Paper presented at 2004
International Conference on Engineering Education
October 17 – 21, 2004
University of Florida, Gainesville

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Science and Engineering Expo
Idaho Falls, Idaho, USA

Abstract

The Science and Engineering Expo is a carnival of hands -on activities and interactive demonstrations that feature new developments in science and state -of-the-art technology. It immerses K -12 students in science and engineering careers. The Idaho National Engineering and Environmental Laboratory and Museum of Idaho, USA, have teamed up to deliver the 2004 Expo. My presentation will report highlights, share the model, and explain how student learning in science and engineering is advanced.

Introduction

The Idaho National Engineering and Environmental Laboratory (INEEL) has been home to one of the largest concentrations of technical professionals in the northern Rocky Mountain region for more than 50 years. Currently operated by Bechtel BWXT Idaho, LLC for the U. S. Department of Energy, it is the scene of some of the most advanced research programs in the world. By linking the scientists and engineers, academia, and other professionals, the Science and Engineering Expo helps to foster science and engineering literacy and develop a world-class future workforce.

Objectives of the INEEL Science and Engineering Expo

- Introduce teachers to multidisciplinary information and resources with whom they can develop lasting relationships and enhance their teaching of science, mathematics, and technology.
- Influence grade 7 – 12 students to act on their academic and employment interests in science, mathematics, engineering, and technology.
- Excite grade K-6 students' interests and thoughts about science, mathematics, engineering, and technology.
- Inform families and encourage their participation in science-, mathematics-, engineering-, and technology-related activities.
- Encourage communications between technical experts and students of all ages by showing new developments in science and state-of-the art technology in the community.

A Replicable Model of the INEEL Science and Engineering Expo

1. Identify one or more strategic partners. A strategic partner will assist with the design and execution of the science and technology program, and assist with logistics as related to that partner. In 2004, the Idaho Section of the American Nuclear Society joined the INEEL as a strategic partner.

2. Establish budget and costs. Average annual costs for the INEEL Expo are $200,000 but labor and location are two major cost contributors. Establish a fund-raising plan, if needed. Annually, more than 50 corporate supporters and sponsors contribute $80,000 - $90,000 in cash and cost sharing to the INEEL Science and Engineering Expo.

3. Determine location. The site of the Expo must be large enough to manage the Expo exhibit program and the attendance according to safety regulations. A 10,000 square foot facility, for example, can handle 2,000 people at one time. The site must be visible to draw attention to the Expo, accessible so visitors can find it, and have ample parking for school busses and other vehicles.

4. Determine the scope of the geographic region for the intended audience and establish a communications or promotions plan. Idaho is a rural state. It is divided into six school regions. The INEEL Science and Engineering Expo focuses on the southeastern section of Idaho that includes school regions five and six. This section borders the states of Montana, Wyoming, and Utah.

5. Determine the schedule. The Science and Engineering Expo should be held during the school year so schools can register and bus their students to attend. The INEEL Expo is held over three days during September or October. Thursday and Friday are Student Days and Saturday is Family Day. Daily hours are 9 a.m. – 5 p.m.

6. Establish a system to register and schedule schools and thereby, manage the visitor flow. Consider the human impact on the Expo. The intention of the INEEL Science and Engineering Expo is to expose middle school-aged students to various science subjects and technologies that will stimulate them to consider careers in science, mathematics, engineering, and technology. To make it attractive, the INEEL Science and Engineering Expo is designed as a carnival of hands-on activities, interactive exhibits and demonstrations, and crowd-pleasing presentations. It is an immersion experience. Therefore, it is important to design a learning environment that is not only fun, but also conducive to learning. If students stand ten-deep at a learning station, they do not receive the intended benefit.

7. Establish a theme, the program, and the size of the program. Universities, professional societies, and businesses that represent local, regional, and national interests are invited to populate the INEEL Expo with learning stations. These organizations come together to demonstrate scholarship and technical expertise.

Their experts staff 50 – 60 learning stations in various scientific disciplines, mathematics, engineering, air and space, energy, robotics, computer and medical technology, and more.

8. Design an Exhibitor Registration Form. Exhibitors must register to participate in the INEEL Expo, and upon their acceptance, they are included in the proceedings with an abstract. Organizers of an Expo need to determine equipment and safety needs and they can get this off the registration form. Additionally, the different indoor and outdoor activities described on the Exhibitor Registration Form help to establish a schedule of features that can be used to promote the entire Expo.

9. Establish the program-to-school link. In Idaho, it is important for schools to meet state standards. The INEEL Science and Engineering Expo is a high-impact way to augment the teaching of a traditional science and technology curriculum in K-12 schools. Therefore, the objective of each learning station is linked to at least one of the National Science Education Content Standards and correlated Idaho State Achievement Strands.

10. Set standards for the exhibitors. Standards that exhibitors can meet add much value to the quality of their learning stations and interactions with the visitors. Add some competitive fun by recruiting an interdisciplinary team of judges to evaluate the stations on visual and presentational impact, technical merit, and education value. Award 1st, 2nd, and 3rd place ribbons. Recipients of the Best of Show at the INEEL Science and Engineering Expo take home a traveling trophy for one year.

11. Establish a system to evaluate the Expo. Because of the investment of so many contributors in the Expo, it is important to determine if it was the right thing to do and if so, how it can be improved. A brief survey instrument is given to each student and adult who exits the INEEL Science and Engineering Expo through the Evaluation Station. The instrument asks for demographics to check the education outreach strategy and attendance distribution. The instrument also asks two questions that check appeal or preference. Their intent is to simply find out what students liked the best at the Expo and what interests them the most. The distribution of a representative random sample of answers is compared to the intention of the Expo – to interest students, their teachers, and parents in potential career options in science, mathematics, engineering, and technology. At the INEEL Expo, completed surveys are entered into drawings for teacher and family prizes, and students are invited to select a souvenir as our way of saying “thank you” for coming.

12. Kick-off the Expo. Design an event that will invite special guests to the Expo site to preview the set up and interact with the exhibitors. The INEEL Science and Engineering Expo starts off with a short program and reception for the media, community leaders, corporate sponsors, the exhibitors, teachers, and volunteers.

This event is a celebration of science that gets everyone in the mood and gives the safety engineers another chance to walk down the Expo floor. Guests take away a copy of the proceedings in anticipation of returning on Family Day.

Advancement of Student Learning in Science and Engineering and 2003 Data

An Expo designed to feed the pipeline with students in science, mathematics, engineering, and technology must go beyond exposing and interesting students in these fields. It must assist teachers with follow-through. The INEEL Exhibitor Registration Form, for example, asks for two or three questions from the exhibitors about the learning activity. It is the expectation that an answer to the question will determine whether or not, or to what degree, the student learned.

Once all of the Exhibitor Registration Forms are received at the INEEL, a set of carefully selected questions is given to the teachers prior to their arrival at the Expo. Teachers are able to see how the activities will tie into their teaching and they can use the questions as advanced organizers for student learning.

After the Expo and students return to their classrooms, teachers are able to review the answers to the questions and check their level of learning. Additional follow through is available to teachers through the contacts they make at the learning stations.

The report data for the 2003 INEEL Science and Engineering Expo revealed more of an audience size than the expected 5,000 visitors. Total attendance was firmly estimated at 2,500 adults and 5,000 students. Table 1 shows a comparison between the registered school attendance and actual attendance as evidenced on the sample of evaluation survey instruments.

Table 1
Geographic Attendance Distribution

Representation	**Quantity**	**Registered Attendance**	**Quantity**	**Actual Attendance**
States	1	Idaho	4	Idaho Montana Utah Wyoming
Counties	8	Bannock Bingham Bonneville Butte Jefferson Lemhi Madison Teton	12	Ada Bannock Bingham Bonneville Butte Clark Fremont Jefferson Lk PendOreille Lemhi Madison Teton

School Districts	14	 21, 25 55, 60 91, 92, 93 111 251, 252 291 321, 322 401	20	2 21, 25 52, 55, 59, 60 84 91, 92, 93 111 161 215 251, 252, 253 321, 322 401
Schools	32	*	99	*

*Note. List available upon request.

Adult Age and Gender Demographics

People ranged in age from 2 to 71 years old. The category of adults is defined as 18 years of age and older. Evaluation survey instruments were completed by 367 adults; 208 adults or 57% provided the age demographic. Frequency distributions of adult/parent and teacher/chaperone categories showed that the modal adult age range was 36 – 40.

Three hundred one (301) or 82% of the collapsed categories of adults (adults/parents and teachers/chaperones) provided the gender demographic. Overall, the number of female adults (235) was more than triple the number of male (66) adult visitors. The number of female teachers/chaperones (160) was more than five times the number of male (29) teacher/chaperones.

Student/Child Age and Gender Demographics

The category of students is defined by the range of 2 – 17 years of age. Nine hundred ninety-four (994) or 96.5% of the student sample provided the age demographic. The frequency distribution showed that the modal student age range was 10 – 13 with 11 and 12 year old students predominating the range.

Nine hundred forty (940) or 91% of the student sample provided the gender demographic. Gender was distributed rather evenly with 478 boys and 462 girls.

Audience appeal or preference data were generated by two questions:

- What exhibit or demonstration event did you like the best?
- Which field of science interests you most?

Table 2 shows a comparison of all adult and all student preferences and interests.

Table 2
Comparison of Adult and Student Preferences and Interests

Collapsed Adult/Teacher Categories		Collapsed Student/Child Categories	
Liked Best	**Interests**	**Liked Best**	**Interests**
Medical	Medical	Medical	Flight/Space
Environmental	Biology	Environmental	Environmental
*Robotics	Flight/Space	NASA Starship	Medical
*Energy	Engineering/Technologies	Energy	Chemistry
*Everything	Chemistry	History	Energy

*Note. Preferences received the same score. Due to overcrowding, some school buses were diverted and students were not able to see and participate in robotics activities.

The top two **Liked Best** preferences in Tables 2 were consistent with the results of the judging process.

Preferences were linked to National Science Education Content Standards for grade levels 5 – 9 as follows with the most preferred content area being Life Science:

- Science as Inquiry
- Physical Science
- Life Science
- Earth and Space Science
- Science and Technology
- Science in Personal and Social Perspectives
- History and Nature of Science

What interests the Expo audience is not necessarily a one-for-one correlation with what they liked the best. Students/children said that they were **most** interested in aviation, aeronautics, aerospace, and astronomy in association with the Wright Flyer, Unmanned Aerial Vehicle flight simulator, and NASA Starship 2040 activities and exhibits. This is a validation of the Expo theme and suggestion that the activities and exhibit personnel did have a measurable influence on the students. In 2003, the Expo theme was Earth's Atmosphere and Beyond.

Refer to Table 3 for the return data generated by the question: Would you like to attend the Science and Engineering Expo again next year? There were 1,242 total responses to the question. Answers were stratified by responding categories: adults/parents, teachers/chaperones, and students/children.

Table 3
2004 Projected Return Attendance Data

	Yes	**Unsure**	**No**
Total 1,242	99% 1,225	6	11
Adults/Parents 142	100% 142		
Teachers/Chaperones 199	97% 194	4	1
Students/Children 901	99% 889	2	10

Highlights of the 2004 INEEL Science and Engineering Expo

The presentation will highlight features of the fourth annual INEEL Science and Engineering Expo that took place on September 23 – 25, 2004.