Energy Balance

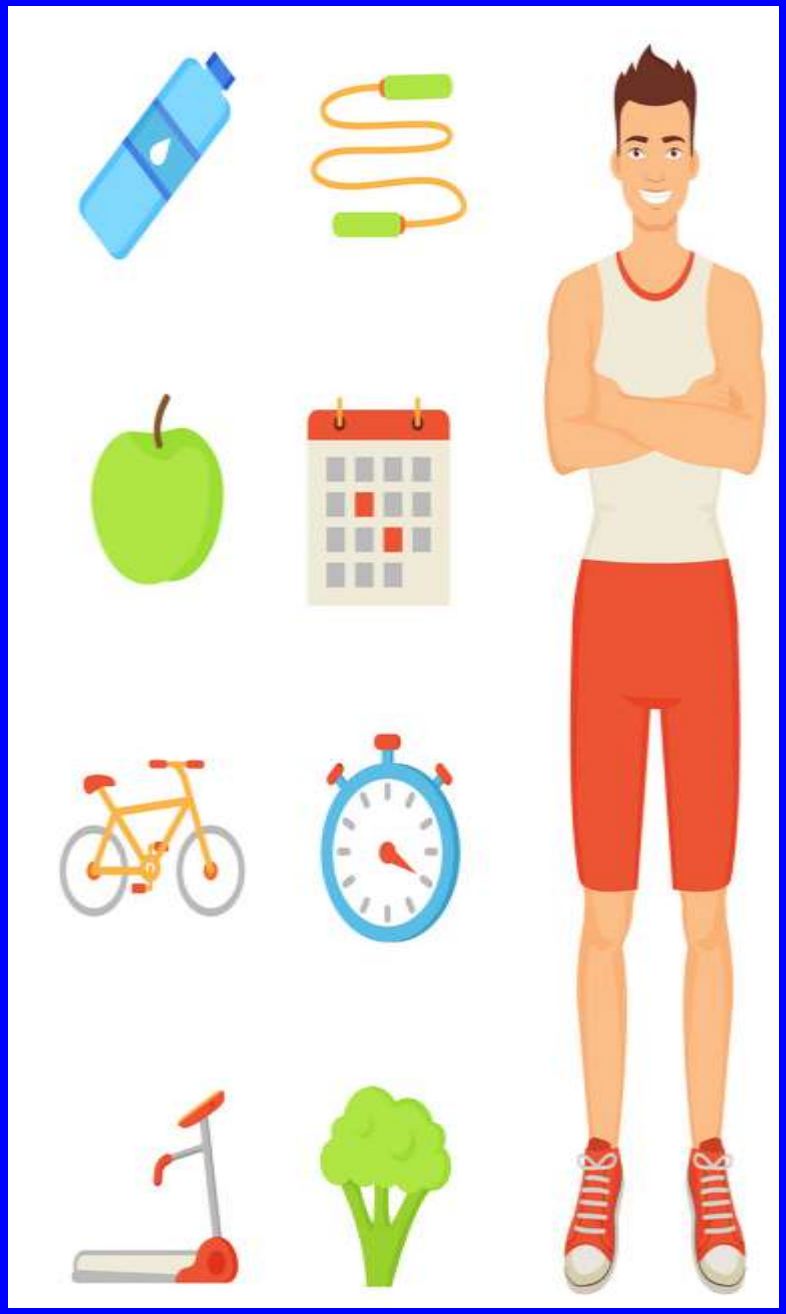
HFA4U

Lesson#2.6

Warmer questions

Pick up the most healthy breakfast menu item

Talk about these three pictures and find the hidden message



How Our Energy Intake and Exercise Effect Our Health

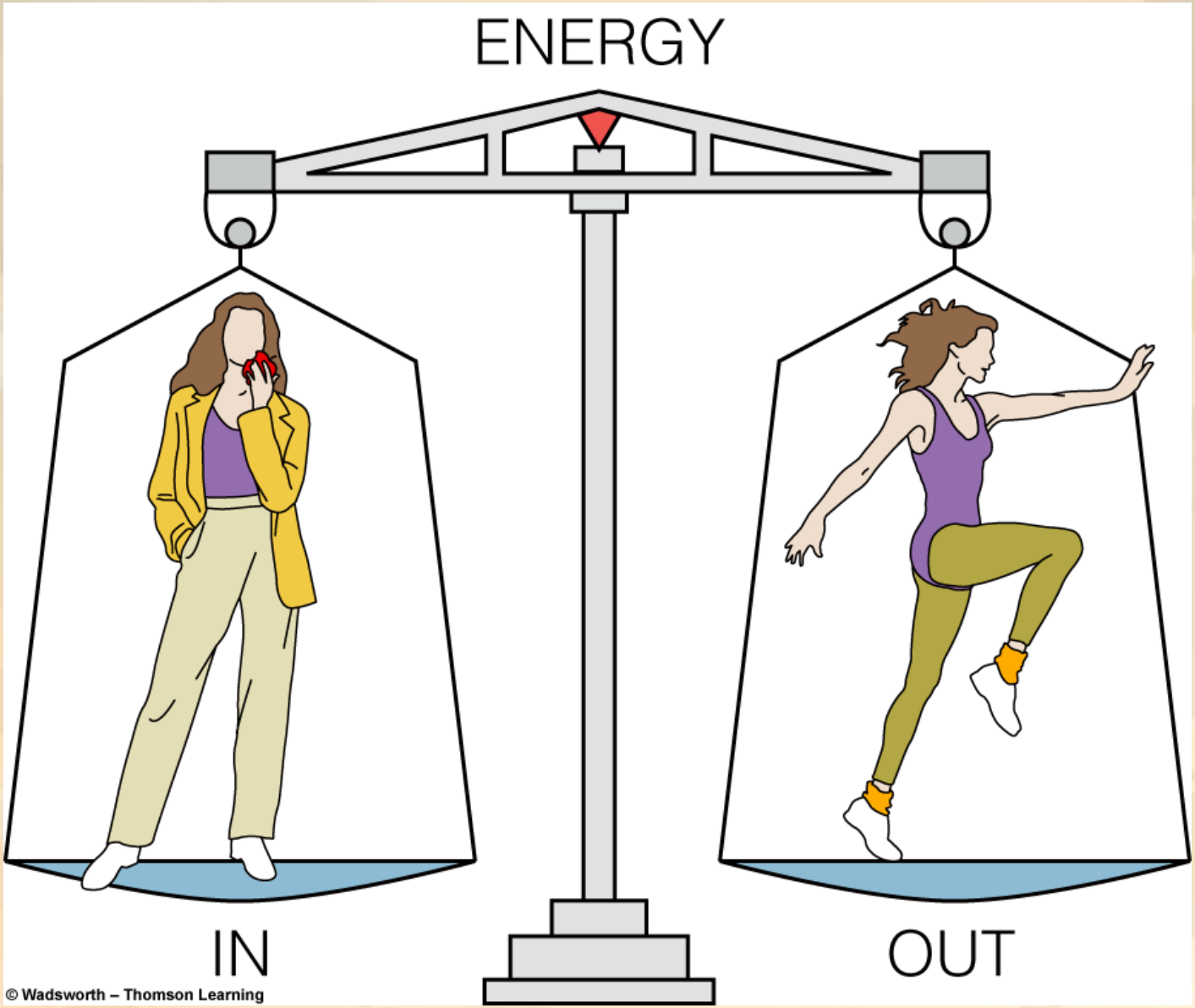
Studying = 1 or 2 kcalories/minute

Objectives

After lecture and class activities, you will be able to:

- **Define energy balance**
- **Identify factors regulating food intake**
- **Describe components of energy expenditure**
- **Calculate energy expenditure**
- **Apply Body Mass Index (BMI) to practice**
- **Discuss health related issues**

Energy Balance



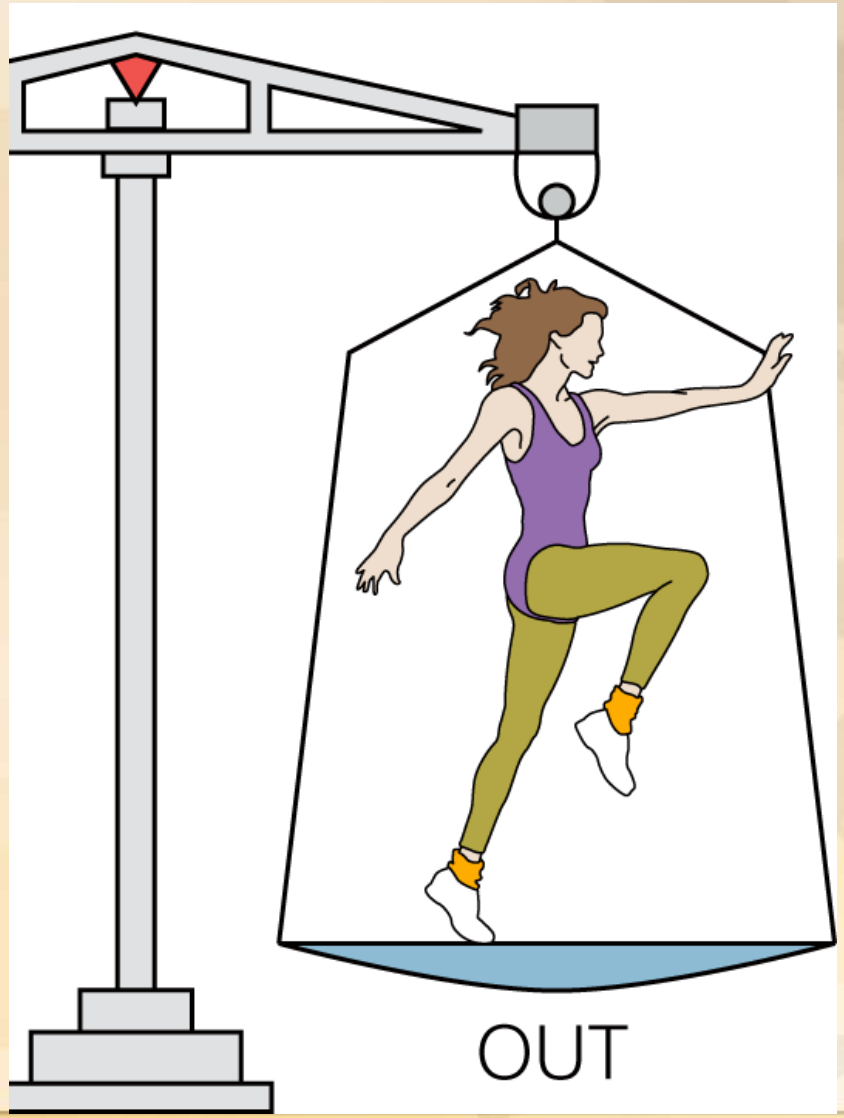
Energy Balance

Energy **Out**

Energy used in:

- Physical Activity
- Body Functions

Measured in Calories or Kilocalories



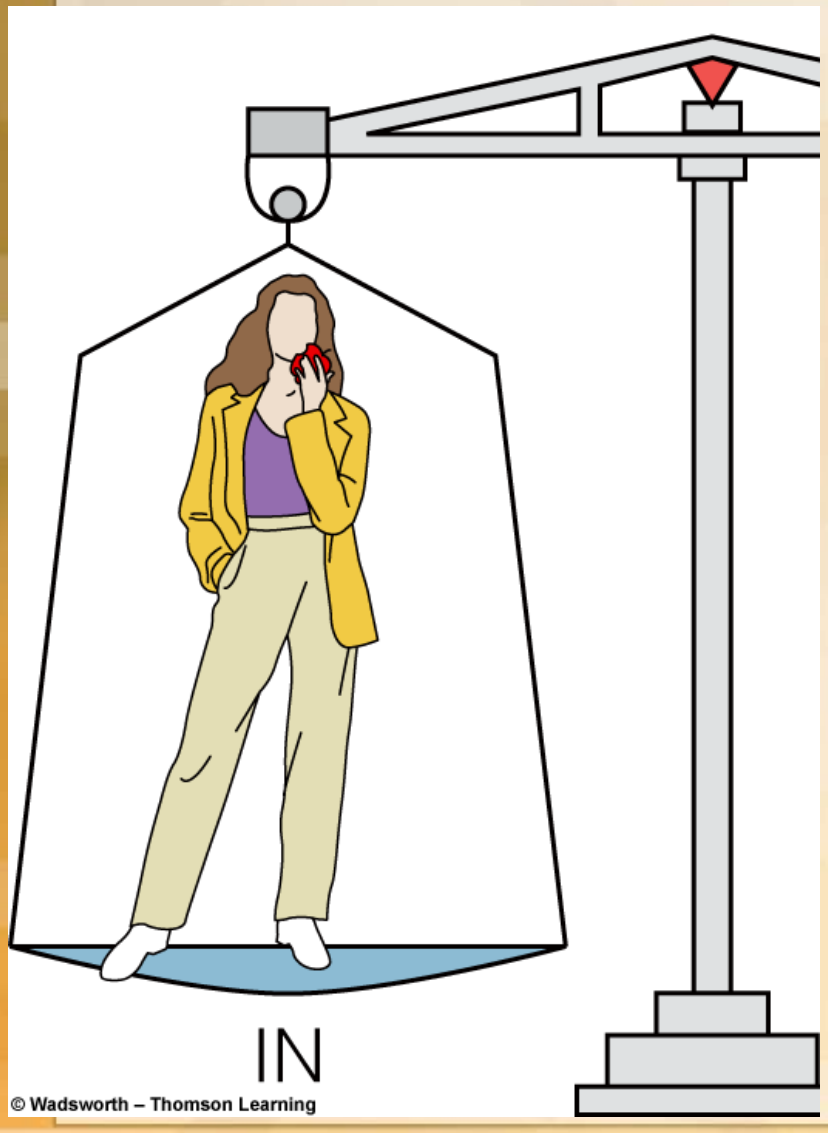
Measuring k.Calories

Indirect Calorimetry

⇐ Metabolic Cart

⇓ “CCM Express”

Energy Balance



Energy **In**

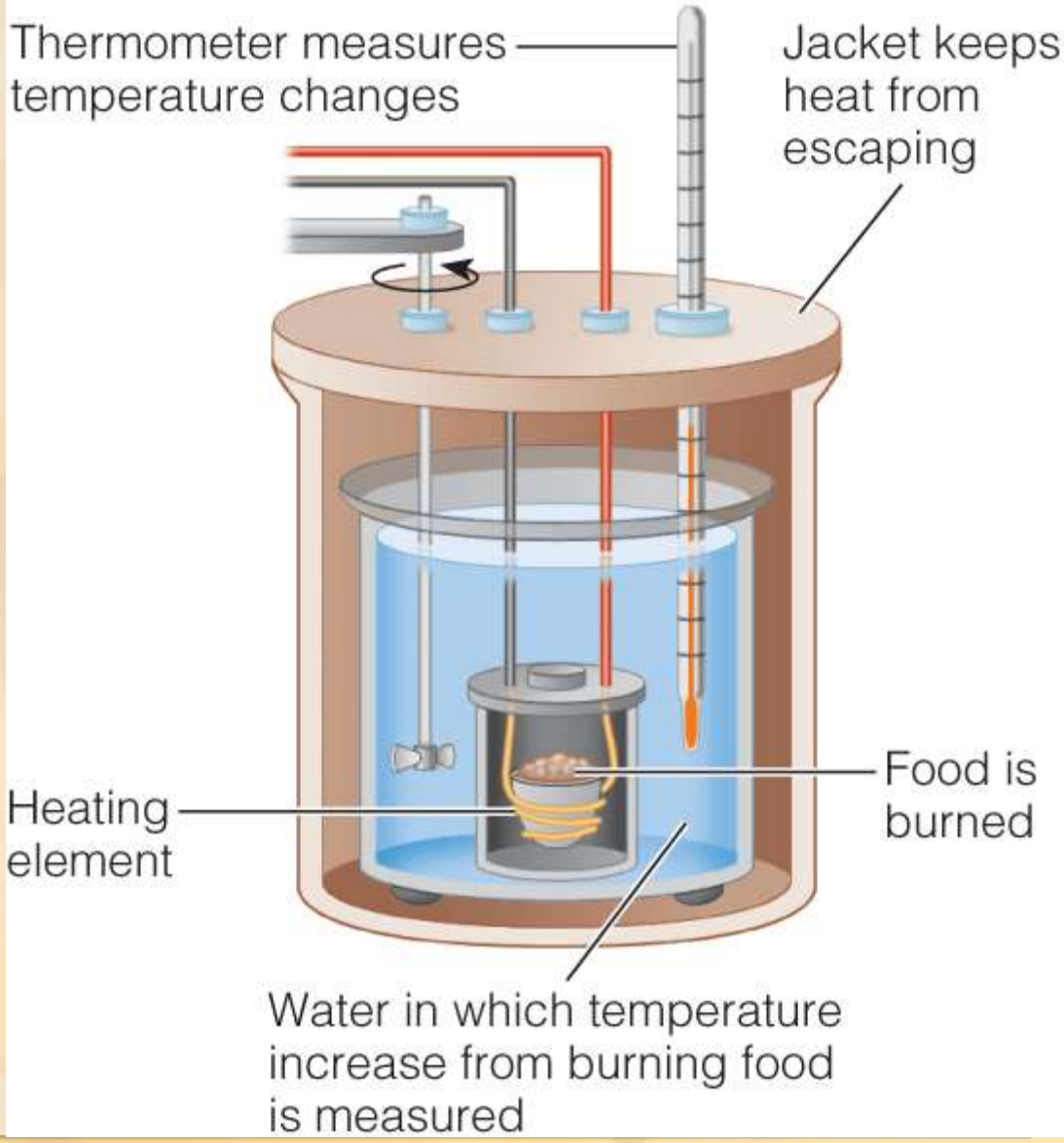
Kilocalories in food we eat.

Calorie is a unit for measuring energy

Kilocalorie = amount of heat necessary to raise the temperature of 1 kilogram of water 1° C.

Measuring kCalories

- **Bomb calorimeter**



Measuring Calories

- **Direct calorimetry-measures heat released**
- **Indirect calorimetry-measures oxygen consumed→amount of energy released**
- **Physiological fuel value-amount of kCalories body derives from food**

Intake Regulation

- **Hunger:**
  - Painful sensation caused by lack of food
  - Initiates food seeking behavior
- **Appetite:**
  - Integrated response to sight, smell, thought, or taste of food
  - Initiates or delays eating

Intake Regulation

- **Satiation:**
  - Feeling of satisfaction and fullness
  - Occurs during a meal
  - Determines how much food eaten
- **Satiety:**
  - Feeling of satisfaction and fullness
  - Occurs after a meal
  - Determines time between meals

Intake Regulation

1 Physiological influences
- Empty stomach
- Gastric contractions
- Absence of nutrients in small intestine
- GI hormones
- Endorphins (the brain's pleasure chemicals that are triggered by the smell, sight, or taste of foods and enhance the desire for delicious foods)

2 Sensory influences
- Thought, sight, smell, sound, taste of food

Seek food and start meal

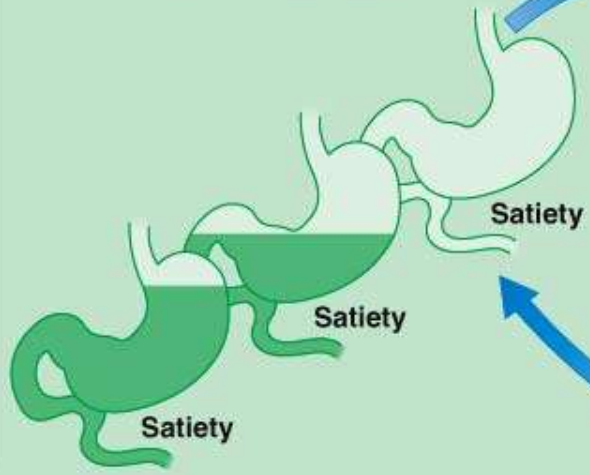
Keep eating

3 Cognitive influences
- Presence of others, special occasions
- Perception of hunger, awareness of fullness
- Favorite, ethnic, or religious foods
- Time of day
- Abundance of food or free food

4 Postingestive influences
(after food enters the GI tract)
- Food in stomach triggers stretch receptors.
- Nutrients in small intestine elicit hormones (for example, fat elicits cholecystokinin, which slows gastric emptying).

End meal

5 Postabsorptive influences
(after nutrients enter the blood)
- Nutrients in the blood signal the brain (via nerves and hormones) about their availability, use, and storage.
- As nutrients dwindle, satiety diminishes.
- As satiety diminishes, hunger develops and the sequence begins again.

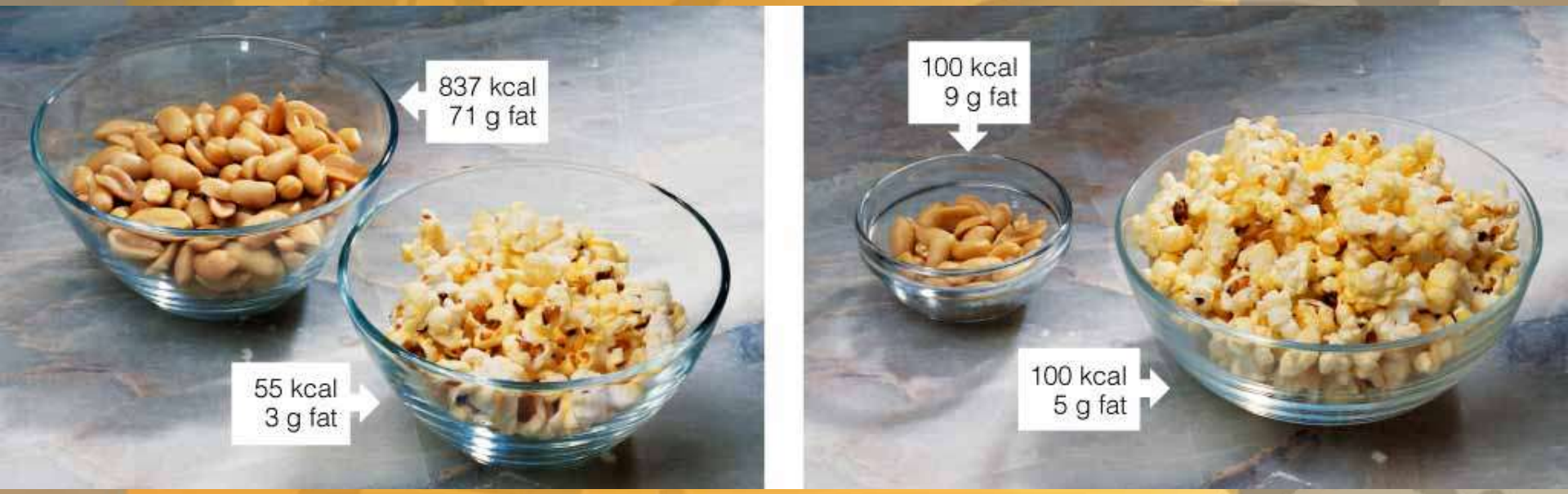


Intake Regulation

- Overriding hunger and satiety
  - Stress eating-eating in response to arousal
- Sustaining satiation and satiety
  - Satiating-power to suppress hunger and inhibit eating
  - Protein; fiber; fat(?)

Intake Regulation

- Sustaining satiation and satiety
  - lower-fat foods can be eaten in larger portions for the same number of kcalories



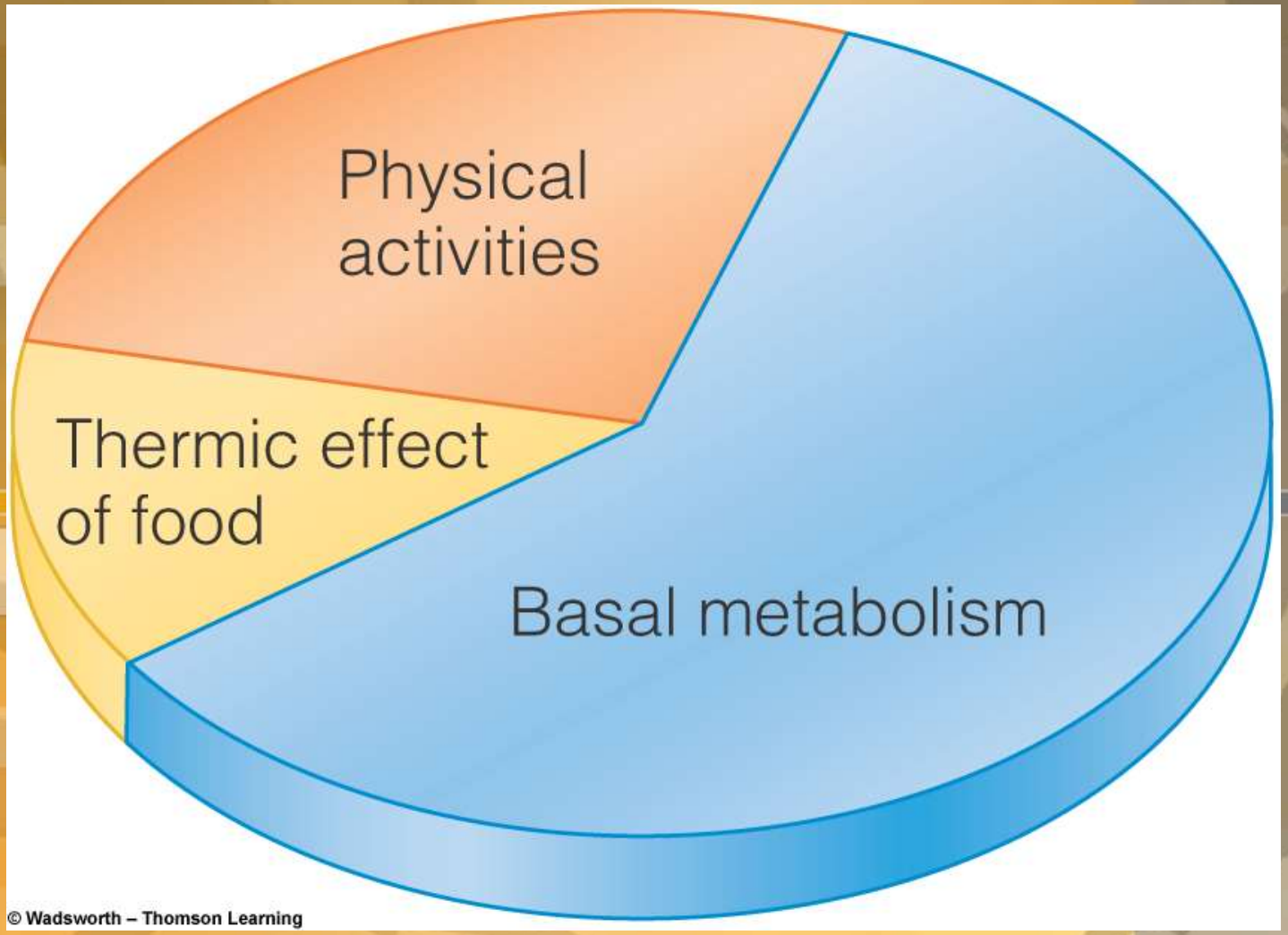
Intake Regulation

- **Hypothalamus: brain center**
  - **Controls**
    - **Appetite**
    - **Water balance**
    - **Body temperature**
- **Neuropeptide Y: chemical of brain**
    - **Stimulates appetite**
    - **Diminishes energy expenditure**
    - **Increases fat storage**

Energy Expenditure

- **Basal Metabolism**
  - Energy needed to maintain life when body at complete rest
- **Physical Activity**
- **SDA**
  - Energy required to process food

Components of Energy Expenditure



Energy Expenditure

(Frequently Used Terms)

- **Basal metabolism**
- **Basal metabolic rate (BMR); *kcal/kg/hr***
  - **Rate of energy use; specific conditions**
    - **12 fast and restful sleep**
    - **Without physical activity or excitement**
    - **Controlled environment; temperature**
- **Resting metabolic rate (RMR)**
  - **Less stringent criteria; RMR>BMR**

Estimating Energy Requirements

- **Gender**
  - **Muscle mass (protein) metabolically active**
    - **Body fat: men=13-21%**
    - **Body fat: women=23-31%**
- **Growth**
  - **BMR↑ in children and pregnancy**
- **Age**
  - **2% ↓BMR for each decade after 20's**

Estimating Energy Requirements

- **Physical activity**
  - **Increase BMR**
- **Body composition**
- **Body size**
  - **Body Surface Area**

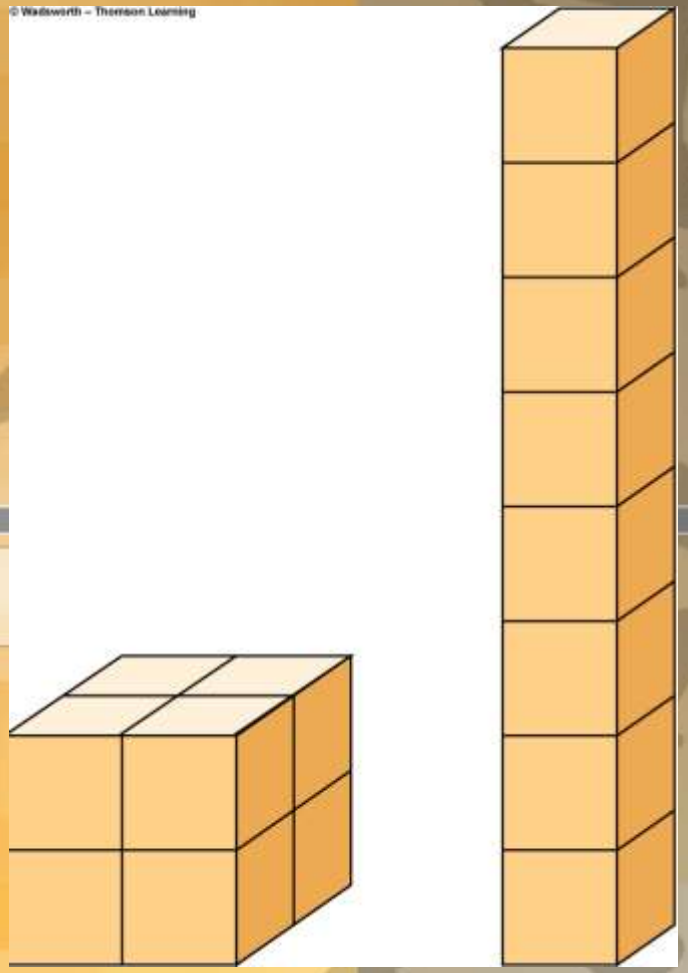


TABLE 8-1 Factors That Affect the BMR

Factor	Effect on BMR
Age	Lean body mass diminishes with age, slowing the BMR.[a]
Height	In tall, thin people, the BMR is higher.[b]
Growth	In children and pregnant women, the BMR is higher.
Body composition (gender)	The more lean tissue, the higher the BMR (which is why males usually have a higher BMR than females). The more fat tissue, the lower the BMR.
Fever	Fever raises the BMR.[c]
Stresses	Stresses (including many diseases and certain drugs) raise the BMR.
Environmental temperature	Both heat and cold raise the BMR.
Fasting/starvation	Fasting/starvation lowers the BMR.[d]
Malnutrition	Malnutrition lowers the BMR.
Hormones (gender)	The thyroid hormone thyroxin, for example, can speed up or slow down the BMR.[e] Premenstrual hormones slightly raise the BMR.
Smoking	Nicotine increases energy expenditure.
Caffeine	Caffeine increases energy expenditure.
Sleep	BMR is lowest when sleeping.

Components of Energy Expenditure

- **Physical activity**
  - **Calories-Time-Weight**
  - **See Table**

TABLE 8-2 Energy Spent on Various Activities

The values listed in this table reflect both the energy spent in physical activity *and* the amount used for BMR.

Activity	kCal/lb/min[a]	kCalories per Minute at Different Body Weights				
		110 lb	125 lb	150 lb	175 lb	200 lb
Aerobic dance (vigorous)	.062	6.8	7.8	9.3	10.9	12.4
Basketball (vigorous, full court)	.097	10.7	12.1	14.6	17.0	19.4
Bicycling						
13 mph	.045	5.0	5.6	6.8	7.9	9.0
15 mph	.049	5.4	6.1	7.4	8.6	9.8
17 mph	.057	6.3	7.1	8.6	10.0	11.4
19 mph	.076	8.4	9.5	11.4	13.3	15.2
21 mph	.090	9.9	11.3	13.5	15.8	18.0
23 mph	.109	12.0	13.6	16.4	19.0	21.8
25 mph	.139	15.3	17.4	20.9	24.3	27.8
Canoeing, flat water, moderate pace	.045	5.0	5.6	6.8	7.9	9.0
Cross-country skiing						
8 mph	.104	11.4	13.0	15.6	18.2	20.8
Golf (carrying clubs)	.045	5.0	5.6	6.8	7.9	9.0
Handball	.078	8.6	9.8	11.7	13.7	15.6
Horseback riding (trot)	.052	5.7	6.5	7.8	9.1	10.4
Rowing (vigorous)	.097	10.7	12.1	14.6	17.0	19.4

Running						
5 mph	.061	6.7	7.6	9.2	10.7	12.2
6 mph	.074	8.1	9.2	11.1	13.0	14.8
7.5 mph	.094	10.3	11.8	14.1	16.4	18.8
9 mph	.103	11.3	12.9	15.5	18.0	20.6
10 mph	.114	12.5	14.3	17.1	20.0	22.9
11 mph	.131	14.4	16.4	19.7	22.9	26.2
Soccer (vigorous)	.097	10.7	12.1	14.6	17.0	19.4
Studying	.011	1.2	1.4	1.7	1.9	2.2
Swimming						
20 yd/min	.032	3.5	4.0	4.8	5.6	6.4
45 yd/min	.058	6.4	7.3	8.7	10.2	11.6
50 yd/min	.070	7.7	8.8	10.5	12.3	14.0
Table tennis (skilled)	.045	5.0	5.6	6.8	7.9	9.0
Tennis (beginner)	.032	3.5	4.0	4.8	5.6	6.4
Walking (brisk pace)						
3.5 mph	.035	3.9	4.4	5.2	6.1	7.0
4.5 mph	.048	5.3	6.0	7.2	8.4	9.6
Weight lifting						
light-to-moderate effort	.024	2.6	3.0	3.6	4.2	4.8
vigorous effort	.048	5.2	6.0	7.2	8.4	9.6
Wheelchair basketball	.084	9.2	10.5	12.6	14.7	16.8
Wheeling self in wheelchair	.030	3.3	3.8	4.5	5.3	6.0

[a]To calculate kcalories spent per minute of activity for your own body weight, multiply kcal/lb/min by your exact weight and then multiply that number by the number of minutes spent in the activity. For example, if you weigh 142 pounds, and you want to know how many kcalories you spent doing 30 minutes of vigorous aerobic dance: 0.062 × 142 = 8.8 kcalories per minute; 8.8 × 30 (minutes) = 264 total kcalories spent.

Components of Energy Expenditure

- **Thermic Effect of Food (TEF)**
- **Diet-induced thermogenesis (DIT)**
- **Specific Dynamic Action of Food (SDA)**

Calculate Total Energy Needs

- **Calculate your own Total Energy Needs (Basal and Physical Activity) using:**
  - **Mifflin-St Jeor Equation**

BMR Formula

(Mifflin - St Jeor)

MEN

BMR =
(4.536 × weight in lbs)
+ (15.88 × height in inches)
– (5 × age) + 5

WOMEN

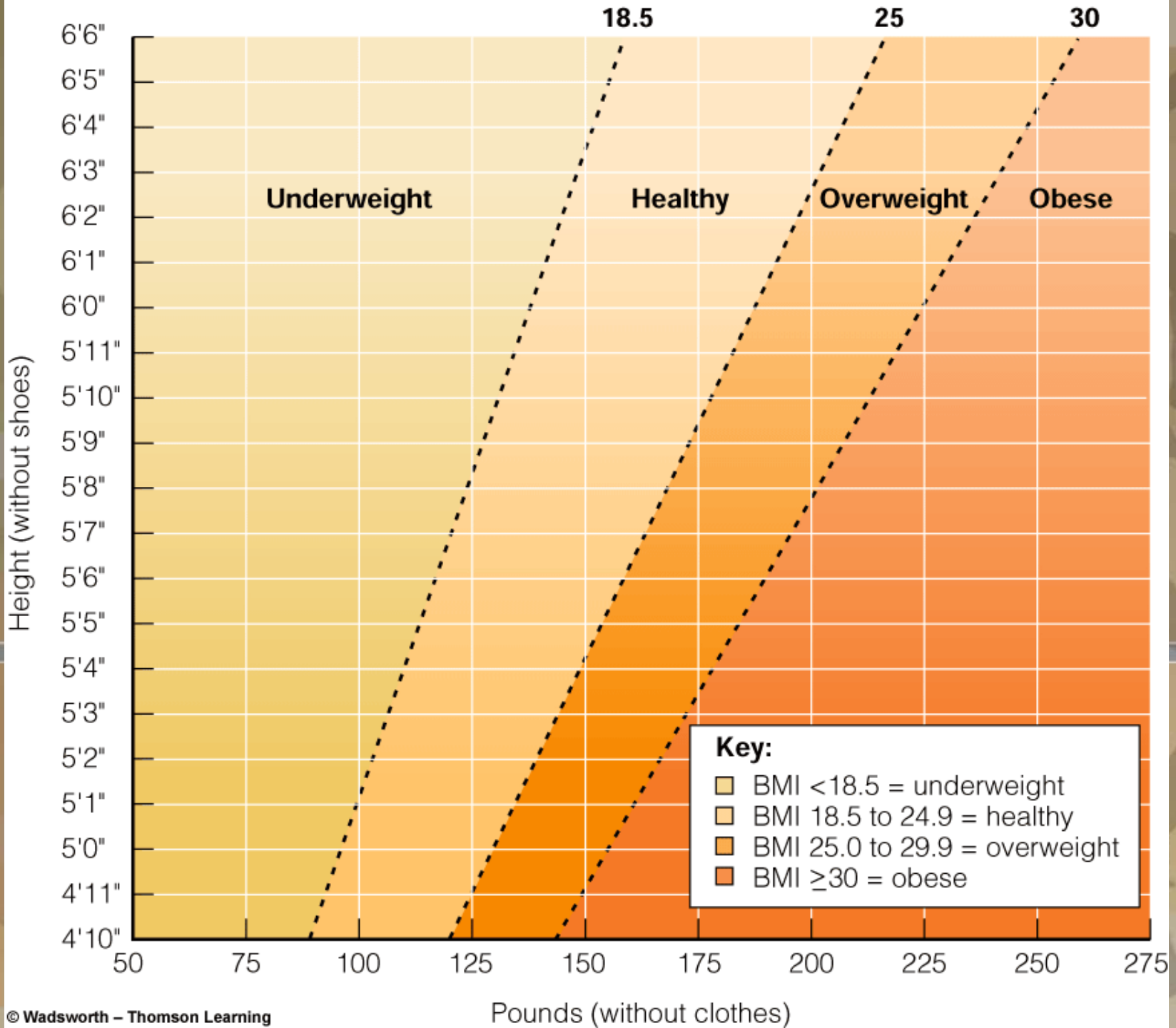
BMR =
(4.536 × weight in lbs)
+ (15.88 × height in inches)
– (5 × age) – 161

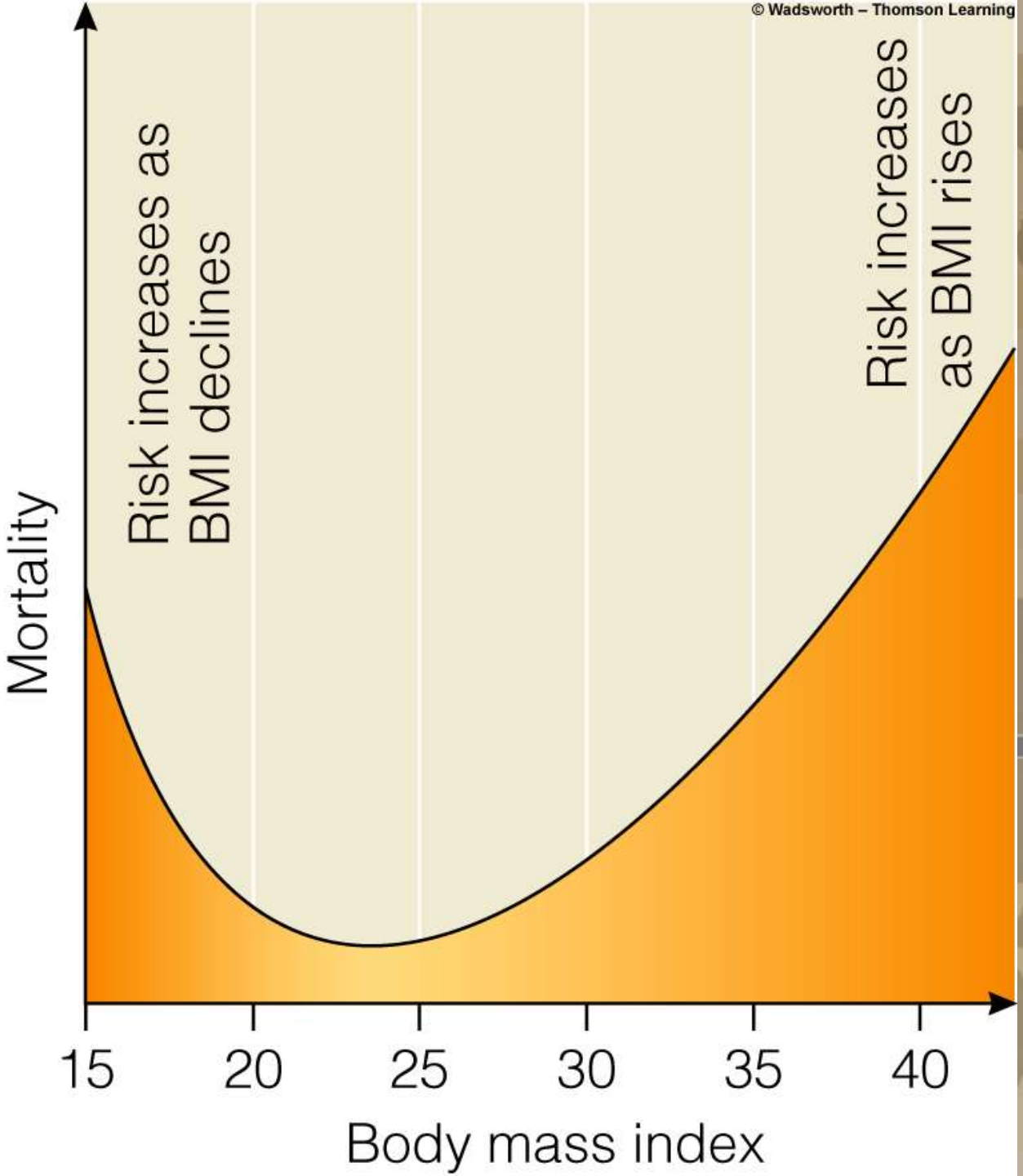
Body Weight, Body Composition, and Health

- **Body composition**
- **Body weight = fat + lean tissue (including water)**

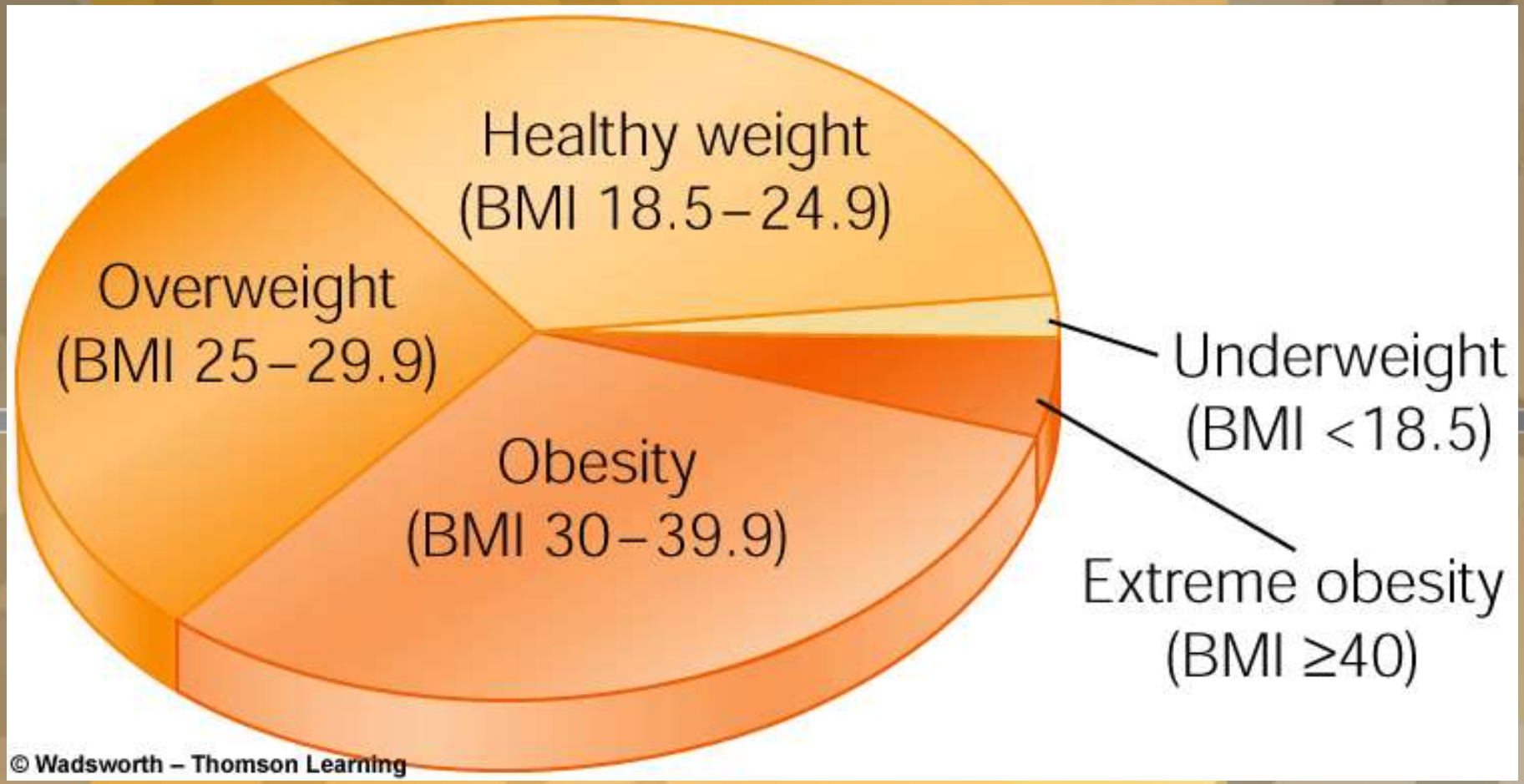
Calculate Total Energy Needs

- **Calculate your own Total Energy Needs (Basal and Physical Activity) using:**
  - **Mifflin-St Jeor Equation**




© Wadsworth – Thomson Learning
Mortality
Risk increases as BMI declines
Risk increases as BMI rises
15
20
25
30
35
40
Body mass index

Distribution of Body Weights in U.S. Adults



Body Fat

- **1lb. Body fat (454 g.) = 3500 kcal**
- **Adipose tissue composition**
  - **87% fat = 395 g.**
    - ***395 x 9 kcal/g = 3555 kcal***
  - **Remainder is protein and water**
- **To lose 1 lb/week**
  - **Reduce kcal by 500/day for 7 days**
- **Wt gain/loss=75% fat+25% lean**

Body Fat and Its Distribution

- **Fat distribution**
  - **Intra-abdominal fat**
  - **Central obesity**
- **Waist circumference (p.263)**
  - **Women: >35 inches (88 cm)**
  - **Men: >40 inches (102 cm)**

Male:

"Apple"

Android

Upper body obesity

Associated:

Heart Disease

Stroke

High BP

Diabetes

Female:

"Pear"

Gynoid

Lower body obesity

Not usually associated with chronic diseases

- Heart Disease
- Diabetes
- Metabolic Syndrome
- Cancer
- Fat and fit versus sedentary and slim

Metabolic Syndrome

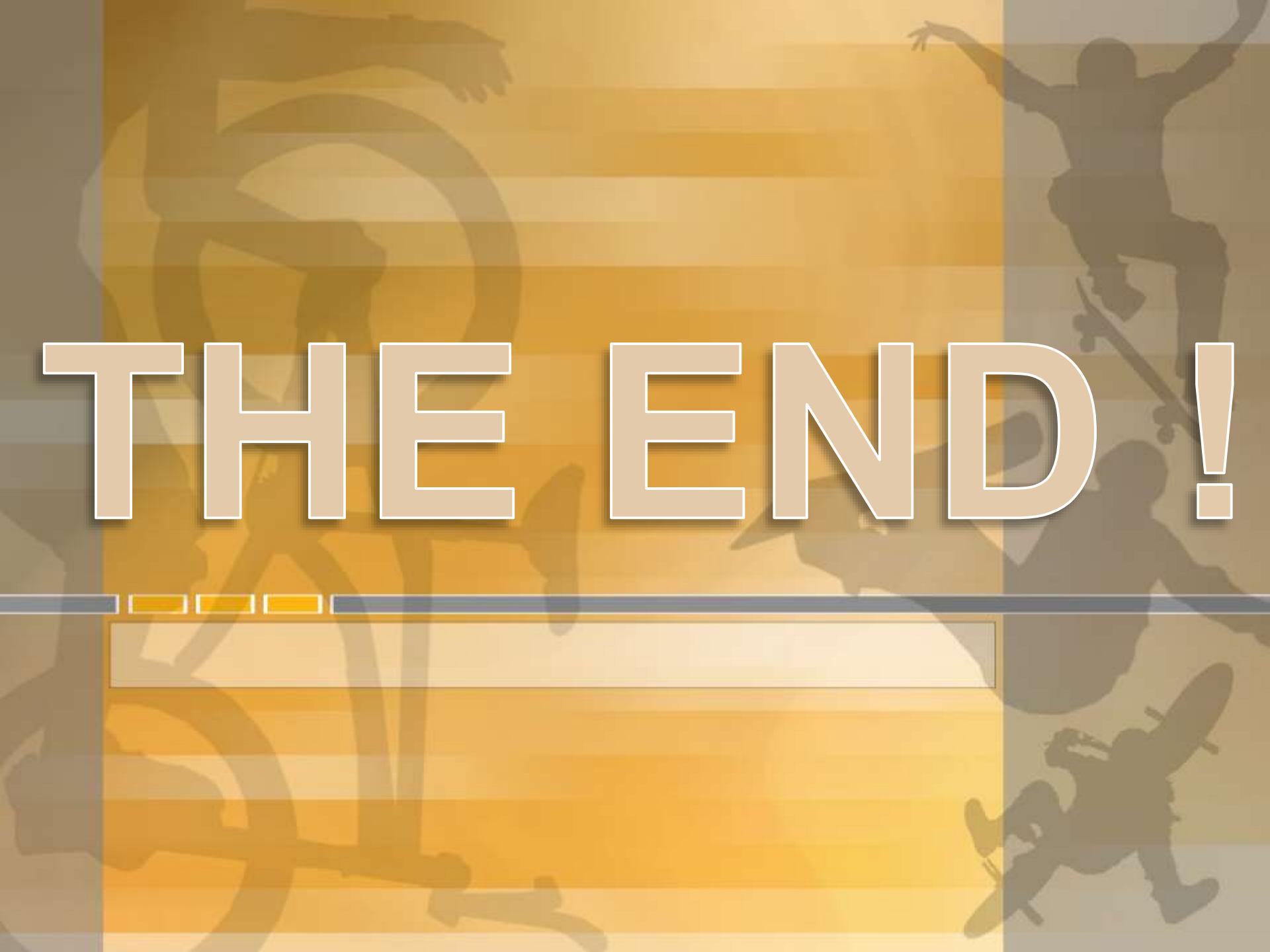
- **Prevalence: 47 million in U.S.**
- **Cluster of at least 3 of the diet related health risk factors below:**
  - **Low HDL (<40 mg/dL or <50 mg/dL)**
  - **Hypertension (≥130/85)**
  - **Insulin resistance**
  - **Fasting glucose ≥100 mg/dL**
  - **Abdominal obesity (>40 in or >35)**
  - **Chronic inflammation**

Class Activity: Case study of different TDEE (AS assessment=10 marks)

In this activity your team will be working on an assigned case study to analyze the nutritional status of the person and will suggest a complete nutritional guideline including food lists.

Go to Moodle: Lesson#2.6, and follow your respective case study (12 minutes)
You will be present in the class.

- **Group 1 (Breakout room#1): Case study 1**
- **Group 2 (Breakout room#2): Case study 2**
- **Group 3 (Breakout room#3): Case study 3**
- **Group 4 (Breakout room#4): Case study 4**


THE END !