

## MATH 30, SPRING 2020: RELATED RATES

1. Read the problem carefully.
  2. Draw a picture if possible.
  3. Introduce notation.
  4. Express the given information mathematically.
  5. Write an equation that relates the various quantities.
  6. Use the Chain Rule.
  7. Substitute into the resulting equation and solve for the related rate.
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**Simple example:** Each side of a square is increasing at a rate of 6 centimeters per second. At what rate is the area of the square increasing when the area of the square is 16 centimeters squared?

1. Ok, I read it!
2. Draw a picture of a square with side length  $x(t)$  and area  $A(t)$ .
3.  $x(t)$  is the length of the side at time  $t$ .  $A(t)$  is the area of the square at time  $t$ .
4. The rate of change of  $x(t)$  (its derivative with respect to time  $t$ ) is given to be  $x'(t) = 6$ .
5. The equation for area of a square says  $A(t) = (x(t))^2$ . (That's why we call it "squared"!)
6. The Chain Rule (or Product Rule, in this case) says  $A'(t) = 2x(t)x'(t)$
7. When the area is  $A(t) = 16$ , that means the side length is  $x(t) = 4$ . Plugging into our equation, we get (at that time  $t$ )

$$A'(t) = 2 \cdot 4 \cdot 6 = 48 \quad (\text{centimeters squared per second}).$$

At this point, I think it's best if you work on problems on your own (see the worksheet). Each problem has its own flavor, but they all follow the same process.