# Related Rates

**Objective:**

Students understand the concept of related rates and can solve AP Level problems dealing with related rates.

**Previous Knowledge:**

Students understand the concept of implicit differentiation and know how to perform problems relating to implicit differentiation.

**Materials:**

Balloons (non – inflated)
Conical Funnels
Empty Water Bottles
Cups of Water

**Set-up:**

Put a balloon, a conical funnel, an empty water bottle, and a cup of water at each table group.

**Procedure:**

- Ask students to play with the materials in their groups. Tell students to discuss what variables affect the rate at which the radius of the spherical balloon changes as the balloon is filled with air. Tell students to discuss what variables affect the rate at which the radius of the surface of the water of the funneling cone changes as water drains out. Tell groups to raise their hands once they figure out the answer. If the answer is correct, tell students that if the rate at which air enters the balloon is 20 cm^3 per second, then how fast is the radius changing? At the end of this activity, have students share their methods with the class.

- Tell students that the point of this activity was to demonstrate that rates of different things in the same system are related to each other. Therefore, the derivatives of different things in the same system are related to each other. Thus the name, related rates. Go through the spherical balloon problem with the class. Make sure to draw a diagram, see what is given, see what is needed to find, set up an equation, and then take the derivative to solve.

- Give groups the classic related rates train problem. Go around and help groups solve.

- Show class the conical drain problem. Ask students to discuss how they would make the equation in terms of one variable instead of two (height and radius). Have students share. Go over the conical drain problem with the class.

- Give students a reflection homework.

- For next day, have a lab day of AP Level related rates problems and circle around helping students.

- Give students related rates project.