

Title

Understanding Geometric Shapes and Spatial Sense in Grades 1-4

Target Audience

This course is intended for pre-service and in-service grades 1-4 teachers.

Course Description

This course explores new ways to broaden and deepen elementary school students' understanding of and experiences with geometry. The activities in the course go beyond identifying shapes; they explore the connection between geometry and spatial relationships by looking at shapes and how they relate to each other and by looking at examples of geometry found in architecture, art, and nature. As a final task, learners will create a visual walking tour that could be used with their students as a "field trip" to help them develop and practice their spatial reasoning skills.

Facilitator

See instructor/facilitator sheet

Credits

To be determined by college or university

Goals and Objectives

Learners will:

- Develop a deeper understanding of geometry and spatial relations and how these concepts enrich the development of problem-solving skills.
- Develop a stronger knowledge of how elementary school students make sense of geometric principals and spatial relations.
- Create strategies for improving their own teaching of geometry and spatial relationships.

Outline of Content and Assignments

This course contains six parts, or sessions. After previewing the course introductory information (Overview, Goals, Session Summary, Assessment, and Competency Map), learners will proceed to the Assignments section to complete the following six sessions, working through each in order. Each session includes assignments and discussion questions. The last course session provides instructions for the final project, which learners should complete and deliver as indicated in the section. The six sessions are:

- Session 1: Prepare for the Online Learning Environment and Examine the Importance of the Study of Spatial Reasoning in Grades 5-8
- Session 2: Multiple Perspectives
- Session 3: Exploring Shapes and Symmetry
- Session 4: Perspective and Space-Making in 2-D and 3-D
- Session 5: Language in the Elementary School Classroom
- Session 6: Final Project

Part 1: Prepare for the Online Learning Environment and Examine the Importance of the Study of Spatial Reasoning in Grades 5-8

Learners will:

Test their computers

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

Become familiar with the course Web site

- Click on the different sections of the course
- Click the “View Video” button to watch a short, informative video about preparing themselves to think like a learner as well as a teacher for this course
- 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 become acquainted with the kinds of questions that learners will answer throughout the course
- Print out the Digital Drop Box instructions for later use (used to post assignments and the learning log to the facilitator)

Read

- “What Research Says About Geometry and Spatial Reasoning.” This article will familiarize learners with the most current research about the content and pedagogy of geometry and spatial reasoning.

Participate in the online discussion

- Learners will introduce themselves to one another, and will post on the Discussion Board at least six different figures (two-dimensional) or shapes (3-dimensional) that can be found around their house or school. They will name the item and the related shape or figure, and analyze, where possible, the design function of the shape or figure (for example, why is a golf ball small and round?).

Part 2: Multiple Perspectives

Learners will:

Read

- “Principles and Standards of School Mathematics (PSSM 2000) Grades PreK-2” and “Principles and Standards of School Mathematics (PSSM 2000) Grades 3-5.” These excerpts from the *PSSM 2000* introduce how the ability to characterize shapes develop mathematical arguments is developed in grades PreK-5.
- “Spatial Skills, Gender, and Mathematics.” In this reading on visualization and visual thinking, the authors argue that visualization is important in mathematics in general, rather than only in geometry.

Complete Math Activities

- Slide Show – Describe Geometric Shapes Activity
- Museum Fabricator Activity

View

- The online Slide Show interactive
- The Drawing Silhouettes interactive

Record in their learning log

- Write two different sets of directions for each of the two designs (four total sets of directions)
- Carefully describe how the three silhouettes are related for each of the two buildings

Participate in the online discussion

- Learners will post their description and read the descriptions that the other learners create and match the images to the descriptions
- Upon completion of all the assignments and readings, learners will read and post responses to the Discussion Board. They will reflect on the variety of objects looked at from multiple perspectives (geometrically) in this session, and why spatial visualization is important to the teaching and learning of mathematics.

Part 3: Exploring Shapes and Symmetry

Learners will:

Read

- “The NCTM PSSM 2000 Geometry Standard for Grades 3-5.” This reading will introduce learners to the concept of symmetry and the practical applications of it in schools and in the world. By learning about the importance of understanding symmetry and how it relates to distance, art, analysis of angles, and coordinate geometry, learners will develop a sense of the complexity of this topic.

Complete Math Activities

- Geometry in Bridges
- Pythagorean Tangram

View

- Virtual Geoboard interactive
- Transformations-Composition interactive

Record in their learning log

- For the “Geometry in Bridges” activity, learners will respond to several questions where they consider the shapes they see and theorize about the functions of those shapes.
- A description of the mathematics behind changing the shapes of the various figures by using symmetrical properties and altering the angles through manipulating the number of sides on the figures.

Participate in an online discussion

- After completing the readings, math activities, use of interactives, and learning log entries, learners will read and post responses to the Discussion Board. They will respond to the following question:
 - Using concrete examples, convince your students that there is a lot more to learn about geometry than merely the names of shapes.

Part 4: Perspective and Space-Making in 2-D and 3-D

Learner will:

Read

- “Principles and Standards of School Mathematics 2000.” This article introduces learners to nets, which is one aspect of visualization. Nets challenge students to move between two- and three-dimensional representations of objects.
- “Dimension.” Learners will read this article to find out how three-dimensional objects have been introduced in elementary school geometry.

Complete Math Activities

- Stem activity
- Nets problem

View

- The Cube Nets interactive

Participate in an online discussion

- After completing all readings and activities, learners will go to the Discussion Board and discuss ways to visualize a cube from a net that is partially shaded in and how a teacher can best explain and coach elementary school students through the same problem.

Part 5: Language in the Elementary School Classroom

Learners will:

Read

- "The Principles and Standards of School Mathematics (PSSM 2000) Grades PreK-2" and "The Principles and Standards of School Mathematics (PSSM 2000) Grades 3-5." These readings focus on the Communication Standard to better understand how reading, writing, and communicating about problems can deepen students' understanding of mathematics.
- "Sharp Corners and Flat Corners." This case study shows first graders trying to explain the shapes of building blocks.

View

- "Lesson Overview" video
- "The Cone and the Polyhedra" video
- "Clarifying Student Thinking" video
- "Sorting into Two Groups" video
- "Teacher Reflections" video

Record in their learning log

- After viewing the video, learners will identify and describe the instructional strategies used to help students talk about the mathematics.
- Using given samples of student work, learners will describe what each student understands or doesn't understand about the geometry they see around their environment.

Participate in the online discussion

- After completing all readings and online learning log entries, and viewing all of the video clips, learners will go to the Discussion Board and share instructional strategies that could help students express their understandings of spatial reasoning and geometry.

Part 6: Final Project

Learners will:

Read

- Sections 1-3 of "A Mathematical Historical Tour of Boston," which shows how to create a walking tour (learners will create a walking tour for the final project).
- Section 4 of "A Mathematical Historical Tour of Boston." This section provides the activities and problems for a mathematical walking tour of Boston. Learners should feel free to skim or read these activities and problems for ideas about how to construct their own mathematical walking tour.

Complete Math Activity

- Solve related sample state assessment problems

Participate in an online discussion

- After completing all readings and activities, learners will go to the Discussion Board and share ideas on assessing students' understanding of geometric shapes and spatial reasoning, and how to support those students having difficulty with spatial reasoning.

Complete a final project

- Complete the following assignment and use the Digital Drop Box in the Student Tools area of the course to submit the project to the facilitator:
 - Create a Mathematical Walking Tour of your school (either inside or outside) or a place in your community (for example, a neighborhood, downtown, museum, or park) that you could use with your students as a "field trip" to help them develop and practice their spatial reasoning skills. There should be a minimum of 10 stops along the walking tour that emphasize the identification of shapes and descriptions of the shapes including complexity and function. Accompanying the walking tour is a handbook for the teacher explaining the importance of spatial reasoning in a student's math education, and the identification and description of potential problem areas associated with spatial reasoning and matching instructional strategies for these issues.
 - The handbook must include a pre- and post-assessment of student understanding. These assessments may include activities from the course, modified to measure student progress.

Record in their learning log

- Respond to the following question: What one or two ideas from this course will be of most use to you in your classroom and why?

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 an online journal
- Participate regularly 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
- E-mail

Academic Dishonesty Policy

To be inserted by university institution only