

## **Title**

Patterns and Relations for Grades 6-8

## **Target Audience**

This course is intended for pre-service and in-service middle school teachers.

## **Course Description**

Patterns and relations are the core of algebra. This course, which is closely aligned with the NCTM Algebra Standard, focuses on how to represent, analyze, and generalize a variety of patterns. Learners will develop a deeper understanding of the mathematics of patterns, and more importantly, acquire and build upon strategies for teaching patterns to middle school students. Learners will read NCTM's *Principles and Standards for School Mathematics*, as well as solve sample patterns problems that have appeared on state tests, in order to connect the mathematics explored in this course with the mathematics students are required to learn. This course identifies common mistakes and misconceptions made by middle students in the course of pattern study. Learners will solve rich, mathematical problems and then use that problem-solving experience to reflect on the misconceptions these problems generate among students. Learners will then collaborate with other learners in the online discussion board to develop and evaluate strategies for helping students overcome their misconceptions. As a final task, learners will craft a thoughtful argument addressing the importance of patterns and relations in the mathematical education of middle school students.

This course provides ample opportunity to engage in a meaningful learning community in order to assess and learn from different teaching strategies and professional experiences.

## **Instructor/Facilitator**

See instructor/facilitator sheet

## **Credits**

To be determined by college or university

## **Objectives**

Learners will:

- Gain a deeper understanding of the underlying mathematics of patterns and relations
- Practice analyzing what middle students commonly understand and misunderstand about patterns and relations
- Learn strategies to improve the methodologies of teaching patterns and relations

## **Outline of Content and Assignments**

After previewing the course introductory information, learners will proceed to the Assignments section to complete the following six sessions, working through each part in order. In these sessions, they will solve rich, mathematical problems as a learner, then use that experience to reflect on the misconceptions these problems generate in students and discuss strategies for helping students overcome their



misconceptions. Learners will also read NCTM's Principles and Standards for School Mathematics, as well as solve sample patterns problems that have appeared on state tests, in order to correlate the mathematics they've explored in this course to the mathematics students are required to learn. As a final task, they will create an argument about the importance of patterns and relations in the mathematical education of middle school students.

Part 1: Orientation (Session 1)

Learners will:

Test their computers

- Run "The Wizard"
- Install all required plug-ins to run PBS TeacherLine courses

Become familiar with the course website

- Click on the different sections of the course
- Watch "Launch Video," a short, informative video about preparing themselves to think like a learner as well as a teacher for this course
- Run the "Launch Interactive" program
- Download a copy of the Learning Log, used to describe how the math problems presented in this course were solved
- Open the Learning Log to get acquainted with the kinds of questions that learners will answer throughout the course
- Print out the Digital Drop Box instructions for later use in Sessions 3 and 6 (used to post Learning Log to the facilitator)

Read

- "What the Research Says About Patterns"  
This article will familiarize learners with the most current research about the content and pedagogy related to the mathematics of patterns and relations.

Collaborate

- Introduce themselves on the Discussion Board
- Learn how to communicate by posting messages on the Discussion Board

Part 2: Getting Started with Patterns and Relations (Session 2)

Learners will:

Identify

- Patterns in numbers and shapes by solving the "Toothpick Triangle" problem

Describe

- Patterns both verbally and symbolically in the Learning Log

View

- Different methods for solving a patterns-related problem by watching a video that presents students explaining their thinking about two different solutions

Discuss

- Students' approach to solving "The Toothpick Problem"
- Responses posted on the Discussion Board, contributing to the discussion



Part 3: Patterns and Relation in More Depth (Session 3)

Learners will:

Read

- “Thinking about Thinking”

Solve

- The “Crossing the River” problem, describing in their Learning Log how they solved the problem, what they did first and why.
- The “Box of Chocolates” problem, describing in their Learning Log how they solved the problem, what they did first and why.

Participate in an online discussion

A major finding of the Third International Math and Science Study (TIMSS), a comprehensive international assessment of teaching and learning conducted in the 1990's, was that, compared to other countries, the American mathematics curriculum attempts to teach too much in too little time, coining the expression that we teach a “mile wide and an inch deep.” For many classrooms, this appears as students finding answers to many problems or engaging in the work of many activities from a wide array of topics, without connecting to the deep meaning of the mathematics. The problems learners will have solved in this session and the previous session were given to help them enlarge their thinking about patterns and the ways students can learn about patterns.

- Using the Discussion Board, read and post responses to the following question: What does the math classroom look like when the goal is to teach depth instead of breadth? Consider the problems already explored in this course.

Extend the Activities

- By asking students to generalize the number of trips it takes for any number of adults and any number of children to cross the river.
- By asking students to generalize the total number of light chocolates and dark chocolates in different shapes of boxes. Learners should try using a triangular box or hexagonal box. How does this impact how students look at the problem?

Part 4: Student Misconceptions and Teacher Interventions (Session 4)

Learners will:

Read

- “What the Research Says About Patterns,” an article that will familiarize readers with the most current research about the content and pedagogy related to the mathematics of patterns and relations
- “A Mistaken Value,” by Fred E. Gross

View Videos

- “Student Misunderstandings and Misconceptions,” which help teachers anticipate and identify student misconceptions around patterns
- “Teacher Interventions,” which helps teachers identify and distinguish between various forms of teacher interventions

Participate in an online discussion

- Consider the video you saw and/or your experience in your own classroom. How can teacher interventions promote the students' understanding of the mathematics?



View video

- “Teacher Reflections”

Part 5: Student Investigations (Session 5)

Learners will:

Read

- NCTM's “Algebra Standards for Grades 6-8”  
What does NCTM contend middle school students should know about algebra, including patterns and relations?
- “How Can Professional Development on Technology Impact Mathematics Learning?” an article which lists several practical ways to integrate technology in the mathematics classroom.
- “What Factors Contribute Most Strongly to Students' Success in Learning Mathematics?”

Solve

- “Frog in the Well” problem and describe how it was done

Explore

- “Frog in the Well Simulation” to recognize different patterns as variables are altered (height of wall, climbing rates, slippage rates). As the variables are changed, learners will note the patterns seen in the table and in the animation.

Investigate

- The “1, 2... What Comes Next” problem

Participate in an online discussion

- Post three original number patterns and the rules in the Discussion Board
- Discuss what strategies are used as a teacher to promote student investigation in the classroom. Relate the answer to personal experience with the “Frog in the Well” problem and the “1, 2... What Comes Next” problem, as well as general strategies that you have read or experienced.

Explore

- “Problems with a Point,” a database that offers the learner a unique opportunity to access challenging problems with solutions and answers. Many of the problems in the database are open-ended.

Part 6: Justifying the Underlying Mathematics (Session 6)

Learners will:

Read

- NCTM's “Algebra Standards for Grades 9-12”

Participate in an online discussion

- How would participants respond if a student asked during class, “Why are we doing all of this patterns stuff? Why does it matter?”

Solve

- “Patterns Problems on State Assessments”

Write

- A classroom newsletter/letter for parents (a non-mathematical audience), providing them with information about the work their children will be doing the next month with patterns and relations. Learners will be encouraged to share their newsletter on the Discussion Board.



Criteria for the project are:

- Explain why patterns and relations are important.
- Include citations from at least three sources to support your explanation.
- Describe some effective ways of teaching patterns to middle school students.
- Explain how the study of patterns can address what students need to know and be able to do in mathematics.
- Responses should be about two pages in length

Write in the Learning Log

- Respond to the question, "What one or two ideas do you take away from this course that you believe will be of the most use for you in your classroom, and why?" Send finished Log to facilitator.

### **Schedule**

This course is scheduled to take approximately 15-20 hours to complete readings, activities, video, assignments, reflections and a final project.

### **Requirements**

Learners are expected to:

- Complete all assignments
- Maintain and online journal
- Participate consistently in Discussion Boards

### **Evaluation**

Pass/fail upon satisfactory completion of assignments and Discussion Board participation

### **Materials (hardware, software, plug-ins)**

#### Technical Requirements

- Word processor
- Internet service provider
- Email

### **Academic Dishonesty Policy**

To be inserted by university institution only

