But why should teachers use reflection in schools to help students enlarge (or multiply) their understandings of lessons? How could we improve teaching and learning if reflection were more frequently an essential part of instruction? When is it appropriate to use reflection in the learning process? Where can teachers find helpful ideas and resources to improve their ability to lead reflection sessions?

These and other questions will be explored in this guidebook, using outdoor education examples to illustrate the key points. These ideas can be used by K-12 teachers and other leaders, no matter what instructional settings they choose. So, come along and enjoy the adventure of reflecting on outdoor experiences. Don't just *do* something, *sit there* and reflect!

Cognitive Science and Implications for Outdoor Education

Why have educators been slow to incorporate reflection into the instructional routines in schools? Supposedly, it takes 25 years for innovations to be adopted in public education. Some take even longer, it seems. Perhaps we need to learn how to capture useful ideas more quickly from the world outside schools and translate them into action faster.

Recently, cognitive psychologists and information processing theorists have been gathering evidence that confirms what some of us have sensed intuitively for years about the human brain and how we learn. Educators need to apply these findings to programming, and soon. The following 12 principles represent a summary of the accumulated insights of current cognitive research and so-called "brain-based" theories of learning (see Caine & Caine, 1991, pp. 80-87). In fact, one can infer guidelines from these principles for selecting educational programs and methods. Following each principle, I have drawn some of these implications for outdoor education.

(1) **The brain is a parallel processor**
The human brain deals with thoughts, emotions, imagination, and dispositions (attitudes toward learning) simultaneously. Outdoor education enables teachers to orchestrate experiences that address everything that the brain can process simultaneously.

(2) **Learning engages the entire physiology.**
The three-part human brain functions according to physiological rules. Structured learning activities can inhibit or facilitate the

workings of the brain. Neuron growth, nourishment, and interactions relate directly to the perception and interpretation of experiences. Outdoor education involves environments that can provide relaxation, nutrition, and exercise. Some learners, in fact, get benefits that are more difficult for them to achieve in the classroom.

(3) **The search for meaning is innate.**
The search for meaning in experience and the need to act on our environment are automatic human responses. The brain naturally registers *familiar* stimuli while simultaneously searching for *novel* stimuli. Human meaning acquisition can be channelled and focused, but it cannot be stopped completely. Outdoor education provides settings that, in many cases, contain familiar as well as novel and challenging elements. Lessons conducted in the outdoors cannot only be exciting and meaningful, but frequently offer students several choices. This variety can supply most students with both familiar *and* novel stimuli to process at their present levels of readiness and in accord with past experience.

(4) **The search for meaning occurs through patterning.**
"Patterning" refers to the way the brain organizes and categorizes information. The human brain is designed to interpret and create meaning; it does not register and retain meaningless patterns over time. Outdoor education involves experiences that engage the mind in forming relevant patterns, often using activities that provide students with immediate feedback.

(5) **Emotions are critical to patterning.**
Cognitive learning never takes place in the absence of emotions or mind sets based on expectancy, personal biases, degree of self-esteem, or the need for interaction with others. Emotion, in fact, facilitates the brain's ability to store and retrieve information. Such emotions often persist long after the learning experience has ended. In the outdoors, for example, the excitement of finding a snake, the fear of the night, and the peace that accompanies a sunset can color the depth of cognitive learning and become significant and lasting memories.

(6) **The brain processes parts and wholes simultaneously.**
The human brain is divided into left and right hemispheres. In healthy people, the two hemispheres interact in the process of learning. One part reduces information into parts and the other perceives it as a whole, or series of wholes. Outdoor education,

when conducted skillfully, provides a natural setting for viewing parts in context among wholes.

(7) **Learning involves both focused attention and peripheral perception.**
The human brain absorbs information both within the focus of awareness and from outside it. Peripheral stimuli can influence the lesson because the brain responds to the entire sensory context in which the lesson occurs. Outdoor education provides a rich source of peripheral stimuli (including people) to engage learning. Teachers who are genuinely comfortable outdoors project this awareness, enhancing the importance of the lesson to students.

(8) **Learning always involves conscious and unconscious processes.**
Human beings absorb information both consciously and unconsciously, at the same time. For this reason, we remember total learning experiences, not just the "telling" that usually constitutes instruction. Outdoor education often incorporates experiential learning methods, and reflection is important to experiential learning. Reflection helps students become more aware of how and what they learn, and it entails both conscious and unconscious processes.

(9) **We have at least two different types of memory: A spatial memory system and a set of systems for rote learning.**
The brain has two primary memory systems. The first is the spatial system, which needs no rehearsal and allows for "instant" memory of experiences. It is designed for registering experience in three-dimensional space, and the human capacity for such memory increases with time. The second is the system for rote learning. This system deals with isolated facts and skills; the brain needs more practice and rehearsal in order to retain them. The more separated this kind of information is from prior knowledge and actual experience, however, the greater the need for practice and rehearsal. Outdoor education usually capitalizes on the personal worlds of learners by engaging the "instant" memory systems through direct experience.

(10) **We understand and remember best when facts and skills are embedded in natural, spatial memory.**
What we learn is shaped by our internal processes and our social environment. All education can be enhanced when specific

information is part of the context of meaningful experience. Outdoor education teaches "in context." It deals with specific facts, concepts, skills, attitudes, and values in the context of

Geology learned first hand is geology fused in the mind forever. (Photograph by George Tarbay, Art-Photo Dept., Northern Illinois University)

firsthand experience. This tendency reduces the need for the extended rehearsal and practice that rote memory working alone requires.

(11) **Learning is enhanced by challenge and inhibited by threat.** When students perceive threat their brains "downshift." Students who sense serious threat become mentally rigid. In this state they often revert to automatic, and even primitive, routines of behavior. Outdoor education, however, provides supportive learning climates and challenging lessons, with a base in students' interests.

(12) **Each brain is unique.** Everyone's memory systems are integrated differently, and because learning changes the structure of the brain, individuals become even *more unique* as they grow and learn. Outdoor education works in a setting that cultivates this individuality. Students can express a much wider range of visual, tactile, emotional, and auditory preferences than is possible in a classroom. That is, students have greater freedom to develop the disposition to learn.

These 12 principles suggest that educators—both those who teach in the outdoors and those who teach (as yet) only in classrooms—need to provide for reflection in their instruction and in their curriculum. We need not wait 25 years in order to begin to expand the meanings of experiences in the minds of our students.

Six Illustrative Scenarios

Described next are several scenarios that illustrate how we might do this.

Scenario #1. A sixth-grade class learned about dichotomous keys for identifying trees before going out on the school grounds to use them. After Mrs. Jones guided the class in keying out a maple tree together, the students divided into trios and were asked to find a different tree to identify it cooperatively. After a while, she gathered the students in a circle for a discussion and asked some questions to help sharpen their skills, pausing after each question to give students time to formulate their responses:

- How many think you used the key correctly to identify your tree?
- How could you be sure you were right?

The sense of wonder is re-awakened in students as they discover a nest. (Photograph by Northern Illinois University Art/Photo, DeKalb, IL)

- Did you ever get "off track" and then correct yourself?
- Did any of you discover a helpful tip in using the key that you will share with the whole group?

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