

## Evaluation

The Evaluation is an assessment tool to find out what the student knows and doesn't know. For example, before a student can write the symbol for a number (numeral), and he must understand the Concept of Number. If a student does not have one-to-one correspondence in counting, the student is not ready to start subtraction.

Do not teach or correct during any test. Record the information to use in planning an appropriate program. Make notes about what the student does and what needs to be learned in future lessons. The information will tell you where to begin instruction. At the end of the test is Basic Mathematical Knowledge required to succeed in *Patterns in Arithmetic: Subtraction - Booklet 2*. In addition, individual lessons list prerequisites.

## Summary of Evaluation Tools

Concept of Number/Cardinality - Teacher hides different amounts of a group of blocks.

One-to-one Correspondence - Count blocks one by one.

Conservation - Teacher asks how many blocks are in both hands, mixed up several times.

Difference Between - How much larger one number is than another?

Addition - Teacher writes an addition problem; student proves understanding by building a model.

Subtraction - Teacher writes a subtraction problem; student proves understanding by building a model.

## Materials for Evaluation Tools

Copy and use one Evaluation record sheet for each student

Small blocks or beans

Scratch paper

Pencil

**Concept of Number/Cardinality** - The quantity a number stands for. It links the number 4 with the amount four.

Materials - Any small manipulative

Ask the student to count three blocks into your hand. You hide one block and ask, "**How many blocks are hiding?**" The student answers "one." Hide a different amount. Be sure to hide all of the blocks and none of the blocks. The student should be able to answer how many are being hidden. If she says the amount that is in the open hand, say, "**Yes, there are x here. How many are hiding in this hand?**" Point to the hand with the hidden blocks. If the student:

- Confidently says the correct number: Increase the amount of blocks until she is saying the wrong amount. *Do not say*, "Yes, that is right," or "No, that is wrong." Do not show the hidden blocks. Nod and act the same with each guess. Circle the number at which she starts having difficulty.
- Counts on her fingers: Write down that she can figure out the solution manipulatively only. Record which number she needed to start using manipulatives. See Lesson below.
- Misses the amount of blocks that are hidden: Write down the number with which she started having difficulty. If three is the number she is working on, open your hand and have her count the blocks again to make sure she remembers how many blocks she started with. Again hide blocks to see if she now understands the task better. If this doesn't work, drop the blocks and ask her to put two blocks in your hand. Have the student count the blocks in your open palm. Then hide one block and ask, "**How many are hiding in the closed hand?**" If she does not say one, end the test. She has very little understanding of numbers. Work on counting activities. See Lesson below.

Lesson: See *Mathematics Their Way*, Chapter 7.

**One-to-one Correspondence** - Each object is counted one by one. There is a direct link between each object and its numeric name.

Materials - Any counting object such as beans, buttons, blocks, etc.

Put out five blocks. Ask, "**How many blocks are there?**" If the student:

- A) Says the number five immediately: Pick up those blocks and put down three blocks. Ask, "**How many now?**" If the correct answer is given, put out four blocks. Then six, then start adding two or three blocks at a time until there are about fourteen blocks OR the student starts miscounting. If there is any hesitancy in the voice, ask her to count them again. Tell her she can touch the blocks if she wants to. Ask, "**Are you sure?**" When she counts the correct amount, have her recount to prove she knows the answer, even when she is correct. Record the highest number she can count correctly.
- B) Counts the number of blocks mentally or by touching each one: Pick up those blocks and put down three blocks. Ask, "**How many now?**" If the correct answer is given, put out four blocks. Then six, then start adding two or three blocks at a time until there are about fourteen blocks OR the student starts miscounting. If the student can successfully count this many blocks, this test is complete.
- C) Guesses the wrong amount: Have the student count the blocks carefully. Try having the student count objects by touching each object as she counts them. Record that she needs to work on one-to-one correspondence.
- D) Counts the wrong amount: Have the student count the blocks carefully. If she can't count them one by one successfully, she needs work on one-to-one correspondence.

Lesson: *Mathematics Their Way*, Chapter 4: Counting - Invariance or Conservation of Number or *Patterns in Arithmetic: Addition - Booklet 1*, Breaking Up Numbers - Three Circles; *Patterns in Arithmetic: General Math - Booklet 1*, Circle Game; and One-to-one Correspondence on the Internet: Interactive STEM, Mathematics in Early Grades: Counting and Cardinality

**Conservation of Number:** Conservation - the total remains the same no matter how a number is expanded:  $2 + 3 = 5 = 2 + 1 + 2$ .

Materials - Any small manipulative

Have the student count out five to seven blocks into your hand, the amount depends upon the sophistication of the student you are working with. Make a judgment based on what the student has done up until now. Close your hands over all the blocks, mix them up. Leave some blocks in one hand and some in the other one. Open your hands palms up and ask, "**How many now?**" Sometimes you have to ask, "**How many are in both hands?**" If the student:

- A) Says the correct amount: Mix the blocks up and put a different combination in each hand but use the same amount of blocks. Again ask how many blocks. If the student says the correct amount, add another block and repeat with a couple of different combinations. If the student says the correct amount, make it a higher number (but raise the amount only by two or three blocks). Mix the blocks up again and ask how many. Have her look and tell you how many blocks there are in total with an increasing amount of blocks. Record the highest number she does correctly or stop at about twelve blocks. The student understands conservation.
- B) Stops and counts each block or guesses the wrong amount: Have her count the blocks one by one. Mix them up and have her count again. Ask, "**How many blocks altogether?**" If she counts by

touching each block and does not automatically say the total amount of blocks, it means she does not understand Conservation. Try a lower number of blocks. Record the highest number she can do correctly. She does not understand that it is always the same amount (with five or fewer blocks) no matter how many ways they are mixed up.

Lesson: See *Mathematics Their Way*, Chapter 4: Counting - Invariance or Conservation of Number or *Patterns in Arithmetic: Addition - Booklet 1*, Breaking Up Numbers - Three Circles

### Difference Between

Materials - Any counting object such as beans, buttons, blocks, etc.

Tests the understanding of the concept of Difference Between.

The problem is: "**Sam has six pennies. Trudy has ten pennies. How many more pennies does Trudy have than Sam?**"

- A) The student says Trudy has four more pennies than Sam. "**How do you know that?**" "Because ten is four more than six."
- B) The student counts out the objects for Sam and Trudy by lining them up in two rows, one above the other and counts the difference. Counting indicates a lower level of understanding.
- C) The student writes the subtraction problem  $10 - 6 = 4$ . The student understands Difference Between.
- D) The student is uncertain about what she is doing: End the test.

### Addition

Materials - Any manipulative, paper, and pencil

Write the equation  $3 + 2 = \underline{\quad}$  or write it vertically: 
$$\begin{array}{r} 3 \\ + 2 \\ \hline \end{array}$$

Ask, "**Have you done a problem like this before? How do you solve it?**" If she is able to record five as the sum, have her build or prove the answer with blocks. Say, "**Show me what this means.**" If the student:

- A) Puts out two blocks for the two and three blocks for the three, pushes all the blocks together and says the answer is five: Give her a more difficult problem. For example,  $7 + 5$ . If she can successfully do this problem, ask her to write three problems: a very easy one, a very hard problem, and a problem that is not too hard but also not too easy. If the hard problem is too hard, watch and see how she deals with it. Tell her she doesn't have to answer it right now. You are getting a range of her ability. It will tell you where to start working and what size problem she is currently working on. Staple this paper to her evaluation sheet.
- B) Tells you two plus three equals five or is blank: Have her do the problem in her head, with blocks, or on her fingers: If she is not sure what to do and can't read the equation, have her build it. Point to the two. Say, "**Put out this many blocks.**" Have her do this. Point to the three. Say, "**Put out this many blocks.**" Have her do this. Ask, "**How many blocks in all?**" She should be able to count them one by one or say five immediately. This may make her remember having done this before but without the symbols.
- C) Is uncertain about what she is doing: End the evaluation.

Lessons: *Patterns in Arithmetic: Addition - Booklet 1*; Review *Mathematics Their Way*, Chapters 7, 8, and 9.

## Subtraction

Materials - Any manipulative, paper and pencil

After the student has successfully completed the addition test, try some subtraction problems. If the addition test was difficult, do not go on to subtraction. You are pushing to see what the student knows and what needs to be worked on.

Write the equation  $5 - 1 = \underline{\quad}$  or write it vertically:  $\begin{array}{r} 5 \\ - 1 \\ \hline \end{array}$ .

Ask, "**Have you done problems like this before? How would you solve 5 - 1?**" If she is able to record four as the difference, ask, "**How could you prove this answer with blocks?**"

If the student:

- A) Puts out five blocks and takes away one block from the five: Give her a more difficult problem. For example,  $8 - 3$ . If this problem is done successfully, have her write three problems: a very easy one, a medium problem that is not too hard but also not too easy, and a really hard problem. If the hard problem is too hard, watch and see how she deals with it. Ask, "**How do you think you would prove it (or build it)?**" If she cannot answer the hardest one, admire it, and tell her she will learn how to answer it. You are getting a range of her ability. It will tell you where to start working and what size problem she is currently working on. Attach this sheet, note the level of the problems and the student's level of self-confidence and self-challenge. The student may be ready for *Patterns in Arithmetic: Subtraction - Booklet 2*.
- B) Puts out five blocks and adds one block to represent the one being taken away, then takes one block away, leaving five blocks: The student has not successfully proven the solution with manipulatives. Try another problem to see if she can subtract rotely but just doesn't have a physical model for proving the answer. See *Patterns in Arithmetic: Subtraction - Booklet 1* for building subtraction models.
- C) Is uncertain about what she is doing: End the test.

## Basic Mathematical Knowledge

*Patterns in Arithmetic: Subtraction - Booklet 2* assumes that the student has learned what is typically taught to a six-year-old or is in first grade. A student should have the following basic mathematical knowledge before beginning this program:

- Concept of Number/Cardinality - to about 6.
- One-to-one Correspondence - to 8.
- Conservation of Number - up to 5.
- Difference Between - none, it will be learned.
- Addition - can add numbers with sums up to 20.
- Subtraction - can subtract numbers with differences up to 10.

# Evaluation

Name \_\_\_\_\_

Date \_\_\_\_\_

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Concept of Number/Cardinality    4    5    6    7    8    9

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1:1 Correspondence                      \_\_\_\_\_ Highest number successfully counted

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Conservation of Number                      \_\_\_\_\_ 1-5                      \_\_\_\_\_ 6-10

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Difference Between

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Addition

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Subtraction

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Comments