Many city streets have been built using a grid. Even a city like Vancouver, which has an irregular shape, is set up this way. What types of lines do the streets that run side by side form? What types of lines do the streets that cross each other at right angles form?

What are parallel and perpendicular line segments?

1. Fold a sheet of blank paper in half, then into quarters, and then into eighths. Unfold the paper and use a ruler and a pencil to draw line segments along the creases. Label the endpoints from A to K, as shown.

2. Identify each pair of line segments that you think are parallel. Use your ruler to measure the perpendicular distance between the line segments. Make two measurements, one at each end. Record the measurements in a table.

3. Identify each pair of line segments that you think are perpendicular. Use your protractor to measure the angles made by these line segments. Record the measurements in a table.
**Reflect on Your Findings**

4. **a)** Describe the two measurements you made for each pair of line segments you thought were parallel. What do you think is true about the distance between parallel line segments?

**b)** What kind of angle did you measure for each pair of line segments you thought were perpendicular? What do you think is true about the angle made by perpendicular line segments?

**Example 1: Identify Parallel and Perpendicular Line Segments**

Look at the picture of the roller coaster.

A C

B D

E F

**a)** Are line segments AC and DF **parallel**?

**b)** Are line segments DF and BE **perpendicular**?

**Solution**

**a)** Measure the perpendicular distance between AC and DF in two locations. If the measurements are the same, AC is parallel to DF.

**b)** Place a protractor at point E on line segment DF. If \( \angle BEF \) or \( \angle BED \) measures 90º, DF and BE are perpendicular.

**Show You Know**

**a)** Are line segments AC and BE **perpendicular**? How do you know?

**b)** Would a line segment joining A to D be parallel to line segment BE? How do you know?
**Example 2: Draw Parallel Line Segments**

Draw a line segment, AB. Draw another line segment, CD, parallel to AB.

**Solution**

Use a ruler to draw a line segment. Label its endpoints A and B. Place the edge of a right triangle along AB as shown. Place a ruler against the bottom edge of the triangle.

Slide the triangle along the ruler. Draw along the perpendicular edge of the triangle to create a line parallel to AB. Label the endpoints of the parallel line segment C and D.

Check:

Verify that line segments are parallel using one of these methods:
- Use a Mira.
- Use paper folding.

**Right Triangle**

It is called a right triangle because it has an angle of 90°.
Example 3: Draw Perpendicular Line Segments

Draw a line segment, EF. Draw another line segment, GH, perpendicular to EF.

Solution

Use a ruler to draw a line segment. Label its endpoints E and F. Mark a point along EF. Label this point G.

Place a protractor at point G. Mark a point that is at right angles to line segment EF. Label this endpoint H.

Connect points G and H to draw a line segment perpendicular to EF.

Check:
Verify that line segments are perpendicular using one of these methods:
• Use paper folding.
• Use a Mira.

Remember to mark the angle with a small square to show that the lines are perpendicular.
**Key Ideas**

- Parallel line segments are line segments in the same plane that do not intersect.
- The perpendicular distance between parallel line segments must be the same at each end of the line segments.
- Some ways to create parallel line segments include
  - using a ruler and a right triangle
  - using paper folding
- Perpendicular line segments are line segments that intersect at 90°.
- Some ways to create perpendicular line segments include
  - using a ruler and a protractor
  - using paper folding

**Communicate the Ideas**

1. **a)** What are five examples of parallel line segments in the real world? Sketch each example.

   **b)** What are five examples of perpendicular line segments in the real world? Sketch each example.

   **c)** Share your lists and sketches with a partner.

2. Are each of the following pairs of lines and line segments parallel, perpendicular, or neither? Explain how you know.

3. **a)** What are two methods you might use to draw parallel line segments?

   **b)** What do you know about parallel line segments that helps you to draw them?

4. **a)** What are two methods you might use to draw perpendicular line segments?

   **b)** What do you know about perpendicular line segments that helps you to draw them?
5. What are the parallel and perpendicular line segments in the painting?

Composition in Black, Blue, Yellow, and White. 1936. Mondrian, Piet (1872–1944)

6. Identify the parallel and perpendicular streets in the diagram.

7. On a piece of paper, draw a 7-cm line segment as shown.

   a) Draw two line segments that are parallel to GH.
   b) On a separate piece of paper, draw GH again. Draw two line segments that are perpendicular to GH.

8. Draw a 9-cm line segment as shown.

   a) Draw two line segments that are parallel to DE.
   b) Draw DE again. Draw two line segments that are perpendicular to DE.

9. Are the wings of this biplane parallel or perpendicular? How do you know?

10. Are the red line segments on this rectangle parallel? Explain how to verify your answer.

11. Name and sketch at least two objects in the real world that include
    a) parallel lines
    b) perpendicular lines
    c) both parallel and perpendicular lines

12. The drawing shows part of a Chinese lattice design. Copy the design, using only parallel and perpendicular line segments.
13. Dakota has a shelf on her bedroom wall for her soccer trophies. She wants to hang another shelf parallel to it. Use what you know about drawing parallel line segments to explain how Dakota can do this.

14. You are designing a seesaw. You need to place a perpendicular support from R to CD. Copy the diagram and draw the support.

15. Using parallel and perpendicular lines only, make a copy of this letter F that is 5 cm high. Draw the reflection of your letter.

16. Draw parallel line segments and a third line that intersects them.

- a) Measure angles 1 to 8 and write each measurement inside the angle.
- b) What do you notice about the angles?