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Contents

On the Cover
The 2006 Keystone Policy Summit Group celebrates the completion of their policy paper at the Keystone Science School, CO.

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Correction

In the Spring 2006 issue of the NCSSSMST Journal, we published the student paper by Lindsey Haines, Targeting Intracellular Proteins Resistant to TRAIL Induced Apoptosis in Cancer Cells.

In error, we stated the incorrect school for Lindsey Haines. We apologize for the error.

Abstract
Apoptosis is a process of cell self-destruction to eliminate damaged cells. Cancer cells express various mechanisms that inhibit apoptosis. Tumor-necrosis-factor Related Apoptosis Inducing Ligand (TRAIL) is naturally produced by the body, and it kills cancer cells while sparing normal cells. Similar to the obstacles observed in chemotherapeutic drugs, TRAIL exhibits resistance in certain malignant cells. In this laboratory study, mechanisms used to override TRAIL-induced apoptosis were tested by studying the effects of blocker genes in lung carcinoma, glioma and the pancreatic cancer cell lines by silencing inhibitors. Gene silencing using siRNA vectors is an effective way to test molecules associated with TRAIL induced apoptosis. This study indicated that c-FLIP is an apoptotic inhibitor and that there are also many other inhibitors yet to be tested. Crystal violet assays, Western blot analyses, light microscope photographs, and fluorescent microscope photographs were utilized for making qualitative observation of the dead cancer cells; also, quantitative measurements of live cancer cells were conducted. This research improved our understanding of signal transduction pathways and the apoptotic mechanisms induced by the TRAIL ligand.

Lindsay Haines is a 2006 graduate of the Center for Advanced Studies at Wheeler High School, Marietta, GA

Editor's Note E-Learning

by Gary L. White

E- Learning. This is a growing trend in higher education. Physical universities are making their presence known on the Internet through select degree offerings where most or all of the courses are presented on-line – a Virtual Learning Environment. My own college is struggling with choosing a direction for its future. How effective is e-learning? Will the products of e-learning (i.e., students who successfully complete the courses) demonstrate the same level of competency as students exposed to traditional instruction?

When I worked on my degree in computer science, I spent many hours researching the efficacy of CAI (Computer Aided Instruction or Computer Assisted Instruction). At that time, most CAI (PLATO, WISE, etc.) techniques focused on drill and practice. Research on the results of these methods of instruction showed that there were no statistically significant improvements in learning using the (then developed) CAI techniques. So, what are colleges offering today?

In a discussion with a colleague, I found that the college algebra course is being offered through e-learning. The curriculum comes from the authors of the text and consists mostly of drill and practice followed by a test that mimics the content of the drill and practice. According to my colleague, many of the students are passing. But then I enquired about the success of these students in successively more complex courses in mathematics, and I was not surprised to hear that these e-learning students evidenced a gap in their foundational knowledge that was greater than students exposed to traditional methods.

Most higher education institutions today comprise two schools: one of day students who are mostly full-time, and another of evening students. The evening students are primarily those workers in the community trying to advance themselves educationally, with the hope of securing better jobs or better positions within their companies. By looking at enrollment age statistics, a majority of daytime students enter college directly out of the high school environment. They are practiced learners looking to advance in the workplace. Often their exposure to computer technology is current. The best of these students exhibit success in e-learning environments and well developed skills to carry to the next level.

I teach the evening students, and generally, they represent a unique community. They have been out of school for 2 or 3 or 40 years and are now trying to improve themselves. E-learning may not be reasonable for these students. They need the personal touch of a classroom teacher and a cooperative learning environment with other students around them. They need to learn how to learn all over again.

So, should my school redesign itself and jump feet first into e-learning? Not yet! For one thing, the techniques in many e-learning presentations do not appear to have caught up with the technology. Most textbook authors are using older methods of CAI that are easy to develop. But these methods have not been proven statistically effective in improving learning. Many authors and publishers haven't learned from the research.

Innovative instructional techniques like podcasting, m-learning (mobile), and on-line discussions are providing the new-age worker with quick and effective skill banks. Some educational institutions are beginning to incorporate these techniques into specialized coursework and they are working on refining those methods to produce students whose skills rank higher on Bloom's Taxonomy in the analysis and evaluation areas. But developing these methods is costly both in money and time, and at this point, textbook publishers as a group have not made this leap in development.

What about the high school level? In knowing what can be done with a computer, certainly some of the most innovative minds I know are high school students. They are technology sponges – the PIXAR and Microsoft developers of the future.

(Continues on page 7)

Gary L. White is Co-Editor of the NCSSSMST Journal and is a Computer Science Teacher at the Center for Advanced Technologies in St. Pete, Florida.

President's Message

Inside a Consortium School: An Interview with Janet Hugo

Janet Hugo, PhD is Director or Arkansas School for Mathematics, Sciences, and the Arts and current President of NCSSSMST.

When people ask me about NCSSSMST, its mission, and its goals, I have to give them a short history lesson and a brief overview of pedagogy to explain how our schools play a unique role in educating our future leaders in science, mathematics and technology. Here is a capsule view of my responses. How would you respond for your own institution?

How was NCSSSMST established?

In 1988, a group of mathematics, science and technology schools established the National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology in order to address some common concerns about the state and future of math and science education. The fifteen charter members from 1988 have now grown to almost 100 institutional member schools and an even greater number of affiliate colleges and universities.

The current profile of the Consortium member schools indicates that (NCSSSMST, 2004):
75% are full-day schools
25% are half-day programs
18% are residential
80% are non-residential
2% take both residential and non-residential students
69% are grades 9-12
4% are grades 10-12
22% are grades 11-12
5% include elementary and/or middle school students.

How do the courses offered at Consortium schools differ from traditional public schools?

The courses available to students at consortium-type schools are beyond what one would typically find in the average high school. For example, [one school] offers Biomedical Physics, Immunology, Microbiology, Multivariable Calculus, Number Theory, Differential Equations, Math Modeling, Greek Literature Studies, Women Writers, Computer Programming III, Web Application Development, et al. The focus at these schools is not on the College Board's Advanced Placement offerings, but on courses beyond AP. The students are expected to work at a college level of instruction and learning.

In addition to specialized courses, are there other academic benefits of attending a Consortium school?

Probably the majority of these specialized schools have a focus on or graduation requirement of research. This can range from on-campus oversight of a project to off-campus collaboration with a university, business, or institution. Many of the students work with a research professor at an in-state university. Other schools have on-campus requirements where the students are assigned a research mentor with whom they will work over the course of their enrollment. Students compete in science fairs, research symposia, etc., as the capstone for the project. Many of our students also participate in summer research type programs to assist the process.

Who are the students that attend Consortium schools?

Our students are not necessarily identified as "gifted/talented." Many are academically able, which means they are capable of excellence in academics, but may not have had the opportunity for high level engagement at their regular high school. Consortium schools are not focused on just gifted/talented students; rather, we are looking for students who want and would benefit from the academic rigor that we provide.

What attracts students to Consortium schools?

Students are brought together with a common focus – not just an interest in mathematics and science but because they are looking for a richer educational opportunity. They are attracted by the lack of disciplinary issues in the classroom, the commitment of the instructors to excellence, the number of advanced course offerings, the opportunity to interact with students who have similar interests, and the improved chances for college admission and scholarships.

What makes the instruction at residential schools unique?

One will find instructors who are life-long learners. Students get turned on to mathematics and science because their instructors are engaging, and the instructors' love of learning is contagious. One finds a great deal more interaction between students and instructors at these schools. Students are eager to spend time with people who are interesting and interested in them. I call it "hanging on the faculty member's legs." One can usually find these instructors surrounded by students during off periods or after classes. When a student conducts research under the tutelage of an interested teacher, the mutual excitement grows.

How do instructors emphasize learning in their classrooms?

Instructors do not spoon-feed information. Rather, they focus on student responsibility for solving the problem, digging for the information, researching for understanding. One will not find traditional instruction at these schools – the "I'll tell you, then you'll repeat it back to me" style of instruction that is found in the majority of educational settings. We really do teach and expect the development of critical thinking skills and something beyond simple understanding. It is a thing of beauty to behold!

Our mission

The mission of NCSSSMST, the national's foremost alliance of schools dedicated to transforming mathematics, science, and technology education, is to create synergies among schools engaged in educational innovation by shaping national policy, fostering collaboration and developing, testing, implementing, and disseminating exemplary programs.

E-learning

(Continued from page 5)

Their multi-media techniques are cutting edge, and that kind of influence is needed in the development of materials suitable for e-learning. As these students move up the educational ladder and into professions, certainly some of them will be enlisted to help create effective e-learning engines.

In the meantime it is up to the existing educational professionals to climb out of the box and use the new technology in effective ways. We can create an on-line discussion group to let students interact with each other, and to allow you to interact with them beyond the classroom. You can make your own podcasts of finding solutions to quadratic equations or balancing chemical equations.
Put these on your school's web site for students to access. Make them available for downloading to iPods or other media players.

NCSSSMST claims a position at the forefront of education. This forefront is moving out on the Net. So we, too, need to move beyond the confines of 4 walls and into "ether" to reach more and more students. And be certain to check out John Teahan's article in this edition describing some educational uses of Web 2.0. This is yet another way to provide learning opportunities that will allow your students to strive for excellence.

The Effect of Metal Oxide on Nanoparticles from Thermite Reactions

Student paper by Lewis Ryan Moore

Abstract

The purpose of this research was to determine how metal oxide used in a thermite reaction can impact the production of nanoparticles. The results showed the presence of nanoparticles (less than 1 micron in diameter) of at least one type produced by each metal oxide. The typical particles were metallic spheres, which ranged from 300 nanometers in diameter to as large as 20000 nanometers in diameter. The smallest spheres were iron, whereas the largest were manganese. The most interesting result was the formation of manganese oxide nanotubes. This research may provide reason to further investigate the use of thermite reactions in nanoparticle production.

Introduction

The purpose of this research was to investigate the production of nanoparticles formed as a result of a thermite reaction. The goal of this research was to determine what types of nanoparticles could be produced utilizing thermite reactions with different metal oxides. Current methods of producing metallic nanoparticles are extremely expensive, such as by injecting molten metal into an inert atmosphere at high pressure. Therefore, the rationale for this project was to determine if nanoparticles could be produced in a cheap and efficient manner utilizing thermite reactions.

A thermite reaction is defined as a highly exothermic oxidation reduction reaction between a metallic oxide and aluminum powder. The most common form of thermite uses iron (III) oxide and has been used since the before the start of the twentieth century in applications such as welding. The reaction for iron oxide thermite follows: $Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe\,(l) + Al_2O_3 + \text{heat}$. Thermite mixtures are safe and are difficult to initiate by accident due to the fact that they require heat of several hundred degrees Celsius for the reaction to be initiated. Ignition is often performed by using a magnesium fuse or a chemical reaction to provide the energy required to initiate the reaction, such as potassium permanganate hypergol.

Recent attention to nanotechnology has given new focus to thermite reactions. The intense heat reached during the reaction is capable of creating several forms of nanoparticles. The most common nanoparticles produced with thermite reactions are carbon nanotubes which are formed when a small amount of carbon is added to the thermite mixture, usually in the form of graphite. A recent discovery has pointed to the fact that thermite reactions can be used to produce hollow metallic spheres that are only nanometers in diameter. These have many potential applications, one of which is for producing hydrogen gas for fuel cells by reacting the nanoparticles with an acid. Another application of the nanoparticles is nanofiltration which uses the small particles to filter out toxics that may be found in water. Yet another potential application is to use nanoparticles in new propellants, such as rocket fuel, because their small size allows for them to be consumed more rapidly and release more energy.

There have also been military uses of thermite, including thermite grenades and incendiary bombs (Cheetham, 2003.) Because the thermite mixture consists of a fuel (Al) and an oxidizer (metal oxide) a thermite mixture can burn under almost any conditions. Also, because the reaction results in pure metal from the oxide, it has been used to purify various metals for many uses, including purifying uranium metal from uranium oxide.

The recent National Nanotechnology Initiative expects an increase in the funding for research and development of nanotechnology to reach over

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1 billion dollars, due to the plethora of applications nanotechnology can have for society. Nanotechnology can provide major economic, environmental, military, and medical benefits. In the near future, nanotechnology may decrease the size of a modern PC to a pocket sized appliance, or even smaller (National Nanotechnology Initiative, 2005.) There has been some research into using metallic nanoparticles as a replacement for expensive catalysts in several organic reactions that currently require the catalytic action of a noble metal which may also be harmful to the environment (Chin, 2002). Iron nanoparticles are being investigated for various reasons including their special magnetic and electrical properties. The unique properties exhibited by nanoparticles have led many researchers to look at nanosized composites that will allow for potential superconductors at the nano level (Sudakar and Kutty, 2004). More exotic thermite mixtures are being tested to produce new alloys and composite materials. These are often produced as nanoparticles, which possess many new desired properties. Ni3Si has been combined with Cr through the utilization of thermite reactions. The resulting material has tremendous strength and could prove useful in building materials (Bi et al., 2005). Nanoscale composites are one of the most extensively researched nano materials. This is because of the importance they have in reducing the size of computers, while increasing the power. Even the electrical connections are being influenced by nanotechnology. Research is being performed on new soldering compositions using silver nanoparticles because they have a higher density and thus less electrical resistance (Moon et al., 2005).

The research hypothesis for this project was that all metal oxides tested would produce nanoparticles of various types as a result of thermite reactions. The null hypothesis was that all metal oxides tested would not produce any nanoparticles.

Materials and Methods

The materials needed for this research project were ferric oxide powder, cupric oxide powder, manganese (IV) oxide powder, aluminum powder, and magnesium ribbon. The metal oxide was combined with the aluminum powder in proportions based on proportions found during alpha testing. The ratios were: Fe_2O_3:Al 3:8, CuO: Al 3:2, MnO_2:Al 1:1. Twenty grams of each mixture were added to a container made from aluminum foil in the top of a crucible and then placed in a large beaker filled with sand. A strip of magnesium ribbon was then placed in the mixture, and the beaker was set inside a fume hood. A butane lighter was used to light the magnesium and initiate the reaction. The resulting metal was collected by washing the crucible with methanol. Next the slurry of metal and methanol was triple filtered allowing the smallest particles to remain suspended in methanol until they could be analyzed with the electron microscope, reducing the possibility of oxidation of the samples. The methanol was evaporated and the solid particles were collected and placed on carbon tape. The samples were then loaded into the LEO 440 scanning electron microscope and any particles found were recorded by the computer. The size of the particles was measured using the software included with the electron microscope.

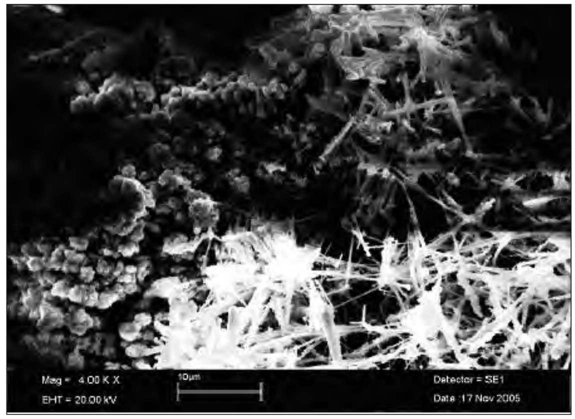
Results

Table 1: Nanoparticle size, type, diameter, number found and range

Particle Type	Material	average diameter	number found	size range
sphere	Manganese Metal	9416.67nm	6	3000-20000nm
tube	Manganese Oxide	909 nm	too many to count	na
sphere	Iron Metal	918.86 nm	35	800-3000 nm
hollow sphere	Iron Metal	2000 nm	1	2000 nm
sphere	Copper Metal	1401.11 nm	9	330-4500 nm

Table 1 shows the particle statistics from the electron microscope results. These include the chemical composition, and the average diameter and the number of particles found. It is very likely that there were many particles missed during the electron microscope analysis.

Image 1: Cluster of Manganese Oxide Nanotube



This is an image of manganese oxide nanotubes found using the electron microscope. The nanotubes were the most interesting particles found in the analysis, and only one example of a manganese oxide nanotube cluster was found. The other particles were spherical in nature.

Discussion and Conclusion

The results show a variety of sizes on particles formed by the thermite reactions. These range from small solid and hollow metallic spheres to clusters of nanotubes. Based on the reaction times, ferric oxide is the most vigorous reaction, but produces a higher temperature; whereas cupric oxide thermite was the most explosive but had the lowest temperature. Based on the classification size for a true nanoparticle, the results obtained show that there were in fact metallic nanospheres produced by the reaction. The smallest spherical particles that can be classified as nanoparticles were produced in the cupric oxide reaction, and in the ferric oxide thermite reaction. In the manganese dioxide reaction, there were no metallic nanospheres produced; however a large cluster of manganese oxide nanotubes was found. The hypothesis was if various oxides were tested, then nanoparticles would be produced. The research hypothesis was supported by the variety of particles that was found. Due to the nature of the research, there was no statistical analysis used to determine significance. The results are similar to previous research.

Limitations

Some bias included the time between the reactions and the analysis with the electron microscope, which allowed for significant oxidation of the samples. Because the separation technique was unproven, other particles may have been lost while filtering, evaporating, or transferring samples. Another source of error may have been that the limitations of the electron microscope prevented accurate detection of other particles.

Future project could be improved in a variety of ways. These include testing more metal oxides, different atmospheres for the reactions, different ratios of reactants, and using a more reliable separation technique, a higher resolution electron microscope, and faster access to an electron microscope for analysis.

Acknowledgements

I would like to thank Dave Bonar for helping with the thermite reactions and supervising the experimentation. I would like to thank Rockdale Magnet School for Science and Technology for funding and allowing me to perform the research. And finally I would like to thank Phil Lacasse and the other 2005 GHP Chemistry Majors for allowing me to build upon their research and answering questions over thermite reactions. I would like to thank Susan Gary for helping obtain materials and contacting Delta for the electron microscope as well as providing transportation to and from Delta. I would also like to thank Doug Jury for helping me analyze the samples on the electron microscope at Delta Tech Ops.

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Measuring the Components of Ecosystem Respiration in the Headwaters of the White River

Student paper by Courtney Brown

Abstract
Sediment oxygen demand (SOD) is the rate that dissolved oxygen leaves the water column in a body of water due to the build-up and decomposition of organic carbons in the sediment. The introduction of organic materials changes the chemistry of streams, and many chemical reactions occurring in bodies of water, with the exception of photosynthesis, require oxygen. Also, when the organic carbons are in the sediment of streambeds, bacteria and other microorganisms go to these organic materials to feed on them and decompose them. The combination of these two events results in an increased oxygen demand and, therefore, a decrease in streams' dissolved oxygen (DO). This increase in the oxygen demand does not only have the potential to be harmful to the aquatic life in these streams, but can also lead to a build-up of total organic carbons (TOCs) where they pour into Beaver Lake, thereby polluting the lake. This pollution can lead to dangerous effects with the potential to be hazardous to one's health, such as disinfection bi-products (DBPs).

An experiment was done to measure oxygen dynamics in the sediment and water column of the White River.

Introduction
Sediment oxygen demand (SOD) is the rate that dissolved oxygen leaves the water column in a body of water due to the build-up and decomposition of organic carbons in the sediment (Doyle & Lynch, 2006). This organic matter can come from many sources. The two different types of sources that introduce organic material into bodies of water are point and nonpoint sources. Point sources are anything, such as a wastewater treatment plant or a drain from an industry or factory, that is large and exclusive. Smaller and more spread out sources are called nonpoint sources. This category can include farms, feedlots, runoff from streets, construction sites, and runoff from septic tanks (Terry, 1997).

In northwest Arkansas, two major point sources are agriculture and runoff from urban growth. There are many farms all around the streams that lead into Beaver Lake. Organic materials, such as plants and animal feces, have the potential to go into these streams and increase the SOD rate. Furthermore, northwest Arkansas is becoming one of the fastest growing urban populations in the United States. Due to this population increase, the amount of organic wastes from the urban areas also increases, creating yet another source of an increased SOD rate. One major point source is the wastewater treatment plant, located upstream from the West Fork on the White River, one of the rivers that flows into Beaver Lake.

The Water Pollution Control Act of 1972 calls for the regulation of runoff into natural waters from both point and nonpoint sources. It requires states to put more importance on the permit system and for stricter punishments of infractions. It also forces states to increase funding for construction grants. The objectives of the Act include making water better for recreational activities, such as fishing and swimming, and eliminating pollution discharges (Terry, 1997).

The introduction of organic materials changes the chemistry of streams. Many of the chemical reactions occurring in streams, with the exception of photosynthesis, require oxygen. Also, the organic carbons in the sediment of streambeds are fed upon by bacteria and other microorganisms, resulting in a decrease in the amount of oxygen in these areas.

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With this knowledge, the water column and sediment of a stream or river can be used to determine whether or not the ecosystem is carbon-limited. A water ecosystem lacking carbons is considered carbon-limited; whereas, an ecosystem that has a large plethora of carbon is not carbon-limited. In systems that are not carbon-limited, there is an increased oxygen demand and, therefore, a decrease in streams' dissolved oxygen (DO). This increase in the oxygen demand does not only have the potential to be harmful to the aquatic life in these streams, but can also lead to a build-up of total organic carbon (TOC) where they pour into bodies of water, thereby polluting the water.

One potential threat brought about by an increased number of carbons in the lake is the formation of disinfection by-products (DBPs). These possibly toxic chemicals can be either organic or inorganic and are formed from reactions between organic compounds and oxidants, such as chlorine, which are used in the wastewater treatment plants to treat the water (Kilduff & Karanfil, n.d.). Studies have shown that human intake of DBPs can be linked to such health problems as cancer and reproductive and developmental defects (Richardson, 2006).

In order to determine whether bodies of water are carbon-limited systems, different tests can be run. The first of these was a five day biochemical oxygen demand (BOD) test. This measures the levels of DO in mg/L found in the water column of the stream. The results show how much of an oxygen demand there is just in the water of the stream, regardless of the sediment or surroundings.

A second test is the specific oxygen uptake rate (SOUR) test, which measures the rate at which dissolved oxygen leaves the sediment. This test can be followed by a potential oxygen uptake rate (POUR) test, which finds what the oxygen uptake rate of the system would be if the system had an unlimited source of carbons. Since the higher the carbon levels in the water, the lower the amounts of dissolved oxygen, if one puts an unlimited source of carbons in the water, this will give the sediment its highest potential uptake rate. The SOUR can then be compared to the POUR to see if the system is carbon-limited. If the POUR is much higher than the SOUR, then there is a shortage of carbons in the water, and the system is carbon-limited; if the SOUR is close to the POUR, then the system has plenty of carbons, meaning the system is not carbon-limited. To the best of this experimenter's knowledge, no prior research or experimentation was done to date in order to find the potential oxygen uptake rate by adding carbons to the sediment and finding the oxygen uptake rate.

The Beaver Lake Watershed is in Northwest Arkansas spread across Washington, Madison, Benton, Carroll, and Franklin counties. The water basin includes a drainage area of 1,186 square miles. 300,000 acre-feet of this region is used for flood control, and approximately 920,000 acre-feet is employed for the production of electricity and water supply. Beaver Lake is the main source of drinking water for Beaver and Carroll counties, a region that includes more than 300,000 people (Arkansas Water Resources Research Center, 1990, p. 1).

Most of the water quality problems, such as low dissolved oxygen and high levels of fecal coliform, algae, iron, manganese, and turbidity, occur in the upper regions of the lake. These issues have been linked to an increased level of nitrogen, phosphorus, and carbon runoff from urban point and nonpoint sources and rural nonpoint sources, due to the large number of confined animals in the region. Additionally, eighty-five percent of the water that flows into Beaver Lake enters the lake upstream of Highway 12 bridge; however, less than twenty percent of the actual lake is in this area. Therefore, there is a larger concentration of pollutants in the upper region of the lake (Arkansas Water Resources Research Center, 1990, p. 1).

The objective of this project was to measure oxygen dynamics in the sediment and water column of the White River. In order to meet this objective, two hypotheses were tested. The first of these was that two stream sites in the Ozark Highlands exhibit different oxygen dynamics, measured as biochemical oxygen demand and specific oxygen uptake rate (SOUR). The second hypothesis was that respiration rates of sediment from two Ozark Highland streams are limited by carbon energy sources, as measured as SOUR.

Materials and Methods

Five-day biochemical oxygen demand (BOD) tests were performed on the water samples from each of the three streams to measure the rate of the decrease of DO in the water column (APHA, 1998). The unfiltered stream water was placed into a 300-milliliter BOD bottle. An YSI 5010 BOD Probe and an YSI 5100 DO Meter were used to perform the BOD tests. The probe was cleaned and calibrated with reverse osmosis (RO) water for fifteen minutes. The DO in milligrams per liter at calibration was recorded. The probe was then placed in the BOD bottle holding the stream water. When the meter reading stabilized, the measurement for DO in milligrams per liter was recorded. Then the probe was removed, and a lid was put on the bottle. Some deionized (DI) water was put around the base of the lid to completely seal the bottle. This process was done three times with water from the same stream. It was repeated with the sampled water from all three streams, performing the BOD5 experiment a total of fifteen times. The fifteen BOD bottles containing stream water were labeled and stored in an incubator (Sheldon Manufacturing, Inc.) at twenty degrees Celsius for five days. After that, the bottles were taken out, and the same process was repeated with the water from each of the three streams.

Experimentation for this project included sampling two different sites from streams that flow into Beaver Lake. The sub-watersheds sampled included the Middle Fork of the White River (MWR) and the West Fork of the White River (WWR). Labeling of the sites was done by taking the abbreviation of the site name and adding the number of the country road or highway on which it was located (i.e. MWR 57 is located on the middle fork of the White River on Country Road 57). Sites were chosen based on the deposition of their environments. Desirable sites had fine sediment with few large rocks, little or no canopy, and low flow velocity. Also, since a range from low to high in the SOD rate was needed for this experiment, sites were chosen based on of their SOD rate. One site was sampled from the middle fork of the White River, and one site was sampled from the west fork: MWR 57 and WWR 16, respectively.

Samples of the water and sediment from the same streambed were collected from each site. The water was collected in opaque, 1-liter bottles. The samples of sediment were put in plastic containers. Samples were placed in ice chests with ice packs and transported to the lab. All water samples were analyzed within six hours of being collected, and sediment was stored in a refrigerator when not being tested. Sediment samples were analyzed within one or two days of being collected.

Oxygen uptake rate (OUR) tests were conducted to find the oxygen consumption rate of the sediment collected from the streams. Two samples from the same site, one without sugar and one with sugar, were tested simultaneously. Two YSI 5010 BOD Probes and the YSI 5100 DO Meters were used to perform this test. The probes were calibrated for fifteen minutes in RO water, and the DO levels in mg/L at calibration were recorded. Two 300-milliliter BOD bottles were filled with RO water. A lab spatula was used to fill two stainless steel weighing boats with fifteen grams apiece of sediment from the same streambed, the exact weight in grams being recorded.

Approximately one gram of sugar was put into a third weighing boat, the exact weight in grams being recorded. An OHAUS Scout scale was used to weigh the sediment and sugar. The sediment from one weighing boat was poured into one of the BOD bottles, and the sediment from the other weighing boat was poured into the other bottle. The sugar was poured into one of the bottles along with the sediment, and the bottle with the sugar was labeled. A VWR 200 Mini Stirrer was put into each of the bottles. The bottles were put on top of 220 Mini Hot Plate/Stirrers, and the power was turned on to a high enough setting to stir the sediment adequately. A probe was placed in the top of each bottle, and the stirring mechanism was activated. The initial DO levels were recorded, and every minute, the DO levels were recorded. When the DO levels changed no more than 0.05 mg/L in a minute for three consecutive minutes, readings were recorded every five minutes. This continued until the DO levels did not change more than 0.1 mg/L in five minutes or more than 0.02 mg/L in a minute for three consecutive minutes.

Specific oxygen uptake rate (SOUR) were calculated by determining the OUR per gram dry weight of sediment. A lab spatula was used to put wet sediment from the same streambed into three different stainless steel weighing boats, and each was measured on the OHAUS Scout scale to approximately fifteen grams of sediment, the exact weights being recorded. The sediment from each weighing boat was put into a different crucible. De-ionized (DI) water was used to ensure that all the sediment went from the weighing boats into the crucibles. All three crucibles were put into a Thermolyne Furnatrol 133 oven at 110 degrees Celsius for at least twenty-four hours. The next day, the crucibles were removed from the oven, and each of the three samples of dry sediment was weighed on the scale. To find the reduction in the weight of the sample after removing the moisture content, the weight of the wet sediment had the weight of the dry sediment of the same sample subtracted from it; the difference was then divided by the weight of the wet sediment. The SOUR test was performed for both sites.

Discussion and Results

From the five day BOD test, the DO levels from the first day of the three samples of water from the same stream were averaged. Five days later, the new DO levels of the three samples from each site were averaged. For MWR 57, the average DO on the first day was 6.72 mg/L, and the average DO on the fifth day was 4.76 mg/L. For WWR 16, the average DO on the first day was 8.04 mg/L, and the average DO on the fifth day was 6.81 mg/L.

To analyze the OUR results, the amount of DO in mg/L for each of the three samples from the streambed were averaged at each minute. The average of the three samples of sediment from the same streambed when sugar was added was also found at each minute. Then, the actual DO and potential DO at each site were compared in a graph, the actual DO being the samples without sugar and the potential DO being the samples with sugar (see Figures 1 and 2).

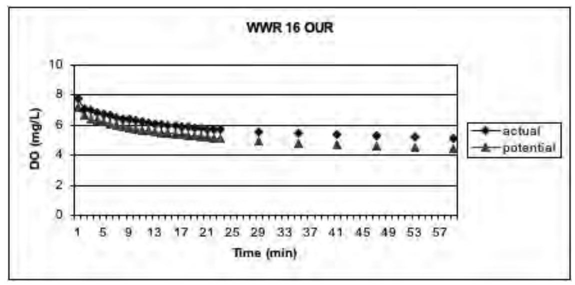

Figure 1. WWR 16 OUR Graph, University of Arkansas, 1 Aug. 2006.

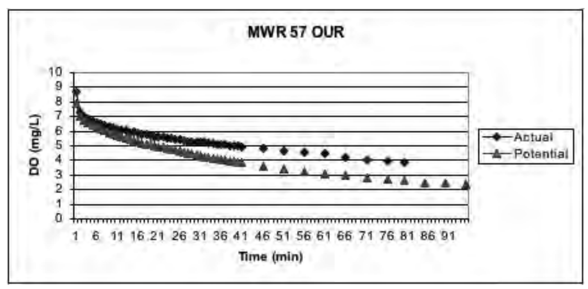

Figure 2. MWR 57 OUR Graph, University of Arkansas, 1 Aug. 2006.

For the SOUR and POUR tests, the weights of the wet sediment were compared to the weights in grams of the dry sediment to find the moisture content. The average for MWR 57 was 0.20 grams dry weight sediment (g DW sed) and the average reduction in WWR 16 was 0.23 g DW sed.

The average reduction was used to find the specific oxygen uptake rate for the sediment without sugar from each site. For each site, the final average DO from the three samples without sugar was subtracted from the initial average DO of the three samples without sugar. The difference was divided by the average reduction in grams of dry weight sediment for that site. The quotient was then divided by the number of minutes the OUR test lasted.

The objective of this project was to measure oxygen dynamics in the sediment and water column of the middle and west forks of the White River. When carbons were added to the sediment, it was found that there was only a minimal difference between the specific oxygen uptake rate of the sediment and its potential oxygen uptake rate. Overall, increasing carbon sources did not increase SOUR a great deal, considering the difference in rates ranged from 0.01 to 0.04 mg/L*g DW sed.*min.

However, even at these low numbers, the difference in response between sites suggests the systems have different carbon budgets. WWR 16 had the lower response and is located in a lower stream reach with a high contrast in the sediment. It also receives runoff from the wastewater treatment plant located upstream of this fork, and thus the SOUR as that site was not organic compound limited. MWR 57, however, is in a headwater stream with little organic carbon load. It responded to being enriched by consuming more oxygen. Therefore, the first hypothesis that the oxygen dynamics in both sites along the White River would be different failed to be rejected due to the different response to the addition of sugar between the site located on the middle fork and the site located on the west fork. The second hypothesis that the respiration rates of sediment in the two different sites are limited by carbon energy sources was rejected due to the very minimal change between the specific oxygen uptake rate and the potential oxygen uptake rate found by enriching the sediment with carbons.

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Student Recommendations for Improving Nutrition in America's K-12 Schools

By Student Participants in the 2006 Keystone Youth Policy Summit

Program Introduction and Overview
Co-hosted by the National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology (NCSSSMST) and The Keystone Center, the third annual Keystone Center Youth Policy Summit focused on Adolescent and Childhood Nutrition in America's K-12 Schools. In June 2006, 40 students from 10 math and science schools came together in Keystone, Colorado, to develop recommendations for solutions to this ever-increasing problem in the United States.

After months of research and study, students spent the week of June 19 to 23 working in stakeholder groups, discussing, arguing, developing, and finally reaching resolutions and recommendations. With guidance from The Keystone Center staff members and Consortium representatives, these 40 high school students produced viable approaches for addressing a problem that is confounding policy makers.

We are proud of the initiative shown by these students and the quality of their product that resulted. We believe you will find their final report to be well-researched, thoughtful, and practical. This report comes from the very population of individuals that are affected most by the need to educate and learn about proper nutrition and the effects of poor diet on overall health.

Please use the students' final report to help young people make good choices. Distribute it to those who are involved in policy and decision-making on food, nutrition and exercise initiatives in America's schools.

The Keystone Center and the NCSSSMST support the continuing focus on quality education and opportunities for students in math, science, and technology. You may contact us with questions or find additional information regarding our organizations by visiting our websites at www.ncsssmst.org and www.keystone.org.

According to a report from the Institute of Medicine, obesity among children and youth has more than tripled over the past four decades. More than 15 percent (9 million) of U.S. children and youth are obese, and another 15 percent are at risk of becoming obese.[1] Decision-makers in government, industry, the public health community, the medical professions, schools, etc., are striving to identify successful, feasible strategies for preventing and treating childhood obesity and other nutrition-related problems affecting America's children.

Schools are viewed by many experts as especially important venues for assessing and combating the problem. School-aged children and adolescents spend consume a significant percentage of their meals and calories in school. Schools constitute important environments in which to learn about, and engage in, sound nutrition and appropriate physical activity. While in school, students are subjected to formal education, peer information-sharing, social marketing messages, and commercial promotions related to nutrition. Time spent on school grounds and engaged in school activities represents an essential opportunity for educators to influence children's behaviors and attitudes regarding nutrition.

Forty of the brightest high school students in the country gathered in Keystone, Colorado, to participate in The Keystone Center's Youth Policy Summit on "Nutrition in America's K-12 Schools." The 2006 Summit, now an annual collaboration between The Keystone Center and The National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology (NCSSSMST), focused on identifying ways to help reverse incidence of obesity through school-based interventions.

The students prepared for the Summit by engaging in semester-long independent research projects on relevant dimensions of the problem – e.g., consumption patterns among school-aged children, nutrition standards for various foods served in schools, trends in nutrition and physical education, the physiology of childhood obesity, and the psychological and emotional impacts of overweight and obesity. Throughout their stay in this picturesque mountain village, students also received orientations in interest-based negotiation and problem-solving, and spent a day interacting with a panel of national experts who shared diverse perspectives and backgrounds. Finally, the students spent three days in intense negotiations, playing the roles of actual key stakeholders and developing consensus recommendations for addressing nutrition problems in the school environment. This resulting report is being disseminated to decision-makers in government, industry, education, and the public health community.

While the students generally maintained a focus on schools, they encountered several aspects of the problem that necessitated a broader approach. Rather than artificially isolating the school environment, some recommendations in this report therefore call for broad action meant to affect schools as well as other venues for change. In their deliberations, the students considered the following questions.

Questions/Issues

1. There is considerable debate about the role different foods play in the obesity problem as it is experienced within the U.S school-aged population. What foods or eating behaviors are most contributive to obesity-related health problems in schools, and what changes should be encouraged?

2. What changes, if any, should be made to the federally funded school meals program administered by the USDA? What changes, if any, should be made to current practices regarding the availability of other foods in schools?

3. Should food-related advertising and marketing in schools be restricted in any way? If so, please recommend appropriate changes, being mindful of financial trade-offs.

4. What is the appropriate role of school curricula and extra-curricular activities in combating obesity and nutrition problems?

5. What key messages should children receive about healthy eating and active lifestyles, in order to address the problem of obesity? What strategies would be effective in getting those messages across? Who is in charge of getting the message to the public?

6. What else, if anything, should be done within K-12 schools to help prevent and treat child and adolescent obesity-related problems?

7. What are the most pressing issues over the next 10 years and what, in order of priority, should government give incentive or underwrite with its limited research budget?

Final Policy Recommendations

Issue 1. There is considerable debate about the role different foods play in the obesity problem as it is experienced within the U.S school-aged population. What foods or eating behaviors are most contributive to obesity-related health problems in schools, and what changes should be encouraged?

The poor eating habits and food choices of school-aged population is a major contributor to the increasing obesity epidemic in the United States. Many adolescents prefer foods with large quantities of calories, fats (both saturated and *trans*), sugar, and cholesterol. These foods are also usually devoid of the much needed vitamins and minerals which are staples of a healthy diet. This lack of nutrients is due to a deficiency of certain healthful foods such as fruits, vegetables, and dairy products.

Oftentimes, the vegetables that children consume, such as french fries, are low in nutrients and poorly prepared. Subsequently, these vegetables are poor suppliers of the aforementioned nutrients. Beverages also play a large role in this obesity epidemic. Vending machines in schools supply students with beverages that contain large quantities of calories and sugars. Although many vending machines also offer healthier choices with reduced calories and sugar, students do not seem educated enough to choose these healthier options. Their poor decision making is one of the primary reasons for our nation's obesity problem.

It is imperative that appropriate measures, such as encouraging an increase in nutritional education and changes in the food offered in school meals and vending machines, be taken in order to stem the flow of this growing obesity epidemic.

Issue 2. What changes, if any, should be made to the federally funded school meals program administered by the United States Department of Agriculture (USDA)? What changes, if any, should be made to current practices regarding the availability of other foods in schools?

The majority of beverage companies are already shifting toward a healthier product profile in high schools, consisting of low- or no- calorie soda, juice, and sports drinks. As healthier alternatives to current drink programs are already being created by companies, no recommendations will be made regarding beverage vending machines in schools.

A 50-50 program consisting of 50 percent healthy[1,2] and 50 percent top-selling items should be implemented within the food vending machines and the a-la-carte menus within each school's meal program. The 50-50 program should be evaluated at the beginning of each school year, replacing any of the previously designated top-selling items with the top-selling items of the immediately preceding year. Coupled with proper nutritional education, the 50-50 plan could help create an environment in which, each year, the availability of healthy items increase in a participating school without necessitating a change in vendors.

If the items in the 50 percent "healthy" section are also a part of the 50 percent top-sellers, they would only count as a top-selling product, and would be replaced by another healthy item in the healthful 50 percent. This policy would be applied to both food vending machines and the a-la-carte menus in school. Along with the new food policies, nutrition education should be emphasized in schools in order to guide the students in making healthy food choices.

The government could also offer incentives, such as fruit and milk grants, to increase the availability of healthy foods in schools. Ultimately, the hope is that healthier items will replace all "unhealthy" items in the top-selling half, resulting in an entirely healthy portfolio of school foods.

Issue 3. Should food-related advertising and marketing in schools be restricted in any way? If so, please recommend appropriate changes, being mindful of financial trade-offs.

While advertisements in schools are not necessarily negative, some restrictions should be imposed on the food-related marketing in the learning environment. Since some companies already practice restraint in marketing, the changes proposed are not drastic but would help the nation's youth to lead healthier lifestyles and make wiser decisions about the foods they consume.

The first suggested change is the exclusion of any advertisements that portray products not actually sold in schools. This measure should help the obesity problem by allowing younger children only the option of healthier products during school hours, which, paired with better nutrition and healthy lifestyle information, would help youths make better choices earlier in life.

Companies are also encouraged to use positive role models, such as athletes, to endorse their healthy products. When school advertising is converted to such beneficial messages, there will be no need to reduce the overall number of messages.

Other methods of advertising, such as vending machine panels, should also promote healthy options and lifestyles. Advertising in schools is regulated on a school-by-school basis. It is primarily up to the companies' discretion; however, healthier choices are strongly encouraged.

Issue 4. What is the appropriate role of school curricula and extra-curricular activities in combating obesity and nutrition problems?

Education plays an essential role in contributing to the physical activity and education of youth. As such, elementary and middle school students should engage in some equivalent of physical education or physical activity daily throughout the entire school year. High school physical education should be required for a minimum of 270 hours per student throughout their high school career. Medical exemptions from this rule are acceptable, by individual school discretion.

If participating on a varsity sport team requires a class taken during the school day, participation in this class may be substituted for physical education class credit. Students who practice for a sports team only outside of the normal school day should not be exempt from the physical education class. In addition to varsity sports taken during regular school hours, the only classes that should be substitutable for the physical education class are weightlifting, yoga, dance, swim, and other classes promoting lifelong physical activity. These classes are also to be taken during school hours.

Competitive sports that promote inactivity should be removed from the K-12 physical education curriculum. Sports that promote lifelong physical activity, such as running, swimming, tennis, and other individual sports, are strongly recommended. Individual schools should have final discretion as to which sports are offered.

It is strongly recommended that schools offer the option of intramural sports after school to provide students with an opportunity to play sports in a less competitive atmosphere. These extracurricular activities should not count for school credit and should not replace the physical education class. Supervisors could include coaches, Parent Teacher Association members, and other volunteer school personnel. It is suggested that schools use their own physical education equipment, or that provided by students, for the intramural activities. This will cut down on unnecessary costs; fundraising will help cover additional costs. Permission slips could help eliminate the school's liability for student injury.

Nutrition curricula are integral to combating obesity. All K-8 students should be required to spend time on nutrition curriculum annually. In the regional equivalent of "high school," a one semester course on health and nutrition should be taught in class by teachers trained in the area of nutrition education, and it should be a graduation requirement. Guidelines on nutrition course curricula should be provided by appropriate government agencies. It is recommended that an equal amount of time be spent on health and nutrition, and that a separate nutrition class be offered as an elective for those students who wish to pursue an interest in nutrition education. Schools are strongly urged to make nutrition education interactive and integrate nutrition concepts into other classes where applicable (such as family and consumer science or cooking).

All students in the 6th and 11th grades should be required to take a standardized test which includes health and nutrition. It is strongly recommended that the standardized test have the same guidelines and requirements that the state utilizes for other math and reading standardized tests.

Issue 5. What key messages should children receive about healthy eating and active lifestyles, in order to address the problem of obesity? What strategies would be effective in getting those messages across? Who is in charge of getting the message to the public?

Children need to receive effective messages about healthy eating and active lifestyles to stop the growing problem of obesity.

Children need to be informed about nutrition beginning at an early age and benefit from a healthy lifestyle. Children should know that that obesity is a disease, not just cosmetic, and that being healthy does not equate to being thin. They need to get at least 30-60 minutes of physical activity per day. They need to understand the importance of moderation in eating and that calories consumed should be the same as calories expended. One possible slogan for conveying these messages could be "BEAM"–Balance, Education, Activity, Moderation. For children to understand these concepts, many different strategies can be used. One way to get the message across is a "Tip of the Day" guide in which tips and strategies, created by the individual schools, are given to students by monetary-free means. Tips would be creative, interesting, incorporated from the teachings of the curriculum, and distributed by way of morning announcements, "Channel One," or some other monetary-free means not related to the private sector.

Industry and perhaps other parties could launch a "Healthier Lifestyle Campaign." A generic logo and motto such as "health first" could be used in campaign materials and corporations could sponsor the campaign by television commercials, posters, billboards, etc. that portray one or more influential athletes, celebrities, political figures acting on a volunteer basis to promote a healthier lifestyle.

The "Healthier Lifestyle Campaign" would give the private sector an opportunity to promote healthier products while creating awareness of a healthier lifestyle. Healthier products of individual sponsors could also be promoted within the campaign by product placement. The sponsoring companies and corporations would fund the campaign as they see fit. The "Healthier Lifestyle Campaign" would be comparable in reach to the "Read" Campaign or the "Verb" Campaign. Excluding elementary schools, the "Healthier Lifestyle Campaign" would be visible in the middle and high schools, in stores, and in public areas.

Parenting and pregnancy classes in the community could also be used to promote nutrition, since new parents need to be informed that eating habits are established at an early age. Awareness of healthy eating habits should be taught in classes and/or through supplementary materials.

It is the responsibility of the community, corporations, and schools to get the message to the public. If the public is better informed, then they can prevent children from becoming obese while teaching them healthy eating behaviors. They can also help any obese children to start being healthier and losing weight.

Issue 6. What else, if anything, should be done within K-12 schools to help prevent and treat child and adolescent obesity-related problems?

Strategies to prevent and treat child and adolescent obesity-related problems in K-12 schools include teaching nutrition in pregnancy classes to propagate good nutrition at an early age, distribution of healthy snacks at elementary schools and regulation of food in schools, encouragement of exercise programs and in-school physical activities, health awareness classes and information distribution, and government-funded advertisements warning about the dangers of obesity and suggesting strategies for prevention and treatment.

Nutrition awareness in pregnancy classes is recommended because of long-term eating habits children develop at an early age. Parents who learn proper nutrition in these classes will be better able to help their children develop a healthy diet.

Like nutrition awareness in pregnancy classes, distribution of healthy snacks in elementary schools helps develop lifelong healthy eating habits in young children.

Coupled with good nutrition, exercise is an integral part of a healthy lifestyle. Teaching children to begin exercising at an early age will help encourage lifelong fitness and early association of exercise with entertainment.

While the previously discussed strategies encourage children to develop good habits, information distribution helps change the habits of children who already eat an unhealthy diet. More importantly, adults who receive information brought home by children about healthy eating will be more likely to take action in their children's nutrition and levels of physical activity. Similarly, government-funded advertisements will help propagate awareness of the negative effects of obesity and the importance of diet and exercise.

Issue 7. What are the most pressing issues over the next 10 years and what, in order of priority, should government incentive or underwrite with its limited research budget? There are many research imperatives which require government funding. If these needs could all be addressed, then the rate of obesity (and related diseases) would decrease. Over the next 10 years, the most pressing issues in obesity research should be genetic research, innovative food preparation techniques, and obesity prevention and treatment. All of these issues should be addressed simultaneously, with equal priority.

Continuing government funded research should be aimed at pinpointing genes that contribute to obesity–already, over 200 genes have been found to play a role in obesity. Formal studies should be conducted to see which genes cause the most damage. This research may be funded by pharmaceutical companies, university grants, and governmental tax breaks for private companies. Genetic research should continue because twin and adopted children studies have already shown the genetic predisposition to obesity.

Secondly, innovative food preparation techniques should be researched further. Research should focus on development of new technologies that make food healthier and cheaper to the public. Funding for research on innovative food preparation techniques would be provided by selective government grants and the private companies themselves. The main goal of this research is to introduce these new products to the consumer with the intent of increasing demand for healthier products through education and assisted campaigns.

Thirdly, funding should be provided to study obesity prevention. More research needs to be focused on understanding trends in societal eating habits and causes of obesity, through inventories of stores, schools, etc. Private companies can use this research to assist them in providing healthier products that would be received by the public. Research needs to be conducted for exercises and curricula that would be most effective for school-age children. Diet plans that would most benefit certain age groups and to-be-parents need to be studied.

The final issue that needs to be researched is obesity treatment, with priority placed on the needs of children whose age prevents them from invasive surgery and whose degree of obesity prevents them from sufficient exercise. Safe non-invasive methods of reducing obesity need to be studied, including safe metabolism-boosting medicines and diet pills. Safer techniques which would allow more obese children to receive weight reduction treatment also need to be examined. Medication that would be given for treatment should be through prescription.

Conclusion

If the aforementioned recommendations and legislations were acted upon, the issue of childhood obesity would move closer to resolution. These reforms would provide a good first step towards a world where the problems of obesity and debate about proper nutrition would be remnants of the past. Any funding provided to aid in solving the issue of obesity would be an appropriate investment in the health and prosperity of the nation, when considering the amount of money which is currently spent on obesity-related costs. It is with this vision of the future in mind that this body of students highly encourages that the solutions detailed in this report be implemented with the utmost of urgency.

Footnotes

1 A healthy product made by the private sector must meet the nutrition standards set by the Child Nutrition Promotion and School Lunch Protection Act of 2006. It puts limits on fat and saturated fat as well as requirements for protein, vitamins, and minerals.

2 Healthy, as defined for providing or serving a complete meal, is based upon the pyramid and serving guidelines set by the Harvard School of Public Health that alters and includes the USDA Dietary Guidelines and My Pyramid.

Reaching Teachers and Students: Stargazing on the Lake

Julie Dowling, Illinois Mathematics and Science Academy
Jay Thomas, Ed.D., Aurora University

Overview

With support from the Alfred P. Sloan Foundation, Siemens Foundation, and the Associated Colleges of Illinois (ACI), NCSSSMST hosted its third summer science program in June 2006 at Aurora (IL) University's Lake Geneva, Wisconsin, campus. This program followed the successful programs held at North Carolina Central University in 2003 and Princeton University in 2005. The mission of all three programs has been to increase the percentage of underrepresented populations enrolled and matriculating at NCSSSMST schools.

The Alfred P. Sloan Foundation, which has generously supported the summer science program in the past, continued its support for this third event with the express purpose of engaging underrepresented groups in careers in mathematics and science and encouraging them to apply for admission to NCSSSMST schools. A second goal of the 2006 program was to create opportunities for young, innovative, pre-service teachers of mathematics, science, and humanities. The juncture of new teachers, underrepresented students, and experienced NCSSSMST master teachers created a powerful opportunity for learning, reflection, and application in a science-rich context.

Student Program Design

The 2006 summer science program began with a goal of expanding knowledge through an exploration of astronomy but developed into much more than just stargazing. Thirteen students, three master teachers, and four pre-service teachers spent four days at Aurora University's lakeside campus in a context rich with opportunities for a deeper understanding of our physical universe and our place and responsibility in it.

For students and pre-service teachers, each day of the summer program began under the direction of Mr. Jeff Ortmann, an instructor of gifted students at Jonas Salk Elementary School and a very experienced outdoor education instructor. Mr. Ortmann had been conducting outdoor education experiences for a variety of students at the Lake Geneva campus for many years prior to the NCSSSMST program. Mr. Ortmann led students in team-building exercises and field-based science activities, including a trek to a Kishwaketo Wetlands preserve, and studies in water conservation and biology.

The University of Chicago's historic Yerkes Observatory provided the context for the astronomy-based afternoon lessons. On the first afternoon, students were provided an opportunity to begin thinking about space, distances, and possibilities for space travel through an integrative lesson in basic trigonometry led by Ms. Julie Dowling and science fiction writing led by Mr. Steve Williams. Both are Aurora University graduate students who will be teaching mathematics and English, respectively. Mr. Ed Moyer of the Proviso Mathematics and Science Academy engaged students in mathematical exercises that calculated relative distances between planets in our solar system. He concluded his lesson with recent images from the Hubble telescope depicting the birth and death of stars. Mr. Moyer involved the students in generating lists of things that they thought they knew and things they wished to know about the solar system, which directed the discussion toward common misconceptions about astronomy. On the third afternoon, Dr. Robert Kiely of the Illinois Mathematics and Science Academy (IMSA) challenged students' assumptions about science with a compelling session on the evolution of scientific thinking from Aristotle through Darwin. Dr. Kiely challenged the students

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in discovering the origin of the scientific method and society's effect on and understanding of what is "acceptable" science.

On the third morning and into the final afternoon, Mr. Tim Staples, vice-principal at Urbana (IL) High School, introduced to students a classic problem-based learning scenario. With the assistance of the pre-service teachers, Mr. Staples challenged students to design their ideal high school for the study of astronomy and aquatic biology. The students were actively engaged in the deliberate process of designing a specialized school, from the architecture of the building and its facilities to the selection of students and staff. Dr. Joan Barber of the North Carolina School for Science and Mathematics and NCSSSMST past president, concluded the session with a challenge to students to remain engaged in their passionate pursuit of science through educational opportunities.

Student Teacher Program Design

The distinguishing feature of the 2006 summer program was the opportunity for pre-service teachers to challenge themselves through direct interaction with students from high-needs schools, gifted middle school students, and experienced master teachers. While many, if not most, similar programs rely on younger staff to serve as mentors and counselors, the AU summer science program recognized the need and opportunity for developing young, innovative, and progressive teachers who will meet the needs of specialized student groups.

Pre-service teachers from Illinois applied to the program by responding to questions about their interest in teaching both gifted students and students from high needs schools. Candidates were required to be either juniors or seniors in college or graduate students in a teacher certification program. The pre-service teachers provided residential support and tutored students throughout the program in all areas of academic certification, from biology to mathematics.

Pre-service teachers were given the unique opportunity to enhance and refine their pedagogy throughout their observations and interactions with both master teachers and students. After each afternoon session the pre-service teachers participated in seminars in which they had the opportunity to question the teaching methods and learn from experience and insights of the master teachers.

Discussions ranged from content, pedagogy, and classroom management to the nature of knowledge and teaching and surviving gifted adolescents.

Following the experience, each of the teachers reflected on three questions: In what ways did the experience enhance your understanding of teaching and learning among students from high needs schools? In what ways did the experience enhance your understanding of teaching and learning among students who have been identified as high achieving? In what ways did the experience enhance your understanding of teaching and learning in the areas of mathematics and science? The remainder of this article comprises the reflections of the program's four pre-service teachers. As you read them, try to recall your first encounters with such students.

Teacher and Teacher-Candidate Reflections

How did the summer science experience enhance your understanding of teaching and learning among students from high needs schools?

The summer science experience introduced me to many difficulties that students from underprivileged/ high needs schools encounter. I had been previously unaware of some of the problems that these students encounter on a day-to-day basis.

I think we were able to observe a discernable difference in the teaching and learning with these students. For example, when conducting the class in water study and working with the students observing specimens under microscopes, I discovered that [some] had never used microscopes before; as a result, I was impressed by their excitement and enthusiasm in discovering this new "microscopic world". They were disappointed when the lab ended saying they could have stayed and observed these amazing microorganisms for hours.

I began to understand how the interactions and situations that some students encounter make it difficult to excel and prosper in the environment in which they live.

[Several female students] demonstrated enthusiasm, stating that their experiences in most classes involved paper/pencil/book learning and very little "hands-on" experience.

Working with both the students and the NCSSSMST scholars provided me with insight on how to deal with such situations as gang influence, poverty, and disinterest in specified subjects. I realize now that the best way to relate to high needs students and any students, for that matter, is to be honest with both yourself and them. By letting these students know that I was interested in their accomplishments they were more willing to attempt tasks and assignments that at first appeared difficult.

Although this was a rewarding experience I was able to realize some frustrations I might experience as a teacher. I found I did not like watching students struggle for answers, along with students having negative attitudes and looking for negative attention. I think it is good I was able to find out what frustration I might experience in the classroom so I will know what to expect and be prepared to handle what happens.

In general, I think I learned more about differences in teaching and learning of girls compared to boys as opposed to the high needs schools students.

During the program we spent two days, instead of the typical one morning, doing the team building activity because the students were so discouraged and disorganized. The students demonstrated lack of teamwork, inability to listen, inability to stand back and let someone else take the lead, as well as being easily discouraged. This translated easily into the classroom experience at camp. For many of the students if they didn't get the concept the first time around they were likely to give up on it entirely. These students also demonstrated that in their classical classroom setting they worked independently and had very little, if any, exposure to group work.

How did the experience enhance your understanding of teaching and learning among students who have been identified as high achieving?

The summer science experience enhanced my understanding of teaching and learning among high achieving students by first hand observation of how these students behave, communicate, and interact in both a learning environment and a leisure environment.

It became apparent that such students thrive in situations that "test" their intelligence and permit them to express their opinions and ideas. However, this experience also emphasized the weakness of gifted students in group activities. It became evident to me that high achieving students may have difficulty working as a group to accomplish specific activities.

Gifted students become adjusted to succeeding and they had difficulty coping with an activity that was difficult for them. A shortcoming of the group included the students' unwillingness to work together, the propensity to give up, and the struggle to respect others ideas regarding the task.

Throughout the years, they have been the mentors to average students and it seemed that they had difficulty relying on each other to complete a given task.

While it was evident that most of the students were either high achieving or exceptionally bright, there were obvious discrepancies among the students regarding their abilities and/or desires to learn, their cooperation and listening skills, and their seriousness, dedication, and perseverance to learn.

How did the experience enhance your understanding of teaching and learning in the areas of mathematics and science?

I was able to observe different scholars and how they successfully teach their subject manner. It became apparent that there is not one particular way to conduct a classroom.

I was pleasantly surprised and impressed with some genuine ìah haî moments and enthusiasm demonstrated during such times as actual newly found "love of nature" and being outdoors in generally unfamiliar situations, interesting observations and connections being made during the wetlands and lake study activities.

Many different methods were used during the summer science experience, and I believe that they were all effective. One commonality between all the lessons was the level of the enthusiasm for the material by the scholar. Each teacher had a passion for his/her subject that was expressed throughout the lessons. I believe that educators can make any subject interesting and enlightening by showing excitement and relating the material to their students. After observing the different educators I began to realize that these teachers were capable of monitoring the class for opportunities to involve students in activities that are interesting and also enhanced the students' understanding and comprehension.

[Students demonstrated] real interest and knowledge in astronomy, and [I noted] some very profound connections, revelations, and understanding of some of the principles and mechanisms of evolution during Dr. Rob Kiely's dynamic lecture and visual history of science, which extracted a very rapid and surprising comprehension of sophisticated scientific thought from Aristotle to Darwin.

The first day was a struggle for the counselors and aspiring teachers. We discovered during that first morning where our personal levels of tolerance and patience were. Many of us realized how frustrating it was to us to see the students frustrated and not getting the answer that many times we just wanted to give them the answer so that we could move on. I think this is typical for many aspiring teachers because we have high expectations for all of our students and we don't always have all the tools we need to take a step back and guide the students through the process.

This experience was not only one of the most rewarding experiences of my life but also an affirmation of my desire to be an educator. There is no better way to make sure teaching is right for you but by experiencing and spending almost all of your time with children for five days.

The 2006 summer science program proved to be a very successful program for students, pre-service teachers, and master teachers as well. In fact, several faculty asked to be more deeply involved in the design and delivery of future NCSSSMST summer science programs. After three such programs, NCSSSMST has demonstrated that this opportunity is an effective and replicable model for reaching under-served student groups. What we found to be especially powerful, as evidenced in the preceding comments, was the change in perspective that this program caused among our pre-service teachers. They were challenged by the divergent thinking of the middle school students, they were surprised by the varying academic backgrounds that these students brought with them, and they were certainly rewarded by the intellectual engagement with students and master teachers. It is our hope, then, that as NCSSSMST explores new ways to engage talented young students, we also should look to cultivate the talents of young and talented teachers.

Teaching with an Ever-Spinning Web: Instructional Uses of Web 2.0

by John Teahan

In little more than a decade, the Web has become an essential medium for information, entertainment, and commerce, making its adoption among consumers quicker than any other medium before it. The majority of American classrooms have become connected to the Internet in the same short time span. Previously, science or mathematics students might have had access to only a few dozen images in a printed textbook; now, thanks to the Web, they have access to hundreds of thousands of images illustrating almost any conceivable topic.

Likewise, teachers now face a new generation of robust web-based applications conducive to classroom use. With a wealth of resources categorized as "Web 2.0," search-weary teachers are increasingly challenged to mine the instructional gold within the fast-moving river of social networking tools. Coined by book publisher Tim O'Reilly, the term "Web 2.0" refers to a second generation of services available on the World Wide Web that allows groups of users to share information and collaborate online. Blogs and wikis have been two breakout applications in the pop cultural landscape, but other tools have inherent utility for instruction. This article will consider two such applications – Del.icio.us and Flickr – in terms of their practicality and the unique ways they can enable today's teachers.

The open-ended nature of these applications and their use of free-flowing *microcontent* (blocks of content that can be saved, summarized, addressed, copied, and built into new projects) are two qualities that have driven their popularity (Alexander, 2006). Another advantage is the virtual field testing that these resources undergo from other users worldwide. James Surowiecki's (2004) book, *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations,* suggests that information aggregated by groups often results in decisions superior to ones made by individuals equipped with the same information. This collective intelligence ensures that queries have a level of quality control.

Del.icio.us and Flickr feature all of the characteristics described above, making them relevant and valuable for teachers and students. Both are freely available over the Web and offer a variety of opportunities for classroom integration.

Del.icio.us (http://del.icio.us)

Social bookmarking web sites (sites in which bookmarked resources are organized by preference and shared) have become a popular means to store, classify, and search links through the Internet (Bull, 2006). The del.icio.us bookmarking tool hinges on the premise that if a significant number of likeminded individuals find a resource useful, you might, too. Being a web-based tool, it is possible to compile a list of the resources that are accessed most often and "tagged" by category. For example, search the del.icio.us database of popular items tagged with "Law of cosines" or "kinetic energy" and you will generate of list of the most useful sites for those topics as ranked by other users.

One classroom strategy using del.icio.us involves collaboration through use of a tag agreed upon by individuals in a specific group. Students in a Trigonometry class at Tech High School, for example, could collectively bookmark resources with TrigTechHS. This would allow everyone else in the class to search on these resources by using that tag. Over time, an entire class or groups within the class could solve proofs together and have their work fully

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documented and searchable on the Web. The web-based nature of the application allows access to the work-in-progress through any live Internet connection—no special software or downloads are necessary, giving students universal access to the shared work.

Flickr (http://www.flickr.com)

Flickr is a photo sharing site with an online community platform that has grown into a shared repository of thousands of photo images. Its popularity has been fueled by its innovative online community tools that allow photos to be tagged and browsed by category. Until recently, the resources and facilities for incorporating images into classroom teaching have been limited to low-resolution overhead transparencies and slides. The digital photography boom has vastly improved the resolution of images, but finding topic-specific pictures had always been a hit or miss prospect using a general search engine.

Photograph of a lunar eclipse acquired from Flickr.

Flickr provides readily available photos depicting different aspects of mathematics and science. Tagging similar to that found in del.icio.us makes it possible for classes or teams to tag groups of photos illustrating lab assignments or fieldwork.

As a resource, Flickr provides many opportunities for observation activities in science. Within an astronomy unit, for example, the teacher can ask a class to compare images of lunar and solar eclipses found in *Flickr's* directory. A discussion can follow about which images best represent each specific phenomenon. The selected images can be tagged specifically for the class. The last part of the lesson can involve students writing a descriptive paragraph and a detailed diagram on how solar and lunar eclipses differ.

Although the prospect of fully embracing any technology trend can be daunting, the ubiquity and interactive nature of Web 2.0 allows teachers to become familiar with it using personal interests outside the classroom before committing to implementation in professional settings. Once familiar with the characteristics of the Web 2.0 environment, teachers can adapt available tools for specific units and lessons, getting a foothold in this exciting development in Internet technology.

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Scientist and engineer shortage: myth or reality?

By Jan F. Post

Dr. Jan F. Post is on the chemistry faculty at the Oklahoma School of Science and Mathematics in Oklahoma City.

Framework of this article

With clockwork regularity, the real or perceived shortage of scientists and engineers in the US pops up as a topic of debate in academic and industry circles. Discussions of an imminent shortage have deep impact for education, career prospects, immigration, and "The American Dream." The purpose of this article is twofold. First, it will pose a somewhat alternative view of the current job market for scientists and engineers. Second, the article will explore how this issue affects our students at NCSSSMST schools: gifted and talented high school students with an interest in math and science. Post-graduate data suggest that our students do well in their chosen careers in science or science related areas, and accumulating evidence, summarized in this article, shows that there is no current shortage of scientists or engineers. The argument will be made that it is more important that our nation's most capable students meet the demand for important math and science jobs than to create a large pool of college graduates with math and science degrees. In a nutshell: quality is more important than quantity.

The Current Job Market for Engineers

1992 Nobel laureate in economics Professor Gary S. Becker (2005) wrote in the Wall Street Journal that "America needs millions more engineers and IT workers." He proposed that "H1-B visas be folded into a much larger, employment-based green card program with the emphasis on skilled workers. The annual quota should be multiplied many times beyond present limits, and there should be no upper bound on the numbers from any single country." Becker argued that the science and engineering fields are not attracting sufficient Americans and that changing immigration policy would benefit American society by attracting foreign-born scientists. Restricting the numbers of scientists and engineers coming to the US will lead, according to Becker, to research and development work being outsourced to countries like India and China. A fundamental question in such arguments that is never raised is: how many scientists and engineers do the US, or any country for that matter, actually need to ensure economic progress?

An official with the American Chemical Society recently wrote an opinion piece with the title "America's Gathering Storm" (Grob Schmidt, 2005). The article makes a plea for increasing math and science education in the US, noting that China graduated 600,000 engineers last year and India 350,000, while the US figure was 70,000. This comparison is not valid for two reasons. First of all, the population of these countries is four to five times as large as the US population and their economies are in the early stages of development, thus creating a large need for technical workers.

Furthermore it is doubtful that all these graduates find employment at the level US engineers expect. When Indian college graduates are happy with jobs in call centers, answering queries from unhappy customers in America and Europe, one may question the value of those college degrees. Do we want to train US college graduates for jobs that any reasonably intelligent high school graduate can handle?

Very recently, a Duke University study showed that the numbers quoted above were indeed based on a flawed comparison between the US, India, and China. When only B.Sc. degrees are counted, the US graduates 289.3 engineers annually per million citizens, India 103.7, and China 271.1 (News item in Science, Jan.6, 2006; www.memp.pratt.duke.edu/outsourcing). The numbers of 350,000 for India and 600,000 for China quoted above included sub-baccalaureate degrees like two- and three-year certificates. These lower degrees were not included in the US number of 70,000. When bachelors and sub-baccalaureate degrees are lumped together, the US graduates 757.6 engineers annually per million citizens, India 199.1, and China 496.8. Therefore, on a per capita basis the US still has an advantage and the situation is not nearly as dire as some would have us believe.

Ever since the author of this article arrived in 1981 from The Netherlands on an H-1 visa with a Ph.D. in physical chemistry, he has been puzzled by the regularly recurring outcry from academia and industry that the US is facing a huge shortfall in scientists and engineers. I believe the opposite to be true: there is a numeric surplus, except perhaps in a few niche areas. Statistical as well as ample anecdotal evidence indicates that there is indeed an oversupply of engineers (Begley, 2005). According to data from the American Society for Engineering Education, the number of bachelor degrees in engineering has increased from 61,553 in 1999 to 72,893 in 2004, an 18 % increase in 5 years. Based on these numbers and a career of 30 years for the average engineer, one can conservatively estimate that there must be between 1.0 and 1.5 million working engineers in the US at present. The increase in bachelor degrees awarded in computer science was even more significant: 85% from 1998 to 2004. However, total engineering employment fell 8.7% from 2000 to 2003, according to an analysis by the Center for Labor Market Studies at North-Eastern University in Boston of Bureau of Labor Statistics data (Begley, 2005). Thus, the statistics show increasing numbers of engineering graduates on the one hand and a shrinking labor market on the other. This situation is of course great for employers, but for many job seekers it is extremely frustrating. Companies are less and less willing to train otherwise excellent candidates and can pick and choose from hundreds of job applicants. “Bill Gates would never hire himself” is the saying one sometimes hears to describe the current rigidity of companies when it comes to hiring people. If you would have millions of engineers entering the US supplementing the ones already here, as Becker proposes, a few thousand may rise to the top and become successful innovators and entrepreneurs by way of a Darwinian slug fest. The rest may be doomed to under- or unemployment, as dictated by the law of supply and demand. This would certainly not be a scenario to attract young talented American students to the engineering profession.

The Situation In The Basic Sciences: Not Much Better

In the basic sciences, the same rule applies: oversupply equals under-demand (Weaver, 2005; Butler, 2005). To illustrate: the number of interviews for research chemists and chemical engineers at the annual meetings of the American Chemical Society has plummeted from 6,846 in 2000 to 2,976 in 2005, a drop of more than 56% in five years (Mehta, 2005). Total chemical industry employment has dropped from 991,700 to 879,900 during the period 1995-2005 (Heylin, 2005). Excluding pharmaceuticals makes the numbers even more ominous: a drop from 763,400 to 587,200. We don’t have data on the job market for physicists and biologists, but anecdotal evidence from fellow scientists points in the same direction: it’s tough going for young scientists just starting their careers. After obtaining a Ph.D., young scientists opting for an academic career spend a number of years in temporary low-paid post-doctoral positions, while hoping for a faculty position. Periods approaching ten years in this academic waiting room are not unheard of. Academic research is becoming more and more dependent on these post-doctoral scientists. In biomedicine the ratio of post-docs over principal investigators has doubled from 1:1 to 2:1 over the last two decades (Brumfiel, 2005). More than half of these post-docs have been recruited from abroad. A quote from this article reads: “The principal investigators need to change their ways. To create a more stable workforce and encourage home-grown researchers, postdoctoral positions should focus on education, and research labs should employ a higher proportion of permanent staff scientists”. Also, companies are now introducing post-doctoral programs as an extra selection process before hiring scientists in permanent positions. Many post-docs in academia ultimately get discouraged and leave a once-promising career choice. Less than one third of post-docs will end up in an academic, tenure-track research position. This lucky one third faces another uphill struggle, the struggle for research funding. The unwritten rule in academia is: no funding, no tenure. Most of the federal funding goes to established senior investigators, which leaves the crumbs falling off the table for the junior investigators to fight over. By necessity, junior investigators spend more energy on obtaining scarce research funds than on doing creative work.

The pressure on all scientists to publish first and obtain funding has led to some notorious cases of scientific fraud. The most recent case concerns a Korean scientist who fabricated data on 9 human stem cell lines. Some senior investigators in medicine are "too busy" (presumably with fund raising, visiting conferences, or commercializing their research) to write their own papers and use ghostwriters who are often paid by companies plugging their products (Mathews, 2005). We all know that science makes great contributions to human progress, or we wouldn't be doing the work that we do at NCSSSMST schools. What is generally less well known is that the pressure in academia to publish leads to vast amounts of research that has little or no value.

According to statistics from ISI (Institute for Scientific Information) 50% of all peer reviewed scientific publications are never cited by other scientists and only 5% have lasting value in that they are still being cited 5 years after publication.

For many college professors, research comes first and teaching is an afterthought. As a result, students interested and gifted in science are turned off by uninspired teaching and indifferent professors (Cech & Kennedy, 2005). Losing promising students this way is a sad and unnecessary loss. The predominating mindset of today's college professors was recently addressed in a discussion in *Physics Today*. The article dealt with the question: why don't we see any new Einsteins? One of the respondents wrote: "Today's scientists are jet-setting, grant swinging, favor-trading hustlers looking for civil servants who will provide them with a pipeline into the US Treasury". Another memorable quote from the same respondent: "You can't be a used-car salesman and have deep thoughts about the structure of the universe at the same time". These quotes contain some hyperbole of course, but they certainly get the point across. All in all, academia does not always offer an inspiring picture to our talented youngsters. Consequently, academic careers have lost much of their appeal over the last two or three decades. Nobody should be surprised that a large proportion of the brightest American students opt for professions like medicine, law, or finance over a career in science or engineering. The professional schools tightly regulate the labor markets in these fields, ensuring that their graduates enjoy good job prospects and financial rewards.

The Role Of NCSSSMST: How Can We Help Our Students?

With all the negative factors affecting the job market for scientists and engineers, should we still encourage our students at NCSSSMST schools to choose science and engineering careers? The answer should be a qualified yes. We should encourage them but at the same time we should inform our students of economic trends in science and engineering, so that they will learn to think about career issues. We should also make our students aware that there is a whole range of careers besides being a scientist for which a solid grounding in science is essential. Examples that come to mind are science writer, patent attorney, science educator, and many other careers that value both talent and scientific training and habits of mind.

There is evidence from post graduate research conducted among Consortium schools that Consortium school graduates are earning undergraduate degrees in mathematics and science at a significantly higher percentage than non-Consortium graduates (Thomas and Love, 2002). This finding has been consistent among schools and across time, and, since many of our students self-select into our programs and schools by virtue of interest and ability, such a finding should be affirming but not surprising. Deeper analysis of longitudinal data indicates that, while many of our graduates are pursuing degrees in more traditional math and science fields such as medicine, engineering, or math-science education, a significant number are pursuing careers and applying skills in divergent ways. Approximately 25 percent of Consortium school graduates earn double majors which combine disciplinary study in interesting ways, such as mathematics/Slavic studies, music/computer science, classic literature/biology, and political economy/computer science. One graduate commented, "I chose my double major because it allowed me to combine art and technology."

It is also important to note, however, that enrollment in a Consortium school can have an effect on choice of college major among groups that are typically underrepresented in science and technology. According to Blaisdell and Tichenor (2002) minority graduates of NCSSSMST schools, "look remarkably like their non-minority counterparts, which is exceptionally different from the college population" (p. 16).

Conclusion

Ultimately, the markets themselves should determine the number of graduates from engineering and graduate schools. To look outside the US for candidates for math, science, and technology expertise is to overlook a capable and well-trained body of scientists. To ensure that the US stays at the forefront of scientific and engineering innovation will demand a shift in emphasis from quantity to quality. To meet a need for scientists requires a shift in perspective and practice. When students graduate from a Consortium school, we hope that they see science and technology broadly: integrated and with other disciplines, rich with possibility, and not bound by traditional role stereotypes. Our best and brightest students who are passionate about science and who take a broader view of career possibilities will most certainly distinguish themselves. However, in college they should be encouraged with financial aid and enriched course work, just like we provide at NCSSSMST schools. We at NCSSSMST should make US employers in industry, academia, and elsewhere aware that our group of students is a national treasure and should be treated as such. This doesn't mean that they should be pampered, it means that they should be given every possible encouragement and opportunity to let their talents flourish.

A recent National Academy of Sciences study argued for the introduction of 25,000 new undergraduate scholarships for science and engineering (Dawson, 2005). As educators of gifted students, we know that genuine creativity, the spark of genius, is rare, even among top students. Yet it is this small group of creative individuals who will be the leaders in their fields and upon whom future economic growth depends. The NCSSSMST schools try to identify these students and help them along by getting them accepted by the best universities. Another benefit of graduating from a NCSSSMST school is that these students often receive substantial financial aid without which for many of them it would not have been possible to attend college. NCSSSMST schools challenge their students with college level courses, research programs, and internships with universities or companies, thereby stimulating curiosity and initiative. NCSSSMST has only been in existence for seventeen years, so it is too early to quantify its impact on society. However, nurturing our best and brightest is bound to be beneficial. If our efforts at NCSSSMST could work in conjunction with future government policies that focus on making the best use of our most talented students, all of America will greatly benefit.

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Teaching and Learning: The Oxford Experience

By Cheryl A. Lindeman

It all started with an invitation from the Oxford Round Table. I was summoned to participate in a lively debate at Exeter College in the Oxford University about, "Science and Faith: The Great Matter." If you have participated in an Oxford University summer experience, I am sure you will agree it is a once in a lifetime learning endeavor. The Oxford Round Table gatherings are coordinated by Harris Manchester College: "The purpose of the Oxford Round Table is to promote human advancement and understanding through the improvement of education." http://www.oxfordroundtable.co.uk/new.htm

The objective of this column is to share a teaching and learning experience through my Oxford Round Table participation.

Preparing for the Oxford Round Table involved the normal travel arrangements. The next step was trying to figure out what was expected of me. All participants were invited to write a paper to present during one of the five days of the Round Table. No guidelines were given – just submit your paper. I spent two months trying to decide what to write about. My title was easy: "Is Darwin in your classroom?" Knowing that most of the invited participants were college professors who are scholars in their fields of science and religion, I was very uncertain about my paper. Without a reading list, I spent several hours in a used book store looking for scholarly books on the topics. Authors such as Dawkins, Behe, Wilson, Dobzhansky, Watson and of course Charles Darwin were on my top ten list.

"Where to begin?" I chuckled to myself. "Read" was the response that came back to me. So, I set out my course to decide the order of my reading list. Start with Darwin and then expand to others. It seemed like a plan.

In early May I started to get emails from one of the participants explaining how he was the designated person to collect the electronic papers and distribute them to the group. Within one week I had ten papers to review. It was clear that I made the right decision not to submit a paper. The ten papers were from experts in their fields – geology, philosophy, religion, biology, anthropology. Themes emerged —- biological evolution, the case against creationism, the place of intelligent design discussions in classrooms, what undergraduates think about Darwin. More papers were distributed, and now I had twenty-five papers to review and make comments on by mid-July.

It was exciting to meet all the participants during our opening reception at Exeter College. We were indoctrinated to the Oxford traditions and lovely table settings.

David Browning, our facilitator, is the Head of Islamic Studies Center at the University of Oxford. He welcomed us and challenged us to be in the spirit of the Oxford learning community – to listen, to question, to ponder and to have dialogue with each other.

He admitted that the British don't seem to have an issue with the Evolution, Creationism & Intelligent Design controversies. They don't have major lawsuits or, "all that fuss," as there are in the, "States." He was anxious to hear what each participant had to say.

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The setting for our presentations and debates was the famous Oxford Union Old Library.

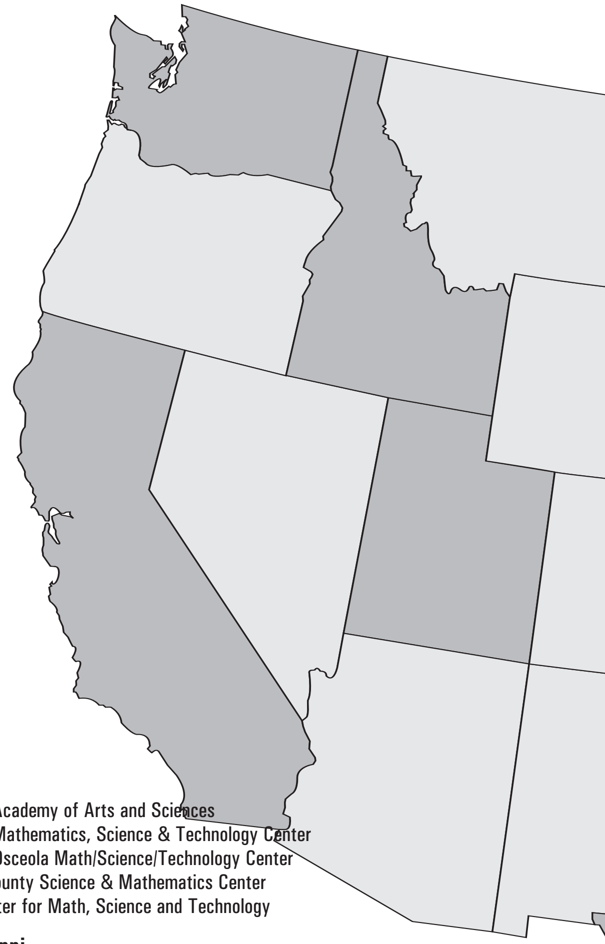
The Oxford Union is known for its world famous debates with some controversial persons (http://www.oxford-union.org/); Malcom X, Mother Theresa, Richard Nixon, and The Queen herself are in debate pictures lining the halls of the Union building. We were fortunate to have our discussions in the Old Library, which is a historical landmark. The Old Library has pre-Raphaelite murals depicting the Knights of the Round Table legends painted by young artists between 1857-1859. It was very easy to get lost in the murals during some of the paper presentations!

The outcomes of the Oxford Round Table included hearing a variety of interpretations about where and when the discussion of Evolution, Creationism and Intelligent Design should be taught. The consensus of the group was, without a doubt, that biological evolution belonged in all science courses where the discussion about organisms, biochemical processes and DNA are outlined. The age level includes middle school through college. Debating the three topics belongs in philosophy, religion or upper level courses in evolution. College students have the ability to listen to a variety of view points and learn to analyze the various positions. In Oxford, it is very likely that a student will study the three topics and meet with a tutor over the course of a semester. The final result in the Oxford model is a long paper with a huge reading list.

Back in the United States, I decided to research more about the historical letters and writings by Darwin. I was amazed to find his complete works online along with his letters. They can be found at: www.darwin-online.org.uk and http://www.lib.cam.ac.uk/Departments/Darwin/index.html. From this information I have developed a unit on evolution that will be an online learning activity using BlackBoard technology. When my students found out I went to Oxford last summer, they were all eyes and ears. They seemed to like the idea of, "no class," and all papers. I am sure they would have a different impression after spending a year at Oxford.

After the incredible learning experience, I was able to hear a lecture by Richard Dawkins at one of our local colleges. As an Oxford Professor, he gave a traditional reading of his new book, The God Delusion, and it was clear that my Oxford experience helped me to sit back and ponder what he was saying. It was a scholarly event to add to my wonderful memories of Oxford. If you receive an invitation to attend the Oxford Round Table, by all means accept it! Having the opportunity to leisurely study, reflect, debate and dialogue with educators from all around the globe is a "top 10" experience of a lifetime.

Institutional and Associate Members



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Alabama School of Fine Arts - Russell Science Center
Alabama School of Mathematics & Science

Arkansas
Arkansas School for Mathematics, Sciences and the Arts

California
California Academy of Mathematics & Science

Connecticut
LEARN-Marine Science High School of SE Connecticut*
Science & Technology Magnet HS of Southeastern Connecticut
The Greater Hartford Academy of Mathematics and Science

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The Charter School of Wilmington

Florida
Center for Advanced Technologies
MAST Academy
Middleton High School

Georgia
Academy of Mathematics and Medical Sciences at South Cobb HS
Academy of Mathematics, Science & Technology at Kennesaw Mountain HS
North Springs High School Math/Science Magnet Program
Northside High School Engineering Magnet Program
Rockdale Magnet School For Science and Technology
Tech High School
The Advanced Academy of Georgia
The Center for Advanced Studies at Wheeler High School

Idaho
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Illinois Mathematics and Science Academy
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Macomb Academy of Arts and Sciences
Macomb Mathematics, Science & Technology Center
Mecosta-Osceola Math/Science/Technology Center
Sanilac County Science & Mathematics Center
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Mississippi
Mississippi School for Mathematics & Science

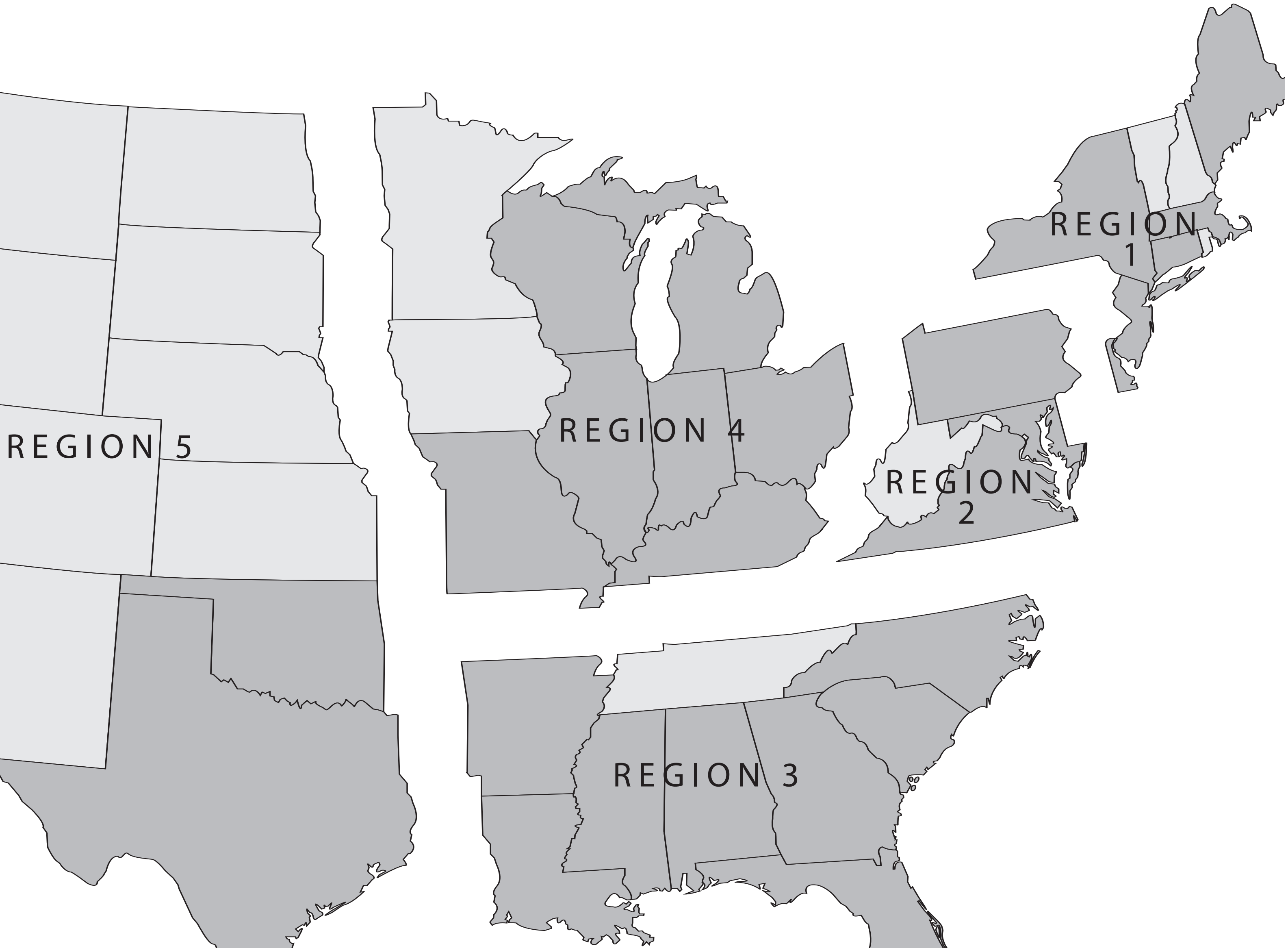
Missouri
Missouri Academy of Science, Mathematics and Computing

New Jersey
Academy for the Advancement of Science & Technology
Academy of Allied Health & Science
Biotechnology High School
Communications High School
Dwight Englewood School
High Technology High School
Marine Academy of Science & Technology
Marine Academy of Technology and Environmental Science
Morris County Academy for Mathematics, Science and Engineering
Red Bank Regional HS Academy of Information Technology & Finance
Science High School
Union County Magnet High School

New York
Brooklyn Technical High School
High School for Math, Science and Engineering at The City College
Manhasset High School
Oceanside Senior High School
Queens HS for the Sciences at York College/CUNY
Staten Island Technical School High School
Stuyvesant High School
The Bronx High School of Science

North Carolina
North Carolina School of Science & Mathematics

Ohio
Hathaway Brown School
Metro High School



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Oklahoma School of Science & Mathematics

Pennsylvania
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South Carolina
Christ Church Episcopal School**
South Carolina Governor's School for Science & Mathematics
Spring Valley High School Magnet Program

Texas
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Conroe ISD Academy of Science & Technology
John Jay Science & Engineering Academy
Liberal Arts and Science Academy of Austin at LBJ HS
Texas Academy of Mathematics and Science

Utah
Academy for Math, Engineering & Science
Early College High School*
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Ocean Lakes High School Mathematics & Science Academy
Piedmont Governor's School for Mathematics, Science and Technology
Roanoke Valley Governor's School for Science & Technology
Shenandoah Valley Governor's School
Southwest VA Governor's School for Science, Mathematics & Technology
The Appomattox Regional Governor's School for the Arts and Technology
The Governor's School of Southside Virginia
The Mathematics & Science High School at Clover Hill
Thomas Jefferson HS for Science and Technology

Washington
Camas Academy of Math and Science*

Wisconsin
Conserve School

*Associate schools in planning stages.
Members as of December 15, 2006
**Affiliate School Membership

Journal Author Guidelines Abridged Version

Complete version located at www.ncsssmst.org/publications

Editorial Scope

The purpose of the journal is to provide a forum for the discussion of innovation in secondary mathematics and science education and to disseminate information about Consortium member institutions.

Objectives

- To publish feature articles related to innovation in secondary mathematics and science education. Topics may include interdisciplinary curriculum; implementation of reform standards; infusion of technology into curriculum; creation of student centered active learning environments; original research of mathematics and science pedagogy; theoretical or conceptual positions; connections between science, mathematics, technology and society; connections between research and practice; discussion of current issues in mathematics and science education; and development of community and higher education partnerships. See feature article summaries on web site.
- To provide a forum for high school faculty members to report innovative classroom practices. See teacher practice summaries on web site.
- To provide a forum for Consortium students to report results of their original research. See student research summaries on web site.

Directions to Contributors

Submit one paper copy of your manuscript, typed double spaced on 8 1/2 x 11″ paper. Manuscripts should be between 12 and 24 pages in length and must conform to the style of the current publication manual of the American Psychological Association available from APA, 1200 Seventeenth Street, N.W., Washington, DC, 20036. Submission of computer readable copy will facilitate the manuscript review and publication process. Please send an electronic version preferably in MS Word format. The name(s) and affiliation(s) of the author(s) email address(es) should appear on a separate cover page. To ensure anonymity in the review process, names of author(s) and affiliation(s) should not appear elsewhere in the manuscript. An abstract of 100-150 words should be typed on a separate page. Manuscripts that do not conform to these specifications will be returned for proper style change.

No manuscript will be considered which has already been published or is being considered for publication by another journal. Authors must include a letter stating that the manuscript they are submitting is original and has not been accepted or published elsewhere. Make sure to download the unabridged guidelines from the web site.

Copyright

The journal is copyrighted by the National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology. Material published in the journal may not be published elsewhere without the written permission of NCSSSMST.

Handling of Manuscripts

All manuscripts will be acknowledged upon receipt. The manuscript will be reviewed by at least two members of the Editorial Review Board. See web site for more details.

Tables and Figures

All tables and figures must be submitted in camera-ready form (publication quality). Tables and figures should not be imbedded in the Word document. Authors will be charged a set-up fee of $25.00 if artwork is not acceptable quality. Tables and figures should be prepared on separate sheets at the end of the running text. Indicate in the text where they are to be inserted. Tables and figures should conform to APA guidelines.

Photographs

Photographs are encouraged and welcomed if they are relevant and support the content of the article. See web site for more details.

Submission Check List for Feature Articles and Teacher Partner Summaries

___ Cover page
___ 1 paper copy
___ Electronic version emailed
___ Cover letter signed by all authors
___ APA format used for all citations and references cited

Journal Author Guidelines
Student Research Summaries

Directions to Contributors
The manuscripts should follow the format of a research paper written in an abbreviated form. Manuscripts must include the following sections: Abstract, Introduction (encompassing literature review), Methods, Results, Discussion and Conclusions and References (APA format). The total number of tables, figures, graphs, pictures, etc., submitted with a manuscript is limited to three.

Manuscripts should be between 6 and 7 double spaced pages in length including tables, figures, and photographs.

Copyright
For publication, manuscripts must include a cover letter from the student and faculty or administration acknowledging the student's research. If necessary, a letter from the student's mentor not associated with the school must be included if research was conducted outside the student's school.

Submission Check List
___ Cover page, including title, students' full name, class year, high school and email address
___ One paper copy with all graphics placed in the document
___ School letter of support including teacher's phone and email address
___ Student author letter stating original work
___ Mentor letter if applicable
___ Photographs if applicable including credit description
___ Tables/figures in separate document but show placement
___ APA format used for all citations and references cited (visit www.apastyle.org)
___ Electronic version emailed to NCSSSMST contact listed below

Notification of manuscript receipt will be sent to the student and teacher. If revisions are needed, the student and teacher will be given instructons.

Complimentary Copies
Upon publication, each author will receive a complimentary copy of the journal issue in which the article appears.

Submission of Manuscripts
Send manuscript to:
Dr. Cheryl Lindeman
NCSSSMST Journal
Central Virginia Governor's School for Science and Technology
3020 Wards Ferry Road
Lynchburg, VA 24502
(434) 582 1104, FAX (434) 239 4140
Submit electronic copy to: clindema@cvgs.k12.va.us
www.ncsssmst.org

About NCSSSMST

The National Consortium for Specialized Secondary Schools of Mathematics, Science & Technology (NCSSSMST) was established in 1985 to serve educators and students in the growing number of specialized high schools throughout the United States. NCSSSMST is a forum and clearinghouse for the exchange of information and program ideas among faculty, staff, and students from member schools and affiliated organizations.

The Consortium comprises a network of research and development secondary schools with strong college and university affiliate members. As of December 2006, the 100 member schools and centers located in 30 states enroll more than 37,000 students. Each member school addresses specific needs of its area, and most serve districts or states, depending on their charter. Two associate institutions are in the process of developing new schools. Over 100 colleges and universities are members and participate in program-related activities or sponsor special events.

Brief History

Seeking to increase communication among the mathematics, science, and technology specialized schools, four such schools—the North Carolina School of Science and Mathematics, the Thomas Jefferson High School for Science and Technology (VA), the Louisiana School for Math, Science and the Arts, and the Illinois Mathematics and Science Academy—hosted an organizational meeting in the spring of 1985. Representatives from 15 schools attended, and NCSSSMST was founded to foster growth and interaction among similar programs.

Governance

NCSSSMST is a nonprofit organization with IRS 501(C) (3) tax-exempt status and is incorporated as a non–stock corporation in the Commonwealth of Virginia. The Board of Directors, composed of leadership from institutional members, meets at least four times a year to establish policy and set direction. The fiscal year is July 1 through June 30. NCSSSMST has implemented a strategic plan, and the board serves as the strategic planning team. The institutional membership elects the Board of Directors and officers of the corporation for three-year terms. The Board employs an Assistant to the President to handle day-to-day business.

Membership

NCSSSMST membership is extended to public and private secondary schools, colleges and universities, organizations, and individuals whose primary interests are congruent with the mission of the Consortium.

Categories for membership are as follows:

Institutional Membership — Open to specialized secondary schools or schools with specialized centers located in the United States that have nonprofit status and primary objectives congruent with the Consortium's mission.

Associate Membership — Open to specialized secondary schools or programs which, upon enrolling students, have primary objectives congruent with the Consortium's mission and will meet the requirements for institutional membership.

Affiliate Membership — Open to colleges and universities, businesses, associations, summer programs and agencies that have demonstrated an interest in and support for the Consortium and whose work furthers the mission of the Consortium. Affiliate member categories include: college and university; nonprofit organization; private business or organization; government agency; school outside of the U.S.; summer science programs; middle school; other school not qualifying as an institutional or associate member.

Individual Membership — Open to persons who have demonstrated an interest in and support for the Consortium or whose work furthers the mission of the Consortium.

The benefits of membership include an annual student conference, annual professional conference, an Issues and Connections conference series, student research symposia hosted by colleges and universities, summer institutes, and the following publications:

• Newsletter — published three times a year
• NCSSSMST Journal — a juried forum (published twice a year)
• Membership Profile — biennial report of the Consortium
• WWW site—www.ncsssmst.org—organization's link on the site

Corporation Business Office

NCSSSMST, 3020 Wards Ferry Road, Lynchburg, VA 24502; 434-582-1104; FAX 434-239-4140

NCSSSMST wants to thank

Rensselaer Polytechnic Institute

for hosting the 13th Annual NCSSSMST Student Research Symposium.

Thank you

Rensselaer

Thanks!

To AMES, Academy for Math, Engineering & Science and University of Utah for sponsoring the 2006 Student Conference.

ACADEMY
FOR MATH, ENGINEERING & SCIENCE

THE UNIVERSITY OF UTAH

It was a huge success!

Salt Lake City, Utah
NCSSSMST
student conference 2006

Dates to Remember ...

Visit www.ncsssmst.org for updated calendar information.

February 23	Last Day to Register for Professional Conference online
March 7-10	Professional Conference NCSSSMST Expedition 2007 Philadelphia, PA
March 15	School Registrations Due for Student Research Symposium at the University of Arkansas
June 10-13	Student Research Symposium Hosted by University of Arkansas
June 10-22	Keystone Policy Summits Keystone, CO

NCSSSMST

National Consortium for Specialized Secondary
Schools of Mathematics, Science & Technology

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