RightStart™ Mathematics

by Joan A. Cotter, Ph.D.
with Tracy Mittleider, MSEd

LEVEL A LESSONS

Second Edition

Activities for Learning, Inc.

A special thank you to Kathleen Cotter Clayton for all her work on the preparation of this manual.

Note: Rather than use the designations, Kindergarten, First Grade, etc., to indicate a grade, levels are used. Level A is kindergarten, Level B is first grade, and so forth.

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www.RightStartMath.com

For more information: info@RightStartMath.com
Supplies may be ordered from: www.RightStartMath.com

Activities for Learning, Inc.
321 Hill Street
Hazelton, ND 58544-0468
United States of America
888-775-6284 or 701-782-2000
701-782-2007 fax

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RightStart™ Mathematics Objectives for Level A

Name ______________________________ Year ________

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Numeration				
Can recognize quantities to 100 by grouping in 5s & 10s				
Knows even numbers				
Knows odd numbers				
Can count by twos to 100	N/A	N/A		
Can count by fives to 100	N/A	N/A		
Can count by tens to 100	N/A	N/A		
Money				
Knows name and value of penny, nickel, and dime	N/A			
Place Value				
Knows 10 ones is 1 ten	N/A			
Knows 10 tens is 1 hundred	N/A	N/A		
Knows 37 as 3-ten 7	N/A	N/A		
Addition				
Understands addition as combining parts to form a whole	N/A			
Can partition numbers 3–10 into parts	N/A			
Knows number combinations equal to 10	N/A	N/A		
Knows number combinations up to 10	N/A	N/A		
Subtraction				
Understands subtraction as missing addend	N/A	N/A		
Understands subtraction as separating	N/A	N/A		
Problem Solving				
Can solve addition problems	N/A	N/A		
Can solve missing addend problems	N/A	N/A		
Can solve basic subtraction problems	N/A	N/A		
Geometry				
Knows mathematical names for triangle, rectangle, and circle				
Knows mathematical names for cubes, cylinder, sphere, and cone				
Knows parallel and perpendicular lines				
Can continue a pattern on the geoboard	N/A			
Time				
Knows days of the week	N/A			
Knows months of the year	N/A			
Can tell time to the hour	N/A	N/A	N/A	
Can tell time to the half hour	N/A	N/A	N/A	
Measurement				
Can determine length in centimeters and inches	N/A	N/A	N/A	
Fractions				
Can divide into halves and fourths	N/A	N/A	N/A	
Knows unit fractions up to 1/10	N/A	N/A	N/A	

How This Program Was Developed

We have been hearing for years that students in Japan do better than U.S. students in math. The Asian students are ahead by the middle of first grade. And the gap widens every year thereafter.

Many explanations have been given, including less diversity and a longer school year. Japanese students attend school 240 days a year.

A third explanation given is that the Asian public values and supports education more than we do. A first grade teacher has the same status as a university professor. If a student falls behind, the family, not the school, helps the child or hires a tutor. Students often attend after-school classes.

A fourth explanation involves the philosophy of learning. Asians and Europeans believe anyone can learn mathematics or even play the violin. It is not a matter of talent, but of good teaching and hard work.

Although these explanations are valid, I decided to take a careful look at how mathematics is taught in Japanese first grades. Japan has a national curriculum, so there is little variation among teachers.

I found some important differences. One of these is the way the Asians name their numbers. In English we count ten, eleven, twelve, thirteen, and so on, which doesn't give the child a clue about tens and ones. But in Asian languages, one counts by saying ten-1, ten-2, ten-3 for the teens, and 2-ten 1, 2-ten 2, and 2-ten 3 for the twenties.

Still another difference is their criteria for manipulatives. Americans think the more the better. Asians prefer very few, but insist that they be imaginable, that is, visualizable. That is one reason they do not use colored rods. You can imagine the one and the three, but try imagining a brown eight–the quantity eight, not the color. It cannot be done without grouping.

Another important difference is the emphasis on non-counting strategies for computation. Japanese children are discouraged from counting; rather they are taught to see quantities in groups of fives and tens.

For example, when an American child wants to know 9 + 4, most likely the child will start with 9 and count up 4. In contrast, the Asian child will think that if he takes 1 from the 4 and puts it with the 9, then he will have 10 and 3, or 13. Unfortunately, very few American first-graders at the end of the year even know that 10 + 3 is 13.

I decided to conduct research using some of these ideas in two similar first grade classrooms. The control group studied math in the traditional workbook-based manner. The other class used the lesson plans I developed. The children used that special number naming for three months.

They also used a special abacus I designed, based on fives and tens. I asked 5-year-old Stan how much is 11 + 6. Then I asked him how he knew. He replied, "I have the abacus in my mind."

The children were working with thousands by the sixth week. They figured out how to add 4-digit numbers on paper after learning how on the abacus.

Every child in the experimental class, including those enrolled in special education classes, could add numbers like 9 + 4, by changing it to 10 + 3.

I asked the children to explain what the 6 and 2 mean in the number 26. Ninety-three percent of the children in the experimental group explained it correctly while only 50% of third graders did so in another study.

I gave the children some base ten rods (none of them had seen them before) that looked like ones and tens and asked them to make 48. Then I asked them to subtract 14. The children in the control group counted 14 ones, while the experimental class removed 1 ten and 4 ones. This indicated that they saw 14 as 1 ten and 4 ones and not as 14 ones. This view of numbers is vital to understanding algorithms, or procedures, for doing arithmetic.

I asked the experimental class to mentally add 64 + 20, which only 52% of nine-year-olds on the 1986 National test did correctly; 56% of those in the experimental class could do it.

Since children often confuse columns when taught traditionally, I wrote 2304 + 86 = horizontally and asked them to find the sum any way they liked. Fifty-six percent did so correctly, including one child who did it in his head.

The following year I revised the lesson plans and both first grade classes used these methods. I am delighted to report that on a national standardized test, both classes scored at the 98th percentile.

Joan A. Cotter, Ph.D.

Some General Thoughts on Teaching Mathematics

1. Only five percent of mathematics should be learned by rote; 95 percent should be understood.
2. Real learning builds on what the child already knows. Rote teaching ignores it.
3. Contrary to the common myth, "young children can think both concretely and abstractly. Development is not a kind of inevitable unfolding in which one simply waits until a child is cognitively 'ready.'" —*Foundations for Success* NMAP
4. What is developmentally appropriate is not a simple function of age or grade, but rather is largely contingent on prior opportunities to learn." —Duschl & others
5. Understanding a new model is easier if you have made one yourself. So, a child needs to construct a graph before attempting to read a ready-made graph.
6. Good manipulatives cause confusion at first. If a new manipulative makes perfect sense at first sight, it is not needed. Trying to understand and relate it to previous knowledge is what leads to greater learning. —Richard Behr & others.
7. According to Arthur Baroody, "Teaching mathematics is essentially a process of translating mathematics into a form children can comprehend, providing experiences that enable children to discover relationships and construct meanings, and creating opportunities to develop and exercise mathematical reasoning."
8. Lauren Resnick says, "Good mathematics learners expect to be able to make sense out of rules they are taught, and they apply some energy and time to the task of making sense. By contrast, those less adept in mathematics try to memorize and apply the rules that are taught, but do not attempt to relate these rules to what they know about mathematics at a more intuitive level."
9. Mindy Holte puts learning the facts in proper perspective when she says, "In our concern about the memorization of math facts or solving problems, we must not forget that the root of mathematical study is the creation of mental pictures in the imagination and manipulating those images and relationships using the power of reason and logic." She also emphasizes the ability to imagine or visualize, an important skill in mathematics and other areas.
10. The only students who like flash cards are those who do not need them.
11. Mathematics is not a solitary pursuit. According to Richard Skemp, solitary math on paper is like reading music, rather than listening to it: "Mathematics, like music, needs to be expressed in physical actions and human interactions before its symbols can evoke the silent patterns of mathematical ideas (like musical notes), simultaneous relationships (like harmonies) and expositions or proofs (like melodies)."
12. "More than most other school subjects, mathematics offers special opportunities for children to learn the power of thought as distinct from the power of authority. This is a very important lesson to learn, an essential step in the emergence of independent thinking." —*Everybody Counts*

13. The role of the teacher is to encourage thinking by asking questions, not giving answers. Once you give an answer, thinking usually stops.
14. Putting thoughts into words helps the learning process.
15. Help the children realize that it is their responsibility to ask questions when they do not understand. Do not settle for “I don’t get it.”
16. The difference between a novice and an expert is that an expert catches errors much more quickly. A violinist adjusts pitch so quickly that the audience does not hear it.
17. Europeans and Asians believe learning occurs not because of ability, but primarily because of effort. In the ability model of learning, errors are a sign of failure. In the effort model, errors are natural. In Japanese classrooms, the teachers discuss errors with the whole class.
18. For teaching vocabulary, be sure either the word or the concept is known. For example, if a child is familiar with six-sided figures, we can give him the word, hexagon. Or, if he has heard the word, multiply, we can tell him what it means. It is difficult to learn a new concept and the term simultaneously.
19. Introduce new concepts globally before details. This lets the children know where they are headed.
20. Informal mathematics should precede paper and pencil work. Long before a child learns how to add fractions with unlike denominators, she should be able to add one half and one fourth mentally.
21. Some pairs of concepts are easier to remember if one of them is thought of as dominant. Then the non-dominant concept is simply the other one. For example, if even is dominant over odd, an odd number is one that is not even.
22. Worksheets should also make the child think. Therefore, they should not be a large collection of similar exercises, but should present a variety. In RightStart™ Mathematics, they are designed to be done independently.
23. Keep math time enjoyable. Our emotional state at the time we learn something is attached to that information. A person who dislikes math will avoid it and a child under stress stops learning. If a lesson is too hard, stop and play a game. Try the lesson again later.
24. In Japan students spend more time on fewer problems. Teachers do not concern themselves with attention spans as is done in the U.S.
25. In Japan the goal of the math lesson is that the student has understood a concept, not necessarily has done something (a worksheet).
26. The calendar must show the entire month, so the children can plan ahead. The days passed can be crossed out or the current day circled.
27. A real mathematical problem is one in which the procedures to find the answer are not obvious. It is like a puzzle, needing trial and error. Emphasize the satisfaction of solving problems and like puzzles, of not giving away the solution to others.

RightStart™ Mathematics

Ten major characteristics make this research-based program effective:

1. Refers to quantities of up to 5 as a group; discourages counting individually. Uses fingers and tally sticks to show quantities up to 10; teaches quantities 6 to 10 as 5 plus a quantity, for example 6 = 5 + 1.
2. Avoids counting procedures for finding sums and differences. Teaches five- and ten-based strategies for the facts that are both visual and visualizable.
3. Employs games, not flash cards, for practice.
4. Once quantities 1 to 10 are known, proceeds to 10 as a unit. Temporarily uses the "math way" of naming numbers; for example, "1 ten-1" (or "ten-1") for eleven, "1-ten 2" for twelve, "2-ten" for twenty, and "2-ten 5" for twenty-five.
5. Uses expanded notation (overlapping) place-value cards for recording tens and ones; the ones card is placed on the zero of the tens card. Encourages a child to read numbers starting at the left and not backward by starting at the ones.
6. Proceeds rapidly to hundreds and thousands using manipulatives and place-value cards. Provides opportunities for trading between ones and tens, tens and hundreds, and hundreds and thousands with manipulatives.
7. Teaches mental computation. Investigates informal solutions, often through story problems, before learning procedures.
8. Teaches four-digit addition on the abacus, letting the child discover the paper and pencil algorithm.
9. Introduces fractions with a linear visual model, including all fractions from 1⁄2 to 1⁄10. "Pies" are not used initially because they cannot show fractions greater than 1. Later, the tenths will become the basis for decimals.
10. Teaches short division (where only the answer is written down) for single-digit divisors, before long division.

Second Edition

Many changes have occurred since the first RightStart™ lessons were begun in 1994. First, mathematics is used more widely in many fields, for example, architecture, science, technology, and medicine. Today, many careers require math beyond basic arithmetic. Second, research has given us new insights into how children learn mathematics. Third, kindergarten has become much more academic, and fourth, most children are tested to ensure their preparedness for the next step.

This second edition is updated to reflect new research and applications. Topics within each level are always taught with the most appropriate method using the best approach with the child and teacher in mind.

Daily Lessons

Objectives

The objectives outline the purpose and goal of the lesson. Consider the words; "to introduce" is not the same as "to review." When a topic is introduced, it is not expected to be mastered during that lesson. When a topic is reviewed, proficiency should be close.

Materials

The manipulatives needed for the lessons are specially chosen items needed to teach the lessons. Occasionally, common objects, such as scissors, will be needed and will be listed in bold type.

Warm-up

The warm-up provides review, memory work, or an introduction of the day's topics. It can be reduced, modified, or expanded to meet a child's needs.

Activities

Activities are the heart of the lesson. These are the instructions for teaching the lesson. When guided to ask a question, the expected answer from the child is given in square brackets.

Explanations

Special background notes and supporting information for the teacher are provided here.

There are Overview Videos to guide and support you weekly. The provided QR code will direct you to the appropriate video.

Games

Games, not worksheets or flash cards, provide practice. The games, found in the *Math Card Games* book, should be played as many times as necessary until proficiency or memorization takes place. Games are important to learning math, just as books are important to learning reading.

The *Math Card Games* book includes extra games for the child needing more help and more challenging games for the advanced child.

Instructional videos for all the games used in the RightStart™ Mathematics curriculum are available on Vimeo for a small subscription fee.

Instructional game videos

Worksheets

The worksheets are designed to be completed independently in order to demonstrate understanding of the day's lesson. Some lessons, especially in the early levels, have no worksheet.

In conclusion

Each lesson ends with a short summary based on the day's learning.

Timeline

Each RightStart Math level is designed for one school year. This level should be completed in full before beginning the next level.

Joan A. Cotter, Ph.D.
info@RightStartMath.com

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Lesson 2: Subitizing 4 and Patterning

OBJECTIVES:
1. To learn finger sets and tally marks for 4
2. To recognize quantities 1 to 4 without counting
3. To recognize and continue a simple pattern

MATERIALS:
1. Music for "Yellow is the Sun"
2. *Yellow is the Sun* book
3. Finger cards, cut apart (Appendix p. 2)*
4. Tally sticks
5. Tiles

ACTIVITIES FOR TEACHING:

Warm-up. Continue teaching the song, "Yellow is the Sun."

Yellow is the Sun

Yellow is the sun.
This is only one. (Raise one finger.)

Why is the sky so blue?
Let me show you two. (Raise two fingers.)

Salty is the sea.
One more and it's three. (Raise three fingers.)

Hear the thunder roar.
Here's the mighty four. (Raise four fingers.)

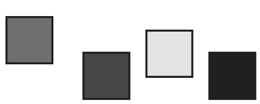
Ducks will swim and dive.
My whole hand makes five. (Raise five fingers.)

Read the book *Yellow is the Sun* to the child.

Quantities 1 to 3. Show the finger card* with 2 fingers for one to two seconds and ask the child to show the quantity with his fingers on his left hand and to build it with tally sticks. Repeat with finger cards 1 and 3. Also, clap 2 times. Ask: How many claps did you hear? [2] Repeat with 3.

Subitizing 4. Show 4 with your fingers and ask the child to show 4 with his left hand. Then show 4 tiles and say: This is 4. See the figures below.

Four.



Four tiles.

Rearrange the 4 tiles and ask how many he sees. Remove 1 tile and ask: How many? [3] Replace it and again ask: How many? [4] Now clap 4 times and ask: How many claps did you hear? [4]

EXPLANATIONS:





It is unimportant which fingers on the left hand the children use to show the quantities.

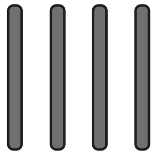
*The finger cards are found on page 2 in the Appendix at the end of this Lesson book. They are also included in the Appendix packet.

In future lessons, the dot, bead, and tally cards will be needed. They are also found in the Appendix pages 6, 7, and 19 and in the Appendix packet.

If you are making copies from the Appendix pages, use one color for the sets of finger cards, another color for the dot cards, a third color for the bead pattern cards, and a fourth color for the tally stick cards. You will need two of each of the four card sets.

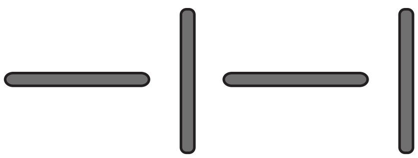
ACTIVITIES FOR TEACHING CONTINUED:

Changing quantities. Tell him to make 4 with 4 tally sticks. Then ask him to remove 2 sticks and say how many? [2] Ask him to add 1 and say how many? [3] Repeat with one more.



Four.

Introducing patterning. Take a group of tally sticks and lay one out horizontally. Place another next to the first vertically, the third one horizontally and the fourth one vertically. Give the child a tally stick and ask: What do you think comes next? Tell him we will call this the "do-re" (doe-ray) pattern. Tell the child to continue to lay out the pattern.



Continuing the pattern with tally sticks.

Next take out the tiles and lay out a red tile followed by a blue tile and then another red tile. Ask the child which color would come next in the do-re pattern? [blue] Ask him to continue the pattern.

Continuing the do-re (AB) pattern.

Encourage him to make the same pattern with different colors.

In conclusion. Ask the child to say how many fingers he sees while you do the following: Raise 4 fingers, then put 1 down and back up several times. [4, 3, 4, 3, . . .] Ask: Do you hear a do-re pattern? [yes]

EXPLANATIONS CONTINUED:

Our brains are wired to look for patterns.

Patterns are often named using letters of the alphabet. The letters are used sequentially, naming each different element of the pattern. For example, a strictly alternating pattern is AB. To avoid using the letters of the alphabet for beginning readers, we will use musical scale names to designate pattern names. The names are do (doe), re (ray), mi (me), fa (fah).

You might want to teach him the “Do Re Mi” song from the “Sound of Music.”

Conclusions may be a summary of the day’s lesson or an expansion of the lesson to challenge higher level thinking.

Lesson 8: Subitizing 7 and the Cotter Abacus

OBJECTIVES:

1. To subitize 7
2. To learn the terms *above* and *below*
3. To learn the terms *top* and *bottom*
4. To enter 1 to 5 beads on the Cotter Abacus without counting

MATERIALS:

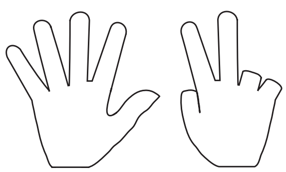
1. *Yellow is the Sun* book
2. Finger cards
3. Tally sticks
4. Tiles
5. Cotter Abacus

ACTIVITIES FOR TEACHING:

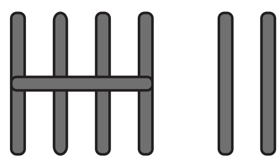
Warm-up. Continue reading the book and singing the song, "Yellow is the Sun."

Show the finger cards 1 to 6 at random for 2 seconds and ask the child to show them on his fingers. Also have him show the number with tally sticks and say the numbers.

Quantity 7. Show 7 to the child with your fingers. Ask him to show it on his fingers. Also ask him to build it with the tally sticks. Now, ask him to make a 7 with the tiles, using two colors as shown below.



Seven.



Seven.

Seven.

Above and below. To help the child understand the words *above* and *below*, ask the child is your nose above or below your mouth. Ask: Is your chin above or below your eyes? Repeat with different parts of the face using the words above or below.

Now have the child show you something under the table or desk. Ask him to name something above his head.

Top and bottom. Point out examples of *top* and *bottom*, such as "Where is the *top* of the window" and "Where is the *bottom* of the window." Repeat for the top and bottom of a page in a book.

Cotter Abacus. Show the child the Cotter Abacus. Help him learn to handle it with respect, as due any tool. You might give him a few minutes to make patterns and designs.

EXPLANATIONS:

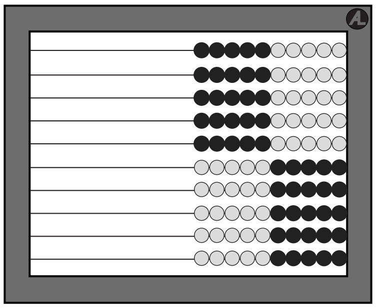
It might help to say "sev-en" as you point to the "two" part of 7.

As this point, 7 must be shown as 5 on the left hand and 2 on the right, not, for example, as 4 on one hand and 3 on the other.

The terms *above*, *below*, *top,* and *bottom* are part of the spatial terms a child needs to know.

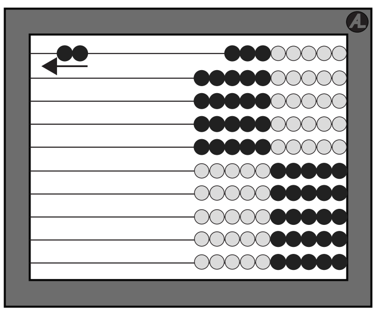
ACTIVITIES FOR TEACHING CONTINUED:

Entering quantities. Show him how to place the abacus with the circle logo at the top. This means the circle will be on the right and the wires horizontal. Demonstrate clearing the abacus by lifting the left edge so the beads fall toward the side with the circle. See the figure below.

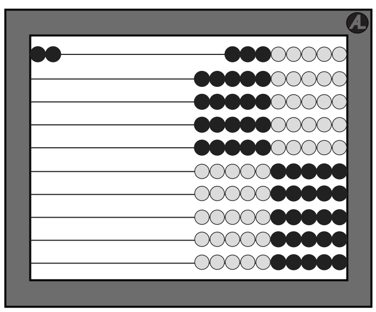


Abacus cleared.

Ask the child to clear the abacus. Ask him to show 2 with his fingers. Ask him to enter 2 on the top wire. See the figures below.

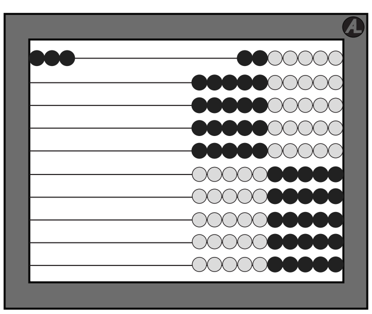


Entering 2 as a unit.

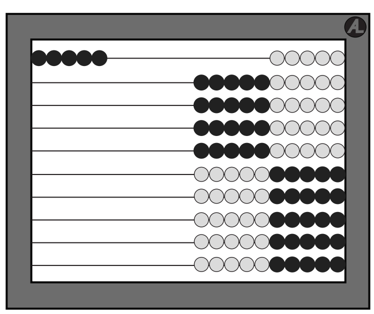


Two.

Ask him to clear the abacus. Then ask him to show 3 with fingers and enter 3 on the abacus. Repeat for 5 and ask how he could tell it was 5. [a whole hand, all the dark colored beads on a wire] Lastly, ask him to show 4 and enter 4.



Three.



Five.

In conclusion. Show 5 on your fingers and ask: How much is this? [5] Repeat for 7.

EXPLANATIONS CONTINUED:

To enter a quantity on the Cotter Abacus, move the beads from right to left. This allows the eyes to travel from left to right as in reading.

Quantities are entered on the abacus as a group; they are not counted. If a child counts when entering a quantity, simply say: Okay, now can you enter (3) without counting.

Lesson 94: Dozens & Partitioning Teens into Tens

OBJECTIVES:

1. To introduce the term *dozen*
2. To partition teens

MATERIALS:

1. **Egg carton with 2 eggs or other objects**
2. Place-value cards
3. Cotter Abacus
4. Dry erase board
5. Worksheet 34, Partitioning Teens

ACTIVITIES FOR TEACHING:

Warm-up. Ask the child to count by 1s to 80.

Ask the child to count by 10s to 200.

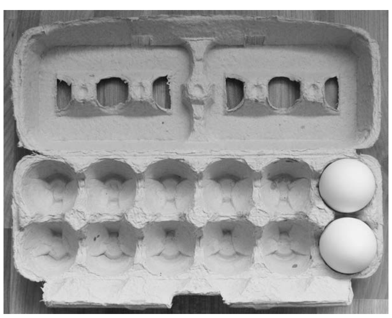
Ask the child to count by 5s to 100.

Ask: How much is 43 + 1? [44] How much is 44 + 2? [46] How much is 78 + 1? [79] How much is 99 + 1? [1 hundred]

Ask the child to show parallel lines using his arms. Then ask him to show perpendicular lines.

Ask the child to listen to the pattern and to continue it with the next number: 46, 47, 48; [49] 57, 56, 55; [54] and 50, 60, 70. [80]

Dozen. Show the child an egg carton. Tell him that it holds one *dozen* eggs. Open the carton as shown below. Ask him: How many eggs would fit? [12] Ask: How many eggs are in a dozen eggs? [12] How many buns are in a package of a dozen buns? [12]



An egg carton.

Then ask the child to solve the following problem:

How many eggs are in 2 dozen eggs?

Let him solve the problem in his own way and to explain how he did it. Ask him to show his solution with place-value cards. [24]

If appropriate, ask him to find the number of eggs in 3 dozen. [36]

EXPLANATIONS:

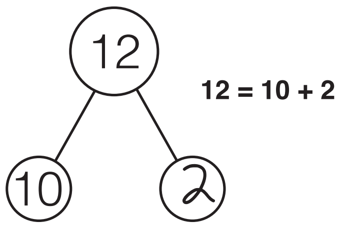
While the term dozen has virtually no mathematical significance, 12 continues to be important in a cultural sense. We have 12 in a dozen, 12 months in a year, 12 hours on the clock, and 12 inches in a foot.

Showing the egg carton with two eggs (or similar objects) makes the ten empty spaces more prominent.

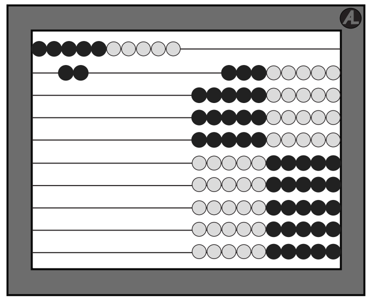
ACTIVITIES FOR TEACHING CONTINUED:

Ask the child if it is easier to count by dozens or by tens and why.

Partitioning the teens. Draw a part-whole circle set and write 12 in the whole and 10 in the left part-circle. Ask: What goes in the other part-circle? Ask him to demonstrate the partitioning on the abacus and to explain it.



Partitioning 12 into 10 and 2.



Next ask him to say and write the equation. [12 = 10 + 2] Also ask him for the inverse: What is 10 + 2? [12]

Repeat with 15 written in the whole-circle and 10 in the left part-circle. Continue with other teen numbers.

Practice. Ask the child: Sixteen is 10 and what? [6] Fifteen is 5 and what? [10] Thirteen is 3 and what? [10] Nineteen is 10 and what? [9]

Problem. Give him the following problem:

> Lee hid a dozen eggs. Lee's friends found 10 of them. How many of them are still hidden?

Ask: What does the word dozen means? [12] How many eggs were found? [10] How many are still hidden? [2]

Worksheet 34. Ask the child to do the worksheet for partitioning the teens into 10 and another number. The problems and solutions are as follows:

15 = 10 + **5**
19 = 10 + **9**
13 = 10 + **3**
11 = 10 + **1**
17 = 10 + **7**
16 = 10 + **6**
14 = 10 + **4**
18 = 10 + **8**
12 = 10 + **2**
20 = 10 + **10**

In conclusion. Ask: How much is a dozen? [12] How much is a half dozen? [6]

EXPLANATIONS CONTINUED:

English-speaking child usually have difficulty conceptualizing the teen numbers as 10 + another number. In other words, the child tends to see 14 as 14 ones, rather than a ten and 4 ones. The following activities are designed to help him make that connection, which becomes harder since he started using the traditional names. Refer back to the math way of saying the numbers, if necessary.

Name: ______________________________

15 = 10 + ____

19 = 10 + ____

13 = 10 + ____

11 = 10 + ____

17 = 10 + ____

16 = 10 + ____

14 = 10 + ____

18 = 10 + ____

12 = 10 + ____

20 = 10 + ____

Lesson 104: Comparing Weights

OBJECTIVES:

1. To become aware of weight
2. To introduce the term *heavier*
3. To compare weights

MATERIALS:

1. **Two identical glasses, one empty** and **one with water**
2. Geometric solids
3. *Math balance, two weights, **two 4-inch (10 cm) paper cups,** and **two rubber bands**
4. **Small objects to weigh: plastic, metal, etc.**

ACTIVITIES FOR TEACHING:

Warm-up. Ask: How much is 15 plus 1? [16] How much is 15 minus 1? [14] How much is 10 plus 1? [11] How much is 10 minus 1? [9] How much is 12 plus 1? [13] How much is 12 minus 1? [11]

Ask the child: Is 1 plus 1, adding or subtracting? [adding] Is 9 and 2 more, adding or subtracting? [adding] Is 10 minus 1, adding or subtracting? [subtracting] Is taking 2 from 8, adding or subtracting? [subtracting]

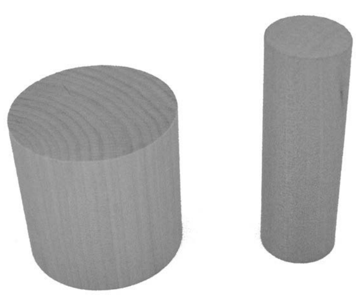
Ask the child: After adding on the abacus, will your answer be greater or less? [greater] After subtraction, will your answer be greater or less? [less]

Ask the child: How long is one edge of a tile? [1 inch] How long are 2 edges of a tile? [2 inches] How long are 3 edges of a tile? [3 inches] How long are all four edges of a tile? [4 inches]

Ask: Which is longer, an inch or a centimeter? [inch] Which is shorter? [centimeter]

Comparing weights. Set two glasses, one empty and one half full of water in front of the child. Ask him to carefully lift the empty glass and set it down. Then ask him to lift the glass with water and tell him the second glass is *heavier*. Explain that the glasses look alike, but the one with water feels heavier.

Ask him to find the two cylinders from the geometric solids. Ask: Which one is taller? [the right cylinder shown below] Ask him to lift each one. Which cylinder is heavier? [the left cylinder]



The two cylinders.

EXPLANATIONS:

*To prepare the math balance to be used as a scale, punch holes in two paper cups and insert a rubber band in the holes as shown above. Instead of the rubber bands, twist ties or two paper clips per side will also work.

Clear plastic cups allow the child to see the contents of the cups more easily, but use only cups with plastic code 1. The code is found in the recycling triangle, usually on the bottom. (A cup with plastic code 6 is brittle and often breaks when making the hole, leaving sharp edges.)

ACTIVITIES FOR TEACHING CONTINUED:

Comparing weights using the scale. Hang a cup from each 10-peg on the math balance as shown below. Tell the child we will now use the math balance as a scale and we will not be using the numbers.

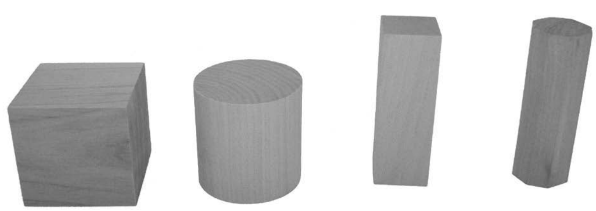
The math balance converted to a scale.

Ask the child: What do you think will happen if we put a blue weight in each cup? Tell him to try it. [stays balanced]

Comparing the solids using the scale. Ask: What do you think will happen if we put one cylinder from the geometric solids in each cup? Ask him to try it. [The cup with the heavier cylinder sinks.]

Ask him to choose any two geometric solids, guess which is heavier, and then check with the scale. Ask him to try several combinations.

As a challenge, give him several solids and ask him to use the scale to figure out which one is heaviest. Then ask him to put the solids in order from heaviest to lightest.



Four geometric solids in order by weight.

Comparing other objects using the scale. Ask him to compare two other objects, such as a piece of styrofoam and a piece of plastic or metal. Encourage him to find things to compare.

In conclusion. Ask: Can you always tell which of two things is heavier by just looking? [no] How can you find out? [by weighing]

EXPLANATIONS CONTINUED:

If necessary, move the little white weights to adjust the balance.

This can be done by first comparing any two items. Then take the heavier one and compare it with the others.

Your solids may have a different order, because the weights may vary.