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# NACTA Journal

**the professional journal advancing the scholarship of teaching and learning in agricultural, environmental, natural, and life sciences**

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# Students Opinions of a Student Response System for Introductory Packaging Classes

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## Abstract

Student response systems (SRSs) were used during the spring and fall semesters of 2006 in two introductory packaging classes, PKG 101 and PKG 221 at Michigan State University, to routinely ask questions in class and then display the students' responses in real time. At the semester end, students' opinions regarding the system were collected (using the SRSs) and then analyzed. Their likelihood of preferring a class with SRSs was estimated by fitting a probit model with student demographics (gender, major, and course grade) as predictor variables.

Across the two classes, 82% of students or more claimed that the SRS motivated them to attend class, and 58% or more stated it motivated them to participate and listen. In addition, students stated that SRSs enhanced their classroom experience (62% or more) and helped them to study (47% or more). Overall, students who preferred a class with SRSs were 34% of PKG 101 students and 62% of PKG 221 students. To sum, students were particularly motivated to attend class, but their overall preference for the SRSs varied by class.

With regards to the correlates of preference for SRSs, three main inferences can be taken from this study. 1) Demographic factors such as gender and grade were not indicated to significantly affect the likelihood that a student liked the SRS; 2) students within the course major (Packaging) were more likely to prefer a class with an SRS; and 3) class characteristics and/or the implementation of SRSs can play a critical role on the likelihood that students will like the use of SRS in class.

Keywords: Student Response Systems, Audience Response Systems, Clickers, Students opinion, Educational Technology.

## Introduction

Student response systems (SRSs), also called clickers or student-polling systems, are tools that seek to create a more active learning environment in large classes by allowing students to interact. They are known by varied names, including: audience-paced feedback systems (APF), audience response system (ARS), classroom performance system (CPS), electronic response system (ERS), hyper-active teaching technology (H-ITT), interactive engagement (IE), interactive audience response systems (IRIS), interactive learning systems (ILS), interactive student response systems (ISRS), personal response systems (PRS), peer response system (PRS), group response system (GRS), wireless response system (WRS), personal response system (PRS), and classroom response system (CRS) (Auras and Bix, 2007; Lowery, 2005). Regardless of terminology, they are a growing technology in K-12 and higher education classrooms throughout the world (Barber and Njus, 2007; Kay and LeSage, 2009; MacArthur and Jones, 2008).

In principle, SRSs facilitate the interaction between faculty members and students on an ongoing basis by allowing instructors to ask multiple choice, true/false and numerical questions during class and then display the anonymous responses in the aggregate in real time. Additionally, SRSs allow for the collection of attendance data and provide immediate feedback to the students on their grasp of the material and to the instructor on student understanding of presented concepts. As a result, these systems can be used as an assessment of both teaching and learning in real time.

SRSs consist of three basic components: a student input device (keypad), an operating system software loaded onto the instructor's classroom computer, and an overhead projection system that displays the questions asked and the distribution of student responses (Figure 1 shows a pictorial view of a model system). The data generated during classes can be collected and recorded in a computer or web-based software. For an entire description of different SRSs see the following references (Lowery, 2005; Auras and Bix, 2007; MacArthur and Jones, 2008; Kay and LeSage, 2009; Barber and Njus, 2007).

The use of SRSs have been reported to increase student attendance (Fies and Marshall, 2008), attention (Kay and LeSage, 2009), engagement and interaction (Caldwell, 2007; Trees and Jackson, 2007), discussion (Draper and Brown, 2004), and student performance (Caldwell, 2007; Crossgrove and Curran, 2008; Suchman et al., 2006). Moreover, SRSs have been linked to assessment benefits such as improving the just-in-time feedback process (Beatty, 2004), providing more formative assessments (Beatty, 2004; Caldwell, 2007), and allowing the comparison of understanding across students (Caldwell, 2007; Kay and LeSage, 2009). They have

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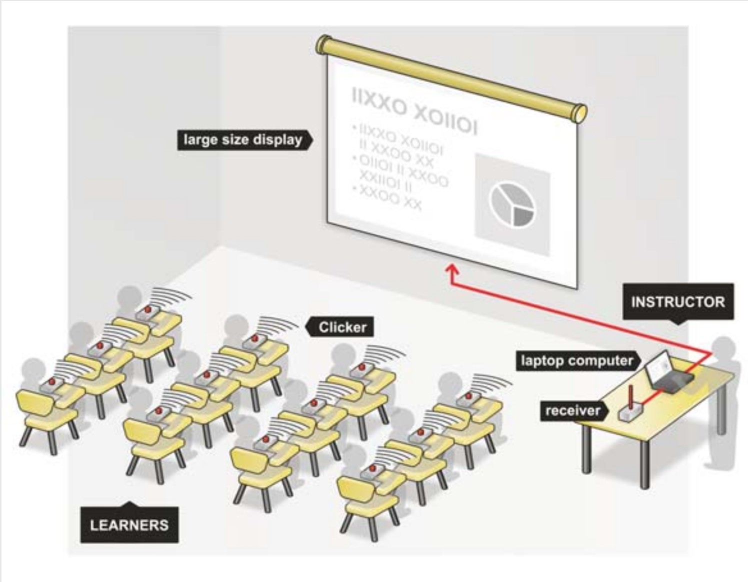

Figure 1. Typical configuration of student response systems.

been indicated to be a particularly useful tool for large classroom settings (MacGeorge et al., 2008).

Most of the current research has centered on demonstrating the gains in learning due to the implementation of SRSs. They have been correlated with more effective, learner-centered environments that leverage a more "active atmosphere" (Caldwell, 2007; MacGeorge et al., 2008). Although research evidence varies regarding the degree that SRSs improve students' learning (Caldwell, 2007; Crossgrove and Curran, 2008; Gauci et al., 2009; Trees and Jackson, 2007), most scholarship finds that SRSs help students' attendance and participation (Caldwell, 2007; Fies and Marshall, 2008; Kay and LeSage, 2009; Smith and Rosenkoetter, 2009; Trees and Jackson, 2007). Therefore, a large number of higher education institutions are implementing SRSs (Auras and Bix, 2007; Lowery, 2005; Smith and Rosenkoetter, 2009). Increasing implementation of the systems by higher education promotes research regarding the acceptance of this new pedagogical tool by the students that must invest in them (Lowery, 2005; MacGeorge et al., 2008; Smith and Rosenkoetter, 2009). The objective of this work was to examine students' opinions of an SRS utilized in two introductory packaging classes at the School of Packaging (SoP), Michigan State University (MSU; East Lansing, MI).

## Materials and Methods

### Implementation of an SRS at the School of Packaging

PKG 101 (Principles of Packaging) is an introductory course taught every semester on campus and online. Because there are no specific prerequisites, PKG 101 frequently serves to fill elective credits for varying majors, some related to packaging (such as Marketing) and others less directly so (such as Animal Science). As a result, the backgrounds, interests, and engagement levels of students enrolled in the class vary widely. By contrast, students in PKG 221 (Glass and Metal Packaging) are primarily packaging majors, and those that are not are generally in fields for which the presented topics are relevant (Food Science, etc.).

In both classes, approximately 10 minutes before the beginning of class, the instructor setup and initialized the SRS by plugging the receiver (see Figure 1) into an available universal serial bus port on a laptop system, starting the projection system, booting the computer, and then starting the presentation system (PowerPointTM in this case). After this, the instructor started the SRS software, which triggered a "join screen," allowing the students to register their presence by clicking a specific sequence on their transmitter. This procedure was the same for both classes.

Once the join-session was closed, students that had logged on were able to use the SRS to answer questions posed throughout the lesson. Students were only able to log their SRS in while the join screen was active (at the beginning of class), so they had to be on time to log participation for a particular class session.

In both PKG 101 and 221, one or two questions were routinely asked at the beginning to review the previous class. For PKG 101, generally four to six more questions were scattered throughout the remaining 1 hour and 20 minute session. For PKG 221, two to three questions were asked at intervals of around 15 to 20 minutes throughout its 50 minute session.

Data presented here reflects MSU students' opinions of the SRS as reported in end-of-semester surveys carried out in each of the two classes (PKG 101 and PKG 221) upon completion of two different semesters (spring 2006 and fall 2006). Methodologically, the data were examined through tabular analyses as well as multivariate analyses detailed below.

### SRS Survey Administration

At the close of the spring and fall semesters of 2006, students in both PKG 101 and 221 were surveyed using the SRS to obtain student feedback regarding the implementation and use of the systems (IRB #06-123, 2006). Eight questions were posed which sought to address students' opinions related to the use of SRSs. Questions were meant to explore various aspects of system using, including: attendance, participation, comprehension of the material, class enhancement, and overall preference for the clickers (for exact wording see later Tables 1 and 2). Additionally, after the semester ended and final grades had been submitted, an e-mail was sent to the students who had signed an informed consent form in order to obtain open-ended responses regarding the use of SRSs in packaging education.

### *Statistical analyses*

The collected data from students that had signed a consent form was analyzed using tabular break-downs and multivariate analyses. The tabular analyses consisted of cross-tabulations between the eight questions and three student characteristics: gender, major, and class grade. That is, students' responses to each question were broken down in percentages for the whole sample, and then for males and females, non-packaging majors and packaging majors, and students with a GPA less than 2.5 and those with a GPA more than 2.5. Difference between two-sample proportions tests were carried across student characteristics (e.g., comparing males versus females, packaging versus non-packaging students, etc.) for each response. For example, 54% of males in PKG 101 answered that they were motivated to participate in class by the clickers compared to 67% of females. The corresponding proportions, 0.54 and 0.67, were then tested statistically with a two-sample differences in proportions test and found to be statistically different at the $\alpha = 0.05$ level. For a full description of proportion tests see Freund and Wilson (2003). The statistical significance in the proportions' differences was assessed using both $\alpha = 0.05$ and $\alpha = 0.10$ levels.

The multivariate analyses were conducted to predict a student's preference for a class with an SRS as a function of student characteristics (gender, major, and class grade) and opinions on the remaining questions. The dependent variable is discrete and binary, with "1" indicating a strict preference for a class with an SRS, and "0" indicating either indifference or preference of a class without the SRS. Ordinary least squares (OLS) regression is not appropriate under these circumstances since the dependent variable is not continuous. Probit models are used specifically when the dependent variable is discrete and binary, as in the present case. Coefficients that link the independent variables to the discrete outcomes are estimated using maximum likelihood estimation, with positive coefficients interpreted as increasing non-linearly the probability of a positive outcome (or a "1"). For example, if the coefficient for being a Packaging Major is 0.41 in the present probit model with a p-value of 0.07, this suggests that at the $\alpha = 0.10$ level, being a packaging major increases the probability of preferring classes with clickers. Since the effect is non-linear, the exact increase in probability needs to be computed and cannot be read off directly from the coefficient, as can be done with OLS regressions. A detailed description of a probit model can be found elsewhere (Greene, 2008). The probit model predicting the likelihood of a student preferring a class with an SRS was estimated with STATA, version 10.0 (College Station, TX, USA).

Initial multivariate analysis of the data indicated that the class, whether PKG 101 or PKG 221, had a significant effect on students' preference for an SRS ($p=0.08$). This suggested that aspects related to the class, such as, the SRSs' implementation by the faculty, class content, or students selection into a class, could mediate students' opinion of SRSs. Therefore, to make sure that the results were properly presented, and that the aggregate data did not occult class effects the responses from students were analyzed separately by class.

## Results

The characteristics of students enrolled in PKG 101 and PKG 221 during the two semesters of interest are presented in Figure 2. A total of 181 students were enrolled in PKG 101 during the spring 2006 semester and 165 during the fall 2006 semester. Of these students, 66% (spring) and 52% (fall) consented to participate in the study. In PKG 221, a total of 94 students were enrolled during spring 2006 and 82 students during fall 2006, of which 64 and 65% consented to participate, respectively. Female students, students with a class grade higher than 2.5, and packaging majors were more likely to provide consent than other groups.

Demographically, females represented 30 to 40% of respondents in these classes across semesters, with lesser female representation occurring in PKG 221. Reflective of the nature of the class, only 23% (spring) and 38% (fall) of PKG 101 respondents were declared Packaging majors, while 87% of respondents were declared majors in the PKG 221 class during both reporting semesters. The majority of PKG 101 respondents 52% (spring) and 80% (fall) had a grade point average of 2.5 or higher. The same held true for PKG 221 respondents, who comprised 68% of the spring sample and 79% of those responding in the fall semester. Thus, when contrasting the composition of PKG 101 and PKG 221 classes, the most significant difference is in terms of the percentage of packaging majors, which is larger for the more advanced class.

Tables 1 and 2 present the aggregate responses to each of the questions by PKG101 and PKG 221 students, respectively, over the two semesters. The percentages are from the total number of respondents for the first column, and then from each given sub-samples (e.g., males, females, packaging majors, etc.). As with any human subject study, subjects were not required to participate in all aspects of the study, but could drop in and out of participation as they wished. As a result, the number of total respondents changed slightly from question to question.

Focusing first on PKG 101, students reported that the use of SRSs motivated them to attend class (82%), to participate and listen (58%), and in general SRSs enhanced their classroom experience (62%). However, in this class some aspects of the SRS drew less than majoritarian support: only 43% of the students considered the instructor to be more organized when the SRS was employed, 48% of the students reported that the SRS helped them to understand the material, and 47% indicated that SRS questions helped them to study. Overall, 34% of PKG 101 students preferred a class with clickers, and 44% preferred a class without them.

Relatively few sub-samples indicated evidence of statistically significant differences in the proportions (or percentages) for the PKG 101 class. The most notable difference related to gender. The proportion of females who indicated that the SRS motivated them to participate and listen in class (67%) was greater than the proportion of male respondents (54%), p=0.04. Females also indicated that the questions were helpful during study at a higher proportion than their male counterparts (58 versus 41%), p<0.01.

The vast majority of PKG 221 students reported that the SRS motivated them to attend class (93%), to participate and to listen (78%) in class, and, in general, enhanced their classroom experience (72%). Moreover, a majority also reported that the SRS helped them to understand the class material (65%) and helped the instructor be more organized (65%), and that the questions helped them to study (68%). Overall, 62% of the PKG 221 students preferred a class with clickers and 30% preferred a class without them. As with PKG 101, there are also few notable differences across subgroups for the PKG 221 class.

From the tabular analysis we observe that preference for SRSs varies from 34 to 62% from one class to the other while few demographic differences can be observed. However, to properly account for confounding variation,

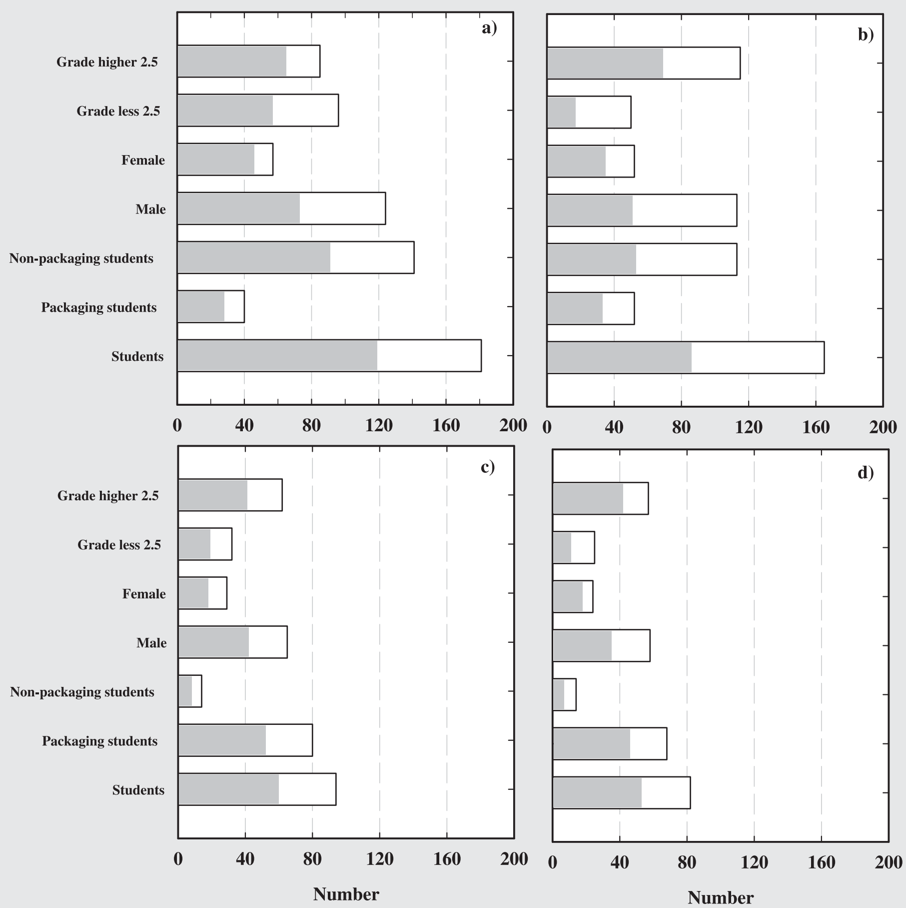


**Figure 2. Student demographics; white and gray color bars indicate total number of students and consent students, respectively; a) PKG101 SS06, b) PKG101 FS06, c) PKG221 SS06, d) PKG221 FS06.**

**Table 1. Cross Tabulation of Student Opinions of Clickers and Selected Covariates in PKG 101, Spring 2006 and Fall 2006**

| | | Percentage (%) of the number of respondents | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | All Sample | Males | Females | Non Packaging | Packaging | Grade less than 2.5 | Grade more than 2.5 |
| Q1: Did the clicker motivate you to attend class? | Yes | 82.3 | 81.2 | 84.4 | 83.8 | 77.9 | 77.6 | 85.2 |
| | Indifferent | 10.4 | 9.4 | 12.2 | 9.4 | 13.2 | 9.2 | 11.1 |
| | No | 7.3 | **9.4*** | **3.3*** | 6.8 | 8.8 | **13.3**** | **3.7**** |
| Q2: Did the clicker motivate you to participate and listen in class? | Yes | 58.5 | **53.9**** | **67.4**** | 60.3 | 53.6 | 53.2 | 61.6 |
| | Indifferent | 13.0 | **15.6*** | **8.14*** | **9.8**** | **21.7**** | 12.8 | 13.2 |
| | No | 28.5 | 30.5 | 24.4 | 29.9 | 24.6 | 34.0 | 25.2 |
| Q3: Did the clicker help you to understand and comprehend the class material? | Yes | 47.7 | 46.7 | 49.5 | 44.7 | 55.7 | 50.0 | 46.3 |
| | Indifferent | 16.5 | 15.6 | 18.3 | 17.9 | 12.9 | **11.2*** | **19.7*** |
| | No | 35.8 | 37.7 | 32.3 | 37.4 | 31.4 | 38.8 | 33.9 |
| Q4: Did the use of clickers enhance or disrupt your classroom experience? | Enhance | 62.2 | 59.8 | 66.7 | 61.3 | 64.7 | 59.2 | 63.9 |
| | Neither | 27.4 | 27.8 | 26.7 | 26.2 | 30.9 | 32.6 | 24.2 |
| | Disrupt | 10.4 | 12.4 | 6.7 | **12.6**** | **4.4**** | 8.2 | 11.8 |
| Q5: Do you think the questions that were asked were fair? | Yes | 90.3 | 89.8 | 91.3 | 90.9 | 88.7 | **85.1**** | **93.4**** |
| | No | 9.7 | 10.2 | 8.7 | 9.1 | 11.3 | **14.8**** | **6.6**** |
| Q6: Do you feel that the instructor was more or less organized as a result of the use of the clicker system? | More | 42.6 | 39.8 | 47.8 | 39.9 | 50.0 | 38.8 | 44.8 |
| | No Difference | 36.1 | 35.1 | 38.0 | 37.3 | 32.9 | 40.8 | 33.3 |
| | Less | 11.8 | 13.5 | 8.7 | 13.5 | 7.1 | 11.2 | 12.1 |
| | Unable to Assess | 9.5 | **11.7*** | **5.4*** | 9.3 | 10.0 | 9.2 | 9.7 |
| Q7: Did the questions help you in your effort to study the material? | Yes | 46.8 | **40.6**** | **58.4**** | 45.5 | 50.7 | 40.8 | 50.3 |
| | Indifferent | 12.2 | 14.6 | 7.9 | 12.8 | 10.4 | 13.9 | 11.2 |
| | No | 40.9 | **44.8*** | **33.7*** | 41.7 | 38.8 | 45.1 | 38.5 |
| Q8: Do you prefer a class with or without clickers? | With | 34.1 | 32.6 | 37.1 | 31.8 | 40.6 | 37.0 | 32.3 |
| | Indifferent | 22.2 | 20.9 | 24.7 | 21.9 | 23.2 | 17.0 | 25.5 |
| | Without | 43.7 | 46.5 | 38.2 | 46.3 | 36.2 | 46.0 | 42.2 |

*Note 1:* Differences of proportions tests were carried out by student characteristic: males compared to females, packaging majors compared to non-packaging majors and low GPA students compared to high GPA students, for each question and response. Statistical significance is indicated by ** when at the 0.05 level and by * when at the 0.10 level.
*Note 2*: For the whole sample of PK 101 students the number of respondents varied between 253 and 261. Male respondents varied between 165 and 176 while female respondents varied between 86 and 93. Non-packaging respondents varied from 184 to 197 and packaging respondents varied between 68 and 71. Respondents with a grade less than 2.5 varied between 93 and 101 and respondents with a grade greater than 2.5 varied between 159 and 162.
*Note 3:* Column percentages by question may not add up to 100% due to rounding.

**Table 2. Cross Tabulation of Student Opinions of Clickers and Selected Covariates in PKG 221, Spring 2006 and Fall 2006**

| | | Percentage (%) of the number of respondents | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **All Sample** | **Males** | **Females** | **Non Packaging** | **Packaging** | **Grade less than 2.5** | **Grade more than 2.5** |
| | Yes | 92.6 | 92.5 | 92.9 | 100.0 | 91.2 | 92.6 | 92.6 |
| Q1: Did the clicker motivate | Indifferent | 5.3 | 4.5 | 7.1 | 0.0 | 6.2 | 7.4 | 4.4 |
| you to attend class? | No | 2.1 | 2.9 | 0.0 | 0.0 | 2.5 | 0.0 | 2.9 |
| | Yes | 78.0 | 76.7 | 74.1 | 69.2 | 79.5 | 76.0 | 78.8 |
| Q2: Did the clicker motivate | Indifferent | 6.6 | 6.3 | 7.4 | 15.4 | 5.1 | 8.0 | 6.1 |
| you to participate and listen in class? | No | 15.4 | 14.1 | 18.5 | 15.4 | 15.4 | 16.0 | 15.1 |
| | Yes | 65.6 | 65.1 | 66.7 | 64.3 | 65.8 | 69.2 | 64.2 |
| Q3: Did the clicker help you | Indifferent | 11.8 | **9.1*** | **18.5*** | 0.0 | 13.9 | 3.8 | 14.9 |
| to understand and comprehend the class material? | No | 22.6 | 25.8 | 14.8 | 35.7 | 20.2 | 26.9 | 20.9 |
| | Enhance | 72.0 | 73.8 | 67.9 | 69.2 | 72.5 | 76.9 | 70.1 |
| Q4: Did the use of clickers | Neither | 18.3 | **12.3**** | **32.1**** | 15.4 | 18.7 | 11.5 | 20.9 |
| enhance or disrupt your classroom experience? | Disrupt | 9.7 | **13.8**** | **0**** | 15.4 | 8.7 | 11.5 | 8.9 |
| | Yes | 92.6 | 93.9 | 10.7 | **78.6**** | **95.0**** | **100.0*** | **89.5*** |
| Q5: Do you think the questions that were asked were fair? | No | 7.5 | 6.1 | 89.3 | **21.4**** | **5.0**** | 0.0 | 10.5 |
| | More | 64.9 | 68.2 | 57.1 | 57.1 | 66.2 | 62.9 | 65.7 |
| Q6: Do you feel that the instructor | No Difference | 28.7 | 25.8 | 35.7 | 35.7 | 27.5 | 29.6 | 28.4 |
| was more or less organized as a | Less | 4.3 | 4.5 | 3.6 | 0.0 | 5.0 | 7.4 | 2.9 |
| result of the use of the clicker system? | Unable to Assess | 2.1 | 1.5 | 3.6 | 7.1 | 1.2 | 0.0 | 2.9 |
| | Yes | 68.4 | 68.7 | 67.9 | 64.3 | 69.1 | 66.7 | 69.1 |
| Q7: Did the questions help you in | Indifferent | 8.4 | **5.9*** | **14.3*** | 7.1 | 8.6 | 7.4 | 8.8 |
| your effort to study the material? | No | 23.2 | 25.4 | 17.9 | 28.6 | 22.2 | 25.9 | 22.1 |
| | With | 62.4 | 63.1 | 60.7 | 64.3 | 62.0 | 70.4 | 59.1 |
| Q8: Do you prefer a class with or | Indifferent | 7.5 | 9.2 | 3.6 | 7.1 | 7.6 | 3.7 | 9.1 |
| without clickers? | Without | 30.1 | 27.7 | 35.7 | 28.6 | 30.4 | 25.9 | 31.8 |

*Note 1:* Differences of proportions tests were carried out by student characteristic: males compared to females, packaging majors compared to non-packaging majors and low GPA students compared to high GPA students, for each question and response. Statistical significance is indicated by ** when at the 0.05 level and by * when at the 0.10 level.
*Note 2*: For the whole sample of PKG 221 students the number of respondents varied between 91 and 95. Male respondents varied between 65 and 67 while female respondents varied between 27 and 28. Non-packaging respondents varied between 13 and 15 and packaging respondents varied between 78 and 81. Respondents with a grade less than 2.5 varied between 25 and 27 and respondents with a grade larger than 2.5 varied between 66 and 68.
*Note 3:* Column percentages by question may not add up to 100% due to rounding.

multivariate analyses need to be carried out. So, two different probit models were fitted for each class to predict students' preference for a class with clickers, as seen in Table 3.

**Table 3. Probit Models Predicting a Student's Preference for a Class with Clickers (Question 8)**

| | PKG 101 Model 1 | | PKG 101 Model 2 | | PKG 221 Model 1 | | PKG 221 Model 2 | |
|---|---|---|---|---|---|---|---|---|
| Dependent Variable: "1" prefers class with clickers and "0" is indifferent or prefers class without clickers | | | | | | | | |
| | Coefficient | p-value | Coefficient | p-value | Coefficient | p-value | Coefficient | p-value |
| *Student Characteristics* | | | | | | | | |
| Female | 0.150 | 0.38 | -0.194 | 0.37 | -0.016 | 0.96 | 0.052 | 0.90 |
| Packaging | 0.251 | 0.16 | **0.415** | **0.07** | 0.059 | 0.88 | -0.741 | 0.28 |
| Grade Less 2.5 | 0.162 | 0.33 | 0.324 | 0.13 | 0.316 | 0.32 | 0.474 | 0.32 |
| *Student Opinions* | | | | | | | | |
| Price is Too High | | | -0.355 | 0.16 | | | 0.497 | 0.32 |
| It should not Cost | | | **-0.971** | **0.01** | | | 0.839 | 0.41 |
| Q1 Answered yes (Attendance) | | | -0.198 | 0.46 | | | 0.014 | 0.98 |
| Q2 Answered Yes (Participation) | | | **0.355** | **0.10** | | | 0.697 | 0.15 |
| Q3 Answered yes (Comprehension) | | | 0.035 | 0.87 | | | 0.712 | 0.18 |
| Q4 Answered Yes (Enhance Class) | | | **0.765** | **<0.01** | | | **1.031** | **0.02** |
| Q5 Answered Yes (Fair Questions) | | | 0.684 | 0.20 | | | 1.108 | 0.24 |
| Q7 Answered Yes (Study) | | | 0.202 | 0.33 | | | 0.468 | 0.36 |
| Constant | -0.593 | <0.01 | -1.617 | 0.01 | 0.181 | 0.66 | -2.569 | 0.02 |
| Number of respondents | | 261 | | 215 | | 93 | | 85 |
| Pseudo $R^2$ | | 0.009 | | 0.18 | | 0.008 | | 0.404 |
| LR Statistic | | 3.24 | | 49.03 | | 1.09 | | 45.09 |
| | | Prob[ $Chi_3^2$ <LR]= 0.35 | | Prob[ $Chi_{11}^2$ <LR]=0.0001 | | Prob[ $Chi_3^2$ <LR]= 0.78 | | Prob[ $Chi_{11}^2$ <LR]= 0.0001 |

*Note 1:* Coefficients in bold achieve statistical significance at the 0.10 level or less.
*Note 2:* The Pseudo $R^2$ is a measure of goodness of fit for discrete models which is an analog to the $R^2$ in regression analysis. The LR statistic compares the likelihood of a model without predictor variables to one with all the predictor variables. Smaller values of the statistic, which can be linked to a $Chi^2$ distribution, indicate we cannot reject the hypothesis that all factors have no influence (for more details on these measures of fit see Greene 2008, P. 498 and P. 790 [17]).

Model 1 included student demographic factors (gender, packaging and grade less than 2.5) as predictor variables. In model 2, all the demographic variables were included plus the responses to questions 1 through 5, question 7, and students' assessment of SRS cost (i.e., price is too high and it should not cost). In the case of PKG 101, model 2 indicates that packaging majors were more inclined to like a class with clickers ($p=0.07$). In addition, PKG 101 students who reported that the SRS enhanced their class experience were more likely to prefer a class with clickers ($p<0.01$), but if they believed clickers should not cost, they were less likely to prefer them in a class ($p=0.01$). In the case of PKG 221, no predictor variable was indicated to influence preference for a class with clickers, except for the opinion that SRS use enhanced the class ($p=0.02$).

## Discussion

Faculty observed increased attention and engagement in the classes employing the SRS as has been documented in the literature (Caldwell, 2007; Kay and LeSage, 2009; Trees and Jackson, 2007). Student responses are congruent with this (see Table 1 and 2, Qs 1 and 2). However, not all aspects related to the SRS prompted support of the SRS, or were consistent across the two classes. For example, in terms of SRSs' influence on study efforts, 53% of PKG 101 students indicated the SRS questions did not help them or made a difference to review the material (Table 1, Q 7). By contrast, PKG 221 students were favorably inclined to the SRS in relation to their study. Despite the positive responses to many questions for both classes, and qualitative feedback obtained via email, PKG 101 and PKG 221 students responded differently to Question 8 (i.e., prefer a class with SRSs or not). A majority of PKG 101 students did not prefer a class with clickers (Table 1, Q8), though if they were already packaging majors this inclination was dampened (Table 3, Model 2). If they thought the SRS should not cost, they were then significantly less likely to prefer a class with them (Table 3, Model 2). This begs the question why? Perhaps it relates to the cost of the clicker relative to the benefits that they provide; or maybe the clickers force accountability in classes that were previously more or less anonymous in nature. Maybe it is related to adoption difficulties that the instructors observed with some students. On occasion, students had difficulties registering the clicker correctly, consistently bringing the keypad to class (some are forgotten, others are lost or broken) and maintaining the system (having fresh batteries on hand, etc.). In the case of PKG 221, where around 85% of the students already belong to the packaging major, they preferred a class with SRSs, and overall they displayed positive responses to Questions 1-7. Since most of the students were already part of the major, they may already be more willing to accept this tool to engage in class and the material, and they may have a higher tolerance for difficulties encountered.

Preszler et al., found that the percentage of students for whom clickers were a distraction or were detrimental gradually increased as grades decreased (Preszler et al., 2007). Moreover, these authors also found that the "students' opinions of the influence of the clickers on their ability to learn the course material also varied by grade" (i.e., students with higher grade thought that the clickers helped them to learn). As shown in Table 3, this study failed to find an effect of class grade on students' preference for an SRS in a class (Question 8) for either PKG 101 or PKG 221.

These findings reinforce previous work conducted by the research team (Auras and Bix, 2007), which suggests that the instructors' approach to using clickers has a profound impact on the success or failure of the implementation. The authors encourage faculty to consider various implementation aspects when introducing and using this tool. Items for consideration include: policy issues (lost, forgotten, broken or malfunctioning equipment, accommodations for visually impaired students, students with anxiety disorders, etc), and assessment issues (points for attendance, credit for participation, points for right and wrong answers, and implementation of peer instruction). A number of authors have explored these topics, and the reference section of this article is a good beginning for looking at implementing SRSs in classes.

## Summary

Overall, three main inferences can be taken from this study. 1) Demographic factors such as gender and grade were not found to have a significant effect on the chance of preferring a class with SRSs, 2) students in the packaging major were more likely to prefer a class with SRSs, and 3) class level (i.e., freshman or sophomore in this case) and implementation of SRSs can play a crucial role in students' preference for SRSs.

PKG 101 and 221 students, surveyed during two consecutive semesters, indicated that the implementation of an SRS in their classes motivated them to attend and helped them to comprehend and study the class material. However, PKG 101 students indicated that they preferred classes that did not employ an SRS. On the contrary, most of PKG 221 students indicated that they preferred a class with SRS. Further study is needed to understand this dichotomy. Future efforts should continue to examine the implementation of SRS across classes.

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# Where Have Our Animal Science Graduates Gone?

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## Abstract

Five hundred twenty-five alumni of the Department of Animal Science at Washington State University (WSU) were queried about their job history, and a return of 195 replies (37.1%) was obtained. Of these, 89 and 106 were from males and females, respectively, and 159 B.S. degrees and 58 M.S./Ph.D. degrees were reported. Career-wise, 116 and 129 (total = 245) jobs were reported to have been held by male and female alumni, respectively, with nearly 30% of alumni being involved in higher education, 17% possessing a job in the allied animal/food industry, 12% having a career in some aspect of veterinary medicine, and a little over 10 % indicating a traditional career in farming, ranching, dairy or feedlot. A smaller (20 year) window of time was evaluated, with only B.S. level alumni respondents between the years 1988 to 2007. During this time, 740 official B.S. degrees in Animal Science were awarded to 237 male and 503 females. A total of 98 (13.2%) responses were received from 26 (~11%) male and 72 (14.3%) female graduates. The top three careers of this group were some aspect of the veterinary profession (25.5%), the allied animal/food sciences area (19.4%) and the farming/ranching/dairy or feedlot field (9%).

## Introduction

Where has the Washington State University (WSU), Animal Sciences (AS) graduates gone? Have the alumni used their skills that were provided them, while at WSU, in a favorable manner? Answers to these questions could help the AS department make decisions regarding class content, emphasis of classes and in formulation of long-range departmental goals (Ingram et al., 2004; Good and Kochan, 2008). Moreover, information derived from alumni about their career dynamics could provide rationale for forming areas of AS departmental excellence (Good and Kochan, 2008) with which to better prepare future graduates for diverse careers (Ingram et al., 2004).

Assessment methods to obtain information from dynamic populations include formal surveys (Denniston and Russell, 2007; Rasmussen et al., 2008), as well as casual questionnaires. Portions of both may be mined for useful information (Riley, 1997). However, unless the participants of surveys are provided an incentive (Jobber et al., 2002; Hardin and Ainsworth, 2007), most surveys are inefficient and result in only small returns (Braunsberger et al., 2007; Denniston and Russell, 2007).

In an effort to develop a "family atmosphere" relationship with alumni, the AS Department at WSU formed an alumni association called the Friends of Animal Science (FAS; Dodson, 2008). As this group has been communicating effectively by email for two years, this network was used to ask graduates about their career jobs. For this report, replies from the established FAS network were assessed for general career information. The goal was to provide an indication of how useful the degree in Animal Science was for each respondent, and the subsequent mining of all replies could provide more detailed information, if desired.

## Methods

Information on animal science alumni was obtained from the WSU Foundation office in April, 2006. While the information bundle contained a host of information, ~1150 email addresses were used to form an initial alumni database. The database was probed to assess support for forming the FAS (alumni) group (Dodson, 2008). An initial email message sent to alumni resulted in ~300 return messages saying that the email address was no longer valid, or that individuals were not interested at that time in forming such an alumni organization. From 2006 to present, the database has been quite dynamic, with alumni receiving messages about the FAS, requests to nominate individuals for departmental awards, and general information. As a normal function, new alumni interested in hearing about the WSU Department of Animal Science or FAS rotated onto the database (email address added) and others, either tired of hearing about the department or FAS or simply "moving on," rotated off the database. In October of 2009 there were 525 valid alumni email addresses in the database.

For the purposes described herein, all individuals of this database were simply (and non-formally) asked: "...If you do not mind, I am interested in collating information about you so that we can get an idea of what you are doing. Please take a few minutes and let me know the degree(s) you obtained at WSU, the types of jobs you have had over your lifespan, and any other information you might want me to evaluate..... This information is coming to me and me alone, but will be useful to the future direction of the department and to others. The Department of

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Animal Science will NOT use this information for any other purpose (fund raising, advertisements, etc)." Two additional email messages were sent to the alumni database thanking those who responded, and asking others to send in their small career summaries. Responses were obtained over the course of the next two weeks. Subsequently a total of 195/525 emails were received. The results were collated and compiled for this report. The WSU, Institutional Review Board (IRB) did not review this (informal) assessment message, prior to it being sent to our alumni. However, as we are in the process of developing/sending a formal survey to all alumni, that (formal) survey document is being reviewed by the WSU IRB.

## Results and Discussion

In the past, the AS Department at WSU has not done a good job in effectively communicating with alumni. Typically, a student would graduate, and then the AS Department would not hear anything about them from that point onwards. However, the need to create synergistic alumni relations has now been a prevailing mindset in the AS Department, and other departments, at WSU. To this endpoint, the AS Department has created an effective and viable alumni organization called the Friends of Animal Science, whereby alumni volunteers support a wide-range of departmental activities. As a long-term department effort, the AS Department is implementing strategic planning initiatives and curriculum evaluations, and forming consensus groups to provide constructive input to the department. Alumni have been asked to provide input regarding their career choices in an effort to determine how effective our program offerings are for current or future students. While it is recognized that the future animal scientist will not be the same as in the past, the AS Department at WSU is taking measures to ensure a quality education that prepares career-ready professionals.

According to the US government, an animal scientist is broadly defined as one whom "develops better, more efficient ways of producing and processing meat, poultry, eggs and milk," and approximately 5,400 animal scientists were gainfully employed in 2006 (US Department of Labor). There are approximately sixty animal sciences departments in North America. Not considering poultry science or dairy

**Table 1. Number of Department of Animal Science degree recipients alumni that responded to a (non-reward) request by email regarding their career (N = 195/525; 37.1% responded).**

| Graduation Years | Response Total | Male | Female | BS Degree | MS/PhD Degree |
|---|---|---|---|---|---|
| 2006-2009 | 14 | 5 | 9 | 12 | 3 |
| 2001-2005 | 54 | 12 | 42 | 48 | 6 |
| 1996-2000 | 15 | 7 | 8 | 14 | 4 |
| 1991-1995 | 16 | 6 | 10 | 11 | 10 |
| 1986-1990 | 26 | 15 | 11 | 20 | 10 |
| 1981-1985 | 21 | 6 | 15 | 15 | 8 |
| 1976-1980 | 19 | 13 | 6 | 15 | 5 |
| 1971-1975 | 11 | 7 | 4 | 8 | 3 |
| 1966-1970 | 3 | 3 | 0 | 1 | 3 |
| 1961-1965 | 2 | 2 | 0 | 1 | 1 |
| 1956-1960 | 5 | 5 | 0 | 5 | 4 |
| 1950-1955 | 7 | 7 | 0 | 7 | 1 |
| <1950 | 2 | 1 | 1 | 2 | 0 |
| Totals | 195[a] | 89 | 106 | 159 | 58 |

[a]Some individuals received more than one academic degree at WSU, but were only counted one time.

**Table 2. WSU Department of Animal Science alumni of Table 1 that indicated having a job in the listed vocations.**

| Job[a] | Male | Female |
|---|---|---|
| Farm/Ranch/Dairy/Feedlot (25; 10.2% total) | | |
| owner | 3 | 7 |
| operator | 3 | 0 |
| production manager | 5 | 2 |
| laborer | 1 | 4 |
| Veterinary Clinic (30; 12.2% total) | | |
| owner | 5 | 3 |
| associate | 1 | 14 |
| technician | 1 | 2 |
| assistant | 0 | 3 |
| clerical | 0 | 1 |
| Wildlife (5; 2% total)) | | |
| zoo/sanctuary | 0 | 2 |
| research laboratory | 1 | 1 |
| marine mammals | 0 | 1 |
| Allied Animal/Food Industry (42; 17.1% total) | | |
| biotechnical | 0 | 3 |
| clothing | 0 | 1 |
| farm store/nursery | 2 | 2 |
| finance | 1 | 3 |
| food/food processing | 5 | 4 |
| health | 3 | 5 |
| insemination technician | 1 | 1 |
| nutrition/supplements | 4 | 4 |
| pet | 0 | 2 |
| pharmaceutical | 0 | 1 |
| Higher Education (72; 29.4% total) | | |
| pursuing a degree | 4 | 4 |
| faculty | 29 | 8 |
| instructor | 2 | 3 |
| administrator | 8 | 4 |
| facility manager | 4 | 1 |
| research technician | 2 | 3 |
| K-12 (17; 6.9% total) | | |
| substitute | 1 | 5 |
| kindergarten/elementary | 0 | 4 |
| science | 1 | 3 |
| agriculture | 0 | 2 |
| administrator | 0 | 1 |
| Medical (9; 3.4% total) | | |
| physician/physician assistant | 1 | 0 |
| nurse/EMT | 0 | 3 |
| clinical laboratory/IVF | 2 | 2 |
| social programs | 0 | 1 |
| Finance (6; 2.4% total) | | |
| non-agriculture | 2 | 2 |
| insurance | 1 | 1 |
| Government (24; 9.8% total) | | |
| state/local | 2 | 4 |
| federal (including USDA) | 8 | 6 |
| international | 2 | 0 |
| military | 2 | 0 |
| Private Business (15; 6.1% total) | | |
| construction/real estate | 1 | 1 |
| education materials | 1 | 0 |
| pharmaceutical/health | 0 | 1 |
| consultant | 4 | 3 |
| other (including sales) | 3 | 1 |
| Total (245) | 116 | 129 |

[a]May have designated multiple occupations.

**Table 3. Graduating (B.S. level) student numbers for the Department of Animal Sciences Washington State University for 1988 to 2007 (20 years).**

| | B.S. Level Graduates | | |
|---|---|---|---|
| Year | Number | Male | Female |
| 2007 | 45[a] (5) | 10 (1) | 34 (4) |
| 2006 | 48 (6) | 8 (1) | 40 (5) |
| 2005 | 39 (10) | 9 (3) | 30 (7) |
| 2004 | 36 (16) | 8 (3) | 28 (13) |
| 2003 | 53 (8) | 11 (1) | 42 (7) |
| 2002 | 42 (10) | 11 (2) | 31 (8) |
| 2001 | 48 (5) | 10 (1) | 38 (4) |
| 2000 | 45 (9) | 17 (3) | 28 (6) |
| 1999 | 56 (1) | 19 (0) | 37 (1) |
| 1998 | 36 (1) | 9 (0) | 27 (1) |
| 1997 | 57 (2) | 29 (1) | 28 (1) |
| 1996 | 31 (2) | 7 (2) | 24 (0) |
| 1995 | 22 (2) | 9 (2) | 13 (0) |
| 1994 | 32 (1) | 16 (0) | 16 (1) |
| 1993 | 31 (3) | 12 (1) | 19 (2) |
| 1992 | 26 (5) | 11 (0) | 15 (5) |
| 1991 | 22 (0) | 11 (0) | 11 (0) |
| 1990 | 18 (3) | 10 (2) | 8 (1) |
| 1989 | 30 (6) | 14 (3) | 16 (3) |
| 1988 | 23 (3) | 6 (0) | 17 (3) |
| **Totals** | **740(98)[b]** | **237(26)[c]** | **503(72)[d]** |

[a]Number is the actual number of official graduates from the Department of Animal Science for the specific year indicated. Number to the right (in parentheses) are the numbers of alumni that responded to email request for information.

[b,c,d]Represents 13.24% of total graduates during the 20 year period [10.97% of male and 14.3% of female students in the overall graduate population.

**Table 4. WSU Department of Animal Science (BS level) alumni of Table 3 that indicated presently having a job in the listed vocations.**

| Job | Male | Female |
|---|---|---|
| Farm/Ranch/Dairy/Feedlot (9; 9.2% total) | | |
| owner | 3 | 1 |
| operator | 0 | 1 |
| production manager | 0 | 2 |
| laborer | 0 | 2 |
| Veterinary Clinic (24; 24.5% total) | | |
| owner | 3 | 0 |
| associate | 1 | 14 |
| technician | 0 | 4 |
| assistant | 0 | 2 |
| Wildlife | | |
| zoo/sanctuary | 0 | 1 |
| Allied Animal/Food Industry (19; 19.4% total) | | |
| biotechnical | 0 | 1 |
| consultant | 1 | 1 |
| crops/farm management | 0 | 2 |
| finance | 0 | 1 |
| food/food processing | 2 | 2 |
| health | 1 | 1 |
| insemination technician | 1 | 0 |
| nutrition/supplements/feed | 3 | 2 |
| pet industry | 0 | 1 |
| Higher Education (15; 15.3% total) | | |
| pursuing a degree | 4 | 5 |
| faculty | 1 | 0 |
| instructor | 0 | 1 |
| administrator | 0 | 2 |
| facility manager | 0 | 1 |
| research technician | 0 | 1 |
| K-12 | | |
| substitute | 0 | 2 |
| kindergarten/elementary | 0 | 1 |
| science | 0 | 2 |
| agriculture | 0 | 1 |
| administrator | 0 | 1 |
| Medical | | |
| physician | 1 | 0 |
| nurse/EMT | 0 | 3 |
| clinical laboratory | 0 | 0 |
| social organization | 0 | 1 |
| Finance | | |
| non-agriculture | 1 | 1 |
| insurance | 0 | 2 |
| Government | | |
| state/local | 1 | 2 |
| federal (including USDA) | 0 | 3 |
| Private Business | | |
| construction | 0 | 1 |
| consultant | 0 | 0 |
| research laboratory | 1 | 1 |
| sales | 1 | 0 |
| Homemaker | 0 | 1 |
| Not employed | 0 | 1 |
| Other (oil refinery) | 1 | 1 |
| Total (98) | 26 | 72 |

science departments, if only the animal science departments produced 60 viable graduates each, annually, it would only take two years to fill all animal science positions. Consequently, it is evident that not everyone who obtains a degree in animal science will obtain positions as traditional animal scientists. As the data illustrate, many non-traditional jobs are career destinations for our graduates. Animal-related fields such as the veterinary medical profession are an important and desired career pathway for some animal science graduates. Trained animal scientists are well prepared for diverse careers, and that is good given the backgrounds and career interest areas that today's students possess.

Graduates from the Department of Animal Sciences at WSU (Table 1, Table 2, Table 3, and Table 4), representing a time span of 60 years, appear supportive of efforts to obtain information about their career directions. Most of the respondents were female, interested in veterinary school, and disinterested in farming or ranching. These results parallels those reported for other institutions (Buchanan, 2008). The job categories of graduates (Table 2) suggest that, while veterinary medicine may have at one time been of interest to a majority of students that interest was in many cases not be their actual vocation a few years after leaving WSU. Careers in higher education and the allied animal/food sciences were popular, and graduates are likely to fill numerous non-traditional non-animal positions instead of attempting veterinary school.

It has been reported that B.S. level graduates change their jobs 10 times before they are 38 years old (Terkanian, 2006). Part of the 20 year range used for this report falls into that age category (Table 3; Table 4), but students who shared their career history did not change jobs as many times as that previously reported (data not shown). This is heartening and suggests that either graduates obtained good jobs and stayed there, or they made the most of it and are responsible employees. Popular vocations for alumni (from 1988 to 2007) appear to be related to veterinary medicine, allied animal/food science, and higher education.

Academics are responsible for training career-ready students so that they can obtain a job after they graduate. Is the AS Department at WSU doing that, or can it do better? Alumni input to the informal questions were numerous, detailed, and many replies contained much more information than was requested. Moreover, student messages (almost to a person) state: "if you need any further information, just let me know." Graduates at both the B.S. and

Table 5. Accomplishments of selected B.S. level alumni from WSU Department of Animal Science.

| Name | Year Graduated | Accomplishment(s) |
|---|---|---|
| Jeff Boivin | 1987 | General Manager at the Cow Palace, LLC, an 8,000 cow dairy and oversees a 10,000 head feedlot. |
| Jennifer (DeVoe) Damon | 2004 | Farm Operations Specialist, Sakuma Bros. Farms, Inc. [1,200 acres of strawberries, raspberries, blueberries, blackberries and apples] |
| Callie Fernandez | 2003 | Relationship Manager at US Bank, focusing primarily on small business and agriculture lending |
| Melinda Fernyhough | 2000 | Manager of Scientific Affairs and Nutrition Research, Hartz, Inc |
| Kevin Grove | 1990 | Director of Obese Resource and Metabolic Disease Working Group, Oregon National Primate Research Center, Beaverton, OR |
| Crystal Hedden | 2006 | Quality Assurance Manager for slaughter and fabrication divisions at Washington Beef Processing Plant [Owned by AgriBeef] |
| Julie L. (Hayes) Hopkins | 1985 | Marine biology; studying humpback whales in Hawaii and doing environmental impact statement, IHA permit, and biological evaluation work in 15 of the worlds seas. Sea Turtles; Worked onboard surverys for monitoring Naval submarine/sonar exercises for marine mammal and sea turtle effects. Bears; Grizzly Bear Outreach Project [http://www.bearinfo.org/] |
| Barbara (Stevenson) Jackson | 1976 | Owner/operator: Animal Health Express and Vaquero Feed and Livestock Supply [http:// www.animalhealthexpress.com, http://www.vaquerofeed.com] |
| Cameron McGinnis | 2004 | Plant Manager at Mora Iced Creamery, located on Bainbridge Island, WA |
| Colleen Nolan | 1982 | Dean of School of Natural Sciences and Mathematics at Shepherd University, West Virginia |
| Esther Ovbiebo Tongo | 1982 | Founder & CEO of Getsym Enterprises Inc., and Esther's Authentic Foods brands- Esther's Ready Stew [http:// www.readystew.com] |
| Kelly Torrisi | 2003 | Veterinarian at an Equine Ambulatory practice in Northern California [All About Equine Veterinary Services in Chico California] |
| Aura (White) Schneidmiller | 2002 | Registered Nurse |

Table 6. Accomplishments/present positions of selected M.S. and Ph.D. level alumni from WSU Department of Animal Science.

| Name | Year Graduated | Degree(s) | Accomplishment(s) |
|---|---|---|---|
| Janine Brown | 1980; 1984 | M.S. & Ph.D. | Head of the world's largest wildlife reproductive endocrinology laboratories associated with the Smithsonian and National Zoo |
| Ching-Fong Chang | 1982; 1986 | M.S. & Ph.D. | Vice President of the University, Director Center for Excellence of Marine Bioscience and Biotechnology; National Taiwan Ocean University |
| Sandra Davidge | 1985 | M.S. | Canadian Research Chair (I) in Women's cardiovascular health; Scientist, Alberta Heritage Foundation for Medical Health, Professor, Departments of OB/GYN, University of Alberta |
| Matt Gibson | 1989 | Ph.D. | Vice President – ICM Feed: (Division of ICM, Inc. – Ethanol Design and Engineering firm). Oversee all business operations of company which provides specialty ingredients into food and livestock industries. |
| Debora Hamernik | 1984 | M.S. | Associate Dean of the Agricultural Research Division (ARD), Associate Director of the Nebraska Agricultural Experiment Station, and Professor of Animal Science at University of Nebraska |
| Jim Kinder | 1975 | Ph.D. | Chair of the Department of Animal Sciences and Interim Chair of Human Nutrition, the Ohio State University |
| Lee McDowell | 1971 | Ph.D. | Faculty, Animal Science department at the University of Florida; multiple awards for academics, international relations and mentoring students |
| Terry Nett | 1972 | Ph.D. | Associate Dean for Research and Graduate Education, Colorado State University |
| Steven J. Pylot | 1999 | M.S. | Fulltime rancher/farmer with family, running a set of black cows that calve in May and run all calves as yearlings, seed 3500 acres of crop, custom haul cattle, hay and feedlot. |
| Gary D. Smith | 1993 | Ph.D. | Co-Director for Alfred A. Taubman Medical Research Institute Consortium for Stem Cell Therapies, University of Michigan |
| Kenny Wells | 2006 | M.S. | Manager of the Jackson Agriculture Research Station, where applied research on beef cattle reproduction and forages/grazing is conducted; Ohio State University |

graduate levels have asked to receive this summary of the responses received, suggesting that our alumni are still interested in the department. The simple fact that our graduates participated in the formation of the FAS (alumni) group, the first of such on the WSU campus, speaks volumes about their loyalty. In looking towards the future, the department has a continued obligation to train the best animal science student for the changing times.

The information contained within Table 5 and Table 6 document specific alumni and their current career positions. The diversity of the job choices suggests that a solid foundation was provided by WSU, but in some cases the graduate had to learn other tools in order to be successful at a vocation. The AS department is continuing to assess options for a flexible and workable degree program to meet the needs of continuing and new students (Table 7). In turn, alumni are routinely asked for input, and will continue to be asked in order to make our degrees valuable in meeting the needs of students in the 21st Century. For example, the authors are working with the WSU, Social and Economic Science Research Center to develop a formal survey document, with specific hypotheses/objectives, which will be sent to alumni in an attempt to assess details of how the AS Department might better service B.S., M.S. and Ph.D. students.

So, where have the WSU AS Department graduates gone? The results of this report suggest that they are gainfully employed, responsible and contributing members of all walks of life. While not all AS graduates are working in an animal-related field, and while their positions are diverse, they remain sensitive to the department and responsive to questions and requests posed to them. As no one was rewarded via any incentive for supplying information for this report, it could also be said that graduates are still enthusiastic about making the department better for future students.

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**Table 7. Steps that the Department of Animal Sciences, Washington State University is doing to aid graduate job/career success.**

| Step | Outcome |
|---|---|
| Student member on teaching committee | Real-time feedback on curriculum |
| Senior exit interview | Historical feedback on "total academic picture" |
| Hands-on opportunities | Provide experience in practical areas |
| Internship programs | Provide practical experience in field |
| Faculty open-door policy | Develop internal network that might be used for employment |
| Departmental alumni association | Two-way communication with alumni |
| Commodity group interaction | Network for graduate job opportunities |
| Curriculum assessment | Use information from all steps to revise curriculum to better serve students |

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# What Do College Freshmen Know About Agriculture? An Evaluation of Agricultural Literacy

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## Abstract

The purpose of this study was to evaluate the agricultural literacy of college freshmen at a central Texas university. A score of 70% was considered acceptable; however, the mean overall score on the agricultural literacy test was fairly low (50.4%). A comparison of the overall mean literacy scores based on gender showed that male literacy scores ($M$ = 51.3%) were significantly different ($p < .05$) than female scores ($M$ = 49.9%). Students majoring in science ($M$= 54.0%) achieved an overall literacy score which was significantly ($p < .05$) higher than undecided majors ($M$ = 47.4%). The mean literacy scores of students previously enrolled in high school agriculture classes ($M$ = 54.1%) were noticeably higher than those students who were not enrolled in high school agriculture ($M$ = 49.6%), but the overall scores were not significantly different ($p < .05$). Agricultural literacy should be considered a critical aspect of general education throughout the public school system. Additionally, colleges and departments of agriculture should consider the results of the study and start discussions about what the profession should do about agricultural illiteracy.

## Introduction

In 1988, the National Research Council (NRC) recommended that students in grades K-12 receive some systematic instruction in agriculture (NRC, 1988). This recommendation was heartily endorsed by agricultural literacy experts, citing that as voters, policy makers, and consumers, Americans should be well informed about their food and fiber system. The apparent lack of agricultural literacy among the general population in 21st century America is an ongoing concern (Leising et al., 2003; Pense and Leising, 2004; Bellah and Dyer, 2007).

Previous research indicates that nearly 90% of the American population is two to three generations removed from production agriculture (Leising et al., 1998). Today less than 2% of the population is living or working on farms (Womochil, 2007). The result of this separation from agriculture is a population that knows little about its food supply, a situation which agricultural educators consider potentially dangerous. Agriculture determines a nation's general welfare and standard of living, yet in 21st century America, the population knows little about the production, processing, marketing, distribution, regulation, and research that make up its food and fiber supply (Leising et al., 1998). Lack of understanding about agriculture can also lead to public misunderstandings about agricultural issues, such as the environmental impact of agriculture, the utilization efficiency of resources in agriculture, and the safety of our food supply (Nordstrom et al., 2000).

Agricultural products are abundant and critical to American lifestyles, and a strong case can be made for consumer awareness regarding understanding of agricultural systems (Terry, 2004). Bellah et al.,(2004) suggest that agricultural literacy must be viewed as lifelong learning. Furthermore, the educational system must make a conscious effort to address agricultural literacy and redesign curricula to include more agricultural literacy competencies.

Many agriculture producer organizations provide educational materials for teachers to use in the classroom. Two programs, Agriculture in the Classroom (AITC), and A Guide to Food and Fiber Systems Literacy (FFSL), stand out in providing helpful materials and guidelines to promote literacy in agriculture nationwide. These programs, while not formally connected, provide teachers with valuable information, including lesson plans and curriculum, to integrate agriculture into core academic areas. The integration of material other than that following state-based standards has been extremely difficult for teachers due to concerns about high stakes testing and educational accountability mandated by No Child Left Behind legislation (USDE, 2010). Teachers are pressured to teach only competencies related to high stakes test items and information required by state standards. Deviation from this practice is avoided due to concerns about non-renewal of teaching contracts or contribution to loss of school funding due to low test scores. As a result, the agricultural literacy curricula offered by AITC and FFSL are often overlooked. General education faculty members at college and universities experience similar problems. Faculty members with an agriculture background find it hard to deviate from the syllabus to discuss pertinent agricultural issues.

The AITC program was established in 1981, and

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is the "largest public effort to educate people about agriculture" (Leising et al., 2003, p. 1). Its goal is "to help students gain a greater awareness of the role of agriculture in the economy and society, so that they may become citizens who support wise agricultural policies" (AITC).

During the 2002 school year, the USDA, in association with the Department of Agricultural Education at Oklahoma State University, conducted a study to evaluate agricultural literacy among high school students. The study took place in Arizona, Montana, Oklahoma, and Utah, and concluded that AITC trained teachers had a positive influence on student cognition regarding agriculture. Students demonstrated more agricultural knowledge compared to students in classrooms with no AITC training (Leising et al., 2003).

In another response to the NRC mandate suggesting that students receive "systematic instruction in agriculture" (C. Igo, personal correspondence), an intercollegiate group of researchers created standards to assist educators in evaluating student knowledge about agriculture. The final result was A Guide to Food and Fiber System Literacy, A Compendium of Standards, Benchmarks, and Instructional Materials for Grades K-12 (Leising et al., 1998).

FFSL "summarizes what America's youth should know about Food and Fiber Systems to be agriculturally literate by the time they graduate from high school" (Leising et al., 1998, p. 4). The guide defines agricultural literacy as "possessing knowledge and understanding of food and fiber systems. An individual possessing such knowledge can synthesize, analyze, and communicate basic information about agriculture" (Leising et al., 1998). Prior to the FFSL guide the emphasis in the education sector was on the development of educational materials (Leising and Pense, 2001). Although the guide contains suggestions for using the FFSL, and bringing the food and fiber curriculum to the classroom, the emphasis is on providing standards for measuring agricultural knowledge based on five themes:

1. Understanding Food and Fiber Systems
2. History, Geography, and Culture
3. Science, Technology, and Environment
4. Business and Economics
5. Food, Nutrition, and Health

In 1999, a research project was developed to "assess food and fiber knowledge of selected students in kindergarten through eighth grade before and after receiving instruction based upon the Food and Fiber Systems Literacy Framework standards and benchmarks" (Igo et al., 1999, p. 50). The study concluded that the FFSL was an effective guide for instruction in agriculture for grades K-8. In the years following the K-8 study, Pense and Leising developed and tested a measurement instrument for students in grades 9-12 based on the FFSL standards and benchmarks for that age group (Pense and Leising, 2004). A study was conducted in Oklahoma among students from six high schools who were expected to graduate in the spring of 2002 (Pense and Leising, 2004). It concluded that students did have some agricultural knowledge, but in overall agricultural knowledge "did not demonstrate that they were agriculturally literate, as defined by the FFSL Framework" (Pense and Leising, 2004, p. 94).

## Purpose and Objectives

The purpose of this study was to evaluate the agricultural literacy of college freshmen at a central Texas university using the FFSL Assessment developed by Leising et al. (2003).

Specific objectives of the study were to:

1. Determine if college freshmen could achieve a score of at least 70% on the FFSL student assessment.

2. Determine the mean overall scores of each of the five thematic areas on the FFSL student assessment.

3. Determine if overall test scores differed among gender, college major, and previous enrollment in high school agriculture courses.

## Materials and Methods

The instrument used in this study was a criterion-referenced multiple-choice test designed for a study associated with Oklahoma State University in 2001 (Leising et al., 2003). The instrument had previously been validated and pilot tested (Pense and Leising, 2004). The resulting instrument was known as the FFSL student assessment.

The sample population for this study consisted of the freshman class at a central Texas university. The university had 27,485 registered students, 4,571 of whom had completed zero to 29 credit hours and were considered freshmen. The ease and availability of electronic mail made it possible to include the entire freshmen population in the sample, and it was decided to invite all of them to participate.

Students who opted to respond did so voluntarily. After comparing the demographic makeup of the respondents to the non-respondents, it was noted that the participants accurately represented the freshmen student population at the university (Dillman, 2000). The freshman class consisted of 2066 males (45%) and 2505 females (55%); 194 males and 307 females responded to the survey. The most popular major of the freshman class was students who were undecided (28.2%). Similarly, 27.9% of the respondents classified themselves as undecided. Similar findings were recorded for other college majors.

The data was analyzed using descriptive statistics, analysis of variance (ANOVA), and t-tests in SPSS. Descriptive statistics included mean, standard deviation, aggregate mean, and frequencies. FFSL mean scores were also computed for gender, college major, and prior enrollment in agriculture classes in high school.

## Results and Discussion

Of the 501 participants in the study, a majority (61%) were female. Eighty-eight of the respondents indicated that they had been enrolled in agriculture courses while attending secondary school. As shown in Table 1, 140 (27.9%) of the respondents indicated that their current major was "undecided." Science was the next most common major indicated by respondents (21.8%). Additional majors included Arts (19.2%), Education (16.4%), Social Science (9.7%), and Pre-Law (5.0%).

Although the original FFSL authors did not determine a test score that represents an adequate level of agricultural literacy for college freshmen, we used a score of 70% on the assessment to indicate that the participant was minimally literate in agriculture. The overall mean score in our study was fairly low ($M = 50.4\%$) and very few students (14%) scored 70% or higher (Table 3).

Sub-scores for all participants based on the five thematic areas of the FFSL were calculated and ranged from a low of 40.2% for Theme 5 "Food, Nutrition, and Health" to a high of 57.1% for Theme 2 "History, Geography, and Culture" (Table 2).

**Table 1. Major Areas of Study of Study Participants**

| College Major | *n* | % |
|---|---|---|
| Undecided | 140 | 27.9% |
| Science | 109 | 21.8% |
| Arts | 96 | 19.2% |
| Education | 82 | 16.4% |
| Social Science | 49 | 9.7% |
| Pre-Law | 25 | 5.0% |

**Table 2. Mean Agricultural Literacy Scores of Study Participants**

| | All Participants | |
|---|---|---|
| Agricultural Themes | Mean | *SD* |
| Overall | 50.4 | 16.6 |
| (1) Understanding Agriculture | 55.7 | 19.9 |
| (2) History, Geography & Culture | 57.1 | 25.5 |
| (3) Science & Environment | 52.3 | 23.2 |
| (4) Business & Economics | 45.4 | 22.9 |
| (5) Food, Nutrition, & Health | 40.2 | 15.9 |

**Table 3. Overall Agricultural Literacy Test Scores Above and Below 70 Percent**

| Overall Test Score | *n* | % |
|---|---|---|
| Students Scoring Below 70 % | 429 | 85.6 |
| Students Scoring Above 70 % | 72 | 14.4 |

The observation that the mean for Theme 5 was nearly 10 points lower than the overall mean score, was discouraging since topics related to this theme are generally included in school curricula and appear frequently in the news media (Table 2). However, the mean score for Theme 2 was somewhat encouraging in the sense that history is a required subject throughout high school. Students should have a basic understanding of history in general, and might logically apply that understanding to the historical and geographical questions relating to agriculture. The relatively high score of 55.7% for Theme 1 "Understanding Agriculture" indicated that there might be a general understanding that agriculture plays a role in everyday life among the respondents. The fact that Theme 3 "Science, Technology, and Environment" scores were higher than Theme 4 "Business and Economics" scores may be related to the fact that more science majors responded than students in majors related to business and economics. Additionally, many agricultural competencies are science based, strengthening the ongoing argument and effort to offer high school agriculture as science credit.

**Table 4. Mean Agricultural Literacy Test Scores Based on Gender**

| Gender | *N* | *M* | *SD* | Minimum Score | Maximum Score |
|---|---|---|---|---|---|
| Male | 194 | 51.3 a[1] | 17.7 | 14 | 86 |
| Female | 307 | 49.9 b | 15.8 | 10 | 86 |

[1] $t = 0.372$, $p = 0.016$*

**Table 5. Differences between Overall Agricultural Literacy Test Scores Based on College Major**

| College Major | *n* | Mean | *SD* |
|---|---|---|---|
| Science | 109 | 54.0 a[1] | 16.8 |
| Social Science | 49 | 52.2 ab | 16.3 |
| Arts | 96 | 52.1 ab | 16.8 |
| Education | 82 | 48.6 ab | 16.1 |
| Pre-Law | 25 | 47.6 ab | 18.3 |
| Undecided | 140 | 47.4 b | 15.9 |

[1] Means followed by the same letter are not statistically different at the 0.05 probability level.

**Table 6. Differences between Overall Agricultural Literacy Test Scores Based on Prior Enrollment in High School Agriculture**

| Enrolled in Agriculture Classes in High School | *n* | Mean | *SD* |
|---|---|---|---|
| Yes | 88 | 54.1 a[1] | 17.8 |
| No | 413 | 49.6 b | 16.2 |

[1] $t = 2.3$, $p = 0.22$

The mean score for male participants was 51.3% with a range of 14% to 86% (Table 4). Female participants achieved an average score of 49.9% with and range of 10% to 86%. A t-test indicated that the difference between male and female mean scores was statistically significant ($p < .05$).

When comparing the agricultural literacy scores between college majors, science majors had the highest mean score (54%) and undecided students had the lowest (47.4%). The difference was statistically significant ($p<.05$). There were no other statistically significant differences among majors (Table 5).

The final comparison examined how students who were enrolled in agriculture classes in high school scored on the FFSL evaluation compared to those who did not participate in high school agriculture. Study participants were asked if they had taken agriculture classes during high school, without indicating how many classes, type of classes, or how many semesters classes had been taken. Table 6 shows that very few (n= 88) of the freshmen participated in agriculture classes while in high school. The overall score of those participants had taken agriculture classes in high school ($M$ = 54.1%) was higher than the mean score of those who did not take agriculture classes ($M$ = 49.6%). There was no statistical difference between the two groups. However, students who had some initial background in agriculture appear to be better equipped to discuss and make decisions related to agricultural issues.

## Summary and Recommendations

The primary conclusion drawn from this study is that college freshmen at one central Texas university know little about the systems that provide their life sustaining food and fiber. Agriculture is a critically important component of Texas' economy so it is surprising that students were so agriculturally illiterate. It is important for other institutions to perform similar studies to determine if their results concur with our findings.

Agricultural literacy should be considered a critical aspect of general education throughout the public school system. Additionally, colleges and departments of agriculture should consider the results of this study and start discussions about what the profession can do to battle agricultural illiteracy. Based on the findings of this particular study, colleges and/or departments might consider offering a general agriculture course as part of the core curriculum for the university. The general agriculture course(s) could satisfy several core curriculum areas, including natural science, social science, or international perspective. Such an implementation could potentially have an added benefit of increased student enrollment in agriculture by sparking student interest and thus increase student credit hours generated. Implementation at the college level would also help close the gap of agricultural illiteracy since it is sometimes difficult for public school teachers to implement such a curriculum due to accountability measures.

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# Using Insects to Promote Science Inquiry in Elementary Classrooms

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## Abstract

The University of Nebraska-Lincoln and Nebraska public schools created Bugs in the Classroom, a professional development initiative with the goal of empowering teachers to use insects in science inquiry instruction in elementary classrooms. The initiative included workshops for elementary educators on science inquiry and teaching with insects. This paper includes a description of the workshop as well as an evaluation of the impact of the workshop on participating teachers' knowledge of scientific inquiry, entomology knowledge, and inquiry practice. Also included are recommendations for similar professional development activities.

## Introduction

Science education research has demonstrated that most students learn best through experiencing the nature or processes of science and by connecting new information to their existing knowledge (Bransford et al., 1999; Montague and Mussen, 1998; Driver et al., 1985; Driver et al., 1994). The National Science Education Standards support transforming science education to engage students in active learning through inquiry-based teaching and learning, and to provide students with opportunities to personally construct their own knowledge by asking questions, developing testable hypotheses, collecting and analyzing data, interpreting and communicating results of their work (National Research Council, 1996a). Education researchers have demonstrated that inquiry-based teaching and learning can improve student attitudes towards science, enhance their performance in science, and promote scientific literacy (Haury, 1993; Lindberg, 1990; Mattheis and Nakayama, 1988; Rakow, 1986).

Professional development, which is a component of the National Science Education Standards (National Research Council, 1996a), is one avenue for empowering teachers to use science inquiry. Among the recommendations made by the National Science Education Standards (National Research Council, 1996a) is to provide professional development opportunities for science teachers led by research scientists. The benefits of partnering science teachers with research scientists include invaluable hands-on research experience, opportunities to develop critical thinking and problem-solving skills, and long-term collaborations between science teachers and scientists (National Research Council, 1996b). Scientists as content experts also build teachers' knowledge of science, and through modeling of inquiry, teacher confidence (Loucks-Horsley et al., 2003).

Recognizing the need for professional development opportunities that promote and improve inquiry instruction in the science classroom, the Department of Entomology at the University of Nebraska-Lincoln and Nebraska public schools created the Bugs in the Classroom initiative. The Bugs in the Classroom initiative included a series of workshops for elementary education teachers to stimulate their interest in science and to engage them in inquiry-based learning experiences. The primary goal of the initiative was to improve participating teachers' science process understanding and their ability to teach science using an inquiry-based teaching approach. While the focus of Bugs in the Classroom was on improving inquiry-based pedagogy, emphasis was also placed on content knowledge. Content instruction is an important component of reform strategies in science education and effective professional development programs (Kennedy, 1998; Supovitz and Turner, 2000). Further, Borko (2004, p.5) states, "Professional development that includes an explicit focus on both knowledge and the process of science can help teachers develop these powerful understandings." Therefore, a goal of the workshop was improving knowledge of key concepts related to science inquiry and insect biology instruction.

Project coordinators used insects not only because of their area of expertise but because children are fascinated by insects, they are excellent model organisms for teaching many biological processes common to all living organisms, and they have a huge impact on human society (Center for

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Insect Science, 1993). Insect life cycles, behaviors, adaptability, and evolutionary success provide unlimited possibilities for students to generate and test hypotheses (Matthews et al., 1996; Matthews et al., 1997). Insects also have a huge impact on food production, an especially relevant topic in Nebraska where the economy is dominated by agriculture.

### *The Workshop*

Three workshops were offered to both urban and rural school districts. A total of 82 elementary school teachers with a mean of seven years teaching experience participated in the workshop. While 82% of teachers stated that they had used inquiry instruction in their science teaching prior to the workshop, experience teaching science through the inquiry process was not a prerequisite for participation.

The workshop's goals were to improve teachers' knowledge of basic entomological concepts, science inquiry process understanding, and inquiry teaching practices. The outcome of the workshop was having teachers implement science inquiry investigations (prepared by the *Bugs in the Classroom* coordinators) in their classrooms. These inquiry investigations utilized insects as the teaching tool with exercises ranging from physiological and behavior studies to food preference inquiries. A complete list of the lessons can be found at http://entomology.unl.edu/k12/index.shtml.

Day one of the two-day workshops focused on science inquiry and entomology concept acquisition and participants working with live arthropods. The mode of instruction for day one was a series of lectures, hands-on opportunities with live arthropods, and structured inquiry investigations to introduce key insect biology and science inquiry concepts. Participants spent the second day conducting a series of insect-based inquiry investigations, matching the inquiry investigations with the National Science Standards, and developing their own innovative inquiry investigations. Engaging teachers in inquiry teaching was an important component of the workshop. Practice builds teacher confidence in incorporating new teaching techniques and is a critical component of quality professional development (Klein, 2001; Loucks-Horsley et al., 2003). Throughout the two-day workshop, there were also opportunities for participants to ask the coordinators questions related to the inquiry teaching approach and the insects used in the inquiry investigations.

After attending the workshop, project coordinators encouraged participating teachers to teach critical thinking and problem solving skills to their students by embedding biological content involving insects in an inquiry-based pedagogy. Each participating teacher received a teaching kit containing all the materials needed to conduct the insect-based inquiries they engaged in during the workshop. They were also encouraged to contact the coordinators if they had questions regarding insects, the lessons, and science inquiry instruction.

In addition to basic demographic data, coordinators were also interested in determining the impact of the *Bugs in the Classroom* on participants and their teaching. The evaluation instrument, created by an independent evaluator, focused on changes in participating teachers' understanding of insect biology and science inquiry. This evaluation also looked at self-reported changes in teacher's use of science inquiry in the classroom. Finally, the evaluation sought to determine the long-term impact on science inquiry application in the classroom. In particular, did teachers incorporate more science inquiry into their curriculum, and was there evidence available to document changes in their instruction.

## Materials and Methods

Project coordinators conducted pre- and post-workshop evaluations to measure workshop-related changes in teacher knowledge of insect biology and their understanding of application of science inquiry teaching approaches. The pre-workshop evaluation (administered at the beginning of the workshop) contained questions on entomological concepts and science process (inquiry) understanding (see Table 1). Insect biology questions were selected based on basic entomology concepts and knowledge needed to conduct the project inquiry investigations. Coordinators selected science process understanding questions in a similar manner, but they also took into account the State and National Science Education Standards for inquiry by including questions covering basic principles of science inquiry understanding. The pre-workshop evaluation also included self-assessment items to measure participants' insect biology and science inquiry understanding in relation to their perceived ability to incorporate science

**Table 1. Entomology and Science Process Questions**

| |
|---|
| *Entomology understanding* |
| Which of the following diagrams is an insect? (4 diagrams including 3 non-insect arthropods). |
| List the names of three insect orders (scientific or non-scientific names). |
| List 3 different forms or types of insect communication. |
| Name three social insect groups. |
| *Science inquiry understanding* |
| List the six steps for conducting a scientific inquiry. |
| Which of the following is a testable hypothesis? |
| Which of the following is the best example of a scientific inquiry? |

| Table 2. Teacher Confidence in their Knowledge Questions |
| --- |
| *Pre & Post Workshop* |
| My current level of insect biology is such that I can effectively use insects in science inquiry lessons. |
| My current level of science inquiry understanding is such that I can effectively incorporate science inquiry into my classroom. |

inquiry investigations in the classroom (see Table 2). These questions measure change in confidence, before and after the workshop, in using insects and the inquiry methodology in teaching. Finally, the evaluation included a question asking participants to list the number of inquiry lessons instructed in the semester before the workshop (see Table 3).

The post-workshop evaluation (administered at the conclusion of the workshop) contained matching questions from the pre-workshop evaluation for measuring the impact of the workshop on participants' entomology and science process understanding. Also included was a question asking participants if their definition of inquiry changed as a result of attending the workshop, and a question asking if they planned to incorporate more insect-based inquiry lessons in their classrooms as a result of the workshop (see Table 3).

A six-month follow-up survey was conducted to determine the long-term impact of *Bugs in the Classroom*. Coordinators administered the survey via mail following teachers' participation in the workshop. The intent was to measure the impact of *Bugs in the Classroom* after the inquiry investigations were used in their classrooms. The survey included questions on the impact of the workshop on participants' instruction and practice of science inquiry teaching in the classroom (see Table 3). The survey also included a single open-ended question to gain additional insight regarding participants' workshop experience and its impact on their teaching.

All questions were checked for content validity with a trial-group of graduate students and faculty members in the Department of Entomology. Chronbach's alpha coefficient was calculated to determine the internal reliability of the evaluation instrument. The internal reliability for the evaluation instrument was $\alpha = 0.74$. The test-retest reliability was calculated using a Pearson's correlation coefficient. The test-retest reliability was $r = 0.40$.

McNemar Tests were used to determine the differences between pre-and-post-workshop responses to content knowledge. Wilcoxon sign-ranks test was employed for questions regarding self-assessment ratings, with exceptions to use as noted in the results.

Prior to initiating the study, the survey instrument, methodology, and informed consent form were approved by the University of Nebraska Institutional Review Board. The informed consent form contained information about the study and the workshop participants' rights to be excluded from the study. Informed consent was presented to participants at the pre, post, and six-month evaluations.

## Results

Only participants that attended both days of the workshop, taught science as one of their subjects were included in analysis (N= 59). For the six-month follow-up survey, 48 participating teachers returned their surveys. An alpha level of 0.05 was used for all statistical tests.

### *Entomology knowledge*

There was no significant change from pre- to post-test in participants' ability to identify an insect (McNemar's, P=1.00). Most participants (89.5%) understood the basic characteristics of an insect and could identify an insect from non-insect arthropods. To evaluate participants' understanding of key insect biology concepts, we compared pre- and post-workshop insect biology responses. For each of the insect biology questions there was a significant change in the number of questions answered correctly (see Table 4).

Teachers were also asked to assess their insect biology and science inquiry knowledge in relation to their ability to teach science inquiry lessons with insects, before and after the workshop. These questions were used as an indicator of changes in participating teachers' confidence. Results for these

| Table 3. Science Inquiry Practice Questions |
| --- |
| *Pre-Workshop* |
| During the previous semester (2 school quarters), what is the number of lessons or activities you instructed that used insects for science inquiry? |
| *Post-workshop evaluation* |
| As the result of the workshop I plan to incorporate more science inquiry lessons using insects into my curriculum. |
| *6-month survey* |
| As the result of the workshop I have incorporated more science inquiry lesson using insects into my curriculum. |
| As a result of the workshop I have used inquiry in my non-life science curriculum. |
| During the previous semester (2 school quarters), what is the number of lessons or activities your instructed that used insects for science inquiry? |

questions are summarized in Table 5. For both questions there was a significant positive shift in the level of agreement with the self-assessment questions from the pre- to post-workshop sessions.

**Table 4. Insect Biology Understanding Change Pre to Post-Workshop**

| | Pre-workshop | | Post-workshop | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *z* | *p* |
| Three insect orders | 0.90 | 1.27 | 2.05 | 1.22 | 4.86 | 0.01** |
| Three ways insects communicate | 1.71 | 1.05 | 2.56 | 0.53 | 4.20 | 0.01** |
| Three insect social groups | 2.17 | 1.10 | 2.92 | 0.43 | 4.17 | 0.01** |

NS, *,**, ***, Nonsignificant or significant at *P=0.05, 0.01, or 0.001*, respectively using Wilcoxon signed-ranks test

**Table 5. Self-Assessment of Understanding: Level of Agreement to Confidence Statements**

| | Pre-workshop | | Post-workshop | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *z* | *P* |
| My current level of insect biology understanding is such that I can effectively incorporate science inquiry using insects into my instruction. | 2.93 | .96 | 4.08 | .77 | -5.145 | 0.01** |
| My current level of science inquiry understanding is such that I can effectively incorporate science inquiry into my classroom. | 3.37 | .95 | 4.27 | .72 | -4.960 | 0.01** |

Likert scale (1 = strongly disagree, 5= strongly agree).
NS, *,**, ***, Nonsignificant or significant at *P=0.05, 0.01, or 0.001*, respectively using Wilcoxon signed-ranks test

### *Science inquiry knowledge*

For the six steps of the science inquiry process knowledge question, there was a significant difference, $P = 0.001^{***}$ $z$=6.00, in the number of correctly identified steps in the science inquiry process from the pre-workshop evaluation ($M$=3.25, $SD$=1.65) to the post-workshop evaluation ($M$=5.51, $SD$=0.70).

There was a significant positive change in the number of participants that correctly identified a testable hypothesis. However, there was no statistically significant change in the number of participants that correctly identified the best example of a science inquiry investigation (see Table 6). Teachers were also asked, “As a result of the workshop my definition of science inquiry has changed.” In total, 69.5% of teachers answered yes, 30.5% answered no.

### *Science inquiry practice*

There was no significant difference ($t$=1.81, $P$=0.24) in the number of science inquiry investigations reported taught pre-workshop ($M$=3.38, $SD$=5.44) and six months following the workshop ($M$=4.69, $SD$=5.59). Teachers were also asked to determine if they had used inquiry teaching in their non-life science courses. Thirty-eight participants responded to this question, 92.1% answered yes, 7.9% answered no. This indicates that a large proportion of the participants also utilized the inquiry approach in their non-life science teaching.

**Table 6. Change in Science Inquiry Knowledge Pre- to Post-Workshop**

| | W1 W2 | R1 W2 | R1 R2 | W1 R2 | c² | P |
|---|---|---|---|---|---|---|
| Testable Hypothesis | 6.77% | 0% | 44.06% | 49.15% | 27.03 | 0.01** |
| Best Science Inquiry Example | 11.86% | 6.78% | 72.88% | 8.47% | --- | 1.00NS |

NS, *,**, ***, Nonsignificant or significant at *P=0.05, 0.01, or 0.001*, respectively using McNemar Tests; *W* = wrong, *R* = right

The open-ended question included a variety of data regarding participants' workshop experience and their implementation of the project. Nineteen participants responded to this question and their written responses are categorized as follows.

Three teachers stated that their knowledge of inquiry increased because of the workshop. *“I have dramatically increased the amount of science inquiry in my 2nd grade classroom because I have a better understanding of how to conduct the project properly. I was never a fan of insects and now have two African millipedes, three Madagascar hissing cockroaches, and multitude of offspring.”*

*“This workshop has enabled me to see how the science inquiry process helps students better understand how to solve problems in a more systematic way.”*

*“It has made me much more aware of the extent I can use the scientific method and inquiry with my kindergarten students. As any teacher knows, you can never have too many hands-on activities!”*

Three teachers mentioned that the workshop increased their confidence in teaching science and/or use of inquiry in the classroom.

*“Of all the subjects I teach, science in the past has been my least favorite subject to teach. However, this workshop has given me confidence to bring science alive to my students.”*

*“The biggest value was having two people who are entomologists. Both gave me lots of resources and materials to take back and use right away. I did not have any experience with entomology. So now, I have [added] confidence.”*

*“I feel confidence in using organisms in my classroom now.”*

Five teachers commented on a change in their use of inquiry in the classroom.

*"I have dramatically increased the amount of science inquiry in my 2nd grade classroom because I have a better understanding of how to conduct inquiry properly."*

*"It provided many more activities and inquiries for the elementary classroom. I have always taught science based on the scientific method and I am always looking for new ideas. I have changed my teaching to allow for more student questioning."*

*"I have incorporated more science inquiry into science activities other than insects."*

*"The science inquiry approach was built upon to a further step than I had been doing in the past."*

*"The workshop was valuable because I performed many of the inquiries so I could see which I wanted to use and be ready to incorporate right away. I now try to look at my unit plans and see if I can rearrange activities as inquiries and use them to introduce topics instead of reading to them to introduce an activity."*

Three teachers commented on parent or school community involvement in the project.

*"I have parents requesting to have a baby roach at home so that their children can experience their life-cycle first-hand. Wow!"*

*"The students are enjoying the cockroach and taking them home on the weekends. Can't say the parents have gotten the interest there but we will get there."*

*"A group of teachers at our schools who attended the workshop are trying to put together and insect night for families to attend at our school."*

Some teachers also provided comments on the challenges of incorporating science inquiry into their classroom.

*"Unfortunately, due to the current emphasis on meeting the state-science standards and objectives (as measured by the CR tests) we as teachers are having to teach/exam a huge amount of materials into a fairly short time period, thus leaving little to no time for inquiry based activities. Another "problem" is that only one of our quarters deal with the life science realm. I have not made enough connections to see how I could do inquiry-based activities…"*

*"Good workshop but our curriculum is being directed to doing CRTs and teaching to the test more than inquiry. Inquiry is great, but the time it usually takes makes it hard to get all the topics in we are supposed to cover."*

*"It was a very memorable workshop. I just have trouble coming up with the time to do much. Either it's the wrong time of the year... Also with state testing it is hard to find time to work inquiry in."*

Others provided insight as to why they did not incorporate the inquiries into their classroom.

*"I usually do more with insects during the second semester in the spring so I have not had the chance to incorporate many of the activities we did this summer."*

*"It has at least given me a better understanding of what inquiry looks like so I can modify my existing lessons or create new ones. I do plan on using some from the workshop in the spring semester – more science in the spring."*

## Conclusions and Summary

Based on the evaluation summaries, it is evident that the workshops successfully stimulated interest in science and engaged teachers and their students in inquiry-based learning experiences. As a result of the workshops, teachers not only improved their understanding of inquiry science, but also their knowledge of insect biology. Teachers also reported that their confidence in teaching with insects improved as a result of the workshop. Based on teacher feedback we believe this is largely due to the hands-on nature of the workshops and the information provided about rearing and obtaining insects.

Teacher's knowledge and understanding of inquiry-based pedagogy also improved as a result of the workshop. Participating teachers were able to identify more essential steps of the inquiry process after completing the workshop. Teachers also improved in their ability to identify a testable hypothesis post workshop. However, teachers did not show a significant increase in their ability to identify the best example of an inquiry investigation. This is due to a high percentage (72.9%) correctly identifying testable hypotheses before the workshop.

As a measure of confidence, teachers reported that their knowledge of inquiry increased, and as a result, they felt that they could better incorporate inquiry investigations in their classrooms. On a related question, a majority of participants stated that they planned to include more science inquiry lessons using insects in to their classrooms as a result of the workshop. However, the six-month follow-up survey did not show a significant self-reported increase in the number of inquiry investigations than prior to the workshop. One explanation is that many teachers did not incorporate inquiry in their classrooms before administration of the six-month follow-up survey. The six-month follow-up survey was administered at the end of the fall semester (second quarter) following *Bugs in the Classroom* workshop. Three teachers reported that they had yet to incorporate the inquiry investigations into their classrooms and would do so in the spring semester. These teachers simply did not incorporate inquiry investigations into their classrooms yet. Other teachers mentioned constraints that prevented them from incorporating inquiry lessons in their classrooms. Time and policy constraints are one of the many barriers in incorporating reform curriculum (National Research Council, 1996; National Science Foundation, 1998). These constraints, especially the belief by some participating teachers that the *Bugs in the Classrooms* inquiry investigations would not facilitate student learning of key concepts assessed by the local criterion referenced tests (referred to as C.R.T.s by participants). While the inquiry investigations were developed to teach core concepts of the state's department of education science standards, for some teachers there was a belief that the *Bugs in the Classroom* inquiries deviated too far from their locally- approved curriculum. Future professional development endeavors should involve collaborations between teachers, school administrators, districts, and state level groups to address curriculum and time constraints. Conversations between these groups may help address concerns of how curriculum from initiatives like *Bugs in the Classroom*, while not a part of the approved curriculum, can be used to address state and national science education standards.

While there was no statistically significant increase in the number of inquiry lessons, evidence from the evaluations supports that inquiry instruction did change in some classrooms. Several teachers mentioned an increase in the number of steps in the inquiry process used in their instruction. This may be a result of the workshop changing teachers' definition of inquiry and that the prepared inquiries as a part of *Bugs in the Classroom* engaged students and teachers in all steps of an inquiry investigation. Another change in inquiry instruction use was that a majority of teachers reported that they also used inquiry in their non-life science classrooms. While this was not a primary goal of *Bugs in the Classroom*, it shows that teaching strategies covered in the workshop had an impact on other subject areas. As this was an unexpected result, we did not inquire further as to which subjects inquiry teaching methods were also used in or to what extent. However, based on participants' feedback on the six-month evaluation, it is possible that they recognized the benefit of inquiry teaching methods in other subject areas. Asking additional questions would offer some insight into the "richness" of the inquiry used in other subject areas.

Finally, teachers commented on parent and school community interest in the *Bugs in the Classroom* curriculum. This supports the positive impact of this project on participating school communities and parents' interest in science instruction. Community support is an important component of reforming science teaching and curriculum (National Science Foundation, 1998). Projects like *Bugs in the Classroom* can serve as a foundation for teachers, school administrators, and parents working together to develop and support expanded science instruction reform initiatives.

*Bugs in the Classroom* clearly shows that readily available and low cost organisms, especially insects, can be an effective vehicle for inquiry instruction. More importantly the results from *Bugs in the Classroom* demonstrate that professional development led by research scientists can impact elementary teachers' knowledge of science processes and science as inquiry teaching practices. In addition to fulfilling the outreach mission of a land grant institution, the positive outcomes of having research scientists contribute to the professional development of pre- and in-service teachers were evident in feedback from the participants. Land grant institution scientists are experts in the husbandry and location of low-cost resources, and they are daily practitioners of scientific inquiry. By precept and example, they can provide elementary educators valuable insights on teaching science content and process.

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# Demographics of an Undergraduate Animal Sciences Course and the Influence of Gender and Major on Course Performance

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## Abstract

Over a period of three 10 week quarters, students enrolled in an introductory animal sciences course were evaluated with the objectives of identifying demographic variables of the student population and their relation to performance, factors associated with enrollment, and interest areas in animal sciences. The findings showed that the majority of participants were female and classified as animal sciences majors. Veterinary medicine was a career objective of 59% of the students, while less than 5% indicated an interest in pursuing a career engaged in food animal production. Companion animals (dogs and cats) represented the species interest of nearly 50% of the students, followed by equine at 24%. Food producing animals (cattle, goats, poultry, sheep, and swine) represented the primary interests of only 20% of students; however, 43% indicated that cattle was the most beneficial species learned and reported lack of prior knowledge (27%) as a primary reason for the selection. Students perceived nutrition as the most valuable discipline learned, followed by reproduction and behavior. There were no differences in overall course performance between male and female students or animal sciences and non-agriculture majors; however, the mean cumulative course grade was lower for agriculture majors excluding animal sciences ($P < 0.05$).

## Introduction

While the number of students enrolling in animal sciences departments remains strong, the demography of the student population continues to evolve (Buchanan, 2008). Traditional roles of animal sciences departments in preparing graduates for careers in production agriculture are being replaced by more fundamental missions to educate students for diverse careers in the sciences (Kauffman, 1992). An increasing number of animal sciences students are urban, female, and declare career interests that are dominated by the veterinary profession (Edwards, 1986; Mollett and Leslie, 1986; and Reiling et al., 2003). Furthermore, increased diversity in animal species and scientific discipline interests accompany changes in the student population. Greater percentages of students in animal sciences have interests in companion animals and behavior, topics that were nonexistent in early curricula of animal sciences departments, but are now routinely taught (Buchanan, 2008).

In order for an academic program in animal sciences to remain successful, it must be relevant in a changing society and address the interests and needs of its students. To this end, educators must be knowledgeable of their audience. The overall aim of this study was to characterize students enrolled in an introductory animal sciences course at a land grant university, with the objectives of identifying demographic variables of the student population and their relation to performance, as wells as factors associated with enrollment including student motives for entering the course and career objectives. In addition, student interest areas in animal sciences were documented.

## Methods

The cohorts for this study were students enrolled in Introductory Animal Sciences at The Ohio State University between autumn 2007 and autumn 2008. This 10 week course consisted of four 48-minute lectures and one of three 108-minute laboratory sessions each week. Introductory Animal Sciences is a course that utilizes a biological systems based approach to equip a broad range of students with the knowledge and critical thinking skills required to address questions concerning the maintenance, reproduction, and performance of domestic animals utilized for human benefit. The course embodies fundamental concepts in areas of genetics, reproduction, nutrition, behavior, and biotechnology; and students are introduced to the molecular and cellular mechanisms that underscore the function of biological systems and how knowledge in this area is applicable toward advancement of domestic animals. The focus is on traditional agricultural species including: cattle, sheep, swine, poultry, and horses; as well as non-traditional species including: llamas, alpacas, and aquatics. The course is a degree requirement within the animal sciences major and animal production minor.

Pre-course questionnaires were developed to address demographic variables (gender, major classification, and career objectives), motives for course enrollment, and species areas of interests. The

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pre-course questionnaire was provided to students who attended the initial day of the course (n=210). Post-course questionnaires were developed to assess students perceived value of subject matter taught (animal species and disciplines) and was provided to students who attended the final day of the course (n=199). Gender and overall course performance were determined from course enrollment records. Course performance was based on final course grades (n=212) that were determined from examinations, writing composition, laboratory exercises, and participation. Statistical analysis were performed by ANOVA using the general linear model (PROC GLM) procedures of SAS (version 9.1; SAS, Cary, NC) appropriate for a completely randomized design to determine differences in means for cumulative grades. Predictors in the model were gender and major classification (animal sciences; agriculture, excluding animal sciences; or non-agriculture). Data are presented as means ± SEM with $P \leq 0.05$ considered significant. Fisher's Exact Test (PROC FREQ) was used to evaluate the relationship between categorical values (major classification and career objectives on species interests) with $P \leq 0.05$ considered significant.

## Results and Discussion

This survey provides a random sample of the student population of an introductory animal sciences course at a land grant university. The majority of participants (Table 1) were female (79%) and classified as animal sciences majors (78%) with the remaining data set consisting of other agricultural (13%), non-agricultural (8%), or undecided (1%) majors. The greater percentage of females enrolled in the course is in agreement with findings of Hoover and Marshall (1998) and Koon et al., (2009) that reported greater enrollments for females versus males in college of agriculture classes, but differs from Mollett and Leslie (1986) and McMillan et al. (2009) that reported nearly equal gender distribution of animal sciences students. Greater female enrollment in the current study may be attributed to the primary career objectives of students, with approximately 59% of total students indicating veterinary medicine as their career objective, increasing to 68% when only animal sciences majors were considered (Table 2). Previous findings of others demonstrated that the percentage of students that declare veterinary medicine as a professional objective closely parallels the gender distribution of introductory animal sciences courses (Edwards, 1986). Female enrollment reflects the drastic change in the ratio of men to

**Table 1. Gender and Major Classification of Students Enrolled in an Introductory Animal Sciences Course**

| Variable | Number | Percent |
|---|---|---|
| Gender | | |
| Female | 167 | 78.77 |
| Male | 45 | 21.23 |
| Major classification | | |
| Agribusiness | 10 | 4.81 |
| Agricultural Communication[1] | 3 | 1.44 |
| Agricultural Education[1] | 10 | 4.81 |
| Animal Sciences | 158 | 75.96 |
| Animal Sciences/Veterinary Technology | 4 | 1.92 |
| Biology | 8 | 3.85 |
| Undecided | 2 | 0.96 |
| Zoology | 6 | 2.88 |
| Other[2] | 7 | 3.37 |

[1] Animal Sciences may be required as a minor course
[2] Food, Agricultural, and Biological Engineering, Crop Science, English, Food Business Management, German, Landscape Architecture, Nutrition

**Table 2. Career Objectives of Students Enrolled in an Introductory Animal Sciences Course**

| Career objectives | Total Students | | Animal Sciences Majors[1] | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Animal care[2] | 13 | 6.57 | 10 | 6.33 |
| Business | 10 | 5.05 | 1 | 0.63 |
| Education | 10 | 5.05 | 0 | - |
| Food animal production | 7 | 3.54 | 7 | 4.43 |
| Uncertain | 10 | 5.05 | 10 | 6.33 |
| Veterinary technician | 12 | 6.06 | 12 | 7.59 |
| Veterinary medicine | 117 | 59.09 | 108 | 68.35 |
| Other[3] | 19 | 9.60 | 10 | 6.33 |

[1] Includes students pursuing the Animal Sciences/Veterinary Technology dual degree.
[2] Approximately 79% of total students and 67% of Animal Sciences majors that listed animal caretaker as a career goal specified desired employment with a zoo, while the remaining areas were equine training and rehabilitation.
[3] Includes postgraduate studies in human medicine, law, or reproduction; athletics; library sciences; journalism; and wildlife conservation.

**Table 3. Motives for Students Enrolling in an Introductory Animal Sciences Course**

| Reason | Number | Percent |
|---|---|---|
| Major requirement | 95 | 42.24 |
| Minor requirement | 18 | 8.57 |
| Animal interest | 47 | 22.38 |
| Elective | 1 | 0.48 |
| Exploration[1] | 6 | 2.86 |
| Increase animal experience | 2 | 0.95 |
| Increase animal knowledge | 26 | 12.38 |
| Preparation for veterinary school | 15 | 7.14 |

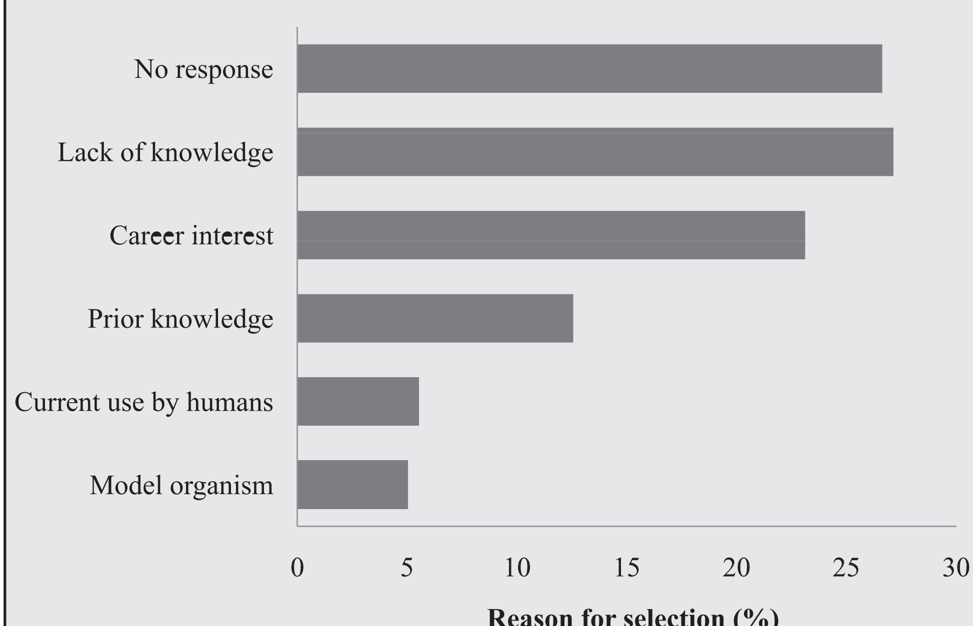
[1] Exploration is a program designed to assist students in deciding on a major or minor through investigation of courses within a degree program

women in veterinary medicine during the last three decades with women now representing greater than 70% of all veterinary students (Brown and Silverman, 1999; Elmore, 2003). The percentage of students classified as animals sciences majors exceeded other reports where 50% or less of student enrollment was ascribed to animal sciences majors (Edwards, 1986; Reiling et. al., 2003). The requirement of the course for additional agricultural majors and select veterinary college admissions is expected to contribute to the percentage of majors and non-majors that enroll in an introductory animal sciences course at different universities. Indeed, a nearly 30% enrollment of biomedical majors was reported by Edwards (1986) and attributed to the pre-professional course requirement of the universities veterinary college. A pre-professional course requirement for introductory animal sciences is not mandated for veterinary admissions at the university of the current study. While the majority of students enrolled in the course were interested in veterinary medicine, only 7% stated preparation for veterinary college as a motive for enrollment with 42% stating the need to satisfy a major requirement as the primary motive (Table 3).

Less than 5% of students indicated an interest in pursuing a career engaged in food animal production. This percentage is considerably less than the 25% reported nearly 25 years ago (Edwards, 1986), but is comparable to the more recent 8% reported by Reiling et al., (2003). An increase in efficiency of production agriculture has been met with a decreased demand for individuals engaged in production practices and is reflective of the U.S. census data (1990) that indicates less than 2% of the U.S. population lives or works on farms. Yet, there remains a requirement for knowledgeable graduates to address the needs of the world's food and agricultural systems and recruitment of qualified students to this end remains a concern (Wildman and Torres, 2001). Findings by Conroy (2000) show that agricultural occupations of interest are established as early as middle school and less than 7% of middle school students report an interest in production agriculture. Factors including reduced exposure to agriculture professions, influences of family and friends, and lack of role models in the profession are known to play a role in selection of an agricultural major (Wildman and Torres, 2001) and are likely to contribute to career decisions. It is expected that the greater percentage of women enrolled in animal sciences also contributes to the lesser reports of career interests in production agriculture as there are fewer numbers of females in agriculture positions to serve as role models and a less inclusive environment in agricultural sciences for females (Beck and Swanson, 2003).

Thirty-seven percent of students responded that information learned regarding nutrition was most valuable toward their academic goals, followed by reproduction and behavior (25 and 17%, respectively; Table 4). Greater percentages of students reported reproduction (36%) and genetics (25%) as the second most valuable discipline topic learned. This is in contrast to Reilings et al., (2003) that reported greater disciplinary interests in behavior relative to subjects of nutrition and reproduction for introductory animal sciences students. Companion animals (dogs and cats) represented the species interest of nearly 50% of the students entering the course (Table 5), followed by equine (23.5%). Food production animals (cattle, goats, poultry, sheep, and swine) represented the primary interests of only 20% of students. With 77% of households reporting animal ownership of dogs or cats and 20% owning horses (AVMA, 2007) the interest in companion animals and equine is not surprising as students in animal sciences are often most interested in animals of familiarity (McNamara, 2009). Upon completion of the course, 43% of students reported that the knowledge of cattle learned was most beneficial toward their academic goals (Table 5). It should be noted that the course focus is food producing animals and equine with discussions of companion animals and exotics restricted to comparative purposes; however, when

**Figure 1. Student reasons for most valuable species learned in an introductory animal sciences course**



asked if the course should include additional species, 44% of students responded no, whereas 16% and 5% suggested additional information on companion and exotic animals, respectively, should be included. Lack of prior knowledge (27%) was a primary reason provided for the most beneficial species learned (Figure 1). This data suggests that the knowledge and applications of the science of large domestic animals can be used to deliver fundamental biological principles to students regardless of species interests.

The species interests of students were related to major classification and career objectives ($P < 0.001$; Table 6). A greater percentage of students in non-agricultural related majors declared companion animals as their primary species interests (61%) compared to animal sciences (49%) and agricultural majors excluding animal sciences (38%). For animal sciences and non-agricultural majors, equine represented the second most reported species interests, whereas, agricultural majors excluding animal sciences were more likely to report cattle second to companion animals (Table 6). When species interests relative to career objectives were assessed, greater than 80% of students considering a profession in veterinary medicine reported interests in companion animals or equine. The limited interests in food producing animals for students that reported primary career goals in veterinary medicine was most pronounced when poultry and small ruminants were considered. These findings supports recent suggestions that there is a disproportionate number of veterinary students pursuing companion animal and equine medicine, resulting in an increased demand for students interested in food supply medicine to maintain the security of the food

**Table 4. Primary and Secondary Discipline Interests of Students Enrolled in an Introductory Animal Sciences Course [1]**

| Discipline[2] | Primary, % | Secondary, % |
|---|---|---|
| Behavior | 17.22 | 18.84 |
| Domestication | 9.27 | 5.80 |
| Genetics | 10.60 | 24.64 |
| Lactation | 0.66 | 0.00 |
| Nutrition | 37.09 | 14.49 |
| Reproduction | 25.17 | 36.23 |

[1] 151 of 199 students completing the survey question responded with their primary discipline interests; whereas, only 69 students provided their secondary discipline interests.
[2] In addition to the listed disciplines, cell biology is covered, however, was not selected as a primary or secondary interests by students.

**Table 5. Primary Species Interests and Most Beneficial Species Learned of Students Enrolled in an Introductory Animal Sciences Course [1]**

| | Interest | | Learned | |
|---|---|---|---|---|
| Species | Number | Percent | Number | Percent |
| Cat | 17 | 8.50 | - | - |
| Cattle[2] | 30 | 15.00 | 78 | 43.33 |
| Dog | 80 | 40.00 | - | - |
| Horse | 47 | 23.50 | 43 | 20.48 |
| Goat | 3 | 1.50 | 4 | 2.22 |
| Lamoids | 2 | 1.00 | 1 | 0.56 |
| Poultry[3] | 3 | 1.50 | 10 | 5.56 |
| Sheep | 3 | 1.50 | 13 | 7.22 |
| Swine | 11 | 5.50 | 31 | 17.22 |
| Other[4] | 4 | 2.00 | - | - |

[1] 200 students responded to species interest in the pre-questionnaire, whereas 180 students responded to the most beneficial species learned in the post-questionnaire. The course focus included food animals and equine. Discussions of companion and exotic animals were for comparative purposes primarily.
[2] Includes both beef and dairy cattle
[3] Includes chickens, ducks and turkeys
[4] Includes ferrets and rabbits

**Table 6. Effect of Major Classification and Career Objectives on Species Interests of Students Enrolled in an Introductory Animal Sciences Course**

| Variable | | Species Interests, %[1,2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | Cattle | Companion animals | Horses | Poultry | Small ruminants[3] | Swine | Other | *P-Value* |
| Major classification | | | | | | | | | < 0.001 |
| Animal Sciences[4] | 148 | 14.19 | 48.65 | 25.68 | 2.70 | 3.38 | 0.68 | 4.73 | |
| Agriculture[5] | 32 | 25.00 | 37.50 | 18.75 | 3.13 | 9.38 | 6.25 | - | |
| Non-agriculture[6] | 18 | 5.56 | 61.11 | 16.67 | - | 5.56 | 6.25 | - | |
| Career objectives | | | | | | | | | <0.001 |
| Animal care | 13 | 7.69 | 5 | 38.46 | - | - | - | - | |
| Business | 10 | 50.00 | - | 40.00 | - | - | - | 10.00 | |
| Education | 10 | 20.00 | 50.00 | 10.00 | - | 10.00 | 10.00 | - | |
| Food animal production | 7 | 71.43 | - | 14.29 | 14.29 | - | - | - | |
| Uncertain | 10 | 30.00 | 30.00 | 20.00 | - | 10.00 | 10.00 | - | |
| Veterinary technician | 12 | 8.33 | 75.00 | 8.33 | - | 8.33 | - | - | |
| Veterinary medicine | 117 | 7.69 | 55.55 | 25.64 | 0.85 | 2.55 | 5.13 | 2.56 | |
| Other | 19 | 21.05 | 31.58 | 15.79 | 5.26 | 10.52 | 5.26 | 5.26 | |

[1] A dash indicates that no student within the respective major classification or career objectives selected that species.
[2] Association between major classification or career objectives and species interests, Fisher's exact test.
[3] Includes goats, sheep, alpacas, and llamas.
[4] Includes Animal Sciences/Veterinary Technology dual degree students.
[5] Excludes Animal Sciences majors.
[6] Students enrolled in colleges other than the College of Food, Agricultural, and Environmental Sciences.

supply (Leighton, 2004; Prince et al., 2006). Interestingly, of the limited number of students reporting career objectives in food animal production, 71% reported cattle as their species interests and none reported interests in small ruminants or swine (Table 6).

Data regarding the impact of student gender on performance in agricultural courses is conflicting. Although higher-order learning abilities do not appear to differ between gender of students enrolled in the college of agriculture (Torres and Cano, 1995; McMillan et al., 2009) reported that female performance in undergraduate animal sciences courses was greater than males; whereas, Mousel et al., (2006) reported no difference in grade distribution between gender of students enrolled in an introductory forage crops management course. In the current study, there were no differences in overall course performance between male and female students ($P > 0.05$). Class performance also was similar between animal sciences and non-agriculture majors, whereas, the mean cumulative course grade was lower for agriculture majors excluding animal sciences ($P < 0.05$). Mousel et al., (2006) reported differences in grade distributions among agricultural majors enrolled in an introductory forage crop management course and attributed the findings to differences in agricultural background, with students that lacked an agricultural background being disadvantaged. Although information regarding agricultural background was not collected in the current study, this is not anticipated to be a factor underlying current grade differences between majors as it is well established that an increasing number of animal sciences students are classified as urban or suburban (Mollett and Leslie, 1986). It is more likely that the learning styles of students contributed to differences in grade distribution. Cano (1999) and Torres and Cano (1994) determined that students enrolled as animal sciences majors were predominantly field independent (analytical) learners, whereas field dependent (global) learning styles were more frequently reported for students of agribusiness and agricultural communications majors. Furthermore, field independent learners are more likely to report a greater cumulative grade point average than field dependent learners (Cano, 1999). As nearly 50% of the agricultural students excluding animal sciences declaring agricultural communications or agribusiness as their major, it is plausible that differences in learning styles contributed to class performance differences noted in the current study.

## Summary

The mission of animal sciences to equip students with the knowledge and abilities to maintain animals for human use remains relevant despite the changing demographics of the student population. As greater percentages of students enroll in animal sciences with interests in companion animals and equine, educators must recognize the greater use of animals by humans that extends beyond agriculture. This study suggests that animal sciences instruction does need to drastically shift away from the teachings of food producing animals to meet the needs and interests of students enrolled in an introductory animal sciences course. Instead, focus should be directed toward student's comprehension of the global nature of the study of animals that encompasses multiple species and disciplines by using large domestic animals as a resource for teaching fundamental knowledge of biological principles. While the majority of students enrolled in the course were female with professional interests in veterinary medicine, success in the course was unrelated to gender. The minor interests in a career involving food animal production was not surprising in light of reports of the number of the U.S. population involved in production agriculture, but causes concern regarding the future availability of knowledgeable graduates to address the needs of food agriculture.

**Table 7. Mean Cumulative Course Grade by Gender and Major Field of Study of Students Enrolled in an Introductory Animal Sciences Course**

| Variable | n | Grade, %[1] |
|---|---|---|
| Gender | | |
| Female | 167 | $81.05 \pm 1.36$ |
| Male | 45 | $80.87 \pm 3.06$ |
| Major classification | | |
| Animal Sciences[2] | 162 | $82.38 \pm 1.52^a$ |
| Agriculture[3] | 27 | $76.09 \pm 2.52^b$ |
| Non-agriculture[4] | 19 | $84.42 \pm 3.43^a$ |

[1] Values are means ± SEM. Labeled means within a row with superscripts without a common letter differ within variable, $P<0.05$.
[2] Includes Animal Sciences/Veterinary Technology dual degree students.
[3] Excludes Animal Sciences majors.
[4] Students enrolled in colleges other than the College of Food, Agricultural, and Environmental Sciences.

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# Public School Administrators' Ratings of the Biological and Physical Science Competencies Needed By Beginning Agricultural Science Instructors

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## Abstract

As we enter a new era of global competition, it is appropriate to examine science content needs of agricultural science instructors in order to keep agricultural education in the public school setting scientific and technologically advanced. This study examined public school administrators' ratings of the biological and physical science competencies needed by beginning agricultural science instructors.

A three-round Delphi technique was used to collect the data. Each round allowed the expert panelists (school administrators) to converge on a consensus that the identified biological and physical science competencies were ones needed by beginning agricultural science instructors. The study revealed that consensus (≥ 75% agreement) was reached for 12 competencies in the biological science area and 17 competencies in the physical science area. The study recommends that teacher education programs restructure to include a required course for future agricultural science instructors on how to effectively incorporate biological and physical science competencies in to the existing agriculture curriculum.

## Introduction

In today's educational news, much is heard about increasing the science and math competencies of our school students due to the fact that the United States is lagging behind other countries in both discipline areas (OECD, 2010). To mend that situation, the STEM (science, technology, engineering, and mathematics) Coalition was developed to increase awareness in Congress about these four discipline areas (STEM Coalition, 2010). Also, state education agencies have incorporated more math and science credits into the graduation plan of the future students (No Child Left Behind, 2010). The Perkins Act (2006) provided funds to help with the integration of academics and technical education (Hyslop, 2008). The integration of science into agriculture courses has proven to be a difficult task though. Agriculture teachers do not posses confidence and self-efficacy about the subject matter (Warnick, 2004). Most recommending institutions of agricultural science instructors require the completion of courses similar to what was required in the past. Bruening et al., (2001) explain these past course requirements as the remains of an older production-manufacturing era of society even though it is evident that the purpose and scope of contemporary agricultural science has shifted away from the production model (National Council for Agricultural Education (NCAE), 1999).

Teacher education programs lag behind in preparing beginning teachers with the knowledge and skills required to fully integrate these science competencies into the agriculture classroom (Warnick, 2004). As a result, Joerger (2002) recommended that a need existed to provide up-to-date pre-service and in-service activities to agriculture teachers to prepare them for the changing technology of the discipline. Peake et al., (2007) discovered that Georgia agriculture teachers put a high importance on integrating science in to agriculture. The same researchers also discovered that the top rated pre-service and in-service training need for the teachers was the "integration of current agricultural technological advances in to the curriculum."

There have been a multitude of studies performed related to agricultural science instructor professional development competencies (Joerger, 2002; Edwards and Briers, 1999; Dobbins and Camp, 2000; Roberts and Dyer, 2004; Peiter et al., 2003). However, there has been little research related to biological and physical science competencies needed by beginning agricultural teachers. Currently, teacher credentialing agencies assume that these competencies of beginning teachers are gained by satisfying the requirements of a bachelor's degree in a scientific field such as agriculture. This creates a dilemma for newly hired agriculture teachers. Even though they have obtained bachelor's degrees in

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agriculture (a high science area), they may not understand how to effectively implement science competencies in to the curriculum (Warnick, 2004).

## Purpose and Objectives

The National Standards for Teacher Education (AAAE, 2001) indicated that a balanced curriculum for agricultural instructors consisted of three specific areas: general education, technical agriculture content, and pedagogy professional skills. Roberts et al., (2006) found that the document failed to indicate the specific competencies and traits agricultural science teachers should possess. The purpose of this study was to identify one facet of the specific competencies: the biological and physical science competencies needed by beginning agricultural science teachers. The specific objectives of the study were as follows:

1. Identify the biological and physical science competencies needed by beginning agricultural science instructors through a panel of public school administrators.
2. Formulate recommendations to be utilized for the future planning of teacher preparation.

## Materials and Methods

This study focused on identifying the biological and physical science competencies needed by beginning agricultural science instructors. It was determined that the best means of collecting the necessary information would be obtained by utilizing the Delphi technique. The Delphi is a process used to provide a detailed examination of a topic or problem through the use of an expert panel (Beech, 1999; Adler and Ziglio, 1996; Chizari, 1990; Stufflebeam, et al., 1985). Delphi allows the development of a consensus on issues without bringing participants in face to face contact. At the initiation of the Delphi technique, the panelists will typically have opposing opinions and differentiated ideas related to the research questions; however, it is expected that consensus can be reached and obtained after the panel converges on the issues being studied.

A group of 12 innovative public school administrators from Texas was identified and nominated to serve as expert panelists. Demographical information of the group is presented in Table 1. These public school administrators were nominated by three primary sources: members of the state education agency, members of the State Board of Educator Certification, and graduate faculty from a university reputable for teacher training. All nominated participants on the panel were superintendents, principals, or career and technology directors who had experience with supervising agricultural education programs. Some expert administrators who were nominated included those serving on the State Board of Educator Certification Committee to aid in the development of standards for agricultural science and technology in Texas.

**Table 1. Demographical Information of Expert Panelists**

| Characteristic | | Number of ADM Experts |
|---|---|---|
| Age Range | | |
| | 21 to 30 | 1 |
| | 31 to 40 | - |
| | 41 to 50 | 5 |
| | 51 to 60 | 6 |
| Gender | | |
| | Female | - |
| | Male | 12 |
| Experience | | |
| | Public School Teaching | 12 |
| | Public School Administration | 12 |
| | Other Professional Experience | - |
| Education Level | | |
| | Master's Degree | 9 |
| | Doctoral Degree | 3 |

A three-round Delphi was issued to collect the data. The objective of the first-round questionnaire was to ask the experts to identify the biological and physical science competencies needed by beginning agricultural science instructors. Biological science was defined as "the scientific study of living things, which include animals, plants, and other living organisms and can include those things which are closely associated with living organisms" (Merriam-Webster, 2010). Physical science was defined as "the scientific study of non-living things including physics, chemistry, and astronomy" (Merriam-Webster, 2010).

The second-round questionnaire included all of the competencies identified by the panel experts in the first-round and used a format of 1 to 6 scale to further refine their opinions. They were asked to rate the identified competencies using the following scale: 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = somewhat agree, 5 = agree, and 6 = strongly agree. At least 75% of the experts had to rate the competencies a 5 or 6 in order for it to be considered a consensus agreement (Weatherman and Swenson, 1974). The round two instruments also provided a column for the participants to make comments. If the participants believed that a competency should be placed within a different conceptual area, another column was provided for the panelists to respond respectively. Also, a separate section was provided to allow panelists to add additional competencies to any of the two previous conceptual areas should they feel that additional competencies be identified.

The purpose and intent of the third-round was to further refine the responses identified in the second-round questionnaire. To accomplish that, a dichotomous "Yes or No" response instrument was used. Experts responded with a "Y" if they were in agreement that the specific competency was one needed by a beginning agricultural science instructor and with "N" if not. A consensus was reached with the use of the third-round questionnaire; therefore, the researchers determined that an additional fourth-round questionnaire did not need to be administered.

## Results and Discussion

In round 1, expert panelists were asked to identify the biological science competencies needed by beginning agricultural science instructors. Due to extenuating circumstances, one identified expert panelist had to withdraw from the study. Respondents (n=11) listed as many biological competencies as deemed necessary for a beginning agriculture instructor to possess. As seen in Table 2, 25 competencies were recorded during this initial round. Upon examination of the 25 competencies, it was found that four major themes surfaced: animal science, plant and soil science, environmental science, and horticulture/floriculture science. Additionally, expert panelists were asked to identify the physical science competencies needed by beginning agricultural science instructors. Table 3 indicates that 26 competencies in this area were identified by expert respondents. These competencies also fell in to major theme areas: earth science, soil science, agricultural engineering, and chemical aspects of agriculture. Duplicate and redundant responses for both the biological and physical competencies were combined.

After the initial round, competencies were collected and expert panelists were asked to rate their agreement that each one was needed by a beginning agricultural science teacher. As shown in Table 4, all (100%) responding experts (n=11) were in agreement that plant and soil science, anatomy of animals, animal nutrition, and animal health were biological science competencies needed by beginning teachers. Eight additional biological science competencies fell in to the general consensus category (≥ 75% rated the competency a 5 or 6). For approximately half of the 25 identified biological competencies, experts did not reach the agreement level, thus they did not appear in the round 3 instrument. The two competencies that received the lowest level of agreement (36.3%) included: the economics of higher level of production through improved biology and specialty animals including canine, avian, and tropical fish.

Table 5 indicates that responding experts (n=11) reached 100% agreement in four physical science competency areas including plant science (fertilizers, minerals, inorganic and organic), feed rations / feed additives, welding (gas and electric), and water requirements of plants. In an additional 13 physical science competencies, the experts reached consensus agreement (≥ 75% rated the competency a 5 or 6). The remaining eight physical science competencies did not make consensus, thus were not deemed important by school administrators and did not make it to round three. Two physical science competencies related to weather had the lowest level of agreement with school administrators. These included concepts associated with moon phases and climatology (36.3% agreement) and modern technology used to influence weather (27.3% agreement). Even though two columns were made available for experts to make changes to the competencies or provide comments, the option was not utilized by any of the respondents on either the biological or physical science competencies.

The round-three instrument was developed from the responses of the round-two instruments. Again, the instrument used a dichotomous rating scale of Yes or No to measure whether or not the experts believed the biological or physical science competency was one that was needed by beginning agricultural science instructors. It

**Table 2. Responses from Round-One: Biological Science**

| Biological Science Competencies | |
|---|---|
| Anatomy of animals-how life is sustained; cell growth | Entomology |
| Plant and animal reproduction | Agricultural biotechnology |
| The future role of genetics in the production of plants and animals | Environmental and natural resources systems |
| Global impact of biological science | Animal physiology systems; cardiovascular, nervous |
| The economics of higher level production through improved biology | Animal health and nutritional resources |
| Biotechnology and its future in our society | Agricultural chemicals |
| Animal anatomy and physiology | Microbiology |
| Animal genetics and reproduction | Skeletal systems |
| Food and fiber production | Animal nutrition |
| Environmental knowledge | Animal health and parasites |
| Breeds of livestock | Artificial Insemination/Embryo Transfer |
| Broad based knowledge of specialty animals- canine, avian, tropical fish: Applicable in urban environment | Horticulture/Floriculture |
| | Plants and soil science |

**Table 3. Response from Round-One: Physical Science**

| Physical Science Competencies | |
|---|---|
| Soil science; formations and types | The interaction of the physical environment with basic living organisms |
| Plant science; Fertilizers, minerals, inorganic and organic | Water requirements of plants |
| Earth science; Weather conditions/planning seasons | Soil classification systems |
| Feed rations/ feed additives | Inorganic and organic fertilizers |
| Welding; gas and electrical | The development of consumer products |
| Basic engineering physics for shop projects | General physic; Industrial, engineering, and manufacturing concepts |
| Chemical properties associated with plant and animal production | Soil structures |
| The influence of weather on production agriculture | Photosynthesis |
| Modern technology used to influence weather | Soil profiles |
| Physical concepts associated with power systems | Soil classes |
| Physical concepts associated with moon phases and climatology | Electricity; Basic terms and principals |
| Environmental issues facing our future generations | Engines and power supplies; internal combustion engines |
| Global warming and its effect on agriculture | |

was decided a priori by the researchers that any competency which yielded a 75% or greater “Yes” rating among the administrator panel would be considered having reached consensus by the group. Table 6 shows the responses to the round-three instrument. Consensus for 12 competencies was reached in the biological conceptual area and for 17 competencies of the physical science conceptual area. All of the biological and physical science competencies that reached consensus in round two did so in round three. Thus, a panel of experts from public school administration was in agreement that 12 competencies in the biological science area and 17 competencies in the physical science area were needed by beginning agricultural science instructors.

**Table 4. Percentage of Agreement for Round-Two Biological Science Competency**

| Competency | % Agreement |
|---|---|
| Plants and soil science | 100.0% |
| Anatomy of animals-how life is sustained; cell growth | 100.0% |
| Animal nutrition | 100.0% |
| Animal health and parasites | 100.0% |
| Plant and animal reproduction | 90.9% |
| Animal anatomy and physiology | 90.9% |
| Animal health and nutritional resources | 90.9% |
| The future role of genetics in the production of plants and animals | 81.8% |
| Horticulture/Floriculture | 81.8% |
| Agricultural biotechnology | 81.8% |
| Animal genetics and reproduction | 81.8% |
| Breeds of livestock | 81.8% |
| Food and fiber production | 72.7% |
| Environmental knowledge | 72.7% |
| Entomology | 72.7% |
| Environmental and natural resources systems | 72.7% |
| Agricultural chemicals | 72.7% |
| Skeletal systems | 72.7% |
| Artificial Insemination/Embryo Transfer | 72.7% |
| Animal physiology systems; cardiovascular, nervous | 54.5% |
| Microbiology | 54.5% |
| Biotechnology and its future in our society | 45.5% |
| Global impact of biological science | 45.5% |
| The economics of higher level production through improved biology | 36.3% |
| Broad based knowledge of specialty animals- canine, avian, tropical fish: Applicable in urban environment | 36.3% |

**Table 5. Percentage of Agreement for Round-Two Physical Science Competency**

| Competency | % Agreement |
|---|---|
| Plant Science; fertilizers, minerals, inorganic and organic | 100.0% |
| Feed rations/ feed additives | 100.0% |
| Welding; gas and electrical | 100.0% |
| Water requirements of plants | 100.0% |
| Soil Science; formations and types | 90.9% |
| Basic engineering physics for shop projects | 90.9% |
| Inorganic and organic fertilizers | 90.9% |
| Photosynthesis | 90.9% |
| Electricity; basic terms and principals | 90.9% |
| Engines and power supplies; internal combustion engines | 90.9% |
| Chemical properties associated with plant and animal production | 81.8% |
| The influence of weather on production agriculture | 81.8% |
| Soil classification systems | 81.8% |
| The development of consumer products | 81.8% |
| Soil structures | 81.8% |
| Soil profiles | 81.8% |
| Soil classes | 81.8% |
| The interaction of the physical environment with basic living organisms | 72.7% |
| Earth Science; Weather conditions/planning seasons | 72.7% |
| Physical concepts associated with power systems | 72.7% |
| Environmental issues facing our future generations | 63.6% |
| Global warming and its effect on agriculture | 54.5% |
| General physic; Industrial, engineering, and manufacturing concepts | 45.4% |
| Physical concepts associated with moon phases and climatology | 36.3% |
| Modern technology used to influence weather | 27.3% |

## Summary

The purpose of this study was to examine public school administrators' ratings of the biological and physical science competencies needed by beginning agricultural science instructors. The results of this study may be used to assist agricultural teacher education programs in making changes to existing curriculum and to start conversation about possibly adding a course to teach future instructors how to effectively implement science in their agriculture classrooms. It may seem that the biological and physical science competencies identified by the expert panelists in this study are nothing out of the ordinary, but as found by Warnick (2004), many agriculture teachers do not possess confidence to integrate scientific concepts in to their agriculture courses.

The study found that three-fourths or more of the administrators of agricultural education programs agreed on 29 competencies needed by beginning agricultural science instructors. Among these competencies, 12 were associated with the biological sciences and 17 were associated with the physical sciences. The biological and physical science competencies that did not reach consensus may have done so for two reasons. These reasons could include: 1) geographical locations of the agricultural education programs and 2) background experience of the expert panelists. Expert panelists that indicated that science concepts related to specialty animals (canine, avian, and tropical fish) were needed may have done so due to the fact that they live in an urban or suburban area and have a high enrollment rate of non-traditional agriculture students. Expert panelists who live in a geographical area with more of a traditional agriculture student population may have rated these competencies very low, thus dropping it to a level that was not high enough for general consensus. Additionally, if an expert had a strong background in mechanics or animal science, they may have the perception that all beginning agriculture instructors should be strong in this area.

**Table 6. Percentage of Agreement for Round-Three Competency**

| Agricultural System | Competency | % Agreement |
|---|---|---|
| **Biological Science** | Anatomy of animals-how life is sustained; cell growth | 100.0% |
| | Plant and animal reproduction | 100.0% |
| | Animal anatomy and physiology | 100.0% |
| | Animal genetics and reproduction | 100.0% |
| | Breeds of livestock | 100.0% |
| | Plants and soil science | 100.0% |
| | Animal health and nutritional resources | 100.0% |
| | Animal health and parasites | 100.0% |
| | Horticulture/Floriculture | 100.0% |
| | The future role of genetics in the production of plants and animals | 90.9% |
| | Agricultural biotechnology | 90.9% |
| | Animal nutrition | 90.9% |
| **Physical Science** | Soil Science; formations and types | 100.0% |
| | Plant Science; fertilizers, minerals, inorganic and organic | 100.0% |
| | Feed rations/ feed additives | 100.0% |
| | Welding; gas and electrical | 100.0% |
| | Water requirements of plants | 100.0% |
| | Soil classification systems | 100.0% |
| | Inorganic and organic fertilizers | 100.0% |
| | Soil structures | 100.0% |
| | Photosynthesis | 100.0% |
| | Soil profiles | 100.0% |
| | Electricity; basic terms and principals | 100.0% |
| | Engines and power supplies; internal combustion engines | 100.0% |
| | Basic engineering physics for shop projects | 90.9% |
| | Chemical properties associated with plant and animal production | 90.9% |
| | The influence of weather on production agriculture | 90.9% |
| | Soil classe | 90.9% |
| | The development of consumer products | 81.8% |

With a national perspective in mind, the National Council for Agricultural Education conducted a comprehensive review of a strategic plan for agricultural education. It produced several initiatives, including the publication The *Reinventing of Agricultural Education for the Year 2020* (NCAE, 1999). Its mission focuses primarily on the career preparation of students with emphasis on making students aware of global agricultural systems, food and fiber systems, and natural resources systems that are related to agriculture. Because of this shift in focus of agricultural education as defined by the National Council for Agricultural Education (1999), our study was necessary to determine the appropriate biological and physical science competencies needed by beginning instructors of agricultural education. Teacher education programs should be restructured to incorporate all of the recommended biological and physical science competencies by the administrators of agricultural education included in this study; and teach future agriculture education instructors how to integrate these science-based competencies into their agriculture courses. Even if these competencies are already included in curriculum, it may strengthen the self efficacy and confidence of future teachers to add a course whose sole purpose is to teach the integration of science in to the agriculture classroom. This could add credibility to the agriculture program at the high school or middle school level in two ways: 1) if agriculture is not offered as a science credit, having a teacher with a strong background in science could strengthen the program and 2) team teaching opportunities could increase between the agriculture and science departments. Additionally, teacher education programs and state agriculture teacher organizations should provide frequent professional development opportunities for teachers to keep up to date with the changing pace of science competencies within agriculture.

Joerger (2002) recommended that pre-service activities should be current and keep up to date with changing technology. Many of the expert panelists identified competencies that deal with a science that is ever changing and becoming more highly advanced. Some of these areas include teaching cell physiology, animal reproduction practices, the role of genetics, soil sciences, biotechnological practices, and engines / alternative fuels. The future will require new, innovative approaches to teaching agricultural science using much different information. Teaching future agricultural science instructors how to effectively integrate these biological and physical science competencies is a start of how agricultural education can contribute to closing the gap between the United States and other countries in the discipline of science.

Since this study was directed toward Texas agricultural education instructors, generalizations can not be made beyond this population, but it raises the question of similar needs in other states. Science integration in to the agriculture classroom is not state specific and should be examined nationally to keep agricultural education on the forefront of scientific advances. The study examined only one group (administrators) of many to identify the biological and physical science competencies. It would be beneficial to examine the ratings of other groups, such as current agriculture instructors, science instructors, and teacher educators nationally.

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# The Impact of Participation on Freshmen Experiences in a College of Agriculture

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## Abstract

The purpose of this study was twofold: (1) to investigate the characteristics of the participants who competed on a competitive team at the collegiate level and (2) to identify any differences between participants and non-participants of a competitive team at the collegiate level. The population of this study was traditional freshmen in the College of Agricultural Sciences and Natural Resources enrolled in the fall semester of 2007 at Texas Tech University. The sample consisted of two groups. The first group, participants, consisted of students who participated on a competitive team during their first year of college. The second group, non-participants, consisted of students who did not participate on a competitive team. A panel of academic experts used the Student Services Center to find criteria that could match non-participants to participants in an attempt to control for extraneous variables. The extraneous variables included gender, ACT score or equivalent, and academic major. The sample for this study consisted of (N=28) traditional freshmen students. Data was collected at the end of the year from the 28 students surveyed. The results showed that several variables were related to student perceptions and academic success. Further research is recommended to determine to what extent these variables are related. The results from this research can be used to model what impacts a freshman student's perceptions have on first-year academic success.

## Introduction

According to Garton et al., 2002, most universities agonize about students' academic performance and continued enrollment. Mallinckrodt and Sedlacek (1987) found that, when compared to the other years in college, the freshman year has the worst retention rate. Why is this? Freshmen students enter the college environment during a crucial transition in their life. Responsibility shifts from parents to the individual student. As a result, students are trying to balance academics, adapt to a new location, and establish new friendships (Tinto, 1993; Noel et al., 1985; Chemers et al., 2001).

There are two outcomes resulting in how a freshman student handles the challenges and decisions during their first year at college including the completion of their first year of college or dropping out of school. According to Astin et al., (1987) students who dropout from public universities are more likely to say that they left college for academic reasons over any other. From the fall of 2006 to the fall of 2007, Texas Tech University's College of Agricultural Sciences and Natural Resources lost 20 freshmen which accounted for 12% of traditional freshmen students (Texas Tech University, 2007). According to Texas Tech (2007), out of those 20 students, 10 had a GPA lower than a 2.0. However, there were no reports explaining reasons for the other 10 students dropping out were found.

In order for students to adjust to college life successfully, Ting (1997) indicated that students need to take responsibility for one's behavior, improve leadership skills, cope with change, handle stress, practice time management, and have self discipline. Most students manage to transition successfully and thus are able to excel academically. However, there are students who are unable to manage this transition and leave college during or immediately after their freshman year (DeBerard et al., 2004).

In the past two decades researchers have tried to better understand and predict student retention and academic success. Vernon (1996) reported that factors besides academic performance impact student retention. When analyzing agriculture students, Dyer and Breja (1999) noted retention was not best predicted by the traditional admission criteria such as ACT and high school rank. What makes the difference in being a successful student or a dropout? Do some students come into college better prepared? Or, once students arrive at college do they get involved in extracurricular activities that help and teach them how to be successful in college? Researchers have tried to identify predictors of college success; including aptitude test scores (e.g. SAT and ACT) (Garton, et al., 2002; Mouw and Khanna, 1993), high school GPA (Ting and Robinson, 1998), emotional intelligence (Parker, 2002), and involvement (Astin, 1993).

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Ting and Robinson (1998) account high school GPA for largest variance when measuring first-year college GPA. However, Mouw and Khanna (1993) discounted pre-college variables such as high school GPA and college entrance as predictors of college success. This was due to the fact that even though the variables were highly correlated among each other, alone the variables have little impact on college success. Mouw and Khanna (1993) concluded from the results of the study that more research needs to be conducted to explain college GPA. Garton et al. (2002) suggested further research should be conducted in colleges of agriculture to establish valid and reliable predictors of student success within those colleges.

Many researchers have studied the relationship between involvement in extracurricular activities and academic success (Astin, 1999; Bauer and Liang, 2003). Astin (1999) described student involvement as physical and psychological energy that the student devotes to studying, spending time on campus, actively participating in student organizations, and frequently interacting with faculty members and other students. Bauer and Liang (2003) found that academic-related activities were positively and statistically significantly associated to a student's first year GPA.

Astin (1999) suggested that researchers should further examine the connection between particular forms of involvement and particular outcomes. Astin (1999) explained that it would be practical to establish whether particular student characteristics are significantly associated to different forms of involvement and whether a certain form of involvement generates different outcomes for different types of students. Another student benefit derived from participation is the strengthening of their perceptions of institutional and social support (Berger and Milem, 1999). Berger and Milem (1999) suggested that research be conducted to look at the relationship between student behavior and perceptions could aid in hope of explaining student outcomes.

Collectively, do students who choose to participate in competitive, extracurricular activities have a set of pre-determined characteristics that draw them into that type of activity? If so, what is the difference in academics and perceptions of the first year of college between students who chose to participate in competitive events than those who did not?

This study sought to better understand two components of college freshmen: (1) to investigate why freshman chose to participate in competitive extracurricular activities and (2) to determine if there was a difference in academic achievement and perceptions of the first year experience between students who chose to participate in competitive organizations and those who chose not to participate. The following research objectives were developed to outline and guide this study.

1. Describe participants and non-participants by academic major, ACT score or equivalent, emotional intelligence score, critical thinking ability, strengths, personality type, and high school size.
2. Describe the relationship between participation and first-year academic performance.
3. Examine relationships between participation and student perceptions of their first year of college experience.

## Methods

The population of this study was traditional College of Agricultural Sciences and Natural Resources freshmen enrolled in the fall semester of 2007 at Texas Tech University. The sample consisted of two groups. The first group, participants, consisted of students who participated on a competitive team during their first year of college ($n$ = 15). The second group consisted of students who did not participate on a competitive team. A panel of academic experts used the Student Services Center, which focuses on recruitment and retention of students within the college as well as student development for currently enrolled students, to find criteria that could match non-participants to participants in an attempt to control for extraneous variables. The extraneous variables to be controlled for included gender, ACT score or equivalent, and academic major. Fifteen non-participant students were identified to represent the control group. However, two students failed to provide data resulting in a comparison group of 13 non-participants. All students were traditional freshmen who entered the university in the fall of 2007 majoring in one of the agricultural degree programs within the college. The sample of this study consisted of ($N$ = 28) traditional freshmen students.

The treatment for this study was considered to be participation on an intercollegiate, competitive, extracurricular team within the college. During the 2007-2008 academic year there were 15 freshmen on the wool judging team. While this sample is small, it does include all of the available students due to the nature of the study and its focus on freshman students and their first year experiences. At Texas Tech University, incoming freshman interested in a competitive, intercollegiate judging team are required to participate on the wool judging team their first year. Members of the team attended practice for three to four hours a day, two to three days each week. During these practices, students were taught technical evaluation skills associated with the event and were taught to orally present and defend their placing on classes they had judged. In addition, the fixed and frequent practice schedule allowed students to develop relationships with each other, set common goals, and have accountability to the team and all of its members.

Six data collection instruments were used to gather information for this study. The Watson-Glaser Critical Thinking Appraisal® was used to assess their critical thinking ability. Emotional intelligence was measured using the Bar-On EQ-I. The Myers-Briggs Type Indicator® Form M was used to identify their personality type. The Gallup's StrengthsFinder was used to establish the individual talents of subjects. Researchers utilized the 2008 Your First College Year Survey to obtain the subject's perception of their first year in college. The 2008 instrument was used as data collection was completed at the end of the students' freshman year in May of 2008. Finally, a researcher-developed questionnaire was administered to collect information concerning high school and collegiate experiences. The researcher-developed instrument contained only descriptive items. Face and content validity was established by an expert panel of university faculty. Reliability was not a concern for this instrument, because questions solicited were factual and did not stipulate extensive thought or time from the student. Therefore reliability of the instrument was not vulnerable (Dillman, 2000). Each of the other instruments used are standardized and are commercially available. Subsequently, each provides evidence of validity and reliability deemed to be appropriate for use in this study.

For this study, data collection was completed on a single day to control for the threat of testing location as recommended by Fraenkel and Wallen (2006). There were six instruments administered to students. The Myers-Briggs Type Indicator Form M, and the Watson-Glaser Critical Thinking Assessment were completed by paper and pencil, while the First Year of College Experience Survey, Gallup's StrengthFinder, Bar-On EQ-I, and a researcher developed questionnaire concerning high school and collegiate extracurricular involvement were administered electronically.

The objectives of this study determined the data analysis procedures used. Data was analyzed by the Statistical Package for the Social Science (SPSS) version 16.0 for windows. For the study's first objective frequencies, percentages, means, and standard deviations were used for description and comparison of subject characteristics. The second objective sought to describe the relationship between participation and first year academic performance. Means, medians, standard deviations, ranges, Point-biserial correlation coefficients, and coefficients of determination were used to measure this objective. The third objective of this study was to examine the relationship between participation and the student's perceptions of their first year experience. To measure this objective, Point-biserial correlation coefficients were calculated. Davis' (1971) conventions were used to describe the magnitude of relationship of the correlation coefficients.

## Results

Twenty-eight students completed the study. The majority of students (64.3%) majored in animal science followed by agricultural communications majors (28.6%). The most popular high school size reported by the participant group was 5A (33.3%), which is the largest enrollment classification in Texas with more than 1,985 according to the 2006 – 2007 classification criteria provided by the University Interscholastic League (2010). The most popular high school enrollment size indicated by non-participants was 2A (38.5%). A 2A high school has 195-414 students enrolled (University Interscholastic League, 2010).The mean ACT score or equivalent for participants was 26.21 with a standard deviation of 3.76 compared to non-participants' mean score of 25.62 with a standard deviation of 3.84. The mean emotional intelligence score for participants was 100.07 with a standard deviation of 10.99 while non-participants' mean score was 98.62 with a standard deviation of 9.22. The Watson-Glaser Critical Thinking Assessment (WGTCA) mean score of participants was 26.67 with a standard deviation of 5.96, and for non-participants the mean WGTCA score was 26.23 with a standard deviation of 6.47.

Students took the Myers Briggs Type Indicator to determine their psychological type. Overall the dominant psychological preferences assessed by the MBTI® were Extraversion (71%), Sensing (71%), Thinking (64%), and Judging (57%). For all students surveyed the most frequently observed psychological types were ESTP (18%), ESTJ (14%), ISTJ (14%), and ESFP (11%). Less prominent psychological types were ENTP, ENFP, ISFP, ISFJ, INTP, and INTJ representing 3.6% of the population.

The MBTI has four preference scales (dichotomies) that measures how an individual's mind operates. The first scale, Extraversion-Introversion (E-I), measures how an individual directs their energy and attention. Sensing-Intuition (S-N), the second scale, assesses how one prefers to receive information. The third scale, Thinking-Feeling (T-F), evaluates how a person desires to make a decision. Judging-Perceiving (J-P), the fourth scale, appraises how an individual is orientated to the outer world.

In an analysis of the first dichotomy Extrovert/Introvert, the participant and non-participant groups were similar. In both cases, a majority of students (participants 67%, non-participants 77%) were determined to be extroverted. On the Sensing/Intuitive scale, a strong majority of participants (80%) had a preference toward Sensing while only 61% of non-participants preferred sensing.

On the Thinking/Feeling scale, 73% of the participant group preferred thinking and only 27% preferred feeling. In contrast, for non-participants, only 54% preferred thinking, 46% preferred feeling. The final scale, Judging/Perceiving revealed the largest difference between the two groups. Seventy-three percent of the participants were identified as judging, while only 38.5% of non-participants were identified as judging.

Students also took the Gallup's StrengthFinder Assessment. Of all students combined, the most common strengths were achiever (11.5%), competition (7.7%), and adaptability (6.2%).The most popular strengths of participants were competition (11.4%), achiever (8.6%), and restorative and discipline both at (5.7%). For non-participants the most frequent strengths recorded were achiever (15.0%), adaptability (8.3%), strategic (6.9%), and relator (6.9%).

The second objective sought to describe the relationship between participation and first-year academic performance As displayed in Table 1, the mean for the participant's ($n=15$) first-year academic performance (GPA) was 3.62, the median 3.77, the standard deviation .34. Their academic performance ranged from 2.92 to 4.0. The mean for the non-participant's ($n=13$) first-year academic performance was 3.35, the median 3.34, the standard deviation .58. The range for non-participant's first year academic performance was 2.17 to 4.0. The Point-biserial correlation calculated to indicate the relationship between participation and academic performance was .29. The coefficient of determination ($R^2$) calculated was .08. According to Miller (1994), the coefficient of determination "describes the amount of variability in Y which is explained by the knowledge of X" (p. 6). Eight percent of the variance of first year academic performance could be explained by a student's participation.

Objective three was to examine relationships between participation and the student's perceptions of their first year of college experience. Correlations were calculated to compare the participant's and non-participant's perceptions of their first year of college (Table 2). The direction of the relationships was a function of how each group was coded (participants = 1, non-participants = 0). The relationship between participation and students' perceptions of hours spent per week with student clubs and groups was positive and moderate ($r_{pb}$ = .35) according to Davis (1971) conventions. The relationship between participation and a student feeling like they were more than just another number on campus was positive and moderate ($r_{pb}$ = .44). Finally, a negative moderate relationship ($r_{pb}$ = -.35) was found between participation and the perception that students were able to balance their academics and extracurricular activities. Negligible relationships ($r_{pb}$ < .09) were found between participation and critical thinking ability; problem solving skills; hours spent per week socializing with friends, exercising, partying, working for pay off campus, volunteer work; and seeing oneself as part of the campus community.

**Table 1. First-Year Academic Performance (GPA) of Freshman Students (N=28)**

| Participation | *n* | *M* | *Md* | *SD* | Range |
|---|---|---|---|---|---|
| Participants | 15 | 3.62 | 3.77 | .34 | 2.92-4.0 |
| Non-Participants | 13 | 3.35 | 3.34 | .58 | 2.17-4.0 |

**Table 2. Influence of Participation on First Year of College Perceptions (N=28)**

| Perception | $r_{pb}$ | Magnitude |
|---|---|---|
| Time spent during the week in student clubs and groups | .35 | Moderate |
| Feel like I am not just another number on this campus | .44 | Moderate |
| Able to find a balance with academics and extracurricular | -.35 | Moderate |

*Note*. Participant = 1, non-participant = 0.

## Summary

Objective one of this study was to describe participants and non-participants through various characteristics. While students in both groups were similar on many characteristics, there was a difference in size of enrollment of high school. Students in the participant group more frequently reported coming from a large high school setting. Texas Tech University is a big campus and requires and adjustment regardless of backgrounds. However, it may be that students from larger high schools more easily assimilate to activities on campus.

ACT or equivalent, emotional intelligence, and critical thinking ability scores were assessed and reviewed for each student. Overall, there were no practical differences found between participants and non-participants. This undoubtedly resulted from how researchers matched non-participants to participants on the criteria of ACT or equivalent scores. However, the similarities on critical thinking and emotional intelligence suggest that these variables may not be closely associated with the decision to participate in an extracurricular competitive event.

The results from the study indicate that freshmen students in the College of Agricultural Sciences and Natural Resources at Texas Tech University were more likely to prefer Extroversion than an Introversion. This could be a reflection of the culture at Texas Tech University, and how extroverts are attracted to the type of faculty and activities Texas Tech offers. When analyzing the psychological type of participants on the remaining scales almost three-fourths of the participants prefer Sensing, Thinking, and Judging. This demands attention, because the non-comparison group is mostly spilt among those three scales. It is not clear if students were attracted to participate in extracurricular activities because of their preferences, or if certain students were encouraged to participate more than others. Psychological assessments could prove useful to students who are not sure what organizations with which they want to be involved.

Strengths were also determined to help better understand the differences between participants and non-participants. The most popular strengths found among students were achiever and competition. More than half of the participants had competition as one of their five strengths. Discipline was also a popular strength for participants when compared to non-participants.

These findings suggest participating in intercollegiate judging activities may serve as an outlet for students with a competitive strength. Perhaps assessing student's strengths may allow universities to aid students in finding organizations or activities to get involved.

From the findings, participants are more likely to spend a greater number of hours per week being involved in a club or student group, than non-participants. Participants might feel they spend more hours per week involved in student groups and clubs, because their participation on the judging teams requires 10-20 hours of their time a week.

Participants also indicated they found it more challenging to balance academics and extracurricular activities. This could be influenced by the fact that participants missed consecutive days of school due to extracurricular activity involvement. Freshmen participants most likely have a hard time balancing academics and extracurricular activities, because the course load is tougher than their high school course load. In high school, they could balance their extra-curricular activities and school work, but in college it becomes more of a challenge.

One, of the most interesting items found in this study, is that participants felt like they were more than just another number on the university campus. This can be attributed to the fact that as a participant on an intercollegiate judging team, they travel all over the nation to represent the university. This could provide the individual with a self-pride and their school. Another cause of this might be the interpersonal relationships established with faculty and students during the experience, which can promote the students' feeling of belonging.

When comparing participants to non-participants, academic performance was higher for participants. This was true even though students were matched on ACT or equivalent score. This could be explained by two things. First, participants miss class, and have to meet with their professors face-to-face to get their make-up work. Second, for the majority of participants one of their strengths was competition. Therefore, the students' competiveness with the peers could influence their academic performance. Furthermore, in order to maintain eligibility on a judging team students have to maintain a pre-determined grade point average.

The Point-biserial correlation coefficient between participation and academic performance was .29. In addition, the coefficient of determination was .08. Eight percent of the variance of first year academic performance could be explained by a student's participation. One misconception, that this study challenges, is that grades decline when students participate in extracurricular events. Readers should use caution in generalizing the results from this study. They should only be used to describe the limited sample studied. Yet, these results should prove advantageous to teachers, advisors, and administration who work with freshman student retention and success.

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# Screens-to-Nature: Opening Doors to Traditional Knowledge and Hands-on Science Education[1]

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## Abstract

Science teachers continuously struggle to develop hands-on, stimulating pedagogical tools that capture the enthusiasm of their students, while simultaneously grappling with issues of cost-effectiveness and relevance to real-world situations. These constraints are particularly pronounced when educating indigenous students, who navigate daily between traditional and Western knowledge systems. An innovative "Screens-to-Nature" (STN) system, a portfolio of field-deployable bioassays and practical training, offers a well-designed alternative approach to transdisciplinary education, by immersing students in a guided approach to bioexploratory research. The STN bioassays simply and expediently give students the tools to detect bioactive, health-protecting properties present in local, indigenous plant materials, microbes, and fungi. The tests are reliable, accurate, low-cost, and relevant for multiple scientific disciplines. Students are transformed from observers into active researchers, able to observe and record their own uncharted scientific discoveries. Because the STN system can be implemented on traditionally-important medicinal herbs and foods, links between indigenous knowledge and Western science, as well as youth-to-elder communications, are fostered. Case studies from multiple global locations have provided positive insights as to how the STN system can stimulate the science education experience and provoke expanded science discovery.

## Challenges for Science Educators

Teachers have voiced an increasing struggle to sustain students' attention and interest in science courses. Introductory science courses such as those found in high school and undergraduate curricula are challenged to motivate students for several reasons: they are usually 'required' rather than elective courses, class sizes can be large, and students tend to have negative preconceptions of science classes (Kern and Carpenter, 1984; Lila and Rogers, 1998). Students frequently criticize the impersonal lecture style in these courses, which discourages interaction between the students and professor (Seymour and Hewitt, 1997). Often there is a perceived disconnect between the material being taught in class and the

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'real-world,' further isolating students from learning (Bransford et al., 1999). This decline in student attitude has an impact on the retention and application of knowledge transferred in class (Henderleiter and Pringle, 1999), as students are only motivated to spend time to learn and to analyze problems they find interesting (Bransford et al., 1999). These results are all the more disturbing for university level courses, as the undergraduate years have been found to be a “filter point” in mathematics, science, and engineering classes, a critical time when negative experiences in classes can lead students to alter their career paths (Seymour and Hewitt, 1997).

As an added complication, the rapid advances of science that have occurred in the latter half of the 20th century have resulted in an eruption of interest in interdisciplinary research. Both life and physical sciences are becoming more dependent on each other (NRC 2003), and this intermingling of disciplinary tools is essential to identifying and understanding the mechanisms of the most pressing problems of the day (Jacobson and Robinson, 1990). The marked shift in real world research requirements necessitates a parallel shift in teaching strategy in order to ensure future scientists and members of society are able to participate in a broader, collective scientific discovery process (Godwin and Davis, 2005). While a transdisciplinary research approach is essential to progressive scientific discovery, individual disciplines have tended to move in the opposite direction, increasingly emphasizing the value of specialization, and developing very different philosophical outlooks and underlying paradigms (Jacobson and Robinson, 1990). Thus, modern teachers face a plethora of hazards and obstacles when they attempt to develop educational programs that reflect the current and future trends of scientific discovery.

If this is true for science students in industrialized countries, the situation is even more challenging for students from indigenous communities and from developing countries, as Western science concepts have frequently been imposed on top of indigenous knowledge systems during colonialism. Classroom globalization has precipitated a considerable increase in diversity of students in the classroom (Carter, 2008; Quigley, 2009). For example, a single classroom in Africa might contain both foreign exchange students and indigenous learners, or urban students mixing with students from rural areas, creating a learning environment comprised of multiple background and experience levels. Thus, educators have to recognize and adapt to the diversity of knowledge systems represented within one class. However, not enough attention has been paid to the complexity of indigenous students' learning methods, and the cultural conflicts that confront students between home and the classroom (Carter, 2008; Le Grange, 2007; Lee, 2001). Most formal science teaching is primarily based on Western science concepts, which have been accorded a superior position over indigenous knowledge systems (IKS) and thus tend to marginalize IKS' importance and contribution to science education (Maurial, 1999; Ntuli, 2002; Odora-Hoppers, 2002). The tension between the two knowledge systems alienates students both at home, contributing to the disappearance of IKS, and at school, resulting in underperformance in science education.

While laboratory sessions are usually an integral part of science courses, many curricula tend to take a pedantic approach involving 'cook-book' lists of tasks for students to follow ritualistically. Students are not engaged in thinking about the larger purposes of their investigation and of the sequence of tasks they need to pursue to achieve those ends (Hofstein and Lunetta, 2004). Classic laboratory experiments provide a great deal of control and reproducibility (Diamond, 1986), but can be reduced to a mechanistic abstraction, in stark contrast with everyday environments where contextual reasoning is often required. By limiting the hands-on education experience only to classic laboratory exercises, students are given little chance to translate their knowledge into real world situations (Resnick, 1987), which is central to indigenous knowledge systems. Though there has been a resurgence in the debate about the necessity to integrate IKS into science education (de Beer and Whitlock, 2009), there remain many unresolved questions - including resources, perceptions, policies, and indigenous rights – how IKS can find an equitable place in science teaching.

In this manuscript, an innovative “Screens-to-Nature” (STN) system is introduced as a conduit to direct, participatory science instruction, with the added advantage that students are able to make novel, undocumented discoveries with real-world applicability using resources that have cultural significance. The STN system, described below, centers around a core set of themes: bioexploration and its applications to plant biology, human health, biodiversity conservation, community frameworks, traditional ecological knowledge (TEK), and traditional medicine. Three case studies are provided from educational experiences in Africa, South America, and North America to illustrate how the STN system can help students to mediate between indigenous knowledge systems and science education.

### *Global Institute for BioExploration*

Millions of people in developing countries die each year from infectious and chronic diseases. Unfortunately, the modern pharmaceutical industry has not focused on addressing the medical needs of developing countries, and available drugs are often costly and ineffective. The current drug development paradigm favors developed countries, and relies heavily on expensive, instrumentation-intensive proprietary technologies and patent protection to bring lucrative drugs to the market. This paradigm is rarely questioned, even for infectious tropical diseases not well served by it. In 2003, Rutgers University, in collaboration with University of Illinois in Urbana- Champaign, founded the Global Institute for BioExploration (GIBEX, see http://www.gibex.org) with a mission to enable and empower scientists from the developing world to carry out their own therapeutic lead discovery and to promote sustainable exploration of local biodiversity for products related to human health. North Carolina State University became part of the GIBEX team in 2008. GIBEX's approach to biodiscovery is based on a “Reversing the Flow” principle intended to bring simple pharmacological assays into developing countries, instead of removing biological materials from these countries to feed pharmaceutical discovery engines in developed countries. GIBEX works with universities and other research institutions in developing countries to equip local scientists and students with innovative, cost-effective, and portable pharmaceutical-discovery assays that can be directly deployed into forests, savannas, deserts, meadows, and marshes. Often, traditional knowledge can be used to zero-in on promising target endemic plants, useful for specific disease conditions. Seventeen developing countries have joined the GIBEX community since 2003, demonstrating a success of its mission. It is not surprising that, in contrast to conventional bioprospecting, GIBEX activities are enthusiastically and consistently supported by local universities, governments, and community leaders.

### *The STN System*

The central premise of the “Reversing the Flow” approach is the Screens-to-Nature” (STN) system, developed through collaborations between Rutgers University, North Carolina State University (NCSU), and the University of Illinois (UI). STN is comprised of a portfolio of field-deployable bioassays that allow students to explore the bioactivity, and potential human health ramifications, of natural plant extracts, while mastering basic biological and chemical principles. Currently, a score of individual STN assays have been designed to investigate the pharmaceutically-relevant activity of natural plant chemicals (such as biologically-active plant alkaloids, or anthocyanin pigments and related flavonoids) for human health protection. Relevant health targets include chronic and infectious disease agents (parasitic worms, protozoan pathogens, fungi, and bacteria), metabolic disorders (diabetes and obesity), and general health protection (via the antioxidant potential or anti-inflammatory properties of phytochemical constituents). The STN system engages students in 1) plant identification and field collections, 2) study of traditional, historic natural product use and ethnobotany, 3) vouchering and archiving, 4) computer-based data entry 5) extraction tactics, and 6) screening plant samples using biologically-relevant bioassays based on recognized, diagnostic chemical reactions or responses. All STN bioassays have been lab-validated, and are presented in tandem with a comprehensive field training manual which explains the set up, execution, and significance of each bioassay in the kit.

### *Illustration of an STN Assay*

Bacterial infections, including Escherichia coli, cholera, typhoid, bacterial pneumonia, and campylobacter, are serious health hazards worldwide. The World Health Organization estimates that bacterial-related diarrhoeal diseases account for approximately 2,000,000 deaths per year, making bacteria one of the largest causes of infectious disease deaths worldwide (World Health Organization, 2009). One pertinent bioassay in the STN portfolio uses non-parasitic bacteria found in saliva samples as a simple model organism to gauge bacterial lethality when exposed to a plant's bioactive extracts. The oral bacteria, while non-lethal, provide a good indicator to screen for natural extracts that would be lethal to more infectious agents, and would therefore provide potential cures for diseases caused by bacteria.

The antibacterial STN assay process begins in the field, where students identify and collect plants in the wild. Both traditional ecological/medical knowledge (provided by elders and traditional healers) and/or ethnobotanical reference books can be used to zero in on prospective candidate plant species which might have efficacy in this bioassay. Each plant's location is recorded (using a portable GPS unit) and two small samples are taken: one for extraction and one for positive taxonomic identification and retention as a herbarium specimen. An extract can be prepared from any and all parts of the plant that may have medicinal value, including the leaves, bark, fruit, roots, or inflorescences. Extraction may be done in ways that mimic a traditional method of preparation (e.g. a poultice, tea infusion, or masticant), or pulverized in alcohol, a laboratory standard that extracts multiple compounds from the plant and creates a stable extract. Depending on the availability of candidate samples and the time allotted, several different plant extracts can be screened in a single assay run. The assay includes positive and negative controls. Extracts are used within 24-48 hours because the active principles may be sensitive to degradation.

The non-pathogenic bacteria are cultivated quickly on readily-available media (LB agar). The screening procedure involves plating a small sample of diluted saliva into each well of a 48-well plate (an easy way for an individual student to create a uniform inoculum), after which the plant extract is added to the culture. The plates are allowed to incubate overnight, and are then observed, ranked on a scale of 0 (bacteria cover the entire well surface, no antibacterial activity after treatment with the plant extract) to 3 (no noticeable growth of bacteria after treatment). Data, generated in duplicate assays, on the effectiveness of each plant extract is recorded in a computer-based database. Student teams are subsequently provided with potential strategies for further evaluation of plant extract bioactive potential, through laboratory-based bioassays, if warranted.

Other bioassays in the STN portfolio specifically evaluate the ability of plant extracts to regulate blood sugar levels in diabetic patients (by inhibiting key human enzymes that degrade starches into sugar), to inhibit microbial and parasitic infections (by inhibiting fungal or roundworm growth), to bolster immunity (through antioxidant action), or to inhibit viral infections (by breaking down proteins involved in viral replication), for example.

### *Advantages of the STN System as an Educational Tool*

The assays that make up the STN system are designed to be simple and efficient, using a rigorously-tested, guided step-by-step approach to each experiment. In-field work is kept manageable by pre-measuring all main reagents to ensure reproducibility and standardization of the results. The tests rely upon visual indicators to qualitatively determine the bioactive potency (or, alternatively, the inactivity) of each extract. For example, viability, after exposure to a plant extract, of a model organism like a nematode is gauged by visually evaluating movement and appearance under magnification; in other cases, colorimetric chemical reactions mark the efficiency of the plant components to inhibit critical enzymes or disease pathogens. These design elements ensure that a broad spectrum of students can be engaged in the laboratory exercise, even when they lack previous laboratory experience. The bioassays are functional on a miniature scale, requiring as little as two grams of material for analysis and utilizing multi-well plates to increase efficiency, minimize costs, and allow multiple samples to be evaluated in a reasonable time frame.

The materials required for the extraction of plants and the set up and implementation of assays are generally inexpensive and readily-available, such as oatmeal and yeast used as growing media for worms or common agar and saliva to generate bacteria in the assay described above. Solvents used for bioassays are non-toxic, affordable, and easily accessible on a global scale. Students are engaged in a hands-on discovery process from the beginning to the conclusion of each STN experiment, actively collecting, extracting, assaying, and analyzing medicinal plants. Through directed study, students are introduced to modern research techniques such as pipetting, use of positive and negative controls, replication of experiments, preparing and using growth media, and analysis of experimental results. The hands-on attributes of the STN place the student in direct control of the research discovery process, conducting tests that, while based on previous research with plant extracts, have no predetermined outcome. Many of the candidate plants can be expected to demonstrate biological activity in some screens. Moreover, STN bioassays create a richer, more complete educational experience than the didactic exercises of many conventional labs by combining two differing styles of experimentation: the rigor and reproducibility of bench-top laboratory experiments and the larger context and applicability of fieldwork (Diamond, 1986).

The multi-disciplinary approach to the STN system blends several fields of science into a single educational experience, including such diverse topics as biochemistry, plant biology, organic chemistry, ecology, ethnoecology, indigenous knowledge, medicine, and human health. This web of interrelated science leads the students beyond the results to formulate more complicated questions and explorations, facilitating critical thinking and discussion from a single bioexploration lab experiment. The incorporation of fieldwork with the laboratory assays places the STN results in a real-world context, incorporating scientific theory into a contextual environment that is relevant and applicable to the students' life. This inquiry-based approach is essential for implementing state and federal science curriculum standards (Llewellyn, 2002; National Research Council, 1996).

### *Case Studies*

To date, Rutgers, NCSU, and UI faculty and graduate students have conducted seven training courses over the past three years, with participating communities in Africa, South America, and the United States. In each case, the bioexploratory research experiences have proven to be invaluable learning tools for both educators and students.

#### Case Study 1 - Africa

Training sessions in Africa were conducted in Botswana (supported by GIBEX and the University of Botswana) and South Africa (supported by GIBEX and a grant from the Key International Science Capacity (KISC) initiative of the South African National Research Foundation), in Kenya (supported by GIBEX and the University of Nairobi, with the additional participation of students from Makerere University, Uganda) and in Tanzania (supported by GIBEX and a grant from the National Collegiate Inventors and Innovators Alliance, NCIIA). Local university professors, students, technicians, traditional healers, and local community members all participated in the training workshops. Each group entered into the workshop with different preconceived ideas as to how plant-based medicinal knowledge could be utilized effectively. Traditional medicine accounts for 80% of health care administered in Africa, 90% of which is plant-based (Kasilo et al., 2005). Traditional healers, confident in their remedies, were initially skeptical as to how science could add to their considerable practical knowledge, while, conversely, some participants from the university questioned the benefits of utilizing the TEK of local communities as the basis of investigative research.

The STN approach provided an excellent means to familiarize African students with science methods and to encourage receptivity of local people to the potential benefits of science-based examination of indigenous wild species. Despite their initial opinions, both healers and university members grew to acknowledge the strengths of a system combining STN assays with traditional knowledge. In Botswana, for example, community members and traditional healers taking part in the workshops voiced renewed pride as the results of the STN assays substantiated the traditional knowledge. All participants indicated that their experience with the STN assays increased their motivation to learn more about plant active chemistry and bioactivity, to conserve traditional knowledge, and to seek higher cooperation between traditional and modern healers. Levels of participation and interest grew substantially, and by the end of the seminar, many local people were bringing extra plants from their own backyards to be tested, merely curious to see if they "worked."

Following the on-site training in Gabarone, the STN assays were introduced to students in a cell biology class at the University of Botswana (led by Dr. K. Marobela). Predominantly second-year medical students performed STN assays in the laboratory to determine the antibacterial, anti-parasitic, and enzyme-inhibitory activities of traditional plants. Two special lectures accompanied the STN laboratory module, covering drug discovery methodologies, natural products, and how to interpret and draw appropriate conclusions from the STN assays. Following the laboratory sessions, students (n=164) were surveyed to ascertain their perspectives of the impact of STN on classroom education. Eighty-one percent of students (n=133) completed the questionnaire, and responses were categorized to analyze the contribution of STN assays to student understanding, and interest level in medicinal plants and indigenous knowledge systems, as well as the suitability of utilizing STN to aid in integrating IKS into university science education.

Nearly three quarters of students (74%) responded that the STN system was beneficial in aiding their understanding of medicine-related scientific disciplines (Figure 1). The students felt that using the STN system in an educational setting gave them insights into the methodology of drug research and development, and how plants can be an important source of drugs (Table 1). As one student explained, "It has given me a clearer understanding how to tackle a problem through scientific methods. It has given me a greater appreciation for research in the field and how this can be used to solve health problems."

Using traditional medicinal plants as the foundation of the STN laboratories translated into an increased motivation to learn and research medicinal plants in 125 students (82%). Nearly 20% of the students felt engaged in exploring the link between indigenous knowledge and medicinal applications; 12% stated that the results made them rethink the value of IKS, while an additional 5% expressed excitement in the possibilities that IKS can provide solutions in investigating "everyday life issues" (Table 1). This is reflected in the student comments: "STN helped me to belief (sic) in many things I used to doubt in relation to traditional knowledge;" "It has shown me the concrete aspects of what I have believed all along that traditional knowledge can be coupled to modern technology for better and more efficient results." Virtually every student surveyed (94%) agreed that the STN system is a useful tool to bridge the gap between indigenous knowledge and biomedical science education.

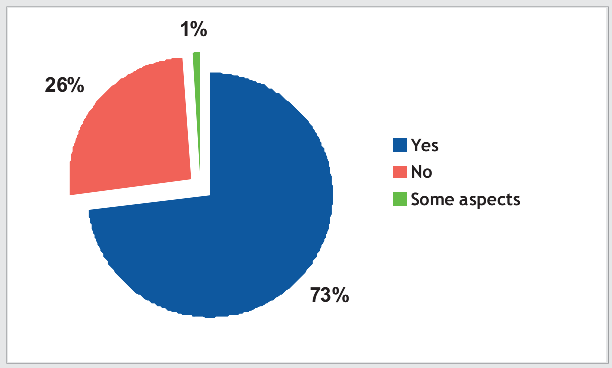


**Figure 1. Student responses to "Has 'screens-to nature' (STN) plant testing contributed to your ability to understand aspects of science better?"**

**Table 1. Leading Responses of Students to Benefits of STN System in Science Education**

| Survey Response | % Student Response (n=84) |
|---|---|
| Plants have effects and can potentially contribute to human health | 37 |
| Insights into research/drug discovery/drug development | 33 |
| Insights into pharmacology/biochemistry/cell biology/medicine | 13 |
| Rethink the value of indigenous knowledge | 12 |
| Science can be combined with indigenous knowledge and everyday life issues | 5 |

## Case Study 2 – Ecuador

Ecuador was the initial test site for implementation of STN in South America (funded by GIBEX, and a targeted seed grant from the College of ACES, ACES Global Connect, University of Illinois, in support of joint projects in bioexploration). The project in Ecuador enjoyed a great degree of synergy by engaging government (Ministry of Environment), non-governmental organizations (NGOs), the University of San Francisco Quito (USFQ), and local ecotourism guides. The course was conducted in the Maquipucuna Foundation's ecological reserve north of Quito and incorporated two groups of students; one comprised of students and professors from USFQ and one made up of local guides, farmers, and park rangers.

The cloud forest environment provided the project in Ecuador the ability to explore a region with very high biodiversity; the guides identified over a dozen plants with medicinal properties within the first half-mile of hiking. The STN system provided an excellent method for engaging students who had no scientific background (Figure 1). Combining a detailed manual with lectures in a guided lab approach empowered the students in their own learning experience, allowing them to independently carry out assays. One Ecuadorian educator remarked, "A brilliant project, very well done for being clear and simple … so that people without any scientific background can do it without [the training instructors]." Another elaborated that, by using the STN assays, "[the guides] realized they were capable to do some research … the assays and demonstrations … and visual aids and hands-on really helped re-enforce the assay."

**Figure 2. In Ecuador, author Dr. Gili Joseph works with local guides on pipetting technique while screening plants for roundworm lethality.**

**Case Study 3 – North America**

Finally, the STN system has been conducted with American Indian/Alaska Native partners in both Alaska (supported through the EPA STAR program, National Center for Environmental Research) and in North Dakota (funded through the USDA Tribal Colleges Research Grants Program). High school and elementary school teachers and students, and local residents from three distinct Alaska Native villages – Point Hope, Seldovia, and Akutan – participated, with additional involvement from the Alaska Native Tribal Health Consortium. United Tribes Technical College (UTTC) in Bismarck, North Dakota served as the hub for the STN training with participants from five tribes in the Dakotas. In these teaching sessions, both tribal elders and youth were engaged simultaneously in learning and applying the STN assay system to locally-important subsistence foods and indigenous herbs.

By linking elders, youth, and other community members in the laboratory exercises, the STN approach successfully integrated the traditional knowledge and modern scientific practices into a cohesive educational experience. In the Alaska cases, prior to working with STN materials, students conducted interviews with elders and other adults to gather local information on the use and importance of berries and other subsistence foods in the community past and present. Interaction between elders and younger community members generated enthusiasm for passing along traditions to the next generation, potentially helping to mitigate a trend in Native American tribes in which successive generations rapidly lose their traditional culture and knowledge (Tsuji, 1996). Elders in North Dakota led the plant collection and identification fieldwork, sharing their knowledge about the plants' medicinal value and place in local tribal culture with the students. The students had the opportunity to utilize the STN assay system to develop scientific support for their elders' traditional health claims for the plants. The students responded positively to this interdisciplinary scientific approach, saying the best parts of the project were "learning about traditional plants and the different uses for them," and "learn[ing] the properties of the [plants]." The STN bioassay kits were used by community teachers for follow-up investigations in the field with the same and different classes, which helped to reinforce the system and its integration into the curriculum.

## Summary

Active student participation in science courses can greatly enhance the connection between the laboratory environment and the real world. Active learning scenarios enable instructors to substantially impact the attitude and interest of the students, and thus enhance their retention of material. The goal of these multidisciplinary laboratories is to heighten student engagement with the scientific material, translating into a feeling of "excitement" by the students. This is the single largest factor in improving student attitude towards labs (Basey et al., 2008), as well as towards science (Freedman, 1997). Students report higher feelings of confidence, interest, and enjoyment with the laboratory when they are participants (Henderleiter and Pringle, 1999; Kern and Carpenter, 1984). The advantages of applicable, hands-on laboratories go beyond a higher enjoyment of the subject matter; they are more effective in transmitting information to the students (Freedman, 1997), and catalyze significant improvement in student achievement on test scores compared

to a standard laboratory (Rissing and Cogan, 2009).

Using the STN system, teachers engage students by adding real-world context to the labs. Using a multidisciplinary, interactive approach, the STN assays expand scientific skills and concepts into directed field experiments that activate student attention and interest. Utilizing local indigenous wild plant species as the subjects for experimentation, including traditional extraction methods, and possibly relying on the expertise of engaged local healers or villagers to facilitate field collections infuses educational labs with a cultural context.

STN assay results invariably reinforce traditional medicinal uses for local plants, and provide an entrée for instructors to incorporate tribal histories and cultural practices into the classroom and field instruction. This context helps students realize the relevance of science principles (Medina-Jerez, 2008), and bridges the gap between the classroom and the real world (Anagnopoulos, 2006). The STN system is particularly relevant to indigenous students, as it mediates between their bifurcated knowledge systems (the Western-oriented classroom curriculum and indigenous knowledge at home), and efficaciously bolsters performance and decreases alienation from the learning process. Concepts of crossover between science and culture have received greater attention in recent years, with several states incorporating the idea that cultural observations and traditional knowledge can play a part in scientific investigation and discovery into their educational rubrics and standards (AKDEED, 2009; NDDPI, 2006).

The STN approach has the potential to provide substantial benefits to students and school programs as compared to traditional lab exercises. The STN assays are inexpensive, readily deployable to the field or class laboratory, and implement modern laboratory techniques while encouraging a synergistic relationship with the traditional culture and knowledge of the students. Students have found this to be a great learning experience, saying, "I learn best when I get involved with hands on learning." "The screens were totally ingenious, sensible, and useful … [providing a] strong connection between local guides' knowledge and scientific tests," asserted another participant. In perhaps the best demonstration of the effectiveness of the STN system and its ability to engage students in science, two students from the Ecuador training course have initiated post-graduate research at the University of Illinois and Rutgers University, based upon traditional plants examined in the initial STN screening. Teachers have found it a useful resource, saying it provides, "so many great ideas for my classes," and, as one college instructor commented at the end of a STN workshop session, "I am excited to go further."

The positive feedback obtained by students, local school educators, and administrators during each of the previous Screens-to-Nature training sessions, and the post-instructional survey results from Botswana all highlight the potential of the assays to enhance secondary and university science, technology, engineering, and mathematics education. In order to more completely evaluate the effects that a hands-on curriculum utilizing the Screens-to-Nature system would have on student education, additional detailed analysis is essential. We are currently pursuing opportunities to conduct full-scale educational analysis of STN system to evaluate its impact in a teaching environment, including a control student group (tutored using traditional classroom laboratories), as well as methodical pre- and post-course analysis for both the test and control classes. This anticipated analysis will determine the statistical significance of the training on student performance or outlook as a result of a biodiscovery-based educational experience, as well as the potential for STN experiences to encourage post-secondary educational pursuits in science.

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# High Mastery Levels Achieved On Verbatim-Type Responses By Use of Lecture Objectives

Donald J. Stucky

**Abstract**

*In two of five semesters students from a junior-senior level crop production course were provided written lecture objectives at the beginning of each new major subject category. Students were informed that the majority of test questions from lectures would be based on data and concepts specified in the lecture objectives. Throughout the study period approximately 20 percent of the questions were identical or nearly identical. The remaining questions were changed because of updated course material and/or because an item analysis indicated something was wrong with the question. This study examined whether scores achieved on (i) identical or nearly identical questions, and (ii) all questions, differed when students were/were not provided lecture objectives.*

*The mean of each question was calculated and statistically compared by a standard t test. The means and standard deviations for similar or identical questions based on lecture objectives were 81.4 and 11.9 as compared to 68.8 and 18.0, respectively, when students did not have lecture objectives. The difference was significant at the 1 percent level. Students provided with lecture objectives also received higher mean scores on all multiple choice questions. These differences indicated that students provided with lecture objectives achieved higher scores on verbatim-type responses than students who did not have access to lecture objectives.*

## Introduction and Literature Review

Conscientious instructors constantly strive to improve the effectiveness of their lectures. Several learning aids have been integrated with the presentation of material to help students increase their comprehension of lectures. Techniques used include slides, lecture outlines, overhead projectors (Himes 1976), videotape clips (Burger and Aleamoni 1972), crop simulation models (Holt et al. 1976), and classroom demonstrations (Wolf and Carson 1975). In addition to these physical aids Baker (1969) and Shrode (1976) suggested methods to improve classroom student rapport.

Another technique is the use of lecture objectives. They are given to students prior to the lecture and specify data or concepts the lecturer has determined are the most important to aid students master the subject matter. Therefore, they are the source of many test questions. Generally Mager (1962) is credited with the increased use of objectives in classrooms. Elson (1972) and Gronlund (1970) suggested alterations and/or modifications to Mager-type objectives. Ching (1976) outlined a partial list of specific objectives used in a beginning agriculture economics course and Anderson (1974) listed objectives for an Agronomy course. Both examples were based on Mager type objectives. Lewis (1973) listed objectives for a soil morphology course based on Gronlund-type objectives. These authors and O'Conner (1973) summarized positive attributes of objectives as follows: (i) some concepts or data are more important than others, (ii) since students rarely retain all material presented in a course, use of lecture objectives insures that the information with which they become most familiar includes the most important data and concepts, (iii) they furnish the student with justification for critical reading, and (iv) they stimulate class discussion. Evidence to substantiate these attributes is limited. Anderson (1975), Royer (1977), and Staley (1978) reported improved performance with lecture objectives. Staley stated that improvement was greater with verbatim items than with paraphrase items. Vebatim-type responses are answers which are provided with the examination question and students designate the correct response, i.e., true/false or multiple choice. Paraphase type responses require students to write the answer as on an essay examination. Jacobson (1972) reported equivalent results on tests and that most students felt it was easier and more efficient to learn using objectives.

The purpose of this study was to determine whether students provided with lecture objectives, vs students not provided with objectives, received higher scores on tests.

## Methods

In two of five semesters (1973-1977) in a junior-senior level crop production course students (40-60/semester) were provided with lecture objectives at the beginning of each new major subject category. Approximately ten categories were covered during a semester. The amount of material varied between categories and the number of lecture objectives ranged between 10 and 20/unit. Students were informed that the majority of test questions from lectures would be based on data and concepts specified in the lecture objectives. A similar aid was not provided for readings from the course textbook.

Three examinations were given each semester. During the first three semesters students did not receive lecture objectives, and both multiple choice and true/false questions were given. Scores were calculated by the computer from mark-sense sheets and questions were evaluated by an item analysis system similar to that described by Sorensen and Hart, 1975. The anaylsis indicated that most true/false questions did not discriminate between high-achieving and low-achieving students. Therefore, true/false questions were not given during the two semesters that students received lecture objectives. After each examination students were required to turn in the answer sheet inside the test instrument. After scanning, the optical sensory unit placed the student's score on the answer sheet. This score was placed by the instruc-

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tor on the test instrument and both the answer sheet and the test instrument were returned to students for class discussion of questions. After discussion the test instrment was returned to the instructor and then grades were recorded. Recording of the grades from the test instrument insured the security of questions during this study.

## Results

Through the five year period of this study about 150 questions were given each semester and 24 multiple choice questions were either identical or nearly identical. A question was considered "nearly identical" if the wording was changed, but the degree of difficulty and knowledge required to answer the question was the same. Because of new information and/or poor questions (determined by the item analysis), the remaining questions were not the same throughout the study period. The means of each of the 24 questions for the semesters the lecture objectives were/were not available were calculated and statistically compared by a standard t test. The means and standard deviations for questions based on lecture objectives were 81.4 and 11.9 as compared to 68.8 and 18.0, respectively, when students did not have lecture objectives. The difference was statistically significant at the 1 percent level. Thus, a higher degree of learning with less deviation was achieved when questions were based on material emphasized via lecture objectives.

Data for each test during the study period for all multiple choice questions are presented in Table 1. Differences in test means of scores achieved between the two groups ranged from 1.2 to 9.1 points. Initially the author was surprised that there was not a greater difference in means between the two groups. An analysis of test questions indicated that during semesters that lecture objectives were available to students 79 percent of the multiple choice questions contained four or five choices as compared to 58 percent of the multiple choice questions given during semesters that students did not receive lecture objectives. Also by providing lecture objectives test questions could be designed to probe specific data in more detail.

**Table 1. Scores achieved on all multiple choice questions by students who were/were not provided with the lecture objectives during a five semester study period.**

| | Test mean scores | | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | With lecture objectives | | | Without lecture objectives | | | |
| | Semester | | | | | | |
| | 1 | 2 | $\bar{x}$ 1 & 2 | 3 | 4 | 5 | x 3-5 |
| | % correct | | | | | | |
| 1 | 77.9 | 79.5 | 78.7 | 62.5 | 72.4 | 73.8 | 69.6 |
| 2 | 73.5 | 67.7 | 70.6 | 57.5 | 70.3 | 70.7 | 66.2 |
| 3 | 72.5 | 68.8 | 70.6 | 64.0 | 74.4 | 69.8 | 69.4 |

## Discussion and Summary

It seems logical that if students were told what topics would be emphasized on examinations, their scores should be higher than if they were not informed. However, in one of the four studies where measurements were made, Jacobson (1972) reported equivalent scores, and in another study Staley (1978) stated that providing objectives facilitated learning on verbatim but not on paraphase items. Since performance in Anderson's (1975) study and this one was measured with multiple choice questions, both studies would be classified as measurements of verbatim responses. Thus, providing students with lecture objectives improved student performance on verbatim-type questions. However, the usefulness in improving students' ability to apply or extrapolate has been measured in only one study *and additional* research is needed.

It also seems logical and inevitable that many students who were provided with lecture objectives would reduce the amount of time they would devote to organizing and reviewing notes, and evaluating which factors were most important. Some proponents of instructional objectives promote their use, in part, by reasoning that students should not be required to play guessing games with the instructor. I am uncomfortable with that rationale because a good examination should reflect the tenor of lectures; therefore, students aren't required to guess but rather to evaluate and consolidate relevant material presented in lectures. It is important that students have opportunities to develop these skills in our classrooms, and we need to determine if by providing lecture objectives such opportunities are significantly reduced.

The advantages listed earlier for objectives are valid and important; however, the major advantage of objectives is that students receive better lectures: to prepare lecture objectives the instructor must first determine what is important and why it is important to the student.

The challenge to instructors is to devise a system which incorporates the advantages of lecture objectives and neutralizes the risk that many students may utilize lecture objectives as a crutch rather than a positive aid.

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## The Conversion to Sustainable Agriculture: Principles, Processes, and Practices

***S.R. Gliessman and M. Rosemeyer, editors. 2010. CRC Press, Taylor and Francis Group, Boca Raton, Florida. Cloth, $89.95, 370 pp. ISBN 978-0-8493-1917-4.***

The process of converting conventional systems to those more sustainable over time should be the key focus of courses in agricultural science. Whether these classes present a focus on components in genetics and crop improvement, nutrient management, irrigation, or integrated control of pests, the pieces of the puzzle need to come together into a coherent, productive, and profitable integrated production system. Editors Gliessman and Rosemeyer have assembled a collection of chapters that deal with basic principles of how the conversion process works, and how this fits into a historical progression of agricultural systems as implemented in organic production. What follows are eleven chapters of specific examples from geographically distinct regions, plus a final statement on how to convert the global food system. This would be a useful teaching reference.

A framework and context for conversion is provided by senior editor Stephen Gliessman (Ch. 1) with a list of current critical issues:

- Uncertain energy costs
- Low profit margins in agriculture
- New and promising practices in organic systems
- Increased environmental concerns and regulations
- Awareness of links between nutrition and health
- Appreciation of integrating conservation with other goals
- Growing markets for organic/ecological products

Especially useful to those not acquainted with conversion is a series of guiding principles taken from Gliessman's own popular textbook *Agroecology* (2007): recycling and use of renewable resources, management of whole systems rather than the parts, greater dependence on biology and natural processes, adapting systems to natural conditions rather than dominating the environment, and seeking justice and equality of benefits as integral goals in system design. Steps in the process follow the well-known methods introduced by Stuart Hill (1985) in Canada – efficiency, substitution, redesign – but add a fourth level which is reconnecting consumers with farmers who produce food.

Details about conversion are provided by co-editor Martha Rosemeyer – production and economics, plus social and ecological dimensions that emerge while farmers make this change (Ch. 2). She emphasizes the role of farmers in our learning process, and gives weight to practical experience along with the results of controlled experiments. The useful strategy of replicated or long strip comparisons on farms, where the designs provide statistical comparison as well as visual demonstration, is endorsed as a way to combine farmer and researcher wisdom into the process. Especially valuable in this chapter is a description of parameters that are used to evaluate success in systems, easily quantified in production and economic terms but less well understood and accepted in the environmental and social spheres. Dr. Rosemeyer concludes that practical methods and measures are needed to help farmers make the conversion, but that quantifiable criteria for evaluating systems success are also important for policy makers who influence the food system context in which these changes take place. The last chapter in this section on history of organic farming (Ch. 3) provides a useful overview, but for more depth and broader coverage of the roots in northern Europe the serious reader is referred to the excellent review by Lockeretz (2007) that for some reason was not cited in this chapter.

The most extensive section of the book, *Global Perspectives,* chronicles the research and farmer experience in conversion to sustainable systems in three regions of the U.S., two in Mexico, and six other countries and regions around the world. Highly specialized farming systems that separate crops from livestock, as in the Northern Midwest of the U.S. (Ch. 4), complicate the conversion process since farmers are locked into large land and equipment investments. For decades they have pursued a strategy of enlarging operations rather then making them more ecologically sustainable. This farming environment has created a type of personal expectations and community norms that accept the status quo and disappearance of small towns and rural infrastructure, creating barriers to sustainability that are difficult to overcome. The road to sustainability in northwest fruit production (Ch. 5) is complicated by market concentration on a few varieties, on growing competition for water, and by insect pests that are difficult to manage with controls other than chemicals. Conversion of strawberry production in California to systems less dependent on chemicals also presents unique challenges (Ch. 6). Loss of approved chemical fungicides for soil fumigation has forced the industry to adopt new IPM strategies, and problems are only now being solved by research. What emerges from these examples is recognizing the importance of different challenges in each region and each type of cropping system. As complex as ecosystems themselves, the solutions do not follow any simple established menu of practices.

In Ontario (Ch. 7), the environmental farm plans provide federally funded support for conversion to more sustainable practices, but the program has attracted relatively few participants. The focus has been on ecological, economic, and social sustainability. Organic food production in Mexico in 2007 reached a value of $430 million, and this specialized activity is concentrated in coffee for export and small farm agriculture (Ch. 8). The case for revitalizing traditional agriculture in Mexico is proposed as a way to solve the threats of diet changes, loss of traditional knowledge, and decline in biodiversity on farms (Ch. 9). The *ejido* program of land reform that accompanied the Mexican revolution in the early part of the last century provided a foundation for sustainable agriculture that endures to the present. Cuba represents a truly unique model of sustainability in agriculture, due to their loss of petroleum and economic support from the former soviet union and a massive modification of farming practices from chemical-based to essentially organic on a national level (Ch. 10). A neocolonial system gave way to more dispersed ownership and management, a move toward integrated pest management and vermiculture to promote soil fertility, and a large increase in urban and peri-urban food production. Cuba in fact provides an intriguing look at one potential future for sustainable agriculture in many more parts of the world where conventional production resources are scarce.

An example of strong institutional and government involvement is found in the European Union (Ch. 11), where substantial support is provided for conversion to organic/ecological production. From a low level in France of 2% organic to a high in Austria (11%), there is considerable interest in organic production and food sales across Europe. Prices are near double for certain products such as eggs, potatoes, and wheat, providing a significant incentive to produce these specialty products. Japan (Ch. 12) has a 2000-year history of sustainable farming, although agriculture now represents only 1% of the GDP. There has been recent legislation supporting sustainable and organic farming, and the marketing sector has been especially well developed.

In the Middle East, better known today as Southwest Asia, the three dominant systems are dryland cereals, irrigated agriculture, and extensive pastoralism (Ch. 13). The major limitation in all systems is water, while lack of appropriate production inputs plus poor government policies and support programs have seriously limited food security in the region. Some of the most effective conversion strategies have included introduction of organic fertilizers and IPM for pests, system redesign to better use available rainfall, and national policies as well as research and education to promote sustainable food production. Australia is another dry environment for agriculture (Ch. 14), with changes in demographics, local demand, and international markets affecting stability in the food system. The collapse of world wool prices highly impacted the industry. Growing concerns about chemical residues in food, impacts of agriculture on the rural landscape, and the need for sustainability have sparked some changes. Ecolabels for food have emerged, but there is slow change toward more sustainable systems. The book provides two case studies from different regions to illustrate both current challenges and changes in agriculture.

In a concluding chapter on *Transforming the Global Food* System, editor Stephen Gliessman describes the growing role of the consumer in shaping how we grow food and the emerging perspective that we need to think beyond crop yields as the major indicator of success. More farmers are certifying for organic production in the U.S., and they appear to be younger and more diverse, with smaller farms and lower gross sales, and often have off-farm work, compared to the overall farm population. However, in the Midwest we currently have 80% of all farm families with at least one person working off farm, and 40% have both spouses working elsewhere; it would appear that the organic farmer profile is not all that different in our region. Most importantly, there is an emerging culture of sustainability, with concern about organic foods, value-added products, and specialty farming. These can all lead to greater stability on the farm and greater value that can accrue to the farm family.

Overall, this is a balanced book with chapters that fit together in a logical pattern. The book opens new perspectives to those in the U.S. and Europe with the focus of many chapters on countries and systems not familiar to many of us. The country case studies illustrate unique and successful alternatives that are being used around the globe. What is clear is that no single menu or formula exists for success, and profitable and sustainable systems must be developed in each agro-eco-region as well as market situation. National policies, economic situations, and incentives differ among countries, and globalization is impacting many local decisions. The book is recommended as a good introduction to global agriculture and for learning about alternative opportunities to develop sustainable food systems.

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## Illustrated Anatomy of the Bovine Male and Female Reproductive Tracts

***By K. June Mullins and Richard G. Saacke, 2003, Germinal Dimensions, Inc., Blacksburg Virginia, soft cover, 87 pages, $30.00, ISBN 0-9743745-0-4.***

This book is of significance to persons deeply interested in reproductive anatomy of cattle. Target audiences for this publication include educators, students, veterinary technicians, and bovine artificial insemination (AI) and embryo transfer (ET) technicians. This monograph evolved from the authors' 35 years of experience teaching animal reproduction at Virginia Polytechnic Institute and State University (Virginia Tech) and is aimed toward bridging the gap between gross anatomy and histology/microanatomy of bovine reproductive tract structures. The authors note that their book purposefully excludes discussion of function or physiological importance of the anatomical features illustrated.

The uniqueness of this monograph is two-fold. Firstly, the book contains a collection of detailed, full-color illustrations that are well-labeled and easy to understand. Common terminology and Latin nomenclature are used for each anatomical structure, and text is fairly limited which helps keep readers focused. The basic format of the monograph is to have detailed figure legends on the left-hand page and the corresponding illustrations on the right-hand page (as the book is laid open). Secondly, the authors have combined their personal observations of reproductive tract structures with those published in the scientific literature for the development of their illustrations. In several cases, the authors report that their observations were not in complete concordance with previous publications. The bibliography contains 33 references spanning a time period from 1950 to 2000.

The authors have done a marvelous job presenting the anatomy of reproductive tract structures of the cow and the bull in a sequential manner, starting with illustrations of gross anatomy and progressing to sub-gross and then microanatomy depictions. This manner of presentation lets the reader see the "big picture" before delving more deeply into organs/glands at the tissue and cellular levels. Many of the 38 figures consist of two to six illustrations that collectively comprise the figure.

Female reproductive anatomy is the focus of the first 18 figures in the monograph. Anatomy of the ovary, oviducts, uterus, cervix, and vagina is presented along with illustrations of the placenta and placental-uterine attachments in a pregnant cow. Highlights of these figures include detailed illustrations of the ovarian follicle wall and the corpus luteum, chronology of follicular development, changes in architecture of the oviduct along its length, and organization of tissue layers of the cervix.

Male reproductive anatomy is the focus of the final 20 figures in the book. Anatomy of the testis, scrotum, spermatic cord, epididymis, urethra, penis, and accessory sex glands (vesicular, prostate, and bulbourethral) is presented along with illustrations of spermatozoa. Highlights of these figures include the stages of the cycle of the seminiferous epithelium during spermatogenesis, a rotational view of ejaculated spermatozoa, the disseminate prostate gland, and the global view of male reproductive tract structures showing spatial relationships.

Although this monograph is excellent in many ways, some of the figures must be carefully studied to completely understand the structure being illustrated due to subtle differences in shading of adjacent cell types. Students with no previous background in histology and reproductive anatomy may initially find some of the illustrations a bit overwhelming; however, such students likely will need to spend only a few extra minutes with supplemental reference material before gaining a good understanding of the illustrations. Similarly, persons wishing to achieve a complete understanding of bovine reproductive anatomy and physiology will need to consult additional textbooks on physiology.

This monograph is an excellent value, and educators who teach a laboratory course in livestock reproductive anatomy may wish to consider adopting this as a laboratory textbook. Similarly, educators who teach a lecture course in domestic animal reproductive physiology may wish to consider placing this book on reserve for their students as a supplement to their required reproductive physiology course textbook (physiology is difficult to understand without strong knowledge of anatomy). Those who train AI and ET technicians also will undoubtedly find this monograph useful. This monograph would have been even better had the authors included the collection of illustrations in electronic format for use in classroom teaching and other educational presentations.

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## Structure & Function of Plants

***By Jennifer W. MacAdam. 2009. Wiley – Blackwell, John Wiley & Sons, New York. Paper, $62.99, 287 pp. ISBN 978-0-8138-2718-6.***

The first-time reader of a text on plant anatomy and physiology will be amazed by the level of detail and the sparkling presentation in *Structure & Function of Plants*, a valuable introduction on how plants are built and how they work. Those who may have taken botany courses some years or decades ago will find this book a pleasant departure from the older black and white texts and photos of yesteryear. Not only is much more known today about how plants work, the presentation here in detailed figures and spectacular photos brings this topic alive.

The author begins with chapters on the structures of plant cells, meristems, and tissues, and then aggregates these into discussions of roots, stems, and leaves. The segue into function comes with discussion of translocation, then reproduction, and followed by plant nutrition. Plant-water relations are presented, then the functions of macromolecules and enzymes. Chapters on photosynthesis and respiration describe these processes in great detail, with accompanying figures and photos that bring plants to life on the printed page. Final chapters on environmental regulation of plant growth and development, hormonal regulation, and secondary plant metabolites conclude the book. There is an exhaustive glossary, four pages of references, and an index. Surprising to this reviewer was the omission of the two seminal texts by Katherine Esau on plant anatomy from 1953 and 1961, yet the preponderance of modern literature is a definite asset of the book.

Author Jennifer MacAdam is in the Department of Plants, Soils, and Climate at Utah State University. Although she credits colleagues for providing some of the excellent photos, and an illustrator for turning her ideas into easily accessible drawings, we must congratulate the author on an excellent choice of material and a clear writing style that provides the detailed anatomical precision and up-to-date biochemical explanation that makes this a scientifically credible text and useful reference. It would be an excellent book to have on the shelf for teachers and researchers who want to check on plant structural and functional facts to help support their work.

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## Publishing and Citation Analysis: Needed Academic Partners

“Twenty years ago--only 45 % of all articles published in the top 4,500 top science journals were cited within the first five years after publication," and this "has dropped to ~ 41 % in 2009" (Bauerlein et al., 2010). Possible reasons are due to 1) there being an increasingly higher number of scientific journals available for publishing modest information (low-cited publications), 2) increasing demand on reviewers leading to lesser amounts of time for a quality review, and 3) increasing pressure on new faculty members to demonstrate productivity (Bauerlein et al. 2009).

Even the competition among citation search engines may be a cause of inflated publication rates as citation numbers may be used as a measure of productivity and some citation search engines (early in their development and when first introduced to the public) have been shown to bias citation data (Jacso, 2006; this author has written numerous articles on this subject). Consequently, publishing only in journals that are serviced by (say) Google Scholar might result in high citation numbers......therefore showing higher productivity. Alternatively, use of other citation search engines (like all of ISI products) result in quite low citation numbers (Jacso, 2006). Depending on one's agenda, one might use one citation search engine over others. Realistically, a judicial use of numerous citation search engines and over a lengthy timeframe is required in order to obtain solid citation data (Dodson 2008; 2009).

In the science/teaching/advising business, and regardless of citation search engine used, one needs to publish new knowledge and perform citation analyses on their papers. The published paper needs to be in a journal whereby peers can gain from its appearance. Resulting citations show how well the paper was received, and the strength of its utility. Papers recently published, but already receiving citations, might be viewed as well-received, whereas papers with long-term publication dates and few citations might be viewed as lesser important papers.

As academicians, we work at institutions whereby a budget cut might fall each day. Pressure is increasingly placed on us to "perform" with limiting resources. Publishing papers that impacts one field remains a core measure of productivity. While the (actual) measure of citations (per paper) over time is a bit tedious, it is needed and will be a vital part of justifying existence of departments, programs, and individuals.

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## Asking Questions

Asking and answering questions are central to the learning process and to effective teaching. Do teachers use this technique and do they ask questions that require students to think?

Good questioning techniques help instructors achieve three extremely goals:

**Formative Assessment** – Questions provide immediate feedback to help you determine if your students are learning. Your students' responses signal you to proceed or possibly to return to some of the points they didn't quite understand.

**Student Engagement** – If you are asking questions, good questions, your students are thinking. Questions put their minds in gear so to speak. In that way, your questions are a catalyst for learning.

**Rich and Enhanced Learning** – Well constructed questions get students thinking about the important concepts and help them go beyond memorization to learning and understanding.

What questions should instructors ask? Obviously instructors should use their course learning objectives as the basis for questions. The questions should be those underlying concepts, principles, facts, and details associated with the course outcomes. These could be called the micro-objectives. Formulate question so the correct responses will validate your students' command of those micro-objectives – the concepts, principles, facts, and details by which you will assess their command of the course objectives.

Questions instructors should use are ones we all know: Who, What, Where, When, Why, and How? Instructors should also use cause-and-effect and hypothetical questions.

Other types of questions that could be added to the list are for those teaching a lab or hands-on course, is performance. Such a question might begin with “Show me how …” or “Please demonstrate …”

Perhaps the most challenging tactic is to wait silently for an answer. The silence can feel awkward, but it may be the only way to get some students to respond. Still it should not be overdone. A long period of silence will create a stressful situation for the students.

If you criticize a student's response, or in any why make a student feel dumb, you will lose that student. Actually, it may even be worse. You may create an enemy whose written comments on his or her end-of-term evaluation will be less than flattering.

Some final words of wisdom about asking questions in class:

•Prepare questions in advance, ones that will promote student learning.

•Don't be too rigid. Improvise. Adapt to your students' responses.

•Avoid yes/no questions, especially ones like, “Did everybody understand that?” and the totally useless “Are there any questions?”

•Use technology such as online threaded discussions and clickers.

•Use questioning techniques that engage your students but don't intimidate or criticize them.

•Use questions to find out what your students know, not ones that embarrass or punish them for what they don't know.

•Reflect on your questioning after each class. Decide what worked and what didn't work. Make adjustments for the next class.

•Work on your technique. Questioning is a skill and an art.

•Practice your art. Questioning must be a habit. You need to make good questioning your habit.

•Ask one of the most important questions of all: How am I doing?

# NACTA Yesterday

## 50+/- years ago Vol V, No. 2, 1961

From John Carters presidents message..."The National Association of College Teachers of Agriculture has something for every educator and can contribute many intangibles to his becoming a more effective teacher-which I am sure is the goal of every member. You can contribute to NACTA, but even more important, NACTA can give you much more in return."

*This is no less true in 2010. It's amazing how these don't change. In our recent meeting in Stillwater on the Oklahoma State campus, our membership was just about 1000.*

## 30 Years Ago (Vol. XXIV, No 4)

Bits from the NACTA Conference of 1080..."NACTA membership in Canada is at 53, but awareness and knowledge of NACTA and NACTA work is increasing. The future for NACTA membership in Canada remains bright. During the year the coordinator for Canada visited most Schools of Agriculture, and improvement of teaching methods as well as teaching practices were discussed with administrators. NACTA's role in this area was brought to the attention of school directors. The reception was favorable. All schools now have the portfolio displays carrying the NACTA brochure. A large potential for membership was uncovered at Community Colleges which in Canada have more than half of the country's post secondary education programs in agriculture. I feel that in Canada each institution should have a NACTA representative since there is often little contact between institutions. A letter containing names of Canadian NACTA members was mailed to all Canadian institutions (administrators and instructors) in February, 1980. Several follow-up inquiries were received after this letter, asking about membership details...." Paul Stelmaschuk, Coordinator for Canada.

*A reminder of the years Canada has been active in NACTA as we go back to Canada in 2011. As we look at Alberta for 2011, we have quite a ways to go to get Canada back to its 1979 membership numbers.*

## 20 Years Ago (Vol. XXXIV, No. 3)

In his report on NACTA Challenges, John Mertz made these comments..."there are some old challenges that are taking on new dimensions for us: World hunger is one such challenge. World hunger is not a new problem. And boatloads of Haitians and mobs of desperate Chicano dashing across our southern borders bring that problem even closer to home. Here we sit, the world's most productive agricultural enterprise ever....and we don't even seem to make a dent in the problem, not even if we give it away. Why not? What's the matter with those people? Why don't they be like us and solve their production problems?

The answer, or at least a large part of the answer, is ignorance. I have had the opportunity to visit one of the world's deepest pockets of poverty several times in the last year, the Republic of Haiti. And, I suggest that it is ignorance that lets some of the Haitian peasants I have seen grow their rows of crops across contours, up and down steep slopes of that island republic...."

*It is amazing how things remain the same. This could have been written in today's newspaper. A snap shot of membership and finances of the organization.*

## 10 Years Ago (Vol. 44, No 3)

Jean Gleichsner from Fort Hays State University, NACTA's first woman president gave us the following charge."I am excited and honored to be the first and I hope not the last woman president of NACTA. I plan to continue the strong tradition of leadership displayed by past presidents. My challenge for the members of NACTA involves three easy steps.

Step 1: NACTA members need to get involved in NACTA. Attendance at the annual NACTA Conference is an excellent start towards achieving this goal. All of you in attendance today have successfully accomplished the first step.

Step 2. NACTA members need to stay involved. Sign up for a committee and contribute. Identify a colleague that deserves recognition through the NACTA Awards Program and encourage, cajole, or prod them to complete the application process. Contribute to the NACTA Journal-- the Journal offers opportunities to share our ideas about teaching, so let's share them.

Step 3. Get others involved. Share the NACTA Journal with colleagues at your institution. Bring a colleague to the next conference in Canada and let them experience NACTA first hand. Dare I say what an experience that will be for them."

*Jean was not our only woman to serve as president in the past 10 years and our membership has continued to increase in diversity, however her simple steps are still a relevant charge in 2010. Seems this is still a concern on our campuses…it was relevant then and is now…look up the rest of Dale's article and read his action plan to address this issue.*

James "Jim" McKenna
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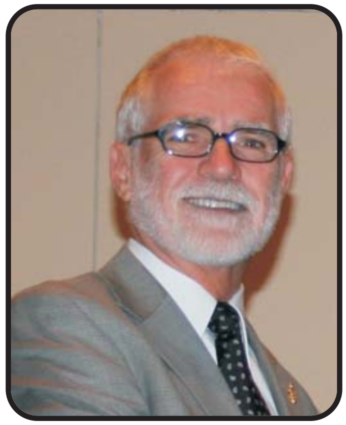
# Incoming NACTA President's Message

***Kirby Barrick,***
***University of Florida - Gainesville***
***2010 - 2011 NACTA President***



Another school year begins—a wonderful time of the year! New students with their maps, trying to find the right building for that 7:30 a.m. class. Parking lots overflowing (with parking police on active duty!). Renewed enthusiasm for fall sports. Invigorated faculty, fresh from summer research, teaching, hopefully a little time away with family and friends. It is a wonderful time.

Personally, fall semester is a new beginning as I transition from administration after 21 years to being what I always wanted to be—a college professor. Teaching, research, extension programs, working with new faculty, and continuing some international activities are all on the agenda for this semester and beyond. It has to be the best job in the world.

If you missed the NACTA conference last June, you missed some excellent programs and presentations and a good time, thanks to the efforts of our colleagues at Penn State. Thanks to all who had a part, large or small, in making our annual conference an enjoyable and worthwhile event.

More faculty at all of our institutions could benefit from membership and participation in NACTA. I encourage you to work with administrators in your departments and colleges to have them provide NACTA memberships for new faculty. Be sure that your colleagues are given the opportunity to join as well. For those of us with primary interest in teaching, NACTA is a great organization.

The NACTA Journal is a good read only to the extent that all of us contribute manuscripts for the review process. As I talked with many of you during the annual conference I learned about a variety of programs, research activities and exemplary practices that need to be shared with the larger community. Check out the NACTA web site to see how easy it is to submit to our journal. Others need to know what you have done and how your efforts have improved student learning and teacher effectiveness.

Finally, it's not too early to begin planning for the 2011 NACTA conference at the University of Alberta. Get the dates on your calendar—June 14-18. I'll see you there!

Kirby Barrick
2010 - 2011 NACTA President
University of Florida - Gainesville

# NACTA Business Meeting Minutes

***June 25, 2010,***
***Penn State University***

President Mike Mullen called the meeting to order at 11.50 am. There were 89 people in attendance.

Agenda was approved. First time attendees and the Executive Committee members were recognized.

The Secretary/Treasurer's reports were presented by Marilyn Parker. As of May 28, 2010 the NACTA checking balance was $34,793. Journal printing expenses were down but website expenses have increased due to creating the new NACTA website. Website costs will now be mainly maintenance fees. Membership numbers have decreased even though there were 66 new members from the 2009 June Conference at Oklahoma State University. At this point in time, there are 177 new members of NACTA and 180 people did not renew their NACTA memberships for 2010. Most of the non renewals were people who joined last year and were granted 6-month membership as part of the registration for the conference. Thank you to the regional directors for encouraging and sending membership reminders.

We appreciate the Dean's program bringing in new NACTA memberships. Some institutions, along with renewing memberships for their faculty, also provided funding to bring in new NACTA members.

We are pleased to have had two new Institutions join NACTA - Lakeland College, Vermilion, Alberta, Canada and Wright State University-Lake Campus, Celina, Ohio. Two institutions did not renew their NACTA 2010 membership and five are still pending.

Only about 100 NACTA members participated in the electronic voting which is not a large percentage of the NACTA members but is comparable to the number of people who voted in previous years. This is our first year of total electronic voting on our new NACTA website. We would encourage all to vote next year.

This year 33 Teaching Awards of Merit and 9 Graduate Student Awards of Merit were presented. This number is down again from last year. This is available to all NACTA Institutions and we need to encourage them to take advantage of this award. There is no cost involved for the institution.

Moved and seconded to approve both reports. Motion passed.

The Editor's report was presented by Rick Parker. The feedback on electronic items is good. He encouraged NACTA members to submit content for the NACTA website; have NACTA members access the website more often; IRB (Institutional Review Board) has been added to "Instructions for Authors" which is available on the website. The posters from the conference will be posted to the website in PDF format. NACTA is now on Facebook.

Moved and seconded to approve his report. Motion passed.

The membership report was presented by Ron Hanson. We have lost some numbers and we need to encourage memberships and participation on committees. He recognized those deans' schools that supported the Deans Program and indicated how important this program is to increasing NACTA memberships. There were 110 memberships paid through the Dean's program for 2010.

Moved and seconded to approve his report. Motion passed.

The book sales from the silent auction were approximately $700.

Prasanta Kalita, Teacher Recognition Committee Chair, indicated that award submission information is online for 2011.

### *New Business Items:*

New Officer positions were recognized: President-elect Jeannette Moore, North Carolina State University; Central Regional Director-elect Kevin Bacon, Western Illinois University; and Canadian Regional Director-elect Martin Zuidhof, University of Alberta. The NACTA Nominations committee is appreciative to those who were willing to run for these positions. President Mullen welcomed NACTA members to run for NACTA Offices and to vote. This was the first year for electronic voting on the new NACTA website. We need to encourage all NACTA members to vote.

### *Committee Chairs:*

Ann Marie VanDerZanden was reappointed as chair of the Educational Issues & Teaching Improvement Committee and Neil Douglas was reappointed as the Journal Awards Committee chair. Phil Hamilton accepted reappointment as the International Committee chair.

### *Constitutional issues:*

Liaison language was discussed relating to CAST. The Executive committee will look at the language of the NACTA Constitution.

The Business meeting was recessed.

## Foundation Business Meeting

Kevin Donnelly, Past President, directed the Foundation meeting.

Kevin made a proposal to solicit NACTA Life members to contribute to the NACTA Foundation. He asked for input to some questions regarding the approach - Do we need specific amounts? What about

Regional Endowments or specific areas to donate to? He is also coordinating an effort to attain funding from the NACTA Judging Conference coaches to develop an award for service to students through the coaching teams and advising other student activities.

The NACTA Foundation report numbers were given by Marilyn Parker, NACTA Secretary/Treasurer. Tom Lindahl, NACTA Foundation Director, was in attendance earlier in the conference and worked with Marilyn in preparing the report.

The NACTA Foundation fund performance from July 1, 2009 to April 30, 2010 is as follows (a full report from UW-Platteville Foundation comes in July):

- The total return for the fund was $12581.08.
- Two percent of this gain was placed into the spendable account which was $1266.93.
- The payment to the UW Foundation for management of the fund was $1740.34.
- This leaves the gain amount for this 10 month period as $9573.81.

Moved and seconded to approve the Foundation report. Motion passed.

Foundation Meeting adjourned and return to Business meeting.

Lyle Westrom announced that the 2011 NACTA Judging contest will be in Modesto, California April 14-17.

Business Meeting adjourned at 12.45 pm.

# Secretary / Treasurer Report

## Secretary's Report

Membership records for NACTA are maintained in a Microsoft Excel file. This provides the least expensive and the most flexible recordkeeping system. The records include addresses, email addresses, year paid, membership type, and region. Records can be sorted and presented in a variety of ways and most NACTA members can be sent an email. Members continue to receive a unique membership number.

Email is used extensively to maintain contact with members, to answer inquiries and to renew memberships. This use of email results in a substantial savings in postage. A NACTA E-Newsletter is sent out almost monthly to update members. This also helps keep email addresses current.

Individuals and institutions can renew their membership with a check or with a credit card. Credit card payments can be mailed or faxed. Members continue to take advantage of the 3-year payment option.

Membership notifications go out through email to individuals in the fall. If dues are not paid by the end of February of the next year, their name is taken off the mailing list. Members receive at least two personal reminders concerning their dues payment. Reminders also go out through the NACTA E-Newsletters and to the regional directors. If a member does not have email, a reminder letter is mailed.

NACTA memberships paid (or ongoing) in 2009-2010 consisted of the following:

| Category | Number |
|---|---|
| Institutional Active | 432 |
| Active | 34 |
| Life | 129 |
| Graduate Students | 39 |
| Emeritus | 10 |
| Complimentary | 9 |
| Institutions | 112 |
| Library | 65 |
| **Total** | 830 |

A number of universities/colleges promote NACTA memberships and pay for a one year membership for several individuals. Some institutions pay for 3-year memberships to NACTA. In addition, some schools' departments pay for their NACTA memberships yearly. Those that have participated this past year are: Pennsylvania State University; Virginia Tech, Purdue University; University of Florida; University of Nebraska; University of Illinois; Delaware Valley College, Doylestown, PA; Crowder College, Neosho, MO; Sam Houston State University, Huntsville, TX, Abilene Christian University, TX, and Tennessee Tech University, Cookeville, TN. For the record, if you know of some that have been missed, please inform the Secretary.

Total new members for 2009-2010 – 132 Institutional Active (45 from the 2009 Oklahoma State NACTA/SERD Conference) and 21 Active (17 from the 2009 conference). There were 21 new graduate students and three new Life memberships. Approximately 180 did not renew for 2010 - many of them long time members who had paid for the one or 3-year memberships.

We maintain a database of past members' email addresses; periodically they receive an e-newsletter to see if their intent may have changed to renew their memberships. The NACTA Secretary appreciates the involvement of the Membership director and the Regional directors to encourage Institutional memberships and reminders for general memberships.

We have eight Canadian members; seven Canadian Institutions and four Canadian libraries. We have two foreign members, and two foreign libraries.

Every new member receives a letter welcoming them into NACTA and their name is passed to the Regional Director and the Membership Director. Regional directors have been supplied with lists of members in their regions twice a year and when they request. Every renewing member receives an email thanking them for their renewal and encouraging them to become active in the organization.

All member institutions received notification by email of their ability to present the Teaching Award of Merit Certificates and other advantages of Institutional membership. This year 33 Teaching Awards of Merit and 9 Graduate Student Awards of Merit were presented. This number is down again from last year. **How can we make them more aware of this award?** This information is available on the NACTA website. There were several current NACTA members that received this award.

Several institutions were very late or are still in the process of renewing or did not renew for 2010 - Middle Tennessee State University, Murfreesboro, TN (did not renew), Auburn University (pending), Western Illinois University, Macomb, IL (pending), Wilmington College, Wilmington OH, Tennessee Tech University, Cookeville, TN (pending), Morrisville State College, Morrisville, NY (pending), and Texas A&M University (dean change-pending). These schools have been members of NACTA for several years. There were two new Institutions - Lakeland College, Vermilion, Alberta, Canada and Wright State University-Lake Campus, Celina, Ohio. There have been several dean changes which makes obtaining institutional memberships challenging. If you are aware of these changes, please let the secretary know so the billing will go to the correct person. The Regional Directors were very helpful in obtaining some of these institutional membership renewals.

About 100 NACTA members participated in the voting for officers – down from last year.

*Action Item:* Encouraging new memberships and retaining memberships is an ongoing theme.

Submitted by:
Marilyn Parker
Secretary
June 2010

## North American Colleges & Teachers of Agriculture
## *Profit & Loss*
***June 2009 through May 2010***

| | June '09 - May 10 |
|---|---|
| **Ordinary Income/Expense** | |
| **Income** | |
| Member Contributions | -2,310.00 |
| Membership Dues | 64,325.00 |
| Misc Income | 550.00 |
| Position Announcement | 100.00 |
| Royalties Income | 178.64 |
| Transfer from Foundation | 5,600.00 |
| **Total Income** | **$68,443.64** |
| **Expense** | |
| Awards | 5,600.00 |
| Conference Expense | 4,521.47 |
| Credit Card Fees | 1,269.15 |
| Equipment | 74.19 |
| Fall Exec Mtg | 1,142.46 |
| Honorariums | 20,000.00 |
| Insurance | 150.00 |
| Journal-Misc Expense | 3,472.89 |
| Journal Printing | 12,000.00 |
| Membership Refunds | 0.00 |
| Misc Expense | 388.18 |
| Postage | 2,938.81 |
| Professional Fees | 1,491.50 |
| Promotional | 1,257.00 |
| Secretarial Help | 111.75 |
| Supplies | 1,609.47 |
| Travel | 2,023.06 |
| Web Site Expense | 17,858.00 |
| **Total Expense** | **$75,907.93** |
| **Net Ordinary Income** | **-$7,464.29** |
| **Net Income** | **-$7,464.29** |

## Treasurer's Report

Above is a profit and loss statement created by QuickBooks. The accounting firm of Mayes & Waters, in Rupert, Idaho, provided help in verifying the records. A detailed Profit & Loss statement is available for any NACTA member.

The membership dues are the major factor in keeping NACTA financially viable. In order to totally support the annual teaching awards, the current membership would need to double. Conference book sales monies of $1031 from the Oklahoma State 2009 conference were deposited into the Foundation Savings account for the EB Knight and Jack Everly awards. The increase in dues in June 2007 put NACTA in the black in 2008-2009. One-time costs associated with the new NACTA website and the first annual hardcopy of the Journal put NACTA in the red for the 2009-2010 year. These costs will be less next year keeping NACTA in the black provided current memberships levels are maintained or preferably increased.

The ending bank statement for May 2010 is $34,793.04.

Marilyn B Parker
NACTA Secretary/Treasurer
June 2010

# NACTA Teaching Award Of Excellence Recipients

| Year | Recipient | Institution |
|---|---|---|
| 2009 | Shelly Schmidt | University of Illinois |
| 2008 | Robert M. Skirvin | University of Illinois |
| 2007 | Foy D Mills Jr | Abilene Christian University |
| 2006 | Rick Rudd | University of Florida, Ag Education & Communication |
| 2005 | Wayne Banwart | University of Illinois, Environmental Soil Science |
| 2004 | Allen Zimmerman | The Ohio StateUniversity-ATI |
| 2002 | Ronald J. Hanson | University of Nebraska-Lincoln, Agricultural Economics |
| 2001 | Linda C. Martin | Kansas State University, Animal Science |
| 2000 | Donald W. Hall | University of Florida, Entomology |
| 1997 | Keith J. Karnok | University of Georgia, Agronomy |
| 1996 | Gary E. Moore | North Carolina State University, Ag & Extension Education |
| 1995 | Bryan Schurle | Kansas State University, Agricultural Economics |
| 1994 | Bryce H. Lane | North Carolina State University, Horticultural Science |
| 1993 | Merle D. Cunningham | Purdue University, Animal Science |
| 1992 | Russell E. Mullen | Iowa State University, Agronomy |
| 1991 | Thomas E. Loynanchan | Iowa State University, Agronomy |
| 1991 | Miles McKee | Kansas State University, Animal Science & Industry |
| 1990 | Jimmy G. Cheek | University of Florida, Ag & Extension Education |
| 1989 | Max B. McGhee | University of Florida, Ag & Extension Education |
| 1988 | Donald F. Post | University of Arizona, Soil Science |
| 1987 | Gerry L. Posler | Kansas State University, Agronomy |
| 1986 | A.W. Burger | University of Illinois-Urbana, Agronomy |
| 1985 | Charles L. Rhykerd | Purdue University, Agronomy |
| 1984 | Lyndon N. Irwin | Southwest Missouri State University, Animal Science |
| 1983 | Clinton O. Jacobs | University of Arizona, Ag Education |
| 1982 | Robert P. Patterson | North Carolina State University, Crop Science |
| 1981 | Lee W. Doyen | Cloud County Community College, Agribusiness |
| 1980 | Thomas M. Sutherland | Colorado State University, Animal Breeding & Genetics |
| 1979 | Maurice G. Cook | North Carolina State University, Soil Science |
| 1978 | Thomas L. Frey | University of Illinois, U.C., Ag Economics |
| 1977 | Donald M. Elkins | Southern Illinois University, Plant Science |
| 1976 | Robert R. Shrode | University of Tennessee, Animal Science |
| 1975 | Henry D. Foth | Michigan State University, Soil Science |
| 1974 | Donald A. Emery | North Carolina State University, Crop Science |
| 1973 | John R. Campbell | University of Missouri, Dairy Science |
| 1972 | David J. Mugler | Kansas State University, Dairy Science |
| 1971 | James L. Ahlricks | Purdue University, Agronomy |
| 1970 | Monroe R. Krummow | Sam Houston State University, Dairy Science |
| 1969 | Frederick E. Beckett | Louisiana Polytechnic Institute, Ag Engineering |

# NACTA Distinguished Educator Award Recipients

| | | |
|---|---|---|
| 2010 | Jean Gleichsner | Fort Hays State University, KS |
| | James Wangberg | University of Wyoming |
| 2009 | James R. McKenna | VPI and State University |
| | Steven S. Waller | University of Nebraska |
| 2008 | Wayne L. Banwart | University of Illinois |
| 2008 | Kevin J. Donnelly | Kansas State University |
| 2008 | Rick Parker | Rupert, Idaho |
| 2007 | Linda C Martin | Oklahoma State University |
| 2005 | Larry Erpelding | Kansas State University |
| 2005 | Jimmy Cheek | University of Florida |
| 2005 | L.H. Newcomb | The Ohio State University |
| 2003 | Kenneth L. Esbenshade | North Carolina State University |
| 2003 | Harley W. Foutch | Middle Tennessee State University |
| 2002 | Graham A Jones | University of Saskatchewan |
| 2001 | R Kirby Barrick | University of Illinois |
| | Don M Edwards | University of Nebraska |
| | Marvin E Oetting | College of the Ozarks |
| 2000 | Larry J Connor | University of Florida |
| | John M White | Virginia Tech |
| 1999 | Joseph J Jen | Cal Poly-San Luis Obispo |
| 1998 | W Anson Elliot | Southwest Missouri State University |
| 1997 | Gerry L Posler | Kansas State University |
| | Thomas J Lindahl | University of Wisconsin-Platteville |
| 1995 | Marion E Ensminger | Agriservices Foundation |
| | Detroy E Green | Iowa State University |
| | Robert M McGuire | State University of New York |
| | James Mortensen | Pennsylvania State University |
| 1994 | G M “Mike” Jenkinson | University of Guelph |
| | James L Oblinger | North Carolina State University |
| 1993 | David J Mugler | Kansas State University |
| | Robert C Sorensen | University of Nebraska |
| | Charles E Stufflebeam | Southwest Missouri State University |
| | Thomas M Sutherland | Colorado State University |
| 1991 | Ted E Hartung | University of Nebraska |
| 1990 | John R Campbell | Oklahoma State University |
| 1989 | Lee W Doyen | Cloud County Community College |
| | E Grant Moody | Arizona State University |
| 1988 | J Wayland Bennett | Texas Tech University |
| 1987 | Robert R Shrode | University of Tennessee1986 |
| 1986 | H Bradford Craig | North Carolina State University |
| 1985 | Russell L Miller | Louisiana State University |
| 1984 | Hal B Barker | Louisiana Tech University |
| | A W “Tom” Burger | University of Illinois |
| | Franklin E Eldridge | University of Nebraska |
| | Jack C Everly | University of Illinois |
| | J Keith Justice | Abilene Christian University |
| 1983 | Frank R Carpenter | Kansas State University |
| | Thomas J Stanly | Stephen F Austin State University |
| 1982 | O J Burger | Cal State University-Fresno |
| | Edward C Frederick | University of Minnesota-Waseca |
| | Paul E Sanford | Kansas State University |
| 1980 | Darrell S Metcalfe | University of Arizona |
| 1979 | Robert A Alexander | Middle Tennessee State University |
| | Robert D Seif | University of Illinois |
| 1978 | Murray A Brown | Sam Houston State University |
| 1977 | G Carl Schowengerdt | Southeast Missouri State College |
| 1976 | John A Wright | Louisiana Polytechnic Institute |

# Past Presidents of NACTA

| | |
|---|---|
| 2009-2010 | Mike Mullen, University of Kentucky |
| 2008-2009 | Kevin J. Donnelly, Kansas State University |
| 2007-2008 | Wayne L. Banwart, University of Illinois-Urbana-Champaign |
| 2006-2007 | Allen Zimmerman, The Ohio State University |
| 2005-2006 | Keith Karnok, University of Georgia |
| 2004-2005 | Linda Clarke Martin, Oklahoma State University |
| 2003-2004 | James R. McKenna, Virginia Polytechnic Institute and State University |
| 2002-2003 | Ronald J Hanson, University of Nebraska-Lincoln |
| 2001-2002 | Danny E Terry, Western Illinois State University |
| 2000-2001 | Jean Gleichsner, Fort Hays State University, Kansas |
| 1999-2000 | R Bruce Johnson, Southwest Missouri State University |
| 1998-1999 | Bryce H Lane, North Carolina State University |
| 1997-1998 | Ed Yoder, The Pennsylvania State University |
| 1996-1997 | Richard (Rick) O Parker, College of Southern Idaho |
| 1995-1996 | Larry H Erpelding, Kansas State University |
| 1994-1995 | Harley W Foutch, Middle Tennessee State University |
| 1993-1994 | Douglas A Pals, University of Idaho |
| 1992-1993 | Thomas J Lindahl, University of Wisconsin - Platteville |
| 1991-1992 | Gerry L Posler, Kansas State University |
| 1990-1991 | John C Mertz, Delaware Valley College, Pennsylvania |
| 1989-1990 | G M “Mike” Jenkinson, University of Guelph, Ontario |
| 1988-1989 | Dale W Weber, Oregon State University |
| 1987-1988 | Lyndon N Irwin, Southwest Missouri State University |
| 1986-1987 | Robert C Kirst, University of Arkansas, Monticello |
| 1985-1986 | A W “Tom” Burger, University of Illinois |
| 1984-1985 | Robert C McGuire, SUNY Agricultural and Tech College, Cobleskill |
| 1983-1984 | H Bradford Craig, North Carolina State University |
| 1982-1983 | Lee W Doyen, Cloud County Community College, Kansas |
| 1981-1982 | Russell L Miller, Louisiana State University |
| 1980-1981 | C E Stufflebeam, Southwest Missouri State University |
| 1979-1980 | Robert R Shrode, University of Tennessee |
| 1978-1979 | O J Burger, California State University, Fresno |
| 1977-1978 | Frank R Carpenter, Kansas State University |
| 1976-1977 | Edward C Frederick, University of Minnesota, Waseca |
| 1975-1976 | William R Thomas, Colorado State University |
| 1974-1975 | Robert A Alexander, Middle Tennessee State University |
| 1973-1974 | Jerome K Pasto, The Pennsylvania State University |
| 1972-1973 | John Beeks, Northwest Missouri State University |
| 1971-1972 | J Wayland Bennett, Texas Tech University |
| 1970-1971 | Darrell S Metcalf, University of Arizona |
| 1969-1970 | Murray A Brown, Sam Houston State University, Texas |
| 1968-1969 | Franklin E Eldridge, University of Nebraska |
| 1967-1968 | Dan O Robinson, Arizona State University |
| 1966-1967 | Keith Justice, Abilene Christian University, Texas |
| 1965-1966 | Hal B Barker, Louisiana Tech University |
| 1964-1965 | Lloyd Dowler, California State University, Fresno |
| 1963-1964 | Thomas J Stanly, Stephen F Austin State University, Texas |
| 1962-1963 | Roy J Stuckey, Wilmington College, Ohio |
| 1961-1962 | John T Carter, University of Houston, Texas |
| 1960-1961 | G Carl Schowengerdt, Southeast Missouri State University |
| 1959-1960 | Ralph A Benton, Southern Illinois University |
| 1958-1959 | T R Buie, Southwest Texas State University |
| 1957-1958 | Burton W DeVeau, Ohio University |
| 1956-1957 | M Hayne Folk, Louisiana Tech University |
| 1955-1956 | E B Knight, Tennessee Tech University |

# Join NACTA

**NACTA**
north american colleges and teachers of agriculture
connect | develop | achieve

## *Join NACTA today!*

***(North American Colleges and Teachers of Agriculture)***
***— a professional organization dedicated to advancing the scholarship of teaching and learning in agricultural, environmental, natural, and life sciences.***

- Members receive the quarterly *NACTA Journal,* a professional, peer reviewed journal emphasizing the scholarship of teaching. The Journal also includes book reviews, teaching tips, and abstracts.
- Members attend the annual conference held at different colleges and universities in the U.S. and Canada, and where members present papers on innovative teaching concepts.
- Each year NACTA recognizes outstanding teachers with a variety of awards including: Teaching Awards of Merit, Teacher Fellows, Regional Outstanding Teacher Awards, NACTA-John Deere Award, Teaching Award of Excellence, Distinguished Educator, and Graduate Student Teacher Awards.

**Membership Categories (circle one):**
- **Institutional Active Dues are $75/year (if your University/college is a member)**
- **Active Dues are $100/year**
- **Graduate Student $25/year - Emeritus $25/year**
- **Lifetime -- $750 -one payment (or $800 if made in four payments of $200)**
- **Institutions ($150 - 4 year schools and $100 - 2-year schools)**

### *To join complete the following form.*

| | | |
|---|---|---|
| ***Name:*** | | ***Email:*** |
| ***Institution:*** | | ***Telephone:*** |
| ***Address 1:*** | | |
| ***Address 2:*** | | |
| ***City:*** | ***State:*** | ***Zip:*** |

Send a check payable to NACTA for the correct amount or you can pay using a credit card (VISA and MasterCard only); phone calls also accepted 1-208-436-0692:

**Name on Card** ______________________

**Card Number:**______________________

**Expiration (month/date):** ______________

**Three digits on the back of your card to the right of the signature block:** __________

***Send your completed form to -***

**Marilyn B. Parker**
**NACTA Secretary/Treasurer**
**151 West 100 South**
**Rupert, ID 83350**

***For more information visit the NACTA website: www.nactateachers.org or email nactasec@pmt.org***

# 2010 - 2011
# NACTA Officers


## President
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# Regional Directors

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## Central Director
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Email: tracyaod@montana.edu


# Committee Chairs

***Journal Awards:***
Neil Douglas, Berea College, Kentucky
***Membership & Public Relations:***
Ron Hanson,
University of Nebraska - Lincoln
***Educational Issues and Teaching Improvement:***
Ann Marie VanDerZanden,
Iowa State University
***Teacher Recognition:***
Prasanta Kalita, University of Illinois
***Book Review and Instructional Media Review:***
Greg Pillar, Queens University of Charlotte, NC
***International Comte Chair:***
Phil Hamilton, Mount Olive College, NC
***NACTA Foundation Advisory Council:***
Mike Mullen, University of Kentucky

# Liaisons

***NACTA Judging Contest***
Lyle Westrom, University of Minnesota, Crookston
***Delta Tau Alpha***
Jean Gleichsner, Fort Hays State University, KS
***AASCARR***
Kevin Bacon, Western Illinois University
***APLU***
Jean Bertrand, University of Georgia
***CFAVM & CADAP***
Kent Mullinix, Kwantlen Polytechnic University, Surrey, BC
***CAPICU***
Foy Mills, Abilene Christian University, TX

# Journal Review Board

# NACTA Committee Members
# 2009 - 2010*

### *Journal Awards*
Neil Douglas, Chair
Berea College, Kentucky
Neil_Douglas@berea.edu

### *Membership & Public Relations*
Ron Hanson, Chair,
University of Nebraska - Lincoln
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### *Educational Issues & Teaching Improvement*
Ann Marie VanDerZanden, Chair
Iowa State University
vanderza@iastate.edu

### *Teacher Recognition*
NACTA Teacher Recognition Committee

Prasanta K. Kalita, Chair, University of Illinois
W. Stephen Damron, Oklahoma State University
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