Teaching energy

Motivating the energy mouse

We have included an energy mouse with this edition of *Classroom Physics*. These toys are captivating as they zip across the desk. And they are an excellent way of initiating and illustrating discussions about energy, how it is stored and how it is dissipated.

How to tell the energy story

A good place to start is the act of pulling back. The pulled-back mouse is storing energy. It does so by virtue of a coiled, elastic spring that has become tighter. You might say: "the mouse is storing energy elastically".

But where and how was the energy stored before? The answer is that it was stored chemically in our bodies. Put simply, our bodies allowed glucose and oxygen to react so that our muscles could do some work in pulling the mouse back. The products of the reaction (carbon dioxide and water) store less energy than the reactants.

Choosing a start point before it is pulled back and an end point afterwards, we can say that the energy stored chemically has decreased and the energy stored elastically has increased. These changes have been brought about by mechanical working (figure 1).

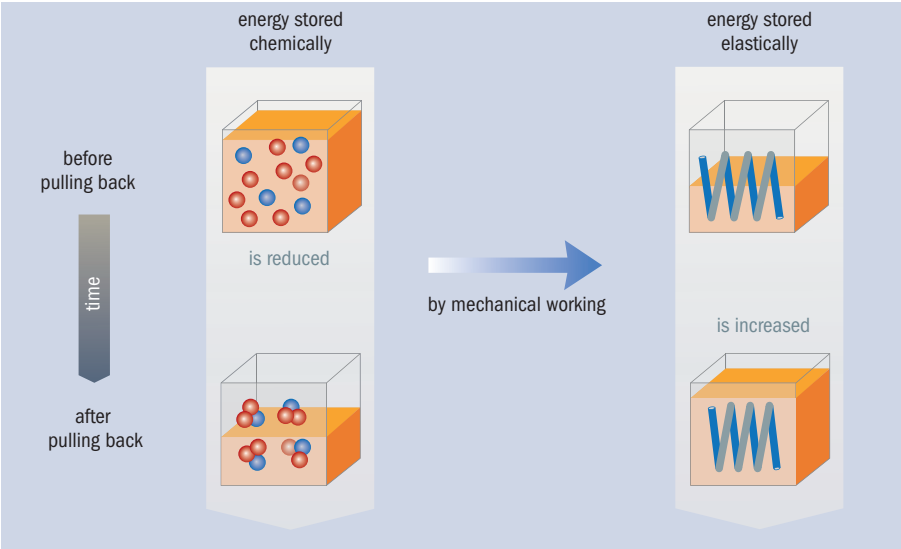

Figure 1. Illustrating the changes in the way energy is stored before and after pulling the mouse back.

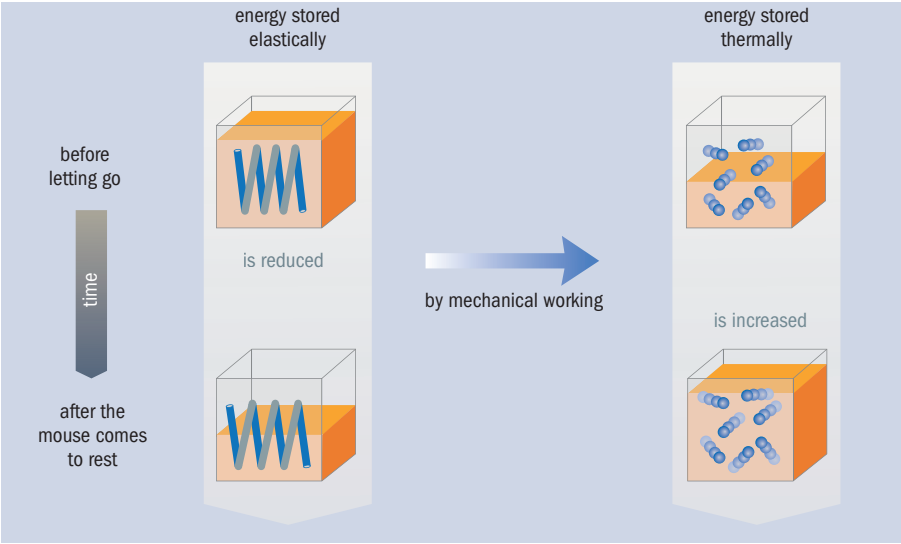

Figure 2. Illustrating how energy is dissipated in the mouse's sprint.

Choosing different start and end points

You (or your students) can choose the start and end points depending on the discussion you want to have or the analysis that you are curently doing.

For example, to start a discussion about dissipation, I suggest choosing a start point when the mouse is pulled back. The end point is when it comes to a stop having run its course. The amount of energy stored elastically has gone down (because the spring has uncoiled) and the amount of energy stored thermally (by the bearings and the surroundings) has increased. The process that led to the rise in temperature is mechanical working. This is illustrated in figure 2.

Mechanical working

It is always good to discuss the physical mechanisms by which the mouse accelerates, travels at a constant speed and slows down, all the while raising the temperature of its bearings and the surroundings. These processes are a really important part of the story, but they are separate from the energy analysis. For the whole process (pulling back, letting go and the mouse's sprint), the analysis is that the energy stored chemically is reduced and the energy stored thermally by the surroundings is increased.

Profound implications

This analysis is pleasingly simple. However, it highlights a profound and important point: the energy stored in a usable way (chemically) has decreased; it is now stored in a less usable way by a large mass whose temperature increased minutely. The total amount of energy is unchanged, but it has been dissipated. This would also be true for a bicycle ride, a car journey or an aeroplane flight.

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Above: An energy mouse. Left: A dissected mouse showing the coiled spring, which stores energy elastically.

The point is that journeys have a cost in terms of energy utility. To get benefit from the journey, we have reduced the usefulness of the Earth's energy stores. And we will never recover that usefulness – that is why there is currently an energy crisis.

For more information and ideas: visit www.talkphysics.org/mouse. If you post any nice ideas or pictures of uses, we will send you a dozen mice. Until they run out.