The starting point and the end goal for any instructional practice is student understanding. Students enter biology classrooms with ideas about the nature of life and of living organisms, and good instruction will take these prior understandings into consideration (Arnaudin & Mintzes, 1985). Modern educational theory, as evidenced in the conceptual change model of learning, encourages science instructors to focus less on fact-based, rote learning mechanisms and more on conceptually-driven instruction (NCR, 1996; Posner et al., 1982). In teaching for conceptual change, the instructor plans instruction by first eliciting students’ prior understandings and then incorporating these understandings into the learning structure of the class (Champagne et al., 1980). One challenge to teaching for conceptual change is to find new ways to formatively assess (probe) what students know. In this article, probing strategies will be discussed for assessing students’ understanding prior to and during instruction.

Tools for Determining Students’ Prior Knowledge

Scientific explanations sometimes require students to think in novel ways. Students’ thinking about scientific phenomena often comes from informal experiences. Sometimes the student’s thinking is congruent with scientific understanding and sometimes the thinking is inconsistent with scientific understanding (Keeley, Eberle & Farrin, 2005). Often, explanations in biology are counterintuitive to students. For instance, students incorrectly believe that when the lungs inflate the chest expands. The accurate explanation is that when the chest expands the lungs inflate. When I am teaching the respiratory system, I must take this into consideration or students will maintain their inaccurate thinking even after instruction. A teacher must take the prior knowledge of the students into account. Otherwise the students may resist the scientific explanation. These barriers to learning may exist in students at all grade levels. Determining prior knowledge of students will help the teacher customize lessons to improve student learning. Assessment examples in this article are called “probes” and are, for the most part, formative or diagnostic in nature. The probes are assessments “for learning, not assessments of learning” (Keeley, Eberle & Farrin, 2005, p. 3). Probing strategies will:

- help students understand their own learning
- reveal students’ misconceptions
- help students build a more coherent, holistic conception of life science concepts (AAAS, 2005).

If students are not engaged in their own learning, “they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but revert to their preconceptions outside of the classroom” (Bransford, Brown & Cocking, 1999, p. 14). Science content is often taught as isolated pieces of information. Students need to learn the holistic conception of life science concepts; science is a set of larger concepts with many associated facts (NSTA, 2002).

Special Considerations for Science Instructors

Before adopting any particular instructional innovation, science instructors must adapt the strategy to meet the needs of the particular student population in their school context. As expected, science learning expectations vary greatly among and across college science courses (Bilica, 2004). The variances occur due to factors, such as the nature of the institution (private or public, large or small) and the audience for the course (science majors or non-majors). “No size fits all” is applicable to science instruction. The three probing strategies described in this article can be used effectively in a variety of contexts; however, we encourage instructors to consider ways to adapt use the strategies to meet the needs of their own students and courses (NSTA, 2002). The aim of this article is to provide support for science instructors who wish to implement new strategies to probe student understanding, not to prescribe a single best way to conduct a science course.