Classic experimentation and working models for engaging and inspiring students

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Our students have a robust, innate propensity and desire to learn and to actively assimilate knowledge. They are naturally curious, with powerful intrinsic motives to understand their world. Accordingly, we, as teachers, must capitalize on this inherently active and curious nature so that learning becomes a joy and an activity to be sought out. By capitalizing on our students’ inherent curious nature, they will be impatient to run home, study, contemplate, learn, grow, and create (2).

The pioneer work of Giulio Ceradini, illustrating the mechanism of closure of the semilunar valves, was highlighted in a recent historical review (1, 3) and is a catalyst for achieving these goals. Ceradini used ingenuity, a pig heart preparation, tubes, a manometer, and a visualizing apparatus to document that semilunar valve closure is a consequence of the decelerated systolic efflux. This original, imaginative, and creative work can be the spark that ignites the scientific flame in the heart of our students.

To highlight his historic work and enhance our students’ appreciation of classic experimentation as well as this simple yet elegant structure, we developed a simple working model of the semilunal valve. A simple, working model is in itself more engaging and inspiring than copious content delivered from someone’s mouth. Accordingly, activity-based models are more valuable for nurturing our students’ innate propensity and desire to learn than many hours of passive instruction.

The model is inexpensive and simple to build. All that is required are two sections of plastic tubing [one 10-cm-long section, 31 × 25 mm (outside and inside diameters), and one 5-cm-long section, 25 × 19 mm (outside and inside diameter)], a good pair of scissors or a similar cutting device, and a long balloon. The diameter of the balloon must be similar to the diameter of the smaller tubing and at least 10 cm in length.

Once the materials are assembled, cut the larger and longer 10-cm tubing into two sections of ~5 cm in length. Next, make a longitudinal slit (~3 cm in length) along the smaller tubing such that you have a slit along both sides. Carefully trim the edges of the slit to make room for the outside wall of the balloon.

Now, cut the balloon into two cross sections of ~3.5 cm in length. Place one edge of the balloon section into the slit and stretch the other edge over the side of the tube. Repeat this procedure for the other balloon section. At this point, you should have the smaller tube with two balloon sections extending from the end (Fig. 1A).

The next step is to fold the free ends of the balloon segments over the sides of the smaller tube (Fig. 1B) and insert one section of the larger tubing over the end of the smaller tube that has the folded balloons (Fig. 1C). The final step is to insert the
last section of larger tubing over the end of the smaller tubing that does not have the folded balloons.

Once the model is fully assembled, place the model under a facet and run water through one end (Fig. 2A). Reverse the ends and repeat the procedure (Fig. 2B). As you will discover, water will flow through the model in only one direction. A discussion of the physiological significance of one-way valves in the heart will naturally evolve to their importance in veins (an often underdiscussed and appreciated regulatory mechanism).

This student-implemented (veterinary and human medical students) protocol for building and testing the model along with the assigned readings of the pioneering work of Giulio Ceradini (1) was rewarding for the teacher and students. The teachers facilitated the process by asking leading questions to guide the students toward the development of their own conclusions. The activity encouraged in-class discussion, collaborative problem-solving, and inquiry-based thinking. This activity also focused student learning on how to use scientific knowledge to solve important questions. This is important because learning is not committing a set of facts to memory but the ability to use resources to find, evaluate, and use information.

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