- **Theme Music:** **Fleetwood Mac**

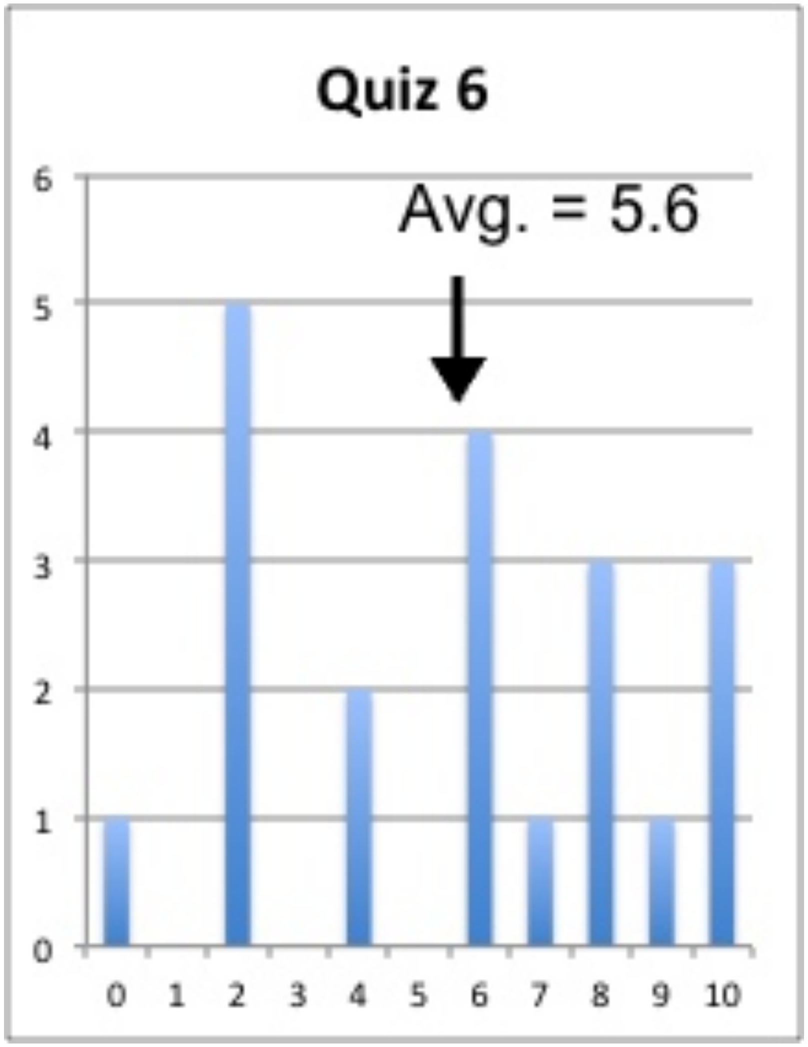
  Silver Springs

  Cartoon: **Pat Brady**

  Rose is Rose

Quiz 6

	6.1	6.2.1	6.2.2	6.2.3
A	0%	0%	10%	0%
B	5%	**70%**	**25%**	**55%**
C	**45%**	5%	**45%**	15%
D	10%	**20%**	15%	**25%**
E	**45%**	5%	5%	5%
F	**65%**			
G	5%			



Foothold ideas: Kirchhoff's principles

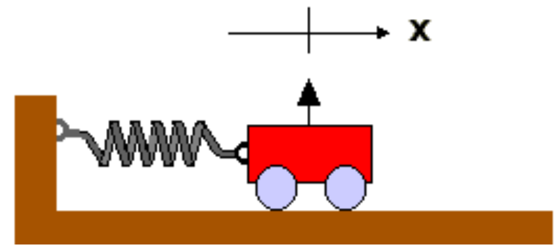
1. ***Flow rule***: The total amount of current flowing into any volume in an electrical network equals the amount flowing out.
2. ***Ohm's law***: in a resistor, $\Delta V = IR$
3. ***Loop rule***: Following around any loop in an electrical network the potential has to come back to the same value (sum of drops = sum of rises).

- *The Constant Potential Corollary*: Along any part of a circuit with 0 resistance, $\Delta V = 0$, i.e., V is constant.

Foothold ideas: Harmonic oscillation

- There is an equilibrium (balance) point where the mass can stay without moving.
- Whichever way the mass moves, the force is in the direction of pushing it back to its equilibrium position.
- When it gets back to its equilibrium, it's still moving so it overshoots.

Model system: Mass on a Spring

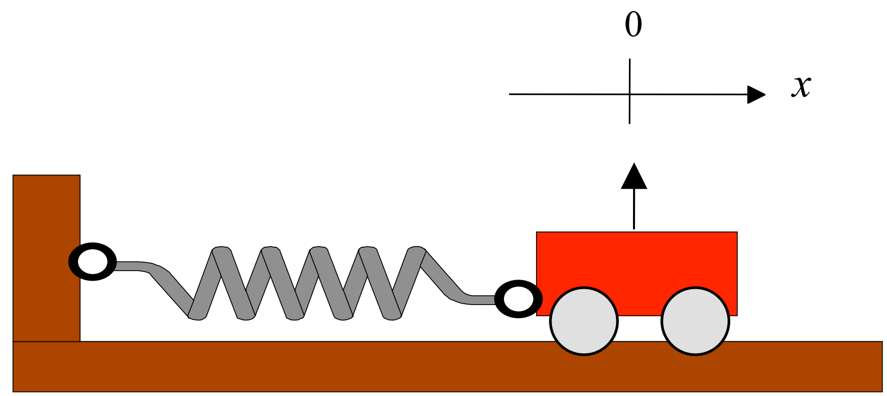


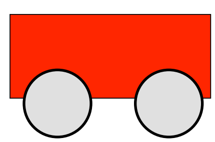
- Consider a cart of mass *m* attached to a light (mass of spring << *m*) spring.
- Choose the coordinate system so that when the cart is at 0 the spring it at its rest length
- Recall the properties of a (nice) spring.
  - When it is pulled or pushed on both ends it changes its length.

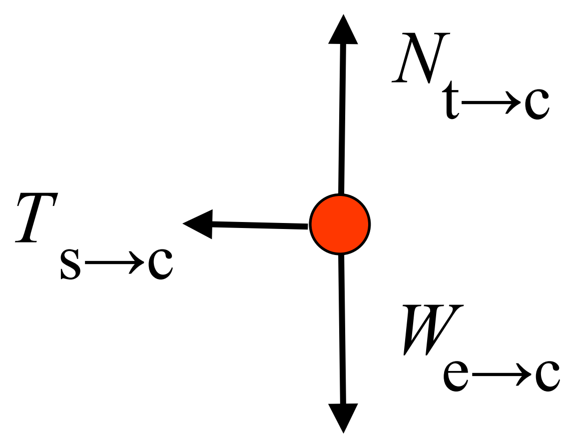
$$T = k\Delta l$$

Analyzing the forces: cart & spring

- FBD:
  What are
  the forces
  acting on the cart?







Doing the Math: The Equation of Motion

- The N2 equation for the cart is

$$a = {F_{net}}\Big/{m} = {-kx}\Big/{m} = -\left(\frac{k}{m}\right)x$$

- What kind of a quantity is k/m?

$$\left[\frac{k}{m}\right] =$$

Mathematical structure

- Express $a = F^{net}/m$ in terms of derivatives.

$$\frac{d^2x}{dt^2} = -\omega_0^2 x$$

- Except for the constant, this is like having a functions that is its own second derivative.

$$\frac{d^2f}{dt^2} = -f$$

- In calculus, we learn that sin(t) and cos(t) work like this. How about: $\boxed{x = \cos t}$?