NSTA Press: Stop Faking It! Energy

Work, Energy, and Simple Machines

Dr. Bill Robertson

Tuesday, May 5, 2009
NSTA Web Seminar
Energy: Stop Faking It!

Bill Robertson
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Work, Energy, and Simple Machines
Which of the following describe what happens with the ruler?

<table>
<thead>
<tr>
<th>The harder it is to move the rock, the less your end of the ruler moves</th>
<th>The easier it is to move the rock, the less your end of the ruler moves</th>
<th>No matter how much your end of the ruler moves, the amount of force you have to apply doesn’t change</th>
</tr>
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</tbody>
</table>
Let’s Pause Two Minutes for Questions?
Work
Work = (net force) (distance object moves in the direction of the force)
Is this person doing work on the trash bag?

YES  NO
Work done on a system adds energy to the system.

Work done by a system subtracts energy from the system.
Before You Begin

Efficiency and Entropy A is a simulation that allows you to change the position of a pencil acting as the fulcrum of a lever. For each position of the pencil, the energy input and output will be revealed on the screen. What do you notice about these numbers?

Use the instructions tab to reveal the specific instructions to operate this interactive simulation.
Pencil Position
Before You Begin

Efficiency and Entropy B is a simulation that shows you situations with three different types (sizes) of gears. As you observe the gears in motion, the energy input and output for each situation will be revealed on the screen. What do you notice about these numbers?

Use the instructions tab to reveal the specific instructions to operate this simulation.
As long as we account for the work in, is our ruler system a closed system (no energy in or out)?

<table>
<thead>
<tr>
<th>Answer 1</th>
<th>Answer 2</th>
<th>Answer 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, because conservation of energy depends on having a closed system</td>
<td>No, there is no such thing as a closed system</td>
<td>Almost. There are always losses due to thermal energy, but those losses could be relatively small.</td>
</tr>
</tbody>
</table>
If we believe in conservation of energy, then the work you do on a system shows up as energy of the components or work done by the system.
Let’s Pause Two Minutes for Questions?
Work done on ruler

becomes

gravitational potential energy of rock

becomes

kinetic energy of ruler

becomes

thermal energy
If we ignore heat losses due to friction, then we can say that

Work done on the system = work done by the system

or

Work in = Work out
$F_1 d_1 = F_2 d_2$
Since $d_1$ is larger than $d_2$, what do we know about the forces?
\[ F_1 = F_2 \]

\[ F_1 > F_2 \]

\[ F_1 < F_2 \]
F_1 \cdot d_1 = F_2 \cdot d_2
$d_1$ is now smaller than $d_2$

How do $F_1$ and $F_2$ compare?
\[ F_1 = F_2 \]

\[ F_1 > F_2 \]

\[ F_1 < F_2 \]
F_1 \cdot d_1 = F_2 \cdot d_2
With simple machines, there is almost always a tradeoff between force and distance.
True or False? The $F_1 d_1 = F_2 d_2$ we just used is the same as the "law of the lever."

<table>
<thead>
<tr>
<th>True</th>
<th>False</th>
</tr>
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</table>
You push down on a lever, moving your end four times as far as the end with the rock moves. How does the force exerted on the rock compare to the force you exert?

<table>
<thead>
<tr>
<th>They’re the same.</th>
<th>The force you exert is four times the force exerted on the rock.</th>
<th>The force you exert is one fourth the force exerted on the rock.</th>
</tr>
</thead>
</table>
Let’s Pause Two Minutes for Questions?
Pulleys
How does your pull in the previous slide compare to the force exerted on the washer?

<table>
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<tr>
<th>The same</th>
<th>Twice as large</th>
<th>Half as large</th>
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The force you exert is the same as the force exerted on the weight.
Sometimes all a simple machine does is change the direction of the force you exert.
How does your pull in the previous slide compare to the force exerted on the washer?

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Small input force

Large output force

"Not now, Marge! Just tell me when the tire is off the ground."
Your kinetic energy is getting weak. You can't resist my magnetism.
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  - High School
  - College

- Select your state to begin: Choose a state

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Al Byers, Assistant Executive Director e-Learning

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