The Shifts for CCS – Math

A Webinar Series

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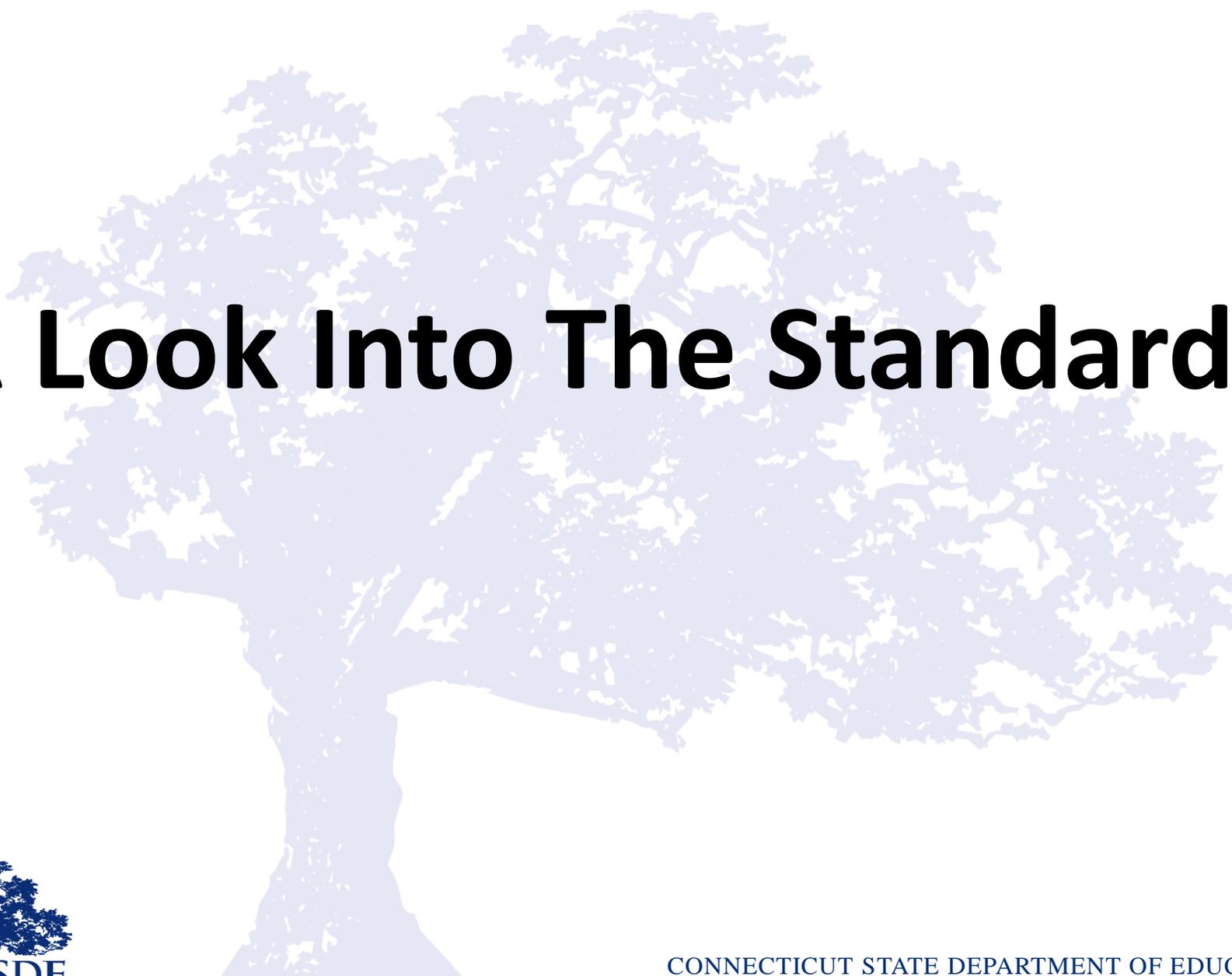
A Look Into The Standards

What's in the CCS-Math?

- The Standards for Mathematical Content
  - What students should know and be able to do
  - Content Domains
  - Domains into clusters
  - Clusters into standards

- The Standards for Mathematical Practice
  - The habits of mind

Organization of the Standards for Mathematical Practice

2. Reason abstractly and quantitatively

3. Construct viable arguments and critique the reasoning of others

4. Model with mathematics

5. Use appropriate tools strategically

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

1. Make sense of problems and persevere in solving them
6. Attend to precision

The *Standards for Mathematical Practice* were based on the NCTM Process Standards and the National Research Council's (NRC) Strands of Mathematical Proficiency.

Three Instructional Shifts for CCS - Mathematics

Focus on the Standards; teach less but for understanding.

Coherence – Carefully connect the learning within and across grades so that students can build new understanding on foundations built in previous years.

Rigor – Means a balance of solid conceptual understanding, procedural skill and fluency, and application of skills in problem solving situations.
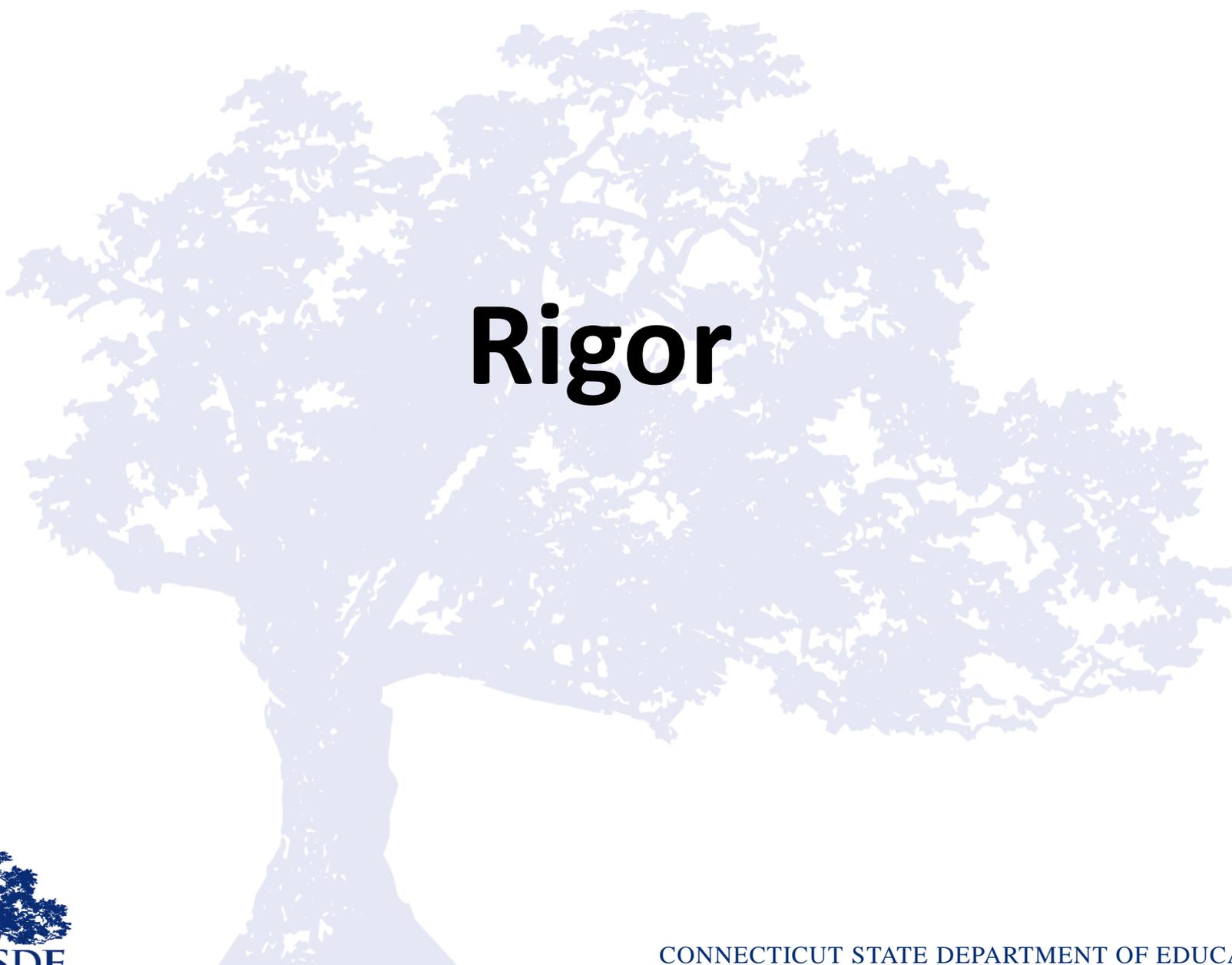
Rigor

Shift 3: Rigor

Application

Conceptual understanding

Procedural skill and fluency

In major topics, pursue conceptual understanding, procedural skill and fluency, and application

✓The CCSSM require a balance of:

-Conceptual understanding

-Procedural skill and fluency

-Application in problem-solving situations

✓Equal intensity in time, activities, and resources over the duration of a course

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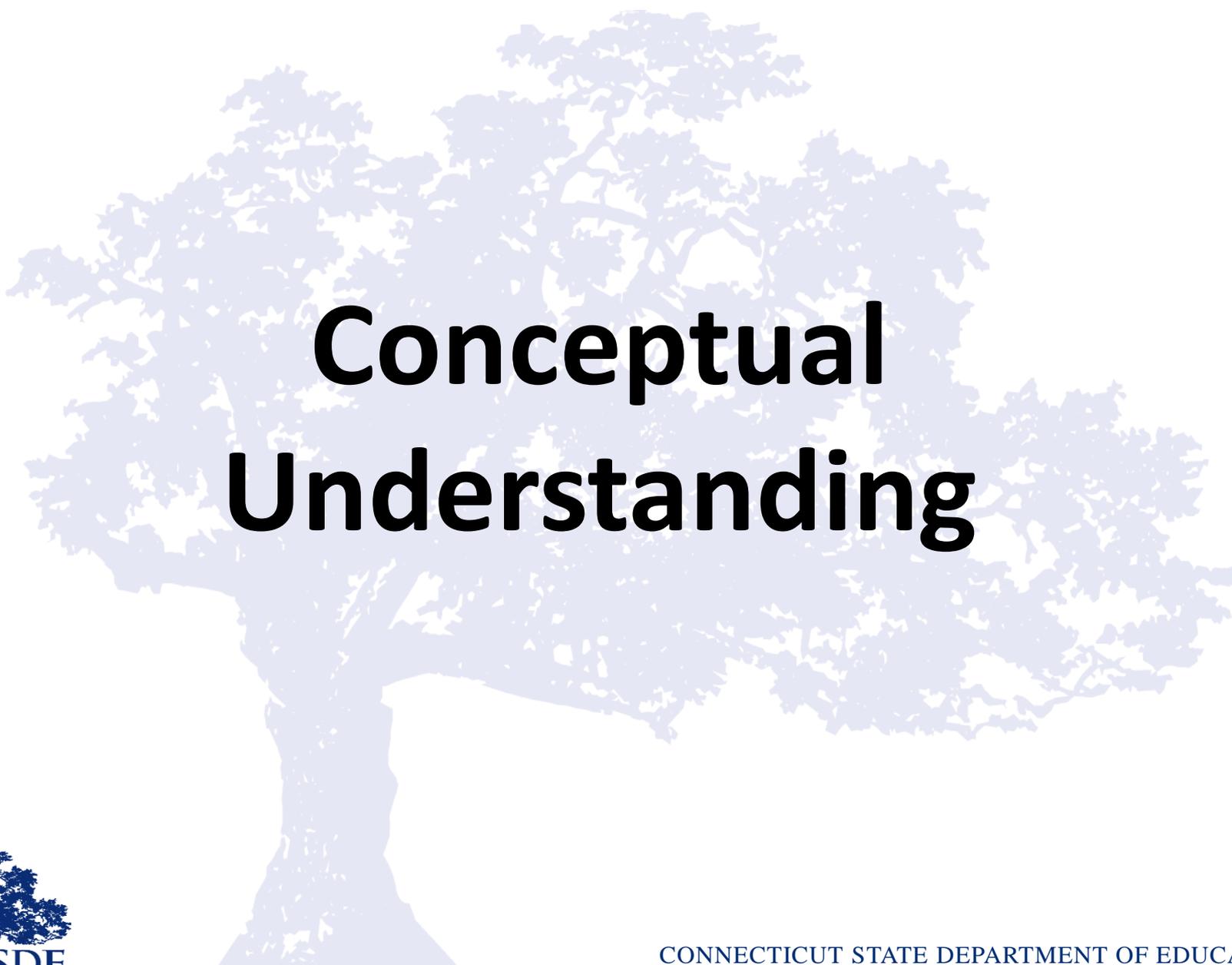
Conceptual Understanding

Conceptual Understanding

- Teach more than "how to get the answer" and instead support students' ability to access concepts from a number of perspectives

- Students are able to see math as more than a set of mnemonics or discrete procedures

- Conceptual understanding is about mathematical ideas, often distinct from context.

- Conceptual understanding supports the other aspects of rigor (procedural skill and fluency, and application)

Conceptual Understanding in Instruction

- Measuring understanding in assessment is difficult, so the instruction needs to be centered around the understanding

- Conceptual understanding is produced through rich problems, hands-on activities, skillful questioning, student discussion, etc.

- Conceptual understanding is about big ideas in math

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Relationship to the Standards

There are clusters and standards that explicitly require students to understand concepts.

K.OA.A.1
1.NBT.B, 1.NBT.C
2.NBT.A, 2.NBT.B
3.OA.A.1, 3.OA.A.2
4.NF.A, 4.NBT.A,
4.NBT.B,
5.NF.B, 5.NBT.A,
5.NBT.B

6.RP.A, 6.EE.A.3
7.NS.A, 7.EE.A
8.EE.B, 8.F.A, 8.G.A
N.RN.A.1, A.APR.B
A.REI.A.1, A.REI.D.10,
A.REI.D.11, F.IF.A.1,
F.LEA.A.1,
G.SRT.A.S, G.SRT.C.6,
S.ID.C.7

Building Conceptual Understanding

4.NF.A Extend <mark>**understanding**</mark> of fraction equivalence and ordering.

- The language in the standard speaks to conceptual understanding.
- Students need to understand more than just a process of "multiply the top and bottom number to make an equivalent fraction."
- Students need to understand what it means for numbers to be written in equivalent forms.

Exercises vs. Problems

Problems

- Students learn new mathematics
- Students are asked to use what they already know to answer mathematical questions that they haven't been taught to solve
- Opportunity for discussion and allows teachers to see what students understand

Exercises

- Students apply what they have already learned to build mastery
- Repetition to develop a skill

Questioning

- High-quality problems provide opportunities for discussion

- Good quality questions are easy to discuss.

- Questions should elicit a range of responses from students which will enable class discussions to lead to conceptual understanding of a topic

- Questions do not have to be complex, but need to elicit student thinking about the conceptual understanding required in the Standards

Conceptual Understanding Examples

4.NF.C <u>Understand</u> decimal notation for fractions, and compare decimal fractions.

1.7 or 17 twelfths

a. Which number is larger?

b. Explain how you can tell without drawing a picture.

8.EE.C.8.a <u>Understand</u> that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

a. Draw a line that intersects this line.
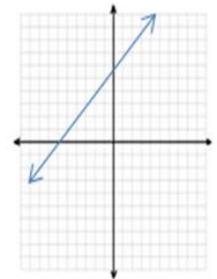
b. Write a system of equations that is represented by these two lines.

c. What is the solution to the system?
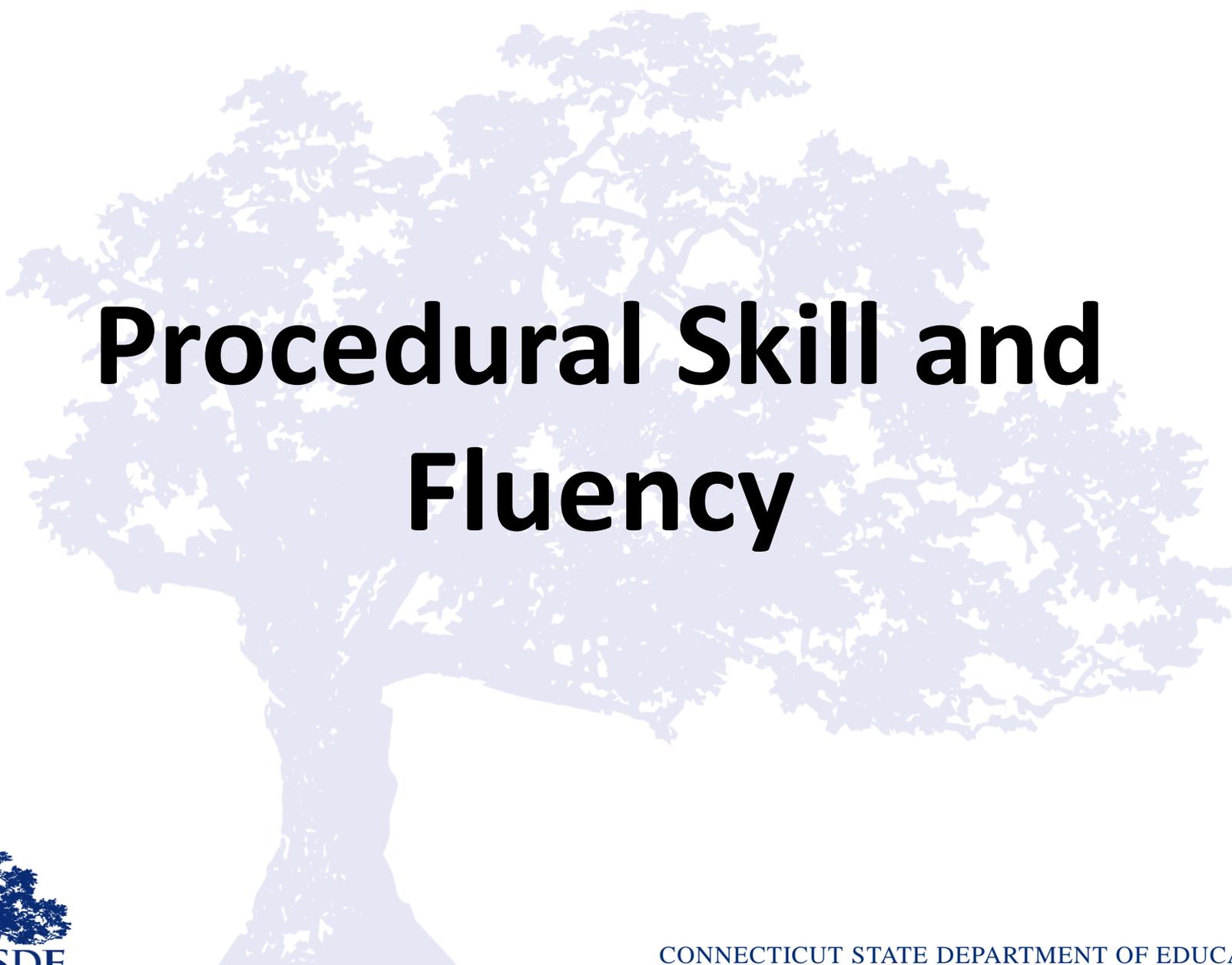
Procedural Skill and Fluency

Procedural Skill and Fluency

- The Standards require speed and accuracy in calculation.

- Materials structure class time and/or homework time for students to practice core functions so that they are more able to understand and manipulate more complex concepts

- The high school standards do not set explicit expectations for fluency, but fluency helps students get past the need to manage computational details so that they can observe structure and patterns in problems

Required Fluencies in K-6

Grade	Standard	Required Fluency
K	K.OA.5	Add/subtract within 5
1	1.OA.6	Add/subtract within 10
2	2.OA.2 2.NBT.5	Add/subtract within 20 (know single-digit sums from memory) Add/subtract within 100
3	3.OA.7 3.NBT.2	Multiply/divide within 100 (know single-digit products from memory) Add/subtract within 1000
4	4.NBT.4	Add/subtract within 1,000,000
5	5.NBT.5	Multi-digit multiplication
6	6.NS.2,3	Multi-digit division Multi-digit decimal operations

Procedural Skill and Fluency

5.NBT.B.5 Fluently multiply multi-digit whole numbers using the standard algorithm

1. $49 \times 975 =$ _____

2.
$$6,751$$
$$\times 609$$

3. What is the product of 9 and 740?

4. Multiply 28 and 5,555.

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Developing Fluency

- More than just timed tests
- Different forms of repeated practice

Fluency in High School

- Similar to conceptual understanding, the language of the cluster or standard indicates procedural skill and fluency

  A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it

- Additional examples of high school standards for procedural skill and fluency:

  - A.SSE.A.1B
  - A.SSE.A.2
  - A.APR.A.1
  - A.APR.C.6
  - F.BF.B.3

  - G.GPE.B.4
  - G.G.PPE.B.5
  - G.GPE.B.7
  - G.CO.A.1
  - G.SRT.B.5

Procedural Skill and Fluency in Practice

Course	Fluency
Algebra 1	• Solving characteristic problems involving the analytic geometry of lines • Fluency in adding, subtracting and multiplying polynomials • Fluency in transforming expressions and seeing parts of an expression as a s single object
Geometry	• Fluency with triangle congruence and similarity criteria • Fluency with the use of coordinates • Fluency with the use of construction tools
Algebra 2	• Divide Polynomials with remainder by inspection in simple cases • See structure in expressions and use this structure to rewrite expressions • Fluency in translating between recursive definitions and closed forms

Looking for Balance

Procedural skill and fluency should be interwoven with conceptual understanding.

Application

Application

- Students can use appropriate concepts and procedures for application even when not prompted to do so

- Provide opportunities at all grade levels for students to apply math concepts in "real world" situations, recognizing this means different things in K-2, 3-5, 6-8, and high school

- Teachers in content areas outside of math ensure that students are using grade-level-appropriate math to make meaning of and access content

Example

2.OA.A Represent and solve problems involving addition and subtraction

A pencil costs 59 cents, and a sticker costs 20 cents less.

How much do a pencil and a sticker cost together?

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Engaging With Problem Solving

Divide.

6. $270 \div 9$ 7. $350 \div 7$ 8. $490 \div 7$ 9. $320 \div 8$

10. $240 \div 6$ 11. $720 \div 8$ 12. $200 \div 5$ 13. $300 \div 6$

14. $1,800 \div 2$ 15. $5,600 \div 7$ 16. $3,000 \div 5$ 17. $1,000 \div 2$

18. There are 150 cheerleaders marching in the parade in 5 equal groups. If each group has the same number of cheerleaders, how many are in each group?

19. The Fourth of July celebrations will feature a "Battle of the Bands." The 8 winning bands will share equally the total prize money of $2,400. How much will each band receive?

A grower packs 4,568 peaches. He packs the most peaches possible, dividing them equally into 9 boxes, and then gives away the remaining peaches.

• How many peaches does he give away?

• If he sells 7 boxes, how many peaches does he have left?

Rigor in the Standards

The language of the standards assist in determining the appropriate use of rigor in instruction.

- Conceptual Understanding

- Procedural Skill and Fluency

- Application

What does student learning look like if the teacher is balancing rigor?

Look Fors

Students are either working *toward* or *using* understanding.

Conceptual Development

- Students work on tasks that elicit ideas, discussions, and connections that lead to new understanding
- Students ask and answer questions about understanding

Fluency and Procedural Skills

- Students engage in meaningful practice
- Students connect procedural skills with representations

Application

- Students apply knowledge to new, but accessible situations that extend their understanding

Conceptual Understanding

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations.

x	-3	2	3
y	-3	7	9

A

x	0	2	4
y	5	7	9

B

x	-1	0	2
y	5	1	7

C

x	-1	0	2
y	1	3	7

D

1a. Which of these tables of values satisfy the equation $y = 2x + 3$? Explain how you checked.

_____

_____

_____

b. By completing the table of values, draw the lines $y = 2x + 3$ and $x = 1 - 2y$ on the grid.
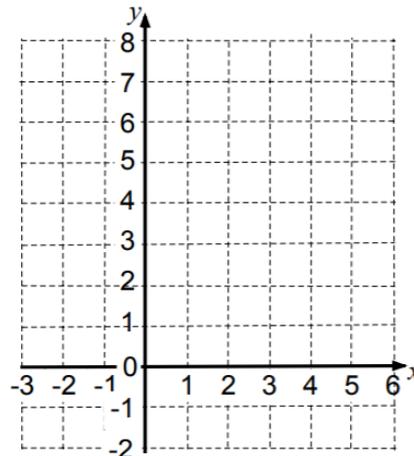
$y = 2x + 3$

x	-2	0	
y			5

$x = 1 - 2y$

x	0		5
y		0	

c. Do the equations $y = 2x + 3$ and $x = 1 - 2y$ have one common solution, no common solutions, or infinitely many common solutions? Explain how you know.

_____

Procedural Skill and Fluency

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations.

Solve each of the following systems:

$-4x - 2y = -12$
$4x + 8y = -24$

$x - y = 11$
$2x + y = 19$

$8x + y = -1$
$-3x + y = -5$

$5x + y = 9$
$10x - 7y = -18$

*Source: Leinwand, S., Brahier, D., and Huinker, D., Principles to Action***, pg. 20
A.REI.C.6

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Application

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations.

You are trying to decide which two smartphone plans would be better. Plan A charges a basic fee of $30 per month and 10 cents per text message. Plan B charges a basic fee of $50 per month and 5 cents per text message.

a) How many text messages would you need to send per month for Plan B to be the better option? Explain your decision?

b) If the cell phone company decided to offer unlimited texts for $80 per month, do you think that you would change your smartphone plan? Use mathematical reasoning to support your decision.

Adapted from Illustrative Mathematics and Leinwand, S., Brahier, D., and Huinker, D., Principles to Action, 2014, pg. 20
A.REI.C.6

Summary

Common Core State Standards:
A New Foundation for Student Success

Thank You

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