Addressed or Prepped VA SOL:
G.2 The student will use the relationships between angles formed by two lines intersected by a transversal to
   a) prove two or more lines are parallel; and
   b) solve problems, including practical problems, involving angles formed when parallel lines are
      intersected by a transversal.

G.3 The student will solve problems involving symmetry and transformation. This will include
   a) investigating and using formulas for determining distance, midpoint, and slope;

G.4 The student will construct and justify the constructions of
   a) a line segment congruent to a given line segment;
   c) the bisector of a given angle,
   f) an angle congruent to a given angle;

SOL Progression

Middle School:
- Draw polygons in the coordinate plane given coordinates for the vertices
- Use coordinates and absolute value to find distances between points with the same first
  coordinate or the same second coordinate
- Find areas of triangles and quadrilaterals
- Apply the Pythagorean Theorem to find unknown side lengths in right triangles

Algebra I:
- Write equations and use them to solve problems
- Solve multistep linear equations

Geometry:
- Name points, lines, planes, segments and rays
- Find segment lengths using the Rule Postulate, the Segment Addition Postulate, midpoints,
  segment bisectors and the Distance Formula
- Classify polygons and angles
- Find perimeters and areas of polygons in the coordinate plane
- Construct congruent segments and angles, and bisect segments and angles

A couple of days ago, when my math teacher asked,
"Any questions?"
I asked, "What is the meaning of life?"
She simply replied,
"The meaning of life is math."

Today, we realized that, in the alphabet
M is the 13th letter
A is the 1st letter
T is the 20th letter
And H is the 8th letter:
13 + 1 + 20 + 8 = 42
Section 1.1: Points, Lines and Planes

SOLs: prep for G.3

Opening: Name the polygon

1. 2. 3. 4. 5. 6.

Objectives: Students will be able to:
- Name points, lines and planes
- Name segments and rays
- Sketch intersections of lines and planes
- Solve real-life problems involving lines and planes

Vocabulary:
- Collinear points – points on the same line are called collinear
- Coplanar points – points lying on the same plane are called coplanar
- Defined terms – terms that can be described using known words (like point or line)
- Intersection – the set of points the figures have in common
- Line segment – a collection of collinear points between two endpoints; can be measured
- Line – has one dimension; a collection of points that goes on forever, defined by two points; represented by a line with arrowheads on the ends
- Opposite Rays – two rays that together make a line
- Plane – has two dimensions; flat surface made up of points that extends without end; defined by at least three points (or two intersecting lines); represented by a shape that looks like a wall or piece of paper
- Point – has no dimension; a location in space; usually named by coordinate location; represented by a dot
- Ray – a part of a line with an endpoint and extending forever in only one direction
- Space – is a boundless, three dimensional set of all points
- Undefined terms – terms not defined
Core Concept:

**Undefined Terms: Point, Line, and Plane**

**Point**
A point has no dimension. A dot represents a point.

**Line**
A line has one dimension. It is represented by a line with two arrowheads, but it extends without end. Through any two points, there is exactly one line. You can use any two points on a line to name it.

**Plane**
A plane has two dimensions. It is represented by a shape that looks like a floor or a wall, but it extends without end. Through any three points not on the same line, there is exactly one plane. You can use three points that are not all on the same line to name a plane.

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**Core Concept**

**Defined Terms: Segment and Ray**

The definitions below use line \(AB\) (written as \(\overline{AB}\)) and points \(A\) and \(B\).

**Segment**
The line segment \(AB\), or segment \(AB\), (written as \(\overline{AB}\)) consists of the endpoints \(A\) and \(B\) and all points on \(\overline{AB}\) that are between \(A\) and \(B\). Note that \(AB\) can also be named \(BA\).

**Ray**
The ray \(AB\) (written as \(\overrightarrow{AB}\)) consists of the endpoint \(A\) and all points on \(AB\) that lie on the same side of \(A\) as \(B\).

Note that \(AB\) and \(BA\) are different rays.

**Opposite Rays**
If point \(C\) lies on \(\overline{AB}\) between \(A\) and \(B\), then \(\overline{CA}\) and \(\overline{CB}\) are opposite rays.

---

**Common Misconception:** Ray \(\overrightarrow{BC}\) and \(\overrightarrow{CB}\) are different! See example above
NOTE: All example problems in the student notes are hyperlinked to the book’s videos on how to do them through the student notes pdf file on-line at our class’s web page.

Example Problems:

Example 1

a. Give two other names for $\overline{DE}$ and plane $C$.

b. Name three points that are collinear.

Name four points that are coplanar.
Example 2

a. Give another name for \( \overline{TR} \).

b. Name all rays with endpoint \( P \).

c. Which of these rays are opposite rays?

Example 3

a. Sketch two intersecting lines \( a \) and \( b \) that lie in plane \( W \).

b. Sketch line \( d \) that intersects plane \( D \) in only one point. Label the point \( A \).

c. Sketch a plane \( X \) that contains \( \overline{PQ} \) and a point \( B \) not on \( \overline{PQ} \).

Example 4

Sketch two planes \( R \) and \( S \) that intersect in line \( \overline{AB} \).
Example 5

The diagram shows a juice box.
Name two different planes that contain $\overline{QP}$.

Concept Summary:
- Rays have one endpoint and line segments have two endpoints
- Two points determine a line
- Points on the same line are collinear
- Two lines intersect in a point
- Three noncollinear points determine a plane
- Two intersecting lines determine a plane
- Points or lines on the same plane are coplanar
- Two planes intersect in a line

Khan Academy Videos:
1. Euclid as the father of geometry
2. Terms and labels in geometry
3. Lines, line segments and rays

Homework: Geometric Concepts WS probs 1-5

Reading: student notes Section 1-2
Section 1.2: Measuring and Constructing Segments

SOLs: prep for G.3.a and G.4.a

Opening: Plot the point in the coordinate plane.

1. A(8, -5)
2. B(2, 0)
3. C(5, -1)
4. D(1, 3)
5. E(1, -3)
6. F(4, 4)
7. G(6, 4)
8. H(-3, 1)

Objectives: Students will be able to:
- Use the Ruler Postulate
- Copy segments and compare segments for congruence
- Use the Segment Addition Postulate

Vocabulary:
- Axiom – a rule that is accepted without proof; also called an postulate
- Between – with three collinear points, one is between the other two
- Coordinate – location of points on a number line or the x-y coordinate plane
- Congruent Segments – when line segments have the same length, they are congruent (\( \cong \))
- Construction – a geometric drawing that uses a limited set of tools, usually a compass and straightedge
- Distance – length between points
- Postulate – a rule that is accepted without proof; also called an axiom

Core Concept:

![Postulate 1.1 Ruler Postulate](image)

The points on a line can be matched one to one with the real numbers. The real number that corresponds to a point is the coordinate of the point.

The distance between points A and B, written as AB, is the absolute value of the difference of the coordinates of A and B.
**Big Ideas Chapter 1: Basics of Geometry**

### Core Concept

**Congruent Segments**

Line segments that have the same length are called *congruent segments.* You can say “the length of \( AB \) is equal to the length of \( CD \),” or you can say “\( AB \) is congruent to \( CD \).” The symbol \( = \) means “is congruent to.”

\[
\begin{align*}
A & \quad B \\
\quad C & \quad D \\
\end{align*}
\]

Lengths are equal. \( AB = CD \)

Segments are congruent. \( \overline{AB} = \overline{CD} \)

“is equal to”

“is congruent to”

**Note:** Numbers (distances) are equal; things (line segments, angles, polygons) are congruent

---

### Postulate

**Postulate 1.2 Segment Addition Postulate**

If \( B \) is between \( A \) and \( C \), then \( AB + BC = AC \).

If \( AB + BC = AC \), then \( B \) is between \( A \) and \( C \).

\[
\begin{align*}
A & \quad B \quad C \\
\end{align*}
\]

Sum of the Parts is equal to the Whole \( \Rightarrow \) *part + part = whole*

**Examples:**

**Example 1**

Measure the length of \( \overline{AB} \) to the nearest tenth of a centimeter.

\[
\begin{array}{c}
A \\
\hline
B
\end{array}
\]

**Example 2**

Plot the points \( P(-4, 3) \), \( Q(3, 3) \), \( R(-1, 4) \), and \( S(-1, -2) \) in a coordinate plane.

Then determine whether \( \overline{PQ} \) and \( \overline{RS} \) are congruent.
Construction: Copy a Segment

Use a compass and straightedge to construct a line segment that has the same length as \( \overline{AB} \).

![Construction Diagram]

Example 3

a. Find \( XZ \).

b. Find \( CD \).

Example 4

The cities shown on the map lie approximately on a straight line. Find the distance from Sacramento, California, to San Bernardino, California.

![Map of California with cities labeled]

Concept Summary:

The measure of a total distance is the sum of the measure of its parts.

Measures can be equal.

Segments (and angles, triangles and polygons) can be congruent; which means their measures are equal.

Khan Academy Videos:

1. Dividing line segments: graphical
2. Dividing line segments

Homework: Geometric Concepts WS probs 6 – 10

Reading: student note Section 1-3
Section 1.3: Using Midpoint and Distance Formulas

SOLs: G.3.a

Opening: Find the slope.

1.  

2. (4, -4), (1, 2)

Objectives: Students will be able to:
Find segment lengths using midpoints and segment bisectors
Use the Midpoint Formula
Use the Distance Formula

Vocabulary:
Approximate – close to this value, but not exactly (math symbol: \( \approx \))
Bisect – to cut into two equal parts
Distance – the length of a segment connecting two points
Midpoint – the point that divides the segment into two congruent segments; bisects a segment
Right angle – an angle that measures 90 degrees; in the corner of a Pythagorean triangle; usually denoted as a red square
Segment Bisector – a point, ray, line, line segment or plane that intersects the segment at its midpoint

Core Concept:
Segment with endpoints \( (x_1, y_1) \) and \( (x_2, y_2) \):
Length of the segment using Distance formula: \( \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \)
Midpoint of segment is \( \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \)
**Core Concept**

Midpoints and Segment Bisectors

The **midpoint** of a segment is the point that divides the segment into two congruent segments.

![Diagram of midpoint](image)

\[ M \text{ is the midpoint of } AB. \]
\[ So, AM = MB \text{ and } AM = MB. \]

A **segment bisector** is a point, ray, line, line segment, or plane that intersects the segment at its midpoint. A midpoint or a segment bisector **bisection**s a segment.

![Diagram of segment bisector](image)

\[ \overline{CD} \text{ is a segment bisector of } AB. \]
\[ So, AM = MB \text{ and } AM = MB. \]

---

**Core Concept**

The **Distance Formula**

If \( A(x_1, y_1) \) and \( B(x_2, y_2) \) are points in a coordinate plane, then the distance between \( A \) and \( B \) is

\[ AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}. \]

The Distance Formula is related to the **Pythagorean Theorem**, which you will see again when you work with right triangles.

**Distance Formula**

\[ (AB)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2 \]

**Pythagorean Theorem**

\[ c^2 = a^2 + b^2 \]
Example Problems:

Example 1

In the figure, $PM = 1.8 \text{ mm}$. Identify the segment bisector of $PQ$. Then find $PQ$.

![Diagram of P, M, Q, and T]

Example 2

Point $M$ is the midpoint of $AB$. Find the length of $AB$.

![Diagram with A, M, and B with coordinates]

Construction: Bisect a Segment

Construct a segment bisector of $AB$ by paper folding. Then find the midpoint $M$ of $AB$.

![Diagram of A and B with midpoint M]

Example 3

a. The endpoints of $AB$ are $A(-8, 7)$ and $B(5, 1)$. Find the coordinates of the midpoint $M$.

![Diagram with A and B and midpoint M]
Big Ideas Chapter 1: Basics of Geometry

b. The midpoint of $\overline{PQ}$ is $M(2, -3)$. One endpoint is $P(4, 1)$. Find the coordinates of endpoint $Q$.

Example 4

Your school is 4 miles east and 1 mile south of your apartment. You bicycle 5 miles east and then 2 miles north from your apartment to a friend’s house. Estimate the distance between your friend’s house and your school.

Concept Summary:
Distances can be determined on a number line or a coordinate plane by using the Distance Formula or Pythagorean Theorem (on SOL formula sheet).
The midpoint of a segment is the point halfway between the segment’s endpoints.
If given an endpoint and a midpoint, then find the other end by “traveling” the same distance (using a graph or equations).

Khan Academy Videos:
1. Distance formula
2. Midpoint formula

Homework:
Day 1: Midpoint worksheet 1, Midpoint worksheet 2
Day 2: Distance worksheet

Reading: student notes Section 1–4
Section 1.4: Perimeter and Area in the Coordinate Plane

SOLs: G.3.a

Opening: Find the perimeter and area of the polygon

1.  
2.  
3.  
4.  

Objectives: Students will be able to:
- Classify polygons
- Find perimeters and areas of polygons in the coordinate plane

Vocabulary:
- Concave – if any line aligned to the sides of the figure passes through its interior
- Convex – not concave ("side line" does not pass through interior)
- Irregular polygon – not regular (not all angles equal or not all sides equal)
- n-gon – a polygon with n sides
- Perimeter – the sum of the lengths of sides of the polygon
- Polygon – a closed plane figure formed by three or more line segments called sides
- Regular polygon – a convex polygon with all segments congruent & all angles congruent
- Sides – line segments that make up a polygon

Core Concept:

**Polygons**
In geometry, a figure that lies in a plane is called a plane figure. Recall that a polygon is a closed plane figure formed by three or more line segments called sides. Each side intersects exactly two sides, one at each vertex, so that no two sides with a common vertex are collinear. You can name a polygon by listing the vertices in consecutive order.

The number of sides determines the name of a polygon, as shown in the table. You can also name a polygon using the term n-gon, where n is the number of sides. For instance, a 14-gon is a polygon with 14 sides.

A polygon is convex when no line that contains a side of the polygon contains a point in the interior of the polygon. A polygon that is not convex is concave.

<table>
<thead>
<tr>
<th>Sides</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Triangle</td>
</tr>
<tr>
<td>4</td>
<td>Quadrilateral</td>
</tr>
<tr>
<td>5</td>
<td>Pentagon</td>
</tr>
<tr>
<td>6</td>
<td>Hexagon</td>
</tr>
<tr>
<td>7</td>
<td>Heptagon</td>
</tr>
<tr>
<td>8</td>
<td>Octagon</td>
</tr>
<tr>
<td>9</td>
<td>Nonagon</td>
</tr>
<tr>
<td>10</td>
<td>Decagon</td>
</tr>
<tr>
<td>12</td>
<td>Dodecagon</td>
</tr>
<tr>
<td>N</td>
<td>N-gon</td>
</tr>
</tbody>
</table>
Note: Perimeter has linear units, such as feet or meters. Area has square units, such as square feet or square meters.

**Example Problems:**

**Example 1**

Classify each polygon by the number of sides. Tell whether it is convex or concave.

![Polygon a.](image)

![Polygon b.](image)

**Example 2**

Find the perimeter of \( \triangle PQR \) with vertices \( P(-1, 4), Q(2, 4), \) and \( R(2, -1) \).
Example 3

You are making a banner for the school basketball game. The diagram shows the four vertices of the banner. Each unit in the coordinate plane represents 1 foot. Find the area of the banner.

Example 4

Find the area of $\triangle ABC$ with vertices $A(1, 3)$, $B(3, -3)$, and $C(-2, -3)$.

Concept Summary:
- Figures are either concave or convex, regular or irregular
- Concave has one interior angle greater than 180 (or a “cave” like indentation)
- Regular means all parts (sides or angles) are equal
- Perimeter is a one-dimensional measure of length around a figure (add up its sides)
- Area is a two-dimensional measure of surface (square feet or feet$^2$ -- square units of measure)
- Area of commonly used figures are on SOL formula sheet (but not always perimeter formulas)
  - Square: Perimeter = 4s Area = $s^2$
  - Rectangle: Perimeter = 2l + 2w Area = lw
  - Triangle: Perimeter = all sides added Area = $\frac{1}{2} bh$

Khan Academy Videos:
1. Perimeter and area
2. Perimeter and area of composite shapes

Homework: Figures-2D worksheet

Reading: student notes section 1-5
Section 1.5: Measuring and Constructing Angles

SOLs: G.4.e and G.4.f

Opening: Solve the equation to find the value of the variable

1. \( x^\circ + 40^\circ = 110^\circ \)
2. \( r^\circ - 44^\circ = 135^\circ \)
3. \( n^\circ - 19^\circ = 125^\circ \)
4. \( y^\circ - 55^\circ = 35^\circ \)
5. \( 2r^\circ + 10^\circ = 140^\circ \)
6. \( 2w^\circ - 65^\circ = 175^\circ \)

Objectives: Students will be able to:
- Name angles
- Measure and classify angles
- Identify congruent angles
- Use the Angle Addition Postulate to find angle measures
- Bisect angles

Vocabulary:
- Angle – set of all points consisting of two different rays that have the same endpoint (vertex)
- Angle Bisector – a ray that divides an angle into two congruent angles
- Congruent angles – have the same measure
- Degree – one three hundred and sixty-sixtieth of a circle
- Exterior – region of all points not between the two rays that form the angle
- Interior – region of all points between the two rays that form the angle
- Opposite rays – are collinear rays with the same end point (& form a 180 degree angle)
- Ray – part of a line with one end point
- Sides – composed of rays

Types of angles:
- Right angle – measure of the angle equal 90 degrees
- Acute angle – measure of the angle is less than 90 degrees
- Obtuse angle – measure of the angle is greater than 90 degrees (but less than 180)
- Straight angle – measures 180 degrees (a line)

Vertex – is the common endpoint
Core Concept:

Types of Angles

**Acute Angle**: Measures greater than 0° and less than 90°

**Right Angle**: Measures 90°

**Obtuse Angle**: Measures greater than 90° and less than 180°

**Straight Angle**: Measures 180°

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Postulate 1.3 Protractor Postulate

Consider $\overline{AB}$ and a point $A$ on one side of $\overline{AB}$. The rays of the form $\overline{OA}$ can be matched one to one with the real numbers from 0 to 180.

The **measure** of $\angle AOB$, which can be written as $m\angle AOB$, is equal to the absolute value of the difference between the real numbers matched with $\overline{OA}$ and $\overline{OB}$ on a protractor.

---

Postulate 1.4 Angle Addition Postulate

**Words**: If $P$ is in the interior of $\angle RST$, then the measure of $\angle RST$ is equal to the sum of the measures of $\angle RSP$ and $\angle PST$.

**Symbols**: If $P$ is in the interior of $\angle RST$, then

$$m\angle RST = m\angle RSP + m\angle PST.$$

---

Example Problems:

**Example 1**

Write three names for the angle.
Big Ideas Chapter 1: Basics of Geometry

Example 2

Find the measure of each angle. Then classify each angle.

a. \( \angle RQU \)

b. \( \angle TQU \)

c. \( \angle UQS \)

Construction: Copying an Angle

Example 3

a. Identify the congruent angles in the roof frame.

b. \( \angle EDG = 40^\circ \). What is \( \angle EFG \)?

Example 4

Given that \( \angle PQR = 102^\circ \), find \( \angle SQR \) and \( \angle PQS \).
Construction: Bisect an Angle

Construct an angle bisector of $\angle U$ with a compass and a straightedge.

Example 5

$\overline{VB}$ bisects $\angle AVC$ and $m\angle AVC = 158^\circ$. Find $m\angle BVC$.

Concept Summary:
- Angles named with three letters and the vertex (hinge point) is always the middle letter
- Angles are classified by their measures as acute, right, obtuse or straight
- Congruent angles have equal measure
- Angle bisector cuts an angle into two equal halves

Khan Academy Videos:
1. Measuring angles in degrees
2. Measuring angles using a protractor
3. Acute, right and obtuse angles

Homework: Angles worksheet 1 columns 1 and 4 (first and last)

Reading: student notes section 1-6
Section 1.6: Describing Pairs of Angles

SOLs: G.2

Opening: Solve

1. \(4x - 0 = 12\)  
2. \(7 = -11c - 4\)  
3. \(11 = -19x - 8\)  
4. \(7 = 5n + 5 - 4n\)  
5. \(3x + 2 + 8 = 2x - 5\)  
6. \(x + 5 + 6x + 17 = x - 2\)

Objectives: Students will be able to:
- Identify complementary and supplementary angles
- Identify linear pairs and vertical angles

Vocabulary:
- Adjacent angles – two coplanar angles that have a common vertex, a common side, but no common interior points
- Complementary Angles – two angles whose measures sum to 90°
- Linear pair – a pair of adjacent angles whose noncommon sides are opposite rays
- Perpendicular – two lines or rays are perpendicular if the angle (s) formed measure 90°
- Supplementary Angles – two angles whose measures sum to 180°
- Vertical angles – two non-adjacent angles (opposite) formed by two intersecting lines; vertical angles are congruent (measures are equal)!!
Core Concept:

**Complementary and Supplementary Angles**

Two positive angles whose measures have a sum of 90°. Each angle is the complement of the other.

Two positive angles whose measures have a sum of 180°. Each angle is the supplement of the other.

**Adjacent Angles**

Complementary angles and supplementary angles can be adjacent angles or nonadjacent angles. Adjacent angles are two angles that share a common vertex and side, but have no common interior points.

**Linear Pairs and Vertical Angles**

Two adjacent angles are a linear pair when their noncommon sides are opposite rays. The angles in a linear pair are supplementary angles.

Two angles are vertical angles when their sides form two pairs of opposite rays.
Example Problems:

Example 1

In the figure, name a pair of complementary angles

a pair of supplementary angles

and a pair of adjacent angles.

Example 2

a. \( \angle 5 \) is a complement of \( \angle 3 \), and \( m\angle 3 = 53^\circ \). Find \( m\angle 5 \).

b. \( \angle 4 \) is a supplement of \( \angle 2 \), and \( m\angle 4 = 29^\circ \). Find \( m\angle 2 \).

Example 3

The veins in a leaf form a pair of supplementary angles.
Find the measures of the angles when
\( m\angle 1 = (7x + 13)^\circ \) and \( m\angle 2 = (25x + 7)^\circ \)
Example 4

Identify all of the linear pairs and all of the vertical angles in the figure.

Example 5

Two angles form a linear pair. The measure of one angle is eight times the measure of the other angle. Find the measure of each angle.

Concept Summary:

- There are many special pairs of angles such as
  - adjacent angles – angles that share a side
  - complementary angles – angles that sum to 90 degrees
  - linear pairs – adjacent angles that are supplementary (and form a straight line)
  - supplementary angles – angles that sum to 180 degrees
  - vertical angles – angles that are across an “x” from each other
- Vertical angles are congruent
- Linear Pairs are supplementary

Khan Academy Videos:

1. Vertical angles
2. Equation practice with vertical angles
3. Complementary and supplementary angles
4. Equation practice with complementary angles
5. Equation practice with supplementary angles

Homework: Angle worksheet 1 finish

Reading: student notes chapter review section
Section 1.R: Chapter Review

Objectives: Students will be able to:
Review Key Concepts of the chapter

Key Concepts:
- Points, Lines, and Planes
  - There is exactly one line through any two points
  - There is exactly one plane through any three noncollinear points
- Distance
  - In the coordinate plane, the distance between two points \((x_1, y_1)\) and \((x_2, y_2)\) is given by
    \[ d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2} \]
  - Geometry teachers like to use Pythagorean Theorem, \(a^2 + b^2 = c^2\) to figure out the square of the distance, and then take the square root
- Midpoints
  - Graphically it is the middle on the line connecting the two points at the halfway point
  - In the coordinate plane, the coordinate of the midpoint of a segment with endpoints \((x_1, y_1)\) and \((x_2, y_2)\) is given by
    \[ Midpoint = \left( \frac{x_1+x_2}{2}, \frac{y_1+y_2}{2} \right) \]
  - Statistically the midpoint is the average of the endpoints
- Angles
  - An angle is formed by two noncollinear rays that have a common endpoint, called a vertex. Angles can be classified by the measures:
    - Acute: less than 90
    - Right: equal to 90
    - Obtuse: more than 90 (but less than 180!)
  - Adjacent angles are two coplanar angles that have a common vertex and a common side, but no common interior points
  - A linear pair is a pair of adjacent angles with noncommon sides that are opposite rays (form a line!)
    - Linear pairs are adjacent (a letter, a or b and a number, 1 or 2)
    - and supplementary -- they always add to 180
  - Vertical angles are two nonadjacent (opposites: \(a\) and \(b\) or 1 and 2) angles formed by two intersecting lines
    - Vertical angles are congruent!
    - Major Theorem in Geometry!
  - Complementary angles are two angles with measures that sum to 90
  - Supplementary angles are two angles with measures that sum to 180
- Polygons
  - Line segments for sides
  - Area and perimeter for some are on the formula sheet
- Constructions
  - Bisectors cut things (segments and angles) into equal halves
  - Practice the steps; not only to do, but to recognize the procedure

Study: Chapter 1 quiz and review sheet in preparation for Chapter 1 Test
Big Ideas Chapter 1: Basics of Geometry

Five Minute Reviews:

Section 1-1:
Algebra Review
1. \(6x + 45 = 18 - 3x\)

2. \(x^2 - 45 = 4\)

3. \((3x + 4) + (4x - 7) = 11\)

4. \((4x - 10) + (6x + 30) = 180\)

5. Find the slope of the line \(k\).

6. Find the slope of a parallel line to \(k\)
   a. \(\frac{1}{2}\) b. 2 c. \(-\frac{1}{2}\) d. -2

Section 1-2:
Find the following from the picture
1. A point

2. A line

3. A ray

4. A line segment

5. A plane

6. 3 collinear points

7. 3 non-collinear points

8. A line not in the plane
Section 1-3:
Find $BD$ in the following drawings

1. 

2. 

3. $CD = 60$
   $CB = 2x + 5$
   $BD = 9x$

4. 

Section 1-4:
1. The endpoints of $\overline{QR}$ are Q(1, 6) and R(-7, 3). Find the coordinates of the midpoint M.

2. Find the distance between S(-5, -2) and T(-3, 4).

3. Identify the segment bisector of $\overline{QR}$ and then find QR.

4. The midpoint of $\overline{GH}$ is M(4, -3). If G(-2, 2), then find H’s coordinates
Section 1-5:
1. Find the perimeter and area of the figure shown to the right.

2. Find the area and perimeter of a rectangle with width 10 and length of 15.

3. Find the area and perimeter of a square with a side of 6.

4. Name and classify the following:

Section 1-6:
Find the angle measure and classify the angle
1. \( m\angle MXN \)

2. \( m\angle NXP \)

3. \( m\angle OXQ \)

Use the diagram and the given angle measures to find the indicated measure.
4. \( m\angle PQT = 41.5^\circ \) and \( m\angle TQR = 48^\circ \). Find \( m\angle PQR \).

5. \( m\angle PQR = 89^\circ \) and \( m\angle TQR = (2x + 4)^\circ \)
   and \( m\angle PQT = (3x + 5) \). Find \( x \)
Section 1-R:

\( \overline{BD} \) bisects \( \angle ABC \). Use the diagram and the given angles to answer 1 and 2.

1. \( m\angle ABD = 57^\circ \). Find \( m\angle DBC \) and \( m\angle ABC \).

2. \( m\angle ABC = 110^\circ \). Find \( m\angle DBC \) and \( m\angle ABD \).

3. \( \angle B \) is supplement of \( \angle A \) and \( m\angle A = 65^\circ \). Find \( m\angle B \)

4. \( \angle C \) is complement of \( \angle A \) and \( m\angle A = 60^\circ \). Find \( m\angle C \)

5. \( \angle D \) is a linear pair with \( \angle A \) and \( m\angle A = 55^\circ \). Find \( m\angle D \)

6. \( \angle E \) is vertical with \( \angle A \) and \( m\angle A = 45^\circ \). Find \( m\angle E \)
Construction Directions:

Construct a line segment congruent to a given line segment.

**Construction: Copying a Segment**

Use a compass and straightedge to construct a line segment that has the same length as $\overline{AB}$.

**Solution**

**Step 1**

Draw a segment

Use a straightedge to draw a segment longer than $\overline{AB}$. Label point $C$ on the new segment.

**Step 2**

Measure length

Set your compass at the length of $\overline{AB}$.

**Step 3**

Copy length

Place the compass at $C$. Mark point $D$ on the new segment. So, $\overline{CD}$ has the same length as $\overline{AB}$.

Midpoint by folding:

**Construction: Bisecting a Segment**

Construct a segment bisector of $\overline{AB}$ by paper folding. Then find the midpoint $M$ of $\overline{AB}$.

**Solution**

**Step 1**

Draw the segment

Draw $\overline{AB}$ on a piece of paper.

**Step 2**

Fold the paper

Fold the paper so that $B$ is on top of $A$.

**Step 3**

Label the midpoint

Label point $M$. Compare $AM$, $MB$, and $\overline{AB}$.

$AM = MB = \frac{1}{2} \overline{AB}$
Construct an angle congruent to a given angle.

**CONSTRUCTION**  
**Copying an Angle**

Use a compass and straightedge to construct an angle that has the same measure as $\angle A$. In this construction, the **center** of an arc is the point where the compass point rests. The **radius** of an arc is the distance from the center of the arc to a point on the arc drawn by the compass.

**SOLUTION**

**Step 1**

![Step 1 Image]

**Step 2**

![Step 2 Image]

**Step 3**

![Step 3 Image]

**Step 4**

![Step 4 Image]

**Draw a segment**  
Draw an angle such as $\angle A$, as shown. Then draw a segment. Label a point $D$ on the segment.

**Draw arcs**  
Draw an arc with center $A$. Using the same radius, draw an arc with center $D$.

**Draw an arc**  
Label $B$, $C$, and $E$. Draw an arc with radius $BC$ and center $E$. Label the intersection $F$.

**Draw a ray**  
Draw $DF$. $\angle EDF \cong \angle BAC$.

Construct an angle bisector of a given angle.

**CONSTRUCTION**  
**Bisecting an Angle**

Construct an angle bisector of $\angle A$ with a compass and straightedge.

**SOLUTION**

**Step 1**

![Step 1 Image]

**Step 2**

![Step 2 Image]

**Step 3**

![Step 3 Image]

**Draw an arc**  
Draw an angle such as $\angle A$, as shown. Place the compass at $A$. Draw an arc that intersects both sides of the angle. Label the intersections $B$ and $C$.

**Draw arcs**  
Place the compass at $C$. Draw an arc. Then place the compass point at $B$. Using the same radius, draw another arc.

**Draw a ray**  
Label the intersection $G$. Use a straightedge to draw a ray through $A$ and $G$. $\overline{AG}$ bisects $\angle A$. 


Distance between two points with coordinates

Example: \((2, 3)\) and \((-2, -4)\)

Formula: \(d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}\)

Solution using formula:

\[d = \sqrt{(2 - (-2))^2 + (-4 - 3)^2}\]
\[d = \sqrt{4^2 + (-7)^2}\]
\[d = \sqrt{16 + 49} = \sqrt{65} \approx 8.09\]

Solution using Pythagorean Theorem: \(a^2 + b^2 = c^2\)

\[4^2 + 7^2 = c^2\] (left or right blocks)\(^2 +\) (up or down blocks)\(^2\)
\[16 + 49 = c^2\]
\[65 = c^2\]
\[\sqrt{65} = \sqrt{c^2}\]
\[\sqrt{65} = 8.09 = c\]

Bisector cuts into two congruent (equal) parts

\(m\angle a = m\angle b\)
\(\angle a \cong \angle b\)

AB = BC
AB \cong BC
B is a midpoint!!
Midpoint  a point halfway between two coordinate points

Example: Given two endpoints  
(2, 3) and (-2, -4)

Formula:  
\[
\left( \frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2} \right)
\]

Solution using formula:

\[
\left( \frac{-2 + 2}{2}, \frac{-4 + 3}{2} \right)
\]

\[
\left( \frac{0}{2}, \frac{-1}{2} \right) = \left( 0, \frac{-1}{2} \right)
\]

Example: Given An endpoint and a midpoint  (Travel Problem)

MidPoint (2, 3)  
and (-2, -4) End point

Graphing Solution using triangles:  
Midpoint is 7 up and 4 right from the  
endpoint. Move 7 up and 4 right from  
midpoint to get to the other endpoint.

Solution using numbers:

- MP(2, 3)  
- EP(-2, -4)  
- Travel (+4, +7)

\[
\text{MP - midpoint}
\]

\[
\text{Trvl - travel distance}
\]

\[
\text{OEP - other endpoint}
\]

From EP to MP is travel; from MP to OEP is travel
Angles: between two rays hinged at a vertex

- **Obtuse**: Greater than (> 90°)
- **Straight**: Equal (= 180°)
- **Right**: Less than (< 90°)

**Special Angle Pairs**

- **Complementary**: a pair of angles that sum to 90°
  \[ m\angle a + m\angle b = 90° \]
  \[ m\angle a = 90° - m\angle b \quad m\angle b = 90° - m\angle a \]

- **Supplementary**: a pair of angles that sum to 180°
  Linear Pair: \[ m\angle c + m\angle d = 180° \]
  \[ m\angle c = 180° - m\angle d \quad m\angle d = 180° - m\angle c \]

- **Vertical Angles**: have the same measure (congruent)
  \[ m\angle a = m\angle a \]
  \[ m\angle b = m\angle b \]
  \[ m\angle a + m\angle b = 180° \] (linear pair)

- **Adjacent Angles**: share a common side (ray)

**Linear Pairs**: supplementary adjacent angles
Big Ideas Chapter 1: Basics of Geometry

**Angles:**
Named by 3 letters: $\angle BGA$
Acute – less than $90^\circ$ $\angle BGC$
Obtuse – greater than $90^\circ$ $\angle AGF$
Complementary – adds to $90^\circ$ $\angle BGA, \angle BGC$
Supplementary – adds to $180^\circ$ $\angle AGF, \angle FGD$
Vertical Angles are equal $\angle BGA, \angle FGD$
Linear Pairs add to $180^\circ$ $\angle BGC, \angle CGF$

**Other Angle Items:**
Three angles in a triangle add to $180^\circ$
Two acute angles in a right triangle add to $90^\circ$
No angle is greater than $180^\circ$
Only a straight angle (a line) equals $180^\circ$

**Angles or Segments:**
Sum of the parts = Whole

**Distance formula:**
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
(form of Pythagorean Theorem $a^2 + b^2 = c^2$)

**Midpoint formula:**
$$\left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2}\right)$$
average

Given EP and MP, find OEP
“travel problem”
draw it out on graph

EP: $(a, b)$
MP: $(c, d)$
travel: $(c-a, d-b)$
OEP: $(2c-a, 2d-b)$

<table>
<thead>
<tr>
<th>Figure Names</th>
<th>Sides</th>
<th>Sum of Interior $\angle$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle</td>
<td>3</td>
<td>180</td>
</tr>
<tr>
<td>Quadrilateral</td>
<td>4</td>
<td>360</td>
</tr>
<tr>
<td>Pentagon</td>
<td>5</td>
<td>540</td>
</tr>
<tr>
<td>Hexagon</td>
<td>6</td>
<td>720</td>
</tr>
<tr>
<td>Heptagon</td>
<td>7</td>
<td>900</td>
</tr>
<tr>
<td>Octagon</td>
<td>8</td>
<td>1080</td>
</tr>
<tr>
<td>Nonagon</td>
<td>9</td>
<td>1260</td>
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<tr>
<td>Decagon</td>
<td>10</td>
<td>1440</td>
</tr>
<tr>
<td>Dodecagon</td>
<td>12</td>
<td>1800</td>
</tr>
</tbody>
</table>

Perimeter is all sides added up