

# Teaching Algebra to Middle School Students<sup>™</sup> Online

**T**eaching Algebra to Middle School Students Online offers an overview of the major concepts required to teach algebra to middle school students and focuses on developing and enhancing knowledge of algebraic number sense. Participants will explore the use of narratives and storytelling designed to describe, analyze, and solve real-life problems as a means for teaching algebraic topics to their students.

To the right are the key areas of focus for the eight-week online asynchronous course. For more information, refer to the syllabus, which provides a detailed outline of the course material as well as a bibliography of research on which the course is based.

## In this course, participants will

- ▶ Apply narrative or storytelling techniques to explain mathematical concepts in algebra using real-life experiences and their own understanding of algebraic concepts.
- ▶ Plan for and use journal writing in classroom instruction and in their own professional development.
- ▶ Demonstrate algebraic number sense concepts involving integers in stories and examples based on everyday life situations.
- ▶ Explain basic algebraic properties and be able to identify those properties when applicable to a given contextual setting.
- ▶ Explain the expressions of approximate and direct relationships in data using tables and graphs, linear, polynomial, and exponential relationships, and sequences.
- ▶ Apply and translate correct algebra vocabulary when discussing topics or content.

# Teaching Algebra to Middle School Students™ Online

## Course Description

This course provides an overview of and an opportunity to review the major concepts necessary to teach algebra to middle school students. Among the several core competencies that students need to develop strong skills in algebra is algebraic number sense. Teachers will have opportunities to evaluate their own mastery of algebraic number sense, develop a stronger number sense, and explore ways to help students enhance their own number sense. In addition, participants will learn the importance of scaffolding concepts for student understanding.

Algebraic topics in this course include

- Integers and properties of integers
- Order of operations.
- Mathematical properties of numbers
- Expression of approximate relationships in data
- Using coordinate graphs and tables to develop equations
- Linear functions
- Properties of slope
- Ratios and proportions
- Introduction to quadratic equations

This course will challenge teachers to explain these concepts and to demonstrate how they will teach and relate them to their students. Participants will also explore methods of teaching mathematical concepts that use narrative and storytelling to describe, analyze, and solve contextual mathematical problems in real-life applications.

## Course Outcomes

Upon completion of this class, the learner is expected to be able to:

1. Develop methods for relating mathematic/algebraic concepts to students' real-life experience with mathematics and understanding math concepts.
2. Apply narrative or storytelling techniques to explain mathematical concepts in algebra.
3. Apply national, state, and district standards to his or her own curriculum development.
4. Define number sense of principle concepts in algebra.
5. Evaluate his or her own mastery of number sense.
6. Demonstrate algebraic number sense concepts involving integers in stories and examples based on everyday life situations.
7. Demonstrate and apply the order of operations in mathematics.
8. Prepare a lesson that instructs students on the order of operations.
9. Explain number properties and identify them when they are applicable to a given contextual setting.
10. Solve and interpret real-life problems involving patterns, then verbalize and define the patterns for students.
11. Develop activities that allow students to identify and relate real-life problems involving patterns from their own experiences.

12. Design a learning experience that explains how to coordinate graphs and tables to develop equations.
13. Explain the expressions of approximate and direct relationships in data using tables and graphs; linear, polynomial, and exponential relationships; and sequences.
14. Interpret and predict future events or outcomes, given a linear function.
15. Relate properties of ratios and their connection to slope in given situations.
16. Demonstrate and explain the difference between a linear and a quadratic equation.
17. Apply correct algebra vocabulary when discussing topics or content and translate formal math vocabulary into terminology that students can understand.
18. Teach students how to translate casual explanations of math problems and data into formal mathematical problems (e.g., using *multiply* vs. *times* as a verb).
19. Research mathematical topics and methodologies on the Internet and create his or her own resource repository for classroom use.
20. Master instruction of basic use of graphic calculators and software to complete algebraic calculations.
21. Explore the issue of low female student engagement in mathematics and develop plans for engaging and building girls' confidence in algebra.
22. Plan for and use journal writing in classroom instruction and in his or her own professional development.

### Required Texts

Friel, S. (2002). *Navigating through algebra in grades 6–8*. Reston, VA: National Council of Teachers of Mathematics.

Countryman, J. (1992). *Writing to learn mathematics: Strategies that work*. Portsmouth, NH: Heinemann.

Instructors and learners will also use instructor-generated materials, learner-generated materials, and Web-based resources to facilitate learning.

### Topical Outline

### List of Concepts

#### Developing Number Sense: Integers

Basic properties of integers (positive, negative, absolute); simple operations involving integers; demonstration of operations to students, using manipulatives and number line; definition and examples of number sense; evaluation of one's own algebraic number sense

#### Developing Number Sense: Order of Operations

Rules of order of operations for addition, subtraction, multiplication, and division; application of order of operations to multifaceted equations; practice demonstration of Order of Operations

#### Developing Number Sense: Properties of Numbers

Properties: Commutative, Associative, Distributive, Identity Property of Zero, Multiplicative Inverse; identification of properties in given contextual situations or information/data; teaching properties to students

|   |   |
|---|---|
| <b>Identifying Patterns (in Data)</b>             | Identification of patterns, relations, and functions; identification of patterns in given sets of data or real-life contextual situations; recording and writing narrative in the patterns identified from contextual situations; translation of patterns and narrative into formal mathematical language; teaching translation skills to students; applying formal mathematical and algebraic vocabulary |
| <b>Linear Relationships and Functions–Part I</b>  | Difference and relationship between function and equations; anatomy and structure of an equation; how to build equations from contextual data; writing a narrative or descriptive story around an equation; linear relationships; ratio and proportions; definition and nature of a variable(s); demonstration of how to isolate variables in an equation to determine their value                        |
| <b>Linear Relationships and Functions–Part II</b> | Description of linear relationship using a table, graph, or words; generation of an expression or equation to represent a contextual situation; identification of linear relationships in everyday life   |
| <b>Analyzing Forms of Linear Equations</b>        | Identification of the properties of slope, given sets of data and a linear equation; rise over run; point slope; slope intercept; demonstration of how to determine slope from contextual data  |
| <b>Introduction to Quadratic Equations</b>        | Basic properties and structure of quadratic equations; demonstration of everyday examples of applying quadratic equations   |

## Course Assessments and Links to Course Outcomes

Throughout the course, the learner will be assessed and evaluated on the completion of the following assessments. Learning activities include large- and small-group discussions and assessments for a total of 1119 points.

| Modules      | Topics of Modules                              | Points      | Correlation With Course Outcomes |
|--------------|--|-------------|----------------------------------|
| Module 1:    | Developing Number Sense: Integers              | 142         | 1, 2, 3, 4, 5, 6, 17, 18, 21     |
| Module 2:    | Developing Number Sense: Order of Operations   | 170         | 1, 2, 7, 8, 17, 20, 21, 22       |
| Module 3:    | Developing Number Sense: Properties of Numbers | 144         | 1, 2, 9, 10, 11, 17, 19, 21      |
| Module 4:    | Identifying Patterns (in Data)                 | 167         | 1, 2, 11, 12, 17, 19, 21         |
| Module 5:    | Linear Relationships and Functions–Part I      | 129         | 1, 2, 11, 12, 17, 19, 21         |
| Module 6:    | Linear Relationships and Functions–Part II     | 128         | 1, 2, 11, 12, 13, 17, 19, 21     |
| Module 7:    | Analyzing Forms of Linear Equations            | 109         | 1, 2, 11, 12, 13, 14, 15, 19, 21 |
| Module 8:    | Introduction to Quadratic Equations            | 130         | 1, 2, 16, 17, 18, 19, 20, 21     |
| <b>Total</b> |  | <b>1119</b> |                                  |

Criteria specific to each assessment will be explained in conjunction with the instructional activities.

### Instructional Methodology

The instructional methodology of this course focuses on developing, enhancing, and improving the instructional expertise and pedagogical knowledge base of practicing educators. Strategies include presentation of new content through online readings, active construction of knowledge through practice and problem solving, collaborative group work, personal reflection, structured small-group or whole-class discussion, analysis of assigned reading, and the application of course content and skills to participant's individual grade level, subject area(s), and classroom.

### Grading Scale

The course facilitator will post the grading scale.

### Performance Learning Systems' Late Policy

There will be a 10% deduction of points per day for all posts and submitted assignments which are late. Replies posted after the due date will earn no points. In rare cases, partially or poorly completed assignments may be resubmitted for partial credit at the discretion of the instructor. The following exceptions apply:

- If a participant is sick/hospitalized or has a death in the family, the timing of makeup work may be arranged with the course facilitator. No points will be deducted if the work is completed according to the agreement.

- If a participant is on vacation/traveling/etc., the participant must contact the course facilitator ahead of time to avoid a penalty. This type of absence may occur only once during a course. All posts should be submitted for the missed module before leaving; replies may be completed according to agreed-upon timing when the participant returns.
- If a participant has difficulty completing everything in a week, an extension can be granted if the participant contacts the facilitator during the week (not at the last minute).

### **Performance Learning Systems' Participant Drop Policy**

- Participants are eligible to receive a refund if they attend class for one week or less. This means participants must withdraw by the end of Module 1 to receive a refund.
- Refunds of the balance of tuition paid will be given, minus the \$50 deposit.

### **Performance Learning Systems' Academic Integrity Policy**

Performance Learning Systems expects absolute academic honesty and integrity from every course participant. The specific Academic Integrity and Honor Code policies of our partner colleges and universities are embraced and enforced by PLS instructors. The following are considered to be serious violations:

- Plagiarism: the use of another's ideas, data, or words without proper acknowledgment.
- Fabrication: the use of invented information or the falsification of research or other findings with the intent to deceive.
- Collusion: improper collaboration with another in preparing assignments or projects.
- Cheating: an act of deception by which a student misrepresents that he or she has mastered information on an academic exercise that he or she has not mastered.
- Academic Misconduct: tampering with grades, or taking part in obtaining or distributing any part of student work that is not his or her own.

Violation(s) or suspected violation(s) will be investigated and pursued according to specific college/university procedures.

### **Identity Authentication**

The college/university, Performance Learning Systems (PLS), and students share a joint responsibility to ensure that each student's contribution in an online course activity comes from that student alone. For the student, this responsibility has two parts:

1. Students are responsible for positively ensuring that every contribution to an online course created with the students' computer account is made by the student alone. Contributions covered under this policy include: written assignments; quiz and exam submissions; discussion forum postings; live participation in text-based chat sessions, phone conferences, and videoconferences. If a student allows another person to write or make any kind of submission to an online activity in the student's name, then this constitutes cheating and will be treated as a violation of academic honesty.
2. Students are responsible for ensuring the integrity of their computer account security by following the actions required of them by the PLS Acceptable Use Policy. These actions include keeping passcodes private, updating passcodes

when required by Performance Learning Systems, and reporting breaches of the security policy to the IT Helpdesk.

### **Course Evaluation**

The evaluation of learner work will be based on the defined criteria for learner assessments. The criteria for learner assessments will be outlined for students prior to instructional activities and engagement with student learning targets (outcomes). Grading is based solely on the evaluation of student learning targets and defined criteria for learner assessments.

Formative assessment of learning outcomes is conducted throughout the course, using a variety of means that include the following: completion of assessments; constructive contributions to class discussions (whole-class as well as small-group); sharing of valuable, pertinent, and/or applicable ideas and experiences; and active participation in online interactions. It is expected that each participant will contribute to the academic quality of the course.

Summative assessment includes the completion of weekly learning activities and assignments for which the participant will need to synthesize class content, apply it to his or her own practice, and complete a plan for implementing the major components of content and skill acquired during the course.

## Course Outcome Correlations With INTASC Standards for Teachers

|   | Course Outcomes   |
|---|---|
| <b>Standard 1: Subject Matter</b><br>The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.   | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21     |
| <b>Standard 2: Student Learning</b><br>The teacher understands how children and youth learn and develop, and can provide learning opportunities that support their intellectual, social, and personal development.  | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13                             |
| <b>Standard 3: Diverse Learners</b><br>The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners.  | 4, 5, 6, 20   |
| <b>Standard 4: Instructional Strategies</b><br>The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills.   | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21 |
| <b>Standard 5: Learning Environment</b><br>The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation.  | 1, 2, 20, 21  |
| <b>Standard 6: Communication</b><br>The teacher uses knowledge of effective verbal, nonverbal, and media communication techniques to foster active inquiry, collaboration, and supportive interaction in the classroom.   | 4, 5, 6, 7, 18, 21  |
| <b>Standard 7: Planning Instruction</b><br>The teacher plans and manages instruction based upon knowledge of subject matter, students, the community, and curriculum goals.   | 1, 2, 3, 20, 21   |
| <b>Standard 8: Assessment</b><br>The teacher understands and uses formal and informal assessment strategies to evaluate and ensure the continuous intellectual, social and physical development of the learner.   | 3, 7, 9, 11, 18   |
| <b>Standard 9: Reflection and Professional Development</b><br>The teacher is a reflective practitioner who continually evaluates the effects of her/his choices and actions on others (students, parents, and other professionals in the learning community) and who actively seeks out opportunities to grow professionally. | 4, 5, 6, 10, 11, 12, 21   |
| <b>Standard 10: Collaboration, Ethics, and Relationships</b><br>The teacher fosters relationships with school colleagues, parents, and agencies in the larger community to support students' learning and well-being.   | 18, 21  |

The Interstate New Teacher Assessment and the Support for Consortium (INTASC) standards were developed by the Council of the Chief State School Officers and member states. Copies may be downloaded from the Council's website at <http://www.ccsso.org>.

© Council of Chief State School Officers. (1992) Model standards for beginning teacher licensing, assessment, and development: A resource for state dialogue. Washington, DC: Author. <http://www.ccsso.org/content/pdfs/corestrd.pdf>.

## Course Outcome Correlations With National Board for Professional Teaching (NBPTS) Propositions and Standards

### Proposition 1: Teachers are Committed to Students and Their Learning.

NBCTs are dedicated to making knowledge accessible to all students. They believe all students can learn.

**Course Outcomes**  
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,  
14, 15, 16, 17, 18, 19, 20, 21, 22

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.

21, 22

NBCTs understand how students develop and learn.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 22

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.

NA

NBCTs are also concerned with the development of character and civic responsibility.

NA

### 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.

1, 2, 6, 9, 10, 11, 18

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.

1, 2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15,  
16, 17, 18

They are able to use diverse instructional strategies to teach for understanding.

1, 2, 6, 9, 20, 22

### 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.

1, 2, 22

They know how to engage students to ensure a disciplined learning environment, and how to organize instruction to meet instructional goals.

3

NBCTs know how to assess the progress of individual students as well as the class as a whole.

3

They use multiple methods for measuring student growth and understanding, and they can clearly explain student performance to parents.

NA

### 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.

1, 2, 19, 20, 21, 22

They are familiar with learning theories and instructional strategies and stay abreast of current issues in American education.

19, 20, 21, 22

They critically examine their practice on a regular basis to deepen knowledge, expand their repertoire of skills, and incorporate new findings into their practice.

1, 2, 5, 10

**Proposition 5: Teachers are Members of Learning Communities.**

|  |           |
|--|-----------|
| NBCTs collaborate with others to improve student learning.   | <b>NA</b> |
| They are leaders and actively know how to seek and build partnerships with community groups and businesses.              | <b>NA</b> |
| They work with other professionals on instructional policy, curriculum development and staff development.                | <b>19</b> |
| They can evaluate school progress and the allocation of resources in order to meet state and local education objectives. | <b>3</b>  |
| They know how to work collaboratively with parents to engage them productively in the work of the school.                | <b>NA</b> |

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