Chapter 11 Reading Guide

***you might find it helpful to review LDLs, HDLs and cardiovascular function from chapter 5.**

1. Why is risk of toxicity of fat soluble vitamins greater than it is of water-soluble vitamins?
2. What is a free radical? Provide a couple examples of how they might be formed in the body. Be sure to include one example of free-radical formation because of normal body function, and one because of environmental exposures.
3. Explain what free radicals do that make them dangerous. Focus on cell membrane and LDL structure.
4. List several diseases that are associated with free radical damage.
5. How exactly to antioxidants protect against free radical damage? Also explain antioxidant enzyme systems.
6. List the vitamins, minerals and other dietary substances that have antioxidant roles.
7. For each of the vitamins, minerals and other dietary substances in this chapter,
    a. Explain how it works against free radicals
    b. List the chemical names of the different forms, indicating which is/are active (when applicable)
    c. Note whether it is fat-soluble or water-soluble (keeping in mind what this means in terms of how it is absorbed and whether it is likely stored)
    d. List other functions, if discussed (many of the further questions will guide you through this, though)
    e. Discuss deficiency/toxicity symptoms
    f. If applicable (ie, if the book talks about it), address common causes of deficiency in the US today
    g. List good, non-fortified food sources
    h. If mentioned, discuss the effect of heat and light on its availability in food.

8. Where is most vitamin A, D and E stored in the body (this has different answers)?

9. Explain the relationship of V-E, V-C, glutathione and glutathione reductase. How is the mineral selenium involved?
10. Why is V-E's action crucial to so many aspects of our health?
11. What are tocopherols and trienols? Which is/are active in the body?
12. What is the primary cause of vitamin E deficiency in the US?
13. Why do red blood cells burst as a result of vitamin E deficiency?
14. Name the anemia caused by erythrocyte hemolysis. What are some other symptoms of vitamin E deficiency?
15. What negative effect can high doses of vitamin E cause?
16. Why do French fries fried in peanut oil have very little vitamin E, even though fresh peanut oil has lots of vitamin E?
17. a) List some food sources of vitamin E. b) Avocado is a fruit that is very high in fat (mostly unsaturated). Do you think avocado is a good source of vitamin E?
18. Why doesn't your pet dog need to eat foods rich in vitamin C, but you and your pet guinea pig do?
19. Discuss the many roles of vitamin C. Don't forget collagen in the future, by the way. It'll come up again in upcoming chapters!
20. Have studies indicated conclusively that taking megadoses of vitamin C will prevent an impending cold?
21. Explain the statement: "taking large doses of vitamin C makes expensive urine." (true of most water-soluble vitamins, by the way)
22. Why might you want to eat an orange with iron-rich foods if you are iron-deficient, but not if you have hemochromatosis?
23. Define "provitamin" and provide an example.
24. What are carotenoids, and how are they related to beta-carotene? List them and describe their colors. Which can be converted to vitamin A?
25. Are there any carotenoids in spinach and kale, even though they appear dark green? Explain.
26. Explain the methods and results of the Finnish ATBC Cancer Prevention Study. Are the results considered conclusive?
27. Explain why you get more lutein from a roasted tomato than a fresh tomato.

28. A) What are the three active forms of vitamin A? b)Collectively, what are they called? c) Briefly describe each of their individual functions.
29. Where is vitamin A stored in the body?
30. A) What is the name of the visual PIGMENT of rod cells described in the book? B) What are the two components of that pigment?
31. A) In the absence of light, in what conformation does retinal exist in receptor cells of the retina (name it, and state whether it is straight or bent)? B) what conformation does it convert to with light energy?
32. Describe the series of events that leads to information about vision being sent to the brain, starting when light energy changes the conformation of retinal.
33. Why will a vitamin A deficiency lead to problems with skin and the digestive tract lining? Immune function?
34. Worldwide, how common are vitamin A deficiencies?
35. Describe some of the symptoms of a vitamin A deficiency. Name the conditions mentioned. Why do people with celiac disease and who eat lots of Olestra run a risk of V-A deficiency?
36. Is it possible to overdose, or have toxicity symptoms, of beta-carotene from food alone? From supplements?
37. Describe symptoms of vitamin A toxicity; also potential problems with the acne treatments RetinA and Accutane.
38. Do animal sources of vitamin A provide retinoids or carotenoids? What about plant sources?
39. What food source could potentially lead to vitamin A toxicity if eaten excessively?
40. Are animal sources or plant sources more reliable in terms of the amount of selenium they contain? Explain.
41. Explain the roles of copper, zinc, magnesium and iron as antioxidants, and generally the other stuff they do. We'll get to those details in later chapters.
42. Describe generally what cancer is and how it develops. You don't need to name the stages, but describe the progression.
43. What is a carcinogen? Provide several examples.
44. How can free radical damage promote (exacerbate) the development of cancers?

45. Be sure to check out table 10.3, and don't miss the asterisked footnote! It's the most important part of the table!
46. Also be sure to check out the Highlight: cancer prevention. Add to it: don't smoke or quit
47. Discuss the many health problems associated with smoking.
48. How do antioxidants work to help prevent cancer? Have studies indicated that antioxidant rich foods or supplements are more effective? Explain. Be sure to think about the Finnish study in this context, too.
49. What are phytochemicals, where are they found (food sources), and what is their known health benefit? Does evidence suggest that they are more effective from foods or from supplements? List several types of phytochemicals and corresponding food sources.
50. Discuss the role of antioxidants, fiber, folate and phytochemicals in reducing risk of CVD. What types of foods would provide ample amounts of these substances?
51. Describe how heart attack and stroke are related.
52. How can the antioxidant activity of vitamin E help defend against heart disease and stroke? Be sure to mention LDLs.
53. Discuss the role of antioxidants in preventing certain diseases of aging.
54. Which of the following best describes a daily diet that would contain lots of antioxidants and other substances likely to help prevent cancer, CVD, and cataracts? Which is vegetarian?
    a. Breakfast: oatmeal with blueberries and honey; Lunch: large salad of organic mixed greens with almonds, kidney beans, shredded cabbage, a little organic cheese, and an olive-oil based vinaigrette; Dinner: kale with onions sautéed in olive oil, an omelette with organic eggs, broccoli, tomatoes, mushrooms and nitrite/nitrate-free turkey sausage, and whole wheat toast; Snacks: apple, grapes with walnuts
    b. Breakfast: bacon, eggs, and white toast; Lunch: a low-fat deli turkey sandwich with lettuce and tomato on white bread; Dinner: grain-fed steak, baked potato with low-fat sour cream, frozen corn; Snacks: baked potato chips, Pop-Tart, orange

c. Breakfast: Energy Bar (highly fortified candy bar); Lunch: white bagel with fat-free cream cheese, Rock Star drink (highly fortified soda with caffeine); Dinner: spaghetti, canned tomato sauce, whole-wheat garlic bread, small salad of Bibb lettuce only and a vinaigrette; Snacks: bag of low-fat popcorn, banana

Supplemental Lectures

I. **Antioxidants-** Reminder: atoms are composed of protons (positive), neutrons (neutral) and electrons (negative). The electrons zip around the protons and neutrons, much like the planets circle around the sun. Anyway, when bonds form, electrons are shared or swapped between specific atoms in specific ways. So, chemical reactions- when chemical bonds change- are all about moving electrons around. Each atom, and each molecule, needs a certain number of electrons to be stable (less reactive); certainly, the molecules of cells will only be functional if they have the right number of electrons. Cell activity often inadvertently produces unstable compounds that are missing an electron.

These unstable compounds are now called free radicals. Free radicals ravage working molecules by stealing electrons from them. This will stabilize the free radical, but turn the pilfered molecule into another free radical; it will steal an electron from someone else, and so on! This kind of domino effect of electron stealing is NOT good for maintaining cell functioning. So, cells keep lots of molecules on hand that can stop this domino effect: antioxidants.

Antioxidants are molecules that can be stable with a couple of different numbers of electrons. So, they can give up an electron or two and still be perfectly stable. Antioxidants will quickly donate electrons to free radicals, stabilizing them, and preventing any other free radicals from being formed. For example, vitamin C is an electron donor.

For clarification, electron transfers (when an electron moves from one molecule to another) usually involve H (hydrogen). H atoms have one electron; they happily give it up and exist as H+ (positive because there is now one more proton than electron). So, when vitamin C loses 2 H, the 2 electrons from the Hs go to the free radical, and the H+s just stick around, dissolved in the water of the cell. The 2 electrons vitamin C donates are actually part of H atoms.

II. More on carotenoids and retinoids:

I think the book alluded to this, but didn't state it clearly. The retinoids are provided primarily by animal sources, and the carotenoids by plant sources. As far as toxicity, it is the retinoids that have the greatest potential to be ingested in toxic amounts. The carotenoids are quite benign even when taken in large doses in supplement form (though as you know, this is unnecessary and may have longer-term negative effects if done on a regular basis).

On the other hand, the retinoids are unusual among vitamins in that it is possible to overdose from food alone if you choose the right food. Specifically, too much liver can provide toxic amounts of vitamin A. Even among the fat-soluble vitamins, this is an exception. It is virtually impossible to get toxic amounts of most vitamins or minerals from food alone.

III. Antioxidants in sugar?

Well, sort of. But not the white granulated kind. Honey and maple syrup do contain small amounts of antioxidants, and maple syrup contains some minerals (such as calcium and magnesium). Blackstrap molasses contains fairly abundant calcium, iron and magnesium. Dates, bananas and applesauce are naturally very sweet and mushy and can be a good sweetener in some recipes. There are other sweeteners that may contain small amounts of antioxidants or nutrients. Check out the link to PCCs guide to natural sweeteners from Chapter 4.

Anyway, the point of this is: when you have decided to sweeten something, consider using one of these alternatives. At least that way, you get a little more than just pure sucrose.