# Geometry

## Standard

Instructional programs from prekindergarten through grade 12 should enable all students to—

## Pre-K–2

### Expectations

In prekindergarten through grade 2 all students should—

- **Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships**
  - recognize, name, build, draw, compare, and sort two- and three-dimensional shapes;
  - describe attributes and parts of two- and three-dimensional shapes;
  - investigate and predict the results of putting together and taking apart two- and three-dimensional shapes.

- **Specify locations and describe spatial relationships using coordinate geometry and other representational systems**
  - describe, name, and interpret relative positions in space and apply ideas about relative position;
  - describe, name, and interpret direction and distance in navigating space and apply ideas about direction and distance;
  - find and name locations with simple relationships such as “near to” and in coordinate systems such as maps.

- **Apply transformations and use symmetry to analyze mathematical situations**
  - recognize and apply slides, flips, and turns;
  - recognize and create shapes that have symmetry.

- **Use visualization, spatial reasoning, and geometric modeling to solve problems**
  - create mental images of geometric shapes using spatial memory and spatial visualization;
  - recognize and represent shapes from different perspectives;
  - relate ideas in geometry to ideas in number and measurement;
  - recognize geometric shapes and structures in the environment and specify their location.

## Grades 3–5

### Expectations

In grades 3–5 all students should—

- **Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships**
  - identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes;
  - classify two- and three-dimensional shapes according to their properties and develop definitions of classes of shapes such as triangles and pyramids;
  - investigate, describe, and reason about the results of subdividing, combining, and transforming shapes;
  - explore congruence and similarity;
  - make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions.

- **Specify locations and describe spatial relationships using coordinate geometry and other representational systems**
  - describe location and movement using common language and geometric vocabulary;
  - make and use coordinate systems to specify locations and to describe paths;
  - find the distance between points along horizontal and vertical lines of a coordinate system.

- **Apply transformations and use symmetry to analyze mathematical situations**
  - predict and describe the results of sliding, flipping, and turning two-dimensional shapes;
  - describe a motion or a series of motions that will show that two shapes are congruent;
  - identify and describe line and rotational symmetry in two- and three-dimensional shapes and designs.

- **Use visualization, spatial reasoning, and geometric modeling to solve problems**
  - build and draw geometric objects;
  - create and describe mental images of objects, patterns, and paths;
  - identify and build a three-dimensional object from two-dimensional representations of that object;
  - identify and build a two-dimensional representation of a three-dimensional object;
  - use geometric models to solve problems in other areas of mathematics, such as number and measurement;
  - recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.

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## Geometry

### Standard

*Instructional programs from prekindergarten through grade 12 should enable all students to—*

### Grades 6–8

**Expectations**

In grades 6–8 all students should—

- precisely describe, classify, and understand relationships among types of two- and three-dimensional objects using their defining properties;
- understand relationships among the angles, side lengths, perimeters, areas, and volumes of similar objects;
- create and critique inductive and deductive arguments concerning geometric ideas and relationships, such as congruence, similarity, and the Pythagorean relationship.

### Grades 9–12

**Expectations**

In grades 9–12 all students should—

- analyze properties and determine attributes of two- and three-dimensional objects;
- explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them;
- establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others;
- use trigonometric relationships to determine lengths and angle measures.

### Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

- use coordinate geometry to represent and examine the properties of geometric shapes;
- use coordinate geometry to examine special geometric shapes, such as regular polygons or those with pairs of parallel or perpendicular sides.

### Specify locations and describe spatial relationships using coordinate geometry and other representational systems

- use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations;
- investigate conjectures and solve problems involving two- and three-dimensional objects represented with Cartesian coordinates.

### Apply transformations and use symmetry to analyze mathematical situations

- describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling;
- examine the congruence, similarity, and line or rotational symmetry of objects using transformations.

### Use visualization, spatial reasoning, and geometric modeling to solve problems

- draw geometric objects with specified properties, such as side lengths or angle measures;
- use two-dimensional representations of three-dimensional objects to visualize and solve problems such as those involving surface area and volume;
- use visual tools such as networks to represent and solve problems;
- use geometric models to represent and explain numerical and algebraic relationships;
- recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life.

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