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Annual membership dues are $50. Annual membership renewals shall be due on January 1, April 1, July 1, or October 1. New members shall renew on whichever date most closely follows the date of their initial membership. HAPS Hotline: (800) 448-HAPS (4277). Information on membership, meetings, and more! Send correspondence to: HAPS, 222 S Meramec, Suite 303, St. Louis, MO 63105. Check out our new webpage at: http://www.hapsweb.org/

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We are now, according to the "experts," truly into the new millennium. You've probably seen many predictions about what significant social and technological events will occur in the next few years. We all know that to make predictions is a fool's game at best. So I'm going to look backward before looking forward. At 12 years of age, HAPS is a very young organization. Yet in that brief time-span, with a membership of approximately 1200 members throughout North America and beyond, we have become a well respected organization with affiliations with the American Physiological Society and the American Anatomists Association. Our members have been invited to participate in their conferences and vice versa. Our annual and regional conferences provide members with phenomenal opportunities to network with each other, update their knowledge on current developments in the biological and medical fields, and to interact with publishers and other vendors. Members, in developing their own policies and procedures in their institutions, have used the various position papers we have prepared. Our achievements thus far are, of course, due to the dedication and hard work of our committees, Board members and many other committed individuals.

Here are some examples of recent activities by your executive Board and committees. The Board recently approved the policies and procedures for our Safety Committee chaired by Sandy Lewis (Pierce College WA). Sandy's committee is currently looking at developing a brochure on lab safety. Thanks to the diligent work of Phil Tate, a hotel contract has been signed confirming Phoenix, AZ as the site for the 2002 Annual Conference. By the way, let me remind you to register for the 2001 Conference in Maui. Ric Martini promises us that we will have many highly informative and entertaining events. To make it easier for you to register for the conference (and renew your membership), we are now able to accept major credit cards (e.g. Visa, MasterCard and Discover). John Waters, our treasurer, has set up an e-mail address that allows Board members and committee chairs to send messages to either all members or members in a given region. Needless to say, our webmaster, Jim Pendley, deserves much praise for his ongoing efforts at keeping our listserv running efficiently. We have joined the American Institute of Biological Sciences (AIBS), an umbrella organization consisting of over 70 professional societies and organizations. There are many benefits to belonging to AIBS, too numerous to mention here. Cris Martin attended an AIBS meeting on our behalf and was very excited about the additional exposure we receive by belonging to this organization.

By the time you read this, the Board and committee chairs will have completed our mid-year (January) meeting. During this meeting, we will have discussed a variety of topics such as a position paper proposed by the Cadaver Committee, new policies and procedures for the Grants and Scholarships Committee, an Animal Care Resource list prepared by the Animal Use Committee, and a host of other topics. We are in the process of a redesign of the HAPS web site. As an additional member benefit, the Board has recommended placing the HAPS-EDucator and other HAPS publications on-line. The Membership Directory is slated to be the initial publication to be presented on-line; this will not only cut publication and mailing costs but also facilitate regular updates. These activities will be taking place gradually over an extended period of time. Look for updates in future issues of the HAPS-EDucator.

As you can see, our past accomplishments are impressive, but we now need to project into the future. While the Board can set a course for the organization, it can't operate in a vacuum. For example, our membership seems to have plateaued at around 1200. It is surprising to hear that there are still A&P teachers out there who have not heard of us. How can we bring these people into the organization? Furthermore, how do we see HAPS evolving over the next 5-10 years? There may be areas that we have not yet included in our mandate. One that comes to mind is the all-pervasive concern with the degradation of the environment. Should we join with other groups in expressing concerns over this issue?

It is with the planning of our future goals that we need your input. In this regard, I would really like to hear from you (e-mail me at either: ruschin@admin.humberc.on.ca or henryruschin@home.com).

Let's go into the new millennium with both the wisdom of the past and the zeal for a successful future. Happy New Year!!
Greetings from Maui!

We have a terrific group of update speakers arriving from all points of the compass. All eight slots are filled, and we will be presenting a list of speakers and topics in a later announcement. Activity planning is going well, including the banquet luau. But to make things work smoothly, we need to ask that people who are planning to attend HAPS 2001 take action soon.

As of mid-December, 2/3 of the hotel rooms in the conference room blocks had been reserved. If you plan to attend and you have NOT called to make a reservation, please do so as soon as possible. We need to know the numbers well in advance so we can plan and coordinate activities, buses, and all the innumerable details involved.

It is also important that after you make your hotel reservations, you register for the conference so that we can prevent cash-flow problems while we prepare programs, mailings, and make advance payments for activities.

After you have reserved a room and registered, start calling the airlines and checking the bargain corners of the www. Flights are limited, seats are limited, and deals are VERY limited. Start now to avoid unpleasant surprises!

That's the short story from here.

Aloha, and see you on Maui.

The people of Maui, and the other islands too, love to find an occasion that requires eating. Moreover, after attending a number of HAPS conventions, I know we island folk are not alone in that regard. Many of our meals have a unique taste because we are fortunate to live in a mix of different cultures, with each adding their own flavors and food combinations. Let me introduce some of the foods I hope you will have a chance to experience during the convention. (Note that sticky white rice is quite a common accompaniment to breakfast, lunch, or dinner.)

Typical mainland breakfasts often include eggs, bacon, and home-fried potatoes. While here, try the local combination of eggs with Portuguese sausage and sticky white rice. You can even order it at McDonald's. Also served with sticky white rice are omelets which may include Portuguese sausage, or a Chinese sausage made from pork called Lup Cheong, green onions, cheese, and mushrooms. Those with high cholesterol, however, may want to avoid an island breakfast classic, the Loco Moco. It generally consists of hamburger steak resting on sticky white rice topped with two fried eggs and brown gravy. Other breakfast favorites are banana, mango, or macadamia nut pancakes. Instead of maple syrup, top those pancakes with coconut syrup. Go ahead, get Portuguese sausage on the side.

Ah, it is time for lunch. You can order sandwiches and salads with a local twist, but the standard fare is a “plate lunch” or salamin. Each plate lunch comes with “two scoop” rice (yes, the sticky white kind) and a scoop of macaroni salad. The entree or entrees you add to that are myriad, but favorites include teriyaki beef, kalbi (sliced beef) ribs, pork ribs, fried chicken or fish, shoyu chicken, and pork or chicken katsu served with a not too spicy sauce. Saimin is the “lite” alternative to the plate lunch. It is Chinese chow mein noodles in a tasty broth. Additions often include a red and white slice of fish cake (called kamaboko), green onions, a red colored char siu pork, Spam, and slices of hard-boiled egg. Yes, all the McDonald's restaurants in Hawaii offer saimin as well as an “Island Tastes Menu” of three different plate lunches!

As usual, choices for dinner are much more varied. The luaus usually give visitors their first taste of Hawaiian food. Kalua pig is one of the main dishes. It is cooked in a pit lined with hot rocks, then removed and prepared by shredding (usually after the guests have had their first mai tai). Other Hawaiian foods include lomi lomi salmon (a mix of salmon, tomatoes, and onions), squido luau (sliced pieces of squid cooked with taro root and coconut milk), poi (mashed taro root), and lau lau. Lau lau is made with pork, chicken, and/or fish, which is wrapped in taro leaves and then further wrapped in ti leaves and steamed. Restaurants serve these foods as the Hawaiian plate. Another favorite is teriyaki; you will find chicken, beef, or seafood marinated in teriyaki and either grilled or barbecued. Fresh fish is also a must for dinner. Those landed locally and commonly served are open ocean fish such as tuna (aku, tombo, and ahi), mahi-mahi (dorado), ono (wahoo), and the opah (moonfish). Delicious bottomfish include opakapaka (pink snapper), onaga (red snapper), uku (gray snapper) and hapu (sea bass). Restaurants will offer fresh fish prepared in a variety of ways: raw slices (such as ahi sashimi) or chopped (poke style), or baked, steamed, grilled, fried, or sautéed.

Enjoy your stay on Maui this summer and I hope you discover local foods that will “broke da mouth.”
Sickle Cell Anemia: The Search for a Cure Continues

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Introduction

In the languages of the Nigerian tribes that live in the southern regions of the country, the words "Abiku" and "Ogbanje" refer to children with sickle cell disease. These words mean "rebirth," because they believe these children, who have a very short life expectancy, would reincarnate. However, they rarely survive beyond middle age (5,6). Sickle cell anemia, a potentially lethal disease with variable clinical manifestations, results from the homozygous expression of a mutant β globin gene (1). It is an inherited condition that has its highest incidence in black Africans and African Americans but is also found in the Mediterranean countries such as Greece, Italy and Israel, Saudi Arabia, India and some parts of Asia. Sickle cell disease is believed to have originated in Africa, as it has been traced back as far as 1670 in one family belonging to the Krobo tribe in Ghana (2). In the U.S., about 0.3% (about 72,000) of African Americans have some form of sickle cell disease, while about 10% carry the sickle cell trait.

The red blood cells of people with sickle cell disease contain an abnormal type of hemoglobin, the oxygen-carrying pigment, called hemoglobin S. This abnormality is due to a point mutation in the DNA encoding the β globin sequence, resulting in the replacement of glutamic acid with valine in the 6th position of the β globin chain. A single point mutation in the DNA codon for glutamic acid appears to result in a base triplet that is transcribed into a messenger RNA (mRNA) which codes for valine. The sequence of normal β mRNA shows a ribonucleotide triplet of guanosine-adenosine-guanosine (GAG) that codes for that normal β glutamic acid. A single base transversion of adenosine to uridine would produce the messenger codon guanosine-uridine-guanosine (GUG) that codes for valine. The globin chain is synthesized with the use of the abnormal mRNA template, and the abnormal β' globin chain then complexes with α chains to form the sickle hemoglobin tetramer (α₂β'₂), which is called hemoglobin S (Hb S) (1,2).

Hemoglobin S is sensitive to a deficiency of oxygen. When HbS is deoxygenated, it becomes relatively insoluble as compared to hemoglobin A and aggregates into long polymers. These polymers align themselves into paracrystalline gels, which become stacked within the red cells in filaments that twist into helical rods. These rods then cluster into parallel bundles that distort and elongate the cells, causing them to become rigid and assume a sickle shape (3). At this stage, the sickled red cells become fragile and are easily destroyed, leading to anemia. This phenomenon is, to some extent, reversible after the cells become oxygenated once more, but repeated sickling ultimately results in irreversible distortion of the red blood cells. The sickled red cells can become lodged in the body's blood vessels thus blocking blood flow and preventing the red cells from delivering oxygen to the tissues of the body. The oxygen deprived body parts soon become extremely painful, and a vicious cycle develops when lack of oxygen causes more cells to sickle (known as a sickle cell crisis). This causes swelling and severe pain in the arms, legs or abdomen and can damage important internal organs. In addition, the sickle red cells make the child more susceptible to serious diseases by weakening the immune system. Sickled cells live only 10 to 20 days in comparison to the normal red cell's 120-day life span (2).

An individual is said to be homozygous (Hb SS) for sickle cell anemia if he inherits the abnormal hemoglobin (Hb S) gene from both parents. A person who inherits the sickle-cell gene from one parent and a normal hemoglobin gene (Hb A) from the other is a carrier of the sickle cell trait. Because the red blood cells of heterozygous (Hb AS) persons contain both Hb A and Hb S, such cells require much greater deoxygenation to produce sickling than do those of patients with sickle cell anemia. The great majority of individuals with the sickle cell trait thus have no symptoms of disease, although certain manifestations, mainly associated with vigorous exertion at high altitudes, have been seen. The overall mortality rate of carriers of the sickle cell trait is no different from that of a normal.

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comparable population. Sickle cell carriers (Hb AS) are resistant to malaria, and in many parts of Africa they live longer and have more offspring than noncarriers who are exposed to malaria (1,2).

Symptoms and Complications

The first manifestation of sickle cell disease in children is a severe infection as sickling damages the immune system by causing the child’s blood filtering organ, the spleen, not to function properly. Although the disease can manifest itself in a variety of ways, the most common symptom is known as an acute pain crisis, or painful episode, when the sickled red blood cells clump in small blood vessels preventing the flow of oxygenated blood from reaching body tissues. The symptoms can appear anywhere in the body and endanger virtually all organs. Pain becomes a harbinger of potential catastrophe; tissues die from lack of oxygen (3). Patients sometimes suffer strokes, (7) but the most deadly manifestation of sickle cell disease in adults is “acute chest syndrome,” (8) in which sickled red blood cells get trapped in blood vessels in the lungs of people with the syndrome. Acute chest syndrome, characterized by chest pain, fever, and high blood pressure in the lungs, is the most life threatening complication of sickle cell disease. When this syndrome strikes children, congestive heart failure can result.

Treatments

Presently, there is no cure for sickle cell disease. However, the understanding of the molecular pathogenesis of sickle cell anemia has barely led to the discovery of specific or nontoxic therapy, for the prevention of the clinical manifestations of sickle cell disease. The mainstay of treatment for painful crises are analgesics, hydration, prophylactic antibiotics to prevent infections, and other measures to relieve symptoms during the patient’s recurring crises, when blood vessels are occluded and there is excessive blood and tissue destruction. Reversible sickling is enhanced by increasing the intracellular hemoglobin S concentration and is inhibited by the intracellular presence of hemoglobin F or A. In the mid-1990s, however, the drug hydroxyurea was found to reduce the principal symptoms of sickle cell anemia. Hydroxyurea apparently activates a gene that triggers the body’s production of fetal hemoglobin, a blood protein ordinarily produced in large amounts only by infants shortly before and after birth (4). Hydroxyurea therapy increases the proportion of fetal hemoglobin in the bloodstream of adult patients from 1 to about 20 percent, a proportion high enough to markedly lessen the circulatory problems that arise during crises.

Approximately 10 percent of children with sickle cell anemia experience strokes, which are among the most serious complications of this disease. Strokes can cause motor and neuropsychological impairment, affecting a child’s ability to move, speak and learn. Once a child with sickle cell anemia has had a stroke, his or her risk of having another is roughly 80 percent (8). It has been established that administering blood transfusions every three to four weeks to children with sickle cell anemia who are at high risk for stroke reduces their rate of stroke by 90 percent. Although utilization of therapeutic blood transfusion has been limited by factors that complicate such therapy (iron overload, hepatitis, and isoimmunization), the benefits of preventing strokes and their debilitating effects far outweigh the risks associated with repeated blood transfusions. Most of the children developed excess levels of iron (iron overload), which can be harmful to several vital organs (2). This complication is treated with a procedure called chelation therapy, a painful, inconvenient and expensive process that involves subcutaneous infusions of a drug that removes the iron.

The concept of molecular manipulation of the sickle hemoglobin molecule has led to great optimism among researchers that effective therapy is possible, and a wide variety of approaches in designing specific antisickling agents is proceeding. The potential toxicity of some of these antisickling agents, such as urea, prevents their being used at a concentration high enough to inhibit in vitro sickling substantially. Clinical trials performed on some of the antisickling agents like sodium cyanate, potassium cyanate, amino acids, and peptides show increased red cell mass, increased red cell survival, and a slight increase in oxygen affinity as well as a small decrease in the number of painful crises. Plant extracts such as hydroxybenzoic acids (9) and phenylalanine have also been implicated as potential antisickling agents; however their mechanism of action has not been fully elucidated. Most recently some researchers have proposed that Interferon (11,12) and nitric oxide (10) may help treat sickle cell anemia. Because nitric oxide causes blood vessels to dilate, enabling more blood flow through them, researchers suggest that inhaling nitric oxide might limit the sickling of blood cells and prevent cells from sticking to vessel walls.

It is apparent that pharmacological approaches can be effective only in the symptomatic treatment of sickle cell disease. Bone marrow transplantation is the only therapy that has been reported to cure patients with sickle cell disease, though the procedure is associated with a 10 to 50 percent risk of mortality and substantial additional risk of morbidity due to graft-versus-host disease (GVHD). Bone marrow transplantation would be recommended only when the disease becomes life threatening. However, if bone marrow transplantation is to be performed for sickle cell disease, it should be performed in children before they develop alloantibodies or enough organ damage to greatly increase the risks of transplantation. It is hoped that the ultimate cure for sickle cell disease would be gene therapy.

References


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**A Case Study Examining the Temporal-Spatial Clustering of Polymyositis-Dermatomyositis in a Northwestern Ohio City**

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Anatomy and Physiology instructors can incorporate case studies into their courses because this approach allows students to study a phenomenon previously unexplored or one that is not easily understood through statistical techniques (Yin, 1989). The following study demonstrates that the field of scientific inquiry need not be limited to quantifiable measures. Reality is too complex and multifaceted to be adequately grasped by a single method. For example, numerous theoretical and empirical issues in the world cannot be addressed through strict adherence to the natural science model.

The case study design allows for a combination of descriptive, quantitative methods with the qualitative techniques for discovering meaningful associations. Case study research recognizes, identifies, and conceptualizes phenomena not previously known. It also involves finding connections or relationships that were not previously reported. As a research endeavor, the case study contributes uniquely to the knowledge of individual phenomena. For physiology instructors, case studies can be used to introduce students to other scientific methodologies. They also serve as a focal point for generating class discussion and individual conceptualization on aberrant physiological mechanisms in an interesting format.

**The Case Study**

Using a holistic and general perspective approach, this qualitative case study examines a temporal-spatial clustering of the autoimmune disease, polymyositis-dermatomyositis (PM-DM). A case study model is a method that relies on an in-depth, multifaceted investigation using qualitative research methods to explore a single phenomenon in rich detail. Case histories provide clues to connecting links which may well escape quantitative researchers. According to Stouffer (1980), phenomena of life are often better distinguished by pattern rather than by quantity. The three cases in this paper represents a temporal-spatial clustering of a rare disease pattern.

Myositis is an umbrella term used to capture the family of idiopathic myopathies, which are the rarest inflammatory illnesses within the entire class of autoimmune diseases. Three discrete groups of inflammatory myopathies exist: polymyositis (PM), dermatomyositis (DM), and inclusion body myositis (IBM) (Dalakas, 1991). Dermatomyositis is PM accompanied by skin lesions and a characteristic rash (Bohan and Peter, 1975; Rider, 1995). The incidence of all three of these myopathies together is estimated at 1 in 100,000 (Banker and Engel, 1986; Medsger, Dawson, and Masi, 1970). It is estimated that PM and DM combined affect approximately 20,000 people in the United States, with nearly 1,400 new adult cases per year.

Subjects were three adult individuals who lived the majority of their lives in Walbridge, Ohio. The prevalence of the currently known cases of adult PM-DM in Walbridge, Ohio, approximates 3 per 4,675 (3 per 4,675 = 0.000641711).

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Compared to the worldwide prevalence rate of .00006, this suggests a temporal-spatial clustering of reported PM-DM in this northwestern Ohio town. Additionally, these individuals lived in the same neighborhood. The onset of disease was between the years 1992 and 1996 in two females and one male aged 17, 28, and 34, respectively, at the time of their diagnosis.

Regarding immunopharmacology, the cases were being treated according to suggested methods. All were on prednisone, two cases were prescribed Imuran, and one was currently being treated with methotrexate.

A history of familial autoimmune diseases demonstrated that there were instances of such diseases in other family members. Case A had a brother with juvenile arthritis, Case B had no family members with an autoimmune disorder, and Case C had a mother who was hypothyroid, and a cousin recently diagnosed with DM.

It is known that infections can trigger autoimmunity through molecular mimicry. Likewise, autoimmune disease might be a result of chance antigenic similarities between pathogen and human macromolecules - a concept requiring further investigation, particularly since all subjects have been exposed to pathogens. In terms of previously known viral infections, each subject had previously been exposed to at least one viral infection. Cases A and C had at least one bout of influenza and Case B suffered from infectious mononucleosis caused by the Epstein-Barr virus. Each of these illnesses occurred several years before the diagnosis of PM-DM.

Key findings indicated that the cases were not within the usual bimodal distribution peaks of 15 years and 50 years for PM-DM. Generalized muscle fatigue and characteristic manifestations of proximal muscle weakness led them to seek medical care. The incipience of symptoms occurred in the fall season for each case, a finding not previously recorded in the literature. Specific etiological factors and immunopathogenetic mechanisms were not identified from these data.

Although this study identified no definitive elements in PM-DM development, increased attention on environmental agents as possible factors in PM-DM etiology is recommended. Limited observation suggests an undetermined exposure coupled with environmental cofactors and genetic constitution may play a role in PM-DM development in predisposed subjects.

Qualitative information may provide circumstantial evidence that leads to PM-DM development. Facts could also give indications that implicate factors not yet uncovered in the etiology of PM-DM. Equally important is the identification of specific autoimmune antibodies for the purposes of developing particular immunosuppressive therapies.

This descriptive narrative provides information relative to contemporary and historical events in the lives of each study subject. This study provides data for the development of future research.

References

Oops - We Erred

Some copies of the last edition of the HAPS-EDucator contained printing errors in Ted Nammm’s article on the human genome project. Thus, this edition of the HAPS-ED contains a corrected, reprinted copy of Dr. Nammm’s article as an insert.
Everything I Needed To Know About The Cell
I Learned In Kindergarten

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In January 2000, the director of the Masters of Arts in Teaching (MAT) program of the Zoology Department at Miami University approached me to teach a summer workshop on Cell Biology. In the past the department had sponsored a number of these workshops for high school teachers dealing with many different biological topics, but this particular workshop had a bit of a twist. Under a grant from the Howard Hughes Medical Foundation, the MAT program in Zoology was to reach out not just to high school science teachers, but also to extend our programs to include middle school and grade school teachers down to the kindergarten level. The challenge to me thus became two-fold. One was to provide a solid, content oriented background in basic cell biology to grade school teachers (K-6) who had little to no science background. The second was to try to help these teachers make the concepts and ideas we discussed relevant to the children in their classrooms.

I decided to approach this as a cooperative venture between the teachers and me. I provided them with scientific content, background, and guidance while they worked on ideas for taking these concepts into the classroom and incorporating them into viable and relevant lesson plans. While it is always hard to gauge the success of these ventures, I am pleased to be able to report that it was an overall success. In fact, one of the teachers in my course, who turned her final class project into a grant for microscopes for use in the fourth grade classroom, learned in October that her grant would be funded.

The workshop, entitled Biology of the Cell, was offered as a three-credit graduate level course in the MAT program in Zoology at Miami University. The course ran for three weeks with the students meeting 3 days per week from 9AM-5PM. It was advertised as part of the regular summer graduate education program at Miami University. Of the 12 teachers who initially registered for the course, 11 completed the session. Their teaching experience ranged from kindergarten through grade six.

My first task was to try to find a unifying theme for the course. With all the interest and excitement generated in the news about the human genome project last spring, I thought that would be a good place to start. Not only was it timely and relevant, but I thought it might capture the interest of both the teachers and their students. Each participant received a binder with course materials at the start of the course. Inserted on the cover of that binder was a copy of a cartoon I found on the editorial page of our local newspaper related to the announcement of the sequencing of the human genome. The picture shows a man talking to his wife while reading a newspaper with the headline "Human Genetic Code Cracked." In the caption, he is telling his wife "Whaddaya know...as it turns out, we DO come with an instruction manual!" Using this cartoon as the theme, I started the workshop on the first day by hanging a large poster illustrating the human genome with some known genetic markers on one side of the room, while on the other side of the room I hung a large picture of the cell alongside the classic full sized chart showing all of the biochemical pathways of the cell. I then introduced the workshop by walking from one poster to the other while telling the group that we were going to look at the basic principles involved in how that instruction manual, buried in that genome, was used to create the complex, structurally sound, metabolically active, fully functioning cell in the other picture. With the very diverse and weak science background most of the teachers possessed, I decided to stick to the basics of cell

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structure and function, much as I do in my early introductory lectures in A & P. The syllabus started with some basic chemistry that included atomic and molecular structure, chemical bonding, organic and inorganic components of the cell, protein structure and molecular transport. Building on this information we were then able to look in some detail at cell structure and function including DNA structure and function, protein synthesis, cell replication (contrasting mitosis and meiosis), and the basics of cell respiration and cellular energetics.

The informational portion of the course was supplemented with numerous laboratory exercises and activities. Some of these were routine laboratory exercises illustrating standard concepts such as diffusion, osmosis, cell replication, protein synthesis, enzyme activity, and the proper use and care of a microscope. However, a few activities engaged the group more than the others by opening several unanticipated lines of discussion. These discussions ranged from how so many disease states are a simple manifestation or aberration of basic individual cellular problems, to the numerous ethical and legal issues raised by the human genome project. One of these activities was a simple exercise on the use of the scientific method. This involved viewing a 10-minute videotape dealing with the importance of the nucleus to the cell. At various points in the taped presentation, the instructor pauses the tape to allow the students to form hypotheses and design experiments to test them. Some of the more direct hypotheses had been anticipated and experiments testing them are found further along on the video. I anticipated this exercise taking approximately 30 to 45 minutes to complete, including a discussion on how similar activities could be used in the grade school classroom. The exercise proved so popular and engendered so much discussion concerning both the topic itself (nuclear manipulation and transplantation) and the uses of similar activities to illustrate the scientific method, that after 3 hours the only thing that actually brought the discussion to an end was the fact that it was 5 o’clock and class was over.

Another very effective and timely activity was an exercise illustrating the techniques of gel electrophoresis and the use of DNA fingerprinting. A colleague who routinely performs this exercise with groups from grade school to high school ran this exercise with the teachers. The teachers were divided into teams of two or three. They received what was supposed to be a confidential FBI memo asking the laboratory teams to help in the identification of a corpse and a suspected serial killer. The teams were supplied with prepared DNA samples from the victim, which they ran on gel electrophoresis and compared to known DNA fingerprints of seven different missing persons. Once they had identified the current victim, each of the teams was then given prepared DNA from hair samples collected at several different crime scenes. The object was for the teams to work together to discover which of eight different suspects was at each of the crime scenes by matching their DNA fingerprints. This was a popular activity, which gave them a great insight into the unique qualities of DNA and really cemented some of the concepts of genetic shuffling and independent assortment that we discussed with meiosis.

A third exercise, which became the cornerstone of the workshop, revolved around the construction of a cell model with bubble wrap, pipe cleaners, modeling clay and other assorted sundries. I am greatly indebted to Terri Biddle from Hagerstown Community College for sharing this cell model exercise, which she developed.

I used the lab as the introduction to cell structure and function. We had discussed some basic chemistry with a brief introduction to organic and inorganic molecules before they attempted the construction of their own cell models. We then used those models over the course of the next several days as we investigated individual cellular organelles and the complex structure and physiology of the cell. The exercise proved useful for several reasons. One major point, which strongly impressed the students, was how different each individual cell turned out. Although each of them started with the same materials and the same set of instructions, because of interpretation, the results were similar but each cell had its own unique characteristics. This led us into a lengthy and informative discussion of cell differentiation and some of the major ramifications of that process including examples of what happens when the differentiation process goes awry. It was interesting to watch the learning process evolve as the teachers worked on their models. Initially they would ask for their construction materials by name such as, “May I please have more pipe cleaners?” or, “I need to tape this bubble wrap together.” As they became more interested and involved in the process, although the topic had not been formally introduced yet, one heard such things as, “I need some more mitochondria over here” or, “Be careful, you dropped some chromosomes on the floor.” The exercise made such an impression that most of them took their models home to use in their own classrooms. (Anecdotally, it was clear to me, as well as to the rest of the class, that by far the best teachers with scissors, tape and glue were the kindergarten teachers!)

At the end of the course, the teachers were asked to come up with ways they could use aspects of what they had learned in the workshop in their own classrooms. While some individuals modified some tried-and-true lab exercises from various texts and web sources, several came up with some innovative ways to pique the interest of a younger grade school audience. The exercises ranged from projects involving edible cell models and cell mobiles to the construction of a cell pillow to emphasize the three dimensional nature of living organisms. The teachers of K-2 students placed particular emphasis on games, stories and puzzles to interest the children about the topic. They created several types of picture and shape puzzles with the cell as the main theme, as well as several games including a cell dice game, cell bingo and several versions of matching card games including an interesting variation on the game of Old Maid. All of the exercises, in some way, had the major emphasis of capturing the imaginations of even the youngest students and encouraging them to explore and investigate.

Working with these teachers was a tremendously pleasant and rewarding experience. I found them a very dedicated, hard-working, resourceful, and talented group of individuals. Should the opportunity arise for any of you in the future, I would highly recommend the experience. After all, they are providing the bedrock of knowledge for our next generation of scientists and informed citizens.
When to Teach the Urinary System

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One of the many lively and productive discussions on the HAPS e-mail list, HAPPL, occurred October 11 to 14, 2000. It began when I posted a question about the most appropriate time in A&P II to teach the urinary system—shortly after the circulatory and respiratory systems, or later in association with the reproductive system?

There are acceptable rationales for either approach. Most A&P textbooks present the urinary system just before the reproductive system, presumably because of the anatomical proximity of the two systems, their related embryological origins, our habit of thinking of them collectively as “the urogenital (genitourinary) system,” and our consignment of both to the practice of urology, since the disorders of one system often affect the other.

But there are also good arguments in favor of presenting the urinary system close to the circulatory and respiratory systems, as we find in Harrison’s Principles of Internal Medicine, Ganong’s Review of Medical Physiology, Guyton and Hall’s Textbook of Medical Physiology, McCance and Huether’s Pathophysiology, and undergraduate human physiology textbooks (Fox, Sherwood, Silverthorn, Vander et al.). Concepts of circulatory physiology (capillary fluid exchange, vasmotion) are necessary to an understanding of glomerular filtration and reabsorption by the peritubular capillaries. The lungs and kidneys regulate the Pco2 and pH of the blood, and the kidneys regulate the electrolytic and organic composition of the blood plasma. Assuming there is a beating heart, no other organ governs blood pressure as much as the kidneys do, through their regulation of water balance and their collaboration with the lungs in synthesizing angiotensin and indirectly stimulating aldosterone secretion. The kidneys also regulate the hematocrit and blood Po2 through their secretion of erythropoietin. The bicarbonate buffer system is an important topic in both respiratory and urinary physiology. Finally, urinary pathology has more impact on circulatory function than on reproductive function.

In my opinion, the urinary-reproductive association is warranted in anatomy courses and textbooks, but the physiological ties between the circulatory, respiratory, and urinary systems should override the anatomical issue in courses and textbooks where the emphasis is on physiology. If we teach circulatory physiology, then immunology, the respiratory system, the digestive system, and metabolism before arriving at the urinary system, the relevant circulatory concepts are likely to have grown “rusty” in the students’ minds by a few weeks and probably two or more examinations, and must be taught over again to lay a foundation for renal physiology.

It was clear that most HAPPL respondents regarded the circulatory-respiratory-urinary sequence as the most logical. No one defended the urinary-reproductive association on scientific or pedagogic grounds, although some achieve a close circulatory-respiratory-urinary-reproductive link by moving digestive physiology out of the way.

Discussants who teach a circulatory-respiratory-urinary sequence for the above reasons included Dayton Ford (St. Louis College of Pharmacy), Mildred Galliher (Cochise Community College), Kris Kilibarda (Iowa Western Community College), Dave Parker (Northern Virginia Community College), Eileen Shull (Scott Community College), and me. Kris Kilibarda remarked, “When the units are taught this way, the students can actually see the connections—one in a while one even comments, ‘Haven’t we been on this topic a really long time?’ To me, that is interconnectedness!” David Evans (Pennsylvania College of Technology) said that he disliked a laboratory manual he once used that lumped the reproductive and urinary systems together in one chapter. “Students were seriously confused.

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1 The full text of the discussion can be found in the HAPPL archive at www.hapsweb.org/ (then click on “HAPPL ListServe”), mostly for the dates 11-14 October 2000 and with the subject lines “Teaching the urinary system” and “Sequence.” Some of the responses summarized in this article were off-list but are used with the writers’ permission. To subscribe to HAPPL, send an e-mail message to HAPPL-request@seimath.imperial.cc.ca.us (“HAPPL” must be uppercase) with only the word SUBSCRIBE in the message space, or send a request personally to Jim Pendley at pendley@imperial.cc.ca.us.

Educational Issues - continued on page 11
over that chapter” because it was necessary for them to have circulatory concepts fresh in their minds in order to understand renal physiology. Dave Parker similarly remarked, “I guess I don’t find the association anatomically between the urinary and reproductive system sufficient to sacrifice the connecting links established by the previous mentioned [circulatory-respiratory-urinary] sequence.” Years ago, when he tried the usual textbook sequence, he found it difficult for students to see the connecting links.

Some respondents teach either the respiratory or the urinary system before the circulatory system. Don Kisiel (Suffolk County Community College) and David Mork (St. Cloud State University) teach a digestive-respiratory-circulatory-urinary-reproductive sequence, following an intake-circulation-excretion motif thereby associating the urinary system with the circulatory system at one end of the sequence and with the reproductive system at the other. “Thus, following capillary exchange, I can segue into filtration and reabsorption in the nephron. And the ‘urogenital’ relationships are a natural” (Kisiel). Judith Gibber (Columbia University) is experimenting with teaching urinary a few weeks before circulatory. David Woodman (University of Nebraska, Lincoln) said that in anatomy, he teaches the urinary system just prior to reproduction, but in physiology he teaches it very early in A&P I, just after homeostasis, cell membranes, and transport mechanisms.

No one argued for delaying the urinary system until just before the reproductive system (in combined A&P courses) on scientific grounds, although some such as Cris Martin (Ursuline College) said they teach this order because they’ve simply followed the textbooks or because they are bound by the decisions of curriculum committees. Cris said that she sees this sequence as unfortunate, because “I find myself rushing through digestion to get to urinary because I, too, love to see the ah-ha’s that students always have when they see everything tied together. (In my opinion, these ah-ha’s are the best thing about teaching.)” Lee Weller (University of Tasmania) said that he has experimented with different sequences but has found it ineffective to depart from the one used in the textbook, whatever that sequence may be, because it confuses students to jump back and forth in the book.

Moving the urinary system up to follow the respiratory system raises the question of when to treat the digestive system. This was not discussed extensively, but it seemed generally agreed that digestive physiology (and the ensuing topic of nutrition and metabolism) is relatively flexible in its placement. Mildred Galliher and I place it after the urinary and water-electrolyte-pH chapters, before the reproductive system. Don Kisiel and David Mork, as already noted, cover it before the circulatory system.

Returning to the original question on the urinary system, we may well wonder along with Dave Parker, “Maybe someone needs to tell me what I am missing by not doing the textbook order,” or with Lee Weller, “If so many A&P teachers think the common (textbook) sequence is not pedagogically desirable, why are there so many textbooks with the ‘wrong’ sequence available...and so few with the ‘right’ sequence?”

These questions went unanswered on-list, but Judy Gibber examined the treatment of the urinary system in textbooks as early as 1822 and offered some interesting observations off-list. Magendie (1822), Kirkes (1853), and Foster (1891) drew a close connection between the respiratory and circulatory systems, but relegated the urinary system to the back of the book and lumped urine with secretions such as tears, saliva, bile, pancreatic juice, milk, and semen. Budgett (1916) similarly grouped urine with these secretions, but showed at least some awareness of principles of filtration and osmotic pressure in renal function. He did not indicate any awareness of the role of the kidneys in blood pressure and acid-base balance. Nor, half a century later, did Langley (1965), although Langley presented the systems in circulatory-respiratory-urinary order.

Most of the concepts that justify a circulatory-respiratory-urinary sequence are relatively recent ideas. Introductory textbooks tend to pattern themselves after those that have gone before, and various market influences make it difficult to break from tradition, especially when the high cost of textbook development creates a low tolerance for risk. But if A&P textbooks place the urinary system between the digestive and reproductive systems just because “that’s the way it’s always been done” or because we are clinging to nineteenth-century pedagogy, the logic of this sequence bears reconsideration.

References

Why I Fear Bill Nye the Science Guy

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Bill Nye is a Seattle engineer, stand-up comic, and host of PBS's "Bill Nye the Science Guy" television show. He has the bizarre notion that science should be fun and even entertaining. His show was (it is no longer on PBS) popular with kids and adults alike, many of whom were not even science nerds. Bill Nye the Science Guy was highly polished and well produced. For example, this show frequently contained catchy music videos that reinforced the topic of the day (e.g., gravity, digestion, atoms, etc.). They would visit a research location, sometimes in other countries, and have interviews with scientists to give viewers a first-hand look at the process of science. In addition, the content was good - not just fluffy content, but some meaningful and important science concepts. It was wonderful television.

Funding for Bill Nye's program came from at least two sources: The National Science Foundation and Walt Disney. No wonder the animations and music videos looked and sounded so good. Behind Bill Nye's show was a large cast of animators, producers, actors, computer programmers, and money. Combine those resources with an engaging and funny science guy and you have the makings of a winning television program.

So why am I afraid of Bill Nye? It's not an easy question to answer, but here I go.

My students currently must arise early on Monday mornings to attend my 8 a.m. lecture on anatomy and physiology. In my course I use a nice computer and projection system to display some cool simulations and activities on the physiology of the neuromuscular junction, for example. Many of my students attentively take notes as I explain neuromuscular junctions while others sleep in their chairs (and still others sleep in their dorms). It is not only my class at the University of Minnesota that is examining the neuromuscular junction at this time. All over the country, and even all over the world, students are getting up to attend 8 a.m. classes that cover the neuromuscular junction! "Acetylcholine diffuses across the synapse and binds with receptors on the motor end plate. Questions? Anyone? Anyone?"

One of my more confused students may accidentally get up and go to a college across town, attend the wrong A & P course, and be exposed to the same content I am presenting in my classroom.

There are two big issues here. First, I am fortunate to have access to computers and other technologies to help me create simulations and activities for my students, but I have relatively little compared to the resources available to Bill Nye. I would love to get the Disney folks together to build a few neuromuscular junction animations. Somehow I think that the people who created The Lion King, Tarzan and a few hundred other movies might do a little better job at creating animations than what I can do with my Macintosh. They could probably even create virtual reality presentations that would allow students to put on computerized goggles and see neurotransmitter substances zipping by their heads. Turn one way to see the neuron with calcium moving into the terminal and the acetylcholine coming out. Then turn the other way to see the motor end-plate and the receptors being hit by thousands of acetylcholine molecules. Potentially, very cool stuff! Conclusion: I am no match for Disney.

Second issue: Why do students have to get up for 8 a.m. classes to hear the same information that they could just as easily watch on a video? Let us face it, most science classes do not have the dynamic, mind-opening, truth-revealing discussions that we hope for. Nor do they have the student-to-student interactions that we know are important but do not facilitate since it is too easy to lecture about the neuromuscular junction. So again, why must students show up for 8 a.m. classes to hear, in essence, a talking head? I do not know the answer, but I believe a big part of it goes back in our industrial history to when workers had to show up on time. Then teachers needed to train our future work-force to show up when the assembly line started. I often think about the importance of showing-up on time because it annoys me when students walk in late for exams. I know it is still important, especially for people who work in service industries and for people trying to catch an airplane, bus, train, etc., but promptness is not as important as it used to be. Many companies now do not care when you work, as long as the work gets done. This is especially true in high-tech companies where engineers and technicians are rarely working at 8 a.m., but can frequently be found on task at midnight. Those of us who have on-line components of our courses know that students access the computer servers at all hours, with peak periods at night. (As A & P instructors, our advanced understanding of metabolism make us aware of the fact that most of our students are much more awake at night than at 8 a.m.) So if your goal is for students to understand the anatomy and physiology of the neuromuscular junction, does it really matter what time they learn it? So what if they learn it best at 3 a.m. by watching or even participating in a Disney animation? Wonderful! Your students know the concepts so you've met your goal. Conclusions: Students can learn anatomy...
and physiology outside of class time. Being on time is not an essential factor in being a knowledgeable A & P student.

Now add into this mix distance-learning, on-line courses, and administrators. Many of us are now pressured to put our courses on line or to facilitate some form of distance-learning opportunity. Our administrators tell us that we are hoping to better serve our students, but the real reason is money. (Many administrators and some educators believe that distance learning and/or on-line learning equates to easy money for relatively little work, but this is a topic for a later column.) Schools are capitalizing on technologies that enable them to accommodate students who cannot drive to a campus or cannot attend courses at traditional times. And with the help of technology such as the Internet, CD-ROMs, videotapes, and e-mail, we can produce a good learning experience for those who wish to participate. Distance-education students still pay tuition, but there are no rooms or labs to maintain, and this is where the notion of easy money comes from. Colleges and universities are increasingly amorphous with 24-hour clocks. A University of Minnesota student may live in Nigeria and complete his course work on the Internet at 2 a.m. Conclusions: It is becoming less necessary to show up to a classroom to get an education. And there is increasing pressure for more distance-learning courses.

Now comes the scary part. What if Disney goes into the education business? What if Walt Disney University takes over the anatomy and physiology teaching market? Let us see what it would take. They would probably start by finding 10 or maybe even 100 of the best anatomy and physiology teachers and researchers in the world, then double their current salaries for their help in creating the best A and P program ever for Disney U. There they would work with Disney cartoonists, artists, computer programmers, and graphics specialists to put together the best animations and teaching tools ever. They could hire Bill Nye, Brad Pitt, or maybe even one of those cute doctors from “ER” to make presentations that would be recorded, edited, re-recorded, re-edited and turned into a highly organized, sexy, and effective product that would be put on video tape, DVD, CD, TV, or whatever. The final product would be available in a form that could be used at anytime and anywhere. Cost? About $30 per student. I think they could still make enough money to please Michael Eisner (CEO of Disney). “Why take Murray Jensen’s Human Anatomy and Physiology course at 8 a.m. when I can take Walt Disney’s Human Anatomy and Physiology course and do the work (work?) anytime day or night?” students would wonder.

Colleges and universities could then start contracting with Disney U. to provide A & P courses in place of their own A & P course. Disney and university lawyers would work out all the financial arrangements, and the colleges could then get rid of all those people who teach anatomy and physiology and use the empty classrooms for more administrative offices. In many cases the students would learn more anatomy and physiology than they do now. Let’s face it, our students today have grown up with MTV, Disney, computer games, etc.; they learn differently than did students of 20 years ago. They are more suited to learning through Disney than through my 8 a.m. lecture.

So why am I afraid of Bill Nye The Science Guy? Because when I see him on television I see the future of education. I see wonderful animations and activities that I cannot even dream of making. I see students engaged in virtual learning environments that promote much greater learning experiences than my lectures. I see students completing their assignments at 2 a.m. when they are most awake and sleeping at 8 a.m. I see Disney University. And I also see much less of a need for anatomy and physiology instructors.

So what can we do to prevent this? Nuke Orlando? Nope, it’s more difficult than that, and it’s material for the next column. ♦

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The Sliding Filament Mechanism: A Physiology Simulation for the Large Classroom Setting

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Have you ever struggled with having to explain complex physiological processes to students? For years I experienced this in my large lecture classroom of freshman students. I would typically cover muscle contraction using graphic representations on an overhead projector to illustrate the process. I tried the analogies and practical examples. I accompanied my explanations with interactive questioning strategies to formatively assess student learning. I distributed a muscle song, and we sang it to reinforce concepts and heighten the learning motivation. I used examples of golf clubs, beads, and buttons to enhance the visualization of the myofilaments. Just when I thought I had refined my explanation of the sliding filament mechanism so that most of the students were “getting it,” I asked the class not only to answer five brief questions, but also to explain why they had selected their answers. I expected that they would have understood the process enough to be able to provide some explanations in their own words. To my surprise many of the students told me that they had selected answers because they remembered what I had said or that they remembered what it looked like in their notes. For higher order questions requiring analysis and synthesis, my students questioned how they were supposed to know that type of information. To my dismay I discovered that they were trying to learn physiological processes using mainly recall.

A New Teaching Plan
At Human Anatomy and Physiology Society Conferences I became aware of the increased emphasis that was being placed on multisensory learning in the anatomy and physiology classroom. I remember hearing that students tend to learn and remember better, and to enjoy learning more if they are taught through their learning style strengths rather than through the teacher’s strengths. I had seen activities developed for the small classroom or the laboratory setting, but not much that applied to the large classroom. It became my goal to attempt to construct a teaching plan for muscle contraction that would force students to move from their note-taking mode for physiology to one of inquiry. To accomplish this, I first had to create a novel large classroom situation so that my students’ responses to the subject matter would change. I thought that by introducing this activity early in the course, students would begin to change their approach to learning physiology. This is how the muscle contraction simulation developed.

How The Muscle Simulation Plan Works
As an introduction to the plan, I first made the students aware of the complexity of the process by giving them an assigned reading, the muscle contraction process, from their textbook. This was followed by a multiple-choice pretest of a few questions covering the main concepts. The class complained bitterly that the reading was difficult. The test was perceived as unfair, but it was used to heighten their attention to the simulation that follows. If you would like to attempt this simulation in your class, the materials and specific directions are given. I have tried this simulation in large and small classes, but it works better in the large lecture classroom.

Materials used in the simulation:
Strips of plastic for actin, myosin, tropomyosin and titin myofilaments
4-6 paper plates for troponin molecules
4-6 ATP molecule signs
Calcium signs to be made by class members
1 Bubble gun for acetylcholine molecules

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Different color strips of a shower curtain make great myofilaments. Using a dark colored plastic, cut the myosin strips about 8 inches wide and glue them so that the resulting single myosin is long enough for 5-7 students to stand behind. Using a lighter colored plastic, cut two actin strips about 5 inches wide and each long enough for 3 students to stand behind. Two thin strips of garbage bags or coiled telephone cords are used for the titin myofilaments. The construction paper labels are stapled to the regions indicated with their respective letters on the thin and thick myofilaments:

\[
\begin{array}{cccc}
A & H & M & H & A \\
\hline
A & H & M & H & A
\end{array}
\]

Actin

\[
\begin{array}{cccc}
Z & I & I & Z \\
\hline
Z & I & I & Z
\end{array}
\]

Troponin/Tropomyosin Complex

\[
T \quad T
\]

To make tropomyosin and troponin, cut two plastic strips about 1-2 inches in width and the same length as the actin strips. Cut two holes in the center of 4-6 paper plates. Threading each tropomyosin strip through 2-3 of the paper plates makes two tropomyosin-troponin myofilaments. Label the troponin plates. Four to six sheets of construction paper were used to make the ATP molecules (not shown in the diagram). Use "ADP + Pi" for labeling so that the sheet can be folded to illustrate hydrolysis of the ATP at the appropriate time.

Participants Needed:

Five to seven students are needed to form the one myosin myofilament:

\[
\begin{array}{cccccccc}
\hline
\hline
\hline
\hline
1 & 2 & 3 & 4 & 5 & 6 & 7 \\
\hline
\hline
\hline
\hline
\end{array}
\]

- Students 1-3 and 5-7 will use their arms as cross-bridges.
- Students 4 will represent the bare region of the myofilament.

Six students are needed to form two actin myofilaments and 2-discs:

\[
UUU \quad UUU
\]

All the students not acting as myofilaments are asked to imagine that they are sitting in the smooth endoplasmic reticulum. They will be responsible for releasing calcium ions during the simulation. I play the role of the motor neuron.

Beginning the Simulation

Demonstration of Muscle Fiber Ultrastructure

1. To assemble myosin and actin myofilament with attached 2-discs, have the seven myosin students hold the thick strip labeled:

The students should stand behind the strip, facing the audience so that the audience can clearly see the banding. I take considerable time talking about the banding as the students assemble the myofilaments.

Have the six actin students hold the thin labeled strips:

\[
\begin{array}{cccc}
Z & I & I & Z \\
\hline
Z & I & I & Z
\end{array}
\]

These students should stand holding their strips so that the audience can see the labels, but they should be in front of the thick filament mentioned above such that the M and H are exposed. I discuss the actin and the Z discs. Then get the students at the ends of myosin to hold the titin strip and the other end of the titin is given to the Z person.

2. Introduce the concept that the sarcomere is an area of the muscle between the Z discs. A muscle is composed of thousands of sarcomeres. As the sarcomeres shorten, the whole muscle shortens.

3. Point out the banding on the myofilaments.

4. Direct the myosin students not to move at all. Actin students are to do all the moving.

5. During this part of the simulation, the actin students are asked to walk sideways toward the M line, still keeping their strips facing the audience. Changes in banding patterns are analyzed. For instance, we discover that the H zone disappears and that actin can overlap at the center. So the students can better see the disappearance of the I band, have them shift positions, with the myosins now in front and the actins behind. This whole concept is difficult for the students, so we just walk through it a couple of times with students asking questions and my explaining the change in the banding patterns, emphasizing that the myosin does not move or shorten.

6. Key assessment questions explored in this section are:

- What happens during muscle contraction? (Actin students walk towards each other.)
- What happens to the banding? (H?) (A?) (I?) (Z?)

Demonstration of Specific Parts of Myofilaments

1. Have myosin students (1-3) and (5-7) illustrate the cross bridges using their hands and arms:

- Display the cross bridges by their waving arms.
- Raise and lower their arms to illustrate high and low energy levels of the myosin heads.

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Introduction

A major component of any anatomy education is the mastery of sensory and motor nerves of the peripheral nervous system (PNS). Using traditional lectures and diagrams alone can hinder students from effectively understanding the three-dimensional organization of the PNS. Students learn more effectively when they actively participate in a task rather than having the information passively “fed” to them (Cross, 1987). Building a model of the PNS is one self-directed strategy that enables students to visualize the PNS in three dimensions as well as its relationship to the central nervous system. Initially students assemble a simple model of the spinal cord. During consecutive lab periods, students replicate the different regions of the spinal cord (the cervical, brachial and lumbosacral plexus) by attaching representations of nerves to the spinal cord then labeling the muscles and cutaneous regions each innervates. The model can be used to bridge the students’ knowledge of anatomy with related clinical deficits. Upon completion of each region, students use the model to answer clinical questions from case studies describing nerve damage in that region of the body.

Research on learning and personality traits indicates that every student receives and translates information through preferable styles of learning (Fleming, 1992). Students use their preferable styles to learn the organization of the PNS and answer questions pertaining to case studies. The kinesthetic student learns the model’s organization as he/she physically assembles the parts (tactile style). The visual learner examines the structural arrangement of the nerves on the model while referring to diagrams for guidance. The aural student retains information by talking aloud about the organization that is observed (verbal sorting) after listening to oral instructions (Sealey, 1985; Sarasin, 1998).

Construction of the Model

This activity uses one hour each of four different laboratory periods. Each demonstration should be completed during the appropriate unit of the course.

Laboratory 1: Spinal Cord Base

A spinal cord base is created from a Styrofoam block of the following dimensions: 4 inches in width, 2 inches in depth, and 32 inches in length (Fig. 1). To create a smooth surface for labeling, cover the Styrofoam with white glue then, after the glue has dried, paint it with poster paint. Using a measuring stick and marker, draw 31 marks spaced 1 inch apart along the long edge of the board. At each mark, draw lines across the width of the board to represent the spinal segments (Fig. 1). Label the spinal segments with a marker (cervical 1-8, thoracic 1-12, etc.).

![Figure 1. The dimensions and labeling of the spinal cord base](image)

Brachial Plexus Worksheet

For each of the nerves that have their origin from the cervical spinal segments C5-T1: 1) place the appropriate motor (m) or sensory (s) fibers into their spinal segments; 2) label each nerve; 3) combine branches to form larger nerves (when indicated); and 4) write the nerve’s function(s) on the tag (and worksheet.)

<table>
<thead>
<tr>
<th>Spinal Segment</th>
<th>Type</th>
<th>Nerve name</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 (5 roots)</td>
<td>m</td>
<td>1) dorsal scapular</td>
</tr>
<tr>
<td></td>
<td>m</td>
<td>2) branch of long thoracic</td>
</tr>
<tr>
<td></td>
<td>m</td>
<td>3) suprascapular</td>
</tr>
<tr>
<td>Upper trunk</td>
<td>m</td>
<td>4) branch of upper trunk; join this new root w/ a C6 root and label this junction as the upper trunk</td>
</tr>
<tr>
<td>branch of Post. Div.</td>
<td>m</td>
<td>5) join C5 root of upper trunk with new roots from C7 and C8 and label junction posterior division</td>
</tr>
</tbody>
</table>

Function

---

Teaching Tips - continued on page 18

HAPS-EDucator - Winter 2001 - page 17
Laboratories 2, 3 and 4: Brachial, Lumbosacral, and Cervical Plexi

Students construct these plexi using pipe cleaners following instructions on a worksheet/guide that includes a list of nerves, their modalities, segmental origins, and functions (Fig. 2).

Students insert pipe cleaners along the 2-inch edge of the board at a location that coincides with their respective spinal segments. They place motor nerve fibers toward the anterior surface and sensory nerve fibers toward the posterior surface (Fig. 3). For those nerves that have multiple branches, they twist pipe cleaners together to form a larger nerve (i.e. the phrenic nerve in Fig. 3). They attach a tag labeled with the name of a nerve and the body region it innervates on the corresponding pipe cleaner(s).

Figure 3. Spinal cord model from spinal segments C1 to C5.

This diagram displays the labeling of the spinal segments, the organization of the sensory (s) and motor (m) components of the model, and the specific labeling of the phrenic nerve with nerve roots from C3 to C5.

Applying the Model to Clinical Case Studies

Since the majority of anatomy students are pursuing careers in the allied health fields, case studies are used to encourage them to use their models to help them identify what specific movement or sensation would be affected in neural injuries. Students are given case studies accompanied by a set of questions after each unit. An example of a case study and the questions used to study the brachial plexus is:

The victim of a motor vehicle accident is admitted to the ER with an immobilized neck. The patient presents with deep lacerations and traumatized tissue in the right side of the neck region. During exploratory surgery, the surgeon discovers torn nerves on the right side at spinal cord level C5 and C6. Due to the severity of the nerve damage, the surgeon suspects that the patient will have permanent motor and sensory deficits.

- What are the major motor deficits (loss of movement) involved with this injury?
- What are the sensory deficits (dermatomes)?
- How will the affected limbs appear in resting condition?

Students use the model and higher-order thinking skills to effectively answer the clinical questions concerning this case study. First students identify all the nerves that have their origin from spinal segments C5 and C6. Next, they identify all the structures supplied by those nerves, thus revealing the muscles and dermatomes affected by the damage. Finally once the affected muscles are identified, the loss of movement and resting conditions of the limbs can be determined.

Discussion

This activity was designed to help students master the three-dimensional complexity of the PNS and to improve clinical applications of the factual material. It was learned from a survey of students that the models are useful in understanding the anatomical organization and the functional relationships between the nerves and their target muscles and dermatomes, especially in the more complex regions of the PNS. Therefore, this activity fulfilled its original purposes:

1. To provide students with a representation of the PNS that was helpful for understanding its three-dimensional complexity
2. To promote higher-thinking skills by using the model and case studies to examine the relationships between peripheral nerve damage and clinical deficits.

We would like to acknowledge the Kean University students who participated in this activity and for the contributions made by Dr. Madeline Butler and Dr. Francine Glazer.

References


Teaching Tips - continued on page 19
Introducing A Long-term Experiment Into A Traditional Lab Course

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Phone: (610) 932-8300 ext. 3512
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Introduction

Laboratory-based science courses set many goals for students including introduction of factual information, formation of a conceptual framework for learning, acquisition of specific laboratory techniques, and comprehension of experimental methods. The first three goals listed can be easily met by the traditional three-hour a week laboratory. However, providing students with a rich experience in the experimental method, as used by scientists, cannot be done as easily. Many science students acquire this type of experience through summer internships or academic year research in funded research labs. However, not every student is able to take advantage of summer internships and not every institution of higher learning has sufficient research labs to provide all students with a “real world” experiment.

Therefore, to provide my Vertebrate Physiology students with a real world rich experimental experience, I have designed a 10-12 week mouse feeding experiment that fits within the traditional three-hour a week laboratory course. The students are required to spend some time each week outside of class taking care of the mice. Since the students do the mouse work each week in addition to performing regularly scheduled lab assignments, the bulk of the mouse work is fit into a short time during the laboratory period. I chose a feeding experiment because it does not require the students to handle dangerous substances and is frequently done in animal science settings to address specific needs.

Including this long-term experiment in my Vertebrate Physiology class for the last three years has given me an opportunity to approach this project from different angles. I have settled on a schedule and set of duties for the students that work for us. This article may be used as a guide for others who may be interested in this approach.

Goals

Successful completion of the goals I set for this experiment provide student experience with:

- handling animals
- designing and carrying out an experiment
- thinking through results and possibly changing the experimental protocol
- writing a scientific paper based on personally obtained results
- learning about all the details that go into planning and executing an experiment.

Background

During the first lab period, I discuss some reasons for performing feeding experiments, then provide the students with previous years’ data. Due to budgetary and space constraints, the class is limited to the number of mice available. After reviewing the experimental design, I allow the class to design the experiment in any manner they wish. Small groups (two to three students) brainstorm to come up with an experimental design; then all of the small groups pool their ideas. The class modifies these individual designs to come up with a single design. For example, one year one small group came up with the idea of doing a one-week pilot study using a wide range of food weights and using smaller numbers of mice per group. Then they wanted to take the one-week results and use them to design the full experiment the following week. The whole class thought this was a good idea so this became the experimental design for the whole class. One result was that two of the lower range food weights provided so little food to the mice that they were starving, and those experimental groups were dropped before the week was up. This exercise gave the students experience with thinking through and testing the parameters of an experiment. Each group works all semester on mouse care as well as on the mid-term and final group lab reports.

Student Activities

To maximize student involvement, I utilize several full laboratory periods as described below and require the students to perform specific tasks during each of these laboratory periods.

- During the first lab, the students brainstorm about their experimental design, as described above, and decide on two or three experimental groups and a control group. The experimental groups are always fed a certain percentage of body weight. The amount fed to the control group varies, and this is one decision that needs to be made during the brainstorming period. Once the experimental groups (for example, 10% and 20% body weight per day) and control group (for example, 15% body weight per day) are determined, the students decide the number of mice to be used per group and the number of mice per cage. Some years there has been one cage per group, and other years, two cages per group.
Teaching Tips - continued on page 19

• Students label the cages and prepare them with food, water, and shavings.
• I order the mice and put them in their cages when they arrive. I care for them until the next laboratory period, and then I assign the student groups specific days to care for the mice on a rotating schedule.
• Students are responsible for daily weighing the food, feeding each cage, and changing the water.
• During each laboratory period each group cleans its cages, reweighs its mice, and readjusts the food weights for the week. This way the students can do their other laboratory exercises and they are not in each other’s way in the mouse lab.

• The students also have time during each laboratory period to discuss what is happening with the mice and what information each week's weight data is providing. Sometimes changes are made in the protocol. A lab notebook is kept in the mouse room in which all data is recorded.
• I incorporate a statistics lab and require the students to provide mouse feeding and weight data in tables and graphs and to perform statistical analyses on the data. These data are presented in mid-term and final reports that are written like a scientific paper. The final report includes a section on recommended future experiments based on their results.

<table>
<thead>
<tr>
<th>Week</th>
<th>Laboratory Exercise</th>
<th>Mouse Experiment Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Experimental Design</td>
<td>Design the experiment and prepare the cages</td>
</tr>
<tr>
<td>2 - 5</td>
<td>Perform traditional three-hour laboratory exercises</td>
<td>Spend about twenty minutes per week cleaning the cages,</td>
</tr>
<tr>
<td>6</td>
<td>Introduction to statistics, including calculation of</td>
<td>weighing the mice, and recalculating the amount of food they are to be fed</td>
</tr>
<tr>
<td></td>
<td>mean, mode, and median, standard deviation, t-test, and</td>
<td>Outline the format of the mid-term lab report and review the data</td>
</tr>
<tr>
<td></td>
<td>Chi-square</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Perform additional traditional three-hour laboratory</td>
<td>Mid-term mouse lab report due</td>
</tr>
<tr>
<td>7-11</td>
<td>exercises</td>
<td>Spend about twenty minutes per week cleaning the cages,</td>
</tr>
<tr>
<td>12</td>
<td>No lab meeting</td>
<td>weighing the mice, and recalculating the amount of food they are to be fed</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Collect final mouse weight data; sacrifice mice, observe</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>fat deposits, and harvest organs; clean animal room</td>
</tr>
</tbody>
</table>

Benefits

The most important benefits are the excitement this exercise generates, the increasing interest with which students approach class each week, and their deeper understanding of experimental design and hypothesis testing. They find this exercise more meaningful than most of the 2-3 hour exercises that make up the bulk of college science laboratory classes. For example, one student told me, “This class is more fun than any other science class I’ve taken.” Another student, who is now teaching high school biology, used her digital camera to take pictures of the mice, the students weighing and caring for them, and the final sacrifice showing proper dissection to use in her future classes.

The students’ comfort level with handling mice greatly increases which benefits those going to summer internships or graduate school. Although some students never get very comfortable handling the mice, one student told me “I can’t believe I’m not afraid to touch mice any more,” and there are always a couple of students who volunteer to care for the mice on weekends because they enjoy handling animals.

Most of our students don’t take an undergraduate statistics class, so this exercise provides them with an introduction to statistics. After preparing their own tables and graphs, and spending time sifting through data to decide what to present and how to present it, students better understand how to interpret similar tables and graphs in the literature. Much of the lecture time and a large portion of their tests are spent on interpretation of tables and graphs. Between midterms and finals I see an improvement on that section of their exams and increased sophistication in their in-class discussions, but I haven’t formally tested for significance of results. Finally, the students better understand the importance of the human factor in determining the success or failure of a scientific endeavor. For these reasons, I continue to refine this long-term experiment every year. It is our duty as professors to help make science come alive for our students. This is one process that has worked at my university.
Good news! We have increased interest in hosting regional conferences. Several people have volunteered their time and effort to host a conference in their area. These people are giving many hours out of their busy schedule to provide updates in the field of anatomy and physiology. Your task, should you choose to accept it, is to either attend one of these regional conferences AND/OR host one of your own. We need MORE conferences!

I received an email from one of our members, Joy Jennings-Pineda, at SMSU-West Plains, Mo. I have her permission to quote from her.

Are there any regional conferences near me (or anything related actually) that I might attend? If we do not use our development monies (travel) we may not have them next year—so I am desperately looking! Last spring we thought we might have one in Missouri, but it fell through at the last minute. I cannot afford to go to Hawaii, but certainly could make it to a closer regional conference. If you can help at all I would appreciate it.

This is just one of many messages and sentiments that I get from our members. We need more hosts in each state and province. How can we let Joy and other members down? Departments budget for travel but often faculty do not have a place to go. Let’s see if we can provide our members and potential members the opportunity to network with other instructors as well as to get updates on significant advances in their fields of study.

HAPS can make this relatively simple and effortless. We have a step-by-step Guide to hosting a Regional HAPS. We provide a suggested timeline for tasks to be completed and we have a list of vendors who can help provide funding and/or workshops. Take time right now to talk to your administrators to get their support. Often they will provide funding and facilities to help you. Then take time to complete the proposal on page 30 and email or fax it to me. Choose your committee members and a theme for your conference and start planning the details of your conference. Do it NOW!

**Regional Conferences Dates:**

**Feb. 3, 2001-Clark College**
Vancouver, WA
John Martin-host
jmartin@clark.edu
360.992.2282

**Feb. 24, 2001-Triton College**
River Grove IL
Bob Anthony-host
708.456.0300

**March 10, 2001-Delaware Technical & Community College**
Wilmington DE
Joan Barber-host
jbarber@hopi.dtcc.edu
302.453.3784

**March 30-April 1, 2001-Collin County Community College**
Plano TX
Donna White and Mary Weis-hosts
dgwhite@ecccd.edu
972.881.5889

**May 24-25, 2001-NY University**
New Jersey/New York area
Elizabeth Harper
eh403@nyu.edu

Contact your regional director or Mary Bracken if you are interested in hosting a conference in your area. Contact numbers are on the inside front and back covers of this journal.

**Committee Updates - continued on page 22**

HAPS-EDucator - Winter 2001 - page 21
Call for Nominations

Bill Perrotti, President-Elect
Chair, Nominating Committee
Mohawk Valley Community College
1101 Sherman Drive
Department of Life Sciences
Utica, NY 13501
(315) 732-5519
wperrotti@mvcc.edu

The annual process of drawing up a slate of candidates for election of officers continues to progress. As you probably know, it is my responsibility to chair a Nominating Committee (this year consisting of Pam Langley, Carl Schuster, and Lucia Tranel) charged with recruiting and finalizing a slate of candidates for this spring’s election. What follows is the set of operating principles (endorsed by the Board) which the committee has drawn up and which will guide us in this process. A maximum of two candidates has been set for the position of President-Elect. This was done to ensure that whoever is elected will have the support of at least a majority of the membership who vote. For all other offices, the maximum number of candidates has been set at three. Members of the Nominating Committee will solicit suggestions from other HAPS members, come up with a list of possibilities, discuss them, and rank order them. Only after this part of the process has been completed will potential candidates be approached individually about running for specific offices. Realizing that this process is not perfect or an exact science and limited by the extent to which the committee members can know all specific details, we are using an agreed upon set of criteria to make decisions about candidates and fill the election slate. Among the criteria being used are such factors as years of HAPS membership, committee participation and/or leadership, current or previous elected or appointed positions, attendance at regional and/or national conferences, presentations made at regional and/or national conferences, other special work for HAPS, provision of support from home institution, and a willingness to serve. All discussions of potential candidates will remain confidential within the committee.

In late March or early April, you will be receiving brief biographies of all candidates and ballots on which to indicate your choices. Please exercise your vote. The ballots will include lines for write-in candidates for each of the offices. When voting, if you decide to write-in the name of a candidate other than yourself, please do the individual the courtesy of letting him/her know your intention in advance. Ballots are to be returned to the national office where they will be counted by one of the staff. It will be my pleasant duty to announce the results of the voting during the annual business meeting at the HAPS 2001 conference in Maui.

What follows is a brief description of the positions up for election this year.

President-Elect: The year-long training period of the President-Elect provides a spot on the Board of Directors and ensures a smooth transition to the presidency the following year. The President-Elect works closely with the President and is privy to all of the decision making and much of the correspondence in which the President engages. During the training year, the President-Elect is responsible for chairing the Nominating Committee for the next election. Please keep in mind that the position of President-Elect actually involves a three-year commitment (first President-Elect then President and finally Past President). The term for all other offices is two years.

Secretary: The Secretary is responsible for notifying the membership of all general meetings and for keeping minutes of all general, Board of Directors, and Steering Committee meetings. The Secretary also maintains HAPS records and manuals and directs communications from members to the appropriate individual.

Regional Directors: The Regional Directors are elected by the entire membership and exist to ensure that there will be individuals from across the continent serving on the Board of Directors. Each Regional Director is responsible for communicating with his/her constituents via small group meetings and written communications. They also serve as members of the Regional Conference Committee to promote local/regional conferences in their respective regions. Regional Directors are also responsible for support and communication with various HAPS committees assigned to them. The term of office for this position is two years with the opportunity to be re-elected for one additional consecutive term. The regions up for election this year are the South and the Central.

When you receive the election package, consider not only your choices for this election but also where you can fit your talents and energy to help HAPS grow and prosper. The benefits we derive from membership are the fruits of the labors of others who have volunteered their time to enrich all of our professional lives. Please get involved so that we can continue this wonderful work. As you contemplate where you can fit into the bigger HAPS picture, don’t limit yourself to elected positions… consider also committee work. That is truly where the “rubber meets the road.” Surely there is a role, a task, or an initiative that fits your interest and that can flourish with your help. Check the brief committee descriptions included in this issue and feel free to contact me or any of the committee chairs about ways you can participate. Speaking personally, HAPS has been invaluable to my career in A&P. My formal involvement has been a way for me to give back to the many individuals in HAPS who have helped me over the past decade. If all of us just recognize that by contributing in some little way, no one will have to do it all… HAPS and each of us will be the better for it.
Committee Updates - continued from page 22

Publications Board

Colin Wheatley, Former Chair
WCB McGraw-Hill
25 Kessel Court, Suite 202
Madison, WI 53711
Colin_Wheatley@mcgraw-hill.com

As I’m certain you’ve noticed, Susan Baxley of Troy State University Montgomery has replaced Caryl Tickner as editor of the HAPS-ED. Caryl resigned in early 2000 after having filled the position admirably for several years. It was time to give her a rest as she already had other duties on the HAPS Board of Directors. In our search for a new editor we asked Susan to take the reins and she accepted. With this important responsibility it is important that we now give Susan plenty of support. It’s a lot of work, especially in finding the articles and reviewing them for acceptance. Often the editor needs advice and input. Thus, we are pleased that Mike Glasgow from Anne Arundel Community College has accepted the responsibility to be the new Editorial Advisory Panel Chairperson who replaces Dave Parker and Judith Osborn.

To keep the HAPS-ED the fine publication that we all enjoy, Mike and Susan are seeking HAPS members to serve on the Editorial Panel and to serve as assistant editors. In his new position, Mike will be talking with the current panel members regarding their desire to continue on the panel or to be released. Many who have served many years may want to move on to other things. If you are interested in serving on the HAPS-ED Editorial Advisory Panel, please let Mike know. The responsibilities include soliciting good manuscripts and ideas for the publication, reviewing and editing the proposed articles and advising Mike and Susan on editorial policy. Remember, it’s your publication, so let’s give it plenty of help.

Membership Committee

Kevin Petti, Chair
Department of Science & Health
San Diego Miramar College
10440 Black Mountain Road
San Diego, CA 92126-2999
(619) 388-7491
kpetti@sdc.ed.cc.ca.us

Greetings HAPS Members!

In the last issue of the HAPS-EDucator I announced the membership drive. As you recall, new HAPS members, and existing members who recruit three new members, will receive a limited edition lumbar vertebra mug (see photo). Also, for those of you who recruit five new members, HAPS will reimburse your Maui conference registration fees. Depending upon when you register, this can be a value of up to $225!

Half-way through our fiscal year the membership drive has been quite successful. We have outpaced the new member rate for each of the last two years, and since July 1, 2000, over 80 new HAPS members have joined the ranks of our organization.

Also, I am pleased to award an incentive mug to our Northeast Regional Director, Don Kisel. Don has successfully recruited three members. Keep it up Don; only two more new members for you to receive HAPS 2001 Maui conference registration reimbursement.

Several members are only one more recruit away from their mug. You still have time to recruit members for your mug and Maui registration fee reimbursement. Go to http://www.hapsweb.org, click on “Membership” and download the membership form or make copies of the membership form on page 32 of this HAPS-ED. You can also contact me at kpetti@sdc.ed.cc.ca.us for brochures and literature about HAPS. Be sure your recruit writes your name on the “Referred By” line. This is the only way for you to receive credit towards the incentives.

Once again I would like to welcome our new members and thank those of you participating in the membership drive.

Committee Updates - continued on page 24

HAPS-EDucator - Winter 2001 - page 23
### HAPS Distance Education Survey

**Tom Lancraft, Chair**  
St. Petersburg Junior College  
Natural Science  
P.O. Box 13489  
6605 Fifth Ave. N.  
St. Petersburg, FL 33733  
(727) 341-4797  
lancraft@spjc.edu

127 have completed the HAPS Survey as of November 29, 2000 at 01:13 PM

<table>
<thead>
<tr>
<th>Question</th>
<th>Percent (%) of all respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Questions 1-7 cover descriptions of courses)</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>8. I feel pressured to develop or teach a distance course.</td>
<td>14</td>
</tr>
<tr>
<td>9. I receive adequate financial compensation and/or release time for</td>
<td>18</td>
</tr>
<tr>
<td>developing 10. I receive adequate financial compensation for teaching</td>
<td></td>
</tr>
<tr>
<td>distance courses.</td>
<td></td>
</tr>
<tr>
<td>11. I receive adequate financial compensation and/or release time for</td>
<td>12</td>
</tr>
<tr>
<td>maintaining a distance course.</td>
<td></td>
</tr>
<tr>
<td>12. I am familiar and comfortable with my institution's copyright and</td>
<td>19</td>
</tr>
<tr>
<td>ownership policies for distance courses.</td>
<td></td>
</tr>
<tr>
<td>13. I receive adequate administrative support for developing distance</td>
<td>10</td>
</tr>
<tr>
<td>courses.</td>
<td></td>
</tr>
<tr>
<td>14. I receive adequate technical support for developing distance courses.</td>
<td>8</td>
</tr>
<tr>
<td>15. In the future, distance courses will replace most of the traditional</td>
<td>40</td>
</tr>
<tr>
<td>course offerings at my institution.</td>
<td></td>
</tr>
<tr>
<td>16. In the future, funds for laboratories will be reduced as a direct</td>
<td>26</td>
</tr>
<tr>
<td>result of distance course offerings.</td>
<td></td>
</tr>
<tr>
<td>17. I am comfortable with the level of security in assessment for online</td>
<td>19</td>
</tr>
<tr>
<td>courses.</td>
<td></td>
</tr>
<tr>
<td>18. The best class size for a distance course is 20-25 students.</td>
<td>3</td>
</tr>
<tr>
<td>19. Communication (electronic or otherwise) is the most important aspect</td>
<td>2</td>
</tr>
<tr>
<td>of a well designed course.</td>
<td></td>
</tr>
<tr>
<td>20. A good course will have multiple assessment techniques.</td>
<td>2</td>
</tr>
<tr>
<td>21. Students entering distance courses are adequately prepared.</td>
<td>8</td>
</tr>
<tr>
<td>22. All forms of lecture content can be successfully delivered over the</td>
<td>19</td>
</tr>
<tr>
<td>internet.</td>
<td></td>
</tr>
<tr>
<td>23. All forms of laboratory content can be successfully delivered over</td>
<td>66</td>
</tr>
<tr>
<td>the internet.</td>
<td></td>
</tr>
<tr>
<td>24. At my institution, distance sections of courses are just as</td>
<td>3</td>
</tr>
<tr>
<td>transferable as traditional sections of the same course.</td>
<td></td>
</tr>
<tr>
<td>25. At my institution, there is a tendency for distance education courses</td>
<td>9</td>
</tr>
<tr>
<td>to be less rigorous than conventionally taught courses.</td>
<td></td>
</tr>
<tr>
<td>26. At my institution, there is inadequate screening of students who</td>
<td>0</td>
</tr>
<tr>
<td>enroll in distance education courses.</td>
<td></td>
</tr>
<tr>
<td>27. At my institution, many students who enroll in distance education</td>
<td>0</td>
</tr>
<tr>
<td>courses do not have the adequate learning and/or technical skills</td>
<td></td>
</tr>
<tr>
<td>necessary for academic success.</td>
<td></td>
</tr>
<tr>
<td>28. A science laboratory requires manipulation of physical objects.</td>
<td>0</td>
</tr>
<tr>
<td>29. A science laboratory experience should have cooperative and/or</td>
<td>0</td>
</tr>
<tr>
<td>collaborative learning elements.</td>
<td></td>
</tr>
<tr>
<td>30. A science laboratory experience must be interactive.</td>
<td>0</td>
</tr>
<tr>
<td>31. A science laboratory experience should include investigatory</td>
<td>0</td>
</tr>
<tr>
<td>elements (i.e., prediction, experimentation, and data collection, analysis,</td>
<td></td>
</tr>
<tr>
<td>and interpretation.</td>
<td></td>
</tr>
</tbody>
</table>

To respond to the survey, go to [http://instcomp.spjc.edu/cfd/develop/alan/haps/desurvey.cfm](http://instcomp.spjc.edu/cfd/develop/alan/haps/desurvey.cfm)  
To view the results directly, go to [http://instcomp.spjc.edu/cfd/develop/alan/haps/haps_results.cfm](http://instcomp.spjc.edu/cfd/develop/alan/haps/haps_results.cfm)
HAPS Technology Committee Survey 2000

Sandra Stewart, Former Co-Chair
Vincennes University, MSC
1002 N. First St.
Department of Life Science
Vincennes, IN 47591-5201
(812) 888-5775
Sstewart@indian.vinu.edu

The following is the report of the fifty-eight responses to the second Technology Survey conducted by the HAPS Technology Committee at the Charlotte HAPS Conference in 2000.

The results of this survey were consistent with the information provided by ninety-two surveys at the Ft. Worth HAPS Conference in 1998. There has been an increase in the number of faculty using CD's in instruction and an increase in faculty putting notes and the course syllabus online at www.hapsweb.org.

To encourage greater participation in the Distance Education Survey, the committee hopes to have a survey available online to the membership in 2001. If you would like more information about the surveys, would like to comment about these surveys, or offer suggestions for future surveys, please contact Tom Lancraft or Jim Pendley, Co-Chairs, HAPS Technology Committee.

1. Courses taught:
   ◆ Anatomy and Physiology Lecture - 42
   ◆ Anatomy and Physiology Lab - 39
   ◆ Anatomy Lecture - 11
   ◆ Anatomy Lab - 8
   ◆ Physiology Lecture - 17
   ◆ Physiology Lab - 14
   ◆ Human Biology Lecture - 9
   ◆ Human Biology Lab - 6

2. Institution description:
   ◆ Community College - 30
   ◆ Four Year College or University - 28
   ◆ High School - 0

3. Media used:
   ◆ CD ROM: Lecture - 36; Lab - 38; Student Tutorial - 28
   ◆ Laser Disc: Lecture - 12; Lab - 10
   ◆ LCD Projectors: Lecture - 36; Lab - 17
   ◆ Power Point: Lecture - 36; Lab - 27

4. Reason why technology was not used or used very little (1 being the most important reason to 5 being least important):
   1. Lack of funding for equipment and programs
   2. Lack of time in preparing materials for use
   3. Lack of instructor education on use
   4. Feel that the material can be taught better without the use of technology
   5. Lack of instructor interest in using.
   Comments:
   ◆ "I am strongly supportive but time and faculty expertise are limiting."
   ◆ "Excellent. Takes organization."
   ◆ "Faculty attitude toward acceptance of media is critical, especially at the dean/dept. appropriation level."
   ◆ "Release time is very limited."
   ◆ "Another tool to help students understand the subject."
   ◆ "Technology is adjunct to teaching."
   ◆ "Some CDs don't offer anything that excellent texts already offer."
   ◆ "Use as supplement."
   ◆ "Necessary and very useful - does some things better than I."
   ◆ "Not a cure-all. Often expensive."

5. Grants for Technology:
   Received grants - 16
   ◆ Most were for equipment
   ◆ Sources were primarily institutional
   ◆ Others included: NSF-ILI; NIH, NSF, and state grants

6. Use of the web for instruction:
   ◆ Taught the entire course online - 3
   ◆ Faculty reported the following available to their students online:
     ◆ Syllabus - 27
     ◆ Notes - 19
     ◆ Remedial - 10
     ◆ Prerequisites - 4
     ◆ Test - 5
     ◆ Lab notes - 16
     ◆ Others included asynchronous discussion, seminars, graphics, generating messages to the class, e-mail, assignments, diet analysis online

7. Distance Education:
   Teaching distance education classes - 5
   Classes taught:
   ◆ Intro to Biology
   ◆ General Genetics
   ◆ Anatomy Lecture
   ◆ Physiology Lecture
   ◆ TV Human A&P
   ◆ Bioscience Lab
   ◆ Medical Terminology

Committee Updates - continued on page 26

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Committee Updates - continued from page 25

8a. Should anatomy and physiology lecture be taught as a distance education course?
- Yes -27
- No -12
- Maybe -6

8b. Should anatomy and physiology lab be taught as a distance education course?
- Yes -8
- No -39
- Maybe -1

Comments:
- "I don’t know how to verify participation in lab."
- "Need the third dimension and hands-on (tactile) experience."
- "I still believe a lab component is needed several weekends."
- "Skeptical."
- "Need to come to campus for lab."
- "Computer component of lab could be done but need wet lab experience."
- "Depends on content."
- "Worry about test sites, hands-on lab."
- "The physical interaction with instructors and specimens is invaluable for learning and real life."
- "It will be whether we like it or not."
- "OK for non-majors."
- "Future will have interactive exercises that will be adequate."
- "Need to come to site for some work."
- "Not yet. Virtual reality may hold the answer."
- "I don’t think that computer/WWW experience are a substitute for wet labs."

9. How may the Technology Committee help?
- Continue review of software
- Hold workshops at HAPS Conferences
- Present information on what others are doing
- Provide evaluations of software programs
- Set standards for technology instruction
- Continue to discuss distance education
- Provide suggestions for applications for software in lecture and lab
- Provide information about grants
- Develop statistics on use/success of technology at the national level

REGIONAL CONFERENCE

HAPS and Collin County Community College invite you to attend a regional conference at the Spring Creek Campus in Plano, Texas. The conference will be held March 30 - April 1 and will include update seminars, workshops, and plenty of chances to meet and network with regional colleagues.

Details will be available soon. For more information, or to suggest topics of interest to you, contact:

Donna White
Collin County Community College
Department of Math and Natural Science
2800 E. Spring Creek Pkwy
Plano, TX 75074
972-881-5889
dgwhite@ccccd.edu

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THE GLOVE

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philip.stephens@villanova.edu
http://www.bio.villanova.edu

Introduction

Influences from many directions put pressure on instructors to reduce animal sacrifice in teaching laboratories. While many instructors may be open to using alternative preparations, they will do so only if the new exercises do not have a negative impact on their students’ laboratory experience. If wet laboratories are to be continued, there is an obvious need to develop laboratory exercises that use students as lab animals. Examples of such exercises include recording human electrocardiograms instead of using isolated frog hearts, and extracellular myograms rather than isolated frog gastrocnemius muscles. I have developed a simple device, the glove, that allows the student to painlessly stimulate their own nerves to examine motor unit recruitment, twitch time periods, work, summation, tetanus and fatigue.

Methods

Two small, disposable ECG electrodes are attached to the lateral edge of the palm of one hand. One is placed just below the knuckle of the little finger on the edge of the palm and the other just above the wrist. The electrodes are attached to an auxiliary unit with a stimulator, which is driven by the stimulus output from a data acquisition unit.

The student volunteer carefully places his/her hand inside a latex glove, being careful not to dislodge the electrodes. A transducer strip is carefully fed along the back of the hand and along the back of the little finger. Two or three small rubber bands are placed around the little finger to hold the transducer strip in place. The leads from the transducer are attached to the auxiliary unit, which provides a simple bridge balance control and an 8 pin socket to connect the transducer output to the data acquisition unit.

The software associated with the data acquisition unit is set up to produce one or more pulses to trigger the shocks delivered to the student. Any evoked muscle contractions cause the little finger to curl towards the palm, which bends the transducer strip and produces a signal on the computer screen. The shock is initiated by a stimulus pulse from the data acquisition unit, while the intensity of the shock applied to the hand is controlled by a dial on the auxiliary unit. It takes a little time for the volunteer to become accustomed to the involuntary movements evoked by the shocks. After this initial period, however, most students appear relaxed. At this point the volunteer is asked to place the back of his/her hand on the corner of the bench, with their fingers dangling over the edge so that a 10 or 20 g. weight can be hung from the little finger, and the experiment is repeated to test the effect of weight on the twitch.

Experiments

The relationship between stimulus intensity and the amount of twitch can be examined by measuring the amplitude of applied shocks from the dial on the auxiliary unit and the amount of induced finger movement from the computer screen (Figure 1). Figure 2 shows a graph of typical student data.

The effect of weight on the amount of finger movement can be examined using shock intensities sufficient to induce a maximum finger movement. The amount of work, movement x weight, can be plotted against weight (Figure 3), and the contraction and relaxation times can be measured from the computer screen. The latency period can be examined if a second Bayonet-Neill-Counselman (BNC) cable and a T-connector are used to feed the stimulus output from the data acquisition unit into a second recording channel. In this way, the user can measure the time difference between the stimulus pulse that triggers the shock and the onset of the finger movement.

Conclusions

The glove apparatus allows students to examine certain mechanical properties of skeletal muscle without animal sacrifice. The time required for preparation and clean up is less than with the frog muscle since there are no salines or dissections. There is no animal death; the preparations do not die in the middle of the session, and my students appear to enjoy being used as lab animals. On the negative side, some volunteers appear apprehensive when electrical shocks are applied to induce muscle activity, and some
Conference Review - continued from page 27

Complain of fatigue and cramping. From the instructor's point of view, this system does not permit any length-tension relationships to be studied; however, I have replaced this part of my lab with a computer simulation.

Of course there are some who see this exercise as pandering to those who would take animals out of the laboratory. My personal belief is that students, especially Biology majors who intend to go on to professional or graduate school, should do more dissection not less. I am afraid that this argument will continue, but in the meantime there is equipment for those instructors who wish to adopt non-animal alternatives.

Acknowledgement

I would like to thank CBSciences/iWorx for lending me a stimulation unit, refining the product and making it commercially available.

Figure 1: A typical chart trace showing an evoked finger movement (upward deflection). The two cursors have been placed on the trace before and at the peak of the movement to measure the amount of finger movement.

Figure 2: A graph to show the relationship between stimulus intensity and the amount of finger movement.

Figure 3: The relationship between weight and work done.
PROPOSAL FOR A REGIONAL CONFERENCE

Name of Conference Coordinator

Coordinator's Address

Phone ______________________ Fax ______________________

Proposed Site/Host Institution

Proposed Date(s) ______________________

Please supply the following information on separate sheets of paper:

• Outline of Proposed Budget
  (see Budget section of Guide for Coordinators of HAPS Local Conferences)

• Written statement of administrative support/approval from the host institution agreeing to co-sponsor
  the HAPS Regional Conference and to allow use of its facilities

• Request for seed money, if needed (see HAPS support in Guide)

• List of 3-digit zip codes (first 3 digits) for areas to be included in mailings (usually not more than a
  250-mile radius)

Send a copy to:

Mary Bracken
Chair of HAPS Regional Conferences
% Trinity Valley Community College
PO Box 668
Terrell, TX 75160
bracken@tvcc.cc.tx.us
Please print or type neatly.

Name: 

Institution: 

Address: 

City: 

State/Province: 

Zip: 

Country: 

Phone: ( ) 

Fax: ( )

E-Mail: 

Guest name(s) 

MAIL FORM TO: HAPS/OSG, 222 S. MERAMEC, SUITE 303, ST. LOUIS, MO 63105 OR FAX (IF USING CREDIT CARD) TO HAPS 314-863-6457

<table>
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<th>MEMBER</th>
<th>NON MEMBER</th>
<th>*GUEST</th>
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<td>Until December 1</td>
<td>$165</td>
<td>$250</td>
<td>$65</td>
</tr>
<tr>
<td>December 1 – April 1</td>
<td>$180</td>
<td>$265</td>
<td>$80</td>
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<tr>
<td>Beginning April 1</td>
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<th>2 day package – June 3-4 or June 5-6</th>
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<tr>
<td>December 1 – April 1</td>
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<tr>
<td>Beginning April 1</td>
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</tbody>
</table>

*Applies to non-teaching guests only. Guest fee (12 years of age or older) includes Saturday evening reception, two continental breakfasts and all refreshment breaks. Guest fee does not include update seminars or workshops. The annual banquet (luau) fee and additional activities will be charged separately per individual member and/or guest, as done for previous conferences. Please note: there may be limited guest space for vendor-sponsored activities.

Charge Card: 

Card Number ____________________________ Expiration Date __________

VISA   MC   Discover

Name on Card ____________________________

_____ I have enclosed a check or PO payable to HAPS '01

_____ I am paying by credit card

_____ I am not pre-registering, but send me the final registration package when it's available.

_____ Please send me a proposal form for: ______ Workshop ______ Poster Session ______ Exhibitor Space

Pre-registrants automatically receive the final registration package in March 2001. Banquet and optional activities, as well as more detailed information regarding workshops and seminars will be included in the March 2001 mailing.
MEMBERSHIP FORM

PLEASE CHECK ONE:

☐ NEW MEMBERSHIP  ☐ RENEWAL  ☐ CHANGE OF INFORMATION

NAME

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>Middle Name or Initial</th>
<th>Preferred Title (Dr., Mr., Ms., Mrs.)</th>
</tr>
</thead>
</table>

INSTITUTIONAL NAME

DEPARTMENT/DIVISION

MAILING/DIRECTORY ADDRESS

CITY ___________________ STATE/PROV. _________ ZIP/POSTAL CODE ________

COUNTRY

PHONE ___________________ FAX ___________________

E-MAIL ___________________

REFERRED BY ___________________

INTEREST SURVEY

PLEASE CHECK BOXES IF YOU ARE INTERESTED IN OUR HAVE EXPERIENCE IN ANY OF THESE AREAS:

☐ USE OF CADAVERS  ☐ COMPUTERIZED LIBRARY SEARCHES
☐ LECTURE TESTING METHODS  ☐ COMPUTERIZED DATA ACQUISITIONS
☐ LAB TESTING METHODS  ☐ VIDEOIMAGE ACQUISITION
☐ MANAGEMENT/ADMINISTRATION  ☐ INSTRUCTOR/COURSE EVALUATION
☐ IMPLEMENTING COMPUTERS IN THE CLASSROOM  ☐ GRADEBOOK PROGRAMS
☐ RADIOISOTOPES/SPECIAL CHEMICALS IN THE LAB  ☐ TEAM TEACHING
☐ DISABLED/LEARNING/DISABLED LEARNERS  ☐ LAB SAFETY
☐ PHYSICAL FACILITIES DESIGN  ☐ DISSECTION/ANIMAL USE
☐ MUSEUM DISPLAYS  ☐ MULTIMEDIA PUBLISHING
☐ GRANTS  ☐ HTML PROGRAMMING
☐ LEADERSHIP SKILLS  ☐ OTHER
☐ WRITING ARTICLES, TEXTBOOKS OR MANUALS
☐ ELECTRONICS IN THE LAB

COMPLETE THIS FORM AND MAIL TO: HAPS MEMBERSHIP, 222 S. MERAMEC, SUITE 303, ST. LOUIS, MO 63105.

CHECKS PAYABLE TO HUMAN ANATOMY AND PHYSIOLOGY SOCIETY for US $50 FULL TIME FACULTY, $35 ADJUNCT FACULTY/STUDENTS.
HAPS COMMITTEES AND BOARDS

Have you ever wondered where you could obtain a standardized anatomy and physiology test? Or maybe you are thinking about an educational project and are looking for funding? Do you feel strongly about a particular issue and would appreciate an opportunity to discuss it with other HAPS members? The following committee chairs invite input from HAPS members and willingly provide information on the activities of their committees.

ANIMAL USE TASK FORCE
Craig Clifford, Chair
Northeastern State University
611 N. Grand Avenue
Tahlequah, OK 74464
(918) 456-5511 x 3827
clifford@cherokee.nsuok.edu

A three-year plan includes widely distributing the HAPS policy statement, developing animal use internet links on the HAPS Home Page, monitoring relevant legislation, and creating a resource packet for HAPS members. Suggestions and questions from members are welcome.

COMPETENCY TESTING COMMITTEE
San Drogo, Chair
Mohawk Valley Community College
1101 Sherman Dr.
Utica, NY 13501
(315) 792-5409
sdrogo@mvmcc.edu

This committee recently completed and tested an approved HAPS Standardized Test for Human Anatomy and Physiology. Any HAPS member may obtain a copy of the test by writing to the Chair.

CORE CURRICULUM AND ASSESSMENT COMMITTEE
Dan Lemons, Chair
Dept. of Biology
City College of New York
Convent Ave. at 138th St., J526
New York, NY 10031
(212) 650-8543
daniel@harold.sci.ccny.cuny.edu

This committee has developed a second, revised edition of the HAPS "Human Anatomy and Physiology Course Guidelines." The second edition includes new guidelines relating specifically to the laboratory component of the course.

HAPS-EDUCATOR ADVISORY PANEL
Michael Glasgow, Chair
Anne Arundel Comm. College
101 College Parkway
Department of Biology
Arnold, MD 21012
(410) 541-2272
MSGlasgow@mail.aacc.cc.md.us

Members of the HAPS-Educator Editorial Advisory Panel provide advisory and support services to the HAPS-Educator editor such as reviewing articles and proofreading the final draft of the HAPS-Educator before it goes to press.

GRANTS AND SCHOLARSHIPS COMMITTEE
Richard Faircloth, Chair
Anne Arundel Comm. College
101 College Parkway
Department of Biology
Arnold, MD 21012
(410) 541-2272
RFaircloth@mail.aacc.cc.md.us

This committee is responsible for reviewing all grant and scholarship proposals, selecting proposals to receive funding, and submitting its recommendations to the Board of Directors for approval.

MEMBERSHIP COMMITTEE
Kevin Petti, Chair
Dept. of Science & Health
Miramar College
10440 Black Mountain Rd.
San Diego, CA 92126-2999
(619) 556-7231
kpetti@sdccd.cc.ca.us

Committee members assist the Chair with recruiting members and compiling membership information.

NOMINATING COMMITTEE
William Perrott, Chair
Mohawk Valley Community College
1101 Sherman Drive
Department of Life Sciences
Utica, NY 13501
(315) 792-5519
Wperrott@mvmcc.edu

The committee chair is always the current President-Elect. The responsibility of the committee is to recruit nominees for the elected offices and appointed positions of the HAPS organization.

ANNUAL CONFERENCE COMMITTEE
David L. Parker, Chair
Northern Virginia Community College
3001 North Beauregard Street
Alexandria, VA 22311-3097
(703) 845-6004
nparkd@nvcc.vaccc.edu

The primary responsibilities of this committee are development of a standardized fees structure for the annual conference, formulation of guidelines and assistance for the conference coordinator, and generation of a calendar of conference sites.

REGIONAL CONFERENCE COMMITTEE
Mary Bracken, Chair
Trinity Valley Community College
Biology Department
1200 East Interstate 20
Terrell, TX 75160
(972) 563-9573
bracken@tvcc.cc.tx.us

The committee provides mentoring assistance to coordinators of regional conferences. Anyone interested in hosting a regional conference should contact the Chair.

TECHNOLOGY COMMITTEE
Thomas Lancraft, Co-Chair
Natural Science Department
St. Petersburg Jr. College
Box 13489
6605 5th Ave. N.
St. Petersburg, FL 33733
(727) 341-4797 or (727) 341-4306
lancraft@spjc.edu

Jim Pendley, Co-Chair
Imperial Valley College
P.O. Box 158
Imperial, CA 92251
(619) 352-8320 x 303
pendley@imperial.cc.ca.us

The committee monitors and reports on technological changes influencing anatomy and physiology teaching, such as advances in instructional software and data acquisition equipment.

DISTANCE EDUCATION TASK FORCE
Tom Lancraft, Chair
St. Petersburg Junior College
Natural Science
P.O. Box 13489
6605 Fifth Ave. N.
St. Petersburg, FL 33733
(727) 341-4797
lancraft@spjc.edu

This committee is responsible for developing and distributing a HAPS position paper on distance learning.

SAFETY COMMITTEE
Sandy Lewis, Chair
Dept. of Biology
Pierce College
1601 39th Ave. S.E.
Puyallup, WA 98374
(253) 840-8377
slewis@pierce.ctc.edu

The Safety Committee is developing standards for safety in the laboratory.

CADAVER USE TASK FORCE
John Martin, Chair
Clark College
1800 E. McLoughlin Blvd.
Department of Biology
Vancouver, WA 98663
(360) 992-2282
jmartin@clark.edu

The goals of this committee are to develop guidelines for use of cadavers in anatomy and physiology instruction.
HAPS 2001 15TH ANNUAL CONVENTION
JUNE 2-7, 2001
WESTIN MAUI
808-526-4111 OR 808-667-2525

(early reservations strongly suggested)

For Further Information Contact:
Ric Martini
800-572-2113
martini@maui.net

Watch the HAPS web page for updated information:
www.hapsweb.org
An Update on the Human Genome Project

Ted Namm, Ph.D.
University of Massachusetts at Lowell
Health and Clinical Sciences
3 Solomont Way, Suite 4
Lowell, MA 01854-2881
(978) 934-4476
(978) 934-3006 fax
Theodore_Namm@uml.edu

It is the mid-1940’s. You are part of a team that has just invented “ENIAC,” the world’s first computer. A time machine suddenly appears in your lab; the traveler emerges and begins to explain the benefits of an e-commerce web site. You have absolutely no clue what this person is talking about, do you?

Now consider the present: the date is June 26, 2000, and the headlines are proclaiming the “completion” of the Human Genome Project. A time machine appears in your school; the traveler emerges and asks where the nearest grocery store is located. He needs to purchase a photoreactive repair supplement to uncouple a thymine dimer in gene 45, DNA exon 288, chromosome 17. You have absolutely no clue what this person is talking about, do you?

Each scenario contains both scientific fact and science fiction. In actuality, the June 26, 2000 announcement puts genome research in the same era as computers were in the 1940’s. At this moment, we only have a “rough draft” of the genome. Significant gaps must be filled in, errors must be corrected, existing databases have to be updated, and perhaps most important, all this technology must be refined so that the average person can have his/her DNA sequenced. This is many years away. Fifty years from now (or sooner), geneticists will have the technology to routinely manipulate, bank, “bottle,” and alter DNA and all of its ancillaries. We may yet be able to go to a grocery store, find the aisle that contains DNA repair pills, and fix the normal “bumps and bruises” in DNA. Who knows – similar supplements may also be able to change mutated DNA into normal DNA.

A Brief History

In 1985, a major conference was held in Santa Fe, New Mexico, to assess the feasibility of a Human Genome Initiative. In 1986, the Department of Energy (DOE) allotted $5.3 million to document critical resources necessary to start the project. In 1987, a congressionally sanctioned DOE advisory committee recommended that a multi-disciplinary, joint technological effort be formally undertaken at specifically designated sites to begin the sequencing of the human genome. In 1990, the DOE and the National Institutes of Health (NIH) presented a joint funding plan to Congress, which signaled the formal beginning of a 15-year effort to sequence the entire human genome. Dr. Francis Collins was appointed to head the National Human Genome Research Institute (NHGRI), to oversee the project, and to channel the many sources of public funding to the 16 international research and technology venues.

By 1997, despite astonishing advances in software, sequencing technology, and robotics, less than 10% of the genome had been sequenced. However, with the technology in place, the predicted exponential growth in sequence revelation had already commenced, and the target date of 2005 was still realistic. At that time, Dr. J. Craig Venter shocked the scientific community by announcing that his company, Celera Genomics, would complete the genome project by 2001. Celera Genomics is a privately funded company using DNA sequencers manufactured by Perkin-Elmer. Celera utilized a “whole shotgun” approach to sequencing (discussed later on), a much faster technique than NHGRI was using. Quickly, NHGRI and other scientists began to question the accuracy of this “renegade” approach. A rather intense rivalry – actually, a cutthroat competition – arose between the publicly funded and privately funded efforts, and the race was on.

When President Clinton made the announcement to the public about the “completion” of the project, he wore J. Craig Venter on one arm and Francis Collins on the other. The two scientists were congenial, congratulating each other when socially appropriate.

Educational Issues - continued on page 7