MATH 7423 – Algebra for Inservice Teachers  
Fall 2008  
Dr. Janie Cates (jcates@westga.edu)  
Wednesdays, 5:30 – 8:00 p.m. Boyd 305

**Purpose:** *PSC Standards* – 2 xi, 3, 4, 5, 6, 7, 8 ii, iii, v, vi, 9, 10, 11, 12, and 13  
This course focuses on preparing P-5 mathematics specialist candidates to:

- Understand and use the major concepts and techniques of algebra for grades P-5, including expressing, transforming, and generalizing patterns and quantitative relationships through a variety of representations, including tables, graphs, algebraic symbols, verbal descriptions, manipulatives, and geometric figures.
- Solve problems using multiple strategies, manipulatives, and technological tools; interpret solutions; and determine reasonableness of answers and efficiency of methods.
- Develop critical thinking by nurturing collaboration, hands-on exploration, manipulative use, problem-based inquiry, technology utilization, and activity implementation addressing various learning styles and multiple intelligences.
- Select and use a variety of formative and summative assessment techniques to monitor student progress, gauge students’ mathematical understanding, and interpret school-based progress.

**Learning Outcomes:** *PSC Standards* – 2 xi, 3, 4, 5, 6, 7, 8 ii, iii, v, vi, 9, 10, 11, 13  
All students will learn to:

1. Understand patterns, relations, and functions.
2. Represent and analyze mathematical situations and structures using algebraic symbols.
3. Use mathematical models to represent and understand quantitative relationships.
4. Analyze change in various contexts.
5. Demonstrate a deep understanding of how P-5 students learn mathematics and of the pedagogical content knowledge appropriate to P-5 mathematics teaching. [Alternate wording: Cultivate insight into how P-5 students learn mathematics and develop pedagogical content knowledge appropriate to P-5 mathematics teaching.]

**Course Objectives:** *PSC Standards* – 2 xi, 5, 7, 8 iii, v, vi  
All students will be able to:

**Content Objectives**

- Express, extend, and generalize numerical and algebraic patterns and sequences.
- Understand equality and equations as balance between quantities.
- Recognize and create representations of quantitative relationships, including tables, graphs, algebraic symbols, verbal descriptions, manipulatives, and geometric figures, and translate flexibly among such representations.
- Understand and use letters to represent numbers or quantities (variables, unknowns, and parameters).
- Explore mathematical problems in mathematical and real-world contexts and interpret results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.
- Recognize and use the commutative, associative, distributive, additive and multiplicative identity, and additive and multiplicative inverse properties.
• Recognize contexts in which proportional reasoning is appropriate and distinguish them from additive contexts.
• Understand proportional relationships as multiplicative, where comparisons are relative and involve division, as opposed to additive contexts, where comparisons are absolute and involve subtraction.
• Recognize proportional relationships in tables, symbols, diagrams, and words.
  o Understand that in a proportional relationship, one variable is a constant multiple of another.
  o Understand that the graph of a proportional relationship passes through the origin.
  o Understand that a proportional relationship can be represented symbolically as $y = kx$.
  o Understand that in a table, the ratio of $y/x$ is constant.
• Understand and apply properties of exponents, including zero, rational, and negative exponents, as well as scientific notation.
• Understand and use absolute value as distance on a number line.
• Evaluate numerical and algebraic expressions.
• Add, subtract, multiply, factor, and divide algebraic expressions concretely, such as with length and area models, and abstractly.
• Discover, recognize, and use patterns and special products in polynomials.
• Solve equations and inequalities in one variable, using graphical, numerical, and symbolic methods, as well as informal reasoning, such as “backtracking” and the “cover-up” method.
• Apply properties of equality to solve for a given variable in a formula.
• Understand and apply the geometric meanings of the midpoint formula and the distance formula (i.e., the Pythagorean Theorem).
• Understand and use the notion of function to express relationships between quantities.
• Interpret and create function graphs, formulas (closed and recursive), and tables.
• Determine whether a quantitative relationship given graphically, numerically, or symbolically is a function.
• Investigate characteristics of particular classes of functions, especially linear, quadratic, and exponential functions, with some attention to absolute value, greatest integer, and piecewise-defined linear functions.
• Recognize linear, quadratic, and exponential functions from graphs, tables, symbols, and contexts.
• Identify and interpret the domain, range, intercepts, and zeros of functions, using various representations.
• Recognize and interpret rate of change in contexts, tables, and symbols and as slope in graphs and via a definition.
• Recognize and interpret $y$-intercept in graphs, contexts, tables, and symbols.
• Using graphs, tables, and symbolic methods, determine extreme values as well as intervals over which a function is increasing or decreasing.
• Determine the equation of a line in slope-intercept, point-slope, or standard form, including vertical and horizontal lines, given information such as points on the line, the slope, or the equation of a parallel or perpendicular line.
• Apply symbolic, graphical, and other methods to solve systems of equations and inequalities.
• Use the language of mathematics to formulate accurate, precise, and pedagogically appropriate definitions of terms related to algebra.
• Reason from definitions to determine examples and nonexamples of mathematical ideas and to show that two definitions are or are not equivalent.

**Pedagogy and Professional Development Objectives**

• Select and use appropriate concrete materials and technological tools for learning mathematics.
• Select, use, and determine the suitability of the wide variety of available mathematics curricula and teaching materials.
• Recognize the role of national, state, and local level mathematics standards and legislation in developing local curriculum and planning instruction that addresses the needs of diverse student populations.
• Demonstrate knowledge of different types of mathematical instructional strategies.
• Use multiple strategies to assess students’ mathematical knowledge.
• Identify professional mathematics organizations and describe their contributions to the teaching of mathematics and the professional development of teachers.

**Technology: PSC Standard – 5**
Using technology as a tool for learning and doing mathematics and for accessing Web-based instructional materials is a significant component of this course. Suggested tools include graphing calculators such as the TI-73 Explorer and TI-83 Plus SE; data collection devices such as the Calculator-Based Ranger (CBR) with a built-in motion detector and the Calculator-Based Laboratory (CBL2) with temperature probes, pressure probes, and microphones; TI-Graph Link cable; and software such as *The Geometer’s Sketchpad*, *TI-InterActive!*, and *TI-Connect*.

**Manipulative Materials: PSC Standard – 8 vi**
Pattern blocks, two-color counters, geoboards, snap cubes, algebra tiles or algeblocks, Hands-on Equations, graph paper, etc.

**Instructional Materials: PSC Standard – 9**

**Texts**

**Resources**

• *Activities for algebra with the TI-83 plus* (Texas Instruments, 2001)
• *Addenda Series Grades 5-8, Patterns and Functions* (NCTM, 1991)
• *Data collection activities for the middle grades with the TI-73, CBL and CBR* (Texas Instruments, 1998)
• *Math and science in motion: Activities for middle school* (Texas Instruments, 1997)
• *Mathematics Teaching in the Middle School* (NCTM Journal)
• *Real-world math with the CBL2 and LabPro* (Texas Instruments, 2002)
• *Teaching Children Mathematics* (NCTM Journal)

Web-Based Resources: *PSC Standards* – 2 xi, 8 iii, vi, and 9
• NCTM Electronic Principles and Standards - [http://standards.nctm.org/](http://standards.nctm.org/)

**Instructional Methods:** *PSC Standards* – 3, 4, 6, 7, 8 vi, 9, 10, 11, 12, and 13

This course will develop a mathematical and pedagogical knowledge base that reflects the spirit of the NCTM *Principles and Standards* (2000) and the *National Board for Professional Teaching Standards* (1998); diverse learning styles; multiple intelligences; and contributions of underrepresented groups and diverse cultures through the use of varied instructional strategies and methods including:

- guided discussion
- modeling and simulations
- cooperative and collaborative grouping
- student presentations and hands-on activities that actively engage students in the learning process.

**Evaluation Methods:** *PSC Standards* – 2 xi, 3, 4, 5, 6, 7, 8 iii, v, vi, 9, 10, 11, 12, and 13

Student performance will be evaluated through the use of varied assessments including projects, in-class presentations, tests, reflective logs, peer and self-assessment, content and pedagogical proficiency demonstrations, and a teaching/instructional unit.

**Assignments:**

- All assignments are individual assignments.
- Assignments must be in a typed, double-spaced format with Times/Times New Roman font, size 12, and 1-inch margins unless otherwise indicated.
- **Assignments are due at the BEGINNING OF CLASS on the designated date.**
- Failure to meet deadlines and/or follow directions will result in a grade reduction of at least 10% per assignment.
- Technical/computer problems are not an acceptable excuse for a late assignment.
- Rubrics are provided for each assignment and must be turned in with the corresponding assignment. Assignments submitted without the rubric will counted as late submissions.
- If you are absent, it is your responsibility to get any missed work and turn in any assignments that are due. **An absence DOES NOT change an assignment’s due date.** Remember: Assignments are not negotiable, however, due dates are. Contact the instructor to make arrangements if necessary BEFORE the assignment is due.
- If you have questions about the expectations of an assignment, see me before the assignment is due.
- If you have questions about assignment grades, see me privately AFTER class.

1. **GPS Algebra Investigation** –
   - Examine the GPS Algebra strand for your grade band (K-2, 3-5, 6-8).
   - Write a reflection to include:
     - What concepts and skills are you building on from the previous grade?
o How will you further develop these concepts and skills in your grade?
o How will students be using what they learn in your classroom next year?
o How will you incorporate the process standards into your teaching of algebra?

3. **Field Assignments** – You will have 2 filed assignments to complete this semester. Each filed assignment should be student-centered and focus on the algebra concepts for your grade level. At least one of the field assignments should **integrate mathematics and literature**. Complete the write-up as described on page 9 of the syllabus.

*NOTE*: For the field assignment integrating mathematics and literature, include an annotation of the literature book.

4. **Teachable Unit** - Develop a grade level appropriate unit of instruction for the algebra strand to teach at your grade level. *(Note: K-2 does not have a specific algebra strand. You will need to focus on the standards that are algebra-related.)* Details and unit information are located on pages 10-18 of the syllabus.

5. **Tests** – There will be three tests during the semester. The test questions will be in a format similar to the activities we do in class and the practice problems at the end of each section. See course outline for dates.

**Grading**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points Possible</th>
<th>Evaluation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS Investigation</td>
<td>25</td>
<td>Rubric</td>
</tr>
<tr>
<td>Field Assignments (2 @ 25 points)</td>
<td>50</td>
<td>Rubric</td>
</tr>
<tr>
<td>Teachable Unit</td>
<td>50</td>
<td>Rubric</td>
</tr>
<tr>
<td>Tests (3 @ 100 points)</td>
<td>300</td>
<td>Exam</td>
</tr>
<tr>
<td>Professionalism/Participation</td>
<td>25</td>
<td>Observation</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>450</strong></td>
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</tr>
</tbody>
</table>

Final grades will be distributed according to the following scale:

- A = \(405 \leq x < 450\)
- B = \(360 \leq x < 405\)
- C = \(315 \leq x < 360\)
- F = \(x < 315\)

*The final letter grade of “A” will be reserved for those students who demonstrate excellence in all of their work and contributions to class.*

**Professionalism/Participation Policy**: Students are expected to attend all class and lab sessions and conduct themselves professionally at all times. Professionalism will be graded as follows:
<table>
<thead>
<tr>
<th>Points</th>
<th>Tardy/ Leave Early</th>
<th>Absences</th>
<th>Behavior Unbecoming a Professional</th>
<th>Late Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20-24</td>
<td>1</td>
<td>1</td>
<td>1 event</td>
<td>1</td>
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<tr>
<td>15-19</td>
<td>2</td>
<td>2</td>
<td>2 events</td>
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<td>10 – 14</td>
<td>3</td>
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<td>3 events</td>
<td>3</td>
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<td>0 – 9</td>
<td>&gt; 3</td>
<td>&gt; 2</td>
<td>&gt; 3 events</td>
<td>&gt; 3</td>
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</tbody>
</table>

Cell phones are not allowed in the classroom. If you have a cell phone, it must be turned off or set to vibrate.
<table>
<thead>
<tr>
<th>Class</th>
<th>Date</th>
<th>Topic (Sections)</th>
<th>Class Activities</th>
<th>Assignments Due</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>August 20</td>
<td>Syllabus, Pretest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>August 27</td>
<td>6.3 – Multiplying Negative Numbers</td>
<td>J, K, L, M, N, O</td>
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<tr>
<td></td>
<td></td>
<td>6.4 – Scientific Notation</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>3</td>
<td>7.6 – Ratio and Proportion</td>
<td>X, Y, Z, BB, CC, DD</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>September 10</td>
<td>12.1 – Factors and Multiples</td>
<td>A, B, D, E, G, J</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>12.2 – GCF and LCM</td>
<td></td>
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<tr>
<td>5</td>
<td>17</td>
<td>12.3 – Prime Numbers</td>
<td>K, L, M, N, O, P</td>
<td>Unit – Part 1</td>
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<td>12.4 – Even and Odd</td>
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<td>12.5 – Divisibility Tests</td>
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<tr>
<td>6</td>
<td>24</td>
<td>12.6 – Rational and Irrational Numbers</td>
<td>Q, R, S, T, U</td>
<td></td>
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<tr>
<td>7</td>
<td>October 1</td>
<td>Test #1 – Classes 2-6</td>
<td></td>
<td>GPS Investigation</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>13.1 – Mathematical Expressions, Formulas, and Equations</td>
<td>A, B, D, F, G, H</td>
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<tr>
<td>9</td>
<td>October 15</td>
<td>NO FACE TO FACE – Complete Field Assignments 1 &amp; 2</td>
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<tr>
<td>10</td>
<td>September 22</td>
<td>13.2 – Solving Equations</td>
<td>J, K, M, O</td>
<td>Field Assignments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solving Inequalities</td>
<td></td>
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</tr>
<tr>
<td>11</td>
<td>November 29</td>
<td>13.3 – Sequences</td>
<td>P, Q, S, T, W, X</td>
<td>Unit – Part 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.4 - Series</td>
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<tr>
<td>12</td>
<td>5</td>
<td>Test #2 – Classes 8, 10, 11</td>
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<tr>
<td>13</td>
<td>November 12</td>
<td>13.5 – Functions</td>
<td>CC, DD, EE, FF, HH</td>
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<tr>
<td></td>
<td></td>
<td>13.6 – Linear Functions</td>
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<tr>
<td>14</td>
<td>19</td>
<td>Writing Equations of Lines</td>
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<td>15</td>
<td>26</td>
<td>Thanksgiving Holidays</td>
<td></td>
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<tr>
<td>16</td>
<td>December 3</td>
<td>Systems of Equations and Inequalities</td>
<td></td>
<td>Algebra Unit</td>
</tr>
<tr>
<td>17</td>
<td>December 10</td>
<td>Test #3 – Classes 13, 14, 16</td>
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</tbody>
</table>
Suggested Homework Activities – It is a good idea to work through the practice problems at the end of each section. The answers for these are provided in your textbook.

<table>
<thead>
<tr>
<th>CHAPTER 6</th>
<th>CHAPTER 7</th>
</tr>
</thead>
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<td>Section 6.3 – p. 281 (1-3)</td>
<td>Section 7.6 – pp. 365-267 (1-14)</td>
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<tr>
<td>Section 6.4 – p. 285 (1-4)</td>
<td>Ch. Summary and Study Items – pp. 378-381</td>
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<tr>
<td>Ch. Summary and Study Items – p. 288 (6.3 &amp; 6.4)</td>
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<table>
<thead>
<tr>
<th>CHAPTER 12</th>
<th>CHAPTER 13</th>
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<tr>
<td>Section 12.1 – pp. 651-652 (1-4)</td>
<td>Section 13.1 – pp. 702-704 (1-13)</td>
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<td>Section 12.2 – p. 658 (1-7)</td>
<td>Section 13.2 – p. 722 (1-5)</td>
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<tr>
<td>Section 12.3 – p. 667 (1-5)</td>
<td>Section 13.3 – pp. 736-737 (1-5)</td>
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<td>Section 12.4 – p. 670 (1-3)</td>
<td>Section 13.4 – pp. 747-748 (1-2)</td>
</tr>
<tr>
<td>Section 12.5 – p. 675 (1-2)</td>
<td>Section 13.5 – pp. 759 – 760 (1-4)</td>
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<td>Section 12.6 – p. 686 (1-11)</td>
<td>Section 13.6 – p. 772 (1-3)</td>
</tr>
<tr>
<td>Ch. Summary and Study Items – pp. 691-693</td>
<td>Ch. Summary and Study Items – pp. 776-778</td>
</tr>
</tbody>
</table>

You are responsible for knowing the following terms and their meaning:

- scientific notation
- ratio (how many groups?)
- ratio (how many in each group?)
- rate
- equivalent ratios
- proportion
- divisible
- multiple
- to factor
- greatest common factor
- least common multiple
- prime numbers
- Fundamental Theorem of Arithmetic
- Sieve of Eratosthenes
- trial division
- factor tree
- even
- odd
- terminating decimal
- repeating decimal
- square root
- variable
- expression
- formula
- equation
- evaluate an expression
- evaluate a formula
- solve an equation
- solution
- sequence
- arithmetic sequence
- geometric sequence
- Fibonacci sequence
- series
- arithmetic series
- geometric series
- function
- graph of a function
- linear function
- slope
- y-intercept
- x-intercept
- slope-intercept form
- standard form
- polynomial
- absolute value
- system of equations
- system of inequalities
- domain
- range
- closed formula
- recursive formula
Field Assignments

1. Select a grade level appropriate activity.

2. Identify the GPS for the activity.

3. Begin Write-Up...
   □ Title of Activity
   □ Source
   □ Grade level
   □ Standard(s) and element(s)
   □ Book Annotation (for Math & Literature Field Assignment)
   □ Brief description - 1 to 2 sentences
   □ Prerequisite skills
   □ Potential misconceptions, difficulties, etc.

4. Students DO the activity.

5. Complete Write-Up...REFLECT...
   □ What went well?
   □ What didn’t?
   □ Insights - from you and your students
   □ What adjustments would you make for next time? Why?

6. Staple Write-Up to front of activity copy.

7. Submit.
CULMINATING ACTIVITY: Developing an Instructional Unit

During this course, students will develop a 5-10 day unit of instruction for the Algebra strand to teach at their grade levels. The teaching unit is to serve as the culminating assessment and to address best practices for mathematics at the elementary level and PSC Standards 2 xi, 4, 5, 6, 9, 10, 11, and 12 for the Early Childhood mathematics endorsement. The unit offers an opportunity for the teacher to connect with other instructional areas both across mathematics strands and with other disciplines.

The teaching unit must include the following:
• Strategies addressing diversity (gender, ethnicity, learning styles, etc.) to support full participation by all students;
• Appropriate use of technology, print and electronic resources, and manipulative and visual materials;
• Interdisciplinary activities and problem solving;
• Effective uses of student groupings such as peer teaching and collaborative grouping;
• Varied instructional strategies based on current research and local, state, and national standards; and
• Formative and summative assessments to determine student achievement.

First half of the course (Part One):
1) Choose topic, Identify NCTM standards and GPS standards – what are the key GPS? Supporting GPS?
2) Develop essential question for the unit
3) Develop concept map for the unit
4) Develop essential questions for each of the lessons
5) Design culminating activity – this is the unit’s summative assessment
6) Design rubric for the culminating activity

DUE DATE for Part One: September 17, 2008

In the second half, but prior to the end of term (Part Two):
Revise Part One
7) Develop the launch activity (capture attention and engage learners)
8) Develop the acquisition lessons (lessons for students to acquire knowledge), at least one lesson for each essential question
9) Develop the extending/refining lessons (lessons that extend the content)
10) Design formative assessments

DUE DATE for Part Two: October 29, 2008

At the end of the term (Part Three): December 3, 2008

Revise Part Two
11) List resources and materials – Have you included a variety of resources – technology, manipulatives, visuals, etc?
12) Develop timeline, pacing guide (day by day plan)
13) Specify differentiation methods – How are you meeting the needs of all students? What strategies – instructional and grouping – are you using in your unit?
14) Specify interdisciplinary activities and problem solving – How are these incorporated in your unit?