

**2007-2008
Brierley Lecture
On
College Teaching**

**Charles W. Walker
Professor of Zoology
Center for Marine Biology
Marine Biomedical Research Group**

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Introduction

Michael Lim

Department of Neurosurgery and Oncology
The Johns Hopkins University

Good afternoon, my name is Michael Lim and I first met Dr. Walker in 1991 as a freshman where I started in his lab. He has been a close mentor for me throughout college and my career and it is a great honor for me to introduce Dr. Walker. Dr. Walker, for years you have written for me recommendations for medical school and grants, and today, I have the privilege of singing your praises to this audience.

To give you some background, Dr. Walker obtained his undergraduate degree in Zoology at Miami University and his Masters and Ph.D. in Zoology and Developmental Biology at Cornell University. UNH were then fortunate enough to recruit Dr. Walker. In his career, he has made great contributions in science. I initially looked him up in pubmed to count his publications, but I stopped because there was too many. He has easily authored and presented in over 100 peer reviewed journals and meetings. He work shed light on many signaling pathways in invertebrates such as he starfish and clams. His findings produced invertebrate models for studying human malignancies such as CML and AML. He is also the recipient of numerous awards and prestigious grants. However, while he is immortalized through his contributions in science, I think that his most profound contribution is his teaching which is why we are all here today. I remember my first day as a student sitting in his classroom. He came in wearing a Tie-dye t-shirt, shorts, and birkenstocks. He began the class by sitting on the counter, smiling and then said welcome. You immediately knew that he was happy to be there and excited to teach. Dr. Walker has always viewed teaching as a privilege. I know that he looks forward to teaching his classes everyday. He sincerely wants to share with each student his passion and love for molecular and cellular biology. If you ever sat in his lecture, you know that someone loves their job when some of his most common adjectives to describe the topic of signaling pathways and development are words such as marvelous, amazing, exquisite, and beautiful. However, some might argue that the adjectives he uses are reflective of the 70's child in him. In response to his lectures, students stop looking at the clock and stop trying to figure out what parts of his lecture are going to be on the test – rather they begin to appreciate the beauty of science and develop a true interest. It is no surprise that many students such as I then went to work in his lab. In his laboratory, he continued to carry the same energy and passion. He's produced many technicians, graduate students, and physician-scientists. Now coming from a perspective of having my own lab, I realize how much energy, time, and resources is required in teaching students.

When I heard that Dr. Walker was nominated for the Brierly award for teaching, I could not think of a better teacher or person. His efforts in teaching have had a profound influence in all of us because we all carry elements of him in each of us today. I now see parts of Dr. Walker in my scientific thinking, the way I conduct lab meetings, and in mentoring of students. I am sure that I can speak for all of us in saying thank you. It is a truly great honor for my to introduce Dr. Walker for this teaching award.

Dedication

“This lecture is dedicated to my parents, George and Jane Walker, who started me down this path; to my father-in-Law, Dr. Everett Nelson, who taught me to listen to people and to my wife, Wilise Walker, whose special MAGIC about enjoying life each day is transferred through me to my students.”

BUILDING A COMMUNITY OF SCHOLARS WITHIN AND BEYOND UNH OR HOW WE CAN "PAY FORWARD" OUR UNDERSTANDING OF THE WORLD AROUND US.

*Charles W. Walker
Professor of Zoology
Center for Marine Biology
Marine Biomedical Research Group*

Special thanks to Drs. Haney of Zoology and Fagerberg of Plant Science for nominating me. And thanks to the UNH Faculty Awards Committee who choose me for this award. Thanks to my current and former students who wrote letters for me. Many of them are here today. What I appreciated most were your comments about things that I do in my teaching and finding out that these were actually appreciated by you even 20 years ago, like telling stories about cells as opposed to just giving lectures, using drawings on the chalk board, talking to students before class, etc. I am also humbled by the large number of my current and former students (28) who are here today to listen to my comments. And I am grateful for the presence of my family members and friends, fellow UNH faculty and staff. Thanks lots to you all for being here.

Today I would like to tell you a story about how I became interested in science and teaching and what I do now as a teacher. The Brierley lecture is also a once in a lifetime opportunity to present information about my vision of college teaching and what I feel is important for the future of teaching in my college, The College of Life Science and Agriculture.

HOW I BECAME INTERESTED IN SCIENCE AND TEACHING:

High School in Cincinnati; Miami University, Oxford, Ohio and Cornell University, Ithaca, New York (1961-1976):

I grew up hunting fossils in and around Cincinnati, Ohio, in what was a shallow tropical sea 450 million years ago. Most Saturdays were exciting times for my mom, dad and me since a new road cut or mall project seemed to spring up weekly chock full of well-preserved invertebrate fossils from a very different time on earth. Somehow this led to my involvement in Saturday morning classes on fossils and minerals given at the Cincinnati Museum of Natural History. There were tests on what we had learned the previous time and I kept bringing home goodies as prizes for doing well on these. After that I ended up going to Miami University as a Zoology major. My first class in Zoology was a remarkable experience for me!! This class was taught by a fascinating teacher, who was often surrounded by a fog of fragrant pipe tobacco, occasionally broke into German and asked us to actually think about and not just memorize information. That person is my current chairman in the Zoology Department here at UNH, Dr. Jim Haney. He also taught me about living marine and freshwater invertebrates and spent lots of hands-on time with students on field trips into nature to see some of the things he loved. One creature I remember in particular was the freshwater ectoproct, *Cristatella mucedo*. This interesting animal is composed of many individuals that are clonally derived. It normally filters freshwater and the entire organism can move. To this day no one understands how *Cristatella* moves and, thanks to Dr. Haney, this question has intrigued me for the last 40 years. Also at

that time, the Chairman of Zoology at Miami was Dr. Charley Vaughn. In his youth, he had been a “barnacle”. In 1928 the very first Marine Zoological Laboratory in the United States dedicated to teaching was established under the leadership of UNH Zoology Professor C. Floyd Jackson on Appledore Island, one of the Isles of Shoals off Portsmouth. Students in this course, like Charley Vaughn, were called “barnacles”. Later, in 1967, Dr. Jack Kingsbury and other Cornell faculty members established a modern course for undergraduates, Field Marine Science, on Star Island. Dr. Vaughn urged me to take this course and with financial help from my parents, I did in 1967. This was a life changing experience for me as it has been for so many over the last 40+ years. I also met my future major professor for my Cornell Master’s and PhD degrees, Dr. John Maxwell Anderson. I am so please to point out that “Dr. A” as I call him made the 400-mile trek from Cornell with his son Stephen and is here today. How can I describe the multiple influences that Dr. Anderson had on me at Cornell as a graduate student and their importance to me even today? From him I learned first hand at the Shoals and in the creeks and lakes around Ithaca about the group of animals that we both love. Most importantly, he taught me how to write, a vital aspect of my success in obtaining grants from the National Cancer Institute, United States Department of Agriculture and the National Science Foundation. And he taught me to draw, one feature of my lectures that my students have most often identified as vitally important to their understanding. He has been the most important influence in my academic life and I thank you Dr. A. It should also be pointed out that this is the second time he has been so honored in connection with a Brierley award. Dr. Nancy Kinner also invited him here and honored him during her Brierley presentation in 1996.

There were others at Cornell that influenced my teaching. Dr. John Heiser was a student in the Shoals course with me in 1967 and we both ended up at Cornell as graduate students. John gave me extensive hands on experience in the “Vertebrates” course taught there for many years. We dissected over 20 different animals in that course as we learned vertebrate anatomy and passed it on to our students. Fitting the standard vertebrate body plan into a tubular format of the snake is a fascinating accomplishment. I was fortunate at Cornell to be a teaching assistant for freshman courses taught by both Drs. Antonie Blackler and William Keeton – the former was a showman the latter a stand and deliver lecturer. Both were highly effective as teachers even though they had totally different approaches. It occurred to me that blending these approaches would be a super idea.

University of New Hampshire (1976-Present):

My first class here at UNH was in 1976. What an experience!!! When I arrived on campus, I had no idea that I would be asked to teach during my first term. However, I ended up assisting in Introductory Zoology 412 with another professor. That person slowly worked me into the course, but he had wanderlust and one morning came to class, drew a sailboat on the board and said, “I have been building this boat for 3 years; it is finished and now I am going to sail it.” That was the last I saw of him. Now, faced with total responsibility for all of these people, I felt overwhelmed. I had never done anything like this during my undergraduate and graduate education. The largest class that I had taught as a graduate student was a small laboratory for 20+ students in embryology. Initially in that class of >200 in Spaulding 135, I felt like an insect on a pin. I remember stopping once and saying that I had never done this kind of thing before and that It was difficult. I think I said to the students you should try this it is not easy. After that the class was totally with me. I learned that in a class with that many people, it was most important to choose one’s words carefully. Talking about the details of mitosis or cell division is always a challenge and there are a number of new words involved that don’t necessarily make

any sense, like chromatid. What is a chromatid, anyway? I decided that I had to present mitosis to this large group from the point of view of mechanics. What is necessary to convert one cell with 46 chromosomes into 2 cells with 46 chromosomes? This gave me a chance to talk about DNA replication and its importance. This made sense to the class and got me telling stories about biology rather than just using words. I might add that at that time people did weird things like streak naked through class, not once, but twice. I remember that one of those experiences occurred while we were talking about vertebrate anatomy and I pointed out how opportune it was that we had just witnessed such a demonstration. By the end of the term, I was loving this opportunity to pass on things I had learned about biology to others and the students were totally on line with the course.

Since those early years, I have become very comfortable with my efforts at teaching. But I must point out that I am always a little nervous just before class. I believe it is important to be on edge, but not over the edge. I often tell people that I feel like I have been on a 32-year vacation here at UNH. I enjoy going to work. I am very grateful to be at a university that simultaneously appreciates and rewards teaching and research. Dr. Jack Lockwood, was Director of Research when I came to campus and he was extremely helpful to me as I set up my laboratory. To me, teaching and research go hand-in-hand, especially in the research laboratory. Interestingly several schools just seem to be embracing this idea, for example in a recent article in the New York Times (2007), "Harvard Task Force Calls for New Focus on Teaching and Not Just Research." This kind of thinking was underway at UNH when I first came here!!

What I believe about College Teaching:

When I received the COLSA excellence in teaching award in 1998, a representative of the student newspaper asked me what I do to be an effective teacher? My answer was difficult to provide, since I had never thought about it before. Finally, I realized that it is very difficult to write down and provide such information to others. But finally, I did come up with certain things that I believe are absolutely necessary.

1. You must be fully prepared. Lets face it, if you don't know what you are talking about students sense this immediately. And this process of learning new things never ends for biologists. Lectures for the advanced course that I teach, called Cell Hell change radically from year to year. One year we tell students we have no idea what promyelocytic leukemia bodies (PML bodies) do in the nucleus and the next year we can lay out probable functions for these structures based on literature that emerged in the intervening time. To me the thing most fun about lecturing is figuring out how to include new material while still retaining the basic umbrella format of my lectures. I do find myself saying more and more about less and less! It is also very clear that preparation for my lectures is vital to my development as a researcher. By requiring one to master new and unfamiliar areas of biology, teaching naturally leads one into totally new areas of investigation and enhances one's research program. It is also true that research can inform teaching as much as teaching informs research.

2. You must be enthusiastic. Enthusiasm is an ethereal thing that can come and go depending on the events of the day. It is sometimes difficult to muster enthusiasm at 8AM in the morning. In the shower, I talk to myself about being enthusiastic; this helps. I also find that listening in the car on the way to work to lectures by Dr. Robert Greenberg is very inspiring. Greenberg weaves superb stories about the composers and history of western classical music

in his excellent DVDs entitled, "Listening to and Understanding Great Music" (Greenberg, 2001).

3. **You must treat all students with equal respect and attention**; those that perform well and those that do not and help the latter to succeed if possible, 4. **You must be willing to spend time with students** (Cooper, 2004). Performance is always bimodal on my first essay exam in Principles of Biology a class of 120-140. 30-40 students in the class receive grades less than 70. My mission after the exam is to bring as many students as I can from the second to the first category. I ask everyone that received less than a 70 to come and see me in my office. Most do come and so I get to meet them and find out why they had problems on the first test. We work together to solve their problems. Maybe they need to learn how to take notes, find a quiet place to study, change their attitude about the material (Maybe they are bored. I tell them to change their mind, boredom is just a state of mind), maybe it is my lecture style. For most, we can work things out and their performance does improve.

5. Finally, I believe **quality teaching is all about ones personal MAGIC**. And each of us has a different magic. To some using this magic comes naturally and it would be difficult for them to tell you how it happens. Others have to work hard to develop their magic. To me, magic is the most exciting thing about teaching and the one that makes people in all disciplines great at what they do. At this time, I would like to recognize four professors that have been very influential to me and who have their own special magic, Dr. Ed Tillinghast for his passion with chemistry of molecules important to biologists, Dr. Win Watson for the incredible work he accomplishes with students in Physiology and Neurobiology, Dr. Wayne Fagerberg for the lectures that I anticipate each year on energy metabolism and also on plant embryology (especially exciting to me in the Spring as my garden emerges) and Dr. Art Borror for his fascinating early morning field trips to Duck Island where after visiting baby cormorants in their nests, I could appreciate that birds are remnant dinosaurs.

How I Teach Freshman the Principles of Biology:

I have often wondered how can anyone teach about Biology poorly. It is such an exciting subject to me!! After all, what could be more fun than telling students that the romantic composer, Tchaikovsky died because the alpha subunits of his heterotrimeric G-proteins were malfunctioning!!!

For me, teaching freshmen about Biology is a great privilege and honor. I believe it should honor all that teach this course. It is always exciting to me to find new faculty that ask to teach freshman, like Dr. David Berlinsky, a recent hire in Zoology who did just that while simultaneously developing an extremely well-funded research program.

This is what I tell my students in their first lecture.

1. **Biology is a foreign language**. Memorization is a necessary first step. As Bruce Alberts, author of the most recent text, Molecular Biology of the Cell (2008) has pointed out, "Analyses have revealed that there are more new words to be learned in some science courses than in a foreign language class (2007)". But just incorporating these words into your vocabulary is only the beginning! What about integrating these terms into an understanding of how things actually work in the cell. How is it best to demonstrate to students the complexity of the world around them, so that those words have a context? When we lecture, we must explain things in a linear

fashion. A leads to B, which may lead to C and D or perhaps some other permutation. For example, we must describe each signal transduction pathway separately beginning with a ligand that binds to a specific receptor in the cell, which changes the shape of a receptor and then activates or inactivates a process in the cell. But that is just not how things happen in cells!! Many pathways interact with each other and often at several levels. For example cAMP will block the pathway leading to cell division at a molecule called *raf*. I have often thought that to get across the concept of interaction, it would be great to stage a lecture where 5 or so people all lecture at the same time on pathways that interact and occasionally they might walk over to someone else and talk to them when pathways interact. This is much more realistic, but would of course be total chaos. Somehow the cell can usually keep this all organized and students need to transcend words to do the same. Students need to be able to make the leap from just learning the pathways to understanding in their own head how all this complexity occurs.

2. Short and long term memory. The biological basis for short and long-term memory tells students a lot about how they should study for biology courses. After each lecture everything heard and observed is stored in short-term memory in the hippocampus, an ancient part of the brain deep in your head. Short-term memory is based on covalent modification of existing proteins; they are phosphorylated, methylated, etc. This is ephemeral memory that will disappear if not reinforced since proteins can quickly be dephosphorylated, etc. So it is vitally important for students to study each lecture carefully as soon as possible after it occurs; I always suggest one hour at least in a quiet place. This will give students a chance to determine what they know and what they don't know. What they **don't know is most important**, since they can then get help to fill in gaps in their understanding before they completely forget that the gaps exist. To begin moving things to long-term memory, I always suggest that students put together study groups with others in the class. Such study groups take my old test from Blackboard and find an empty classroom on campus. Individuals in the group should volunteer to answer certain questions on the test at the board with chalk in front of everyone. If they are missing something, others will help fill in the gaps. Don't be shy! Remember it is much better to be embarrassed in this venue than on the test. As my good friend and teaching colleague, Wayne Fagerberg says in quoting Einstein, "You don't really understand anything unless you can explain it to your grandmother." By this method, students will eventually transfer concepts from the short to long term memory, a much more secure version that actually requires accessing the nuclei of brain cells in the cerebrum just under your skull and expressing new genes in those cells to make larger or new synapses.

3. Another thing I always say to students is that biologically speaking; they owe their mom a great deal. Without her, we couldn't get through cleavage during development. Remember that she produces eggs. These are very large cells, much larger than any of your other body cells. Your mother places lots of informational molecules in the egg during oogenesis (mRNA and proteins). After fertilization of the haploid egg by the haploid genetic information from the sperm, these maternal information molecules are useful as cells carry out cleavage. During cleavage, cells divide very rapidly (every hour or less) and they don't have time to express the new genetic combinations put together at fertilization. So making new proteins during cleavage depends upon the informational molecular that mom produced during oogenesis. The first time the genome of the new individual is expressed is at gastrulation when many embryos autoabort. And we have all made it through cleavage to gastrulation thanks to mom. So when students go home at the Thanksgiving break, I tell them that they should give special love and thanks to mom for all of this!!!

BUILDING A COMMUNITY OF SCHOLARS: RESEARCH IS MORE FUN WITH A FRIEND:

In my lab we usually have from 5-20 undergraduates at one time along with graduate students and a post-doctoral student. Sometimes there have been so many that they have to work in shifts. Initially a frustration for me is that undergraduates leave for graduate school or additional research training just about the time that they learn what they are doing. So technology transfer became an important issue for me and I started asking students to teach the next generation of students in the lab. Then it occurred to me that this was just as valuable for the students as it was for our laboratory. As juniors and seniors, I feel that it is their responsibility to begin to give back and I came up with the following ideas:

- 1. It is important for undergraduate students to learn about being graduate students and post-docs by direct interaction, so that they can do so more effectively when it is their chance.
- 2. Conversely, it is important for graduate students and post-docs to be involved in mentoring students in my lab to understand the importance of teaching undergraduates in a research context.
- 3. I want graduate students and post-docs to get feedback from undergraduates about the job they are doing and about how they might improve.
- 4. I feel it is important for undergraduates who might become post-docs to be more sensitive to the integration of teaching and research and to experience ahead of time how to do it well.

PAYING FORWARD OUR UNDERSTANDING OF THE WORLD AROUND US:

Students as Teachers and Mentors:

I ask students in my lab to do what I do, Teach. Teaching for me requires stimulating students to be excited about telling others what they have learned. Undergraduates should be proud of what they learn and be especially willing to pass it on. I believe developing this point of view should be part of their education and that we can help in this process because of the following points.

- 1. An academic program like ours in Biology that is vertically integrated, incorporating components that extend from the beginning of the freshman year to the completion of the senior year, offers an ideal context for the engagement of seniors as mentors for first year students in classes and later in the research laboratory.
- 2. The senior year should be more than a final year of coursework and senioritis.
- 3. I envision a guided, mentorship program for seniors as an invaluable opportunity for them to gain, through the process of teaching, a deeper and more mature understanding of the knowledge acquired during their three prior years of undergraduate studies.

How to do this in the College of Life Sciences and Agriculture?

- Establishing a Capstone mentorship program for seniors, consisting of two distinct but closely integrated components:
- A. Senior Mentor Scholars might take a 2-credit course, to be taught by faculty members who give inspiring and creative lectures, in which the students would complete *Entering Mentoring* - A Seminar to Train a New Generation of Scientists and be instructed in the art of mentoring. (Developed by the Wisconsin Program for Scientific Teaching; 2005).
- B. Simultaneously, seniors would serve as mentors to first year students within the context of our first year biology course. Specific service roles could include those of assistant lab TA's, tutors, and conveners of organized study sessions.
- Successful programs like this have been formalized at several colleges and universities in the United States (Gerwin, 2005; Howell, 2005; Mervis, 2007). I would hope that we could do more of this kind of thing and perhaps develop a more formalized program in the College of Life Sciences and Agriculture.

Final Comments:

Thank you all for listening; I am sure if you were giving this lecture about your excellent skills as a college teacher, some things would be different and more relevant to your areas of expertise than what I have had to say. To me that is the remarkable beauty of this business in which we are all involved. Each person can use their special Magic to fascinate and enlighten their students. Kahlil Gibran – in the Prophet (2002) said of teaching, “For the vision of one man lends not its wings to another”

As Cell Biologist Harvey Lodish (2004) has suggested: “I firmly believe that each of us has benefited from inspiring teachers and thus that each of us **has acquired the obligation** to teach at whatever level we can in order to train and inspire the generations of scientists who will follow us.”

Finally, I want to thank my wife, Wilise Rene Walker who calls me just before each lecture and calms me down as she did today. I hope that much of her special MAGIC about enjoying life each day is transferred through me to my students.

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