When is it Time for Science?

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The title of this article begs the question, "When should we be teaching science to our children?"

Even before birth human beings may recognize natural phenomena such as pressure and temperature differences, and spontaneously react to changes in such things. These are learning experiences. It can be argued that as the brain continues to grow and develop, connections are beginning to be formed and subconscious memories created. Information gathered through the senses may be stored in unarticulated patterns in the brain. Here is the foundation for a scientific understanding of nature.

The cover photographs in this issue of the *Spectrum* show children engaging in the study of our world. Innate curiosity fuels the desire to investigate the nature of objects and how these things work. Children's first teachers are the care giving individuals that provide for and protect them. Perhaps, more often than not, these individuals may not realize that by supplying a safe and enriched learning environment they are facilitating the learning of science.

There is a vast array of scientific understandings waiting to be uncovered. As children explore and investigate they formulate ideas and understandings that may be incomplete or downright wrong. Ideas about our surroundings and the way things work become established by building schemata. A schema is a mental codification of experience that includes a particular organized way of perceiving cognitively and responding to a complex situation or set of stimuli (Webster's Ninth New Collegiate Dictionary, 1988). New experiences offer the opportunity for schemata to be expanded, substantially modified, or thrown out altogether. This is the challenge that defines the work of teachers of science.

Every dedicated teacher of science wants the best for his or her students. That would include a comprehensive and deep understanding of the concepts and principles of the life, physical, and Earth/space sciences, and the nature of science along with the skills and abilities to engage in scientific inquiry. Such expectations can lead to a scenario of "just-in-case" teaching as opposed to "just-in time" teaching.

"Just-in-time" teaching employs developmentally appropriate learning experiences that are designed to pique the interest of the learner in the same way that the unarticulated curiosity of the young child promotes inquiry and investigation. The intrinsic motivation prompted by the curiosity inherent in "just-in-time" teaching is diminished in a smorgasbord of decontextual "just-in-case" teaching. The vacuum of context leaves the learner with an unconnected assortment of facts that may be remembered just in case a situation arises that requires this knowledge. "Just-in-case" teaching comes about as an attempt to deliver the "stuffed curriculum" in the short amount of time teachers have with their students. The useful result of such an approach is questionable.

As young children grow older they develop increased capacities to make connections and learn. One description of these capacities is found in the work of Jean Piaget (Piaget, 1983). Without going into the specifics of the various stages of development, it might be said that learners display stages of conceptual development that are earmarked by abilities to deal with increasingly sophisticated and complex material and situations. One of the important attributes of this development is language acquisition.

The transition from the unarticulated curiosity of young children, through the carefully articulated questions posed by teachers of science, to the self-formulated questions of the scientifically-minded individual can depend greatly on the conceptual development of the learner. At very early ages, it is not apparent that children formulate well articulated questions to drive their inquiry. As learners display behaviors indicating more highly developed conceptual capacities, teachers of science can introduce scenarios and situations of increasing sophistication and complexity. Even if the objective of a lesson might be the knowledge or understanding of a simple scientific fact or skill, if it is embedded in a complex situation where there are numerous extraneous or competing variables, learners may not have achieved the developmental capacity to sort out the meaning of the lesson.

Teachers of science need to take into account the developmental level of the learner as lessons are being planned. It is by no means the case that just because students cannot use the appropriate language or mathematical skills that learning experiences cannot be designed to assist students as they engage in their personal scientific inquiry. "Effective teaching requires that teachers know what students of certain ages are likely to know, understand, and be able to do; what they will learn quickly; and what will be a struggle" (National Research Council, 1996).

Learning environments that are rich in physical objects to investigate can support the information gathering and classification of very young children. These kinds of experiences are not relegated to just young children. Any circumstance that is new to the learner can employ concrete learning activities. More mature learners can move more quickly from this level to more abstract stages of learning by building upon the knowledge they have acquired. Establishing an experience base upon which to build more complex and sophisticated knowledge is key to being able to understand our world. Considering the notion that human beings begin their investigation of nature pre-birth and continue it throughout life, it might be said that the learning of science goes on all the time.

"Just-in-case" science teaching needs to give way to "just-in-time" science teaching. So, the answer to the question, "When should we be teaching science to our children?" may be answered by the statement, "When it is time for science."

References:

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