4th Grade Living Environment Unit
Student Misconceptions

Common Misconceptions Observed by Classroom Teachers of Unit

Many students do not differentiate between observations and inferences. When making written observations of the terrariums, many students include opinions and speculations about what the organisms are doing. Extensive modeling of making observations is necessary to facilitate student learning within this area. Showing and critiquing anonymous student work samples, such as those from another class, also serve as effective methods for helping students improve their observational skills.

When drawing the terrariums, many students add details not present. For example, the students will draw faces on the hermit crabs. Again, modeling and reviewing/critiquing student work samples will help students improve in their abilities to make sketches that accurately portray the details they see.

During the pilot of the unit, it was uncovered that many students believed the animals only obtained water through their drinking dishes. Students further generalized that animals in nature only take-in water through streams, lakes, and other large bodies of water. Students do not view puddles, raindrops and especially foods as sources of water.

Misconceptions about the Nature of Science and Scientific Inquiry (AAAS, 1993, p. 332-333)

Experimentation
Upper elementary- and middle-school students may not understand experimentation as a method of testing ideas, but rather as a method of trying things out or producing a desired outcome (Carey et al., 1989; Schauble et al., 1991; Solomon, 1992). With adequate instruction, it is possible to have middle-school students understand that experimentation is guided by particular ideas and questions and that experiments are tests of ideas (Carey et al., 1989; Solomon et al., 1992). Whether it is possible for younger students to achieve this understanding needs further investigation.

Students of all ages may overlook the need to hold all but one variable constant, although elementary students already understand the notion of fair comparisons, a precursor to the idea of "controlled experiments" (Wollman, 1977a, 1977b; Wollman & Lawson, 1977). Another example of defects in students' skills comes with the interpretation of experimental data. ...Students tend to make a causal inference based on a single concurrence of antecedent and outcome or have difficulty understanding the distinction between a variable having no effect and a variable having an opposite effect. [After conducting just one experiment or one trial of an experiment, students are inclined to conclude that the independent variable in an experiment caused a change in the dependent variable.] Furthermore, students tend to look for or accept evidence that is

consistent with their prior beliefs and either distort or fail to generate evidence that is inconsistent with these beliefs. These deficiencies tend to mitigate over time and with experience (Schauble, 1990).

Nature of knowledge

Students' ideas about the nature of knowledge and how knowledge is justified develop through stages in which knowledge is initially perceived in terms of "right/wrong," then as a matter of "mere opinion," and finally as "informed" and supported with reasons (Kitchener, 1983; Perry, 1970). This research provides some guidance for sequencing the benchmarks about the nature of scientific knowledge. For example, it suggests that students may not understand before they abandon their beliefs about knowledge being either "right" or "wrong" that scientists can legitimately hold different explanations for the same set of observations. However, this research does not say when, how quickly, and with what experiences students can move through these stages given adequate instruction. Several studies show that a large proportion of today's high-school students are still at the first stage of this development (Kitchener, 1983; Kitchener & King, 1981). Further research is needed to specify what school graduates could understand, if from a young age they were taught that different people will describe or explain events differently and that opinions must have reasons and can be challenged on rational grounds.

Students' Understanding of Classification (AAAS, 1993, p. 340)

Some research indicates that in 2nd grade there is a shift in children's understanding of organisms from representations based on perceptual and behavioral features to representations in which central principles of biological theory are most important. Children at this age can begin to understand that animals of the same species have similar internal parts and offspring (Keil, 1989). When asked to group certain organisms, lower elementary-school students form groups of different status—for example, organisms that are able to fly and organisms that fight each other. Upper elementary-school students tend to use a number of mutually exclusive groups rather than a hierarchy of groups. Some groups are based on observable features; others on concepts. By middle school, students can group organisms hierarchically when asked to do so, whereas high-school students use hierarchical taxonomies without prompting (Leach, et al., 1992).

Misconceptions about the Interdependence of Life (AAAS, 1993, p. 342)

Relationships between organisms

Lower elementary-school students can understand simple food links involving two organisms. Yet they often think of organisms as independent of each other but dependent on people to supply them with food and shelter. Upper elementary-school students may not believe food is a scarce resource in ecosystems, thinking that organisms can change their food at will according to the availability of particular sources (Leach et al., 1992). Students of all ages think that some populations of organisms are numerous in order to fulfill a demand for food by another population (Leach et al., 1992).

Habitat
Middle-school and high-school students may believe that organisms are able to effect changes in bodily structure to exploit particular habitats or that they respond to a changed environment by seeking a more favorable environment (Jungwirth, 1975; Clough & Wood-Robinson, 1985a). It has been suggested that the language about adaptation used by teachers or textbooks to make biology more accessible to students may cause or reinforce these beliefs (Jungwirth, 1975).

<u>Students' Understanding of Controlled Variables</u> (AAAS, 1993, p. 360)

Upper elementary-school students can reject a proposed experimental test where a factor whose effect is intuitively obvious is uncontrolled, at the level of "that's not fair" (Shayer & Adey, 1981). "Fairness" develops as an intuitive principle as early as 7 to 8 years of age and provides a sound basis for understanding experimental design. This intuition does not, however, develop spontaneously into a clear, generally applicable procedure for planning experiments (Wollman, 1977a, 1977b; Wollman & Lawson, 1977). Although young children have a sense of what it means to run a fair test, they frequently cannot identify all of the important variables, and they are more likely to control those variables that they believe will affect the result. Accordingly, student familiarity with the topic of the given experiment influences the likelihood that they will control variables (Linn & Swiney, 1981; Linn, et al., 1983). After specially designed instruction, students in 8th grade are able to call attention to inadequate data resulting from lack of controls (see for example Rowell & Dawson, 1984; Ross, 1988).

Source:

American Association for the Advancement of Science (1993). *Benchmarks for science literacy*. New York: Oxford University Press.