

Chapter 1 Reading Guide:

Answer these questions as you study the text. If you have any questions, be sure to write them down and post them in the discussion room.

1. a. What are the six nutrients? B. Which are organic? C. What does “organic” mean, in this context? D. Define nutrient.
2. a. If you take a supplement of pure vitamin C with no added sugar, so you get any kcalories? Why or why not? B. Which nutrients can be used for energy?
3. How many kcalories are in a food with 3g of fat, 20g of carbohydrate, and 4 g of protein?
4. What other chemical (besides the above nutrients) can provide energy?
5. Is bread a PURE carbohydrate food? Why or why not?
6. When measuring the amount of energy in a food, what unit is used? What exactly IS a kilocalorie?
7. What are some example functions of vitamins? Of minerals?
8. Define EAR, RDA, AI, UL. Use Ca^{2+} as an example, and list the values for Ca^{2+} . (Hint, look on the front and back pages of your textbook).
9. Define AMDR. What IS it, for carbs, fats and proteins?

10. You are a researcher interested in whether Calcium (Ca^{2+}) in the diet helps to moderate weight.
 - a. Design a case control (epidemiological) study to try to get at this question.
 - b. Design a clinical trial study to try to answer this question.
 - c. If you find a correlation, does that necessarily prove causation?

Be sure to mention: your control group(s), sample size, placebo, blind or double blind?

11. Trace the stages of nutrient deficiency, using vitamin B12 (cobalamin) as an example.
12. What are four risk factors for chronic diseases that you have control over?
13. Discuss some ways to know whether you can trust nutrition information that you read or hear from media, friends, advertisements, etc. Be sure to read the chapter and “Nutrition Debate” AND the required Harvard link to answer this.
14. A. What’s the difference between an atom (element) and a molecule? B. Which nutrients are molecules? Which nutrients are typically single elements?
15. What are phytochemicals? Do you think they should be called nutrients? Why or why not?

16. List the a) water-soluble vitamins, b) fat-soluble vitamins and c) common minerals I've included in this supplemental lecture.
17. Define malnutrition, undernutrition, overnutrition, nutrient deficiency, nutrient toxicity.
18. List several nutrition assessment methods and discuss their pros/cons. Be sure to include anthropometric analyses.

Supplemental Information:

I. How foods store energy:

- a. Background: what IS energy? I hate defining energy; it's an intangible concept. It is the ability to do work, or, to make something change (ex, move). Anyway, energy comes in two basic forms: potential (stored) energy, and kinetic (the energy of movement.)
 - i. Kinetic energy: the energy of movement. Includes a ball flying through the air, or a molecule bouncing around in space. Heat is a form of kinetic energy: the random movement of molecules/atoms (the faster they go, the hotter it gets). Kinetic energy also includes a rubber band flying through the air toward the back of your little sister's head.
 - ii. Potential energy: stored energy. When you stretch the rubber band back and aim it at your sister, you know that there is stored energy in that rubber band, because when you let go it will move, and will do work (startle your sister). Energy is stored in chemical bonds, so when chemical bonds are broken, energy is released. Cells take advantage of the fact that chemical bonds store energy. They

purposefully break bonds to use the released energy.

- iii. Energy conversions: energy is converted between forms. When you pull the rubber band back, you are converting kinetic energy (moving your hand & the rubber band) to stored energy. Whenever energy is converted between forms, some of the energy is converted to heat, whether you mean to do that or not. So, when cells break chemical bonds to release energy to do work, some heat is always produced.

Homeotherms (warm-blooded animals) take advantage of that fact to maintain stable temperatures. We "waste" tons of energy, just contracting & releasing muscles constantly to break bonds & release heat. Your pet boa constrictor ("cold-blooded") can go without food for much longer than your pet guinea pig because the boa wastes much less energy on heat production.

- iv. Ways that cells store energy: for our purposes, what you need to know is that cells can store energy in chemical bonds (see below) and by maintaining concentration gradients of certain chemicals (we'll get to that way later)
- b. We know our bodies can extract energy from carbohydrates, protein and fats. Therefore, we know that energy is STORED in food, in the nutrients I just mentioned. So, how is energy stored in these nutrients? Well, as you know nutrients are simply chemicals. Carbs, proteins, and fats are each specific types of MOLECULES: substances that are made of many

elements bound together. Carbs are made of Carbon (C), Oxygen (O) and Hydrogen (H); fats are made of C, H and a little bit of O; and proteins are made of C, H, O, and Nitrogen (N)

- c. Anyway, the elements that make up these nutrients are bound together in specific ways. We'll get to that in later chapters. Well, it turns out that **energy is stored in chemical bonds**. For example, in a molecule of the sugar "glucose," there are 6 C, 12 H and 6 O. These atoms are bound together, but there is tension, or energy, in the bonds between the atoms. It's THIS energy, the energy in chemical bonds, that our bodies access when we eat food. Each individual cell in our bodies gets some of the nutrients from food, and breaks the bonds of those nutrients to release the energy stored there.

- d. Vitamins are made of molecules of C, H, O (and some other elements) too! Why can't we get any energy from them? Because cells don't have the machinery to break their bonds and get their energy! Our cells only have the machinery to break the bonds of carbs, proteins and fats to get energy. By the way, vitamins do HELP to get energy from carbs, proteins and fats. Vitamins are part of the machinery!

II. The "single element nutrients:" minerals- these guys all carry a charge. So, when you see them written in their abbreviated form (example calcium: Ca^{2+}), you will notice that they have "plusses" or "minuses" after them. Ca^{2+} , for example, carries a charge of 2 plus. Na^+ (sodium) carries a charge of 1 plus. Cl^- (chloride) carries a charge of 1 minus.

III. Some stuff that our bodies need nutrients for: keep in mind that we are made of trillions of individual cells. When you eat food, that food is broken down into tiny particles-nutrients- that are small enough to make it from our digestive tract into our blood. The nutrients then travel through the blood, and are used by EACH INDIVIDUAL CELL. For example, you are made of ~30 trillion cells; that means, to keep your body alive for a few seconds, you currently need at least 30 trillion molecules of glucose (a carbohydrate), fatty acid, or amino acid (what protein is made of).

- a. Growth (cell division)
- b. Muscle contraction (each individual muscle cell shortens)
- c. Maintenance of tissues (cell division, cell replacement, cell repair)
- d. Defense against pathogens (immune cell motility and function)
- e. Moving particles to and from areas; for example, cells of the kidneys pick and choose what stuff should stay in the blood and what stuff should go into the urine as waste.

IV. Size perspective- (see powerpoint for an image): We are multicellular organisms. We are made of **organ** systems (ex, heart, skin, digestive organs). Those organs are made of **tissues** (specific types of cells that work together to perform a particular function; for example, muscle is a tissue made of cells that all shorten. Connective tissue is made of cells that help “tie” the body together). Tissues are made of **cells**. Cells are little bags of chemical reactions: very SPECIFIC chemical reactions. Within cells are sealed off areas where specific functions

(reactions) occur. These sealed off areas are called **organelles**. For example, the nucleus is an organelle where the DNA is stored. Mitochondria are organelles where most of the energy from food is extracted. Anyway, cells and organelles are made of **molecules**. And molecules, as you know, are made of **elements/atoms**.

V. **More information about the nutrients**

- a. Carbohydrates- made of C, H and O in the ratio of 1:2:1 (CH₂O). For example, glucose is C₆H₁₂O₆.
 - i. Primarily used for energy by cells
 - ii. Also used for some structure and function (for example, cells use a covering of sugar to help them stick in place... sugar is sticky!)

- b. Proteins- made of C, H, O and N; no particular ratio.
 - i. Made of long chains of smaller molecules called amino acids (like a beaded necklace, where each bead is an amino acid and the necklace is the protein).
 - ii. Primarily used for structure and function, for example: keratin (hair and nails), enzymes (these are the chemicals that drive all the specific reactions going on in cells), hemoglobin (carries O₂ to our cells).

- c. Lipids- made of lots of C and H and a little O; no particular ratio. Defined by the fact that they do not mix with water.
 - i. Very important for both energy and structure and function; for example, many hormones are cholesterol based, and the covering of each cell is fatty.

- ii. Include triglycerides (what we call “fat,” and what we can use for energy), phospholipids (what covers our cells) and cholesterol (cells can NOT extract energy from cholesterol).

d. Vitamins- Organic, fairly complex molecules.

- i. Diverse in form and function
- ii. Generally, we can say that vitamins HELP in cell reactions. For example, most B vitamins are needed to help extract energy from carbs, fats and proteins. Vitamin K helps build clotting proteins in the blood. Vitamin C helps build collagen, the protein that ties the body together.
- iii. Two types: water soluble (Bs plus C) and fat soluble (A,D,E,K)
- iv. These are the vitamins (1-8 are B-vitamins):
 - 1. B1- thiamin
 - 2. B2- riboflavin
 - 3. B3-niacin
 - 4. Biotin
 - 5. Pantothenic acid
 - 6. B6- pyridoxine
 - 7. Folic acid / folate
 - 8. B12- cobalamin *of note, this is only found naturally in animal sources: meat, eggs, dairy
 - 9. C
 - 10. A
 - 11. D, *of note, we can make enough of this with sufficient exposure to sunlight
 - 12. E
 - 13. K

e. Minerals- Single elements, carry a charge

- i. Also very diverse in function; for example, Ca^{2+} is part of bones, is required for neuron and muscle cell function, is required for cell clotting and the list goes on. Iron (Fe^{2+}) is part of hemoglobin and actually binds (carries) O_2 through the blood, and is essential for the function of mitochondria.
- ii. I won't list all of the minerals because there are so many and we'll spend 2 chapters on them. But here are some of the better known minerals (those with the chemical symbols and charges indicated will be ones you'll see often):
 1. Sodium- Na^+
 2. Iron- Fe^{++}
 3. Calcium- Ca^{++}
 4. Magnesium- Mg^{++}
 5. Potassium- K^+
 6. Chloride- Cl^-
 7. Zinc- Zn^{++}
 8. Chromium
 9. Selenium

f. Water- nothing extra to say beyond what's in the text!

g. Other stuff in food:

- i. Fiber- technically a carbohydrate, but we can't break it down into small enough pieces to get the sugars into our blood. Therefore, it stays in the digestive tract and eventually ends up in the toilet. More on that later!
- ii. Phytochemicals
- iii. Other chemicals, such as caffeine, preservatives, etc.