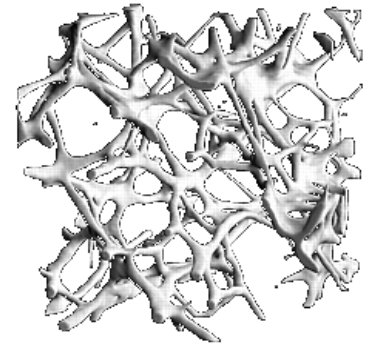


# CASE TEACHING NOTES for "Osteoporosis: Marissa, Jeremy and Eleanor"



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## INTRODUCTION

This case focuses on the physiology of bone homeostasis and methods of prevention and treatment of osteoporosis. One of the overall purposes of the case is to show students that osteoporosis is not simply a disease that afflicts elderly women. It affects men as well as women and carries both genetic and environmental risk factors. Although its prevalence increases with age and is more common in women than in men, anyone can develop this disease.

This case works well in an introductory nutrition course, a bone physiology course, a patho-physiology course, or a general education course focusing on the human body and disease. It would be beneficial to precede this case by teaching your students some endocrinology so that they have some knowledge of parathyroid hormone (PTH), calcitonin, bone and calcium storage, and hormone replacement therapy.

This case works particularly well in a course that meets biweekly for 80 minutes each class. Ideally, it takes two class periods to teach. For example, if a class meets on Tuesdays and Thursdays, the first half of the case is presented on Tuesday and the second half is presented the following Tuesday, allowing the students enough time to do the required research in between classes. Although a class size of 50 or less is ideal, this case could be adapted for use in large lecture halls with moveable seating.

## Objectives

In working through this case study, students will learn that osteoporosis can affect anyone and that calcium is not the only factor in preventing it. It is a far more complex disease than most people realize.

Students should be able to do the following upon completing the case study:

1. Accurately define osteoporosis.
2. List several risk factors for osteoporosis.
3. Describe the roles of osteoblasts and osteoclasts in bones.
4. Understand basic bone physiology and the concept of peak bone mass.
5. Explain how hormones, notably PTH, calcitonin, and estrogen, affect bone and blood calcium levels.
6. Understand that bones serve as calcium reservoirs.
7. Explain why calcium is vital to bone health.

8. Explain how vitamin D, sodium, caffeine, and alcohol affect calcium levels in the body.
9. List the best sources of calcium, in addition to dairy products and calcium supplements.
10. Explain how weight-bearing and/or resistance exercises protect and strengthen bones.
11. Understand how long-term use of glucocorticoids can increase the risk of developing osteoporosis.
12. Understand how hormone replacement therapy (HRT) can treat and/or prevent osteoporosis.
13. Know the pros and cons of HRT.
14. Know some options other than HRT available for osteoporosis.

## CLASSROOM MANAGEMENT

### Day 1:

Present the opening question to every student and allow approximately five minutes for individual brainstorming. This question was chosen because it may lead students to the assumption that only calcium affects bone health. Also, the student is unsure of who the speaker is. The ambiguity is intentional; this way, the student does not associate the disease with a specific type of person. They soon learn from the case study that osteoporosis is an extraordinarily complex issue. They will return to this question in the follow-up assignment, presumably with much greater sophistication.

Using the blackboard, have students share their questions and comments. Here are some examples of what they may come up with:

- What is osteoporosis?
- Why is calcium good for bones?
- What if a person can't have dairy products?
- Who gets osteoporosis?
- Are there any treatments?
- Is this disease genetic?
- What prevents osteoporosis?

Next, divide the class into three, equally sized groups, depending on the class size. Make sure each group has males and females. Distribute to each group one of the three scenarios (mini-cases). Each mini-case purposefully involves different genders and age groups, again to show the students that this disease can affect anyone. Allow each group several minutes to read the scenario. Have each group identify what they need to know to answer the questions listed at the end of each mini-case. The students will have to divide the work up among the group members to order to efficiently research the questions in their text as well as via the Internet and library. It is optional whether to provide the students with a reference list to use. Reading the case scenario and discussing and dividing up the research should take approximately 20 minutes. Explain to the students that they will have one week to research their topics and will be responsible for sharing what they find with their group and with the rest of the class.

The remaining class time can be used to cover another topic such as the menstrual cycle since it deals with estrogen and menopause, two key topics in this case study. Discussion of this topic could continue into the next classes until the case study resumes.

### Day 2:

Once the three groups have reassembled, have students discuss their results within their group. Their goal, of course, is to understand how each bit of information fits together to present a cohesive story about the individual in their case. Each group should select a member to share the information with the rest of the class. This can be done verbally or with an overhead projector or other audio-visual aids. (The

quality of the presentation can be greatly enhanced if the groups are given a few days to put together a group production.) During the presentation, the instructor will have many opportunities to intervene so the all of the main points are addressed. Make sure the other groups realize beforehand that they must understand other groups' research in order to complete the final assignment and to potentially earn extra credit. Fifteen minutes is a reasonable time for each presentation.

Take a five-minute break, and then divide the class into three new groups at random. (This utilizes the jigsaw method because members from each of the three original groups are now forming new groups and combining their knowledge.) Picking questions out of a box, have a contest to see which new group can answer the most questions correctly in 15 minutes. To make sure everyone participates, ask a question of each group member. A student should only have the option to pass one time. (These rules can obviously be changed depending on the size of the class.) Use the blackboard to tally the scores. The questions should stem directly from the case study as well as from the notes that the groups presented to the class. Thus, the teacher can see whether the objectives were met. The group that wins can earn extra credit, exemption from a future assignment, or some other reward.

Use the remaining time to summarize the case and its objectives and to pass out and explain the follow-up assignment. This should be due next class. (The follow-up assignment helps to summarize everything for the students and gives the teacher something concrete to use to judge whether each student met the objectives.)

### **Follow-up Assignment:**

Now that the case study is complete and critical information has been shared among the class and reinforced, each student is responsible for answering the question initially handed out at the beginning of the case study.

*I've always been told that calcium is important for strong, healthy bones. My mom says that as long as I drink milk, I won't develop osteoporosis. Is this correct? Is there anything else I can do to protect myself?*

Responses should be as detailed as possible, incorporating relevant information learned from the case. Tell the students that they should feel free to extend their research and add to their knowledge. Responses should be at least two pages in length and due next time class meets.

## **ANALYSIS OF MAJOR ISSUES**

Osteoporosis is the progressive loss of bone density due to a higher rate of bone resorption in comparison to bone formation, which can lead eventually to bone mass below fracture threshold. It does not, however, affect bone mineralization. Below are general answers to the questions that each group was given to research.

### **Answer Key**

Answers to the questions posed in the case study are provided in a separate answer key to the case. Those answers are password-protected. To access the answers for this case, go to [the key](#). You will be prompted for a username and password. For the username and password, contact the National Center for Case Study Teaching in Science administrator at [answerkey@sciencecases.org](mailto:answerkey@sciencecases.org).

## INTERNET REFERENCES

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**Image Credit:** Trabecular bone architecture of a lumbar spine bone biopsy of a 42-year-old male (left) vs. that of an 84-year-old woman having clinically manifested osteoporosis (right). Images used with permission, courtesy of Ralph Mueller, Ph.D., ETH Zuerich and Harvard Medical School, Boston.

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