TO Post of the month

The Jigsaw

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The Jigsaw

Post of the Month: February 2005

by Ron Okimoto



Subject: Re: Teaching science Re: Op-Ed: Why evolution is still correctly called a theory

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Robert Grumbine wrote:
> >This sort of ignorance is exactly why I begin each semester with an
> >anlysis of what is, and is not, "science".
>
> I make it one of my early labs when I teach astronomy.
>
> How do you teach it or about it?

I found that I had to teach the nature of science at both the undergraduate and graduate levels for the honors class and molecular genetics class that I taught. Even at the graduate level the understanding of science cannot be taken for granted. It turned into my one lecture spiel. I'd hand out essays by Richard Feynman and Peter Medewar on the nature of science for the students to read and then we'd work on a jigsaw puzzle. I'd use the puzzle as an example of how science works. I'd use those cheap 100 piece kid puzzles that you can buy at Wal-Mart. I found that the two puzzles that I purchased had an identical cut out pattern with different pictures.

The first thing that we'd do is turn over the pieces and I'd try and get the students to think about the problem. Just looking at the pieces, can they come to some sort of idea of what the picture was. Unless you have some type of super genius that can assemble the pieces in their mind the students can only come up with vague ideas of what the picture might be. We do this in science all the time. Even the assumption that it will make a picture that they can make sense of should be pointed out to them. Try and get them to think about what they are doing. When they start to assemble the puzzle ask them what they are doing. None of the students I've had have tried the random assembly of just putting any two pieces together. Get them to understand that they are hypothesis testing by grouping the pieces by whatever character that they are using (color, pattern, shape). Ask them why their hypotheses fail so often. Get them to understand the problem that science deals with when you make assumptions based on incomplete data. If they were able to take all the characteristics of each piece and make a perfect analysis they would never be wrong in their choice of which pieces fit where, but using the Mark I eyeball and only a limited set of characters you often make mistakes. You have to expect to be wrong quite often in science. You have to be able to test your hypotheses.

A few students always assemble the edge of the puzzle first. I point out that this is just what scientists try and do when they create a framework and build on it. We usually get the easiest pieces in place first and the edges are the easiest pieces to fit because they only have three interacting sides to consider. Science does what it can and builds on it. About this time someone notices that I've taken away the corner pieces. When they ask for the corners I ask them how they know that the puzzle has corners. It isn't a trick question. We make assumptions like this all the time, and it is based on our experience, but they can also see that some pieces are missing based on their expected square side and only two interacting edges. They have a hypothesis that something is missing and it is based on their experience and the physical evidence. I throw out the corners and they have to scratch their heads because I've given them the corners to another puzzle, but they still fit and they still complete the outside of the puzzle. I tell them that science is full of pieces that don't quite fit, but that are good enough to help us get a better idea of what it is that we are working on.

As the puzzle gets completed I make them note how the qualitative as well as quantitative nature of the hypotheses that they are testing improves as they acquire more knowledge of what the picture looks like. The picture never gets perfect because the corners don't match, but it is obviously good enough to get a pretty good idea of what the picture is.

I don't think that I've ever brought up creationism or ID in this lecture, but if you want to you can just state the fact that ID as a "concept" has never been able to place a piece in the puzzle of nature. They have tested quite a few pieces to see if they fit, but there isn't a single one left in place at the end of the day. Essentially, it is a concept with a 100% failure rate upon testing. The only pieces left on the board are the ones that haven't been tested yet. It has been found to be worse than just randomly picking any two pieces and trying them to see if they fit. If any student doesn't believe this, just ask them for a single piece that ID has placed in our scientific knowledge. You won't find a list of these things at the Discovery Institute because there are no ID scientific successes. The farce is that they have lists of scientists that were or are religious and state their scientific successes without telling anyone that usually these guys were responsible for kicking out an ID piece from where it didn't belong. These guys are known for their scientific contributions and not their ID contributions. This is why many scientists define science in such a way that ID is excluded from consideration. It simply has never worked, and it has been a monumental waste of time. Definitions like those that exclude ID get put in place to protect the incompetent from themselves. Most rational scientists can figure out for themselves that they can think about ID, but they can't really expect to use it for anything. Not a single success and a 100% failure rate upon testing is pretty convincing to most scientists.

Ron Okimoto