

Medical School Anatomy and Pathology Workshops for High School Students Enhance Learning and Provide Inspiration for Careers in Medicine

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Abstract

“Anatomy and Pathology Workshop” is a cadaver-based outreach program that models medical education to large groups of high school students. This study was designed to evaluate the impact of this program on students’ knowledge of anatomy and interest in biomedical science. A total of 144 high school students participated in the workshop in 2015. Preworkshop and postworkshop assessments were administered to assess students’ learning. A postworkshop survey was conducted to solicit students’ reflections and feedback. It was found that student performance in the postworkshop examination (mean 78%) had significantly improved when compared to the performance in the preexamination (mean 54%), indicating that this program enhances learning. Students were also inspired to consider opportunities in medicine and allied health professions—97% indicated that they had a better understanding of medical education; 95% agreed that they had better understanding of the human body; 84% thought anatomy was interesting and exciting; and 62% of the students indicated that they looked forward to studying medicine or another health profession. Students rated the instructors highly—95% agreed that the instructors were professional and served as role models. Medical/graduate student instructors were also highly regarded by the high school students—96% thought it was valuable to have student instructors and 94% thought that student instructors were caring and enthusiastic about teaching. In summary, this study demonstrates that outreach programs provided by medical schools help young adults during their formative years by modeling professionalism, providing role models, enhancing learning, and encouraging many to consider opportunities in the health professions.

Keywords

anatomy, education, high school students, outreach, pathology

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Introduction

High school years are a formative time in life when young adults acquire enduring interests and motivation to learn. In order to shepherd the young minds toward stable and virtuous professions, it is fundamental to inspire their curiosity for knowledge, foster their interest in art and science, and promote enthusiasm for work ethics. For these reasons, academic institutions in the community are able to play a critical role in influencing and helping the younger generation by providing

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unique experiences that promote student professionalism, learning, and scholarship. Innovative programs have been created to stimulate student interest in science and technology.¹⁻³ Other programs have been designed to eliminate or minimize specific harmful behaviors, such as tobacco use⁴ or unprotected sex.⁵

Medical schools with abundant resources for research and teaching can provide a wealth of enrichment opportunities for young adults. Medical school programs have been described, which encourage and motivate underrepresented minorities and low-income high school/college students to set high standards and help prepare them for careers in the health sciences.⁶⁻¹¹ Other programs have been described, which train high school biology teachers to effectively communicate preclinical medical concepts, so as to stimulate greater interest in the medical and life sciences.¹²⁻¹⁴ Although immensely valuable, these community outreach programs are labor-intensive and can, therefore, accommodate only limited numbers of students.

In order to meet the needs of large groups of high school students, the anatomy and pathology faculty at Sidney Kimmel Medical College at Thomas Jefferson University created an outreach program 10 years ago. This program models pre-clinical, basic science medical training. For the first several years, interested high school biology students were invited to visit our dissection laboratory to examine dissected cadavers and isolated organs. Based on the feedback received from students and teachers, we reorganized this outreach program recently to greatly enhance opportunities for student learning. Lectures were added to provide an overview of basic anatomical and pathological concepts. Cadavers and organs showing pathologic changes were organized as stations that focused on a particular topic or body region. Graduate/medical student instructors were recruited to help teach in the anatomy laboratory. The revised outreach program (termed "Anatomy and Pathology Workshop") is now offered each year to more than 100 students from many different regional and center city high schools. The students are seniors currently studying biology and/or anatomy and physiology (A&P). We hypothesize that human anatomy with cadaver dissection and examples of organ pathology will open an exciting and unknown world of science to young students. Through this program, high school students will (1) have an interactive experience with instructors who model medical training, (2) strengthen their basic knowledge of anatomy and pathology, and (3) be inspired to pursue a biomedical science and/or health profession.

Methods

Participating Students

A total of 144 senior high school students from high schools in Pennsylvania and New Jersey traveled to Thomas Jefferson University in 2015 to attend an Anatomy and Pathology Workshop. School A is private religious school in center city, Philadelphia, with a student body composed primarily of

low-income and underrepresented minority students. School B is a small, private school in New Jersey and the majority of the students are Caucasian. School C is a large public school in suburban New Jersey, with a more racially diverse student body (about 65% Caucasian, 20% Indian, 10% Asian, and 5% African American). The students were all enrolled in a senior A&P course in their respective school. Students enrolled in the "MedScouts" program at Thomas Jefferson University also attended an Anatomy Workshop in 2015. MedScouts is a year-round, after-school mentoring program that is run by Jefferson medical students for the benefit of disadvantaged students in Philadelphia. This popular mentoring program aims to prepare disadvantaged, low-income, and/or underrepresented minority students for a successful transition to higher education (college and beyond).

Instructors

The Department of Pathology, Anatomy, and Cell Biology is composed of a diverse faculty with a spectrum of interests that includes diagnostic pathology and laboratory medicine, translational research, basic research, and computational/systems biology. The Department plays a major role in undergraduate medical education (eg, anatomy, histology, neuroscience, pathology), providing over 70% of preclinical instruction for students in the Sidney Kimmel Medical College, and is the home of leading textbooks in pathology and cytopathology. The Department Chair, Dr Peiper, encourages innovation in medical education and supports a Pathology Honors Program for medical students, as well as community outreach programs including Anatomy and Pathology Workshops. Departmental teaching faculty provided anatomy and pathology lectures to the visiting high school students and participated in the cadaver-based laboratory review sessions. Second-year medical students and third-year physical therapy students were recruited to serve as laboratory instructors.

Anatomy and Pathology Lectures

The Anatomy and Pathology Workshop has 2 components: (1) PowerPoint lecture presentations that provide an overview and introduction to human anatomy and pathology (1 hour each) and (2) an interactive cadaver laboratory review session. "Introduction to human anatomy" covers the history of the anatomical sciences and describes approaches to the study of the human body (eg, systemic, regional, surface, and sectional anatomy). Diagnostic imaging and real-world applications are highlighted in this lecture. For example, cases of sports injuries and trauma caused by automobile accidents provide an opportunity to discuss safety issues and to emphasize the clinical significance of advanced anatomy training. "Introduction to pathology" covers general causes and mechanisms of disease, including cell injury, inflammation, wound healing, developmental genetic disease, neoplasia, and hemodynamic disorders. This lecture presents common pathologic findings, including myocardial infarction, lung cancer, emphysema, hepatic

cirrhosis, Alzheimer disease, and Down syndrome. These clinical cases provide an opportunity to discuss health risks associated with smoking, alcohol abuse, and infectious disease.

Laboratory Review Sessions

After lectures, the high school students were divided into 6 groups and cycled through 6 demonstration stations in the anatomy dissection laboratory (20 minutes per station). Five of these stations featured normal anatomy of different body regions using prosected cadavers. The 5 body regions were thorax, abdomen and pelvis, upper limb, lower limb, and nervous system. The nervous system station demonstrated a laminectomy, isolated spinal cord, and several human brains. The last station presented isolated visceral organs that exhibited gross pathologic changes, such as abdominal aortic aneurysm, hepatic cirrhosis, primary and metastatic cancers of the liver and lungs, artificial heart valves, and evidence of coronary artery bypass surgery. At each station, an instructor guided the students and encouraged them to examine the anatomical specimens. Pathological changes and clinical applications related to the particular organs and regions of the body were emphasized at each demonstration table using principles of Socratic teaching. Students were encouraged to ask questions and explore the prosected cadavers and pathologic specimens (ie, hand-on, interactive, learning experience).

Workshop Assessments and Surveys

An anonymous preworkshop examination was designated to assess students' knowledge of basic human anatomy. High school A&P teachers administrated the anatomy examination anonymously 1 week before the workshop at Jefferson. The examination consisted of 17 multiple-choice questions that assessed students' understanding of basic anatomy of the major body regions, as well as key anatomical structure/function relationships and associated clinical correlations (Appendix A). The examination was heavily weighted toward anatomy, because 5 of 6 demonstration stations featured prosected cadavers. Thirty-three students from school A, 21 from school B, and 78 from school C completed the preworkshop assessment ("preexamination"). The same set of questions was administered anonymously to the students after they attended the workshop to assess learning. Schools A and B failed to administer the postexamination to their students. Eighty students from school C completed the postworkshop examination ("postexamination") 1 week after they attended the workshop. A postworkshop survey was also conducted to solicit feedback and assess the potential influence of the outreach program. This opinion survey consisted of 15 questions, constructed using a 5-point Likert scale, and 3 open-ended questions for written comments (Appendix B). A total of 128 students (19 from school A, 19 from school B, 80 from school C, and 10 from the MedScouts program) completed the survey.

Table 1. School C Student Performance on Pre- and Postexaminations.

Examination	N	Mean, %	SD	Highest Score, %	Lowest Score, %	P ^z
Preexamination	78	54.00	2.08	82.35	11.76	
Postexamination	80	77.57	2.41	100	47	.001

Abbreviations: N, number of students; SD, standard deviation.

^zz test.

Data Analysis

Student performance on pre- and postexaminations was compared based on data collected exclusively from school C, because schools A and B failed to administer the postexamination to their students. Changes in the performance of students from school C in the pre- and postexaminations were analyzed using *z* tests for proportions at $\alpha = .05$. Examination questions with proportion correct below 0.50 in the preexamination were considered as new concepts to students. Calculations were performed using Stata Statistical Software, version 11.0.^a

Institutional Review Board Exempt Statement

According to the institutional review board (IRB) at Thomas Jefferson University, collection of statistical data on examinations and surveys by course directors is exempt from IRB review pursuant to Title 45 Code of Federal Regulations Part 46.101 (b) governing exempted protocol declarations.

Results

Participation in the Workshop Enhanced Learning

Students from school C completed the preworkshop and postworkshop examinations and their performances on each were compared. The results demonstrate that participation in the Anatomy and Pathology Workshop significantly enhances students' understanding of basic human anatomy. As shown in Table 1, student performance in the postexamination (mean 78%, *N* = 80) was significantly higher than student performance in the preexamination (mean 54%, *N* = 78). The lowest score rose from 12% to 47%, and the highest score rose from 82% to 100% (Table 1). These data indicate that the basic science information presented during the Anatomy and Pathology Workshop was retained. Because the examinations were administered anonymously, students felt no external pressure, and so their scores most likely reflect the true status of their understanding. Although we could not track changes in individual student achievement, the aggregate data clearly demonstrate an overall increase in knowledge regarding human anatomy after participating in the workshop.

Student performance on individual anatomy questions was examined further. The values of proportion correct on

Table 2. Students Mastered New Concepts Regarding Basic Human Anatomy by Attending Anatomy and Pathology Workshops at Jefferson.

Question Number	Question Topics	Proportion Correct: Preexamination	Proportion correct: Postexamination	P*
1	Sciatic nerve/gluteal intramuscular injection	0.09	0.58	.001
2	"Unhappy triad"/knee	0.19	0.96	.001
4	Foreign object tends to lodge in which lung	0.37	0.83	.001
5	Venous blood from the small intestine/portal vein	0.19	0.53	.001
7	Brachial plexus	0.49	0.66	.01
8	Subclavian artery/upper limb	0.14	0.49	.001
9	Triceps brachii/forearm extension	0.35	0.63	.001
10	Sciatic nerve/hamstring muscles	0.23	0.59	.001
16	Ureter	0.50	0.71	.01
Overall mean	N = 9 items	0.28	0.66	.001

*z test.

Table 3. Students Demonstrated Background Knowledge of Specific Topics in Human Anatomy.

Question Number	Question Topics	Proportion Correct: Preexamination	Proportion Correct: Postexamination	P*
3	Mitral valve/left atrioventricular orifice	0.95	0.94	NS
11	Femoral artery/lower limb	0.81	0.79	NS
15	Oocytes/ovary	0.77	0.86	.05
17	The most likely cause of lung cancer	0.79	0.99	.001
Mean	N = 4 items	0.83	0.90	NS

Abbreviation: NS, not significant.

*z test.

Table 4. Workshop Attendance Improved Student Understanding of Topics Previously Taught by the High School Biology Teachers.

Question Number	Question Topics	Proportion Correct: Preexamination	Proportion Correct: Postexamination	P*
6	A fight or flight response/sympathetic fibers	0.77	0.86	.05
12	Temporal lobe/auditory center	0.85	0.95	.01
13	Occipital lobe/visual center	0.90	0.94	NS
14	Cerebellum/maintaining balance and corporation	0.79	0.90	.01
Mean	N = 4 items	0.83	0.91	.05

Abbreviation: NS, not significant.

*z test.

9 of 17 questions in the preexamination were below 0.5. The mean proportion correct on these 9 questions was 0.28 (range 0.09-0.50) in the preexamination, indicating these concepts were new to most of the students. The mean proportion correct rose significantly to 0.66 (ranging 0.53-0.96) in the postexamination (Table 2). In other words, only 28% of the students responded correctly to these 9 questions in the preexamination, whereas 66% of the students responded correctly to these same questions in the postexamination. These data indicate that 38% of the class gained new knowledge as a result of their participation in the workshop. For example, only 19% of the class was aware that "unhappy triad" refers to an injury of the knee joint before the program, whereas 96% of the class understood this concept after participation in the program. Similarly, only 9% of the students in the

preexamination, but 58% in the post examination, understood that improper gluteal intramuscular injection could put the sciatic nerve at risk.

The proportion correct on 4 anatomy questions was high, even in preexamination (0.83), suggesting that the students had some background knowledge of the human body (Table 3). For example, high school students were aware of the fact that the mitral valve guards the left atrioventricular orifice; that oocytes are produced in the ovary; that the femoral artery brings arterial supply to the lower limb; and that the most likely identifiable cause of lung cancer is smoking.

Before attending the workshop at Jefferson, the students in school C had recently completed a unit of study on the central nervous system. As expected, these students performed well on nervous system questions in the preexamination (Table 4). The

mean proportion correct on 4 nervous system questions in the preexamination was 0.83, ranging from 0.77 to 0.90. These data suggest that the students in school C had learned this topic well in their high school.

Comparison of preexamination and postexamination results also suggested that participation in the Anatomy and Pathology Workshop strengthened the preexisting base of knowledge about the human body for some students. For questions on the nervous system, the mean proportion correct in the postexamination was significantly higher than that in the preexamination, rising from 0.83 to 0.91. For questions on general background knowledge, the mean proportion correct in the postexamination was higher than that in the preexamination, rising from 0.83 to 0.90. Although the effect was not statistically significant ($P < .10$), this changed in the right direction.

Students Were Inspired to Consider Future Opportunities in Medicine

Students from the 3 area high schools and the Jefferson MedScouts program ($N = 128$) completed our postworkshop opinion survey. Most of the students indicated that they had a better understanding of what it might be like to attend medical school, or pursue a health profession (97% agree + strongly agree); 95% stated that they had a better understanding of the human body and the concept of organ systems; 84% thought that anatomy is a very interesting and exciting subject; and 72% valued the opportunity to learn about medicine and medical education. Of note, 79% of the students agreed that everyone should have a greater appreciation for people who donate their bodies to medical education, and 60% thought the program inspired them to pursue medicine or a health profession after completing high school. At the end of the survey, we asked again about student interest in medicine with the question: "I look forward to studying a medical or health profession." Surprisingly and encouragingly, 62% of the high school students surveyed in this study responded in the affirmative.

Instructors Were Identified as Role Models for High School Students

During the workshop, faculty and student instructors had close interaction with the high school students. We hypothesized that aspects of instructor professionalism, passion for preclinical basic science, and enthusiasm for teaching would have a positive influence on the high school students. To test this hypothesis, survey questions were designed to ask how the students viewed the instructors. Most (95%) of the students indicated that the faculty instructors were professional and served as good role models, 98% agreed that the faculty instructors were knowledgeable, 85% thought that the faculty instructors were encouraging and had inspired them to learn about and pursue medicine, and 89% thought the faculty instructors cared about their learning.

Of interest is the finding that the student instructors in our Anatomy and Pathology Workshop were highly regarded by

the high school students—96% of the students thought it was valuable to have student instructors in addition to faculty instructors and 94% agreed that student instructors were enthusiastic about teaching. At the end of the workshop, a group of high school students asked—"How can I be that solid as the student instructors?" When asked "solid about what?" the students said "solid in their knowledge and solid as a professional person." These data and the interesting conversations that took place after the workshop suggest that student instructors can have a significant influence on young adults.

Influence of Anatomy Workshop Lectures on Student Safety Issues

Clinical case injuries related to sports and automobile accidents were incorporated into the lectures during the first part of the program. Images of trauma related to automobile accidents were graphic and, arguably, could be viewed as shocking to those not trained as health professionals. However, when asked about automobile accidents and safety in the postworkshop survey, the majority of students did not believe that the clinical cases and images had convicted them to change their views on driving safety. Indeed, only 44% of the students from school A and 48% from schools B and C indicated that they would pay more attention to driving safety. By contrast, all 10 students participating in the Jefferson MedScouts program responded positively to this question on driving safety.

Levels of Enthusiasm for the Workshop Varied Between Student Groups

Compared to students from the suburban schools (schools B and C), students from the private center city school that serves predominantly disadvantaged and underrepresented minorities (school A) were less enthusiastic about a future career in the health professions (Table 5). Only 21% of the students attending school A indicated (agree or strongly agree) that they would like to pursue a health profession career after completing high school, compared to a combined average of 67% of the students attending the other high schools and MedScouts program. Similarly, students attending school A were not as impressed by the workshop as students from the other schools—indeed, only 58% of school A students would recommend our outreach program to a friend, compared to 91% of students attending the other schools/programs. Also of note, the survey revealed that fewer students from school A felt that the faculty cared about their personal learning (74% vs 93% for the cohort) or were encouraging and inspiring (63% vs 88% for the cohort). In this connection, 100% of the students from schools B and C and the MedScouts program commented favorably on the student instructors, whereas only 62% of students from school A were enthusiastic about the student instructors. Similarly, whereas 90% of students from other schools/program agreed that the body donors should be appreciated, only 63% of students from

Table 5. Responses of Students From School A Were Less Enthusiastic for the Workshop.

Topics	School A: Confirmative Response, % (N = 19)	Cohort: Confirmative Response, % (N = 109)	P*
The program inspired me to pursue medicine or another health profession	21	67	.001
I look forward to studying a medical or health profession	16	71	.001
Faculty cared about my personal learning	74	93	.001
Faculty were encouraging and inspiring	63	88	.001
I would recommend the program to my friends	58	91	.001

*z test.

school A agreed with this sentiment. These findings suggest that there are significant differences in the expectations and attitudes between students from different socioeconomic backgrounds.

Examples of High School Teacher Feedback

We received many interesting comments from the high school teachers that accompanied students on their visit to Jefferson. Their comments suggest that deep and extensive discussions occurred among the students after attending the workshop.

- They were really impressed with your graduate students and they are really motivated to choose a career in science.
- The students were completely amazed and excited when they returned. They talked about the trip the rest of the day and on Friday we discussed many of the bodies and alternatives to treating people in a doctor's office.
- It was as professional as ever and I believe that the students were totally impacted by the presentations.
- The students left your building excited and intrigued about their future in medicine and medical-related fields. Every one of them raved about the facilities and was amazed at the possibilities that do not involved treating patients. This experience was one that will remain with them for years to come and really got them excited about science.

Examples of Student Feedback and Reflection

Students' comments indicate that the workshop provided inspiration.

- This trip made me think about the future and how much human biology interests me. It made me want

to eventually have a job in the medical field. There aren't a lot of things I'm passionate about, but this trip verified my passion for learning about medicine. I can now say that I've held a heart in my own bare hands! It was a one in a lifetime opportunity, and I will remember it forever.

- The experience of being able to dissect a cadaver was one of the most incredible and fascinating things I have ever been able to do! I thought it was amazing to be able to actually touch the different parts of the human body that I have studied in intro to bio and am now learning about in human bio. I really enjoyed learning about new anatomy as well, such as the sciatic nerve and where it originates/how it travels down the leg. This cadaver dissection was really beneficial as it showed me just how complex the human body really is. This cadaver dissection opened up my eyes to the field of medicine and how difficult it is to have a career in the health field, as one must know all of the anatomy. PS—Thanks again for arranging this! It is something that I will never forget.

As expected, a few students struggled during the anatomy laboratory session with emotional and psychosocial issues related to death and dying.

- While I was not incredibly hands-on during this lab, I pushed myself to handle and explore parts of the cadavers. This hands-on lab gave us a context in which to learn more about ourselves and the human body in a more passionate way.
- I'm not usually the one to not have any words but this left me speechless. It was nothing like I expected. But in the end I picked up the heart and looked in it, and picked up an arm and lungs and felt muscle and touched the fat and skin. I'm happy I did it.
- The coolest part about today was that when the teacher spoke and I understood the vocabulary he was using. He said the anatomical position was supine. I KNOW WHAT THAT MEANS!

When asked what changes they would make to the workshop to meet their needs, most students said they would not change a thing. However, many commented that they wished they could have stayed longer in the laboratory to continue learning, and some expressed a desire to discuss requirements for entering different health professions.

- I would add other opportunities to explore other parts of the health field, talk to more (medical or physical therapy) students and extend the experience.
- I would like to have a more deep discussion of careers concerning anatomy that are not doctors.
- I would have liked the lectures to focus more on medical careers and classes you must take to become a health professional.

Students from school A did not provide notes or written comments for the open-ended survey questions (neither positive nor negative), making it difficult for us to understand why they were less enthusiastic about the workshop and a future career in the health professions.

Discussion

The Anatomy and Pathology Workshop at Jefferson has proven to be a highly successful and popular outreach program. It provides area high school students with an opportunity to learn about science, life, and medical education. Students are immersed in a 1-day, 6-hour anatomy and pathology experience that includes lectures and a hands-on interactive dissection review. Although the content is simplified, the combination of lecture and laboratory review models pre-clinical basic science medical education. The high school students visited a medical lecture hall and dissection laboratory, interacted with medical students and allied health professionals, and learned new concepts from experienced teaching faculty. Throughout the workshop, instructors attempted to create a supportive, interactive learning atmosphere. Students were encouraged to explore the anatomic specimens and ask questions. Interactive learning has been shown to be an effective way of sparking passion for learning.¹⁵ Results of the opinion survey indicate that 97% of the young people attending the workshop believed that they had gained a better understanding of what it might be like to attend medical school or pursue a health profession. In addition, 95% of the students indicated that they had acquired a better understanding of the human body and concept of organ systems.

An important goal of the outreach program has been to spark interest in the biomedical and health sciences. Therefore, we were very pleased to note that 60% of the participating students indicated that the workshop inspired them (or further strengthened their desire) to pursue medicine or a health profession after completing high school. Eighty-four percent of the students expressed that anatomy is a very interesting and exciting subject. Responses of the Jefferson MedScouts students in the survey were particularly noteworthy—8 of 10 MedScouts students felt that they were inspired by the workshop and 9 of 10 stated a desire to pursue a career in a medical/health profession.

The data also indicate that students from school A were less appreciative of the Anatomy and Pathology Workshop and its instructors, and they were less inclined to consider a future in the health-care professions. As shown in the results, only 4 (21%) of 19 students felt that they were inspired by the workshop, and only 16% wanted to pursue a profession in the medical field. In contrast, the responses of students electing to participate in the MedScouts program were positive and encouraging. It should be noted that students from school A and MedScouts have a similar socioeconomic background (low income families and/or

underrepresented minority). It has been reported that students from disadvantaged backgrounds are often at risk of failure.¹⁶ Clearly, the MedScouts program is successful in inspiring students from disadvantaged backgrounds. The success of the MedScouts program may be attributed to either (1) a year-long history of mentoring by caring (empathic) medical students or (2) the fact that the MedScouts program is a voluntary enrichment program with privileges and responsibilities. The successful outcome of the Jefferson MedScouts program suggests that earlier attention and guidance to children from low-income disadvantaged backgrounds would benefit the younger generation. It would stimulate interest in the joy of learning about science and provide inspiration and hope for the future.

The Anatomy and Pathology Workshop at Jefferson provide an opportunity for high school students to interact directly with medical school faculty and medical students. This close, informal interaction with highly trained professionals is a novel experience for most high school students. The results indicate that the professionalism exhibited by the instructors can have a significant impact on students. The workshop instructors were thought to be inspiring (88%), empathetic (94%), knowledgeable (98%), and good role models (98%). The high school students were also appreciative and welcoming of the medical students as instructors. We believe that student instructors with proven records of professional behavior and expert content knowledge can provide much needed mentoring and guidance to young learners. Teaching also strengthens the competency training of medical and graduate students, by enhancing skills such as professionalism, oral communication, and life-long learning.¹⁷

Although the Anatomy and Pathology Workshop is a 1-day event, the experience appears to have a lasting impact on the visiting students. Feedback from teachers indicates that their students continued to discuss the Workshop for many days. Many students expressed an interest in choosing a career in science or medicine. Individual students' comments highlighted personal experiences, goals, and aspirations. Some students suggested that discussion of specific career opportunities in various medical fields should be added to the outreach program. Being able to understand the use of medical/anatomical terminology also made several students excited and more interested in learning.

In summary, the Anatomy and Pathology Workshop at Jefferson provides an opportunity for large groups of high school students to meet medical school faculty and experience medical education. The program inspires students' interests in science and medicine and enhances their understanding of human anatomy and pathology. It stimulates the students to consider career opportunities in the health professions. We believe that this well-designed, hands-on, and interactive workshop has a tremendous impact on young minds.

Appendix A

Anatomy and Pathology Workshop At Sidney Kimmel Medical College

Program assessment

Choose the single best answer for the following questions.

- Which structure can be at risk if a gluteal intramuscular injection is not done properly?
 - Femoral artery
 - Femoral nerve
 - Gluteus maximus muscle
 - Sciatic nerve
- “Unhappy triad” refers to injury of which joint?
 - Elbow
 - Hip
 - Knee
 - Shoulder
- Mitral valve guards the opening between which paired structures?
 - Left ventricle and aorta
 - Left ventricle and left atrium
 - Right ventricle and left ventricle
 - Right ventricle and pulmonary trunk
- Based on the structure of the main stem bronchi, a foreign object is most likely to lodge in which lung?
 - Left
 - Right
- Venous blood from the small intestine drains to the liver through which vessel?
 - Hepatic artery
 - Hepatic vein
 - Inferior vena cava
 - Portal vein
- During a fight or flight response, the nerve fibers that increase the heart rate are:
 - Parasympathetic nerve fibers
 - Sensory nerve fibers
 - Sympathetic nerve fibers
- Brachial plexus refers to an interconnected set of:
 - Arteries
 - Lymphatic vessels
 - Nerves
 - Veins
- The major artery supplying the entire upper limb is:
 - Aorta
 - Common carotid
 - External carotid
 - Subclavian
- Which muscle extends the forearm?
 - Biceps brachii
 - Deltoid
 - Trapezius
 - Triceps brachii
- Which nerve innervates the hamstring muscles?
 - Common fibular
 - Femoral
 - Inferior gluteal
 - Sciatic
- The major artery that supplies the lower limb is:
 - Femoral
 - Internal iliac
 - Tibial
- Which lobe of the cerebrum contains the auditory center?
 - Frontal
 - Occipital
 - Parietal
 - Temporal
- Visual center is located in which cerebral lobe?
 - Frontal
 - Occipital
 - Parietal
 - Temporal
- Maintaining balance and coordination is the primary function of which of the following structures?
 - Brainstem
 - Cerebellum
 - Cerebrum
 - Thalamus
- Oocytes are produced in which female pelvic organ?
 - Ovary
 - Uterine tube
 - Uterus
- The structure connecting the kidneys to the urinary bladder is:
 - Renal vein
 - Spermatic cord
 - Ureter
 - Urethra
- What is the most likely cause of lung cancer?
 - Reduced blood flow to lungs
 - Inhalation of toxic substances
 - Chronic infection by a virus
 - An abnormality of the immune system

Appendix B

Anatomy and Pathology Workshop—Sidney Kimmel Medical College at Thomas Jefferson University

Please help us to evaluate the outcomes of the Anatomy and Pathology Workshop and to make it even better for your peers in the future. Your responses are confidential and will not be released in form that will identify you personally.

Using a black pencil or ball point pen, please fill in the most appropriate circle for each item. Please do not make any stray marks on the form—restrict comments to boxes provided.

	SD	D	N	A	SA
1 I have a better understanding of what it might be like to attend medical school or pursue a health profession.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2 I have a better understanding of the human body and the concept of organ systems ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3 Everyone should have a greater appreciation for people who donate their bodies to medical education	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4 This program inspired me or further strengthened my desire to pursue medicine or a health profession after high school.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5 Although I don't plan to pursue medicine, I valued the opportunity to learn about medicine and medical school.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6 Human anatomy is a very interesting and exciting subject	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 The clinical cases made me think about my own driving and that I should pay more attention to safety.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8 I would recommend this program to my friends	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9 Faculty instructors were encouraging and inspired us to learn about and pursue medicine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10 Faculty instructors were professional and served as good role models	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11 Faculty instructors made me feel like they cared about my learning.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12 Faculty instructors were knowledgeable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13 It was valuable to have student instructors in addition to faculty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 The student instructors seemed enthusiastic about teaching.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15 I look forward to studying a medical or health profession.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Abbreviations: A, agree; D, disagree; N, neutral; SA, strongly agree; SD, strongly disagree.

Comments

What have you gained/benefited most through this workshop? (Please write your comments completely inside the box below)

What changes would you make to the workshop to meet your learning needs?

Based on your experience in this workshop, do you have further questions about medical science or a career in health profession?

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^a Stat Corp, College Station, Texas.

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