WELCOME TO PHILADELPHIA!

Thank you for participating in our 2014 Regional Meeting. We want to thank our sponsors for supporting the meeting, especially the Philadelphia College of Osteopathic Medicine for being our gracious host and sponsor. In addition, a special thanks to Dr. Camille DiLullo, the planning committee, and the student poster award judges for their hard work in planning a fantastic program.

SAVE THE DATE FOR THESE UPCOMING AAA MEETINGS:
- Annual Meeting at Experimental Biology – March 28-31, 2015, Boston
- Regional Meeting - May 30, 2015 at Western University in London, Ontario - Canada
- Regional Meeting - October 3, 2015 at the Medical College of Wisconsin in Milwaukee, WI

THANK YOU TO OUR SPONSORS:
# Schedule of Events

*All sessions located in Ginsburg Amphitheater, Evans Hall – unless otherwise noted*

## Morning Sessions

<table>
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<th>Time</th>
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<tbody>
<tr>
<td>7:00 am - 7:45 am</td>
<td>Registration &amp; Continental Breakfast <em>(1st Floor Lobby of Evans Hall)</em></td>
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<tr>
<td>7:45 am - 8:00 am</td>
<td>Welcome</td>
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<tr>
<td>8:00 am - 8:50 am</td>
<td>Anatomy and Physiology of Voice Production</td>
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<td>Yolanda Heman-Ackah, M.D., Drexel University College of Medicine</td>
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<tr>
<td>8:50 am - 9:40 am</td>
<td>Effect of Anatomy and other Peri-receptor Factors on Olfactory Function</td>
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<td>Pamela Dalton, Ph.D., M.P.H., Monell Chemical Senses Center</td>
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<tr>
<td>9:40 am - 10:00 am</td>
<td>Break <em>(1st Floor Lobby of Evans Hall)</em></td>
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<tr>
<td>10:00 am - 10:50 am</td>
<td>Marrying Physical Anatomy with Living Anatomy via Ultrasound</td>
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<td>Nova Panebianco, M.D., M.P.H., Hospital of the University of Pennsylvania</td>
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## Concurrent Proceedings

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<tr>
<td>10:50 am - 12:00 pm</td>
<td>Poster Viewing <em>(2nd Floor of Evans Hall)</em></td>
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<tr>
<td></td>
<td>Hands on Ultrasound Opportunity <em>(Room 334)</em></td>
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<tr>
<td></td>
<td>Medical Humanities Video Presentation: The Cadaver Experience as Rite of Passage <em>(Room 326)</em></td>
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<td>Kimberly H. Myers, Ph.D., Penn State College of Medicine</td>
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## Lunch/Posters

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<tr>
<td>12:00 pm - 1:00 pm</td>
<td>Lunch <em>(1st Floor Lobby of Evans Hall. Room 327 for seating)</em></td>
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<tr>
<td></td>
<td>Poster Session and Student Poster Judging <em>(2nd Floor of Evans Hall)</em></td>
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<tr>
<td></td>
<td>Hands on Ultrasound Opportunity <em>(Room 334)</em></td>
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<td></td>
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## Afternoon Sessions

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<tr>
<td>1:00 pm - 1:50 pm</td>
<td>Modality Based Functional Organization of the Mammalian Direct Dorsal Column Pathway</td>
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<td>Wenqin Luo, M.D., Ph.D., University of Pennsylvania School of Medicine</td>
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<tr>
<td>1:50 pm - 2:40 pm</td>
<td>Anatomic Considerations in Osteopathic Manipulative Medicine</td>
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<tr>
<td></td>
<td>Dr. Lauren Noto-Bell, D.O., Philadelphia College of Osteopathic Medicine</td>
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</table>
2:40 pm - 3:00 pm  Break (1st Floor Lobby of Evans Hall)

3:00 pm - 3:50 pm  We Have Never been Individuals: A Symbiotic Account of Life
Scott Gilbert, Ph.D., Swarthmore College

3:50 pm - 4:40 pm  Countering Agents of Chemical Terrorism: Strategies to Mitigate Toxicity
Jeffrey Laskin, Ph.D., Robert Wood Johnson Medical School

**Concurrent Proceedings**

4:40 pm - 5:30 pm  Poster Viewing (2nd Floor of Evans Hall)

Hands on Ultrasound Opportunity (Room 334)

Medical Humanities Video Presentation: The Cadaver Experience as Rite of Passage (Room 326)
Kimberly H. Myers, Ph.D., Penn State College of Medicine
Sponsored by The Arnold P. Gold Foundation

5:30 pm - 7:00 pm  Networking Reception & Poster Awards Announced

*See pages 4-8 for speaker bio’s and abstracts*

**Posters**

(2nd Floor Lobby – Evans Hall)

**Anatomy Education**

1  Cheryl Melovitz-Vasan (Cooper Medical School of Rowan Univ.)
Blended approach in teaching anatomy: use of dissection, prosection, anatomical model and computer

2  Haviva Goldman (Drexel Univ. College of Medicine)
Bones on the road: Development and implementation of a skeletal anatomy outreach program serving elementary and middle school students in the School District of Philadelphia

3  Catherine Mattinson (Gannon Univ.)
80 Students, 5 Cadavers, and 2 Professors: An Undergraduate Human Gross Anatomy Dissection Course

4  Noel Boaz, PhD, MD (Integrative Centers for Science and Medicine)
The central role of Thiel-embalmed cadaveric dissection in a new medical school’s integrated systems-based curriculum emphasizing inquiry-based learning

5  Daniel Anderson (Pennsylvania State College of Medicine) *
An Anatomy Model for Vertical Integration of Basic Science in Medical Education
Matthew Fanelli (Pennsylvania State College of Medicine) *
The impact of a self-directed two-dimensional imaging tutorial of the upper limb on anatomy learning and clinical application

Sean Matchett (Philadelphia College of Osteopathic Medicine) *
New Protocol for Identifying the Anterolateral Ligament

Kathy Svoboda (Texas A&M Univ. Baylor College of Dentistry)
Using Cross Word Puzzles to Increase Active Learning

Tik The (Univ. of the West Indies)
Quo Vadis Teaching Human Anatomy In Medical Schools - A perspective from 60 years’ experience

Saleem Ahmed (Virginia Tech Carilion School of Medicine)
The Art of Demonstration in Anatomy Instruction: Should I Model or Not?

Sonya Van Nuland (Western Univ.) *
E-Learning, Cognitive Load and Dual Task Design: Pitfalls and Possible Solutions

ANATOMY

Devendra Sawant (Alderson Broaddus Univ.)
Serpentine course of renal Segmental Artery Display a Nutcracker Phenomenon: A Case Report

Karen Gana (Fingerlakes School of Acupuncture and Oriental Medicine of New York Chiropractic College)
Anatomical basis of Acupuncture

Collin Flanagan (Philadelphia College of Osteopathic Medicine) *
Thyroid Isthmus Variability in a Population of Cadavers from the Mid-Atlantic USA

Courtney Docherty (Philadelphia College of Osteopathic Medicine) *
A new class of osteoarthritis therapeutic, Extracellular Matrix Protection Factor, alters cytokine production in chondrocytes

Yoke-Chen Chang (Rutgers Univ.)
Targeting connexin 43: cutaneous wound repair using antisense oligodeoxynucleotides (asODN) on nitrogen mustard hairless mouse skin model

Esther Lee (Rutgers Univ.) *
A time course study of nitrogen mustard skin injury using the skin wound marker keratin 17

Matthew Kluckman (Texas Tech Univ. Health Science Center El Paso Paul L Foster School of Medicine) *
Anatomic variation in the glandular branch of the lacrimal artery

Vania Mendes (Univ. of São Paulo) *
Morphometric analysis of the aortic depressor nerve in Wistar, Wistar-kyoto and Spontaneously hypertensive rats

MUSCULOSKELETAL

Patrisia Mattioli (Philadelphia College of Osteopathic Medicine)
The role of matrix metalloproteinases on remodeling in skeletal muscle degeneration/regeneration after injury
21 Michael Bova (Philadelphia College of Osteopathic Medicine) *
Assessing the effectiveness of an Osteopathic Manipulative Treatment Protocol on Postural Asymmetries

22 Ziyao Eric Lu (Rutgers Univ.) *
Collagen XXIV Null Mice Have Osteoporotic Bones

23 Elisabete Carmo (School of Medicine of Ribeirão Preto) *
Can pain in the neonatal period cause long term motor or behavioral changes?

**NEUROBIOLOGY**

24 Zeinab Nasralah (Pennsylvania State College of Medicine)
Diabetes impairs visual function and reduces cytoprotective Nrf2 protein content in retinas of rats

25 Caitlin McMenamin (Pennsylvania State College of Medicine) *
Perinatal high fat diet increases glial density in the brainstem and gastric myenteric plexus of rats

26 Victoria Vinarsky (Philadelphia College of Osteopathic Medicine) *
IMP2 Expression in the Mouse Nervous System

27 Cedric Uytingco (Univ. of Maryland, School of Medicine) *
Characterizing the main olfactory bulb circuitry using intrinsic fluorescence imaging

28 Innocent Edagha (University of Uyo/New York Univ.) *
Histomorphological Effects of Ethanolic Leaf Extract of Nauclea latifolia on Prefrontal Cortex and the Blood Morphology in Plasmodium Berghei Infected Mice

* Finalist for a Student Poster Award Competition

**ABSTRACTS & SPEAKER BIO’S – ORAL PRESENTATIONS**

Yolanda D. Heman-Ackah, M.D.

Dr. Heman-Ackah is an otolaryngologist, certified by the American Board of Otolaryngology, who subspecializes in professional voice care and laryngology. Her background as a trained musician, dancer, and singer makes her uniquely qualified to understand the vocal demands of the performing artist, and to tailor treatment of professional voice disorders based on this understanding. Her primary practice focus is in treating the professional voice user (singers, actors, public speakers, physicians, lawyers, teachers, etc.). Dr. Heman-Ackah received her Bachelor of Arts degree in Psychology and her Doctor of Medicine degree from Northwestern University as part of the Honors Program in Medical Education. She completed a residency in Otolaryngology-Head and Neck Surgery at the University of Minnesota and then completed a fellowship in Professional Voice Care and Laryngology under the preceptorship of Robert T. Sataloff, M.D., D.M.A. in Philadelphia, PA. Following her fellowship, she founded and directed the Voice Center at the University of Illinois at Chicago, where she brought professional voice care to the Chicago voice community and was Assistant Professor of Otolaryngology-Head and Neck Surgery. She has also held the positions of Head of the Section of Laryngology and Co-Director of the Voice Center at the Cleveland Clinic, Associate Professor at Drexel University College of Medicine, and Clinical Adjunct
Associate Professor of Otolaryngology-Head and Neck Surgery at Thomas Jefferson University Medical College here in Philadelphia.

Dr. Heman-Ackah is known nationally and internationally for her pioneering research on the laryngeal chemoreflex, which has furthered our understanding of how laryngeal reflexes can contribute to sudden infant death syndrome, as well as for her research in developing measures for voice analysis and in describing stroboscopy and laryngoscopic findings in singers. Dr. Heman-Ackah has received numerous awards and grants for her research, including awards from the American Academy of Otolaryngology - Head and Neck Surgery, the American Laryngological Association, and the American Laryngological Voice Research and Education Foundation. She has written numerous publications, including co-authoring the first textbook on laryngeal electromyography. She is a member of the Editorial Board of the Journal of Voice and a reviewer for Laryngoscope, Otolaryngology Head and Neck Surgery Journal, and Annals of Otology, Rhinology, and Laryngology. Most recently, she was named a Top Doctor by America’s Top Doctor.

**Abstract** - In this lecture, Dr. Heman-Ackah will review the mechanics of sound production. The anatomy and physiology of voice production as they relate to the mechanics of sound production will be reviewed. Normal and pathologic laryngeal stroboscopic and laryngoscopic videos will be presented to demonstrate both normal and abnormal sound production.

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**Pamela Dalton, Ph.D., MPH**

Dr. Dalton received her PhD from New York University in Experimental Psychology and her MPH from Drexel University. Her research program explores the interaction between physiological, cognitive and sensory factors in the human response to odor. Her work has been supported by grants from the National Institutes of Health, with additional funding from the DOD and industry collaborations. The research she conducts utilizes both laboratory chamber studies and field studies to investigate variation in the sensory, cognitive, and emotional response to odors, irritants and flavors. Other areas of on-going investigations include effects of long-term occupational and residential exposure to volatile chemicals on olfactory sensitivity and the influence of peri-receptor factors on olfactory function.

Dr. Dalton conducts her research at the Monell Chemical Senses Center in Philadelphia, a nonprofit, multidisciplinary, basic research institute devoted to the study of smell, taste and chemical irritation. She has published extensively on the human emotional and perceptual response to odor and given numerous talks and presentations at scientific conferences. She was the team leader for the Olfaction domain of the NIH Toolbox and is currently a member of the Sensory Functioning Team (Taste and Olfaction) in the National Children’s Study Scientific Committee for Health Measurement. She has been a consultant to many groups in the chemical, food, household products, and fragrance industries, as well as government and community organizations involved in odor issues.

**Abstract** - Olfaction begins with the transport of odorant molecules into the nasal passage where they must migrate through a mucus layer to contact and bind with olfactory receptors. Peri-receptor factors, such as nasal anatomy can alter the transport and deposition of those molecules and even slight anatomical variations can lead to significant alterations in olfactory perception.

In this talk, I will provide an overview of the functional characteristics of the olfactory system. I will describe ways of assessing olfactory function and will also discuss recent research from our laboratory that highlights the relevance of anatomy to olfactory perception.

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**Nova Panebianco, M.D., M.P.H.**

Dr. Panebianco completed Emergency Medicine residency training at North Shore University Hospital and fellowship training in Emergency Ultrasound at The University of Pennsylvania. She also obtained a Master’s of
Public Health in 2004 at the State University of New York at Albany. She served as Emergency Ultrasound Co-Director at New York Methodist Hospital for 1 year. She returned to the University of Pennsylvania and has been Associate Ultrasound Director there for 5 years. She has authored several manuscripts and book chapters in Emergency Ultrasound, and lectured at national and international venues. Her research is focused on procedural ultrasound, advanced clinician-performed ultrasound applications and ultrasound education. She is a 2013 Emergency Medicine Foundation grant recipient. Dr. Panebianco is currently the Past-President of the Academy of Emergency Ultrasound (AEUS) in the Society of Academic Emergency Medicine and a board member of eusfellowships.com.

Abstract - For many, studying anatomy is one of the most beautiful and daunting challenges of clinical training. Traditional learning occurs in the anatomy lab, meticulously dissecting structures while trying to grasp the 3-dimensional form in all its complexity. There are limited ways to safely examine living anatomy, and ultrasound is one of them. Modern ultrasound machines are portable, user-friendly, and lack ionizing radiation, making them an ideal tool for assessing living anatomy, both for the student, and for the clinician at the bedside.

Ultrasound can help reinforce the complex concepts learned in anatomy. The same skill can be translated to patient care as one moves from the classroom to the bedside. The goal of this talk is to introduce the audience to the basics of ultrasound imagining and explore how it can be used both in the classroom and the bedside to examine the complex anatomy of the human body. Additionally, this talk will discuss some of the resources available those interested in integrating ultrasound into their educational and clinical practice.

Kimberly J. Myers, Ph.D.

Kimberly R. Myers, M.A., Ph.D., is Director of Competency-Based Assessment and Reflective Learning and Co-Director of Medical Humanities; she is Associate Professor in the Department of Humanities at Penn State College of Medicine, with a joint appointment in the Department of English at Penn State University. Much of her work focuses on medical education, illness narratives, and narrative competence. She has published in professional journals including British Medical Journal, Annals of Internal Medicine, and Academic Medicine and is editor of three international, multidisciplinary collections. Dr. Myers founded and hosts the Penn State Hershey Physician Writers Group, whose members regularly publish creative writing in professional medical journals.

Abstract - Ask any medical student what is most on her mind when she first appears at orientation and she'll likely say, “Gross Anatomy.” What she probably won’t say—although it’s also very much on her mind—is that she’s intimidated by all the unknowns: Am I smart enough to be here (did they make a mistake in admitting me?!)? When I walk into a lab full of cadavers, will I be afraid? Throw up? Pass out? And what about touching a dead body? Worse, what will cutting it up until it no longer looks human do to my psyche, my self-image as a compassionate, caring person? Is this necessary work going to transform me into some kind of psychopath? What kind of professional persona do I want to create in this new place, and how does that impact the personal persona I want to cultivate among these people with whom I will live and work for the next four years?

This presentation examines these and related issues through the sociological lens of rites of passage, a paradigm in which The Cadaver Experience is an inherently liminal phase of both fear and possibility. Using literature and the visual arts as anchors for reflection and discussion, we can encourage and enable students to explore their misgivings and expectations of the new life they are entering—in light of personal experience and cultural beliefs/rituals surrounding death and dead bodies.

Wenqin Luo

Dr. Wenqin Luo is interested in the organization, development, and function of mammalian somatosensory neurons, especially those sensing pain, itch, and touch. She did her Ph.D. research with Dr. Jeremy Nathans at the Johns Hopkins University, where she studied transcriptional regulation of cone opsin genes and protein trafficking
in photoreceptors. In 2006, she joined Dr. David Ginty’s lab at the Johns Hopkins University as a postdoctoral fellow. There she focused on roles of Ret signaling, the receptor tyrosine kinase for GDNF family ligands, in controlling the development of mammalian pain- and touch-sensing DRG neurons. Dr. Luo was recruited to the department of neuroscience, Perelman School of Medicine, University of Pennsylvania in 2011. Her lab is using a combination of genetic, physiological, and behavior approaches to understand functional organization of touch- and pain-sensing circuits, how they are established during development, and how they may interact with each other.

**Abstract** - The human fingertips have the best tactile acuity among skin regions. Two key peripheral mechanisms are known to underlie this acuity: this region has a higher density of Aβ mechanosensory fiber innervation and each Aβ fiber has a smaller receptive field size. The human fingertips were recently shown to be a “fovea” for pain. However, the underlying neuronal mechanism remains elusive, as the fingertips have a low density of nociceptive innervations. Using sparse genetic tracing of mouse non-peptidergic nociceptors, we found that: 1). Similar to human, density of paw innervating nociceptive fibers is lower or comparable to that of the trunk hairy skin; 2). The sizes of receptive fields of individual nociceptors are comparable across different skin areas; and 3). The central terminals of paw and trunk innervating nociceptors display distinctive morphologies. These results suggest that different from the tactile system, differential spinal circuit organization but not the peripheral mechanisms is likely to be the major mechanism for the establishment of the pain fovea.

**Lauren Noto-Bell**

Lauren Noto-Bell, DO is a graduate of Philadelphia College of Osteopathic Medicine (PCOM). She completed her residency in Family Medicine at the Christiana Care Health System in Delaware, and then returned to PCOM to complete a Fellowship in Neuromusculoskeletal Medicine/Osteopathic Manipulative Medicine (NMM/OMM). She is board-certified in Family Medicine and NMM/OMM. Dr. Noto-Bell is a clinician and assistant professor in the OMM Department at PCOM, where she has the honor and pleasure of caring for her patients and educating many future osteopathic physicians.

**Abstract** - Anatomy is at the core of the Osteopathic philosophy, and it pervades the discipline of Osteopathic Manipulative Medicine (OMM), especially as this discipline pertains to the use of Osteopathic Manipulative Treatment (OMT). From its beginnings, in the mind of founder and frontier physician Dr. Andrew Taylor Still, osteopathic medicine has sought to provide a whole-body, unifying approach to the treatment of illness and aberrancy in the human form. The appreciation of musculoskeletal, nervous, circulatory, lymphatic, and fascial anatomy is paramount to the application of contemporary OMM. Despite the fact that osteopathic medicine has been in formal existence for 140 years, many people do not realize how OMM can play a vital role in the recovery and maintenance of health. This lecture aims to provide (1) brief historical background on osteopathic medicine, (2) highlighted similarities and differences in today’s physician medical education (DO vs. MD), and (3) illustrative and clinical examples of the essential interrelationship between applied anatomy and physiology.

**Scott Gilbert, Ph.D.**

Scott F. Gilbert is the Howard A. Schneiderman Professor of Biology at Swarthmore College and a Finland Distinguished Professor at the University of Helsinki. He teaches developmental genetics, embryology, and the history and critiques of biology. He received his B.A. in both biology and religion from Wesleyan University, and he earned his PhD in biology and his M.A. in the history of science from The Johns Hopkins University.

Dr. Gilbert currently has three books in print: *Developmental Biology* (a textbook in its tenth edition), *Bioethics and the New Embryology*, and *Ecological Developmental Biology*, a textbook co-authored with David Epel, which integrates developmental plasticity, epigenetics, and symbiosis into discussions of medicine, teratology, and evolution. He has received several awards, including the Medal of François I from the Collège de France, the
Dwight J. Ingle Memorial Writing Award, the Choice Outstanding Academic Book Award, honorary doctorates from the University of Helsinki and the University of Tartu, and a John Simon Guggenheim Foundation Grant. In 2002, the Society for Developmental Biology awarded him its first Viktor Hamburger Prize for Excellence in Education, and in 2004, he was awarded the Kowalevsky Prize in Evolutionary Developmental Biology.

Dr. Gilbert’s research combines evolutionary biology and molecular developmental biology to answer the question of how the turtle got its shell.

Abstract - During the past decade, molecular studies of symbiosis have demonstrated that we are not biological individuals. Rather, the criteria of anatomy, physiology, immunology, evolution, and development strongly suggests that animals function, develop, and evolve as a consortium of several different species. Symbiotic interactions of animals and plants with microorganisms are now seen to be the rule, not the exception in these disciplines. In humans 90% of the cells are bacterial and around 35% of the blood metabolites are of bacterial origin. Symbionts are both present and functional in completing metabolic pathways and serving other physiological functions. Similarly, these new studies have shown that animal development is incomplete without symbionts. Symbionts also constitute a parallel mode of genetic inheritance, providing selectable genetic variation for natural selection. The immune system also develops, in part, in dialogue with symbionts, and thereby functions as a mechanism for integrating microbes into the animal-cell community. Recognizing the “holobiont”—the multicellular eukaryote plus its colonies of persistent symbionts—as a critically important unit of anatomy, development, physiology, immunology, and evolution, opens up new investigative avenues and conceptually challenges the ways in which the biological sub-disciplines have heretofore characterized living entities.

Jeffrey Laskin, Ph.D.

Dr. Jeffrey D. Laskin is a Professor and Chief of the Division of Toxicology in the Department of Environmental and Occupational Medicine at Rutgers University-Robert Wood Johnson Medical School (RWJMS). He is director of the Toxicology Division at the Environmental and Occupational Health Sciences Institute (EOHSI), a joint program of Rutgers University and RWJMS and is Deputy Director of the Joint Graduate Program in Toxicology at Rutgers University. He is Director of the Rutgers University CounterACT Research Center of Excellence, a major White House initiated national security priority to expedite research on the most promising scientific discoveries that would lead to improved medical countermeasures to protect Americans against a chemical, biological, radiological, or nuclear (CBRN) attack.

Dr. Laskin received a B.A. in Chemistry and Biology from New York University, NY and a Ph.D. in Experimental Therapeutics from Roswell Park Cancer Institute, SUNY at Buffalo, NY. He was a post-doctoral fellow in the Institute for Cancer Research at the College of Physicians and Surgeons at Columbia University in NY before joining the faculty at Rutgers University-Robert Wood Johnson Medical School. Dr. Laskin has served on numerous study sections for the National Institutes of Health and the Defense Threat Reduction Agency and was an invited participant at the National Institutes of Arthritis and Musculoskeletal Disorders Roundtable on Wound Healing. He is a member of the Grant School at Rutgers University, the Pharmacology and Toxicology graduate programs at Rutgers University-Robert Wood Johnson Medical School and the Cancer Institute of New Jersey. Dr. Laskin has also served as a member of the corporation of the Marine Biological Laboratory in Woods Hole, Massachusetts. He is an expert in the toxicity of high priority chemical threats and redox chemistry. Currently, his research is focused on exposure and health effects of chemical warfare agents. He is working to identify biomarkers of exposure and to identify countermeasures to sulfur mustard exposure.

Abstract - The NIH is supporting Centers of Excellence focused on developing new and improved medical countermeasures against high priority chemical threats. These threats include neurotoxic agents such as organophosphorus nerve “gases”, pulmonary agents such as chlorine gas, metabolic/cellular poisons such as cyanide, and vesicating agents such as sulfur mustard. The Rutgers Center is focused on developing drugs to treat
Although sulfur mustard, also known as ‘mustard gas’, has been studied for more than 90 years, the mechanisms mediating its action remain unknown; moreover, to date, there are no effective medical countermeasures against this vesicant. Our Center is studying the mechanism of action of sulfur mustard and the related analog, nitrogen mustard (HN2), in the skin, eyes and lung. These ‘mustards’ contain two electrophilic side chains that can react with nucleophilic sites in proteins, leading to changes in their structure and function. We have discovered that HN2 targets the thioredoxin system. This system, which consists of NADPH, thioredoxin reductase and thioredoxin, is important in redox regulation and protection against oxidative stress. We found that HN2 directly modifies and inhibits thioredoxin reductase. This enzyme exists as homodimers under native conditions. HN2 causes the formation of thioredoxin reductase tetramers and oligomers indicating cross-linking of the enzyme. LC–MS/MS analysis of thioredoxin reductase demonstrates that HN2 adducted cysteine- and selenocysteine-containing redox centers forming monoadducts, intramolecule and intermolecule cross-links, resulting in enzyme inhibition. Efforts are focused on determining how this process contributes to mustard-induced oxidative stress in target tissues and if drugs can be developed to overcome tissue injury.

**ABSTRACTS – POSTER PRESENTATIONS**

(listed alphabetically by first author last name)

**The Art of Demonstration in Anatomy Instruction: Should I Model or Not?**  
Saleem Ahmed, MBBCh., FCPS; Dept. of Basic Sciences, Virginia Tech Carilion School of Medicine; Roanoke, VA

Medical students arrive with a wide range of anatomy knowledge; most however are unfamiliar with Anatomy. Without a three dimensional visualization it is difficult for them to conceptualize cadaveric features which are not easily understandable. To better describe such hard to visualize features, viz. foldings, recesses, reflections, etc., we created and used large scale economical models made from easily available materials.

Difficult concepts, such as configuration of pleura and thoracic structures, peritoneum and abdominopelvic structures were demonstrated, within the context of fifty minute lectures, using transparent plastic sheets and sleeves; cardboard boxes; plastic bottles, condoms and balloon models. Students partook in these demonstrations. At the lecture’s end the students were surveyed on effectiveness of the demonstration using audience response system.

The use of models and demonstrations helped 75-88% students conceptualize and understand better complex, not easy to grasp anatomical structures. Also, lecture attendance improved and students had a greater degree of satisfaction as echoed by reviews.

Demonstrations, with active student role playing, of difficult concepts in a lecture using models greatly helped students understand the arrangement of complex anatomy structures/features, e.g., the peritoneum and its folds/recesses. Demonstrations using inexpensive, easily reproducible models can be applied anywhere. However careful planning and rehearsal must precede their implementation since such demonstrations consume lecture time.

**Level of First Author:** Faculty  
**Topic Category:** Anatomy Education

**An Anatomy Model for Vertical Integration of Basic Science in Medical Education**  
Daniel T. Anderson, Alexander S. Rascoe, Michelle D. Lazarus, Ph.D.; Pennsylvania State College of Medicine; Hershey, PA

Deficiencies in basic science knowledge and clinical transfer have become a focus in medical education. Vertical integration of anatomy into the clinical years has emerged as a new goal for educators to address these concerns. Here, we evaluate the effect of a musculoskeletal anatomy fourth year elective on student knowledge, application, and self-efficacy of clinically relevant anatomy. Using quantitative and qualitative repeated measure assessment, we found that course participation resulted in improved objective anatomical knowledge (from a
mean score of 64.5% to 79.8% \(p<0.05\) after completion). These students also reported increased confidence in applying anatomical knowledge to the in clinic 9 separate clinical scenarios such as differential diagnosis, physical exam, and diagnostic imaging \(p<0.05\). Fourth year students participating in a concurrent humanities (control) course did not significantly improve their anatomical competency or confidence in anatomy transfer. Taken together, these results suggest that effective vertical integration can be accomplished by generating a clinically focused anatomy review course separate from clinical rotations and that this course provides a successful model for vertical integration of anatomy into the clinical years.

**Level of First Author:** Graduate Student  
**Topic Category:** Anatomy Education

**The central role of Thiel-embalmed cadaveric dissection in a new medical school’s integrated systems-based curriculum emphasizing inquiry-based learning**

Noel Boaz, PhD, MD; College of Henricopolis School of Medicine and Integrative Centers for Science & Medicine; Martinsville, VA

The innovative curriculum of the College of Henricopolis School of Medicine is built around 17 evolutionary and developmental structural levels that serve as courses in a vectored (“simple-to-complex”) systems-based approach to the Basic Sciences. Drawing upon Baconian principles, medical students learn anatomy primarily through observation, dissection, and inquiry-based-learning methods in small groups. Anatomy forms the core of this integrated and highly interdisciplinary curriculum. Dissection of Thiel-embalmed cadavers (formaldehyde-fume-free, flexible, and of natural color) is essential to achieving learning outcomes. Professor Walter Thiel of the University of Graz, Austria developed the method which uses a complex mixture of salts and other chemicals, but very little formaldehyde, to “cure” the body. Natural color and texture of the embalmed body allow students to readily discover and make identifications of structures through their own dissections. The elasticity and distensibility of structures render them more resistant to tearing and breakage during dissection. After two years of using Thiel-embalmed cadavers in the anatomy teaching laboratory, the quality of student dissections has been unparalleled, particularly in the extremities and perineum. Clinical procedures are also facilitated by the life-like flexibility of structures.  

**Level of First Author:** Faculty  
**Topic Category:** Anatomy Education

**Assessing the effectiveness of an Osteopathic Manipulative Treatment Protocol on Postural Asymmetries**

Michael J. Bova, Lauren Noto Bell, Kerin M. Claeson; Philadelphia College of Osteopathic Medicine; Philadelphia, PA

Current diagnosis and treatment of lateral spinal curvatures requires relatively invasive techniques, such as radiography. Osteopathic manipulative treatment (OMT) is a unique set of techniques generally used as a minimally invasive complement to conventional treatments, applicable to treating lateral spinal curvatures. In the absence of radiographs, it is generally difficult to detect subtle differences in postural morphology. Therefore, the purpose of this pilot study was twofold. First, with the use of 47 cadaveric specimens, we sought to demonstrate that 2D geometric morphometrics could identify external asymmetries that may be associated with lateral spinal curvatures. Second, we sought to determine whether a specific IRB approved OMT protocol is an effective way to correct external asymmetries, as measured by 2D morphometrics. Here we show that geometric morphometrics is a valid technique to identify postural asymmetries and the shape changes affected by OMT. Furthermore, this system of analysis has the potential to be used as a noninvasive method of screening for lateral spinal curvatures, in lieu of radiographs. Additionally, we determined that practice identifying and tagging landmarks led to greater precision and accuracy, within both the cadaveric and the live subject models. Finally, our results demonstrate how individuals treated with OMT designed specifically to reduce lateral postural asymmetries showed statistically significant reduction said asymmetries. This research was supported in part by the Anatomy Program and the Division of Research at PCOM.  

**Level of First Author:** Graduate Student  
**Topic Category:** Musculoskeletal
Can pain in the neonatal period cause long term motor or behavioral changes?
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It is described that pain experiences in early life can be linked to alterations of behavior in adolescents and adults but experimental substrates for these changes still need investigation. We designed an experimental study to explore if pain in neonatal period can cause long term motor or behavioral changes. The pain groups (male and female Wistar rats, N = 10 per group) were stimulated with a needle on the right paw, twice a day, since birth, for 15 consecutive days. The control groups (male and female Wistar rats, N = 10 per group) were stimulated with a cotton swab. Final experiments were performed 180 days after birth. The anxiety-like behavioral test was assessed by Elevated Plus-Maze. Lateral and medial gastrocnemius muscles, obtained by surgical biopsy, were frozen and stained with HE technique. For muscle morphometry, the number fibers was counted and their area and diameter were measured. Specific statistic tests were applied and differences were considered significant when p<0.05. Generally, females from pain and control groups showed muscle fibers size smaller than males. Female pain group showed a larger number of fibers compared to female control group on the non-stimulated paw while male pain group showed a smaller number of fibers compared to male control group on the non-stimulated paw. In the behavioral test, male pain group showed a higher number of entries in the open arms compared to male control group, indicating hyperactivity. We suggest that exposition of neonates to pain can interfere with anxiety-like behavior and also influence the number and size of the muscle fibers in long term.

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Level of First Author: Graduate Student    Topic Category: Musculoskeletal

Targeting connexin 43: cutaneous wound repair using antisense oligodeoxynucleotides (asODN) on nitrogen mustard hairless mouse skin model
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Gap junction communication is tightly regulated in skin wound healing. Studies showed that targeting of connexin43 (Cx43) accelerates wound closure and improves wound reepithelialization. Nitrogen mustard (NM), a vesicant agent, induces dermal toxicity which includes edema, inflammation, fluid-filled blistering, dermal-epidermal junction (DEJ) disruption, delayed wound repair, and scarring. We treated NM exposed SKH-1 mouse dorsal skin with Cx43 antisense oligodeoxynucleotides (asODN) and evaluated the wound healing response. We assayed for markers of basal keratinocytes, keratin5 (K5); epidermal differentiation, keratin10 (K10); proliferation, Ki67; and basement membrane, laminin 332 (LM332). Immunofluorescent (IF) studies showed reduced K5 expression, loss of K10 and Ki67, and an interrupted LM332 pattern of expression 1 day after NM exposure. By day 3, K10 reappeared in a diffuse pattern. By day 7, the LM332 appearance was thick and continuous. By day 10, there was intense expression of Ki67, accompanied by extreme hyperplasia. Animals treated with Cx43asODN after NM exposure had an accelerated wound rate and improved reepithelialization so that the skin marker patterns above appeared at earlier timepoints. RT-PCR and Western blot analysis showed significant reduction of Cx43 at days 3 and 7. IF studies also showed that Cx43 asODN treatment successfully reduced Cx43 expression and modulated higher Cx26 expression in the wound margin by day 3. The use of Cx43asODN may alter Cx expression and accelerate vesicant wound repair.

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Level of First Author: Faculty    Topic Category: Anatomy

A new class of osteoarthritis therapeutic, Extracellular Matrix Protection Factor, alters cytokine production in chondrocytes
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Articular cartilage damage leads to osteoarthritis (OA), a disease characterized by altered cartilage homeostasis. Several cellular elements including growth factors and proteases are involved in this pathology. Our lab has developed a new class of therapeutic, extracellular matrix protection factors (ECPFs), that protect cartilage from the devastation associated with OA. ECPF-1 targets the interaction between matrix metalloprotease 13 (MMP-13) and transforming growth factor β (TGF-β), but the cellular mechanism of ECPF-1 chondroprotection is unknown. It is well documented that inflammatory cytokines play a role in the pathology associated with OA, and that these molecules are regulated, in some part, by TGF-β biology. To test the downstream effects of blocking TGF-β activation on cytokine production, cultured chondrocytes from embryonic avian sterna were treated for 24 hours with ECPF-1 at 250nM, 2.5μM and 5.0μM concentrations and the production of the inflammatory cytokines, IL-1β and TNF-α, were monitored. Activated TGF-β was reduced and production of IL-1β and TNF-α were altered in response to ECPF-1 treatment including an unexpected increase in these cytokines following 5.0μM addition of ECPF-1. This biphasic effect of ECPF-1 indicates a duality to the protective therapeutic nature and overall mechanism of action of ECPF-1 in the protection of articular cartilage. This work was supported by grants from The Center for Chronic Disorders of Aging and PCOM departmental funds.

Level of First Author: Graduate Student
Topic Category: Anatomy

Histomorphological Effects of Ethanolic Leaf Extract of *Nauclea latifolia* on Prefrontal Cortex and the Blood Morphology in *Plasmodium Berghei* Infected Mice

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*Nauclea latifolia* is an herbal plant of the Rubiaceae family found in Akwa Ibom State, Nigeria and in many other places. Over the years it’s been used in folk medicine as a prophylactic against malaria. We investigated the in vivo histomorphological effects of ethanolic leaf extract of this plant on the prefrontal cortex and on blood morphology in *Plasmodium berghei* infected mice, with forty-two (42) adult mice between 6-8weeks weighing 22-24 g. Previously we reported phytochemical constituents of the extract and the acute toxicity studies, and now present blood morphology, routine haematoxylin and eosin (H&E), as well as immunohistochemistry (IHC) for reactive astrogliosis using glial fibrillary acidic protein (GFAP) antibody. Mice were acclimatized for two weeks and then randomized into seven groups of six mice each. Group 1 served as negative control, and received 10 ml/kg of normal saline. Groups 2 and 3 received 500 and 1000 mg/kg of the extract, groups 4, 5 and 6 received n-hexane, chloroform and butanol fractions at 1000 mg/kg, while group 7 received Coartem® - artemether and lumefantrine 5 mg/kg. All mice were first treated for three days (prophylactic test), through orogavage intubation, before being passaged via intraperitoneal (i.p.) route with *P. berghei*. Mice were subsequently monitored for 72hrs, after which thick blood smears were prepared, giemsa stained for microscopy, and then humanely sacrificed, with the tissues of interest dissected out, and processed for H&E, and IHC for GFAP positivity. Result of smears indicated infectivity for the experiment, and a morphological trend of *P. berghei* multiplication. All mice histological sections showed slight to moderate inflammation, neuronal shrinkage, vacuolation, hypertrophy, hypochromasia, pyknosis and karyorrhexis. Histoarchitecture of the cortex in groups 2, 3, 5 and 6 were slightly affected, while groups 4 and 7 were moderately affected. Reactive astrogliosis was detected in all the groups compared with control, and slight positivity in groups 1, 3, and 5 whereas groups 2, 4, 6 and 7 were moderately positive, which is a good confirmatory result for the H&E. Group 7 however presented near total clearance of parasites in blood morphology plates, but showed moderate neuroinflammation for GFAP. In conclusion, prophylactic therapy caused mild to moderate distortions of infected red blood cells, and offered slight neuro-protection to the neurons and astrocytes at a dose dependent manner in the treated groups possibly via the bioavailability of active principles in the extract, and this may support their continuous use in ethnopharmacology.

Level of First Author: Graduate Student
Topic Category: Anatomy
The impact of a self-directed two-dimensional imaging tutorial of the upper limb on anatomy learning and clinical application
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Medical school curricular trends have focused on condensing formal teaching of basic sciences such as anatomy by highlighting the most clinically relevant material. Radiology is a clinically relevant teaching modality in anatomy education. We used radiology to develop an interactive teaching tutorial. The tutorial is a novel approach in self-directed radiology learning, incorporating traditional structure labelling, while also adding novel approaches such as questions and answers to emphasize the importance of anatomical relationships and clinical correlations. The efficacy of the computer based tutorial was assessed using repeated measures examinations. While both the experimental and control groups participated in the formal anatomy curriculum, the experimental group was additionally exposed to the radiology tutorial. The students who used the radiology tutorial had a 10% greater improvement (p ≤ 0.05) on knowledge assessment compared with those who participated in the medical school curriculum alone. Furthermore, the subjects in the experimental arm of the study showed an 8% (p ≤ 0.05) improvement when answering direct questions and an even greater improvement 16% (p ≤ 0.05) when answering inferred questions as compared to the control group. Our results show that students exposed to the tutorial had improved basic and higher order anatomy knowledge and application suggesting that the interactive tutorial increases student ability to apply anatomic knowledge and may therefore serve as a blueprint for future self-directed learning developments.

Level of First Author: Graduate Student    Topic Category: Anatomy Education

Thyroid Isthmus Variability in a Population of Cadavers from the Mid-Atlantic USA
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Understanding thyroid anatomy is of critical importance for safe and effective thyroid surgeries. As such it is critical to anticipate the variability of thyroid anatomy, given that pre-operative diagnostics do not always detect the presence of items such as the pyramidal lobe, despite its actual frequency. Likewise, the thyroid isthmus, though present more often than a pyramidal lobe, demonstrates great variation in location, width, height, and thickness throughout the medical literature. A recent study in a Korean population of cadavers indicated that the variability of the isthmus was even greater than previously estimated. This prompted us to examine isthmus size and location variability in a population of cadavers from a mid-Atlantic region of the United States. To date, we examined 11 cadaveric thyroids, prior to their dissection by allied health professional students. Results thus far indicate that the mean distance from the inferior border of the cricoid cartilage to the superior border of the thyroid isthmus was 5.90mm (SD = 2.42mm). The mean height of the isthmus was 12.50mm (SD = 4.68). Isthmus width and thickness averaged 12.15mm (SD = 5.14) and 3.44mm (SD = 1.69), respectively. The thyroid isthmus location was observed on the first through third tracheal ring (36%), first through second (36%), first through fourth (18%) and third through fourth (9%). Pyramidal lobes were observed on 3 of the 11 thyroids. This continued work should aid all medical personnel operating on thyroid gland or near its proximity.

This research was supported in part by the Anatomy Program and the Division of Research at PCOM.

Level of First Author: Graduate Student    Topic Category: Anatomy

Anatomical basis of Acupuncture
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Acupuncture is one modality utilized in Traditional Chinese Medicine. From the Western perspective, many have heard and believe that acupuncture involves some kind of “magical” manipulation of an unseen force or energy said to percolate through the body (this “force” is known as Qi). On the contrary, Traditional Chinese Medicine is as based in experiential and empirical evidence as Western Medicine and it is interesting to note that the timeline for the development of Traditional Chinese Medicine pre-dates the emergence of the well-known Greek Fathers
of Medicine by a few thousand years. Chinese practitioners performed post-mortem anatomical studies, produced intricate drawings of the organs and blood vessels, measured the dimensions of bones, and even measured the size, dimensions and capacitances of the various organs. The most complete compilation of the anatomical studies is found in the text known as the Huang Di Nei Jing (Yellow Emperor’s Inner Canon). Students and practitioners of Acupuncture must know the anatomy of the human body in order to define the acupuncture points and properly place the acupuncture needle when treating the patient.

**Level of First Author:** Faculty  
**Topic Category:** Anatomy

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**Bones on the road: Development and implementation of a skeletal anatomy outreach program serving elementary and middle school students in the School District of Philadelphia**

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Early exposure to the anatomical sciences, in a fun and innovative way, can help promote interest and career interest in science, engineering and medicine. To this end, we developed the “Bones on the Road” program to present skeletal anatomy modules at neighborhood elementary and middle schools within the Philadelphia School District. Since 2008, we have delivered a day-long program at the J.S. Jenks School in Northwest Philadelphia, growing it each year so that now it encompasses activities for grades K-5. More recently, we have recreated aspects of the program at two other elementary schools. Each year we recruit 3-4 graduate students (Temple University and Drexel University) and 5-10 medical students (Drexel University College of Medicine) to assist. Materials about the skeleton are sent out in advance to teachers to prepare students, and activities at the event vary by grade. Younger children do tracing activities, relay races and puzzles, and older children incorporating mathematics, engineering and measuring activities, along with topic specific activities such as learning about the effects of nutrition and exercise on bone. We added an additional six-week middle school program in 2012, targeting 6-7th graders as part of their science club. By repeating activities yearly, we can build student knowledge and provide a long-term impact. Nearly all of the students in our original 2008 cohort have participated in Bone Day 2-3 times, and more than ½ have participated all six years. Teachers report including aspects of skeletal biology into lesson plans both before and after the program, thus extending its educational value.

**Level of First Author:** Faculty  
**Topic Category:** Anatomy Education

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**Anatomic variation in the glandular branch of the lacrimal artery**

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The lacrimal artery is classically described as a branch of the ophthalmic artery supplied by the internal carotid artery. In this study, 25 orbits were dissected to discern variations in the lacrimal artery origin and termination and to compare this with previously described observations. Critical differences were observed in arterial origin and glandular branching patterns. We find that the vast majority (92%) of lacrimal arteries originate from the ophthalmic artery with or without middle meningeal contribution. Sole lacrimal gland supply from the middle meningeal system via a canal through the greater wing of the sphenoid bone (the canal of Hyrtl) and lacrimal gland supply originating from both the canal of Hyrtl and the ophthalmic system are less prevalent than previously reported (4%,4%). Further, the glandular branching pattern of the lacrimal artery fits into two categories, those that branch (60.9%) and those that do not branch (39.1%). We find the medial and lateral glandular branches to be of equal diameter with divergence 2.67mm to 40.58mm proximal to the gland parenchyma. The average branch length was 17.88mm (medial) and 13.51mm (lateral). We were not able to confirm the existence of a third branch supplying the lacrimal gland as suggested by Govsa (2005). The key finding here is that the lacrimal gland is predominantly supplied by two significant arterial branches, both of which must be identified during procedures involving the lateral orbit. _This research was supported by TTUHSC PLFSOM._

**Level of First Author:** Graduate Student  
**Topic Category:** Anatomy
**A time course study of nitrogen mustard skin injury using the skin wound marker keratin 17**

**Esther E. Lee**, Hui-Ying Chang, Rita Hahn, Marion K Gordon, Yoke-Chen Chang, and Donald R. Gerecke; Dept. of Pharmacology and Toxicology, Ernest Mario School of Pharmacy, Rutgers Univ.; Piscataway, NJ

Sulfur mustard [SM, Bis (2-chloroethyl) sulfide] and its analog nitrogen mustard [(NM) bis (2-chloroethyl) methylamine] are blistering agents. The dermal toxicity of these vesicants includes edema, inflammation, separation of the epidermis and dermis, prolonged wound healing, and scarring. Keratin 17 (K17) is an intermediate filament protein mainly present in naïve skin appendages. K17 expression can be induced in the suprabasal keratinocytes at wounding and is closely associated with inflammatory skin diseases such as psoriasis. In this time course study, we used the DeadEnd TUNEL assay, proliferation marker PCNA, and skin wound marker K17 to examine the NM skin injury and wound repair. Five μmoles of NM was applied to the dorsal skin of hairless (SKH1) mice. Animals were sacrificed and skin biopsies were collected and prepared for frozen or paraffin sections at 1, 3, 7 and 10 days. H & E histology showed epidermis-dermis junction separation at 1 day, epidermal hyperplasia and infiltration of inflammatory cells to the dermis at 3 days, severe inflammatory response at 7 days, and persistent skin wounds at 10 days post NM exposure. Apoptotic cells were visible at the basal epithelium at 1 day and strong staining continued at 3, 7 and 10 days post NM exposure using the TUNEL assay. Immunohistochemical (IHC) studies showed moderate PCNA staining in the basal cells of the naïve control skin but reduced PCNA staining in the NM injured skin; IHC showed K17 staining in the skin appendages for naïve control, and increased expression with time in the suprabasal epithelium. Overall, K17 can potentially be used as a skin wound marker in NM injury.

**Level of First Author:** Undergraduate Student  
**Topic Category:** Anatomy

**Collagen XXIV Null Mice Have Osteoporotic Bones**

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Collagen XXIV is a fibrillar collagen predominantly expressed in the mouse skeleton from embryonic day 15 to 2-3 months after birth. Mice null for the collagen XXIV gene have bones that are less mineralized than wild type mice. Such a bone density in humans would be considered osteoporosis. To try to understand why collagen XXIV null mice have osteoporotic bones we evaluated the expression of several osteoblastogenic pathway components in wild type (WT) and knock out (KO) mice by quantitative polymerase chain reaction (qPCR). Our results show that components of the osteoblastogenesis pathway are upregulated in collagen XXIV KO mice, including the one negative regulatory pathway that keeps the skeleton from over-producing bone which would ultimately interfere with movement. It is possible that this upregulation is to compensate for the deficient bone density, bit that the concurrent upregulation of Notch 1, the negative regulator of the pathway, plays a role in the collagen XXIV null phenotype, attenuating the bone formation. We have not yet examined the alternative, which is that the bone remodeling pathway may be adversely upregulated by the lack of collagen XXIV collagen.

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**Level of First Author:** High School Senior  
**Topic Category:** Musculoskeletal

**New Protocol for Identifying the Anterolateral Ligament**

**Sean Matchett**, Joseph Guagliardo, Kerin M. Claeson; Philadelphia College of Osteopathic Medicine; Philadelphia, PA

Rediscovery of the anterolateral ligament (ALL) prompted us to identify this ligament and develop a lateral approach to dissection. Subjects in this study were previously used for an anatomy course at PCOM. The eight knees included in the study had an IT band, Biceps Femoris (BF) and Gastrocnemius attached at least 6” above and
below the knee joint, with the knee capsule and ligaments intact. Knees were dissected in the supine position, elevated on a block in an effort to achieve approximately 10-15° of internal rotation and 5° flexion. Working from superficial to deep, the IT band and BF were cut away from the leg, proximally to distally, starting 6” above the knee. We note that the lateral collateral ligament (LCL) attaches to the lateral fibular head just deep to the BF attachment site, and that relationship can be exceptionally tight and difficult to isolate. The LCL was cleared further from distal to proximal. Demarcating the proximal and distal attachments of the LCL will allow for greatest likelihood of identifying the ALL. This is because the ALL’s most frequent proximal site is superficial and posterior to the origin of the LCL but the distal site is more variable. Fibrous bands of the ALL were most often observed crossing diagonally from the area of the LCL origin on the lateral femoral condyle and inserting on the space between the fibular head and Gerdy’s Tubercle. Now that we can confidently identify the ALL, we seek to evaluate its patterns of orientation and the relationship between it and the morphology of the anterior cruciate ligament.

This research was supported in part by the Anatomy Program and the Division of Research at PCOM.

80 Students, 5 Cadavers, and 2 Professors: An Undergraduate Human Gross Anatomy Dissection Course

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An undergraduate course in anatomy has recently become a requirement for many professional programs. Human gross anatomy (HGA) with dissection is beneficial to students entering these programs, but is not frequently offered at the undergraduate level due to limited resources. Gannon University has successfully offered an undergraduate course in HGA with dissection for over 15 years. Each semester, up to two lecture sections of HGA (40 students/section) and four lab sections (20 students/section) of HGA are team-taught by two professors. These two courses must be taken concurrently. The lecture portion consists of three 55-minute lectures per week, and the lab portion is one three-hour lab per week. Students are required to dissect during their scheduled lab course, and they are also required to attend two 30-minute dissection labs (hosted by teaching assistants [TAs]) outside of their scheduled lab course per week. In addition, students can attend up to eight hours of cadaver lab study weekly. Each of the lab sections is assigned one cadaver that the 20 students in that section must fully dissect during the course; dissection occurs in groups of four. Additionally, one cadaver is dissected by the TAs and serves as a prosected cadaver for the course. The number of cadavers is minimal as compared to a professional level HGA dissection course, but is appropriate for the undergraduate level. HGA covers approximately 80% of the material covered in professional level courses. Thus, Gannon University provides undergraduates with the opportunity to take a rigorous HGA course that will prepare them to excel in their professional programs.

The role of matrix metalloproteinases on remodeling in skeletal muscle degeneration/regeneration after injury

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Injury to skeletal and cardiac muscle myofibers In Vivo has been affected experimentally by injection of cobra venom cardiotoxin (CTX). This cardiotoxin has been shown to specifically disassemble myofibers in muscle while leaving the surrounding tissues unaffected. The Matrix Metalloproteinase (MMP) MMP2 has been shown to play a role in the degeneration/regeneration of cardiac muscle. To determine whether MMP2 plays a similar role in the degeneration/regeneration of skeletal muscle, primary embryonic chick skeletal muscle cultures were exposed to low doses of *Naja mossambica mossambica* CTX and examined. Cells at 4 days in culture were exposed to CTX for a period of 30 minutes, 1 hour or 2 hours. CTX was washed out after the treatment period. Cultures were fixed for immunolabeling or harvested for zymography either at 30 minute, 1 hour and 2 hour time points during treatment or at 24 and 48 hour time points post treatment. Examination of anti-MMP2 immunolabeled cultures indicated that CTX treatment did not appear to affect the presence of MMP2 in skeletal muscle at either the
treatment or post treatment time points. However, in identically treated cultures anti–sarcomeric-alpha-actinin immunolabeling demonstrated that myofibers were disassembled in the skeletal muscle of CTX treated cultures by the 2 hour treatment time point. Initial analysis of MMP2 with zymography of post treated cultures at the 48 hour time point showed an increase in MMP2 activity.

**Level of First Author:** Faculty

**Topic Category:** Musculoskeletal

**Perinatal high fat diet increases glial density in the brainstem and gastric myenteric plexus of rats**

*Caitlin A. McMenamin, Kirsteen N. Browning; Dept. of Neural and Behavioral Sciences, Penn State College of Medicine; Hershey, PA*

The perinatal period is critical in the development of neurocircuits required for regulation of visceral functions such as feeding. Obesity promotes a low-level inflammation that activates glial cells which migrate to prevent injury; overactivation, however, may induce neuronal dysfunction. The aim of this study was to examine whether perinatal high fat diet (PNHFD) altered the density of glia in the dorsal vagal complex (DVC; area postrema (AP), nucleus of the tractus solitarius, NTS, and dorsal motor nucleus of the vagus, DMV) and enteric nervous system (ENS) of rats. Sprague Dawley rats were exposed to a HFD from embryonic day 13. Immunohistochemistry was used to identify astrocytes (GFAP) and activated microglia (CD11b) in the DVC as well as glia (GFAP) within the myenteric plexus of the stomach. The average immunoreactive density was examined using Image J analysis of confocal microscopic images. In PNHFD rats, there was a trend (P=0.06) towards an increase in DVC astrocytes in the early (1 week) postnatal period (AP: 36.0 vs. 58.8 and NTS/DMV: 12.9 vs. 17.5) which then declined. In contrast, the density of activated microglia (CD11b) increased in the NTS/DMV after 8 weeks (40.276 vs. 58.539; P<0.05). In the myenteric plexus, PNHFD increased glial density in the corpus and duodenum (70.827 vs. 96.5 and 69.3 vs. 107.2, respectively, P<0.05 for both) after 4 weeks. The present results suggest that, even in the absence of obesity, PNHFD upregulates the density of glia in the DVC and ENS. Further studies will investigate whether these alterations can be reversed or whether PNHFD induces permanent changes in brainstem and ENS function.

*Supported by: NSF 1160604*

**Level of First Author:** Graduate Student

**Topic Category:** Neurobiology

**Blended approach in teaching anatomy: use of dissection, prosection, anatomical model and computer**

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Comprehensive knowledge and understanding of human body which is foundation to medicine, partly comes from dissection. Dissection helps develop anatomical knowledge, value 3-D relationships, appreciate normal variations, mental mapping for integration, motor skill and promotes empathy and professionalism. Medical education now is facing limited curriculum time and trained faculty, diminished cadaver availability and cost, and availability of alternate teaching tools; hence the role of dissection is being reevaluated. While dissection plays a major part many schools have included prosection and other teaching aids to teach anatomy which are mostly peer taught. Since 2010, to teach head and neck anatomy to medical students we used prosections and other teaching aids. In contrast to peer teaching, our small group teaching with prosections and teaching aids is faculty led for a period of 4 weeks with 2-3 case based discussion sessions. Like previous years, students’ received focused study guide, structured lab review and periodic quizzes with immediate feedback. We evaluated the effectiveness of this approach analyzing students’ exam performance and course evaluation. We found that students performed as well or slightly better than the classes who dissected head and neck. Students attributed their better performance to more available study time; faculty led small group teaching, ability to ask clarifying questions and availability of learning resources. Analysis of the results and our approach will be detailed in the poster presentation.

*This presentation is supported in part by the CMSRU.*

**Level of First Author:** Faculty

**Topic Category:** Anatomy Education
Morphometric analysis of the aortic depressor nerve in Wistar, Wistar-kyoto and Spontaneously hypertensive rats
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Spontaneously hypertensive rats (SHR) were first inbred from their normotensive ancestors, the Wistar-Kyoto rats (WKY) and it is expected that WKY would be used as the normotensive controls of SHR in diverse experimental protocols. Nevertheless, Wistar rats (WR) have been recently used as the SHR controls as often as the WKY. Previous reports from our laboratory showed differences on the morphology of the aortic depressor nerve (AND) between normotensive WKY and SHR but differences between these two strains and the WR were not yet investigated for the ADN. We aimed to investigate if there are morphological and morphometric differences on the ADN between two different normotensive rats strains and the SHR. Twelve WR, 13 WKY and 9 SHR had their left ADN fixed in 2.5% glutaraldehyde. Semithin cross sections of proximal and distal segments of the ADN were analyzed by light microscopy and a morphometric study of the nerve fascicles and myelinated fibers was performed. Comparison between proximal and distal segments of the three strains revealed a longitudinal symmetry. Comparison between strains revealed that, WKY myelinated fibers and their respective axons are larger compared to WR and to SHR, with no differences between these two, mainly on the proximal nerve segments. On the distal segments, myelinated fibers and their respective axons are also larger on WKY compared to WR but, despite the nonsignificant differences, there is a tendency for the SHR fibers and axons to be smaller than WR. There was no difference on the myelinated fiber number between strains. The investigated parameters (area and diameter) of the myelinated fibers and their respective axons showed important similarity between WR and SHR, which might allow the use of WR as the normotensive controls for SHR. It is well known that for most peripheral neuropathies, nerves are committed distally first. So, the tendency of smaller fibers on the distal segments of SHR might suggest the early installation of a hypertensive neuropathy.

Level of First Author: Undergraduate Student Topic Category: Anatomy

Diabetes impairs visual function and reduces cytoprotective Nrf2 protein content in retinas of rats
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Purpose: To determine the effect of diabetes and metabolic stress on retinal nuclear factor E2-related factor-2 (Nrf2) protein content after light and dark adaptation, and its effect on vision in rats. Darkness was used as a stressor because the retina is more metabolically active in the dark. Methods: Long-Evans and Sprague-Dawley rats were made diabetic by streptozotocin (STZ) injection and compared to age-matched controls (CNT). One group of STZ and CNT rats was sacrificed in light-adapted conditions; the second group was sacrificed after 24 hr. dark adaptation. Retinal Nrf2 protein was determined by immunoblot after 6 and 10 weeks of STZ-diabetes. Behavioral optokinetic testing was used to measure visual function (spatial frequency threshold and contrast sensitivity) after 6 and 10 weeks of diabetes. Statistical analysis was by ANOVA and Newman-Keuls test. Results: There was significantly less Nrf2 after 6 weeks of STZ-diabetes (p<0.05), and visual function was also significantly reduced after 6 and 10 weeks of STZ-diabetes compared to CNT (p<0.05). Conclusion: Diabetes impairs visual function in rats and reduces retinal Nrf2 protein content under metabolic stress. Source of research support: PA Lions Sight Conservation and Eye Research Foundation

Level of First Author: Graduate Student Topic Category: Neurobiology

Serpentine course of renal Segmental Artery Display a Nutcracker Phenomenon: A Case Report
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Nutcracker phenomenon or renal vein entrapment is most commonly seen as a compression of renal vein in between aorta and superior mesenteric artery and the resulting clinical scenario is known as nutcracker syndrome. The nutcracker phenomenon could be asymptomatic or could give rise to nutcracker syndrome with clinical symptoms such as hematuria, proteinuria, flank pain, pelvic congestion in female, and varicocele in male patients. In this case report we are presenting a variant of nutcracker phenomenon leading to compression of left renal vein by overlapping anterior segmental branch of a left renal artery. On a routine dissection of an adult male cadaver, we noticed an unusual arrangement of the structures at the hilum of the left kidney. The left renal segmental artery after arising from the main renal artery runs a serpentine course to enter the hilum of the left kidney anterior to the left renal vein. This variation in the course of left segmental renal artery leads to compression of left renal vein at the hilum of left kidney. The structures in the right renal hilum are normal. The knowledge of such anatomical variations in renal vasculature will not only provide better understanding and management of renal pathology, but it will also help in getting better outcome in renal surgical procedures. This research was supported by the College of Physician Assistant Studies, at Alderson Broaddus University.

Using Cross Word Puzzles to Increase Active Learning
Kathy K.H. Svoboda, L. Bruno Ruest, Robert Spears, Darren Roesch, Lynne A. Opperman; Texas A&M Univ., Baylor College of Dentistry; Dallas, TX

In the last two years, the faculty at Baylor College of Dentistry has developed cross word puzzles to increase active learning activities in several student populations. The puzzles were used in General Histology, Oral Histology, Mechanisms of Development, Dental, Medical, and Applied Pharmacology. All puzzles were developed by faculty members with free online software (Discovery Education Puzzle Maker). In some courses the puzzles were used as homework, while in others they were not graded, but used as an additional study aid. A survey was developed to assess the student’s opinion (dental, residents, graduate). The students circled an answer on a scale of 1-5 with 1 = negative and 5 = positive. Survey questions were:
1. Did you like making (answering) the crossword puzzles?
2. Do you think they help you learn/study the material associated with each puzzle?
3. Do you think they were too easy or difficult?
   If you answer too easy/difficult, do you think we should change the degree of difficulty?
4. Do you think we should keep them in the future?
5. Do you think we should have fewer/more crossword puzzles?
6. Do you think they should be activities to do on your own (do them if you want), mandatory or to keep them in the actual format for bonus points?

All responses were confidential and the student was not identified with the response. In general, most of the students rated the puzzles favorably and thought that they were at the correct level for the information needed for the class. Favorable comments on the instructor’s evaluations also reinforced the concept that the puzzles were appreciated by the students.

Funding for this project was from TAMU-Baylor College of Dentistry, Dept. of Biomedical Sciences teaching budget.

Quo Vadis Teaching Human Anatomy In Medical Schools - A perspective from 60 years’ experience
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Based upon his 60 years’ experience of teaching anatomy, the main author offers his viewpoints relating to the importance of cadaveric dissection. Cadaveric dissection teaches the students the skills of dissection, identification and recognition of structures and topographic relationship of associated structures. More importantly it teaches the student the skills of observation and of the sanctity of the human body; the student learns to deal with real patients / structures rather than some artistic virtual concept of the human body.
However, given the time constraints of current pre-clinical anatomy teaching schedules, these dissections should be limited to selected anatomical parts, supplemented with prospected specimens, CT / MRI images, and video recording in small group practical classes. Anatomical examinations should include practical identification of prospected specimens. Furthermore, anatomical training should be extended outside of the pre-clinical years to the 3rd-4th year medical students, and post-graduate surgical residents. They should be required to re-rotate through anatomy and obtain a passing grade in surgical anatomy. The department of anatomy, jointly with surgery / radiology / pathology should develop and maintain a cadaveric anatomic and surgery center of excellence where students, residents and attendings can practice their surgical skills and develop new surgical techniques on cadavers maintained by the Department of Anatomy.

**Level of First Author:** Faculty  
**Topic Category:** Anatomy Education

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**Characterizing the main olfactory bulb circuitry using intrinsic fluorescence imaging**

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The processing of odor information in the main olfactory bulb (MOB) is mediated by and between individual glomerular circuits. While many studies have elucidated the local lateral connections, more work is needed to understand the connectivity between distant circuits and its contribution to odor information processing. By imaging changes in the intrinsic fluorescence of mitochondrial flavoproteins and NADH that accompany neuronal-associated increases in metabolic load, we are able to map the long distance functional circuitry of individual glomeruli in MOB slices without the use of external dyes or indicators. Using horizontal MOB slices from 3-6 w.o. mice, train stimulation (100µA, 50Hz, 2s) of individual glomeruli elicited robust biphasic fluorescent signal change in both the glomerular layer (GL) and external plexiform layer (EPL). Low magnification recordings showed bilateral signal spread from the stimulated glomerular circuit in both the GL and EPL. Bath application of 10µM gabazine increased signal spread 2-fold in both the GL and EPL, indicating a strong influence of GABAergic interneurons on limiting the response and lateral spread. Surgical microcuts of the GL and/or EPL differentially impacted the unilateral spread of the signal, suggesting that both the interglomerular-interneuron and mitral-granule-mitral pathways contributed to lateral communication in MOB slices. This study highlights the ability of intrinsic fluorescence imaging to understand the functional connectivity of neuronal circuits and for revealing basic information processing strategies within the olfactory bulb.

**Level of First Author:** Graduate Student  
**Topic Category:** Neurobiology

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**E-Learning, Cognitive Load and Dual Task Design: Pitfalls and Possible Solutions**

**Sonya E. Van Nuland**, Kem A. Rogers; Western Univ., London, Ontario, Canada

The rising popularity of commercial anatomy e-learning tools has been sustained, in part, due to increasing class sizes and a reduction in anatomy laboratory hours across many tertiary educational institutions. While e-learning tools gain popularity, the research methodologies used to investigate their impact on student learning remain imprecise. As new user interfaces and interactive features are introduced, it is critical to understand how functionality can influence the load placed on a student’s memory resources, also known as cognitive load. To study cognitive load, a principle called dual-task (a paradigm wherein the learner performs two tasks simultaneously) is often utilized. Yet, poor dual-task designs are frequently plagued with problems including automation of responses, task performance tradeoff and poor understanding of the cognitive load requirements of the primary task, leading to unreliable quantitative results. By modifying the secondary task from a basic visual response to a more cognitively demanding task, such as a modified Stroop test, the automation of secondary task responses can be reduced. Furthermore, by recording baseline measures for the primary task as well as the secondary task, it is possible for task performance tradeoff to be detected. Lastly, it is imperative that the cognitive load of the primary task be designed such that it does not overwhelm the individual’s ability to learn...
new material. These proposed modifications to the dual task methodology will be implemented in a study examining the effect of commercial anatomy e-learning tools on learner cognitive load in September 2014.

Level of First Author: Graduate Student

Topic Category: Anatomy Education

IMP2 Expression in the Mouse Nervous System
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The three homologs of insulin like growth factor-II (IGF-II) mRNA binding protein (IMP) play an essential role in the posttranscriptional regulation of gene expression in nervous tissue. IMP1/ZBP1 (zipcode binding protein) regulates the localization and translation of specific mRNAs allowing for axon guidance and regeneration. Additionally, previous studies show that IMP1 and IMP3 expression decreases dramatically after birth, whereas IMP2 is sustained in brain, liver and other organs throughout life (Leeds et al., 1997; Mueller-Pillasch et al., 1999; Nielsen et al., 1999; Hansen et al., 2004; Gu et al., 2004; Hammer et al., 2005). Of the three homologs, IMP2 is least understood. Our pilot data implicates that IMP2 may play a role in axon regeneration by localizing specific mRNAs. Understanding IMP2 expression pattern is fundamental to further investigation of its functions. We hypothesized that IMP2 is present in both the central and peripheral nervous systems throughout life. Using a custom made IMP2-specific antibody, along with immunohistochemistry, Western Blot, and primary dorsal root ganglion (DRG) culture we examined the expression of IMP2 in the spinal cord and DRG of the mouse at embryonic, postnatal, and adult stages of life. We found that IMP2 expression is present in both the spinal cord and DRG through all developmental stages of life. Ongoing experiments are focused on the role of IMP2 in axon regeneration in the adult nervous system.

Level of First Author: Graduate Student

Topic Category: Neurobiology
Brief History

The American Association of Anatomists (AAA) was founded by Joseph Leidy in Washington, D.C. in 1888 for the “advancement of anatomical science.” Through the individual efforts of its members, and collectively as a pre-eminent scientific society AAA has made many significant contributions in research and education.

Members have been recognized worldwide for leading edge scientific accomplishments in science and medicine, and the generation of documents that have literally changed the approach, direction and emphasis of anatomical science education around the world.

Our Mission

Advancing anatomical science through research, education, and professional development.

Our Vision

Serve as the gateway for conveying the relevance of biological structure as it relates to function from molecules to organisms, and the role of anatomy in team-based, interdisciplinary science, healthcare, and education.

Our Difference

AAA is dedicated to supporting and providing our members with opportunities to enhance their careers, expand their scientific knowledge, and grow their professional network.

“AAA is a great organization and provides many ways to become involved and build careers. As an example, AAA gave me the opportunity to give my first presentation as a graduate student, chair my first platform session as a postdoctoral fellow, organize my first symposium as an assistant professor, and as a professor, to take my first trip to China to participate in a meeting of the Chinese Anatomical Society.

So, AAA has continued to give me opportunities to learn and network from early career up to being a senior faculty member. AAA can do the same for you.”

Lydia DonCarlos, Ph.D., Professor
Loyola University Chicago
Member Since 1988