

### Period 9 Activity Sheet: Power

**Activity 9.1: How Much Power Do Appliances Require?**

- a) **Light Bulbs:** Connect the small hand-cranked generator to the 4-bulb tray.  
 Compare how easily the crank turns when 0, 1, 2, 3, and 4 bulbs are lit. When is the crank easiest to turn and when is it most difficult to turn?
- b) **Appliances:** Use a wattmeter to measure the power requirements of the light bulb, the hair dryer on low and high settings, the toaster, and mixer. Record your measurements and compare them to the power requirements (the wattage) listed on the appliances.

Appliance	Power Measurement	Appliance Wattage
Light Bulb		
Hair dryer (high)		
Hair dryer (low)		(no wattage rating is given)
Toaster		
Mixer		

- c) **Electric Drill:**
- 1) Measure the power requirement of the drill. \_\_\_\_\_
  - 2) Measure again while squeezing the drill bit with the hand clamp. \_\_\_\_\_
  - 3) Explain any difference in power requirements.

**Activity 9.2: How Much Power Do You Use for Daily Activities?**

- a) **The Stairs:** Using the classroom stairs, a timer, a meter stick, and the scale, find the power a member of your group requires to climb the stairs.
- 1) Measure the person's weight in newtons ( 1 lb = 4.45 newtons). \_\_\_\_\_
  - 2) Measure the height of the stairs in meters (1 ft = 0.305 m). \_\_\_\_\_
  - 3) Measure the time in seconds needed to climb the stairs. \_\_\_\_\_
  - 4) Calculate the person's gain in potential energy from climbing the stairs.  
 \_\_\_\_\_

### Activity 9.2, Continued: How Much Power Do You Use for Daily Activities?

- 5) How much work was done against the force of gravity to climb the stairs? \_\_\_\_\_
  - 6) How much power was required when doing this work? \_\_\_\_\_
  - 7) Is the total power the person produced while climbing the stairs more, less, or equal to this amount? Explain your answer.
  - 8) Suppose a student weighing 160 pounds climbs a stairway with a vertical height of 4 feet in 2 seconds. How many horsepower are required? (Hint: 1 hp = 550 ft-lbs/s)  
\_\_\_\_\_
- b) **The Bike:** Using the exercise bike connected to several 50 watt bulbs and a timer, find how much energy is required to light the bulbs.
- 1) How many bulbs were lit? \_\_\_\_\_ How many watts is this? \_\_\_\_\_
  - 2) How long were the bulbs lit? \_\_\_\_\_
  - 3) How much energy did this require?  
\_\_\_\_\_
  - 4) Was the total energy you expended pedaling the bike the same, more, or less than the energy needed to light the bulbs? Explain your answer.

### Activity 9.3: How Much Does Electricity Cost?

#### a) Measuring Electricity - Reading a Kilowatt-hour Meter

- 1) Plug a hair dryer into the kilowatt-hour meter and describe what happens to the meter when the dryer is set on "low."
- 2) What happens when the dryer is changed to "high"?
- 3) How many kilowatt-hours does the dial on the kilowatt-hour meter read? \_\_\_\_\_

#### b) Calculating the Cost of Electricity - Your Electric Bill

- 1) Examine an electric bill. How many kilowatt-hours of electricity were used? \_\_\_\_\_
- 2) What was the total cost of the electricity used? \_\_\_\_\_
- 3) Calculate the cost of electricity used per kilowatt-hour  
\_\_\_\_\_

c) **Conserving Electricity**

Your instructor will demonstrate a compact fluorescent and an incandescent bulb. Compare the brightness of the bulbs.

1) How many watts of power does each bulb use?

Compact fluorescent \_\_\_\_\_ Incandescent \_\_\_\_\_

2) If electricity costs \$0.10 per kilowatt-hour, how much money per hour does the compact fluorescent bulb save compared to the incandescent bulb?

\_\_\_\_\_

3) Explain why the compact fluorescent requires less energy to produce the same amount of light.

d) **Payback Time**

Your instructor will demonstrate a model windmill electric generator used to light 4 bulbs.

1) How many watts of power does the windmill produce when a fan blows onto its blades? (Assume that each of the 4 bulbs requires 62 milliwatts of power.)

\_\_\_\_\_

2) If a real windmill could generate an average of 2,500 times this much power, how many kilowatt-hours of energy could a windmill in continuous operation generate each year?

\_\_\_\_\_

3) Suppose that you have been given the choice of purchasing electricity for \$0.12 per kilowatt-hour or generating your own electricity using a windmill. The windmill costs \$3,000 to purchase and \$200 per year for upkeep.

a) If you use 5,000 kWh of electricity per year, how much money could you save in 10 years by using the windmill as your only source of electric power?

\_\_\_\_\_

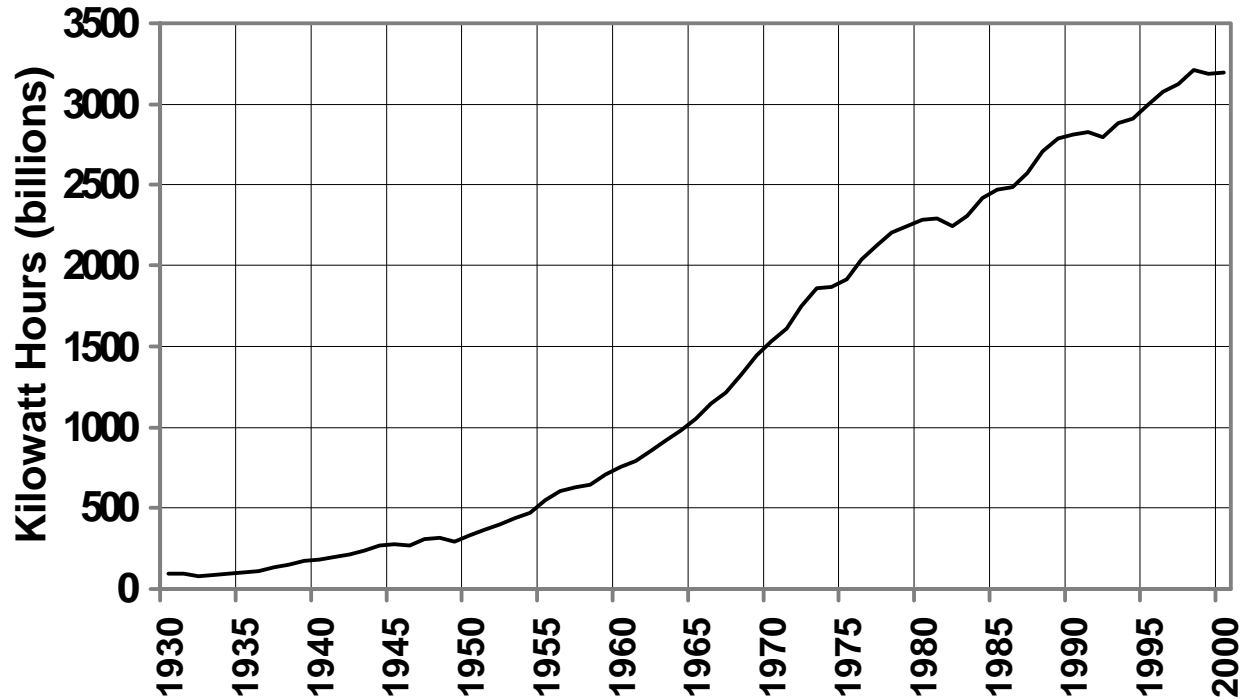
b) Is the payback time for the windmill more or less than 10 years? \_\_\_\_\_

e) **Group Discussion Question:** You have just moved into an apartment and must decide which electric appliances to purchase. Your apartment is not air conditioned and you hear that the furnace is not very warm in winter. You are on a budget and can spend no more than \$1,000 per year for electricity. Using the cost estimates in Table 9.2 in your textbook, decide which appliances you will use.

### Activity 9.4: What Is the Difference between Linear and Exponential Growth?

Your instructor will discuss linear and exponential growth. The figure below illustrates this growth with a graph of the increase in electricity production in the U.S. between 1930 and 2000.

Figure 1: Electricity Production in the U.S.



- a) Identify the time periods during which the rate of increase in electricity production was approximately linear.
- b) Explain how you determined that this growth was linear.
- c) Identify the time periods during which the rate of increase in electricity production was approximately exponential.
- d) Explain how you determined that this growth was exponential.
- e) What is the doubling time of the exponential growth periods? \_\_\_\_\_