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Cover art is provided by Aleanna Gencarelli (nick name Ali G) who took Human Anatomy & Physiology spring 2008 at University of Tulsa, Karen McMahon, instructor. Ali is a sophomore printmaking and graphic design major. She is a member of the women’s varsity softball team. Someday she would like to work on graphic novels about super heroes and her goal is to publish her own graphic novel before graduate school. She took A&P to better understand the proportions of the human body and just to satisfy a basic curiosity. Thank you, Ali, and we look forward to that novel!
HAPS-EDucator is the official publication of the Human Anatomy and Physiology Society (HAPS) and is published four times per year. Major goals of the Human Anatomy and Physiology Society are: to promote communication among teachers of human anatomy and physiology in colleges, universities, and related institutions; to present workshops and conferences, both regional and national, where members can obtain information about the latest developments in the health and science fields; and to encourage educational research and publication by HAPS members. HAPS was established in 1989.

Annual membership dues are $65 for full-time faculty, $50 for retired, part-time faculty, and students. Annual membership renewals shall be due on January 1 or July 1. New members shall renew on whichever date most closely follows the date of their initial membership. Information on additional membership categories, meetings, and more can be found at: http://www.hapsweb.org. Correspondence should be directed to: HAPS, PO Box 2945 LaGrange, GA 30241 or (800) 448-HAPS (4277) or (706) 883-8215 (fax).

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Papers for publication, requests for information, positions available and wanted, and letters to the editor are welcomed. Articles may be submitted to the editor as a Microsoft Word or Word Perfect file as an e-mail attachment. If references are included, please follow the methods suggested in Scientific Style and Format: The CSE Manual for Authors, Editors, and Publishers 7th Edition, Style Manual Committee (Council of Biology Editors) Cambridge, Cambridge University Press 2006 or see the reference guide on the HAPS-EDucator page of The HAPS website (hapsweb.org).

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DEADLINES FOR SUBMITTING MATERIAL TO HAPS-EDucator: August 1 (Fall issue); November 1 (Winter issue); February 1 (Spring issue) ; April 15 (Summer issue).

CONTACT THE HAPS-EDucator Editor: HAPS, PO Box 2945 LaGrange, GA 30241 or hapsed@hapsweb.org.
Hello. It seems like just yesterday I was trying to compose my first President’s letter and now here I am writing my last letter to you from the office of the President. I promised an exciting year and the culmination of this year was the wonderful conference in New Orleans. As I write this, final plans are in place for what will surely be our best conference ever. Record attendance, great programs, enjoyable social events, and New Orleans – what more needs to be said, other than a tremendous thank you to Judy Venuti, Wanda Hargroder, Susan Van Loon, and the rest of the local organizing committee who did so much to make this a truly memorable event. Your efforts are most appreciated, ladies, thank you all.

One of the major ongoing initiatives this year was the continued presence and expansion of the HAPS Institute. The HAPS-I courses are some of our proudest recent achievements. President Emeritus Kevin Patton and Past President Joe Griswold have been most instrumental in seeing HAPS-I move from idea to reality. They both deserve our profound thanks. Kevin plans to step down from the HAPS-I Directorship as soon as a replacement is found, but he has our deep gratitude for all the hard work associated with starting this new initiative. As a result of the HAPS-I instructional model, at least one college is interested in developing a degree program to help people meet accreditation requirements. So the progress goes on. More will be announced as the degree actually becomes available. Whatever degrees are eventually created, we have the HAPS-I development team to thank for being the inspiration.

This is also the time of year for giving recognition to outgoing officers and committee chairs. Although we have a professional management company performing many of our administrative tasks, the heart of HAPS is still the dedicated members who step forward to fill our elected offices and become the chairs and members of committees. All of the programs of HAPS are staffed by members who volunteer additional time to improve the programs and services of HAPS. We thank you all. Receiving special mention are outgoing chairs Amy Way (Grants and Scholarships) and Paul Krieger (Cadaver Use Committee). Thank you for your service. Tom Lehman moves from being chair of both the Web Committee and Steering Committee to being Co-Chair of the Steering Committee with me as I transition to Past President. We will be working on increasing the degree of communication between committee chairs and the Board of Directors to decrease unnecessary delays in moving good ideas forward.

We also say farewell and thank you to Eastern Director Richard Faircloth and Western Director Christine Eckel who are leaving the Board after serving two terms each. Thank you very much for your service and counsel. Deserving our most special recognition is Gail Jenkins who has just completed her third term as Treasurer on top of several years as Marketing Manager. We owe Gail a huge debt of gratitude for the countless hours of work and worry she has expended on behalf of the organization. Although it seems insufficient, thank you, Gail! She hands over the financial reins to Elizabeth Becker, who has previous Board experience, great enthusiasm, and dedication to HAPS. Welcome aboard!

Also leaving us after editing our newsletter since the Summer 2000 edition of the HAPS-EDucator is Susan Baxley. Susan has previously received the President’s Medal in recognition for her outstanding service to HAPS in the role of HAPS-EDucator Editor. Her contribution to the life of the organization is profound and we will miss her greatly, but we recognize that after retirement life can pull one in new directions. We hope to see Susan at an annual conference in the future when her schedule allows and we wish her the best of good fortune in all her future endeavors.

As we move forward together there are new initiatives to be undertaken. There are plans for moving into electronic publishing of the HAPS-EDucator, both to save the organization money and to decrease the production lag-time. We are investigating a more rational registered guest policy at conferences, so that banquet fees are part of the guest registration. There is a new repository of non-copyrighted histology images on our webpage. There is a new journal of anatomy education to which HAPS members can submit articles and access on-line as part of their membership benefits. The list goes on.

Get involved in anything that interests you. We need your energy. We appreciate your efforts. Thanks for all you do in service to HAPS. See you in Baltimore in 2009!
Cruise into Baltimore and join us for the 2009 HAPS Annual Conference! We are excited to invite you to our beautiful city and are looking forward to an awesome conference. Update seminars and exhibits will take place at the recently renovated Renaissance Hotel in the beautiful Inner Harbor area of Baltimore.

Baltimore is home to many outstanding colleges and universities, including the world-renowned Johns Hopkins University and the University of Maryland, Baltimore. Researchers from these universities and other institutions will present update seminars on Sunday and Monday for our conference theme: “Control Yourself – Neuro - and Endocrine Physiology.”

Baltimore is an exciting city with a long history. Founded as a port in the early 1700’s, its location close to the mouth of the Patapsco River near where it empties into the Chesapeake Bay continues to make it important to international shipping. Baltimore’s maritime history is celebrated at the Inner Harbor through the USS Constellation Museum and the Baltimore Maritime Museum, which includes the World War II-era US submarine Torsk, the US Coast Guard Cutter Taney, and an historic lighthouse once used on the Chesapeake Bay. Fort McHenry, famous for protecting Baltimore from British naval invasion during the War of 1812 and Frances Scott Key’s Star Spangled Banner, lies about 2 miles from the Inner Harbor. If you are traveling to Baltimore by car, it is worth the effort to visit the fort to take in the scenery and history.

Several of Baltimore’s historic neighborhoods are within easy walking distance of the Renaissance Hotel. These include the Inner Harbor, Little Italy, Fell’s Point, and Federal Hill. Sites and attractions in the Inner Harbor area include the National Aquarium in Baltimore, the Maryland Science Center and Port Discovery children’s museum. The Science Center has changed its exhibits significantly since 1999 when the HAPS conference was held in Towson and is worth another look. Federal Hill Park and the American Visionary Art Museum are also close by. To the east, the Reginald F. Lewis Museum of African-American History and Culture and the Star-Spangled Banner Flag House are located in Historic Jonestown. A little farther east you can find the Jewish Museum of Maryland. A short cab ride or a hop on a northbound Metro or Light Rail train will take you to the Mount Vernon area where you will find the Walters Art Museum, Maryland Historical Society, and other interesting sites. To the west you can visit the Edgar Allen Poe House and Museum and nearby Westminster Hall.

Sports fans may enjoy a Baltimore Orioles game at Camden Yards if the “Birds” are in town. You may also enjoy visiting the ESPN Zone where you can watch your favorite team on big screen TVs and enjoy good food and better company with fellow HAPS members.
Shopping and dining are readily available in the Inner Harbor. The Gallery (located in the same building as the Renaissance Hotel) and Harborplace (across the street) offer a wide variety of shopping and dining possibilities. Retailers include J. Crew, Ann Taylor, Coach, Brooks Brothers, Urban Outfitters, and Banana Republic. Twenty small eateries and twelve restaurants offer a variety of dining alternatives in addition to the excellent restaurants in the Renaissance Hotel. Historic Lexington Market is a bit farther away and can be reached by Light Rail and Metro. Its many shops feature local cuisine including crab cakes and other Baltimore favorites. Lexington Market also features jazz and rock and roll bands on Fridays and Saturdays.

Our day-long excursion will be to Washington, D.C., where you will be free to roam at will. The Capital and White House are short walks from the Mall. Group tours of the White House are available with reservations, which we can arrange if people are interested. The Smithsonian Institution is constantly updating its museums with new and exciting exhibits, and the American Indian Museum recently opened its doors. All Smithsonian museums are free to the public. A short ride on the Metro will take you to the National Zoo with its pandas and many other exhibits. The International Spy Museum is a short walk from the Mall (tickets are required).

Baltimore is easy to get to from any location in the nation. Baltimore-Washington International Thurgood Marshall Airport is a major hub for Southwest Airlines but is also served by Air Canada, AirTran Airways, American Airlines, Continental Airlines, Delta Airlines, Northwest Airlines, United Airlines, and US Airways. The Inner Harbor can be reached from the airport via airport shuttle service, rental car, or the Maryland Transit Authority’s Light Rail system which has a station a few blocks from the Renaissance Hotel.

The Catonsville campus of the Community College of Baltimore County (CCBC) will host the workshops on Tuesday and Wednesday. Our campus was one of the two original community colleges in Baltimore County established in 1957. In 1998, Catonsville Community College merged with her sister colleges, Essex Community College and Dundalk Community College, to form the Community College of Baltimore County. Located on the Knapp Estate in the southwestern part of the county, the Catonsville campus sits on the rolling acres of a former dairy farm. The campus is easily accessible from I-95 (via I-195 and Rolling Road).

On behalf of the HAPS 2009 Annual Conference Committee, CCBC President Sandra Kurtinitis, and Dean of the School of Math and Sciences Donna Linksz, we welcome you to our town and our campus and hope you will enjoy our hospitality as much as we will enjoy your company.
We are pleased to announce the sponsors of HAPS Institute for this year! Denoyer-Geppert, Elsevier Publishing, and Linked Learning Systems are our 2008 Major Program Sponsors. Morton Publishing is a scholarship sponsor for scholarships to be awarded for next year’s HAPS-I program. Such sponsorships are essential to the ongoing success of our continuing professional education efforts.

To round out this month’s HAPS-I Report, we have a brief article by Ellen Arnestad of the HAPS-I Committee in place of our regular report. Here Ellen lays out the basis for one of the key elements of all HAPS-I courses: peer review of course projects (learning objects).

The Value of Peer Review

Ellen Arnestad
Southern Alberta Institute of Technology
School of Health & Public Safety

Do you ever talk to your colleagues about sports? Do you ever talk to your colleagues about music? My guess is that most of you easily chat around the office about these subjects, but do you ever talk to your colleagues about writing or teaching? Our colleagues are a great source of feedback but we rarely use them in ways that would really improve our practice. Feedback from colleagues is often less judgmental than that of our students or our supervisors and yet we do not often use our colleagues to assist us. People who have experiences similar to our own are invaluable for giving feedback for our ideas and for collaborating on the creation of new class activities and management strategies. Such feedback is why many of us attend the HAPS conference every year. I have often heard HAPS people say that they always feel welcomed at HAPS conferences and that they feel comfortable in exchanging ideas with others.

In creating HAPS Institute, we wanted to form a program that is uniquely “HAPS” in nature—a program founded on our existing strengths. So it was not a stretch for us to see how feedback from peers would be a cornerstone of our courses.

The scientific community has relied heavily on critical discussion (or peer review) for many years as a way of encouraging serious academic work. Peer review is a way of test driving ideas with others and getting more and different viewpoints on research or other projects. This method helps to give perspective to scientists who may have become too close to their work during its creation. It also facilitates consensus building within the scientific community, which is needed to push forward into new realms of knowledge.

In our undergraduate training, we become accustomed to being evaluated by instructors and find it a safe and confidential way for our work to be evaluated. As professionals, we have to trust that our ideas are on par with other professionals and getting the evaluation of one person’s opinion is only one person's opinion. We should now be looking for more than a one-time, single evaluation; we should be collaborating with each other in creating a body of work that we are proud of as a profession. To do this, we need to invest in not only our own work, but that of our colleagues as well.

Within HAPS, we are availing ourselves of this opportunity to create a community of colleagues that we can trust as a nonjudgmental source of feedback for peer review. Within the HAPS Institute program, we are now jumping on this opportunity and formalizing these relationships.
Through peer review, the HAPS-I faculty believe that participants can help each other to create high quality, readable projects with a depth of ideas that will be helpful to the larger anatomy and physiology community. With each of our HAPS Institute courses, we are first deepening our learning in different areas of anatomy and physiology and then improving our teaching skills by learning and creating classroom activities and other teaching resources (course projects) that will allow us to bring this knowledge to our students in a learning-centered way. Through the peer review process we hope to help make the ideas widely understood, better articulated, and audience centered.

In the HAPS Institute courses, we conduct the process of peer review as a discussion. The participants—we call them HAPS-I scholars—post their work for others in their small peer group to review. The job of the reviewer is not to provide answers, but to raise questions. The reviewers act as mirrors, showing the writer how the draft looks to the reader and pointing out areas that need clarification. This is more than a proofreading exercise; it is more like test-driving the writing. HAPS-I scholars get a number of different people reading and commenting on their projects to get different perspectives on how they are interpreted and what questions arise as a result.

The process is not about ripping someone’s work to shreds and then stopping. It is about creating an open dialogue to develop a work that a HAPS-I scholar can be proud of. In the process, the scholar and the reviewers will nurture collegial relationships. It does not mean that one can not or should not say hard things about the content or presentation, because that refines and develops better written work. Ideally, the review process should be done with an attitude of exploring the material to find ways to present the work in the most understandable and accessible style.

Making peer review an important part of our HAPS Institute courses hones skills in giving and receiving feedback and it strengthens the quality of the course projects. Publishing peer-reviewed work in the online Archive of Teaching Resources elevates our standing in academia by creating a professional body of work dedicated to our profession. From this, both our profession and our HAPS-I scholars will benefit. Our participants will have published work in their name and all of these high-quality published projects will give our profession a bank of quality, usable activities with an appropriate depth of ideas to bring into the classroom. Everyone wins.
EDU-SNIPPETS

A column that survives because you, the members, send us your Snippets

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EDU-Snippets is a column designed to let you, the members of HAPS, share your “ways to make sure your students get it.” During these past few years of putting together your ideas into our EDU-Snippets column, we have been continuously amazed at how many teaching and demonstration ideas pop up and are easily transferred from one instructor to another through Snippets. This issue’s column is no exception! Our focus this issue is the Endocrine System. Earlier this year we were excited about how many different hormonal ideas had been presented online and in various educational settings. We were also very aware of how difficult teaching the Endocrine System can sometimes be. So, we decided to make the Endocrine System our theme for this EDU-Snippets column. As always, we have done a bit of editing so that these ideas blend together.

I. Pinning Down the System

Terri Bidle (Hagerstown Community College, bidlet@hagerstowncc.edu) sent us an interesting laboratory exercise designed to help the students master the basic endocrine lists. Terri says…

Introduction:

One of the challenges in covering the endocrine system is helping students develop a mastery of the material without overwhelming them. Since becoming aware of the fact that students across the country normally perform poorly on the endocrine portion of the nursing board exam, I decided to make some changes in my course. One of those changes was to modify the general dissection lab to introduce students to the major endocrine glands (and the organs that contain endocrine tissues) and the hormones that each of these glands releases.

During this lab exercise, students dissect a preserved animal, identify the major endocrine organs and place numbered pins (numbers 1-11) in the major organs. After determining that their animal is pinned accurately (verified by the instructor), the students then place lettered pins (letters a-t) into the glands for the hormones released from each gland. Tables listing the organs and hormones are given below. Lists of all major glands and their hormones remain on the board throughout the lab exercise.

Review of glands and their hormones at the end of lab:

One of the important components of the lab is guiding the students as they attempt to remember the twenty assigned hormones and the organ or organs that produce them, in addition to the spellings, and the pronunciations of the terms. At the end of the lab, the list of glands and hormones on the board is reviewed. Learning strategies for remembering the hormones and glands are shared with the entire lab group. Examples of strategies for recalling the hormones secreted from a specific gland include: “CAD” (cortisol, aldosterone, dehydroepiandrosterone), released from the adrenal cortex and “ASE” (angiotensinogen, somatomedin and erythropoietin), released from the liver. A strategy for mastering spelling is: erythropoietin, a “poet” with an “i” in the middle.

Practice quiz before leaving lab:

At the end of the review, students are given two practice quizzes. On the first quiz, the names of the hormones are given (orally, by their instructor) and the students are asked to list the gland involved. On the second and much more challenging quiz, the name of the gland is given and the students are asked to list the hormones.

Assessment:

A graded quiz is given at the beginning of lab the following week. Students identify the organs and then list all the hormones produced by each gland.

Remarks:

Since introducing this lab (approximately three years ago), I have seen much improvement as more students are able to successfully remember the glands, the hormones they produce, their spellings, and their pronunciations.

<table>
<thead>
<tr>
<th>Number of Pin/ Organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid (1)</td>
</tr>
<tr>
<td>Parathyroid (2)</td>
</tr>
<tr>
<td>Thymus gland (3)</td>
</tr>
<tr>
<td>Heart (atria) (4)</td>
</tr>
<tr>
<td>Pancreas (5)</td>
</tr>
<tr>
<td>Stomach (6)</td>
</tr>
<tr>
<td>Liver (7)</td>
</tr>
<tr>
<td>Small intestine (8)</td>
</tr>
<tr>
<td>Kidney (9)</td>
</tr>
<tr>
<td>Adrenal glands (10)</td>
</tr>
<tr>
<td>Ovary or testes (11)</td>
</tr>
</tbody>
</table>
**Table 2:** List of hormones with lettered pins (a-t)

<table>
<thead>
<tr>
<th>Letter of Pin/ Hormone</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Epinephrine/norepinephrine (ep ´inef´rin)</td>
<td></td>
</tr>
<tr>
<td>b. Insulin</td>
<td></td>
</tr>
<tr>
<td>c. Dehydroepiandrosterone (DHEA) (dě-hi´drō-ep´ē-an-dros ´ter-ōn)</td>
<td></td>
</tr>
<tr>
<td>d. Erythropoietin (2 answers) (ē-rith´rō-poy´é-tin)</td>
<td></td>
</tr>
<tr>
<td>e. Glucagon (glū´kā-gon)</td>
<td></td>
</tr>
<tr>
<td>f. Aldosterone (mineralocorticoid) (al-dos´ter-ōn)</td>
<td></td>
</tr>
<tr>
<td>g. Vitamin D (calcitriol)</td>
<td></td>
</tr>
<tr>
<td>h. Gastrin</td>
<td></td>
</tr>
<tr>
<td>i. Cholecystokinin, gastric inhibitory peptide, secretin (kō´lē-sis-tō-kī´nín)</td>
<td></td>
</tr>
<tr>
<td>j. Cortisol/corticosterone (glucocorticoid)</td>
<td></td>
</tr>
<tr>
<td>k. Somatostatin (sō´mā-tō-stat´īn)</td>
<td></td>
</tr>
<tr>
<td>l. Angiotensinogen (an´jē-o-ten-sín´ō-jen)</td>
<td></td>
</tr>
<tr>
<td>m. Somatomedins (sō´mā-tō-mē´dīnz)</td>
<td></td>
</tr>
<tr>
<td>n. Testosterone</td>
<td></td>
</tr>
<tr>
<td>o. Estrogen/progesterone</td>
<td></td>
</tr>
<tr>
<td>p. Calcitonin (kal´si-tō´nin)</td>
<td></td>
</tr>
<tr>
<td>q. Thyroid hormone</td>
<td></td>
</tr>
<tr>
<td>r. Parathyroid hormone</td>
<td></td>
</tr>
<tr>
<td>s. Thymus hormones</td>
<td></td>
</tr>
<tr>
<td>t. Atrial natriuretic hormone (ANH) (nā´trē-yū-ret´ık)</td>
<td></td>
</tr>
</tbody>
</table>

**Table 4:** Hormones released from organs in the abdominopelvic cavity

<table>
<thead>
<tr>
<th>Organs</th>
<th>Hormones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreas</td>
<td>Insulin</td>
</tr>
<tr>
<td></td>
<td>Glucagon</td>
</tr>
<tr>
<td></td>
<td>Somatostatin</td>
</tr>
<tr>
<td>Stomach</td>
<td>Gastrin</td>
</tr>
<tr>
<td>Small intestine</td>
<td>Cholecystokinin (CKK)</td>
</tr>
<tr>
<td></td>
<td>Gastric Inhibitory Peptide (GIP)</td>
</tr>
<tr>
<td></td>
<td>Secretin</td>
</tr>
<tr>
<td>Kidney</td>
<td>Erythropoietin</td>
</tr>
<tr>
<td>Adrenal medulla</td>
<td>Epinephrine</td>
</tr>
<tr>
<td></td>
<td>Norepinephrine</td>
</tr>
<tr>
<td>Adrenal cortex</td>
<td>Cortisol/corticosterone</td>
</tr>
<tr>
<td></td>
<td>Aldosterone</td>
</tr>
<tr>
<td></td>
<td>Dehydroepiandrosterone (DHEA)</td>
</tr>
<tr>
<td>Liver</td>
<td>Angiotensinogen</td>
</tr>
<tr>
<td></td>
<td>Somatomedins</td>
</tr>
<tr>
<td></td>
<td>Erythropoietin</td>
</tr>
<tr>
<td>Skin</td>
<td>Vitamin D (active form calcitriol)</td>
</tr>
<tr>
<td>Ovaries/Testes</td>
<td>Estrogen</td>
</tr>
<tr>
<td></td>
<td>Progesterone</td>
</tr>
<tr>
<td></td>
<td>Testosterone</td>
</tr>
</tbody>
</table>

II. **“You Don’t Say” – Endocrine Style**

We also heard from Mary Lee Lusby (Nebraska Methodist College, marylee.lusby@methodistcollege.edu) who told us about the advantages of a fun-filled game in learning about the endocrine system.

We teach the section on hormones at the beginning of the second semester of a two semester A&P course. Students have still not grasped the idea that they cannot learn the names of the hormones, where they are produced, the site(s) where they have action and what the action is, in a short period of time.

For the lab where we cover hormones, I have devised a game like the old TV show “You Don’t Say”. I divide the students into teams of about 5 students. One person from the first team comes to the front of the room and selects a card that contains the name of the hormone, its action, where it is produced, and the site(s) of action. The student then has 30 seconds to describe this hormone without using any of the words on the card.

The student’s team has to make one unified guess as to what the hormone is. A member of another team is looking over the student’s shoulder to make sure he or she does not use any of the words and if the student uses a “forbidden” word, a bell is rung. The next group then gets to guess which hormone is being presented.
III. Let the Endocrine System Flow!

Finally we heard from Michael Atkinson (Oakland City University, matkinson@oak.edu) who gave us some very interesting and novel charts.

I have some background in computer programming and I like the logic of flow charts. So, I developed a flow chart of the endocrine glands and their hormones. During a lecture presentation, I have the students put in arrows from hormone to gland, hormone, or effector to show the relationship between glands in the control of homeostasis. They also have a table to complete listing the function or action of each hormone. I think this gives the students a visual picture of the relationships that they can readily grasp. Below is a table and a flow chart.

Complete the table by writing in the functions of each hormone.

<table>
<thead>
<tr>
<th>Gland</th>
<th>Hormone</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineal gland</td>
<td>Melatonin</td>
<td></td>
</tr>
<tr>
<td>Anterior Pituitary</td>
<td>Growth Hormone</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prolactin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thyroid SH</td>
<td></td>
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<tr>
<td></td>
<td>Adrenocorticotropic</td>
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<tr>
<td></td>
<td>Melatonin SH</td>
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<tr>
<td></td>
<td>Follicle SH</td>
<td></td>
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<tr>
<td></td>
<td>Luteinizing H</td>
<td></td>
</tr>
<tr>
<td>Posterior Pituitary</td>
<td>Oxytocin</td>
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<tr>
<td></td>
<td>Antidiuretic H</td>
<td></td>
</tr>
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<td>Thyroid</td>
<td>Thyroxine</td>
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<td></td>
<td>Triiodothyronine</td>
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<td></td>
<td>Calcitonin</td>
<td></td>
</tr>
<tr>
<td>Parathyroid</td>
<td>Parathyroid H</td>
<td></td>
</tr>
<tr>
<td>Stomach</td>
<td>Gastrin</td>
<td></td>
</tr>
<tr>
<td>Pancreas</td>
<td>Glucagon</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulin</td>
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<tr>
<td>Adrenal Medulla</td>
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<td>Norepinephrine</td>
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<td>Aldosterone</td>
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<td></td>
<td>Cortisol</td>
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<td></td>
<td>Androgens</td>
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<tr>
<td></td>
<td>Estrogens</td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>Renin</td>
<td></td>
</tr>
<tr>
<td>Small Intestine</td>
<td>Secretin</td>
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</tr>
<tr>
<td></td>
<td>Cholecystokinin</td>
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</tr>
<tr>
<td>Testes</td>
<td>Testosterone</td>
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</tr>
<tr>
<td>Ovary</td>
<td>Estrogen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Progesterone</td>
<td></td>
</tr>
<tr>
<td>Placenta</td>
<td>Progesterone</td>
<td></td>
</tr>
<tr>
<td>Thymus</td>
<td>Thymosine</td>
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</tr>
<tr>
<td>Heart</td>
<td>Atrial Natriuretic H</td>
<td></td>
</tr>
</tbody>
</table>
Endocrine Glands & Hormones

Hypothalamus
Neurosecretory Cells

Thyrotropin
Releasing
Hormone
Prolactin
Releasing
Hormone
Prolactin
Inhibiting
Hormone
Corticotropic
Releasing
Hormone
Gonadotropin
Releasing
Hormone
Growth
Hormone
Releasing
Hormone
Somatostatin

Posterior Pituitary

Antidiuretic Hormone
Oxytocin

Anterior Pituitary

Thyroid
Stimulating
Hormone
Prolactin
Adrenocorticotropic
Hormone
Luteinizing
Hormone
Follicle
Stimulating
Hormone
Growth
Hormone

Thyroid

Adrenal cortex
Aldosterone
Cortisol
Adrenal
Androgens

Ovary
Estrogen
Progesterone

Testes
Testosterone

Thyroid
Calcitonin

Parathyroid
Parathyroid
Hormone

Pancreas
Glucagon
Insulin
Somatostatin

Adrenal Medulla
Epinephrine
Norepinephrine

Pineal
Melatonin

IV. And We Hope You Will….

Keep those cards and letters coming! We thank you all for your EDU-Snippet contributions. For the next issue of the HAPS-EDucator, send your EDU-Snippet experiences and ideas to rfaircloth@aacc.edu as soon as possible. Plan ahead. You can even submit your ideas now and maybe in the next issue you too will see your EDU-Snippet in print!
Learning the function of cranial nerves is a challenge for most students. My coverage of this concept has changed since I first began teaching anatomy and physiology over 15 years ago. Initially, I spent only time in lecture (1¼ hour lecture) on the cranial nerves and their functions. I came to realize that my saying it just was not enough. Later I added an optional exercise, “Application of Cranial Nerve Function” that students could complete outside of class (attached). Students could access this on Blackboard™.

In 2006 I made a significant change and added a lab exercise on cranial nerves (½ of a lab period, [1 ½ hours]) and decreased the time I spent in lecture to approximately ½ hour. Students spent time with models of structures innervated by cranial nerves while answering questions about each cranial nerve. Although I had no objective evidence to support this change, when questions were posed during lecture concerning cranial nerves, students appeared to have a better understanding of their functions.

In 2007 I changed the lab to be an interactive exercise in which students test the functions of cranial nerves. I divided the cranial nerves into the 1st set of six cranial nerves and the 2nd set of six cranial nerves. Students answered questions after completing the 1st six and then after completing the 2nd set of six. I also added a flowchart on the cranial nerves, “Cranial Nerve Flowchart”, that visually shows the relationship of the 1st six cranial nerves and the 2nd six cranial nerves (attached). The completing of this flowchart was an optional exercise that students could complete outside of class by accessing it on Blackboard™.

Beginning in 2008 the two optional exercises – “Application of Cranial Nerve Function” and the “Cranial Nerve Flowchart” – will be required assignments. These will be included as the culminating activities of the lab on cranial nerves.

To determine if there were any improvements in student learning, I included the same questions on cranial nerves on the exam this year (attached). The results are shown below for Fall 2006 and Fall 2007. Unfortunately, I do not have results for prior years. I was relieved to see that there was some improvement in Fall 2007. However, students are still confused on several areas (as reflected in the percentage of students who missed the question related to that concept). The most notable areas where a large percentage of students performed poorly include the concepts related to autonomic effectors (question 9) and the three cranial nerves involved with the sense of taste (question 10). Perhaps with the addition of more directed questions in the lab report related to these areas, I can help a larger percentage of students develop a better understanding.

<table>
<thead>
<tr>
<th>Item on Exam</th>
<th>Fall 2006 (Percentage)</th>
<th>Fall 2007 (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 1</td>
<td>59</td>
<td>65</td>
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<tr>
<td>Question 2</td>
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<td>91</td>
</tr>
<tr>
<td>Question 3</td>
<td>83</td>
<td>84</td>
</tr>
<tr>
<td>Question 4</td>
<td>90</td>
<td>97</td>
</tr>
<tr>
<td>Question 5</td>
<td>69</td>
<td>76</td>
</tr>
<tr>
<td>Question 6</td>
<td>88</td>
<td>98</td>
</tr>
<tr>
<td>Question 7</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td>Question 8</td>
<td>71</td>
<td>74</td>
</tr>
<tr>
<td>Question 9</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Question 10</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>All 10 Cranial Nerve Questions</td>
<td>73.8 (n=59)</td>
<td>76.8 (n=58)</td>
</tr>
<tr>
<td>All 88 Exam Questions</td>
<td>71</td>
<td>72.9</td>
</tr>
</tbody>
</table>
Ten Questions on Cranial Nerves

1. Which of the following most ACCURATELY describes the Accessory Nerve?
   a. motor, cranial, and autonomic
   b. motor, cranial, and somatic
   c. motor, cranial, and autonomic and somatic
   d. sensory, cranial, and somatic
   e. motor, spinal and autonomic and somatic

2. Choose the CORRECTLY matched pair.
   a. optic nerve...sense of smell to parietal lobe.
   b. vestibulocochlear nerve...vision to occipital lobe
   c. vagus...major nerve extends down into the thoracic and abdominopelvic cavities.
   d. oculomotor...sensory visual information to occipital lobe
   e. abducens...controls the skeletal muscle of the tongue

3. Choose the cranial nerve CORRECTLY matched with its function.
   a. olfactory – vision
   b. optic – controlling the extrinsic muscles of the eye
   c. hypoglossal – movement of the tongue
   d. facial – movement of the neck and shoulders
   e. abducens – smell

4. To control all the extrinsic eye muscles requires:
   a. optic nerve only
   b. optic nerve and the oculomotor nerve
   c. oculomotor nerve only
   d. oculomotor nerve, trochlear nerve, and abducens nerve
   e. oculomotor nerve, trigeminal nerve, and abducens nerve

5. A reflex to slow the heart would involve which cranial nerve?
   a. accessory
   b. hypoglossal
   c. facial
   d. trigeminal
   e. vagus

6. This nerve transmits sensory impulses involving equilibrium.
   a. olfactory nerve
   b. vestibulocochlear nerve
   c. facial nerve
   d. olfactory nerve
   e. glossopharyngeal nerve

7. This nerve transmits sensations of touch of the face and motor impulses for controlling the muscles of chewing.
   a. trigeminal nerve
   b. facial nerve
   c. glosopharyngeal nerve
   d. hypoglossal nerve
   e. accessory nerve

8. This cranial nerve is a mixed nerve.
   a. accessory
   b. hypoglossal
   c. glossopharyngeal
   d. oculomotor
   e. abducens

9. All of the following cranial nerves extend to autonomic effectors EXCEPT:
   a. oculomotor
   b. vagus
   c. facial
   d. glossopharyngeal
   e. trigeminal

10. The sense of taste is transmitted to the brain along which three cranial nerves:
    a. 1, 2, 3
    b. 1, 3, 5
    c. 2, 3, 5
    d. 1, 4, 5
    e. 3, 4, 5

You are welcome to use the 10 questions on the cranial nerves for a quiz or an exam to see how your students would do.
Cranial Nerve Flowchart

Directions: Fill in the blank with the name of the cranial nerve.

First Six Cranial Nerves

<table>
<thead>
<tr>
<th>Sensory</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smell</td>
<td></td>
</tr>
<tr>
<td>Sight</td>
<td></td>
</tr>
<tr>
<td>Touch and Chewing Muscles</td>
<td>Extrinsic Eye Muscles (spell OAT)</td>
</tr>
<tr>
<td>1 ___________</td>
<td>2 _________</td>
</tr>
<tr>
<td>3 ____________________</td>
<td>4 ____________________</td>
</tr>
<tr>
<td>5 ____________________</td>
<td>6 ____________________</td>
</tr>
<tr>
<td>*also intrinsic eye muscles</td>
<td></td>
</tr>
</tbody>
</table>

Second Six Cranial Nerves

<table>
<thead>
<tr>
<th>Sensory</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing (and Equilibrium)</td>
<td>Taste and Facial Muscles</td>
</tr>
<tr>
<td>7 _______________</td>
<td>8 ____________________</td>
</tr>
<tr>
<td>11 _______________</td>
<td>12 _______________</td>
</tr>
<tr>
<td>Taste and Swallowing Muscles and Parotid Salivary Gland</td>
<td></td>
</tr>
<tr>
<td>9 _______________</td>
<td></td>
</tr>
<tr>
<td>Taste and Swallowing Muscles and Smooth Muscle and Glands of Viscera of Thoracic &amp; Abdominal Cavities</td>
<td></td>
</tr>
<tr>
<td>10 _______________</td>
<td></td>
</tr>
</tbody>
</table>

Sensory

Somatic Motor

Autonomic Motor

Key:
1 – olfactory, 2 – optic, 3 – trigeminal, 4 – oculomotor, 5,6 – abducens or trochlear
7 – vestibulocochlear, 8 – facial, 9 – glossopharyngeal, 10 – vagus, 11 - accessory, 12 – hypoglossal

You are welcome to copy the flowchart and use it in your course.
Application of Cranial Nerve Function

Directions: Using your diagrams, notes and textbooks, determine the spinal nerve or cranial nerve that is damaged based on the symptoms of the individual.

a. olfactory nerve (I)
b. optic nerve (II)
c. oculomotor nerve (III)
d. trochlear nerve (IV)
e. trigeminal nerve (V)
f. abducens (VI)
g. facial (VII)
h. vestibulocochlear nerve (VIII)
i. glossopharyngeal nerve (IX)
j. vagus nerve (X)
k. accessory nerve (XI)
l. hypoglossal nerve (XII)

1. The patient is deaf.
2. The pupil in one eye is dilated due to decreased tone of the constrictor muscles of the iris.
3. An individual has taken a hard blow to the face (e.g. as a result of falling on concrete) and has lost some sense of smell.
4. An individual has diabetes and blood vessels in the retina are damaged, what nerve would be sending less sensory impulses?
5. Due to surgical error, the patient has lost most sensory perception on one side of the face and difficulty chewing.
6. Individual cannot move most muscles of the face.
7. Paralysis of the superior oblique muscle results due to damage of this nerve. The individual’s one eye rotates outward.
8. The patient complains of decreased sense of taste (3 cranial nerves).
9. The individual cannot abduct (move the eye laterally to see something to the side) one eye due to damage to this nerve.
10. Stimulation of this nerve in the region of the neck decreases heart rate.
11. One shoulder droops.
12. The patient has Bell’s palsy.

Key: 1-h; 2-c; 3-a; 4-b; 5-e; 6-g; 7-d; 8-g, i, j; 9-f; 10-j; 11-k; 12-g

Am I in Control of My Own Body?
Understanding the Autonomic Nervous System

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The ANS is a dynamic, responsive system that maintains homeostasis through reflex adjustment to changing conditions - but it is not an intuitive topic for students, and its antique terminology does not help. This article offers a “housekeeping” metaphor to introduce the ANS in everyday language, and short class activities with questions that enable students to answer, “Just how much can I control my own body?” and “What would happen if the ANS failed?”

Housekeeping: the biological function of the ANS

Housekeeping in a complex building (i.e., a hotel) means sending fresh supplies to the right location, maintaining a comfortable temperature, etc. and hotel guests are free to plan their own activities since the building seems to run itself. Similarly “housekeeping” by the ANS adjusts cardiorespiratory control, temperature control, etc. so that the conscious brain is free to think while the body’s routine functions operate automatically. In a hotel or in the body, housekeeping management also provides automatic, rapid responses that protect against internal or external threats or disturbances (see Table 1).

Activity 1: Extensive, protective homeostatic functions of the ANS

Guess how many reflexes are known. A search of the Internet, textbooks, and the Merck manual produces definitions like “rapid, automatic, stereotyped response to stimuli”, and lists of scores of reflexes – far more than anyone guesses. Working in groups to sort the reflexes, students set aside descriptive terms such as spinal/cranial or monosynaptic/polysynaptic and proper names such as Babinski for later research. Are there more autonomic or somatic reflexes? By sorting the reflexes according to body parts involved, it becomes clear that the autonomic group, controlling the imperceptible “housekeeping” functions of glands or smooth muscle in viscera such as heart, iris, stomach, blood vessels, etc., is much larger than the somatic group of reflexes that act in posture and withdrawal. Students may think they control their own bodies, but realize the only organ under conscious control is skeletal muscle!

How does each ANS reflex act to maintain homeostasis and/or provide some kind of protection? For example, chemoreceptor...
reflexes maintain blood gases and therefore pH, and gastric and intestinal reflexes maintain food propulsion at the right rate for digestion and absorption. Cough and gag reflexes protect directly, and the diving and bladder emptying reflexes protect indirectly.

<table>
<thead>
<tr>
<th>Table 1. Comparison of housekeeping in a complex building and in the body</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Who/what does the work?</strong></td>
</tr>
<tr>
<td><strong>When is work done?</strong></td>
</tr>
<tr>
<td><strong>What jobs are done?</strong></td>
</tr>
<tr>
<td><strong>What are job descriptions?</strong></td>
</tr>
<tr>
<td><strong>What is the overall effect?</strong></td>
</tr>
<tr>
<td><strong>What happens when there is no oversight?</strong></td>
</tr>
</tbody>
</table>

**Activities 2, 3, 4: Parts of the reflex arc (afferent limb, integrating center, efferent limb)**

**Activity 2: Efferent limb**

*What bodily activities cannot be consciously controlled?* Students offer goose bumps, stomach gurgling, sweating, fainting, heart thumping, blushing, and so on. After a few hints they add pupillary, bladder, bowel, and sexual functions. These autonomic effects are mediated by efferent (motor) signals from the central nervous system (CNS). Students should note that the dual sympathetic and parasympathetic nerves to viscera shown in textbook illustrations are both efferent – the ANS is predominantly efferent. These nerves are the housekeeping staff that perform the work.

**Activity 3: Afferent limb**

*What work does the ANS perform?* Efferent signals in the ANS cause smooth muscle contraction, gland secretion, and/or regulate cardiac action; all of the uncontrollable bodily activities result from one or more of these actions.

**Activity 4: Integrating center.**

*Does something stimulate the CNS to cause the efferent effects (above), or are these random?* Physiology is anything but random, so we need to consider what the “work orders” are that cause housekeeping nerves to perform some type of job.

*How does it feel to have an X-ray, and what happens?* There is no feeling and nothing happens because the body cannot sense X-rays. It must be able to detect, through some kind of sensory receptor, what is going on in and around itself, and report that work order (afferent limb of the reflex) to a housekeeping office (integration center of the reflex) before appropriate motor work can be done (efferent limb of the reflex).

*What are some work orders for autonomic action?* Students already know that heat causes sweating, embarrassment causes blushing, hunger causes stomach gurgles, etc. Other work orders are unfamiliar, such as baroreceptor afferents that report details of blood pressure, but everyone has felt dizzy on standing up suddenly. The baroreceptor reflex must catch up in its work of “autofocusing” the blood pressure after blood sinks into the legs by gravity.

When enough afferent impulses (work orders) have been identified, students sort them into two categories: *Which are triggered by sensation such as pain, fullness of the stomach, or light shining in the eyes? Which are triggered by memories, thoughts, or emotions such as anxiety, hatred, or sexual attraction?* This establishes that the afferent limb of the ANS reflex can be any type of peripheral sensation, or can be central input from the cerebral hemispheres. Autonomic afferent nerves are few (relaying visceral sensation, and baroreceptor and chemoreceptor input), and somatic nerves provide the afferent limb (or even efferent limb, but if both limbs are somatic, it is a somatic reflex) in some autonomic reflexes (see Table 2).

<table>
<thead>
<tr>
<th>Table 2. Components of visceral and somatic reflexes</th>
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</thead>
<tbody>
<tr>
<td><strong>Efferent limb autonomic</strong></td>
</tr>
<tr>
<td>Baroreceptor reflex alters heart rate via sympathetic or parasympathetic efferents</td>
</tr>
<tr>
<td>Gut sensation alters gut motility via sympathetic or parasympathetic efferents</td>
</tr>
<tr>
<td>Chemoreceptor reflex alters use of respiratory skeletal muscles</td>
</tr>
<tr>
<td>Gut sensation → vomiting using skeletal muscles</td>
</tr>
</tbody>
</table>
Activity 4: Integrating center.

Where are the housekeeping offices that receive reports through the afferent limb? Students can identify the centers of autonomic regulation from these questions: Is the conscious brain involved? Yes, feelings and thoughts cause autonomic effects. Is the limbic system involved? Yes, it is involved in “gut feelings” and moods that cause autonomic effects. Is the brainstem involved? Yes, chemoreceptors and baroreceptors ‘report’ there, and the cranial nerves that serve cough and gag reflexes originate there. Is it likely that the hypothalamus, a center controlling homeostatic functions such as food and fluid intake, should also control autonomic functions through the sympathetic and parasympathetic divisions? Yes, it seems likely.

The hypothalamus is the headquarters or housekeeping main office, but also some branch offices are under hypothalamic control: the spinal cord that integrates autonomic reflexes such as urination, defecation, erection, and ejaculation; and the brainstem that integrates cardiovascular, respiratory, and swallowing functions. Other branch offices are the limbic system, especially the amygdala that responds to gut feelings and olfactory input, the thalamus that integrates sensory input, and even the cerebral cortex with its conscious thoughts.

If the conscious brain is involved, does that make it a reaction like those used in playing video games, and not a true automatic reflex? Blushes and sweaty palms are not voluntary and cannot be directly stopped, so they are autonomic reflexes even though the afferent is conscious thought. In biofeedback, conscious thought can be used to indirectly control ANS reflexes to some extent – focusing on calming topics can slow the heart rate.

Activity 5: Dynamic balance between sympathetic and parasympathetic divisions

Students are familiar with the extremes of autonomic response – fight or flight, rest and restoration – but what happens between extremes? What happens if anxiety causes sympathetic outflow to accelerate the heart, but lying down to rest causes parasympathetic outflow to slow the heart? Which division “wins”? What if low blood sugar causes the need for parasympathetic stimulation of digestion, but fear dries the mouth and slows the intestines through sympathetic outflow?

Homeostasis in non-extreme conditions is maintained by a dynamic balance between the two divisions. Neither ANS division would win – the heart rate would be somewhere between usual rate for ‘at rest’ and a higher rate for ‘anxious’, the food would be eaten with less appetite and digested more slowly than usual.

Activity 6: Easily demonstrated ANS effects

Digital blood vessels undergo sympathetic vasoconstriction in ice water, and reduced blood flow causes pallor and even cyanosis as tissue extraction of oxygen from the sluggish blood continues. On re-warming, sympathetic vasoconstriction is inhibited and skin vasodilation causes redness and tingling. (Google Images show dramatic exaggeration of this in Raynaud’s disease).

The parasympathetic salivation reflex is stimulated by substances such as lemon juice, gum, or clean pebbles in the mouth. Baseline production of saliva is measured over 3-5 minutes in a small graduated cylinder, and the measurement is repeated after exposure to lemon juice, etc.

Normal ventilation is controlled by the brainstem to maintain homeostasis of blood gases. Deliberate alteration of the normal pattern of ventilation in rate and depth for one-half minute alters the pCO2 and pH of the blood, after which chemoreceptor reflexes cause an opposite pattern of abnormal ventilation until homeostasis is restored. Subjects should be unaware of observation during recovery.

Pupillary responses to light are easy to observe, but even easier is the pupillary response to near and far accommodation.

Everyone can demonstrate cardiac changes on exercise – but can everyone explain the parts of the reflex are?

Activity 7: ANS topics for research

Shy-Drager syndrome (multi-system atrophy) is a condition in which extensive autonomic failure is prominent. What symptoms of this illness illustrate how essential autonomic control is to the body?

Ondine’s curse is a genetic condition with inadequate ventilation especially during sleep. How would it be to need to stay awake to consciously control breathing? What part of the chemoreceptor reflex is impaired in this condition? Who was Ondine? (Hint: she inspired ‘The Little Mermaid’.)

The polygraph (lie detector) test works by measuring autonomic responses to emotion, such as alteration in electrical impedance of the skin with nervous sweating. The test is not infallible, and its use in a court of law is controversial. What could happen with hardened liars, or nervous individuals? What prescription drugs would act on the ANS to reduce responses?

Extreme fear in victims of torture acts through the limbic system and hypothalamus to cause a massive sympathetic response. What are the bodily effects of this? Hypoxia of the brain from hanging or strangling has similar effects.

Contradictory signals from the vestibular system, the visual system, and/or the proprioceptive system stimulate the vomiting center in the brainstem. Parasympathetic (vagal) signals reverse the transit in the gastrointestinal system, and coordinated action of respiratory and abdominal muscles force out gastric content. What conditions does this describe?

4 Galen described structures of the ANS in the 2nd century and thought they allowed “sympathy” or coordination of organs. Ackerknecht EH. The history of the discovery of the vegetative (autonomic) nervous system. Med Hist, 1974;18(1):1-8
Forensic Facial Reconstruction

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There are many well-known, reliable techniques used in forensic anthropology today to identify an unknown individual with respect to sex, age, race, and stature. Beyond these four basic determinations, there is increasing interest in the field of law enforcement to assess the individual biological characteristics of an unknown person. Forensic anthropologists, specialists in the human skeleton, can often assess the individuality of a skeleton by looking at unique skeletal anomalies, pathological conditions, or evidence of acute trauma to the bone. In some cases, right or left handedness can be determined or an estimate can be made of the former occupation of the unknown person. An understanding of the variation in a single skeleton coupled with a general understanding of skeletal anatomy is essential to forensic anthropologists. In cases where dental information and other pertinent data are lacking, skeletal data may be the only information available for determining if the remains match those of a missing person. Once the skeletal characteristics are known, it is sometimes easier to identify the individual.

Forensic facial reconstruction is the process of creating the face of an individual on a skull for the purpose of identifying an unknown person. The process is an outgrowth of the observation that the reason there are so many variations in human faces is that each face overlays a bony framework that is unique to the individual and as subject to variation as the individual’s eye color or hair color. There are two broad approaches to facial reconstruction recognized today, the American method, pioneered in the 1940’s by Wilton Krogman and in the 1970’s by Betty Pat Gatiff, and the European or Russian method, pioneered from the 1930’s to the 1970’s by Professor Mikhail Gerasimov. In the American method, average tissue thickness is determined for 21 precise anatomical points on the skull, tissue depth markers are cut from eraser cylinders and glued to the skull in these specific locations and clay is used to fill in the spaces between the markers to fill out the contours of the skull. In the European method individual muscles are made from clay and attached to the skull, one by one, according to the origin and insertion of each muscle. A synthesis of these two techniques, known as the Manchester Method, developed at the University of Manchester in the UK, allows for individual muscles to be attached on the skull while using the tissue depth measurements as a guide of the final architecture of the face. In the Manchester Method a plaster cast is made of the skull and all work is done on the cast. Holes are drilled into the plaster cast and wooden pegs, cut to the appropriate tissue depths are inserted in the holes. After the muscles are formed in clay and attached to the skull in the proper position, a thin layer of clay “skin” is draped over the muscles.

Average soft tissue depth data originally came from sticking pins into cadavers and noting the tissue thickness. Cadaver measurements proved unsatisfactory over the long run because of the changes that normally occur in soft tissues after death. For instance, in a body lying face up, fluids tend to drain away from the soft tissues of the face and settle on the back of the head leaving the face less plump than it was before death. Reconstruction based on cadaver measurements often results in a face that looks much thinner than it did in life. A movement has been underway in the last decade to replace cadaver measurements with new tissue thickness data taken from living subjects using the ultrasonic measuring equipment that is so common in the practice of medicine today. Extensive data are now available for many racial groups, for males and females, for obese and emaciated people, and for “normal” individuals.

The following exercise is one that one of us (Cooper) has done for many years in a Freshmen Seminar in Forensic Science. It is based on the American method of facial reconstruction and can be easily adapted to a beginning human anatomy and physiology course to give students a reliable laboratory experience from which to learn the names and origins and insertions of the muscles of facial expression. It can also be used by individual students for honors credit or perhaps as a learning activity for extra class credit.

In setting up this exercise, it is best to have a minimum of one skull for each pair of students. Cooper has had success using the most inexpensive plastic skulls available and has also had students do interesting reconstructions using some of the special anthropological skulls available from biological supply houses.

The materials needed for this exercise are:

1. A skull (Figure 2)
2. A scalpel or knife
3. A small metric ruler
4. Several boxes of eraser refills, one-fourth inch in diameter
5. A diagram for placement of average tissue depth markers (Figures 1 and 13)
6. Glue (Duco™ cement or crazy glue)
7. Non-hardening clay such as Permolast Modeling Clay™ available from Carolina Biological Supply

In order to construct a face on a skull, a sculptor needs to know the depth of the soft tissues that overlay the bones. In this exercise, known tissue depth markers are cut from eraser re-fills and glued to specific points on the skull. Since current tissue depth tables are often several pages in length and can be quite complex, Cooper has consistently used a simpler table devised by Rhine and Moore in the early 1980’s. (Figure 1 and Figure 13). It is best to allow the glue to dry overnight before proceeding with
the reconstruction. Once the tissue depth markers are firmly in place, flattened strips of clay are placed between the markers to build up simulated muscle. No artistic talent is required to lay the muscular framework on the bony “canvas”. The positioning of the eyes, ears, mouth, and nose are a little more challenging, but generally follow fairly simple rules, and most students will be able to complete the whole face with a little effort though the mouth, eyes, and nose will be the most speculative parts of the reconstruction.

**Process**

1. Cut the eraser re-fills to specified lengths using a scalpel or knife and a ruler. (Figure 2)
2. Glue the eraser pieces to the skull at the specified points. (Figure 3)
3. Line the orbits and nasal area with cotton to protect these delicate regions and to facilitate the removal of the eye and nose clay if the skull is to be reused.
4. Connect the tissue depth markers with strips of clay. It is helpful to roll out the clay strips with a rolling pin or wooden dowel before applying them to the skull. Smooth the clay with your fingertips as you go.
5. **Eyes:** Make eyes by rolling clay into balls 2.5 cm in diameter or use prosthetic eyes (Figure 4). To determine the placement of the eye, bisect the orbit opening with two toothpicks, one horizontal and one vertical. Mark the point where the two toothpicks meet in the center of the orbit and mark where the vertical toothpick touches the clay at the top or bottom of the orbit. Put the eye in the orbit and replace the vertical toothpick. The pupil should touch the vertical toothpick and be centered at the point where the horizontal and vertical toothpicks meet. Center the eye in the orbit so that the inner corner is lower than the outer corner (Figure 5). In life, this slant allows for the drainage of tears. The circular edge of a ballpoint pen that has been taken apart works well to make indentations in the clay eyes for the iris. If prosthetic eyes are used, the hole in one edge of the prosthetic eye should be oriented towards the outer edge of the eye so that the prosthetic left and right eyes can be distinguished from each other.
   a. Develop the eyelids from 6 mm strips of clay cut roughly into the shape of a parallelogram and the length of the eye from the inner to the outer corner.
   b. Lids hug the eyeball before veering off toward the nose so give them an “S” shape before placing them over the eye.
   c. The lower lid is straight while the upper lid is curved since the upper lid does the movement.
6. **Nose:** The curve of the nasal bones dictates the shape of the nose. To approximate the length of the nose, extend a line with a toothpick or string from the lower third of the nasal bone until it meets a similar line extending outward from the anterior nasal spine. Where the two toothpicks meet marks the distance the nose projects from the surface of the skull. The width of the nose depends on the width of the nasal cavity. For the wings or alae add 5 mm of clay to both sides of the nasal opening. Use 8 mm for wider nasal openings. Always double check the measurements as you position the alae since the clay tends to spread in this area. Remember that the nose has a tip or apex that extends downward. In general, a long, narrow nasal aperture is indicative of a long narrow nose and a wide aperture indicates a wide nose. (Figure 6)
7. **Mouth**: The width of the mouth is determined by the outer borders of the cuspids. For a closed mouth, roll a strip of clay the depth of marker 7, the length of the distance across the front eight teeth and the width of the mouth. For example, an average “block of clay” for the mouth might measure 18 mm x 9 cm and be 8 or 9 mm thick. Mark the horizontal midline of the block to approximate the width of the upper and lower lips. It may help to think of the upper lip as a flattened “M”, spreading widely in a gently curving arch (Figure 7). Use other students or photographs as a pattern when forming the lips. The degree of fullness of the lips should reflect the degree to which the jaw bones are extended from the surface of the skull. In the end, the most important aspect of the mouth is that it is in harmony with the face (Figure 8).

8. **Ears**: The ears are generally the same length as the nose. The position of the external auditory meatus indicates the area for proper positioning of the ears and the projection of the mastoid process can influence the extent to which the ears stick out from the skull. It is best to make both ears at the same time to ensure symmetry. Make two flat ovals of clay approximately the thickness of a penny and the length of the nose. To construct the helix around the outer edge, make two clay “worms” and curve the “worms” into “C” shapes on the flat ear pieces (Figure 9). Use other students as a pattern for modeling the finished ear. Fortunately, the ears are not considered to be an important factor in recognition of a face. If they are of normal size and shape, evidence from police artists indicates that no one really looks at them.

9. **Tips for Students**: The three most important things to know are the sex, race, and age of the skull. In the real world, a physical anthropologist would determine this for the forensic sculptor. When using a plastic lab skull, determine the most likely sex of the person from which the plastic skull was modeled. Work the clay smoothly from start to finish, following the curve of the bone. Be especially careful to follow the curve of the bone along the jaw line as this area can spread out quickly if you are not paying attention. Use each other as models or use photographs when shaping the lips, nose, eyelids, and mouth.

To follow the Manchester method, which many practitioners feel gives the most accurate representation of facial features, facial muscles are first modeled in clay and then placed on the skull in the following order from deep to superficial. Refer to any anatomy textbook for the specific origins and insertions of these muscles.

Muscles of the neck are positioned first if the reconstruction includes a base for the skull:
1. Sternocleidomastoid
2. Platysma
3. Trapezius

Muscles of the face and scalp are added directly to the skull in this order:
1. Temporalis
2. Masseter
3. Buccinator
4. Orbicularis oris
5. Mentalis
6. Depressor labii inferioris
7. Depressor anguli oris
8. Orbicularis oculi
9. Levator labii superioris alaeque nasi
10. Nasalis
11. Levator anguli oris
12. Levator labii superioris
13. Zygomaticus major
14. Zygomaticus minor
15. Corrugator supercili
16. Procerus
17. Risorius

The parotid gland is added at this point to help fill out the roundness of the cheek.
To complete the skull using the Manchester method, position a thin layer of clay, approximately 1/3 of an inch thick over the clay muscles to finish. Ultimately, tissue depth guidelines are used to determine the actual thickness of the skin layer. Extra clay may be added or removed in some areas in order to be sure to stay within the tissue depth guides5 (Figures 11 and 12).

As in most fields of endeavor today, there is interest in computerizing the process of facial reconstruction. Those who most favor the use of computers cite a desire to increase the speed and efficiency with which reconstructions can be done and to eliminate dependence on the subjectivity, experience, and knowledge of the person who is doing the reconstruction. Those who argue for the hands-on method of sculpting in clay reply that the subjectivity, the talents, and the expertise of the sculptor are exactly what are most needed in order to arrive at a recognizable facial reconstruction.5

Practitioners of all three methods of facial reconstruction agree that there is an enormous number of variables associated with the process. Everything from the knowledge and experience of the sculptor to the determination of age, sex, and race can have a profound effect on the finished face. The reconstruction will never be as good as a photograph; however, many experts feel that recognition is not based so much on total accuracy as on a sense of proportion associated with the completed likeness. Forensic facial reconstruction can be a difficult and time-consuming process and it should never be thought of as a definitive recreation of a face but, when it is used as a part of a large forensic investigation, it can be a valuable tool that rewards both the sculptor and the family of the person whose identity has been determined.4,5

The texts cited in this article are excellent resources providing an enormous amount of detail relating to the mechanics of facial reconstruction in modern criminal investigations and representative studies in the reconstruction of the faces of ancient people.

References
3. Matlock, S. Forensic sculptor. Personal Interview October 2007. (Suzanne_matlock@merck.com)
Easy-to-Make Knee Ligament Models

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A trip to your building supply store plus some very simple carpentry is all you need to make simple but sturdy knee models that will give your students hands-on experience with knee ligaments and knee injuries. These models are made of two-foot segments of block-style molding cut into fifteen and nine inch pieces and painted white. A black strip painted off-center lengthwise on the “lower leg” visually divides the wooden piece into tibia and fibula. Bones are labeled using Permasign™ stick-on lettering. Because the models can bend in either direction, the posterior or anterior face should be labeled (posterior is labeled on the undersides of these models). Lateral (or medial) sides are labeled as well to help students remember the orientation of lower leg bones. Ligaments are represented by red, blue, green, and yellow hook-and-loop straps sold for wrapping electrical cords. For each model, a single ligament is made detachable by using a hook-and-loop pad at one end of the strip for a connection that can be easily opened. All other connections in each model are made permanent by stapling the hook-and-loop straps to the wood with a staple gun. Mail box letters were used to label the models A, B, C, and D. Each model has a different detachable ligament.

In our lab, students, working in groups of four, identify the ligaments, bend the knee to see how ligaments stabilize the joint, detach the one detachable ligament in each model, and look for abnormal lower leg movements. The models do a good job of showing lateral sway, medial sway, anterior slippage, and posterior slippage from detaching, respectively, the medial collateral, lateral collateral, anterior cruciate, and posterior cruciate ligaments. Students also explore how a torn meniscus immobilizes the knee by inserting a rubber door stop into the back of the models. We would be happy to e-mail our accompanying lab activity and color photos of models to anyone interested. Line drawings of the models are provided below.

Model A
The anterior cruciate ligament is made detachable by placing a Velcro pad on the anterior face of the tibia.
Model B
The posterior cruciate ligament is made detachable by placing a Velcro pad on the anterior face of the femur.

Model C
The medial collateral ligament is made detachable by placing a Velcro pad on the medial face of the tibia.

Model D
The lateral collateral ligament is made detachable by placing a Velcro pad on the lateral face of the fibula.
The keynote presentation at the annual HAPS banquet provided a delightful change of pace from update seminars, pedagogy, and best practices. Angelina Whalley reviewed the evolution of a new idea from concept to implementation, and this was not just any good idea. Whalley described the birth of an anatomical display seen by millions of people the world over. The display originator is Gunther von Hagens, Whalley’s teacher, then colleague and friend, and finally husband. Whalley grew from medical student to business manager and creative designer of the exhibition known as Body Worlds.

Body Worlds was and is a concept that challenges the prevailing wisdom that the sacred, anatomical gift of a human body should be used exclusively to meet the educational needs of medical students and, occasionally, other medical personnel. In stoic Germany, Gunther von Hagens was an anatomist who truly loved teaching. The idea – to teach the general public about the human body – tantalized his creative spirit. Did people really want to learn about their bodies? Would they come? What is the appropriate setting for this type of instruction? How should a display of the body look? What are the logistics of such an undertaking?

Von Hagens is also an inventor. His development of a process called plastination meant that decomposition of the body could be stopped, that bodies could be surgically prepared to reveal a number of features never before displayed, and that these preparations could be transported from one continent to another in perfect form. In the end, it took more than creativity, a new preservation technique, and surgical skill to get things started. It took patience, perseverance, and solutions to challenges no one could imagine at the beginning of this undertaking.

Donation and display of the human body is subject to rigid regulations in most jurisdictions. As one who has worked on state forms for a Willed Body program, I can imagine the record keeping required to satisfy cities in Europe, Asia, and North America. Careful packing and unpacking maintains the quality of the plastinates. However, cultural differences abound in populations in one country. How might cultural sensitivities be addressed in the display when moving from continent to continent? Medical students look at the body in the supine or prone position. Perhaps the “man or woman on the street” does not relate to “correct anatomical position”. How should this audience view the body? In the end, posing bodies in natural postures – people doing things they might do normally – while exposing the musculature involved to maintain these positions or the position of the organs or the vasculature – was the stroke of genius that caused people to line up in country after country.

The Swimmer, Smoker, Winged Man, Reclining Pregnant Woman, and Blood Vessel Family are just a few of the signature displays that my students and I enjoyed in Body Worlds and Body Worlds 2 at the California Science Center in Los Angeles, CA in 2005. I encourage you to see if a museum in your city will contact Whalley and von Hagens to get on the Body Worlds calendar!

Dear HAPS members,

It has been my pleasure and privilege to serve as editor of the HAPS-EDucator for the past eight years. Although I retired from teaching two years ago, I continued to serve as editor. However, my life has gotten so busy with volunteer work that I feel that I can no longer continue in my service to HAPS. I wish each member all the best in the future. I hope that each of you will serve HAPS in some way to continue to make HAPS the friendly, helpful, and encouraging organization that we all love.

Susan Baxley
Summary of a Poster Presentation:
Students Perform Better on Assessments in Human Anatomy Lecture
When Attending a Laboratory Than With Lecture Alone

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Anatomy is a 3-dimensional science, yet lectures and textbooks teach anatomy in 2-dimensions. A laboratory provides an interesting and poorly understood learning environment. This study was undertaken to examine the impact of a laboratory on performance on Human Anatomy lecture exams.

Undergraduate students (3.3% freshmen, 32.5% sophomores, 33.5% juniors, 25.0% seniors, and 5.7% other; N = 765) enrolled in the one-semester Human Anatomy lecture course have the option of enrolling in the accompanying laboratory (72.8% attended both lecture and lab). Students in lab met once per week for 2 hours. The lab consisted of a tutored investigation of 18-20 prosected human cadavers and excised organs. The students also had available an additional 4 hours per week of “open lab,” or non-structured review. Performance was compared between students in the lecture with and without laboratory for each of 5 exams in the course.

Analysis of performance scores showed that beginning with the first assessment, students with lab performed 5.8% better than those with lecture alone (P = 0.0001, n= 765). The difference in performance increased with each subsequent exam. Students with laboratory performed 8.5% better in the second assessment (P < 0.0001, n=765); 10.4 % better in the third (P < 0.0001, n=755); 10.2% better in the fourth (P < 0.0001, n=742); and 11.1% better in the fifth (P < 0.0001, n = 733). Analysis of the total points for the course showed that students with lab performed 10.0 % better than those students taking lecture-alone (P < 0.0001, n=728). Further analysis of the data showed that 64.6% of the students with laboratory received final course grades of “A” or “B.” Only 44.8% of the students with lecture alone received these grades. There was a smaller difference in the range of scores for each exam, as represented by the standard error of the mean (SEM), from students with lab compared to those with lecture only. The SEM for each exam was 1.5 to 2.5-fold lower in the students with lab compared to those with lecture alone. These data suggest that fewer students with laboratory perform poorly than those taking lecture alone.

The data were further analyzed to examine the possibility that good students take lab with lecture while poor students take lecture alone. Senior students were evaluated separately under the assumption that all seniors are good students since they have successfully completed at least 3 years of university. Examination of the assessment scores on 5 lecture exams showed that the performance of senior students taking the lab was 5.1 to 12.2 % better than senior students with lecture alone. Analysis of the total points for the course shows that senior students with lab performed 8.3 % better than senior students taking lecture alone (P = 0.0048, n=179). This pattern was not different than the data from students as a whole. These data suggest that better performance in lecture exams by students with lab is not due to a tendency of good students to take lecture with lab and poor students taking lecture alone.

These data show that students perform better in Human Anatomy lecture exams when attending a laboratory than students taking lecture alone. Furthermore, students with lab are more likely to receive high grades and have a lower chance of performing poorly.
Summary of Workshop #504:
Hybridizing your A&P Class: Pathways to the Creation of Hybrid Science Courses Using a Progressive Design Model

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This is a summary of a presentation made at HAPS 2007 (San Diego) on best practices for the design of hybrid science courses, sometimes called blended classes. It describes my experience with creating undergraduate Anatomy & Physiology (A&P) courses enriched with distance learning-compatible elements. The concepts and designs used here can be applied to other disciplines. About 15% the science courses are now offered at Durham Technical Community College using hybrid or online formats. For A&P classes, use of the progressive design discussed below led to increases in student learning measured by comparing tests of populations of students taking the traditional and hybrid class. Samples so far are too small to report here, but the transition to hybrid courses has been seamless and successful for a variety of courses in biological and physicochemical sciences. None of the concerns about transitioning to online instruction in sciences is significant with hybrids, and blended instruction could soon become the standard for laboratory-based science classes.

Spectrum of distance learning modes
First, I will present some general definitions about what constitutes a hybrid science course. E. B. Lindsay defines a hybrid as “a traditional, face-to-face course that has incorporated online elements”, an almost outdated view after just a few years, since now all our classes have an active online course management system such as Blackboard™. The issue of the extent of this blending with distance learning is addressed by Garnham and Kaleta; who say that “hybrid classes are courses in which a significant portion of the learning activities have been moved online.” But hybrid courses are best defined by Gould, who stresses that the goal of these courses is "to combine the most effective instructional aspects of the traditional classroom with the most effective instructional aspects of the virtual classroom."

Operating with the third definition for a hybrid course, we can distinguish four modes of instruction: the traditional course (only face-to-face), a web-enhanced course (with a website or course management system, as most courses have nowadays), a web-augmented, hybrid or blended course (with substantial class elements moved online), and finally a distance learning or online course (where the majority or all activities are carried out online). There is some overlap between these modes. For example, some online courses do meet a few times in a term, becoming somewhat hybrid in nature. To clarify our terms, we are discussing here courses where some class activities happen only online and are effectively replacing face-to-face class meetings.

Elements of hybrid course design
As I experimented with hybrid class formats for A&P classes, several interesting characteristics of blended distance learning design became apparent and could be very useful to consider while designing a hybrid course with the aim of improving student learning.

Hybrid formats are intrinsically flexible. The decision about what elements of a course are moved online is made by the instructor and it is not in any way preset. The basic formats are created by deciding on the location of the online component with respect to the entire course. This leads to three basic blended course designs; a) Split online/traditional classes: Those where labs and lectures preserve their structure from face-to-face classes, but one of them – typically, lectures – occurs exclusively online; b) Moderately flexible hybrid classes: Courses using synchronous online lectures that mimic a face-to-face class, and with online meetings that occur at fixed times; and c) Very flexible hybrid classes: Lectures are asynchronous and the students complete online assignments and lecture review at their own pace and time. The only synchronous component is the laboratory class, which becomes somewhat less traditional by incorporating elements of lecture content and review. The split online/traditional model has some advantages for scheduling multiple sections of a course tied to a single online lecture series, but relies mostly on the online component for conveying content. In the community college environment, synchronous classes impose high technological demands both on the institution and the students. We thus experimented with the more flexible model for A&P hybrids, and found it less taxing and able to support various modes of assessment.

The level of hybridization of a traditional class is not fixed. Flexible hybrid classes described above have an additional level of flexibility that can support enhanced student learning and retention; this is what we have called here “level of hybridization” and it is simply the relative weight of the online work component carried out by students. One can split the online and face-to-face components of a hybrid science class into distinct halves or by any level of involvement desired, leading to courses that are heavily traditional or heavily online. Although this adaptable balance of distance-learning elements could serve instructional goals such as offering basic A&P courses or advanced pathophysiology-based forms of A&P, the level of hybridization is flexible in one more, sometimes not apparent way that we have found to be the most useful: The boundary between face-to-face and online work can change over the length of a term.
Changing the level of hybridization as you move through the class material allows for improved class design. Since the boundary between traditional and online components of a course can be moved over the length of a term, instructors can add weight to online work as the course progresses. This progressive format starts with a more traditional, face-to-face “blend” of class components, and adds online work as instruction moves through the early topics. The growth of the online segment of the class is helped by devices such as a “Tip-of-the-Week” feature that helps students learn to use basic online tools. Laboratory review of software used in the course – such as virtual dissection or virtual labs – will ease fear and decrease the “sticker shock” drop of students seen in the first weeks of online courses. Also, online work using posted assignments or discussion forums can start after the whole class is up to speed with the online component of the hybrid class. Depending on the characteristics of the student population in a given class and student awareness of online tools (from using course systems such as Blackboard™ to submitting work online), more or less introduction may be needed so that the course will reach a higher online “blend” earlier in the term.

As the A&P course is hybridized, the content components that are taught in the online environment can be selected to improve student learning. Elements of a traditional lecture or laboratory class can be taught face-to-face or in the online environment, but instructors can select media that will be most useful. Some laboratory activities can be taught online, using take-home assignments or online discussion boards. These can also take the form of virtual laboratories – using software that is provided by most publishers of A&P textbooks. Lecture activities that are difficult to carry out in an online asynchronous environment – such as reviews before an exam or Q&A sessions – can be more effectively done in face-to-face labs.

There are many possibilities for creativity in this aspect of hybrid course design. In my own A&P course, I use review questions scattered throughout the online digital lectures to record online attendance. Students complete these questions and bring them to lab to show that they “attended” the lectures. This provides information about the progress of students and leads to discussions of key conceptual points in the lab class. This also encourages the students to progress steadily through the content, and avoids common online course problems such as cramming or students who are left behind and drop the class. On deciding the best placement and nature of course activities, keep in mind that a common problem with distance learning courses is that they either overwhelm or rush students through the material; you may have to drop some favorite activity of yours from the course.

Hybrid course formats and student learning

In the modern world of education, teaching the subject is not enough, and a great deal of educational effort has shifted toward assessing the outcomes of learning4 or in designing alternative models to communicate information away from the classical lec™-6. A flexible, progressive hybrid format design such as the one described here provides a self-sustainable environment where some of the modern techniques of enhanced learning can be practiced. A few directions in this complex universe are put forward below, with the suggestion that you continue experimentation and testing to find what works best in your own teaching environment.

Learning styles should be considered and materials should address their differences. So much has been said and written about this topic that it needs no introduction to the HAPS-EDucator readership. Recent articles in our journal7 have addressed information about learning styles and how they present in combinations for each group of students. At the minimum, you should consider visual learners (for whom mostly visual online content is adequate,) auditory learners (who should supported through the incorporation of audio-clips online or by adding discussions with and between students in the face-to-face class) and kinesthetic learners (a population that seems to be much larger than traditional studies suggested7, and needs to carry out hands-on work to learn.) Tailoring your class to support each style to some extent is a possibility, but the next item has the potential to provide a better answer.

Active learning in hybrid courses can transform completely the class environment to improve effective learning. Most modes of active learning find a suitable vehicle on the hybrid course format, and may be easier to implement there than in purely online environments. Case-based8,9 and problem-based10 learning can greatly enhance A&P course work. Simple applications, such as having a Case-of-the-Week in the form of a separate discussion board, can create excitement for the material and even increase the knowledge base of students taking the class by teaching logical aspects of medical diagnosis. A more sophisticated active learning method, inquiry-based learning11, can lead to research projects and group work both in and out of the classroom. Team-based learning12, even when applied with moderation in a hybrid class, fosters lateral interactions between students and a sense of common goals. Simple team-based exercises can enhance the A&P classroom by creating small teams that compete for a certain lab goal – e.g., quickly learning 10-20 anatomical terms related to a particular model brought to the lab so that they can explain them to the group or class. A more sophisticated form of active learning, the discussion-driven classroom13,14, puts everything on the table for debate and discussion. Forms that are not excessively time-consuming can be tried in class or in the form of a debate-based discussion board.

Adding multiple avenues of student support to a hybrid class can enhance student learning. This aspect of teaching a hybrid class is easily forgotten, perhaps because we maintain a model of traditional teaching in the way we use office hours and time at work. One change in the hybrid course is the more extensive use of e-mail to make appointments or answer questions, but having a general discussion board to act as a class forum is also a good idea. Students can be reached through the course management system – using messages or group e-mails generated by the software. Online office hours may be added using “chat room” features of your system, or as times when you are available to answer e-mails on-the-fly. Be careful not to train your students to expect that you will answer e-mails after midnight or five minutes after they send them. You are not a 24/7 technical...
service. Although there is so much out there on book-specific and publisher-specific websites that your students can use to learn and drill, refer to their supportive information sparingly; you can drown your class in drills and they may not have any time left to actually study the topic. Do not forget the most basic level of “retro” student support: have short chalk sessions of Q&A and review in front of the board or with groups of your students.

The last level of flexibility of hybrid course design is involving students in a process of continuous course redesign aimed to improve student learning. We talked about student learning throughout this section, but I want to conclude with an issue mentioned above, the self-sustainability of our efforts. I believe that in a complex learning environment such as distance learning, and with a conduit as flexible as a hybrid course format, to realize the best promises of education we will have to involve the students in the process of course design. Student feedback should be a key component of hybrid courses, and should include both information obtained during the course as well as surveys that can be administered afterwards to assess the outcome.

Maintaining an optimal balance between traditional and online components of a hybrid course requires constant feedback. Teachers and students are really “peers” in this process of discovery. Simple mechanisms to adapt to course design include frequent short sections of discussion targeted to “fine tune” the class. Many features of my own course were actually suggested by students – who, surprisingly, pay more more attention to details and deadlines than their own teachers. More formal surveys can be collected independent of the usual student evaluations, (giving a few extra points as a reward to encourage anonymous return of completed forms). These should also address about technology resources at hand plus any general aspects of the course formatting that you monitor. Even after a particular term ends, feedback-driven changes are necessary to improve the next iteration of the course. Some of the suggestions may even prompt an overhaul of your class, as modes of delivery could change over time (e.g., when you realize that half your class owns MP3 players that could play video or audio clips taken from your traditional lectures). Future courses are going to involve more and more online collaboration and web interactivity by borrowing from blogging or wiki online interactions15.

One last significant comment to remember while teaching a hybrid course: this is not just an online class. At some point in time and space, you are there and your students are there. You and they are just in a different stage of a continuum of teaching styles for sciences that goes back to the Greeks and their Philosophy schools. Even though you can still walk around and talk with passion about medicine, there will be soon a time when these interactions will spread across the entire planet.

References
1. Lindsay EB. The best of both worlds: Teaching a hybrid course. Acad Ex Quarter 2004; 8(4):16-19.
Introduction and Overview

A recent survey of members of the American Society for Microbiology (ASM) revealed that many are also members of HAPS. In fact, HAPS was in the top five of “other society” memberships listed. It is also known that many educators who participate in ASM faculty development programs do not exclusively teach microbiology. A survey of attendees at the 2007 ASM Conference for Undergraduate Educators (www.asmcue.org) indicates that 74% of attendees teach lower division microbiology courses while 40% teach upper division microbiology courses. However, the data also reveals that 62% of these faculty members are responsible for introductory or general biology and 11% teach human anatomy and physiology.

With these statistics in mind, the ASM Committee on Technology-Enhanced Education (TEE) sponsored a 2007 HAPS workshop highlighting MicrobeLibrary (ML), an online collection of more than 2000 peer-reviewed resources for teaching undergraduate biology and microbiology. The 2007 HAPS workshop, titled “Anatomy and Physiology: Got Microbes?”, consisted of three parts: 1) a brief introduction to ML and its various collections, 2) a hands-on activity in which attendees selected a teaching scenario and were asked to perform a search of ML resources and develop a teaching activity based on their search results, and 3) an activity in which attendees were asked to share one of their own classroom or laboratory activities and consider how they could develop the idea for publication in ML.

What is MicrobeLibrary?

In a 1997 NSF proposal, the original vision of the MicrobeLibrary was “an electronic journal of peer-reviewed educational resources for the teaching community. It will be analogous to an electronic journal of peer-reviewed scientific articles for the research community.” The library first began as a collection of biofilm images. Presently, the library not only consists of over 1000 images and animations, but there are seven distinct collections which include protocols, articles, classroom and laboratory exercises and reviews of educational materials. The structure and inventory for each of the seven is shown in Figure 1. The ML continues to grow; each year, another 200-400 resources are added to the library. The various collections and short descriptions of each are listed below.

**Atlas-Protocol Collection** – standard microbiology protocols supported by a series of images.

**Curriculum Collection** – active learning classroom and laboratory exercises.

**Focus on Microbiology Education** – newsmagazine with teaching strategies, tips, tools, and techniques.

**Journal of Microbiology & Biology Education** – articles driven by outcomes-based research in student learning.

**Microbe** – feature articles from the ASM magazine.

**Reviews** – book, video, software, and website reviews of educational resources.

**Visual Collection** – animations, images, and videos.

Figure 1. ML Structure and Inventory as of October 2007

As of September 2007 there are more than 1500 subscribers to ML. Subscriptions are required to view full text of the articles, activities and other scholarly publications to be used in teaching. However, all resources in the Visual Collection and Atlases may be accessed at no cost. The annual subscription fee is $25 for ASM members and $50 for non-members. Subscription income defers only one-third of the expenses to manage the library. Presently ASM subsidizes the additional management costs, but with the goal of eventually reaching 100% sustainability through additional subscriptions and services. Costs to run the library include staff to manage the review processes and fees for technology support and development.
Why Microbiology at HAPS?

Microbes have a huge impact on human physiology. The human body contains approximately $10^{13}$ human cells and $10^{14}$ bacterial cells that play a role in food digestion, immunology, inflammation, disease and even body odor. Almost every part of the human anatomy is associated with a microbial infection. In fact, the presenters could not have been more pleased when a workshop attendee exclaimed, “I can use microbes to teach every system in the body!” This realization came about during the first activity of the workshop in which attendees were asked to choose from one of the three activities listed below, perform a search of ML resources and try to develop a teaching activity based on their search results.

Participants were asked to choose from one of the following activities:

**Activity 1** – Microbes are the main target of the immune system. Using the MicrobeLibrary, find resources about the immune system and create an activity based on your search results.

**Activity 2** – Biofilm formation is a common post-surgical problem. Using the MicrobeLibrary, find resources about biofilms and create an activity based on your search results.

**Activity 3** – One of the major causes of mortality in people infected with Malaria is renal failure. Using the MicrobeLibrary, find resources about Malaria and create an activity for your class based on your search results.

After taking time to search ML, attendees found a variety of resources to suit their needs. Below are a few examples:

**Activity 1 – Searching for Immune System Resources**

Participants working on the immune system found animations demonstrating how the immune system is activated and regulated, images and descriptions of serological tests used to diagnose disease based on the presence of an immune response, as well as field-tested active learning strategies for teaching topics such as clonal selection and the gene rearrangements required for antibody production and class switching.

**Sample result from the Curriculum Collection:**

*Do-It-Yourself Immunoglobulin Gene Rearrangement*
By Wendy Gorman, Northland College, Ashland, WI.  
http://www.microbelibrary.org/Edzine/details.asp?id=1173

**Activity 2 – Searching for Biofilm Resources**

Participants found over 40 images of biofilms forming on surfaces such as teeth, medical implants, catheters, and medical drip lines. Biofilms of *Listeria monocytogenes* on food production equipment is thought to play a role in transmission of this microbe that can cross the placenta and cause fetal damage. Biofilm formation on medical implants necessitates the removal of approximately 30% of all implants.

**Sample result from the Visual Collection:**

*Image - Scanning Electron Micrograph Showing Listeria monocytogenes and Pseudomonas putida 14-day-old Biofilms Adhered to Nylon*

**Activity 3 – Searching for Malaria resources**

Participants looking for resources about Malaria found a case study that encourages active learning and integrates microbiology with the effects it has on human physiology, as well as images of the protist that causes Malaria.

**Sample result from the Curriculum Collection:**

*Problem-Based Learning: A Patient Returning from Africa*
By Jan Jacobs and Astrid Visschers-Pleijers, University Hospital Maastricht and Maastricht University, The Netherlands  

**Half-fermented Ideas for Teaching**

In the next section of the workshop, attendees were asked to consider resources they might publish in ML, particularly in the Curriculum Collection. Curriculum Collection resources are classroom or laboratory exercises that promote active learning and student inquiry. In order to be accepted into the library, these activities must be field-tested and appropriate for an undergraduate classroom. In addition, the expected student learning goals must be described along with a method for measuring these outcomes.

At the HAPS workshop, participants engaged in an activity originally created by Jean Cardinale, Alfred University. Dr. Cardinale is also the Chair of the MicrobeLibrary Curriculum...
Collection Editorial Committee which is responsible for reviewing submissions to the collection. The activity titled “What is Your Half-fermented Idea for Teaching?” was originally presented at the 2007 ASM Conference for Undergraduate Educators. Faculty members were asked to describe a classroom or laboratory activity they developed involving microorganisms, discuss what they expected students to learn from the activity, and then explain how they determine whether they have met their student learning goals.

After describing individual activities, attendees discussed how they could develop the activity into a submission to the Curriculum Collection. For example, did the exercise include active learning? If not, how could it be modified? Were the learning goals for students clearly articulated and realistic? Were these objectives testable and measurable? Discussions also included how the activity could be adjusted for a variety of student populations and whether any safety issues should be considered.

**Publishing and the Scholarship of Teaching and Learning**

Finally, the presenters emphasized that ASM is committed to recognition of scholarly work and sharing knowledge with a broad community of educators. Several reasons for publishing a resource in the ML were discussed, including the fact that the resources are peer-reviewed and it is an excellent venue for recognizing scholarly work. To this end, upon publication, ML authors receive a press release to share with colleagues, administrators, and communication officers at their institutions. Sharing knowledge with the community is also valued and brings into focus the need to identify effective methods for enhancing student learning as well as engaging students in the sciences.

ASM regularly seeks to build capacity in two areas; 1) users of ML resources, and 2) authors of ML resources. Presenting a workshop at HAPS offered an opportunity to advance both these goals. All ML efforts are community-driven and the library would not exist and grow without many dedicated educators serving as reviewers and authors. Potential contributors were encouraged to submit images or curriculum activities to ML. Attendees interested in analyzing the effectiveness of their teaching approaches were encouraged to apply to the Biology Scholars Program Research Residency (www.biollogyscholars.org) which begins with an intensive, four-day training at the Scholarship of Teaching and Learning (SoTL) Institute to be held July 16-19, 2008 in Washington, DC.

The Biology Scholars Research Residency is one of three independent, but intertwined, virtual residency programs where faculty employ rigorous evaluations of their own teaching with the goal of publishing results demonstrating improved student learning in the laboratory or classroom. In addition, the Biology Scholars Program includes a Writing Residency and Leadership Residency. The ultimate goal of this NSF-supported program is to have participating Biology Scholars lead colleagues in national efforts to sustain undergraduate biology education reform.

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