This explanation, written by Dr. Dewey Dykstra of Boise State for a course he teaches, details a philosophy that is very similar to what is behind this course at BHSU. It is offered as “something to think about”. Dr. Dykstra’s original document has been edited to remove course-specific information, but the general ideas that govern the course you are taking are practically the same.

- Andy Johnson

Welcome to what promises to be one of the more interesting courses you will take at Boise State. It is almost certain to be different than any you have taken in science. The intent of this course is for you to examine and develop with your classmates an understanding of some physical phenomena and to personally experience the process of making sense of the physical world. There will not be lectures in the normal sense. As such the discussion is not easily summarized as you might a normal lecture. It is very important that you participate continuously in the discussion in class. The course is heavily based on experiences in lab, therefore it is also very important that you attend every lab. Since the course is neither based on a textbook nor on standard lectures, if you have not participated in lab, what happens in the class discussion will not make sense or be of any real value to you on exams.

A QUOTATION CONSISTENT WITH THE FOUNDATIONS OF THIS COURSE:

"[Ian] Malcolm had long been impatient with the arrogance of his scientific colleagues. They maintained that arrogance, he knew, by resolutely ignoring the history of science as a way of thought. Scientists pretended that history didn't matter, because the errors of the past were now corrected by modern discoveries. But of course their forebears had believed exactly the same thing in the past, too. They had been wrong then. And modern scientists were wrong now. No episode of science history proved it better than the way dinosaurs had been portrayed over the decades."

I have added italics for emphasis. This comes from Michael Crichton's sequel to Jurassic Park, titled, The Lost World. The novel is a good read; much better than the movie. Very gory in the end. Ian Malcolm, the mathematician who specialized in chaos theory in Jurassic Park, is held over to carry this sequel movie, now often referred to as Jurassic Park II. The Ian Malcolm character is played by Jeff Goldblum in both movies.

Michael Crichton was educated in science and medicine and is an astute observer of our society. I share his sentiment about the status of scientific knowledge and the arrogance often displayed by the scientific community and I carry it to its logical conclusion. I do not think that it is appropriate to associate rightness or truth, in the traditional sense, with scientific knowledge. The best we can say of a scientific explanation is whether or not that explanation of a phenomenon fits our experience with the phenomenon.

Stephen Hawking, perhaps the best known Physicist of the second half of the 20th century, stated it well when he wrote in his book, Black Holes and Baby Universes (Bantam Books, 1993): "A theory is a good theory if it is an elegant model, if it describes a wide class of observations, and if it predicts the results of new observations. Beyond that, it makes no sense to ask if it corresponds to reality, because we do not know what that is."

WHAT THIS COURSE IS NOT ABOUT

In most introductory level science courses the purpose is to transmit the collected knowledge of the scientists to the students. This process is usually referred to as "teaching science." This "knowledge" to be transmitted is generally considered as close to the Truth as we can possibly get at this point in time. In addition as Crichton suggests, all
previous truths are considered corrected, hence superseded by presently accepted scientific Truths. We generally
start with elementary or simplified versions of this Truth or sometimes with previous versions of it which are still
found useful. Nonetheless, these quibbles about the Truth are generally glossed over and the knowledge is taught
and intended to be "received" as Truth.

If this knowledge, properly presented, does not make sense to a particular student, then it is usually assumed to be a
shortcoming of the student. The knowledge itself is handed down from the authority of Science via its
representatives, the instructor and the textbook author. In the case of a conceptual physics course such as this, it is
knowledge handed down from the authority of Physics. This knowledge is considered to be correct, assuming the
professor is a sufficiently true authority on the subject. (For a more detailed perspective on this notion of the
expectations that professors be true authorities see the work of William Perry in *Forms of intellectual and ethical
development in the college years; a scheme* from our Library.) Students are not considered capable of questioning
the veracity of this knowledge. It is the students' job to "get" as much of this knowledge as possible and keep it at
least long enough to pass the exams. In the case of some of your classmates who will be elementary teachers for
example, it is seen as their job to "get" this knowledge so that they can transmit it as accurately as possible to their
students in the future.

**Knowledge as the Best Description of Truth at Present**

In the above view of science courses, knowledge consists of statements or descriptions of Truth or as close as we
can come to it. The Truth it describes exists in nature and can in principle be found by anyone who wishes to look
closely and carefully enough (an approach sometimes called the Discovery, Guided Discovery or Inquiry Method)
and who has the capacity and willingness to work hard. This knowledge can be transmitted from one person to
another. It is a teacher's job to transmit it properly and appropriately. The student must be capable of and prepared to
receive it.

Hence, we have the "folk theory" of science teaching:

> Science teaching is the presentation of scientific truth (as best we know it) by approved methods for the
benefit of those who are capable of getting it and who have worked hard enough.

In contrast to this description of typical science courses, ask yourself: How many courses have you taken in which
the professor says on the first day of the course, "Reading in advance of assignments is NEITHER suggested NOR
encouraged!"? This should be a clue that something is fundamentally different about this course. This course, PHYS
100, is neither about transmitting knowledge to students, nor is it about knowledge which is as near as possible to
Truth. This is the case because the position in this course is that Truth in the common sense of the word (assumed to
exist independent of people and able to be transmitted from one person to another) does not exist. Hence, the course
is not about guessing the right explanation or "real" answer. Neither is it about trying to come up with the same
thing as the scientists. What the course is about can be found in the next section.

If you try to "take" this course as if receiving the Truth, the real answers, the real reasons, is your role in the course, you
will not do as well in the course as you could. You might even do disappointingly badly with that strategy. The
same is true if you "take" this course expecting the instructor to provide you anything as if it is the Truth. In fact you
are likely to have an unhappy experience and a very unsatisfactory grade in the course, if you pursue these strategies
that generally work in most science classes. Hence for one thing, reading textbooks early in a unit, either the
optional one for this course or ones from the library, will not only be not useful, but reading the texts has proven to
be highly counter-productive to some students in previous semesters. There will be readings provided at the
library, but not until the end of each unit.

**WHAT THIS COURSE IS ABOUT**

This course is about "doing" science. To "do" science is, in collaboration with each other, to make up as good an
explanatory story (theory) that fits our experiences so far with the phenomena as we can. In each unit some
particular phenomena will be studied and a particular starting point for generating our explanations will be
identified. By "good explanatory story" we mean one that fits our experience with the phenomena (It explains our
experiences.) and enables us to make predictions that seem to work out. Remember what Hawking said: a good
theory "describes a wide class of observations, and ... predicts the results of new observations."
In this course, knowledge is probably something entirely different than in any science course you have experienced previously. In the view of knowledge used in this course, there are two types of knowledge. One type is experiential knowledge. Statements of this knowledge are descriptions of experience. In science, such descriptions are usually reserved for specific experiences that more than one person can agree recur under the same conditions. The other type of knowledge is explanatory knowledge. Statements of this knowledge are explanations of experience. These statements generally contain expressions of meaning, belief, or understanding. We make up explanatory stories to fit experiential knowledge and predict new experiences are explanatory knowledge.

A famous historian and philosopher of science, Max Jammer, described science using this notion of the two categories of knowledge in the following way: "...the ambition and hope, still cherished by most authorities ... that physical science could offer a photographic picture and true image of reality had to be abandoned. Science, as understood today, has a more restricted objective: its two major assignments are the description of certain phenomena in the world of experience and the establishment of general principles for their prediction and what might be called their 'explanation.'" In this description from his book: Concepts of Force (Harvard U. Press, 1957), Jammer is saying that the activity of science is to collect experiential knowledge and generate explanatory knowledge about it.

In this course one could think of experiential knowledge as facts. To be a fact in science: 1) when the same conditions are established, the resulting experience should be the same and 2) others must also agree that this is the case. Explanatory knowledge can be referred to as knowledge. Knowledge in science, then, is explanation of facts in science. This "scientific" knowledge must not only explain existing "scientific" facts, but it is expected to be testable. To be testable an explanation must enable predictions about the outcome of previously untried experiences.

Knowledge as the Explanatory Stories We Generate

For the purposes of this course, explanatory knowledge can be thought of as "stories" we make up to explain our experiences. It is the meaning we make of our experiences. Meaning is not in the experiences. It comes from our own minds. Since we make the meaning or the explanation for ourselves, it cannot be "discovered out there". It can change as we think and interact with each other about the experiences and as we have further experiences. We can think of these explanations or meanings on two levels. One is the personal level, the explanation or meaning we make up to associate with experience. The other level is "public," the meaning we come to "take-as-shared" between us when we interact with each other about our respective meanings for common experiences.

In keeping with this description, examining your own personal and each other's initial ideas, then comparing them with the actual phenomena and deciding on how well you think they fit the phenomena will be major parts of this course. Whenever you decide that these initial ideas do not fit the phenomena very well, you will work on dreaming up new possible explanations (or modifications of existing ones) and testing these new ideas to decide how well you think they fit our experience with the phenomena. The goal in each unit will be to come up with an explanation of the phenomena that you can decide on as a class that you can use at least for the purpose of exams. This explanation of the phenomena does not have to be exactly the same as explanations developed previously by any group.

Only you can change your own mind. You might decide to change your own mind in response to influences you consider beyond your control, but it is you who decides this. Why is this important? It applies to any and all aspects of your thinking. At this very moment you already have ideas or notions about the phenomena we will study because you have experienced and had to deal with these phenomena every day of your life. You may not have examined and identified these ideas or notions consciously, but you do know how to deal with these phenomena or you would not have made it this far. In order to make any modifications at all to your own thinking, you must first know what your own thinking is. Unless or until you know that this is, there is no way you can really generate any changes or modifications to your thinking. On exams you will be asked to show evidence of changes or modifications to your thinking in terms of new or modified explanations of the phenomena. Just hearing the results of someone else's modified explanations will not suffice. You have to actively examine and modify your own understanding of the phenomena. No one else can do it for you.

Experience with many semesters and literally several thousand students reveals that students who attempt to take this course as if it was a typical science course; i.e., as receivers of "truth," generally earn disappointingly low grades. Such students are frequently heard to claim that the course was hard, unfair, unreasonable, disappointing, etc. On the other hand, students who decide to actually examine their own ideas with their classmates, compare their
ideas with the phenomena, and dream up and test new explanations when existing ideas appear not to fit the phenomena do much better in the course. This latter group also generally finds the course a much more pleasant experience and they get better grades. The choice is up to you.

FOUR DISPOSITIONS NEEDED FOR SUCCESS IN THIS COURSE

These are responsibilities students have in this course to themselves and to each other.

1. Desire to communicate and share ideas with others

Because this course is about you really trying to make sense of the phenomena we will study, we all need to communicate with each other what we think about the phenomena we experience in lab and then respond to each other's ideas. The course is not about what has been written or said by someone outside of our class about the phenomena and not about memorizing something the text, the instructor or some "smart" student says. It is not about what is a right or wrong explanation of the phenomena. Instead it is about you and your classmates building explanations that fit our experiences so far. To do this we must communicate with each other.

2. Willingness to take risks with one's ideas

The only way that satisfying and useful understandings of anything have ever been achieved by human beings is through people being willing to express tentative ideas to their colleagues and then participate in the testing of these ideas to see if they appear useful and satisfying. This means that sometimes someone's idea 'falls apart' and is discarded. Only through working together and sifting through all the possibilities we can come up with is there true progress in developing satisfying and useful explanations of the phenomena we experience. It is not wrong nor is it a 'failure' to have proposed an idea that is eventually discarded. The class needs your ideas. It is a 'failure' not to propose one's ideas to the class.

3. Willingness to live with ambiguity

If one cannot live with the uncertainty that exists while one is trying to build satisfying and useful explanations, then one will always avoid the process and will always be dependent on, and at the mercy of, others who have pursued the process and claim to have worked out useful understandings for themselves. Furthermore, those who avoid uncertainty now will not have had the practice and experience dealing with it. Such folks will be more at a loss to face uncertainty when it inevitably occurs later in life and there is no one around to help.

4. Respect for and interest in the ideas of others

In order to actually hear the ideas of others, to understand the ideas of others, one must suspend judgment and be tolerant of the ideas of others. Without this disposition the sharing of ideas with others is just so much wasted time. If we cannot really share ideas with each other, we are truly each alone in trying to make sense of the world around us. No one does well under those circumstances. We do not have to be alone in this process. In fact culture and society are what human beings have constructed in order take advantage of the tremendous power of multiple, interacting minds working toward common goals.