

Science on the Move Mobile Science Lab: School Science Education and Outreach

What is Science on the Move?

The Science on the Move Program involved the use of two tractor-trailer semis outfitted with state-of-the-art science equipment and driven by veteran high school science teachers. The mobile science labs (MSL's) roamed South Dakota visiting small and remote districts from February 2003 through May 2009. Each participating district had at least one designated cooperating teacher, with each cooperating teacher having attended a summer institute to become familiar with the labs and to prepare for school year visits.

Project Partners:

The project was coordinated by Black Hills State University's (BHSU's) Center for the Advancement of Mathematics and Science Education (CAMSE). Partners included South Dakota Board of Regents, K-12 schools from across South Dakota; South Dakota State University's (SDSU's) Department of Physics and College of Engineering; University of South Dakota's (USD's) Sanford School of Medicine, Division of Basic Biomedical Sciences. Major funding was provided by South Dakota Governor's Office of Economic Development. Additional support was provided by BHSU, the National Science Foundation through South Dakota's Experimental Program to Stimulate Competitive Research (SD EPSCoR), and Vernier Software and Technology.

Web Site: <http://www.camse.org/scienceonthemove/>

Core Academic Areas/Grade Level:

All strands of science; grades 5-12

Goal:

The primary goal of Science on the Move was to provide high quality, cutting edge science to students in South Dakota schools, especially those students in small, rural schools. The MSL's provided SD students with an opportunity to perform science activities using advanced equipment, technology, and methods usually not available in small schools.

By doing so, the program helped to excite students and teachers about science and encouraged students to consider science as a possible career choice.

Week-long workshops were held in the summer to acquaint teachers with the equipment and technology aboard the MSL's. Teachers who attended these workshops then had the opportunity to schedule the MSL at their school.

Program & Benefits:

Each mobile lab was outfitted with state-of-the-art science equipment making it feasible for students and teachers to do hands-on investigations that would not have been possible in the regular classroom. The mobile labs had 11 built-in lab stations equipped with computers. Additionally, 10 laptop computers were available for use in classrooms. Using the project's equipment, students could perform a wide variety of lab activities in biology, chemistry, physics, and earth science. Vernier LabPro equipment was used for real-time measurement and graphing of a wide range of data. DNA electrophoresis equipment provided for investigations in molecular biology. Oil-immersion microscopes, GPS units, spectrophotometers, spectroscopes, radiation monitors, and other cutting-edge tools were also available.

Benefits for Teachers: Teachers participating in this program benefited in several ways: (1) increased content knowledge and increased awareness of high-tech science equipment, (2) access to equipment and inquiry-based activities that were unavailable to them at their school (3) increased teacher confidence in their ability to deliver instruction, and (4) support from a community of teachers that shared a common goal and vision for instruction.

Benefits for Students: Students benefited in increased content knowledge and improved attitudes toward science. Education research shows that in order for students to develop a deep understanding of science they need to be actively engaged in science. The MSL program followed that model by focusing on inquiry-based laboratories and activities that could easily be incorporated into the school curriculum.

Background:

In 2002, a group of professors and business professionals from across South Dakota decided that there was a serious need to improve science opportunities for students across the state, especially those students in small, rural schools. Their vision became reality when former Governor William Janklow allocated funds for the construction of the Mobile Science Labs.

Under the direction of Governor Janklow and members of the Math, Science and Technology Council, two 53-foot semi-trailer trucks were converted into mobile labs. Funding for the projects was provided through the Governor's Office of Economic Development and private dollars. The costs to construct the labs were kept low by utilizing inmates at Mike Durfee State Prison, who completed much of their construction. The computers and electronics were installed by instructors at Mitchell Technical Institute.

In February 2003, hoping that the new labs would spark students' interest in science and technology, the mobile science labs began traveling the state and visiting schools. During this time activities were piloted and refined to fit the needs of students and teachers.

During the summer of 2003, a summer training program began as a means of introducing teachers to the equipment and activities available onboard the traveling labs. A summer institute was held at 3 locations around the state (SDSU, USD, and BHSU). Seventy-two teachers attended these 1-week summer institutes and were designated the first official "Science on the Move Teachers." This designation entitled their school to a visit from the Mobile Science Lab during the following school year.

In the summer of 2004, "Science on the Move Teachers" were invited to return for a second year of training, dubbed the "MSL Veteran Teacher Summer Institute." A new cadre of South Dakota Science teachers also attended "new teacher" training. Fourteen of the initial 72 teachers elected to return for year two "Veteran" training, and there was an overwhelming response for the new teacher training -- over 100 applications for 35 spots available.

The summer of 2005 again provided 3 training opportunities for new teachers. All were quickly filled; adding 100 new Science on the Move teachers to the pool of eligible teachers. In 2006, 44 new teachers were trained and in 2007, 94 more. During the summer of 2008, the final summer institute, 55 new teachers were in attendance. Over the six summers (2003 through 2008), a total of 414 teachers attended the Mobile Science Lab summer Institutes.

While the summer training institutes were deemed successful, the number of teachers eligible for mobile science lab visits did present scheduling challenges. Other challenges came in the form of equipment and weather.

Lessons Learned:

- Teacher Involvement. Teachers must be involved in the planning, development, and implementation of the program. In our case, elementary, middle school, and high school teachers were not truly involved until

after the trucks were outfitted and most of the equipment was already purchased. A handful of teachers were involved as part of the curriculum committee, but they were limited somewhat by having to design activities that could utilize the existing equipment and space. Though the program has been a success, we still feel that early teacher involvement is essential.

- Advanced Planning. Each MSL had several sets of lab manuals and binders containing available lab activities. These were mailed to teachers prior to the MSL visit to ensure that the activities chosen matched the curriculum standards, were likely to enhance student learning, and that all consumable items were on the MSL prior to the school visit. Once the activity/activities were chosen, it was the responsibility of the teacher to make an adequate number of copies of the lab for their students. The teacher then mailed the lab manuals to the next teacher on the list so it would be received in advance of their MSL visit. This type of advanced planning was vital to success. Often small schools are geographically isolated, so running to the store to get an item was not an option.

Additionally, with more than 400 teachers eligible for school visits, allocating a specific number of days to a school visit required much forethought and planning. The number of requests dictated that schools could only get one visit from the mobile science labs per school year. In order to use this time effectively, teachers/schools were asked to provide a plan of use. This outlined how many teachers were planning activities, which activities were planned and how many students would be served. Every attempt was made to utilize the MSLs fully for one or more days at each site visit. Since some of the equipment onboard the MSLs could be moved into a classroom, several classes could be held concurrently. Priority was given to school visits that could take the fullest advantage of the program day. Community open houses were encouraged and held whenever possible as a way to involve the entire community in science.

- Scheduling. The state of South Dakota covers roughly 77,000 square miles. With such a vast area to cover and numerous requests for visits, scheduling was designed to optimize the number of schools that could be visited each year. Unfortunately, this meant that school visits were scheduled geographically. This type of scheduling required flexibility by the teachers involved. For example, if a teacher's wish was to have the students complete an activity involving electrophoresis, that teacher had to structure their school year curriculum to teach that content around the time of the MSL visit.

- Time. Time is crucial to conducting any type of lab activity. For this reason the MSL curriculum was primarily composed of activities that could be done in a typical science period of 45-50 minutes. However, this was active working time; this did not include time for getting to the truck, the taking of attendance, etc. Consequently, there were popular activities that did require more time, thus requiring teachers to either get creative or, in some cases, or to drop the lab activity from consideration. Furthermore, it was crucial to plan ahead so that that MSL staff could prepare the necessary chemical solutions, gather necessary supplies, and troubleshoot equipment to ensure students had time to complete the activity.

- Class Size. The number of students in a class only became an issue when there were more than 22 students on board the mobile science labs. At this point overcrowding caused some problems as there were only 11 lab stations on each mobile lab. And though the stations were staggered so they weren't one behind the other, there needed to be room for an instructor (or two) to move about the student groups.

- Before and After. As part of the summer training institutes, teachers were encouraged to plan activities/instruction that would happen both before and after the Mobile science lab visits; preparing students for the upcoming visit or providing continuation of the concepts, or closure to the unit of study. The expectation was that the MSL's would provide enrichment to the current curriculum and not be the only curriculum. However, some follow-up activities required equipment not owned by the schools and not

available once the MSLs left, making this difficult at times.

- Equipment. Equipment such as power inverters, heating/cooling units, etc. needed to be designed for use in a particular climate. For example, the power inverters on the MSL's would not function below freezing (and they put them on trucks that operate in SD year round!) Keeping the trucks functioning, especially in extreme weather, had its challenges; but with the inventive use of space heaters and portable fans, occupants were kept comfortable and the equipment functioning. Of course, gelled diesel fuel in the truck, generator problems, and Department of Transportation inspections sometimes interfered with normal operations.

- Weather. The weather could be an issue, especially during the winter months in South Dakota. If the temperature was below 40 degrees the trucks had to be plugged into outlets to operate engine block heaters. Every effort was made to arrive for scheduled visits; however, a semi tractor trailer just is not made to travel some icy or snow-covered roads. Additionally, if the school to be visited canceled classes due to weather that school often had to lose its MSL visit so that the remaining school visits could be kept on schedule.

- General Requirements. Several other requirements deserve mention:

Parking Space. The mobile science labs were over 70 feet long and had a wide turning radius. There had to be enough space to accommodate the lab and provide easy in and out access. Additionally, the space needed to be relatively level.

Transportation. Once the MSL was set up at a school, it became immobile. Transportation was necessary for the MSL-based instructor to travel to hotels, dining establishments, local stores etc. while the lab remained at the school.

Water. Access to water is essential for most science activities. In the case of the MSLs, there were sinks onboard, but not running water. To solve this, several 3-5 gallon portable water containers were used to provide the water necessary for activities and cleanup.

Waste. The mobile science labs did not have gray water tanks. Any liquid waste generated during science activities was collected in dump buckets for proper disposal.