# GRADE 3 - AMARA SPACED REPETITION SEQUENCING RECOMMENDATIONS

Student mastery of skills is highly dependent on adequate exposure and threshold repetitions. For example, a student must correctly practice a skill over a short period (spaced) a threshold number of times (repetition). Spaced repetition is an efficient and effective means to reach the minimum number of repetitions for each student. General guidelines for the number of repetitions for most students are listed in the following table.

| Student Classification | Number of Repetitions for Skill Mastery |
|---|---|
| Gifted and Talented Identified | 1 to 4 repetitions |
| General Education Students | 8 to 18 repetitions |
| Students Receiving Special Education Services | Varies widely from student to student – Consult each student's Individual Education Plan and follow legal guidelines |

Below are the general recommendations for specific skill areas using Amara supplemental daily resources. Due to student dynamics, each classroom's teacher will experience different levels of intervention and presentation of each skill in a spaced repetition process. Therefore, spaced repetition pedagogy is unique for each classroom due to varying student ability in mathematics.

It is suggested that 3 to 8 skills be presented quickly in a highly accountable and engaging teaching mode for approximately 5 to 10 minutes at the onset or the end of the core lesson. *Many skills will require little time for students to master, but others may take more days for students to demonstrate mastery*. The document appears lengthy, but there is an abundance of commentary provided to inform teachers of specific pedagogy and examples. However, it is essential the classroom teacher is highly organized, prepared and plans a spaced repetition process that provides a quick transition between skills. Consistency is the key to success in most human endeavors, and this process is not an exception.

The teacher should observe the students to determine which students require more practice. After skill mastery is achieved by all students, a teacher can drop that skill from the list below and add a new one. A variation in spaced repetition methodology is when the teacher presents a specific math skill each day until the majority of students have demonstrated skill proficiency. At that point, the teacher can engage students requiring additional practice in a small group setting while the other students complete independent work. Amara's Skill Support Resources are designed for both of these types of activities and are available on the Amara4education website for purchase. Also, it is recommended that students master math facts and process skills using Formative Loop's daily (www.formativeloop.com) numeracy program

Class-wide accountability and comprehension checks can be done with small white boards, raising hands, a show of fingers to represent number answers, or paper and pencil to name a few. Teachers can position themselves to observe paper-pencil responses and identify specific students that demonstrate a lack of skill proficiency. Finally, please note that the skill list below is a guideline. A teacher should evaluate their students and adjust the list as they feel is appropriate.

**Recommended Skill List – Third Grade**

1.) **Math Facts: Addition**. Student proficiency in math fact operations must be pressed as students are presented addition content in daily core lessons and/or Amara resources. Math fact mastery is essential in arithmetic mathematics for students to master many dependent concepts This goal is supported during space repetition, and basic addition number sentences should be shown in a variety of ways. For example in addition: 5 + 7 = 12 *and* 12 = 7 + 5. With small amounts of practice,

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students adapt to the differing addition equation form that will be beneficial as students transition into the upper elementary and middle school grades. Formative Loop offers a slow build-up via a short daily 5-minute *writing* assessment that is ***key*** to students ingraining their math facts.

2.) **Whole Number lines and short whole number sequences (with missing numbers).** Students should review whole number lines in 3rd grade. Newly enrolled students may have not had sufficient exposure in the primary grades to master the concept. Hence, some students will struggle at the end of a ten multiple series to determine the previous number (e.g. 19, 29, 39, etc.) when required to count backwards. A significant number of students also struggle with numbers greater than 109 and less than 120 until sufficient exposure to that content. It is also recommended that a brief review of the end of each hundred series be a repetitive process. For example, short number sequences of the number sequences involving 199, 299, 399 through 1,099 should also be given until numeracy proficiency is demonstrated. Finally, students must also complete patterns by determining missing numbers to complete a short sequence in ascending and descending order. For example: ___, 50, 51, ___ , 53, ___ , 55 and descending order: 24, 23, ___ , 21 ___ , 19, ____. This early semester review of critical material will be highly beneficial when students are rounding numbers to the nearest 10 or 100 and are provided a review of integers on a whole number line. Use Amara Skill Support Resources for convenient access to blank number lines.

3.) **Addition Models.** Use whole number lines, circles, dominos, squares, etc., in short learning spurts. In time, students will demonstrate proficiency of the physical understanding of addition as presented in core lessons and Amara daily resources – for both math facts and larger whole number sentences. Use Amara Resources Skill Support for blank number lines practice sheets and addition models that assist in facilitating skill mastery. Once completed with the practice sheet, students can flip the sheet over for more quick repetitions of additional math skills in this spaced repetition list.

4.) **Compute missing addends.** 5 + ___ = 7 *or* ___ + 5 = 11. Revisit as many times as required for student proficiency. Also, recommend providing students number sentences that are in a different form than they are normally accustomed: 8 = ___ + 3 *or* 12 = 9 + ___. Students should be familiar with number sentences besides the standard left to right.

5.) **Addition Vocabulary:** Addends and sum. Given: 4 + 5 = 9. Indicate the correct mathematical name of each numeral (4 and 5 are *addends*, and 9 is called the *sum)*.

6.) **Commutative Property of Addition.** Students should fully understand that addends can be switched – unchanging the overall addition equation. For instance, 5 + 4 = 9 *and* 4 + 5 = 9 are representations of the same math equation. It is highly recommended that the teacher stress that subtraction does **NOT** possess the same property. For instance: 12 – 5 = 7. But, 5 – 12 does not equal 7. It equals *negative* 7 – there are still 7 spaces between 5 and 12, but subtracting a larger number from a smaller one produces a difference that is negative.

7.) **Place Value Base 10 Blocks.** Begin with Tens and ones. Include hundred and thousand base 10 block daily review at appropriate time during the fall semester. Use the second grade Amara Skill Support Resource for access to practice sheets for a quick daily review. Students can engage in independent or guided work, and then flip the sheet over and review 3 or 4 more skills on this list.

8.) **Even and Odd Numbers.** Begin with small numbers to show why the ones digit determines if a number is classified as even or odd. It is recommended to divide up the number in 2 equal groups to show an odd number. For example, 6 is an even number due to the fact it can be separated in two equal groups of 3. Seven (7) is an odd number because it cannot. *The divisibility rule of 2 will not make sense to students at this point in the third grade year*. Use larger numbers until a pattern can be established that even numbers end in 0, 2, 4, 6, 8; and odd numbers in 1, 3, 5 ,7, 9. Finally, a valuable tactile method is for students to use their fingers on each hand to determine if a number is

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even or odd regardless of magnitude. The students match fingers on each hand. For instance, if the number is 6, students should count to 6 alternating extending a thumb/finger on each hand – starting with the thumbs. Then, match the 3 extended fingers on each hand. The two thumbs and extended fingers all pair up – with none left over. Hence, the number 6 is even. If the number were 7. one hand would have an extended finger that does not match with a finger on the other hand. Consequently, 7 is classified as an odd number.

9.) **Making 10 with number sentences.** Begin with number sentences as needed, and transition to mental math using fingers. For example, during spaced repetition process, a teacher can extend 6 fingers and students respond by raising 4 fingers. This method is an easy visual to determine if students have mastered the skill as well as those who have not. Third grade students will easily grasp this invaluable Base 10 concept. Transition to a verbal reply for students, using appropriate inside student voices. The teacher can say 2, and students respond with 8.

10. **Multiples.** Students should be able to count (skip count) by 1's, 2's, 10's and 5's – in this order of presentation/exposure/initial introduction. Include in the spaced repetition process of each multiple of 3's, 4's, 6's, 7's, 8's, 9's, 11's and 12's in small amounts each day to increase numeracy ability. Students will become adept very quickly with minimal practice. Add in multiples of 100 (0, 100, 200, 300, …) and 15's (clocks to 60) and 25's (for coins to 200) as the sequencing of core curriculum and Amara reaches that point of the school year. This exercise is invaluable for not only numeracy building, but to use in understanding the physical meaning of multiplication as a repetitive adding concept. It is highly recommended that multiples be practiced in small chunks until they are mastered for numeracy and multiplication math fact proficiency later in the fall semester. The author also suggests sending the multiple exercises in the Amara Skill Resource for homework so students practice the skill independently at home in the evening.

11. **Standard Form Place Value.** Students are given so a number of tens and ones, and they write the number in standard form. For example. 0 ones and 6 tens. Students respond with the number 60. Transition at the appropriate time for larger numbers in the hundreds, thousands and ten thousands.

12. **Place Value Whole Number Expanded Form.** Begin with 2-digit expansion to show the value of each digit. 34 = 30 + 4. Transition to 3-digit expansion when appropriate in lesson sequencing (208 = 200 + 0 + 8). At the appropriate time, expose students to 4 and 5-digit numbers to show the value of each digit. Please note, many students struggle with zeros (0's) in a number. For example, 34,050 = 30,000 + 4,000 + 0 + 50 + 0 = 30,000 + 4,000 + 50.

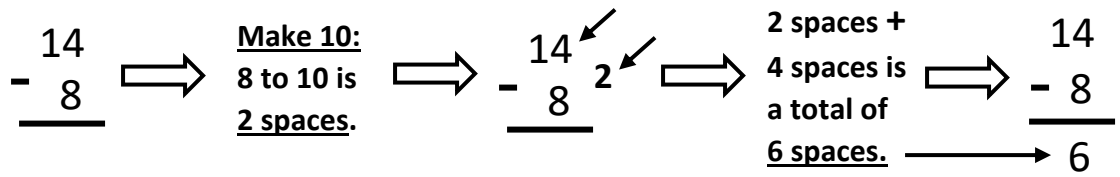
13. **Place Value Whole Number Expanded to Standard Form:** It is recommended to provide an expansion ***with zeros*** included in the number, so students reassemble the number to standard form and demonstrate that they understand zero as a placeholder. For instance, the teacher writes on the white board or document camera: 20,000 + 400 + 1. The students respond with the number in standard form: 20,401. Many times, students that have not mastered place value concepts will write this number as 241, omitting the zero placeholders.

14. **Computing sums for simple addition equations.** 15 + 13 = ? ; 21 + 38 = ? ; Note: Regrouping or carrying should be included in third grade problems. Increase the digit size of the numbers until summing 5 digit numbers with regrouping. It has been the author's experience that when students are provided 2 to 3 simple addition problems each day during the spaced repetition process, the mass of students will rapidly become adept at the addition algorithm process.

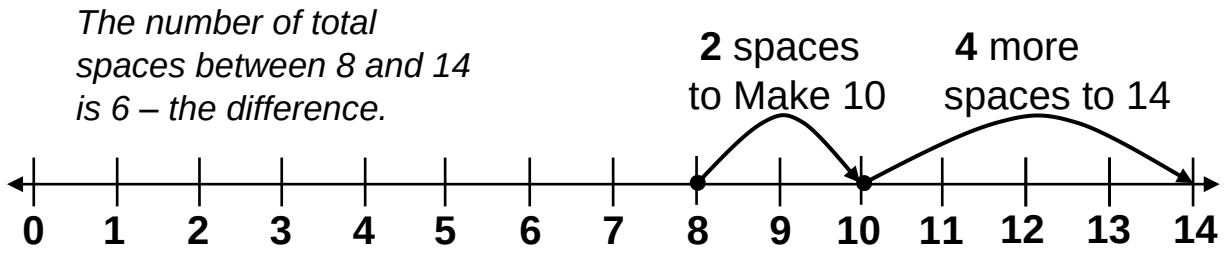
15. **Math Facts: Subtraction**. As with addition, students must become proficient in subtraction. Again, as with addition, basic subtraction number sentences should be presented to students in a variety of ways. For example in subtraction: 12 – 8 = 4 *and* 4 = 12 - 8. With small amounts of practice, students adapt to the differing subtraction equation forms. Again, math fact mastery is

essential in arithmetic mathematics for students to master many dependent concepts. Note: Formative Loop offers a slow build-up via a short *writing* assessment that is key to students ingraining their math facts. Formative Loop is an essential resource to ensure ALL students are held accountable with a daily written assessment until all facts are mastered. The writing piece presses all three areas of cognitive development – thinking, saying the fact to themselves and writing the fact. The digital aspect affords the teacher/math coach to track each student's progress in real time. Example for computing subtraction for 1 digit from 2 digit subtraction math facts using Making 10. The 'Making 10' skill set should be mastered, so the student is not learning more than one skill at a time. ***Use a number line to show students why this works with subtraction facts, so students understand it ONLY works for subtracted math facts from 1 digit from 2 digits and pass through number 10.***

Example:




**The 'WHY' this math works for subtraction facts:**




16. **No commutative property for subtraction.** 5 – 3 = 2, but 3 – 5 does not equal 2. It equals negative 2. Only addition and multiplication possess commutative mathematical properties. This mathematical fact should be stressed to students.
17. **Subtraction Models.** Use whole number lines, circles, dominos, squares, etc., and students should demonstrate proficiency at the physical understanding of subtraction as presented in core lessons and Amara resources – for both math facts and larger whole number sentences. Use Amara Resources Skill Support for blank number lines practice sheets that can easily be used for students to demonstrate skill. Once completed, students can flip the sheet over for more quick repetitions of additional math skills to master in the spaced repetition process.
18. **Subtraction Vocabulary.** Stress the subtraction terms: Minuend, Subtrahend and Difference. Note: **S**ubtrahend can be remembered by students since it is the number **S**ubtracted – both words start with the letter '**S**'. For example, 6 – 4 = 2. Since 4 is the numeral subtracted, it is also called the subtrahend. Correct vocabulary must be reinforced, so students ingrain the math terms into long-term memory.
19. **Computing differences for simple subtraction equations.** 26 – 17 = ? ; 54 – 31 = ? ; Note: Include regrouping or carrying in third grade problems. Increase the digit size of the numbers until differences are computed for 5 digit numbers with regrouping – **especially across zeros (e.g. 503 – 298)**. It has been the author's experience that when students are provided 2 to 3 subtraction problems each day during the space repetition process, that the mass of students will rapidly become adept at

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the subtraction algorithm process. **Note:** Many students require at least one problem a day of subtraction across zeroes to master skill. It is a difficult task for students at this grade level.

20. **Missing Subtrahends and Minuends.** Mastery of this skill only takes practice and exposure. Initially, but children become very adept after only 3 to 4 days of quick daily practice. Begin with small numbers. __ - 3 = 1 *or* *8* - ___ = *5*. Again, use the correct vocabulary (subtrahend or minuend) when discussing the solution to each problem.
21. **Computing an addition or subtraction number sentence in words.** Teacher states, *"What is 2 less than 9?"* or, *"What is 1 more than 5?"* Transition to larger numbers and especially numbers that are 1 or 2 less than a multiple of ten. For example, *"What is 1 less than 30?" or, "What is 2 less than 40?"* Transition to larger numbers that students can easily add or subtract mentally. For instance, "*What is 45 – 15?"* or "*What is 40 + 15?"*
22. **Fact Family – Addition and Subtraction Quick Review.** Provide the students with three related numbers, and students write the fact family. For instance, teacher writes on the document camera: 5, 11 and 6. Students write the 2 addition and 2 subtraction equations. 5 + 6 = 11; 6 + 5 = 11; 11 – 5 = 6; 11 – 6 = 5.
23. **Making 10, 100 and 1,000.** Once the student has mastered making 10, Making 100 and 1,000 proficiency is completed rapidly. After making 10 is mastered, it is recommended that students engage in doing all three related number sentences at the same time to show the Base 10 connection: 4 + ___ = 10 (previously mastered); 40 + ___ = 100; 400 + ____ = 1,000. Transition to mental math after students master equation form. For instance, teacher will provide students with quick multiples of 10 or 100 and students show answer on white boards or respond orally with the correct answer (e.g. teacher says 60 and students respond with 40). Teacher should closely monitor any student(s) who may be struggling if student verbally responses are given.
24. **Adding 3 or 4 numbers in a number sentence.** The numbers selected should be small in value (e.g. 5 + 2 + 3 = ?). Use a number line from Amara Skill Support Resources to have ready-made whole number lines. Students should understand that the physical understanding of addition does not change with more addends in the math equation. The teacher should model this process on blank whole number lines and students complete a quick assessment to ensure understanding. Transition to summing 3 or 4 two-digit numbers to increase numeric ability and prepare students for perimeter problems later on in the semester.
25. **Ordering Whole Numbers Review.** Use three (3) small value 2-digit numbers. Transition to 3 digit numbers at the appropriate time during the school year. Order numbers in both directions: 'greatest to least' and 'least to greatest." This is a review of 2nd grade material.
26. **Comparing two or three numbers with < , > or = .** Teach students to place 2 dots by the *larger number* and 1 dot by the *smaller number*. Connect the dots to form a < or >. If equal numbers are compared, place 2 dots by each numeral, then connect with a horizontal line so the dots and lines form an equal (=) sign. Transition to comparing three digit numbers in the same manner when the daily core lessons and Amara Daily Resource reach that sequence point in the fall semester. Example below.

    Compare 36 and 42 using < , > or = .

    36 42 ➡ 36 • : 42 ➡ 36 <: 42

    **Note:** If the numbers are equal, then, place 2 vertical dots by each number and connect the dots with two horizontal, parallel lines to form an equal sign (=).

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27. **Mental Math String Computations.** It is recommended to practice adding and subtracting in larger number computations, as students' numeracy skills improve. For example, 50 + 20 – 30 = ?? *or* 100 – 40 + 10 + 5 = ??. Transition to hundreds and/or thousands as students' ability merit.
28. **Doubles/Equal Addends:** 6 = ___ + ___ ; ___ + ___ = 10 ; Transition to mentally double a one digit number. For example: Given 4 – Double to 8. Recommend students understand the Base 10 pattern of doubling numbers applies to larger two and three digit numbers. For instance, Double 2, Double 20, and Double 200. Double 5, Double 50, Double 500, and Double 5,000. Daily mental math exercises until students are adept at doubling numbers.
29. **Computing Halves.** Begin with small numbers. Halve 4 *or* 8 *or* 12, etc. Transition to larger numbers. It is recommended that the teacher show pattern numbers at first. For example, half of 6 is 3. Half of 60 equals ??. Half of 18 is 9. Half of 180 is ??. Students must understand the patterns of numbers.
30. **Spelling numbers in word form from 1 to 20, multiples of 10 to 100.** Cumulative practice every day spelling two (2) number words and students will spell the numeral names correctly from 1 to 10 with relative ease. For instance, a teacher can write 1 and 2 on the document camera or white board, and students correctly spell the numbers in word form. Then, the teacher adds the numerals 3 and 4, but students cumulatively spell 1, 2, 3 and 4 until they reach the number 10. Repeat cumulative spelling exercise beginning at 11 and ending at 20. Then, repeat again for multiples of ten (0, 10, 20, 30, etc. to 100.) Students should physically write the words on a piece of paper or small, erasable white boards. **NOTE:** English Learners (EL) will struggle with words like thirty and thirteen due to the 'th' sound since the words may sound similar to them – there's not a 'th' blend sound in Central American or Mexican Spanish. ELs/ELLs may require more practice until distinction between the two words is recognized. However, small amounts of practice/exposure and any issue is rectified.
31. **Addition/Subtraction Fact Family.** It is recommended to begin with students filling in the missing numbers and transition to students writing and completing a fact family given 3 related numbers. For instance, given 5, 7 and 2. Students write addition and subtraction fact family: 2 + 5 = 7; 5 + 2 = 7; 7 – 2 = 5; 7 – 5 = 2. Transition to larger fact family numbers. For instance, the teacher writes: *20, 50, 30*. Students respond with 50 – 20 = 30; 50 – 30 = 20; 20 + 30 = 50; 30 + 20 = 50.
32. **Multiplication Facts.** If the multiples practice was consistently reviewed during earlier spaced repetition sessions and sent home for homework, multiplication fact proficiency is accelerated. It is recommended to begin with small multiplication facts so students comprehend that multiplication is nothing more than repetitive adding. For instance 3 x 4 = 12 or 3 + 3 + 3 + 3 = 12 *or* 4 + 4 + 4 = 12. It is also recommended that a *build-up program* like Formative Loop be used. Hence, the student writes the math facts and does not use a computer keyboard to fill in the products. It is the author's opinion that the process of *physically writing* the products ingrains the multiplication and math facts more than verbal responses and entering keystrokes on a computer.
33. **Multiplication models (Group, Array, Area and Number Lines).** It is imperative that students are aware of the physical meaning of multiplication. The teacher can show these models quickly until the students realize they are representations of a math fact with only a different model. For instance, the teacher can show three circles of 4 items in each circle (group model) OR a number line with three equal jumps of 4 OR an array of 3 stars by 4 stars OR a grid or 3 columns by 4 columns. Quick demonstrations where the children write down the math fact of 3 x 4 = 12. Multiplication is nothing more than repetitive adding no matter what the model. Hence, the multiple work that students complete early on in the semester is invaluable to building numeracy and physical

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understanding of multiplication concepts and models. Students should also create a model when provided a simple multiplication math fact (e.g. 4 x 2 = 8 – students draw an array or group model.)

34. **Computing a multiplication number sentence in words.** Teacher says, "What are 3 equal groups of 4?" or "John has 5 coins in both of his hands. How many total coins does he have?" Transition to larger numbers, as appropriate. "What are two equal groups of 20?" *or* "What are 6 equal groups of 10?" *or* There are 4 soldiers in each row of a 5 column formation. How many soldiers are there in the formation?" The teacher should provide simple math sentences that can be completed mentally, but require students to visualize the model in their minds. Note: The teacher should draw the group model or array *initially*, so students are visually aware of what they are computing.
35. **Multiplication Vocabulary.** Factors and Product. Students must know both terms. It is recommended to begin by providing a math fact: 5 x 6 = 30. The students should name the factors and the product. Transition to larger numbers: 50 x 7 = 350. Also, show the math fact of one of the models described in 32.) above, and the students write the equation and label the factors and product as well.
36. **Commutative Property of Multiplication.** Students should fully understand that factors can be interchanged. For instance, 5 x 4 = 20 *and* 4 x 5 = 20 are representations of the same math equation. It is highly recommended that the teacher stress that division does **NOT** possess the same property.
37. **Missing Factors – Multiplication.** This exercise is beneficial for a variety of reasons. First, students learn to view multiplication as a division problem – whether they realize it or not. Two, it provides students an immediate tool to compute a missing side in an area word problem or diagram – given the total area of a parallelogram and one of its sides. Lastly, students develop a sense of numeracy about multiplication. When finding a missing factor, students are no longer computing products in a one directional means of multiplying two factors to compute a product. When there is a missing factor, they must examine the multiplication process much more completely.
38. **Place Value – Word Form.** Write the 2 and 3 digit numbers in word form each day until mastered. This is a critical skill to learn. Students should include the hyphen between words. Example: Teacher presents the number '48.' Students write forty-eight. Transition to higher numbers involving 4 to 6 digit numbers as students demonstrate proficiency at each level.
39. **Computing word operations given a series of commands.** Students should be adept at computing a string of operations. For example: *"Double 9, divide by 3, add 2, halve the last number. What is your answer?"* Transition to larger word number commands – *"Add 50 and 50, multiply by 2, subtracting 50, divide by 5. What is your number?"* Note: It helps entry-level teachers to prepare 10 of these number sentences in advance and then readily show the students a couple number sentences on the document camera or overhead to practice during the short spaced repetition period.
40. **Perfect Squares – Multiplication.** This is a useful skill for students to own. It reinforces multiplication, but it also shows them two important mathematical ideas. First, students learn to calculate the area of squares or an equal sided array. Second, it shows students a physical picture of why teachers use the term "*square a number"* (i.e. 4 x 4 = $4^2$ = 16) when they are in 5th and 6th grades. Recommend to show physical models as an array or gridded square (i.e. equal sided square). Note: Perfect Squares: 1 x 1; 2 x 2; 3 x 3; 4 x 4; 5 x 5; 6 x 6; 7 x 7; 8 x 8; 9 x 9; 10 x 10.
41. **Teacher gives word problems – students draw array or group model.** A significant number of students have difficulty knowing if a word problem is a division, multiplication, addition or subtraction problem at this age. Hence, the teacher can provide very simple (verbal) word problems **<u>or</u>** he/she can write them down on a piece of paper and place it on the document camera. Problems should be simple by design. For example, *"John has 3 rocks in all four of his pants pockets. How many rocks does John have?"* Students should draw the group model – 4 circles with 3 stars/dots

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inside each circle for 12 total rocks. When students can draw the math operation model (multiplication, in this case), they completely understand it. The group model can be used for any size numbers in multiplication. For example, *"There were 3 soccer teams with 20 players on each team. How many soccer players are there?"* The student can respond by drawing 3 circles and placing the number 20 in each circle for a total of 60 soccer players. The same methodology can be used to illustrate the physical meaning of arrays. For instance, *"There are soldiers positioned in 3 rows and 4 columns. Draw the array and compute the total number of soldiers."*

42. **Rounding Numbers to the nearest 10; 100; 1,000 or 10,000.** Begin rounding to the nearest 10 and transition to the 100's, etc. when it is appropriate to do so. It is important for students to understand when they are rounding a number less than 5 (i.e. 4, 3, 2, 1) to the nearest 10, it is zero (0). And, when rounding to the nearest 100, that a number equal to 49 or less is also zero. Use Amara Skill Support Resources for quick half-sheet exercises to verify mastery. Transition to larger digit numbers when appropriate.
43. **2-Dimensional Shape Review.** Students should recognize the name of the polygon (straight sided and closed figure) and a circle with the correct mathematical name. Begin with square, rectangle, circle and triangle – add pentagon, hexagon, parallelogram (e.g. *rectangle, rhombus, or square*), quadrilateral, rhombus, trapezoid, and octagon. Note: Teacher can state polygon or circle name: Students respond by drawing it on paper or small white boards for a rapid review. Example: Draw a rectangle, a square and a rhombus. Students create quick sketches, and the teacher questions students, *"What are these three polygons called?"* - Parallelograms. Teacher continues, *"Are they also called quadrilaterals?"* - Yes, they are.
44. **2-Dimensional Shape attributes and classification –** Students should be able to immediately compute the number of sides and vertices (corners) and angles of any 2-dimensional polygons as presented in core lessons and Amara daily resources. Begin with triangles, squares, circles, rectangles. Note: Teacher can state polygon and directions. Students respond by drawing the circle or polygon on paper or small white boards for a rapid review. Example: Draw the three parallelograms. Students respond by drawing a rectangle, square and rhombus. Example: List all the four-sided figures. Quadrilateral (draw a four-sided non-regular figure), trapezoid and all three parallelograms.
45. **Estimation Problems (Quick Oral Practice).** These problems should be very simple in context using small numbers to ensure the students have mastered the skill. The students MUST ROUND the numbers before adding or subtracting – a common mistake is for students to add the numbers and then round either the final difference or sum. Example. *"John bought gum for 25 cents and a candy bar for 46 cents. ABOUT how much money did John spend?"* ***Please note on this problem the following***. If the students rounds 25 and 46 correctly, first, the estimated sum will be correct – 80 cents (30 + 50). However, if they round the sum by adding the addends first (incorrectly), then the estimated sum is 70 cents (25 + 46 = 71). Again, an incorrectly computed <u>*estimated*</u> sum since 71 rounds to 70. Students must round addends, subtrahends or minuends, first.
46. **Division Models – Understanding Division.** Students should be provided simple visual separation problems to completely master the physical meaning of division. The teacher should prepare these models and problems in advance. For example, the teacher could have drawn a picture of 6 flowers and 2 flower pots. The students should be able to visualize and write the division problem that describes placing an equal number of flowers in each pot (6 ÷ 2 = 3). Quick problems that correctly demonstrate the arithmetic concept, so students can mentally visualize the process with larger numbers. It is also effective to show a division model on a number line. Again, the teacher should prepare examples so they can be presented rapidly. In this case the whole number line would show

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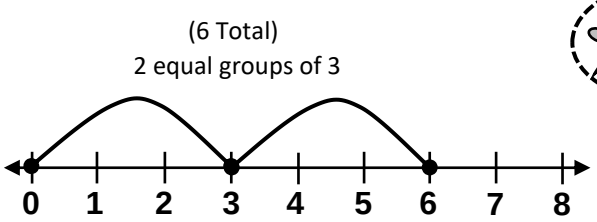
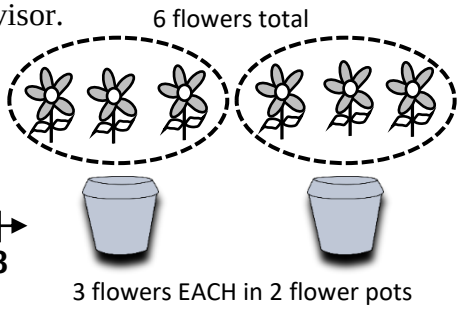
two equal groups of 2, 6 total. The students rapidly visualize there are 3 in each group. The whole number line is effective for either multiplication or division since it provides the product/dividend; hence, students are computing missing factors or quotient or divisor.

***Example:*** Physical meanings of **6 ÷ 2 = 3**




***Note:*** Students should respond by writing the division problem that reflects the model: ***6 ÷ 2 = 3***

47. **Division Facts.** Steady diet each day until most of the class has mastered. It is highly recommended that the students engage in Amara Skill Support practice sheet entitled, "Find the Missing Factor." These 3 sheets are highly effective for students to learn their division facts after they have mastered multiples (skip counting) and their multiplication facts to 12. Recommend Formative Loop!
48. **Clocks. Reading and understanding time.** Begin with hours and half-hours. Students should begin by recognizing the time shown on the clock. It is recommended that besides showing 10:30 or 2:00 o'clock form, use terms like "half-past" ; "quarter till" ; "quarter after" so students understand the vernacular of clock time description. Transition to 10 and 5-minute increments when it's appropriate to do so. Many students will struggle with clock times near the hour until they have had sufficient and corrective practice. For example, 5 minutes till 4 (e.g. 3:55). Please note: Three clock examples per spaced repetition session a day for 6 to 7 days, maximum, and all students have mastered this skill. Always use diagnostic monitoring during these daily sessions.
49. **Missing Clock Hands.** After mastering reading time, students can be given a series of blank clocks with the hands missing. Students are provided a time (2 o'clock, 2:15, 3:30, 5:45), and they draw the hands. **Note:** The teacher should use the vernacular of time: half-past 3, a quarter till or after some given hour, so students become familiar with that means of describing time. Blank clocks are available in the *second grade* Amara Skill Resource packets. The students can complete several exercises and flip the sheet over for more skill development during the spaced repetition session.
50. **Related Multiplication and Division Equations.** This is a valuable review of math facts and relationships between two operations as well as student preparation for fact families. Provide students with a multiplication or division equation. For instance, 6 x 5 = 30. Students write the two complimentary division equations: 30 ÷ 5 = 6 and 30 ÷ 6 = 5. Practice similarly with addition and subtraction, as needed.
51. **Fact Family – Multiplication and Division.** Example: Provide students with three related numbers, and students respond with the correct fact family. The teacher provides the following numbers: 4, 32, 8. Students respond with: (4 x 8 = 32; 8 x 4 = 32; 32 ÷ 8 = 4; 32 ÷ 4 = 8).
52. **Fraction Review.** Students should be able to identify in both group form **<u>and</u>** as a single diagram the following fractional denominators: ½, $^1/_3$, ¼, $^1/_5$, $^1/_6$, $^1/_8$, $^1/_{10}$.
    a.) **Group Form Example:** a set of 5 birds with 4 shaded. $^4/_5$ is the fraction.
    b.) **Polygon/Circle Form Example:** A circle or rectangle equally separated into fourths with a couple segments or all segments shaded. Students respond with the fractional amount shaded or not shaded. **Note:** Students should be familiar with the terms quarter, half, thirds, halves, fourths, fifths, sixths, eighths and tenths in word form. Example three-fifths ($^3/_5$) or four-fourths ($^4/_4$) or two-tenths ($^2/_{10}$). **Note:** Teacher should stress that quarters and fourths are synonymous.

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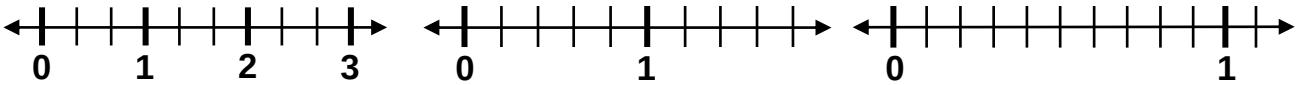
# GRADE 3 - AMARA SPACED REPETITION SEQUENCING RECOMMENDATIONS

**53. Fraction vocabulary.** It is highly recommended that the correct vocabulary of proper fraction, improper fraction, mixed number, numerator and denominator be used when describing fractions, or students will not recognize these same mathematical terms in print form on a state assessment. Note: Students should be given a blank figure or diagram and immediately be able to compute the denominator. Students must also be reminded that fractions always possess equal segments of division. A critically important introduction in fraction concepts are fractional number lines. Students should be given a blank fractional number line with only the whole numbers listed (see below). Students should be able to determine the fraction that describes the number line by counting the '**SPACES**' and *NOT* the LINES between the whole numbers. Prepare the number lines in advance for the rapid review of the fractional number lines and fraction identification as annotated in number 51 above. Focus on halves, fourths, and tenths, but it is an easy and extremely valuable exercise to complete thirds, fifths and eighths fractional number line recognition as well in third grade. Example: Write the **denominator** of the fractional number lines on the line provided.




a.) _____ (Thirds) b.) _____ (Fifths) c.) _____ (Tenths) ← *Answers*

**Vocabulary Notes:**

*Proper fractions* are less than 1 whole or 1 (e.g. ½ , $^{7}/_{8}$, $^{2}/_{4}$).
*Improper fractions* are **greater than or equal to** 1 whole (e.g. $^{4}/_{3}$, $^{2}/_{2}$, $^{6}/_{6}$, $^{9}/_{5}$).
*Mixed Numbers* possess both a whole number and a proper fraction (e.g. 1 ½ , 2 ¾).

**54. Draw a fraction and shade it.** Students should draw fraction in halves or thirds or fourths of polygons or circles. This exercise is easy to do once students know how to divide a figure in equal parts by partitioning. Partition 2 dimensional figures in halves between each tick mark(s), and students will easily create equally parsed two-dimensional figures up to 8. After equal divisions are created, shade some fractional amount as provided by the teacher's instruction. For instance, the teacher may say, "*Draw a square on your paper. Divide the figure into fourths* (half on each side of square – connect lines)", or he/she may say, *"The numerator is 3 and the denominator is 4. Draw and shade your square." or "Shade three-quarters of the parallelogram."*

**55. Comparing Fractions with < , > and = sign.** The teacher can begin with equal sized fraction diagrams of halves through tenths. Comparing fractions using diagrams is relatively easy for elementary students because one is evaluating the area of each fraction. A more difficult fraction comparison is when there is no diagram and only the fractions in number form are given and compared. If the numerators OR the denominators are the same, this is an easy comparison for students. For instance, $^{1}/_{3}$ and ¼ are compared or $^{2}/_{5}$ and $^{4}/_{5}$. However, if the numerators and denominators are both different, this is much more difficult for third grade students to visualize and compare. For example, comparing $^{2}/_{5}$ and $^{3}/_{6}$ is challenging for most students. In fifth grade, students learn to compute a common multiple/denominator and compute equivalent fractions with the same denominator, but those skills are not taught until fourth and fifth grades. In this case, there are a couple methods. **One method** that is effective at this age is to teach students to multiply the numerator by the other fraction's denominator and then compare. For example, when comparing $^{2}/_{5}$ and ¼, multiply the 2 and 4 to obtain 8. Then, multiply the 5 by 1 for a product of 5. Since 8 is bigger than 5, the fraction $^{2}/_{5}$ is larger than ¼. See example below. There is a lack of physical

understanding in this method, however, the amount of qualitative work on fractions when comparing fractions with different numerators and denominators will be extensive.

$$\frac{2}{5} \bigcirc \frac{1}{4} \Rightarrow \overset{8}{\frac{2}{5}} \times \overset{5}{\frac{1}{4}} \Rightarrow \frac{2}{5} > \frac{1}{4}$$

**Another method** to compare proper fractions is for the teacher to teach halving numbers to mastery. Then, the student takes half of the fraction's denominator. Hence, if a fraction is $^{7}/_{12}$ – then, half of the denominator 12, is equal to 6. So, $^{6}/_{12}$ is equal to the fraction ½. In doing so, the student can compare $^{7}/_{12}$ to $^{6}/_{12}$ and know that it is greater than ½ or $^{6}/_{12}$. The student knows the relative size of the fraction $^{7}/_{12}$. The teacher should also practice determining if the fraction is closest to 0 (zero) and 1 Whole with fractions. So, the fraction $^{1}/_{8}$ is closest to 0 (zero) and the fraction $^{7}/_{9}$ is closest to 1 Whole. With an ability to estimate fractions to 0 (zero), greater or less than $^{1}/_{2}$ and 1 Whole, a 3rd grader, *with threshold practice*, can accurately compare most proper fractions.

56. **Coin Names and Values Review.** Penny 1¢; Nickel 5¢; Dime 10¢; Quarter 25¢; Half-dollar 50¢. Show visuals of coins and students write down or visually show using their fingers how much the coins are worth. For a penny, nickel and dime, students can show value by showing appropriate number of fingers. For a quarter or half-dollar, students can show two fingers on one hand and 5 on the other to represent a quarter.
57. **Adding Coins and Bills.** Teacher can show a picture or name some amount of bills and a couple coins. Students quickly add coins and bills. Students must write the total sum as both 3 dollars and 35 cents and $ 3.35. Note: Students should count coins from largest value to smallest values. If a student is given 2 quarters, a penny and a dime, the students should count the quarters first, then the dime and lastly, the penny for it is easier to mentally add in this manner for most students.
58. **Group Model with Two by One Multiplication Digits.** Begin with small numbers and gradually build to larger multiplication equations. But, solidify a physical concept of multiplication (repetitive adding) using two by one digit numbers. For example, show students a group model for multiplication and they compute a product. Reverse the process each day as well. Provide the multiplication problem and students draw the group model that represents the equation. Finally, provide a short but simple verbal word problem and students create the group model and complete the computation. The Amara Skill Resource Packet has both multiplication and division group model diagrams for student practice.

Example: $\underset{1}{30}\ \underset{2}{30} \ldots \underset{6}{30} \Rightarrow$ **30 x 6 = 180**

59. **3 Dimensional or Space Figure and attributes review.** Teachers should review the names of all space figures from the primary grades: triangular prism, triangular pyramid, cube, rectangular prism, rectangular pyramid, pentagonal prism, hexagonal prism, octagonal prism, and sphere. Students should be able to count the correct number of the faces, vertices and edges on each space figure. Students often struggle between the appearance of a prism and a pyramid. A pyramid comes to a single point from each side. Hence, if the figure has a single vertex, it is a pyramid, not a prism.
60. **Elapsed Time.** The student must first be able to read and understand clock time. It is recommended that the teacher show two clocks (quarter hours, half hour or hour time only). Students calculate the elapsed time. Problem types should be simple– no problems involving a transition from AM to PM. For example, one clock may show 3:45 and a second clock 4:15. Students compute the elapsed time.

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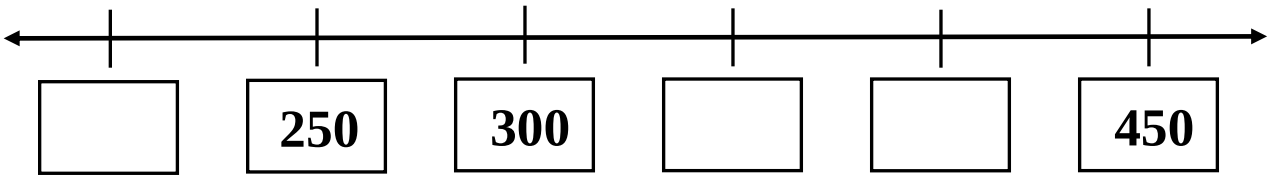
# GRADE 3 - AMARA SPACED REPETITION SEQUENCING RECOMMENDATIONS

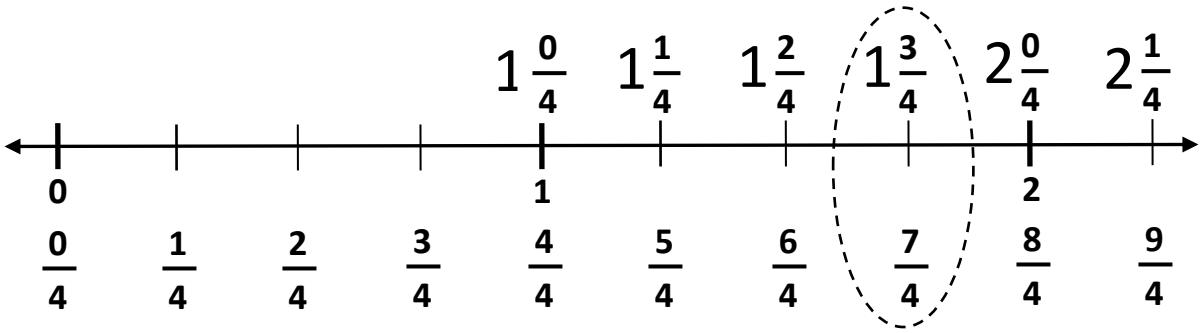
Note: it is helpful to require students to learn the first five multiples of 15 separately (e.g. 0, 15, 30, 45, 60) as a separate skill in spaced repetition. In five days, all students will have mastered multiples of 15, and elapsed time is much easier since students previously have mastered skip counting (multiples) of 5 and 10s. Finally, as students become more proficient, the teacher can provide simple word/verbal problems involving elapsed time. For instance, *"Luz left home at 4:30 and she returned at 5:15. How long was she gone?"*

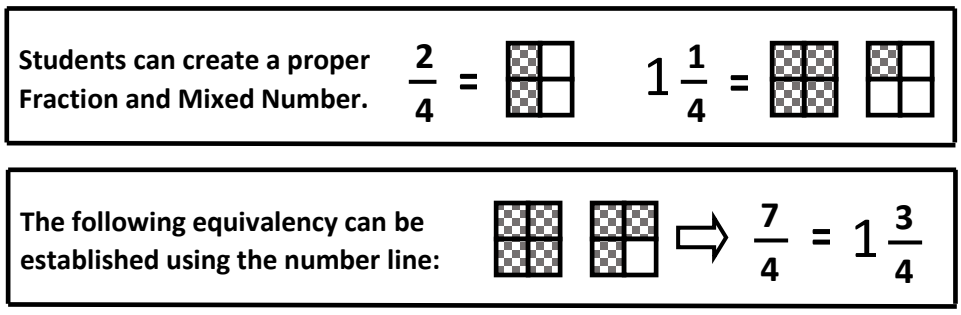
61. **Base 10 Place Value Expansion.** Students should be exposed to a daily diet of two problems until this skill is mastered. Begin with the two-digit numbers then transition into 3, 4 and 5 digit numbers. Students should be given a two-digit number and write the number in expanded base 10 form. For example: 34 = (3 x 10) + (4 x 1) or 409 = (4 x 100) + (0 x 10) + (9 x 1).
62. **Large Whole Number Lines – Fill in the missing numbers.** The teacher can use the blank number lines located in the Amara Skill Support Resources to create number lines of any size. The teacher should present a number line with missing values and students quickly calculate the missing whole numbers. Transition to larger numbers as students demonstrate proficiency of two and three-digit numbers.

    **Example:** Whole number line completion with an increment of 50.




63. **Fractional Number Lines – Proper Fractions and Mixed numbers – ½'s , ¼'s and 1/8's.** This exercise is a powerful skill for students to master. The students have learned to compute the denominator of a fractional number line earlier in the semester. Hence, given a blank number line with only whole numbers shown e.g. (0, 1, and 2 below), students should complete the fractional number line with the proper fractions (and improper fractions, if time permits) and mixed numbers.




After students complete the fractional number line, the teacher should choose a proper fraction and mixed number/improper fraction for students to draw that represents the fraction as well as a

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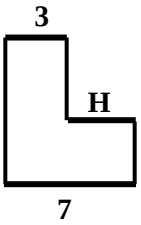
complete understanding of a fractional number line. If improper fractions are shown, an equivalency can be shown (see examples above).

64. **Find the Missing Side(s) of an L-Polygon.** The teacher can present an L-Shaped Polygon (Hexagon) and the students find the missing sides. Use the Amara Practice Sheets on this skill for homework, after this skill has been presented in class. It should be noted that this is a challenging task for almost all students in this grade; however, with sound pedagogy and short practice sessions, students master it. It is also an important skill to understand for computing perimeter and area problems. The teacher should focus only on the horizontal dimensions initially with vertical dimensions NOT present on the figure (first example on the left). After the horizontal process is mastered, do the same for the vertical dimensions (middle example). Finally, combine both missing horizontal and vertical dimensions on the same diagram (example on right). Students master this skill with correct practice and consistent pedagogical instruction.



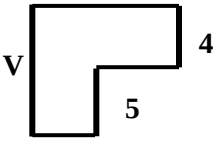

**H Calculation**

3 + H = 7

or

7 – 3 = H

**Horizontal L-Shape**



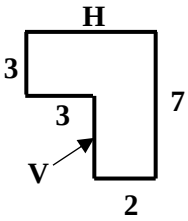

**V Calculation**

4 + 5 = V

or

5 + 4 = V

**Vertical L-Shape**




**H & V Calculation**

2 + 3 = H

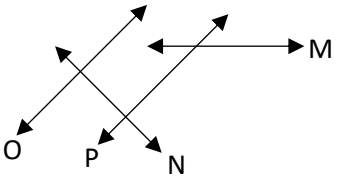
and

7 - 3 = V

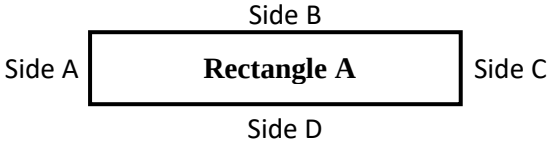
**Horizontal-Vertical L-Shape**

65. **Parallel and Perpendicular Lines.** The word 'para**ll**el' has two L's (i.e. **ll**) in its name adjacent to each other. Hence, students can remember para**ll**el lines by this mnemonic. Students should be given parallel and perpendicular lines in a diagram, and then name two of each as an example. Extend the concept into parallelograms – which may be more difficult at first exposure. Students can write two lines as parallel and/or two lines as perpendicular. See examples below.

**Examples:**




Lines O and P are parallel




Sides A and B are perpendicular

66. **Area and Perimeter Qualitative Understanding.** Students must understand the difference between these two arithmetic concepts. An easy introduction for students to conceptually grasp is for the teacher to instruct students to hold up a book/novel or a piece of paper, and the students visually show what the *perimeter* means with their hand – by feeling the OUTSIDE of the paper/book/novel edge. The students can do the same with *area*, but use their hand to feel the inside of the paper/book/novel.

**Vocabulary Note:**

*Area* is the *inside space* of a 2-dimensional polygon. Its units are square units/inches/centimeters; whereas, *Perimeter* is the distance around the outside of a 2 dimensional polygon. Its units are

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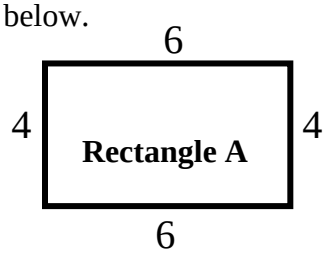
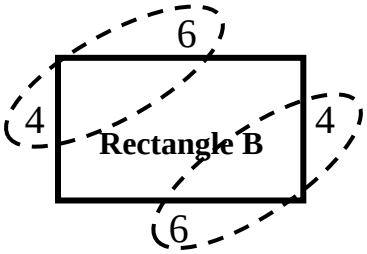
linear units in millimeters, centimeters or inches. Also, the prefix 'peri' means **around**. And, 'meter' means **measure**. Hence, perimeter is defined as '**measure around**.'

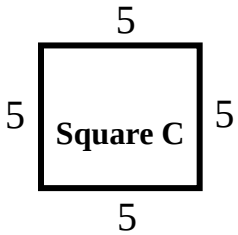
67. **Perimeter and Area Computations – Simple Grid.** Students have a gridded rectangle or square. Students count the squares inside the parallelogram and compute the area. Students can also count the squares on the outside edge of the polygon and compute the perimeter. It is recommended the students place a check (✓) on the inside of the rectangle when computing the area, and place a check (✓) on the outside edge when calculating the perimeter so they count correctly.
68. **Perimeter and Area Computations – Parallelograms and Polygons – without grid.** Use <u>only</u> **area** calculations on parallelograms, but **perimeter** computations can be for any polygon from a triangle to an octagon. Provide two problems each day for a week and a half, and the students will own this content.
69. **Perimeter and Area Computations – L-Shaped Grid.** Similar procedure to 67 above. Students should be given a simple L-Shaped Grid, and the students count to compute the area and perimeter. Easy examples to promote the concept should be provided.
    **Note:** Require students to use checks (✓) for each outside grid edge to minimize and eliminate errors in counting.
70. **Perimeter and Area Computations – L-Shape without grid.** If given all the sides and the students are not required to calculate a missing side as shown in 64 above, then it is relatively easy for children that possess math fact competency to compute the perimeter and area of polygons. The **perimeter** computations are straightforward adding problems of six numbers. However, on the **area** computations, the students should separate the L-Shape polygon into two (2) separate rectangles. Then, they should compute the area of each rectangle and add the two products together to find the total area of the L-shaped polygon. The most difficult aspect of the area computation is for students to choosing the correct adjacent sides to multiply and compute the area of each rectangle. If this is the case, then require students to lightly shade one rectangle and crosshatch the other rectangle so they may better visualize the two discrete rectangular areas of the L-shape.
71. **Parallelogram Perimeter computations using multiplication.** Students often become accustomed to only adding when computing the perimeter of rectangles and squares. The perimeter formula that involves multiplication often confuses them – Perimeter of a rectangle = 2 x (L + W) or a square = 4 x (s). However, if the students calculate the perimeter by addition only, and then use the formula with a visual group model, they readily understand it. After that, only several days practice in the spaced repetition process and they become highly proficient in either computation. See examples below.




**<u>Perimeter of Rect. A</u>**
**P =** 4 + 6 + 4 + 6 = 20




**<u>Perimeter of Rect. B</u>**
**P =** 2 x (4 + 6) = 20
Note: 2 equal groups of 10.




**<u>Perimeter of Square C</u>**
**P =** 5 + 5 + 5 + 5 = 20
**P =** 4 x (5) = 20
Note: 4 equal groups of 5.

**Note:** Stress that the operations in the parenthesis are always computed first. Hence, (4 + 6) is added and then, the sum of 10 is multiplied by 2.

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Additionally, there are **TWO equal groups** of 10 – (i.e. 4 + 6) should also be a focal point of the pedagogy. Circle or ring the two equal groups as in the diagram, so students conceptually comprehend why it is mathematically possible to multiply the two equal groups.

**72. Add Skills at the discretion of classroom teacher based on professional judgement and experience.**

**Author's Note:** A daily spaced repetition session should require between 5 to 12 minutes of time. However, some teachers vary this time depending upon the skill and circumstances in their classrooms. It is important to note that the teacher must be highly organized in order to move quickly through the process and maintain student engagement. It is highly recommended that the teacher use a diagnostic medium in these sessions. For example, students that struggle academically should be seated in the classroom so the teacher can readily observe their work and accuracy. As those students master the skills, then the teacher knows to replace the mastered skill with a new one. The teacher can also work with those few students either individually or in a small group to ensure that they master the skill at a later time in the class or day. ***A teacher's objective must be mastery of grade level math skills by ALL students or a numeracy gap will foment and widen in later grades***.

Additionally, a couple weeks later, for instance, the teacher can **spiral review** to previously presented math skills and guarantee with absolute certitude --- that all students have indeed mastered grade level or prior grade level skill(s). *Application mathematics* in the arithmetic elementary grades are generally given in the form of a short 'story' or 'word' problem. These word problems are nothing more than a combination of discrete arithmetic skills listed in this document. If those arithmetic skills are mastered, there is a high probability that students will not be overwhelmed and easily solve arithmetic application problems correctly.

Blaine C. Helwig

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