

Table 1. Geometric means of antibody titers against KLH in serum of lambs vaccinated at 3 initial ages and sampled at 3 times after initial vaccination.

Wk after initial vaccination	3 d age	5 wk age	10 mo age
2	38	132	606
4	210	264	400
6	1213	765	264

Key Words: sheep, vaccine, age

495 Control of *Haemonchus contortus* using three chemical classes of anthelmintics and copper oxide wire particles in meat goat kids.

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Resistance to chemical anthelmintics is becoming a very common problem in many small ruminant herds throughout the US, with an increasing number of herds experiencing total anthelmintic failure. Research has shown copper oxide wire particles (COWP) to be a potential alternative to current chemical control products for *H. contortus* in sheep and goats. To determine the effectiveness of COWP, a research project was conducted to compare COWP to each of the three classes of chemical

dewormers in young meat goat does. Forty meat goat doe kids were available for this project and represented two age groups (fall and spring born). The does were randomly assigned within age group to one of five treatments: control, albendazole (20 mg/kg), COWP (2 g/hd), levamisole (12 mg/kg), or moxidectin (0.4 mg/kg). Fecal samples were collected and egg counts performed, using modified McMaster procedure on d 0, 7, 14, 21, and 28 for each animal. Anemia levels were monitored using the FAMACHA system. Animals were treated on d 0 according to their assigned treatment group and all animals were placed in dry lot on fescue hay and a pelleted feed for 14 d. After 14 d all animals were turned out on a highly infected pasture. Data were analyzed using Proc Mixed in SAS with age and treatment as fixed effects. Correlations between FAMACHA scores and FEC were all positive and significant. The correlation decreased at d 7 ($r = 0.37$, $P = .019$) but recovered by d 28 ($r = 0.50$, $P = .0013$). Treatment had an effect ($P < 0.01$) on egg counts on all days post treatment. Levamisole was the most effective treatment in both age classes on all days. There were no differences between other treatments except albendazole had lower egg counts than the others on d 7 of the experiment. In this study, COWP showed no reduction in fecal egg counts in young does. Over the whole study, COWP and moxidectin did not differ from the control treatment in reducing egg counts. All chemical classes reduced ($P < 0.05$) egg counts by d 7 when compared to the control but only levamisole was still lower by d 14.

Key Words: meat goat, parasite, COWP

Teaching/Undergraduate and Graduate Education: Teaching Issues

496 Comparative development of critical thinking skills in animal science undergraduates who enroll in evaluation courses. L. M. White* and K. D. Layfield, *Clemson University, Clemson, SC.*

Challenges faced by American colleges and universities are numerous, including preparing an individual that is capable of higher order thinking. This stipulates that a person is proficient at making independent decisions and thinking critically. Producing a person that is capable of these essentials is no easy task and has been the topic of much discussion and deliberation. Evaluation courses have remained an integral part of animal science programs throughout the country. An evaluation course teaches general accepted criteria for evaluating a particular animal, industry standards and rules to compare multiple animals, and emphasizes defense of judgments both written and orally. Popular opinion believes that students in an evaluation class gain needed and useful experience in judgment, analytical and critical thinking. These attributes of evaluation courses are believed to contribute to higher order thinking. Therefore, this study sought to quantify the change in critical thinking ability of students enrolled in an evaluation course. The Watson-Glaser Critical Thinking Appraisal (WGCTA) exam provided means to objectively analyze critical thinking ability by examining five constructs: inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments. The sample population consisted of students enrolled in evaluation courses (E) and a non-evaluation course (N) at Clemson University: Equine Evaluation (n=17), Livestock Evaluation (n=20), and Animal Reproduction (n=45). Students were issued the WGCTA during the first (pre-test) and last week (post-test) of class. The N group scored 19% of a standard deviation lower than the mean for both groups, while the E group scored 25% of a standard deviation higher than the mean. The mean change in score from pre-test to post-test for the N and the E group was -3.16 and 0.12, respectively and showed a trend toward significance ($P < 0.06$). Students enrolled in an evaluation course tended to have increased their critical thinking ability score from pre to post test.

Key Words: critical thinking, Watson-Glaser, evaluation

497 Enhancing underrepresented, minority student learning through agricultural and natural resources based research. R. L. Stanko*^{1,2}, S. D. Nelson¹, J. C. Laurenz³, and M. R. Garcia¹, ¹Texas A&M University, Kingsville, ²Texas AgriLife Research, Beeville, ³Eastern New Mexico State University, Portales.

A multi-disciplinary, multi-institutional project was initiated to increase the experiential learning of minority agriculture students. A focal point of this program was to provide first-hand experience to scientific research as an opportunity to increase skills in an ever-increasingly, competitive, and science-oriented job market. Two upper-level courses were established to teach experimental techniques and research methodology. One course was developed for teaching Experimental Techniques in Plant, Soil, and Environmental Science and the other for techniques in Animal Science. Courses combine experimental techniques and hands-on laboratory exercises. Students completing either course and interested in pursuing agricultural research in their own area of interest were encouraged to seek faculty mentors. USDA-Hispanic Serving Institution grant monies were made available and selected students were supported to serve as research aides, conduct research projects, and present research findings at annual symposia and professional society conferences. The program has expanded to include support for graduate students who receive short-term research experience external to the university. During the course of the project, 31 undergraduate and 11 graduate students were supported under the guidance of faculty mentors or senior scientists at collaborating institutions. Over 50% of participants were Hispanic, and 90.5% considered to be minorities in the agricultural sciences. Retention rate has been 100% with all students in the program either graduating or planning to graduate. Eight of the 11 (72.7%) M.S. students went on to Ph.D. or DVM and 14 of 31 (45.2%) B.S. graduates have continued onto M.S. thus far. All other graduating seniors have obtained career positions in their field of study within 3 mo. of graduation. Participation and completion of this program has given students experiential learning and skills necessary to make sound decisions concerning future employment

or continued collegiate education. Moreover, these participants have a competitive edge in career preparation for professional agriculture.

Key Words: experiential learning, minority, student

498 Teaching livestock production for niche markets. P. J. Lammers* and M. S. Honeyman, *Iowa State University, Ames.*

Niche markets for livestock products are growing nationally. Broadly, niche markets address consumer demand for product differentiation and enable producers to take a more active role in price determination. Commodity livestock production usually requires large-scale production to be economically viable. Commodity livestock operations are out of reach for beginning farmers without extensive financial support. Many young people would like to engage in livestock production as owner-operators, but lack the assets and capital necessary to make commodity production a feasible career choice. Other individuals may not want to engage in commodity livestock production due to personal choice and ethics. Successfully producing livestock for niche markets requires a similar but different skill set than commodity livestock production. Existing courses in livestock management offered by most universities do not extensively address the unique aspects of production for niche markets. Students familiar with conventional animal production typically understand growth in the context of grain-based diets usually supported by growth enhancers. Niche markets often operate under a different set of performance expectations that are not fully understood by students. For example, grass-based dairy and beef production is a major niche market with a production context that is novel to most undergraduates. Therefore, we developed a course focused on livestock production for niche markets. Producer experience guided the establishment of realistic production benchmarks for the major species of livestock under niche market conditions. Producers were also instrumental in discussion of processing and marketing logistics as well as costs and returns for niche markets. Class lectures on production focused on managing livestock to improve performance coupled with financial evaluation of management choices. Students interested in raising livestock as owner-operators may find that niche markets can help them achieve their goals. Understanding livestock production under niche market conditions as well as how niches change over time will better prepare students to engage in entrepreneurial livestock production for niche markets.

Key Words: entrepreneur, niche markets

499 The effectiveness of a distance education laboratory in 'Anatomy of Domestic Animals'. J. Bing*, S. Pratt, L.-A. Gillen, and C. Farin, *North Carolina State University, Raleigh.*

The objective of this study was to determine if a laboratory course in 'Anatomy of Domestic Animals' offered in a distance education (DE) format was as effective in helping students learn as a live face-to-face laboratory. It was hypothesized that student learning of material presented in DE format would be as effective as material presented in live format. At the beginning of the semester, 83 students were asked for consent and completed both a pre-test on anatomy material and a pre-survey to determine their experience with, and attitude towards DE. Alternating each week, the laboratory topic was presented either as a traditional face-to-face laboratory (wet-labs and dissection) or as a virtual DE laboratory (videos, animations and dissection software). Two laboratory practical exams were given, one at mid-semester and one at the end of the semester. The practical exams had two sections; a timed

identification station section and a short answer section, with material from all labs (both DE and live) split approximately equally. Questions from the pre-test were included in the exams. At the end of the semester, students completed a post-survey regarding if they thought DE was a viable alternative to a live laboratory. Student grades from the DE and live material on each of the lab exams were compared using ANOVA. Learning was evaluated based on the students' performance on pre-test and post-test questions from material presented as DE or live format, using paired t-tests. Results are presented as mean±SEM. Significant learning was achieved in the class, as shown by a significant ($P<0.0001$) increase in pre-test ($42\pm1.8\%$) vs post-test ($88\pm1.2\%$) scores, though there was no difference in the change of score between live and DE material ($P=0.94$). There was a significant effect of the type of learning on exam scores, such that students scored higher ($P<0.0001$) on material from DE ($77\pm1.4\%$) vs. live ($71\pm1.4\%$) laboratories. The post-survey indicated that 79.3% of students thought DE laboratories were a viable alternative to live laboratories. The results of this study indicate that anatomy material can be effectively taught by distance education.

Key Words: distance education, anatomy

500 Teaching a 'dog lab' in a traditional animal science department. G. M. Hill*, B. B. Snedegar, J. A. Snedegar, and J. E. Link, *Michigan State University, East Lansing.*

Animal science (ANS) departments do not maintain a dog kennel for teaching purposes. However, as the need for trained individuals in the companion animal industries increases and more students without agricultural backgrounds enroll in ANS courses, ANS educators have added curriculum to meet the educational needs of students interested in these career opportunities. This year in our entering freshmen class, 19% of the students had a dog or a cat as their primary experience with animals and 22% owned horses. In the Michigan State University introductory ANS course, we designed a 'dog lab' to accompany companion animal lectures. Students enrolled in the class, faculty and several local breeders were invited 'to bring their dogs to class'. Requirements were: up-to-date vaccinations, a hard-sided kennel and a friendly personality. A breeder presented the American Kennel Club's dog group classifications and their functions. Legislative concerns and actions were discussed by a veterinarian; grooming needs and basics were demonstrated by a professional groomer, and dog activities such as rally, obedience and agility were demonstrated in a 2 h lab period. Each guest dog was presented to the class with comments relative to its breed and purpose. As a lab exercise, pre-formed student groups were asked to select a dog and utilizing its size and breed classification, to integrate information gained from the lab and available resources to suggest a nutritional product that would meet the needs of their selected dog. Reports were to be 200 words or less and creativity, accuracy and group cooperation were considered in the grade. During the end of semester course evaluations, students have rated this laboratory as either their first or second favorite lab in each of the past 6 semesters. Thus, it is possible to expand laboratory experiences into the companion animal curriculum by using knowledgeable dog breeders and enthusiasts to provide a 'dog lab' in a traditional ANS department.

Key Words: curriculum, teaching laboratory, companion animal

501 Using companion animal classes to teach biology, nutrition, critical thinking and media literacy to animal sciences majors and

across the University community. S. Rocco and J. P. McNamara*, *Washington State University, Pullman.*

Many Animal Science Departments have taught classes on topics related to pet animals, often the goals relate solely to meeting student interests or to increase enrollment. However, such courses proved a serious opportunity to improve critical analysis, media and information literacy, quantitative reasoning, and integration of social, economic and biological sciences. An example would be in-depth analysis of the human animal bond and all its economic, social and technical implications. There are also concerns from some faculty that we should only teach classes directly related to getting students prepared for a job. In order to increase the depth and breadth of reach of animal sciences courses, two courses at WSU, AS 205, Companion Animal Nutrition (General University Biology Course) taught to all classes and majors; and AS 464, Companion Animal Management, a primarily major course for seniors, have been used to help increase not only scientific knowledge, but media and information literacy, critical thinking across a wide spectrum of endeavors, quantitative reasoning and working with groups to solve complex, real, problems. Lessons in the biology class investigate connections between nutritional chemistry, animal diversity, and practical decision making (use of pet food labels); or the biology behind the interaction of nutritional states and potential disease and its impacts on society. In the advanced class, students work together to research topics from mechanisms of genetic diseases; to discussion of the human animal bond and how it affects economic and political decisions; and they develop teaching modules used by the students in the introductory class. Students self-reported using Likert scale and in text responses that 80 to 90% of students reported improvement in critical thinking and media literacy skills. They also reported a high degree (more than 60% of students reported improvement) of application of basic biology to everyday life decisions.

Key Words: companion animals, undergraduate education, critical thinking

502 Innovative dairy teaching through a broad-based Dairy Consortium. G. R. Hagevoort*¹, M. A. Tomaszewski², and R. Collier³, ¹*New Mexico State University, Clovis,* ²*Texas A&M University, College Station,* ³*University of Arizona, Tucson.*

Over the last two decades, Land Grant Universities have decreased their investment in dairy education while allied industry has increasingly become involved with dairy producers in problem areas that affect dairy management. The Land Grant Universities of the Southwest established a multiple university, multi disciplinary and interagency Southern Great Plains Dairy Consortium (SGPDC). There are three legs to the consortium of which two (research and extension) move in unison, while the third leg (teaching), has progressed on its own. While the research and extension part of the consortium is trying to obtain federal funding for its efforts, the teaching program in the meantime has found financial support from producers, producer trade organizations and allied industry. Its inaugural program was launched in the summer of 2008 in Clovis, New Mexico, an area chosen for its close proximity to dairies with a wide variety of management levels, housing styles and parlor designs. This location provided a unique opportunity to teach students

advanced dairy science with a large dose of hands-on, real-world dairy management training in the large herds of the Southwest. The program is coordinated by faculty from the participating universities. The different modules were taught by nationally recognized and experienced faculty in dairy management. Eighteen students from six different universities attended the inaugural program for which they obtained credit with their home universities. In addition to classroom instruction, a large portion of each day was spent on local dairies applying the science and evaluating management practices. Exit evaluations resulted in unanimous high approval ratings for the program. This class is well on its way to become an industry wide training program for graduating dairy and ag-business majors in line to become herd managers, technical representatives, extension agents, etc. While 8 universities had joined the original program in 2008, three additional universities have since joined the consortium while planning the 2009 program.

Key Words: innovative dairy teaching, large dairy herd management, Southern Great Plains Dairy Consortium

503 The Dairy Cattle Breeding Simulation Program (DCBSP 4.9), an interactive software to teach animal breeding principles and practices. J. Casellas^{1,2}, A. Ahmadi², R. A. Verdugo², G. A. E. Gall², and J. F. Medrano*², ¹*Genètica i Millora Animal, IRTA-Lleida, Lleida, Spain,* ²*Department of Animal Science, University of California, Davis.*

We have developed the Dairy Cattle Breeding Simulation Program (DCBSP) to teach undergraduate and graduate students animal breeding principles associated with selection for multiple traits in dairy cattle. The structure of this program was originally developed at Virginia Tech by M. McGilliard and R. Pearson using a contemporary comparison genetic evaluations procedure. The program was modified throughout the years at the University of California-Davis and a web-based interface was developed to interact in the teaching environment. The new version of the program (DCBSP 4.9) has been completely rewritten in Fortran90 and focuses on the genetic evaluation of dairy traits by a multivariate animal mixed model, also allowing for marker assisted selection. This software simulates a population of dairy cattle herds and AI bulls through several generations by integrating students' decisions about mating, culling, and selection of new heifers and AI bulls. All simulation parameters (e.g. number of herds and cows, variance components, effect of genetic markers) can be defined by the administrator of the program in relation to the animal breeding course. During each running period, the program simulates the composition of each herd during a virtual year, generating new calves and new productive records and performing a genetic evaluation for all phenotypic traits. A herd-specific extensive summary of all demographic, productive and genetic data is provided to the students at the end of each running period. Students make mating and culling decisions on the basis of the predicted transmitting abilities for phenotypic traits, β -lactoglobulin and κ -casein genotypes, and inbreeding, and upload this information to a server. After several running periods, the genetic trend can be evaluated, providing a realistic experience for the development of animal breeding skills that will be relevant to students with a basic knowledge of animal breeding.

Key Words: animal breeding, dairy cattle, teaching