

# Arkansas State University graduate students enhance communication skills and science education in the Arkansas Delta



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## ABSTRACT

Interest in science careers begins during the early years of a child's education. Enhanced science curriculum in grades 6-8 in six area public schools is facilitated by the National Science Foundation. The Arkansas State University GK-12 Program targets rural public school districts in the Arkansas Delta region which are represented by diverse ethnic student populations. In the first two years of our program, 2,381 public school students have been exposed to enhanced science learning. Graduate Fellows team-teach one day per week with their two Mentor Teachers to enhance the science environment and strengthen Mentor Teachers' content knowledge and experience. Hands-on learning for the students is directed by the Graduate Fellows based on their research experiences. Lesson plans written by the Fellows are aligned to the Arkansas Science Curriculum Frameworks, and spark excitement and inquisitiveness in the students. Increased understanding of their research and improved communication skills are obtained by the Graduate Fellows while middle school students are introduced to cutting-edge science curriculum. Lesson plans are available to classroom teachers for further use and facilitate continued enhanced science curriculum to encourage student interest in STEM careers.

## INTRODUCTION

The NSF-funded GK12 Program at ASU is in the 3<sup>rd</sup> year of a 5 year continuing grant. NSF currently has 142 active GK12 programs nationwide. Graduate Fellows are placed into area rural school districts with ethnic diversity (Figure 1) and socio-economic challenges (Table 1) to enhance science curriculum to these students.

NSF Program goals are stated as:

- 1)improved communication, leadership and team building for the Fellow
- 2)enhanced teaching and learning experiences for school children

ASU Program Goals are as follows:

- 1)improve Fellows' communication to a broad audience to create a deeper understanding of his/her research
- 2)enhance teachers' science experience
- 3)increase students' interest in STEM careers through exposure to enriched STEM environment
- 4)strengthen ASU & rural school districts' partnerships

Graduate students are matched to school districts (Mentor Teachers) based on personality tests and team-building exercises. Graduate Fellows and Mentor Teachers are on a 1:2 ratio to increase exposure of rural middle school students to cutting-edge science.

Training for Fellows includes:

- Summer workshop to introduce 6E lesson plans and pedagogy skills
  - Inquiry-based lesson plan development with Mentor Teachers:
    - 1) engage 2) explore 3) explain 4) elaborate 5) extend 6) evaluate
- Fall & Spring workshops with Mentor Teachers for lesson plan development
  - Reflect on improvements as Fellow becomes familiar with classroom
- Mid-year reflection to increase team-building and program evaluation
  - Evaluate first semester and discuss improvements for remainder of year
- End of year reflection to evaluate success & build for following year
  - Evaluate academic year and discuss student assessment

Item	Pre summer workshop	Academic year end	Significance
Develop students' conceptual understanding of science.	4.0 (0.8)	5.0 (0.0)	0.018
Have students work in cooperative learning groups.	4.0 (0.8)	4.9 (0.4)	0.045
Have students participate in appropriate hands-on activities.	4.3 (0.8)	4.9 (0.4)	0.172
Encourage students' interest in science	4.7 (0.5)	5.0 (0.0)	0.172

## METHODS

The project evaluator assesses the Fellows, Mentor Teachers, and students to measure the success and offer recommendations for the continued success of the GK12 Program. The recommendations are continually addressed during the academic year. Public school administrators are invited to select workshops and also evaluated to measure Program support in their local school.

Fellows are evaluated for their preparedness to teach, perception of their contributions to the classroom, and their classroom activities.

Teachers are evaluated for their perception of the Fellow's classroom contribution, student classroom response to Fellow, and increased interest in science as a result of the Program.

Students are evaluated for their change in confidence and interest in science class, plans to continue in science-related education, and communication with parents/friends about classroom activities with the Fellow.

Evaluation and statistical treatments:

Evaluations were based on a Likert-scale ranging from 5 (strongly agree) to 1 (strongly disagree). Pre/post measures were compared with paired t-test; single sample tests were evaluated with a one sample t-test comparing means to a value of 3 (neutral point of scale).

Lesson plans in the 6E format fitting the Arkansas frameworks are incorporated into Fellows' pedagogy. Each Fellow produces a minimum of 10 peer-reviewed lesson plans published on ASU GK12 website (<http://www2.astate.edu/gk12/>).

## TEACHING ACTIVITIES

Graduate Fellow activities include hands-on activities to enhance science curriculum learning in the classroom and in the field. Classroom activities include building models, organism dissection, activities to learn adaptations and genetic variations, and brain activities (Figure 2). Research has shown that retention of material after 24 hrs is 75% when the learned material is "practiced by doing" and up to 90% when it is taught or immediately used (Sousa, 2006). For this reason, Fellows incorporate hands-on activities for student engagement during lesson plans whenever possible. Field activities have included building plumb houses for their school yard, trips to ASU to experience research laboratories, and day trips to ASU-affiliated field stations (Figure 3). These activities have proved highly successful for retention of learned material and interest in science-related careers as noted in student surveys.

Sousa, D.A. 2006. How the brain learns. 3rd ed. Thousand Oaks: Corwin Press

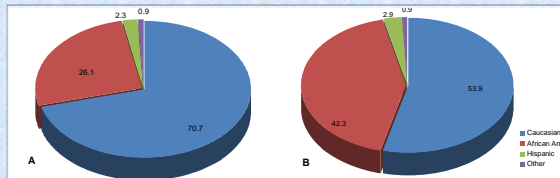


Figure 1. Student diversity in Arkansas rural schools districts served by NSF GK12 Fellows. A) 2008-2009, B) 2009-2010

Table 1. Participating GK12 School data from 2006 to 2009. Source: <http://norms.uark.edu/>

School	Armored	Cross County	Forrest City	Harrisburg	Nettleton	Wilson	Wynne
Grade Range	7th-12th	7th-12th	7th-8th	5th-8th	7th-9th	5th-6th	6th-8th
Total Enrollment	208	325	554	341	696	309	697
Free/ Reduced Meals	25	100	100	75	52	69	57
Accredited	YES	NO	YES	NO	YES	YES	YES
<b>2006/2007</b>							
Attendance Rate	92.6	91.7	94.1	93.2	95.1	93.6	94.3
Graduation Rate	85.3	89.9	NA	NA	NA	NA	NA
Dropout Rate	1	5.7	1.2	0.3	0.6	NA	0.7
Remediation Rate	50	72	NA	NA	NA	NA	NA
<b>2007/2008</b>							
Attendance Rate	93.7	91.2	94.3	94	94.3	93.4	94.3
Graduation Rate	86.7	64	NA	NA	NA	NA	NA
Dropout Rate	3.9	3.9	1.3	0.6	0.7	NA	0.6
Remediation Rate	42.3	72.2	NA	NA	NA	NA	NA
<b>2008/2009</b>							
Attendance Rate	94.6	91.5	93.7	93.3	94.4	94.2	94.5
Graduation Rate	91.8	74	NA	NA	NA	NA	NA
Dropout Rate	1	6	2	0	0	NA	0
Remediation Rate	NA	NA	NA	NA	NA	NA	NA

## RESULTS

Fellows' evaluations revealed a significant increase in confidence in classroom teaching and pedagogy (Table 2) and Mentor Teachers were confident that science curriculum and student learning was enhanced (Table 3).

Students' surveys noted a greater interest in science and the curriculum taught when Fellows were in classroom (Table 4). Increased discussion with parents and friends also reflect greater interest in the subject and possible continuation in science.

Fellows indicated on each survey an increase communication skill, speaking confidence, and excitement for their research.

Mentor Teachers' perspectives include the following comments:

- "Good role model, opens up their eyes to new possibilities."
- "My students are excited and engaged when the Fellow comes to my classroom...they are not hesitant to ask questions."
- "Our Fellow made science fun and interesting. He makes the students want to learn."

## DISCUSSION

Graduate Fellows are fulfilling the NSF goals of an enriched graduate experience and enhanced communication skills.

Fellows are learning pedagogy skills they take with them when entering the workforce.

Rural middle school students in the Arkansas Delta are becoming more excited about the sciences with GK12 Fellows in the classrooms.

Arkansas State University is connecting with area public schools as teachers, parents, and students visit the University and are exposed to graduate research through the Fellows.

Mentor Teachers are experiencing new lesson plans included in the state science curriculum through their GK12 Fellow

Peer-reviewed lesson plans taught by the Fellows are available to the Mentor Teachers on the GK12 website (<http://www2.astate.edu/gk12/>).

Fellows and Mentor Teachers work as a team to encourage experience-based learning in the science curriculum.

Table 3. Quantitative rating of Mentor/Teacher survey triangulated with open-ended responses to Fellow's classroom activity. Likert scale = 1-5; n = 16; higher score = higher agreement with statement.

Item	Mean	SD
My students respond favorably to my fellow	4.8	0.4
My students seem more interested in science this year, as a result of the visiting fellows	4.5	0.8

Table 4. Results of student surveys to determine increased interest in science with GK12 Fellow in classroom. Likert scale = 1-5; n = 600; higher score = higher agreement with statement.

Item	Mean	SD
The resident scientist coming to class helped me to learn the subject.	4.218	1.036
The resident scientist coming to class made me feel more confident about this class.	4.122	2.312
The resident scientist coming to class made me more interested in getting more education in science after high school.	3.786	1.159
Having the resident scientist come to class made me more interested in science.	4.039	1.097
Having the resident scientist come to class made the subject more fun.	4.420	0.933
I talked to my parents/guardians about the things we did in class when the resident scientist came to class.	3.325	1.496
I talked to my friends about the things we did in class when the resident scientist came to my class.	3.603	1.346

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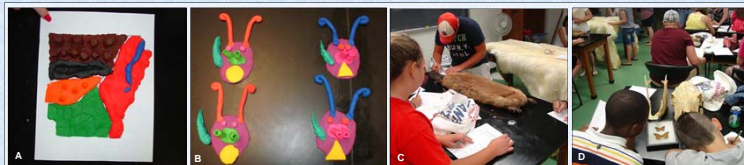


Figure 2. Hands-on classroom activities are great tools for retention of learned material. Classroom activities used by Fellows include A) producing geographical highlights of Arkansas with Play-doh; B) Punnett Squares demonstrating possible allelic combinations in aliens; C) adaptations in mammal coloring and fur; D) skull and teeth adaptations.



Figure 3. School trips to ASU's Bearitage field station included hands-on learning and demonstrations by GK12 Fellows. A) Jonathan Stanley demonstrates safe handling of reptiles; B) Students experience bird tracking with telemetry; C) Students find and identify aquatic insects with the use of a hand lens with help from Teresa Brueggem.