
Anatomy Outreach Days: One Approach to Large-Scale Anatomy Outreach Events

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Abstract

The Anatomy Outreach Program (AOP) at The Ohio State University aspires to enhance anatomical knowledge and appreciation of the human body through interactive laboratory experiences. In May 2022, the AOP held a 3-day outreach event called Anatomy Outreach Days (AOD). AOD exposed more than 300 high school students across Ohio to various human anatomical donor materials, a facilitator panel, and an anatomy-themed game room. Anatomy Outreach Team (AOT) members were recruited to facilitate the different activities with student participants. AOT facilitators guided students through nineteen anatomy stations across five laboratory spaces, spending roughly ten minutes per station. At these stations, students were taught using human anatomical donor materials such as hearts, lungs, and joint prostheses or participated in activities like listening to heart sounds. Post-event Likert-based surveys evaluating student and teacher experiences of the event were distributed following the event; 48 student responses and 7 teacher responses were received. Participant satisfaction with their experience at AOD was rated as 'excellent' with a score of 4.56 for students and 4.86 for teachers. The survey results also showed that students and teachers would highly recommend AOD to their peers. It was concluded that the logistical format of AOD at The Ohio State University was conducive to a positive experience for student and teacher participants.

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Key words: anatomy education, outreach, educational outreach, high school students, outreach events

Introduction

Anatomy educational outreach programs (AEOPs), such as the Division of Anatomy's Anatomy Outreach Program (AOP) at The Ohio State University, act as a mechanism for university scientists to engage educators, students, and the public in a more rigorous scientific dialogue. These programs benefit participants by providing supplemental science learning experiences for students, granting teachers access to new methods of exploring and building knowledge, and fostering positive teaching and communication skills for scientists, graduate students, and other facilitators (Tanner et al., 2003). Outreach programs in STEM (Science, Technology, Engineering, and Mathematics) have been found to share some common goals, including increasing overall student participation in STEM, promoting science, supporting science teaching, and encouraging interest in education and career aspirations (Husher, 2010). More specifically, AEOPs cited within the literature shared common goals of increasing interest and participation in the anatomical sciences by familiarizing students at all levels with anatomical concepts, improving awareness of the links they share with everyday

life, and introducing anatomy as a possible career option (Cook et al., 2020; Houtz & Quinn, 2006). The AOP works to uphold these goals and positively impact the community while embracing its mission to enhance anatomical knowledge and appreciation of the human body.

Much of the existing literature surrounding STEM outreach programs (AEOPs included) focuses on program descriptions and anecdotes from program leaders and, while these references are essential and valuable, there is very little quantifiable information for comparison with new programs or studies (Bogue et al., 2012; Laursen et al., 2007). Millar et al. (2019) stated: "Although this approach has led to some understanding of outreach programs it underplays the level of complexity in running outreach programs and leaves a gap in understanding how student identity and aspirations toward science are supported in science outreach." Examples of anatomy-specific programs from the literature highlight the use of short-duration, small-scale (e.g., 1-2 hours and small groups of 50 or less at one time) events held across several months that are often successful and, like the AOP's

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traditional session, they represent only one modality (Adams et al., 2020; Cale et al., 2023; Diaz et al., 2019; Hubbard et al., 2005; Ruth et al., 2023). This study aims to fill a gap in the literature focusing on a large-scale anatomy educational outreach event, a modality that is relatively absent from the literature. An emphasis will be placed on program planning, logistics, and participant satisfaction. Through this project, we hope to create a reference point for future events and research specific to the interests and attitudes of participants concerning participation in large-scale outreach events.

The Anatomy Outreach Program (AOP) at The Ohio State University serves hundreds of high school students across Ohio year-round, offering human anatomical donor lab visits and opportunities to discuss education and career paths within healthcare and science. During the 2021-2022 academic year, the AOP hosted in-person, hands-on anatomy outreach sessions for over 400 students enrolled in anatomy or other high school science courses. A typical anatomy outreach session lasted 1–2 hours, including an introduction to the lab and safety practices plus 4 interactive stations (central nervous, cardiopulmonary, musculoskeletal, and gastrointestinal systems; see Table 1 for station descriptions). Each station had specimen trays, probes, and a myriad of anatomic specimens. During the session, all students were given gloves and were encouraged to be hands-on with the various anatomic materials. This allowed students to explore the anatomy of different organs and systems on healthy specimens that could

subsequently be compared to specimens with pathologic or surgical changes that alter the organ’s appearance, structure, or function. Facilitators were instructed to introduce themselves and their station topic to the participants and to choose a starting place for the station (e.g., the anatomic features of the healthy human heart). From that starting point, we encouraged facilitators to allow student questions to guide the topics of discussion while maintaining relevance to anatomy, medicine, and education.

Table 1. Descriptions of topics and materials used for AOP outreach session stations prior to AOD 2022.

Station	Station Topic	Anatomic Specimens/Materials Used
		Description of Station
1	Anatomy of the Brain and Eyes	Brain with good Gyri and Sulci, Brain in Midsagittal Section, 2 set of eyes.
		Identify and describe anatomic features & functions of brain, cerebellum, and brainstem, including lobes, fissures, major gyri & sulci, blood supply, & cranial nerves. Describe the anatomy of the eye.
	Anatomy of the Lungs and Lung Pathologies	Respiratory system en bloc (Hyoid bone, larynx, trachea, bronchi, & lungs), mature adult healthy lungs, lungs from young adult. Healthy, smoker, and cancerous lungs. Pleural effusion/pericarditis. Lungs with adenocarcinoma.
		Describe the anatomy of the lungs and bronchial tree. Compare and contrast mature and young adult lungs. Compare and contrast healthy lung with lung pathologies.
2	Liver Anatomy and Pathologies	Healthy liver and gallbladder. Pathology specimens (early-stage liver cancer, late-stage liver cancer, liver with alcoholic cirrhosis, pigmented gall stones).
		Discuss the anatomy and functions of the liver and gall bladder. Discuss differences between healthy liver and liver pathologies. Describe the formation of gall stones and the different types.
	Anatomy of the Kidney	Healthy mature kidney, healthy kidney from young adult, horseshoe kidney.
		Demonstrate the anatomy of the healthy kidney. Compare adult kidney to young adult and cystic kidneys. Describe the formation of a horseshoe kidney.
Female Reproductive Anatomy	3 isolated uteruses.	
	Discuss parts and functions of uterus, fallopian tubes, and ovaries.	
3	Full prosected donor	Fully prosected donor, emphasis on musculoskeletal system and neurovasculature in the limbs. Face and external genitalia always covered.
		Discuss the anatomy of the anterior thigh, including muscles and neurovasculature. Use femoral triangle to show difference between artery, nerve, and vein. Station often used to discuss and answer questions about body donation and donor preservation.
	Joints & Joint Replacements	Joint prosections: Shoulder, elbow, hip, & knee..Hip & knee replacement prosections.
		Explore various joints, describing associated bones, ligaments, and special relationships. Compare and contrast healthy, arthritic, and replacement joints.
4	Anatomy of the Heart	3 healthy hearts with varying levels of dissection.
		Demonstrate the internal and external features including coronary vasculature of the heart. Discuss size and orientation within thorax.
	Cardiovascular Pathology	1 healthy heart. Hearts with various pathologies/surgical interventions: enlarged heart, LVAD, LVAD with mitral valve replacement, pacemaker, stent, double CABG, & sternum with scar tissue from open heart surgery. Isolated abdominal aortic aneurysm & abdominal aorta with plaque buildup.
		Compare and contrast healthy heart with heart pathologies and surgical interventions. Discuss purpose of surgical interventions, and implications of vascular disease/conditions.

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Over the past few years, discussions with teachers and student participants highlighted areas for improvement and expansion of the existing outreach session that would allow the program to evolve into something larger and more robust. To create a more dynamic and meaningful anatomy outreach event for participants, the AOP redesigned the existing Anatomy Outreach Days (AOD) held for many years at the beginning of May. In previous years, AOD was limited to a 1-hour laboratory session with anatomy graduate student facilitators for each participating school group. The new AODs were scheduled for early May of 2022, hoping that students nearing the end of their anatomy coursework could have one final experience to solidify their knowledge and interest in anatomy and healthcare. AOD was expanded from 1 one laboratory space with 4 system-based stations to 5 laboratory spaces with 19 unique stations, consisting of hands-on human anatomical donor material stations, panels, and skill-based activities (Table 2). Through this expanded outreach event, the AOP could cover more anatomical regions with more human anatomical donor materials and activities than any other outreach event hosted by the group previously.

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Room Number & Topic	Station Topic	Anatomic Specimens/Materials Used
		Description of Station
1: Central Nervous System (CNS)	Protection of the CNS	Skull models, Vertebral Column model, Brain with Meninges, Brain & Spinal Cord with Meninges, CSF Ventricular Model
		Describe the anatomic structures that surround and protect the components of the CNS. Discuss CSF production, flow, reabsorption, and functions.
	Anatomy of the Brain	Brain with good Gyri and Sulci, Brain in Midsagittal Section
		Identify and describe anatomic features & functions of brain, cerebellum, and brainstem, including lobes, fissures, major gyri & sulci, blood supply, & cranial nerves.
Anatomy of the Spinal Cord	Laminectomy prosection, isolated spinal cords.	
	Explore the gross anatomy of the spinal cord.	
2a: Game Room	Category is... Anatomy!	AOT prepared trivia questions to quiz students on anatomy & physiology topics.
		Participants form two groups and compete to win prizes.
	Mystery Bone Boxes	10 boxes with 1 bone model in each, e.g., sacrum, ulna, & tibia.
		Participants place hands into boxes through a small slit and try to determine the bone by touch only.
Skelly Says	Articulated Skeleton Model, notecards with actions.	
	Student work together to perform muscle actions and determine which muscle(s) are responsible.	
2b: Facilitator Panel	College & Beyond	--
		3-4 facilitators answer participant questions. Topics could include life in college, picking a major, gap years, pre-programs, clubs & activities, etc.
3: Musculoskeletal System (MSK)	MSK Anatomy: Anterior Thigh	Donor with dissected lower limb.
		Discuss the anatomy of the anterior thigh, including muscles and neurovasculature.
	MSK Anatomy: Anterior Arm & Pectoral Region	Donor with dissected upper limb.
		Discuss the anatomy of the anterior arm and pectoral region, including muscles, major branches of brachial plexus, and axillary artery.
Joints & Joint Replacements	Joint prosections: Shoulder, elbow, hip, & knee. Hip & knee replacement prosections.	
	Explore various joints, describing associated bones, ligaments, and special relationships. Compare and contrast healthy, arthritic, and replacement joints.	
4a: Cardiovascular System	Anatomy of the Heart	3 healthy hearts with varying levels of dissection.
		Demonstrate the internal and external features including coronary vasculature of the heart. Discuss size and orientation within thorax.
	Cardiovascular Pathology	1 healthy heart. Hearts with various pathologies/surgical interventions: enlarged heart, LVAD, LVAD with mitral valve replacement, pacemaker, stent, double CABG, & sternum with scar tissue from open heart surgery. Isolated abdominal aortic aneurysm & abdominal aorta with plaque buildup.
		Compare and contrast healthy heart with heart pathologies and surgical interventions. Discuss purpose of surgical interventions, and implications of vascular disease/conditions.
Heart & Lung Sounds	10 stethoscopes, diagrams for pulse points and heart/lung sounds. Heart model. Sanitizing wipes and hand sanitizer.	
	Go over proper use of stethoscope. Demonstrate the four auscultation areas for the aortic, pulmonic, tricuspid, and mitral valves, and the common respiratory auscultation areas.	
4b: Respiratory System	Lungs In-Situ	Mediastinum/thorax prosection.
		Demonstrate the boundaries of the pleural spaces and relationships to other structures. Explore the locations/functions of the esophagus, aorta, sympathetic chain, phrenic and vagus nerves.
	Anatomy of the Lungs	Respiratory system enbloc (Hyoid bone, larynx, trachea, bronchi, & lungs), mature adult healthy lungs, lungs from young adult. Bronchial tree model.
		Describe the anatomy of the lungs and bronchial tree. Compare and contrast mature and young adult lungs.
Lung Pathologies	Healthy, smoker, and cancerous lungs. Pleural effusion/pericarditis. Lungs with adenocarcinoma.	
	Compare and contrast healthy lung with lung pathologies.	
5: Digestive & Urogenital Systems	Anatomy of the Digestive System	Isolated digestive system prosection (Distal esophagus to anus, includes accessory organs, abdominal aorta, IVC, and kidneys.) Pathology specimens (early-stage liver cancer, late-stage liver cancer, liver with alcoholic cirrhosis, pigmented gall stones).
		Discuss the anatomy and functions of the digestive tract and accessory organs. Discuss differences between healthy liver and liver pathologies. Describe the formation of gall stones and the different types.
	Anatomy of the Urinary System	Healthy mature kidney, urinary system enbloc (isolated kidneys, ureters, and bladder), healthy kidney from young adult, horseshoe kidney, cystic kidney.
		Demonstrate the anatomy of the healthy kidney, ureter, and bladder., Compare adult kidney to young adult and cystic kidneys. Describe the formation of a horseshoe kidney.
Anatomy of the Reproductive Systems	Bisected female and male pelvis (external genitalia covered), 3 isolated uteruses.	
	Identify the components of the internal reproductive organs, showing relationships to urinary and digestive system structures. Discuss parts and functions of uterus, fallopian tubes, and ovaries.	
Hallway	Photo Booth	Backdrop, tripod with cellphone attachment, articulate skeleton in lab coat.

Table 2. AOD 2022 activity station descriptions

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Important goals of AOD 2022 were to determine student and teacher satisfaction with the event, identify areas of improvement, and gather data surrounding participant characteristics and academic/career goals. Based on prior experience of running AOD, it was expected that teachers and students would have high satisfaction with the event and would be very likely to recommend it to a peer. The authors made no predictions regarding participant characteristics and academic/career goals, as this data was being collected from AOD participants for the first time.

AOD 2022 was designed to allow participants to be hands-on with healthy and pathological human anatomical donor materials and to explore healthcare with our dedicated and insightful facilitators. As discussed by Clark and colleagues (2016), hands-on outreach sessions are a more effective way to facilitate student understanding of physiology than didactic-style learning. Additionally, the hands-on experience that AOD provided for the students enabled us to highlight the human body's complexity, which can be challenging for the students to appreciate from textbooks and 2D images. We hoped that the AOD provided a memorable experience for students that could elicit or solidify their interest in science and anatomy or confirm their future academic/career goals. With our goal in mind, we developed and distributed a post-event survey for students and teachers after the hands-on graduate/professional student-led outreach event.

Methods

Research Approval

This project was approved by the Institutional Review Board (Approval #2022B0140) of The Ohio State University, and informed consent was obtained from all respondents.

Volunteer Facilitators

Each AOD station was led by one or more facilitators of the Anatomy Outreach Team (AOT). The AOT consists of over 100 dedicated health professional students (e.g., medical, dental, etc.), undergraduate students, and anatomy graduate students at The Ohio State University who volunteer their time to teach and inspire others through their love and passion for human anatomy.

Outreach (Student) Participants

AOD had more than 300 high school student attendees from 13 schools across Ohio, with an average round trip of 92.7 miles to participate in this enriching event.

Planning & Pre-event Timeline

The planning for this outreach event started months before AOD to ensure we had adequate time to solidify the details, identify needs, and assign tasks. In January and February, the AOP administrative team met on several occasions to discuss the specific times and dates when the event was to be held, which laboratory spaces the event would utilize, what groups

would be invited to participate, and a simple description of what activities would be included. The AOD was scheduled for May 4 and 5, 9:00 AM-3:00 PM, and May 6, 9:00 AM-12:00 PM, during which 5 laboratory spaces able to hold up to 50 participants were set up with activity stations.

At the beginning of March, the event details were emailed to teachers and program directors with whom the AOP had previously worked but who had yet to attend a traditional session in the same academic year. This email also included directions for scheduling, which was handled via email by asking teachers to provide a rank order list of preferred dates and times and the number of students anticipated to attend. The administration team worked to assign sessions to each school group, taking careful consideration of their submitted preferences. Emails confirming these details were sent out by the middle of March along with information for preparing students for the event, parking and arrival instructions, and waiver of liability and photo release forms required for all event participants.

At the beginning of April, recruitment of facilitators to lead the stations began via email, and a handful of AOT members volunteered their time to plan the specifics of the activities, create and post signage, and help set up and tear down for the event. The activities and stations were designed to provide a varied experience for participants that incorporated the central themes of science and medicine throughout the event. In addition to learning about the human body through healthy and pathologic anatomic specimens, students had the chance to learn more about the anatomy outreach and body donation programs at The Ohio State University. The week before the event, each participating high school teacher received final details and instructions, a short orientation video, and a reminder to submit all necessary forms. To accommodate the large number of students during AOD, each high school teacher was given a unique schedule that allowed them to cover all stations without overlapping with other student groups.

Event Content

Lab spaces dedicated to the body systems were arranged with 3 stations administered by 1 or 2 facilitators. The tools needed to work with human anatomical donor materials were provided at laboratory tables, including specimen trays, probes, wetting solution, and paper towels. Within each lab space, boxes of gloves and trash cans were arranged near the entrance and exit, and chairs/stools were placed near each lab table. To simplify the material and topics for facilitators, a digital anatomic atlas of the AOD specimens with photos, descriptions, diagrams, and links to more information was provided before the event. Additionally, labels were affixed to each specimen container with a brief description of what to describe and what anatomic features were most prominent on that specimen.

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Each high school class had 30 minutes per lab space, or roughly 10 minutes per station, where they were encouraged to ask questions, interact with the facilitators, and, if they felt comfortable, handle the human anatomical donor materials (Figure 1). The game room and facilitator panel were designed to give the students a break from the sights and smells of the donor labs while providing an engaging activity. Activities and material are described in Table 2; for more detailed descriptions, please contact TR (corresponding author).



Figure 1. (a) Students attempting to identify the bone in the mystery boxes. (b) Students learn how to use stethoscopes to listen to sounds of the heart and lungs. (c) High school students are engaged in learning about the respiratory system at three different stations. (d) Dental student teaching about the anatomy of the brain.

Post-event Survey

Student and teacher perspectives of AOD 2022 were assessed using a post-event survey administered via Qualtrics XM (Qualtrics International Inc., Provo, UT). The student post-event survey consisted of 20 questions of which half focused on student demographics and academic/career goals and the remaining ten questions related to event satisfaction, suggestions, and student perception of the experience (Appendix 1). The teacher post-event survey consisted of

16 questions related to event satisfaction, suggestions, scheduling, communications, and perceived benefits for students (Appendix 2). Details regarding consent to participate in the research study and completion of the post-event survey were sent to teachers by email the Monday following AOD 2022 for distribution to students (and their parents/guardians).

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Data Collection and Analysis

The post-event survey was closed two weeks after it was distributed, and the data collected was then exported from Qualtrics XM. Survey data were de-identified, cleaned, and organized using Microsoft Excel (version 16, Microsoft Corp., Redmond, WA) before being exported to SPSS for statistical analysis (version 27, IBM Corp., Armonk, NY). Qualitative data was organized and assigned to categories based on the whole of the responses, and then codes were assigned for categories to allow for frequency calculations.

Data Security

All data were de-identified and maintained on an external hard drive in a locked file cabinet within the Division of Anatomy.

Results

The survey used to evaluate AOD 2022 received 48 valid student responses and 7 teacher responses from the 332 individuals who attended the event giving a total response rate of 16.6%. The average age for students was 17.2 years, and the majority were in the 11th (37.5%) or 12th (50%) grades. Student ethnicity was primarily reported as Caucasian (75.0%), with other responses including African American (10.4%), Asian (6.3%), and other (8.3%). In terms of academic coursework, 42 out of 48 student respondents (87.5%) reported taking an anatomy and physiology course during their high school career; other popular science courses included chemistry (66.7%) and biology (41.7%; Table 3).

Science Course	Number of students who reported taking course <i>n</i>	Percent of Cases (out of 48) %
Anatomy & Physiology	42	87.5
Chemistry	32	66.7
Earth Science	11	22.9
Biology	20	41.7
Environmental Sciences	2	4.2
Physics	1	2.1
Astronomy	4	8.3
Other	10	20.8

Table 3. Self-reported science courses taken in high school by study participants; the question was designed as 'select all that apply'

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A portion of the survey focused on academic and professional school plans to gauge where students' interests lay with regard to higher education. Most students (77.1%) wanted to earn a bachelor's degree. In comparison, fewer chose to pursue an associate degree (4.2%) or technical school (2.1%), and some students (16.7%) had no academic plans following high school (Figure 2). When asked about

attending professional school (e.g., medical or dental school), respondents were split down the middle, with 24 stating a desire to attend a professional program and 24 who did not. Of those planning to attend a professional program, medical school was the most popular, with 11 responses, followed by physical therapy (6) and other degrees (6; Figure 3).

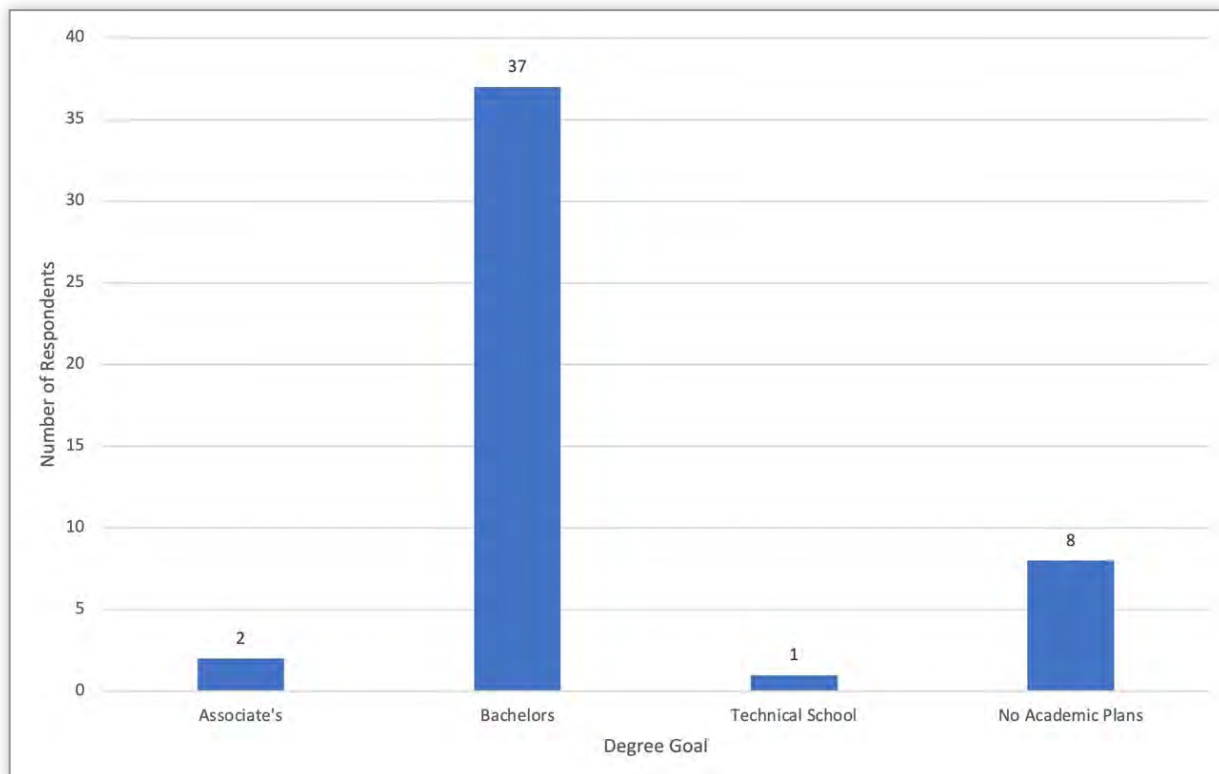


Figure 2. Student participant responses to "What are your academic plans following high school?"

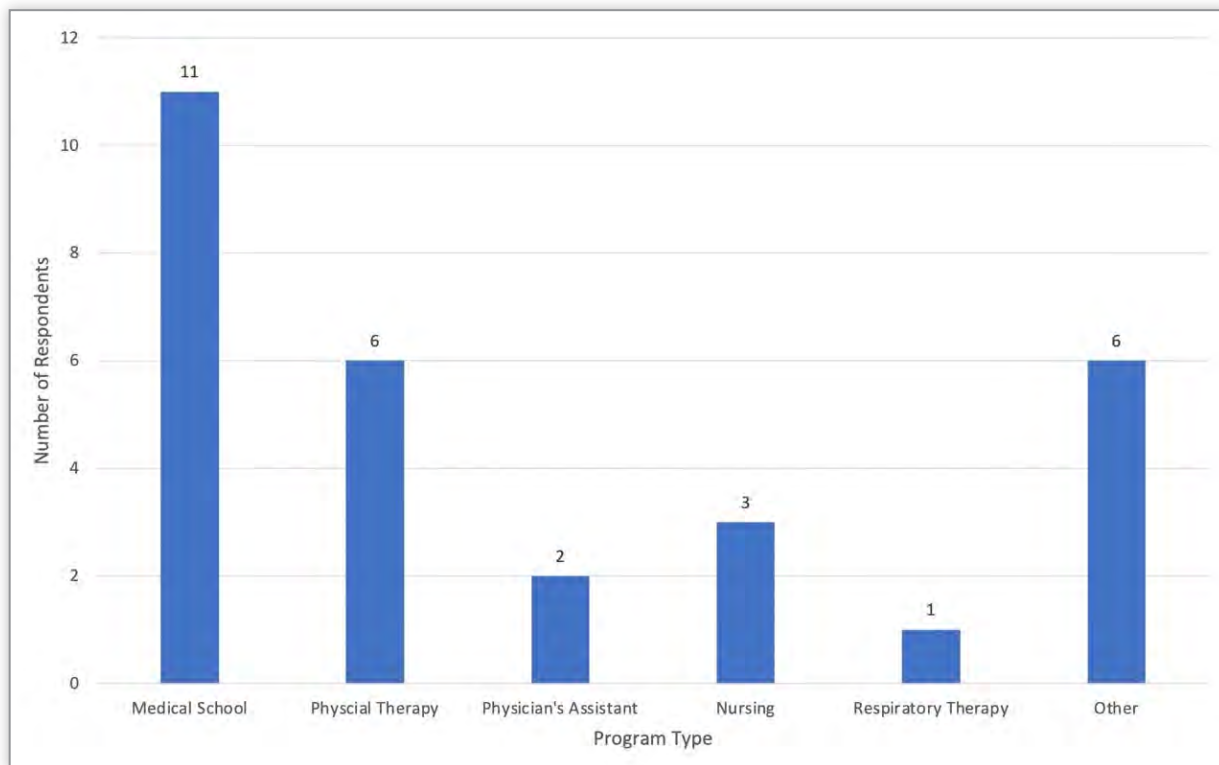


Figure 3. Student participant responses to "Which type of [professional] program/school do you intend to attend?"

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We asked both students and teachers to rate the experience at AOD 2022 and if they would recommend the experience to a fellow student/teacher in the future. On a scale of 1 (poor) to 5 (excellent), students rated the event at 4.56, and teachers rated the event at 4.86. When asked about recommending the event to others, students averaged 4.65, and teachers averaged 5.00, with 1 being very unlikely and 5 being very likely.

The post-event survey had several open-ended questions to gauge the rationale for responses and to collect suggestions and general comments about programming. These questions also explored respondents' perceptions of the most and least

educational activities. Student and teacher responses are summarized in Tables 4, 5 and 6.

Most teacher respondents (71.4%) reported that all activities were educational, while 27 students (56.3%) found the organ stations to be the most educational. Both groups had a large proportion that reported the game room (or a component of the game room) as the least educational activity, with 4 teacher responses (57.1%) and 14 student responses (29.2%). Students suggested changes to activities (11), changes to timing (8), and adding a break to the day's schedule (2). Teachers followed suit, suggesting station changes, length of activities, and adding a break to the schedule.

Response Theme	Number of Responses	Selected open-ended responses
Student (n = 41)		
All Activities	8	"All of them, I think I learned something new in every room"
Facilitator panel	3	"I thought that the student panel was very helpful for me"
Organ Systems	27	"I found the pathology of the organs most educational because it allowed me to compare abnormal organs to healthy ones, as well as what caused them to be abnormal."
Anatomy Trivia	3	"My favorite part of the activities was playing the Jeopardy game of the different systems."
Teacher (n=7)		
All Activities	5	"Really all of it. Most of my students have not been exposed to high level science and most won't go to college so the experience could have a huge influence in their lives."
Facilitator panel	1	"Even the diversity of the team of students was appreciated. The Q and A section was really informative. Every person was on top of their game and so approachable."
Organ Systems	1	"The hands-on lab experiences were most educational."

Table 4. Which activity did AOD participants perceive to be the most educational?

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Response Theme	Number of Responses	Selected open-ended responses
Student (n = 44)		
Urinary & Reproductive Systems	4	"If I had to choose my least favorite part, it would have been the urinary system just because it doesn't interest me."
Games	14	"the game room... I enjoyed having a break but was not able to participate in the activities, therefore I was happy to move out of this room and on to new labs."
Brain	2	"The entire nervous system because it was repetitive at each station and I had already learned all of it."
Heart	1	"I feel like they were all equally educational i just knew more about some of them then others so probably the heart."
None	23	
Teacher (n=7)		
Urinary & Reproductive Systems	1	"Reproductive was good but i think it lacked detail and reality to the topics that they would want to learn more about."
Games	4	"The games were great but of all the things we did that day, they were the least helpful as I could have done them in my classroom."
Heart & Lungs Sounds	1	"The blood pressure station was a little hard to do/hear."
None	1	

Table 5. Which activity did AOD participants perceive to be the least educational?

Response Theme	Number of Responses	Selected open-ended responses
Student (n = 44)		
Timing	8	"Timing, there were a few stations that did not get finished with the section they were teaching."
More facilitator availability	1	"Allow for more openness fore students"
More activities	11	"Something I would like to have done is go to the morgue."
Add a break	2	"I would make it a little less repetitive and maybe provide some sort of snack because I know my entire class was very hungry"
Event Logistics	1	"Maybe go from the third floor to the second, work your way down so it's easier for teachers to get students where they're going without confusion"
No Changes	21	
Teacher (n=7)		
More Time	1	"Longer sessions. Maybe closer to 45 minutes?"
More Specimens/ Content	3	"Increase exploration of reproductive system" "More specimens that deal with smoking and illegal substances"
Add a Break	1	"The three hours was great, but kids need a reboot. Some sort of snack (which I know is difficult in the anatomy building) would have given them a boost."
No Changes	2	

Table 6. What changes to AOD were suggested by participants?

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Discussion

Examples of anatomy outreach programs that have benefitted student participants, teachers, and facilitators can be found in literature. These programs provide unique opportunities to interact and learn about the human body and medicine using various methods, such as small group hands-on anatomy lab experiences, summer camps, and workshops (Cook et al., 2020; Houtz & Quinn, 2006; Meyer et al., 2018). Benefits include enhanced interest and student engagement in science, providing teachers with new methods of navigating and building knowledge on complex topics, and supporting facilitators' positive communication and teaching skills (Laursen et al., 2007; Tanner et al., 2003). It is important to recognize that outreach programs focused on anatomy, science, and STEM can potentially transform students' understanding and interaction with these subjects (Clarke et al., 2019; Ruth et al., 2023). Therefore, it is crucial to continue researching and exploring new approaches and methods, such as AOD 2022, to advance this field further. By learning from these experiences and improving our outreach strategies, we can generate greater student engagement in pursuing education and careers related to anatomy, science, and healthcare.

The AOD event was unlike other anatomy outreach events put on by the AOP, given that it accommodated so many students in a short time and provided more learning opportunities. By sharing this event's details and outcomes, we provide a framework for other programs to build similar experiences for anatomy students in their spheres of influence. Further work is needed to understand how large-scale events such as AOD 2022 impact students' interests in anatomy and the medical field and how much educational utility they hold for participants. Now that we understand the logistics and management of this event, we can shift our focus in this direction.

Part of the post-event survey focused on participants' academic plans following high school, and a surprising number stated a desire to pursue a bachelor's degree and a professional degree. The most common professional degree program selected by students was medical school, while other programs included physical therapy, physician assistant, and respiratory therapy. This information is helpful in several ways. It highlights the interests of our participants and identifies where we can improve programming to meet these interests. Additionally, this aids us in our facilitator recruitment process, identifying areas where we can improve the diversity of professional students we have present at our large-scale events.

A limitation of this study is that a survey was not conducted to look at these same questions from students before AOD. A pre-event survey may have allowed us to determine if there was a change in the academic goals or perceptions of anatomy content following the event. Post-event

evaluations often show high participant satisfaction with outreach activities and positive attitudes toward STEM; this may indicate that only using post-event surveys may lead to misinterpretation of data that could be mitigated with a counterpart pre-event survey (Vennix et al., 2018). However, it should be noted that most respondents were in their third or fourth year of high school. As a result, the impact of the three-hour anatomy-themed event may have been less significant for these students compared to younger participants.

Additionally, the study is limited by the low response rate, with only 16.6% of participants providing feedback. This raises the concern that the data collected may only partially represent the population. While most responses and comments were positive, it is important to consider that those who chose to participate in the study may have been more motivated and engaged. To gain a more comprehensive understanding of the event's impact, future evaluations should aim to increase the response rate and gather feedback from a broader range of participants.

A byproduct of the anatomy lab experiences is an environment where participants can meet and interact with facilitators with similar backgrounds and aspirations. On multiple occasions, students expressed that they enjoyed and appreciated having the opportunity to interact with the facilitators. One student said, "the students working the stations were very upbeat which made the overall experience that much better and I didn't dread going to the next station in fact was excited to continue learning." Another stated: "I loved to see how much knowledge the staff and students had about anatomy and how inviting they were to my class." Teachers also noted the positives of having their students interact with our facilitators: "The student panel was very informative. The team was very down-to-earth and relatable to us. Not pretentious in any way. Fun and approachable."

Open-ended questions measured the activities participants found the most and least educational. In most areas, students and teachers agreed that the organ system stations, or all activities, were the most educational. These stations were designed to be the event's focal point, so these results support our intentions. A few students and teachers discussed how the facilitator panel allowed students to interact with professional students and ask questions about their path to medical school, undergraduate majors and tips, and how to be successful in college, among other topics.

Surprisingly, the game room was the least educational activity reported by students and teachers, though this space often had the highest level of engagement and positive energy relayed from facilitators. The game room was designed to add a buffer to the AOD schedule and to give students a break from the anatomy labs for one of their rotations. The authors recognize that participants prefer the hands-on activities in terms of educational value but having the game room allowed us to adjust group schedules when groups arrived

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late for the start of the event or when groups needed to leave earlier than planned. The game room could easily be omitted or used to fill a gap, so it will likely have a place in future events regardless of feedback. However, the game room will be modified to try new games and activities to increase its educational nature.

The survey asked for changes that students and teachers may like to see in the future; outside of some changes to specific organ stations (e.g., urinary and reproductive stations). Given that most responses focused on logistics and timing of the event schedule, the AOP will work in the future to extend the time per activity and introduce a break (potentially for lunch) into the overall schedule. This will be done by extending the total time of the event from 3 hours to somewhere in the 4–5-hour range. Since there was no previous event of a similar scale to reference, the organizers had little guidance pertaining to the appropriate duration for the AOD. However, they aimed to make it longer and more intensive than the AOP's typical outreach sessions. Participant responses in this area helped corroborate the organizers' observations during the event and created a clear path for improvement for future AODs.

Planning for AOD 2022 presented several challenges, including when to plan the event and being considerate of the time of all groups. Because AOD was traditionally held at the end of the academic year, it conflicts with student, facilitator, and facilities schedules. Many high school students take end-of-year examinations, participate in sports activities, or participate in other end-of-year activities during May. We asked teachers if they could offer an alternative date for AOD, but few had suggestions, stating that they liked having this event at the end of the year when students could get the most out of it and that other times of year were equally hard to schedule. Lastly, accommodating time considerations for all groups was an inherent challenge. With more groups, more opportunities for late arrival or early dismissal impacted the overall event schedule. Because of this, buffer activities and flexibility were required on the part of the organizers and supervisors. Some groups mentioned that the time spent on each station was perfect, whereas others wished more/less time was spent on each station. In this regard, it can be challenging to address the needs of all attendees; we will continue to communicate with our partners to ensure all participants can get the most out of this experience.

Conclusion

Overall, AOD 2022 was a success as it was enjoyable and a great learning experience for our participants, facilitators, and organizers. Meyer and colleagues (2018) discussed the inherent benefit of an outreach day and 'hands-on' experience, relating it to higher scores in anatomy and physiology and helping solidify science understanding in schools without access to cadavers and dissection

opportunities. Similarly, we agree that outreach events help supplement the average high-school anatomy classroom, as these students can interact with human anatomic donors and ask questions related to human anatomy, pathologies, and medical interventions. In addition to the benefits participants see, the outreach days' benefits extend to facilitators lending the opportunity to practice teaching anatomy and engaging with younger people across various backgrounds (Clarke et al., 2019).

The AOD event was not without faults, nor will it be run in the future without making improvements, but for the first time running a large-scale outreach event, the AOP has no complaints. Both students and teachers have expressed their satisfaction with their experience in the anatomy labs, emphasizing their recommendation of it to others. This further supports the point being made. One teacher said, *"Tyler, Dr. Quinn, and every student that participated was very approachable and valuable. It really is an experience like no other and I cannot say enough good things! Thank you for EVERYTHING! It really gives my students an idea if this is an area of education they are interested in pursuing."* A student had this to say about their participation in the event, *"The [donors] were also incredible to see, it made the experience more humane, and it truly helped me reflect on my passion to pursue medicine. Overall, I found all of the organs we looked at incredibly educational, especially when we compared a healthy lung to a smoker's lung."*

The above are just a couple of glowing reviews the event received; numerous teachers and students expressed how much they learned, how surprised they were when viewing a specific specimen, or how much they enjoyed interacting with our facilitators. These words reinforce why we organize and host events such as this, so we may spark interest and solidify participants' desire to continue education in anatomy, science, or healthcare. The authors hope that the data and results reported here help other institutions find a scaffold to plan their anatomy outreach events so that we, as a field, may continue to give back to our communities.

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The authors would like to acknowledge the members of the AOT for their help in organizing and facilitating AOD 2022, the Division of Anatomy faculty and staff, and anatomic donors. Their commitment to outreach and anatomy education made this event possible. Thank you for allowing us to continue to give back to our community. Thank you to our participants and their teachers; we learned as much from this experience as you and will use that to continue improving our efforts for years to come.

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About the Authors

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Appendix 1: Student Post-Event Survey

Item	Response Format
Student Information and Academic/Career Goals	
1. What was your age on your last birthday?	[Drop Down]
2. Please select the gender with which you most identify:	Select all that apply: <input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> Nonbinary/third gender <input type="checkbox"/> Other (please explain) [Text box] <input type="checkbox"/> I would prefer not to answer
3. Please select your grade level:	[Drop Down] 9 th grade 10 th grade 11 th grade 12 th grade
4. Please select the ethnicity(ies) with which you most identify:	Select all that apply: <input type="checkbox"/> Black or African American <input type="checkbox"/> American Indian or Alaskan Native <input type="checkbox"/> Asian <input type="checkbox"/> Native Hawaiian or another Pacific Islander <input type="checkbox"/> White <input type="checkbox"/> Other (please explain) [Text box]
5. What courses have you taken or are taking currently (in high school) that are related to science?	Select all that apply: <input type="checkbox"/> Anatomy (and Physiology) <input type="checkbox"/> (AP) Biology <input type="checkbox"/> Physics <input type="checkbox"/> Earth Science <input type="checkbox"/> Chemistry <input type="checkbox"/> Forensics <input type="checkbox"/> Astronomy <input type="checkbox"/> Environmental Science <input type="checkbox"/> Other (please list any other science course you have taken in high school) [Text box]
6. What are your academic plans following high school?	Multiple choice: <ul style="list-style-type: none"> • Associate's degree (2 year) • Bachelor's degree (4 year) • Technical school • No academic plans • Other (please explain) [Text box]

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Item	Response Format
7. If you plan to enroll in a degree-seeking program of any kind, what is your intended major/topic of study? (if not applicable, please respond "N/A")	[Text box] –
8. Do you plan to attend a professional school/program following a traditional four-year degree? (eg. Medical or Dental school, Physical Therapy, Occupational Therapy, Physician Assistant, etc.)	Multiple choice: <ul style="list-style-type: none"> • Yes • No
9. If you answered "Yes," to above question which type of program/school do you intend to attend?	Multiple choice: <ul style="list-style-type: none"> • Medical school • Dental school • Physical therapy • Occupational therapy • Physician Assistant (PA) • Nursing • Respiratory Therapy • Other (please explain) [Text box]
10. In a few sentences or less, what do you see yourself doing for a career?	[Text box]
Program Satisfaction	
11. On a scale of 1 – 5, with 1 being poor and 5 being excellent, how would you rate your experience with the Anatomy Outreach Day 2022?	Multiple choice: <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5
12. In a few sentences or less please explain the rating you gave in the question above.	[Text box]
13. On a scale of 1 – 5, with 1 being very unlikely and 5 being very likely, how likely would you be to recommend the Anatomy Outreach Days to a classmate or friend that has not participated?	Multiple choice: <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5
14. In a few sentences or less please explain the rating you gave in the question above.	[Text box]
15. What activity or activities did you find the MOST educational?	[Text box]
16. What activity or activities did you find the LEAST educational?	[Text box]

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Item	Response Format
17. What are 2 to 3 aspects of the event that you think were most beneficial to yourself as a student?	[Text box]
18. What is something that you would change about Anatomy Outreach Day?	[Text box]
19. Is there any activity or topic that you would like to see covered in future events that was not included in Anatomy Outreach Day 2022?	[Text box]
20. Do you have any other suggestions or comments relating to the Anatomy Outreach Day as a whole?	[Text box]

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Appendix 2: Teacher Post-Event Survey

Item	Response Format
Program Satisfaction/Suggestions/Comments	
1. On a scale of 1 – 5, with 1 being poor and 5 being excellent, how would you rate your experience with Anatomy Outreach Day 2022?	Multiple choice: <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5
2. In a few sentences or less please explain the rating you gave in the question above.	[Text box]
3. On a scale of 1 – 5, with 1 being very unlikely and 5 being very likely, how likely would you be to recommend future Anatomy Outreach Days to a teacher/school that has not participated?	Multiple choice: <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5
4. In a few sentences or less please explain the rating you gave in the question above.	[Text box]
5. On a scale of 1 – 5, with 1 being very easy and 5 being very difficult, how would you rate the scheduling process for Anatomy Outreach Day 2022?	Multiple choice: <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5
6. In a few sentences or less please explain the rating you gave in the question above.	[Text box]
7. On a scale of 1 – 5, with 1 being very easy to understand and 5 being very difficult to understand, how would you rate the communications distributed by the Anatomy Outreach Program in preparation for Anatomy Outreach Day 2022?	Multiple choice: <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5
8. In a few sentences or less please explain the rating you gave in the question above.	[Text box]
9. Is there any information that you would have found helpful to have received prior to the event that you did not receive as a part of Anatomy Outreach Day 2022 advance communications? Please explain.	[Text box]

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Item	Response Format
10. From your perspective as a teacher, what activity or activities did you find the MOST educational for your students?	[Text box]
11. From your perspective as a teacher, what activity or activities did you find the LEAST educational for your students?	[Text box]
12. What are 2 to 3 aspects of the event that you think were most beneficial to students?	[Text box]
13. Is there a time of year (other than the 1st week of May) that would better accommodate your student group attending an event like Anatomy Outreach Day 2022? Please explain.	[Text box]
14. What is something that you would change about Anatomy Outreach Day?	[Text box]
15. Is there any activity or topic that you would like to see covered in future events that was not included in Anatomy Outreach Day 2022?	[Text box]
16. Do you have any other suggestions or comments relating to the Anatomy Outreach Day as a whole?	[Text box]

