

# Coordinate Plane Content Module

## Skills for Transformations in the Coordinate Plane

### Elementary School

- 4.GM.1j1 Recognize a point, line and line segments, rays in two-dimensional figures
- 4.GM.1j2 Recognize perpendicular and parallel lines in two-dimensional figures
- 5.GM.1j1 Recognize parallel and perpendicular lines within the context of two-dimensional figures
- 5.GM.1a1 Recognize properties of simple plane figures
- 5.GM.1b1 Distinguish plane figures by their properties
- 5.GM.1c1 Locate the x and y axis on a graph
- 5.GM.1c2 Locate points on a graph
- 5.GM.1c3 Use order pairs to graph given points

### Middle School

- 6.GM.1c4 Locate points on a graph
- 6.GM.1c5 Use order pairs to graph given points
- 6.GM.1c6 Find coordinate values of points in the context of a situation
- 6.GM.1c7 Use coordinate points to draw polygons
- 6.NO.1d5 Find given points between -10 and 10 on both axes of a coordinate plane
- 6.NO.1d6 Label points between -10 and 10 on both axes of coordinate plane
- 7.GM.1e1 Construct or draw plane figures using properties
- 8.GM.1f1 Recognize a rotation, reflection, or translation of a figure
- 8.GM.1f2 Identify a rotation, reflection, or translation of a plane figure when given coordinates
- 8.GM.1g1 Recognize congruent and similar figures

### High School

- H.GM.1b1 Use definitions to demonstrate congruency and similarity in figures
- H.GM.1c1 Construct, draw, or recognize a figure after its rotation, reflection, or translation
- H.GM.1d1 Use the reflections, rotations, or translations in the coordinate plane to solve problems with right angles
- H.GM.1e1 Make formal geometric constructions with a variety of tools and methods

## **Plot the Course—The rationale**

Understanding how to find points on a coordinate plane not only serve academic purposes but also address real-life skills students may use on a daily basis like navigating using a map or an atlas. In addition to reading a map, the concept of graphing on the coordinate plane is also used in games such as Battleship or some of the simulation games in which students build amusement parks or entire cities. Other recreation leisure activities, especially in art, incorporate transformation in the coordinate plane like quilting. Mathematically, graphing in the coordinate plane is a prerequisite for many skills across grade bands such as transformations in the coordinate plane, finding missing attributes of polygons, and interpreting graphs.

### **Module Goal**

The goal of this module is to provide detailed instructions on how to graph and create polygons in the coordinate plane as well as how to perform transformations (i.e., reflections, rotations, and translations) within the coordinate plane to teachers of students with disabilities at the elementary, middle, and high school level. This module promotes a mathematical understanding of these concepts so that a teacher can begin to plan how to teach the concepts to students. Additionally, this module will provide instructors with potential adaptations and modifications to consider when designing materials and instruction for students with severe disabilities.

### **Module Objectives**

After viewing the content module, teachers will:

1. Apply strategies for finding ordered pairs and graphing in the coordinate plane
2. Identify attributes of polygons
3. Perform transformations in the coordinate plane
4. Apply transformations in the coordinate plane to real-world applications and activities

## Time for Take Off

Understanding the vocabulary used within the coordinate plane is important for both teachers and students in planning and implementing math lessons. As a teacher, knowing and using mathematical terms not only ensures your instruction stays true to the math content, but also will help with collaborating with other math teachers or content experts. When choosing which vocabulary to teach, it is most important that the teacher selects the most salient, important, or most frequently used vocabulary for each lesson. Below you will find a list of vocabulary included within this module. It may or may not be necessary to provide instruction for all terms as students may have learned them previously. If you are a secondary teacher and are not confident your students have been taught the elementary vocabulary terms, you may want to add those unknown terms to the focus and review of your lesson plan. While providing vocabulary instruction, you may consider including pictures or objects to make the instruction more concrete for students with disabilities (See Ideas to support vocabulary learning below).

### Elementary School

**Point** - an exact location

**Line** - a straight path that extends forever

**Line segment** - part of a line with two endpoints

**Ray** - part of a line that starts at one endpoint and extends forever in one direction

**Perpendicular** - lines that intersect at a  $90^\circ$  angle

**Parallel** - lines that never intersect

**Coordinate Plane** - formed by two axes that intersect at a right angle

**Right angle** - an angle that measures  $90^\circ$  formed by two perpendicular lines

### Middle and High School

**Polygon** - closed plane figure made by three or more-line segments

**Rotation** - when you turn a figure at one point

**Reflection** - a mirror image of an object when the original is flipped

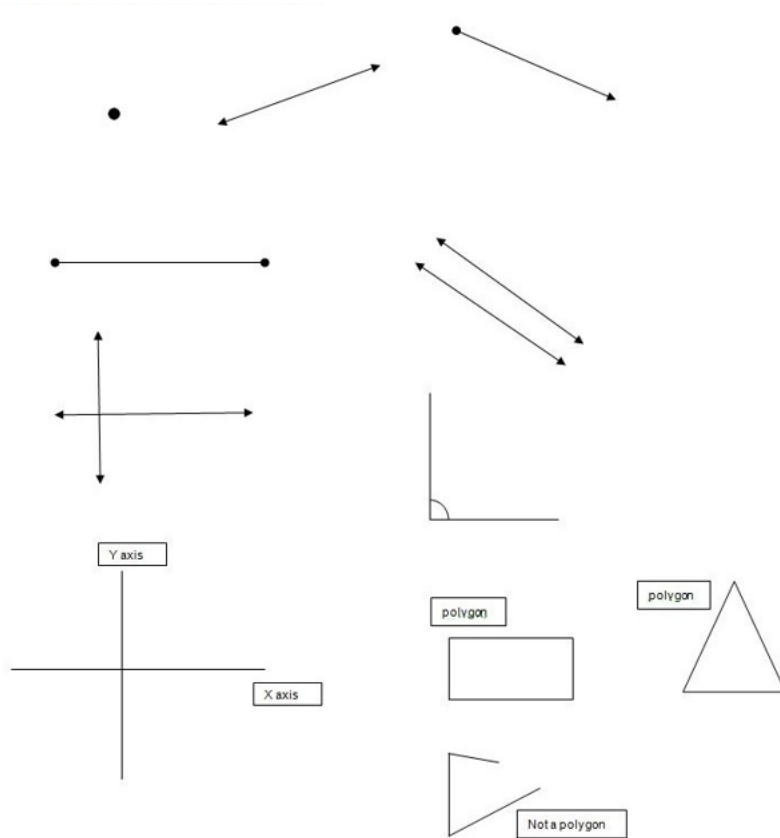
**Translation** - when you slide a figure along a line without turning it

**Congruent figures** - figures that are the same size and shape. If two polygons have the same corresponding sides and angles, they are congruent

**Similar figures** - figures of the same shape but not the same size

## Idea to support vocabulary learning

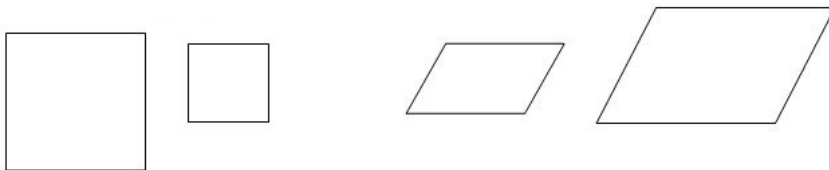
Have student match the term with the correct picture



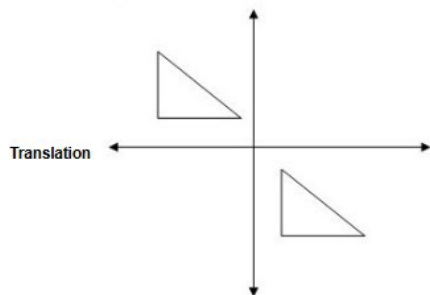
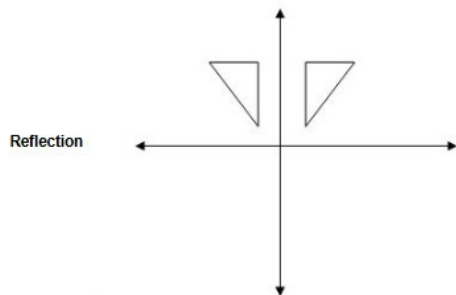
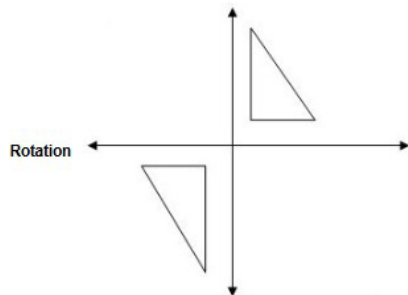
## Congruent Shapes



## Similar Shapes



Idea for systematic instruction: demonstrate the concepts of congruent and similar shapes using examples and non-examples. For example: "This is \_\_\_\_\_, This is \_\_\_\_\_, This is NOT \_\_\_\_\_, This is NOT \_\_\_\_\_, This is \_\_\_\_\_ . Show me \_\_\_\_\_"



## **Floating on Air**

Before you begin teaching students to use reflections, rotations, and translations of figures in the coordinate plane, you must have a deep understanding of these mathematical concepts. Some of these concepts may be familiar to you. Below is a list of skills that should be covered at each grade level in the mathematical strand of measurement. For more complicated concepts, please view the accompanying PowerPoint that will walk you through an example as well as make some suggestions for instruction.

### **Elementary School**

In elementary school skills include:

- 4.GM.1j1 Recognize a point, line and line segments, rays in two-dimensional figures
- 4.GM.1j2 Recognize perpendicular and parallel lines in two-dimensional figures
- 5.GM.1j1 Recognize parallel and perpendicular lines within the context of two-dimensional figures
- 5.GM.1a1 Recognize properties of simple plane figures
- [Properties of Plane Figures PowerPoint](#)
- 5.GM.1b1 Distinguish plane figures by their properties
- 5.GM.1c1 Locate the x and y axis on a graph
- 5.GM.1c2 Locate points on a graph
- 5.GM.1c3 Use order pairs to graph given points

### **Middle and High School**

In middle school skills include:

- 6.GM.1c4 Locate points on a graph
- 6.GM.1c5 Use order pairs to graph given points
- 6.GM.1c6 Find coordinate values of points in the context of a situation
- [Graphing in the Coordinate Plane PowerPoint](#)
- 6.GM.1c7 Use coordinate points to draw polygons
- 7.GM.1e Construct or draw plane figures using properties
- 8.GM.1f1 Recognize a rotation, reflection, or translation of a figure
- 8.GM.1f2 Identify a rotation, reflection, or translation of a plane figure when given coordinates
- [Rotations in the Coordinate Plane PowerPoint](#)
- [Reflections in the Coordinate Plane PowerPoint](#)

- [Translations in the Coordinate Plane PowerPoint](#)
- 8.GM.1g Recognize congruent and similar figures (Insert congruent vs. similar figures PowerPoint here)
- H.GM.1b Use definitions to demonstrate congruency and similarity in figures
- H.GM.1c Construct, draw, or recognize a figure after its rotation, reflection, or translation (See rotations, reflections, and translations PowerPoints)
- H.GM.1d Use the reflections, rotations, or translations in the coordinate plane to solve problems with right angles (See rotations, reflections, and translations PowerPoints)
- H.GM.1e Make formal geometric constructions with a variety of tools and methods

**Note:** In high school transformations in the coordinate plane are presented within word problems and students must determine which transformations (e.g., rotations) need to be performed. Also in middle and high school, students are expected to perform combinations of transformations in the coordinate plane.

Great! Now that you have viewed the PowerPoints most useful to you, the next section will provide some ideas to consider when planning for universal design for learning.

## **Sharing the Sky—Universal Design for Learning**

### **Visual Impairment or Deaf/Blind**

**Representation:** Use graphs and coordinate planes with raised lines and textures

**Expression:** Student states answer or scans raised numbers to select correct answer; use voice output devices for student to select the correct answer

**Engagement:** Teach students to use their hands to scan the raised graph parts of the coordinate plane

### **Physical Impairment: Little/ No Hand Use**

**Representation:** Use computer representation of figures that can be manipulated with switch; create a grid (coordinate plane) on a large surface on the floor that the student can walk over or ride over in wheelchair to find ordered pairs

**Expression:** Student scans and selects points on a graph that represent ordered pairs; use a switch to indicate correct answers; use an eye gaze board to select answer; phrase questions so that they require a "yes/no" response, these can easily be answered using an eye gaze, head turn, two switches, etc.

**Engagement:** Use a computer with AT where the student can click to answer; use figures that are large enough to accommodate the movements that the student is able to make; pair students with another student without a physical impairment and have them work together

### **Lacks Basic Numeracy Concepts**

**Representation:** Color code equations and corresponding parts of a graphing calculator to support students correctly entering equations

**Expression:** Student selects graphs versus drawing them; selection of correct answer is done after a model; student answers "yes/no" questions regarding slope, quadrants, etc.

**Engagement:** Students uses talking calculator and graphing calculator

**Motivational/ Attention Issues**

**Representation:** Incorporate technology including computer representations, videos, animations, and talking calculators

**Expression:** Have students create graphs using high interest manipulative (e.g. stickers for ordered pair coordinates)

**Engagement:** Have students create graphs using high interest manipulatives (e.g. stickers for ordered pair coordinates)

## Prepare for Landing

Below you will find ideas for linking graphing and transformations in the coordinate plane to real-world applications, the college and career readiness skills addressed by teaching these concepts, module assessments for elementary, middle school, and high school teachers, sample general education lesson plans incorporating Universal Design for Learning framework, blog for teachers to share their ideas, and a place to upload and share lesson plans from teachers who completed this module. Teaching a variety of strategies for using the coordinate plane may seem like a lot of work and developing creative, yet concrete demonstrations can be difficult. One way to help assist in a special educator's development within this curricular area is through collaboration with other teachers in your building. Often these skills are practiced outside of a math classroom in other curricular areas like art. Some activities with real world connections include:

1. Make a snowflake reflection.
2. When creating patterns, slides and flips are used by the Kuba people of the Congo (Zaire) region of Africa. Look at some samples of Kuba cloth.
3. Take students outside and allow them to trace reflections of themselves using sidewalk chalk.
4. Using construction and tissue paper, make a mock quilt using reflections, rotations, and transformation of different shapes (have different quilts for different polygons).
5. Use amalgamation to make an art project.
6. Cut a picture of a preferable object in half. Use the second half to demonstrate a reflection (putting the two sides together) and a rotation (put the pictures together with one side upside down).
7. Use examples which incorporate home décor. For example, a student might have to use a reflection to show where the next picture should be hung on the wall to complete a grouping of pictures. Or students may use vocabulary terms like "rotate" to describe where to put furniture in a home decorating layout.
8. Use a photo program and have students orient the pictures correctly.

In addition to the real-world applications of these concepts, skills taught within this content module also promote the following college and career readiness skills.

- Communicative competence: Students will increase their vocabulary to include concepts related to "coordinate plane, rotations, reflections, and translations" In addition, they will be learning concepts such as: "up", "down", "left", "right", "positive", and "negative".

- Fluency in reading, writing, and math: Students will have an opportunity to increase their numeracy and sight word fluency while participating in problem solving related to the "coordinate plane" such as number recognition, counting, and one-to-one correspondence.
- Age-appropriate social skills: Students will engage in peer groups to solve problems related to the coordinate plane that will provide practice on increasing reciprocal communication and age-appropriate social interactions. For example, students might work together with their peers to find ordered pairs to graph the translation of a quadrilateral.
- Independent work behaviors: By solving real life problems related to the coordinate plane, students will improve work behaviors that could lead to employment such as locating items on a map.

## Module Assessments

Below are links to assessments for the purpose of self-checking your understanding of the content in this module. After answering the assessment questions, you may want to review the key to check your work.

[Elementary Assessment pdf](#)

[Elementary Assessment Key pdf](#)

[Middle and High School Assessment pdf](#)

[Middle and High School Assessment Key pdf](#)

In addition to collaborating with other educational professionals in your building, the following list of resources may also help provide special educators with ideas for activities or support a more thorough understanding of the mathematical concepts presented in this content module.

## Additional Resources

- [YouTube for teachers!](#) Simply search for your content area and this website provides a variety of videos including videos of math experts working through math problems step by step (*free registration required*)
- [SMART board exchange](#) has developed lessons by classroom teachers differentiated by grade level. You can also search by skill and/or state standards.
- [Common Core Connectors explanation](#)