Adv Physiol Educ 41: 25–28, 2017;
doi:10.1152/advan.00153.2016.

STAYING CURRENT

Performing international outreach: PhUn Week in an Australian primary school

Patricia A. Halpin

Biological Sciences Program, Biotechnology Program, University of New Hampshire at Manchester, Manchester, New Hampshire

Submitted 23 September 2016; accepted in final form 22 November 2016

Halpin PA. Performing international outreach: PhUn Week in an Australian primary school. *Adv Physiol Educ* 41: 25–28, 2017; doi: 10.1152/advan.00153.2016.—Physiology Understanding (PhUn) Week is an annual science outreach program sponsored by the American Physiological Society in which K–12 students learn about physiology through meeting a physiologist and performing an experiment. Performing PhUn Week at an Australian private primary school during a family vacation in 2014 enabled me to receive a fellowship to return the following year for further implementation. To set up the outreach, I contacted the assistant principal of a public primary school, and she connected me with the physical education (PE) teacher. Together, the PE teacher and I planned the event. Over the course of 2 days, I taught eight classes, a total of 176 K–12 students. I started each lesson by explaining the role of a physiologist. The scientific method was described and explained. A hypothesis, "Exercise increases heart rate," was designed and tested. The students measured their heart rates, exercised, and measured their heart rates again. After data collection, results were reported, and the students all agreed that their hypothesis was supported. We then discussed heart function and why heart rate increases with exercise. The students then performed a pedometer challenge, where they estimated the number of steps during walking, running, and kangaroo hopping. They enjoyed testing their predictions and repeated these experiments several times. The students then made suggestions of ways they could continue this lesson outside of school. This first report of an international PhUn week confirmed that these events form partnerships among educators and inspire K–12 students to think about becoming scientists.

PhUn Week; outreach; elementary school; physiology

PHYSIOLOGY UNDERSTANDING (PhUn) Week began in 2005 and has become an effective outreach program through which K–12 students get to meet a physiologist, learn about physiology, and perform an experiment (3). Besides inspiring students to become scientists, the program forms partnerships between educators and physiologists. Performing outreach is important because it increases public awareness and understanding of science and its benefits to society (5). Outreach can foster collaborations between K–12 teachers and physiologists while enhancing the delivery of scientific information in the classroom (4).

I have been active in outreach since 2004 and participated in PhUn Week activities since 2009. I focused the majority of my outreach efforts with elementary school children and prefer this age group because they are excited about everything and really enjoy performing experiments as well as collecting and analyzing their own data. In addition, the benefits of childhood exploration can have both short-term and long-term impacts (1). To be successful in these outreach endeavors, I coordinated directly with the classroom teachers to choose a date for the PhUn week event and the amount of time to be allotted (typically 45 min to 1 h). When I visited the classroom, I always wore the signature garb of a scientist, my white laboratory coat, and this immediately captured the attention of the students. This also added to their visual literacy about what a scientist looks like. These outreach efforts were always successful and led to a return visit the following year.

The Inspiration

In 2014, when planning our family summer vacation in Australia, I asked my cousin if I could conduct a PhUn week event at her son's school. She was enthusiastic and shared how the principal encouraged parents to find people to perform incursions at the school. She put me in touch with her son's teacher so that the date, time, and PhUn Week activities could be planned. In Australian primary schools, grades 3 and 4 are combined (3–4) as are grades 5 and 6 (5–6). As a result, I performed an exercise physiology experiment with two grade (3–4) classes at a private parochial school serving grades K–6 during the summer of 2014. The students were very engaged and enthusiastic, and the incursion was a success.

Because of this successful event, I applied through my university for a fellowship to return to Australia in the summer of 2015. I proposed to work with students at public, independent, and private primary schools. I would perform a research study and assess what the students learned by gathering pretest and posttest data. I chose two schools in each category to contact.

The Challenges

When I started researching schools, the only contact information for schools consisted of the principals' e-mail addresses listed on the schools' websites. I was disappointed, as I would have preferred to e-mail the classroom teachers directly. Undaunted, I e-mailed the principals of nine schools with my proposal to come and perform physiology activities with their students. The e-mail included my PhUn Week poster, which I presented at the PhUn Week poster and networking breakfast session at EB2015. I specified the incursion I had done the previous summer in an Australian primary school and stressed

Address for reprint requests and other correspondence: P. A. Halpin, Univ. of New Hampshire at Manchester, 88 Commercial St., Manchester, NH 03101 (e-mail: Patricia.Halpin@unh.edu).

that the activity could be tailored to fit their class schedule and would take anywhere from 40 to 60 min. As a local reference I included the name and e-mail address of the teacher I had worked with the previous year (with the teacher's permission).

I received one reply from the new principal of the school I had visited the previous year, and she stated that the school was too busy to have me visit. I was disappointed upon receiving this news and discouraged because I had not heard from any of the other schools I had contacted. In the US, I often get asked by my colleagues how to get into a school to perform outreach; they tell me that they reach out to school principals and receive no reply in return. I was both surprised and disappointed that I was experiencing the same problem in Australia.

I then contacted the teacher I had worked with the previous year and told her the problem I was having connecting with schools. I asked if she knew any of her colleagues who would be interested in this wonderful opportunity. She reached out to several and got back to me and told me that they thought it would be too much work, even though she had assured them that it would not be and that her students had had a wonderful and valuable experience the previous year. This misperception about increased workload on the part of the host teacher is something that I have heard from teachers in the US as well. I am unclear as to where this misperception comes from, but I was now made aware that it persists on both sides of the Pacific. Another comment by some of the teachers she reached out to was that they did not know how to fit the PhUn Week activity into their class schedules. Although this is a valid concern, it seems unlikely that a visiting physiologist can solve this problem.

Undaunted, I continued to inquire different schools and received no reply from any of the principals. When searching the websites of local schools, I found one that also included the name of the assistant principal. I wrote to her directly, and within 1 day I was thrilled to receive the response I had been waiting for. It was short and sweet: "We would be delighted to have you come to our school."

Finally, I had confirmation from one school. I was both relieved and elated.

The Planning

As time was getting short and I needed to book my flight, I then changed my outreach plan yet again. When the assistant principal inquired as to which class I wanted to visit, I replied, "All of them." So we agreed that I would perform outreach with four 3–4 classes and four 5–6 classes, adding up to 176 students (Table 1). Instead of working with a classroom teacher, I would be working with a physical education (PE) teacher for the first time. When I contacted him by e-mail, he replied right away, answering my questions about facilities, length of class time, and background information. I gave the teacher an overview of the content and asked for his insight/input. Together, we planned the activity and chose the dates of my visits, and I booked my flight.

I chose to perform the exercise physiology experiment I had done the year before and to talk with the students about healthy eating. These topics make physiology relevant, and the students can be quickly engaged (2). It was also advantageous to me when traveling far from home that I could perform these experiments without equipment.

Table 1. *Student demographics*

Sex	Demographic Group	*n*
Males = 81	American Indian/Alaskan Native	0
Females = 95	Asian	6
Total = 176	Native Hawaiian/Pacific Islander	0
	Aboriginal/Torres Strait Islander	12
	White	155
	Hispanic/Latino	0
	Other (Indian)	3

PhUn Week in Australia

As in the previous year, I introduced myself as a physiologist and was again told that a physiologist studies physics or physiotherapy. I told the students that physiology is the study of how the body works. It could mean the study of muscles, for instance, or of individual cells.

To provide background for our experiment, I explained how the heart pumps blood through the chambers, and I demonstrated on the PhUn Week squeezy heart. The students love these squeezy hearts and can't wait to get their hands on them. When I handed them out, a student asked, "Can we keep them?" When I replied, "Yes," the class got really excited. Once everyone had a heart, I instructed the students to put their right hand on the top of the heart covering both atria and the left hand at the bottom of the heart covering both ventricles. As a group we all said "Atria," while the right hand squeezed both atria and then "Ventricle," while the left hand squeezed both ventricles in a rhythm. We repeated this several times, and the students enjoyed increasing the heart rate while saying loudly and rapidly "Atria, Ventricle." I then asked, "Why does the heart pump blood?" and one student said, "To help us live!" I explained that blood carries oxygen to all the cells, and the cells use it to create energy; this energy is used to do work, like exercise.

To begin to connect heart and lung function, I had the students take a deep breath to show me how they obtained oxygen from the air. I explained that it was also important to get rid of carbon dioxide through exhalation. I then explained how the heart, lungs, and blood vessels work together to deliver oxygen and remove carbon dioxide. The next part of the presentation described the scientific method, and as a group we designed the experiment we would perform. I asked the students if they knew what a hypothesis was and they described it as, "An educated guess that could be tested." Unlike last year's classes, these students had not yet learned about the scientific method. However, there were a few students per class who knew this information, and the others quickly understood the new material.

As a group, we discussed and agreed on a hypothesis for our experiment: Exercise increases heart rate. Then the method for testing was designed; the students would measure their heart rates, run for 3 min, and then measure their heart rates again. Materials for the experiment were identified: a place to exercise, students, and a timer. As a group, the students took and recorded their resting heart rate for 1 min, and I was the timer.

In Australia, many school playgrounds are made of artificial turf and have a small oval track painted onto the turf. This provided an excellent place for the students to perform the

experiment (if it was raining, we used the gym). One benefit of being in a PE class instead of a traditional classroom was that the students were expecting to exercise. Also, they had only one PE class per week, so they were excited to get started, and all participated actively. Another advantage was that the PE teacher exercised with them and kept them together as a group, which ensured they would all exercise at the same activity level and also achieve an elevated heart rate. After exercise they took their heart rates again.

Then I asked the students, "Who wants to tell me their resting heart rate and their postexercise heart rate?" All of the students raised their hands! This type of enthusiasm was spectacular. Usually, when I ask this same question at my local school in the US, only a few hands are raised, and I choose one girl and one boy to report results to the class. With so many students wanting to report, I selected several boys and several girls. I stressed that using units was very important in science and that you could not just give a number for your heart rate, as it could be beats per second, beats per minute or beats per year. This helped them understand the significance of using specific units when reporting their data. I then had them present their results by adding their data to the following sentence: "My resting heart rate was # beats per minute and my postexercise heart rate was # beats per minute." They enjoyed reporting their data in this manner.

By adding scientific terminology, we are training the students to talk like scientists. When working with students, any opportunity to increase their scientific literacy should be taken. After they had reported their data, I asked the students if their data supported their hypothesis. As a group they all said loudly, "Yes." I told them that exercise increases the demand for energy and thus the demand for oxygen delivery. I also discussed with them why healthy eating is important; it gives them fuel to be active and can help to prevent disease. When prompted, each student gave an example of a healthy food they enjoyed eating.

Because the PE class was 1 h long, and the students were primed to exercise, I had enough time to add another activity. I called it the Pedometer Challenge, and we performed this activity outside if weather permitted or inside the gym if it was raining. I gave each student a PhUn Week pedometer and showed them how to place it on their waistband above their right leg. Then I explained that we needed to calibrate their pedometers for them to get accurate measurements of the number of steps they were taking. The PE teacher walked them as a group 20 steps down the gym floor. Everyone stopped at the same time and checked their step count. If the pedometers were inaccurate, the students adjusted them accordingly and took 20 paces again. We then all lined up at one end of the gym, and I asked them to make a prediction about how many steps it would take for them to get to the end line of the gym. The predictions were varied, and the students got excited to test their prediction. They walked to the end line, stopped, and immediately checked their pedometers. Most had overestimated, and without further instruction they turned around and repeated the experiment. They were excited to report their prediction and actual results. This was the first time I had performed this activity with the students, and it was a big success.

With still some time left in the class period, I said, "Now make a prediction whether the step count will be higher or lower if you run to the end line of the gym." The class was split with their predictions, and quite frankly, I think they got distracted thinking about how much faster it would be to run rather than walk. They quickly ran to the end line and then realized their predictions were very inaccurate. This gave me the opportunity to discuss why science experiments need to be performed so that accurate data can be collected and conclusions drawn. For the final experiment, I had them predict how many kangaroo hops it would take them to hop to the end line. They really enjoyed hopping as fast as they could down the gym floor. Working in the gym with the pedometer challenge was a bit chaotic at times, as the students' extreme enthusiasm and motivation to keep repeating their experiments led to many trips up and down the gym floor, but neither I nor the PE teacher slowed them down for a minute. We had lost control of the class in a good way, and we thoroughly enjoyed watching them having so much fun collecting their data.

I concluded each class by describing that a measure of fitness is when your postexercise heart rate goes back to your resting heart rate quickly after exercise. This rapid return to resting levels means you are fit. To extend the lesson beyond the classroom walls, the students were tasked with challenging their friends to measure fitness and see whose heart returned to rest more quickly after exercise. When I asked how they could continue the pedometer challenge outside of class, some suggested riding a bike or being more active outside of school or on holiday compared with in school. Others came up with challenging their siblings or parents to see who could accumulate the most steps in a day or a week. I encouraged them all to try these and other experiments and report their results to their PE teacher.

With each class I taught after the initial one, the students came into the gymnasium asking "Do we get hearts?" and "Do we get pedometers?" The word was out, and they were very excited. Although teaching four classes back to back was a bit tiring, each new group brought with them their own personality. They asked different questions, and all were eager to participate. When I returned for the 2nd day of classes, students ran up to me from the playground and told me how many steps they had taken the previous day as well as how many steps they had taken so far that day. The enthusiasm they demonstrated was very heart-warming to me, and it made me feel that my lesson had had a positive impact on them.

The direct benefits to students began with meeting a "real" scientist who was also a visitor from outside their country. Through this meeting, they gained an understanding of the functions of the heart and lungs and of how the organs work together. They learned about the scientific method and had the confidence to extend the lesson by performing their own similar experiments in the future. They understood what fitness means and how being active is important to live a healthy life. All of these positive outcomes made physiology relevant in their daily lives.

Besides the enthusiastic response from the students, I received positive feedback from the PE teacher, who said "Thank you. I learned a lot, and I will continue to bring this information into my lessons." Before I left, I met with the assistant principal again to thank her for this wonderful opportunity ask

her what she thought were the benefits to students when incursions take place. She stated:

> "Children learn through social interactions, including interpersonal relations and engagement with others in meaningful, purposeful contexts where connections are made to their lives." "Children learn through the process of metacognition, leading to reconfiguring preexisting understandings and knowledge, which requires active participation with a range of experts using a range of expressions."

As physiologists, we focus on bringing science into the classroom, yet what we are bringing is so much more. Only some of the benefits to the students can be measured, and the rewards to the physiologist are many.

Conclusions

Reflecting on this experience, there are a few things I would do differently. I would use two methods of communication to contact schools so that I might be able to visit several different schools on my next trip. First, I would send an e-mail and then follow up with a phone call to make the connection. I would use the assistant principal I worked with as reference and ask her if she could connect me to other schools. I would also contact the teachers I have worked with and ask whether they could assist me in making more connections.

One of my joys in being a physiologist is being able to perform experiments with K–12 students during PhUn Week every year. I really enjoyed the opportunity to take this experience to students in another country. I wished that I could have spent more time with them. Performing outreach should be part of the career of a physiologist, and I encourage everyone to participate. After your first PhUn week you will be hooked and wonder why you waited so long to start.

ACKNOWLEDGMENTS

Thank you to my cousin Andrea Wilkes Parker, who initiated the connection with St. Joseph's Primary School in Brunswick, VIC, Australia. Thank you to the staff, faculty, and students at St. Joseph's and Princes Hill Primary school (North Carlton, VIC, Australia) for this opportunity to perform international outreach. I also thank the University of New Hampshire (UNH) for providing the funding for this outreach and Margaret Shain Stieben of the American Physiological Society for assistance, support, and PhUn Week supplies. A final thank you goes to R. Michael Pugh (UNH) for providing helpful suggestions for this article.

GRANTS

This work was supported by a UNH Graduate School Summer Fellowship.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author.

AUTHOR CONTRIBUTIONS

P.A.H. conceived and designed research; P.A.H. performed experiments; P.A.H. analyzed data; P.A.H. interpreted results of experiments; P.A.H. prepared figures; P.A.H. drafted manuscript; P.A.H. edited and revised manuscript; P.A.H. approved final version of manuscript.

REFERENCES

1. **Curran-Everett D.** Hearts, lungs, and children: a physiologist returns to kindergarten. *Adv Physiol Educ* 269: S32–S36, 1995.
2. **Limson M, Matyas ML.** PhUn Week: Understanding Physiology. *Sci Teach* 6: 48–51, 2009.
3. **Munzenmaier DH.** Help protect the future of physiology. *Adv Physiol Educ* 30: 100–101, 2006. doi:10.1152/advan.00047.2006.
4. **Ryan MJ.** Are we having PhUn yet? The value of outreach in science and education (Online). Bethesda, MD: LifeSciTRC [2013]. http://blog.lifescitrc.org/k12confab/page/3/.
5. **Ryan MJ.** Following Faraday's footsteps: getting involved in science outreach. *Physiologist* 57: 176–179, 2014.