Your ECOLOGICAL *footprint*

Tracing Your Energy Flows and Changes in Weight

Over the last decade U.S. citizens have become increasingly concerned about their weight. The fraction of the U.S. population that is classified as overweight or obese has increased. These terms are defined relative to an index that accounts for both weight and height called *body mass index* (BMI—a person's body weight in kilograms divided by the square of his or her height in meters). Individuals with a BMI of 25–29.9 are considered overweight; people with a BMI of 30 or greater are considered obese.

There are many hypotheses about the general increase in weight. Some argue about the role of advertising; others say that a sedentary lifestyle is responsible. Whatever the ultimate cause, we can see the immediate cause by tracing the intake and use of energy.

The minimum amount of energy required by a resting human is described by *basal metabolic rate*—the energy used for maintenance. Basal metabolic rate varies by gender, weight, and age. You can calculate your basal metabolic rate using one of the following equations:

$$\text{Male basal metabolic rate} = 66.5 + 13.75 \times (wt) + 5.003 \times (ht) - 6.775 \times (age) \quad (1)$$

$$\text{Female basal metabolic rate} = 655.1 + 9.563 \times (wt) + 1.85 \times (ht) - 4.676 \times (age) \quad (2)$$

Here *wt* is your weight (kilograms), *ht* is your height (centimeters), and *age* is your age in years. These equations were developed by Harris and Benedict in 1919 and measure the kilocalories used per day. Despite their age, the equations still are considered accurate.

Humans are endotherms, so basal metabolic rate also depends on environmental temperature. Scientists find that the human body uses the least energy for thermoregulation (regulating body temperature) at about 26°C (78.8°F). Temperatures above or below that minimum increase energy use through sweating or shivering, respectively.

In addition to general body shape, energy requirements are determined by other uses. A pregnant woman uses about 10 percent more energy than her nonpregnant counterpart. A person fighting an infection with a fever uses more energy than when healthy. Furthermore, not all weight is equal. In general, a kilogram of muscle burns more energy than a kilogram of fat. So all else being equal, a person who uses a lot of energy for storage burns energy more slowly (per unit body weight).

Most people are not at rest all day. Exercise increases the amount of energy used by the body. The more vigorous the exercise, the more energy is required. Table 1 lists the energy burned to sustain a half hour of various activities. The energy cost of these activities varies by height, weight, and gender, but adding this information would greatly increase the complexity of the calculation.

TABLE 1 Energy Cost of Everyday Activities

Activity	Kcal per 30 Minutes of Activity
Walking (3 mph)	113
Climbing stairs	308
Bowling	103
Basketball	274
Aerobics class (high impact)	240
Home activities (light tasks)	86
Home activities (moderate tasks)	120
Home activities (vigorous tasks)	137
Lawn mowing (riding)	86
Lawn mowing (power)	188
Lawn mowing (push)	206
Ping-Pong	137
Mopping	120
Running (8-minute miles)	440
Bicycling	211

Calculating Your Footprint

You can use the information given to approximate your daily change in weight. Use the equations in this box to calculate your basal metabolic rate. Increase this total by the amount of energy you use for the activities described in Table 1. Next determine your energy intake: Use Table 2 to link the foods you eat to their kilocalorie equivalent. Remember to correct your energy intake for the fraction of energy that is lost as feces (see Figure 5.4).

Use the following equations to calculate your energy consumption. (You may have to change units because most food categories have more than one food type.) If you can't find a food item in Table 2, many food containers show the energy content of the food inside.

TABLE 2 Energy Content for Selected Food Types

Food Item	Energy Content	Food Item	Energy Content
Beverages		Milk products and eggs	
Beer	141 kcal/12 oz	Whole milk	208 kcal/cup
Wine	74 kcal/3.5 fl oz	Semiskim milk	179 kcal/cup
Coffee	15.8 kcal/6 oz	Cheese	114 kcal/oz
Tea	2 kcal/fl oz	Eggs	75 kcal/egg
Fats		Cereals, sugar, potatoes, vegetables, and fruits	
Fat for frying	124 kcal/teaspoon	Flour	419 kcal/cup
Margarine	815 kcal/stick	Sugar	774 kcal/cup
Meat		Potato	220 kcal/potato
Beef	218 kcal/3 oz	Vegetables (average)	50–80 kcal/100 grams
Pork	204 kcal/3 oz	Fruits	35–120 kcal/100 grams
Minced meat	86 kcal/slice		
Sausage	144 kcal/link		

_____ kcal (beverages) = _____ oz/day × _____ kcal/oz

_____ kcal (fats) = _____ teaspoon/day × 124 kcal/teaspoon

_____ kcal (margarine) = _____ stick/day × 815 kcal/stick

_____ kcal (meat) = _____ oz/day × _____ kcal/oz

_____ kcal (dairy and eggs) = _____ cups/day × _____ kcal/cup

_____ kcal (plant material) = _____ gram/day × _____ kcal/day

Total Energy Intake _____ kcal

Energy used = Basal metabolic rate [from Equation 1 or 2] + energy used in everyday activities [from Table 1]

Interpreting Your Footprint

Your change in weight can be calculated as the difference between your energy intake and your use of energy (1 kg of body weight is equal to about 7,700 kcal).

_____ Weight change kg/day = (_____ kcal eaten – _____ kcal used)/7,700 kcal/kg

These numbers vary but will be similar from day to day, so multiply the difference by 7 to determine your weekly balance. If you take in more energy than you consume, a positive number indicates that you will gain weight. Conversely, if you take in less energy than you use, a negative number indicates that you will lose weight. Use the number calculated to determine whether you are gaining weight, losing weight, or remaining at about the same weight.

If you are gaining weight, determine the weekly reduction in food intake that would balance your energy intake and energy use. If you don't like dieting, determine the increase in weekly activity that would raise your energy use to the point at which it equals your energy intake.

STUDENT LEARNING OUTCOME

- Students will be able to describe some of the reasons that obesity is becoming more common in the United States and what can be done to reverse this trend.