Big Ideas Math: Geometry

Chapter Summary

Chapter 3: Parallel and Perpendicular Lines

Standards

Common Core:
HSG-CO.A.1, HSG-CO.C.9, HSG-CO.D.12, HSG-GPE.B.5, HSG-GPE.B.6

Core Vocabulary

Coplanar lines that do not intersect are ***parallel lines.***

Lines that do not intersect and are not coplanar are ***skew lines.***

Planes that do not intersect are ***parallel planes.***

A line that intersects two or more coplanar lines at different points is a ***transversal.***

Corresponding angles are two angles that are formed by two lines and a transversal that are in corresponding positions.

Two angles that are formed by two lines and a transversal that are between the two lines and on opposite sides of the transversal are ***alternate interior angles.***

Two angles that are formed by two lines and a transversal that are outside the two lines and on opposite sides of the transversal are ***alternate exterior angles.***

Consecutive interior angles are two angles that are formed by two lines and a transversal that lie between the two lines and on the same side of the transversal.

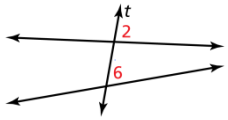
The ***distance from a point to a line*** is the length of the perpendicular segment from the point to the line.

A line that is perpendicular to a segment at its midpoint is a ***perpendicular bisector.***

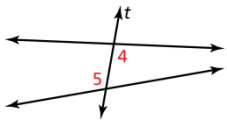
A segment that represents moving from one point to another point is called a ***directed line segment***.

Core Concept

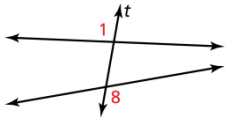
Angles Formed by Transversals



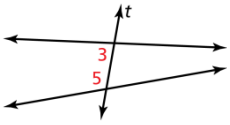
Two angles are corresponding angles when they have corresponding positions. For example, ∠2 and ∠6 are above the lines and to the right of the transversal *t*.



Two angles are alternate interior angles when they lie between the two lines and on opposite sides of the transversal *t*.



Two angles are alternate exterior angles when they lie outside the two lines and on opposite sides of the transversal *t*.



Two angles are consecutive interior angles when they lie between the two lines and on the same side of the transversal *t*.

Essential Questions

What does it mean when two lines are parallel, intersecting, coincident, or skew?

When two parallel lines are cut by a transversal, which of the resulting pairs of angles are congruent?

For which of the theorems involving parallel lines and transversals is the converse true?

What conjectures can you make about perpendicular lines?

How can you write an equation of a line that is parallel or perpendicular to a given line and passes through a given point?

Postulates

3.1 Parallel Postulate
If there is a line and a point not on the line, then there is exactly one line through the point parallel to the given line.

3.2 Perpendicular Postulate
If there is a line and a point not on the line, then there is exactly one line through the point perpendicular to the given line.

Learning Goals

Identify lines and planes.

Identify parallel and perpendicular lines.

Identify pairs of angles formed by transversals.

Use properties of parallel lines.

Prove theorems about parallel lines.

Solve real-life problems.

Use the Corresponding Angles Converse.

Construct parallel lines.

Prove theorems about parallel lines.

Use the Transitive Property of Parallel Lines.

Find the distance from a point to a line.

Construct perpendicular lines.

Prove theorems about perpendicular lines.

Solve real-life problems involving perpendicular lines.

Use slope to partition directed line segments.

Identify parallel and perpendicular lines.

Write equations of parallel and perpendicular lines.

Use slope to find the distance from a point to a line.

Theorems

3.1 Corresponding Angles Theorem
If two parallel lines are cut by a transversal, then the pairs of corresponding angles are congruent.

3.2 Alternate Interior Angles Theorem
If two parallel lines are cut by a transversal, then the pairs of alternate interior angles are congruent.

3.3 Alternate Exterior Angles Theorem
If two parallel lines are cut by a transversal, then the pairs of alternate exterior angles are congruent.

3.4 Consecutive Interior Angles Theorem
If two parallel lines are cut by a transversal, then the pairs of consecutive interior angles are supplementary.

3.5 Corresponding Angles Converse
If two lines are cut by a transversal so the corresponding angles are congruent, then the lines are parallel.

3.6 Alternate Interior Angles Converse
If two lines are cut by a transversal so the alternate interior angles are congruent, then the lines are parallel.

3.7 Alternate Exterior Angles Converse
If two lines are cut by a transversal so the alternate exterior angles are congruent, then the lines are parallel.

3.8 Consecutive Interior Angles Converse
If two lines are cut by a transversal so the consecutive interior angles are supplementary, then the lines are parallel.

3.9 Transitive Property of Parallel Lines
If two lines are parallel to the same line, then they are parallel to each other.

3.10 Linear Pair Perpendicular Theorem
If two lines intersect to form a linear pair of congruent angles, then the lines are perpendicular.

3.11 Perpendicular Transversal Theorem
In a plane, if a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other line.

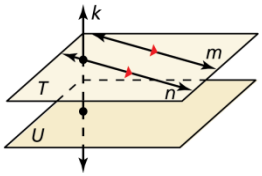
3.12 Lines Perpendicular to a Transversal Theorem
In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.

3.13 Slopes of Parallel Lines
In a coordinate plane, two nonvertical lines are parallel if and only if they have the same slope. Any two vertical lines are parallel.

3.14 Slopes of Perpendicular Lines
In a coordinate plane, two nonvertical lines are perpendicular if and only if the product of their slopes is −1. Horizontal lines are perpendicular to vertical lines.

Core Concept

Parallel Lines, Skew Lines, and Parallel Planes
Two lines that do not intersect are either parallel lines or skew lines. Two lines are parallel lines when they do not intersect and are coplanar. Two lines are skew lines when they do not intersect and are not coplanar. Also, two planes that do not intersect are parallel planes.



Lines m and n are parallel lines ($m \parallel n$).

Lines m and k are skew lines.

Planes T and U are parallel planes ($T \parallel U$).

Lines k and n are intersecting lines, and there is a plane (not shown) containing them.

Small directed arrows, as shown in red on lines m and n above, are used to show that lines are parallel. The symbol $\parallel$ means "is parallel to," as in $m \parallel n$. Segments and rays are parallel when they lie in parallel lines. A line is parallel to a plane when the line is in a plane parallel to the given plane. In the diagram above, line n is parallel to plane U.

Additional Review

- Finding the Distance from a Point to a Line, *p. 148*
- Constructing Perpendicular Lines, *p. 149*
- Partitioning a Directed Line Segment, *p. 156*
- Writing Equations of Parallel and Perpendicular Lines, *p. 158*
- Finding the Distance from a Point to a Line, *p. 159*

Games

- P or P (Parallel or Perpendicular)
- Race for Distance

These are available online in the *Game Closet* at www.bigideasmath.com.

What's the Point?

The STEM Videos available online show ways to use mathematics in real-life situations. The Chapter 3: Square a Treehouse STEM Video is available online at www.bigideasmath.com.