

MATH 5001

Arithmetic and Problem Solving

A course for prospective elementary school teachers

Fall 2008

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This page describes a general plan for the course. Changes may be necessary.

Text: *Mathematics for Elementary Teachers*, **second** edition, (purple with zebras) and the accompanying *Class Activities* manual by Sybilla Beckmann, published by Addison-Wesley. These can be purchased from the UGA bookstore and other bookstores. **Please bring the activity manual to class.**

Course topics: Problem solving (chapter 1), numbers and the decimal system (chapter 2), fractions (chapter 3), addition and subtraction (chapter 4), multiplication (chapter 5), multiplication of fractions, decimals, and negative numbers (chapter 6), division (chapter 7 only through section 7.2 or 7.3). The course focuses on the arithmetic taught in elementary school and a little bit beyond elementary school and goes deeply into this material.

Course objectives: To strengthen and deepen knowledge and understanding of arithmetic, how it is used to solve a wide variety of problems, and how it leads to algebra. In particular, to strengthen the understanding of and the ability to explain why various procedures from arithmetic work. To strengthen the ability to communicate clearly about mathematics, both orally and in writing. To promote the exploration and explanation of mathematical phenomena. To show that many problems can be solved in a variety of ways.

Preparation for your teaching: This course is part of your preparation to become an elementary school teacher who will teach math. The importance of understanding the math you will teach well cannot be overstated. Teacher quality is known to be a major factor in student achievement. Students who build a good foundational understanding of the mathematical ideas in elementary school will be ready for middle school math and beyond. Students who don't have good mathematical foundations in elementary school often get stuck at algebra and these students frequently don't finish high school, thus limiting their opportunities.

Our focus in this course is on the mathematics content itself and not the methods by which you will help children learn math. Even so, a number of the activities we will do in

class can readily be modified for use in elementary school (or middle school). However, we will often go beyond what is feasible with typical students in elementary school. This is to help you understand the material more deeply and to prepare you to guide your students toward “where the math goes next.”

The responsibility of teaching math to children may seem daunting and scary, but we have designed our math and math methods courses here at UGA (MATH 5001, 5002, 5003, and EMAT 3400, 3410) to prepare you for this important responsibility. Of course, it is up to you to take the opportunities these courses provide and to study hard and learn the material well for the sake of your future students. We also hope that you will find the courses interesting and engaging and that you will seek to develop an enthusiasm for math that you will pass on to your students.

Class work: As a teacher, you will have the important responsibility of helping your students understand mathematical ideas and ways to solve math problems. To help prepare you, we will often ask you to explain a mathematical idea, a line of reasoning, or why a solution method is valid to a classmate or to the whole class. As a teacher you will also need to determine how your students are thinking about mathematical ideas so that you can address misconceptions and build on what your students know. This means you will need to listen carefully to your students’ mathematical ideas. So in class, we will ask you to listen carefully to other students’ methods of solution, and we will sometimes ask you to restate or ask a question about another student’s idea, or whether you agree or disagree with a statement. Class time is a time for us to think ideas through and to evaluate the ideas. Even answers that ultimately prove to be incorrect can provide invaluable learning opportunities when we determine where the flaws lie. In order to make productive use of our class time, and as part of your preparation to teach mathematics to children, all students (and the instructor and teaching assistants too!) are asked to do the following in class:

- Show interest in mathematical ideas
- Show interest in different ways of approaching mathematical ideas
- Listen carefully to different ways of solving a problem
- Carefully evaluate a proposed method of solution
- State whether you agree or disagree with a statement (you may feel more comfortable saying you “respectfully disagree”)
- Show interest in learning with and from others

Because our interactive work in class is an important component of this course, **class attendance is required**. In the event of an illness or emergency, please contact Dr. Beckmann as soon as possible. Students with four or more unexcused absences will be dropped from the course.

Writing Intensive Program: This section of MATH 5001 is part of the Writing Intensive Program. The Writing Intensive Program is designed to help courses teach the writing process within various disciplines. Although you have taken English courses on writing, and although these courses will help you with all your writing, mathematical

writing has its own special features. In mathematics, we seek coherent, *logical* explanations, in which the desired conclusion is deduced from starting assumptions.

Our graduate teaching assistants, Whitney Montgomery and Matt Mastin, have been trained by the Writing Intensive Program to help you learn to write good mathematical explanations. Whitney and Matt will give you feedback to help you improve your explanations over the course of the semester.

Why are we emphasizing writing in this course? To be an effective teacher of mathematics, you need to understand the mathematical ideas you will teach well and beyond the level at which you will discuss them with your students. By writing your initial thoughts and then revising your writing to produce clear, thorough, well thought out explanations, you will have a chance to develop and refine your understanding of the ideas you will teach. Because of the benefits of writing, we think that the writing intensive format is a perfect fit for this course.

Types of assignments: All assignments will be posted on the links on the main course page. Some assignments may require that you access WebCT. You should expect to spend at least 2 to 3 hours outside of class for each hour in class.

Written homework assignments to turn in: Expect to have a written assignment due at every class. These **assignments must be typed**. You may write by hand any equations, pictures, diagrams, or the like. Pictures and diagrams can be inserted either within the body of the text or they can be labeled and placed at the end of the document (and in this case you should refer to them by their label within the text). Your written assignments will generally be fairly short, but we expect your work to be highly polished. Turn in only well thought out second or third (or fourth ...) drafts. Mathematics requires precise language, so attend closely to the way you express your ideas. When you teach, you will also need to take care to use correct and precise language, but we will hold you to an even higher standard of expression than would be realistic all the time in a classroom with children. In grading your work we will be looking for the extent to which it meets the following criteria:

- The work is factually correct, or nearly so, with only minor, inconsequential flaws.
- The work addresses the specific question or problem that was posed. It is focused, detailed, and precise. Key points are emphasized. There are no irrelevant or distracting points.
- The work could be used to teach a student: either a child or another college student, whichever is most appropriate.
- The work is clear, convincing, and logical. An explanation should be convincing to a skeptic and should not require the reader to make a leap of faith.
- Clear, complete sentences are used. Mathematical terms and symbols are used correctly. If applicable, supporting pictures, diagrams, and/or equations are used appropriately and as needed.
- The work is coherent.

Explain all your solutions unless there are explicit instructions not to.

You are encouraged to form study groups and to work on homework assignments with your classmates. (Perhaps some of you might like to form facebook groups.) Of course, you must adhere to UGA's Academic Honesty Policy. Therefore, always write your homework up on your own, using your own words to express the ideas you have *discussed* with others. It is not academically honest to simply read someone else's work and then put it in your own words. Instead, when you work with others, you must participate in the development and refinement of the ideas by discussing them. All partners should "give and take" in the discussion. It is not academically honest to allow others to copy your work.

Homework is due at the beginning of class. Because grading late homework adds a significant time burden, late homework cannot be accepted, even with a valid excuse. Please contact Dr. Beckmann as soon as possible if you are unable to hand in an assignment due to an illness or emergency. We will drop up to 3 assignments for which you have a valid excuse.

Please save returned homework since we expect to allow you to revise and resubmit a few selected assignments.

Reading and "don't hand in" assignments: Expect to have a reading assignment due after every class. The reading is designed to help you shore up the ideas discussed in class and be ready for the topic to be discussed in the next class. The "don't hand in" assignments will consist mainly of problems whose solutions are given in the book. You should work the problems first without looking at the solutions and then read the solutions and compare them with your own. It's a good idea to discuss the "don't hand in" problems with a study group. Expect weekly short quizzes on the "don't hand in" problems and the reading.

Minute papers: Occasional "minute papers" will be assigned to do either at the end of class or to post on WebCT before the next class. These minute papers are an opportunity to think through the day's material by writing freely and quickly about it, capturing any insights you had or questions and stumbling blocks you hope to follow up on. Minute papers will be graded only for completion, not for accuracy.

No calculators allowed: Since our focus in this course is on how and why various procedures in arithmetic work, the use of calculators is not allowed unless explicitly stated otherwise.

How your grade will be calculated:

We will grade all your work on a 5 point scale, and we will assign points as follows:

# of points	description	characteristics
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5.25 points	exemplary	work that could serve as a model for other students
5 points	very good	correct work that is careful and thorough
4 points	competent	good, solid work that is largely correct
3 points	basic	work that has merit but also has significant shortcomings
2 points	emerging	work that shows effort but is seriously flawed
0 points	no credit	no work submitted, or no serious effort shown

Your course grade will be based on 3 hour tests, quizzes, homework assignments, and a **comprehensive final exam**. The tests and final exam will emphasize problems that require you to write clear, complete, logical explanations.

hour tests, 3 at 13% each	39%
quizzes, total	15%
minute papers	3%
homework	18%
final exam	25%

Letter grades are expected to be assigned as follows.

for scores from	up to	letter grade
4.6	5 or above	A
4.5	4.6	A-
4.4	4.5	B+
4.1	4.4	B
4.0	4.1	B-
3.9	4.0	C+
3.6	3.9	C
3.5	3.6	C-
2.5	3.5	D
below 2.5		F

Materials needed: Please bring your activity manual to class.

Observers: You may notice that some students never turn in any work and never take any tests! How do they get away with it? These students are graduate students who are

observing MATH 5001 in preparation for eventually teaching courses for prospective elementary teachers.

Research project: A research project that is studying the mathematical preparation of elementary teachers will be videotaping during the semester. Videotaping will focus on the instructor, not on the students. If you do not want your image captured on the videotapes you may choose your seating accordingly. The research project will ask you to complete a pre- and post-test. These tests do not count toward your grade and are voluntary. We hope you will participate in the research project since we believe it will provide useful information on how to improve teacher preparation.

Assignments:

Week 1:

Monday 8/18: first day of class

Due Wednesday 8/20: Read all the course information on the “Information about and policies of this section of MATH 5001”. If you are registered for MATH 7001, read the MATH 7001 information as well. Try to solve the “hi-five” problem from class and be prepared to discuss it some more on Wednesday. The hi-five problem: There are 100 people in a room. If everybody “hi-fives” with everybody else, how many hi-fives will there be?

Due Friday 8/22: Read chapter 1 and section 2.1. Do but don’t hand in: the practice problems in section 1.2. Discuss your solutions with classmates. Compare your solutions to the solutions that are given in the text. **Hand in:** problem 4b on page 11. Remember that problems you turn in must be typed. Please review “Information about and policies of this section of MATH 5001” for additional information on explaining your solutions.

Week 2:

Due Monday 8/25: Read section 2.2. Do but don’t hand in: the practice problems in sections 2.1 and 2.2. Discuss your solutions with classmates. Compare your solutions to the solutions that are given in the text. Also do the following: go to the www.ubtriad.org website and put in the username and password given in class. Click on the yellow button “BBLT’s” and then on the pop up window, click on “development”. Under the “number” category, click on “counting”. Then look at the first 7 categories (and beyond if you are interested!) and for each one, read the description on the right and then click on “more info” on the lower right and view all the videos there (note that some don’t have videos but other have multiple videos if you click above the video frame). The 7 categories you should look at are: pre-counter, chanter, reciter, reciter (10), corresponder, counter (small numbers), producer (small numbers). Poke around some more if you are interested! **Hand in:** In class we said that three things that kids need to be able to do in order to determine the number of things in a collection of 5 things are (1) be able to say the list of counting numbers up to five (in the correct order without leaving any out or duplicating any) (2)

make a one-to-one correspondence between the number words “one,” “two,” “three,” “four,” “five,” and the things in the collection, and (3) know that the last number word they say, “five,” tells them how many things are in the collection. **Describe at least four examples** from the videos of kids who do or don’t fully understand one (or more) of these three items. The examples can refer to a different number of things than 5. Remember to type!

Due Wednesday 8/27: Read section 2.3. Do but don’t hand in: practice problems 1 – 4 of section 2.3. Discuss your solutions with classmates. Compare your solutions to the solutions that are given in the text. (Nothing to hand in due to posting glitch!)

QUIZ FRIDAY. Quiz problem(s) will be similar to “do but don’t hand in” problems that have been assigned so far, which includes the practice problems from sections 1.2, 2.1, 2.2, and 2.3.

Due Friday 8/29: Read section 2.4. Do but don’t hand in: the remaining practice problems of section 2.3. **Hand in:** Problem 11 a, b, c, d on page 47 and *for part b only*, explain why the number is plotted accurately as if you are explaining the problem to someone who didn’t understand how to do it. (For parts a, c, d no explanation is needed; you only need to show the number plotted on the number line.)

Week 3:

Monday 9/1: Labor Day, no classes

Due Wednesday 9/3: Read section 2.5. Do but don’t hand in: the practice problems of sections 2.4 and 2.5. **Hand in:** Problem 7 on page 57 but modified as follows: give Arthur only one explanation, but include a clear discussion of concepts involved in comparing decimal numbers. Don’t just tell Arthur *how* to do the problem correctly but also tell him *why* it makes sense.

[Comment on Quiz 1](#)

Due Friday 9/5: Read the chapter 2 summary and study items and section 3.1. Do but don’t hand in: the practice problems of section 3.1. **Hand in:** Problem 4 on page 62 and problem 9 on page 75. (Note that problem 4 on page 62 is the second item labeled 4 on that page. The first one is the solution to a practice problem.)

Week 4:

Due Monday 9/8: Read section 3.2. Do but don’t hand in the practice problems of section 3.2 as well as parts 2 – 4 of Class Activity 3A in the activity manual and parts 6, 7 of Class Activity 3B in the activity manual. **Hand in:** Problems 3 and 4 on pages 74, 75 of the text (in section 3.1). **MATH 7001** students only: extra problem set 1 due.

Due Wednesday 9/10 : Read section 3.3. Do but don't hand in the practice problems of section 3.2 as well as Class Activities 3I and the rest of 3J in the activity manual on pages 44 – 46. **Hand in:** Problem 5 on page 93 and problem 24 part a only on page 95. **Write each problem on a separate page.** One problem will be peer reviewed.

No office hours Friday since I will be out of town

Due Friday 9/12 : **TEST** on chapter 2 and sections 3.1, 3.2. Test problems will be similar to homework problems (hand in and don't hand in problems) and class activity problems.

Week 5:

Due Monday 9/15: Read section 3.4. Do but don't hand in the practice problems of section 3.4. **Write two helpful comments** on your peer's paper (you may write this right on their paper -- be sure to write visibly). For example, "Your picture really showed clearly how..." or "Could you give a little more detail here? I kind of see what you are saying but ...". In class, hand your peer's paper with your comments on it back to your peer. **Hand in:** Problems 14 and 15 on page 107.

Due Wednesday 9/17 : Read section 3.5. Do but don't hand in the practice problems of section 3.5. Also do but don't hand in problems 6 and 7 on pages 106, 107. **Hand in:** your revised solution to problem 24a, page 95, together with your original solution that has the peer comments on it. Your revised solution should be on a new piece of paper. Also hand in: Problem 7 on page 107.

Due Friday 9/19 : Re-read section 3.5 if you need to and finish the practice problems in that section if you haven't yet. Read the chapter 3 summary and study items. **Hand in:** Problem 4 on page 121 (remember: no calculators! Think about how to make the calculation easy to do.) Optional: if you would like to, you may revise problem 15 on page 107 (Think through carefully! In general, when you compare two fractions you can't just take the denominators into account, can you? Consider a variety of examples! **Use your writing to help you think about fractions at a higher, more general level.**)

Week 6:

Due Monday 9/22 : Read section 4.1. Do but don't hand in the practice problems for that section. **Hand in:** Problem 10 on page 121 and, counts as one problem: Problems 1c and 2a on page 137.

Due Wednesday 9/24 : Read section 4.2. Do but don't hand in practice problems 1 through 5 of section 4.2. To help Whitney and Matt grade more efficiently, we've decided to have you hand in homework only twice a week, on Mondays and Fridays. Part of Friday's homework will be posted on Monday, the remainder on Wednesday.

Due Friday 9/26 : QUIZ on sections 3.3, 3.4, and 3.5. Do but don't hand in the remaining practice problems of section 4.2. **Hand in:** Problem 3 c on page 189 except describe the strategies in words and describe at least two strategies (writing equations with parentheses is optional), and also describe several ways to use a make-a-ten strategy to solve $17 - 9 = ?$, drawing on our work in class on Monday 9/22; also hand in Problem 11 a, b on page 149.

Week 7:

Due Monday 9/29 : Read section 4.6. Do but don't hand in the practice problems for that section and also Problem 1 a, b on page 188. **Hand in:** Problem 9 a, b, c on page 190.

Due Wednesday 10/1 : Read section 4.3. Do but don't hand in the practice problems for that section and also Problems 1, 2, and 3 on page 160 (problem 3 should refer to page 153, not page 124).

Due Friday 10/3 : Read the chapter 4 summary and study items at the end of the chapter (omitting section 4.5 for now). Also read section 5.1. Do but don't hand in: problems 17, 18 on page 162 and problem 2 on page 203. **Hand in:** Problem 11 on page 161 and problem 19 on page 162.

Week 8:

Due Monday 10/6 : Read section 5.2. Do but don't hand in the practice problems from section 5.1 and 5.2. **Hand in:** Problem 5 on page 203 and problem 3 on page 207. **MATH 7001** students only: extra problem set 2 due.

Due Wednesday 10/8 : Read section 5.3. Do but don't hand in the practice problems from section 5.3. QUIZ on sections 4.1 (not including addition and subtraction of negative numbers), 4.2, 4.3, 4.6. To organize your studying, it may help to use the chapter summary and study items at the end of chapter 4.

Due Friday 10/10 : Read section 5.4. Do but don't hand in the practice problems from section 5.4. **Hand in:** Problem 1 on page 222 and problem 7 on page 225.

Week 9:

Due Monday 10/13 : Read section 5.5. Do but don't hand in the practice problems from section 5.5. **Hand in:** Problem 10 on page 225 and your choice of one of the following: EITHER problem 9 on page 214, OR problem 13 on page 225, OR make up and solve your own problem in which you use multiplication and reasonable assumptions to estimate how many there are of some large quantity – try to think of something that might be interesting to kids!

Due Wednesday 10/15 : Study for the test on Friday.

Due Friday 10/17 : TEST on sections 3.3 - 3.5, chapter 4 (not including sections 4.4, 4.5), and sections 5.1 - 5.4 (notice that sections 5.5 and 5.6 are not on this test; they will be on the next test). It may help you to use the chapter summary and study items at the end of the chapters.

Week 10:

Due Monday 10/20 : Read section 5.6. Do but don't hand in the practice problems from section 5.6. **Hand in:** Problems 4 and 12 on pages 246, 247.

Due Wednesday 10/22 : Read section 5.7. Do but don't hand in the practice problems from section 5.7. **MATH 7001** students only: see [7001 info](#) about revising and resubmitting up to 2 problems from the last assignment for some additional credit.

Due Friday 10/24 : Read section 6.1 through page 265. Do but don't hand in practice problem 1 on page 268. **Hand in:** Problem 10 on page 258 and problem 6 on page 270.

Week 11:

Due Monday 10/27 : Finish reading section 6.1. Do but don't hand in the remaining practice problems of section 6.1. **Hand in:** Problem 4 a – d and problem 9 on pages 270, 271.

Due Wednesday 10/29 : QUIZ on sections 5.5, 5.6, 5.7.

Friday 10/31 : Fall break, no classes

Week 12:

Due Monday 11/3 : Read section 6.2. Do but don't hand in the practice problems of section 6.2 and problem 17 on page 272.

Due Wednesday 11/5 : Read the chapter 6 summary and study items, starting on page 287 (for sections 6.1, 6.2 only). Do but don't hand in problem 4 on page 278, and problems 11, 12 on page 271. **Hand in:** Problem 13 a, b on page 271 and problem 6 on page 278.

Due Friday 11/7 : Read section 7.1. Do but don't hand in practice problems 1 and 2 of section 7.1. **Hand in:** Problem 12 on page 271 and problem 2 on page 299.

Week 13:

Due Monday 11/10 : Do but don't hand in problems 7, 8 on page 270 of section 6.1, practice problems 9 -- 12 of section 7.1. **Hand in:** Problem 1 c - g on pages 298, 299 (no explanations needed) and problem 21 on page 301 (this one you do need to explain, as usual).

Due Wednesday 11/12 : Do but don't hand in problems 3, 4, 5, 7 on page 299. Study for the test on Friday.

Due Friday 11/14 : **TEST** on sections 5.5, 5.6, 5.7, 6.1, 6.2, 7.1. It may help you to read the chapter summary and study items at the end of the chapters, to help you organize your studying. **NO OFFICE HOURS** due to out of town trip.

Week 14:

Due Monday 11/17 : No homework due.

Due Wednesday 11/19 : Read section 7.2 to page 306. Do but don't hand in the practice problems 1 - 6 from section 7.2. **MATH 7001** students only: extra problem set 3 due, see [7001 info](#)

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Due Friday 11/21 : Read the rest of section 7.2. Do but don't hand in the rest of the practice problems from section 7.2. **Hand in:** Problem 5 a, b on page 313 and problem 2 a, b, c on page 312.

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THANKSGIVING holiday, week of 11/24

Week 15:

Due Monday 12/1 : Do but don't hand in: Problem 3 a, b, 4 a, b on page 313 and also show how to record the division algorithm for these problems on a rectangle, in the way we discussed on Friday 11/21; also do but don't hand in problems 8, 9, and 14 on pages 313, 314.

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Due Wednesday 12/3 : **QUIZ** on section 7.2, including the way of writing the longhand division algorithm we discussed in class on Friday 11/21. Also, please fill out **course evaluations** at eval.franklin.uga.edu There are two evaluations there for this course: one for the math department, about the course overall, and one for the Writing Intensive Program (WIP), which funded and trained our wonderful teaching assistants, Whitney and Matt. For filling out the two evaluations you will receive extra homework credit (as if you got a full 5 points on an extra credit homework set). The evaluations are available through reading day.

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Due Friday 12/5 : Read section 7.3. Do but don't hand in the practice problems of section 7.3 and also problems 3, 4, 10 on page 325. **Hand in**: Problem 2 on page 325 and problem 16 c (do a and b too but don't hand in) on page 326.

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Week 16:

Due Monday 12/8 : Study for the final exam. Bring questions to class. If you haven't already, please fill out **course evaluations** at eval.franklin.uga.edu There are two evaluations there for this course: one for the math department, about the course overall, and one for the Writing Intensive Program (WIP), which funded and trained our wonderful teaching assistants, Whitney and Matt. For filling out the two evaluations you will receive extra homework credit (as if you got a full 5 points on an extra credit homework set). The evaluations are available through reading day.

Due Tuesday 12/9 : Friday schedule, last day of classes. Study for the final exam.

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Wednesday 12/10 : reading day

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Friday 12/12 : **Comprehensive FINAL EXAM** 3:30 – 6:30 pm in our usual classroom. The final exam covers: chapter 1, chapter 2, chapter 3, chapter 4 (except for sections 4.4, 4.5), chapter 5, chapter 6 (except for sections 6.3, 6.4), and sections 7.1, 7.2, 7.3.