The Tennessee Governor’s School for Scientific Models and Data Analysis

Sunday, May 31st through Friday, July 3rd, 2009

Annual Report to the Governor and the People of the State of Tennessee

Dr. Jack Rhoton, Director

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Center of Excellence in Mathematics and Science Education

Prepared by:
Dr. Jack Rhoton and Ms. Angela Haga, Executive Coordinator
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Tennessee Governor's School for Scientific Models and Data Analysis Program Summary and Evaluation for 2010

I. The People: Leadership Team, Faculty and Staff, Counselors and Students

A. Leadership team: The year-round work of preparation for the 2010 Tennessee Governor’s School for Scientific Models and Data Analysis was carried out by the director, Dr. Jack Rhoton, and the executive coordinator Ms. Angela Haga.

B. Faculty and staff: The for-credit faculty consisted of two (2) full-time East Tennessee State University faculty members: one from the Department of Mathematics, one from the Department of Biology. The faculty and staff biographies are in Appendix A.

C. Counselors: Five East Tennessee State University students served as resident counselors. Since they have more contact with the Scholars than any other staff member, the counselors are a crucial part of the GSSM&DA program. Each of the five (5) counselors was responsible for six (6) scholars with one counselor acting as a resident “counselor at large”. The biographies of the counselors are in Appendix B.

D. Students: The 30 Scholars who attended represented 16 Tennessee counties. There were 16 females and 14 males. Ten of the students were rising seniors and twenty were rising juniors. A statistical breakdown of the student body, including the counties from which the Scholars came, may be found in Appendix C.

II. The Program: Courses, Seminars and More

A. Academic courses: There were two (2) academic courses offered, one at 9:15-12:00 noon and one in the afternoon 1:15-3:00pm. The curriculum was designed to expose the Scholars to a rich selection of mathematics and science courses consisting of general biology, symbiosis, and probability and statistics; descriptions of all of the courses are in Appendix D. The average for the group for BIOL 1110-011 course was (13 A’s at 43% and 10 A-‘s at 33% and 7 B+’s at 23%). The average for the group for MATH 1530-014 course was (29 A’s at 97% and 1 W at 3%).

B. Plenary sessions: The plenary sessions consisted of Dr. Rhoton, Ms. Haga, the counselors, and the GS scholars. The sessions started at 9:00am and were completed by 9:30am. The sessions were on Tuesday’s of the five (5) week period.

C. GS Scientific Models & Data Analysis Web site: Ms. Haga is in charge of the website and is updating it periodically with pertinent information regarding the 2010 Governor’s School and the upcoming 2011 Governor’s School.
III. *The Rest of the Experience*: Culture, Fun, and Competition Embedded in Science

A. Scholars had the opportunity to participate in the following field trips: The Gray Fossil Site in Gray, TN; Warriors Path State Park (Spider Study) in Kingsport, TN; ETSU Medical School Labs, Oak Ridge National Laboratories in Oak Ridge, TN, Historic Jonesborough in Jonesborough, TN; Roan Mountain State Park in Roan Mountain, TN; Fun Expedition in Johnson City, TN; Basler Activity Center (ETSU Campus); Bays Mountain State Park in Kingsport, TN; and the Carter Fold in Hiltons, VA.

B. The staff worked hard to create a learning community, putting students together with each other as well as with the staff and GS Scientific Models & Data Analysis faculty in informal settings such as project group meetings, open time, activities with counselors, and the plenary meetings.

C. The food services provider, ARAMARK, prepared meals while scholars were on campus (breakfast, lunch, dinner). The opening and closing banquets also contributed a sense of formality and accomplishment to the program; Scholars had the opportunity to speak at the closing banquet which was held at the Millennium Centre Ballroom here in Johnson City.

D. An ice cream and cake party celebrating the Scholar birthdays falling within the School provided a brief escape from the students' studies.

E. A memory "*Yearbook*" featuring pictures taken throughout the Governor's School program created by Ms. Haga and was given to all of the Scholars and counselors for a keepsake at the closing luncheon.

F. Ms. Haga also compiled the photos that were taken during the five (5) week Governor's School program into a “Movie” w/music that was shown during the closing ceremonies and she will incorporate the photos (movie) onto a DVD that will be mailed to all the graduating scholars and counselors at a later date.

IV. *The Results*: Scholar Evaluations

The Scholars' satisfaction with the *2009 GS Scientific Models & Data Analysis* program is reflected in the overall rating of the program, with 90 percent of the Scholars rating the program as either "excellent" (5) or "very good" (4)—a cumulative rating of **4.40 out of 5**. Evaluations of various aspects of the program were rated as follows:

A. Overall Program: **4.40 / 5**

B. Academic component/workload: **2.77 / 3**

C. Faculty/courses: **4.00 / 5**

D. Counselors: **2.43 / 3**

E. On-Campus meals: **2.97 / 5**

F. Dormitory Lodging: **2.90 / 3**

Student Evaluation comment results are attached as *Appendix E*. Virtually all of the Scholars wrote specific responses to the “overall feedback” question on the evaluation. A complete, unedited text of those comments is attached, with the numerical specifics, as *Appendix F*. 
V. **The Strengths: Four Keys to Successful Outcomes**

A. A dedicated, talented, and interested faculty and staff who enjoyed working with these gifted and talented rising juniors and seniors.

B. Highly motivated students. All thirty (30) Scholars who began the program completed it. Each of those thirty (30) earned the full seven (7) hours of credit.

C. The successful class for **Scientific Models and Data Analysis** was a for-credit program, which included academic and interpersonal/social components. A full 90 percent of the students thought the balance of activities were “Excellent” or “Very Good,” and the university courses offered were carefully selected as likely to “count” as part of the general education requirements at virtually any institution the students might later attend.

D. The work of the executive director Dr. Jack Rhoton, the instructors, professors, counselors and, especially, the GS Scientific Models & Data Analysis executive coordinator Angela Haga.

VI. **Conclusion**

This 2010 Governor’s School for Scientific Models and Data Analysis program was highly successful. We had a challenging curriculum, an enthusiastic faculty and staff, and a gifted and talented group of Scholars. The Governor’s Schools are among Tennessee’s best investments, and the entire Scientific Models and Data Analysis team is already looking forward to an even better program in 2011.
APPENDIX A

2009 Faculty and Staff Bios
The Tennessee Governor’s School for Scientific Models and Data Analysis

Primary Instructors

Dr. Karl Joplin
Karl Joplin is an Associate Professor in the department of Biological Sciences, College of Arts and Sciences at East Tennessee State University (ETSU). He received his BS from the University of Washington, his MS in Entomology and his Ph.D. in the Molecular, Cellular and Developmental Biology program at the Ohio State University. He did postdoctoral research at OSU before joining the faculty at ETSU. Karl’s undergraduate instructional experience is at a primarily undergraduate institution and includes 1) non-majors biology, 2) General Biology for Majors I and II, 3) General Entomology, 4) Recombinant DNA Laboratory, 5) Evolution, and 6) Honors Great Ideas in Science. His research interests involve Molecular and Physiological Aspects of Diapause in insects, Respiratory Physiology during insect development, and developmental and environmental effects on insect behavior. He has chaired 7 MS projects. He is currently the program director of a HHMI grant SYMBIOSIS: An Introductory Integrated Mathematics and Biology Curriculum. This is a three semester introductory level course that gives the students credit for biology, statistics and calculus.

Dr. Jeff Knisley
Jeff Knisley is an Associate Professor in the department of Mathematical and Statistical Sciences, College of Arts and Sciences at East Tennessee State University (ETSU). He received his BA degree from Carson Newman College, and his MS and Ph.D. degrees in Operator Theory and Applied Mathematics from Vanderbilt University. His work experience includes the Oak Ridge National Laboratory, where he was part of a team that developed applications of neural networks and artificial intelligence. Jeff’s undergraduate instructional experience is at a primarily undergraduate institution, although he frequently offers graduate courses such as Applied Math and Operations Research. His research interests are in computational neuroscience and its applications, although he also has publications in bioinformatics, signal processing, and operator theory. He has experience in Java, C++, LaTeX, Maple, Mathematica, and web development using JavaScript, CSS, ASP, and PHP. He has written or co-written several software packages and applications, including ArborVT with Lee Glenn, a neuroscience data analysis tool whose development was funded by the NIH. He is currently a PI on the HHMI grant SYMBIOSIS: An Introductory Integrated Mathematics and Biology Curriculum, and the NSF grant Talent Expansion in Quantitative Biology.

knisleyj@etsu.edu  http://faculty.etsu.edu/knisleyj/
Support Faculty and Staff

Several ETSU math and science faculty as well as other resource individuals provided special learning sessions that enhanced and enriched the classroom studies. All of the ETSU faculty provided “experimental design” sessions in which they shared their research and the experimental design they used to carry out the research. These sessions provided excellence background information for students as they designed and carried out their own research projects. The students also experienced an array of off-campus trips ranging from studies at the Gray Fossil Site to the Oak Ridge Laboratories. The individuals who led these sessions are also included. A brief bio for each of these individuals is provided below.

Mr. Jennifer Bauer

Ms. Bauer was born in Baltimore, Maryland. She relocated to beautiful East Tennessee not long after graduating from high school. She soon became immersed in the beauty and the biology of the S. Appalachian Mountains and found herself wanting to learn all she could about this very diverse environment. East Tennessee State University is her alma mater, three times over, completing a Bachelors Degree in Biology and Art, followed by an MS in Science Education, and an MA in Teaching. Writing soon became a passion and she has now authored 4 books; A Naturalists’ Teaching Manual; Roan Mountain: A Passage of Time 1st and 2nd Editions; and Wildlife, Wildflowers, and Wild Activities-Exploring S. Appalachia. Jennifer is also a frequent contributor to the Tennessee Conservationist magazine. She is employed as a Park Manager at Sycamore Shoals State Historic Area in Elizabethton, beginning her career in the role of Park Interpretive Specialist at Roan Mountain State Park for 21 years prior to promotion. Of the utmost importance to her in her professional and personal life, is becoming a good environmental and cultural educator, coupled to a strong belief in the importance of conservation and preservation. She is in her 4th year of serving on the board of directors of the Elizabethton/Carter County Chamber of Commerce. The first weekend of May, each year, she directs and organizes the Roan Mountain Spring Naturalists Rally, 2009 being its 51st year. In her “spare” time, she finds herself weaving, learning the banjo, watercolor painting, clogging, and being outdoors as much as possible. Most importantly, she loves to spend as much time as possible with her two daughters, a 2 year old granddaughter, and her husband. She may be contacted at 423-543-5808 or jennifer.bauer@state.tn.us.

Mr. Ken Childress

Mr. Childress is the Department Supervisor for the Nature Interpretive Services Department at Bays Mountain State Park in Kingsport, TN. He was responsible for arranging our tour and scheduling the viewing of the wolves and raptors habitats, he also arranged for the GS students to attend the Nature Program and viewing the area fauna and flora.
Dr. Gary Henson

Dr. Henson has been involved in astronomy research and education for over 25 years. As a research astronomer, he has studied Variable Stars using observatories in New Mexico, Arizona, Oregon, and at ETSU. As an educator he has taught not only at the university level, but has contributed much to public outreach programs throughout his career. He currently serves as the director of both the ETSU Harry D. Powell Observatory and ETSU Planetarium and received the 2004 Distinguished Faculty Award for Service at ETSU. Dr. Henson is the Assistant Professor, ETSU Faculty since 1989, B.S. - University of Central Arkansas, M.S. - University of New Mexico, Ph.D. - University of Oregon (1989). Professional Interests: Visible & infrared photometry and polarimetry of variable stars. He may be contacted at 423-439-6906 or hensong@etsu.edu.

Dr. Fred Hossler

Dr. Hossler is currently a professor in the department of Anatomy and Cell Biology at the James H. Quillen College of Medicine at East Tennessee State University in Johnson City, TN. Dr. Hossler received his B.S. (Biology) degree in 1963 at Muhlenberg College in Allentown, PA, his M.S. (Microbiology) degree in 1965 at Penn. State University in State College, PA, his Ph.D. (Pathobiology) in 1971 at the University of Colorado Medical Center in Denver, CO, and his Post Doctorate (Cell Biology) in 1974 at Yale University in New Haven, CT. He may be contacted at 423-439-2011 or hossler@etsu.edu or Semtemman@aol.com

Dr. Thomas (T.J.) Jones

Dr. Jones is currently working in the biological sciences department at East Tennessee State University and specialized in Behavioral Ecology, Neuroethology, and Science Education. In 1990 Dr. Jones received his B.S. in Biology from the Cleveland State University, and in 1993, he received his M.S. in Biology. In 2000, Dr. Jones received his Ph.D. in Evolution, Ecology, and Evolutionary Biology from the Ohio State University. Dr. Jones has a broad-based research program in the areas of animal behavior, ecology, population genetics, and neuroethology. Specifically, he is interested in the evolution of cooperation, sociality and dispersal strategies. He may be contacted at 423-439-6930 or jonestc@etsu.edu.
**Dr. Debra Knisley**

Dr. Knisley is an Associate Professor in the department of Mathematical and Statistical Sciences, College of Arts and Sciences at East Tennessee State University. She received her B.S. in Secondary Education/Mathematics in 1976 from the Tennessee Technological University, her M.S. in Mathematics in 1979 from the Tennessee Technological University, and her Ph.D. in Mathematics in 1989 from the University of Memphis. Dr. Knisley has previously worked with the James H. Quillen College of Medicine in Johnson City, TN as an NSF Sponsored Visiting Researcher- in the Department of Molecular Biology and Biochemistry (2005-2006), the University of Memphis in Memphis, TN as an Adjunct Professor in the Department of Mathematical Sciences (1988-1989 while completing her dissertation), the Tennessee Technological University in Cookeville, TN as an Instructor in the Department of Mathematics (1985-1988), and at the University of Memphis in Memphis, TN as a Graduate Teaching Assistant (1982-1985). She may be contacted at 423-439-6975 or knisleyd@etsu.edu; http://faculty.etsu.edu/knisleyd/.

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**Dr. Hugh Miller**

Dr. Miller earned his bachelor degree in Microbiology from ETSU in 1979. In 1986 he earned a Ph. D. in biochemistry from the University of Tennessee at Knoxville. After a postdoctoral fellowship at the Medical University of South Carolina, he joined the faculty of the Biological Sciences Department in 1988. While at ETSU, Dr. Miller has mentored several undergraduates and graduate students. In addition, he has been involved with curriculum issues by serving on both the College and University Curriculum committees. During academic year 2005/2006, he served the department of Biological Sciences in the capacity of Interim Chair. Recently, he has been involved in several funded educational grants including the NSF funded ATE grant, NSF funded Talent Expansion in Quantitative Biology, and the HHMI funded Symbiosis grant. Also, he serves the department one of two undergraduate advisors. During the Governor’s School, Dr. Miller was responsible for organizing and running the laboratory component of the Symbiosis course. He may be contacted at 423-439-6922 or millerh@etsu.edu.

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**Dr. Darrell Moore**

Dr. Moore is an Associate Professor in the Department of Biological Sciences at East Tennessee State University. He teaches courses in Experimental Animal Behavior, Animal Physiology, Biology for Majors II, Topics in Organismal Biology, and Neurobiology. His research interests are primarily concerned with determining how the nervous system controls behavior (neuroethology). Because the nervous system is so complex in the vertebrates, he has relied upon relatively simple animals (such as insects and crustaceans) as model systems. His other interests include environmental influences on circadian rhythms in flies (with Dr. Karl Joplin), insect neuroanatomy (requires microdissection), and aggressive behavior and establishment of dominance hierarchies in crayfish. He may be contacted at 423-439-8390 or moored@etsu.edu.
Dr. Diane R. Nelson

Dr. Nelson is Professor Emerita of Biological Sciences at East Tennessee State University, having retired in May 2003 after 35 years of service. In 1993, she received the ETSU Distinguished Faculty Award, the university’s highest award for combined achievements in teaching, research, and service. In April 2000 she was selected by the Association of Southeastern Biologists as the recipient of the Meritorious Teaching Award, the society’s most prestigious award. Although she “officially” retired from ETSU, she continues to conduct research, teach workshops, and provide service to her profession. She teaches Marine Biology occasionally at ETSU and gives programs for the Johnson City Hands-On Museum as well as for numerous civic organizations, churches, and public schools in the Tri-Cities area. She is also Curator of Invertebrates and Science Education Consultant for the ETSU and General Shale Brick Natural History Museum at the Gray Fossil Site. She may be contacted at nelson@etsu.edu.

Dr. Jack Rhoton

Dr. Jack Rhoton has dedicated nearly 20 years at East Tennessee State University, building a nationally recognized professional development program for science education, K-16. Prior to joining ETSU in 1987, Rhoton had 15 years of experience in public school settings in which he served as a high school science teacher and K-12 science supervisor. Known for his creative approaches to investigating science education issues, his work focuses on the preparation of pre-service and in-service teachers of science and mathematics. His efforts have impacted university faculty members; K-12 teachers; and elementary, middle and high school students. He has received nearly six million dollars in grant funding to support math and science education in Northeast Tennessee. A prolific science education author, he has published five books and sixty journal articles, and he has made numerous presentations at the local, state, and national levels. Further, thousands of students have been positively affected as a result of his many endeavors. Rhoton has served as president of the National Science Education Leadership Association (NSELA), Tennessee Academy of Science (TAS), and the Tennessee Science Teachers Association (TSTA). He has also served as program chair for the National Science Teachers Association (NSTA) area Conferences and as an NSTA board member, editor of a series of NSTA/NSELA publications, including the Science Educator Journal. He has received many honors, including the National Science Education Leadership Outstanding Science Education Leadership Award, National Science Teachers Association Distinguished Service Award, East Tennessee State University Distinguished Faculty Award, Tennessee Academy of Science Outstanding Science Teacher Award, and the Tennessee Science Teachers Association Distinguished Educator of the Year Award. He may be contacted at 423-439-7589 or rhotonj@etsu.edu.
**Mitch Robinson, Ph.D.**

Dr. Robinson is the Associate Dean for Graduate Studies. He is currently Associate Dean for Graduate Studies and Professor of Biochemistry and Molecular Biology and at the James H. Quillen College of Medicine. He is a native of western North Carolina and holds a B.S. degree from the University of North Carolina at Chapel Hill and a Ph.D. from Wake Forest University. As Associate Dean, he oversees admissions, curriculum and all academic activities in the M.S. and Ph.D. graduate programs in the College of Medicine. Dr. Robinson is active in teaching a variety of subjects in both the graduate and medical curriculum including intermediary metabolism, lipid metabolism, biochemistry and scientific ethics. He currently serves as the course director for the Medical Biochemistry course taught to all first year medical students. He may be contacted at 423-439-2028 or robinson@etsu.edu

**Dr. Edith Seier**

Dr. Seier is an Associate Professor of Mathematics/Statistics at East Tennessee State University. She received her Ph.D. in Statistics in 1998 from the University of Wyoming. Dr. Seier is currently teaching the following courses: Statistical Modeling, Applications of Statistics, Probability & Statistics (Algebra based), Probability & Statistics (Calculus based), and Time Series. Her areas of interest are: Kurtosis and variability, Statistical Consulting & Data Analysis, Teaching Statistics with an active learning approach, and Applications of Statistics to Biology, Public Health and Medicine. She may be contacted at 423-439-5812 or seier@etsu.edu.

**Mr. Fred Strohl**

Mr. Strohl is the tour coordinator at Oak Ridge National Laboratory and has worked in ORNL's Communications and Community Outreach Directorate since February 1995. Prior to that time, he worked in newspapers and broadcasting for 24 years -- most of that time spent in East Tennessee. Mr. Strohl is a 1976 graduate of Maryville College with a Bachelor of Arts degree in political science. He is married with four children.
Mr. Doug Taylor
Mr. Taylor is the Assistant Dean of Admissions & Records at the James H. Quillen College of Medicine at East Tennessee State University. He oversees the day-to-day operation of Admissions and Records and has been in Admissions for many years and is not only exceptionally qualified, but also eager to offer his assistance. He may be contacted at 423-439-2033 or sacom@etsu.edu.

Dr. Lev Yampolski
Dr. Yampolski is an Associate Professor in the Biological Sciences Department at East Tennessee State University. His Ph.D. is from the N.I. Vavilov Institute of General Genetics, Russian Academy of Sciences. His research interests include the evolutionary role of mutations and mutational biases, the evolution of life-histories and mating systems and speciation. His study of organisms of choice are Drosophila and Daphnia. He may be contacted at 423-439-4359 or yampolsk@etsu.edu.

Dr. Michael Zavada
Dr. Zavada was born and raised in Bridgeport, Connecticut. He received his B.S. and M.S. degree in Botany / Palynology from Arizona State University, Tempe. He received a B.A. in Slavic Languages, and a Ph.D. in Ecology and Evolutionary Biology from the University of Connecticut, Storrs. He spent one year as a Fulbright Scholar in Skopje, Macedonia at the Geologic Institute, and the Center for Foreign Languages. He did post-doctoral work at Indiana University, Bloomington, and Ohio State University, Columbus. He has served on the faculties of The University of the Witwatersrand, Johannesburg, South Africa, The University of Louisiana-Lafayette, was Professor and Chairman of the Department of Biology at Providence College, Providence, RI, and is currently the Chairman of Biological Sciences at East Tennessee State University and a member of the Center of Excellence in Paleontology. His field research has taken him throughout North America, South America, and Africa, including Madagascar. He has received over $ 1.7 million in grants including grants from the National Science Foundation, National Institute of Health, NASA, American Philosophical Society, and National Geographic Society. He has published over 75 papers. In addition to his academic interests, he played baseball at Arizona State University, participates in a variety of sports, and outdoor activities, enjoys travel, and is an instrument rated private pilot. He may be contacted at 423-439-6919 or zavadam@etsu.edu.
APPENDIX B

2009 Counselor Bios
The Tennessee Governor’s School for Scientific Models and Data Analysis

Burl “David” Bishop
Burl David Bishop is a graduate student at ETSU. He is majoring in elementary education with a concentration in secondary mathematics. He has worked for the Sullivan County School system for the past three years. In his free time he enjoys camping, hiking and spending time with his family.

Rachael Griffin - (Lead Counselor)
Ms. Griffin is a 25 year old graduate from the University of Tennessee with a B.S. in Communications and a concentration in performance news journalism. She is currently working on her Masters Degree in Special Education here at ETSU and hopes to graduate in 2011. She currently resides in Bristol, TN with her three dogs and cat. Rachael spends much of her free time fundraising for area philanthropies and attending social events.

David Keys
I am originally from Memphis, TN. After graduating from Memphis Central High School, I attended the University of Tennessee. There, I received my Bachelor’s of Arts in Geography and I am currently working on Master’s of Arts in Teaching. I have been working with adolescents since I was 16, whether serving as a tennis instructor, tutor, or camp counselor. I enjoy playing tennis, traveling, and college sports. My goals are to become a high school Geography and History teacher and eventually become a college basketball coach.
Elizabeth “Liz” Sneed
Liz Sneed is from Kingsport, TN and a graduate of Dobyns-Bennett High School. Currently, Liz is a senior at Carson-Newman College, double majoring in Accounting and Spanish. Liz is a member of the Varsity Women’s Tennis Team and enjoys volunteering at Appalachian Outreach in Jefferson City, TN. Upon graduation in May 2010, Liz will be getting married and residing in Winston-Salem, North Carolina. Liz plans to attain a CPA license and a MBA after having a couple of years of work experience.

Gabriel “Gabe” Tocci
Mr. Tocci was born and raised in Easton Massachusetts. He earned his Associates Degree in Networking Technology from Hesser College in New Hampshire, his Bachelor’s Degree in Computer Science here at East Tennessee State University (ETSU), and he is currently writing his Master’s Thesis that will complete the requirements for his Masters Degree in Computer Science from ETSU. Mr. Tocci is a member of the student chapters of the ACM and IEEE Computer Societies, as well as the UPE Computer Science Honors Society. When not working, he enjoys spending time outdoors performing such activities as hiking, camping, and snowboarding. Mr. Tocci hopes to have his thesis completed this fall and to begin his career here in East Tennessee. To learn more about Mr. Tocci, visit his website at www.GabrielTocci.com.
### Student Demographics

**Student Name, High School, City, & County**

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<thead>
<tr>
<th>Student</th>
<th>Name</th>
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<th>City</th>
<th>County</th>
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</table>
APPENDIX C

2009 Statistical Summary

The Tennessee Governor’s School for Scientific Models and Data Analysis
(30 attendees/45 applicants)

**GENDER:**
- FEMALES - 16/23
- MALES – 14/22

**CLASS 2009-2010:**
- JUNIORS - 20/27
- SENIORS - 10/18

**ETHNIC BREAKDOWN:**
- AFRICAN- 0/0
- AFRICAN-AMERICAN- 0/1
- ASIAN- 2/2
- ASIAN-AMERICAN- 2/10
- CAUCASIAN - 22/29
- HISPANIC - 1/1
- MIDDLE EASTERN - 1/1
- MULTI-RACIAL - 1/1
- NO RESPONSE - 1/1

**HIGH SCHOOLS REPRESENTED:** 26/34

**COUNTIES REPRESENTED:** 16/20 (95 Counties in Tennessee)

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<thead>
<tr>
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<td>ANDERSON</td>
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<tr>
<td>BLOUNT</td>
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<tr>
<td>CHEATHAM</td>
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<tr>
<td>CROCKETT</td>
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<td>DAVIDSON</td>
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<td>GREENE</td>
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<tr>
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<td>KNOX</td>
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<td>MAURY</td>
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APPENDIX D

2009 Course Offerings
The Tennessee Governor’s School for Scientific Models and Data Analysis

Goal and Objectives
The overarching goal of the Governor’s School in Scientific Models and Data Analysis was to broaden the student’s appreciation and knowledge of biology and mathematics through exposure to and integration of a wide range of contemporary biological and mathematical topics. In each case, model building and data analysis will play a critical role and was interwoven in a statistical and biological context. Students were engaged in the scientific method via hands-on research experiences. Resources from ETSU’s strong undergraduate science and mathematics program, research laboratories, and local schools were used to accomplish these objectives. In addition, the program made use of resources from industry, governmental agencies, and academic science establishments. Thus the school provided a series of courses, laboratories, projects, field trips, seminars, lectures, and other activities centered on mathematics, statistics, and biology. The curriculum consisted of courses BIOL-1110-1111 (4 credits, biological science for majors) and MATH 1530 (3 credits, probability and statistics), which were taught in the integrated fashion. The activities of the Governor’s School covered the approved syllabi for these courses and met the required number of contact hours, while extending the scholars’ intellect in directions not possible during a regular school year.

Course Work
We are guided by the conviction that today’s students are attracted to science and mathematics when these are seen as interconnected fields rather than as separate bodies of knowledge. Thus, thirty talented rising juniors/seniors from across the state were immersed in scientific instruction and inquiry in several interdisciplinary fields of science. These included: biology, bioinformatics, mathematics, statistics, and systems ecology. Second, connections between these fields were seen through the ubiquity of mathematical modeling, data analysis, and the need for high level computation. Last but not least, students gained a healthy respect for many disciplines and thus have a variety of career choices to consider as they get ready to enter college. In a nutshell, the students experienced a renaissance style Governor’s School that prepared them for many possible career options. Specific courses are described below:

9:30-12:00pm Course

Math 1530--Probability and Statistics (3 hrs.)
Prerequisite(s): Two years of high school algebra. Descriptive statistics and its relevance, including probability, experimentation, measurement, sampling and survey, informal statistical inference, and hypothesis testing are included.

1:00-3:00pm Course

BIOL 1110--Biology for Science Majors- Lecture I (3 hrs.)
Core requisite: BIOL 1111. The principles of molecular and cellular biology, including metabolism and genetic inheritance. Designed for biology majors, minors, and others who plan to take upper-level courses for which this is a pre requisite. This course contains three (3) hours of lecture and two hours of lab. A common grade will be given in BIOL 1110/11.
BIOL 1111 -- Biology for Science Majors- Lab I (1 hr.)
Core requisite(s): BIOL 1110. Laboratory exercises to gain the ability to identify and use the processes of biological science with materials corresponding to Biology for Science Majors Lecture I. This course contains one (2) two-hour lab per week. A common grade will be given in BIOL 1110/11.

East Tennessee State University
Department s of Biological Sciences and Mathematics
Course: IBMS 1100 SYMBIOSIS I
Number of credits 7- (4 for Biology, 3 for Statistics)
Number of hours per week: 5 hours of lecture and 2 hours of lab

Objectives:
To present Biology as a science that is dependent on quantitative analysis of data. The course covers aspects of biology such as Introduction to the cell and cell growth, effects of size increase on organisms, Mendelian genetics, DNA replication and genomic content and how these characteristics can change over time by Evolutionary processes. To introduce probability, descriptive statistics and statistical inference in the context of the study of Biology. The course covers the typical content of an introductory statistics course plus some additional topics. The notion of statistical inference is introduced very early in the course by means of randomization tests and the exact sampling distribution of the sample proportion based on the Binomial distribution. The examples in probability are mainly oriented toward topics of interest in genetics and bio-informatics at an elementary level.

IBMS 1100 is the first course in a 3 course sequence that integrates biology, statistics, and mathematics, As a result, the mathematics and statistics is introduced, explored, and developed in biological contexts, including surface area to volume ratios, isometric and allometric scaling, fractals in biology, and difference equations and discrete systems in genetics, evolution, and the study of DNA. Pre-calculus concepts and limits are also introduced and developed in IBMS 1100, both due to the natural contexts which arise for doing so (such as log-log plots) and because a major goal of the Symbiosis project is to spread the coverage of calculus I across 2 semesters as a way of promoting greater student success in both calculus comprehension and skill development.

Teaching method: Lectures were prepared mainly in power-point. Hands-on class activities and data analysis in the computer lab were used when appropriate on addition to the wet/dry lab component.

Textbook: Complete class notes, on addition to power point presentations, were written for this course by the instructors under a grant from HHMI, they are available from the D2L platform.

Statistical software: Minitab, R, Maple, Java Applications, Image J, Web-based Applets and Activities

Module 1. - The Scientific Method
The study of Biology is introduced. Aspects of what hypotheses are and how they are tested leads into statistical inference. Examples of hypothesis testing such as von Helmont’s plant growth test and Stanley Prussiner’s Prion Hypothesis are discussed. An introduction of Arbovirus infection of Yellow Fever leads to a discussion of viruses and definition of life. The hypothesis of whether AIDS can be transmitted by mosquitoes is used as an example of the use of quantitative biology. The five themes of biology are introduced as the thread of further modules.
What is Statistics? Role of statistics in the scientific method. An introduction to the role of mathematics and statistics in science in general. Randomization test to test the hypothesis of equal means (medians, variances) of two populations based on experimental data. Why do we study probability? Basic definitions: random experiment, sample space, event. Definitions of probability: classical, relative frequency, axiomatic definition and its consequences; independent events; replicates of a random experiment; Pascal triangle and basic combinatorics. Types of random variables, mass or probability function and density functions. Discrete probability distributions; binomial distribution; applying the binomial distribution to do test of hypothesis about a population proportion. First glance at the limit concept (probability as limit of a relative frequency, along with difficulties in using such a definition). First glance at mathematical models.

Module 2. - The Cell and Statistics
Introduction to the cell. What is the cell and why are they small? What is the concept of multicellularity? The organization of the cell and what are the consequences of the components functions. TANSTAAFL (There ain’t no such thing as a free lunch), a more wide ranging discussion of consequences starting from the more formally known Second Law of Thermodynamics. The transmission of information into and out of the cell. The cell cycle and mitosis as a consequence of cell growth, repair and quiescence. Data production: observational studies and experiments. Basic definitions: population, sample, individual, variables (categorical & quantitative). Displaying and summarizing data for categorical variables, tables and graphs, relative risk, odds ratio, measuring agreement in matched-pairs situations. Displaying and summarizing data for quantitative variables, tables and graphs for one, two and several variables at the time. What are the data telling us? How to decide between the different statistical graphs? Location (mean vs. median, five number summaries) and variability statistics. Sources of variability. Looking at paired data. Correlation. What is statistical inference? Introducing the idea of sampling variability and sampling distribution. Exact sampling distribution of a sample proportion (based on the Binomial distribution) and its application to hypothesis testing and estimating with confidence. Bootstrapping to do inference about a population mean. Randomization or permutation test to test hypotheses about a parameter (mean, median or variance) in two populations.

Module 3.-Size and Scale
What happens to an organism as it grows bigger? Can ants really toss locomotives off the tracks? Can King Kong jump off the Empire State Building? Can Tyrannosaurus rex really run at 80 kph? This module examines the functions that describe what happens when organisms grow (or shrink). Included are organism size as a determining factor in shape, the differences between isometry and allometry, problems with isometric scaling in biology, bacteria size, shape, organization, cell wall structure, and other characteristics. Exponential growth of bacterial populations. Biological models with mass as the independent variable. Area, volume, and surface area to volume ratio. Isometric scaling, slope, equations of lines, allometry and power laws. Limits as tools for approximation. The exponential function. Logarithms. Linear regression and transformed variables. Normal distribution, Fractal Geometry as it relates to biological organisms and the surface area to volume ratio.

Module 4- Mendelian Genetics
Why was Gregor Mendel able to elucidate the laws that determine how organisms pass genetic information from one generation to the next? This crucial process was discovered and then ignored for almost 40 years and yet was the key that Darwin was missing to explain Evolution. The data and
processes that Mendel used to determine these principles are examined. In this context, Meiosis is described as the cellular equivalent of Mendelian Laws. A coin model to understand genotypes and phenotypes for all combinations of homozygous and heterozygous parents. Punnett squares and probability trees, ‘back-testing’. Comparing experimental results with the expected results under an assumed model: Chi-square test of goodness of fit. Review of probability basics. Chi-square test of independence. Fisher’s exact test. Test of homogeneity. Describing dependence with relative risk and odds ratio. Conditional probability and Bayes rule. Discrete distributions, expected value and variance, discrete uniform, Bernoulli, Binomial and its use to test hypotheses about a population proportion. Power of a test. Determining sample size based on the desired power for a test. Poisson distribution, binomial and normal approximations to the Poisson distribution. Introduction to sampling: population, sampling frame, sampling size, sampling methods (simple, systematic, cluster, two-stage, stratified), transect sampling, sampling and non-sampling error, capture/recapture and distance sampling.

**Module 5- DNA genetics**

Mendelian Laws describe how information is passed from generation to generation, but the molecular processes were not determined until the nature and structure of DNA was described. The structure of this molecule and the consequences of replication are covered. Is DNA the same in different organisms? Quantitative tools to look at the composition of the information are developed. DNA as nucleotide sequences, nucleotide frequency, GC content. Independence and conditional probability in the DNA environment. Transition matrix, graph to represent transition matrices. Probability of a given sequence of nucleotides, repeats of a single nucleotide, length of the repeat, geometric distribution. Palindromes, probability of any palindrome and of specific palindromes, space in between palindromes. Comparing two sequences of nucleotides. Similarities that happen just by chance. Random walks (and their use in testing for similarities). Sampling distribution of the sample mean and its use in confidence interval estimation and hypotheses testing. Approximated distribution (normal) of the sample proportion and its use in confidence interval estimation and hypotheses testing. Necessary sample size calculation in the case of estimation based on desired precision and confidence and the case of testing hypothesis based on the desired power. The t-student distribution and its application to inference for the sample mean.

**Module 6- Evolution**

“Nothing in Biology makes sense, except in the light of Evolution” by Theodosius Dobzhansky is the quote that sums up the importance of Evolution to Biology. The genetic basis of Evolution has been described and the applications of these principles to examples are covered, i.e. applications of probability and statistics to populations. Evolution as it relates to population size and density. The Wright-fisher model with the Hardy-Weinberg equations as a special case: rigorous development of the limit concept; continuity; discrete dynamical systems; effect of sample size in the Chi-square test; an introduction to graphs and their use in genetics.
Governor’s School Projects

Students had the opportunity to be engaged in a variety of research projects. The projects centered around the following topics: Flies, Spiders, Salamander, Bootstrapping/Clustering, Neural networks and the Mars Rover, Cancer Cells, Micro Array, and Pure Math. In each project, model building and data analysis played a critical role and was interwoven in a statistical and biological context. Listed below is a brief description of each project as well as the names of students involved in the research. The students reported their research findings to their parents and university faculty on the last day of the Governor’s School.

Dr. Karl Joplin (Flies)
Stephanie Bautista  Henry Loewenkamp
Savannah Brackman  Matthew Marsh
Soo-Min Lee

The life history of organisms demonstrates that different factors influence their life span. A mortality study was conducted showing the different survivorship curves that male and female flesh flies, Sarcophaga crassipalpis, exhibit during their life span. The hypothesis is that they will show a similar rate of mortality during their life span. The data suggests that females have a very different ‘S’ curve than males. Data collection and statistical analysis were performed by the students.

Dr. T.J. Jones (Spiders)
Seif Atyia
Zach Meyers
Jacob Norman

The distribution of the variably social spider, Anelosimus studiosis, may have a bearing on the distribution of sociality. Students conducted a transect survey of a shoreline habitat at Warriors State Park in Kingsport, Tennessee. Distances between webs and the volume of each web were recorded. The data were analyzed by nearest neighbor analysis, correlations between web volume and distance and sociality.

Dr. Jeff Knisley (Salamander)
Lindsey Franklin  Sierra Sorter
Rhea Johnson  Jordon Wells
Decoda Muller

Students investigated the transport of deceased salamanders in mountain environments by placing dead Ambystoma in mountains streams of different energy regimes. The students found that Ambystoma, prior to putrification, is buoyant and the distance it is transported is logarithmically related to energy levels in the stream. Putrifying Ambystoma, sink, and showed shorter distance of transport at similar energy levels and appear have a linear relationship of energy – distance. It is hypothesized that the herpe-fauna preserved at the Gray Fossil Site was probably derived from habitats throughout the basin and that the death assemblage would be biased for young individuals. Mature adults are terrestrial and fossorial and would not be incorporated into the materials transported by mountain streams. Age of the salamander death assemblage at the Gray Fossil Site is skewed in favor of juveniles.
Dr. Jeff Knisley (Bootstrapping/Clustering)
Angela Belic  Sarah Kramer
Liesel Grossner
Erica Hall

When data is not distributed according to a bell curve or any other known distribution, then the data itself can be used to suggest an empirical distribution. The process for doing this is called bootstrapping, and in this presentation, it is applied to some non-bell shaped curve data in anthropology.

Dr. Jeff Knisley (Neural networks and the Mars Rovers)
Margaret Davis  Whitney Sides
Cassie Duncan
Veronica Shreve

The Mars Rovers, Spirit and Opportunity, are too far away to be controlled effectively. Instead, they were given their own artificial “brains,” which are known as neural networks, so that they could make their own decisions as they explore the surface of Mars. Likewise, students were given a neural network and the task of training the network so that it could navigate an artificial “terrain”, thus reproducing the artificial intelligence of the Mars Rovers.

Dr. Hugh Miller (Cancer Cells)
Garrett King

A lymphoma cell line called U937 appears to have heterogeneous sizes. The students tried to answer the question; does the size of U937 cells change as the cells age in culture? Cells that had been cultured for various times were applied to microscope slides and images of random fields were captured. Cell areas were analyzed using the Image J software.

Dr. Hugh Miller/Dr. Karl Joplin (Micro array)
Rachael Huskey
Jacob Learned

Students were introduced to microarray data from a study of diapausing and non-diapausing flesh flies, Sarcophaga crassipalpis. The data were normalized and examined for genes that are diapause up- or down-regulated during this developmental state. Genes were then identified using the GenBank dataset.

Dr. Jeff Knisley (Pure math)
Jim Hyde  Hughes Miller
Stephen Joiner  Herak Patel
David Klumpe

The process of Mark/Recapture is frequently used to estimate the size of a population of animals, people, cells, etc. However, the Mark/Recapture method has many shortcomings, not the least of which is that it has an infinite expected value and a huge variation, thus causing estimates to vary from the actual population by hundreds or thousands. A modification of the naïve Mark/recapture method, however, is shown mathematically to have a finite expectation – in fact, the expected value is the actual population size itself. Mathematically, it is also shown that the variation in the modified estimates has much less variation.
APPENDIX E

2010 Student Evaluation Results
The Tennessee Governor’s School for Scientific Models and Data Analysis

I. Overall Program

Your overall rating of the 2010 Governor’s School for Scientific Models and Data Analysis Program is that it was:

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<th>Percentage</th>
</tr>
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<td>Excellent</td>
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<tr>
<td>Very good</td>
<td>12/30</td>
<td>40%</td>
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<tr>
<td>Good</td>
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<td>10%</td>
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<tr>
<td>Fair</td>
<td>00/30</td>
<td>0%</td>
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<tr>
<td>Unsatisfactory/poor</td>
<td>00/30</td>
<td>0%</td>
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II. Academic Component/Workload

The opportunity to earn seven hours of university academic credit was:

What is the level of your satisfaction with the Governor’s School Program offered as a university credit program?

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<th>Level</th>
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<th>Percentage</th>
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<tr>
<td>The for-credit aspect is very important to me</td>
<td>23/30</td>
<td>77%</td>
</tr>
<tr>
<td>I am neutral on the for-credit aspect</td>
<td>07/30</td>
<td>23%</td>
</tr>
<tr>
<td>I would have preferred that the program be offered on a non-credit basis</td>
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III. Core Educational Program

Did you find the material covered interesting?

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<tr>
<td>Most of the time</td>
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<td>40%</td>
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<tr>
<td>Some of the time</td>
<td>03/30</td>
<td>10%</td>
</tr>
<tr>
<td>Occasionally</td>
<td>01/30</td>
<td>03%</td>
</tr>
<tr>
<td>Not at all</td>
<td>00/30</td>
<td>00%</td>
</tr>
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Do you think the textbook was useful to your learning the course material?

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<tbody>
<tr>
<td>All of the time</td>
<td>00/30</td>
<td>00%</td>
</tr>
<tr>
<td>Most of the time</td>
<td>01/30</td>
<td>03%</td>
</tr>
<tr>
<td>Some of the time</td>
<td>11/30</td>
<td>37%</td>
</tr>
<tr>
<td>Occasionally</td>
<td>18/30</td>
<td>60%</td>
</tr>
<tr>
<td>Not at all</td>
<td>00/30</td>
<td>00%</td>
</tr>
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</table>

The division of time spent on classroom lectures, team projects and homework was well-balanced:

<table>
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<tr>
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</tr>
<tr>
<td>Most of the time</td>
<td>13/30</td>
<td>43%</td>
</tr>
<tr>
<td>Some of the time</td>
<td>08/30</td>
<td>27%</td>
</tr>
<tr>
<td>Occasionally</td>
<td>05/30</td>
<td>17%</td>
</tr>
</tbody>
</table>
In general, did you have enough time (in and out-of class) to finish all of your homework and project assignments:

- Yes: 28/30 (93%)
- No: 02/30 (07%)

Weekly tests appropriately covered material presented in class and in-class learning exercises:

- All of the time: 06/30 (20%)
- Most of the time: 14/30 (47%)
- Some of the time: 06/30 (20%)
- Occasionally: 04/30 (13%)
- Not at all: 00/30 (00%)

You feel that the scores you earned on tests reflected the actual extent to which you mastered course material:

- Very closely: 05/30 (17%)
- Somewhat: 18/30 (60%)
- Not very much: 07/30 (23%)
- Not at all: 00/30 (00%)

The assigned team design projects were interesting and contributed to your learning experience:

- All of the time: 12/30 (40%)
- Most of the time: 12/30 (40%)
- Some of the time: 05/30 (17%)
- Occasionally: 01/30 (03%)
- Not at all: 00/30 (00%)

IV. On-Campus Meals

You feel that the food served on-campus was of good variety and quality:

- Always: 00/30 (00%)
- Most of the time: 09/30 (30%)
- Some of the time: 13/30 (43%)
- Not very often: 06/30 (20%)
- Never: 02/30 (07%)

V. Dormitory Lodging

You feel that your stay in the Governor’s Hall dormitory was:

- Excellent accommodations and enjoyable: 27/30 (90%)
- OK accommodations but not great: 03/30 (10%)
- Not satisfactory: 00/30 (00%)
VI. Faculty (Professor)/Courses

The teaching effectiveness and general helpfulness of the professors (Dr. Karl Joplin and Dr. Jeff Knisley) was:

- Excellent: 09/30, 30%
- Very good: 13/30, 43%
- Good: 07/30, 23%
- Fair: 01/30, 03%
- Poor: 00/30, 00%

VII. Resident Counselors

The effectiveness and helpfulness of the five Governor’s School Counselors (as a group) in providing dormitory oversight and in accompanying you on group activities were:

- Very effective/helpful: 15/30, 50%
- Usually/somewhat effective/helpful: 13/30, 43%
- Not very effective/helpful: 02/30, 07%

VIII. Special Activities

The following activities included in the 2010 Governor’s School for Scientific Models and Data Analysis Program were of substantial value and should be repeated in future programs:

- Visit to Gray Fossil Site, Paleontology Dig (Dr. Michael Zavada) --------------- 16/30, 53%
- Visit to Warriors Path State Park for Spider Study (Dr. Thomas T.J. Jones)------ 26/30, 87%
- Visit to ETSU Campus Arboretum/Planetarium (Dr. Timothy McDowell)---------- 13/30, 43%
- Visit to ETSU Medical School Laboratory (Dr. Mitch Robinson)------------------ 27/30, 90%
- Visit to Oak Ridge National Laboratories (Fred Strohl/Ms. Angela Haga)------- 25/30, 83%
- Visit to Historic Jonesborough, Jonesborough, TN (Dr. Jack Rhoton)------------- 22/30, 73%
- Visit to Roan Mountain State Park, Roan Mountain, TN (Jennifer Bauer)------- 27/30, 90%
- Visit to Bays Mountain State Park, Kingsport, TN (Dr. Jack Rhoton)------------ 27/30, 90%
- Visit to the Carter Fold, Hiltons, VA (Dr. Jack Rhoton)------------------------ 27/30, 90%
- Off-campus meal events-------------------------------------------------------- 00/30, 00%
- Activities at the ETSU main library------------------------------------------- 00/30, 00%
APPENDIX F

2009 Comments (Field Trips)
The Tennessee Governor’s School for Scientific Models and Data Analysis

COMMENTS: Opinions of scholars

Overall opinion of field trips
Comments:

- The medical labs was the best field trip in my opinion
- Jonesborough, Bays Mountain, and the Carter Fold were my favorites
- Oak Ridge could have been a better tour
- They should be scheduled at better times (not the night before an exam or a project is due)
- Roan Mountain and Jonesborough was so much fun
- The spider study was great and very involved.
- I think more field trips could have been designed around what we were doing in class. Some things had nothing to do with what we learned
- I wish we had more time on Roan Mountain. Everyone seemed to enjoy it
- Field trips need to be planned better. Too close to assignments and exams
- The field trips were fun but, I wish we could have done something more exciting like going to an amusement park
- Roan Mountain needs to be longer
- I really liked all the field trips and guest speakers
- The trip to the Carter Fold was very fun
- Jonesborough and Carter Fold seemed like pointless field trips irrelevant to what we were studying
- I really liked visiting the ETSU Medical School labs
- Roan Mountain and Bays Mountain were my favorite and then Jonesborough and Oak Ridge
- Oak Ridge could have been better and a lot of driving for a short time there
- All field trips were excellent!
- Bays Mountain was very good
- The activities were all fun, interesting, and well organized
- I really thought Oak Ridge was a good experience and the field trips to the parks and such were educational and gave us a little break
- I enjoyed all of the field trips

Visit to Gray Fossil Site, Paleontology Dig (Dr. Michael Zavada)
Comments:

Visit to Warriors Path State Park for Spider Study (Dr. Thomas T.J. Jones)
Comments:
Visit to ETSU Campus Arboretum (Dr. Timothy McDowell)
Comments:

Visit to ETSU Medical School Laboratory (Dr. Mitch Robinson)
Comments:

Visit to Oak Ridge National Laboratories (Fred Strohl)
Comments:

Visit to Historic Jonesborough, Jonesborough, TN (Dr. Jack Rhoton)
Comments:

Visit to Roan Mountain State Park, Roan Mountain, TN (Jennifer Bauer)
Comments:

Visit to Bays Mountain State Park, Kingsport, TN (Dr. Jack Rhoton)
Comments:

Visit to the Carter Fold, Hiltons, VA (Dr. Jack Rhoton)
Comments:

On-campus meal events
Comments:

- I am a vegetarian and there was generally nothing to eat but pizza every day in the cafeteria

Governor’s Hall (Dorm)
Comments:

- Best dorm I’ve ever stayed in
- The dorm was great (elevators need work)
- My roommate was great! A good facility

Visit to Fun Expedition in Johnson City, TN with counselors
Comments:
What other activities would you have liked to be included in the Governor’s School Program?

Comments:

- Going to an amusement park or on a trip somewhere overnight
- Tour of Eastman Chemical Company
- Having a history lesson on ETSU
- It would be nice to have more field trips
- More activities with medical stuff
- More group activities without counselors
- More free time around campus
- More planned fun activities
- I think that on weekends there should be more opportunities to do some fun activities like movies or shopping

Overall Program Evaluation

Comments: