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# **Early Grade Math Assessment: Meeting with Expert Panel**

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RTI International, Research Triangle Park, North Carolina, USA

# About the Presentation

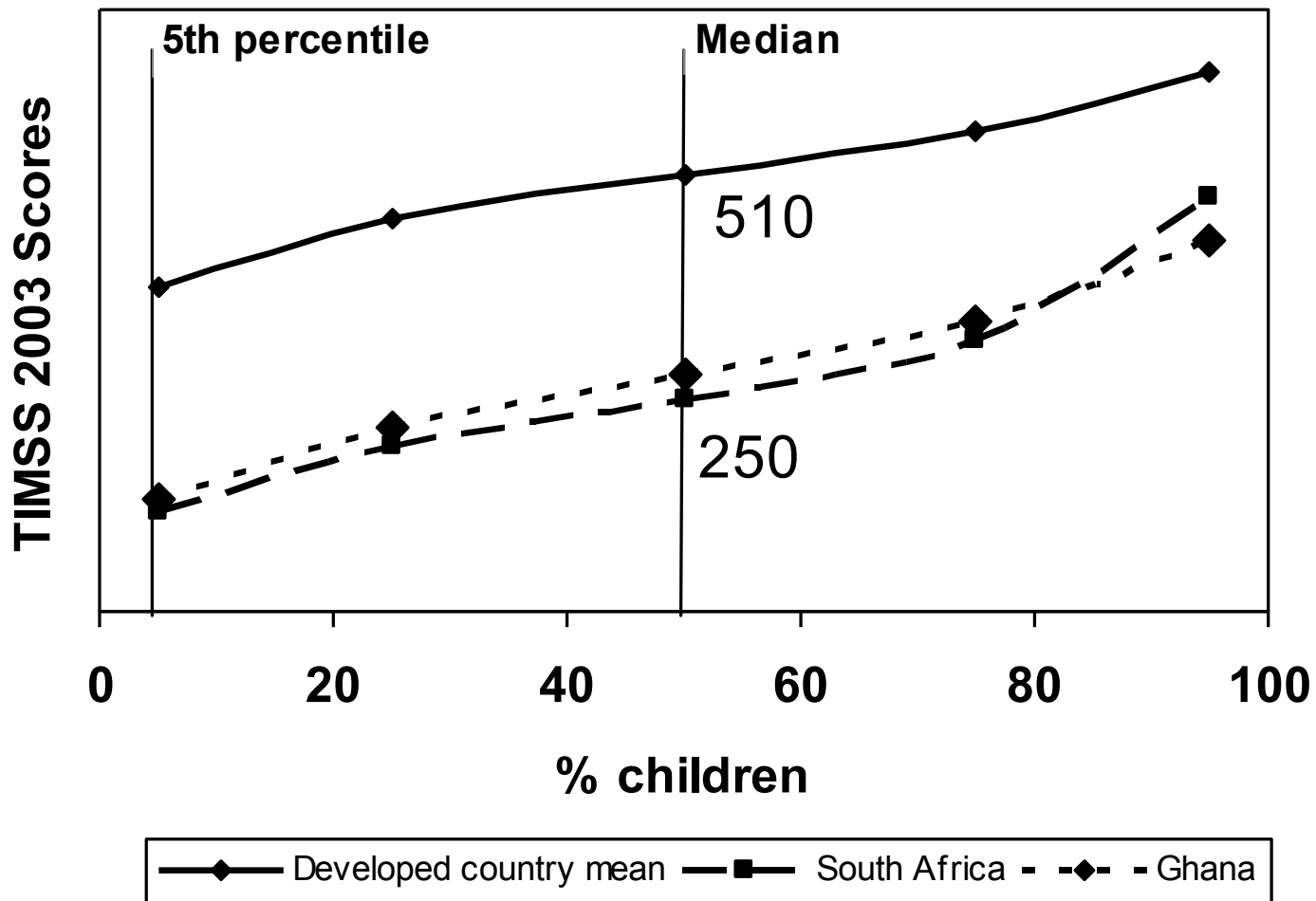
- This presentation was given to a group of experts and members of the donor community: USAID, World Bank, and the Hewlett Foundation. This group convened to review a new instrument to measure the extent to which schoolchildren in early primary grades in developing countries are learning math skills: the Early Grade Math Assessment (EGMA). The panel meeting took place at the offices of RTI International in Washington, DC, January 15-16, 2009.
- Funding came from the EdData II project, Task Order 2, USAID No. EHC-E-02-04-00004-00, led by RTI International.

# Outline

- Why Math?
- Why an Early Grade Math Assessment?
- Essential Components
- EGMA Contents
- Next Steps

# Why Math?

## Developed countries compared to Africa



# Why Math?

## National Mathematics Advisory Panel

- Panel formed to advise on improvement in math education.
- Recommendations were made based on over 16,000 research publications, policy reports, and testimony.

## Why an EGMA?

- Assessment time
- Cost
- Policy awareness purpose
- Local-level monitoring purpose

# Essential Components: What Do We Know?

## *Fourth Grade Objectives*

### *NAEP*

- *Number Properties & Operations*
- *Measurement*
- *Geometry*
- *Data Analysis & Probability*
- *Algebra*

### *TIMSS*

- *Number*
- *Patterns and Relationships\**
- *Measurement*
- *Geometry*
- *Data*

\*The TIMMS algebra content for the fourth grade is known as patterns and relationships

## Essential Components: What Do We Know?

- Number: Whole numbers including operations (i.e., addition, subtraction, multiplication, division)
- Number: Fractions and Decimals (i.e., comparing, ordering)
- Geometry & Measurement
- Algebra
- Data Display



# Essential Components: What Do We Know?

## ***A Brief Look At Objectives In Other Countries for First through Third Grade***

### ***South Africa***

- *Number, Operations, & Relationships*
- *Patterns*
- *Shape & Space*
- *Measurement*
- *Data Handling*

### ***Jamaica***

- *Number & Computation*
- *Pattern & Algebra*
- *Measurement*
- *Data Handling*
- *Shape & Space*

# Essential Components: Number and Operations

Standard by the  
National  
Council of  
Teachers of  
Mathematics –  
For Number  
and Operations

Grade Level	Goal
Pre-kindergarten	Developing an understanding of whole numbers, including concepts of correspondence, counting, cardinality, and comparison
Kindergarten	Representing, comparing, and ordering whole numbers and joining and separating sets
First Grade	Developing understandings of addition and subtraction and strategies for basic addition facts and subtraction facts, including whole number relationships (e.g., tens and ones)
Second Grade	Developing understanding of base-ten numeration system and place-value concepts including fluency with multi-digit addition and subtraction

# Essential Components: Number and Operations in the US

- A look at Number and Operations curriculum in three locations in the US
  - Kindergarten
    - Identify and use whole numbers from 0-30 was reported for two locations. One Location reported the use of whole numbers from 0-20.
  - First Grade – all three locations
    - Count, read, write whole numbers to 100.
  - Second Grade – all three locations
    - Identify, count, and represent whole numbers to 1,000

# Essential Components: Number and Operations in the US

- Additional Number and Operations curriculum objectives in three locations in the US
  - Kindergarten – all three locations
    - Recognize the equivalence of sets,
    - understand language such as “more” or “less”
  - First Grade – all three locations
    - Identify numbers missing in a sequence
    - Read and write single digit addition and subtraction
  - Second Grade – all three locations
    - Identify place value of a given digit in three digit numbers.
    - Add and subtract whole numbers up to 1,000

## Essential Components: Number and Operations Outside of the US

- A look at Number and Operations curriculum in four locations outside of the US:
  - Kindergarten - Identify and use whole numbers from 0-10
    - Was reported for one location.
    - There was no curriculum available for kindergarten at the other three locations.
  - First Grade - Count, read, write whole numbers to 100
    - Was reported by two locations.
    - Another location reported to count, read, write whole number to “34” and the last did not specify.
  - Second Grade - Identify, count, and represent whole numbers to 1,000
    - Was reported in one location.
    - Of the three other locations, one reported to 200, one reported to 50, and the last one did not specify.

# Essential Components: Number and Operations Outside of the US

- Additional Number and Operations curriculum objectives in four locations outside the US
  - Kindergarten
    - Recognize the equivalence of sets is seen in one location.
    - understand language such as “more” or “less” is seen in one location.
  - First Grade
    - Identify numbers missing from a sequence is seen in two locations. One of the two locations reports this activity to the number “20”.
    - Read and write single digit addition and subtraction is seen in all locations with two locations reporting to 100, one location reporting to the number “20” and one location reporting to the number “34”.
  - Second Grade
    - Identify place value of a given digit in three digit numbers reported at two locations.
    - Add and subtract whole numbers up to 1,000 is reported for one location. One location reports up to “200”. One location reports to “50”. The last location does not specify.

# Essential Components: Geometry

Standard by the  
National  
Council of  
Teachers of  
Mathematics -  
Geometry

School Year	Overall Goals
Pre-kindergarten	Identifying shapes and describing spatial relationships
Kindergarten	Describing shapes and space
First Grade	Composing and decomposing geometric shapes
Second Grade	_____

# Essential Components: Geometry in the US

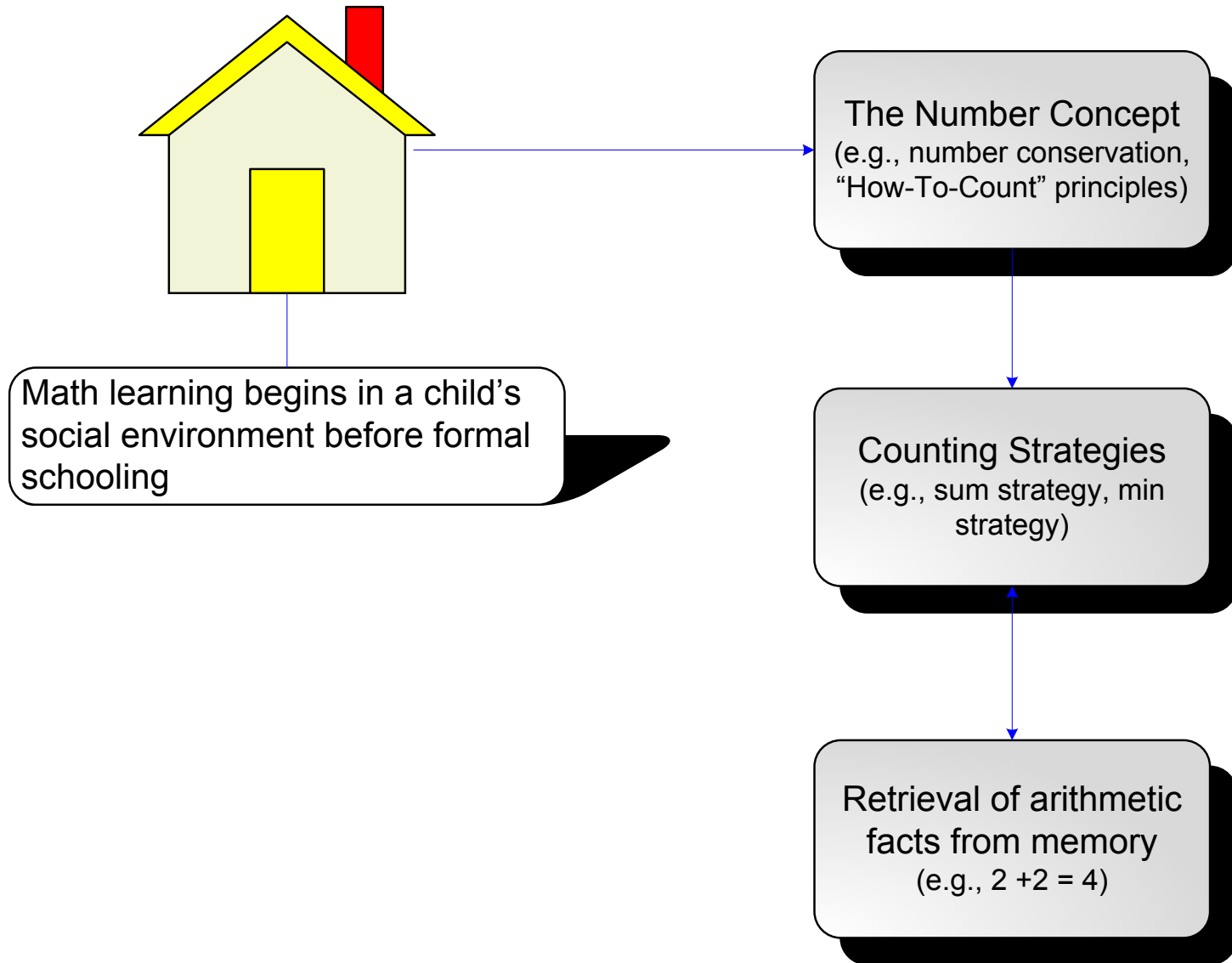
- A look at geometry curriculum in three locations in the US
  - Kindergarten –
    - Draw and name triangles, rectangles, circles, cubes, and spheres.
    - Identify likeness and differences of shapes.
    - Create and extend patterns on number, shapes or objects
  - First grade –
    - Identify, create, and sort trapezoids, hexagons, and parallelograms.
    - Identify and name cylinders, cones, and rectangles.
    - Identify and create repeating and growing patterns.
  - Second grade –
    - Describe and classify plane and solid geometric figures according to number of sides, angles, faces, or edges.



# Essential Components: Geometry Outside of the US

- A look at geometry curriculum in four locations outside the US
  - Kindergarten –
    - Draw and name triangles, rectangles, circles, cubes, and spheres was seen in one location.
    - Create and extend patterns on number, shapes or objects was seen in one location.
  - First grade –
    - Identify, create, and sort trapezoids, hexagons, and parallelograms.
    - Identify and name cylinders, cones, and rectangles seen in three locations.
    - Identify and create repeating and growing patterns seen in three locations.
  - Second grade –
    - Describe and classify plane and solid geometric figures according to number of sides, angles, faces, or edges.

# Essential Components: Children's Knowledge



# EGMA Contents

## NUMBER AND OPERATIONS

- Oral Counting Fluency
- One-to-one Correspondence
- Number Naming Fluency
- Quantity Discrimination
- Missing Number
- Word Problems
- Addition and Subtraction

## GEOMETRY

- Shape Recognition
- Pattern Extension

# Counting Fluency

- Important precursor in development of number concepts
- Opportunity to learn of children's
  - ability to count, and
  - familiarity and knowledge of the sequence of numbers.
    - In the US, most children start school with an understanding of number 1 through 9. Some have the understanding of up to 19.
    - Children's knowledge as to moving on to a new series of numbers. Example: ...8, 9, [new series begins], 10, 11..19, [new series begins], 20...

# Counting Fluency Assessment

## TASK 1: ORAL COUNTING

**MATERIALS:** STOPWATCH

**STOP RULE:** STOP THE CHILD IF CHILD MAKES AN ERROR WHILE COUNTING OR AT THE END OF A MINUTE

**SCORING:** RECORD THE LAST SPOKEN CORRECT NUMBER AND THE TIME ON THE STOPWATCH.

**DIRECTIONS:** START THE STOPWATCH TO COUNTDOWN FROM 60 SECONDS WHEN THE CHILD BEGINS TO COUNT. STOP THE STOPWATCH AND THE CHILD AS SOON AS THE CHILD MAKES AN ERROR OR AT THE END OF A MINUTE. RECORD THE TIME AND THE LAST NUMBER THE CHILD SAYS CORRECTLY, BELOW.

SAY: I want you to count for me. I will tell you when to begin and when to stop. Count for me from one to as high as you can count. Are you ready? Okay begin, one...

INTERVIEWER: IF THE CHILD DOES NOT START COUNTING SAY: Watch me count. One, two, three....ten. Okay, just like me, I want you to count as high as you can. Okay begin, one...

TIME ON THE STOPWATCH: \_\_\_\_\_

LAST NUMBER CHILD SAID CORRECTLY: \_\_\_\_\_

# One-to-One Correspondence

- Representation of a collection of objects through the application of number words.
- Child needs
  - Knowledge of number-word sequence to carry this task out.
  - To keep track of each counted and uncounted object – tagging (Gelman & Gallistel, 1986).
  - To coordinate two processes at once.
  - To understand that the last number-word counted in a group of objects represents the group as a whole.

# One-to-One Correspondence Assessment

## TASK 2: COUNTING: ONE-TO-ONE CORRESPONDENCE - PRACTICE ITEM

**MATERIALS:** SHEET "A"

**STOP RULE:** STOP THE CHILD IF S/HE DOUBLE COUNTS A CIRCLE, INCORRECTLY COUNTS A CIRCLE, OR IF TIME ON THE STOPWATCH RUNS OUT

**SCORING:** RECORD 1) THE LAST SPOKEN CORRECT NUMBER AND 2) THE RESPONSE THE CHILD GIVES TO YOUR FOLLOW UP QUESTION

**DIRECTIONS:** PLACE SHEET "A" WITH THE FOUR CIRCLES IN FRONT OF THE CHILD.

SWEEP YOUR HAND FROM LEFT TO RIGHT OVER THE CIRCLES AND SAY: **Here are some circles. I want you to point and count these circles for me.**

POINT TO FIRST CIRCLE AND SAY: **Start here and count the circles.**

HOW MANY CIRCLES DID THE CHILD COUNT: \_\_\_\_\_

IF THE CHILD DOES NOT SAY THE NUMBER AFTER COUNTING THE CIRCLES SAY: **How many circles are there?**

NUMBER OF CIRCLES CHILD SAYS THERE ARE: \_\_\_\_\_

IF CHILD DOES NOT RESPOND OR RESPONDS WITH THE INCORRECT ANSWER, COUNT THE CIRCLES OUT LOUD, POINTING TO EACH ONE AND SAY: **One, two, three, four, there are four circles. Now you count the circles.**

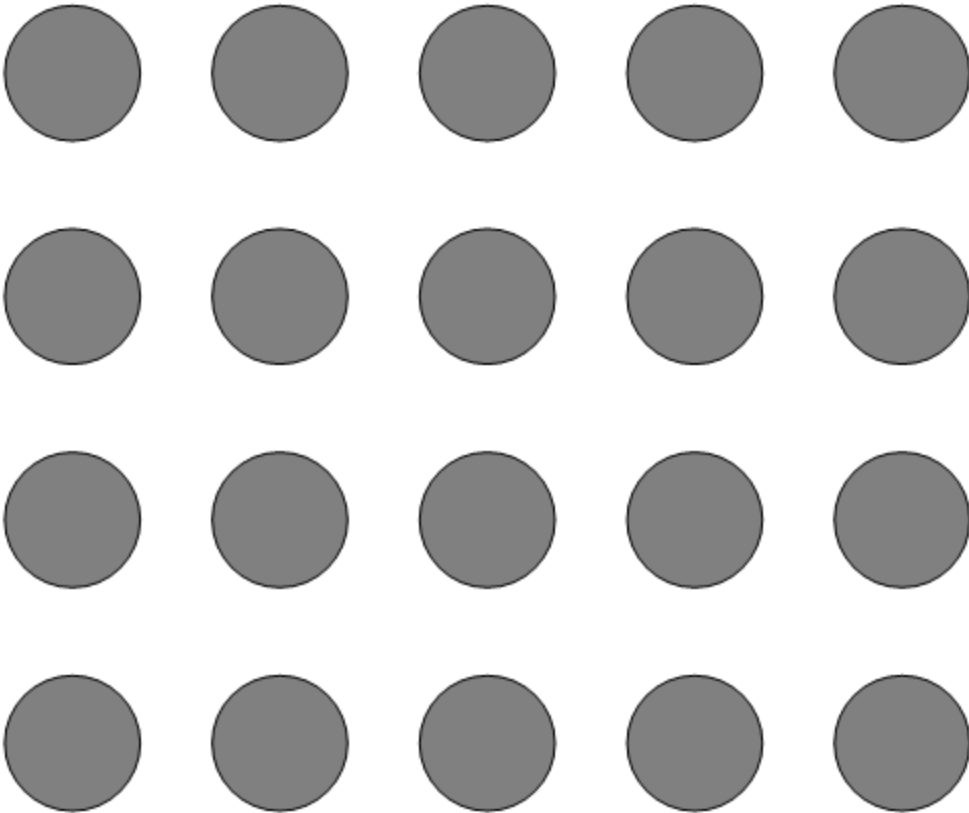
IF THE CHILD DOES NOT SAY THE NUMBER OF CIRCLES AFTER COUNTING THEM, SAY: **How many circles are there?**

IF CHILD SAYS "FOUR" SAY: **That's right, four. Let's do another one.**

IF CHILD DOES NOT SAY "FOUR" SAY: **There are four, let's do another one.**

# One-to-One Correspondence Assessment – Student Worksheet

SHEET B



A worksheet titled "SHEET B" containing a 4x5 grid of 20 gray circles. The circles are arranged in four rows and five columns, intended for a one-to-one correspondence assessment. The worksheet is framed by a black border with corner marks at the top-left, top-right, bottom-left, and bottom-right. A red horizontal bar is visible at the top of the page, and a blue vertical bar is on the left side.



# Number Identification

- Recognition and understanding that each of the numbers viewed is a constant with one number-word associated with it.
- NCTM Standards:
  - kindergarten students are to be familiar with numbers to at least 20,
  - first grade students are to be familiar with numbers to at least 100,
  - second grade students are to be familiar with numbers to at least 1000.

# Number Identification Assessment

## TASK 3: NUMBER IDENTIFICATION ITEM - EXERCISE ONE

**MATERIALS:** SHEET "C1" AND STOPWATCH

**STOP RULE:** STOP THE CHILD IF S/HE MAKES 4 ERRORS ONE RIGHT AFTER THE OTHER OR IF TIME ON THE STOPWATCH (30 SECONDS) RUNS OUT

**SCORING:** FOR EACH NON-RESPONSE OR INCORRECT NUMBER WORD, PLACE A "/" THROUGH THE NUMBER. RECORD ONE POINT FOR EACH CORRECT RESPONSE. ENTER THE NUMBER CORRECT PER ROW IN THE FAR RIGHT COLUMN. TOTAL FAR RIGHT COLUMN AND RECORD OVERALL TOTAL WHERE INDICATED.

**DIRECTIONS:** PLACE SHEET "C1" WITH THE GRID OF NUMBERS IN FRONT OF THE CHILD. START STOPWATCH FOR THIRTY SECONDS AS SOON AS THE CHILD STARTS RESPONDING.

SWEEP YOUR HAND FROM LEFT TO RIGHT OVER THE NUMBERS AND SAY: **Here are some numbers. I want you to point to each number and tell me what the number is.**

POINT TO FIRST NUMBER AND SAY: **Start here.**

IF A CHILD STOPS ON A NUMBER FOR 5 SECONDS – TELL THE CHILD WHAT THE NUMBER IS AND POINT TO THE NEXT NUMBER AND SAY: **What number is this?**

NUMBER CORRECT  
PER ROW

6	1	19	4	
10	16	3	9	
15	12	7	13	

CHILD SCORE (OVERALL TOTAL CORRECT): \_\_\_\_/12

TIME ON THE STOPWATCH: \_\_\_\_\_

**IF CHILD GETS FOUR NUMBER WORD ERRORS IN A ROW, DISCONTINUE AND GO TO TASK 4.**

# Number Identification Assessment – Student Worksheet

SHEET C1

6	1	19	4
10	16	3	9
15	12	7	13

# Quantity Discrimination

- Ability to make judgments about differences.
  - Use of mental number line.
  - Ability to make magnitude comparisons.
- For kindergarten and first graders
  - This understanding demonstrates a “critical link to effective and efficient counting strategies to solve problems” (Clarke, et al., 2008, p.49)
- To measure children's
  - understanding of where numbers are positioned on a number line.
  - knowledge of communicating the bigger number.

# Quantity Discrimination Assessment

## TASK 4: QUANTITY DISCRIMINATION MEASURE – EXERCISE ONE

**MATERIALS:** SHEET "D1" AND COVERSHEET

**STOP RULE:** STOP THE CHILD IF S/HE GETS 4 ERRORS ONE RIGHT AFTER THE OTHER.

**SCORING:** RECORD ONE POINT FOR EACH CORRECT RESPONSE.

**DIRECTIONS:** PLACE SHEET "D1" WITH THE COVERSHEET COVERING THE ITEMS IN FRONT OF THE CHILD. WHEN YOU ARE READY TO BEGIN, BRING COVERSHEET DOWN TO REVEAL THE FIRST NUMBERS TO THE CHILD.

**SAY:** Look at these numbers. Which one is bigger?

IF THE CHILD DOES NOT RESPOND TO AN ITEM, REPEAT THE QUESTION ONCE, WAIT THREE SECONDS, MARK WITH A SLASH "/" IF THERE IS STILL NO ANSWER, MOVE ON TO THE NEXT ITEM.

REPEAT THE QUESTION FOR EACH OF THE ITEMS. CIRCLE THE CHILD'S RESPONSE FOR EACH ITEM.

- |    |    |    |       |
|----|----|----|-------|
| 1. | 8  | 6  | _____ |
| 2. | 15 | 3  | _____ |
| 3. | 4  | 16 | _____ |
| 4. | 11 | 10 | _____ |
| 5. | 20 | 19 | _____ |
| 6. | 7  | 12 | _____ |

CIRCLE THE ANSWER GIVEN BY THE CHILD.  
FOR NON-ANSWERS, PLACE A SLASH "/" ON THE  
SPACE AT THE END OF THE ROW.

PLACE THE TOTAL RESPONSES CORRECT ON  
THE LINE FOR CHILD SCORE.

Child Score: \_\_\_\_ / 6

**IF CHILD GETS FOUR INCORRECT IN A ROW, DISCONTINUE AND GO TO TASK 5.**

# Quantity Discrimination Assessment – Student Worksheet

SHEET D1

8	6
15	3
4	16

# Missing Number

- A more in-depth look at children's knowledge of numbers.
  - “ $6 + 3$ ” is 3 more than 6 and “7, 8, 9” follow “6”.
- Based on NCTM's focal points, children should be learning
  - To count by 1s, 2s, 5s, and 10s.
  - To count backwards.
- Children will be asked to name a missing number in a set or sequence of numbers.

# Missing Number Assessment

## TASK 5: MISSING NUMBER MEASURE - PRACTICE

**MATERIALS:** SHEET "E" AND COVER SHEET

**STOP RULE:** STOP THE CHILD IF S/HE GET 4 ERRORS ONE RIGHT AFTER THE OTHER.

**SCORING:** RECORD THE CHILD'S RESPONSES BELOW.

**DIRECTIONS:** PLACE SHEET "E" WITH THE COVER SHEET ON TOP IN FRONT OF THE CHILD. SLIDE THE COVER SHEET DOWN WHEN YOU ARE READY TO BEGIN WITH THE PRACTICE ITEM.

SWEEP HAND FROM LEFT TO RIGHT OVER PRACTICE ITEM AND SAY: **Here are some numbers. One, two, three, what number goes here?**

CHILD'S RESPONSE: \_\_\_\_\_

IF CHILD SAYS THE CORRECT ANSWER, FOUR, SAY: **That's right four. Let's do some more.**

IF CHILD DOES NOT SAY CORRECT ANSWER OR DOES NOT RESPOND AFTER 5 SECONDS, SAY: **There are four. Count with me. POINT TO EACH NUMBER AND SAY: One, two, three, four, five.**



# Missing Number Assessment – Student Worksheet

SHEET E	
P	1, 2, 3, ____, 5
1	28, 29, ____
2	11, 12, ____

# Word Problems

- Research shows children solving word problems in kindergarten and first grade.
- Greater computational and problem solving competence in math as well as in other subjects.
- Better understanding as to methods used in solving problems.

Types/Classes of Verbal Problems	Definition	Example
Joining/ Separating	Initial quantity with some direct or implied action that causes a change in the quantity.	<b>Addition:</b> Johnny had 3 fish. His father gave him 8 more fish. How many fish did Johnny have altogether? <b>Subtraction:</b> John had 8 pieces of candy. He gave 3 pieces to his friend. How many pieces of candy did he have left?
Combine (Part-Part-Whole)	Relationship involves two distinct quantities that are parts of a whole.	<b>Addition:</b> Some children were fishing. 3 were girls and 8 were boys. How many children were fishing altogether? <b>Subtraction:</b> There were 11 children at the school. Three children are boys and the rest are girls. How many girls are at the school?

# Word Problems Assessment

## TASK 6: WORD PROBLEMS

**MATERIALS:** COUNTERS

**STOP RULE:** STOP THE CHILD IF S/HE GETS BOTH QUESTION 1 AND QUESTION 2 INCORRECT

**SCORING:** ENTER CHILD'S ANSWER ON THE LINE WHERE INDICATED FOR EACH ITEM. FOR EACH OF THE QUESTIONS: IF THE CHILD DOES NOT RESPOND, CIRCLE THE NR. IF THE CHILD REFUSES TO ANSWER, CIRCLE THE RF. IF THE CHILD SAYS THAT HE OR SHE DOES NOT KNOW, CIRCLE THE DK.

**DIRECTIONS:** PLACE COUNTERS TO THE SIDE OF THE CHILD.

SAY: I have some problems that I am going to ask you to solve for me. Here are some things to help you count. You can use them if you want to, but you don't have to. Listen very carefully. If you need me to, I will repeat the question for you. Okay, let's get started.

PRACTICE ITEM: SAY: Tommy had 2 candies. Sarah had 3 candies. How many candies did they have altogether?

IF THE CHILD CORRECTLY ANSWERS THAT THEY HAD 5 CANDIES ALTOGETHER, SAY: **That's right. They had five candies altogether. Let's do another one.**

IF THE CHILD DOES NOT CORRECTLY ANSWERS, SAY: **They had five candies altogether.** USE THE COUNTERS AND READ THE PROBLEM DEMONSTRATING THREE COUNTERS FOR TOMMY AND TWO COUNTERS FOR SARAH. IF THE CHILD STILL DOES NOT ANSWER THE PROBLEM, SAY: **There are five all together. Let's do another one.**

FOR THE FOLLOWING QUESTIONS, IF THE CHILD DOES NOT RESPOND TO AN ITEM, REPEAT THE QUESTION ONCE, WAIT THREE SECONDS AND MOVE ON TO THE NEXT ITEM. RECORD THE SCORES BELOW.

# Addition/Subtraction Problems

- Children start school with some basic knowledge of addition and subtraction concepts.
- With age and experience, perception of difficulty for addition and subtraction problems and strategies used in solving them change (Siegler, 2003).

Strategy	Description of Strategy
<b>Sum</b>	Child puts fingers up or uses counters to represent both addends. An example of this is “ $3 + 2$ ”. Here the child puts up three fingers on one hand and two fingers on his/her other hand. Then, the child start counting from one – counting each finger “1,2,3,4,5”
<b>Finger Recognition</b>	Child puts up fingers and then says “5” without counting. An example of this is “ $3+2$ ”. Here the child puts up three fingers on one hand and two fingers on the other hand. Looks at fingers and says “5”.
<b>Min</b>	Child may use fingers or counters in solving from the larger addend. An example of this is “ $3+2$ ”. Here the child may start counting from three, put up two fingers or counters to represent the two – counting only these two fingers or counters “4,5”.
<b>Retrieval</b>	Say an answer and explain that they just knew it.
<b>Guessing</b>	Say an answer and can only be explained as guessing.

Information Retrieved from Siegler & Jenkins (1989).

# Addition/Subtraction Problems Assessment

## TASK 7: ADDITION/SUBTRACTION PROBLEMS – PRACTICE ITEMS

**MATERIALS:** SHEET “F1”, AND COUNTERS

**STOP RULE:** STOP THE CHILD FROM CONTINUING IF S/HE GETS 4 ERRORS ONE RIGHT AFTER THE OTHER

**SCORING:** ENTER CHILD’S ANSWER ON THE LINE FOR EACH ITEM. CIRCLE “0” IF ANSWER WAS INCORRECT. CIRCLE “1” IF ANSWER WAS CORRECT. FOR EACH OF THE QUESTIONS: IF THE CHILD DOES NOT RESPOND, CIRCLE THE NR. IF THE CHILD REFUSES TO ANSWER, CIRCLE THE RF. IF THE CHILD SAYS THAT HE OR SHE DOES NOT KNOW, CIRCLE THE DK.

**DIRECTIONS:** PLACE THE COUNTERS TO THE SIDE OF THE CHILD. PLACE SHEET “F” IN FRONT OF THE CHILD. IF THE CHILD DOES NOT RESPOND FOR AN ITEM, REPEAT THE QUESTION ONCE, WAIT THREE SECONDS AND MOVE ON TO THE NEXT ITEM. RECORD THE SCORES BELOW.

### PRACTICE ITEM ONE:

SAY: **Now we are going to do some addition and subtraction problems.**

POINT TO THE COUNTERS AND SAY: **Here are some things you can use to answer these questions.**

POINT TO THE FIRST ADDITION PROBLEM ON SHEET F1 AND SAY: **How much is 1 and 2 altogether?**

IF THE CHILD CORRECTLY ANSWERS “3”, SAY: **That’s right, one and two altogether is three. Let’s do another one.**

IF THE CHILD DOES NOT CORRECTLY ANSWER, SAY: **The answer is three.** USE THE COUNTERS AND READ THE PROBLEM DEMONSTRATING BY PUSHING ONE COUNTER TO THE CHILD AND SAY: **This is one.** THEN PUSHING TWO COUNTERS TOWARD THE CHILD AND SAY: **This is two.** COUNT ALL THREE COUNTERS ALOUD AND SAY: **One and two altogether is three. Let’s do another one.**

# Addition/Subtraction Problems Assessment – Student Worksheet

SHEET F1	
P1	$1 + 2 = \underline{\quad}$
P2	$3 - 2 = \underline{\quad}$

# Geometry

- Children bring a level of informal geometry skills such a perception of shape and space to school.
- Formal schooling provides opportunities to build on existing knowledge as children
  - learn of their surroundings, and
  - learn how to communicate their position in relation to these surroundings.

# Shape Recognition

Shapes Presented to Children	Usual Visual Prototype of Shapes	Outcomes/Observations
Circles	----	<ul style="list-style-type: none"> <li>Identified accurately by children.</li> <li>Differences – only a few younger children chose other shapes (e.g., ellipse)</li> </ul>
Squares	With horizontal base	<ul style="list-style-type: none"> <li>Identified “fairly” well by children</li> <li>Difference – younger children chose non-square rhombi.</li> </ul>
Triangles	Equilateral or isosceles with horizontal base	<ul style="list-style-type: none"> <li>Identified less accurately by children.</li> <li>Orientation did not seem to have much of an effect. Lack of symmetry had an effect, with children rejecting a triangle if the point at the top was not in the middle.</li> </ul>
Rectangles	Horizontal, elongated and twice as long as they are wide	<ul style="list-style-type: none"> <li>Identified less accurately by children.</li> <li>Difference – many children accepted long parallelograms or right trapezoids. Children seem to make selection based on the ratio of height to base.</li> </ul>

Clements (1999) demonstrates two studies: study one by Hannibal and Clements, 1998 conducted with 3 to 6 year old children sorting shapes by type (e.g., triangles, rectangles); study two by Clements, Swaminathan, Hannibal, & Sarama (1999) conducted with children 3 years 6 months through 6 years 8 months of age.



# Shape Recognition Assessment

## TASK 8: SHAPE RECOGNITION

**MATERIALS:** SHEETS "G1" THROUGH "G4"

**STOP RULE:** N/A

**SCORING:** THE CORRECT SHAPES ARE MARKED WITH A PATTERN OF DOTS ON THEM. FOR EACH CORRECT SHAPE THE CHILD IDENTIFIES, HE OR SHE GETS A POINT. ENTER THE SCORE ON THE LINE THAT FOLLOWS EACH FIGURE.

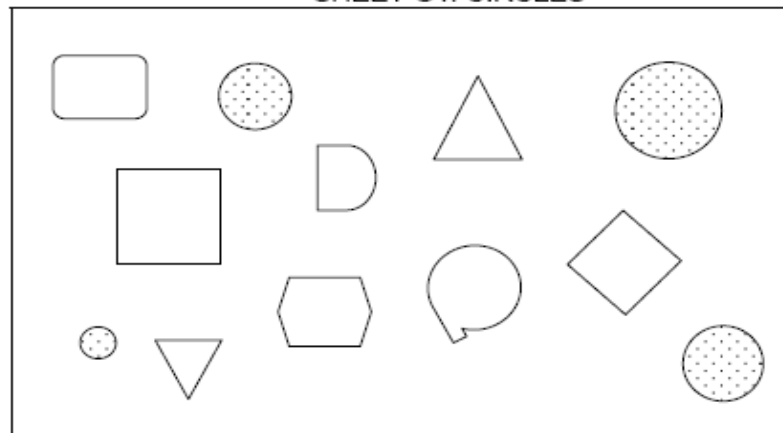
**DIRECTIONS:** FOR EACH OF THE SHAPES BELOW, ONCE THE CHILD FINISHES PLACING THE COUNTERS ON TOP OF THE SHAPE SHEET, MARK THE SHAPES WITH A "✓" ON YOUR SHEET. THEN, RECORD THE NUMBER OF SHAPES THAT WERE COUNTED CORRECTLY. MAKE SURE TO FOLLOW THESE INSTRUCTIONS FOR EACH SHAPE SHEET PRESENTED TO THE CHILD.

**SAY:** Now we are going to play another game with shapes.

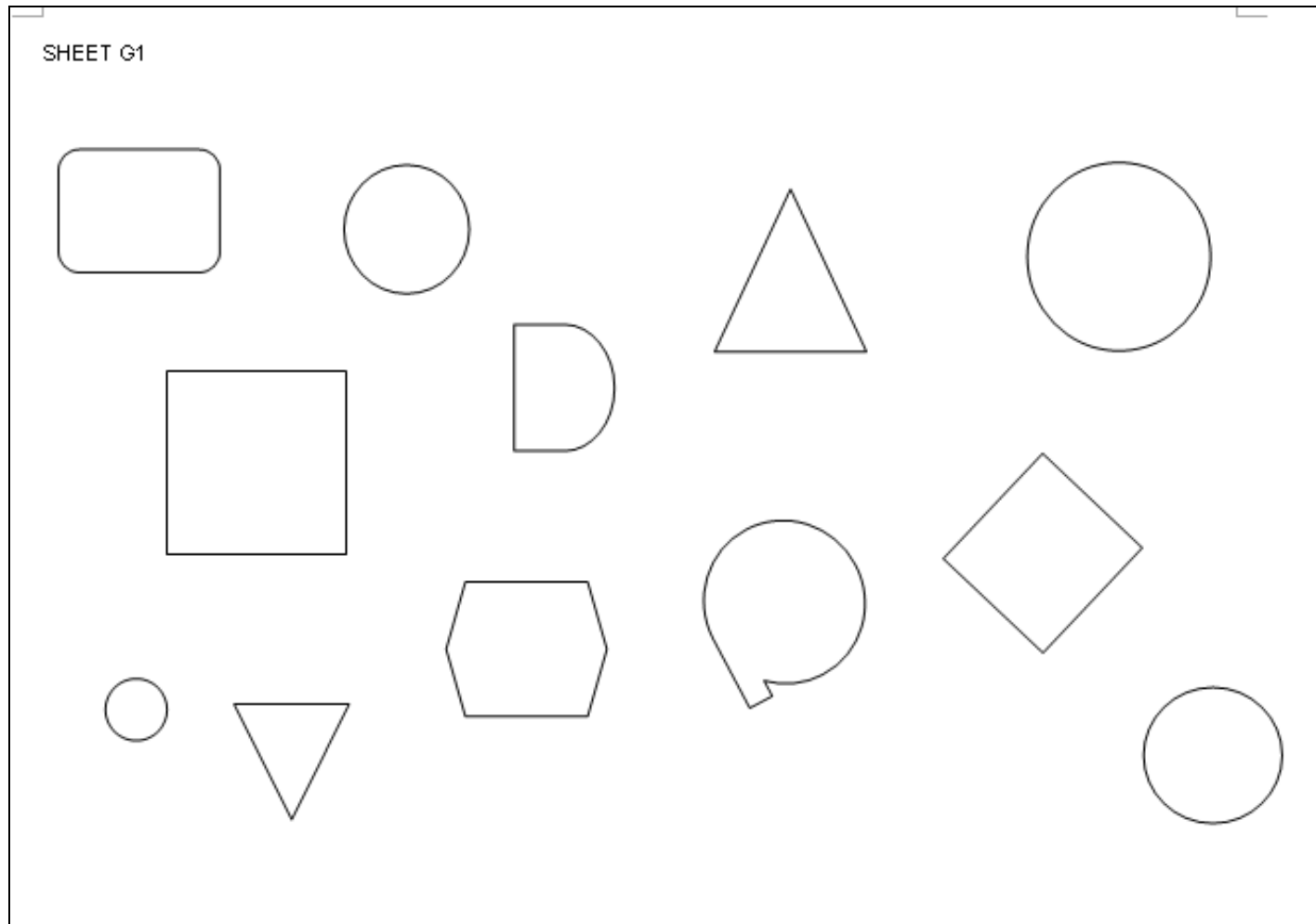
PLACE THE COUNTERS TO THE SIDE OF THE CHILD.

POINT TO THE COUNTERS AND SAY: I want you to place the counters on all of the circles you find on this sheet. PLACE THE SHEET IN FRONT OF THE CHILD. Let me know when you are done.

SHEET G1: CIRCLES



# Shape Recognition Assessment – Student Worksheet



# Pattern Extension

- The ability to identify similarities and differences between the objects in a pattern, and make predictions on how patterns are to continue (Greenes, 1999; Clements, 2004).
  - This is the beginning of algebraic thinking (e.g., ability to deduce beyond available information)
  - This enhances the development of spatial thinking (Casey, 1999)
- Children need to
  - retain the attributes of the shapes in memory, and
  - recognize and test what shape(s) come next in the patterns (Grande, et al.; NCTM, 2008).

# Pattern Extension Assessment

## TASK 9: PATTERN EXTENSION

**MATERIALS:** SHEETS "H1 THROUGH H5"

**STOP RULE:** STOP THE CHILD FROM CONTINUING IF S/HE GET 3 ITEMS INCORRECT IN A ROW

**SCORING:** RECORD ONE POINT FOR EACH CORRECT RESPONSE.

**DIRECTIONS:** DO NOT PLACE THE SHEET IN FRONT OF THE CHILD UNTIL YOU SAY: **I am going to show you a pattern.**

PLACE SHEET H1 IN FRONT OF THE CHILD. POINT TO THE PATTERN MOVING HAND FROM LEFT TO RIGHT OVER PATTERN AND SAY: **I want you to finish this pattern for me.**

THEN MOVE HAND ACROSS RESPONSE OPTIONS AT BOTTOM OF PAGE AND SAY: **Which one of these goes here?** POINT TO THE BLANK AT THE END OF THE PATTERN.

REPEAT THE INSTRUCTIONS ABOVE FOR EACH OF THE ITEMS. CIRCLE THE CHILD'S RESPONSES BELOW. FOR ANY ITEMS THE CHILD DOES NOT ANSWER, PLACE A "/" ON THE LINE FOR THAT ITEM.

1.	A	B		
2.	A	B	C	
3.	A	B	C	
4.	A	B	C	
5.	A	B	C	

CHILD SCORE (OVERALL TOTAL CORRECT): \_\_\_\_/5

# Pattern Extension Assessment – Student Worksheet

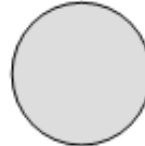
SHEET H1



A



B



# Next Steps

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**Literature review**

**Draft development of items  
approach**

**Preparation for and meeting with  
experts**

**Continue development of math  
toolkit based on expert panel**

**Identification of potential  
countries for piloting the**

**Working with identified countries**

# Piloting the Instrument

- Working with the ministry of education
- Training enumerators
- Collecting data in identified schools
- Reviewing and reporting data collected

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