2009 –'10; Course: EDUC 267E, Sec 01

Development of Scientific Reasoning and Knowledge

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Office hours. T. & Th. 5.30 – 8.00pm

Course Meetings:

- Aug 18th thru Sept. 17th, in CERAS room 204, T. 4.30–6.00pm; Th. 4.45–6.15pm
- Sep 23rd thru Oct. 9th, in CERAS room 300, W.12.45–2.45pm; F. 9.00–10.00am

Course Description:

Ideas that people have about the teaching and learning of science rest on a set of particular beliefs and commitments, that are, most commonly, personal theories about how children learn, about what science is, and about how science knowledge came to be. For some people, for example, teaching is thought to be mostly about knowing the science and telling it in such an engaging way that the students will actually listen; for if the students listen well, it is supposed, they will learn and understand by some process of absorption. For others, there may be a belief in a necessary connection between doing something with one's hands and learning, and where the role of language or thinking is powerfully reduced to the principle of "Hands-On" as good science teaching. Still others espouse "The Scientific Method" as a process by which both science and science learning are purported to proceed. There are those who believe that learning science is so very odd and difficult that only a very few children can really engage in it; so, the fundamental goal of science class has to be one of simply "having fun". Last, there is a commonly held view that young children are concrete and simplistic thinkers, who cannot engage in creating scientific argumentation.

Research and good practice, however, attest to the fact that young children's thinking can be very sophisticated. Other extensive research provides evidence that being told how the world works from a scientific perspective does not result in "absorption". Rather, children [and adults] listen with what they already know and this existing understanding changes both what they hear and what they derive from incoming information. Further, philosophy of science teaches us that scientists develop their knowledge by processes of argumentation that are either accepted as valid, or not, by the community of scientists, and that these processes do not follow the rigid rules and steps of the so-called "Scientific Method".

There is, then, much to learn. Our tasks in this course are to find ways to make building scientific understandings commonplace and to make a scientific view of phenomena highly accessible, so that all our K-8 students will be able to articulate not only what they have come to know, but how they have come to know it, and why they

trust that knowledge. We will hold a focus on what children can do in reasoning their way around data, evidence, and argument, rather than on what they cannot. In taking on these tasks we will engage those personal theories about science, about learning, and about children to construct well-grounded and different understandings. We will approach each science topic to encounter both the proverbial big picture and to place specific objects and phenomena in that big picture. By looking at the objects of the science, and their characteristics, how they have been classified/categorized by scientists, what events take place that affect these objects, and how we can argue from evidence about the cause of those effects, we will do science, lots of it. We will learn how to find and create trustworthy evidence so we know not only "what" we know but on what grounds we trust it and find it a reliable explanation of the real world.

One important but on-going task will be to identify aspects of school science that serve to put some children on the outside and to exclude. We will challenge the idea that young students are simplistic, concrete thinkers. We will examine objects and phenomena and you will begin to gain confidence in speaking about them scientifically but in everyday English. We will investigate aspects of the natural world in a lab. setting, and take at least one trip into the "wild". We will, as much as possible, seek to describe, explain, and predict in ordinary every-day English, attaching specialized scientific vocabulary as is helpful after an understanding of some event has been reached. In approaching science learning and teaching in this way, we do so not because the children are young, but because this is the best way for everyone to build up a fundamental store of understandings both about the world that science has investigated, and about the argumentations, creations and models that are the source of trust in the science knowledge that has been created over the centuries.

Robust research with students of all ages has shown that every day, common conceptions that are alternative to those of science, e.g that "the sun sets and rises" are still the explanations of choice after, even years of, science classes. A most disconcerting finding, you will agree! It seems that these pre-existing ideas interfere with the building of scientific understandings, perhaps because we have not specifically taken them into account in science teaching. These alternative conceptions will be an ongoing part of our discussions and learning and you will investigate them yourselves with your own students as a pre-assessment.

We will examine closely both the State's science Content Standards, and its Investigation and Experimentation standards, as well as the National Science Standards to seek guidance about what science education experts think children should know, understand and be able to do at various stages.

Throughout the course, then, we will be constructing understandings of:

1. how children build scientific understandings, and what that understanding might look and/or sound like in young children;
2. what school science is and how the words and concepts of the standards are connected to the doing of it, through investigations and argumentation, and

3. physical, life, and earth science constructs so that we extend and deepen our own understanding of the science of the standards.

As we explore objects and phenomena, we will listen to ourselves describe, classify, explain, and predict in order to hear what scientific understanding sounds like. Our discussions will concern how teaching can foster such understandings in children. In these ways, it is my intention to have you build powerful frameworks for approaching the teaching of any science.