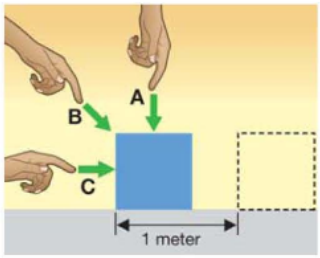
2. Copy the table below onto a piece of paper. Then, use the graphic to fill it in. In the Work Done? column, write *yes*, *no*, or *some*. In the Motion of the Block column, describe how the block would move under each force.



Force	Work Done?	Motion of the Block
A		
B		
C		

3. It's moving day and you need to move boxes and furniture from your old second-floor apartment on Main Street to your new fifth-floor apartment on Harmony Street. You have to take the stairs to move your furniture from the old apartment. But, you can use the elevator to get up to your new apartment on the fifth floor.
   a. Describe one way in which your muscles DO do work while moving your boxes and furniture down from the second floor.
   b. Describe one way in which your muscles DON'T do work while moving your boxes and furniture down from the second floor.
   c. Does the elevator do work moving your boxes and furniture up to the fifth-floor apartment?
   d. Which involves more work in the scientific sense: moving the boxes and furniture down from the second floor or up to the fifth floor? Explain your reasoning.
   e. You take one box up to the fifth floor by taking the stairs. If the elevator had taken the same box up to the fifth floor, would it have done more, less, or the same amount of work as you? Explain your reasoning.
4. Name two simple machines that are found on a bicycle.
5. How does the mechanical advantage of a second-class lever compare to the mechanical advantage of a third-class lever?

Section 7.2

6. Identify at least one way that energy is involved in the following situations.
   a. A wave at the ocean knocks over a sand castle.
   b. Your houseplant grows better when it is placed in sunlight.
   c. When you drop a plate, it breaks into pieces.
   d. Your hair dryer works when you plug it in to an electrical outlet.
7. Copy the following table onto a piece of paper and fill it in based on your understanding of potential and kinetic energy.

	Potential Energy	Kinetic Energy
Formula		
What happens to energy when the mass of an object increases?		
What happens when the object is lifted to a higher height (without a change in speed)?		
What happens when the speed of an object increases (without a change in height)?		

8. A roller coaster track is a good example of the law of conservation of energy. Use this law to explain these facts about a roller coaster track.
   a. The largest hill for a roller coaster track is the first hill on the track. The hills after the first are smaller.
   b. To get to the top of the first (highest) hill, a motor pulls the cars up to the top. After the top of the first hill a motor is not needed to keep the cars going.
   c. The roller coaster cars move really fast at the bottom of a hill on the track but slow down as they move up a hill (not including the first hill).

Section 7.3

9. Your lab partner shows you results from an experiment with a simple machine. The output work is 10 joules and the input work is 8 joules. She asks, "Does this data look correct?" What would be your response and why?
10. Mikhail lifts a 500-newton weight 2 meters in 2 seconds. Tobias lifts the same 500-newton weight 2 meters in 4 seconds.
    a. Which boy does more work?
    b. Which boy uses greater power?
    c. The human body is only 8 percent efficient. To obtain the amount of work accomplished by Mikhail or Tobias, how much input work was required?

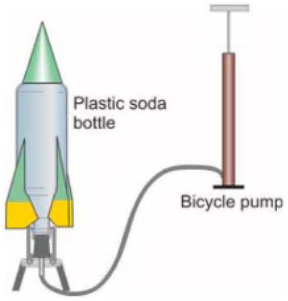
Problems

Section 7.1

1. Sara's mother gets a flat tire on her car while driving Sara to school. They use a jack to change the tire. It exerts a force of 5,000 newtons to lift the car 0.25 meters. How much work is done by the jack?
2. How far does Isabella lift a 50-newton box if she does 40 joules of work lifting the box from the floor to a shelf?
3. A lever has an input arm that is 2 meters and an output arm that is 3 meters. What is the mechanical advantage? Does this lever multiply force? Why or why not?

Section 7.2

4. A bottle rocket is a toy that is made from an empty soda bottle. A bicycle pump is used to pump air into the bottle. The rocket shoots upward when it is released from the launcher, allowing the high-pressure air to come out.



   a. Work is done as the pump is pushed, forcing air into the bottle. What happens to this work? Does it just disappear?
   b. Suppose a person does 2,000 joules of work using the pump. What is the maximum kinetic energy the rocket can have after it is launched?
   c. Do you think the rocket could actually have this much kinetic energy? Explain why or why not.
5. What is the minimum energy required to lift an object weighing 200 newtons to a height of 20 meters?
6. If 300 joules of energy are used to push an object with a force of 75 newtons, what is the maximum distance the object can move?
7. Calculate the potential energy of a bird sitting on a tree limb. The mass of the bird is 0.1 kilogram and it is 5 meters off the ground.

Section 7.3

8. A machine is used to lift an object a distance of 2 meters. If the power of the machine is increased, what happens to the time it takes for the object to be lifted 2 meters?
9. During construction, a crane lifts a 2,000-newton weight to the top of a 50-meter-tall building. How much power must the crane have to perform this task in 5 seconds? Give your answer in watts, kilowatts, and horsepower.
10. What is the minimum time needed to lift a 1,000-newton weight 20 meters using a motor with a maximum power rating of 8,000 watts?

Applying Your Knowledge

Section 7.1

1. Spend one day recording a variety of tasks that you do that involve doing work in the scientific sense. Also record the machines that allow you to do certain tasks. Then, spend the next day doing one or two of these tasks without using the machine. Answer the following questions.
   a. Was more or less work done using the machine? How do you know?
   b. Was the power output more or less with the machine? How do you know?
   c. What are your thoughts about using machines to accomplish work?
2. Does mechanical advantage have units? Why or why not?

Section 7.2

3. Solar energy and hydroelectric energy are important sources of energy. Find out more about either one of these forms of energy. What's being done to make it a more efficient source of energy, and where is it being used in the United States?
4. Nuclear energy is a controversial energy resource. Find out why. List two pros and two cons for this form of energy.
5. Here is some data for kinetic energy versus speed for a moving object. Make a graph of this data and answer the following questions. Place kinetic energy on the *y*-axis and speed on the *x*-axis.

Speed (m/s)	Kinetic Energy (J)
12	720
24	2,880
48	11,520
60	18,000

   a. What is the mass of the object represented by this data?
   b. Use your graph to find the kinetic energy at 30 m/s. Then use the kinetic energy formula to check yourself.
   c. Should the relationship between kinetic energy and speed be described as *linear* or *exponential*? Explain your answer.
6. A water-powered turbine makes electricity using the energy of falling water. At the location of one turbine, 100 kilograms of water fall every second from a height of 20 meters.
   a. How much potential energy does 100 kilograms of water have at a height of 20 meters?
   b. How much power in watts could you get out of the turbine if it was perfectly efficient?
   c. Research the efficiency of modern water-powered turbines. How efficient are these devices?