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Fat Dogs and Coughing Horses: K-12 Programming for Veterinary Workforce Development

Sandra F. San Miguel, DVM, PhD, DABVP (Swine Health Management) [associate dean for Engagement and professor],

Veterinary Clinical Sciences, Purdue University College of Veterinary Medicine, 625 Harrison Street, West Lafayette, Indiana, 47907

Loran Carleton Parker, PhD [assessment specialist for the Discovery Learning Research Center],

Purdue University Discovery Park, Discovery Learning Research Center, 207 South Martin Jischke Drive, Suite 203, West Lafayette, IN 47907-1791

Omolola A. Adedokun, PhD [assessment coordinator for the Discovery Learning Research Center],

Purdue University Discovery Park, Discovery Learning Research Center, 207 South Martin Jischke Drive, Suite 203, West Lafayette, IN 47907-1791

Wilella D. Burgess, MS [managing director of the Discovery Learning Research Center],

Purdue University Discovery Park, Discovery Learning Research Center, 207 South Martin Jischke Drive, Suite 203, West Lafayette, IN 47907-1791

Kauline S. Cipriani Davis, PhD [director of Diversity Initiatives],

Purdue University College of Veterinary Medicine, 625 Harrison Street, West Lafayette, Indiana, 47907

Thaddaeus D. Blossom [program manager],

Department of Veterinary Clinical Sciences, Purdue University College of Veterinary Medicine, 625 Harrison Street, West Lafayette, Indiana, 47907

Jessica L. Schneider [program coordinator],

Department of Veterinary Clinical Sciences, Purdue University College of Veterinary Medicine, 625 Harrison Street, West Lafayette, Indiana, 47907

Ann M. Mennonno, MS [first and second grade teacher],

Center for Inquiry at School 27, 545 E. 19th Street, Indianapolis, IN 46202

Joseph D. Ruhl, MS [science teacher],

Lafayette Jefferson High School, 1801 S. 18th Street Lafayette, Indiana 47905

Jennifer H. Veatch, MS [science teacher],

Crawfordsville High School, One Athenian Drive Crawfordsville, IN 47933

Amy J. Wackerly, BS [third grade teacher],

Dr. San Miguel is the primary author to whom correspondence should be addressed: amasss@purdue.edu.

Sandra F. San Miguel, research area: P-12 scholarly engagement for the veterinary profession.

Loran Carleton Parker, research area: quantitative and qualitative methods of educational research, evaluation, and assessment.

Omolola A. Adedokun, research area: quantitative and qualitative methods of educational research, evaluation, and assessment.

Wilella D. Burgess, research area: STEM learning and assessment of education programs and methodologies.

Kauline S. Cipriani Davis, research area: diversity and inclusion in veterinary medicine.

Soo Yeon Shin, research area: mathematics education.

Timothy L. Ratliff, research area: cancer immunotherapy.

Center for Inquiry at School 2, 725 North New Jersey Street, Indianapolis, IN 46202

Soo Yeon Shin [doctoral candidate], and

Discovery Learning Research Center, Purdue University Discovery Park, Discovery Learning Research Center, 207 South Martin Jischke Drive, Suite 203, West Lafayette, IN 47907-1791

Timothy L. Ratliff [professor of Comparative Pathobiology]

Robert Wallace Miller Director Purdue University Center for Cancer Research, Department of Comparative Pathobiology, Purdue University College of Veterinary Medicine, 625 Harrison Street, West Lafayette, IN 47907

Abstract

Workforce development strategies to educate, inform, and diversify the veterinary profession of the future must begin with children in elementary school. This manuscript provides a description of the Fat Dogs and Coughing Horses program, which takes a multifaceted approach toward informing young students, beginning in first grade, about the interesting work and career opportunities available in the field of veterinary medicine. The program, a collaboration among Purdue University and Indiana public schools, is supported by a Science Education Partnership Award from the Office of Research Infrastructure Programs, a component of the National Institutes of Health. The overall goal of the program is to provide formal and informal educational opportunities for students, parents, teachers, and the public about the science involved in keeping people and their animals healthy. Examples of health concerns that impact both people and their pets are used to inform and excite children about careers in the health sciences. The program resulted in (1) curricula for students in grades 1–3, 6, and 9; (2) four children's books and a set of collectible cards which highlight veterinarians, veterinary technicians, and research scientists who work with animals; and, (3) four traveling museum-grade exhibits. Preliminary assessment data has shown that the implementation of the curricula enhanced student science learning, and science attitudes and interests. The program provides evidence that partnerships among professionals in veterinary medicine and K-12 education can result in impactful workforce development programs.

Keywords

Workforce development; K-12 education; veterinary medicine; curricula; traveling exhibit; children's books

Introduction

The veterinary profession must navigate and succeed in an increasingly multicultural society to remain relevant. In 2011, the U.S. veterinary medical profession was about 90% Caucasian/White and 53.3% female.^{1,2} The U.S. veterinary medical student population was 86.6% Caucasian/White and 77.4 % female.³ Development of a veterinary workforce, reflective of the U.S. population's gender, race, and ethnicity, is necessary to achieve a future body of veterinary professionals who are well-positioned to meet societal grand challenges.

This transition cannot occur rapidly. The initial step is for K-12 and undergraduate students to consider a career in the veterinary profession. Recently, Daly and Erikson⁴ surveyed a group of undergraduate students who reported that they developed interest in veterinary medicine during high school. Many recruitment programs focus on high school students because career decision-making is emphasized during high school. However, children form impressions about careers at a very young age from the adults in their lives, their toys, the books that they read, and what they are taught in school.^{5,6,7,8} Researchers developing The

Association of American Veterinary Medical Colleges' National Recruitment Promotion Plan recognized this and cited U.S. elementary school students as the largest key audience to target for recruitment strategies.⁹

Stimulating interest in veterinary science occupations is a key first step, but students also must build the skill set needed to succeed in their career of interest. In the U.S., few elementary school teachers have formal training in science education.¹⁰ Moreover, inadequate science instruction is amplified in schools in low income areas.¹¹ This leaves elementary school-aged children, especially those of low socioeconomic status, at a disadvantage for science learning. Lack of exposure in middle school students also can impact career choice. Eighth graders with an expectation of careers in life sciences were almost twice as likely to graduate with a baccalaureate degree in that area compared to students without that early expectation.¹² Thus, children of all races, ethnicities, and genders are less likely to pursue Science, Technology, Engineering, and Mathematics (STEM) fields, including veterinary medicine, without exposure at a young age.

Reaching these underrepresented groups requires that school science curricula highlight a diverse array of scientists and science 'settings' such that students with diverse backgrounds and interests can identify science as a career path connected to their own lives and become interested in science careers.¹³ However, students do not have adequate access to this diverse representation of science and scientists. They typically learn about scientists and their work through teacher explanation, textbooks, or TV shows^{14, 15} and this produces a very narrow and stereotypical view of scientists (such as the archetype Caucasian man in a white lab coat working in an isolated laboratory environment).^{13,16,17} Compounding the problem, the health, animal, and veterinary sciences are often relegated to parts of the K-12 curriculum that are not explicitly labeled science such as health and physical education courses or extracurricular activities (e.g., 4-H) and this may lead students to disassociate veterinary and animal sciences and related careers from the science learned in school. For example, K-12 students perceive veterinarians as experts in taking care of pets, rather than as scientists who study how to keep both animals and people healthy.¹⁸ Animal science and veterinary science include a diverse array of disciplines and professions that are directly related to health science; animals and animal models are critical to the advancement of human health science, yet students often do not perceive animal scientists and veterinary scientists as working in a science career. In summary, effective workforce development with long-term impact for the veterinary profession will require efforts at multiple levels in the K-12 schooling system based on input of time and resources from stakeholders.

This manuscript describes an example, and preliminary results, of a multifaceted K-12 workforce development program led by the Purdue University College of Veterinary Medicine. The program, entitled, "Fat Dogs and Coughing Horses: Animal Contributions towards a Healthier Citizenry"^a, is supported by a Science Education Partnership Award (SEPA) from the Office of Research Infrastructure Programs (ORIP), a component of the National Institutes of Health (NIH).

Fat Dogs and Coughing Horses Program Description

The Fat Dogs and Coughing Horses project was developed to address the problems described above, namely, the low numbers of students pursuing science careers, in general, and veterinary science careers, in particular; and the lack of diversity in the current pool of students who are choosing veterinary science careers. The project aims to address these problems by increasing students' interest in veterinary science careers and enhancing student

^a<http://www.vet.purdue.edu/engagement/sepa/index.php>

preparedness for studying veterinary science by enhancing their knowledge of health science concepts. To achieve these goals, the program develops, implements, and disseminates educational programs for K-12 students, parents, teachers, and the public about the science involved in keeping people and their animals healthy. Specific aims of the project include:

1. Development, delivery, and assessment of innovative, hands-on, problem-based learning curricular modules for grades 1–3, 6, and 9 that fill educational gaps in health science education and meet Indiana and national academic standards.
2. Excite and recruit K-12 students to careers in health science research by providing role models for students.
3. Design and produce interactive traveling exhibits that highlight the science involved in keeping people and their animals healthy.

To accomplish our objectives, an interdisciplinary team was formed. The team included university faculty and staff experts in veterinary medicine, assessment, diversity and inclusion, science, education, and traveling exhibit development. Experts outside of the university included elementary, middle, and high school teachers, and children's museum staff. The logic model for the program can be seen in Table 1. A description of program deliverables follows:

1. Curricula

Purdue University partnered with teachers at eight public schools in Indiana. Veterinarians and veterinary technologists provided subject matter expertise and classroom resources (i.e. books, models, supplies, etc.), teachers developed and implemented the curricula in their classrooms, and assessment experts evaluated the impact of the curricula on the knowledge and attitudes that children formed about science. Curricula are available as free online downloads from the program website.^a

The elementary school curriculum, entitled “Pets, Vets, and Me” was aimed at students in grades 1–3. Students explore health and wellness by engaging in activities that allow them to see the similarities and differences among people and their pets. Activities include: (1) exploring the needs and wants of children and pets; (2) development of scientific observation and animal care skills by using live animals in the classroom; (3) exploring and comparing nutritional needs for people and their pets; (4) learning about preventive medical care; (5) discovering the benefits of exercise programs; (6) exploring pet care professions; (7) researching medical issues; and (8) adding up the costs of owning various pets. Physicians, veterinarians, and veterinary technicians visit the class and discuss their careers. Children participate in wellness exams for themselves and dogs, and take visiting dogs for a walk around their school. Interactive classroom activity centers were developed where children play veterinary-related video games, watch videos of veterinary visits (Virtual Vet Visits), read books, hatch eggs and care for chickens, care for crayfish, read radiographs, use microscopes, and pretend to be a veterinarian. The curriculum culminates in students creating a final project surrounding the care of a pet.

The middle school curriculum, entitled, “Haley's Comet has a Cough”, was aimed at students in grade 6. Students explore the respiratory system, asthma in people, and heaves in horses. Activities include (1) comparing tools and technologies used by veterinarians and physicians, (2) comparing careers in veterinary and human medicine, (3) investigating the proper care for horses and their environment, (4) exploring the human respiratory system, (5) investigating the causes and treatments for asthma, (6) comparing the anatomy of people, cats, dogs, and horses, and (7) investigating the clinical trials process and the scientific method. Students participate in web-based veterinary cases and prepare a brochure or public service announcement about a curriculum-related topic for their final project.

The high school curriculum was aimed at ninth grade science students. It was designed as individual lessons that could be integrated throughout the year. Concepts included (1) the scientific method, (2) the use of compound and dissecting microscopes, (3) animal diversity, (3) life cycles, (4) cells, (5) biochemistry, and (6) the social implications of the biological sciences. The goals included helping students appreciate that all organisms are similar, and this similarity makes it possible for pharmaceuticals and medical procedures perfected in non-human animals to be applied to people, making for healthier pets, livestock, and people. The curriculum uses a real-world, practical application approach with examples from veterinary and human medicine. Veterinarians and research scientists visit the classrooms and talk about their careers. High school students visit the Purdue University College of Veterinary Medicine, meet veterinarians and veterinary technicians, participate in an interactive comparative anatomy activity, and tour the campus.

2. Role Modeling

The role modeling portion of the program utilizes books, collectible cards, and visits. Four grade appropriate books were developed to highlight the breadth of careers in veterinary medicine. The “How I Became a Scientist” activity book¹⁹ was targeted at a third grade audience. The book highlights eight scientists (including three veterinarians) from all over the world who work with animals. A reading, math, or observational skill activity related to the scientist’s work is also presented. The “How I Became a Veterinarian” chapter book²⁰ was also targeted at a third grade audience. This book features seven veterinarians representing careers in anesthesiology, cardiology, pathology, equine medicine, lab animal medicine, and molecular diagnostics. A “day in the life of” story is presented, followed by the personal story of each veterinarian including information about growing up, family, pets, and school. A collectible card series, highlighting the veterinarians featured in this book, also was developed. Each pack of cards contains regular cards describing and picturing the role models, one randomly packed special gold foil card, and stickers. Children can “collect” their favorite veterinarians. “Fat Dogs and Coughing Horses: Be the Vet, Solve the Case”²¹ is aimed at a middle school audience. This interactive book allows readers to solve three cases while learning about the role of various veterinary team members. Seven veterinarians and a veterinary technician are featured. Lastly, “Let’s Cure Cancer”²² is an informative book aimed at the high school or general public audience that describes advances in cancer treatment in people and pets throughout history. The book highlights ten scientists (veterinarians, veterinary technicians, research scientists) involved in advancing our knowledge of cancer. All books are available for free as an online download and print copies are available for classrooms. Library bound copies of “How I Became a Veterinarian” were provided to all public libraries in Indiana. Lastly, traditional classroom visits by veterinarians, veterinary technicians, physicians, and research scientists are scheduled with teachers as part of the curricula. The books “come alive” when the students get to meet the featured scientists and researchers.

3. Traveling Exhibits

Four interlocking traveling exhibits, each approximately 250 square feet, were developed. Each exhibit incorporates interactive elements and a quiz to assess the visitor’s learning experience.

“Tucker’s Trials” focuses on developing new medicines. The learning objectives for visitors are to understand that: (1) animals play important roles in the development of new medicines that help both people and animals; (2) human clinical trials are important to developing treatments for illnesses and injuries; (3) human clinical trials are very expensive and require lots of time and volunteers; and (4) human clinical trials test new treatments to make sure that they are safe, effective, and better than current treatments.

“Lucky’s Back” emphasizes comparative nervous system anatomy and spinal cord injury. The learning objectives for visitors are to understand that: (1) the nervous system of dogs and people works the same way; (2) the nervous system sends and receives signals; (3) injuries can prevent signals from being sent along the nervous system; and, (4) injured spinal cords can sometimes be repaired.

“Holly’s Heaves” centers around comparative respiratory system anatomy, asthma in people and cats, and heaves in horses. The learning objectives for visitors are to understand that (1) the respiratory system of people and other animals works the same; (2) the respiratory system brings in oxygen and removes carbon dioxide; (3) asthma can affect the respiratory system in people and other animals, making it difficult to breathe; and (4) asthma cannot be cured, but the signs can be decreased by avoiding triggers and using medications.

“Hot Dog’s Fitness Challenge” emphasizes healthy food and exercise choices for people and dogs. Visitors get to perform an exercise to help them burn the calories of a virtual “treat.” Exercises include dancing, hitting a heavy bag, arm circles, and steps. The learning objectives for visitors are to understand: (1) body condition scoring in dogs; (2) relationships between body condition and health issues in animals and people; (3) healthy food choices in animals and people; and (4) how exercise burns calories.

Veterinarians and research scientists provided the subject matter expertise and experts in exhibit design from Purdue University College of Agriculture’s Exhibit Design Center produced and rent the exhibits. Exhibits debuted at the Indiana State Fair and are now traveling.

Fat Dogs and Coughing Horses Program Impact

Study methods

This study protocol was reviewed and approved by the Purdue University Human Research Protection Program and the Purdue Animal Care and Use Committee. The study was performed in compliance with institutional guidelines for research on humans and animals.

Formative and summative assessment of the impact of the program on student science learning as well as science attitudes and interests continues to be performed by experts at Purdue University’s Discovery Learning Research Center and will be published elsewhere.

Data were collected from participating classrooms through attitudinal surveys, as well as, cognitive and affective assessments of students both before and after their exposure to the curricular materials and role models. Briefly, students in each class were asked to respond to questions regarding the curriculum before and after curricular implementation. Paired sample t-tests were used to analyze differences in responses to the Likert survey statements listed below. A P value of < 0.05 was considered significant.

Preliminary data

Preliminary data from two elementary schools and one high school is available. The implementation and assessment of the high school and middle school curriculum is still in progress.

Preliminary data from two multi-age, early elementary classrooms (n=40) showed that 88% of students reported that they liked learning about how to keep animals and people healthy and 93% agreed that they enjoyed meeting scientists. Moreover, students were more likely to agree with statements such as “people just like me can become scientists” ($p=0.02$), and “I would like to become a scientist” ($p=0.03$) after participating in the curriculum.

Similarly, in one ninth grade classroom (n=23), 91% of students reported that they liked learning about how drugs and other treatments for diseases are developed and 81% agreed that they would like to learn more about medical and veterinary science. Students were more likely to agree with statements such as “I would like to take AP science classes” ($p = 0.01$); “I would like to do more science activities outside school” ($p=0.03$); “I would like to study science in college” ($p=0.02$); and, “I would like to become a scientist” ($p = 0.01$), after participating in the curriculum.

Unanticipated impact

As part of the third grade curriculum, a poultry veterinarian brings specific pathogen free eggs to participating classrooms and explains how to incubate eggs and care for chicks. Classrooms are equipped with incubators and chick rearing enclosures. The first time we hatched eggs was in an urban classroom. Parents contacted teachers and Purdue University faculty after the chicks hatched to see if they could adopt the chicks so their children could experience showing animals at the local fair. That year, participating students won two blue ribbons and grand champion cockerel. Parents became engaged in their children’s education and were calling the teachers and the veterinary college to learn more so that they could help their children. Today, our partner elementary schools, both in urban locations, have coops housing laying hens. First through third graders have become leaders at their respective schools and teach older children how to care for the hens. They have incorporated nutrition lessons by baking items for the school using the eggs they collect.

Lessons Learned/Implications

The development of the partnership required to successfully implement this program, coupled with the promising preliminary findings, have important implications for programs to expand and diversify the veterinary pipeline.

First, successful planning, development, and implementation of veterinary workforce development programs requires regular, consistent communication of clear goals and expectations with all partners and stakeholders. The diversity of stakeholders and perspectives necessitates that roles, activities, and expected contributions of each stakeholder be clear and explicit.

Second, veterinary workforce development efforts must include teachers and other experts as active participants and stakeholders. For example, since veterinarians are not experts in K-12 curriculum development, they need to partner with grade school teachers who are experienced and trained to develop curricular materials and teach the K-12 audience. While veterinary professionals could, and should, serve as content experts, teachers should always take the leadership role in curricular development and delivery.

Third, given that school budgets are becoming increasingly tight, veterinary workforce development efforts that include the use of supplies and consumables should include strategies for making these items easily available, accessible, and inexpensive for teachers.

Fourth, workforce development programs may need to include professional development and training activities to help faculty learn how to communicate complex research ideas to lay audiences, including K-12 students, who may not understand high level science concepts and terminologies. Training should include methods to engage all students in the discussion, what language is appropriate for various grade levels, phrases to use if a student replies with an incorrect answer that will not discourage that student from future participation or result in negative emotional responses, appropriate giveaways (do not give a bottle of hand sanitizer

to a first grader), grade level appropriate activities, and what to do when the teacher leaves the room.

Fifth, there also are implications for the development and implementation of recruitment programs that consider the context and cultures of the participating schools. For example, after our first curricular implementation, an African American third grade student said that he did not want to be a veterinarian because no one in the books about veterinary medicine we placed in his classroom looked like him. He was right.⁶ We altered the direction of our program to address this major gap in workforce development.

Sixth, veterinary workforce development programs should include rigorous evaluation of program impact and outcomes including formal feedback from teachers, parents/guardians, and students. Clear data is needed to understand the most impactful methodologies in order for resources to be used wisely and for successful K-12 programs to be replicated by others. Ideally, program evaluation should extend beyond program delivery and include strategies to assess long-term impact of the program on student outcomes. For example, do program participants seek out and participate in other science-related activities both formally (enroll in school science courses) and informally (science extracurricular programs)? Ultimately, do these students pursue and succeed in STEM careers, particularly careers in the veterinary profession?

Lastly, K-12 engagement can be extremely rewarding.

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Table 1**Project Logic Model**

Goal	Program Elements	Outcomes	Outcome Measures
Enhance knowledge and understanding of health science.	<ul style="list-style-type: none"> Curricular modules for 1st–3rd, 6th, and 9th grade Enrichment activities Traveling exhibit Teacher education 	<ul style="list-style-type: none"> Better understanding of clinical trial process and role of animals Increased understanding of science involved in keeping people and pets healthy Enhanced ability to make informed healthcare decisions 	<ul style="list-style-type: none"> Focus groups Questionnaires Pre/post knowledge test Attitudinal survey Teacher self-efficacy measures Activity survey Numbers of participants
Increase student interest in pursuing careers in health science research.	<ul style="list-style-type: none"> Positive animal models Curricular modules and activities Enrichment activities Classroom visits 	<ul style="list-style-type: none"> Increased awareness of career opportunities in health science Enhanced understanding of the role of animals in health science research Enrollment in upper level or advanced science and math classes Increased interest in health science research career opportunities 	<ul style="list-style-type: none"> Pre/post interest survey Pre/post knowledge survey Self-efficacy measures Draw a Scientist Activity Longitudinal tracking