As educators, we are continually designing new methods and procedures to enhance learning. During this process, good ideas are frequently generated and tested, but the extent of such activities may not be adequate for a full manuscript. Nonetheless, the ideas may be quite beneficial in improving the teaching and learning of physiology. *Illuminations* is a column designed to facilitate the sharing of these ideas (illuminations). The format of submissions is quite simple: a succinct description of about one or two double-spaced pages (less title and authorship) of something you have used for the classroom, teaching, lab, conference room, etc. You may include one or two simple figures or references. Submit ideas for inclusion in *Illuminations* directly to the Associate Editor in charge, Stephen DiCarlo (sdicarlo@med.wayne.edu).

**SIMPLE, INEXPENSIVE MODEL SPIROMETER FOR UNDERSTANDING VENTILATION VOLUMES**

Spirometers are useful for enhancing students’ understanding of normal lung volumes, capacities, and flow rates. Spirometers are also excellent for understanding how lung diseases alter ventilation volumes. However, spirometers are expensive, complex, and not appropriate for programs with limited space and budgets. Therefore, we developed a simple, inexpensive, small model of a spirometer. Activity-based models are more valuable for enhancing learning than many hours of passive instruction. The model spirometer enables students to measure ventilation volumes as well as simulate lung diseases and positive pressure (mechanical) ventilation. The spirometer consists of a glass 5-ml syringe connected to the “tracheal tube” of an existing model [(1), Fig. 1]. A glass syringe is used because the plunger slides with less resistance. The spirometer must be filled with air before it is attached to the tracheal tube. When the plunger of the lung apparatus (“diaphragm”) is pulled down, the air contained in the spirometer flows into the balloon (“lung”). Conversely, when the diaphragm is pushed up, the air flows from the lung into the spirometer. This volume, “tidal volume,” can be measured. In addition, the number of “breaths” per time, “respiratory rate,” can be determined, and minute ventilation can be calculated by multiplying tidal volume by respiratory rate. By use of this approach, students are able to determine lung volumes, capacities, and flow rates. Furthermore, the effects of obstructive and restrictive lung diseases can be simulated. An obstructive lung disease can be simulated by placing a clamp on the tracheal tube. A restrictive lung disease can be simulated by limiting the range of the diaphragm movement. Finally, mechanical ventilation can be simulated by using the plunger of the spirometer, forcing air to move into and out of the lung. This simple addition to an existing model (1) enhances students’ understanding of ventilation volumes.

**REFERENCES**


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10.1152/advan.00034.2003
We have used a lunchtime review of the answers to the morning’s examination to help students understand physiological concepts. This system helps students by correcting their misconceptions, reinforcing correct information, and giving them an opportunity to alert faculty to misleading or ambiguous questions.

Our human physiology one-semester, six-credit-hour course had four term examinations plus a comprehensive final examination. The class of about 180 dental, pharmacy, and physician assistant students was taught by four to six faculty members. The term exams were given from 8:00 to 9:50 AM, with answer keys being distributed when all students were finished.

The course coordinator met in the lecture/examination room with students at noon on the day of the examination. He invited students to propose alternative correct answers to the 50 multiple-choice questions in their sequential order. Miskeyed answers were corrected immediately, clearly incorrect answers were explained, and possibly correct alternatives were “taken under advisement” for further consideration.

The students’ answer sheets were scored by machine that same afternoon. The scoring print-out also summarized the number of students who answered each choice. The course coordinator met with the faculty member who had written each question that was controversial. The scoring showed whether the alternative answer was a general misconception or was isolated to a few students. The coordinator presented the arguments of the students to the faculty member, who then decided whether to allow an alternative correct answer. Once corrections had been made, the answer sheets were rescored to produce student grades. The posted grades included a printed explanation of why alternative answers had been accepted or rejected by the faculty.

This system was tried with medical students but not continued, because emotions were too high during the post mortem to achieve learning. Faculty simply considered alternatives where fewer than 50% of the students marked the correct answer. (This was also done for the final examination of 50 questions in the six-credit-hour course). For other than medical students, the examination post mortem is a teaching opportunity.

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10.1152/advan.00043.2003