

COMPILATION: Unit 7 - what is work?

Date: Fri, 16 Mar 2001

From: John Barrer <forcejb@YAHOO.COM>

When Greg S. discussed the Arons-based "energy with less work" approach at Orlando in 1998, I thought it was a great way to approach the topic. I believe my students' conceptual understanding has benefited greatly from the focus on energy transfers into and out of a well-specified system as well as changes within that system. But recently there have been a couple of threads on the phys-l listserv that make me wonder if I've been creating future problems. Folks seem to be VERY firmly wedded to "work" as a "tangible something" rather than simply a process for energy exchange by "mechanical" means.

Date: Sat, 17 Mar 2001

From: Brenda Royce

When I was studying work and energy in my college classes, it always bugged me that energy was defined as 'the capacity to do work' and work was ... well, only described with equations, which made it hard to visualize the physical reality described by the term 'work' (and by extension, 'energy'). To make matters worse, the chapters in the texts often focused on the work, which seemed nebulous to me, as the first or central concept in the chapter (which I would now think of as a chapter on energy). I see the same unfocused concept in my students who have encountered 'work' in a prior class. When asked what work is, they will almost universally recite 'work equals force times distance', but cannot tell me what that means except as a calculation.

When I saw the material teaching work as a process of transferring energy, it was for me like having the fuzzy image from a projector snap into focus. It placed energy as the central concept (tho' the texts I've encountered probably meant for me to see it that way -- I hadn't been given a conceptual framework to see it clearly), and work now has conceptual meaning -- a transfer of energy. Even the role of force became clearer as the mechanism for the energy transfer. I don't have to teach specific situations and their accompanying equations; instead we can focus on analyzing the system for the relevant energy types involved and simply apply the principle of the conservation of energy to that situation. Add to that the use of area under the F-x graph as the starting place for calculating the amount of energy transferred in a process (work), we don't have to think differently about constant force and changing force situations. Furthermore, those students who go on to calculus based physics will have prior experience associating physical meaning with the integration process. My students are much clearer in their thinking (I'm sure in part because mine is clearer), and far better equipped to effectively handle a variety of situations than when I used a more traditional approach.

In response to John's concern about work as a 'tangible something', I see 'work' as a tangible 'process', instead of a 'something'. In my perception, it seems the 'somethingness' of work is

more an artifact of our language usage than physical reality. If this is setting up students for future difficulty, I'd also really like to know, because it did the opposite for me.