Problem Solving Strategies for Third Graders

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Overview

The purpose of this curriculum unit is to develop students' critical thinking skills. This unit is designed to further students' understanding of addition, subtraction, multiplication, and division number stories (word problems) and to provide students with problem solving strategies. It addresses the following strategies: Guess and Check, Find a Pattern, and Draw a Picture. Using these strategies, students explore:

1. How are addition, subtraction, multiplication, and division related to each other?
2. What are some strategies for solving addition and subtraction word problems?
3. What are some strategies for solving multiplication and division word problems?

This unit is intended to complement the School District of Philadelphia's pre-existing curriculum (*Everyday Math*). The allotted time for this unit is three weeks in the fall. The focus is addition and subtraction word problems. Its audience is third grade students in a low to mid-income urban neighborhood.

Rationale

Mathematics is the single most important discipline to be taught because of its pervasiveness in our society. It is used every day, in almost every capacity of daily existence. Problem solving is essential because it teaches within a context. It develops the skills that are necessary to find solutions, and it motivates the mind much more than skills that are taught in isolation. Problem solving is a pathway for skills already learned, gives it the real life framework needed by students to persevere through increasingly complex problems. (Taplin, no date) It gives students confidence, a starting point, and the ability

to transfer skills when faced with new mathematical situations (Higgins, 1999). The National Council of Teachers of Mathematics recommends a focus on problem solving because it involves skills used in everyday life. It allows for students to create and build upon their own theories about mathematics. It allows for the transference of previously learned material into new situations, which allows for deeper learning and understanding and adaptation to new situations. Problem solving also allows for logical reasoning, vital in today's society. (Taplin, no date)

The School District of Philadelphia (SDP) uses *Everyday Math* as its curriculum, and solving the four basic operation number stories is a major theme in the SDP's Planning and Scheduling Timeline for third grade. These four operations are fundamental skills in mathematics, while number stories apply these skills into everyday life. These concepts show up repeatedly in Everyday Math. Yet, the curriculum fails to provide students with critical thinking skills that are necessary for the students to develop an instrumental understanding of this topic. Thus, teachers need to supplement the curriculum with concrete approaches that will help students develop these necessary skills.

Problem solving involves discovery rather than passive learning. Because of the NCTM's recent focus, it has resurfaced in standardized testing, giving teachers an increased need to integrate it into math lessons. (Higgins, 1999) The pedagogical focus of this unit centers on Guess and Check, Find a Pattern, and Make a Picture. These strategies will help students master number stories. The lessons in this curriculum unit address the shortcomings in the curriculum and present students with strategies to be used with a variety of word problems that will address the state standards. With these problem solving skills, students will achieve in higher grades and high stakes testing where critical thinking skills are expected and required. Students with problem solving capabilities were found to be better communicators of what they did, had a higher understanding of the usefulness of math and had higher levels of mathematical achievement than their peers who did not possess the same skills (Higgins, 1999). This will greatly enrich students' learning experiences because they will have more tools at their disposal to enhance their understanding of the four basic operations. They can then apply this understanding into everyday life through number stories. They will develop a "relational understanding" instead of "instrumental understanding" of this topic. In the end, the hope is the students will then use this understanding in other aspects of their lives, their education, and their future.

Mathematical Background

The three strategies that are the most conducive to a third grade classroom are: Guess and Check, Find a Pattern, and Make a Picture. These strategies will be a springboard for the critical thinking that is the emphasis of this unit. They can be explained as follows:

1. Guess and Check
    a. Students make a reasonable estimate of the answer, check to see if it satisfies the problem, and continuously adjust their answer until it is correct.
2. Find a Pattern
    b. Students look for a pattern within a group of numbers, shapes or other objects. Then they apply the pattern to a new situation.
3. Draw a Picture
    a. Students create a picture that illustrates the problem that they are working with. This picture, in turn, allows the student to solve the problem.

The focus will be on addition/subtraction number stories in the fall. The three strategies will be taught within a series of word problems. The word problems will be aligned with the student's depth of knowledge at that time of the year. They will be limited to single and double-digit addition, and subtraction. These lessons will build from the students' previous learning. Once each strategy has been mastered, the next will be taught. When they all have been mastered, students will show their understanding by being able to choose the best strategy (for them) to use to solve the problem and explain why and how that strategy assisted them.

The goal of these lessons is to prepare the students for more advanced mathematic concepts such as multiplication and division.

E.g. 1: Jack has $10. He wants to buy 5 notebooks. Each notebook cost $1.75. Does Jack have enough money to?

Guess #1: The notebook is about $2. $2 x 5 = $10, so Jack has enough.
Check #1: $1.75 x 5 = $8.75

E.g. 2: Extensions of Multiplication and Division Facts

6 x 7 = 42	12 / 4 = 2
6 x 70 = 420	120 / 4 = 20
6 x 700 = 4200	1200 / 4 = 200

E.g. 3: What's My Rule?

In
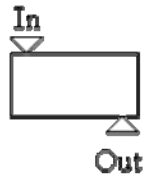
in	out
3	12
5	20
-	28
9	
	44

In
x4
Out

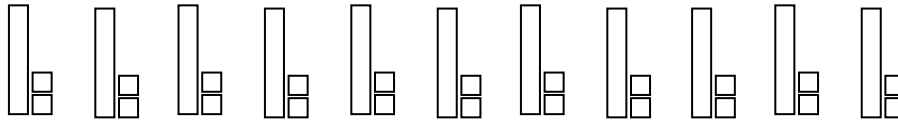| in	out
3	12
5	20
-	28
9	36
11	44

E.g. 4: Mike bought 9 packets of candy. There were 8 pieces of candy in each pack. How many pieces of candy did Mike buy?
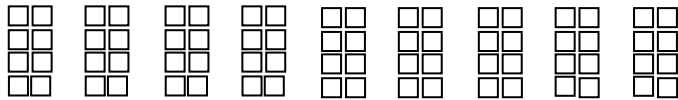
8 + 8 + 8 + 8 + 8 + 8 + 8 + 8 + 8= 8 x 9 = 72

E.g. 5: Janice is planting carrots in her garden. She has 132 carrots seeds and she wants to plant 12 carrots in a row. How many rows of carrots can Janice plant?

132 / 12 = 11

Strategies

After a brief introduction of Guess and Check, Make a Picture, and Find a Pattern and their usefulness in solving mathematical word problems, this unit will focus on each of the three strategies in depth.

Strategy #1: Guess and Check
Guess and Check is the first approach taught. The students are most familiar with this strategy. The emphasis will be on using logic to adjust their guess. Students often do not pay attention to the outcome of their guess, continue in the wrong direction, get frustrated and then give up.

Eg. #1: Find Differences
Which is more, 154 or 131? _____   How much more? _____

Guess #1: 154 is more.
Check #1: 154 is after 131 on the number grid.

Guess #2: 154 is 5 more than 131.
Check #2: 131 + 5 = 136. 136 is a lot less than 154, so the guess needs to be a lot bigger than 5.

Guess #3: 154 is 25 more than 131.
Check #3: 131 + 25 = 156. 156 is now bigger than 154, so the guess needs to be smaller than 25. Also, 156 is two bigger than 154.

Guess #3: 154 is 23 more than 131.
Check #3: 131 + 23 = 154.

E.g. #2: Solving Problems with Dollars and Cents
Amy has $2. She wants to buy a notebook that costs $0.99 and a box of pencils that costs $1.49. Does Amy have enough money to buy the notebook and the box of pencils?

Guess #1: The notebook is about $1 and the box of pencils is about $1.50. $1 + $1.50 = $2.50, so Amy does not have enough.
Check #1: $0.99 + $1.49 = $2.48

Strategy #2: Find the Pattern
Find the Pattern is the last approach taught. Problems may involve any of the four processes and will eventually extend beyond numbers to shapes and other objects. This skill lays the groundwork for many more complicated math problems that our students will face. Mastering this skill will assist them the most in their future schooling.

E.g. #1: Number Grids

541		543
	552	
561		563

26	27
36	
46	

E.g. #2: Frames and Arrows

Rule
- 2

17 ⟳ ⃝ ⟳ 13 ⟳ ⃝ ⟳ ⃝ ⟳ 7

Rule						
+3	○	23	26	○	○	35
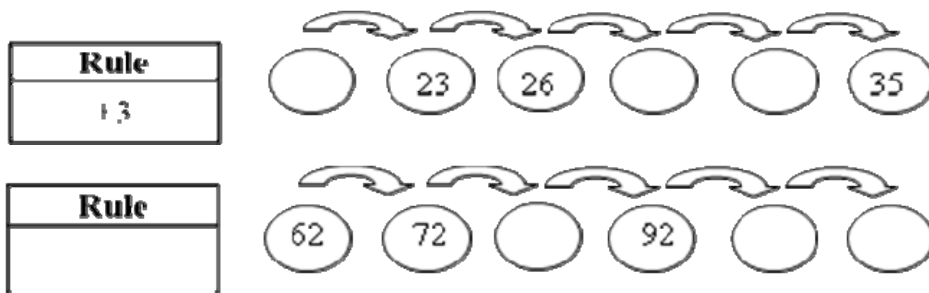
Rule						
	62	72	○	92	○	○

E.g. #3: Extensions of Addition and Subtraction Facts

12 – 5 = 7	11 – 7 = 4
120 – 50 = 70	21 – 7 = 14
1,200 – 500 = 700	81 – 7 = 74

E.g. #4: What's my rule?

In
Out

in	out
34	40
40	46
50	56
56	
	68

In
+6
Out

| in	out
34	40
40	46
50	56
56	60
62	68
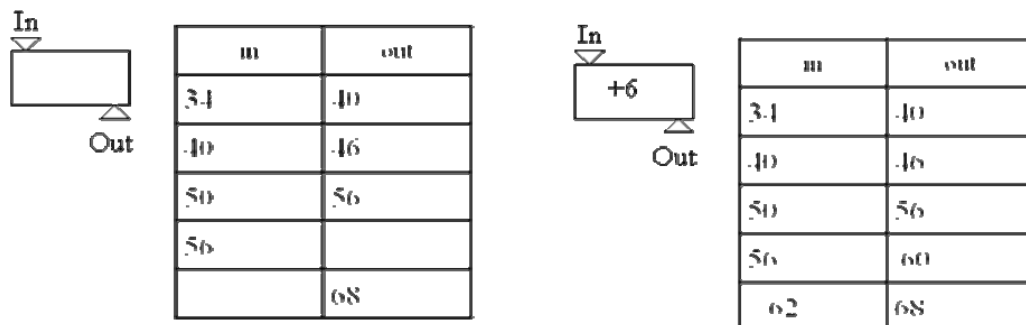
Strategy #3: Draw a Picture

Draw a Picture is the second strategy taught. During the fall, this strategy solidifies students' understanding of addition and subtraction. In the spring, students use this strategy to gain a conceptual understanding of multiplication and division. They can actually see how it is different from addition and subtraction too.

E.g. #1: Parts-and-Total

Marissa read her book for 25 minutes on Monday and 30 minutes on Tuesday. How many minutes in all did she read?
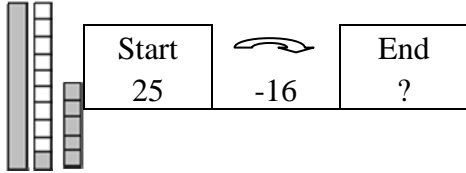
Monday   Tuesday

Total	
?	
Part	**Part**
25	30
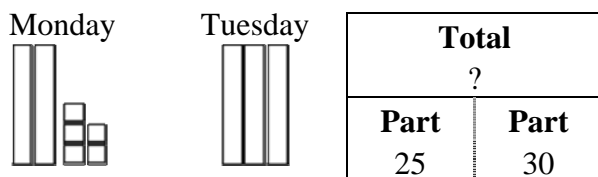
Number Sentence: 25 + 30 = 55

Answer: 55 minutes

Check: 55 minutes is greater than both parts.

E.g #2: Change Number Stories

Marcus had $25 in his wallet. He spent $16 at the store. How much money was in Marcus's wallet then?
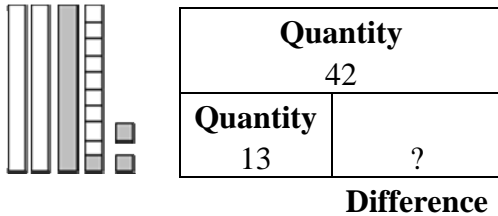
Start	⌒	End
25	-16	?

Number Sentence: 25 – 16 = 9

Answer: $9

Check: 16 + 9 = 25

E.g. #3: Comparison Number Stories

Jenna has $42. Her brother has $13. How much more does Jenna have?

Quantity 42	
Quantity 13	?

Difference

Number Sentence: 42 – 13 = 29

Answer: $29

Check: 13 + 29 = 42

Each lesson, in order to ensure student engagement, will consist of direct teacher instruction as well as partner and independent activities.

Classroom Activities

- Two Lessons on Guess and Check
  - These lessons can be found below.
- Four Lessons on Make a Picture
  - These lessons can be found below.
- Six Lessons on Find a Pattern
  - The first four lessons can be found below.
- Review
  - This will be one to two lessons depending on the students' needs. It will be a

review of all the strategies.
- Assessment
  - This lesson can be found below.

Lesson Plan (Guess and Check) – #1

Objectives:
- The students will learn:
  - To use guess and check to find differences between pairs of numbers.
  - To identify patterns in a number grid.

PA Mathematics Standards:
- 2.1.3.F – Apply number patterns (even and odd) and compare values of numbers on the hundred board.
- 2.5.3.A – Use appropriate problem-solving strategies (e.g., guess and check, working backwards).

Materials:
- Number Grid (1-100)
- *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 13*
- Students' Math Notebooks
- *Everyday Mathematics (Grade 3) – Home Links: p. 19*

Plans:
1. Warm Up (5 minutes)
   a. Teacher displays a Number Grid (1-100) on the board.
   b. Teacher asks: *Which is less 27 or 23? How much less? How did you figure that out?*
      i. Students: *23 is less. 23 is 4 less than 27. I counted backwards on the number grid.*
   c. Teacher asks: *Which is less 45 or 37? How much less? How did you figure that out?*
      i. Students: *37 is less. 37 is 8 less than 45. I counted backwards on the number grid.*
   d. Teacher asks: *Which is less 93 or 48? How much less? How did you figure that out?*
      i. Students: *48 is less. 48 is 45 less than 93. I counted backwards on the number grid.*
   e. Teacher thinks aloud: *Counting backwards took a long time. I wonder if there's an easier method of solving this.*
2. Introduction (5 minutes)
   a. Teacher writes on the board and asks: *What do you think guess and check*

mean?
- b. Students will write in their math notebooks what they think guess and check means.
- c. Students share their thoughts with a partner.
- d. Students share their thoughts with the class. Teacher will record the students' ideas.
3. Model (10 minutes)
    - a. Teacher reads problem: *Which is less 30 or 57? How much less?*
    - b. Teacher thinks aloud: *I know that 30 is not in the same row as 57 and there are 10 numbers in one row, so I'm going to guess 10. Now I'm going to check if my guess is correct.*
    - c. Teacher performs the check on the board.
      $30 + 10 = 40$
    - d. Teacher thinks aloud: *Ok 10 got me closer to 57, but I'm not there yet. I know that 40 is not in the same row as 57, so I'll guess another 10.*
    - e. Teacher performs the check on the board.
      $40 + 10 = 50$
    - f. Teacher thinks aloud: *Ok another 10 got me closer to 57, but I'm not there yet. I know that 50 is in the same row as 57, so I'll guess something less than 10. I'll guess 8.*
    - g. Teacher performs the check on the board.
      $50 + 8 = 58$
    - h. Teacher thinks aloud: *Now I'm over 57. I know that 58 is 1 more than 57. So I'm going to subtract 1.*
    - i. Teacher performs the check on the board.
      $58 - 1 = 57$
    - j. Teacher thinks aloud: *To get from 30 to 57, I did 10 + 10 + 8 – 1, so 30 is 27 less than 57.*
4. Guided Practice (15 minutes)
    - a. Teacher reads problem: *Which is less 34 or 86? How much less?*
        - i. Students make guesses, explain their guess, and check their guesses.
    - b. Teacher reads problem: *Which is less 56 or 92? How much less?*
        - i. Students make guesses, explain their guess, and check their guesses.
        - ii. Teacher guides the students to see that each row has 10 numbers, so the students can make their guesses more accurate if they counted by tens.
5. Independent Practice (15 minutes)
    - a. *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 13.*
6. Wrap Up (10 minutes)
    - a. Review *Everyday Mathematics (Grade 3) – Student Math Journal*

(Volume 1) – p. 13.
7. Homework: *Everyday Mathematics (Grade 3) – Home Links: p. 19*

Lesson Plan (Guess and Check) – #2

Objectives:
- The students will learn:
    - To use guess and check to solve problems involving money.
    - To determine when a situation needs an exact answer or an estimate.

PA Mathematics Standards:
- 2.1.3.J – Estimate, approximate, round or use exact numbers as appropriate.
- 2.5.3.A – Use appropriate problem-solving strategies (e.g., guess and check, working backwards).

Materials:
- *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 20 & 21*
- Students' Math Notebooks
- *Everyday Mathematics (Grade 3) – Student Reference Books – p. 214*
- *Everyday Mathematics (Grade 3) – Home Links: p. 25*

Plans:
8. Warm Up (5 minutes)
    a. Students share their observations about the stationery store poster in *Everyday Mathematics(Grade 3) – Student Reference Books – p. 214.*
    b. Talk the terms *for sale* and *on sale*.
    c. Discuss the difference between the *sale price* and the *regular price*.
9. Introduction (5 minutes)
    a. Teacher writes on the board and asks: *What do you think estimate mean*?
    b. Students will write in their math notebooks what they think guess and check means.
    c. Students share their thoughts with a partner.
    d. Students share their thoughts with the class. Teacher will record the students' ideas.
    e. Teacher poses the questions: *When would you estimate and when would you calculate the actual cost?*
    f. Students will write in their math notebooks what they think guess and check means.
    g. Students share their thoughts with a partner.
    h. Students share their thoughts with the class. Teacher will record the students' ideas.
10. Model (10 minutes)

a. Teacher reads the problem: *I'm at the stationary store. I have $2. Do I have enough money to buy a notebook and a box of pencil?*
b. Teacher thinks aloud: *The problem does not ask for an exact amount. It only asks whether $2 is enough to pay for the items, so I'm going to estimate. According to the stationary store poster, the pencils cost $1.49 and the notebook costs $0.49. First I'll round $1.49 up to $1.50 because $1.49 is closer to $1.50 than $1.40. Then I'll round the $0.49 to $0.50 because $0.49 is closer to $0.50 than $0.40. Now I'll add $1.50 and $0.50, which equals $2 exactly. Since I rounded both amounts up, I know that the actual cost amount is a little less than $2. So, I have enough money.*
c. Teacher then checks that the estimate was correct.
$1.49 + $0.49 = $1.98

11. Guided Practice (15 minutes)
   a. Teacher reads problem: *I'm at the stationary store. I have $5. Do I have enough money to buy a box of pens, a box of pencil, and a box of crayons?*
      i. Students make estimates, explain their estimates, and check their estimates.
   b. Teacher reads problem: *I'm at the stationary store. I want to buy want to buy a notebook, a box of paper clips, and a box of pens. About how many dollar bills will I need to give to the shopkeeper?*
      i. Students make estimates, explain their estimates, and check their estimates.

12. Independent Practice (15 minutes)
   a. *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 20 & 21.*

13. Wrap Up (10 minutes)
   a. Review *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 20.*

14. Homework: *Everyday Mathematics (Grade 3) – Home Links: p. 25*

Lesson Plan (Patterns) – #1

Objectives:
- The students will learn:
  - To understand and identify a pattern.
  - To predict how to continue a pattern.

PA Mathematics Standards:
- 2.8.3.A – Recognize, extend, create and replicate a variety of patterns including attribute, activity, number and geometric patterns.

Materials:
- "We Will Rock You" by Queen

- *Everyday Mathematics* pattern blocks and base ten blocks

Plans:
1. Warm Up (5 minutes)
   a. Teacher introduces the first 1 minute of the song "We Will Rock You" by Queen.
      i. What beat do you hear throughout the beginning of the song? Use your mouth to make the sound
      ii. What beat do you think you will hear throughout the rest of the song?
      iii. We listen to confirm.
2. Introduction (5 minutes)
   a. Teacher asks: *Without the song, let's recreate this beat with our hands.*
      i. Teacher asks: *This is called a pattern. It is a beat that creates a musical pattern and it repeats over and over again.*
      ii. Teacher asks: *Once a pattern is recognized, you can use part of it to predict the rest of the pattern.*
   b. Teacher asks: *Who can come up with another clapping pattern for us?*
      i. Teacher asks: *Who can continue this pattern?*
      ii. We continue in this way for a few examples.
3. Model (10 minutes)
   a. Teacher asks: *Patterns also exist in other areas.*
   b. Teacher draws a pattern on the board using 6 shapes.

   △ △ ☐ ◯ △ △ ☐ ◯ △

   c. Teacher thinks aloud: *The first thing I need to do is figure out what the pattern is. I notice that the pattern repeats the first shape, and then changes to the next shape and then the next. So I know, the pattern is going to continue in the same way repeating the first shape and then changing to the next two shapes.*
   d. Teacher continues in this way with the following patterns:

   ◇ △ ◇ ◇ △ △ ◇ △ ◇ ◇

   ☐ ☐ ◇ ◯ ◯ ◇ ☐

   ◇ ◇ ◯ ◯ △ ☐ ◇

4. Guided Practice (15 minutes)
   a. Teacher poses a pattern on the board using shapes. Students have triangles, squares, diamonds and hexagons in front of them.
   b. Teacher asks: *What is the pattern?*

   ◇ ◇ ◇ △ △ ☐ ◇

i. Teacher asks: *What do we need to do to continue this pattern?*
ii. Continue the pattern with your blocks.
iii. Teacher asks: *What should it be?*
iv. Teacher writes the continued pattern on the board.
c. Teacher poses an additional pattern using base ten blocks.

i. Teacher asks: *What is the pattern?*
ii. Teacher asks: *What do we need to do to continue this pattern?*
iii. Continue the pattern with your blocks.
iv. Teacher asks: *What should it be?*
v. Teacher writes the continued pattern on the board.

5. Independent Practice (15 minutes)
    a. Students complete the following problems with a partner using pattern and base ten blocks.
        i. △△△□◇△ , ____ , ____ , ____
        ii. ▢▫▯▫▯▢ , ____ , ____ , ____
        iii. ◇▢◇◇▢◇◇◇ , ____ , ____ , ____
6. Wrap Up (10 minutes)
    a. Review the problems from independent practice.
7. Homework: Students create three shape patterns using triangles, hexagons, diamonds, and squares and three music patterns using claps, beats, and pops.

Lesson Plan (Patterns) – #2

Objectives:
- The students will learn:
    - To transfer knowledge of patterns to numbers and to recognize and complete said patterns.

PA Mathematics Standards:
- 2.8.3.A – Recognize, extend, create and replicate a variety of patterns including attribute, activity, number and geometric patterns.

Materials:
- Calculators (optional)
- Number lines/grids found in most classrooms.

Plans:
1. Warm Up (5 minutes)
    a. Teacher claps a pattern, asks someone to continue it.
    b. Students volunteer clapped patterns that the class continues.
2. Introduction (5 minutes)
    a. What is it called when something is repeated over and over again?
        i. Teacher asks: *Do you only find patterns in music? Where else do you find patterns?*
        ii. Teacher explains: *In math, many times you will see number patterns. Number patterns are similar to music and shape patterns in that there is something that repeats over and over.*
        iii. Teacher explains: *Usually, it is not the actual numbers that repeat, but something that is done to the numbers that repeats.*
    b. Teacher asks: *Who can come up with a pattern?* Any kind of pattern, but make sure it repeats.
        i. Teacher asks: *Who can continue this pattern?*
        ii. We continue in this way for a few examples.
3. Model (10 minutes)
    a. Teacher posts a series of numbers on the board. 2, 4, 6, __, __, __.
        i. Teacher thinks aloud: *What is happening to the numbers as they continue? They are increasing. Each time the number increases by 2.*
        ii. Teacher thinks aloud: *What is the pattern rule? Since, each time the number increases by two, the pattern is +2. That is what happens to each of the numbers. Two changes to 4 by increasing by two, four changes to 6 by increasing by two and so on.*
    b. Teacher posts the following on the board. 15, 20, 25, _,_, _
        i. Teacher thinks aloud: *What is happening to the numbers as they continue? They are increasing. Each time the number increases by ten.*
        ii. Teacher thinks aloud: *What is the pattern rule? Since, each time the number increases by five, the pattern is +5. That is what happens to each of the numbers. Fifteen changes to 20 by increasing by five, 20 changes to 25 by increasing by five and so on.*
4. Guided Practice (15 minutes)
    a. Teacher posts this chart on the board.

Number	Changes To…	How?	Continue the Pattern
17	24		

      i. Teacher asks: *What happens to 17? Does it increase or decrease?*
     ii. Teacher asks: *It increases by how many? (You may use calculators, number lines/grids or whatever may assist you in finding this)*
   iii. Teacher fills in the "How?".
   iv. Teacher asks: *If we know how it changes, can we continue the pattern? What is the continued pattern?*
    v. Teacher writes in 60/50 and 29/49 into the "Number and "Change to parts of the grid. Teacher continues with students in a similar fashion.

5. Independent Practice (15 minutes)
    a. Students complete the following chart with a partner using calculators, number lines or number grids.

Number	Changes To…	How?	Continue the Pattern
30	60		
100	150		
200	125		
135	16		

6. Wrap Up (10 minutes)
    a. Review the chart from independent practice.
7. Homework: Students will complete the following chart.

Number	Changes To…	How?	Continue the Pattern
98	71		
64	83		
162	147		
186	208		
302	275		

Lesson Plan (Patterns) – #3

Objectives:
- The students will learn:
  - To understand and identify a pattern.
  - To predict and continue a pattern.

PA Mathematics Standards:
- 2.8.3.A – Recognize, extend, create and replicate a variety of patterns including attribute, activity, number and geometric patterns.

Materials:
- Frames and Arrows Chart
- *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 23*
- *Everyday Mathematics (Grade 3) – Home Links: p. 37*

Plans:
1. Warm Up (5 minutes)
   a. Teacher posts the following chart on the board.

Number¹	Changes To…	How?	Continue the Pattern
80	73		
100	123		
167	140		

2. Introduction (5 minutes)
   a. Teacher states: *We are going to practice number patterns in a different way.*
      i. Teacher explains: *We are going to look at patterns in a Frames and Arrows diagram. In this type of diagram, the "how" is going to be called the "rule". The rule is written in a rule box and is represented by arrows showing that you apply the rule to each number. Instead of writing the next numbers on lines, you will write them inside the frames.*
      ii. Teacher states: *The frames and arrows look like this:*


3. Model (10 minutes)
   a. Teacher posts this diagram on the board.
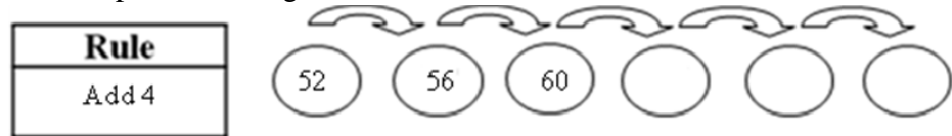
      i. Teacher thinks aloud: *Which part of this diagram in the "how"? I know the rule is the how. That is going to be what I have to do to*

each of the numbers in my diagram. So, 52+4=56. It changes to 56. Then 56+4=60. I am going to finish this diagram by adding 4 to 60 and then to each answer that I get. 60+4=64, that is the next number to add. 64+4=68, the next number. Lastly, 68+4=72.

   b. Teacher posts the next problem:

Rule

◯ 24 34 44 54 ◯
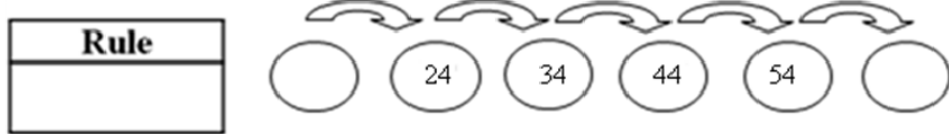
      i. Teacher thinks aloud: *I don't have the rule, so I need to look at the pattern that is happening with the numbers. If I start with 24 and I then go to 34, I am increasing, I am increasing by 10. That happens with each of the numbers, so that must be the rule. I continue the pattern by adding 10 to 54 and continue once more to find the last number.*
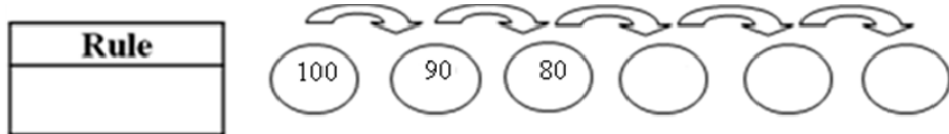
4. Guided Practice (15 minutes)
   a. Teacher posts the following frames and arrows on the board.

Rule
+ 15

5 20 35 ◯ ◯ ◯
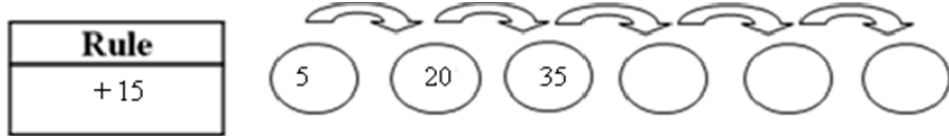
      i. Teacher asks:
         1. *What's the rule?*
         2. *What are we trying to find out?*
         3. *Will the numbers increase or decrease as we move right? Why?*

   b. Teacher posts the following frames and arrows on the board.

Rule

100 90 80 ◯ ◯ ◯

      i. Teacher asks:
         1. *What are we trying to find out?*
         2. *What pattern do we see?*
         3. *Are the numbers increasing or decreasing as we move right? Why?*

   c. Teacher posts the following frames and arrows on the board.

Rule
- 6

◯ 50 44 38 ◯ ◯
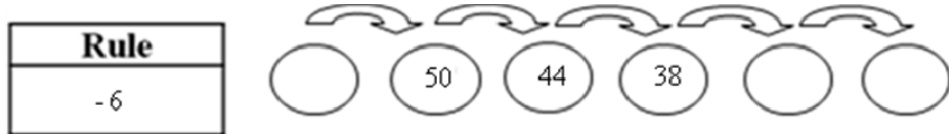
      i. Teacher asks:

1. *What's the rule?*
2. *What pattern do you see?*
3. *Are the numbers increasing or decreasing as you move to the right?*
4. *If the numbers are decreasing as you move to the right, what pattern should you see if you move to the left?*
5. Independent Practice (15 minutes)
    a. Students complete *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 23* with a partner.
6. Wrap Up (10 minutes)
    b. Review *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 23.*
7. Homework: *Everyday Mathematics(Grade 3) – Home Links: p. 37*

Lesson Plan (Patterns) – #4

Objectives:
- The students will learn:
    - To recognize a variety of patterns and complete them.

PA Mathematics Standards:
- 2.8.3.A - Recognize, extend, create and replicate a variety of patterns including attribute, activity, number and geometric patterns.

Materials:
- No materials needed.

Plans:
1. Warm Up (5 minutes)
    a. Teacher asks*: We have looked at patterns in a few different ways. Who remembers the types of patterns we have talked about?*
2. Introduction (5 minutes)
    a. Teacher states: *During this lesson, I am going to give you a few problems involving patterns and you are going to decide how you will solve them. We will practice a few together, and then you will work on your own.*
3. Guided Practice (15 minutes)
    a. Teacher reads problem: *Joseph always wears a certain combination of socks throughout the week, and his socks are only in green, black and white. He starts with the darkest colors first and always wears each color for two days before he moves on to the next color. What is Joseph's pattern?*
        i. Teacher asks:
            1. *So, what should we look at first to solve this problem?*

> *First, his pattern is for the week, so how many colors do we need to figure out?*
> 2. *We are using the clues to help guide us, so what do we do next? We know that the pattern is going to involve three colors. He starts with the darkest first, so which will he wear on Sunday? If he always wears a color twice, then what will Monday's color be?*
> 3. *Next, for Tuesday, he moved to a different color, the next darkest is what color? And Wednesday's color will be? Last, for Thursday and Friday, he will wear what? Then for Saturday and Sunday. The pattern will do what? Repeat.*

4. Independent Practice (15 minutes)
   a. Students work with a partner to complete the following problems:
      i. Susie works for her aunt cutting the lawn everyday for 5 days. Because of the heat, she works only a certain number of hours each day. Monday she works for 20 minutes, Tuesday she works for 40 minutes, Wednesday, 80 minutes. How long will she work, in total for the entire week if she continues in this pattern?
      ii. Bob collects toy airplanes. He loves playing with them, but destroys many of them in his crash rein-enactments. He starts off the week with 100 planes. After the first big crash, he has 80 planes. After the second, he's left with 40. After the next crash he has 20. If the pattern continues, how many will he have after his next crash?
6. Wrap Up (10 minutes)
   a. Review the answers and strategies to solving the problems from independent practice.
7. Homework: Students will complete a worksheet composed of the best student pattern problems submitted.

Lesson Plan (Make a Picture) – #1

Objectives:
- The students will learn:
  - To create a picture that illustrates the problem that they are working with.
  - To use parts-and-total diagrams to help solve parts-and-total number stories.

PA Mathematics Standards:
- 2.1.3.L – Demonstrate knowledge of basic facts in four basic operations.
- 2.2.3.A – Apply addition and subtraction in everyday situations using concrete objects.
- 2.5.3.A – Use appropriate problem-solving strategies (e.g., guess and check, working backwards).

Materials:
- Parts-and-Total Diagram
- *Parts-and-Total Worksheet #1*

Plans:

15. Warm Up (5 minutes)
    a. Teacher poses these fact extension problems.
        i. $70 + ? = 100$
        ii. $20 + ? = 100$
        iii. $40 + ? = 100$
    b. Review what a cube ($\square$) equals.
16. Introduction (5 minutes)
    a. Teacher displays and introduces the parts-and-total diagram.
    b. Teacher explains that students will learn to draw a picture to help them solve parts-and-total number stories.
17. Model (10 minutes)
    a. Teacher reads problem: *Two pythons laid clutches of eggs. One clutch had 8 eggs. The other had 5 eggs. How many eggs in all?*
    b. Teacher draws a picture for the problem.
       $\square\square\square\square\square\square\square\square$　$\square\square\square\square\square$
    c. Teacher thinks aloud: *What do you want to find out? Total number of eggs laid.* Write a question mark in the Total box.
    d. Teacher thinks aloud: *What do I know from my picture? Pythons laid clutches of 8 and 5.* Write 8 and 5 in the Part boxes.

Total	
?	
Part	**Part**
8	5

    e. Teacher thinks aloud: *What will I do to find the total number of eggs laid? Add 8 and 5.*
    f. Teacher solves $8 + 5$ by counting the eggs in the picture.
    g. Teacher writes a number model to summarize the story and to show what he/she did.
       $8 + 5 = 13$
    h. Teacher does check aloud. *Does my answer make sense? How do I know? It makes sense because the total number of eggs has to be larger than either the clutches.*
18. Guided Practice (15 minutes)
    a. Teacher reads problem: *A queen termite laid about 6 eggs on Monday and about 7 eggs on Tuesday. About how many eggs did she lay in all?*

       b. Teacher ask students:
           i. *What should we draw for the picture?*
          ii. *What do we want to find out?*
        iii. *Where do we write this information in the parts-and-total diagram?*
        iv. *What do we know from our picture?*
         v. *Where do we write this information in the parts-and-total diagram?*
        vi. *What will we do to find the total number of eggs laid?*
      vii. *Does our answer make sense? How do we know?*
       c. Students completes problem with a partner.
           i. *Two clutches of Mississippi Alligator eggs were found. Each clutch had 7 eggs. What was the total number of eggs found?*

19. Independent Practice (15 minutes)
       a. Students complete the following problems:
           i. *Ms. Han painted 7 eggs yesterday and she painted 3 eggs today. How many eggs did Ms. Han paint in all?*
          ii. *Ms. Flores read 6 books about pythons and 8 books about Mississippi Alligators during the summer. What was the total number of books Ms. Flores read?*

20. Wrap Up (10 minutes)
       a. Review the problems from independent practice.

21. Homework: Students complete *Parts-and-Total Worksheet #1*.

Lesson Plan (Make a Picture) – #2

Objectives:
- The students will learn:
  - To create a picture that illustrates the problem that they are working with.
  - To use parts-and-total diagrams to help solve parts-and-total number stories.

PA Mathematics Standards:
- 2.1.3.L – Demonstrate knowledge of basic facts in four basic operations.
- 2.2.3.A – Apply addition and subtraction in everyday situations using concrete objects.
- 2.5.3.A – Use appropriate problem-solving strategies (e.g., guess and check, working backwards).

Materials:
- Parts-and-Total Diagram
- *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 36*
- *Everyday Mathematics (Grade 3) – Home Links: p. 41*
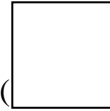
Plans:
1. Warm Up (5 minutes)
    a. Teacher poses these fact extension problems.
        i. $72 + ? = 80$
        ii. $134 + ? = 140$
        iii. $230 - ? = 223$
    b. Review what a cube (□), a long (▯), and a flat (▭) equals.
2. Introduction (5 minutes)
   a. Teacher displays the parts-and-total diagram.
    b. Teacher review a parts-and-total number story from *Make a Picture* lesson #1's homework.
    c. Teacher explains that students will learn to draw a picture to help them solve more challenging parts-and-total number stories.
3. Model (10 minutes)
    a. Teacher reads problem: *Two Agama lizard laid clutches of eggs. One clutch had 16 eggs. The other had 23 eggs. How many eggs in all?*
    b. Teacher draws a picture for the problem.
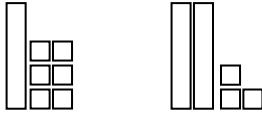
    c. Teacher thinks aloud: *What do you want to find out? Total number of eggs laid.* Write a question mark in the Total box.
    d. Teacher thinks aloud: *What do I know from my picture? Agama lizards laid clutches of 16 and 23.* Write 16 and 23 in the Part boxes.

Total	
?	
Part	**Part**
16	23

    e. Teacher thinks aloud: *What will I do to find the total number of eggs laid? Add 16 and 23.*
    f. Teacher solves *16 + 23* by counting the eggs in the picture.
    g. Teacher writes a number model to summarize the story and to show what he/she did.

    $$16 + 23 = 59$$

    h. Teacher does check aloud. *Does my answer make sense? How do I know? It makes sense because the total number of eggs has to be larger than either the clutches.*
4. Guided Practice (15 minutes)
    a. Teacher reads problem: *A giant toad laid about 5,000 eggs and another giant toad laid about 8,000 eggs on Tuesday. About how many eggs did the two toads lay in all?*

        b.   Teacher ask students:
             i.   *What should we draw for the picture?*
            ii.   *What do we want to find out?*
          iii.   *Where do we write this information in the parts-and-total diagram?*
          iv.   *What do we know from our picture?*
           v.   *Where do we write this information in the parts-and-total diagram?*
          vi.   *What will we do to find the total number of eggs laid?*
         vii.   *Does our answer make sense? How do we know?*
        c.   Students completes problem with a partner.
            i.   *Two clutches of Green Turtle eggs were found. Each clutch had 104 eggs. What was the total number of eggs found?*
5.   Independent Practice (15 minutes)
        a.   Students complete *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 36.*
6.   Wrap Up (10 minutes)
        a.   Review *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 36.*
7.   Homework: *Everyday Mathematics (Grade 3) – Home Links: p. 41*

Lesson Plan (Make a Picture) – #3

Objectives:
- The students will learn:
    - To create a picture that illustrates the problem that they are working with.
    - To use parts-and-total diagrams to help solve parts-and-total number stories.

PA Mathematics Standards:
- 2.1.3.L – Demonstrate knowledge of basic facts in four basic operations.
- 2.2.3.A – Apply addition and subtraction in everyday situations using concrete objects.
- 2.5.3.A – Use appropriate problem-solving strategies (e.g., guess and check, working backwards).
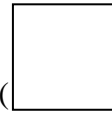
Materials:
- Parts-and-Total Diagram
- *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 37*

Plans:
8.   Warm Up (5 minutes)
        a.   Teacher poses these fact extension problems.

i. $1,000 - ? = 800$
ii. $1,010 - ? = 990$
iii. $1,250 - ? = 1,160$

    b. Review what a cube (▢), a long (▯), and a flat (▭) equals.

9. Introduction (5 minutes)
    a. Teacher displays the parts-and-total diagram.
    b. Teacher review a parts-and-total number story from *Make a Picture* lesson #2's homework.
    c. Teacher explains that students will learn to solve Parts-and-Total number stories for a missing part by drawing pictures.

10. Model (10 minutes)
    a. Teacher reads problem: *An alligator clutch had 30 eggs. Only 14 hatched. How many eggs did not hatch?*
    b. Teacher draws a picture for the problem.
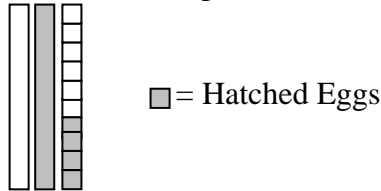
▨ = Hatched Eggs

    c. Teacher thinks aloud: *What do you want to find out? Total number of eggs not hatched.* Write a question mark in one of the parts box.
    d. Teacher thinks aloud: *What do I know from my picture? The alligator laid 30 eggs, and 14 eggs hatched.* Write *30* in the Total box and *14* in one of the Part boxes.

Total	
30	
Part	**Part**
14	?

    e. Teacher thinks aloud: *What will I do to find the number of eggs not hatched? 30 subtract 14.*
    f. Teacher solves *30 – 14* by counting the eggs in the picture.
    g. Teacher writes a number model to summarize the story and to show what he/she did.

$$30 - 14 = 16$$

    h. Teacher does check aloud. *Does my answer make sense? How do I know? It makes sense because the number of eggs not hatched is less than the total number of eggs and 14 + 16 = 30.*

11. Guided Practice (15 minutes)
    a. Teacher reads problem: *A python clutch had 54 eggs. Only 13 hatched. How many eggs did not hatch?*
    b. Teacher ask students:
        i. *What should we draw for the picture?*

      ii. *What do we want to find out?*
      iii. *Where do we write this information in the parts-and-total diagram?*
      iv. *What do we know from our picture?*
      v. *Where do we write this information in the parts-and-total diagram?*
      vi. *What will we do to find the number of eggs not hatched?*
      vii. *Does our answer make sense? How do we know?*
    c. Students completes problem with a partner.
      i. *A queen termite laid about 6,500 eggs in a lifetime, but only about 5,200 eggs hatch overall. About how many eggs do not hatch?*

12. Independent Practice (15 minutes)
    a. Students complete *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 37.*

13. Wrap Up (10 minutes)
    a. Review *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 37.*

14. Homework: Students will complete write one parts-and-total problem with the missing total and one parts-and-total problem with a missing part. Then they will solve their own problems.

Lesson Plan (Make a Picture) – #4

Objectives:
- The students will learn:
    - To create a picture that illustrates the problem that they are working with.
    - To use parts-and-total diagrams to help solve parts-and-total number stories.

PA Mathematics Standards:
- 2.1.3.L – Demonstrate knowledge of basic facts in four basic operations.
- 2.2.3.A – Apply addition and subtraction in everyday situations using concrete objects.
- 2.5.3.A – Use appropriate problem-solving strategies (e.g., guess and check, working backwards).

Materials:
- Parts-and-Total Diagram
- *Everyday Mathematics (Grade 3) – Student Math Journal (Volume 1) – p. 51-52*
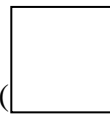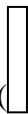- *Everyday Mathematics (Grade 3) – Home Links: p. 51-52.*
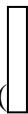
Plans:
1. Warm Up (5 minutes)
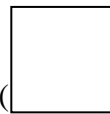
a. Teacher poses these fact extension problems.
  i. $8 + ? = 17$
  ii. $8 + ? = 37$
  iii. $8 + ? = 67$
b. Review what a cube (□), a long (▯), and a flat (▭) equals.

2. Introduction (5 minutes)
a. Teacher has a couple of students write their parts-and-total number stories from their *Make a Picture* lesson #3's homework on the board and have the class solve the problems.
b. Teacher explains that students will learn to draw a picture to help them solve parts-and-total number stories that have three or more parts.

3. Model (10 minutes)
a. Teacher reads problem: *The ostriches in the zoo had 4 clutches this year. They laid 13 eggs, 9 eggs, 7 eggs, and 11 eggs. How many eggs were laid in all?*
b. Teacher draws a picture for the problem.
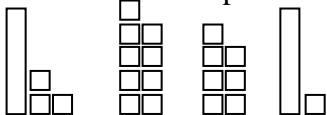
c. Teacher thinks aloud: *What do you want to find out? Total number of eggs laid.* Write a question mark in the Total box.
d. Teacher thinks aloud: *What do I know from my picture? There are four clutches, so there are four parts. The four clutches are 13 eggs, 9 eggs, 7 eggs, and 11 eggs.* Draw a Part-and-Total with 4 parts. Write 13, 9, 7 and 11 in the Part boxes.

Total			
?			
Part	**Part**	**Part**	**Part**
13	9	7	11

e. Teacher thinks aloud: *What will I do to find the total number of eggs laid? Add 13, 9, 7 and 11.*
f. Teacher solves *13 + 9 + 7 + 11* by counting the eggs in the picture.
g. Teacher writes a number model to summarize the story and to show what he/she did.
   13 + 9 + 7 + 11 = 40
h. Teacher does check aloud. *Does my answer make sense? How do I know? It makes sense because the total number of eggs has to be larger than the individual clutches.*

4. Guided Practice (15 minutes)
a. Teacher reads problem: *Jose brought milk for 35 cents, apple juice for 55 cents, grape juice for 45 cents and orange juice for 65 cents. How much money did he spend?*

b. Teacher ask students:
   i. *What should we draw for the picture?*
   ii. *What do we want to find out?*
   iii. *Where do we write this information in the parts-and-total diagram?*
   iv. *What do we know from our picture?*
   v. *Where do we write this information in the parts-and-total diagram?*
   vi. *What will we do to find the total amount of money?*
   vii. *Does our answer make sense? How do we know?*
c. Students completes problem with a partner.
   i. *Michelle drove from Houston, Texas to Wichita, Kansas. On the first day, she drove 245 miles. On the second day, she drove 207 miles. On the third day, she drove 158 miles and arrived in Wichita. How many miles did she drive in all?*

5. Model (10 minutes)
   a. Teacher reads problem: *Over the summer, 3 children read a total of 19 books. One child read 6 books, and another child read 9 books. How many books did the third child read?*
   b. Teacher draws a picture for the problem.

   Total =   □ = child #1
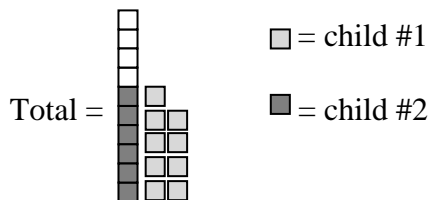
                   ■ = child #2

   c. Teacher thinks aloud: *What do you want to find out? Total number of books child #3 read.* Write a question mark in the Total box.
   d. Teacher thinks aloud: *What do I know from my picture? The total number of books read is 19. There are three children, so there are three parts. Child #1 read 6 books, and child #2 read 9 books.* Write *19* in the Total box and *6* and *9* in the Part boxes.

Total		
19		
Part	**Part**	**Part**
6	9	?

   e. Teacher thinks aloud: *What will I do to find the number of books child #3 read? 19 subtract 6 and 9.*
   f. Teacher solves *19 – 6 – 9 by crossing out 6 cubes and 9 cubes.*
   g. Teacher writes a number model to summarize the story and to show what he/she did.

$$19 - 6 - 9 = 4$$

      h. Teacher does check aloud. *Does my answer make sense? How do I know? It makes sense because the number of books read by child #3 is less than the total and 6 + 9 + 4 = 19.*

6. Guided Practice (5 minutes)
   a. Students completes problem with a partner.
      i. *Zookeepers watched a clutch of 54 python eggs. On the first day, 18 eggs hatched. On the next day, 11 more hatched. How many eggs, did not hatch?*

7. Independent Practice (5 minutes)
   a. Students complete the Parts-and-Total question:
      i. *Carl has $2.50 for juice or milk at lunch. On each of 2 days, he buys grape juice for 45 cents. On the third day, he buys milk for 40 cents. How much money does he have left?*
   b. Review Parts-and-Total question.

8. Wrap Up (5 minutes)
   a. Review the problem from independent practice.

9. Homework: Students will complete *Everyday Mathematics (Grade 3) – Home Links: p. 51-52*

Lesson Plan (Assessment) – #3

Objectives:
• The students will use previously learned problem solving skills to find a solution to a mathematical problem. Students will be assessed on their ability to do this.

To PA Mathematics Standards:
• 2.5.3.A – Use appropriate problem-solving strategies (e.g., guess and check, working backwards).

Materials:
• Calculators (optional)

Plans:
1. Warm Up (5 minutes)
   a. Teacher asks: *What are the different strategies we have discussed that help us solve problems?*
      i. The class reviews each and what skills they involve.
   b. Teacher explains: Today we are going to use these skills. You are going to receive a word problem. You are going to decide which strategy you are going to use and how you are going to use it.

2. Assessment (15 minutes)
   a. Students complete the following problem copied from the board or written

out on paper:

    i. *Maryanne liked to go fishing with her dad. She often caught small fish, however, that had to be put back into the water. Over the summer, she goes about three days every week and she decided to keep track of how many fish she caught during the month of July so that she could tell her friends. For the first week in July, she kept 5 fish, but that was only half of what she actually caught. The second week, she caught a total of 20 fish. Realizing later she could only keep about half. For the third and fourth weeks, she caught a total of 70 fish. Assuming that there is a pattern to how many were caught and kept, how many fish did she catch for week three and four separately and how many did she catch for the month of July.*

3. Wrap Up (10 minutes)
   a. Each student/or selected students presents his or her answers and strategies used for the problem. Students are assessed based on the strategies used, their understanding of the strategy and the correct answer.

Bibliography/Resources

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Appendices

Name: _____

Date: _____

Grade: _____ **/ Room:** _____

Parts-and-Total Worksheet #1

Directions: Solve each problem. Remember to use the strategies we talked about in class.

Strategy Reminder:
1. *What should we draw for the picture?*
2. *What do we want to find out?*
3. *Where do we write this information in the parts-and-total diagram?*
4. *What do we know from our picture?*
5. *Where do we write this information in the parts-and-total diagram?*
6. *What will we do to find the total amount of _____?*
7. *Does our answer make sense? How do we know?*

Problem #1
There were 4 boys and 5 girls absent from Mitchell Elementary today. How many students were absent in all?

Picture

Total	
Part	**Part**

Number Sentence: _____   Answer: _____

Check: _____

Problem #2
Jane has 9 apples and 2 bananas. How many pieces of fruit does Jane have?

Picture

Total	
Part	**Part**

Number Sentence: _____   Answer: _____

Check: _____