Course Overview

In this course students study the topics presented in geometry but in a modified format. On occasion, students find that problems and/or explanations have been adapted to a simpler format. Students are given extra guidance with more difficult problems. Students formally define geometric figures; describe and apply the properties of similar and congruent figures; and justify conjectures involving similarity and congruence. They recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines, and parallel lines; use coordinate geometry to represent and examine the properties of geometric figures including slope, midpoint, distance, parallel, and perpendicular lines; draw and construct representations of two- and three-dimensional geometric objects using a variety of tools such as straightedge, compass, and technology. Students represent and model transformations in a coordinate plane and describe the results; prove or disprove conjectures and establish the validity of conjectures about geometric objects, their properties and relationships by counterexample, inductive and deductive reasoning, and critiquing arguments made by others. Students use right triangle trigonometric relationships to determine lengths and angle measures; use algebraic representations to model and solve problem situations and to describe and generalize geometric properties and relationships.

POINTS, LINES, PLANES

Unit Overview

In this course, you will learn about mathematics through lines and shapes. You will learn theory through studying theorems and postulates. You will apply theory by solving problems about lines and shapes. Look around and you will see that just about everything has a geometrical shape. Some objects have very basic shapes like rectangles and parallel lines while others are more complex like ovals and octahedrons. In essence, there is geometry behind most objects with which we are familiar. Enjoy this course and along the way learn to appreciate the beauty of geometry in your world!

In the first unit you, will examine points, lines, and planes; and their connections. You will learn how to name geometric figures and learn special relationships about them.

Points and Lines

Collinear and Coplanar

Points and Lines

Point - A point is a location on a line. It has no dimensions but is represented by a dot.

Line - A line is a straight length that extends indefinitely into space. Lines have no width or thickness but are represented by straight edge marks.

Line segment – A line segment is a part of a line usually named with its endpoints.

Intersection - Intersection is the point or line where two shapes meet. When two lines cross each other, there is one point at the place where they cross called the point of intersection. Two planes meet at and share a line of intersection.
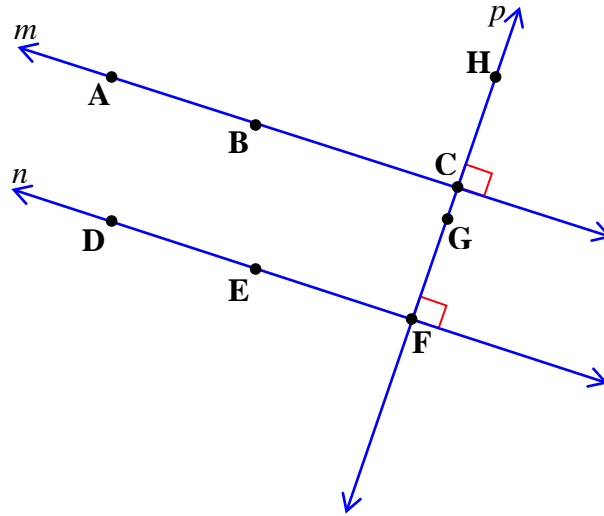
Parallel lines - Parallel lines are lines that lie in the same plane, are equidistant apart, and never meet.

m   *n*
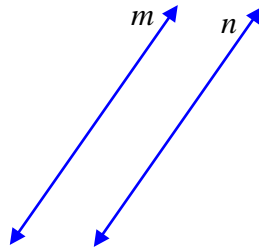
Perpendicular lines - Perpendicular lines are lines that intersect and make right angles at the point of intersection. Right angles are denoted by a square shape as shown in the diagram below.

p

q
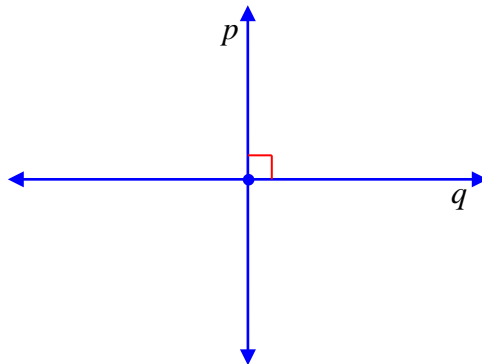
Example: Refer to the given diagram to answer the questions.

(a) Name a point.

   Point A – Other points are B, C, D, E, F, G, H. Generally in this geometry course, points will be named with capital letters.

(b) Name a line.

   Line *m* is one line in the diagram. It can be named another way by using any two points named on the line. Have you ever heard the expression "the shortest distance between two points is a straight line"? Well, we can name a line by using any two points on it. So line *m* can also be named as $\overleftrightarrow{AB}$, read Line AB. Other names for this line are $\overleftrightarrow{AC}$, $\overleftrightarrow{BC}$, $\overleftrightarrow{BA}$, $\overleftrightarrow{CA}$, *and* $\overleftrightarrow{CB}$.

   * When writing the name of a line on paper, you draw a mini-line above the two letters as shown in the previous paragraph. When referring to a line online, just type in "line AB" via the keyboard.

(c) Name a line segment.

   One line segment (part of a line) starts at Point A and ends at Point B. Its name is $\overline{AB}$, read segment AB. Some other segments are $\overline{BC}$, $\overline{GH}$, and $\overline{EF}$. There are many more segments in the diagram.

   * When writing the name of a line segment on paper, draw a mini-segment above the two letters as shown in the previous paragraph. When referring to a line segment online, just type in "segment AB" via the keyboard.

(d) Name a point of intersection.

   Point C is a point of intersection. It is the point where line *m* intersections with line *p*.

(e) Name a pair of parallel lines.

   Lines *m* and *n* are parallel because they are equidistant apart. The lines may also be called $\overleftrightarrow{AB}$ and $\overleftrightarrow{DF}$. Another way to state this answer is $m \| n$ or

   $\overleftrightarrow{AB} \| \overleftrightarrow{DF}$.

   * When referring to parallel lines on paper, draw mini-parallel lines between the names for the lines as shown in the previous paragraph. When referring to parallel lines online, just type in "line m is parallel to line n" or "line AB is parallel to line DF".

(f) Name a pair of perpendicular lines.

   Line *m* is perpendicular to line *p* since the two lines intersect to make right angles. Another way to state this answer is $m \perp p$.

   * When referring to perpendicular lines on paper, draw mini-perpendicular lines between the names for the lines as shown in the previous paragraph. When referring to perpendicular lines online, just type in "line m is perpendicular to line n".

Collinear and Coplanar

Collinear points - Collinear points are points that line up in a straight line. They lie on the same line.

Plane - A plane is a flat surface. A plane extends forever in all directions. Flat tables, floors, ceilings, and walls are examples of parts of planes.

Coplanar points - Coplanar points are points that lie on the same plane.

Example 1: Refer to the diagram to answer the questions.
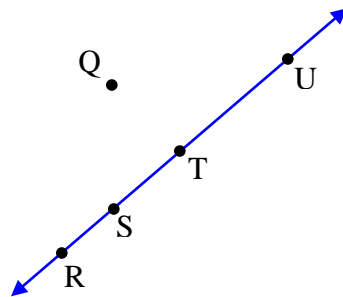
a) Name a line segment.

There are many line segments in the drawing. Here are a few of them: $\overline{ST}, \overline{RU}, \overline{TR}$.

b) Name the point(s) that are collinear.

Points R, S, T, and U are collinear because they all line on the same line.

c) Name a point that is not collinear with points R and S.

Point Q is not collinear with R and S because they do not all line on the same line.

d) Name a point that is collinear with Q. Point U is collinear with Q since a straight line can be drawn through Q and U.

*Q is not collinear with **all** of the other points collectively; however, Q is collinear with any one of the points. Q is collinear with U; Q is collinear with T; Q is collinear with S; and Q is collinear with R.

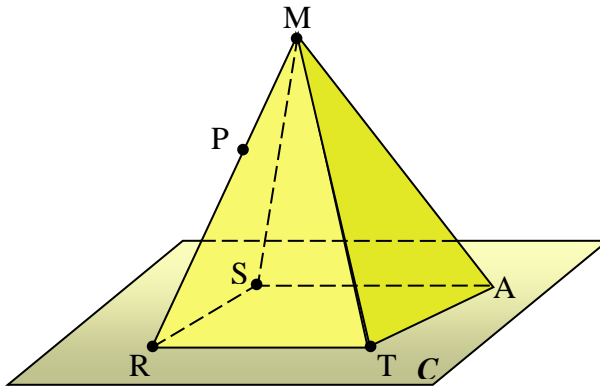*Example 2*: Refer to the diagram to name the plane.
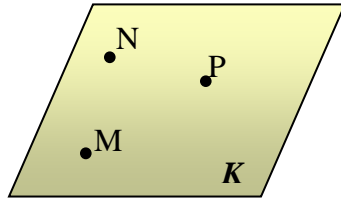
You can name the plane several ways:

K is the single letter designated as the plane's name.

Also any three letters in a plane can be used to name the plane such as plane MNP, plane MPN, plane PMN, plane PNM, plane NPM, and plane NMP.

Example 3: Refer to the 3-dimensional diagram to answer the questions.

a) Name a plane that contains point S.

plane *C* or plane *SRT.*

b) Name a plane that does not contain point S.

plane MAT or plane MTR

c) Name three coplanar points.

   Points R, S, and A are coplanar because they all lie in plane C. Another example of coplanar points are points M, T, and A which lie in a different plane, a side of the pyramid.

d) Name a point the would not be coplanar with point A.

   Point P would not be coplanar with A because they do not fall on the same planes. Point P lies in plane MRT while point A lies in planes C and MAT.

e) True or False. The bottom of the pyramid is part of plane C.

   True. The bottom of the pyramid and the portion of plane C that is displayed are both parts of the same plane the extends on forever. Another name for plane C is plane RSA.

f) Name three collinear points.

   Points M, P, and R are collinear points since they all lie on the same line segment.

g) Name three non-collinear points.

   Points M, S, and A are non-collinear since they do not line up in a straight line.