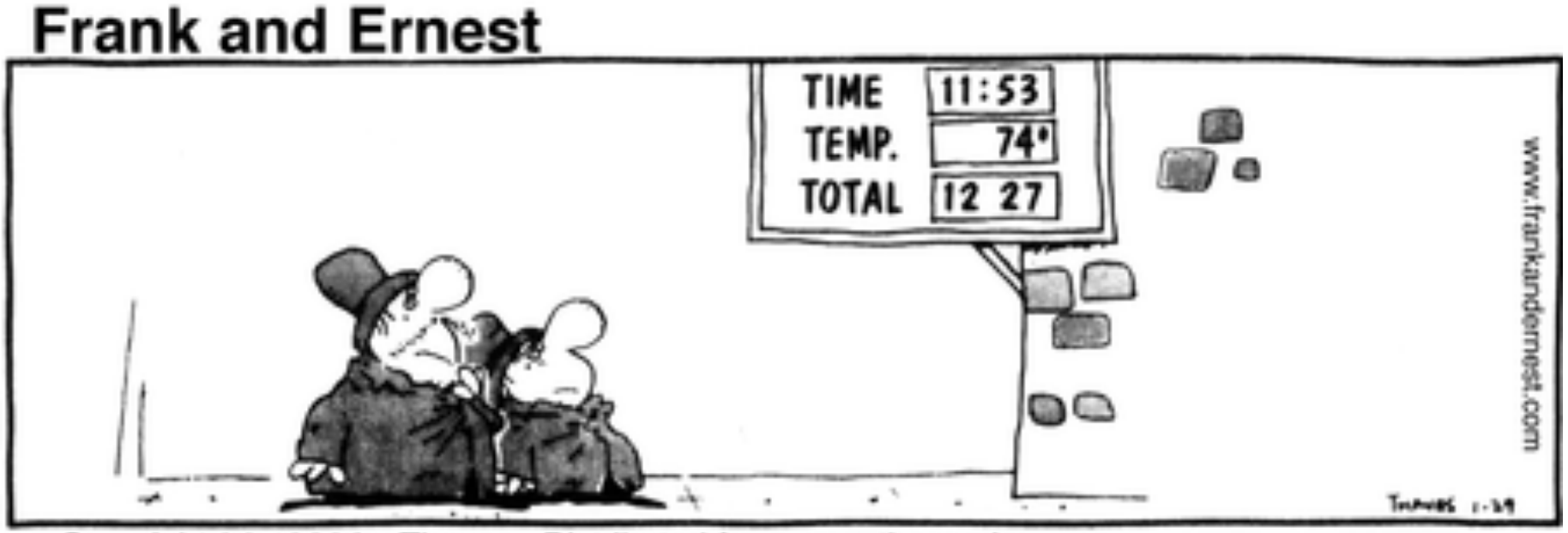
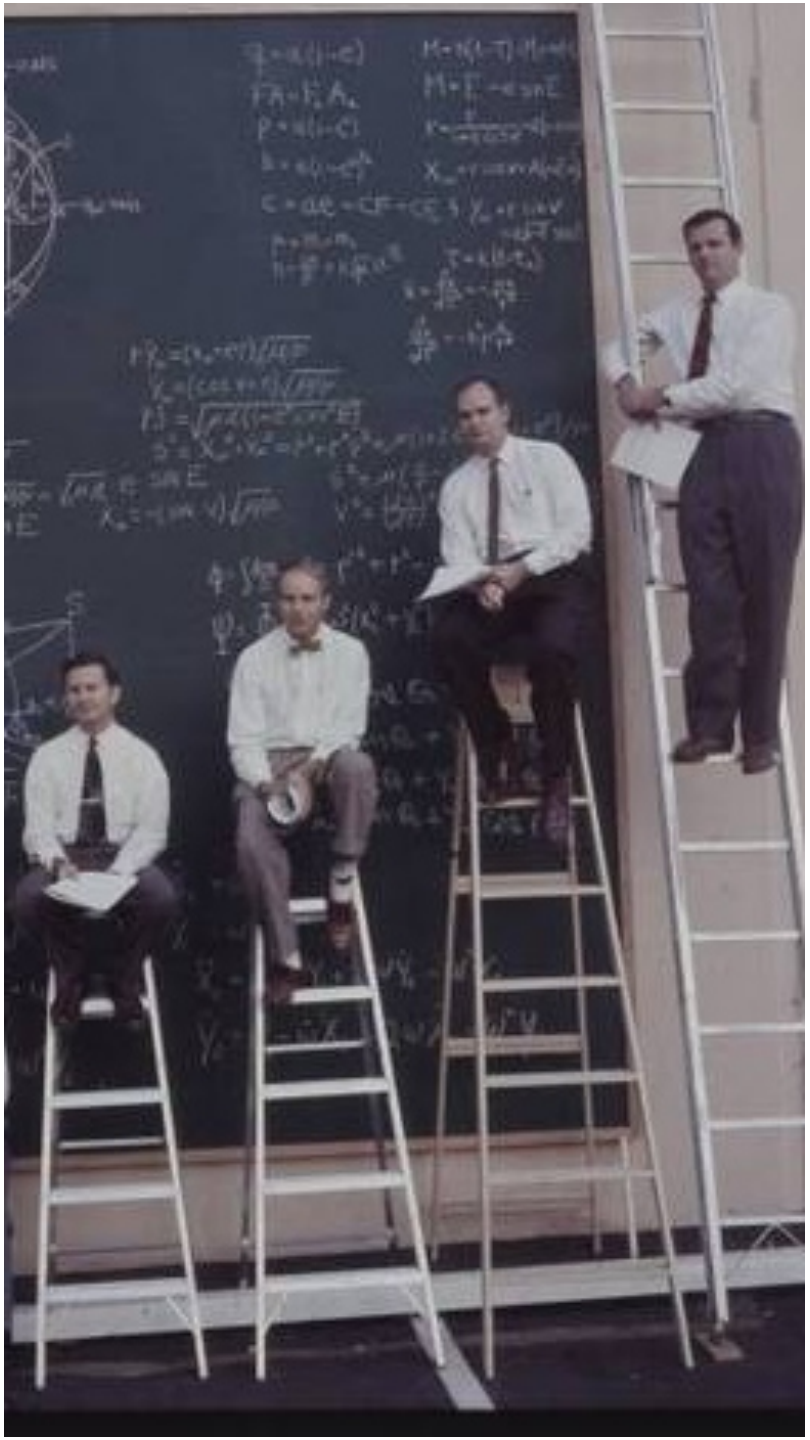
- **Theme Music: Ella Fitzgerald**

  Too Darn Hot

- **Cartoon: Bob Thaves**

  Frank & Ernest





The Equation of the Day

Force from potential energy

$$F = -\frac{dU}{dx}$$

$$\vec{F} = -\vec{\nabla} U$$

Foothold ideas: Forces from PE

- For conservative forces, PE can be defined by

$$\vec{F} \cdot \Delta\vec{r} = -\Delta U$$

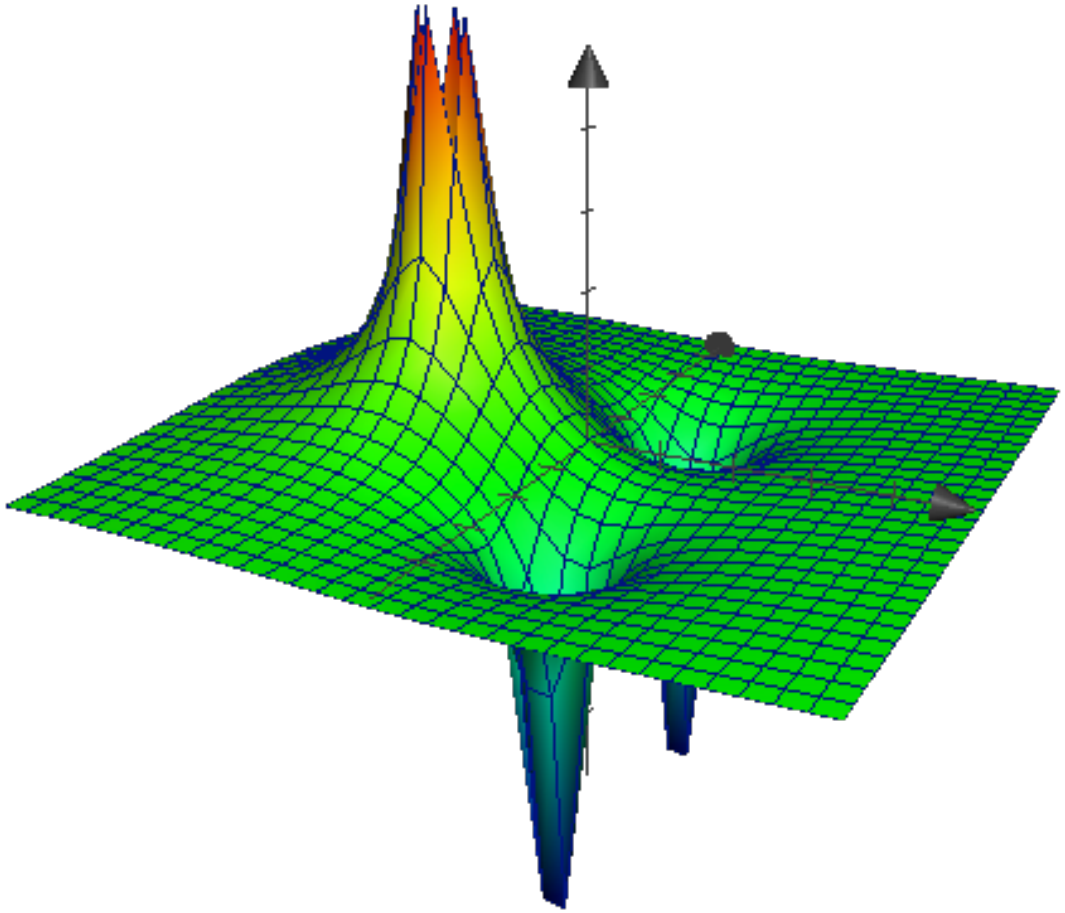
- If you know U, the force can be gotten from it via

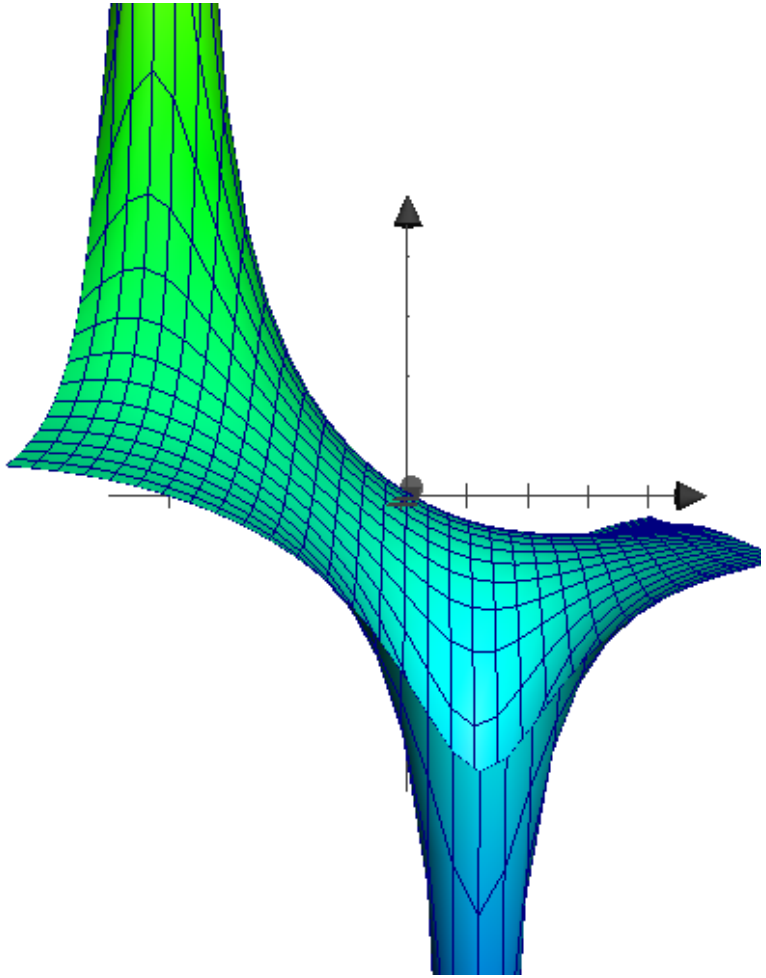
$$F_{\parallel}^{type} = -\frac{\Delta U_{type}}{\Delta r} = -\frac{dU_{type}}{dr}$$

- In more than 1D need to use the *gradient*

$$\vec{F}^{type} = -\left(\frac{\partial U_{type}}{\partial x}\hat{i} + \frac{\partial U_{type}}{\partial y}\hat{j} + \frac{\partial U_{type}}{\partial z}\hat{k}\right) = -\vec{\nabla} U_{type}$$

- The force always points down the PE hill.

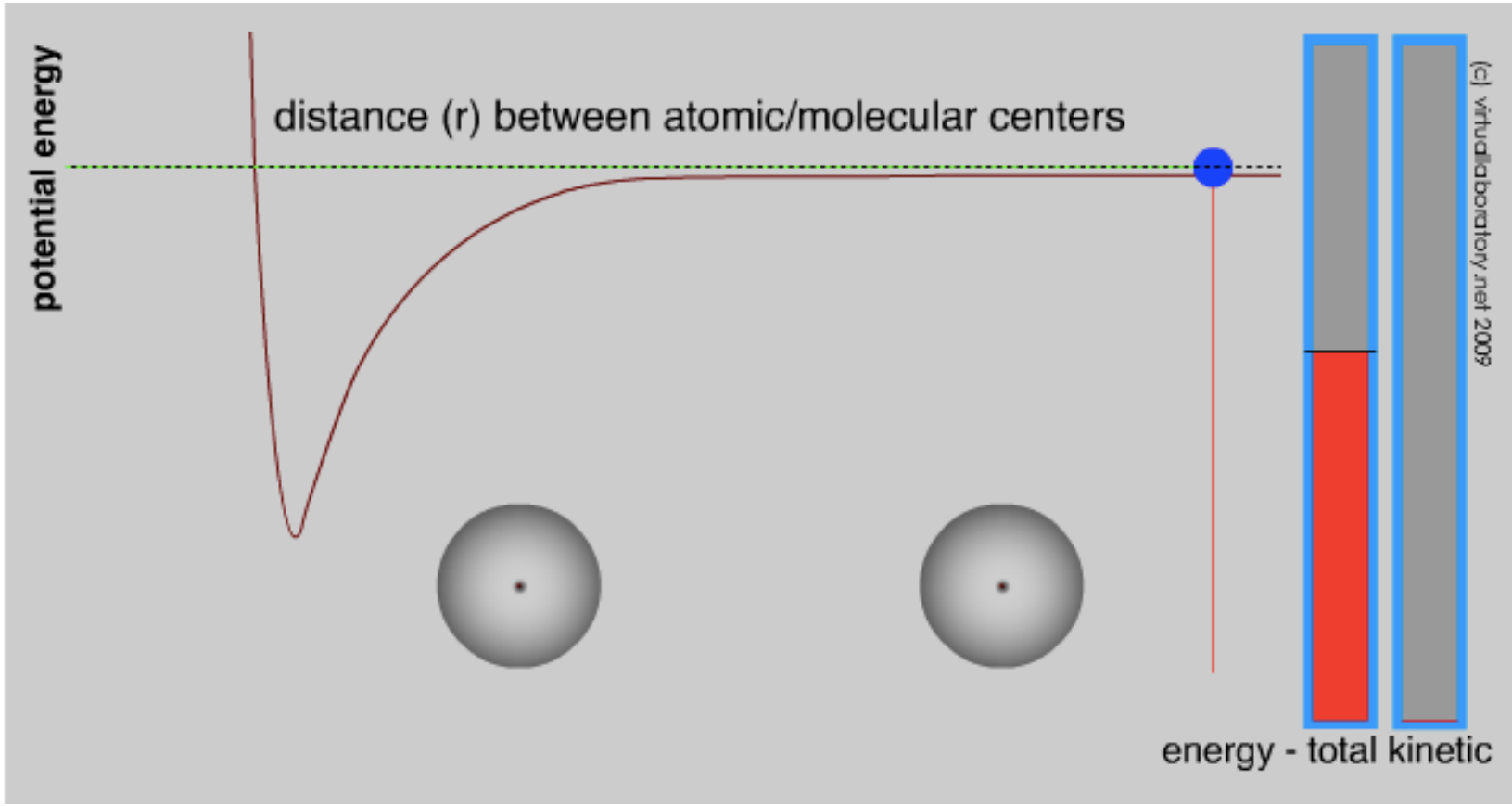




Moving to molecules

- Apply our Newtonian framework and results to atoms and molecules.
- See what goes over directly, what we have to add.
- Can we integrate what we know about atoms and molecules from chemistry with the physics we have learned?

Molecular forces



http://besocratic.colorado.edu/CLUE-Chemistry/activities/LondonDispersionForce/1.2-interactions-0.html

Foothold ideas: Bound states

- When two objects attract, they may form a *bound state* – that is, they may stick together.
- If you have to do positive work to pull them apart in order to get to a separated state with KE = 0, then the original state was in a state with negative energy.

What is the **velocity** and **force** at point A,B,C Consider both magnitude and direction! (Draw a diagram in your notes and put arrows to indicate the directions.)