Exploring Tangent Lines
with Geometer’s Sketchpad

In this activity, we will discover some basic properties of tangent lines.

***Def. Tangent line –*** *a line that intersects a circle at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
 (called the point of tangency)*

**Part 1: Tangent Theorem**

1. Construct circle O (label the center “O”).
2. Construct a point on the circle and label it P (don’t use the construction point that is on the circle.)
3. Construct the radius $\overbar{OP}$
4. Now construct point A outside the circle.
5. Construct line $\overleftrightarrow{AP}$ (not a line segment).
6. Select only the line and the circle. Then use the construct menu to construct “Intersections”
7. Select and measure $∠APO$.
8. Now move point *P* around the circle until the line intersects the circle at *exactly* one point.
We now have $\overleftrightarrow{AP}$ tangent to circle $O$

What is $m∠APO$ when $\overleftrightarrow{AP}$ is tangent to circle $O$?

**Tangent Line Theorem:If a line is tangent to a circle then the line is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the radius**

**Part 2: Tangent Segments**

1. Construct Circle *O*.
2. Construct points *A* and *B* on the circle (don’t use the construction point).
3. Construct radii $\overbar{OA}$ and $\overbar{OB}$
4. Construct a *line* perpendicular to $\overbar{OA}$ through point *A*
5. Construct a *line* perpendicular to $\overbar{OB}$ through point *B

 What are these lines called? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
6. Now highlight only the two lines that you constructed in the last two steps and construct the intersection using the Construct menu.
7. Find this intersection and label it point *C*.
8. Segments $\overbar{CA}$ and $\overbar{CB}$ are called **tangent segments**. Measure the lengths of $\overbar{CA}$ and $\overbar{CB}$.

Move points *A* and *B* and observe the measurements of the tangent segments.

What is true about their measures?

**Tangent Segment Theorem:** **Tangent segments are always \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Part 3: Common Tangents (advanced)**

Common tangents are lines that are tangent to two different circles.

Here’s your task:

Continue with your construction from part 2 and make two circles that have common tangents as seen in the picture below. You should be able to move both circles and change their size and still have common tangents (as long as the second circle is smaller than the first).

Hint: The center of both circles lies on the line $\overleftrightarrow{OC}$ that goes through the center of the first circle and the intersection of the tangent lines of the first circle.

