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 (dicarlo@med.wayne.edu).

**Guarding against Instructor Complacency**

The education literature abounds with texts and articles to the effect that students learn best from instructors who are excited and passionate about their teaching. If you, the instructor, don’t think your subject is interesting, it is for sure your students won’t. One of my favorite passages that exemplifies, by extreme, problems that can be encountered by complacency on the part of an instructor comes from the second book of the Harry Potter series (J. K. Rowling, *Harry Potter and the Chamber of Secrets*, 1999, p. 148). The essence of the passage is as follows:

“History of Magic” was the dullest subject on their schedule. Professor Binns, who taught it, was their only ghost teacher. . . . Ancient and shriveled, many people said he hadn’t noticed he was dead. He had simply got up to teach one day and left his body behind him in an armchair in front of the staff room fire; his routine had not varied in the slightest since. . . . Today was as boring as ever. Professor Binns opened his notes and began to read in a flat drone like an old vacuum . . .”

I dare say that any experienced teacher, myself included, has been guilty at one time or an other of being like Professor Binns in failing to notice that, at the least, the passionate teacher in us no longer exists. Complacent from presenting the same material semester after semester, one day we simply get up to go to class and leave the passionate educator within us sitting behind in our office chair.

It doesn’t matter what we teach or how we teach it; the result of instructor complacency and boredom is the same—a transference of complacency and boredom to students. Even teaching methods that have a high level of active student involvement, such as problem-based learning, can be transformed into painfully dull routines by instructors who, like Professor Binns, drone on through the class period as though their minds and spirits are elsewhere, which they no doubt are. On the other hand, a didactic lecture, the method most touted as being the mother load of dull teaching, can be made into an exciting and meaningful learning experience by an instructor who is animated and passionate about the subject being presented.

So, how do we keep the passionate educator in us alive? One of the most helpful strategies that I have found to keep myself and my students interested in what is going on is exemplified by what is presently being done in this article; namely, using examples from the entertainment media (e.g., books, movies, TV shows) as auxiliary learning tools. In the present case, a passage from a novel, *Harry Potter*, was used to illustrate the problem of instructor complacency, a topic we discuss in our teacher training courses for graduate students. In other types of media, video clips represent an almost infinite source of relevant examples if you are willing to spend the time looking. A favorite clip is the “Lucy and Ethyl in the choco-
late factory” scene from the I Love Lucy show, which can be used to teach the concept of receptor saturation.

A related strategy is to use “interesting” examples from your own life to underscore lecture material—the “life is better than fiction” idea. This procedure is based on the observation that students are generally thrilled, as well as amazed, to learn that their professors are human. A favorite story of mine, which I use to teach temperature regulation, is about the time I got my wife hypothermic on a hike in the Grand Canyon. The fact that it was my wife and that she is still plotting to get back at me make it an engaging story for me as well as the students.

In brief, all instructors need to be on guard to not let enthusiasm and passion slip away from the classroom. Favoring presentations with relevant cameos from the entertainment media, as well as from real life, is one way to keep both you and your students excited and engaged in the material.

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10.1152/advan.00009.2002.

AN ANALOGY FOR EXPLAINING ERYTHROCYTE FRAGILITY: CONCEPTS MADE EASY

Undergraduate medical students often find it difficult to understand the phenomenon of osmotic fragility. An osmotic fragility test primarily indicates the surface area-to-volume ratio (SAVR) of red blood cells (RBC). Osmotic fragility of RBCs is defined as the case with which the cells burst in hypotonic solutions and is expressed in terms of the concentration of the saline solution in which the cells are hemolyzed (Fig. 1).

To demonstrate this concept, one can use a simple method. Take three small polyethylene bags (4 × 4 in.) to the class. Blow air into one of the bags to fill the bag to the maximum and tie the open end with a thread. Label it “S.” Similarly prepare bags one-half and one-quarter filled with air. Label them “N” and “L,” respectively. Ask the students to imagine bag N as a normal RBC, bag S as a spherocyte (enlarged RBC), and bag L as a leptocyte (flattened RBC). Draw diagrams for all the bags on the board.

Now, place these bags on the table. Take the S bag and put maximum pressure on it with your palms. In this analogy, the mechanical pressure applied on the bag simulates an osmotic challenge to a hypotonic exposure. The applied mechanical pressure is increasing the pressure inside the bag, which is analogous to the pressure inside an RBC that is exposed to a hypotonic solution. The bag will quickly burst, as it has less SAVR. Repeat the procedure with bags N and L. Bag N will bulge out and resist bursting. This is because of a greater SAVR. Similarly, bag L, because of a higher SAVR, will further resist bursting to pressure compared with bag N.

On the same board, draw an osmotic fragility curve. Point the drawing of bag N to the normal curve. Similarly point the bag S to the right of the curve and bag L to the left of the curve (Fig. 1).

Explain the SAVR in all three states. The osmotic fragility of RBCs reflects their ability to take up a certain amount of water before lysing. This is determined by their SAVR. The ability of the normal RBC to withstand hypotonicity results from its biconcave shape, which allows the

FIG. 1. The figure shows a normal osmotic fragility curve with right and left shifts in spherocytosis and leptocytosis, respectively. The normal cell swells when placed in a 0.6% saline solution. Normally hemolysis begins at 0.42%, when the red blood cell (RBC) volume increases to ~145% of normal. In a 0.35% saline solution, the cells are fully hemolyzed. RBC volume at this concentration, before it bursts, is about 165% of normal (critical hemolytic volume).
cell to increase its volume by \( \sim 70\% \) before the surface membrane is stretched. Once this limit is reached, lysis occurs. Emphasize at this point that an RBC cannot accommodate more than its capacity by overstretching.

Now it will be easy for you to explain the abnormal states. A spherocyte (bag S) will burst at higher saline concentrations. Here, SAVR is less, even before the osmotic (mechanical) challenge is given. The RBC’s ability to take in water before stretching the surface membrane is thus more limited than normal, and it is, therefore, particularly susceptible to osmotic lysis. Thus, in this case, the osmotic fragility curve will shift to the right. That is, the lysis will start at an even lower hypotonic challenge. A leptocyte (bag L) has a higher SAVR to begin with. Thus it will accommodate the osmotic challenge of lower saline concentrations and will burst after taking more water. As a result, there will be a shift to the left in the curve. That is, the lysis starts at a higher hypotonic challenge.

This analogy will definitely enhance the students’ understanding of the concept of osmotic fragility, not only in terms of factual recall, comprehension, and analysis, but also in its application and synthesis.

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10.1152/advan.00008.2002.

Experiment to Help Students Understand Pulmonary Compliance

Compliance is a difficult concept for students to grasp, and in particular, pulmonary compliance is quite difficult because it involves an understanding of both lung and chest compliance. To help students understand pulmonary compliance characteristics, relaxation curves for the chest cage (Fig. 1A), lung (Fig. 1B), and combined lung-chest cage (Fig. 1C) are often presented to medical students. To facilitate an understanding of the relaxation curves, we demonstrate how the curves are generated by substituting a balloon for the lungs and a tennis ball for the chest cage. Students are told that when the lung is removed from the chest cage, it closely resembles a collapsed balloon. Subsequently, a collapsed balloon is connected to a pressure transducer that is coupled to a data acquisition system. The students observe that, when pressure inside the balloon equals outside pressure, or transmural pressure is zero, balloon volume is close to zero. Starting from essentially zero balloon volume, a measured volume of air is put into the balloon, and the recoil or relaxation pressure associated with the addition of that air volume is recorded. Additional measured volumes of air are added to the balloon, and the corresponding recoil or relaxation pressure is recorded. Compliance of the balloon is obtained by plotting balloon recoil or relaxation pressure on the x-axis and balloon volume on the y-axis. The slope of this plot is balloon compliance.

Next, students are told that, in the absence of the lung, the moderately inelastic chest cage resembles a punctured tennis ball. Subsequently, a tennis ball, punctured by an 18-gauge needle, is connected to the pressure transducer. The students observe that, when transmural pressure is zero, the tennis ball has considerable air. Starting at this initial, or equilibrium volume, a compliance curve for the ball can be constructed by the sequential addition or removal of measured volumes of air and recording the corresponding recoil or relaxation pressure. With the sequential addition of air, a positive recoil pressure is recorded. Subse-

FIG. 1. Relaxation curves for the chest cage (A), lung (B), and combined lung-chest cage (C).
sequently, the ball is returned to its equilibrium volume, and measured volumes of air are removed and the corresponding negative recoil pressures are recorded. Compliance of the ball is obtained as described above for the balloon. When plotted, data obtained during these demonstrations look remarkably like the relaxation curves obtained with the lung and chest cage (Fig. 1). During this demonstration, the students actually observe the procedures and analysis involved in generating relaxation curves. This process brings the concept “alive” and provides a further appreciation of the compliance of the lung and chest wall.

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