

Chapter 12 Reading Guide

1. Discuss the role of collagen in bone. Remind yourself: which vitamin is directly required for cells to build collagen?
2. Discuss the role of hydroxyapatite. List at least 2 minerals that are part of hydroxyapatite.
3. List several functions of bone.
4. Is bone static and unchanging? That is, once you reach adult size, do your bones stay the same size and shape throughout the rest of your life? Explain. Be sure to mention the roles of osteoclasts and osteoblasts. You may want to wait until the end of the chapter to gain a full understanding of your answer.
5. Explain how exercise affects bone remodeling (also addressed at the end of the chapter)
6. Around what age does resorption rate exceed formation rate of bone? Why is it important to achieve good bone health before this age?
7. List each of the nutrients mentioned in this chapter. For each:
 - a. Is it a vitamin or a mineral?
 - b. Is it water soluble or fat soluble?
 - c. When applicable, name the different forms (ex, phylloquinone and menaquinone are forms of V-K)
 - d. Their specific function with bone health, and any other functions discussed
 - e. Symptoms of deficiency and toxicity, and the names of the def/tox syndromes, when mentioned
 - f. How common deficiency is in the USA today, and why deficiencies occur here, when discussed
 - g. Why toxicities occur
 - h. Good, non-fortified food sources
 - i. Don't worry about where in the small intestine they are absorbed, or the method (fac. Diffusion, active transport etc)
8. Which vitamin is required for optimal calcium absorption?
9. Why is it so important that blood concentrations of calcium are maintained, and why is that more immediately important than bone calcium?

10. If blood calcium is too high or too low, does this reflect a problem with diet? Why or why not? Be sure to think about this one.
11. Explain the responses of the body to falling blood calcium levels; name the hormones involved, where each comes from, and their effects (how each contributes to stabilizing blood calcium).
12. List several food sources besides dairy that provide decent amounts of bioavailable calcium.
13. Pho soup is prepared from a beef stock in which beef bones are soaked and slow cooked. Is Pho probably a good source of calcium?
14. For a young person (teenager let's say), what is the best way to protect against bone loss after age 35?
15. What does the term "bioavailability" mean? Many nutrients have factors that affect their bioavailability. What are some factors that affect calcium bioavailability? By the way, that is a really difficult word to type fast!
16. Discuss specifically how taking high-dose $2+$ minerals (Mg^{2+} , Zn^{2+} etc) can affect Ca^{2+} (calcium) availability.
17. Many calcium supplements contain high levels of lead. Discuss how you can find lead-free calcium supplements.
18. Speaking of lead, it is a $2+$ metal. The body thinks it is calcium. One way to reduce your potential "lead load" (lead in the body) is to eat a diet high in calcium, iron, and the other $2+$ minerals. We are exposed to lead from a variety of sources, like it or not. Why do you think the status of your diet would affect the amount of lead that ends up in your body, or ends up interfering with calcium function?
19. What are two ways vitamin D is different than other vitamins?
20. Explain how vitamin D is activated by sunlight, naming the compounds produced and areas of the body involved (ie, describe the whole process). What is the active form of vitamin D called?
21. Why should we, as residents of the Pacific Northwest, be more careful to take vitamin D supplements in winter than Floridians?

22. Discuss correlations found between cancer, autoimmune diseases (ex, MS) and vitamin D (see link). *keeping in mind that more and more evidence is pointing in this direction, but there is still some controversy around this,
23. Which form of V-D is provided by animal foods? Plant? Which is more effective?
24. Describe vitamin D's role in increasing blood calcium.
25. Describe some factors affecting how much sunlight is needed to activate enough vitamin D.
26. Discuss the difference between rickets and osteomalacea.
27. Why can celiac disease and prolonged use of antibiotics lead to a V-K deficiency?
28. Besides food, we have one other small source of vitamin K. What is it?
29. Why are newborns often given a V-K supplement? (Extra info FYI: breastmilk is fairly low in V-K)
30. No extra questions re: phosphorus besides those from #7
31. Discuss some factors that affect magnesium bioavailability.
Note: the book does not use this term explicitly.
32. Describe a difference between hydroxyapatite and fluorohydroxyapatite.
33. What is osteoporosis? Why is it potentially dangerous beyond just the risk of bone fractures? Discuss several modifiable and non-modifiable factors that affect the development of osteoporosis.
34. Considering the vitamins and minerals covered so far, why is variety in the diet important?

Supplemental Lectures

- I. **Mineral interactions-** excess intake of certain minerals can interfere with the absorption of other minerals. This is really only an issue when taking mineral supplements, not minerals from food. A general rule is that similarly charged minerals interfere with each others' absorption. For example, if you take a Ca^{2+} supplement with a meal, the excess Ca^{2+} may interfere with the absorption of other $2+$ minerals: iron (Fe^{2+}), magnesium (Mg^{2+}), zinc (Zn^{2+}). For

this reason, some authorities recommend taking supplements between meals.

II. A little more on vitamin D and calcium

- a. The active form of Vitamin D (called “calcitriol”), as you know from the reading, is a hormone. Remember, hormones “tell” cells to do things. Calcitriol specifically targets cells lining the small intestine. Remember those cells of a villus, responsible for building tunnels to absorb nutrients? Those are the cells that respond to calcitriol. They respond by building calcium channels; so, calcitriol enables absorption of calcium from the diet. Without enough calcitriol, you will get VERY little calcium from your diet into your blood.
- b. A little bit about the importance of calcium (Ca^{2+}); you’ll see this repeated by the book. We all know that Ca^{2+} is important for bones. However, Ca^{2+} plays a variety of other roles that are crucially important, for example: muscle function, neuron function, and blood clotting. These functions depend on there being enough calcium in the BLOOD. If there isn’t enough Ca^{2+} in the blood to support these functions on a second-by-second basis, you die quickly.

Bones, on the other hand, can spare Ca^{2+} . Therefore, bones serve as Ca^{2+} reservoirs. When BLOOD Ca^{2+} starts to drop, bones will give up their Ca^{2+} to the blood. So, major variations in blood calcium are rare, regardless of diet. They would typically be caused by a problem with the hormone system, such as too much or too little PTH being produced.

Vitamin D (calcitriol) helps maintain bones by ensuring that when you eat something with Ca^{2+} , you actually absorb that Ca^{2+} . This spares the bone calcium, and allows bones to take up excess calcium from the blood.

III. Miscellany-

- a. Vitamin D supplements and food sources are typically in the D3 form; the last inactive precursor, the one that needs to be activated by the kidneys.
- b. Osteomalacia is caused by an acute vitamin D deficiency combined with severe depletion of calcium from the bones; osteoporosis is caused by chronic low-level deficiencies of either (or both) vitamin D and calcium.

IV. A little bit about lead

- a. As stated above, it is a 2+ metal, and the body thinks it is calcium (or one of the other 2+ minerals)
- b. Unfortunately, lead does not perform the functions of calcium. So, when it is used to help with neurotransmitter release (like calcium does), nothing happens. When it is used for muscle contraction, nothing happens. When it is used for blood clotting, nothing happens. When it is used to help with hormone communication, nothing happens. When... okay you get it. This is why it's a toxin.
- c. The "nothing happening" is really important. Calcium is absolutely crucial for cell functioning. With high enough exposure, lead is immediately toxic, but low-level exposure can manifest in other ways. In children, it means loss of IQ points and behavioral problems (reflecting neurological development problems) which is irreversible. In adults, it means a higher probability of developing dementia and a higher risk for stroke.
- d. Lead is stored in the bones and incorporated into the crystalline structures as "calcium." When your blood calcium drops and bone is broken down to provide calcium to the blood, some of the stored lead is released into the blood in addition to calcium.
- e. There are many sources of lead, and remodeling older homes is one of the most common sources for us. If you are considering it, stop now and send me an email. I'll give you more info about how to avoid lead dust exposure. In a later chapter, I will include more information about sources with links.

- f. Please immediately go to www.cspc.gov and check the recalls of children's products for lead if you have children, and throw out any cheap children's costume jewelry right now, regardless of whether it's been recalled. (Many non-recalled items simply haven't been tested). Look through all of the pictures so that you can get a good idea of what to look for in your toys, and make the decision about whether or not you want to keep suspect items.