MATH 117. NUMBER SENSE FOR PK-8 TEACHERS. (3 hours)

Developing the Number Strand by Pat Jones ISBN: 0-9728-373-0-2

Course Description:
This is a language-intensive study of the Number Strand as it develops sequentially from grades pre-K through 8. It focuses on number sense, natural connections among the big ideas in mathematics, patterns and problem solving, and the use of numbers in familiar, real situations.

This content in this course aligns with that of K-8 schools, giving prospective teachers the knowledge of mathematics that they will need to effectively teach the CCSS content. Also, an emphasis is placed on the Standards for Mathematical Practice as described in the CCSS, allowing prospective teachers to experience what their future K-8 students will experience. Prospective teachers enrolled in this course are expected to:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriately tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Entrance Requirements:
Minimum ACT math score of 19, or College Algebra with a grade of C or better, or MATH 107 with a grade of C or better. Restriction: Education majors only.

Course Outcomes:
Students will learn

- how important concepts can be developed in a smooth progression, giving special attention to significant mathematics and cognitive transitions;
- how the Big Ideas are rooted and interconnected in real-world contexts, and how they can be modeled using familiar objects and situations;
- how number sense, spatial sense, intuition, and problem-solving permeate everything;
- that reasoning and ordinary language are essential components of concept development.

Students will have intuition, skills and deep understanding of the number sense concepts in pre-K through 8th grade.

Instructional Methods:

Visual aids such as charts and drawings are presented to help the students grasp the mathematical concepts. A wide variety of techniques, approaches, and appropriate tools will be used as students are encouraged to solve problems in different ways. Emphasis is placed on the students' ability to express "in writing" how they solve various types of problems and how they know that the answer is correct. Manipulatives will be used to model mathematical topics and arithmetic operations.

Calculator: Students are not allowed to use calculators. Students are expected to use the methods developed to do calculations mentally and well as incorporating these methods to pencil and paper work. All explanations should be clear and concise and written at an elementary level.

Evaluation: The grading scale is the normal ten point grading scale. Grades will be calculated by (number of points earned)/ (total possible points). Averages or final grades cannot be given out over the phone.
90%- 100% A
80% - 89% B
70% - 79% C
60% - 69% D
Below F

3 one hour exams (100 points each).
Possible homework, pop-quizzes, and projects (maximum of 50 points)
Comprehensive final exam (200 points)
Note: **You MUST bring your pictured I.D. card for all tests!!**
On test days, **cell phones MUST be turned OFF and packed away !!**

Attendance:
Students are expected to attend all classes.

Communication: You will receive information intended for all students via emails from instructor and/or News Forum on Moodle. Discussion Forums will be opened on Moodle for you to post both general and content specific questions. These forums will be available for view by all students, so they are not to be used to communicate with instructor regarding personal information or issues. Students needing to communicate with the instructor regarding personal information or issues should do so through individual e-mail.

E-mail Guidelines: You MUST use your university issued e-mail address/account. You are expected to check e-mail on a regular basis – for this course that expectation is at least once every 48 hours. If you receive an email from the instructor which requires/requests a reply, the reply is expected within 48 hours of the time it was sent by the instructor. You can expect responses to emails from the instructor within 2 business days.

Online Etiquette: The objective in an online discussion is to share questions, comments, or information with other students. It should be a positive experience for everyone. Please be conscientious in proofreading your posts, not only for grammar or spelling mistakes, but more importantly to insure the idea conveyed is the desired idea, and also that your posting is not offensive or degrading to classmates or instructor.

Lesson	Topic	Homework
1	**Introduction to Course** • Develop the concept of place value for two-digit numerals. • Understand the concept of addition as combining two quantities in order to find a total amount. Recognize situations in which addition is relevant.	Page 3 Examples 1,2
2	• Understand the concepts of subtraction as the result of	Page 3 Examples 1,2

	"removing" or of "comparing". Recognize the relevance of subtraction in both of these contexts. • Use the phrases "same amount as", "same as", and "is" to develop the concept of equal. Use verbal number sentences with labels on all numbers. Include the words plus, minus, and equal. • Use the word one-half orally. • Read, write, compare, order, and use two-digit numbers in a wide variety of familiar situations. • Recognize words that indicate opposites, in stories and ordinary situations.	Page 5 Examples 1 - 5
3	• Use the word one-half orally. • Read, write, compare, order, and use two-digit numbers in a wide variety of familiar situations. Recognize words that indicate opposites • Extend the concept of place value to hundreds. • Recognize which operation (addition or subtraction) is relevant in a particular situation. • Learn addition and subtraction "facts" by using them every day in activities and familiar situations.	Page 8 : Student Question Page 9: Examples 1 – 4 Page 10: Examples 1 - 5
4	• Understand that the order in which two numbers are added doesn't affect their sum. • Add and subtract numbers (with labels) which are written vertically, and don't require repackaging. • Use addition and subtraction every day in activities and problems which include all the Big Ideas of mathematics. • Understand that the order in which two numbers are added doesn't affect their sum. • Add and subtract numbers (with labels) which are written vertically, and don't require repackaging. • Use addition and subtraction every day in activities and problems which include all the Big Ideas of mathematics.	Page 12: Examples 1 – 9 Page 15: Examples 1 , 2 Page 16: Examples 1 -3
5	• Use mental strategies for adding, subtracting, and estimating whole numbers. • Relate addition and subtraction in number sentences. • Find sums and differences, through hundreds, with repackaging. • Read, write, compare, add, and subtract three-digit numbers in familiar situations which involve many different Big Ideas of mathematics. • Develop a conceptual understanding of multiplication as combining equal-numbered sets of things. Use the words times, multiply, and product, and the symbol ×. • Understand the special roles of 0 and 1 in multiplication. • Understand that multiplication is commutative.	Page 18: Examples 1 – 3 Page 30: Examples 1 – 15 Page 37 Activities/Problems 1 – 7 Page 41 Examples 1 - 4

	• Separate a set of objects into equal shares in as many ways as possible.	
6	• Be able to read, write, add, and subtract amounts of money using $ and decimal point. • Use symbols to represent fractions. • Extend understanding of place value through thousands. • Read, write, compare, and use numbers through thousands. • Use numbers in familiar situations which involve opposites.	Page 46 Problems 1 – 5 Page 48 Problems 1 – 6 Page 53 Examples 1 – 8
7	• Understand the concept of division, and the language (words and symbol) associated with it. • Write equations to describe situations that involve division. • Learn multiplication and division "facts" by using them every day in real situations and in equations. • Understand the inverse relation of multiplication and division. Use appropriate labels in multiplication and division equations.	Page 56 Activities/Problems 1 – 3 Page 59 Activities/Problems 1 , 2 Page 61 Problem H Page 61 Examples 1 – 13
8	• "See" whole numbers which end in zero, as some number of tens or hundreds. • Use different fractions to represent the same portion of an object or set of things. • Add and subtract fractions which have the same name (denominator). • Compare fractions which have the same numerator by thinking of the relative "sizes" of the equal parts. • Relate unit fractions and division. Use this relation to find fractional parts of "nice" whole numbers. • Find a total amount when a fraction of it is known. • Use fractions in a wide variety of real world situations. • Understand and use order symbols (> and <). • Use opposites in games and other real contexts	Page 67Activities/Problems 1 – 5 Page 70 Examples 1 – 8 Page 76 Examples 1 –6 Page 79 Examples 1 – 5 Page 80 Examples 1 – 10
9	**Review for Test 1**	
10	**Test 1**	
11	• Understand and relate the concepts of mixed numbers and improper fractions. Read, write, and use these numbers in real situations. • Understand that a quantity may be represented by many different fractions, and that a set of equivalent fractions results from "seeing" the object or set from different points of view. • Connect and extend the concepts of money, fractions, and place value to develop the meaning of decimals. Understand the verbal relation between fractions, or mixed numbers, and decimals. Be able to translate one representation to the other by recognizing their common name. Read, write, add, subtract, and compare	Page 90 Problems 1 – 6 Page 93 Examples 1 – 3 Page 98 Application of Lesson 1 – 6 Page 102 Application of Lesson 1 – 4 Page 104 Examples 1 – 8

	decimals in problem contexts—especially those which involve money and metric units of measurement. • Understand the literal meaning of percent as "for each hundred". • Know, and quickly recall, all the pairs of whole numbers whose product is 100. Be able to apply this in translating among fractions, terminating decimals, and percents.	Page 106 Examples 1 - 4
12	• Apply the concepts of factor and multiple in real contexts. Understand and use the word multiple appropriately. • Recognize numerals which end in zeros as some number of tens, hundreds, or thousands. Be able to mentally find products of one-digit multiples of 10, 100, and 1000. • Have a conceptual understanding of the Distributive Property. Use parentheses to clarify the meaning of equations which apply the Distributive Property. • Understand how to find the product of multi-digit numbers using partial sums.	Page 108 Examples 1 – 8 Page 111 Examples 1 – 5 Page 113 Application of Lesson 1 – 6 Page 116 Application of Lesson 1 – 6 Page 121 Application of Lesson 1 - 4
13	• Understand that multiplication is commutative and associative • Understand and use some strategy for doing division in order to answer questions about real things. • Understand, read, and write numbers through millions. Connect standard numerals, expanded notation, and names of numbers. • Understand and use opposites in familiar contexts.	Page 121 Examples 1,2 Page 131 Examples 1,2
14	• Solve problems which include all representations of rational numbers, and which connect Big mathematical ideas in real situations.	Page 134 Examples 1 – 11 Supplemental Problems
15	Cont: • Solve problems which include all representations of rational numbers, and which connect Big mathematical ideas in real situations.	Page 134 Examples 1 – 11 Supplemental Problems
16	Cont: • Solve problems which include all representations of rational numbers, and which connect Big mathematical ideas in real situations.	Page 134 Examples 1 – 11 Supplemental Problems
17	• Understand and use the percent symbol. Translate between percents and fractions or decimals which are represented as hundredths. Know, and quickly recall, the percent equivalents for easy unit fractions; be able to find percents of numbers in problem contexts. Solve percent problems using proportional reasoning. • Connect the representations of rational numbers as fractions, mixed numbers, decimals, percents, and ratios. Select the most meaningful and/or the most efficient representation in a particular context.	Page 140 Examples 1 – 3 Page 141 Problems 1, 2 Page 143 Problems 1 – 7 Page 148 Problems 1, 2 Page 149 Examples 1 - 7

18	• "See" numbers multiplicatively. Understand what primes, factors, and multiples are. Be able to systematically list the factor pairs of a number. Be able to find common factors for a set of numbers. Apply all of this in solving problems. • Understand what equivalent fractions are. Generate all the fractions which are equivalent to a given fraction. Apply knowledge of equivalent fractions in problems involving proportionality and addition/subtraction of fractions.	Page 156 Problems 1 ,2 Page 160 Problems 1 – 7 Page 162 Application of Lesson 1 , 2 Page 174 Problems 1 – 6
19	• Understand and use parentheses to clarify the meaning of equations and expressions. • Understand and use opposites in real contexts. • Use all forms of rational numbers in solving a wide variety of problems in real contexts.	Page 175 Problems 1 – 5 Page 183 Examples 1 - 15
22	**Review Test 2**	
21	**Test 2**	
22	• Extend the concepts and applications of decimals to include thousandths. Translate among fractions, terminating decimals, and mixed numbers in real contexts. • Have a conceptual understanding of multiplication of fractions. Recognize situations in which multiplication of fractions is relevant. Know how to find the product of any two fractions. • Relate multiplication of decimals to multiplication of fractions. Be able to find the product of two decimals, and recognize whether this product is reasonable within the given context.	Page 191 Problems 1, 2 Page 198 Problems 1 – 5 Page 204 Application of Lesson 1 - 5
23	• Be able to mentally divide decimals by 10 or 100. • Understand and use fractions as quotients. • Recognize situations in which division of fractions is relevant. Be able to follow some process for finding the quotient of two fractions. • Be able to correctly apply a division process which involves decimal dividends and/or divisors. Recognize whether a quotient is reasonable within the given context. • Relate infinite repeating decimals to fractions.	Page 207 Problems 1 , 2 Page 208 Problem Set
24	• Be able to solve a wide variety of problems which involve percents as they are encountered in everyday life—including "percent off ", percent increase and decrease, and percents which are less than 1%. • Understand what negative numbers are, and use them to represent opposites of real quantities. Be able to find sums, differences, products, and quotients which involve negative numbers; apply this knowledge in problem contexts. • Be able to solve a wide variety of problems which involve	Page 224 Problems 1 – 7 Page 229 Problems 1 – 6 Page 233 Problem 7, 8

	percents as they are encountered in everyday life—including "percent off ", percent increase and decrease, and percents which are less than 1%. • Understand what negative numbers are, and use them to represent opposites of real quantities. Be able to find sums, differences, products, and quotients which involve negative numbers; apply this knowledge in problem contexts.	
25	• Understand and use number lines. • Understand what multiples of a number are. Be able to list the multiples of a particular number as products (e.g.: 1 × 7, 2 × 7, 3 × 7, 4 × 7, etc.) Identify common multiples and least common multiple for a set of numbers. Apply all of this in solving problems in real contexts.	Page 240 Activity/Problem 1 – 5 Page 245 Problems 1 - 8
26	• Use exponents when convenient in writing the prime factorization of whole numbers, and in representing large numbers (with or without scientific notation). • Know what a perfect square is, and recognize perfect squares up to 144. Understand what a square root is. Use the radical sign to indicate positive square roots. Be able to approximate square roots to the nearest integer mentally, and to the nearest hundredth using a calculator. • Understand what pi is; use the symbol; use a reasonable approximation of in real situations. • Distinguish between rational and irrational numbers; understand that Real numbers are all the numbers which have a place on the number line, and which can be represented as decimals.	Page 250 Problems 1 – 5 Page 252 Problems 1, 2
27	**Review for Test 3**	
28	**Test 3**	

On registration day, 138 players signed up for the summer baseball league. They will be assigned to 6 teams with the same number of players on each team.

How many players will be on each team?

Guide the class through a series of subtractions.

138	players
– 6	(1 player per team)
132	players left
– 12	(2 players per team)
120	players left
– 24	(4 players per team)
96	players left
– 24	(4 players per team)
72	players left
– 30	(5 players per team)
42	players left
– 30	(5 players per team)
12	players left
– 12	(2 players per team)
0	23 players on each team
players left	

Notice: This is one possibility for doing the subtraction. Let students decide how many players per team to subtract each time.

3. There are 300 M&Ms in a bag. Sixty of them are yellow.

a. For each 100 M&Ms in the bag, how many are yellow?

b. For each 50 M&Ms, how many are yellow?

c. For each 25 M&Ms, how many are yellow?

d. For each 5 M&Ms, how many are yellow?

e. What portion of the M&Ms are yellow?

Be sure that it's clear from the class discussion that all of these fractions are reasonable and correct answers to part e: $\frac{60}{300}$, $\frac{20}{100}$, $\frac{10}{50}$, $\frac{5}{25}$, or $\frac{1}{5}$. It follows that all of the fractions represent the same quantity – they are all equal.

f. What percent of the M&Ms are yellow? (Remember that percent means out of each hundred.)

Example 6: (Activity)

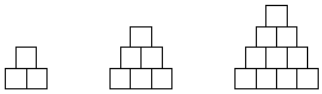
a. Give each child 4 red tiles and 12 blue tiles. Tell them to build a red square with a blue border around it.

Ask: How many more blue tiles than red tiles do you have?

b. Give each child 2 more red tiles, and tell them to use all 6 red tiles to make a rectangle.

Ask: Do you have enough blue tiles to make a border around your rectangle? How many more do you need?

c. Show the class these figures made of cubes.



Have students build the next two figures, and put an index card in front of each figure showing how many cubes it has.

Ask: What is the total number of cubes in the first three figures? (Discuss different strategies for finding the sum.)

What is the total number of cubes in the last two figures? (Compare counting on and adding. Which is easier?)

The last figure has how many more cubes than the third figure? (Ask students to explain how they got the answer.)