

Work and Kinetic Energy

Purpose: To analyze situations involving work and relate the amount of work done by that force to the kinetic energy change.

Getting Ready: Navigate to the **Kinetic Energy Simulation** found in the **Physics Interactives** section at **The Physics Classroom**.

<https://www.physicsclassroom.com/Physics-Interactives/Work-and-Energy/Work-and-Kinetic-Energy>

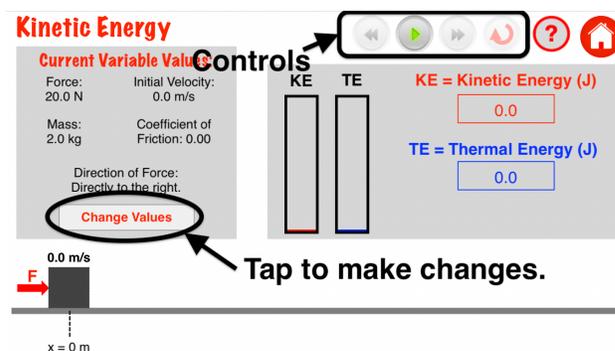
Navigation:

www.physicsclassroom.com => Physics Interactives => Work and Energy => Work and Kinetic Energy

Getting Acquainted/Play:

This interactive has multiple parts – **Put On The Force**, **Another Angle on Force**, and **Putting On The Brakes**. You will use all three parts. Tapping on any of the options will open a simulation window looking like that at the right. Observe the **control panel** in the top right for controlling the simulation (Play | Pause | Forward | Back | Reset).

Also observe the grey box on the left that lists current values of the five variables that can be changed. Observe the **Change Values** button; it can be used to change the values of the variables. Tapping on the Home button (top right) will return you to the Main Menu screen with the three options. Spend some time familiarizing yourself with the interface. Change some input parameters, play the animation, and observe the output displays. Notice that three additional features appear once a simulation has completed – a **KE vs. v Graph** button, a button for viewing a **Two-State Bar Chart**, and a *Scrubber* (at bottom) that allows you to step forward and backward through the most recent simulation. Once you're acquainted with *finding your way around*, continue with the directions.



Part 1: Put On The Force ... No Friction; Initial Velocity = 0 m/s

- From the Main Menu, tap on the **Put On The Force** option. Run three trials with any Force and Mass values you wish. For each trial, record the final kinetic energy, the Work done by the force (found on the **Two-State Bar Chart**), and the distance over which the force acts. Tap on the **Change Values** button to change the values of the input parameters. Keep the coefficient of friction set to 0.00 and the initial velocity set to 0.0 m/s. Record all values and complete the table below. In the last column, calculate the product of force and distance.

Part 1: Put On The Force ... No Friction; Initial Velocity = 0 m/s

Force (N)	Mass (kg)	KE _{init} (J)	KE _{fin} (J)	Work (J)	x _{fin} or d (m)	F•d
		0				
		0				
		0				

- What is the relationship between Work and the final Kinetic Energy?

3. What is the relationship between value of the force, the distance over which the force acts, and the work done on the object?

Part 2: Put On The Force ... No Friction; Varying Initial Velocity

4. Repeat an investigation similar to Part 1, but this time keep the force and the mass the same from trial to trial and vary the initial velocity. Conduct three trials. Record the data in the table.

Part 2: Put On The Force ... No Friction; Varying Initial Velocity

v_{initial} (m/s)	KE_{initial} (J)	KE_{final} (J)	Work (J)

5. What is the relationship between Work, the initial Kinetic Energy, and the final Kinetic Energy? Make a claim and support it with evidence and reasoning. Use some data and calculations as part of your support.

Part 3: Putting On The Brakes ... No Friction; Varying Initial Velocity

6. Return to the Main Menu (using the Home button). Tap on the third option – Putting On the Brakes. Now the force will be against the motion. Run four trials with varying initial velocity but the same Force and Mass. Collect data for the Initial Kinetic Energy, the Final Kinetic Energy, and the Work Done. If needed, use the *scrubber* to navigate to the beginning of the simulation to retrieve the initial kinetic energy.

Part 3: Putting On The Brakes ... No Friction; Varying Initial Velocity

v_{initial} (m/s)	KE_{initial} (J)	KE_{final} (J)	Work (J)

- Review your claim made in Question #5. Revise it here so that it is consistent with the Part 3 data. Support your claim by referencing specific data in the above table and explaining how the data supports your claim.

Part 4: Put On The Force ... With Friction; Varying Initial Velocity

- Return to the Main Menu (using the Home button). Return to the first option – Putting On The Force. Now we will consider the effects of friction. Run four trials with varying friction, varying force, varying initial velocity and a constant mass. Record your data in the Part 4 table.

Part 4: Put On The Force ... With Friction; Varying Initial Velocity

Force (N)	Mass (kg)	v_{init} (m/s)	μ	KE_{init} (J)	KE_{fin} (J)	Work (J)	TE (J)

- The presence of friction introduces a new term – **thermal energy**. Surfaces heat up as they rub across each other and the heating results in the production of thermal energy. Analyze your data and make a claim in the form of an equation with symbols that express the relationship between the last four columns.

Equation (claim): _____

Support your claim with evidence and reasoning. Use some data and calculations as part of your support.

Part 5: Another Angle On Force ... No Friction; No Initial Velocity

10. Return to the Main Menu (using the Home button) and navigate to the second activity – Another Angle on Force. Now we will consider situations in which the force is at angles to the horizontal. Run four trials with no friction and no initial velocity. Collect some data in order to make a claim that describes the relationship between the angle and the work, force, and distance. The last column is left blank; you can use it to perform calculations as needed.

Part 5: Another Angle On Force ... No Friction; No Initial Velocity

Force (N)	Angle (°)	KE _{init} (J)	KE _{fin} (J)	Work (J)	x _{fin} or d (m)	
		0				
		0				
		0				

11. What is the relationship between Work, Force, Distance, and Angle? Make a claim and support it with evidence and reasoning. Use some data and calculations as part of your support.

12. Write a short paragraph in which you summarize your findings from this activity.