

Independent Study Course Syllabus

Course Number: MAT 914
Course Title: Patterns and Problem Solving

Online Distance Learning

<p>Instructor: Wilbert Reimer Phone number: (559) 255-2308 Email: wreimer@fresno.edu Website: www.pdcourses.com</p>	<p>Units: 3 Grade Level: 3-12</p>
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Course Description

Teaching students to recognize patterns in mathematics--and to use patterns to solve problems--is the objective of this course.

Many of us already know that problem solving can be an exciting, exhilarating adventure. Students who have caught this enthusiasm may simply be given a problem and "turned loose" to see what they can find. Others, frustrated by lack of direction or insecure about process, will find the activities in this course guiding them towards success. With just a little help, every student can make some significant discoveries about mathematics. Each experience will sharpen their mathematical skills and increase their problem solving confidence.

The goal of this course is to equip teachers to help students use patterns to make discoveries. Difficult problems become simpler when order and relationships are uncovered.

Participants will read and respond to several brief articles introducing the theories behind pattern recognition. The major component of the course involves selecting and teaching classroom-ready activities included in the text. Participants are also asked to design several problem solving activities of their own.

This course was developed to reinforce the Common Core State Standards in Mathematics and the five core propositions of the National Board for Professional Teaching Standards. Students

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will be asked to make connections between their work and these standards or the standards of their own states.

Course Dates:

Self-paced; students may enroll at any time and take up to one year to complete assignments.

You have up to one year from the date of registration, and no less than three weeks (one week per credit), to complete the course.

Course Materials

Text for this course: **(On Enclosed CD)**

Reimer, Wilbert. *WHAT'S NEXT? Using Patterns to Solve Problems*,
Volumes 1, 2, and 3.

The course booklet contains an appendix of reading materials and resources. Information about Fresno Pacific University, the School of Professional Studies, and the instructor, plus details on course policies and procedures is also included.

Course Requirements

To complete this course satisfactorily, participants must submit

1. A short paper on the role of patterns in mathematics.
2. A paragraph identifying three activities chosen from the specified website.
3. A list of the 10 activities you selected as appropriate for your grade level.
4. Five lesson plans and evaluations, one for each of the activities you selected to teach.
5. Two lesson plans and evaluations for the pattern-based activities you designed and taught.

See the "Schedule of Topics and Assignments" for more details on these assignments.

All work should be typed and sent to the instructor at one time when the course is completed. Please keep a copy; work will not be returned. Students have one full year to finish the course but should not send completed work in less than three weeks from registration.

Send completed work by email attachments to: wreimer@fresno.edu

OR

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Mail all the above items to:
Wilbert Reimer
1549 S. Lind Avenue
Fresno, California 93727

National Standards:

Common Core Standards for Mathematics

a. Problem Solving

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals.

b. Reasoning

Mathematically proficient students make sense of quantities and their relationships in problem situations.

c. Constructing Arguments

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments.

d. Modeling

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.

e. Using Strategic Tools

Mathematically proficient students consider the available tools when solving a mathematical problem.

f. Attending to Precision

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning.

g. Using Structure

Mathematically proficient students look closely to discern a pattern or structure.

h. Expressing Repeated Reasoning

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts.

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National Board for Professional Teaching Standards: Five Core Propositions

In addition to the content standards referenced above, this course supports the following core propositions that characterize National Board Certified Teachers (NBCTs).

Proposition I: Teachers are Committed to Students and Their Learning

- NBCTs are dedicated to making knowledge accessible to all students. They believe all students can learn.
- They treat students equitably. They recognize the individual differences that distinguish their students from one another and they take account for these differences in their practice.
- NBCTs understand how students develop and learn.
- They respect the cultural and family differences students bring to their classroom.
- They are concerned with their students' self-concept, their motivation and the effects of learning on peer relationships.

Proposition 2: Teachers Know the Subjects They Teach and How to Teach Those Subjects to Students.

- NBCTs 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.

- NBCTs 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.
- NBCTs know how to assess the progress of individual students as well as the class as a whole.
- They use multiple methods for measuring student growth and understanding, and they can clearly explain student performance to parents.

Proposition 4: Teachers Think Systematically about Their Practice and Learn from Experience.

- NBCTs 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.

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Proposition 5: Teachers are Members of Learning Communities.

- NBCTs collaborate with others to improve student learning.
- They are leaders and actively know how to seek and build partnerships with community groups and businesses.
- They work with other professionals on instructional policy, curriculum development and staff development.
- They can evaluate school progress and the allocation of resources in order to meet state and local education objectives.

Learning Outcomes:

Participants in this course will be able to

- understand and describe the important role patterns play in mathematics. (CCSS a-h; NBPTS Props. 2, 3, 4)
- demonstrate the power of using patterns to solve problems. (CCSS a-h; NBPTS Props. 2, 3, 4)
- identify and utilize a wide variety of problems that can be solved by discovering patterns. (CCSS a-h; NBPTS Props. 2, 3, 4)
- design and teach problem solving activities in the classroom. (NBPTS Props. 1-5)
- demonstrate how the activities are connected to a standards based curriculum. (NBPTS Prop. 5)

Schedule of Topics and Assignments

In this course you will become familiar with many of the patterns that appear in mathematics and you will learn to utilize patterns as a powerful problem solving strategy. You will be inspired and encouraged to share these tools with your students.

A. Reading:

1. Read the following articles in the appendix:
 - a. "Mathematics: The Science of Patterns," by Richard Thiessen
 - b. From the NCTM Standards: Standard 8: "Patterns and Functions"
 - c. From the NCTM Standards: Standard 13: "Patterns and Relationships"
 - d. "Mathematics--The Search For Patterns"
2. Write a short paper (250-400 words) reflecting on the role of patterns in mathematics. Think about the following questions as you select your comments. Why is it important to introduce the idea of patterns to students at all grade levels? Why do you think mathematics is sometimes called the study of patterns? Does a background and understanding of patterns help us make connections in daily life? How can an understanding of patterns help us solve problems?

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3. One of the best online mathematics sites is the **National Library of Virtual Manipulatives for Interactive Mathematics**. This site includes many activities relating to patterns and problem solving. A CD containing all of their interactive activities is also available. Examine this website and, in a short paragraph, identify three activities you could utilize in your teaching. <http://matti.usu.edu/nlvm/nav/vlibrary.html>

B. Activities:

The activities in this course operate on two levels. On the first level, students are encouraged to recognize a pattern and use it to complete a table and solve the problem presented. On the second level, students are challenged to find a general formula for the problem; they learn to generalize on the basis of specific data. This process is at the heart of the scientific method.

The text, *What's Next?*, contains over 130 pattern based activities. Although the text is divided into three volumes, the activities in each reflect a wide range; volume designations do not indicate differences in difficulty, and the volumes are not sequential.

1. Read carefully the preface to any one of the three volumes, called "Figuring Out *What's Next?*" This short section will introduce you to the text and to the basic principles underlying the use of patterns to solve problems.
2. Next, preview the activities and select 10 activities appropriate for your grade level from the three volumes. Feel free to modify the activities to make them easier or more challenging for your students.

On one page, list the ten activities you have selected. Beside each, identify

- a. possible learning objectives for the activity.
 - b. how the activity could complement your curriculum.
 - c. why you think students would become engaged by this activity.
3. Prepare lesson plans and teach* five of the selected activities. You may follow the accepted lesson plan format for your district or a plan that is functional for your teaching situation. While it should be specific and detailed, it need not be more than one or two pages. Each plan should include the following elements:
 - a. Grade level
 - b. Date presented
 - c. Activity used
 - d. Lesson objectives
 - e. Outline of presentation procedures
 - f. Methods for evaluating or assessing student progress and growth
 - g. State or national standards addressed

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Evaluate* the success of each lesson. Write three short paragraphs responding to each of these questions.

- a. How fully were your objectives met?
- b. How did students respond?
- c. How might you adjust the lesson or reinforce the concepts taught?

C. Design Your Own Pattern-Based Activities:

Design and teach* two pattern-based activities of your own with the goal of having your students discover a mathematical result or concept.

As before, you may follow the accepted lesson plan format for your district or a plan that is functional for your teaching situation. While it should be specific and detailed, it need not be more than one or two pages. Each plan should include the following elements:

- a. Grade level
- b. Date presented
- c. Description of activity used
- d. Lesson objectives
- e. Outline of presentation procedures
- f. Methods for evaluating or assessing student progress and growth
- g. State or national standards addressed

Evaluate* the success of each lesson. Write three short paragraphs responding to these questions:

- a. How fully were your objectives met?
- b. How did students respond?
- c. How might you adjust the lesson or reinforce the concepts taught?

***Note: If you wish to complete this course while you are *not* teaching prepare the lessons for future use in your classroom. If you design one additional pattern-based activity (for a total of three) you may omit the teaching and evaluation of all the lessons and activities without penalty.**

Evidence of Learning:

- Instructor observed evidence of understanding of course objectives as demonstrated through student's reflective writing assignments. (Assignments A2, A3)
- Instructor observed evidence of understanding mathematical terminology and procedures as demonstrated through student's completed activities. (Assignments B2, B3, C)
- Student demonstrated openness towards and creative use of a variety of learning methodologies and strategies. (Assignments A2, A3, B2, B3, C)

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- Student demonstrated his/her understanding of effective design of lesson plans. (Assignments B3, C)
- Student reflected the use of critical thinking skills (Assignments A2, A3, B2, B3, C)
- Student made connections to state content and/or professional teaching standards. (Assignments B3, C)

Grading Policies and Rubric:

Grades will be determined using the following percentages:

Short paper on role of patterns:	10%
Paragraph on website activities:	5%
List of ten appropriate activities:	15%
Five activity lesson plans:	50%
Two original activities and evaluations:	20%

Responses and lessons will be evaluated to determine thoughtful, engaged reflection, incorporation of text concepts, and effective, creative classroom procedures. Coursework is to be typed. Follow course instructions carefully.

Total scores determine the final grade:

- 90 - 100% = A
- 80 - 89% = B
- 79% or below = no credit

All coursework must reflect a minimum "B" quality to receive credit. The discernment between an A and a B is at the discretion of the instructor, based on the quality of work submitted (see assignment rubric). Participants may request either a letter grade (A or B) or credit (CR). Coursework falling short of a "B" or CR grade will be returned with further instructions. Every person with a score of 80% or above will receive three semester units of credit.

Instructor/Student Contact

Students are warmly invited to contact the instructor at any time with concerns, questions, or comments related to course work. They are specifically asked to do so after finishing the reading in Section A and Section B1. At the completion of the course, the instructor will comment on the student's work and make suggestions, if needed

Plagiarism and Academic Honesty

All people participating in the educational process at Fresno Pacific University are expected to pursue honesty and integrity in all aspects of their academic work. Academic dishonesty, including plagiarism, will be handled according to the procedures set forth in the Fresno Pacific University Catalogue. URL <http://www.fresno.edu>.

Scoring Rubric

Written responses	Student's written responses show an exceptional investment of time, energy and thoughtful reflection. The work submitted by the student is original and thorough. The student effectively organizes key insights and demonstrates evidence of interaction with the texts and exercises.	Student's written responses show an adequate investment of time, energy and thoughtful reflection. The work submitted by the student is complete, but lacks thoroughness and originality. The student sufficiently organizes insights and demonstrates evidence of interaction with the course activities.	Student's written responses show little investment of time, energy and thoughtful reflection. The work submitted by the student does not show adequate thought or effort.
Lesson Design	Lesson plans show an exceptional investment of time, energy and thoughtful reflection. Student consistently makes connections to local instructional goals/standards and implements research-based strategies and approaches.	Lesson plans show an adequate investment of time, energy and thoughtful reflection. Student makes some connections to local instructional goals/standards and research-based strategies and approaches.	Lesson plans submitted by the student do not show adequate thought or effort, and may not address specific goals.
Lesson evaluations	Student includes the use of critical thinking and reflection in the evaluation of lessons implemented.	Student includes the use of reflection in the evaluation of lessons implemented, but may lack sufficient detailed analysis.	Student does not demonstrate critical thinking or reflection in the evaluation of lessons implemented.
Presentation	Student effectively organizes key insights into a thoughtful and well-structured presentation.	Student includes several key insights in a presentation.	Student presentation lacks key insights.
Research	Research accesses multiple sources available via the internet. Web descriptions demonstrate thorough engagement with site information.	Research accesses sources available via the internet. Web descriptions demonstrate adequate engagement with site information.	Research fails to access sources available via the internet. Web descriptions demonstrate little engagement with site.

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Final Course Grade and Transcripts

When all work for the course has been completed, students will need to logon to the Center for Professional Development website (<http://ce.fresno.edu/cpd>) to “Submit Grade Form”. Once the instructor fills out the grade form online, students may log back in to request their Grade Report as well as order transcripts online. Please allow at least two weeks for the final grade to be posted. For more information see the Independent Studies Policies and Procedures that were sent to you when you received your course materials, or in your online course. They are available, also at <http://ce.fresno.edu/cpd> - under General Information > CPD Policies.

CONTINUING EDUCATION PROGRAM STUDENT LEARNING OUTCOMES:

CE 1. Demonstrate proficient written communication by articulating a clear focus, synthesizing arguments, and utilizing standard formats in order to inform and persuade others, and present information applicable to targeted use.
CE 2. Demonstrate comprehension of content-specific knowledge and the ability to apply it in theoretical, personal, professional, or societal contexts.
CE 3. Reflect on their personal and professional growth and provide evidence of how such reflection is utilized to manage personal and professional improvement.
CE 4. Apply critical thinking competencies by generating probing questions, recognizing underlying assumptions, interpreting and evaluating relevant information, and applying their understandings to the professional setting.
CE 5. Reflect on values that inspire high standards of professional and ethical behavior as they pursue excellence in applying new learning to their chosen field.
CE 6. Identify information needed in order to fully understand a topic or task, organize that information, identify the best sources of information for a given enquiry, locate and critically evaluate sources, and accurately and effectively share that information.

FRESNO PACIFIC UNIVERSITY STUDENT LEARNING OUTCOMES

Student Learning Outcomes Oral Communication: Students will <i>exhibit</i> clear, engaging, and confident oral communication – in both individual and group settings – and will critically <i>evaluate</i> content and delivery components.
Written Communication: Students will <i>demonstrate</i> proficient written communication by <i>articulating</i> a clear focus, <i>synthesizing</i> arguments, and utilizing standard formats in order to <i>inform</i> and <i>persuade</i> others.
Content Knowledge: Students will <i>demonstrate</i> comprehension of content-specific knowledge and the ability to apply it in theoretical, personal, professional, or societal contexts.
Reflection: Students will <i>reflect</i> on their personal and professional growth and <i>provide evidence</i> of how such reflection is utilized to manage personal and vocational improvement.
Critical Thinking: Students will <i>apply</i> critical thinking competencies by <i>generating</i> probing questions, <i>recognizing</i> underlying assumptions, <i>interpreting</i> and <i>evaluating</i> relevant information,

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and *applying* their understandings to new situations.

Moral Reasoning: Students will *identify* and *apply* moral reasoning and ethical decision-making skills, and *articulate* the norms and principles underlying a Christian world-view.

Service: Students will *demonstrate* service and reconciliation as a way of leadership.

Cultural and Global Perspective: Students will *identify* personal, cultural, and global perspectives and will employ these perspectives to *evaluate* complex systems.

Quantitative Reasoning: Students will accurately *compute* calculations and symbolic operations and *explain* their use in a field of study.

Information Literacy: Students will *identify* information needed in order to fully understand a topic or task, *explain* how that information is organized, *identify* the best sources of information for a given enquiry, *locate* and critically *evaluate* sources, and accurately and effectively *share* that information.