

# PBS TeacherLine Course Syllabus

## **Title**

Understanding the Number System (Grades 3–5)

## **Target Audience**

This course is designed for pre-service and in-service teachers of students in grades 3–5.

## **Prerequisites**

To successfully participate in this course, learners should be familiar with taking an online course or have completed the TeacherLine Practice Learning Online Course. Learners should also have some familiarity with the elementary mathematics curriculum.

To fully participate in applying all of the strategies in this course, learners should have access to either a class or a group of students.

## **Course Description**

In this course, learners will explore concepts of our base-ten number system by looking at properties of numbers, including factors, even and odd numbers, negative numbers, and the relationship among fractions, decimals, and percents. The learner will solve mathematical problems in order to gain insight into misconceptions commonly made by students and develop strategies to address these misconceptions. As a final project, learners will craft a well-rounded lesson plan that incorporates the strategies learned in the course to teach elements of the number system.

## **Instructor/Facilitator**

See instructor/facilitator sheet

## **Credits**

To be determined by college or university.

## **Goals**

Throughout this course, the learners will deepen their knowledge about our number system while learning methods and strategies for teaching the number system to students. These concepts will be presented and explored through articles, videos, interactive applets, online discussions, and online course journal. This course will enhance content knowledge, enhance pedagogy, and increase your students' achievements.

## **Learner Outcomes**

Learners completing the Understanding the Number System (Grades 3–5) course will be able to:

- define concepts and terminology related to our base-ten number system;
- explain how our number system evolved through history;
- design activities that allow students to construct new meaning by building on prior knowledge;

## PBS TeacherLine Course Syllabus

- incorporate activities into math lessons that accommodate multiple learning styles;
- critique samples of student work;
- access the NCTM standards for teaching mathematics;
- design complete and well-rounded lesson plans.

### 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 session in order. It is expected that one session will be completed each week, for a total of six weeks.

During the course, learners are asked to articulate their ideas in various forms. They are encouraged to reflect on their ideas and experiences in their Online Journals. In addition, the weekly discussions are designed to foster articulation and sharing of ideas and strategies. As a final project, learners will develop lesson plans that can be used in their classrooms. An alternative to the final project will be provided as an option to learners who prefer to complete three small projects instead of one large project. These three assignments will be due at the end of Sessions 2, 4, and 6. This Alternative Final Project requires learners to create three classroom activities about our number system as presented in this course.

This course is designed to address NCTM's *Principles and Standards for School Mathematics* (PSSM 2000). The PSSM 2000 reflects some of the most current research on mathematics teaching and learning, and presents a vision of instruction that should enable all students to solve challenging problems.

This course addresses the Equity Principle, also presented in PSSM 2000: "Excellence in mathematics education requires equity-high expectations and strong support for all students."

In Session 1 of this course, you will read the Number and Operations Standard to better understand grade appropriate content for children in this grade band. NCTM states "together, the Principles and Standards constitute a vision to guide educators as they strive for the continual improvement of mathematics education in classrooms, schools, and educational systems."

### Session 1: Orientation and Introductions

Learners will:

- Reflect on their current teaching practices regarding our number system.
- Compare the topics which they are currently teaching or prepared to teach with those addressed in the NCTM Number and Operations Standard for Grades 3–5.
- List children's common misconceptions about our number system and explain strategies to counter them.
- Use knowledge about the properties of numbers taught at this grade band (e.g. factors, integers, square numbers, number value, place value) to identify mystery numbers.

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 like a teacher for this course.
- Run the "Launch Applet" program.

Read

## PBS TeacherLine Course Syllabus

- [NCTM Introduction to the Standards for Grades 3–5.](#)  
This excerpt provides you with an overview of the mathematics that should be taught within this grade band.
- [NCTM Number and Operations Standard for Grades 3–5](#)  
Describes the topics from this standard that are covered in this course.
- [Developing Computational Fluency with Whole Numbers in the Elementary Grades](#)  
This article highlights common errors in computation that arise when students improperly memorize algorithms and have little understanding of our base-ten system. Teaching strategies to help students avoid these errors are discussed.

### Do This Activity

- Using the Mystery Number applet, you will participate in an activity that requires you to deduce a “Mystery Number” based on specific properties given as clues.

### Write Reflections in Online Journal.

- Think about how you currently introduce and/or teach the number system.
- After reading the topics covered in the NCTM Number and Operations Standard, note the topics you currently teach and those that are not currently addressed in your instructional program. If you are not currently teaching, note the topics you feel prepared to teach and those you would like to master before you begin teaching.

### Participate in Online Discussions.

- Learn how to communicate by posting messages on the Discussion Board.
- Introduce yourself on the Discussion Board by sharing your name, where you teach, what subjects you teach and other information you would like to include about your teaching experience. Participate in an icebreaker activity related to the content of the course.
- Identify two or three common student errors from the first reading that you have observed in your classroom and suggest strategies for preventing them
- Discuss the NCTM Number and Operations Standard.

### Review Final Project:

- Read about the final project and the alternative 3-part final project. Begin to think about how to approach this. Read the assessment rubrics for the final project and the alternative final project.

### Extensions (Optional)

- “Working with Diverse Learners”  
Offers suggestions for working with special needs and gifted students.
- "Teaching for Understanding: Questions to ask yourself and your students," by Chris Unger  
This article discusses what teachers can do to develop students' ability to understand deeply.

## Session 2: Our Base-Ten Number System

### Learners will:

- Develop an approach for using the history of the base-ten number system to help students understand our base-ten number system.
- Describe how knowledge of other number systems can be used to increase students' interest and understanding.
- Develop strategies for teaching the importance of place value in number systems through number game activities.

## PBS TeacherLine Course Syllabus

- Compare students' invented number systems to determine their understanding of the base-ten system.

### Read

- [The History of our Base-Ten Number System](#)  
This article describes how humans began using numbers and how number systems evolved. It provides information that helps in understanding our number system.
- [A Closer Look at the Mayan and Babylonian Number Systems](#)  
A look at these ancient number systems that use base 20 and a base 60 provides understanding of our number system.

### Do These Activities

- Play a number cube game called "The Biggest Number" using an interactive applet that reinforces an understanding of place value.
- View an interactive applet in which the learner explores numbers in base 4 in order to gain an understanding of bases other than base 10.
- View a video that shows student work consisting of invented number systems.
- Complete a self-assessment. Learners will take a self-scored quiz to be sure topics presented in the part are understood.

### Write Reflections in Online Journal

- In grades 3–5, how do you introduce the base-ten number system?
- What misconceptions do students have about place value and the base-ten number system?
- How can you use the history of number systems to increase student interest and understanding?
- How can you use the Mayan and Babylonian number systems to increase student interest and understanding?
- What from this part will be most useful to you in your teaching?
- If a pair of human hands had only 8 digits instead of 10, do you think we would still have a base-ten number system? Pose this question to your students.

### Participate in Online Discussions.

- Share ideas about how you will use the information from the two readings to improve your students' understanding of the number system. Also, propose activities that could be used with students to capture their interests.
- Compare the two students' invented number systems from the video. Critique the two systems by analyzing the logic used by each student to create the symbols and compare the ease of writing the symbols and solving problems using the symbols of each system.

Discuss how their choice to model a base-ten system or another system reflects their understanding of base systems. How do you think your students would do with this assignment?

### Alternative Final Project (Part 1 of 3)

If you choose this option, write an original activity based on the material presented in this part. The activity should allow the student to discover a new aspect of the number system through a hands-on or interactive task. The activity should include questions that the teacher can ask during the activity to check for understanding. If an outside resource is used, it must be cited.

### Extensions (Optional)

## PBS TeacherLine Course Syllabus

- Working With Diverse Learners  
Offers suggestions for working with second language learners and special needs students.
- Extension Activities  
Includes ideas for exploring number systems and the history of numbers.
- Optional Readings  
These readings describe number systems from other cultures that use bases other than 10.  
"Babylonian Number System"  
"Indian Number System"  
"Mayan Number System"

### Session 3: Types of Numbers

#### Learners will:

- Identify ways to teach students about types of numbers while addressing different intelligences.
- Identify several strategies for teaching students that fractions, decimals, and percents can be used to represent the same value.
- Discuss ways to teach fractions, decimals, and percents simultaneously so that students can recognize and use common equivalencies.

#### Read

- Teaching Fractions, Decimals, and Percents: Addressing Multiple Intelligences  
This article discusses how Howard Gardner's Theory of Multiple Intelligences can be applied to the teaching of fractions, decimals, and percents.
- Hands-on Number Line: Fractions, Decimals, and Percents  
This article offers a practical activity for teaching fractions, decimals, and percents.

#### Do These Activities

- Watch a video of a teacher working with students and using a meter stick and number cards to teach fraction, decimal, and percent equivalencies.
- View an interactive applet in which learners estimate and then calculate the fraction/decimal/percent of a shaded geometric shape as a means of visualizing common equivalencies.
- Complete a self-assessment to check yourself about what you have learned about equivalencies.

#### Write Reflections in Online Journal

- Among the following: fractions, decimals, and percents, which do you most enjoy teaching and why?
- If you have taught or currently teach these topics, do you teach them simultaneously or one after the other?
- How could the activity from Reading 2 be adapted to the teaching situation you now have or plan to have?
- In this part, you saw concrete examples of how to present the conceptual relationship among fractions, decimals, and percents in a variety of ways: on a string number line, on a meter stick, and as a shaded part of a square. Which model do you think works best to promote student understanding?
- What are the benefits of incorporating both a linear model (the meter stick or number line) and an area model (the squares)?

#### Participate in Online Discussions

- Describe the ways that your students demonstrate different intelligences.

## PBS TeacherLine Course Syllabus

- Which intelligences do you think are commonly overlooked in math lessons? Which ones would you like to address as you plan lessons?
- Refer back to your journal entry from Reading 1 about multiple intelligences. Use your entry to help you formulate ideas about how to teach these topics together. Provide one example or an idea for a hands-on activity that teaches the relationship among these concepts.

### Extensions (Optional)

- Working With Diverse Learners  
Offers suggestions for working with second language learners, special needs students, and gifted students.
- Extension Activities  
Ideas to further explore the concepts of fractions, decimals, and percents.
- Optional Reading  
"Diversity, Learning Style and Culture," by Pat Burke Guild  
This article discusses how educators can facilitate successful learning opportunities for all learners while honoring diversity.  
"Intelligence in Seven Steps," by Howard Gardner, Ph.D.  
This article describes seven historical steps in the development of thinking about intelligence, focusing on the Theory of Multiple Intelligence.  
*So Each May Learn: Integrating Learning Styles and Multiple Intelligences*, by Harvey F. Silver, Richard W. Strong, and Matthew J. Perini, Association for Supervision and Curriculum Development, 2000. ISBN 0-87120-387-1

### Session 4: Classifying Numbers

#### Learners will:

- Describe an activity that helps students discover relationships between numbers based on their factors.
- Solve real-world problems that promote conceptual understanding of factors.
- Use manipulatives (square tiles) to find factors of numbers from 1 to 25.
- Describe a problem-solving situation that requires knowledge of *factors* or *even* and *odd* numbers to find a solution.

#### Read.

- A Constructivist Approach to Understanding Factors  
This article discusses how children develop their own informal knowledge about factors long before it is formally introduced. When teachers provide learning experiences that allow students to construct their own meanings, their computational skills and fluency with multiplication facts improve.
- Problems that Involve Factors  
Four problems created by The Math Forum at Drexel University are presented for you to try. This exercise will help you understand how problems like these help build students' knowledge of factors.

#### Do These Activities

- Participate in an online activity called "Tile Factors" that involves manipulating tiles to find the factors of numbers from 1 through 25.
- Watch a video of a class using manipulatives to explore the concept of even and odd numbers.
- Complete a self-assessment. Learners will take a self-scored quiz identifying the critical thinking levels in a variety of activities.

#### Write Reflections in Online Journal

- How do you currently teach the concept of factors?
- What misconceptions do your students have?
- How often do you use real-world examples to teach math?

## PBS TeacherLine Course Syllabus

- Write observations about how the teacher in the video handled the discussion.
- Reflect on how you have taught the concept of *odd* and *even* in your classes. How can you help students create new understanding by building on what they already know and understand about numbers.

### Participate in Online Discussions

- Consider two students. One student is taught about numbers so that she fully understands factors, prime numbers, and square numbers. The other student memorizes the multiplication tables but doesn't see the relationship between the number of factors of 12 and the number of factors of 24.
- Describe a problem-solving situation that would help students develop an understanding of the relationship between the number of factors of 12 versus the number of factors of 24.
- Think of a problem-solving situation that you would use in your instructional program that requires knowledge of *factors* or *even* and *odd* numbers to find a solution. Share your problem with others. Later, during the week, provide a possible solution to this problem-solving situation.

### Alternative Final Project (Part 2 of 3)

- Write an original activity based on the material presented in Part 3 or Part 4. The activity should be hands-on and/or interactive and allow the student to discover a new aspect of the number system. The activity should include questions that the teacher can ask during the activity to check for understanding. If an outside source is used, it must be cited.

### Extensions (Optional)

- Working With Diverse Learners  
Offers suggestions for working with second language learners and special needs students.
- Optional Reading  
"Helping Students with Disabilities Achieve in Mathematics," by Jean Andrews and Donald Jordan  
This article offers ideas for helping this group of students achieve in mathematics.  
"Constructivist Theory," by Greg Kearsley (based on work of J. Bruner)  
The article summarizes the theory as an active process in which learners construct new ideas or concepts based upon their current/past knowledge.

## Session 5: Up and Down on the Number Line

### Learners will:

- Assess their comfort level for teaching integers and your students' overall readiness to understand basic concepts.
- Review their basic knowledge of integers.
- Describe an activity that uses a real-world context to develop integer concepts.
- Compare strategies and activities designed to strengthen students' understanding of integers.

### Read

- Lesson on Introduction to Integers  
The author provides a refresher on integers and offers ideas for creating integer problems that reflect real-life situations.

### Do These Activities

## PBS TeacherLine Course Syllabus

- Take an interactive applet quiz as a means to review concepts about integers.
- Watch a video of a teacher instructing students using several models of number lines to teach about integers.
- Complete a self-assessment. Learners will take a self-scored quiz to check their understanding of topics presented in this part.

### Write Reflections in Online Journal

- How comfortable are you teaching students about positive and negative numbers?
- At what stage do you believe students are ready to develop an understanding of basic integer concepts? Why?

### Participate in Online Discussions

- Describe an activity you would use to introduce integers using real-life context.
- Share the description of the activity recorded earlier in your journal. Compare the strategy used in the video to introduce integers with the strategy you described. Decide which one of these two activities you believe will be more effective as an introduction to integers, and why.

### Extensions (Optional)

- Working With Diverse Learners  
Offers suggestions for working with special needs students and gifted students.
- Extension Activities  
Includes three step-by-step activities that explore the number system.
- Optional Reading  
"Developmentally Appropriate Practices," Bank Street College  
The article discusses how children's development at specific ages affects the teaching and learning of mathematics.

## Session 6: Final Project: Developing a Lesson Plan on the Number System

### Learners will:

- Identify the key elements of a good lesson plan.
- Compare and contrast a written lesson plan with how it is actually taught.
- Complete and submit a lesson plan based on the Final Project criteria provided in this part;  
**or**  
Complete and submit three activities based on the Alternative Final Project criteria provided in this part.

**NOTE:** If learners select the alternative final project instead of this final project, they are not required to write the lesson plan. They are, however, required to complete the reading and provide feedback to peer's lesson plans.

### Read

- [AskERIC<sup>SM</sup> Write-A-Lesson Plan Guide](#)  
This reading provides an in-depth discussion of the format used to develop the lesson plans in this course. It identifies the elements of a well-designed lesson and offers suggestions for writing lesson plans.
- [Sample Lesson Plan](#)  
A model sample lesson using the guidelines from the first reading is provided as a reference.

### Do These Activities

## PBS TeacherLine Course Syllabus

- Watch a two-part video, [Exploring Square Numbers](#), of a teacher conducting a lesson based on the base-ten number system. This video will contain highlights of the lesson.
- Plan and create as a final project a lesson plan with activity ideas that are not included in this course (that is, ideas of the learner's own invention or from outside documented sources). If possible, the learner is encouraged to teach their lesson plan to a class or group of students.

### Write Reflections in Online Journal

- Do the lesson plans presented in this course differ from lesson plan formats you've used in the past? If so, in what way?
- Before reading AskERIC Write-A-Lesson Plan Guide, reflect on what you consider to be the key elements of well-designed lesson plan. After reading, record any additional elements that you might have overlooked.
- What elements of the lesson plan from Reading 2 were most effective and how can you incorporate these elements into the lesson plan format you currently use?
- Compare the lesson plan and the video. If you were using the lesson plan, what behaviors would be different from those depicted in the video?

### Participate in Online Discussions

- Post final project on the Discussion Board.
- Post critiques of their peer's final projects on the Discussion Board.

### Final Project

Develop a complete lesson plan following the structure presented in the first reading in Session 6. The main activity develops and deepens understanding, so there is synthesis/discussion/application of the new concept. Build into the lesson plan questions that check for students' understanding. Include an assessment component. The most important part of planning a lesson is thinking of good questions to ask the students, and anticipating problems or difficulties that may arise. The plan can also include modifications that can address different special need cases such as ESL, or learning disabilities, depending on the interest of the learner.

### Alternative Final Project (Part 3 of 3)

Write an original activity based on the material presented in Part 5. The activity should be hands-on and/or interactive and allow the student to discover a new aspect of the number system. The activity should include questions that the teacher can ask during the activity to check for understanding. If an outside source is used, it must be cited.

### Extensions (Optional)

- Optional Reading  
"Five Common Mistakes in Writing Lesson Plans (and how to avoid them)," by Dr. Robert Kizlik

### Schedule

This course is scheduled to take approximately 30 hours to complete readings, activities, video, assignments, reflections and a final project

### Requirements

Learners are expected to:

- Complete all assignments.
- Maintain an Online Journal

## **PBS TeacherLine Course Syllabus**

- Participate in Discussion Boards.
- Ask for assistance when they need it.

### **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.