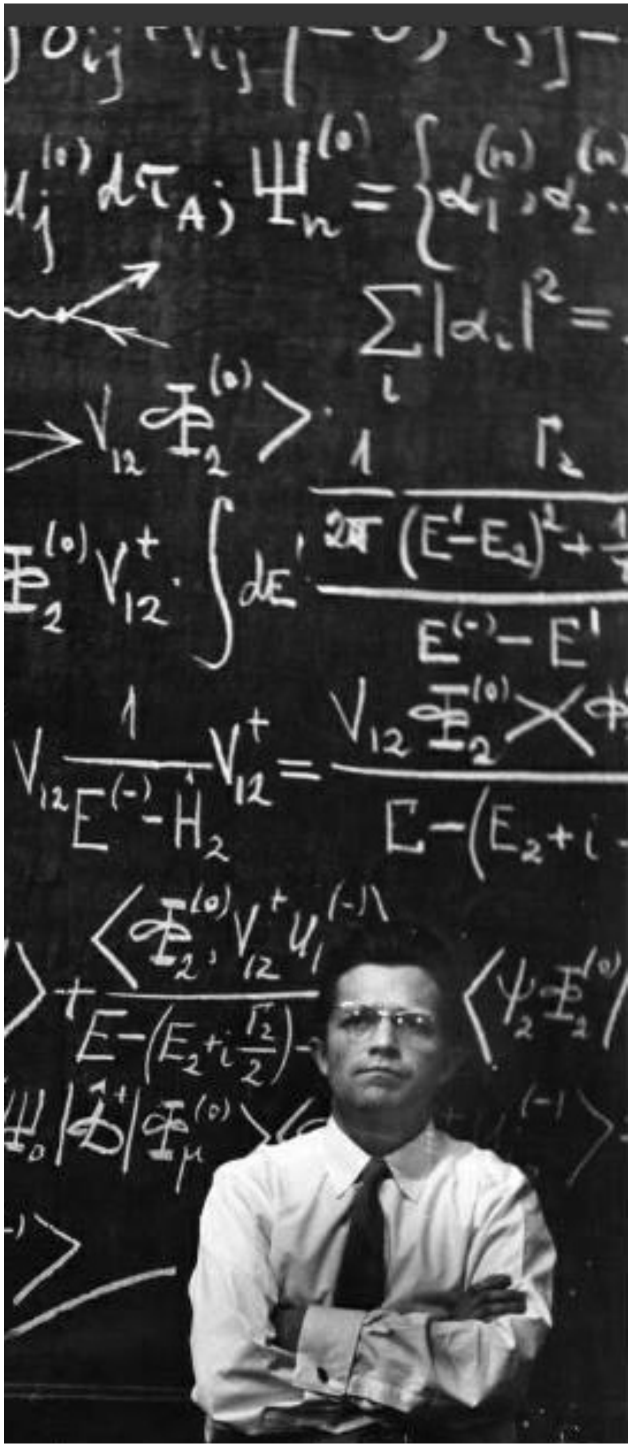
- **Theme Music:** **Cannonball Adderly**
  Work Song
- **Cartoon:** **Mike Peters**
  Mother Goose & Grimm



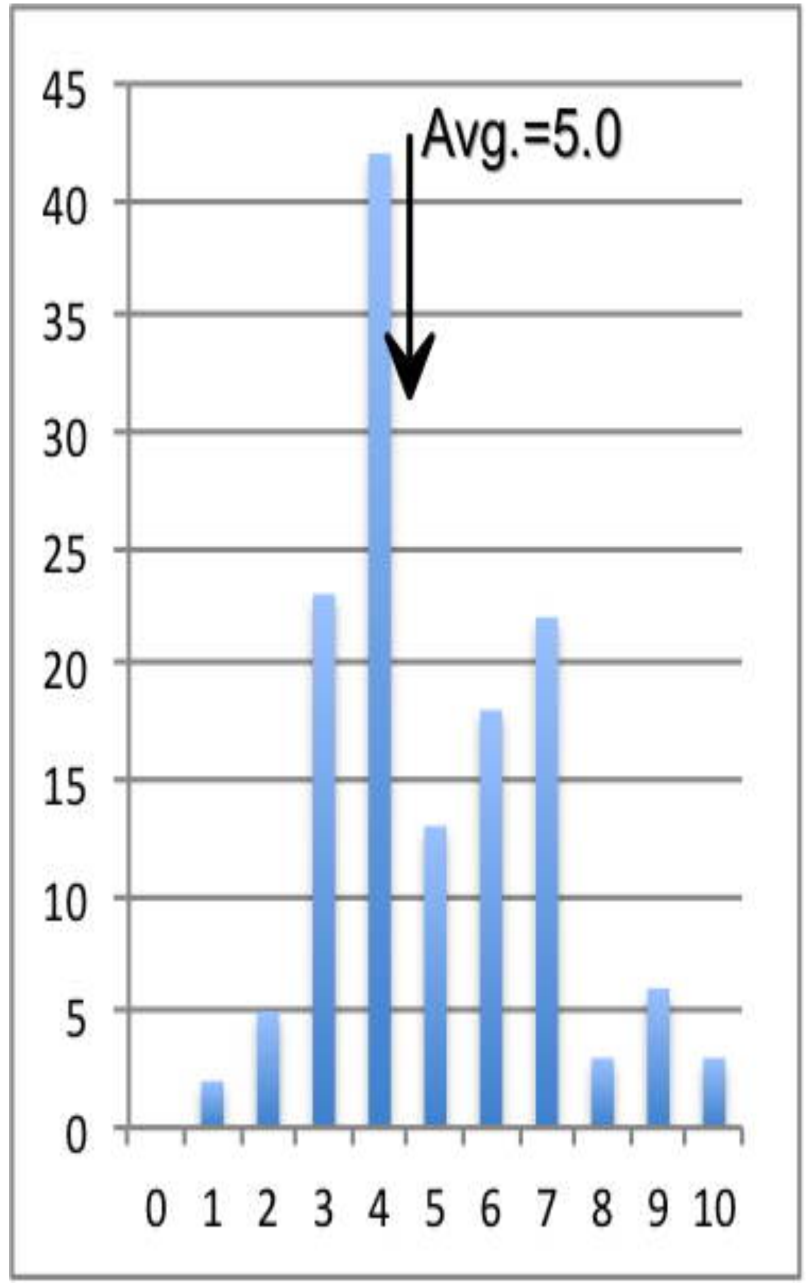
The Equation of the Day

Mechanical energy conservation

$$\Delta\left(\tfrac{1}{2}mv^2 + U\right) = 0$$

Quiz 9

	#1		#2		#3
A	**86%**	**a**	**31%**	a	**26%**
B	9%	**b**	16%	**b**	**60%**
C	5%	**c**	**75%**	**c**	9%
D	0%	**d**	**36%**	**d**	5%
		e	**61%**	e	0%
				f	1%



Basic principle

Starting with an equation is often the right way to solve a qualitative question and remind yourself about basic principles.

The Equation of the Day

$$A_1 v_1 = A_2 v_2$$

$$\Delta p = \left(\frac{8 \mu L}{\pi R^4} \right) Q$$

$$\vec{F}^{net} \cdot \Delta \vec{r} = \Delta \left(\tfrac{1}{2} m v^2 \right)$$

Foothold ideas: Potential Energy

- For some forces work only depends on the change in position. Then the work done can be written $$\vec{F} \cdot \Delta\vec{r} = -\Delta U$$

  U is called a *potential energy*.

- For gravity, $U_{gravity} = mgh$

  For a spring, $U_{spring} = \frac{1}{2} kx^2$

  For electric force, $U_{electric} = k_C Q_1 Q_2 / r_{12}$

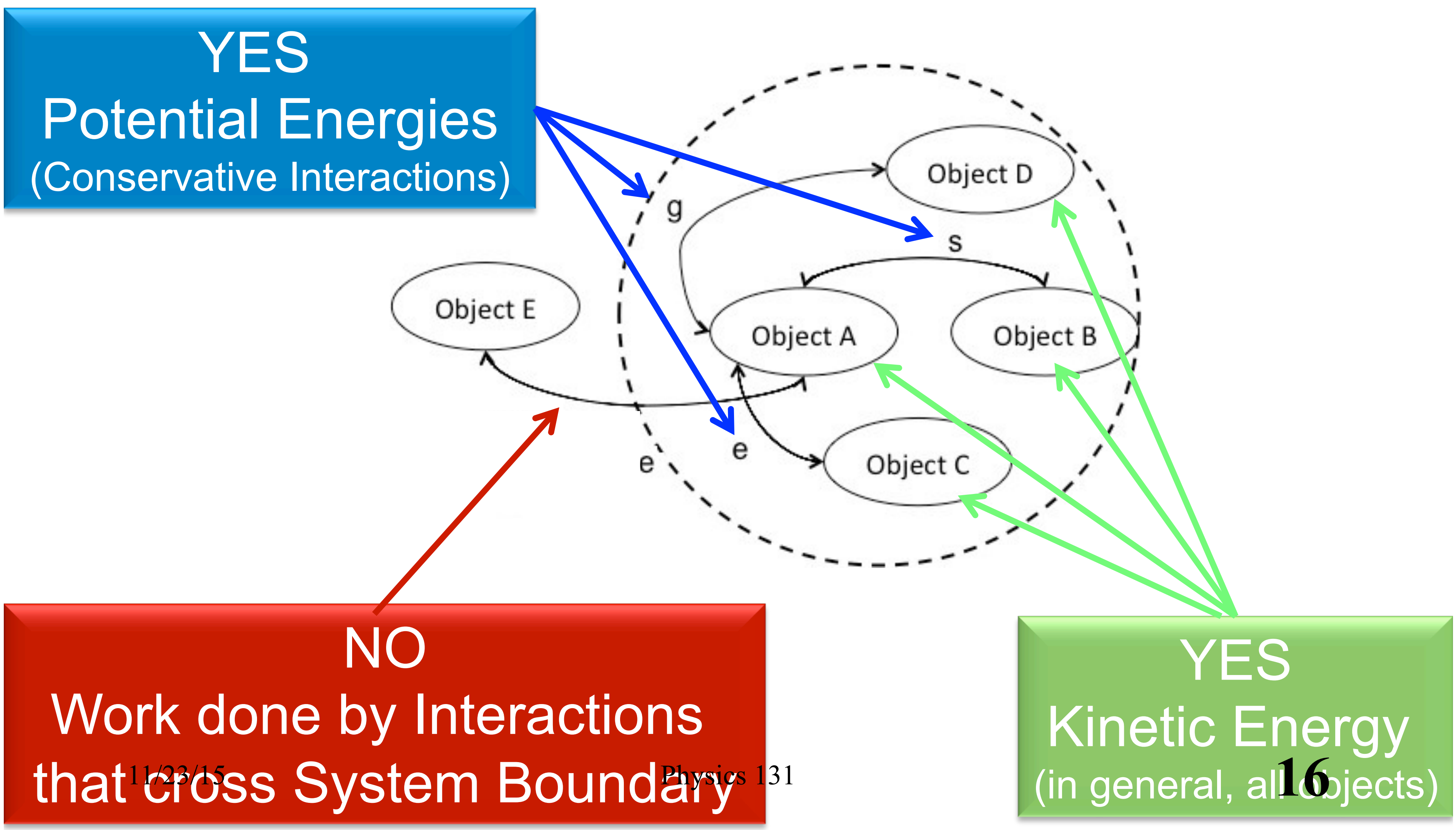
Using Mechanical Energy Conservation

- If resistive forces can be ignored, mechanical energy is conserved (exchanges with hidden internal energy such as thermal or chemical can be ignored)

$$KE_i + PE_i = KE_f + PE_f$$

- *KE* may refer to one or more objects
  PE may refer to one or more interactions.
- If only one object's KE is important and only one interaction matters, this can make things really easy.

Which Energies add to give Total Mechanical Energy?



Foothold ideas:
Energies between charge clusters

- Atoms and molecules are made up of charges.
- The potential energy between two charges is

$$U_{12}^{elec} = \frac{k_C Q_1 Q_2}{r_{12}}$$

No vectors!

- The potential energy between many charges is

$$U_{12\ldots N}^{elec} = \sum_{i<j=1}^{N} \frac{k_C Q_i Q_j}{r_{ij}}$$

Just add up all pairs!