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Assessing Early Numeracy

BC Early Numeracy Project (K-1)

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Assessing Early Numeracy

BC Early Numeracy Project (K-1)

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About the BC Early Numeracy Project

The BC Early Numeracy Project (ENP) was sponsored by the Ministry of Education and involved UBC mathematics teacher educators and teachers from several school districts in the province. The project's purpose was to develop assessment and instructional tools to support early numeracy development, particularly for children at risk. Three classroom resources, *Assessing Early Numeracy*, *Supporting Early Numeracy*, *Whole Group Follow-up* and a parent resource *Math for Families – Supporting Numeracy at Home*, are the result.

Three questions focused the project's development:

- How can we identify children's strengths and weaknesses in early numeracy?
- How can we provide instruction in kindergarten and grade one so that fewer students require intervention later?
- How can we develop intervention plans with appropriate starting points and effective instructional strategies?

We began by examining current research and practice in mathematics teaching to establish what constitutes early numeracy and how best to assess, recognize and support its development. The team drew from the Mathematics IRP and a variety of other sources to design the assessment items. Over a year and a half, we piloted and refined the items, developed the scoring frameworks and finalized the assessment resource. Next, we developed instructional resources to complement the assessment.

“This assessment has expanded my understanding of what is possible in student thinking.”

Who Was Involved

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SD#23 Central Okanagan

SD#27 Cariboo-Chilcotin

SD#35 Langley

SD#38 Richmond

SD#39 Vancouver

SD#40 New Westminster

SD#45 West Vancouver

SD#48 Howe Sound

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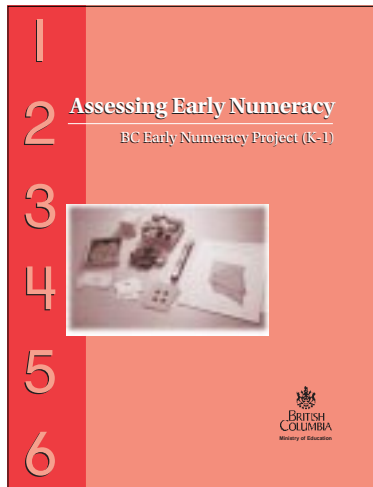
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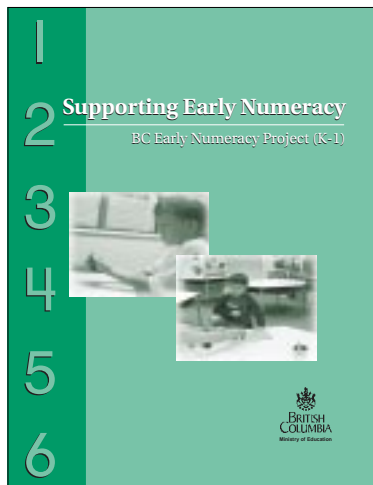
Project Materials

The Assessment and Instructional Support Resources

Assessing Early Numeracy addresses several important components of early numeracy. It was designed to be used at the end of kindergarten or early in grade one, with a focus on identifying children at risk in mathematics. The assessment helps teachers consider which children would benefit from intervention support in grade one and which need extra attention given to the development of specific skills.



Supporting Early Numeracy was designed as a resource for teaching based on assessment results. The goal is for assessment to inform instruction. However, for the assessment to be fair, children must have had the opportunity to learn the concepts and skills assessed. This resource provides instructional suggestions to support grade one students who are at risk of falling behind.

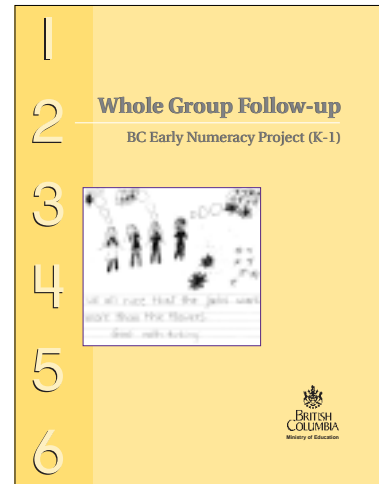


“The ENP project has helped me see how assessment can inform instruction – assessment is well worth the time.”

**“I pay more
attention now
to where
students are
developmentally.”**

Whole Group Follow-up – is designed to provide additional instructional activities to support numeracy. These activities are designed for the teacher to use with the whole class and offer activities that are of value for all levels.

Math for Families – Supporting Numeracy at Home is designed to provide suggestions for ways that families can engage in mathematics and support numeracy through everyday activities at home. The activities provided support the assessment and can be selected by teachers to suggest for support at home. *Math for Families – Supporting Numeracy at Home* is also available as a webpage for parents to access.



The assessment and instructional resources focus on four key aspects of numeracy:

- **Number Skills**—the basic tools of numerate thinking, including counting, reading and writing numerals, and recognizing visual-spatial quantities without counting.
- **Number Concepts**—the “understanding” part of numerate thinking, through sorting, comparing, ordering, patterning, estimating, quantifying, seeing part/whole relationships, joining, separating, grouping, sharing and representing.
- **Visual-Spatial Thinking**—the ability to make sense of visual-spatial information.
- **Attitudes**—the dispositions that support numerate activity: the inclination to make sense, to try hard, to persevere, to see mathematics as fun and relevant, and to see oneself as a capable thinker and problem solver.

The educators who developed the Early Numeracy Project materials believe that supporting young learners to build competency requires:

- building a solid foundation of understanding rather than focusing on speed or memory
- recognizing and supporting differences in developmental stage and learning style
- understanding how children learn mathematics and typical learning patterns for mathematics
- recognizing visual-spatial strengths and the scaffolding that visual-spatial thinking provides for making sense of number
- supporting and enhancing children’s mathematical dispositions and habits of mind

The materials are designed for use by kindergarten and grade one classroom teachers and learning assistance/resource room teachers. The materials are designed to help them become more observant in seeing and hearing what children think and do. The materials do not replace the classroom mathematics program but provide support in the form of in-depth assessment and focused instruction.

“For the assessment to be fair, children must have had the opportunity to learn the concepts and skills being assessed.”

“There is a big change for me in terms of how I assess. ... a lot of kids just aren’t able to share their thinking in a written format or even in pictorial form.”

Assessing Early Numeracy: Key Components

ASSESSMENT ITEMS

Each assessment item provides an opportunity to assess a key aspect of early numeracy. For each item you will find:

- the purpose of the item
- sample results, if available
- instructions for scoring the item according to the framework
- what to look for when using the item
- materials needed
- directions for using the item
- questions to ask

The items are laid out in a standard format for ease of use, with sample results and scoring on the left and directions for using the item on the right.

Item 7. Estimate and Check

This item looks at the child’s meaningful counting range as opposed to the rote counting chain or song.

Assessing Student Performance


SCORING ITEM 7	
1	very unrealistic estimate and incorrect count
2	does not estimate between 10 and 20 counts in unsystematic ways
3	estimates between 10 and 20 counts accurately to 15 uses all of the counting principles listed above
4	as for Level 3 but with confidence and efficiency
5	N/A

Sample Results for Item 7
In field testing of roughly 200 kindergarten students:

- 59% estimated between 10 and 20 (considered reasonable estimates)
- 12% were right on or within 2 of the 15
- 41% were not within +/- 5
- 74% were able to accurately count the 15 to check

INSTRUCTIONAL FOLLOW-UP
Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Estimation
- See Table 2 (p. 17): *Linking Assessing Early Numeracy with Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.




Using Item 7

WHAT TO LOOK FOR:

- Can the child make a reasonable estimate of number (is 15 within the child’s comfort zone)?
- Does the child use a correct and systematic number chain when counting objects?
- Does the child move the objects and count or simply look and count? Is the method accurate?
- Can the child count systematically by 1s, using all of the above skills?

YOU WILL NEED:

- 15 cubes or other counters
- a counting mat



Randomly place 15 cubes under a counting mat, show briefly and ask:

a. “About how many do you think are under here?”

b. “Count, check and see exactly how many.”

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LEARNER PROFILE

RS1 Learner Profile is a resource sheet (RS) that provides a format to note evidence of the child's mathematical awareness, learning characteristics, dispositions and habits of mind.


Use RS1 Learner Profile in conjunction with RS3 Summary of Early Numeracy Assessment Responses to consider which students might benefit most from extra support in grade one.

RS1. Learner Profile					
Name: _____	Birthdate: _____	Age: _____			
Teacher: _____	Grade: _____	Date: _____			
			Not Evident	Always Evident	
MATHEMATICAL AWARENESS SUMMARY (Item 1)					
DISPOSITIONS AND HABITS OF MIND:					
inclination to make sense					
confidence and willingness to take risks					
perseverance					
flexibility in exploring mathematical ideas					
interest, curiosity and inventiveness					
pride in mathematical accomplishments					
LEARNING CHARACTERISTICS:					
organization (of materials, thoughts, work)					
metacognition (shows or tells his or her thinking)					
ability to verbally articulate thinking and procedures					
ability to model or represent thinking on paper					
attention to task and ability to focus					
independence and self-reliance (vs. reliance on others)					
OTHER RELEVANT CONSIDERATIONS:					
BC EARLY NUMERACY PROJECT (K-1)					

“You are really looking at the development of kids...what they understand, how they're using it. That's what is directing the instruction.”

EARLY NUMERACY ASSESSMENT RECORD SHEET

Use the resource sheet, RS2 Early Numeracy Assessment Record Sheet, for recording student responses to each item.

RS2. Early Assessment Record Sheet	
Name: _____	Birthdate: _____ Age: _____
<p>1. MATHEMATICAL AWARENESS</p> <p>a) How old are you? ✓ X</p> <p>b) When is your birthday? ✓ X</p> <p>c) How old will you be on your next birthday? ✓ X</p> <p>d) How many brothers or sisters do you have? ✓ X</p> <p>e) How old is your brother/sister? ✓ X</p> <p>f) What is your telephone number? ✓ X</p> <p>g) How old is your mom/dad? ✓ X</p> <p>h) What year were you born? ✓ X</p> <p>2. RECOGNIZING DOT PATTERNS</p> <p>✓ or X recognized without counting</p> <p>2 4 0 5 3 9</p> <p>3. MATCHING NUMERALS AND SETS</p> <p>✓ or X numeral matched</p> <p>2 4 0 5 3 9</p> <p>4. ORDERING NUMERALS</p> <p>✓ or if ordered correctly</p> <p>0 1 2 3 4 5 6 7 8 9</p> <p>5. COUNTING FORWARD</p> <p>a) How high can you count? _____</p> <p>b) Counts from one to _____</p> <p>c) Counts on from _____ correctly.</p> <p>d) Says number after 4 _____ 10 _____ 25 _____</p> <p>49 _____ 80 _____ 109 _____</p>	<p>6. COUNTING BACK</p> <p>a) Counts back from 10 ✓ X</p> <p>b) Other _____</p> <p>7. ESTIMATE AND CHECK</p> <p>a) estimate _____</p> <p>b) count _____</p> <p>Comments: _____</p> <p>8. COUNTING ON/INVARIANCE</p> <p>a) builds 10 ✓ X</p> <p>b) conserves 10 ✓ X</p> <p>c) provides rationale ✓ X</p> <p>d) counts on ✓ X</p> <p>9. BUILD AND CHANGE</p> <p>Predicts Strategy</p> <p>a) Change 6 to 4 ✓ X</p> <p>b) Change 4 to 8 ✓ X</p> <p>c) Change 8 to 5 ✓ X</p> <p>d) Change 5 to 12 ✓ X</p> <p>10. PATTERN ITEMS</p> <p>Action Patterning clap, clap, pat...</p> <p>a) joins in with you ✓ X</p> <p>b) keeps the pattern going ✓ X</p> <p>If so, continue with pattern items.</p>
<p>10. PATTERN ITEMS - continued</p> <p>Analyzing Patterns RGBB RGBB RG...</p> <p>a) Can you see/describe a pattern? ✓ X</p> <p>b) Can you figure out which colour comes next? ✓ X</p> <p>c) Can you continue the pattern at both ends? ✓ X</p> <p>d) What keeps repeating in the pattern? ✓ X</p> <p>Creating a Pattern Train (only use if necessary)</p> <p>a) draw student's construction and description</p> <p>11. PROBLEM SOLVING</p> <p>a) 4 plates/2 cookies on each</p> <p>Answer: _____</p> <p>Child's strategy: _____</p> <p>b) 10 candies/2 share</p> <p>Answer: _____</p> <p>Child's strategy: _____</p> <p>12. SQUARES PUZZLE</p> <p>RATING <input type="checkbox"/></p> <p>Circle the pieces the child selects:</p> <p></p> <p>Notes: _____</p> <p>13. READING NUMERALS</p> <p>Reads:</p> <p>3 8 36 83 18 147 407 1847</p> <p>Optional Calendar: _____</p>	<p>14. NUMERAL PRINTING</p> <p>Writes: ✓ or record child's effort</p> <p>1 6 3 5 2 7 9 4 0 8</p> <p>12 47 60 15 724 105 2469 6023</p> <p>Can find? Can copy? _____</p> <p>Can show with cards? _____</p> <p>Comments: _____</p> <p>Optional Items:</p> <p>15. COIN SETS</p> <p>Show how to make...12 cents</p> <p>12P 1D+2P 2N+2P 1N+7P</p> <p>Which coins are used with meaning: P N D</p> <p>16. CUBE BUILDING</p> <p>estimate: _____ Rating <input type="checkbox"/></p> <p>3x3x3 cube strategy/explanation: _____</p> <p>17. 100 CHART</p> <p>Does the child:</p> <p>a) read 1- and 2-digit numbers (gray boxes)</p> <p>3 8 14 29 36 75</p> <p>b) find given numbers and determine the number one greater 10 _____ 25 _____ 79 _____</p> <p>c) find given numbers and determine the number one less _____ 7 _____ 13 _____ 40 _____ 100</p> <p>d) write one- and two-digit numerals use patterns to find numbers on a 100 Chart</p> <p>*finds 42 57 83</p>
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BC EARLY NUMERACY PROJECT (K-1)	

“Asking kids to explain their thinking gives you a different level of understanding.”

SUMMARY OF EARLY NUMERACY ASSESSMENT RESPONSES

Use the resource sheet, **RS3 Summary of Early Numeracy Assessment Responses**, to summarize student responses into a profile of strengths and weaknesses. Items are clustered into the three content areas of the assessment: number skills, number concepts and visual-spatial skills.

Use the Summaries and Learner Profiles when planning for instructional follow-up.

RS3. Summary of Early Numeracy Assessment Responses

Name: _____ Birthday: _____ Age: _____

NUMBER SKILLS ITEMS	1	2	3	4	5	COMMENTS
3. Matching Numerals and Sets						
4. Ordering Numerals 0-9						
5. Counting Forward						
6. Counting Back						
13. Reading Numerals						
14. Printing Numerals						
17. 100 Chart (optional)						

NUMBER CONCEPT ITEMS	1	2	3	4	5	COMMENTS
7. Estimate and Check						
8. Invariance/Counting On						
9. Build and Change						
11. Problem Solving						
15. Coin Sets (optional)						

VISUAL SPATIAL ITEMS	1	2	3	4	5	COMMENTS
2. Recognizing Dot Patterns						
10. Pattern Items						
12. Squares Puzzle						
16. Cube Building (optional)						

IMPLICATIONS FOR INSTRUCTION: _____

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RESOURCE SHEETS (RS)

Pages 55–65 provide the basic materials required for using the assessment. They need to be prepared ahead of time by copying them onto card stock and cutting some into separate pieces.

RS5. Dot Cards for Items 2 and 3

A

B

D

F

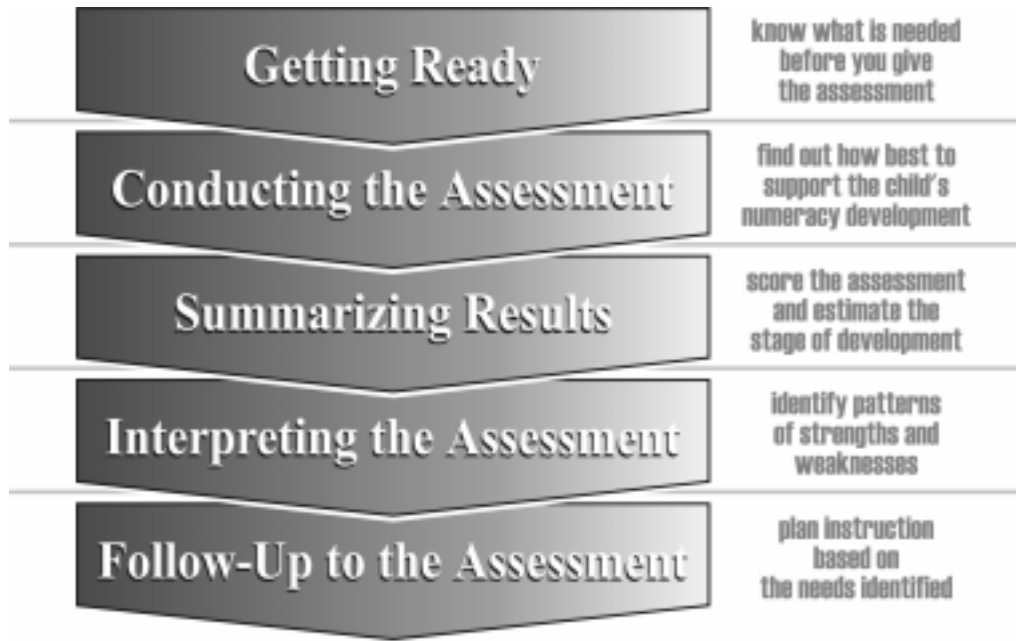
ASSESSING EARLY NUMERACY

RS6. Shapes for the Squares Puzzle, 1 (Cm 12)

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Using the Assessment

Being well prepared is important. Review the steps on the following pages before you conduct the assessment. Keep in mind that your main goal is to identify children's strengths and weaknesses in numeracy.





Getting Ready

Take some time to prepare for the assessment. Knowing what to do—and having the supplies you need at hand—will help you feel more relaxed as you do the assessment and will ensure that the process goes smoothly. Before you start:

- familiarize yourself with the directions (Conducting the Assessment on page 11)
- prepare the materials listed below (pages 55–65), and organize them for ease of use (use a container to keep all materials in one place).

Items to prepare or collect ahead of time:

- copies of **RS1 Learner Profile**, **RS2 Early Numeracy Assessment Record Sheet** and **RS3 Summary of Early Numeracy Assessment Responses** – use 11 x 17 paper to make booklets
- **RS4 Numeral Cards 0-9** – can be made using felt pen on stiff card (roughly 5cm x 8cm)
- **RS5 Dot Pattern Cards** – can be made using cards and stickers
- **RS6 Shapes** and **RS7 Square Form for Squares Puzzle** for Item 12 (cut out shapes) – run off on stiff card
- **RS8 Calendar** for reading one- and two-digit numerals (optional for Item 13)
- **RS9 Numeral Cards** for Item 13
- **RS10 100 Chart** for Item 17 (Item 17 is optional)
- pattern train of 10 Unifix cubes (red, green and blue) for Item 10
- counting mat (minimum 8.5x11 stiff card)
- 3x3x3 cube constructed from Multilink cubes for Item 16 (Item 16 is optional)
- Unifix cubes, blocks or other counters familiar to the child
- paper and pencil (felt pens optional)
- calculator
- mixed set of coins, roughly 10 each of pennies, nickels and dimes for Item 15 (Item 15 is optional)

Conducting the Assessment

The first aim of the assessment interview is to better understand the child's strengths and weaknesses in numeracy. A second aim is to determine what kinds of support or scaffolds best support the child's learning and allow the child to be successful (e.g., different wording, use of materials or help organizing materials).

The assessment takes between 20 and 35 minutes, depending on the child. As you become familiar with using the items, you will learn how much response time to allow. Before starting, reassure the child that in this special time together, you want to learn how they think and work in mathematics.

To begin, seat the child to your left (if you are right-handed) so that you can record as you go.

With the child's help, complete the information at the top of **RS2 Early Numeracy Assessment Record Sheet**, and ask the questions for Item 1, Mathematical Awareness. Ensure the child is at ease before continuing with the assessment.

Record the child's responses directly onto the Record Sheet. Upon completion, go back and fill in **RS3 Summary of Early Numeracy Assessment Responses**. If you can arrange it, using a video recorder to record the first few interviews can be helpful until you become more familiar with the items and their scoring. (Note: you may need parent permission.) Once you are comfortable using the items, it may work best to fill out the profiles as you go, making instructional notes for later use.



If the child does not understand your directions, reword them and note what caused the difficulty. Break the assessment into two sittings.

If an item is clearly too difficult and you have tried some ways to scaffold the item, move on to the next item. These items are starting points for exploring a child's strengths and weaknesses.

End the interview with something the child can do well (e.g., make a pattern with the cubes) so they leave feeling positive about the experience.



Summarizing Results

Scoring criteria are provided for each item, using a range from 1 to 5. (You will find these criteria beside each item in the assessment.)

Items are grouped into three categories. For each category, there is a different basis for scoring. The following chart summarizes the key criteria that distinguish scoring for each category:

Using five stages or levels to describe response to all three sets of items is not meant to suggest that number and visual-spatial abilities develop at the same rates in individual children. Rather, the stages or levels are used to simplify recording and interpretation and to visually allow patterns of strength to emerge so that instruction can be built upon children's abilities.

Table 1: Scoring Criteria

Aspect of Numeracy	Items	Key Scoring Criteria
NUMBER SKILLS	3, 4, 5, 6, 13, 17	<p>Scoring the Number Skills Items:</p> <p>The five levels gradually increase according to number size, showing the range of numbers familiar to the child.</p> <ul style="list-style-type: none"> 1: no systematic grasp of number 2: consistent use of number to 10 3: some familiarity with two-digit numbers 4: comfortable with two-digit numbers 5: can work with numbers above 100
NUMBER CONCEPTS	7, 8, 9, 11, 15	<p>Scoring the Number Concept Items:</p> <p>The five levels increase by conceptual approach to working with number (see chart below).</p> <ul style="list-style-type: none"> 1: no systematic grasp of number 2: counts all from 1; needs perceptual model 3: counts on; mentally represents number 4: beginning to use grouping rather than 1s counting 5: uses reasoning strategies involving grouping and known facts
VISUAL-SPATIAL	2, 10, 12	<p>Scoring the Visual-Spatial Items:</p> <p>The five levels gradually increase according to proficiency in the use of mental imagery.</p> <ul style="list-style-type: none"> 1: no consistent use 2: recognizes and matches shapes 3: uses visual memory to find and use shapes 4: uses dynamic imagery to find and use shapes 5: shows intuitive visual-spatial sense, including dynamic imagery

At the end of the assessment, return to **RS1 Learner Profile** (page 55), and fill in your summary estimates of the child's learning characteristics (these are subjective; use your professional judgment). The number concept items (Items 7, 8, 9, 11 and 15) and visual-spatial items (Items 2, 10, 12 and 16) are particularly useful for assessing these aspects of mathematical disposition. Consider such things as whether the child relates new ideas to what they already know (inclination to make sense) or tries different approaches (flexibility in exploring mathematical ideas).

Summarize the child's responses to the assessment items on **RS3 Summary of Early Numeracy Assessment Responses** (page 56). Use the scoring information for each item as the basis for estimating the stage of development. The Summary is organized to highlight clusters of items. This will help you recognize patterns of strengths and weaknesses in:

- number skills (mainly recognition and recall in nature)
- number concepts (mainly conceptual and developmental in nature)
- visual-spatial items (items related to visual memory and the ability to use visual imagery)



Interpreting the Assessment

Children at any grade level can demonstrate very different levels of mathematical awareness, interest and ability. Although the BC mathematics curriculum specifies expectations for each grade, many children do not fully meet these expectations, while many far exceed them.

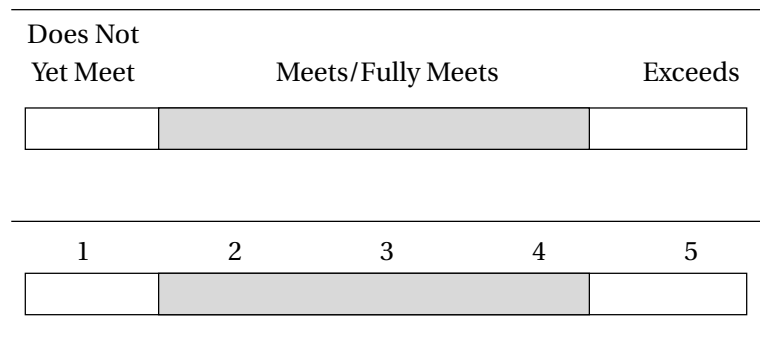
When interpreting the results of this assessment, it is important to keep in mind that the development of early numeracy is closely tied to a child's understanding of number. This understanding depends on the development of concepts, skills and attitudes. Children may

have highly developed skills, such as reading and writing numerals, but little understanding of the underlying number concepts. Similarly, children can understand big ideas about number while lacking related skills to demonstrate or communicate that understanding, or by their lack of confidence to use what they know. In practice, concepts and skills are inextricably connected—one supports the other. For assessment purposes, though, separating out specific components can help identify strengths and weaknesses. Recognizing areas of weakness helps determine what learning experiences children need. Recognizing learning strengths helps determine how to scaffold these learning experiences.

Early Numeracy Project and the BC Performance Standards

The BC Ministry of Education Performance Standards for numeracy are a good starting point for getting a full picture of numeracy performance for children in grade 1. *Assessing Early Numeracy* can provide details on mathematics learning for children in grade 1 who do not yet meet or minimally meet expectations.

The following illustrates how *Assessing Early Numeracy* roughly parallels the Performance Standards scoring.



Both scales above show the range of performance you might expect for the primary grades. The left end of the range includes children at risk, and the right end includes those who may benefit from an enriched math program.

Follow-Up to the Assessment

Once you have completed the Learner Profiles (RS1), Record Sheets (RS2) and Summaries (RS3), you are ready to decide what actions to take. You should be able to plan your instruction based on the needs identified in the assessment. For example, you might begin by identifying students who would benefit from the various strategies provided in *Supporting Early Numeracy*.



CHILDREN'S LEARNING NEEDS	SUGGESTED SUPPORT
Children who struggled with all or most of the assessment items are at risk of falling behind.	These children could benefit from working in a small-group setting outside the classroom to build or strengthen early numeracy skills. The numeracy intervention strategy designed with these children in mind is the Small-Group Intervention (Surprise Box).
Children who performed well on some assessment items and struggled with others might benefit from experiences designed to build specific skills.	These children could benefit from using the activities in Focused Instruction for the Classroom. These resources contain skill-specific activities that are designed to be used in small groups or with the whole class. NOTE: For specific suggestions See Table 2 (p. 17): <i>Linking Assessing Early Numeracy with Supporting Early Numeracy</i> .

Supporting Early Numeracy contains the following resources to assist you in addressing the particular needs of learners in your class.

SMALL-GROUP INTERVENTION

The Surprise Box section provides an instructional sequence for working with at-risk grade one children in a small-group setting outside of the classroom. The Surprise Box resource is designed to develop positive attitudes and kindergarten-level concepts and skills in a supportive environment.

FOCUSED INSTRUCTION FOR THE CLASSROOM

This section includes two sets of structured activities and three “idea files” that can all be used in small groups (or whole groups as appropriate). The five skill-specific sections include:

- **Estimation**—a collection of structured activities that help children learn a variety of strategies to assist with estimation and recognize when it is appropriate to estimate.
- **Pattern**—a sequence of patterning activities that moves from simple hands-on, active pattern tasks to more complex number patterns. This section combines number concepts and spatial thinking.
- **Counting and Numeral Recognition**—an idea file for children who need more time and systematic reinforcement to reach proficiency in counting and numeral recognition.
- **Visual-Spatial Pattern Recognition**—a sequential set of five-minute teacher-led activities aimed at developing mental imagery to support number sense.
- **Math Playground**—a resource file of hands-on spatial explorations for independent centre work, either in the classroom or for small-group work outside the classroom.

Table 2: Linking Assessing Early Numeracy with Supporting Early Numeracy

The following table shows how *Supporting Early Numeracy* connects to the different assessment items in *Assessing Early Numeracy*. A dark screen indicates a major relationship, a light screen indicates a minor relationship, and no screen indicates no relationship.

	Estimation	Pattern	Counting, Numerals	Visual-Spatial	Math Playground
1 Mathematical Awareness					
2 Recognizing Dot Patterns					
3 Matching Numerals and Sets					
4 Ordering Numerals 0-9					
5 Counting Forward					
6 Counting Backwards					
7 Estimate and Check					
8 Invariance and Counting On					
9 Build and Change					
10 Pattern Items					
11 Problem Solving					
12 Squares Puzzle					
13 Reading Numerals					
14 Printing Numerals					
15 Coin Sets •					
16 Cube Building •					
17 100 Chart •					

• optional items

Whole-Group Follow-Up



Often children who are discouraged or disengaged benefit from working as part of a whole class, especially when there are opportunities for success at a variety of levels. The lessons in the Whole-Group Follow-Up section are divided into two sets. The first set builds number skills and concepts; the second set develops visual-spatial thinking. These lessons can be used with children at very different levels of development, and they offer something of value for all levels.

Math for Families – Supporting Numeracy at Home

Children come to school with a great deal of knowledge about mathematics based on experiences they have had with their families. Schools build on this informal knowledge base, recognizing that an ongoing partnership with families can greatly assist the continuing development of mathematical understanding in children.

The Ministry of Education website (http://www.bced.gov.bc.ca/primary_program/) also provides access to *Math for Families – Supporting Numeracy at Home* for ways families can continue to support children's numeracy development through everyday home activities. Please encourage parents to use the ideas on the website. You are also invited to duplicate the parts you would like to share with families in newsletters, conferences or family mathematics sessions.

The Assessment

The assessment consists of a series of items designed for use at the end of the kindergarten year or early grade one, with a focus on identifying children at risk in mathematics.

1. Mathematical Awareness
2. Recognizing Dot Patterns
3. Matching Numerals and Sets
4. Ordering Numerals 0-9
5. Counting Forward
6. Counting Backwards
7. Estimate and Check
8. Counting On/Invariance
9. Build and Change
10. Pattern Items
11. Problem Solving
12. Squares Puzzle
13. Reading Numerals
14. Printing Numerals
15. Coin Sets (optional)
16. Cube Building (optional)
17. 100 Chart (optional)



Item 1. Mathematical Awareness

This item is a warm-up to the assessment and is designed to provide a general estimate of mathematical awareness. Your goal with this item is to put the child at ease.

Assessing Student Performance

SCORING ITEM 1

Item 1 is used to gather information and provide an overall picture of high, medium and low indications of math awareness.

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following section in *Supporting Early Numeracy*:

- Surprise Box
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 1

(% of kindergarten students who answered correctly):

- a) 98%
- b) 57%
- c) 93%
- d) 94%
- e) 84%
- f) 61%
- g) 29%
- h) 9%

Note: These results show how a sample group of roughly 200 kindergarten children from across British Columbia responded when tested in May of their kindergarten year (May 2002).

Using Item 1

WHAT TO LOOK FOR:

- signs of mathematical awareness—what is relevant to the child, what the child pays attention to

YOU WILL NEED:

- RS2 Early Numeracy Assessment Record Sheet (pages 56-57)

Complete the personal information at the top of the Record Sheet with the child, including as many of the questions as are appropriate. The wordings are flexible—use any wording that will help the child understand the questions. Besides exploring general mathematical awareness, ask any other questions you think might help to put the child at ease before starting the assessment items.

- a. How old are you?** (record at top of Record Sheet)
- b. When is your birthday?** (record at top of Record Sheet)
- c. How old will you be on your next birthday?**
- d. How many brothers or sisters do you have?**
- e. How old is your brother/sister?**
- f. What is your telephone number?**
- g. How old is your mom/dad?**
- h. What year were you born?**

Item 2. Recognizing Dot Patterns

This relatively easy item provides a successful start to build the child's confidence.

Assessing Student Performance

SCORING ITEM 2	
How many dot patterns does the child recognize without counting?	
1	does not recognize any patterns
2	recognizes up to three pattern cards
3	recognizes four cards without counting
4	recognizes five cards without counting
5	recognizes all six cards without counting

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Visual-Spatial Pattern Recognition
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 2

In field testing of roughly 200 kindergarten children:

- 99% recognized 2 dots
- 87% recognized 4 dots
- 89% recognized 0 dots
- 55% recognized 5 dots*
- 94% recognized 3 dots
- 79% recognized 9 dots**

*The dot pattern used for 5 involves a 2 and 3 arrangement which is less familiar than the domino pattern.

**Many children who missed naming 9 guessed 10—a reasonable estimate but one that does not consider the three rows of three.

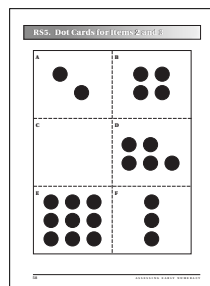
Using Item 2

WHAT TO LOOK FOR:

- Does the child recognize perceptual groupings (visual dot patterns) without counting?

YOU WILL NEED:

- RS5 Dot Pattern Cards



Show the child each dot pattern card for one to two seconds in a random order.

Say: **“I am going to show you some cards quite quickly. Tell me how many dots you see.”**

Item 3. Matching Numerals and Sets

This is another relatively easy item that helps to build the child's confidence and provide a successful start to the assessment.

Assessing Student Performance

SCORING ITEM 3	
How many dot pattern and numeral card matches does the student make?	
1	matches three or fewer
2	matches four or five
3	matches all six
4	N/A
5	N/A

Sample Results for Item 3

In field testing of 179 kindergarten children:

- 12% matched zero to three cards
- 30% matched four or five cards
- 58% matched all six cards with numerals

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Counting and Numeral Recognition
- Estimation
- Visual-Spatial Pattern Recognition
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

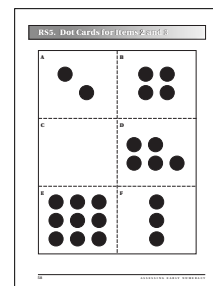
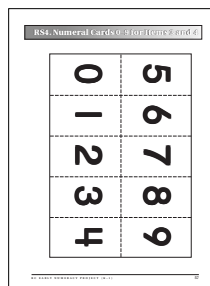
Using Item 3

WHAT TO LOOK FOR:

- Can the child match numerals to dot patterns?

YOU WILL NEED:

- RS4 Numeral Cards 0-9
- RS5 Dot Pattern Cards



Show the child each dot pattern card for one to two seconds in random order.

Spread out the numeral cards face up in random order between the child and the dot pattern cards.

Say: “Find the number to match the dots.”

If the child seems puzzled that there are more numeral cards than sets of dots, explain: “You don’t need to use all the numbers.”

Item 4. Ordering Numerals 0-9

This item builds on the previous one.

Assessing Student Performance

SCORING ITEM 4	
How many numeral cards does the student order correctly?	
1	makes several mistakes with ordering
	confuses numerals
2	misplaces one numeral
3	orders 0 to 9 correctly and systematically
4	N/A
5	N/A

Sample Results for Item 4

In field testing of 180 kindergarten children:

- 14% made several ordering errors
- 18% misplaced one numeral
- 68% ordered all numeral cards correctly, including 0

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Counting and Numeral Recognition
- Estimation
- Pattern
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

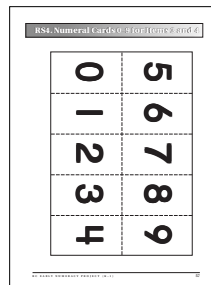
Using Item 4

WHAT TO LOOK FOR:

- Can the child order numerals from least to greatest?
- Is the child aware of 0 and its place in the “great scheme”?

YOU WILL NEED:

- RS4 Numeral Cards 0-9



Remove the 0 card. Shuffle the numeral cards and place them face up randomly on the table.

Say: **“Please put the number cards in order from least to greatest.”** (You may need to say, for example, **“starting with the smallest number.”** Note the wording that makes sense to the child.)

If the child is successful, hand across the 0 card. Ask: **“Where would this one go?”**

Items 5 & 6. Counting Forward and Backwards

A correct and consistent verbal counting chain is integral to building an understanding of counting objects. If ESL children are unable to count in English, check whether they have established the counting pattern in their first language. If so, the problem may be a lack of English patterns rather than a lack of understanding of number.

Assessing Student Performance

SCORING ITEMS 5 AND 6	
Item 5: Counting Forward by 1s	
1	has no consistent counting chain
2	uses a consistent chain to 10 (may not count on or give next number)
3	uses a consistent chain to about 50 (counts on and provides the next number within that range)
4	uses a consistent chain to 100 (counts on and provides the next number within that range)
5	counts fluently by 1s beyond 100 (counts on and provides the next number within that range)
Item 6: Counting Backwards by 1s	
1	has no consistent backwards chain
2	counts backwards from 10 with some success
3	uses a confident and consistent backwards count from 10 to 0
4	uses a consistent backwards chain from 15 or 20
5	counts fluently backwards by 1s in the 100s range

INSTRUCTIONAL FOLLOW-UP

Children who find these items a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Counting and Numeral Recognition
- Estimation
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Items 5 and 6

No sample data available for these items

Using Items 5 and 6

WHAT TO LOOK FOR:

- Does the child know the order of the number names? What is the extent of that knowledge?
- Does the child know what number comes next/before within their counting range?
- Can the child count forward and backwards from any number within their counting range?
- Is the child confident in changing decades within their counting range? (e.g., After the 20s come the 30s, so it is 29, 30....)

YOU WILL NEED:

- no materials

Item 5: Counting Forward by 1s

Ask:

- a. How high can you count?** Record child's estimate and actual count.
- b. Count for me starting at ___** (choose a number based on their estimate).
- c. Count from ___** (choose a number midway in their known counting sequence—not 10 or a multiple of 10).
- d. When I say these numbers, tell me what comes next: 4 ___, 10 ___, 25 ___, 49 ___, 80 ___, 109 ___.**

Item 6: Counting Backwards by 1s

Say:

Count back from 10 (give starting hint if needed).

Count back from ___ (try to determine the range for this skill).

Item 7. Estimate and Check

This item looks at the child's meaningful counting range as opposed to the rote counting chain or song.

Assessing Student Performance

SCORING ITEM 7	
1	very unrealistic estimate and incorrect count
2	does not estimate between 10 and 20 counts in unsystematic ways
3	estimates between 10 and 20 counts accurately to 15 uses all of the counting principles listed above
4	as for Level 3 but with confidence and efficiency
5	N/A

Sample Results for Item 7

In field testing of roughly 200 kindergarten students:

- 59% estimated between 10 and 20 (considered reasonable estimates)
- 12% were right on or within 2 of the 15
- 41% were not within +/- 5
- 74% were able to accurately count the 15 to check

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Estimation
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.



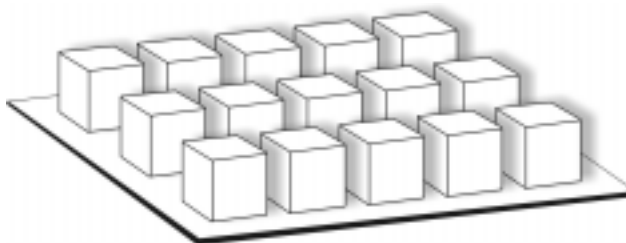
Using Item 7

WHAT TO LOOK FOR:

- Can the child make a reasonable estimate of number (is 15 within the child's comfort zone)?
- Does the child use a correct and systematic number chain when counting objects?
- Does the child move the objects and count or simply look and count? Is the method accurate?
- Can the child count systematically by 1s, using all of the above skills?

YOU WILL NEED:

- 15 cubes or other counters
- a counting mat



Randomly place 15 cubes under a counting mat, show briefly and ask:

- a. “About how many do you think are under here?”**
- b. “Count, check and see exactly how many.”**

Item 8. Invariance and Counting On

This item assesses the child’s ability to accept and hold in mind an established quantity despite changes to its arrangement.

Assessing Student Performance

SCORING ITEM 8	
1	cannot establish a set of 10 counters
2	recounts to determine how many once the items are moved
	is uncertain of the quantity without counting from 1
	for the added 2, counts from 1 to 12
3	after establishing the 10, does not need to recount the new configuration
	can answer “How do you know?” without counting
	can count on the 2 extra cubes without having to recount from 1
4	responds as if you have asked a silly question
	for the added 2, says 12 without obvious counting
5	N/A

Sample Results for Item 8

In field testing of roughly 200 kindergarten children:

- 96% were able to build a set of 10
- 64% were not fooled by perceptual changes in the arrangement and still maintained there were 10
- 60% were able to provide a rationale for why there were still 10
- 53% were able to count on 2 to the 10 (10...11, 12) without going back to 1

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Visual-Spatial Pattern Recognition
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Using Item 8

WHAT TO LOOK FOR (INVARIANCE):

- Does the child recount from 1 after every change?
- Is recounting necessary for the child? What does the child's explanation indicate?

WHAT TO LOOK FOR (COUNTING ON):

- Does the child count on from the established 10 or go back and count from 1?
- Can the child hold the starting quantity in mind?

YOU WILL NEED:

- more than 10 counters all one colour
- two counters of a different colour



a. Ask the child: **“Show me 10 counters.”** (Move the rest aside.) Establish there are 10, then change the arrangement by spreading the counters out.

b. Ask: **“How many now?”**

c. Ask: **“How do you know?”**

Repeat if the child is unsure or counts to check. If the child persists in counting, ask: **“Do you need to count?”**

d. Establish there are still 10, then add 2 blocks of a different colour.

Ask: **“How many are there now?”**

Item 9. Build and Change

This item assesses the concept of increase/decrease, or addition and subtraction without symbols. It also explores whether children can visually analyze part-whole relationships and whether they can use mental imagery to generate a missing subset.

Assessing Student Performance

SCORING ITEM 9	
a) Can the child predict the answer ahead of doing it? <i>Predict</i> [✓] [x] (out of 4)	
Also note: Can the child solve the example using the strategy of their choice?	
1	does not predict or solve any of the examples
2	can't predict how many but may know whether more or less is needed (big idea), or
	may start from 1 to build each new set rather than changing the starting set (predicts 0/4)
3	predicts subtraction examples (a and c) by looking and naming what to subtract but cannot predict addition examples (b and d) without the support of materials (predicts 2/4)
4	correctly predicts and solves examples (a), (b) and (c) without touching (note how the child keeps track) (predicts 3/4)
5	correctly predicts and solves mentally for all examples (note whether the child uses known facts or chunking rather than counting by 1s to determine the needed change) (predicts 4/4)

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Counting and Numeral Recognition
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 9

After field testing, the scoring criteria were revised. Using the new criteria, results are as follows:

- 8% were unable to predict or solve any examples independently (1)
- 17% were able to solve some examples but not able to predict ahead of time (2)
- 31% were able to predict for two subtraction examples and solve other examples using materials (3)
- 30% were able to predict and solve three examples without materials (4)
- 15% were able to predict all four examples ahead of working them out (5)

Using Item 9

WHAT TO LOOK FOR:

- Does the child recognize whether more or less is needed to make the new number?
- Does the child incorporate the starting set without having to start from one to build the new set?
- Can the child visually analyze the subtraction examples to determine what to subtract without touching the materials?
- Can the child predict how many to add without actually using the materials to model?
- How does the child predict for addition? Does the child mentally count on or use visual patterns or known facts?

Note: Examples (b) and (d), particularly, (d) require the child to create a mental representation of what to add, making those examples more difficult. For (a) and (c) students can see what to subtract.

YOU WILL NEED:

- blocks or other counters
- a mat to work on

Use these two warm-up examples to establish the item format of predicting first without touching.

- “Show me 5 blocks. Now change it to 3 blocks. What did you do?” (e.g., I had to take away 2 blocks.)
- “This time tell me first . . . (fold your arms or sit on your hands) . . . “How can you change your 3 blocks to 6 blocks? What will you need to do?” After the child’s response, ask them to go ahead and do it.
- You are working toward having the child tell you first what needs to be done, to see if they can predict the change. Provide another example if needed.

EXAMPLES FOR SCORING:

Predict

- | | | |
|-------------------|---|---|
| a) Change 6 to 4 | <input checked="" type="checkbox"/> [x] | Can the child visually analyze the parts and whole? |
| b) Change 4 to 8 | <input checked="" type="checkbox"/> [x] | Can the child mentally construct the needed part? |
| c) Change 8 to 5 | <input checked="" type="checkbox"/> [x] | Can the child visually analyze the parts and whole? |
| d) Change 5 to 12 | <input checked="" type="checkbox"/> [x] | Can the child mentally construct the needed part? |

Predict: “Tell me first. What do you have to do to change your 6 blocks to 4 blocks?”

Solve: “Check to see if you are right.” Or if there is no prediction, ask: “Show me how you can find out.”

You may need to ask: “How did you figure it out?”

Item 10. Pattern Items

This sequence of pattern items looks at the child’s developing ability to work with simple patterns, a prerequisite to number patterns.

Assessing Student Performance

SCORING ITEM 10	
<i>Action Patterning</i> Can the child:	
<ul style="list-style-type: none"> ● join in with you ● keep the pattern going when you stop (analyze and extend a pattern) ● maintain a rhythmic pattern 	
<i>Analyzing a Pattern</i> How many questions (out of four) are answered correctly? Score according to the number correct.	
1	0 correct
2	1 correct
3	2 correct
4	3 correct
5	4 correct
<i>Creating a Pattern Train</i> This optional check, if completed successfully, would be equivalent to a 3 on the scoring chart.	

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following section in *Supporting Early Numeracy*:

- Pattern
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy*.

Sample Results for Item 10

Action Patterning

- 87% of the field test students were able to complete the action patterning successfully

Analyzing a Pattern

- 22% answered two or fewer questions (1, 2, 3)
- 52% answered three questions correctly (4)
- 33% answered all questions correctly (5)

Creating a Pattern Train

There are no sample results for this item.



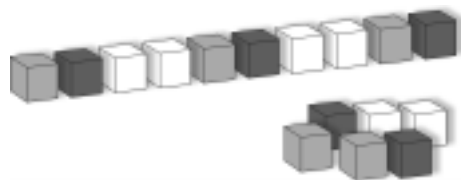
Using Item 10

WHAT TO LOOK FOR:

- Does the child recognize and continue an action pattern?
- Can the child analyze a visual pattern to extend it?
- Can the child apply the pattern rule to both ends of the pattern?
- Can the child identify the pattern stem or chunk that repeats?

YOU WILL NEED:

- a pattern train of 10 Unifix cubes using red, green, blue, blue (i.e., RRGB, RRGB, RG)
- additional Unifix cubes of the same colours



a. Action Patterning (warm-up)

Use this item as an active break.

b. Show the pattern: clap, clap, pat knees; clap, clap, pat knees. Ask: “Can you figure out the pattern? When you do, join in with me. Keep going.”

c. Analyzing a Pattern

Show the Unifix pattern train (RRGB RRGB RG) and ask: “Look at this. Can you see a pattern?”

“Can you describe the pattern?”

“Can you figure out which colour comes next?”

“Can you continue the pattern at both ends?”

“What keeps repeating in the pattern?”

d. Creating a Pattern Train (optional check)

If the child is unable to analyze the above pattern, see if they can make their own pattern train with Unifix cubes and answer the following questions:

“Can you describe your pattern?”

“Can you describe it another way?” or “Can you give this pattern another name?”

“What keeps repeating in your pattern?”

Item 11. Problem Solving

This item reflects the student’s problem-solving confidence, ability and experience.

Assessing Student Performance

SCORING ITEM 11	
Score each problem independently. If students perform at more than one level in parts of the item, choose the most representative level overall to record.	
1	does not work out answer even with teacher help
2	requires teacher support to get the answer
	uses materials to directly model the problem
	strategy unclear
	cannot explain or model the solution
3	independently gets the correct answer
	uses materials to directly model the problem
	can explain or model the solution
4	independently gets the correct answer
	does not need materials to directly model the problem
	uses mental counting strategy (e.g., fingers, taps)
	can explain or model the solution
5	successfully solves each problem using an internalized reasoning strategy involving known facts or chunking
	can explain or model the solution
	does not need materials, but may use them to explain thinking

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Sample Number Lessons (These lessons are available in Whole Group Follow-up)
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 11

With the examples used in the field testing (which were somewhat harder):

- approximately 25% had no idea what to do (1)
- approximately 50% were able to solve the problems by direct modeling using counters and with some teacher support (2 and 3)
- approximately 25% were able to solve the problems without using counters (4 and 5)

Using Item 11

WHAT TO LOOK FOR:

- Does the child find meaning within real problem contexts presented verbally?
- Can the child represent problem situations with concrete materials (Level 2 or 3)?
- Can the child represent problem situations using fingers or drawings (Level 4)?
- Can the child represent problem situations using mental reasoning (Level 5)?
- Is the child able to communicate their understanding of the problem solutions?

YOU WILL NEED:

- counters
- pencils and paper



Provide counters, paper and pencil and let the students know they can use whatever they like to solve the problems. Present the problems verbally first, to see if they can do them independently. If students don't know what to do, repeat the problem. For students who simply say the answer, ask them to show you how they know. Make a note where language appears to be an issue.

a. “If you had 4 plates and 2 cookies on each plate, how many cookies would you have altogether?”

“How did you figure that out?”

Teacher help: “What if we use these plates and counters?” Then repeat the question.

What support does the child need to be successful?

b. “If you and I share 10 candies, how many candies will we each get?”

“How did you figure that out?”

Teacher help: “Let’s pretend these counters are candies.” Then repeat the question.

What support does the child need to be successful?

Item 12. Squares Puzzle

The Squares Puzzle provides useful information on the child's use of visual-spatial imagery and highlights analytical thinking, perseverance and confidence. (For a second look at mental imagery involving 3-D solids, use the Cube Building item, optional Item 16.)

Assessing Student Performance

SCORING ITEM 12	
How does the child deal with the Squares Puzzle? You are looking to see if the child:	
1	does not complete the puzzle
2	requires several hints and scaffolds to complete the puzzle
3	successfully fits pieces into a square after only one clue (e.g., "Let me show you something that might help you.")
4	after some trial and error, independently fits three of the pieces into a square
5	initially selects three correctly, then fits them without assistance (may see two ways to make the square)

- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 12

In field testing of 193 kindergarten children:

- 27% did not complete the puzzle (1)
- 48% required teacher help to complete the puzzle (2 or 3)
- 15% completed the puzzle independently through trial and error (4)
- 11% pointed out the three pieces and fitted them into place with ease (5)

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Visual-Spatial Pattern Recognition
- Math Playground
- Sample Visual-Spatial Lessons (These lessons are available in Whole Group Follow-up)



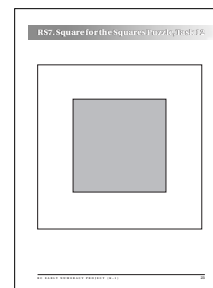
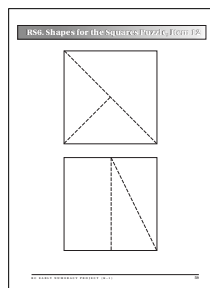
Using Item 12

What to look for:

- Does the child use analytical thinking (e.g., learns from trying different shapes, eliminates possibilities) or random thinking (e.g., does not apply information from previous tries)?
- Does the child mentally manipulate shapes to determine which piece to use, or do they need to use the actual shapes to experiment?
- Can the child apply a hint (hold the mental image of a shape, then find the pieces and apply the idea)?

YOU WILL NEED:

- RS6 Shapes for the Squares Puzzle
- RS7 Square Form for the Squares Puzzle



Place the six shapes randomly in front of the child.

Show the card with the square shape and ask: **“Look at these pieces. Three of them will make this square shape. Look carefully. Which three do you think will work?”**

Let the child choose, then say: **“Go ahead and make the square for me.”**

If the child is stumped, demonstrate how the two small right triangles go together to make the larger right triangle, and say: **“Let me show you something that might help you.”**

Offer other support as needed. Once it is clear what the child can accomplish independently and you have scored the item, help the child complete the square.

Item 13. Reading Numerals

This simple item provides a quick survey of which numerals the child is able to recognize and name from a limited set of examples. These sound-symbol relationships do not necessarily indicate understanding but are important skills in constructing an understanding of our number system.

Assessing Student Performance

SCORING ITEM 13

Besides this item, there are several opportunities in this assessment to collect data on numeral recognition:

Item 3—matching one-digit numerals with dot patterns

Item 13—optional calendar item

Item 17—optional 100 chart item

Use your observations from any or all of these items to summarize performance according to the following:

1	does not read any numerals consistently
2	reads one-digit numerals fairly consistently
3	reads all one-digit and some two-digit numerals
4	reads two-digit numerals consistently
5	reads two- and three-digit numerals comfortably

- Counting and Numeral Recognition
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 13

In field testing of 181 kindergarten children:

- 6% did not read any numerals consistently (1)
- 23% read one-digit numerals (2)
- 13% read some two-digit numerals (3)
- 24% read all two-digit numerals (4)
- 19% read three-digit numerals or higher (5)

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box

Using Item 13

WHAT TO LOOK FOR:

- Does the child recognize numerals, and within what number range?
- Can the child name or read numerals, and within what number range?
- Does the child read numerals left to right?
- Does the child make any consistent errors, such as with teen numbers or zeroes?
- Can the child articulate differences (e.g., *seventeen* and *seventy*)?

YOU WILL NEED:

- RS9 Numeral Cards (3, 8, 36, 83, 18, 147, 407, 1847)
- RS8 Calendar (optional)
- RS10 100 Chart (optional)

3	18
8	147
36	407
83	1847

Month						
Day	1	2	3	4	5	6
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Use the term *numbers* with the children rather than the more mathematically correct term *numerals*.

Show the child the numeral cards one at a time. Discontinue at the first sign of difficulty.

Say: “**Read these numbers.**” (Show 3, 8, 36, 83, 18, 147, 407, 1847.)

For more information on two-digit numerals, use the calendar or 100 chart (these items are optional). Ask: “**Can you tell me what this date is on the calendar?**”

Note any areas of difficulty such as:

- reversals, as in reading 81 for 18
- teens (reading and writing)
- 0s (particularly for three digits and above)
- language confusions (e.g., saying eighty for eighteen)

Item 14. Printing Numerals

Not all children are ready to print numerals in kindergarten, so this may be a skill that has not developed. However, it is important to know whether the child can do it in order to plan appropriate follow-up instruction.

Assessing Student Performance

SCORING ITEM 14	
Is the child able to print numerals? Use the following scale for scoring:	
1	does not print any numerals consistently
2	finds and copies numerals from 0 to 9
3	prints all one-digit numerals from memory
4	prints two-digit numerals from memory
5	prints three-digit numerals correctly

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Surprise Box
- Counting and Numeral Recognition
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 14

In field testing of 180 kindergarten children:

- 82% were able to print all 10 single digits. Numerals were distinguishable, but quality varied.

For the multi-digit items:

- 33% were unable to write any multi-digit numerals
- 22% wrote one two-digit numeral correctly
- 16% were able to write two of the two-digit numerals (most errors involved the teen numerals)
- 16% were able to write all two-digit numerals (47, 60, 15)

- 13% were able to correctly write numerals involving three or more digits

NOTES:

- Numerals that were reversed (e.g., a mirror image of 3) were not counted as wrong. If the numeral was distinguishable, it was counted as correct, reversed or not. 18% of the numerals considered correct were reversed.
- 62% of the kindergarten children reversed at least one numeral, and most of these children were able to print all 10 numerals. Reversals are developmentally typical for the age group so were not counted as an error.
- For the multi-digit numerals, reversals were again ignored. However, transpositions (as in writing 74 for 47) were counted as incorrect.

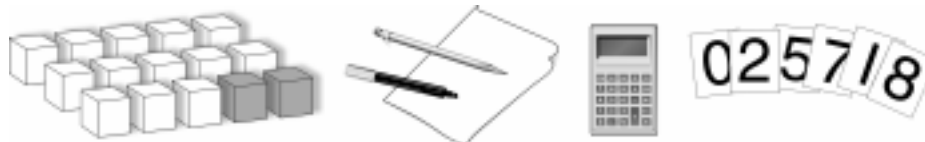
Using Item 14

WHAT TO LOOK FOR:

- Does the child recall numeral shapes from memory?
- Does the child use a comfortable pencil grip?
- Does the child use consistent and reliable motor patterns?
- Does the child have difficulty with fine motor control?
- Does the child have difficulty with reversals? For which numerals?
- Does the child confuse teens and multiples of 10 (e.g., 16/60)?

YOU WILL NEED:

- paper (you may use the back of the 100 chart)
- pencils or felt pens



Children who are unable to print may be able to show how to represent each number if you remove the printing component. Doing this allows you to focus on the child's mental imagery for the numeral, rather than on hand-eye coordination. If unable to print from memory, can the child:

- find and copy numerals?
- show numerals with digit cards?
- display numerals on a calculator?

OPTIONAL:

- RS10 100 Chart for reference
- numeral cards
- calculator

Single Digits:

Say: **"Write these numbers as I say them:
1, 6, 3, 5, 2, 7, 9, 4, 0, 8."**

If the child is unable to recall numerals, provide a 100 chart to see if they can find and copy. If the child is successful with one digit, continue.

Multi-digits:

Say: **"Write these numbers as I say them:
12, 47, 60, 724, 105, 2469."**

As the child works, note:

- pencil grip
- fine motor control
- reversals
- need for reference shapes to copy
- comfort with the item

Is this easy or hard work for the child?

Item 15. Coin Sets (Optional)

This item assesses the child's ability to use coins with meaning, which requires coin recognition, recall of coin values and many-to-one correspondence (e.g., a nickel is worth 5, not 1).

Assessing Student Performance

SCORING ITEM 15	
Which level best describes the child's performance?	
1/2	does not recognize any coins
3	comfortably works with pennies
	does not use nickels or dimes unless counted from one
4	uses two coin types at a time
	can show values in more than one way
5	uses three or more different coins
	can make up all values in different ways

Most kindergarten children (78% in the field test) were unable to do this item. However, for children who are familiar with coins and their use, this item can highlight important information for follow-up teaching. It is also a useful item for recognizing children who require an enriched mathematics program.

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Counting and Numeral Recognition
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 15

In field testing of 181 kindergarten children:

- 78% were unable to recognize any coins (1/2)
- 15% were able to use pennies (3)
- 7% were able to use two or more coins (4/5)

Using Item 15

WHAT TO LOOK FOR:

- Is the child familiar with money? Which coins does the child use with meaning?
- Can the child count on from a starting coin (e.g., 5...6, 7, 8)?
- Can the child manipulate “chunks” of 5s or 10s and use appropriate counting chains (i.e., count by 5s and 10s)?
- Is the child able to shift thinking and counting patterns depending on the coins?
- Does the child demonstrate organizational and analytical strategies (e.g., counting the higher-valued coins first) and metacognitive ability (i.e., can explain their thinking)?

YOU WILL NEED:

- a collection of pennies, nickels and dimes (roughly 10 of each)



Show the child a mixed set of coins. Ask if any look familiar. Only use this item if the child can recognize at least two types of coins and their values.

Ask: **“Do you recognize any of these coins?”**

If yes, ask the following questions to see how many coin types the child is able to use.

“Show me how to make 12 cents. Can you make 12 cents another way? Are there any other ways?”

(12P, 1D+2P, 2N+2P, 1N+7P)

If necessary, ask if a specific coin can be used.

Item 16. Cube Building (Optional)

This item provides a window into the child's analysis of 3-D solids and their ability to use mental imagery for problem solving. Use it for further information on the child's visual-spatial strengths.

Assessing Student Performance

SCORING ITEM 16	
How does the child approach the problem?	
1	does not understand the item
2	doesn't complete the item
	guesses or randomly counts faces
3	counts squares on each side of the cube and explains that you have to count the sides
4	counts outer and inner blocks and explains that you have to count outer and inner
5	counts layers of nine blocks and explains the layers

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Visual-Spatial Pattern Recognition
- Math Playground
- Sample Visual-Spatial Lessons (These lessons are available in Whole Group Follow-up)
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Sample Results for Item 16

This item was not part of the field test.

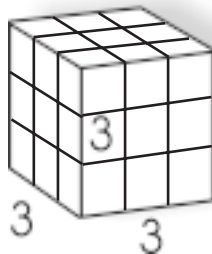
Using Item 16

WHAT TO LOOK FOR:

- How does the child go about answering the question?
- How does the child describe his or her thinking?
- What understanding does the child have of the structure of 3-D solids (mental imagery for 3-D solids)?

YOU WILL NEED:

- a 3x3x3 cube constructed from Multilink cubes (cm cubes are too small)



Show the child the cube. Ask: **“How many little cubes do you think it took to build this bigger cube?”**

Give the child the cube to handle. Note how the child uses the cube to help with thinking. Ask: **“Why do you think it is ___? How could you figure it out?”**

Item 17. 100 Chart (Optional)

If this item is appropriate for the student, it can replace or provide further assessment data to support other items, such as Item 14, Numeral Printing.

This item can be completed as a whole-class or small-group activity, with the exception of reading the numbers.

Assessing Student Performance

SCORING ITEM 17	
Rate the child's overall performance with the item:	
1	unable to complete any examples consistently
2	can successfully work with the one-digit items
3	uses counting to successfully complete most of the examples
4	completes almost all of the 16 boxes correctly
5	uses patterns rather than counting to complete all boxes correctly and independently

Sample Results for Item 17

This item was not part of the field testing.

INSTRUCTIONAL FOLLOW-UP

Children who find this item a challenge might benefit from experience with the following sections in *Supporting Early Numeracy*:

- Counting and Numeral Recognition
- Pattern
- See Table 2 (p. 17): Linking *Assessing Early Numeracy* with *Supporting Early Numeracy* for other sections that can help to develop this aspect of numeracy.

Using Item 17

WHAT TO LOOK FOR:

- Can the child read one- and two-digit numbers (gray boxes)?
- Can the child find given one- and two-digit numbers?
- Can the child determine the number that is one greater?
- Can the child determine the number that is one less?
- Can the child write one- and two-digit numerals?
- Can the child use patterns to find numbers on a 100 chart?

YOU WILL NEED:

- RS10 100 Chart
- pencil or felt pen



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	27	28	29	30	
31	33	34	35	36			48	49	50
51		53	54					59	
61	62	63	64	65		68	69		
71		74	75	76	77	78	79		
91			94	95	96				100

Directions:
a) Read 3, 8, 14, 29, 36, 75.
b) Read 10, 25, 79. Write the number that comes next.
c) Read 7, 13, 40, 100. Write the number that comes before.
d) Find the three shaded boxes that are empty. Write the numbers.

Reading, Writing and Finding Patterns on the 100 Chart:

- Point to each number (3, 8, 14, 29, 36, 75) and ask: **“What number is this?”** Can the child read one- and two-digit numbers?
- Say: **“Find 10, then write the number that comes next (after).”** Repeat for 25 and 79. Can the child write the appropriate numerals?
- Say: **“Find 7, then write the number that comes in front of it.”** Repeat for 13, 40 and 100. Can the child find given numbers and the numbers before or after?
- Say: **“Find the three shaded boxes that are empty. Write the numbers that belong in them.”** Can the child use patterns to find numbers on the chart?

References

The references, resources and acknowledgements used in the development of this project can be accessed on the UBC website: <http://www.cust.educ.ubc.ca/projects/enp.html>

The Early Numeracy Project documents can be accessed online at the following Ministry website: http://www.bced.gov.bc.ca/primary_program/

Resource Sheets

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RS1. Learner Profile

Name: _____ Birthday: _____ Age: _____

Teacher: _____ Grade: _____ Date: _____

Not Evident Always Evident

MATHEMATICAL AWARENESS SUMMARY (Item 1)					
--	--	--	--	--	--

DISPOSITIONS AND HABITS OF MIND:

inclination to make sense					
confidence and willingness to take risks					
perseverance					
flexibility in exploring mathematical ideas					
interest, curiosity and inventiveness					
pride in mathematical accomplishments					

LEARNING CHARACTERISTICS:

organization (of materials, thoughts, work)					
metacognition (shows or tells his or her thinking)					
ability to verbally articulate thinking and procedures					
ability to model or represent thinking on paper					
attention to task and ability to focus					
independence and self-reliance (vs. reliance on others)					

OTHER RELEVANT CONSIDERATIONS:

RS2. Early Assessment Record Sheet

Name: _____ Birthday: _____ Age: _____

1. MATHEMATICAL AWARENESS

- a) How old are you? ✓ X
- b) When is your birthday? ✓ X
- c) How old will you be on your next birthday?
✓ X
- d) How many brothers or sisters do you have?
✓ X
- e) How old is your brother/sister? ✓ X
- f) What is your telephone number? ✓ X
- g) How old is your mom/dad? ✓ X
- h) What year were you born? ✓ X

2. RECOGNIZING DOT PATTERNS

✓ or X recognized without counting

2 4 0 5 3 9

3. MATCHING NUMERALS AND SETS

✓ or X numeral matched

2 4 0 5 3 9

4. ORDERING NUMERALS

✓ or if ordered correctly

0 1 2 3 4 5 6 7 8 9

5. COUNTING FORWARD

- a) How high can you count? _____
- b) Counts from one to _____
- c) Counts on from _____ correctly.
- d) Says number after 4 _____ 10 _____ 25 _____
49 _____ 80 _____ 109 _____

6. COUNTING BACK

- a) Counts back from 10 ✓ X
- b) Other _____

7. ESTIMATE AND CHECK

- a) estimate _____
- b) count _____

Comments:

8. COUNTING ON/INVARIANCE

- a) builds 10 ✓ X
- b) conserves 10 ✓ X
- c) provides rationale ✓ X
- d) counts on ✓ X

9. BUILD AND CHANGE

Predicts Strategy

- a) Change 6 to 4 ✓ X
- b) Change 4 to 8 ✓ X
- c) Change 8 to 5 ✓ X
- d) Change 5 to 12 ✓ X

10. PATTERN ITEMS

Action Patterning clap, clap, pat...

- a) joins in with you ✓ X
- b) keeps the pattern going ✓ X

If so, continue with pattern items.

10. PATTERN ITEMS – continued

Analyzing Patterns RGBB RGBB RG...

- a) Can you see/describe a pattern? ✓ ✗
- b) Can you figure out which colour comes next?
✓ ✗
- c) Can you continue the pattern at both ends?
✓ ✗
- d) What keeps repeating in the pattern?
✓ ✗

Creating a Pattern Train (only use if necessary)

- a) draw student's construction and description

11. PROBLEM SOLVING

- a) 4 plates/2 cookies on each

Answer:

Child's strategy:

- b) 10 candies/2 share

Answer:

Child's strategy:

12. SQUARES PUZZLE

RATING

Circle the pieces the child selects:



Notes:

13. READING NUMERALS

Reads:

3 8 36 83 18 147 407 1847

Optional Calendar:

14. NUMERAL PRINTING

Writes: ✓ or record child's effort

1 6 3 5 2 7 9 4 0 8
12 47 60 15 724 105 2469 6023

Can find? Can copy?

Can show with cards?

Comments:

Optional Items:

15. COIN SETS

Show how to make...12 cents

12P 1D+2P 2N+2P 1N+7P

Which coins are used with meaning: P N D

16. CUBE BUILDING

estimate:

Rating

3x3x3 cube strategy/explanation:

17. 100 CHART

Does the child:

- a) read 1- and 2-digit numbers (gray boxes)

3 8 14 29 36 75

- b) find given numbers and determine the number one greater 10 ___ 25 ___ 79 ___

- c) find given numbers and determine the number one less ___7 ___13 ___40 ___ 100

- d) write one- and two-digit numerals
use patterns to find numbers on a 100 Chart

*finds 42 57 83

RS3. Summary of Early Numeracy Assessment Responses

Name: _____ Birthday: _____ Age: _____

NUMBER SKILLS ITEMS	1	2	3	4	5	COMMENTS
3. Matching Numerals and Sets						
4. Ordering Numerals 0-9						
5. Counting Forward						
6. Counting Back						
13. Reading Numerals						
14. Printing Numerals						
17. 100 Chart (optional)						

NUMBER CONCEPT ITEMS	1	2	3	4	5	COMMENTS
7. Estimate and Check						
8. Invariance/Counting On						
9. Build and Change						
11. Problem Solving						
15. Coin Sets (optional)						

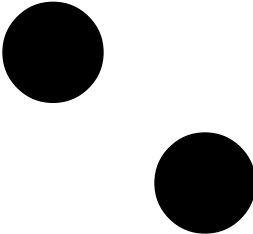
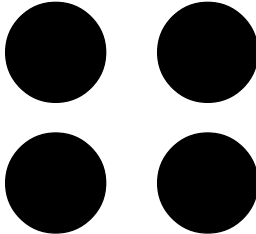
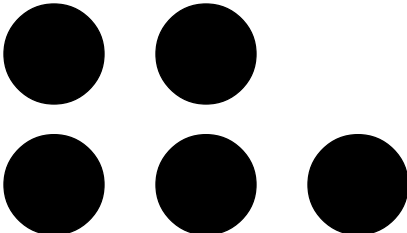
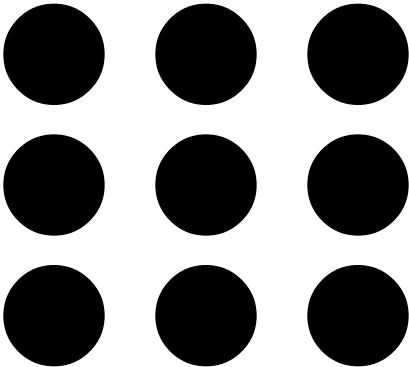

VISUAL SPATIAL ITEMS	1	2	3	4	5	COMMENTS
2. Recognizing Dot Patterns						
10. Pattern Items						
12. Squares Puzzle						
16. Cube Building (optional)						

IMPLICATIONS FOR INSTRUCTION:

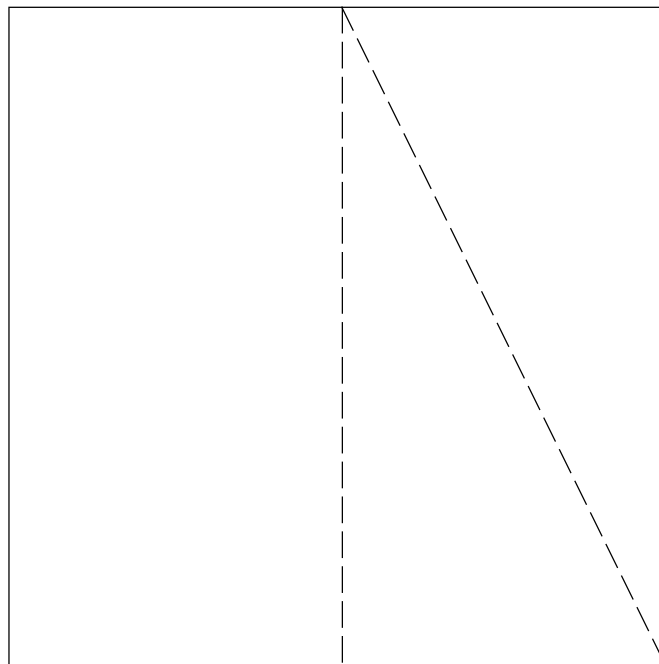
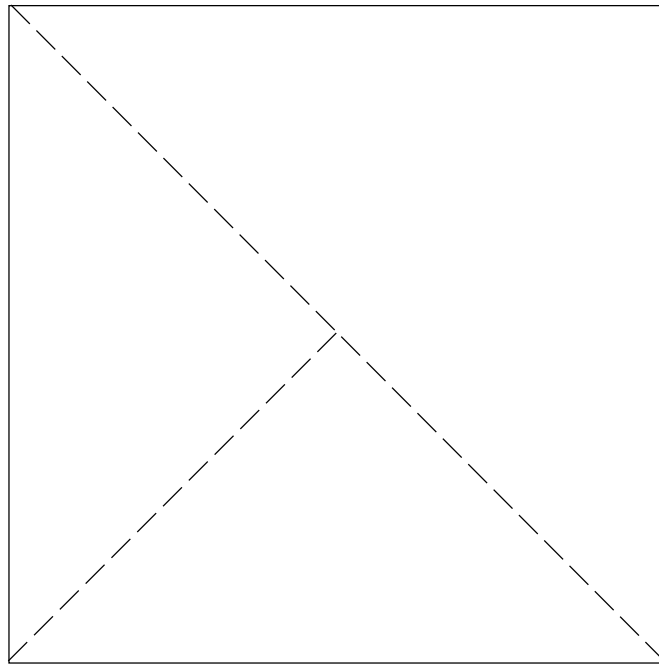
RS4. Numeral Cards 0–9 for Items 3 and 4

0	5
1	6
2	7
3	8
4	9

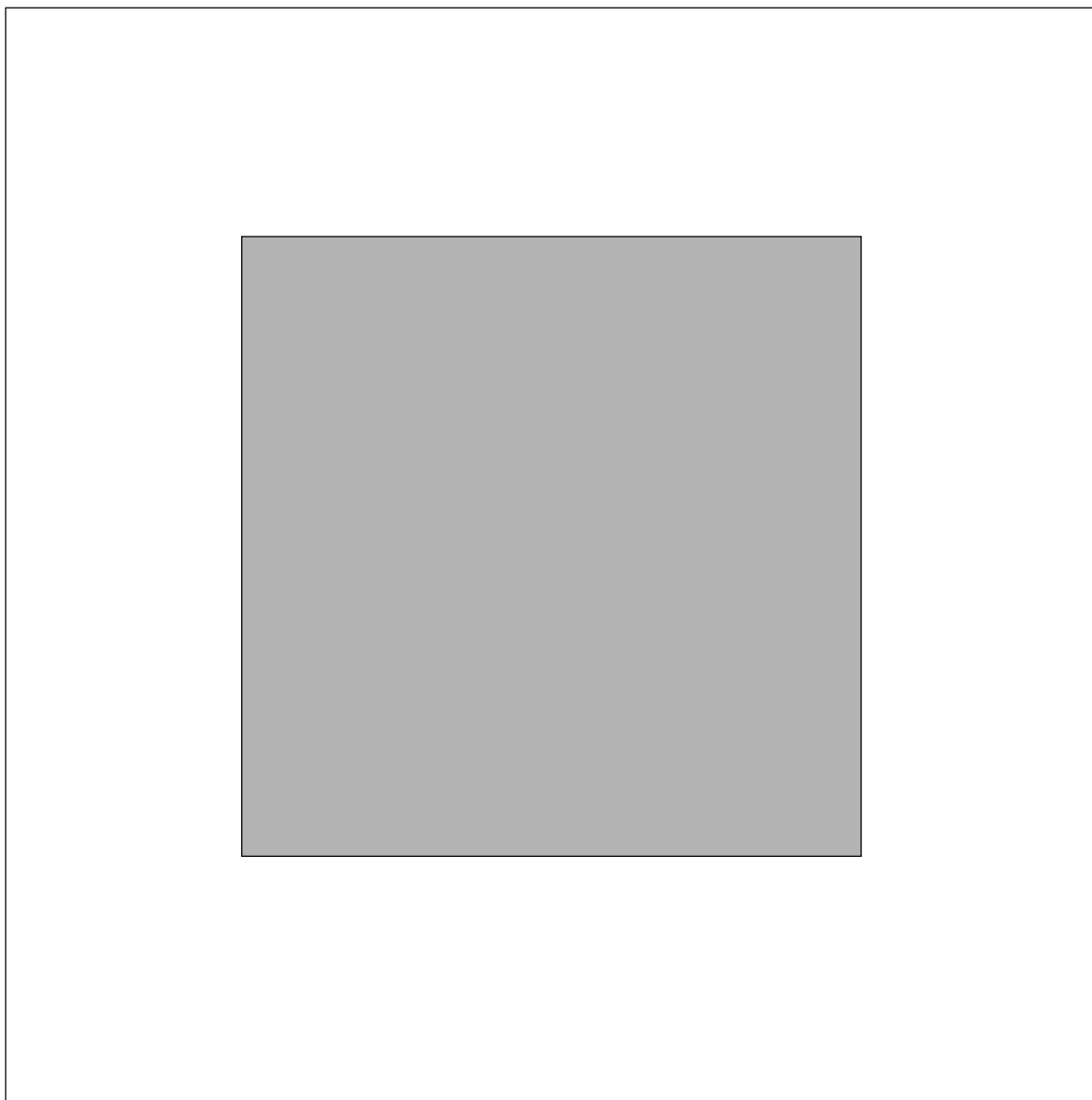
RS5. Dot Cards for Items 2 and 3

A 	B 
C	D 
E 	F 

RS6. Shapes for the Squares Puzzle, Item 12



RS7. Square for the Squares Puzzle, Item 12



RS8. Calendar for Item 13

May						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

RS9. Numeral Cards for Item 13

3

18

8

147

36

407

83

1847

RS10. 100 Chart for Items 13 and 17

Name: _____ Date: _____

1	2	3	4	5		7	8	9	10
		13	14	15	16	17	18	19	20
21	22	23	24	25		27	28	29	30
31		33	34	35	36				40
			44	45			48	49	50
51		53	54					59	
61	62	63	64	65			68	69	
71			74	75	76	77	78	79	
				85	86	87	88	89	
91			94	95	96				100

DIRECTIONS:

- Read: 3, 8, 14, 29, 36, 75
- Find: 10, 25, 79. Write the number that comes next.
- Find: 7, 13, 40, 100. Write the number that comes before.
- Find the three shaded boxes that are empty. Write the numbers.