



The Florida State University  
College of Medicine

# **Clinical Anatomy, Embryology and Imaging**

BMS 6115C

SUMMER  
2013

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## Instructors

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### ***Course Director***

Lynn J. Romrell, Ph.D.  
Professor and Associate Dean  
Room 1110-L  
[lynn.romrell@med.fsu.edu](mailto:lynn.romrell@med.fsu.edu)

### ***Faculty***

Eric Laywell, Ph.D.  
Associate Professor and  
Assistant Course Director  
[eric.laywell@med.fsu.edu](mailto:eric.laywell@med.fsu.edu)

James Cavanagh, M.D.  
Associate Professor  
[jim.cavanagh@med.fsu.edu](mailto:jim.cavanagh@med.fsu.edu)

Christopher Leadem, Ph.D.  
Associate Professor and  
Associate Dean of Student Affairs & Admissions  
[christopher.leadem@med.fsu.edu](mailto:christopher.leadem@med.fsu.edu)

Michael Sweeney, M.D.  
Assistant Professor  
[michael.sweeney@med.fsu.edu](mailto:michael.sweeney@med.fsu.edu)

Hussam Jourdi, Ph.D.  
Assistant Professor  
[hussam.jourdi@med.fsu.edu](mailto:hussam.jourdi@med.fsu.edu)

### ***Teaching Assistants***

#### **Anatomy**

Kyle Andrews  
Shlermine Aupont  
Sarah Avila  
Adam Baptiste  
Logan Blankenship  
William Carraher-Stross  
Alejandro Chavarriaga  
Julia Comer  
Heather Domark  
Clinton Dunn  
Gregorie Elie  
Marielys Figueroa Sierra

Andrew Golden  
Raechel Irons  
Claras Leandre  
Samantha Marrone  
Syeda Muzaffar  
Maxim Olivier  
Makandall Saint-Eloi  
Alexander Schrodt  
Talelia Spence  
Luke Stowers  
Mary Jane Tucker

#### **Informatics**

John Kanter  
Laurence Lentz  
Nima Rezaie  
Eric Webb  
Tristan Weir

#### **Doctoring**

Casey Burnette  
John Dudley  
Hanna Lee  
Amy-Joy Thompson  
Nathan Wass

## Course Overview

### Course Goals

Clinical Anatomy, Embryology and Imaging (BMS 6115C) is an 11 week long course and runs concurrently with the Doctoring 1 Course. The primary goal of the course is to provide the students with a basic understanding of the gross anatomy, embryology and radiologic imaging of the entire body. This knowledge serves as a foundation for the remainder of the student's medical education and future practice of medicine. Second, this course prepares students to apply their understanding of anatomy, embryology, and radiologic imaging as they gain insight into the pathophysiology of disease processes. Students are encouraged to utilize learning resources such as faculty, textbooks, journals and FSU-COM computer resources so that as long term learners the students are able take responsibility for their own continued educational development.

### Competencies

FSUCOM – Competencies - Clinical Anatomy [BMS 6115C]		
Competency Domains	Competencies	Methods of Assessment
Patient Care	Demonstrate understanding of the anatomical foundations of elements of the physical exam.	Observation by faculty and TAs; Integrated sessions with Doctoring
Medical Knowledge	Demonstrate basic knowledge of normal anatomy, embryology, cross-sectional anatomy and radiologic imaging of the human body. Apply anatomical knowledge to recognize and solve clinical problems. Demonstrate knowledge of the anatomical differences in the human body from birth to senescence and recognize the anatomy and laboratory findings related to variations and pathology across the human life cycle. Locate and utilize resources to obtain needed information in a timely manner	Written and practical exams and quizzes; NBME Subject Exam
Practice-based Learning	Demonstrate the ability to recognize when one has reached the limits of their anatomical knowledge when	

	trying to apply it to understanding clinical problems. Engage in self-evaluation.	
<b>Communication Skills</b>	Work together as a professional team in the anatomy laboratory and in small-group study sessions Engage in peer evaluation of team performance.	Faculty and TA observation; Peer and self-evaluation within the assigned teams and during course activities.
<b>Professionalism</b>	Demonstrate professional values, attitudes and behaviors in all interactions with faculty, staff, peers and patients and in all activities.	Faculty and TA observation; Peer and self-evaluation within the assigned teams and during course activities.
<b>System-based Practice</b>		
NOTES: Students observe physician-patient encounters during weekly "Grand Rounds." Faculty and other invited presenters model behavior expected during patient encounters. Students are encouraged to ask questions of the participating patients.		

## ***Learning Objectives***

The student will be able to:

### ***Knowledge***

1. Demonstrate a basic knowledge of normal anatomy, embryology, cross-sectional anatomy and radiologic imaging of the human body.
2. Apply anatomical knowledge to recognize and solve clinical problems.
3. Demonstrate knowledge of the anatomical differences in the human body from birth to senescence.
4. Recognize when one has reached the limits of their anatomical knowledge when trying to apply it to understanding clinical problems, and be able to utilize other resources to obtain needed information in a timely manner.
5. Recognize the anatomy and laboratory findings related to variations, pathology, previous surgery and human life cycle from gestation to the elderly patient.
6. Utilize a variety of resources (faculty, textbooks, computers, internet, etc.) to locate anatomic, embryologic, and/or radiologic information in order to understand how it relates to clinical problems.

### ***Interpersonal skills and communication***

7. Work together as a professional team in the anatomy laboratory and in small-group study sessions.
8. Engage in self-evaluation and evaluate peer performance during the laboratory and small-group experiences of the course.

## **Professionalism**

9. Demonstrate professional values, attitudes and behavior in all your interpersonal interactions with faculty, staff and peers.

## **Course Format**

### **Team Approach**

The team approach is essential in this course, which has a major laboratory component. Medicine is a “team sport.” Appropriate care of patients requires the constant interactions of numerous members of the health care team. Most of us learn best when we share our knowledge with others – good teachers learn from those they teach.

The assigned laboratory teams are expected to work together on the clinical cases presented in lecture and to work as a team to complete the assigned dissection in the laboratory. Students will utilize a variety of digital imaging programs that will supplement learning that occurs in the laboratory setting, lectures, small-group sessions and personal study time. As a side benefit, this course will introduce the student to anatomical terminology commonly used in medicine today. The anatomic knowledge gained during the course will be used in later courses in the curriculum.

### **Anatomy Laboratory**

The laboratory experience will consist of highly interactive, small group activities designed to integrate structure identification with anatomical relationships and clinical significance. A significant portion of the course will be devoted to a dissection lab (four, two hour sessions per week). Student lab teams will be divided into a red and blue team. The red and blue teams will alternate every other day in taking responsibility for the dissections. The “dissecting” team will study the human cadaver, and the “non-dissecting” team will study cross-sectional imaging and radiology of the entire body by anatomical regions.

One member of each team ( $\alpha$  and  $\beta$ ) will be assigned as the team captain for the week. At the end of the lab period (5:00 p.m.), the team captain for the dissecting team will meet with the entire non-dissecting team and review the dissection completed that day. All items identified in bold print in the dissection guide should be shown to the “non-dissecting” team. These daily meetings are essential so that the teams are ready to trade assignments each day.

The ability to recognize and understand anatomical relationships is essential in many aspects of the practice of medicine from performing a basic physical examination to the interpretation of radiographic images. The lectures, laboratory exercises, and independent study assignments will focus on the normal anatomy and common variations seen in the human body. Students are to work in their assigned teams as they study and review the material presented in the course. Exchange of information between the red and blue teams must occur so that all students are able to benefit from every laboratory assignment. The team members are responsible to see that the exchange of information occurs on a frequent basis.

Students not actively dissecting during lab hours and assigned to study osteology, radiology and/or cross-sectional anatomy can do so in the study room adjacent to the anatomy labs or in their respective community areas. The study room in the anatomy laboratory is equipped with models, skeletons,

computers, anatomy software, a computer and LCD projector. The anatomy laboratories and student study rooms are available to students 24 hours a day, seven days a week.

## Lectures

Lecturers will focus the content on major anatomical concepts and introduce clinical presentations aimed at stimulating active student participation. **The lectures are intended to be very interactive between students and faculty. In order for this type of dialogue to occur, the student must read the assigned material before attending a lecture in order to intelligently discuss issues or ask for clarification about a concept.** The lecture is not intended to present all information; students are expected to study information in the assigned text to supplement material presented in the lectures. The textbooks will be the benchmark for the level of detail examined upon for each anatomical region. The radiology component of the course will focus on the recognition of anatomic structures using various radiologic techniques.

## Weekly “Grand Rounds” — Clinical Presentation

Each week will end with a clinical presentation which is planned to emphasize anatomical concepts covered during the week. The material presented may be included on the examinations. These sessions will emphasize the importance of anatomy in developing a differential diagnosis in the treatment of patients.

DATE	TOPIC	PRESENTER
June 7 <sup>th</sup>	Upper Extremity: “Movement Disorder”	J. Latimer, P.T.
June 14 <sup>th</sup>	Upper Extremity	Van Durme, M.D.
June 21 <sup>st</sup>	Extremities: “Knee Injury”	A. Wong, M.D.
June 28 <sup>th</sup>	Thorax, Heart and Lungs: “Shortness of Breath”	K. Brummel-Smith, M.D.
July 12 <sup>th</sup>	Thorax, Heart and Lungs: “Chest Pain”	R. Gonzalez-Rothi, M.D.
July 19 <sup>th</sup>	Head and Neck: “Nausea and Vertigo”	R. Watson, M.D.
July 26 <sup>th</sup>	Abdomen: “Abdominal Pain”	J. Fogarty, M.D.
August 2 <sup>nd</sup>	“Abdominal Pain”	TBA

## Radiology & Cross-sectional Imaging

**The objective of the radiology cross-section component of the course is not to train radiologists.** The objective is to enable students to apply their understanding of the anatomic relationship to interpret and recognize structures visualized by a variety of radiologic techniques.

## Self-Study

Blocks of time are planned each day for independent, self-directed use of faculty resources, educational materials such as videotaped demonstrations, interactive software, the Internet, and even textbooks. **RadSIM (radiology self instructional module)** is a self instructional teaching module produce by Dr. Romrell and the Informatics TAs to enable the students to study and review basic anatomic radiology. This module is available on the course Blackboard site. It is a very popular and useful tool to assist students in their study.

## Policies

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### ***Americans with Disabilities Act***

Candidates for the M.D. degree must be able to fully and promptly perform the essential functions in each of the following categories: Observation, Communication, Motor, Intellectual, and Behavioral/Social. However, it is recognized that degrees of ability vary widely between individuals. Individuals are encouraged to discuss their disabilities with the College of Medicine's [Director of Student Counseling Services](#) and the FSU Student Disability Resource Center to determine whether they might be eligible to receive accommodations needed in order to train and function effectively as a physician. The Florida State University College of Medicine is committed to enabling its students by any reasonable means or accommodations to complete the course of study leading to the medical degree.

#### [The Office of Student Counseling Services](#)

Medical Science Research Building G146

Phone: (850) 645-8256 Fax: (850) 645-9452

This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center

97 Woodward Avenue, South

Florida State University

Tallahassee, FL 32306-4167

Voice: (850) 644-9566

TDD: (850) 644-8504

[sdrc@admin.fsu.edu](mailto:sdrc@admin.fsu.edu)

<http://www.fsu.edu/~staffair/dean/StudentDisability>

### ***Academic Honor Code***

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. (Florida State University [Academic Honor Policy](#))

### ***Attendance Policy***

The College of Medicine has detailed attendance policies as they relate to each cohort and events that conflict with course schedules. See pages 28-29 and 43-44 of [FSUCOM Student Handbook](#) for details of attendance policy, notice of absences and remediation.



## Required/Recommended Materials

Title, Publisher, ISBN	Authors	Edition	Required/ Optional
Clinically Oriented Anatomy, Sixth Edition, Lippincott Williams and Wilkins, ISBN: 9781451119459 2013	Moore, Keith, L., Dalley, Arthur F. and Agur, Anne, M. R.	6 <sup>th</sup> 2009 or 7 <sup>th</sup> 2013	Required
Grants Dissector, Lippincott, Williams & Wilkins, ISBN: 9780781774314	Tank, Patrick W.	14 <sup>th</sup> 2008 or 15 <sup>th</sup> 2012	Required
Langman's Medical Embryology, Lippincott Williams and Wilkins, ISBN: 9781451113426 2011	Sadler, T. W.	11 <sup>th</sup> or 12 <sup>th</sup> 2009 or 2012	Required
Imaging Atlas of Human Anatomy, Mosby, ISBN: 9780723432111	Weir, J., and Abrahams, P.H.	3 <sup>rd</sup> 2005	Required
<b>Choose one of the following atlases:</b>			
(a) Grant's Atlas of Anatomy, Lippincott, Williams & Wilkins, ISBN: 9780781770552	Agur, A.M.R. and Lee, M.J.	12 <sup>th</sup> or 13 <sup>th</sup> 2008 or 2012	More "accurate" illustrations
(b) Atlas of Human Anatomy, Icon Learning Systems/Elsevier, ISBN: 9781416033851	Netter, F.H.	4 <sup>th</sup> 2008 or 5 <sup>th</sup> 2012	Most popular among students
(c) Color Atlas of Anatomy: A Photographic Study of the Human Body, Lippincott, Williams & Wilkins, ISBN: 9780781790130	Johannes W. Rohen, Chihiro Yokochi and Elke Lutjen-Drecoll	7 <sup>th</sup> 2011	Color photographic atlas
(d) Atlas of Anatomy, Thieme, ISBN: 978-1-60406-062-1	Gilroy, A.M., MacPherson, B.R. and Ross, L.M.	1 <sup>st</sup> 2008	Excellent illustrations

### Other required items for the course

- dissecting kit (optional – we supply basic tools)
- lab coat or scrubs
- eye protection – this can be glasses or safety glasses

### Optional items – Plastic apron

### Dissection gloves - Provided

## Grading

The table below indicates the relative weightings for the components. A maximum of 537 points is possible.

### Assessments

Component	Total Points
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	Possible
Written Unit Exams (70 questions each)	
Unit 1 – Extremities and Back	70
Unit 2 – Thorax and Head/Neck	70
Laboratory Exams (70 questions each)	
Unit 1 – Extremities and Back	70
Unit 2 – Thorax and Head/Neck	70
Unit 3 – Abdomen and Pelvis	70
Mid-Unit Quizzes (22 questions each written and practical)	
Unit 1 – Extremities and Back	Formative
Unit 2 – Thorax and Head/Neck	Formative
Unit 3 – Abdomen and Pelvis	Formative
NBME Subject examination	100
<b>TOTAL</b>	<b>450</b>

Each student's correct scores on all examinations will be totaled to give a total correct score. This score will be divided by the possible points throughout the course to produce an overall percent correct in the course. The course director and faculty may drop questions, if they are determined to be flawed or inappropriate.

The quizzes are considered as formative examinations to provide students with an interim assessment of their mastery of the material.

## Grading scale

Grade	Percentage
PASS	≥ 70%
FAIL	<70%

BRIDGE Students will be graded on the Letter grade standard (A=88% or better; B=87.9% to 70%; F= less than 69.9%).

## Important grading issues

To pass the CA course, all students (including BRIDGE) must make at least 70% overall in the course.

Scores will be reported within 24 hrs of each assessment exercise. These scores provide you with information to assess your progress. The level of performance on the internal examination provide a good estimate of the performance level which can be expected on national examination, such as NBME Subject Examinations and the USMLE (see below).

You are encouraged to achieve a solid level of competence in your medical knowledge. You are responsible to develop learning habits which will enable you to be a "life-long learner." You should attain the ability to continue to build your knowledge and understanding of mechanism of disease and health so you can provide your future patients with the highest quality of care possible through your own actions or by referring them to health care specialist with greater knowledge than your own.

## Written and Practical Examinations

### Quizzes

There will be three quizzes, which will occur at approximately the mid-point of each unit. The formative quizzes will include a written and practical component. The scores will not be included in the calculation of the grade. For the practical, students will work independently and then as dissection teams to identify the structures on the cadavers and radiographic images.

### Unit Exams

The unit examinations include a written and laboratory practical component with the exception of Unit 3. For Unit 3 the NBME examination will be considered as the written examination. The two components are of equal value. Two components (written and practical) are given on the same day; both components have 70 test items. The written examination questions will be simple multiple-choice questions (select the best answer). Many written questions will emphasize the clinical application of anatomy and will often be based on clinical scenarios. Information from all course activities is considered testable material for the written exams. The unit examination will not have questions from previous units.

Students will **NOT** be allowed to keep their unit examinations. The unit examinations are not comprehensive; they focus on the material presented within the region of the body being studied in that unit. The approximate percentages for the sources of the written exam questions are as follows:

Lecture-guided topics and clinical presentations, 70-80%

Assigned reading not lectured upon, 5-10%

Integration of X-sectional and radiographic anatomy, 10-15%

### NBME Subject Examination

This is a **comprehensive** examination testing knowledge in anatomy and embryology. These are national examination prepared by the National Board of Medical Examiners (NBME). The questions on the NBME Subject Examinations are written by medical educators selected for their competence in the various medical disciplines. The subject examinations assess the knowledge and understanding of concepts expected in general of medical students trained in the US and Canada. The percentile scores reported on the NBME Subject Examinations give you an indication of your level of achievement within our courses and provide you with the opportunity to assess your knowledge relative to students from other medical schools. This examination will count for 16% of the final grade. Your score on the NBME Subject Examination also gives you insight to the material being assessed on the United State Medical Licensing Examinations (USMLE).

## Laboratory Assessment

### Laboratory Unit Exams

The primary evaluation of the student's anatomical knowledge over the laboratory activities will be through three unit practical examinations during the course. The practical examinations consist of 70 questions consisting of basic identification and association type questions. Approximately 40 structures are tagged on the cadavers, models and skeletons, and the content level is comparable to most of the **BOLDED TEXT** structures in the dissector. About 10 questions will test knowledge about normal radiology and cross-sectional anatomy. The practical examinations are not comprehensive.

## Grading System

FSU COM has adopted a pass/fail grading system which is used in the curriculum for the first and second years (See [page 31](#) of Student Handbook). To achieve a grade of Pass in BMS 6115 (Clinical Anatomy, Embryology and Imaging) a student must meet all of the following requirements:

- 1) A final average  $\geq 70\%$  on the combination of all examination questions. An average  $<70\%$  will receive a grade of fail, which will require remediation or repetition of the course, as determined by

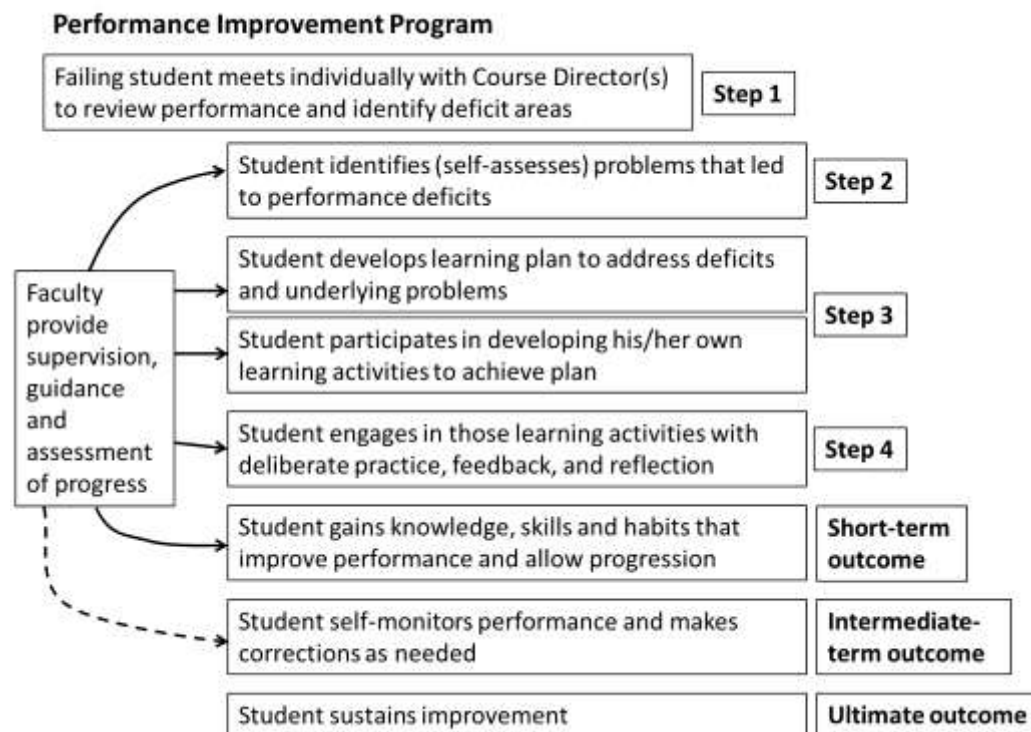
decision of the Student Evaluation and Promotion Committee. A student whose performance is below passing during the course, i.e.,

- <65% on any one exam

OR

- <70% on any two exams in the semester

is required to engage in and complete the Performance Improvement Program in consultation with the Course Director or Assistant Course Director. The purpose of this program is to assist the student in developing the skills and habits necessary to succeed in the curriculum as well as to address specific deficits.



- 2) Satisfactory performance on the NBME Basic Sciences Subject Examination in Anatomy, as determined by the Course Director. The score will be normalized based on class average and historical data.
- 3) Attendance and satisfactory participation in all required sessions, as determined by the Course Director. Unexcused absence from an activity for which attendance is required (for example, Small Group session) may be considered as an issue of Professionalism and require completion of the Performance Improvement Program.
- 4) Demonstration of the attitudes and behaviors of Medical Professionalism in all aspects of the course. Issues of Professionalism may require completion of the Performance Improvement Program.

### Evaluation of teamwork of in lab activities

You will complete self and peer-evaluations within the assigned groups in the laboratory. These assessments will give each team member the opportunity to give and receive constructive feedback. This information will be used in the assessment of your competence in communication skills.



# Anatomy Laboratory Rules and Protocol



# Protocol for the FSU-COM Human Anatomy Laboratory

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Dr. Lynn Romrell is the former Executive Director (served for 25 years) and is currently the representative of Florida State University College of Medicine on the Anatomical Board of the State of Florida. As a member of the Anatomical Board, he is responsible to ensure that dignity is always shown for the remains of the individuals who will their bodies to the State of Florida for the education of medical students and other students in the health care disciplines.

## Lab activity

1. Access. The anatomy lab will be open 24 hours a day, 7 days a week during the semester. After hours, the anatomy lab can be accessed by the card reader.
2. All students, faculty and approved guests must sign "Pledge of Respect" form.
3. Authorized Personnel. Only COM medical students, faculty and other health-related personnel and facility workers are permitted access to the lab. FSU badges are the best form of I.D. All unauthorized persons will be told to leave immediately. After scheduled course hours, campus police regularly patrol the area and will escort trespassers from the lab and report the person(s) responsible for the unauthorized entry to appropriate authorities for corrective purposes. Immediate family members and health-oriented guests of medical students must first receive authorization from Dr. Romrell before being allowed entry into the lab. The lab doors should not be opened for anyone "knocking" other than for an authorized person (i.e. student forgetting their card). Visitation is **NOT** permitted during scheduled dissection periods. During any visit of authorized guests, they should avoid all opened cadaver tanks. Minors will **NOT** be admitted except as part of an organized tour. It is the responsibility of all authorized personnel, faculty and students, to enforce these rules. It is the LAW that donors to the Florida Anatomical Board are guaranteed the respect and confidentiality in the spirit by which their gift was donated to our institution. Any disrespect to the cadavers will be dealt with accordingly.
4. According to Florida law, removal of any cadaver parts, whatsoever, from the laboratory is a crime of grave robbery.
5. NO photographs are to be taken of the cadavers or anything in the laboratory, except for images necessary for cadaver autopsy reports.
6. NO eating, drinking or smoking is allowed in the laboratory or amphitheater.
7. NO radios or tape players are allowed in the laboratory, unless used with earphones.

8. Personal protection in the lab:

- Do not wear sandals or open toe shoes in the lab.
- Recommend wearing scrubs or lab coats. Some prefer an additional plastic apron for protection from fluids.
- Recommend wearing of gloves.
- Wear glasses or protective goggles.
- Material Safety Data Sheets of chemicals used in the laboratory are available in the lab.
- Use dust mask when using electric bone saws.

9. First aid for cuts in the lab: First aid kits are available in the lab

- Remove gloves and wash cut area.
- Cover with sterile bandage.
- Put on clean gloves.

10. All lab coats, dissecting equipment and books should be stored in the locker room or in the cadaver tank. Anything left out after regular lab sessions will be thrown out during daily lab cleaning. **Do not wear dissection clothing or gloves outside of the anatomy laboratory.**

11. Skeletons are available in the lab. Do not remove them from their stands or take them apart.

12. Disarticulated bones are also available, and should not be removed from the lab. Report any broken bone specimens to a faculty member for repair/replacement.

13. The antiseptic soap for washing hands is located on the sinks and locker rooms.

14. **Rule to Remember** - DO not try to catch a dropped tool or retrieve a tool dropped in the tank. In case of injury in the lab during regular lab sessions, notify a faculty member. If an injury occurs after regular lab hours, go to the emergency room.

**Lab waste containers:** There are three types - locate them, learn them, and use them correctly. These are emptied by three different disposal services, which refuse to empty incorrectly parceled waste.

- Type 1. Red-bagged buckets located under each cadaver table. For skin and fat only.
- Type 2. Regular waste receptacles located around the lab. For waste paper, gloves, etc.
- Type 3. Red Sharps containers located around the lab. For scalpel blades only.

**Anatomical Models:** All models should be handled with clean hands or clean gloves only. There will be study areas for looking at the models.

**Dissection Tank and Cadaver**

1. Each group is responsible for keeping the cadaver table clean.



2. The cadaver is covered with a cloth material. Always cover the cadaver with this cloth when leaving the lab. Do not remove the toe or ear tag. This is used to properly dispose of the human tissue.
3. There is one plastic bottle at each table. Fill it only with a wetting solution located in the large crocks at the perimeter of the lab. Use this daily to wet down the cadaver/cloth upon leaving the lab.
4. There is one sponge at each table. It is the responsibility of each group to keep the cadaver and cadaver tray clean.
5. If a dissecting tool falls into the bottom of the cadaver tank, do not retrieve it. Replacement tools can be found in the blue bins outside the female locker room. They are compliments of previous classes.
6. If there is a problem or concern about your cadaver (odor, mold, and fixation) or tank (broken mechanism) contact the course director.

**Keeping your cadaver moist and in good condition and your cadaver table clean, results in a more pleasant lab experience and successful dissection exercises.**

Article from:

**The New York Times**

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March 27, 2009

## Dead Body of Knowledge

By CHRISTINE MONTROSS

Providence, R.I.

AT the risk of sounding like a fuddy-duddy, I would like to say that sometimes, medical imaging isn't all it's cracked up to be.

As a resident in psychiatry, I depend on the technology to treat my patients. From countless computers in the hospital's hallways and at nurses' stations, I call up images of the people I treat: the black, white and gray CT scans of their skulls, the nuanced M.R.I.'s of their spinal cords and ligaments, the rotating Spect scans that show in three dimensions how well — or how poorly — blood flows through their brains. I can leave the room of an 89-year-old woman who has begun picking imaginary bugs out of the air, look into a screen, and see the tumor that is causing her delirium.

Now however, many medical schools are beginning to argue that imaging technology has improved to the point where it should be used in place of the dissection of human cadavers as the central tool of instruction for young doctors-to-be. This is a mistake. No matter how detailed and versatile they become, computer images can never provide the indelible lessons that novice doctors learn from real bodies.

Nearly every medical student in America begins his career by entering a room full of cadavers and taking one of them apart, layer by layer, piece by piece. Doctors have shared this experience for centuries, ever since Vesalius, Da Vinci and Michelangelo defied religion and government, stole bodies from graves and churches, and dissected by candlelight in an audacious pursuit of knowledge about the human body. The process is what you would expect: messy and smelly, tedious and time-consuming, emotionally and physically difficult. It is at times awe-inspiring, and at other times profoundly upsetting. It is also, for the medical schools, very expensive. Even though cadavers are donated, it can cost more than \$2,000 to prepare a body for dissection.

So medical schools are beginning to re-evaluate their anatomy curriculum in the face of the perhaps inevitable argument: Why not reduce, or eliminate altogether, the burdensome cost of dissecting cadavers and replace it with this new and astounding technology? The computers and software — a considerable expense, but one that need be incurred only once — allow students to study images of the body from every angle and on every plane. They can peel away the muscle on a virtual leg to see the bone beneath, then click a different button, reattach the muscle and see how the limb moves.

Computers can show things that still and lifeless cadavers cannot — blood pumping in real time through the heart's chambers, for instance. And it is far easier to visualize nerves and vessels when they're color-coded on a computer than it is to pick through the indistinguishable gray-green tangles inside a formalin-embalmed cadaver. Because all of this can be done anywhere on any screen, students can study anatomy in this way in the library, in their apartments or, surely someday if not already, on their iPods and cellphones.

At the end of the academic year, there would be no need for old cadavers to be cremated, for new human donors to be found, for deep cleaning the anatomy lab. Come September, the whole system would simply reboot.

But what kind of doctors will they be, these students who have never experienced human dissection? They would have been denied a safe and more gradual initiation into the emotional strain that doctoring demands.

Someday, they'll need to keep their cool when a baby is lodged wrong in a mother's birth canal; when a bone breaks through a patient's skin; when someone's face is burned beyond recognition. Doctors do have normal reactions to these situations; the composure that we strive to keep under stressful circumstances is not innate. It has to be learned. The discomfort of taking a blade to a dead man's skin helps doctors-in-training figure out how to cope, without the risk of intruding on a live patient's feelings — or worse, his health. We learn to heal the living by first dismantling the dead.

The dissection of cadavers also gives young doctors an appreciation for the wonders of the human body in a way that no virtual image can match. It is awe-inspiring to hold a human heart in one's hands, to appreciate its fragility, intricacy and strength.

But most important, the cadavers on their stainless steel tables are symbols of altruism to medical students: They are reminders of how great a gift one can give to a stranger in the hopes of healing. Isn't that the most fundamental lesson we want our doctors to carry to the bedsides of their patients?

Christine Montross, a resident in psychiatry at Brown University, is the author of ["Body of Work: Meditations on Mortality From the Human Anatomy Lab."](#)