The First Joseph R. Larsen, Jr. Memorial Event

Banquet Address

Why I Teach Biology

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It is an honor to be asked to give the first Joseph R. Larsen Memorial presentation. Joe Larsen is one of my heroes. The world needs more Joe Larsens. I will say more about Joe at the end of my talk, but let me begin by telling you what I am going to be talking about tonight.

I want to start by talking about the title of this talk "Why I Teach Biology". Then I will spend a few minutes on what I believe are some of the most important issues in biology education. Finally, I will talk a little about what I am doing now and how I see multimedia being used in biology.

This film clip from "Indian Jones and the Temple of Doom" may seem like an exaggeration. Most people are not scared of monkeys and birds. The film is the least popular of the Indiana Jones series because of its gross, distasteful subject matter. I am not going to show you anymore of the film, but those of you that have seen it know it contains scenes that are uncomfortable - even to biologists. There is a point where biologists are ill-at-ease with biology.

I became interested in biology when my fifth grade teacher brought the family's pet indigo snake to school. My attitude toward snakes was like that of the film's heroin until my teacher showed me that I had been mislead. As I look back on my teaching career I realize that I learned some very important lessons that day. I learned not to believe everything I was told about something that was different. I learned to be skeptical, to try and see things from the other being's point of view. Biology can teach us many important lessons about life.

When I was a sophomore in high school a local herpetologist and I started the Minnesota Herpetological Society. I had been a member of the American Society of Ichthyologists and Herpetologists, the Herpetologists League and the American Institute of Biological Sciences for a few years and I had a reprint collection, however, by the time I started university, I had decided that I wanted to teach biology rather than be a herpetologist. Bentley Glass came to the University of Kansas and talked about the Biological Sciences Curriculum Study (BSCS). As I learned more about it, it seemed much more interesting than anything I was doing as a biology student. I decided I wanted to teach BSCS. I never got to do it.

The late Bill Mayer talked about the golden age of biology teaching. The original BSCS second course: *BIOLOGICAL SCIENCE interaction of experiments and ideas* is still one of the best experimental biology courses ever designed. But BSCS has changed. For me, this statement in the teacher's edition of the latest green version (Milani, J., et al., 1987) says a lot about the current state of biology teaching: "This investigation is designed to lead students through most of the major stages of chick development using a 'dry' lab method. What is lost by students not examining actual chick embryos in their various stages of development is more than gained back by seeing the various structures more readily in the various figures presented in the materials." Jean Milani, the person at BSCS who headed the revision team, tells me that these kind of changes have occurred because teachers want them, not because BSCS or the NABT animal use guidelines initiated them.

I developed one third of the in-text labs for the 1989 edition of **Modern Biology** the most popular high school biology text and the one I hated in high school. Even though the book is well written and accurate, it, like most high school books, seems to have evolved into a superficial version of **Biological Science** by Bill Keeton (Keeton 1967), a book that explained and integrated biological concepts better than any book I know of. Keeton's book was longer than most, when it was introduced, because Bill felt that "it is often more difficult for a student to understand an oversimplified 'elementary' presentation than one that is rigorous enough to engender some insight into the relevance of the material". Unfortunately, many of today's college texts, some nearly twice as large as the first edition of **Biological Science**, emphasize description rather than the understanding of basic principles. Many argue that it is impossible to teach a course in the principles of biology anymore, because there is too much to cover and it can only be done superficially. But the issues are not new. Thomas Henry Huxley thought the laboratory was the best place to teach science and "The great aim should be to teach only so much science as can be taught thoroughly; and to ground in principles and methods rather than to attempt to cover a large surface of details." (Glass 1961).

There seems to be far too much emphasis on learning the language of biology to pass sophisticated looking exams, rather than understanding the ideas and concepts. It may be useful for a physician to talk to the anesthetist about not intubating his obtunded, hypovolemic patient with patent lesions, but he could say the same thing in plain english, in nearly as few words. Hazen and Trefil's demonstrations of scientific illiteracy show that literacy is not the ability to speak the jargon of science, but to understand the ideas. The old adage that the most important ideas in science can be explained to a grade school student is still true. Some of the best explanations of modern science can be found in the children's section of the public library. We must stop the current scientific literacy movement from becoming another device for making students demonstrate that they know all the buzzwords. Ashleigh Brilliant's concern that "There has been an alarming increase in the number of things I know nothing about." (Brilliant 1982) has more to do with an increase in terminology than in knowledge. The heart of communication, someone has said, is not words but understanding.

When I first began teaching I had a strong interest in teaching about the process and limits of science. I taught at an unusual college that required students to complete a laboratory practice program as well as standard academic courses and labs. This made it possible to have courses that taught library skills, experimental design, and other methods outside the regular courses. The program existed because the college began as an agriculture school that taught students how to farm by having them do it. I had students read papers in **Science**, identifying the conceptual processes. We also used a wonderful book, **Great Experiments in Biology** by Gabriel and Fogel. The structure of science is really quite simple. We do experiments to test a hypothesis, these result in laws that are explained by theories, which in turn can be tested by experiment and modified, producing better theories. Experiments require controls and usually involve the manipulation of an independent variable, which causes changes in a dependent variable. That shouldn't be hard to communicate. The problem is that much of what is done in science and biology doesn't exhibit this level of sophistication. Much of what is being reported has to be called observation.

For reasons that have never been clear to me, some people seem to feel that learning about the methods of science teaches people to think. Bill Moyers' television series on creativity demonstrated rather clearly that most creative people don't understand what allows them to do it. They all say there is some deep well in the mind or experience that they delve into and the answers appear. The famous Albert Szent-Gyorgyi quote about observing what millions have seen before and seeing what no one has seen before illustrates how unusual breakthroughs are. Louis Pasteur's statement that "chance favors only the prepared mind" is very much to the point. What kind of preparation is important?

It has been said that great writing comes out of a superior devotion to reading. The same relationship is true in biology. Understanding comes from observation and interaction with nature. George Wald said it beautifully: "One can gain knowledge from words, but wisdom only from things."

In 1969 I was asked to develop the laboratory part of a new, one year course in the principles of biology, replacing general botany and zoology. We adopted the Keeton text and lab manual. I spent the next seven years developing and improving the experiments. Cornell was close enough that I traveled there several times to talk with the authors of the lab manual. The most important lesson I learned, however, was that the "secrets" to making experiments work well were found in the minds of the research community, not in the literature. It was the people who did the work that knew how to solve the problems.

As I taught, I realized that the best way to help students understand biology was to get them involved with real things. I left teaching in 1984. The following video illustrates how I tried to reach that end.

There are many forces that make this approach to biology teaching difficult. Cost and time are major problems. The animal rights movement and pressure to use lab time for other activities are reducing the time available for students to interact with living materials. My solutions to these problems are radical, but I have used them with small classes and I know they work. The primary reason for many of these difficulties is the way lecture time and texts are used.

A naive observer of most lectures could easily conclude that the printed book hadn't yet reached the university campus. The function of lecture appears to be to let the students know what's going to be on the exam in the most difficult way possible. Before the invention of the overhead projector students could at least keep up with the lecturer, unless the blackboard was filled with information beforehand. Much of lecture time today is spent having students copy overheads while the teacher amplifies what's on the overhead. No wonder they get confused. Good grades have a lot to do with being able to get accurate transcriptions of what happens in lecture.

A very small part of what is in lecture is not found in texts. Some teachers have been known to give their lectures from one book, while assigning the students another. Bill Keeton's comments about depth of coverage is very pertinent here. If the lecture time is used to transmit content written on blackboards and overheads, the material has to be covered in a superficial way. Just imagine how many lectures it would take to transmit the contents of the average text!

The solution is simple. Find a good textbook and structure the course so students have to read it and understand it before they come to lecture. Use the lecture time to help them understand the difficult material, and to update it. Anyone who has taught for a few years knows where the problem areas are. Test students on their understanding and application of basic concepts, not trivial detail. Even though many students can pick-up the language of biology quickly, most do not understand the principles well. There are many good ways to test understanding. If classes are small, basic questions like how are fats digested or what is the function of oxygen challenge most students. One of the things I liked about the original George Gaylord Simpson text **LIFE** was that hormone charts and other collections of data contained a footnote saying do not memorize this information. It is missing from the new edition. A good text is more than a dictionary or an accurate description of biological phenomena. It should explain basic concepts in terms of fundamental principles in enough depth that students can develop insight.

Lecture time can also be used to talk about the principles of scientific investigation. If students are required to read a chapter in the text and a few great experiments these can be discussed in class.

If lecture is used to fulfil the tutorial functions of the course, more time is available for students to interact with living things. Every lab exercise doesn't have to be an experiment.

Urban life has caused people to change their attitude toward nature. Wild animals are equated with pets. The green movement is producing a religious and political consciousness that is substituting sacred and politically correct attitudes for rational thought. The fact that our environment is at risk because of over population in the first world and that children are now far more concerned about mutant ninja turtles than real ones is alarming. The solution to these problems will come from a better understanding of nature. Better and more relevant biology education It will not be the result of less interaction with living materials or the adoption of ethical attitudes that are inconsistent with nature or themselves.

Now that dissection has been condemned, organizers are trying to stop the death of any animal used for teaching purposes. Douglas Allchin's article on "Dissecting Classroom Ethics" in the January 1991 issue of **THE SCIENCE TEACHER** does a good job of clarifying the ethical issues. His point about "whether there is consistency between not liking dead animals and not eating meat" is fundamental. By separating ethical decisions about fresh muscle in the classroom and in the kitchen, animal rights sympathizers are led into believing they are taking a strong ethical stand on the side of good at little cost to themselves. This does more for their self esteem than it does for animals!

The separation of the biology lab from the kitchen has disabled biology laboratory education. Instructors order preserved material from biological supply companies that could be obtained in nearly living condition at local food stores. The materials obtained from these sources are usually no more dangerous to use than the food we eat routinely. The same cannot be said for preserved material.

Fresh organs, e.g. a pregnant pig uterus, are nearly odorless and very interesting and instructive. I discovered this from my agricultural colleagues when I taught at Delaware Valley College. We need to make more connections with people in agriculture. Fresh asparagus and Brussels sprouts make wonderful subjects for the study of plant anatomy and growth. Nitella cells are very useful for studying osmosis, but they are not easy to culture. Fresh potato sticks are cheap and easy to use. There are lots of opportunities here for students to develop simple systems for study.

A good friend who attend a famous English prep school with Peter Medawar told me that when students misbehaved they had to do an inconvenience. He was required to collect earthworms and to prepare cross sections of the seminal vesicles. The students helped their teacher do research on ciliary behavior. The point is simple. There is plenty of local, inexpensive fresh material that can be used for teaching biology. If students use more of these materials, especially meat market items, they will get over some of their phobias about them. We need to become more comfortable with our own biology. Our society seems bent on rejecting it

How is it possible for students to spend more time with living phenomena if there are so many limitations? I believe that laserdiscs now make it possible for biologists to have instant access to living phenomena so they can gain meaningful experience quickly and inexpensively. The use of laserdiscs in the sciences has not been well thought out by most distributors and developers. The laserdisc player is the ultimate audiovisual machine, the only device capable of all of the functions of the other devices: a random access slide projector, a motion picture projector and an instant loop film projector. There are no bulbs to replace, no heads to clean, no tape or film to wear out - the most reliable AV machine. If laserdiscs are well designed, they can be extremely useful without requiring the use of barcode readers or computers.

The major benefit of this technology is that it allows users to interact with phenomena in a way that is not possible with the real material. Many biological processes and functions can be understood intuitively, in a manner that transmits understanding with much greater clarity than by word. Words also don't do justice to the advantages of laserdiscs. You have to experience it!

When I moved to the University of Calgary, I decided to act on an idea that I had for sometime - to get biology lab people together. I was in New York and I stopped by Cornell to meet the new lab director, Jon Glase. We met and I told him about my idea. The rest is history. We've been good friends ever since and have spent a lot of time on the phone talking about lab teaching. It's the friendships I've developed that have made this organization so meaningful to me. We all share the same problems. We have an understanding that is our own. ABLE has grown in many ways over these baker's dozen years. We have a history that Anna Wilson has worked hard at recording. We have finally made it to the pages of the **Enclycopedia of Associations**, I assume that has increased Leona's junk mail. With the advent of desktop publishing, we've gone into the publishing business and kept Roberta Williams and the editors of the proceeding volumes in our gratitude. We had some special presentations. Who will forget Dave Webb's mesmerizing slide shows or the taste of Ken Perkins and Chuck Curry's tour of edible plants.

The association has a family of officers that have guided the organization on an increasingly stable voyage. These stalwarts even seem to be getting some relief from new members of the group. The survival of an effective organization depends on the infusion of new ideas and energy from its new members. Do not refrain from helping because you think we know all the answers. We don't. But more importantly, by helping you'll help yourself. You will meet new friends, share accomplishments, and have a good time. As important as all these people are, one group makes all this possible. The people who volunteer to host a workshop and the people who take the time to prepare a presentation. The progress of our profession centers around this annual creative effort. It is probably the most difficult and the most rewarding contribution anyone can make to ABLE.

I would like to end by getting back to the reason I am here tonight - Joe Larsen. I do not know if the executive decided to have the first Joseph R. Larsen Memorial Event at the University of Wyoming for the reasons I am about to remind you of, but it is the right place. The university was where Joe Larsen expected to spend the rest of his academic life. He wrote over a hundred letters of application for his first tenure track position in 1963. The University of Wyoming was the only institution perceptive enough to realize that, even though he was in a wheelchair, they could hire an exceptionally talented and determined man. Maybe they knew that if Vincent Dethier accepted him as a post doc, he had to be good. He could have been the host of this year's ABLE meeting! In 1963 Ladd Prosser from the University of Illinois invited him to come there, to a campus with wheelchair access. His work was challenged early in his career by Larry Gilbert and Howard Schneiderman. He responded with a paper in NATURE like few I have seen. If you have students read journal articles to understand the methods of science, the April 24, 1965 issue of NATURE (Vol. 206, page 428) contains one that demonstrates the character of scientific research in a manner not unlike that shown in Jim Watson's *The Double Helix*.

He became head of the department of the institution tied with Cornell as the second best entomology department behind UC Berkeley in 1970. Two years later he became Director of the School of Life Sciences, a position he held until 1984. In 1985 he became Director of the Division of Rehabilitation Education Services. After giving the banquet address at ABLE's tenth anniversary, he traveled to Europe to visit rehab facilities. When he returned to Illinois, he was diagnosed with bladder cancer. He left us in February of 1989.

Joe Larsen could have had a comfortable career as a research scientist and administrator, but he cared about things that have less value in most institutions of higher learning. He knew that students understand biology by working with living systems and he developed a laboratory course in 1965 that he ran by choice for twenty years. He was concerned about employment of his students after they graduated and he worked to improve their opportunities. He didn't have to do any of this, but he did it along with being a leader in research and administration because he cared. Some of you may not agree with his religious views, but for the most part he kept them separate from his work in the biological sciences. Needless to say, he was a great religious leader too.

Joe was a fine example of the adage, if you want something done, give it to the busiest man you know. He took responsibility for a number of essential ABLE functions. He hosted the second meeting of the organization, he developed the index to laboratory manuals, and he put together the slide tape show that is used to tell others about ABLE.

Joe Larsen fulfilled his promise when he said in his introductory letter to me in 1977 "I would very much like to be an active participant in such an organization". His spirit and ideals will always be with us.

In ten days I'll be 50 years old. It's a wonderful feeling to be back home with my friends. I thank you for inviting me.

REFERENCES

Brilliant, Ashleigh (1982). *I MAY NOT BE TOTALLY PERFECT, BUT PARTS OF ME ARE EXCELLENT*. Woodbridge Press Publishing Co. Santa Barbara. p. 104.

Glass, Bentley (1961). Book review of *T. H. Huxley, Scientist, Humanist and Educator*.by Cyril Bibby. *Science* 133:1122-3

Keeton, William T. (1967) *Biological Science*. W. W. Norton. New York. p. xii.

Milani, Jean P. et.al. (1987). *BIOLOGICAL SCIENCE: An Ecological Approach*. 6th ed. Kendall/Hunt Publishing Co. Dubuque