

PHY 101, Introduction to Physics is a survey of physics concepts, and with so much to cover there is always a time constraint limiting how deeply into any one topic we can go. Two factors of my guiding philosophy are: 1) to keep interest high since this will make it more likely students will want to delve deeper into these topics in the future, and 2) to give them the foundations of critical thinking, philosophy of science, and physics so they have some guiding principles to help figure out fact from fiction when they do come across new information. The former means I try not to shy away from the more exotic topics in physics, since those tend to be the most inspiring. Part of the latter means I try to put these topics into a hierarchy of important physics ideas so the students can make sense of them. These are both difficult to do, so I often change several things each semester. In this assessment, I will focus on a very recent change to how my students investigated internal energy.

In my Introduction to Physics class in spring 2016, I integrated a series of mini-lectures, hands-on activities, and conceptual questions for topics relating to internal energy into a single worksheet of questions that students complete as groups. I occasionally interrupted to have students discuss certain questions and so I could help motivate the answers to a few others. It seemed that students in past semesters were getting bored with perhaps the timing of or maybe the linear way we went through the series. Allowing students to work more at their own paces through this broad topic did seem to keep them significantly more engaged than in past semesters. I consider this a success since it fits the 1st factor in my guiding philosophy. Several other things have changed this semester, including the exams I use to assess this part of the course. I timed the exams differently; it is now somewhat integrated with electricity and magnetism. So, I am relying on my assessment of student engagement to tell me how successful this particular change has been. Since it kept students more engaged than past methods, I will continue to use and modify this activity for future semesters.

Details on the activity: I told my students they are individually responsible for knowing the material. So even if they divide-and-conquer, they need to discuss all of the problems to be sure they agree and understand them. Students worked at their own paces though I did intervene on two occasions (which I anticipated from common misconceptions on these questions). After students became acquainted with the activity and had made attempts to tackle various questions, I noticed they had all put an answer (some wrong) for the spacing between atoms in different states of matter. I led them in a short activity trying to compress air and water inside a plastic syringe with their finger over an open tip, and brought up the PhET Atomic Interactions simulation on the projector to get a better idea for this rough spacing in a liquid (it should much like a solid, while students usually draw it somewhere between a solid and a gas). At that time, I also told them of the thermometers they can use to measure the temperature of various objects in the room, including wood, metal, and their own skin. Finally, toward the end of the two days in class, I did notice students struggling with the concept of entropy, which is usually often defined on the Internet in a thermodynamic sense. I gave them a brief history, discussing how entropy has two formulations (thermodynamic and statistical) though we did not write down equations relating to either. The statistical viewpoint, once it is interpreted, does give a deeper and more intuitive understanding of entropy, so I phrased my questions on this topic in that light.