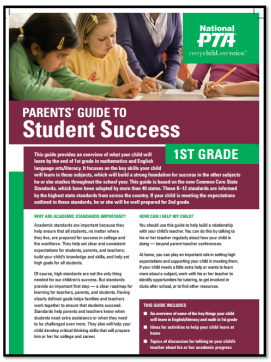
Parent Information

- Parent Roadmaps
- Frequently Asked Questions
- NCTM Family Resources
- Parents' Guides to Student Success

Parent Roadmaps



NCTM Family Resources



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K-12 Resources

- Video
  - Bill McCallum
  - Phil Daro
  - Butterfly Fractions

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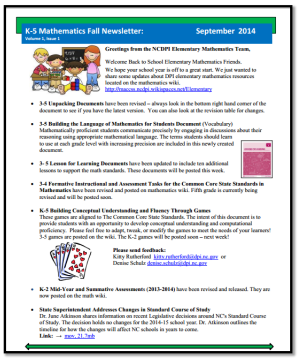

K-5 Mathematics Fall Newsletter: September 2014

Volume 1, Issue 1

Greetings from the NCDPI Elementary Mathematics Team,

Welcome Back to School Elementary Mathematics Friends.
We hope your school year is off to a great start. We just wanted to share some updates about DPI elementary mathematics resources located on the mathematics wiki.
http://maccss.ncdpi.wikispaces.net/Elementary

- **3-5 Unpacking Documents** have been revised – always look in the bottom right hand corner of the document to see if you have the latest version. You can also look at the revision table for changes.
- **3-5 Building the Language of Mathematics for Students Document** (Vocabulary) Mathematically proficient students communicate precisely by engaging in discussions about their reasoning using appropriate mathematical language. The terms students should learn to use at each grade level with increasing precision are included in this newly created document.
- **3- 5 Lesson for Learning Documents** have been updated to include ten additional lessons to support the math standards. These documents will be posted this week.
- **3-4 Formative Instructional and Assessment Tasks for the Common Core State Standards in Mathematics** have been revised and posted on mathematics wiki. Fifth grade is currently being revised and will be posted soon.
- **K-5 Building Conceptual Understanding and Fluency Through Games**
  These games are aligned to The Common Core State Standards. The intent of this document is to provide students with an opportunity to develop conceptual understanding and computational proficiency. Please feel free to adapt, tweak, or modify the games to meet the needs of your learners! 3-5 games are posted on the wiki. The K-2 games will be posted soon – next week!

  Please send feedback:
  Kitty Rutherford kitty.rutherford@dpi.nc.gov or
  Denise Schulz denise.schulz@dpi.nc.gov
- **K-2 Mid-Year and Summative Assessments (2013-2014)** have been revised and released. They are now posted on the math wiki.
- **State Superintendent Addresses Changes in Standard Course of Study**
  Dr. June Atkinson shares information on recent Legislative decisions around NC's Standard Course of Study. The decision holds no changes for the 2014-15 school year. Dr. Atkinson outlines the timeline for how the changes will affect NC schools in years to come.
  Link: → page 31 link

Newsletters

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@ncmathematics

http://maccss.ncdpi.wikispaces.net

Join Our Listserv

1.Send an email to the Listserv by cutting and pasting the following address into the "To" box within your email
application.join-k-5_math@lists.dpi.state.nc.us
[Elementary requests]

2.Leave the subject line and the body of the message blank.

3.Once successfully subscribed, a confirmation email will be sent.

Nominate An Outstanding Teacher

Website: www.paemst.org
Kitty.rutherford@dpi.nc.gov

2014 PAEMST Math State Finalists

Elementary

Heather Landreth

Kayonna Pitchford

Meredith Stanley

DPI Mathematics Section

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For all you do for our students!