ILLUMINATIONS

SUBMITTING ILLUMINATIONS FOR REVIEW

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).

Creating A Simple Powerpoint Multimedia Game

We developed an educational game in pulmonary physiology for first-year medical students based loosely on the popular television game show, *Jeopardy*. The purpose of our game, Pulmonary Jeopardy, was to provide students with an educational tool by which to review material previously presented in class. Our goal was to encourage students to be active participants in their own learning process. The Pulmonary Jeopardy game, complete with questions and links to answers, was developed using Microsoft PowerPoint. Educators with experience using PowerPoint and its capabilities to generate action buttons and text boxes and to apply action settings such as hyperlinks and sound events can easily generate similar games.

To create the game, we first identified eight categories (e.g. general concepts, pulmonary mechanics, pulmonary ventilation, pulmonary blood flow, etc.) and designed a game board similar to the one used for *Jeopardy* (Fig. 1A). The game board slide was the first slide in the presentation and contained text boxes identifying the categories and text boxes identifying dollar amounts arranged below each category (Fig. 1A). The second slide generated was used as a template for all of the question slides (Fig. 1B). The template slide contained an action button ( بلاي اند) hyperlinked to the first slide (Game Board, Fig. 1A). In addition, this template slide also contained four or five additional action buttons ( بلاي اند). These buttons were set to play either an “applause” sound effect for the one correct choice or an “explosion” sound effect for the remaining incorrect choices. This template slide was then copied and pasted repeatedly in the slide sorter view to generate enough slides for all of the questions. Next, multiple-choice questions with their choices were pasted onto each slide. The action buttons were then arranged so that the correct choice had the “applause” action button next to it, and the remaining incorrect choices had the “explosion” action buttons next to them (Fig. 1B). Finally, dollar amounts on the game board slide were hyperlinked to their respective question slides.

We used this game for a review session in class. Students reported that the review session was fun and rewarding. In addition, the game can be distributed as an interactive review tool. This PowerPoint presentation game is available for download at the APS archives for teaching resources (http://www.apsarchive.org/search/FactSheet.asp?ID=150&RetTo=basic). The game can be used “as is” or modified to match individual class needs.

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Sample “Game Board” and “Template Question” slide. Each dollar amount on the Game Board (A) is hyperlinked to a specific “Question” slide (B). Each answer on the “Question” slide has an action button (_sound_event) next to it that plays either an “explosion” sound for incorrect choices or an “applause” sound for the correct choice. Finally, the (sound_event) action button is hyperlinked back to the Game Board slide (A). The students can then continue playing the game by selecting a new dollar amount. FRC, functional residual capacity; FVC, forced vital capacity; TLC, total lung capacity; FEF, forced expiratory flow.

FIG. 1.
Interactive Classroom Demonstration of Skeletal Muscle Contraction

Students in a traditional lecture-style course often struggle to visualize the sequence of events in the molecular mechanism of skeletal muscle contraction as represented in anatomy and physiology textbooks (e.g., Ref. 1). The author of this article has successfully used the following interactive method with first-year nursing students. If the students are able to state the functions of calcium, tropinin, tropomyosin, and cross-bridges, the demonstration requires only 15–20 minutes of class time. The size of the actin and myosin filaments can be varied according to the class size.

For a sample class of 15 students, the required materials are: six apples (actin molecules), six bananas (myosin molecules), six signs with ATP in bold print on one side and ADP + Pi in bold print on the other side, and

![Diagram of muscle filaments]

**FIG. 2.**

A: orientation of each student in the thin-filament during the set-up of the demonstration. Tropomyosin (left forearm and hand) covers the actin-active sites (apples) during the set-up phase of the demonstration. Tropinin (head of student) will bind Ca²⁺ in the interactive part of the demonstration, causing tropomyosin (left forearm and hand) to move, uncovering the actin-active sites (apples). B: students enacting myosin cross-bridge formation following Ca²⁺ binding.
six signs with Ca\(^{2+}\) in bold print on both sides.

To set the stage for the demonstration, first set up a *thin filament* line of six students. Each student in that line will flex the right elbow and place an apple with the stem end facing anteriorly in the palm of the right hand (Fig. 1A). The apple represents an actin molecule, and the stem indentation represents the active site for binding with the myosin cross-bridge. Students will cover the actin-active sites with their left hands and line up all the left forearms, forming one continuous tropomyosin molecule. The troponin molecules are represented by the heads of the students. Next, set up a *thick filament* line of six students facing the thin filament. Each student in that line will hold a banana in the right hand. The bananas (myosin cross-bridges) of all students in the line should be held at a similar angle, pointing toward the opposing actin molecule. (The myosin cross-bridges stay attached to actin until they receive the new ATP molecules.) During the power stroke, the ADP + P\(_i\) sign detaches. This sign should be lifted and flipped over so as to become an ATP sign, which then reattaches to the myosin (at the forearm). 4) As the ATP sign attaches to the myosin, the cross-bridge (banana) detaches from the actin (apple). The ATP is converted to ADP + P\(_i\), so the myosin students flip their signs again. The myosin cross-bridge, now in the high-energy state, reattaches to actin, and the above steps repeat. At some point, ask the Ca\(^{2+}\) students to detach and return to the SR. The tropomyosin covers the active actin sites and the contraction ends. The myosin cross-bridges are left in their high-energy state and wait for the next opportunity to bind with actin.

If time permits, a critique of the demonstration is useful: *In what way might you improve this model to better represent what happens during muscle contraction?* 1) The power strokes of myosin molecules of the thick filament are actually asynchronous. For simplicity, they are represented here as though they all happened at once. 2) The troponin and tropomyosin should be closer together (the heads of the thin-filament students acted as troponin merely for convenience as a symbolic site of Ca\(^{2+}\) attachment). 3) The ATP or ADP + P\(_i\) should be attached to the myosin heads (bananas), but that would also clutter up the demonstration.

**REFERENCES**