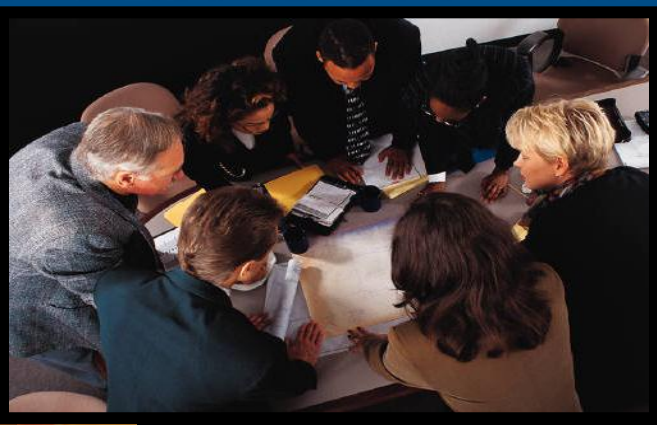
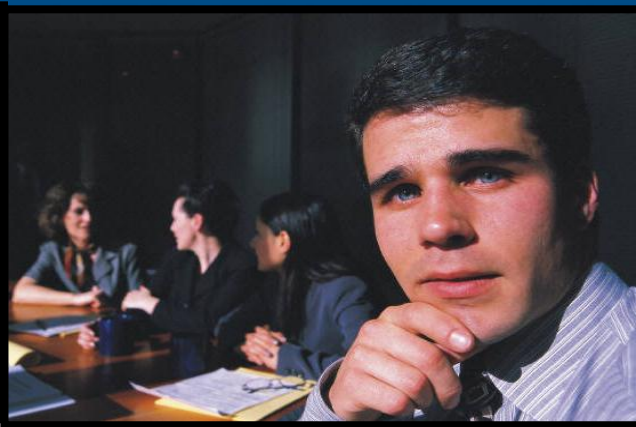
Math Instructional Strategies and the Common Core State Standards

The Leadership and Learning Center™

Brandon Doubek, Ed.D.





Meeting Norms

Goals for This Session:

- Understand the connection between rigorous instruction and 21st century skills in the Common Core State Standards
- Gain an understanding of high-leverage instructional strategies to increase student engagement

Goals for This Session:

- Evaluate connections between feedback and CCSS learning progressions
- Analyze and evaluate implications for effective grading and the Common Core State Standards
- Plan for implementation of Common Core State Standards

Schedule for the Day

Start Time: 8:30

Break 10:00 – 10:15

Lunch: 11:30 – 12:30

End Time: 2:30

What is your role in your school/ district?

A. Elementary Math Teacher
B. Secondary Math Teacher
C. Building Administrator
   –Principal/Assistant Principal
D. Curriculum Coordinator
E. Instructional Coach
F. Central Office
   Administrator/ESC Staff
G. Not Mentioned Above

What is your role in your school/ district?

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F. Central Office
   Administrator/ESC Staff
G. Not Mentioned Above

How long have you been a professional educator?

A. 1- 8 years

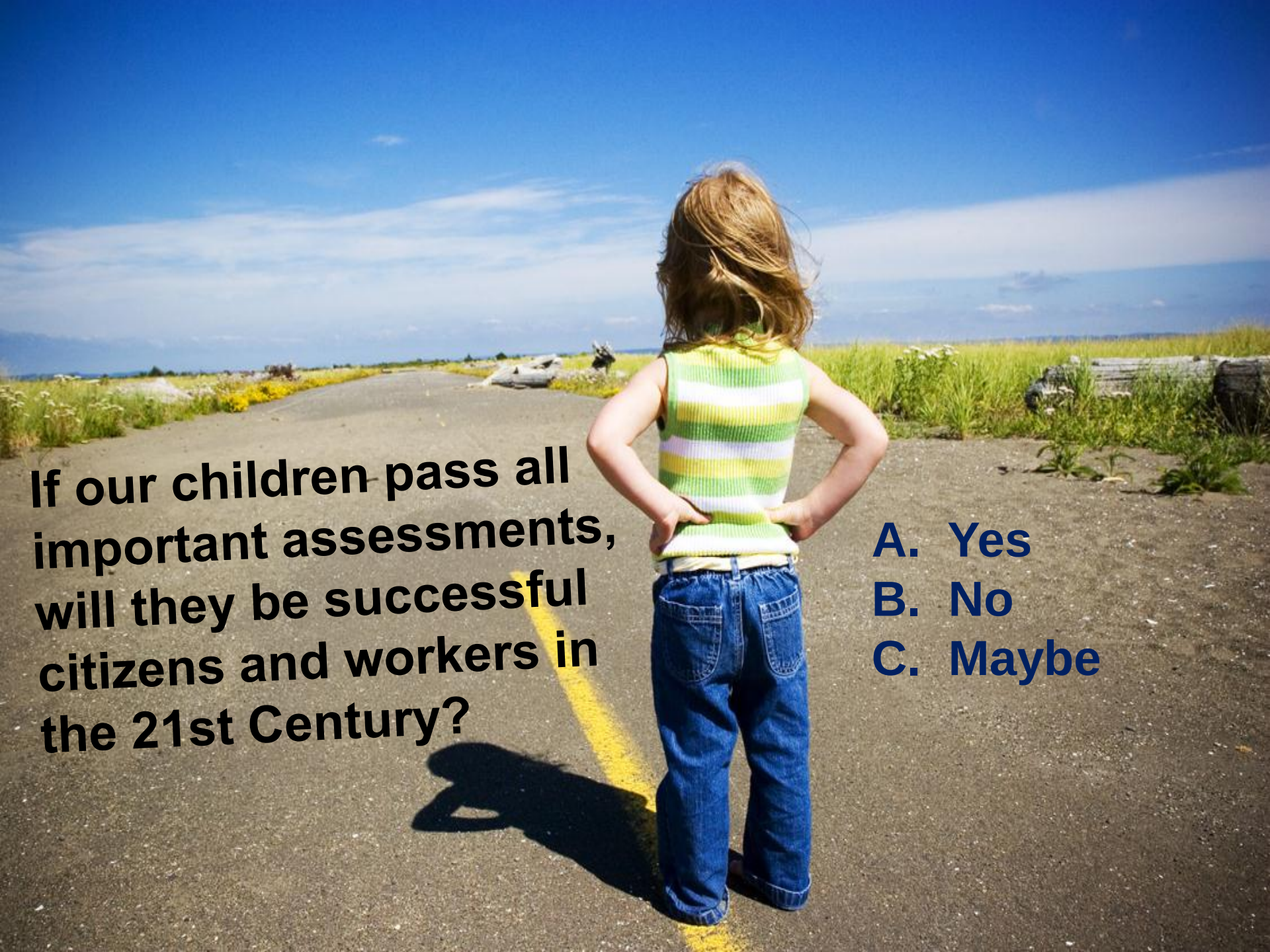
B. 9 -19 years

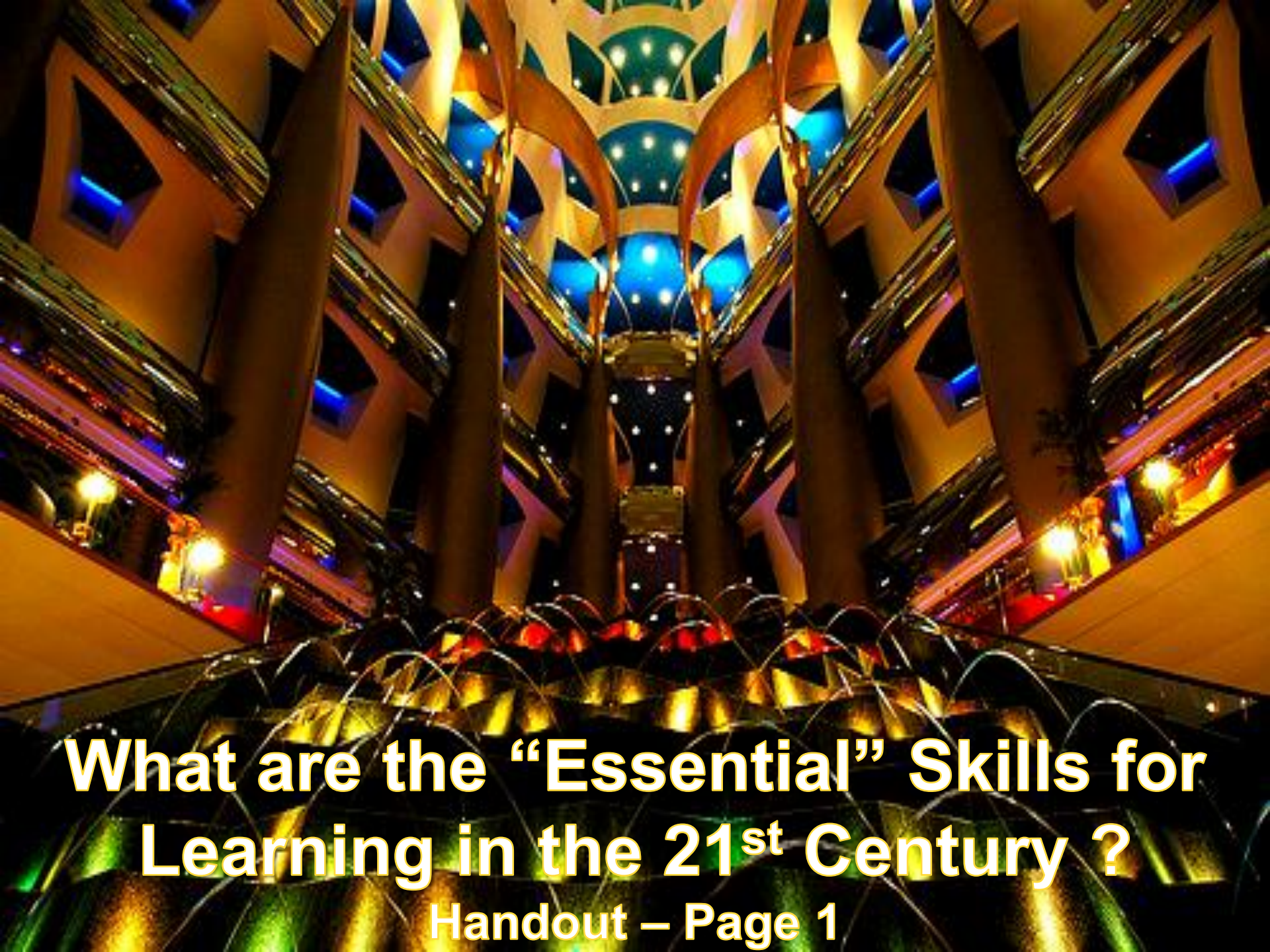
C. 20 – 29 years

D. More than 30 years

Do you have children or grandchildren in:

A. Pre-K
B. Elementary school
C. Middle school
D. High school
E. College
F. Multiple levels
G. None of these


If our children pass all important assessments, will they be successful citizens and workers in the 21st Century?
A. Yes
B. No
C. Maybe



What are the "Essential" Skills for Learning in the 21st Century ?

Handout – Page 1

What are the “Essential” Skills for the 21st Century?

1. Information and Media Literacy
2. Communication Skills
3. Critical Thinking and Systems Thinking
4. Problem Identification, Formulation and Solution
5. Creativity and Intellectual Curiosity
6. Interpersonal and Collaborative Skills
7. Self-Direction
8. Accountability and Adaptability

Partnership For 21st Century Skills

Challenges for Us as Educators

What is literacy in the 21st Century?

"The illiterate of the 21st Century will not be those who cannot read and write, but those who cannot learn, unlearn and relearn."

Toffler, 1979

What was the best lesson you most recently (in the last year) taught or observed?

How do you know it was effective? (concrete indicators)

How do we achieve balanced instruction in math?

Balanced Instruction

1. Computational strength including number sense

2. Application of mathematics (problem solving)

3. Conceptual understanding (teaching for understanding)

Question: What should occur in a balanced math classroom?

TIMSS Report

1. **Math Topics**
   - United States: 78 in 180 days
   - Japan: 17 in 253 days
   - Germany: 23 in 220 days
2. **Length of Textbooks**
   - U.S. fourth-grade math: 530 pages
   - International math: 170 pages
   - U.S. fourth-grade science: 397 pages
   - International science: 125 pages

Teaching Practices—TIMSS

1. **United States**
   - Teacher instructs
   - Teacher solves problem
   - Students practice
2. **Japan**
   - Teacher poses complex problem
   - Students struggle and present solutions
   - Class debates alternative solutions
   - Teacher summarizes solutions
   - Students practice

Reality Check

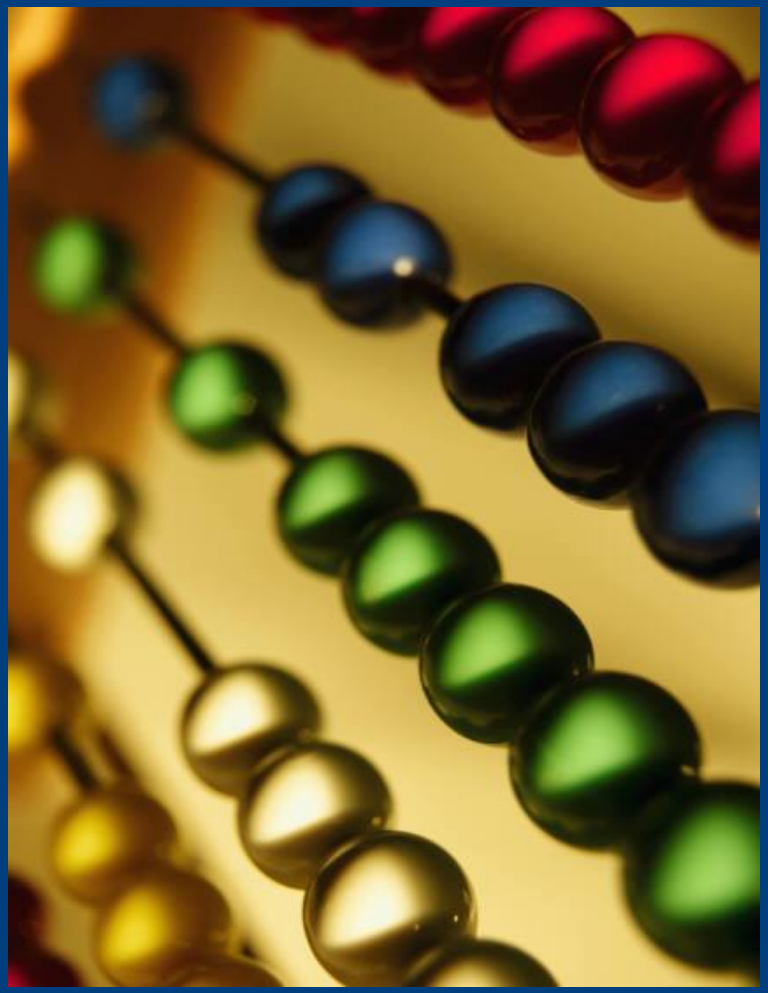
- **“High quality jobs of the future will belong to ‘symbolic analysts’ – people who solve, identify, and broker problems while manipulating images**

Reich (1992)

Number-Sense Activities

- Calculating Mentally
- Sharing Methods

Research Support



- How Do People Develop Number Sense?

Ma and Pa

Number Sense Definition

1. Sense of quantity and relationship to that quantity (rearranging quantity)
0+6, 1+5, 2+4, 3+3, 4+2, 5+1, 6+0
2. Knowledge of the number system
3. Patterns in the number system
4. Reasonable answer

Lawn Mowing Chore

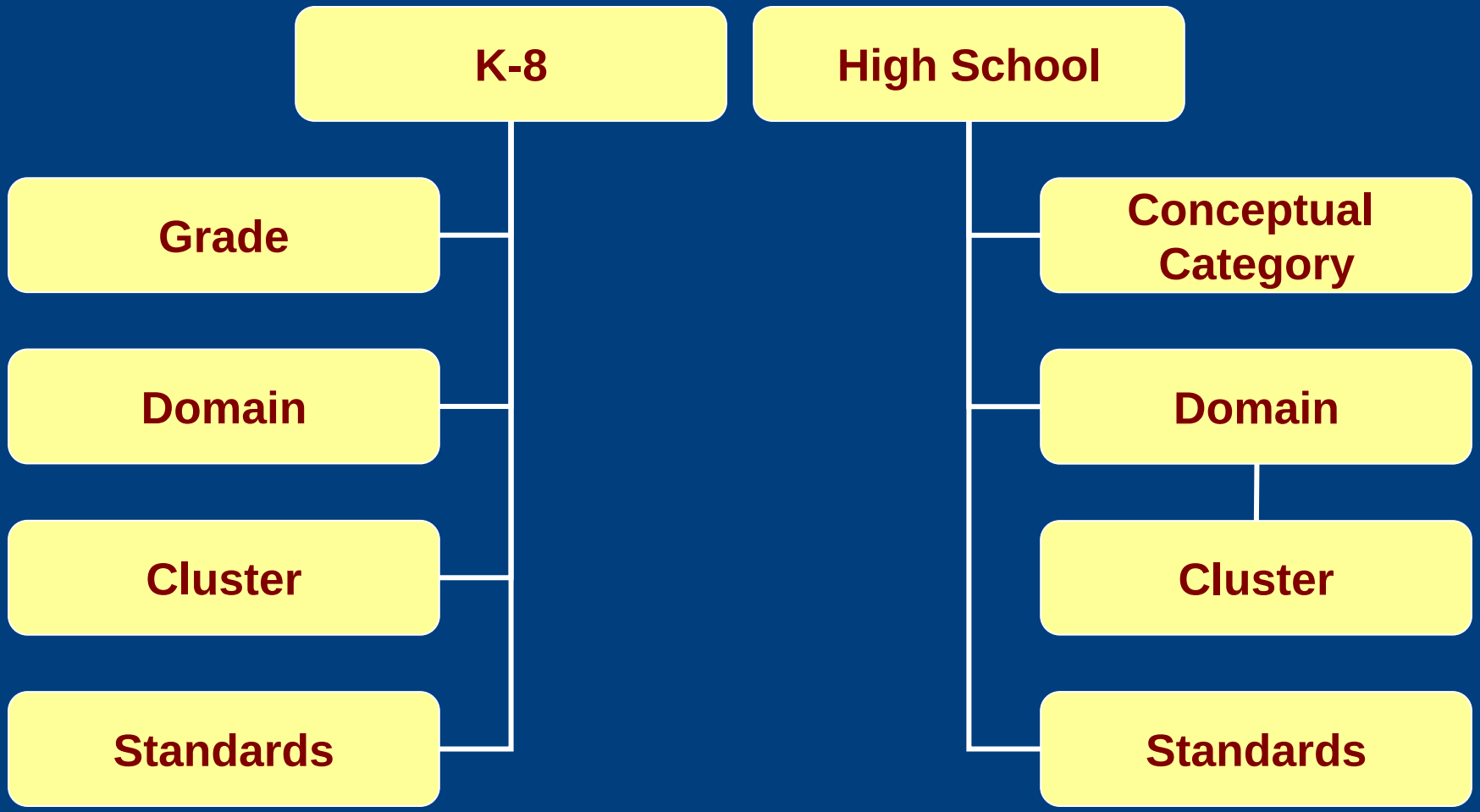
At my house, summer vacation means added chores for my three sons. Every Saturday, the lawn must be mowed. Mark starts the mower and completes 1/3 of the lawn. Sam takes over and mows exactly ¼ of the lawn. Josh finishes off the last 700 square feet of the lawn.

What is the area of my lawn?

Session Documents

- Access the Common Core State Standards and Appendix A at www.corestandards.org
- Understanding the Common Core State Standards for Mathematics – Handout, Page 2

The Big Picture
CCSS: Math Content – Handout, Page 2



CCSSM Mathematical Practices –

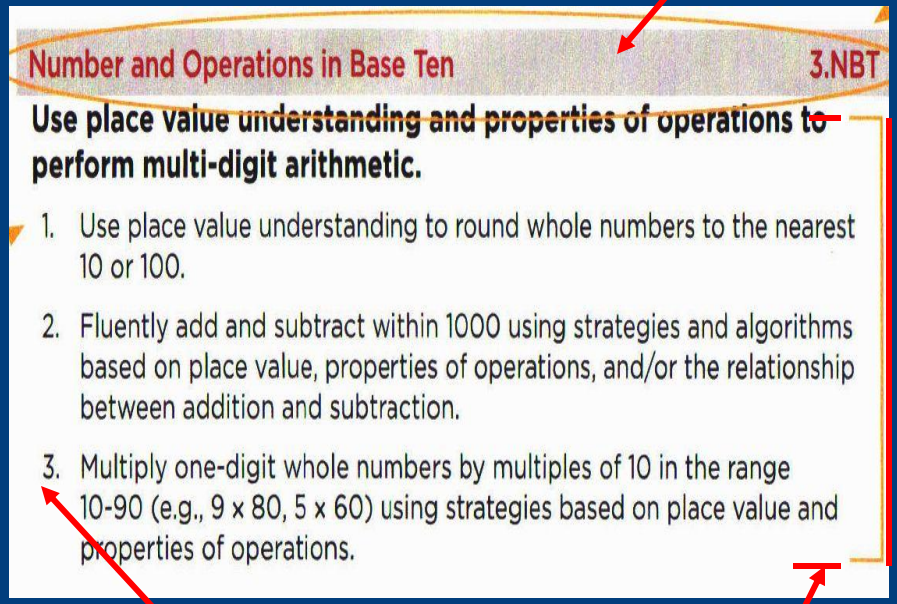
Handouts, Page 3

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.

Integration of Content and Practices

Standards for Mathematical Content

Domain



Standard

Cluster

Standards for Mathematical Practices

Mathematical Practices

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 – Domain

- **Domains are overarching big ideas that connect topics across the grades**
- **Descriptions of the mathematical content to be learned elaborated through clusters and standards**

Overview of K–5 Domains – Handouts, Page 4

Grade K	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Counting and Cardinality					
Operations and Algebraic Thinking	Operations and Algebraic Thinking	Operations and Algebraic Thinking	Operations and Algebraic Thinking	Operations and Algebraic Thinking	Operations and Algebraic Thinking
Number and Operations in Base Ten	Number and Operations in Base Ten	Number and Operations in Base Ten	Number and Operations in Base Ten and Fractions	Number and Operations in Base Ten and Fractions	Number and Operations in Base Ten and Fractions
Measurement and Data	Measurement and Data	Measurement and Data	Measurement and Data	Measurement and Data	Measurement and Data
Geometry	Geometry	Geometry	Geometry	Geometry	Geometry

Overview of 6–8 Domains

Grade 6	Grade 7	Grade 8
Ratios and Proportional Relationships	Ratios and Proportional Relationships	Functions
The Number System	The Number System	The Number System
Expressions and Equations	Expressions and Equations	Expressions and Equations
Geometry	Geometry	Geometry
Statistics and Probability	Statistics and Probability	Statistics and Probability

Common Core – Clusters

- Groups of related standards
- Standards from different clusters may be closely related because mathematics is a connected subject
- Reflect both mathematical understandings and skills, which are equally important

Design and Organization

Standards for Mathematical Content

- K-8 standards presented by grade level
- Organized into domains that progress over several grades
- Grade introductions give 2-4 focal points at each grade level
- High school standards presented by conceptual theme (Number & Quantity, Algebra, Functions, Modeling, Geometry, Statistics & Probability)
- Appendix A: Model pathways for high school courses

Standards for Mathematical Practices

- Carry across all grade levels
- Describe habits of mind of a mathematically expert student

Format of K-8 Standards

Grade Level

Operations and Algebraic Thinking 1.OA

Represent and solve problems involving addition and subtraction.

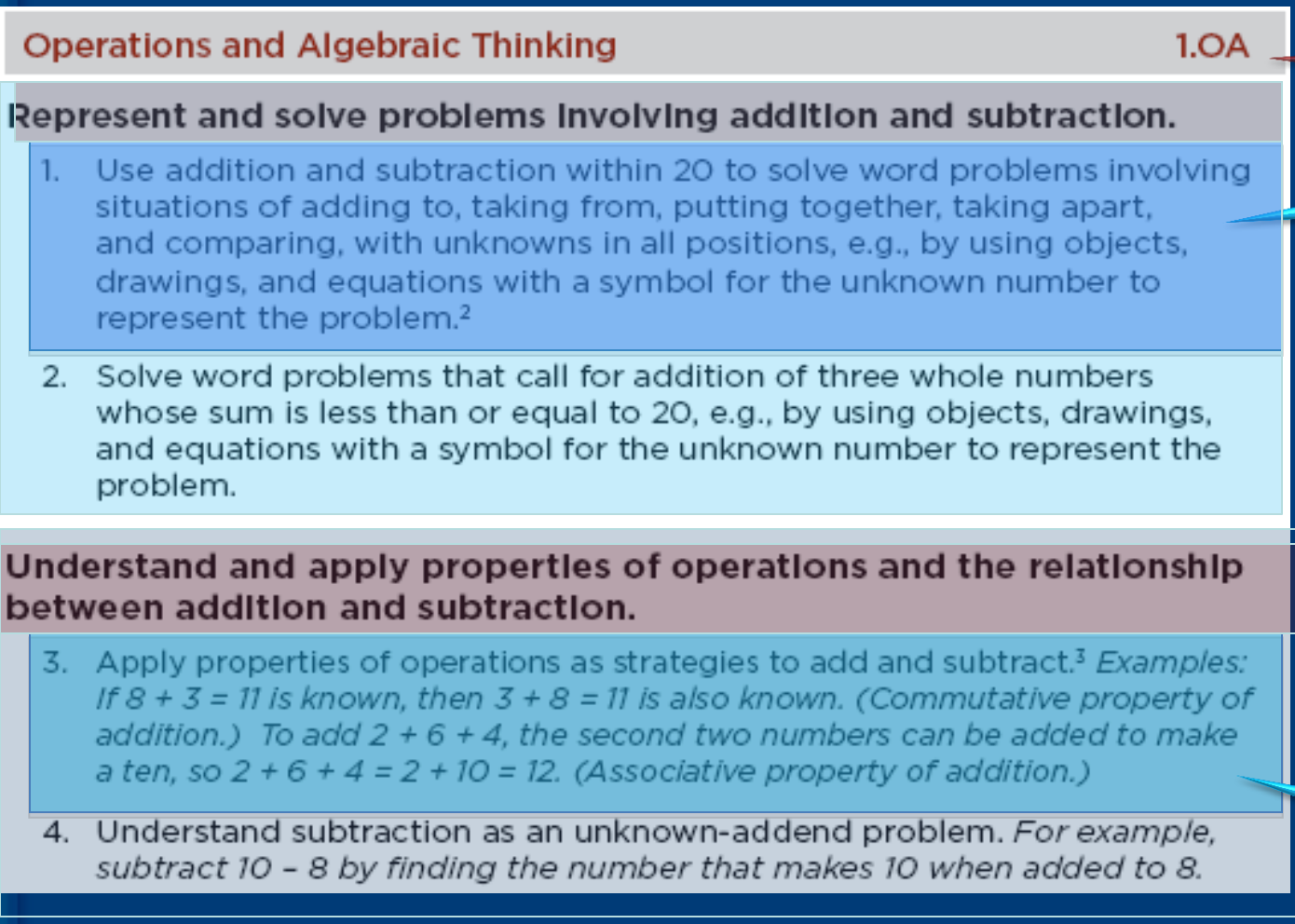
1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.[2]
2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Understand and apply properties of operations and the relationship between addition and subtraction.

3. Apply properties of operations as strategies to add and subtract.[3] *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)*
4. Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.*

Domain

Format of K-8 Standards



Domain

Standard

Cluster

Cluster Statement

Standard

How to Read the Standards

- [7.RP] Ratios and Proportional Relationships
  [7.RP.2a]
- [7.NS] The Number System
  [7.NS.1d]
- [7.EE] Expressions and Equations
  [7.EE.3]
- [7.G] Geometry
  [7.G.6]
- [7.SP] Statistics and Probability
  [7.SP.3]

K–8 Focal Points

Mathematics | Grade 2

In Grade 2, instructional time should focus on four critical areas: (1) extending understanding of base-ten notation; (2) building fluency with addition and subtraction; (3) using standard units of measure; and (4) describing and analyzing shapes.

(1) Students extend their understanding of the base-ten system. This includes ideas of counting in fives, tens, and multiples of hundreds, tens, and ones, as well as number relationships involving these units, including comparing. Students understand multi-digit numbers (up to 1000) written in base-ten notation, recognizing that the digits in each place represent amounts of thousands, hundreds, tens, or ones (e.g., 853 is 8 hundreds + 5 tens + 3 ones).

(2) Students use their understanding of addition to develop fluency with addition and subtraction within 100. They solve problems within 1000

Critical Focal Points

Coherence

- Articulated progressions of topics and performances that are developmental and connected to other progressions
- Conceptual understanding and procedural skills emphasized equally

Progressions Across Grade Levels

EXAMPLE: FRACTIONS

Grade 3	Grade 4	Grade 5	Grade 6
Domain: Number and Operations – Fractions 3.NF	**Domain:** Number and Operations – Fractions 4.NF	**Domain:** Number and Operations – Fractions 5.NF	**Domain:** The Number System 6.NS
Cluster: Develop an understanding of fractions as numbers.	**Cluster:** Extend understanding of fraction equivalence and ordering.	**Cluster:** Use equivalent fractions as a strategy to add and subtract fractions.	**Cluster:** Apply and extend previous understandings of multiplication and division to divide fractions by fractions.
Standards: 1. 2. a. b.	**Cluster:** Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.	**Cluster:** Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	
3. a. b. c. d.	**Cluster:** Understand decimal notation for fractions, and compare decimal fractions.		

Learning Progressions for Understanding Place Value –

Handouts, Page 5

- **Read from bottom to top**
- **How does an increasing grade level *(for example: Grade 1 to 2, Grade 3 to 4 to 5)* add new knowledge to existing knowledge?**

Clarity and Specificity

- **Skills and concepts are clearly defined**
- **Being able to apply concepts and skills to new situations is expected**

[5.NF.7c]

Solve real world problems involving division of fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem.

For example, how much chocolate will each person get if 3 people share ½ lb. of chocolate equally? How many 1/3 cup servings are in 2 cups of raisins?

High School Conceptual Categories –

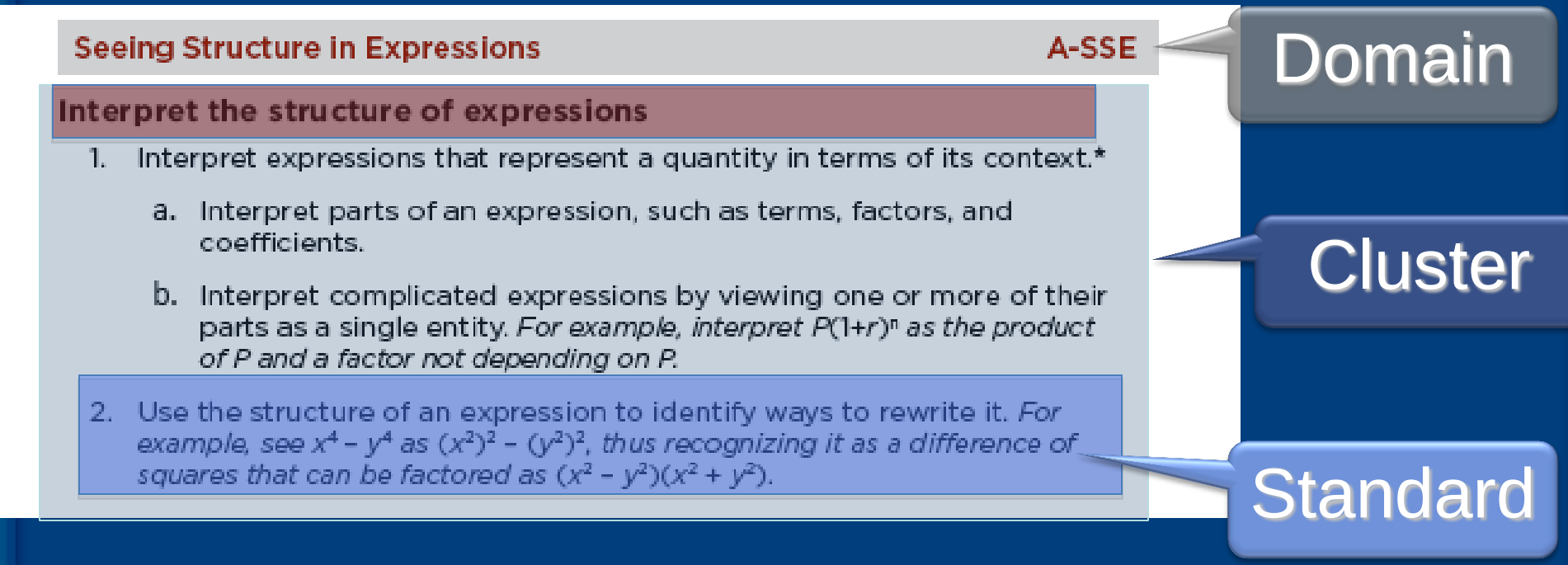
Handouts, Page 6

- The big ideas that connect mathematics across high school – such as Functions or Probability and Statistics
- A progression of increasing complexity
- Description of mathematical content to be learned elaborated through domains, clusters, and standards

Conceptual Categories

Modeling	Number and Quantity
	Algebra
	Functions
	Geometry
	Statistics and Probability

Format of High School



Format of High School Standards

Math Standards for *All*

7. Explain and use the relationship between the sine and cosine of complementary angles.

8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*

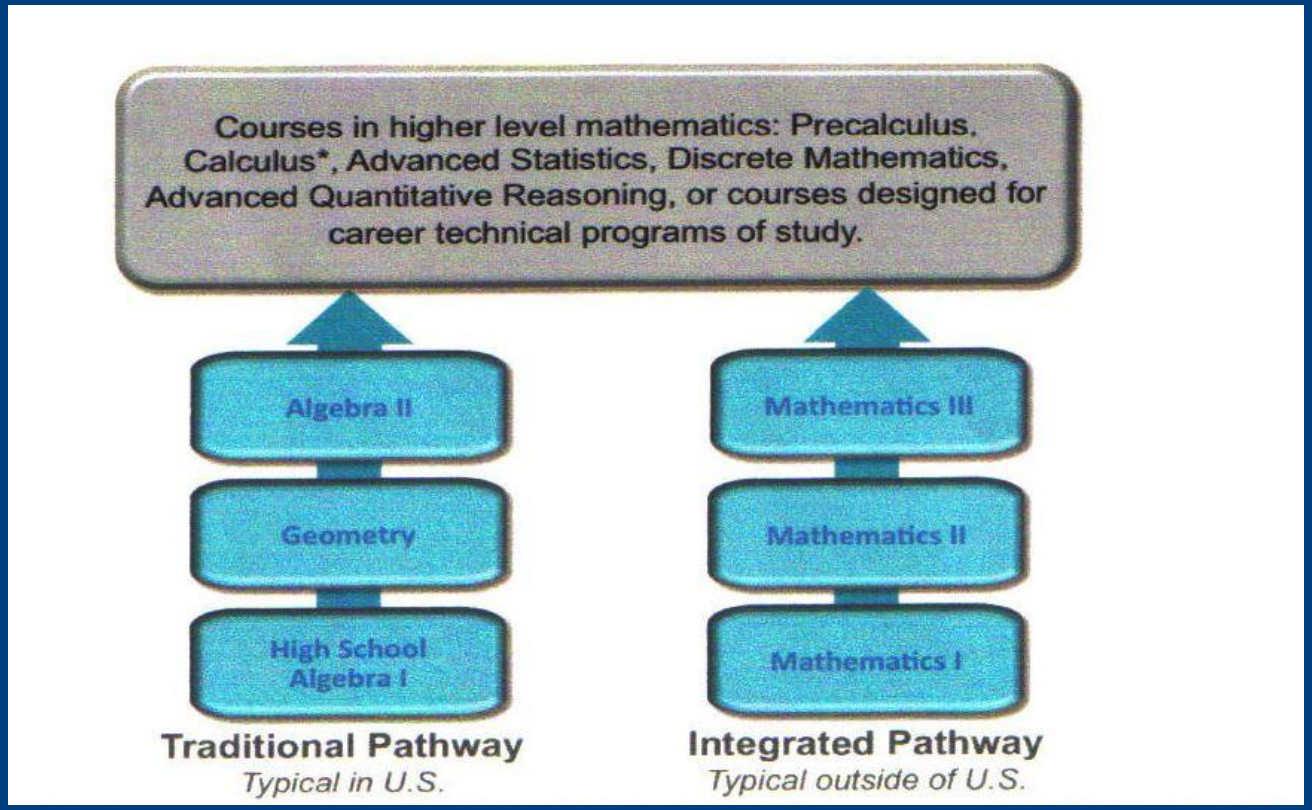
Apply trigonometry to general triangles

9. (+) Derive the formula $A = 1/2\ ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.

STEM

Modeling

Appendix A: Designing High School Mathematics Courses Based on the CCSS *(148 pages)*



CCSS DOMAIN PROGRESSION

K	1	2	3	4	5	6	7	8	HS
Counting & Cardinality									
Number and Operations in Base Ten						Ratios and Proportional Relationships			Number and Quantity
			Number and Operations in Fractions			The Number System			
Operations and Algebraic Thinking						Expressions and Equations			Algebra
							Functions		Functions
Geometry									Geometry
Measurement and Data						Statistics and Probability			Statistics and Probability

Learning Activity #1 – Handouts, Page 7

Resources Needed:

•Hard/electronic copy of the CCSS Standards for Mathematics Document -access at www.corestandards.org

Jigsaw Directions:

•Form teams of eight **(8)** members

•Divide up the **"Digging Into the CCSS"** topics so that two **(2)** team members are responsible for researching only one topic

•Each pair researches their assigned topic **(10 minutes)** and prepares

- **a)** a summary of key points, and
- **b)** one implication for improving current practices in this area

•Team members take turns reporting out key points and implications **(1 – 2 minutes)**

Learning Progressions

"A description of skills, understanding, and knowledge in the sequence in which they typically develop: a picture of what it means to 'improve' in an area of learning." ***Masters & Forster (1997:1)***

"Descriptions of successively more sophisticated ways of thinking about an idea that follow one another as students learn: they lay out in words and examples what it means to move toward more expert understanding." ***Wilson & Bertenthal (2005:3)***

CCSS DOMAIN PROGRESSION

K	1	2	3	4	5	6	7	8	HS
Counting & Cardinality									
Number and Operations in Base Ten						Ratios and Proportional Relationships			Number and Quantity
			Number and Operations in Fractions			The Number System			
Operations and Algebraic Thinking						Expressions and Equations			Algebra
							Functions		Functions
Geometry									Geometry
Measurement and Data						Statistics and Probability			Statistics and Probability

Learning Progressions and Summaries - JIGSAW

Number off at your tables 1, 2, 3 (repeat until all have a number)

- ❖ **Read the Learning Progression AND Summary: (5 minutes)**

1: Pages 10-11: Basic Math Facts

2: Pages 12-13: Data and Measurement

3. Pages 14-15: Problem Solving

- ✓ **REPORT OUT: How are the instructional strategies used earlier connected to these standards?**


How will these standards be assessed?
M·AGRIPPA·L·F·COS·TERTIVM·FECIT

SMARTER

Balanced Assessment Consortium

Gas Bills, Heating Degree Days, and Energy Efficiency

Here is a typical story about an Ohio family concerned with saving money and energy by better insulating their house.

Kevin and Shana Johnson's mother was surprised by some very high gas heating bills during the winter months of 2007. To improve the energy efficiency of her house, Ms. Johnson found a contractor who installed new insulation and sealed some of her windows. He charged her $600 for this work and told her he was pretty sure that her gas bills would go down by "at least 10 percent each year." Since she had spent nearly $1,500 to keep her house warm the previous winter, she expected her investment would conserve enough energy to save at least $150 each winter (10% of $1,500) on her gas bills.

Learning Activity – Handouts, Page 16

Directions: Discuss the following:

- **Is there a process in the school/district to facilitate discussion across grade levels to examine learning progressions for math concepts?**
- **In what ways will the learning progressions be considered in the curriculum design process?**
- **In what ways might the learning progressions provide opportunities for all students to access and accelerate through the mathematics curriculum?**
- **How will units of study be designed and sequenced based on the vertical learning progressions presented in the common core?**

Optional Learning Activity

Directions:

•Using one of the mathematics learning progression examples, locate each of the standards in the Common Core State Standards for Mathematics document.

•Assign the grade level and standard numbering system to each of the standards in the learning progression In order to trace how a learning progression can be located within and across domains.

The Leadership and Learning Center™

Effective Grading Practices and the Common Core State Standards

Why Grading Practices Are So Important

- **Grading practices are part of *feedback*, one of the single greatest influences on student achievement.**
- **Feedback is *only effective* if it meets these criteria:**
  - **Accurate**
  - **Timely**
  - **Fair**
  - **Understandable**
  - **Effective**

What Does “Accurate” Grading Mean?

- The same work by the same student should receive the same grade, even if the teachers are different.
- What are examples of grading and feedback that are “accurate” by this definition?

What Does “Timely” Grading Mean?

- Students receive the feedback in a timely enough manner.
- Students can associate the feedback with the work that generated the feedback.
- What are examples of feedback that are timely?

What Does "Fair" Grading Mean?

- Teacher evaluates the student's work compared to a standard.
- Grade is objective and directly related to the standard, not to subjective considerations or to matters unrelated to the standard.
- Evaluation of the same work is not distorted by the gender, ethnicity, home language, or economic status of the student.
- What are examples of feedback that are fair?

What Does "Understandable" Grading Mean?

- Students and parents understand exactly how grades are earned.
- They see a clear relationship between student actions and the grades on the report card.
- What are examples of understandable grading?

What Does “Effective” Grading Mean?

- There is clear evidence that the use of a particular grading and feedback policy leads to improved student performance
- What are examples of effective grading?

Grading for Math: Handouts, Page 17

- What's the difference between students who receive A's and B's and D's and F's?

An Experiment in Grading Policy –

Handouts, Page 18

- C
- C
- MA = Missing assignment
- D
- C
- B
- MA = Missing assignment
- MA = Missing assignment
- B
- A

Group 1

- A = 100
- B = 90
- C = 80
- D = 70

Group 2

- A = 4
- B = 3
- C = 2
- D = 1

Group 3

- Choose your own system

How Accurate Are We in Grading the SAME Student?

- # of A’s:
- # of B’s:
- # of C’s:
- # of D’s:
- # of F’s:
- Other letter grades:

How Did Each Group Differ in Grading?

- Group 1: 100-point scale
- Group 2: Four-point scale
- Group 3: Self-selected system
- Other differences?

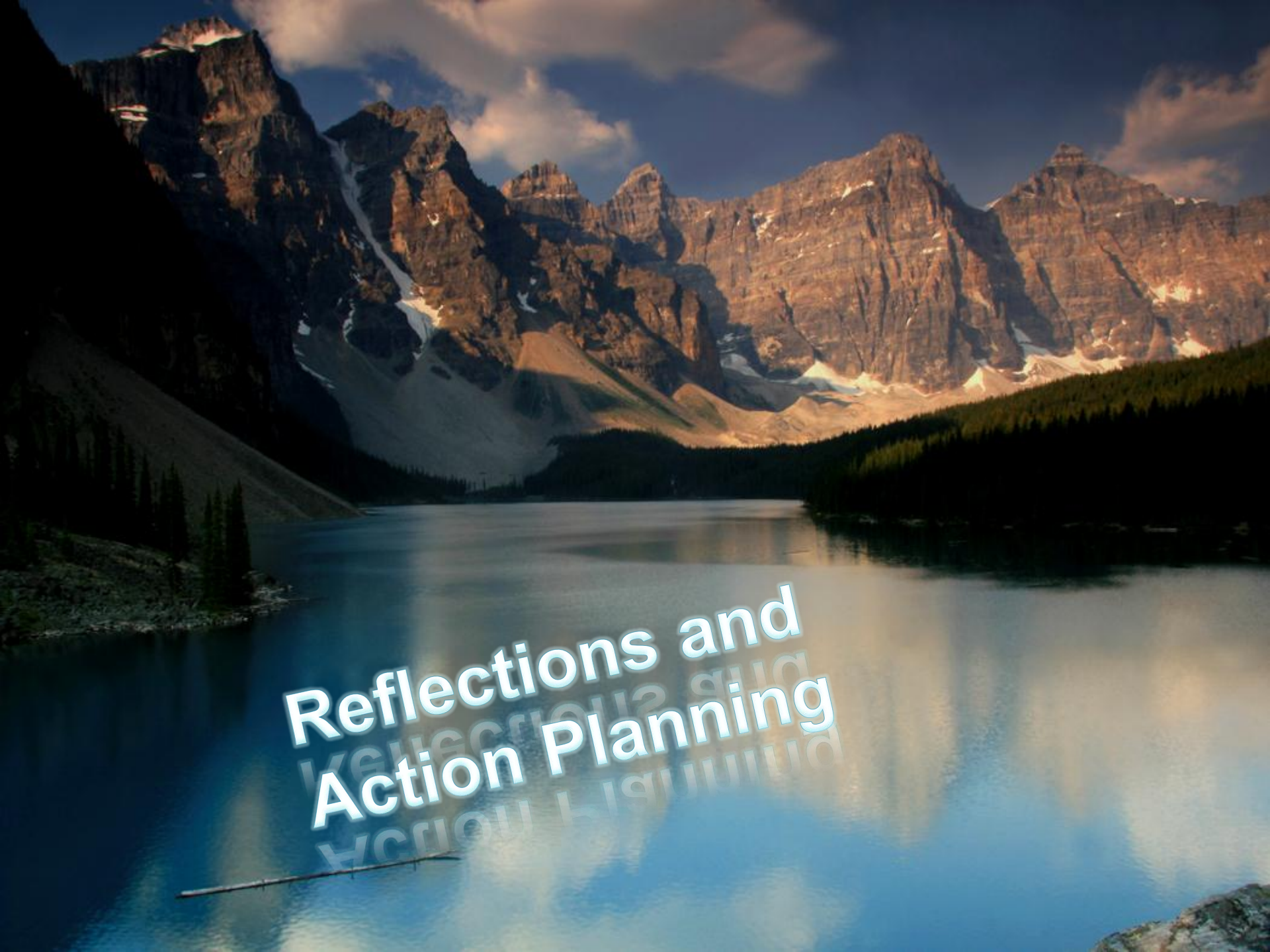
Toxic Grading Practices and Alternatives

- Zeros for missing work
- Average/mean
- Semester killer—one test or project

- Albums, not snapshots
- Best representation of work
- Resilience—menu and personal responsibility

Why Is It So Difficult to Change Grading Policies?

- Tradition of individual policies by individual teachers
- Deep beliefs in using grading as punishment and reward system
- Sincere desire to motivate students and prepare them for the next grade
- Sincere desire to support student morale and self-esteem
- Other reasons it is difficult to change?


Reflections and
Action Planning

Leadership and Learning Center

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