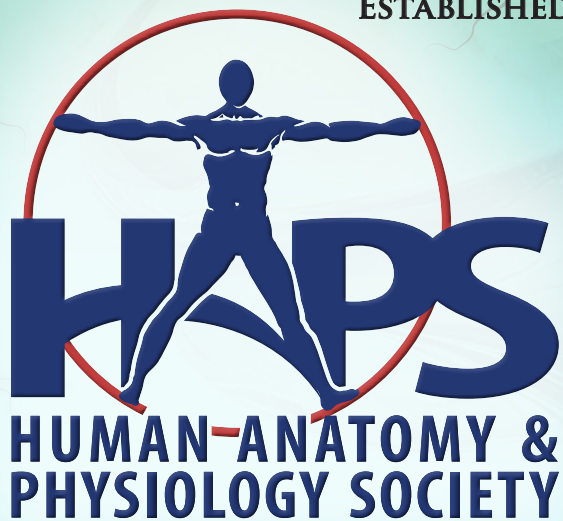


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# EDUCATOR

*Journal of the Human Anatomy and Physiology Society*

MARCH 2017

SPECIAL EDITION

**Instructional Goals and Practices  
in the Introductory Undergraduate  
Pre-Health Professions Anatomy  
and Physiology Laboratory**



  
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# Instructional Goals and Practices in the Introductory Undergraduate Pre-Health Professions Anatomy and Physiology Laboratory

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## Abstract

The Human Anatomy & Physiology Society (HAPS) sponsored two web-based surveys of introductory undergraduate anatomy and physiology (A&P) instructors in the fall of 2013 and 2016. The goal of both surveys was to document the current laboratory learning goals and instructional practices in the introductory A&P courses for nursing and allied health students as described in the HAPS *Course Guidelines for Undergraduate Instruction of Human Anatomy and Physiology*. A total of 105 participants, representing 98 institutions, responded to the 2013 survey, while 567 participants from 470 institutions responded to the 2016 survey. This descriptive study integrates the quantitative data from the 2013 survey with the complete results of the 2016 survey. The study validated a ranked list of 12 priorities for the laboratory experience and reports the frequency of specific instructional practices in histology, scientific inquiry skills, animal and human dissection, and physiology experimentation.

**Key Words:** Undergraduate, anatomy, physiology, laboratory

## Introduction

Why do we include a laboratory component in the introductory undergraduate anatomy & physiology (A&P) course sequence for nursing and allied health students? Discussion of this seemingly straightforward question among A&P educators reveals multiple perspectives and sometimes strongly held beliefs regarding the purpose of laboratory education. A clear understanding of the learning goals for the laboratory experience is critical as institutions work to improve and expand their A&P course offerings in both the on-campus and distance-learning environment. Any discussion of A&P learning goals must be viewed within the context of the instructional level of the course. For example, the learning goals for an undergraduate general education human biology course are different from a pre-professional allied health A&P course sequence, which further differ from biology majors-level anatomy or physiology courses. For clarity, the work described in this study aligns with the introductory undergraduate A&P courses for nursing and allied health as described in the Human Anatomy & Physiology Society (HAPS) *Course Guidelines for Undergraduate Instruction of Human Anatomy and Physiology* (2005).

Two questions frame the discussion of the introductory undergraduate A&P laboratory experience for nursing and allied health students. First, what are the foundational learning outcomes expected of all students in this curriculum, regardless of instructional format? Second, what are the best practices for meeting these learning outcomes? In order to explore these two questions, HAPS sponsored two surveys

of A&P instructors to gather information on the instructional goals and practices currently in use in undergraduate instruction. The detailed results of the first survey in 2013 were documented previously (HAPS 2014). The descriptive study documented in the present paper characterizes the current learning outcomes and practices in the undergraduate A&P laboratory as reported by instructors, and integrates the quantitative data from the 2013 survey with the complete results of a second survey conducted in 2016.

## Methods

### 2013 Online Survey

Members of the HAPS curriculum and instruction committee prepared a 36-question web-based questionnaire composed of both closed-ended and open-ended questions, with a file attachment option for one question. The questionnaire was developed through an iterative process from May to September 2013 and approved by the HAPS Board of Directors for implementation by the Executive Director. The questionnaire was produced using a commercial web-based form builder (JotForm) and made available for a four-month period from October 2013 to January 2014.

Participants were solicited using the websites of HAPS, the American Physiological Society (APS), and the American Association of Anatomists (AAA). Participation was voluntary and was not limited to membership in any organization. The questionnaire asked for each participant's name and email address; however, these fields were not required for survey

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submission. The instructions directed participants to respond only if they were “instructors for introductory undergraduate-level course sequences in human anatomy and physiology for the nursing and allied health student.” (HAPS 2014). Participation focused on this instructor population in order to gather data on courses corresponding to the HAPS *Course Guidelines for Undergraduate Instruction of Human Anatomy and Physiology* (2005).

Of the 111 total responses received, 105 unique participants from 98 different institutions were identified by name or institutional email domain. Multiple responses from survey participants were expected, as some instructors teach A&P at multiple institutions. The divisor (111, 105, or 98) used for the calculation of percentages in the data set was determined by the scope of the associated question. Questions related to an individual participant used a divisor of 105, while questions related to the institution used a divisor of 98. Percentages for questions that were independent of individual or institution used a divisor based on the total number of unique survey responses (111). Twelve survey questions asked participants to “check all that apply” and the percentages for each response within this question type were calculated independently and did not total 100%.

A subset of the survey data was presented in 2014 at the HAPS Eastern Regional Conference (Brashinger 2014a) and the HAPS Annual Conference (Brashinger 2014b). Verbal feedback collected during these two workshops was summarized and documented as part of the final data package for the survey (HAPS 2014).

## 2016 Online Survey

The HAPS Board of Directors authorized a follow-up to the 2013 survey in the summer of 2016. Based on the 2013 survey outcomes, the 2016 survey was revised by replacing all but three of the open-ended questions (Name, Email, and Institution) with closed-ended questions. During the analysis of the 2013 survey results, the responses to the open-ended questions were manually classified into categories. These categories were validated during the 2014 HAPS Eastern Regional and Annual Conferences (Brashinger 2014a, Brashinger 2014b) and then used as answer choices in the 2016 survey. Where possible, the question format was also changed from radio buttons to drop-down menus in order to improve the overall readability of the survey. Three closed-ended tabular questions were added to the 2016 survey to capture additional detail about instructional priorities, the perceived influence in course decision-making, and the performance of specific learning outcomes. The revised 31-question survey was produced using the same commercial web-based form as the 2013 survey and made available from October to December 2016. Participants were again solicited from, but not limited to, the membership of HAPS, APS, and AAA. Participation was voluntary, and participants

were automatically entered in a drawing to receive one of five Amazon gift cards, sponsored by ADInstruments, as an incentive to encourage participation. The survey instructions remained similar to those of the 2013 survey and targeted the same population of introductory anatomy and physiology instructors.

A total of 583 responses to the 2016 survey were received. Sixteen responses were determined to be duplicates, based on the participants' names and/or ISP addresses, and were excluded from analysis. Of the 16 excluded responses, 12 were incomplete duplicates and four were complete duplicate entries submitted weeks apart. It appeared that the participants had completed the survey twice for the same institution. In these cases, the latest submission to the survey was included in the analysis. Four participants did not provide a name or email address and the responses were presumed to be from unique participants from unique institutions. After the exclusion of duplicate entries, a total of 567 responses from 567 participants were included in the analysis. Unlike the 2013 survey data, no participants provided data for multiple institutions.

The institutional affiliation of 124 responses was not provided by the participants. In 105 cases, the institution was determined using the participant's email address. The remaining 19 responses could not be resolved by this method and were presumed to be from unique institutions. For university systems with multiple campuses, each campus was treated as a separate institution because different campuses may have unique instructional practices. For survey questions regarding the institution, the first response received for that unique institution was used in the analysis. For analysis of the 2016 survey data, 567 individuals representing 470 institutions were used for the calculation of percentages, unless otherwise noted.

## Survey Results

The responses to the closed-ended questions from both the 2013 and 2016 surveys are presented in tabular form with frequency and percentage calculations. The open-ended responses from the 2013 survey are not included in this report but are available from HAPS (2014).

## Survey Participants

A total of 105 participants, representing 98 institutions, contributed 111 unique responses to the 2013 survey. The response rate to the 2016 survey was higher, with a total of 567 participants from 470 institutions. Unlike the 2013 survey, no participants in the 2016 survey provided data for multiple institutions. The survey participants reported considerable experience in A&P education, and the overall profile of survey participants is consistent between the two surveys. Almost all of the 2016 survey participants held either a master's ( $n = 236$ , 42%) or terminal degree ( $n = 318$ , 56%) (Table 1).

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A majority of 2016 survey participants ( $n = 430$ , 76%) reported current membership in HAPS (Table 2). The 2013 survey asked only about HAPS membership (yes/no response) while the 2016 survey also included response options for AAA and APS

(check all that apply). Participant rates of membership in APS ( $n = 434$ , 77%) were similar to those reported for HAPS, but not for AAA ( $n = 61$ , 11%).

<b>Table 1. Highest degree obtained by survey participants</b>					
Survey Question <sup>a</sup> : Highest degree obtained at this time:					
	2013 Survey		2016 Survey		
Answer Choices	<i>n</i>	% <sup>b</sup>	<i>n</i>	%	
Bachelors (BA, BS, etc.)	3	3	5	1	
Masters (MS, etc.)	47	45	236	42	
Other Professional Degree or Certification	3	3	6	1	
Terminal Degree (EdD, MD, PhD, etc.)	51	49	318	56	
No Response	1	1	2	0	
Total <sup>c</sup>	105		567		
<sup>a</sup> Answer choices were the same but formatted as a radio button in 2013 and as a drop-down menu in 2016. <sup>b</sup> Percentages total greater than 100% due to rounding. <sup>c</sup> Total number of individual participants in each survey.					

<b>Table 2. Professional memberships of survey participants</b>					
2013 Survey Question: Are you currently a HAPS member? (yes/no; drop-down menu)					
2016 Survey Question: Are you currently a member of any of the following organizations? (select all that apply; check boxes)					
	2013 Survey		2016 Survey		
Answer Choices	<i>n</i>	% <sup>a</sup>	<i>n</i>	%	
American Association of Anatomists (AAA)			61	11	
American Physiology Society (APS)			434	77	
Human Anatomy & Physiology Society (HAPS)	80	76	430	76	
No Response	1	1	128	23	
<sup>a</sup> Percentages based on number of individual participants in each survey (2013, $n = 105$ ; 2016, $n = 567$ )					

The majority of participants in both the 2013 ( $n = 57$ , 54%) and 2016 survey ( $n = 308$ , 54%) had been in their current teaching position for more than 10 years (Table 3). In the 2013 survey, the question of job title was an open-ended response. The responses were manually classified into categories and the frequencies reported in tabular form. These categories were then used as the answer choices in the 2016 survey. The overall distribution of job titles is consistent for participants across both surveys (Table 4). The most common job title was professor, followed by instructor, associate professor, and assistant professor.

With respect to tenure and position term length, the overall distribution is consistent for participants across both surveys (Table 5). Participants most often reported their position as full-time, permanent, non-tenure track faculty. However, tenure-track/tenured positions were more prevalent in the 2016 survey. Survey participants who reported that their position was not permanent or was a special situation were asked to further indicate the duration of their teaching contract (Table 6). Approximately 70% or more of these temporary positions reported a term duration of one year or less.

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<b>Table 3. Duration in current position of survey participants</b>					
Survey Question <sup>a</sup> : How long have you been teaching in your current capacity?					
	2013 Survey			2016 Survey	
Answer Choices	<i>n</i>	%		<i>n</i>	%
Now in first year	4	4		7	1
1-2 years	4	4		19	3
3-4 years	9	9		68	12
5-6 years	11	10		56	10
7-10 years	19	18		105	19
>10 years	57	54		308	54
No Response	1	1		4	1
	Total <sup>b</sup>			105	567
<sup>a</sup> Answer choices were the same but formatted as a radio button in 2013 and as a drop-down menu in 2016.					
<sup>b</sup> Total number of individual participants in each survey.					

<b>Table 4. Job titles of survey participants</b>					
2016 Survey Question: My job title is best described as					
	2013 Survey <sup>a</sup>			2016 Survey	
Answer Choices	<i>n</i>	% <sup>b</sup>		<i>n</i>	%
Academic Leadership (Department/Program Chair, Dean)	6	6		33	6
Professor	28	27		144	25
Associate Professor	14	13		96	17
Assistant Professor	13	12		88	16
Instructor	18	17		116	21
Lecturer	5	5		36	6
Lab Coordinator	3	3		8	1
Adjunct Faculty	9	9		38	7
Other	5	5		7	1
No Response	4	4		1	0
	Total <sup>c</sup>			105	567
<sup>a</sup> In the 2013 survey, the question "Title" was an open text response. Answers were manually classified into categories. These categories were then used as the 2016 answer choices.					
<sup>b</sup> Percentages total greater than 100% due to rounding.					
<sup>c</sup> Total number of individual participants in each survey.					

<b>Table 5. Position status of survey participants</b>				
Survey Question <sup>a</sup> : My position is considered (2 questions)				
	2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	%	<i>n</i>	% <sup>b</sup>
Faculty, not tenure track	55	52	261	46
Tenure-track faculty	10	10	84	15
Tenured faculty	33	31	198	35
Staff or other non-faculty position	6	6	18	3
No Response	1	1	6	1
	Total <sup>c</sup>	105	567	
Full-time permanent	80	76	450	79
Part-time permanent	4	4	15	3
Full-time, not permanent	12	11	54	10
Part-time, not permanent	9	9	39	7
Visiting, short-term replacement, or other special situation	0	0	5	1
No Response	0	0	4	1
	Total <sup>c</sup>	105	567	
<sup>a</sup> Answer choices were the same but formatted as radio buttons in 2013 and as a drop-down menu in 2016. <sup>b</sup> Percentages total greater than 100% due to rounding. <sup>c</sup> Total number of individual participants in each survey.				

<b>Table 6. Appointment duration of non-permanent survey participants</b>				
Survey Question <sup>a</sup> : If your position at this institution is not permanent, what is the typical length of your teaching contract?				
	2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	%	<i>n</i>	% <sup>b</sup>
1 semester	8	38	33	34
1 year (two long semesters, or equivalent)	8	38	35	36
2-3 years	3	14	24	25
4-5 years	1	5	4	4
>5 years	1	5	0	0
No Response	0	0	2	2
	Total <sup>c</sup>	21	98	
<sup>a</sup> Answer choices were the same but formatted as radio buttons in 2013 and as a drop-down menu in 2016. <sup>b</sup> Percentages total greater than 100% due to rounding. <sup>c</sup> Total number of individual participants in each survey who responded to the previous question as a non-permanent position or special situation.				

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## Institutions and Programs

Participants were asked to describe both their institution and their anatomy and physiology courses. The overall profile of the institutions and courses is consistent between the two surveys. Approximately half of the institutions described in both the 2013 ( $n = 55$ , 56%) and the 2016 ( $n = 245$ , 52%) survey were identified as 2-year colleges (Table 7). Based on the 2016 survey, the majority ( $n = 349$ , 74%) of introductory

anatomy and physiology courses are taught in a two-semester combined A&P format, and this finding is consistent with the 2013 survey results (Table 8). Note that in Tables 8 through 10, the divisor used in the analysis of the 2013 data was 111 (the total number of survey responses) and not the total number of unique institutions (98). The number of unique institutions (470) was used as the divisor for analysis of the 2016 data in Tables 7 through 10.

<b>Table 7. Institutional profile</b>					
Survey Question: My institution is best described as (drop-down menu)					
	2013 Survey		2016 Survey		
Answer Choices	<i>n</i>	%	<i>n</i>	% <sup>a</sup>	
2-Year College	55	56	245	52	
4-Year College/University	36	37	205	44	
Technical/Vocational School <sup>b</sup>	4	4	7	2	
Professional School	2	2	6	1	
No Response	1	1	7	2	
	Total <sup>c</sup>		98	470	
<sup>a</sup> Percentages total greater than 100% due to rounding. <sup>b</sup> The answer choice in 2013 was "Technical College" and "Technical /Vocational School" in 2016. <sup>c</sup> Total number of unique institutions in each survey.					

<b>Table 8. Course sequence duration by institution</b>					
Survey Question <sup>a</sup> : How many semesters (or semester equivalents) is your introductory, undergraduate A&P course designed to span?					
	2013 Survey		2016 Survey		
Answer Choices	<i>n</i>	% <sup>b</sup>	<i>n</i>	% <sup>b</sup>	
1-semester A&P course	5	5	25	5	
2-semester combined A&P course	83	75	349	74	
2 semesters, but anatomy and physiology taught as separate courses	18	16	80	17	
>2 semester A&P course (including anatomy and physiology being taught separately)	0	0	14	3	
No Response	5	5	2	0	
	Total <sup>c</sup>		111	470	
<sup>a</sup> Answer choices were the same but formatted as radio buttons in 2013 and as a drop-down menu in 2016. <sup>b</sup> Percentages do not total 100% due to rounding. <sup>c</sup> Total number of individual responses in the 2013 survey. Total number of unique institutions in the 2016 survey.					

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Students commonly take the introductory undergraduate A&P course sequence in preparation for application to nursing or allied health programs. Participants in the 2016 survey reported that students most commonly enroll in the

A&P course at their institution in preparation for a nursing program ( $n = 445, 95\%$ ) (Table 9). Allied health ( $n = 346, 74\%$ ), kinesiology ( $n = 328, 70\%$ ), and professional programs ( $n = 320, 68\%$ ) were all commonly reported reasons for taking A&P.

<b>Table 9. Student career goal by institution</b>				
Survey Question: Students enroll in this course sequence in preparation for the following programs: (select all that apply; check boxes)				
	2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	% <sup>a</sup>	<i>n</i>	% <sup>a</sup>
Nursing	102	92	445	95
Kinesiology (physical therapy, sports medicine, health education, etc.)	76	68	328	70
Allied Health (EMT, medical imaging, medical technology, etc.)	86	77	346	74
Professional (PA, NP, medicine, dentistry, optometry, etc.)	71	64	320	68
Other (dental hygiene, nutrition, etc.)	81	73	311	66
No Response	5	5	0	0
<sup>a</sup> Percentage of individual responses in the 2013 survey ( $n = 111$ ) or unique institutions in the 2016 survey ( $n = 470$ ).				

Anatomy & physiology courses are conducted in a combination of face-to-face and online formats. The 2016 survey participants reported that the traditional face-to-face lecture and laboratory format is the most common instructional practice ( $n = 452, 96\%$ ) (Table 10). The “hybrid” configuration, where lecture is online but the laboratory experience remains on-campus, was reported at 19% ( $n = 87$ ) of institutions. Entirely online A&P courses are relatively uncommon ( $n = 43, 9\%$ ).

Both the 2013 and the 2016 surveys asked participants to provide additional details if they conducted their laboratory online. In the 2013 survey, participants were asked to select all that apply from the following options: computer simulations,

take-home lab kits, or other. Participants were provided an open-ended question to provide additional detail if they chose “other”. In the 2016 survey, the take-home lab kits option was subdivided into commercial lab kits and institutional-designed lab kits/activities to gather additional detail and replace the open-ended question. The combined data for this question from both surveys is provided in Table 11. For courses with an online laboratory component, computer simulations were the most common instructional method reported in the 2016 survey ( $n = 38, 69\%$ ), followed by institutional-designed kits and activities ( $n = 20, 36\%$ ) and commercial laboratory kits ( $n = 16, 29\%$ ).

<b>Table 10. Instructional format by institution</b>				
Survey Question: What lecture and lab instructional formats do you use? (select all that apply; check boxes)				
	2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	% <sup>a</sup>	<i>n</i>	% <sup>a</sup>
Both lecture and lab are face-to-face	100	90	452	96
Lecture is online, lab is face-to-face	23	21	87	19
Lecture is face-to-face, lab is online	2	2	17	4
Both lecture and lab are online	9	8	43	9
No Response	5	5	1	0
<sup>a</sup> Percentage of individual responses in the 2013 survey ( $n = 111$ ) or unique institutions in the 2016 survey ( $n = 470$ ).				

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<b>Table 11. Online laboratory formats</b>					
2013 Survey Question: If your lab is not face-to-face, do you use any of these? (select all that apply; check boxes)					
2016 Survey Question: If your lab is online, which methods do you use for the laboratory activities? (select all that apply; check boxes)					
		2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	% <sup>a</sup>		<i>n</i>	% <sup>a</sup>
Computer simulations	10	91		38	69
Take-home lab kits	5	45			
Other (please specify below)	4	36			
Commercial lab kits				16	29
Institution-designed lab kits and/or activities				20	36
No Response	0	0		5	9
<sup>a</sup> Percentage based on the total number of participants in each survey (11 and 55, respectively) who responded to the previous question as using an online lab.					

### Instructional Goals

The survey asked participants about the perceived prevalence of laboratory activities in the future, their priorities for the laboratory experience, the laboratory learning outcomes at their institution, and their perceived level of influence on those learning outcomes and instructional activities. In the 2013 survey, participants were asked the following open-ended question: Given the financial, space, and other priorities at your institution, do you expect labs to become more or less

prevalent in the next ten years? Participants provided a total of 103 text responses. The responses were manually sorted into three general categories: more prevalent ( $n = 17$ , 17%), stay the same ( $n = 55$ , 53%), and less prevalent ( $n = 31$ , 30%). This question was revised in the 2016 survey as a drop-down menu with those three choices and 89% of participants indicated they expected the prevalence of laboratory activities to remain the same or increase in the next 10 years (Table 12).

<b>Table 12. Future of laboratory activities</b>			
2016 Survey Question: Given the financial, space, and other priorities at your institution, do you expect anatomy and physiology laboratory activities to become more or less prevalent in the next ten years? (drop-down menu)			
		2016 Survey	
Answer Choices		<i>n</i>	% <sup>a</sup>
Less prevalent		60	11
Remain about the same		367	65
More prevalent		137	24
No Response		3	1
	Total <sup>b</sup>	567	
<sup>a</sup> Percentages total greater than 100% due to rounding.			
<sup>b</sup> Total number of responses to the 2016 survey.			

In order to gather information on participants' reasons for teaching the laboratory component of the introductory A&P course, the following open-ended question was included in the 2013 survey: In your opinion, is the laboratory component of the introductory anatomy and physiology courses necessary in achieving your learning goals? Participants provided 73 text responses to the question and the responses almost exclusively supported the necessity of the laboratory component. These responses were manually classified into 12 general categories, which were then discussed and refined at the 2014 HAPS Eastern Regional and Annual Conferences (Brashinger 2014a, Brashinger 2014b). Based on the 2013 survey results and follow-up discussion, the 2016 survey included a series of 12 Likert-type questions (5 point scale) to specifically examine each participant's priorities for the A&P laboratory experience (Table 13). Point values were assigned for the calculation of the mean value for each category. In descending order, the seven most important priorities were:

1. meeting program objectives (mean = 4.3)
2. teaching 3D and structure/function relationships (mean = 4.3)
3. reinforcing lecture content (mean = 4.2)
4. supporting the development of critical thinking (mean = 4.1)
5. engaging and exciting students on the topic of science (mean = 4.1)
6. providing opportunities for student-student interactions and learning (mean = 4.1)
7. providing opportunities for student-instructor interactions and learning (mean = 4.1)

Clinical knowledge, science inquiry skills, and science laboratory skills were rated the lowest priority (mean = 3.4). These data were also analyzed by ranking the categories according to the sum of the high priority and essential responses. Overall, the rankings were similar to those based on means, with the exception that critical thinking moved from 4th to 8th position and tactile/kinesthetic learning moved from 8th to 5th position.



<b>Table 13. Priorities for the A&amp;P laboratory experience</b>							
Survey Question: What are your priorities for the A&P laboratory experience? Please rate each of the following on the scale below (radio buttons)							
Category	$\bar{x}^a$	$n^b$	% <sup>c</sup>	Category	$\bar{x}^a$	$n^b$	% <sup>c</sup>
Critical Thinking	4.1			Reinforce Lecture Content	4.2		
1 – Not a priority		4	1	1 – Not a priority		0	0
2 – Low priority		23	4	2 – Low priority		15	3
3 – Medium priority		129	23	3 – Medium priority		71	13
4 – High priority		182	32	4 – High priority		238	42
5 – Essential		226	40	5 – Essential		242	43
No Response		3	1	No Response		1	0
Clinical Knowledge	3.4			Tactile/Kinesthetic Learning	4.0		
1 – Not a priority		18	3	1 – Not a priority		13	2
2 – Low priority		94	17	2 – Low priority		27	5
3 – Medium priority		205	36	3 – Medium priority		95	17
4 – High priority		168	30	4 – High priority		217	38
5 – Essential		82	15	5 – Essential		211	37
No Response		0	0	No Response		4	1
Teach New Content	3.7			Engage/Excite Students About Science	4.1		
1 – Not a priority		8	1	1 – Not a priority		7	1
2 – Low priority		53	9	2 – Low priority		16	3
3 – Medium priority		167	30	3 – Medium priority		90	16
4 – High priority		185	33	4 – High priority		228	40
5 – Essential		148	26	5 – Essential		223	39
No Response		6	1	No Response		3	1
Science Inquiry Skills	3.4			3D & Structure/Function Relationships	4.3		
1 – Not a priority		16	3	1 – Not a priority		6	1
2 – Low priority		92	16	2 – Low priority		14	3
3 – Medium priority		183	32	3 – Medium priority		78	14
4 – High priority		181	32	4 – High priority		190	34
5 – Essential		94	17	5 – Essential		272	48
No Response		1	0	No Response		7	1
Science Laboratory Skills	3.4			Student-Student Interaction & Learning	4.1		
1 – Not a priority		17	3	1 – Not a priority		8	1
2 – Low priority		98	17	2 – Low priority		15	3
3 – Medium priority		192	34	3 – Medium priority		114	20
4 – High priority		152	27	4 – High priority		221	39
5 – Essential		108	19	5 – Essential		205	36
No Response		0	0	No Response		4	1
Meet Program Objectives	4.3			Student-Instructor Interaction & Learning	4.1		
1 – Not a priority		6	1	1 – Not a priority		2	0
2 – Low priority		5	1	2 – Low priority		13	2
3 – Medium priority		72	13	3 – Medium priority		125	22
4 – High priority		193	34	4 – High priority		226	40
5 – Essential		288	51	5 – Essential		197	35
No Response		3	1	No Response		4	1

<sup>a</sup>Likert-type responses were assigned a point value (1-5) for calculation of the  $\bar{x}$ .

<sup>b</sup>Number of 2016 survey responses.

<sup>c</sup>Percentage of individual responses in the 2016 survey ( $n = 567$ ). Some percentages total greater than 100% due to rounding.

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Meeting program objectives was rated as one of the two highest priorities of the laboratory experience (Table 13). Participants in both the 2013 and 2016 surveys were asked if they had a specific set of laboratory learning outcomes for their courses (yes/no) and if so, they were asked to cite the source of those outcomes (Table 14). The 2013 survey provided the opportunity for participants to attach a file containing their laboratory learning outcomes, and 17

participants elected to do so. More than 60% of participants in both the 2013 and 2016 survey indicated they had specific learning outcomes for the laboratory. It was found that learning outcomes were most commonly either written by the instructor of the course ( $n = 151$ , 42%), or provided by the department or teaching unit ( $n = 135$ , 37%), or they were provided by an institutional ( $n = 94$ , 26%) or national organization ( $n = 92$ , 25%).

<b>Table 14. Reported use and sources of laboratory-specific learning outcomes</b>					
2013 Survey Question: Do you have a specific set of lab learning outcomes that you use in your course? (pull-down menu)					
2016 Survey Question: Do you have a specific set of learning outcomes (distinct from the lecture outcomes) that you use in your course? (pull-down menu)					
	2013 Survey		2016 Survey		
Answer Choices	<i>n</i>	%		<i>n</i>	%
Yes	69	62		362	64
No	33	30		197	35
No Response	9	8		8	1
Total <sup>a</sup>	111			567	
If you answered "Yes" above, where do your laboratory learning outcomes come from? (Select all that apply) (check boxes)					
Government mandated	6	9		29	8
Provided by Institution	11	16		94	26
Provided by Department or Teaching Unit	34	49		135	37
Obtained from National Organization (example: HAPS)	21	30		92	25
Obtained from a Colleague <sup>b</sup>				77	21
Wrote them myself	28	41		151	42
Other source not listed above	10	14		27	8
No Response	0	0		0	0
<sup>a</sup> Total number of responses to each survey.					
<sup>b</sup> This answer choice was not included in the 2013 survey.					

Participants in the 2016 survey were asked to rate their perceived level of influence on their course's laboratory learning outcomes and laboratory activities (Table 15). Participants were asked to rate their level of influence on a five-point Likert-type scale and point values were assigned

for the calculation of the mean value of each of the two questions. Participants indicated they had some influence to significant influence on course learning outcomes (mean = 3.8) and significant influence on the course's laboratory activities (mean = 4.1).

<b>Table 15: Participant perceived influence on learning outcomes and laboratory activities</b>			
Survey Question: How much influence do you have in determining your course's laboratory learning outcomes?			
Category	$\bar{x}^a$	$n$	% <sup>b</sup>
	3.8		
No influence		20	4
Little influence		32	6
Some influence		104	18
Significant influence		219	39
Complete control		134	24
No Response		58	10
Survey Question: How much influence do you have in determining your course's laboratory activities?			
	4.1		
No influence		15	3
Little influence		18	3
Some influence		78	14
Significant influence		208	37
Complete control		191	34
No Response		57	10
<sup>a</sup> Likert-type responses were assigned a point value (1-5) for calculation of $\bar{x}$ . <sup>b</sup> Percentage of individual responses in the 2016 survey ( $n = 567$ ). Some percentages total greater than 100% due to rounding.			

### Instructional Practices

There has been an emphasis in recent years to shift the focus of science instruction from the didactic presentation of facts to more inquiry-based instructional methods. Participants in the 2013 survey were asked to identify which inquiry-based skills (from a list of six) were mastered in their courses. Based on the discussion at the 2014 HAPS Annual Conference (Brashinger 2014b), the list of inquiry-based skills was expanded to nine items on the 2016 survey (Table 16). There was significant discussion regarding the use and interpretation of the term

“mastery” following the 2013 survey, and the question was simplified in the 2016 survey to focus on whether the skill was performed or not. The three most commonly performed skills were data collection ( $n = 392$ , 69%), modeling and simulation ( $n = 277$ , 49%), and data interpretation ( $n = 265$ , 47%). The least reported skills were statistical analysis ( $n = 64$ , 11%), experimental design ( $n = 114$ , 20%), and oral presentation of results ( $n = 133$ , 24%). The 13% ( $n = 72$ ) who did not respond to this question might indicate the percentage of participants who do not perform any of these skills in their courses.

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<b>Table 16. Scientific inquiry skills performed in the introductory A&amp;P laboratory</b>					
2013 Survey Question: What skills are mastered in your course? (check all that apply; check boxes). 2016 Survey Question: Which of the following skills are performed by students in your course? (select all that apply; check boxes)					
		2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	% <sup>a</sup>		<i>n</i>	% <sup>a</sup>
Data collection	64	58		392	69
Experimental design	25	23		114	20
Formulating hypotheses <sup>b</sup>				221	39
Modeling and simulation <sup>b</sup>				277	49
Oral presentation of results <sup>b</sup>				133	24
Graphing as presentation of data	45	41		247	44
Statistical analysis, interpretation of p-value	12	11		64	11
Data interpretation, independent of statistics	58	52		265	47
Scientific writing (more than fill in the blank)	44	40		201	35
No Response	30	27		72	13
<sup>a</sup> Percentages based on number of individual responses in each survey (2013, <i>n</i> = 111; 2016, <i>n</i> = 567).					
<sup>b</sup> This answer choice was not included in the 2013 survey.					

The HAPS Learning Outcomes project currently describes more than 850 individual learning outcomes for the introductory undergraduate A&P course sequence (HAPS 2014). In order to begin to evaluate the current usage of the HAPS laboratory learning outcomes, the 101 outcomes specific to the laboratory experience were manually sorted by the Bloom's taxonomy cognitive level and verb used in the HAPS Learning Outcomes project. Of the 101 outcomes, 84 were observational in nature (ex. identify a structure) at the knowledge and comprehension levels of Bloom's taxonomy. To assess the frequency of usage of the higher-level Bloom's learning outcomes in the A&P laboratory, participants in the 2016 survey were asked to identify whether 12 specific

HAPS learning outcomes at the application level of Bloom's taxonomy were performed in their courses (Table 17). Learning outcome C4.6 was separated into two questions for the survey. The most commonly performed learning outcomes were respiratory volumes and capacities (*n* = 458, 81%), the identification and demonstration of the actions of the major skeletal muscles (*n* = 459, 81%), demonstration of the general movements of synovial joints (*n* = 444, 78%), and demonstration of a stretch reflex (*n* = 380, 67%). The least common application-level learning outcomes performed were the interpretation of enzyme reaction graphs (*n* = 142, 25%), and interpretation of myographs (28-40%).

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<b>Table 17: HAPS laboratory learning outcomes currently performed</b>				
Survey Question: For each of the following HAPS learning outcomes, please indicate if it is currently performed in your anatomy & physiology laboratory				
Answer Choices		<i>n</i> <sup>a</sup>	% <sup>b</sup>	
<b>C4.6: Demonstrate factors that affect enzyme activity, including denaturation.</b>				
Performed		210	37	
Not Performed		322	57	
No Response		35	6	
<b>C4.6: Interpret graphs showing the effects of various factors on the rate of enzyme-catalyzed reactions.</b>				
Performed		142	25	
Not Performed		388	68	
No Response		37	7	
<b>C8.3: Demonstrate various cell transport processes and, given appropriate information, predict the outcomes of these demonstrations.</b>				
Performed		313	55	
Not Performed		214	38	
No Response		40	7	
<b>F8.3: Demonstrate the generalized movements of synovial joints.</b>				
Performed		444	78	
Not Performed		88	16	
No Response		35	6	
<b>G6.1: Interpret a myogram of a twitch contraction with respect to the duration of the latent, contraction, and relaxation period.</b>				
Performed		228	40	
Not Performed		303	53	
No Response		36	6	
<b>G6.4a: Interpret a myogram or graph of tension vs. stimulus frequency.</b>				
Performed		204	36	
Not Performed		323	57	
No Response		40	7	
<b>G6.4b: Interpret a myogram or graph of tension vs. stimulus intensity.</b>				
Performed		200	35	
Not Performed		323	57	
No Response		44	8	
<b>G6.5: Interpret graphs of tension vs. time and muscle length vs. time for isotonic &amp; isometric contraction.</b>				
Performed		161	28	
Not Performed		361	64	
No Response		45	8	
<b>G6.6: Demonstrate concentric and eccentric contraction.</b>				
Performed		225	40	
Not Performed		293	52	
No Response		49	9	
<b>G8: Identify the origin, insertion, and action of the major skeletal muscles and demonstrate these muscle actions.</b>				
Performed		459	81	
Not Performed		71	13	
No Response		37	7	
<b>H11.6: Demonstrate a stretch reflex.</b>				
Performed		380	67	
Not Performed		146	26	
No Response		41	7	
<b>M4.1: Define, identify, and determine values for the respiratory volumes and the respiratory capacities.</b>				
Performed		458	81	
Not Performed		75	13	
No Response		34	6	
<sup>a</sup> Total number of 2016 survey responses. <sup>b</sup> Percentage of individual responses in the 2016 survey ( <i>n</i> = 567). Some percentages total greater than 100% due to rounding.				

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Finally, both the 2013 and 2016 surveys sought to capture information regarding the current instructional practices, and in some cases the vendor or product, used in the introductory A&P laboratory. The 2013 survey included one multiple choice question on general histology instructional practice followed by two open-ended questions to capture the virtual microscopy or computer-based simulation programs in use. The results from the open-ended questions did not contribute significant value and were removed from the 2016 survey to make the survey more efficient. The distinction

between virtual microscopy and computer-based microscopy simulations was unclear upon review of the 2013 survey, and these answer choices were combined and replaced with a single choice (computer-based microscopy simulations) in the 2016 survey. Traditional optical microscopy (microscopes and slides) was the most prevalent method of instruction reported in the 2016 survey ( $n = 464, 82\%$ ) (Table 18). Digital ( $n = 370, 65\%$ ) and print imagery ( $n = 318, 56\%$ ) were also common practices.

<b>Table 18. Histology skills performed in the introductory A&amp;P laboratory</b>					
Survey Question: Histology (check boxes).					
	2013 Survey		2016 Survey		
Answer Choices	<i>n</i>	% <sup>a</sup>	<i>n</i>	% <sup>a</sup>	
Optical microscopy (microscopes and slides) <sup>b</sup>	91	82	464	82	
Digital images	64	58	370	65	
Print images	49	44	318	56	
Virtual microscopy <sup>c</sup>	15	14			
Computer-based microscopy simulations <sup>d</sup>	16	14	142	25	
No Response	12	11	18	3	
<sup>a</sup> Percentages based on number of individual responses in each survey (2013, $n = 111$ ; 2016, $n = 567$ ). <sup>b</sup> This answer choice was "Optical microscopy" in the 2013 survey. <sup>c</sup> This answer choice was not included in the 2016 survey. <sup>d</sup> This answer choice was "Computer-based simulations" in the 2013 survey.					

Similar to the structure of the histology questions, the 2013 survey contained a mixture of multiple choice and open-ended questions regarding the use of animal dissection. The responses to the open-ended questions on the 2013 survey were manually categorized and then reported in tabular form (Table 19). These categories were then used as the answer choices in the 2016 survey. The 2013 survey also included an open-ended question for documenting the specific computer-based simulation programs used for animal dissection. However, the response rate was very low and

the question was not included in the 2016 survey. Preserved organ dissection ( $n = 432, 76\%$ ) and preserved whole-animal dissection ( $n = 297, 52\%$ ) were the most common instructional dissection methods reported on the 2016 survey. Preserved cats ( $n = 205, 36\%$ ) and fetal pigs ( $n = 137, 24\%$ ) were the most common organisms for whole-organism dissection while heart ( $n = 451, 80\%$ ), brain ( $n = 428, 76\%$ ), eye ( $n = 398, 70\%$ ), and kidney ( $n = 346, 61\%$ ) were the most common preserved animal organs used in dissection.

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<b>Table 19. Animal dissections performed in the introductory A&amp;P laboratory</b>					
Survey Question: Animal dissections (check boxes)					
	2013 Survey		2016 Survey		
Answer Choices	<i>n</i>	% <sup>a</sup>	<i>n</i>	% <sup>a</sup>	
Fresh organ dissection	27	24	83	15	
Preserved organ dissection	87	78	432	76	
Fresh whole-animal dissection	3	3	34	6	
Preserved whole-animal dissection	55	50	297	52	
Computer-based simulations	13	12	113	20	
No Response	15	14	74	13	
If you use whole animals for dissection, which organisms do you use? (check boxes) <sup>b</sup>					
Cat	35	32	205	36	
Fetal Pig	16	14	137	24	
Mouse	1	1	2	0	
Rabbit	1	1	5	1	
Rat	8	7	56	10	
Sheep	1	1	56	10	
No Response			221	39	
If you use animal organs for dissection, which organs do you use? (check boxes) <sup>b</sup>					
Blood	1	1	72	13	
Bone	6	5	73	13	
Brain	68	61	428	76	
Eye	55	50	398	70	
Heart	74	67	451	80	
Kidney	45	41	346	61	
Larynx	1	1	48	9	
Liver	1	1	38	7	
Lungs	3	3	121	21	
Muscle	4	4	60	11	
Reproductive Organs	9	8	59	10	
Spinal Cord	4	4	68	12	
No Response			92	16	
<sup>a</sup> Percentages based on number of individual responses in each survey (2013, <i>n</i> = 111; 2016, <i>n</i> = 567). <sup>b</sup> In the 2013 survey, the questions about specific organisms and organs were an open text response. Answers were manually classified into categories. These categories were then used for the answer choices in the 2016 survey.					

Both the 2013 and the 2016 survey included open and closed-ended questions on the use of human tissues and computer models in the undergraduate A&P laboratory. In the 2013 survey, a question asked participants who used computer-based simulations to identify the product they used from either a list of choices or through an open-ended response. The open-ended responses were used to build a

more complete list of choices, organized by vendor, for the 2016 survey. Table 20 lists the answer choices from both surveys. Based on the 2016 survey data, the dissection of cadavers in the undergraduate A&P laboratory experience is uncommon (*n* = 42, 7%), while the use of prosected cadavers is more prevalent (*n* = 126, 22%) than dissection of either cadavers or preserved human organs or tissue (*n* = 78, 14%).

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Computer-based human dissection simulations were the most frequently reported method of human dissection instruction ( $n = 142$ , 25%), and the prevalence of specific vendor products is displayed in Table 20. It is important to note that the percentages reported for data from 2013 and 2016 are not directly comparable, as the 2013 percentages are based on the

number of participants ( $n = 31$ ) who reported use of computer-based human dissection simulations and the 2016 percentages are based on the total number of survey responses ( $n = 567$ ). This change in analysis was made in the 2016 data in order to be consistent with the analysis of the other instructional practices.

<b>Table 20. Human dissections performed in the introductory A&amp;P laboratory</b>				
Survey Question: Human dissections (check boxes)				
	2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	% <sup>a</sup>	<i>n</i>	% <sup>a</sup>
Preserved organs or tissue	18	16	78	14
Dissection of cadaver	8	7	42	7
Use of prosected cadaver	25	23	126	22
Plastic models <sup>b</sup>	47	42		
Computer-based human dissection simulations <sup>c</sup>	31	28	142	25
No Response	41	37	291	51
2013 Survey Question: If you use a computer-based human dissection simulation, which one? (check boxes) 2016 Survey Question: If you use a computer-based human dissection simulation, which products do you use? (check boxes) <sup>d</sup>				
	2013 Survey		2016 Survey	
Answer Choices	<i>n</i>	% <sup>e</sup>	<i>n</i>	% <sup>e</sup>
A.D.A.M. <sup>d</sup>			36	6
Blausen	0	0	1	0
BodyViz <sup>d</sup>			3	1
eScience Labs / Virtual Model <sup>d</sup>			8	1
Hands-On Labs <sup>d</sup>			14	3
McGraw-Hill / Anatomy & Physiology Revealed	21	68	132	23
Open Educational Resources <sup>d</sup>			25	4
Pearson / PAL <sup>d</sup>			124	22
Primal Pictures / Anatomy TV / Stat!Ref <sup>f</sup>			7	1
Primal Pictures / Anatomy TV <sup>f</sup>	2	6		
Stat!Ref <sup>f</sup>	1	3		
Visible Body	3	10	28	5
Wiley / Real Anatomy <sup>d</sup>			24	4
3D4 Medical / Complete Anatomy / Essential Anatomy <sup>d</sup>			10	2
Other (please specify in next question) <sup>d</sup>	9	29		
No Response	1	3	286	50
<sup>a</sup> Percentages based on number of individual responses in each survey (2013, $n = 111$ ; 2016, $n = 567$ ). <sup>b</sup> This answer choice was not included in the 2016 survey. <sup>c</sup> In the 2013 survey, the answer choice was "Computer-based simulations" <sup>d</sup> In the 2013 survey, the questions about specific computer-based human dissection simulations was a multiple choice questions with an open text response for other. These options were added as answer choices in the 2016 survey. <sup>e</sup> Percentages in the 2013 survey are based on the number of individual participants who responded to the previous question of computer-based human dissection simulations ( $n = 31$ ). Percentages in the 2016 survey are based on the total number of individual responses ( $n = 567$ ). <sup>f</sup> These products were separate answer choices on the 2013 survey, but combined under the same commercial vendor in the 2016 survey.				

The final questions on both surveys examined the physiology experiments performed in the introductory undergraduate A&P laboratory. As with the previous sections of the survey, a combination of open and closed-ended questions was used to identify the practices and specific products used for performing physiology experiments. The open-ended responses from the 2013 survey were used to expand the list of answer choices on the 2016 survey. In addition, commercial products that were not part of the 2013 survey but had increased in market visibility were added to the 2016 survey

answer choices. The use of human subjects (blood pressure, EKG, etc.) ( $n = 389$ , 69%) and human tissue (blood, cheek swab, etc.) ( $n = 247$ , 44%) and computer-based simulation ( $n = 216$ , 38%) were the most common physiology experiments reported on the 2016 survey (Table 21). Less than 10% of survey participants reported the use of live animals or animal tissue. The prevalence of specific vendor products for computer-based physiology simulation and data acquisition is displayed in Table 21.

<b>Table 21. Physiology experiments performed in the introductory A&amp;P laboratory</b>					
Survey Question: Physiology Experiments (check boxes)					
Answer Choices	2013 Survey		2016 Survey		
	<i>n</i>	% <sup>a</sup>	<i>n</i>	% <sup>a</sup>	
Live invertebrates (worms, crickets, etc.) <sup>b</sup>	2	2	7	1	
Live vertebrates (whole organism; frogs, etc.) <sup>b</sup>	7	6	25	4	
Animal tissue (isolated organs; heart, etc.) <sup>b</sup>	4	4	53	9	
Human subjects (blood pressure, EKG, etc.)	85	77	389	69	
Human tissue (blood, cheek swab, etc.)	55	50	247	44	
Computer-based physiology simulation <sup>c</sup> (PhysioEx, PhiLS, etc.)	38	34	216	38	
No Response	15	14	103	18	
If you use a computer-based physiology simulation, which products do you use? (check boxes) <sup>d</sup>					
Cyber-Anatomy / SimBioSys			2	0	
McGraw-Hill / LearnSmart Labs			41	7	
McGraw-Hill / PhiLS			31	6	
Open Educational Resources			19	3	
Pearson / PhysioEx			176	31	
SimBio			3	1	
No Response			336	59	
2013 Survey Question: If you use a computer-based data acquisition system in any of your lab activities, which one(s)? (check boxes) 2016 Survey Question: If you use a computer-based data acquisition system in any of your lab activities, which products do you use? (check boxes)					
ADInstruments / PowerLab <sup>e</sup> / LabChart / LabTutor / LT	11	10	60	11	
Backyard Brains <sup>e</sup>	1	1	4	1	
BIOPAC <sup>e</sup> / BSL / AcqKnowledge	15	14	103	18	
iWorx <sup>e</sup> / LabScribe / TA System	11	10	63	11	
National Instruments / LabVIEW / MyDAQ			3	1	
Pasco <sup>e</sup>	1	1	9	2	
Qbit <sup>e</sup>	0	0	0	0	
Sable <sup>e</sup>	0	0	0	0	
Vernier <sup>e</sup> / LabQuest	20	18	82	15	
Other (please specify in next question) <sup>e</sup>	6	5			
No Response	54	49	272	48	
<sup>a</sup> Percentages based on number of individual responses in each survey (2013, $n = 111$ ; 2016, $n = 567$ ). <sup>b</sup> Additional descriptive terms in parentheses added in the 2016 survey. <sup>c</sup> The answer choice in 2013 was "Computer-simulated entire experiments" and "Computer-based physiology simulation" in the 2016 survey. <sup>d</sup> This was an open-ended question in the 2013 survey. <sup>e</sup> Answer choice on the 2013 survey.					

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## Discussion

Rather than being considered definitive, the 2013 data set represents a baseline snapshot reflective of the opinions and practices in the introductory undergraduate A&P laboratory. The 2016 survey built upon that baseline, incorporating many of the open-ended responses into closed-ended answer choices and adding new questions and answer choices based upon the discussions of the 2013 survey data. Participation in the 2016 survey was significantly higher than in 2013, with more than four times the number of instructors and more than five times the number of institutions represented in the 2013 survey. This increased participation occurred in approximately half the time of the original survey and may have been positively impacted by a combination of improved distribution methods and financial incentives for participation in the 2016 survey.

## Survey Participants, Institutions, and Programs

The general profile of the survey participants is relatively consistent across the 2013 and 2016 surveys. Based on the 2016 survey, 98% of participants hold either a masters or terminal degree, and this is consistent with accreditation requirements to teach at the undergraduate level (Table 1). Both 2-year (52%) and 4-year (44%) colleges and universities were well represented in the 2016 survey data (Table 7). A majority of participants (77%) reported current membership in at least one A&P-related professional society (Table 2). The survey participants represent significant experience in A&P education, as 73% of participants have been in their current teaching position for seven or more years (Table 3), 79% hold permanent, full-time positions (Table 5), and 58% hold professor-grade (assistant, associate, full) positions (Table 4). Participants with this level of experience should be well qualified to address questions regarding instructional goals and practices in their respective programs and well positioned to significantly influence the future development of laboratory outcomes and activities (Table 15).

Based on the 2016 survey data, the majority (74%) of introductory undergraduate A&P course sequences are taught in a two-semester (or semester equivalent) combined anatomy and physiology format (Table 8), and most commonly (96%) in a traditional face-to-face lecture and laboratory setting (Table 10). Hybrid (19%) and fully online (9%) instructional approaches are in use at some institutions, but remain in the minority. Even with the prospects of decreasing budgets and institutional resources, 89% of 2016 survey participants felt that A&P laboratory activities would remain the same or become more prevalent in the next 10 years (Table 12).

## Instructional Goals

One of the goals of this study was to document the instructional goals and priorities for the introductory undergraduate A&P laboratory experience. Discussions of the 2013 survey data at the HAPS Regional and Annual Conferences suggested that many of the current instructional

goals in the A&P laboratory were not directly related to laboratory knowledge (Brashinger 2014a, Brashinger 2014b). The results of the 2016 survey support this observation as clinical knowledge, science inquiry skills, science laboratory skills, and teaching new content ranked lowest of the 12 priorities provided in the survey (Table 13). These findings are also consistent with the survey data regarding current practice. Only a limited number of scientific inquiry skills (data collection, modeling & simulation, and statistical analysis) were performed more than 45% of the time (Table 16). These findings have significant implications for the application of inquiry-based teaching initiatives such as the Vision & Change in Undergraduate Biology Education (AAAS 2011) in the introductory undergraduate A&P laboratory curriculum. Although these initiatives may be important for majors in the biological sciences, they might not be as relevant for the introductory undergraduate A&P population. Nursing (95%) and allied health (74%) were the most commonly reported student career goals in the 2016 survey. Future research should examine if the instructional priorities of A&P instructors are aligned with the entry-level expectations of nursing and allied health programs.

Meeting program objectives was one of the top two priorities for the laboratory experience identified by participants in the 2016 survey (Table 13) and majority of programs (64%) reported having learning outcomes specific to the laboratory component (Table 14). The laboratory learning outcomes were most commonly written by the survey participant (42%) or provided by the department or teaching unit (37%). Only 25% of survey participants reported using learning outcomes obtained from a national organization, such as HAPS. However, this survey question does not capture if HAPS learning outcomes were used in the writing of other provided learning outcomes. Of the 101 HAPS learning outcomes designated as applicable to the laboratory, 84 were observational in nature and at the lowest levels of Bloom's taxonomy. Of the remaining 17, 12 were specifically examined in the 2016 survey. Future work on the HAPS laboratory learning outcomes should examine the alignment of the outcomes with the priorities for the laboratory learning experience.

## Instructional Practices

Based on the 2016 survey, optical microscopy (microscope and slides) remains the primary instructional method (82%) for histology (Table 18). However, the use of digital (65%) and print imagery (56%) are common. Although the use of animals in the introductory undergraduate anatomy & physiology laboratory remains under public scrutiny, both whole preserved animal (52%) and preserved organ dissection (76%) remain common practice in the laboratory (Table 19). Three-dimensional and structure/function relationships were identified as some of the top priorities for the laboratory experience (Table 13) and dissection supports this learning priority. Preserved animal organ dissection

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is more prevalent than whole animal dissection, with the most common organs being heart (80%), brain (76%), eye (70%), and kidney (61%) (Table 19). The use of live animals for physiology experimentation is rare (5%) in the introductory A&P laboratory (Table 21).

The prevalence of human cadaver usage in the introductory undergraduate A&P laboratory is noteworthy. Although cadaver dissection at the undergraduate level is relatively uncommon (7%), the fact that nearly a quarter of survey participants reported the use of prosected cadaver specimens suggests the educational value inherent in using these precious gifts in the preparation of students for careers in healthcare (Table 20). Computer modeling was the most commonly reported method of human dissection instruction (25%). The use of human subjects for physiology experimentation was more common than cadaver usage and reported by up to 69% of survey participants (Table 21). However, instructors should remain cognizant of institutional guidelines regarding the use of human subjects and handling and disposal of biological specimens.

### Study Limitations

Both the 2013 and 2016 surveys were based on an initial convenience sample of the membership of three professional societies (HAPS, AAA, and APS). The surveys were also subject to potential snowball sampling, as both participants and non-participants shared awareness of the survey with colleagues outside of the initial distribution. Participation in both surveys was voluntary and participants both self-selected and self-identified as members of the target teaching population.

### Ethics & Conflicts of Interest

Both the 2013 and 2016 surveys were conducted under the approval of the Board of Directors of the Human Anatomy & Physiology Society (HAPS) using HAPS-managed survey instruments. The author is a member of HAPS and has no conflicts of interest with any of the vendors or their products included in either survey. All participants in the 2016 survey were entered into a drawing for five Amazon gift cards, sponsored by ADInstruments, therefore participant compensation was limited and randomized by the HAPS management team.

### Conclusion

The HAPS laboratory instructor surveys provided two opportunities to gather data on the current learning goals and instructional practices in the introductory undergraduate A&P laboratory experience for nursing and allied health students. The surveys provided snapshots of current practices and perspectives on the laboratory experience and represent a foundation for a continuing conversation among A&P educators to discuss the goals of the laboratory experience. This study framed the discussion with two questions: What

are the foundational learning outcomes for this curriculum and what are the best practices for meeting these learning outcomes? The majority of participants in the 2016 survey indicated that they do have learning outcomes specific to the laboratory experience, and that meeting learning outcomes was a top priority. This study validated a ranked list of 12 priorities for the laboratory experience and documented the performance rates of both science inquiry skills and 12 of the HAPS learning outcomes specific to the laboratory. These results provide the context for identifying the foundational learning outcomes for the undergraduate laboratory experience. In addition, documenting the frequency of specific instructional practices in histology, scientific inquiry skills, animal and human dissection, and physiology experimentation in the laboratory provides a starting point for identifying the best practices that are critical to learning in the introductory undergraduate pre-health professions A&P laboratory.

### About the Author

The author is an assistant professor and director of the Natural Sciences program at American Public University System. The university system provides 100% online undergraduate and graduate degree programs to students worldwide through American Military University and American Public University. David designed and currently teaches undergraduate introductory anatomy & physiology courses in an entirely asynchronous distance-learning environment. He also supports the HAPS Curriculum & Instruction committee with an emphasis on online instruction and laboratory learning. [dbrashinger@apus.edu](mailto:dbrashinger@apus.edu)

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# HAPS COMMITTEES AND BOARDS

## ANIMAL USE

[\*Christie Canady, Chair\*](#)

This committee is charged with developing, reviewing, and recommending policies and position statements on the use of animals in college-level A&P instruction.

## CADAVER USE

[\*Melissa Carroll, Chair\*](#)

This committee is charged with developing, reviewing, and recommending policies and position statements on the use of cadavers for human anatomy and physiology education in colleges, universities and related institutions.

## COMMUNICATION

[\*Wendy Riggs, Chair\*](#)

This committee is tasked with helping HAPS establish its voice in a technological landscape shaped by social media. Committee members work closely with the Marketing Committee to facilitate connections within HAPS as well as recruiting potential members via social media.

## CONFERENCE

[\*Tom Lehman, Chair\*](#)

This committee actively encourages HAPS members to consider hosting an Annual Conference. We provide advice and assistance to members who are considering hosting an annual conference.

## CURRICULUM AND INSTRUCTION

[\*Hiranya Roychowdhury, Chair\*](#)

This committee develops and catalogs resources that aid in anatomy and physiology course development and instruction.

## EXECUTIVE

[\*Terry Thompson, President\*](#)

[\*Betsy Ott, Past President\*](#)

[\*Ron Gerrits, President Elect\*](#)

Composed of the HAPS President, President-Elect, Past President, Treasurer and Secretary

## EXECUTIVE DIRECTOR

[\*Peter English\*](#)

## FOUNDATION OVERSIGHT

[\*Bob Crocker, Co-Chair\*](#)

[\*Don Kelly, Co-Chair\*](#)

The HAPS Foundation was established to create a mechanism by which donors could make tax-deductible contributions to projects that support professional development programs for A&P teachers and that enhance the quality of human A&P instruction.

## HAPS EDUCATOR

[\*Kerry Hull, Chair\*](#)

[\*Sarah Cooper, Editor-in-Chief\*](#)

This committee is responsible for publishing a quarterly edition of the *HAPS Educator*, the journal of the Human Anatomy and Physiology Society. The committee works closely with the Steering Committee and the President of HAPS.

## MEMBERSHIP

[\*Leslie Day, Chair\*](#)

This committee is charged with expanding our membership base to include all Human Anatomy and Physiology educators or those individuals, institutions and corporations crucial to the HAPS mission statement of "Promoting Excellence in the Teaching of Human Anatomy and Physiology."

## NOMINATING

[\*Ron Gerrits, Chair\*](#)

This committee recruits nominees for HAPS elected offices.

## PRESIDENTS EMERITI ADVISORY BOARD

[\*Tom Lehman, Chair\*](#)

This committee consists of an experienced advisory group including all Past Presidents of HAPS. The committee advises and adds a sense of HAPS history to the deliberations of the BOD

## SAFETY

[\*Yuli Kainer, Co-Chair\*](#)

[\*Neal Schmidt, Co-Chair\*](#)

This committee develops standards for laboratory safety. The committee maintains a variety of safety documents available for download.

## STEERING

[\*Kyla Ross, Chair\*](#)

This committee consists of all committee chairs. It coordinates activities among committees and represents the collective committee activity to the HAPS BOD.

## TESTING

[\*Jennifer Burgoon, Co-Chair\*](#)

[\*Valerie O'Loughlin, Co-Chair\*](#)

This committee has completed, tested and approved the HAPS Comprehensive Exam for Human A&P and is developing an on-line version of the exam.

## 2017 CONFERENCE COORDINATOR

[\*Mark Nielsen\*](#)

The committee chairs invite input from HAPS members and willingly provide information on the activities of their committees.

[Click here to visit the HAPS committees webpage.](#)