

## Related Rates

(covers Stewart 3.9)

Consider a square that's increasing in size over time. The area  $A$  of a square grows faster than the length  $x$  of its sides. What exactly is the relationship between these rates? We know that  $A = x^2$ , and if we differentiate both sides with respect to time  $t$ , we get:

How fast is the area changing when the sides have length 5 m and are changing at a rate of 1 m/s?

### Ex 1.

Air is being pumped into a spherical balloon so the volume increases at a rate of  $100 \text{ cm}^3/\text{s}$ . How fast is the radius of the balloon increasing when the diameter is 50 cm?

**Ex 2.**

A ladder 10 ft long rests against a vertical wall. If the bottom of the ladder slides away at 1 ft/s, how fast is the top sliding down the wall when the bottom is 6 ft from the wall?

**Ex 3.**

A conical water tank that stands point down has a base radius of 2 m and a height of 4 m. If water is pumped in at a rate of  $2 \text{ m}^3/\text{min}$ , find the rate at which the water level is rising when the water is 3 m deep.

**Ex 4.**

Car A is going west at 50 mph. Car B is going north at 60 mph. Both are going to the same intersection. At what rate are the cars approaching each other when A is 0.3 mi and B is 0.4 mi from the intersection?