Newton's Law of Cooling

- Describes cooling (or heating) of an object
- Assumes that rate of change of temperature of object is proportional to the **difference** between the ambient temperature and the object's temperature

We will set up the general model and work with it… that way, the equations we derive will apply to a wide range of situations

Newton's Law of Cooling

- Describes cooling (or heating) of an object
- Assumes that rate of change of temperature of object is proportional to the **difference** between the ambient temperature and the object's temperature

Write T for the ambient temperature, assumed to be constant

Write $y(t)$ for the temperature of object at time t

Newton's Law of Cooling

- Rate of change of temperature of object is proportional to the **difference** between the ambient temperature and the object's temperature

this difference is $T - y(t)$

$$\frac{dy}{dt} = k\left(T - y(t)\right)$$

constant of proportionality, *k*

Newton's Law of Cooling

$$\frac{dy}{dt} = k\left(T - y(t)\right)$$

Constant of proportionality, *k*

Units? 1/(time)

Sign?

If object is cooler than environment, it will warm up

$T - y(t) > 0$ $dy/dt > 0$

k must be positive

Newton's Law of Cooling

$$\frac{dy}{dt} = k\left(T - y(t)\right)$$

Constant of proportionality, *k*

Units? 1/(time)

Sign?

If object is warmer than environment, it will cool down

$T - y(t) < 0$ $dy/dt < 0$

k must be positive

Newton's Law of Cooling

$$\frac{dy}{dt} = k\,(T - y(t))$$

Positive constant of proportionality, k, units 1/(time)

Will also have an initial condition: $y(0) = y_0$