Why We Need to Eat

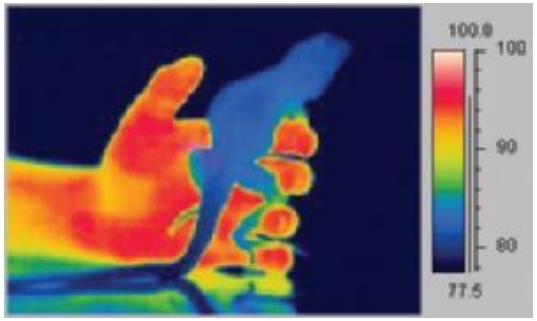
Does what we eat matter?

Food for Growth and Maintenance

- Nutrients are the chemicals that an organism needs in order to grow, build, and repair tissues, and to produce energy.
- The nutrients that are important for keeping our bodies healthy are carbohydrates, proteins, lipids (fats), water, minerals, and vitamins.

Food for Energy

- All animals lose thermal energy, some more than others.
- Note that the reptile is much cooler than the human.
- Why?



Here's why…

- The chemical energy produced by plants (in the form of carbohydrates) is transferred to herbivores and omnivores.
- In endothermic (warm-blooded) animals, some of this chemical energy is used to maintain a fairly constant body temperature. Because our body temperature is normally higher than our surroundings, some thermal energy is lost to the environment.

Factors That Affect Energy Requirements

EXOTHERMIC or ENDOTHERMIC

This frog can survive for weeks on one good meal.

This shrew must consume a large amount of food every day.

Factors That Affect Energy Requirements

BODY SIZE

- Larger animals generally eat more than smaller ones. But small endothermic animals need to eat more for their size than large endothermic animals.
- For example, a 5000 kg elephant might eat 250 kg of food a day - 5 % of its body mass. A 5 g shrew might have to eat 4 g of food a day - 80 % of its body mass!

Factors That Affect Energy Requirements

METABOLIC RATE

- Metabolic rate - the rate at which the body converts stored energy into working energy
- Metabolism - the set of chemical reactions that occur in living organisms that are necessary to maintain life
- Catabolism - the metabolic reactions that break down larger molecules into smaller subunits
- Anabolism - the metabolic reactions that use energy to produce larger molecules from smaller subunits

Factors That Affect Energy Requirements

Metabolic rate depends on a number of factors:

- Body size: The larger the body, the more energy is required to stay alive.
- Physical activity: Muscle burns more energy than fat, so physical activity requires more energy.
- Sex: Males are typically larger in size and have a greater proportion of muscle mass than females of the same size, age, and fitness level.
- Age: Metabolic rate decreases with age (in part due to decreased physical activity and the loss of muscle mass).
- Hereditary factors: Some individuals have a naturally high metabolic rate. In these individuals, the chemical energy obtained from food is very quickly converted into other forms of energy.

Measuring Energy and BMR

- Energy is measured using an SI unit: the joule (J). Joules are small, so we use the kilojoule (kJ) to refer to the energy requirements of people or the energy stored in foods (1 kJ = 1000 J).
- Another unit is also used - a calorie (small c) is the amount of energy required to raise the temperature of 1 g of water by 1 °C. When referring to food energy, Calorie (big C) is used. One Calorie really means 1 kilocalorie, which is equal to 1000 calories, or 4180 J.
- The rate at which energy is used by an organism when it is at rest is referred to as the basal metabolic rate (BMR).
- The BMR is estimated using a calculation that takes into account four variables: height, weight, age, and sex.
- Males tend to have a higher BMR than females by about 10 %. Energy requirements also depend on activity level.

Gravy

Nutrition Facts

Serving Size 1 cup (238.0 g)

Amount Per Serving

Calories 188	Calories from Fat 122
	% Daily Value*
Total Fat 13.6g	**21%**
Saturated Fat 3.4g	**17%**
Polyunsaturated Fat 3.6g	
Monounsaturated Fat 6.1g	
Cholesterol 5mg	**2%**
Sodium 1373mg	**57%**
Total Carbohydrates 12.9g	**4%**
Dietary Fiber 1.0g	**4%**
Sugars 1.9g	
Protein 4.6g	

Vitamin A 0% • Vitamin C 0%
Calcium 5% • Iron 6%

* Based on a 2000 calorie diet

Cheese curds

Nutrition Facts

Serving Size 1 cup, small curd (not packed) (225g)

Amount Per Serving

Calories 232	Calories from Fat 91
	% Daily Value*
Total Fat 10.1g	**16%**
Saturated Fat 6.4g	**32%**
Polyunsaturated Fat 0.3g	
Monounsaturated Fat 2.9g	
Cholesterol 33.8mg	**11%**
Sodium 911.3mg	**38%**
Potassium 189mg	**5%**
Total Carbohydrate 6g	**2%**
Dietary Fiber 0g	**0%**
Sugars 0.7g	**0%**
Protein 28.1g	**53%**

Vitamin A 7% • Vitamin C 0%
Calcium 14% • Iron 2%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Potassium		2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Fries

Nutrition Facts

Serving Size 1 large (169.0 g)

Amount Per Serving

Calories 539	Calories from Fat 259
	% Daily Value*
Total Fat 28.8g	**44%**
Saturated Fat 6.7g	**34%**
Trans Fat 7.4g	
Polyunsaturated Fat 5.1g	
Monounsaturated Fat 16.7g	
Cholesterol 0mg	**0%**
Sodium 328mg	**14%**
Total Carbohydrates 63.4g	**21%**
Dietary Fiber 5.9g	**24%**
Sugars 1.2g	
Protein 6.4g	

Vitamin A 0% • Vitamin C 8%
Calcium 2% • Iron 13%

* Based on a 2000 calorie diet

How Much Energy Do You Need?

Mini Investigation

How Much Energy Do You Need?

Skills: Observing, Analyzing

SKILLS HANDBOOK A2.1, A6.2

In 1918, J. Arthur Harris and Francis G. Benedict, nutrition researchers at the Nutrition Laboratory of the Carnegie Institute of Washington, published a paper based on their study of basal metabolism. The data from their research allowed them to derive a formula that is still the most commonly used method of estimating basal metabolic rate and energy expenditure.

Your BMR is unique to you. It depends on your sex, size (height and mass), and age. The Harris–Benedict formulas for estimating your BMR are as follows:

female

$$\text{BMR} = [655 + (9.6 \times \text{mass in kilograms}) + (1.8 \times \text{height in centimetres}) - (4.7 \times \text{age in years})] \times 4.18$$

male

$$\text{BMR} = [66 + (13.7 \times \text{mass in kilograms}) + (5.0 \times \text{height in centimetres}) - (6.8 \times \text{age in years})] \times 4.18$$

Example:

Tom is a 16-year-old student who is 175 cm tall with a mass of 75 kg. Estimate his BMR.

Solution:

Use the formula for males and substitute the values as follows:

$$\text{BMR} = [66 + (13.7 \times 75) + (5.0 \times 175) - (6.8 \times 16)] \times 4.18$$

$$\text{BMR} = 7773.5 \text{ rounded to } 7800 \text{ kJ}$$

The Harris–Benedict formula uses the following activity factors in conjunction with the BMR to estimate the average individual daily energy requirement.

- little or no exercise — BMR × 1.2
- light exercise or sports 1–3 days/week — BMR × 1.375
- moderate exercise or sports 3–5 days/week — BMR × 1.55
- vigorous exercise or sports 6–7 days/week — BMR × 1.725
- very hard exercise daily or sports & physical job or 2 × training daily — BMR × 1.9

For example, Tom is a fairly active student who plays sports most weekdays. Therefore his average daily energy requirement will be 7800 kJ × 1.55 = 12 090 kJ rounded to 12 000 kJ.

1. Use the appropriate formula to estimate your BMR.

A. Analyze your lifestyle in terms of your level of activity. Multiply your BMR by the appropriate activity factor to estimate your daily energy requirement. T/I A

Average Energy Requirements

Table 1 Average Energy Requirements for Various Activities

Type of activity	Energy required (kJ/kg/h)	Type of activity	Energy required (kJ/kg/h)
sleeping	4.1	walking (6.4 km/h)	20.6
sitting	5.2	badminton	21.5
writing	6.0	mowing lawn	23.0
standing	6.3	cycling (15.3 km/h)	25.8
singing	7.1	hiking, fast dancing	27.0
using a computer keyboard, playing cards	9.0	tennis, downhill skiing	36.2
washing the car, cooking	10.5	climbing stairs, running (8.8 km/h)	37.5
playing the piano	11.2	cycling (20.9 km/h)	40.5
walking (3.2 km/h)	11.6	cross-country skiing	42.0
cycling (13 km/h)	15.8	running (12.9 km/h)	62.0
walking (4.8 km/h)	16.2	competitive cross-country skiing	73.6