

## CASE 26

### The Respiratory- System

Ms. McNaught has recently acquired some computer software that she can use to teach human anatomy and physiology to her high school biology students. The software depicts three-dimensional models of the human body that simulate such physiological phenomena as circulation, respiration, and digestion. The software also allows students to explore the models in a variety of ways—for example, by rotating or magnifying them, isolating particular systems or organs for closer inspection, or running simulations on specific systems.

Today, Ms. McNaught's students are in the computer lab using the new software to examine the “in's and out's” of human respiration. Sitting in pairs at various computer terminals around the room, the students have been instructed to identify the various components of the respiratory system, determine the function of each component, and explain how everything works in harmony to make respiration possible. Ms. McNaught gives each pair of students a worksheet on which to record observations and answer specific questions and then moves around the room to monitor students' progress and provide assistance where necessary. As she circulates, she hears snippets of several conversations.

Beau, a computer wiz, is the first student to bring a model of the respiratory system up on the computer screen. “Okay, Joan,” he instructs his partner, “list these parts of the respiratory system: trachea, lungs, bronchi, bronchiole.” He points to each part of the model as he names it, and Joan dutifully records the terms on the worksheet. Then Beau moves the mouse and clicks on another part of the screen. “Now let's see if we can make this guy breathe....”

As Ms. McNaught moves away from Beau and Joan, she overhears what Russell is saying to his partner Sally. “Put the names of the lobes here. No, not down there. Look at the computer model. This here is the middle lobe. This part down here is called the lower lobe.”

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Sally erases what she's written and then writes “middle lobe” and “lower lobe” the places where Russell has indicated.

“What does it say to do next?” Russell asks.

“Ah...let's see. Oh, now we're supposed to figure out what the diaphragm and the rib cage do during respiration.”

From another direction, Ms. McNaught overhears Carol complaining to her partner Keith. “Quit moving the model so fast. Honestly, I have to tell you this every time we do labs together! You change what's on the computer screen so fast that I can't get everything down on the worksheet. Come on, stop playing around, and turn the screen a little bit so I can at least see some of it.”

The following day, Ms. McNaught conducts a class discussion of the respiratory system. “So who can tell me...what do the diaphragm and the rib cage do when we breathe?”

“The diaphragm moves down and the rib cage moves out,” Diana answers.

87

### 88 Case26

“That's right. The diaphragm is a dome-shaped muscle just below the lungs, and when we breathe, it tightens and moves downward. At the same time, the muscles between the ribs pull the rib cage upward and outward. Now which process are we talking about here—inhaling or exhaling?”

“Inhaling,” Keith answers.

“Good. Can you explain why you know it's inhaling?”

“Well, the diaphragm flattens out, and the rib cage moves forward, so there's

more room inside the chest, and so air can come in.”

“Good job, Keith. So what happens when the air enters the chest?”

After referring to his notes, Mark answers, “Air goes through the trachea and then through the bronchioles and into the alveoli.”

“What happens when the air gets to the alveoli, Mark?” Ms. McNaught asks.

“Well, the alveoli are surrounded by lots of little blood vessels. The oxygen in the air passes through the membranes between the alveoli and the blood vessels and then goes into the blood.”

“Excellent. Now which muscle does most of the work when we breathe?”

“The diaphragm,” Kathy responds.

“Right,” says Ms. McNaught. “About how many times a minute does a typical adult inhale and exhale?”

“About 10 to 16 times,” Oliver replies.

“Is that when we’re resting or working hard, Oliver?”

“When we’re resting,” Martin responds. “It’s faster when we’re running or something.”

“Very good! Okay, class, for your homework assignment this weekend, I’d like you to write a one-page essay describing how the respiratory system works in conjunction with the cardiovascular system. In doing so, I hope you’ll begin to realize just what marvelous machines our bodies really are. Class dismissed.”

*Possible questions for “The Respiratory System”:*

- 1.
- 2.
- 3.
- 4.

*In what ways are the male and female students in Ms. McNaught’s class having different educational experiences?*

*Under the circumstances, why are the male students likely to learn and remember more than the female students about how the human respiratory system works?*

*Like most teachers, Ms. McNaught probably has no idea that her female students are having a different educational experience than the males. As a teacher, how might you minimize gender bias in your classroom?*

*Ms. McNaught ignores the students’ bickering during their laboratory time. Is this a good strategy? Why or why not?*

The Respiratory System 89

**5. How might a computer simulation facilitate students’ ability to construct an understanding of physiological systems?**

**6. Do you think that computer software that provides models and simulations of real-life systems and events can reasonably replace actual physical objects in high school science courses?**