THE AMERICAN
BIOLOGY TEACHER

Guest Editorial

Preventing Plant Blindness

James H. Wandersee Elisabeth E. Schussler

Several studies show that U.S. students prefer to study animals rather than plants (Baird, Lazarowitz & Allman 1984; Wandersee 1986). Although this research shows girls are more interested in learning about plants than boys are, even girls report that they prefer animals. A recent cross-age study we conducted with 4th-, 5th-, 6th- and 7th-grade urban, public elementary and middle school students revealed that those students, overall, were twice as interested in animals as they were in plants—with little change as age increased. About 7% of the 274 students we queried spontaneously expressed a scientific interest in plants, and of that 7%, about two-thirds were girls (Wandersee & Schussler 1998b).

Paradoxically, plants form the basis of most animal habitats and all life on earth (Abbott 1998). While animals frequently steal the spotlight where extinction is concerned, one in eight plant species worldwide is currently threatened by extinction. Intellectually, we know that you don't get pandas without bamboo plants, but culturally this is often forgotten (Abbott 1998).

Because plants differ in many important ways from animals, and because biology is taught by members of the animal kingdom, there is a recognized tendency, even for knowledgeable biologists, to overlook, underemphasize, or neglect plants when teaching introductory biology courses (Darley 1990; Hershey 1993, 1996; Nichols 1919; Uno 1994). As two botanists who are concerned about the implications of this imbalance for the nation's science literacy level, we have launched a national campaign to increase public understanding of plants, using these catchwords: "Prevent Plant Blindness."

Those three simple words appear on our full-color classroom poster which is being distributed to more than 22,000 U.S. science teachers at state and national science teachers' conventions. The poster is designed to be initially puzzling. It shows a tree-lined, riverine environment emblazoned diagonally with the words "Prevent Plant Blindness." Hovering, Magritte-like, in the sky above is a pair of dark-red-tinted spectacles. The implication is that someone wearing these glasses could not see the green plants in the scene below—that if one's vision is "filtered," either physically or conceptually, one may easily miss seeing the plants that appear in one's field of vision.

We consider the current state of underrepresentation as much more than just the result of *zoocentrism* or *zoochauvinism*. That's why we decided to introduce a new term, one that emphasizes the perceptual and visual-cognition bases of why plants are often overlooked and neglected—not just by biology teachers, but by humans in general. Because we knew people were already linguistically familiar with *blind* as a metaphorical adjective (e.g. blind alley, blind ambition, blind chance, blind copy, blind date, blind landing, blind seam, blind spot, blind trust, snow blindness, need-blind admissions, color blindness), we settled upon *plant blindness.*

We define *plant blindness* as (a) the inability to see or notice the plants in one's environment; (b) the inability to recognize the importance of plants in the biosphere and in human affairs; (c) the inability to appreciate the aesthetic and unique biological features of the life forms that belong to the Plant Kingdom; and (d) the misguided anthropocentric ranking of plants as inferior to animals and thus, as unworthy of consideration (Wandersee & Schussler 1998a).

Those persons afflicted with the condition known as *plant blindness* exhibit symptoms such as the following: (a) thinking that plants are merely the backdrop for animal life; (b) failing to see, notice or focus attention on plants in one's daily life; (c) misunderstanding what plants need to stay alive; (d) overlooking the importance of plants to one's daily affairs

(Balick & Cox 1996); (e) failing to distinguish the differing time scales of plant and animal activity; (f) lacking hands-on experiences in growing, observing and identifying plants in one's own geographic region; (g) failing to explain the basic plant science underlying nearby plant communities—including plant growth, nutrition, reproduction, and relevant ecological considerations; (h) lacking awareness that plants are central to a key biochemical cycle—the carbon cycle; (i) being insensitive to the aesthetic qualities of plants and their structures—especially with respect to their adaptation, coevolution, color, dispersal, diversity, growth, pattern, reproduction, scent, size, sounds, spacing, strength, symmetry, tactility, taste and texture (Wandersee & Schussler 1998a).

Why *do* humans overlook plants? Most people think they see all of their surroundings by merely opening their eyes and looking. There is, however, much scientific evidence to the contrary (Catell 1895; Nickerson & Adams 1979). Norretranders (1998) points out that the human eye, during visual perception, generates more than 10 million bits of data every second for visual processing, from which our brain ultimately derives approximately 40 bits per second for our conscious vision to consider; thus, "the bandwidth of our consciousness is far lower than the bandwidth of our sensory perceptors."

In our *plant blindness* presentation, we demonstrate that this is so by asking our audience members to make a sketch of both sides of a U.S. penny (1 cent coin), using only their unaided memory. After a few minutes of "graphic exasperation," and after generating only a partially correct representation at best, we ask them to examine the (dependably flawed) sketches made by others in the audience as well. Finally, we tell them to compare their drawings to a real penny that they extract from their own pocket or purse. Smiles and consternation are evident throughout the room. Everyone wonders: How could I possibly fail to recall the details of something I look at and handle almost every day of the year?

"We. . .tend to be surprisingly bad at recalling details of objects we see or use daily," notes acclaimed memory researcher Alan Baddeley (1982). Just because we looked doesn't mean that we saw everything. Harvard University psychologist Stephen Kosslyn (1993) reminds us that "the mind is not a camera, the brain is not a VCR." Rugg (1998, p. 1151) points out that "all events are not equal; they differ in how they are [initially] encoded into memory." He says that two critical factors determine whether or not we will remember an event: the degree of attention we give to it, and the meaning or importance we ascribe to it.

In seeking a better explanation for *plant blindness*, we have compiled the following characteristics of human perception and visual cognition to answer the question: Why do humans overlook plants?

1. People typically know less about plants than animals. Persons who have had few meaningful educational experiences involving plants have little basis beyond popular culture for plant recognition. We can only recognize what we know. Psychologists would say that plants *have low signal value* for most humans today. Once objects have acquired meaning for an observer, they are more likely to be perceived (*inattentional blindness*). In other words, inattention becomes attention if a stimulus has meaning (Mack & Rock 1998). Also, the stimulus must actually be present—yet approximately half of the biomass of many plants (the root system) is found underground and rarely seen by most people.

2. When flowering plants are not flowering or have inconspicuous flowers, the homogeneity of their green leaves and stems does not serve to visually label them or make them pop out chromatically from their background. If objects are not sufficiently different from their backgrounds, they blend in with their surroundings and nothing is perceived. The visual cortex continuously filters out much more of the information the retina sends it than it retains for conscious analysis. Without our intention to preserve it, visual plant-related data is likely to be discarded.

3. Members of plant populations often grow in close proximity to each other (whether cultivated or natural) and appear relatively stationary—in contrast to the mobility of most animal population members. Static proximity is a visual cue humans use to group objects (Zakia 1997), so individual plants and different plant species tend to be de-emphasized, with the totality merely categorized as "plants." This helps to explain the

"plants as backdrop" phenomenon. Contrary to the cliché, we are actually more likely to see just the forest, and not the trees.

4. For humans, plants are generally nonthreatening elements of an ecosystem and can usually be ignored without dire consequences. Visual habit and general familiarity diminish the conscious attention we give to objects. If vision operates to minimize expended effort, then *low level attributes* may be discarded to make visual processing easier. Note how our visual search is suddenly directed and intensified by the knowledge that poison ivy may be present where we are walking!

5. Visual experiences are structured in the brain by space, time and color. As a consequence of their different mode of nutrition, plants typically offer fewer spacing-based, time-based, and color-based differentiators for humans to observe than animals do (Zakia 1997). The brain is basically a difference detector, and when it finds none, the perceptual field is not perturbed. For example, invasive plants capture our attention because they grow with vigor in places where we don't expect or want to find them.

Couple those facts with these characteristics of nonhuman animal life and you can understand why the students we queried responded as they did. Animals can move quickly via appendages; have to eat regularly like we do; have eyes for vision; exhibit many interesting behaviors; have dramatic and easily observable life cycles; mate, give birth, and raise their young; and interact with, and sometimes play with, humans (Wandersee 1986). Beginning in the first six weeks of infantile life, humans develop a propensity to respond first to things in their environment that have faces, and animals best meet this search criterion.

The Botanical Society of America (Niklas 1995, p. 3), in its turn-of-the-century report titled: *Botany for the Next Millennium*, "...situates the importance of plant studies within three major areas of biological inquiry— the evolution and diversity of life, the development of organisms, and the structure and function of ecosystems." It notes, tantalizingly, "In each area, plants offer a wealth of compelling material and systems that have been underexplored or unintegrated with the main questions of biology, largely because of biologists' narrow training."

If we are to escape from the intellectual, perceptual and visual processing traps that lead to *plant blindness*, those of us who teach introductory courses must work to expand our students' botanical horizons. While the life sciences may be reorganizing themselves along the line of common themes rather than clusters of organisms studied, plants remain distinctly different life forms that have, historically, rewarded our focused study, observation and investigation. There are good scientific reasons why botany, like the plants it studies, needs to maintain its visibility and identity.

We have argued that, instead of invoking the bugbear of zoological conspiracy, there is actually a visual-cognitive-societal basis for why plants (and the plant sciences) are frequently ignored in everyday life, in the introductory biology curriculum, and as a key component of scientific literacy. Functionally, plants remain "the primary mediators between the physical and biological world" (Niklas 1995, p. 11). That is certainly no small feat, and it alone is worth modifying introductory biology teaching to "Prevent Plant Blindness!"

References

Abbott, C. (1998, April 9). Extinction threatens 1 in 8 plants globally. *Yahoo News*, pp. 1–2.

Baddeley, A. (1982). *Your Memory: A User's Guide*. New York: Macmillan.

Balick, M.J. & Cox, P.A. (1996). *Plants, People, and Culture: The Science of Ethnobotany*. New York: Scientific American Library.

Baird, J.H., Lazarowitz, R. & Allman, V. (1984). Science choices and preferences of middle and secondary school students in Utah. *Journal of Research in Science Teaching, 21*, 47–54.

Cattell, J.M. (1895). Measurement of the accuracy of recollection. *Science, 20*, 761–776.

Darley, W.M. (1990). The essence of 'plantness'. *The American Biology Teacher, 52*, 354–357.

Hershey, D.R. (1993). Plant neglect in biology education. *BioScience, 43*, 418.

Hershey, D.R. (1996). A historical perspective on problems in botany teaching. *The American Biology Teacher, 58*, 340–347.

Kosslyn, S.M. (1993, September/October). The mind is not a camera, the brain is not a VCR. *Aldus Magazine*, pp. 33–36.

Mack, A. & Rock, I. (1998). *Inattentional blindness*. Cambridge, MA: MIT Press.

Nichols, G.E. (1919). The general biology course and the teaching of elementary botany and zoology in American colleges and universities. *Science, 50*, 509–517.

Nickerson, R.S. & Adams, M.J. (1979). Long-term memory for a common object. *Cognitive Psychology, 11*, 287–307.

Niklas, K.J. (Ed.). (1995). *Botany for the Next Millennium*. Columbus, OH: Botanical Society of America.

Norretranders, T. (1998). *The User Illusion*. New York: Viking.

Rugg, M.D. (1998). Memories are made of this. *Science, 281*, 1151–1152.

Uno, G.E. (1994). The state of precollege botanical education. *The American Biology Teacher, 56*, 263–267.

Wandersee, J.H. (1986). Plants or animals: Which do junior high school students prefer to study? *Journal of Research in Science Teaching, 23*, 415–426.

Wandersee, J.H. & Schussler, E.E. (1998a, April 13). *A Model of Plant Blindness*. Poster-paper presented at the 3rd Annual Associates Meeting of the 15 Degree Laboratory, Louisiana State University, Baton Rouge, LA.

Wandersee, J.H. & Schussler, E.E. (1998b). *Plants or Animals: Which Do Elementary and Middle Students Prefer To Study?* Unpublished manuscript. Louisiana State University, 15 Degree Laboratory, Baton Rouge, LA.

Zakia, R.D. (1997). *Perception and Imaging*. Boston, MA: Focal Press.