Essential Question: "When can we ignore friction?"

Objectives:

- Students will understand that friction yields a transfer in energy from mechanical to another form (heat, sound.)
- Students will understand that when it appears that total mechanical energy decreases, the "missing" energy is often used to do work on friction. (Frictional forces transfer energy from one system to another)
- Students will be able to calculate the mechanical energy lossed to friction.
- Students will know how friction and thermal energy relate to energy conservation through the equation: $E_{total} = E_{Kin} + E_{Pot} + E_{Therm}$ (thermal energy lost to friction)
- Students will be able to identify situations when friction can and cannot be ignored, and justify their reasoning.

INTRO

Tell students to pull out a piece, let them groan that they think they will be taking notes. Then say "now prepare to throw it at me" "Ready, aim … FIRE!!" Pick up a couple of the papers wads and comment that they look much the same.

Tell students to take out another piece of paper, write an answer to the following question: "Why did you wad up your paper into a ball?"

Share with the person next to you

Discuss reasons for wadding as a class
Possible responses:
Air friction
Air resistance
Drag
Surface area
Easier to throw

Pick up two papers, say that we learned that everything falls at the same rate (according to Newton).
Drop papers while crumpled
Uncrumple one slightly and repeat
Uncrumple completely and repeat

Q: "was Newton wrong?"
Discuss.

Essential Question: "When can we ignore friction?" – write on board and leave it there.

LAB ACTIVITY- Modify Work and Energy Lab (UVA) (45 min)

Discussion - What's happening at the microscopic level? (20 min)
superballs on stiff springs model (get explanation from Heather)

Molecules are moving faster, how do we measure that? (temperature)
Revisit paper wads in light of this model.

Activity Stations- (20 min)
marble dropped in cylinders of different fluids (oil, water, air)
blocks with different surfaces sliding down ramps
Describe each station in terms of model above

Demonstration - Pendulum breaking egg (same as cinderblock pendulum but smaller scale)
Have students describe what happens in terms of energy

Assessment:(this needs more work)
Car going down a hill (PE) at the bottom of the hill the speed limit is ___, how much energy goes into heating the brakes.

You drop a ball from height y, it hits the ground with velocity v. Is mechanical energy conserved? If not describe the physics of what is going on.

Explain when you can ignore friction?