

## LAUNCH

### WHERE DO CROP CIRCLES COME FROM?



## 1.6

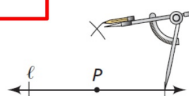
### Compasses, Angles, and Circles

Objectives:

- Use hand construction tools.
- Explain the difference between a construction and a drawing.

**construction** (p. 27) A construction is a guaranteed recipe for drawing a figure with a specified set of tools.


**Example:**





The diagram shows the construction (in progress) of a line perpendicular to a line  $\ell$  through a point  $P$  on  $\ell$ .

**Drawings** are aids to problem solving.  
**Constructions** are solutions to problems.

## Hand Construction Tools

 **Compass** A compass is any device—even a knotted piece of string—that allows you to move a pencil a fixed distance around a certain point. A compass allows you to copy distances and to construct circles of any size that you can place anywhere.

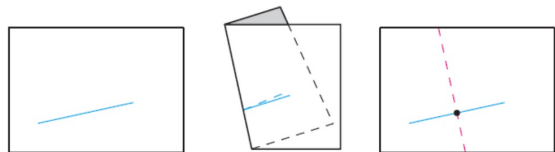
 **Straightedge** An object with a straight edge—even a piece of paper—helps you draw a segment to look straight. In general, a straightedge is unmarked and you cannot use it to measure distances. You can use a straightedge to draw a line through, or a segment between, two points. You can also use a straightedge to extend a drawing of a line.

 **Measuring devices** Rulers and protractors are measuring devices. You can use a ruler to measure the length of a segment or the distance between two points. You can use a protractor to measure an angle.

**Paper** Paper is not just a surface on which to write and draw. You can use the symmetries formed by folding paper to construct geometric figures creatively. You can also use dissection—the process of cutting paper figures and rearranging their parts—as a powerful aid to reasoning.

**String** You can use string and tacks to build devices that you can use to construct circles, ellipses, spirals, and other curves.

A **midpoint** is the point on a segment that is halfway between the two endpoints.



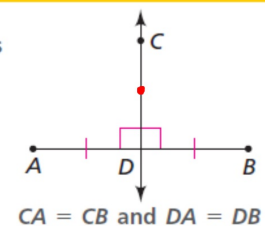
The **perpendicular bisector** of a segment is a line that is perpendicular to a segment at the segment's midpoint.

**Equidistant** means "the same distance."

A **theorem** is a statement that has been proven.

### Theorem 1.1 Perpendicular Bisector Theorem

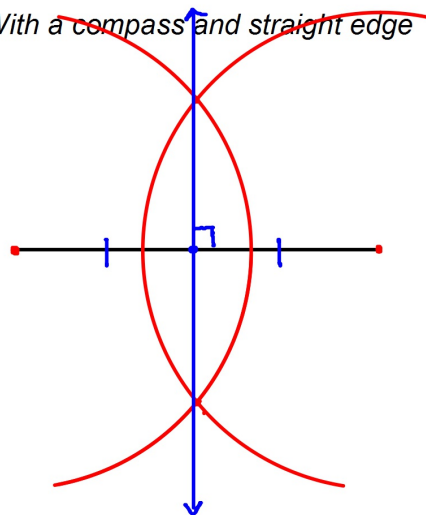
Each point on the perpendicular bisector of a segment is equidistant from the two endpoints of the segment.



### EXAMPLE 1:

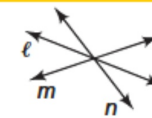
#### CONSTRUCTING A PERPENDICULAR BISECTOR

*With a compass and straight edge*



### Definition

Three or more lines that meet or intersect at one point are **concurrent lines**.

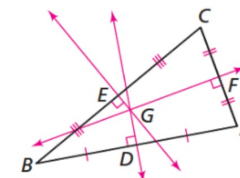


Lines  $l$ ,  $m$ , and  $n$  are concurrent lines.

### Theorem 1.2 Concurrence of Perpendicular Bisectors

In any triangle, the perpendicular bisectors of the sides are concurrent.

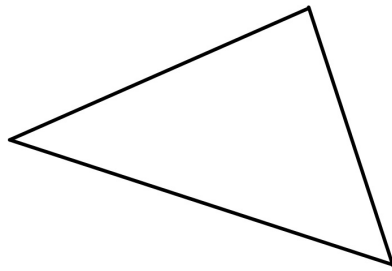
In  $\triangle ABC$ , the perpendicular bisectors of  $\overline{AB}$ ,  $\overline{BC}$ , and  $\overline{AC}$  are concurrent at  $G$ .



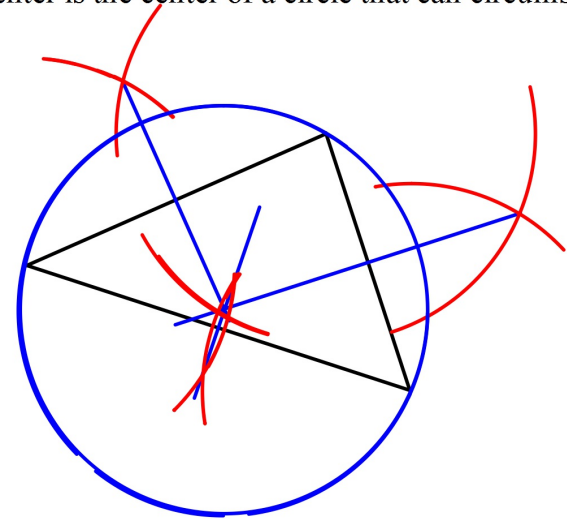
The point where all of the perpendicular bisectors meet is called the **circumcenter** of the triangle.

**EXAMPLE 2:**

Use a straight edge to create a triangle and use a compass and straight edge to locate it's circumcenter



The circumcenter is the center of a circle that can circumscribe the triangle.

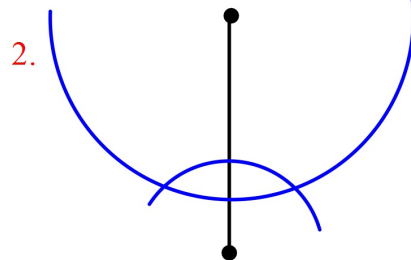
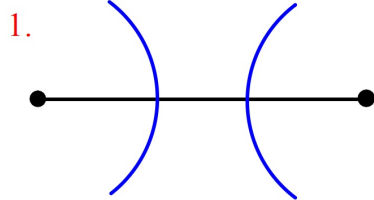


Homework:  
Perpendicular Bisector Constructions Worksheet

---

**Exit Ticket:**

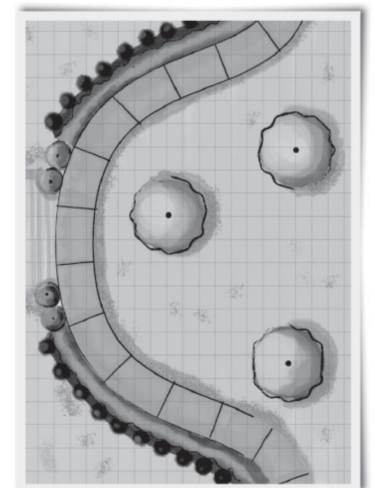
Identify the mistake for each. While constructing the perpendicular bisector of a segment, a student made a mistake and couldn't continue. Identify the mistake that they made:



**EXTRA PRACTICE.... If time**

Salim planted three new saplings. He wants to install a rotating sprinkler to water the three saplings. Where should he install the sprinkler to make sure that all three saplings get the same amount of water?

- Trace the saplings onto your paper.
- Show where Salim should install the sprinkler.
- Explain your answer.

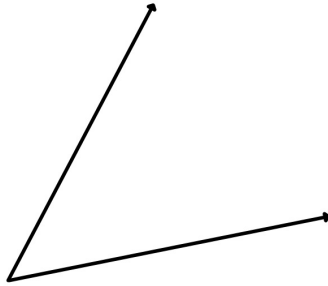


An **angle bisector** is a ray that divides an angle exactly in half, marking two congruent angles.

**EXAMPLE 3:**

**CONSTRUCTING AN ANGLE BISECTOR**

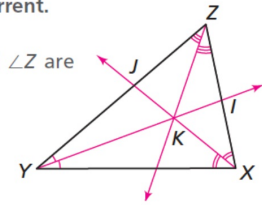
*With a compass and straight edge*



**Theorem 1.3 Concurrency of Angle Bisectors**

In any triangle, the angle bisectors are concurrent.

In  $\triangle XYZ$ , the angle bisectors of  $\angle X$ ,  $\angle Y$ , and  $\angle Z$  are concurrent at  $K$ .



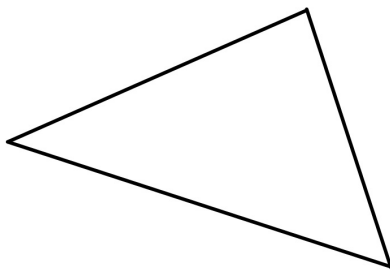
**Definition**

Three or more points that are on the same line are **collinear points**.

The point where all of the angle bisectors meet is called the **incenter** of the triangle.

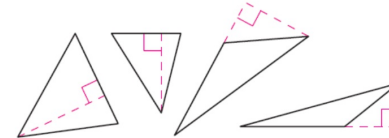
**EXAMPLE 4:**

*Use a straight edge to create a triangle and use a compass and straight edge to locate its incenter*



a. A triangle has three *altitudes*.

An **altitude** is a perpendicular segment from a vertex of a triangle to the line that contains the opposite side.



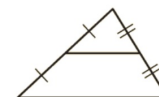
b. A triangle has three *medians*.

A **median** is a segment that connects a vertex of a triangle to the midpoint of the opposite side.



c. A triangle has three *midlines*.

A **midline** is a segment that connects the midpoints of two sides of a triangle.



Homework: Angle bisectors Worksheet