



## Teaching Circumference and Area of Circles

**Course Number:** MAT 953

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**Number of Units:** 2 semester units

**Grade Level:** Teachers in grades 5 – 7

### Course Description

**Rationale and Purpose:** Teachers will extend their understanding of the concepts and teaching of circumference and area of circles using hands-on experiences. They will also reflect upon their teaching planning and practice and engage in dialog with an experienced practitioner in the field. A combination of text, video demonstrations, animations and comics, will increase the teacher's content knowledge as well as pedagogical knowledge. This course has been aligned with specific Common Core State Standards and the activities emphasize the Common Core Mathematical Practices (see standards section below).

**Overview:** The Essential Math series provides a wealth of content knowledge in a multimedia format that will engage and motivate students. Each unit is narrowly focused and conceptually developed – easily aligned to standards – and includes:

**Hands-on Investigations** that form the heart of each lesson.

**Comics** that demonstrate effective teaching strategies and provide an opportunity for students to review or clarify what they learned from the investigations.

**Animation and Video** to visually illustrate the essential concepts. They promote a deeper understanding and make it easy for students to remember.

**Problem Solving** activities that help students apply and reinforce their understanding of the concepts in unique ways.

**Assessments** that provide an opportunity for students to apply their learning and for teachers to determine what depth of understanding has been gained.

**Course Content:** This course builds a foundation for teaching and understanding the circle concepts of circumference and area. It is supported by classroom lessons in the AIMS publication *Circumference and Area of Circles*, which forms the nucleus of the course.

The hands-on activities in this book offer experiences built around two big ideas:

1. Circumference is the distance around the circle and is related to the diameter of the circle by a factor of about three ( $\pi \approx 3.14$ ).
2. The area of a circle is related by a factor of about three to a square with edges the length of the radius.

**Methodology:**

*"For the things we have to learn before we can do them, we learn by doing them."*

~Aristotle

This course is designed around the principles of Experiential Learning and Metacognition. Experiential Learning is the process of making meaning from direct experience. Metacognition is the awareness of the process of learning. The participants in this course will be required to do a set of hands-on activities, be aware of their own learning process while completing these activities, and through thoughtful reflection and analysis, adapt their own teaching strategies to benefit their students' learning experience.

**Overview of Course Requirements:**

- Do the activities in *Circumference and Area of Circles*, using the videos and animations for support and guidance.
- After doing each lesson yourself, reflect upon your experience by responding to questions in the forum.
- Prior to teaching each lesson, apply the Skills for Thinking to the design of discussion questions, tasks, and procedures integral to each lesson.
- Choose one lesson from *Circumference and Area of Circles* and describe how it addresses the four learning environments of the Model of Learning.
- Align the learning goals of *Circumference and Area of Circles* with your state content standards.
- Design a Plan for Implementation of the activities from *Circumference and Area of Circles* including a summary of and rationale for the selection of AIMS lessons.
- Teach the lessons and activities from *Circumference and Area of Circles* with a group of students (if your own students are not available, gather four or more age appropriate students, e.g., from church, friends, or your neighborhood) and record your reflections in the forum.
- Complete the Professional Growth and Reflection assignment describing how the selected articles and the teaching experience impacted you and your teaching.

**Course Materials****Materials Provided**

- The AIMS publication *Circumference and Area of Circles* (ZIP file provided online)
- *A Model of Learning & The Skills for Thinking* (provided online)

**Materials to be provided by each participant**

- Standard paper clips
- String
- Scissors
- Pencils
- Paper
- Water-soluble markers
- Rulers
- 8-10 cans (different sizes)

**Optional Materials (may be purchased by the student)**

To purchase a hardcopy of the AIMS publication *Circumference and Area of Circles*, call 1-888-733-2467 or order online at <http://www.aimsedu.org> (\$9.95).

**Standards**

**Common Core**

In addition to being aligned with the Common Core Content Standards for grades 5-8 listed below, all AIMS activities strive to emphasize the “Mathematical Practices” within the Common Core document.

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 appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

<p>5.OA * Write and interpret numerical expressions * Analyze patterns and relationships * Perform operations with multi-digit whole numbers and decimals to hundredths</p> <p>5.MD * Represent and interpret data</p>	<p>6.EE * Apply and extend previous understandings of arithmetic to algebraic expressions * Reason about and solve one-variable equations and inequalities</p> <p>6.G * Solve real-world and mathematical problems involving area, surface area, and volume</p>	<p>7.NS * Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers</p> <p>7.EE * Solve real-life and mathematical problems using numerical and algebraic expressions and equations.</p> <p>7.G * Draw, construct, and describe geometrical figures and describe the relationships between them * Solve real-life and mathematical problems involving angle measure, area, surface area, and volume</p>	<p>8.NS * Know that there are numbers that are not rational, and approximate them by rational numbers</p> <p>8.EE * Work with radicals and integer exponents</p> <p>8.F * Define, evaluate, and compare functions * Use functions to model relationships between quantities</p>
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## Content Standards

- *Develop and use formulas to determine the circumference of circles and the area of triangles, parallelograms, trapezoids, and circles and develop strategies to find the area of more complex shapes.*  
~NCTM Principles and Standards for School Mathematics  
(Measurement, grades 6-8)
- *Calculate the circumference and areas of rectangles, triangles, and circles, and the volumes of rectangular solids.*  
~American Association for the Advancement of Science  
Project 2061 Benchmark (12B, grades 6-8)
- Participants will identify applicable State Content Standards.

## Standards for Teachers

The National Board for Professional Teaching Standards (NBPTS) Propositions addressed:

- **Proposition 1: Teachers are Committed to Students and Their Learning**
  - Teachers are dedicated to making knowledge accessible to all students. They believe all students can learn.
- **Proposition 2: Teachers Know the Subjects They Teach and How to Teach Those Subjects to Students.**
  - Teachers have mastery over the subject(s) they teach. They have a deep understanding of the history, structure and real-world applications of the subject.
  - They have skill and experience in teaching it, and they are very familiar with the skills gaps and preconceptions students may bring to the subject.
  - They are able to use diverse instructional strategies to teach for understanding.
- **Proposition 3: Teachers are Responsible for Managing and Monitoring Student Learning.**
  - Teachers deliver effective instruction. They move fluently through a range of instructional techniques, keeping students motivated, engaged and focused.
  - They know how to engage students to ensure a disciplined learning environment, and how to organize instruction to meet instructional goals.
- **Proposition 4: Teachers Think Systematically about Their Practice and Learn from Experience.**
  - Teachers model what it means to be an educated person – they read, they question, they create and they are willing to try new things.
  - They are familiar with learning theories and instructional strategies and stay abreast of current issues in American education.
  - They critically examine their practice on a regular basis to deepen knowledge, expand their repertoire of skills, and incorporate new findings into their practice.

## **Learning Objectives / Outcomes**

Through successful completion of this course participants will:

1. Experience hands-on activities that bring to life the concepts of circumference and area of circles. (NBPTS 2, NCTM, AAAS)
2. Analyze their learning experiences resulting in modified instructional practice/planning. (NBPTS 1, 2 & 4)
3. Synthesize connections between professional literature and their teaching & learning experiences [TLE]. (NBPTS 4)
4. Apply national and state content standards and district benchmarks to each TLE. (NBPTS 1 & 4, NCTM, AAAS)
5. Develop a rationale for the selection and implementation of TLEs based on multiple factors [student needs, standards, benchmarks]. (NBPTS 1, 2 & 3)
6. Evaluate their teaching experiences and modify their instructional strategies accordingly. (NBPTS 1, 2, 3 & 4)
7. Develop a deep conceptual understanding of mathematical principles and how to teach them. (NBPTS 2, NCTM, AAAS)

## **Evidence of Learning**

Participants will demonstrate their learning by thoughtfully completing the online assignments. The assignments include completing all of the activities and assessments in the AIMS publication *Circumference and Area of Circles*, and describing how their lessons address the elements from the Model of Learning, Skills for Thinking, Learning Goals, and State Content Standards. Additional evidence of learning will be observed in the reflective responses recorded in the forum as well as from the Professional Growth and Reflection assignment.

## **Assignments**

All Assignments are to be completed online (in Moodle).

Prior to attempting the assignments make sure you:

- Read the AIMS publication *Circumference and Area of Circles*.
- Read the selected articles that substantiate the underlying learning theory and foundation for teaching (linked online).

### **Assignment 1**

- a. Complete the Day 1 activity, Clips, Chains & Circumference, using the comics and video demonstrations. Upload digital photos and scanned activity sheets to verify completion (close-up photos of activity sheets can work if you don't have a scanner nearby). [Learning Objectives 1 & 7] (4 pts, see rubric)

- b. Reflect on your experience by responding to the questions on the Personal Response Forum. . [Learning Objective 2] (4 pts, see rubric)
  - 1. Describe your impressions of the lesson/activity.
  - 2. If you were to teach the lesson tomorrow, what would you emphasize or change from your own personal experience?
  - 3. What features of the lesson/activity were most enlightening?
  - 4. How did this activity change your understanding of the concepts of circumference or area of circles?
  - 5. Describe your attitudes (positive or negative) while completing this activity.
  - 6. How did the video clips, animations, and comics play a part in helping you with this activity and how do you envision using the media files when you teach this lesson to students?
- c. Apply the concepts from the *Skills for Thinking* to the design of tasks and discussion questions that emphasize the concepts, skills and processes for the lesson. [Learning Objectives 2, 3 & 7] (4 pts, see rubric)

### Assignment 2

- a. Complete the Day 2 activity, Stringing Around, using the comics and video demonstrations. Upload digital photos and scanned activity sheets to verify completion (close-up photos of activity sheets can work if you don't have a scanner nearby). [Learning Objectives 1 & 7] (4 pts, see rubric)
- b. Reflect on your experience by responding to the questions on the Personal Response Forum. [Learning Objective 2] (4 pts, see rubric)
- c. Apply the concepts from the *Skills for Thinking* to the design of tasks and discussion questions that emphasize the concepts, skills and processes for the lesson. [Learning Objectives 2, 3 & 7] (4 pts, see rubric)

### Assignment 3

- a. Complete the Day 3 activity, Rolling Around, using the comics, animations, and video demonstrations. Upload digital photos and scanned activity sheets to verify completion (close-up photos of activity sheets can work if you don't have a scanner nearby). [Learning Objectives 1 & 7] (4 pts, see rubric)
- b. Reflect on your experience by responding to the questions on the Personal Response Forum. [Learning Objective 2] (4 pts, see rubric)
- c. Apply the concepts from the *Skills for Thinking* to the design of tasks and discussion questions that emphasize the concepts, skills and processes for the lesson. [Learning Objectives 2, 3 & 7] (4 pts, see rubric)

### Assignment 4

- a. Complete the Day 4 Problem Solving assessment. Upload scanned activity sheets showing your work to verify completion (close-up photos of activity sheets can work if you don't have a scanner nearby). [Learning Objectives 1 & 7] (4 pts, see rubric)
- b. Reflect on your experience by responding to the questions on the Personal Response Forum. [Learning Objective 2] (4 pts, see rubric)

### Assignment 5

- a. Complete the Day 5 & Day 6 activities, Circle Cover-Ups, using the comics and video demonstrations. Upload digital photos and scanned activity sheets to verify completion (close-up photos of activity sheets can work if you don't have a scanner nearby). [Learning Objectives 1 & 7] (4 pts, see rubric)
- b. Reflect on your experience by responding to the questions on the Personal Response Forum. [Learning Objective 2] (4 pts, see rubric)
- c. Apply the concepts from the *Skills for Thinking* to the design of tasks and discussion questions that emphasize the concepts, skills and processes for the lesson. [Learning Objectives 2, 3 & 7] (4 pts, see rubric)

### Assignment 6

- a. Complete the Day 7 activity, Pi Pieces & Parallelograms, using the comics, animations, and video demonstrations. Upload digital photos and scanned activity sheets to verify completion (close-up photos of activity sheets can work if you don't have a scanner nearby). [Learning Objectives 1 & 7] (4 pts, see rubric)
- b. Reflect on your experience by responding to the questions on the Personal Response Forum. [Learning Objective 2] (4 pts, see rubric)
- c. Apply the concepts from the *Skills for Thinking* to the design of tasks and discussion questions that emphasize the concepts, skills and processes for the lesson. [Learning Objectives 2, 3 & 7] (4 pts, see rubric)

### Assignment 7

- a. Complete the Day 8 Problem Solving and Day 9 Assessment worksheets. Upload scanned activity sheets showing your work to verify completion (close-up photos of activity sheets can work if you don't have a scanner nearby). [Learning Objectives 1 & 7] (4 pts, see rubric)
- b. Reflect on your experience by responding to the questions on the Personal Response Forum. [Learning Objective 2] (4 pts, see rubric)

### Assignment 8

Choose one lesson from *Circumference and Area of Circles* and describe how it addresses the four learning environments of the *Model of Learning*. [Learning Objective 3] (12 pts, see rubric)

### Assignment 9

Align the learning goals of *Circumference and Area of Circles* with your State Content Standards and local benchmarks. [Learning Objective 4] (12 pts, see rubric)

### Assignment 10

Design a Plan for Implementation of the activities from *Circumference and Area of Circles* including a summary of and rationale for the selection of AIMS lessons. [Learning Objectives 3, 4 & 5]. (12 pts, see rubric)

1. Describe an overall plan for the implementation of the lessons in *Circumference and Area of Circles* (consider schedule, pacing guide, textbook, benchmarks, using

some or all of the activities).

2. Describe the rationale and purpose for using these experiences in your classroom.
3. Provide your reasoning for leaving out any of the curriculum's elements (activities, comics, animations).
4. Describe how these lessons connect to the particular needs of your students, the curriculum at your school and related concepts and disciplines.

### **Assignment 11**

Teach the lessons from your Plan for Implementation with a group of students (if your own students are not available, gather at least 4 age appropriate students, e.g., from church, friends, or your neighborhood). Record your reflections in the online forum. [Learning Objectives 6 & 7] (12 pts, see rubric)

- 1) Describe general impressions of the relative success of the lesson.
- 2) If you were to teach the lesson again tomorrow, what modifications would you include?
- 3) What features of the lesson were most enlightening with regard to student outcomes or understanding?
- 4) What did you observe students doing that indicated their understanding or misunderstanding of concepts or processes pertinent to the lesson?
- 5) What kinds of comments/conversation did you hear from students that indicated positive/negative attitudes, curiosity, wonder, or persistence?
- 6) Classroom interactions have been anticipated and modeled in the comics. How did your experience compare with the comics?
- 7) Record any other reflections that you think were significant or meaningful.

### **Assignment 12**

Complete the Professional Growth and Reflection assignment describing how the selected articles and hands-on activities impacted you and your teaching. [Learning Objectives 1-7] (12 pts, see rubric)

### **Grading Policies and Rubrics**

Unless otherwise indicated, students successfully completing this course will earn a Credit/No credit grade. Where a letter grade is requested, a letter grade of A or B will be issued based on the number of points earned.

A (or Credit) = 122-136 points

B (or Credit) = 108-121 points

NC (No Credit) = 107 points or less

### **Instructor/Student Contact**

Instructor/Student dialogue will take place in the discussion forum and through feedback at the completion of each assignment through the Moodle grade book tool.

### **References**

National Board for Professional Teaching Standards, (2008) <http://www.nbpts.org/>

State Department of Education list and links for State Content Standards (2009),

[http://wdcrobcolp01.ed.gov/Programs/EROD/org\\_list.cfm?category\\_cd=SEA](http://wdcrobcolp01.ed.gov/Programs/EROD/org_list.cfm?category_cd=SEA)

National Council of Teachers of Mathematics (Standards and Learning Resources),  
<http://www.nctm.org/>

American Association for the Advancement of Science, Project 2061 Benchmarks for Science Literacy, Oxford University Press. New York. 1993

AIMS (Activities Integrating Math & Science), <http://aimsedu.org/>

*The Amazing Circle*, [http://www.aimsedu.org/aims\\_store/The-Amazing-Circle-p-1035.html](http://www.aimsedu.org/aims_store/The-Amazing-Circle-p-1035.html)

*How People Learn: Brain, Mind, Experience, and School*, (1999), Commission on Behavioral and Social Sciences and Education [http://www.nap.edu/openbook.php?record\\_id=6160](http://www.nap.edu/openbook.php?record_id=6160)

Winn, W. & Snyder D. (1996). Cognitive perspectives in psychology. In D.H. Jonassen, ed. *Handbook of research for educational communications and technology*, 112-142. New York: Simon & Schuster Macmillan

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### **University Information**

*“Graduate level course work reflects Fresno Pacific University’s Desired Student Learning Outcomes as it applies to professional development to demonstrate the following:*

- *Oral and written communication in individual and group settings*
- *Content knowledge, and application of such knowledge in the student's area of interest to affect change*
- *Reflection for personal and professional growth*
- *Critical thinking*
- *Cultural and global perspectives to understand complex systems*
- *Computational/methodological skills to understand and expand disciplines, including an understanding of technological systems”*