NEF GRANT APPLICATION FORM

Project Title: Bridge Building in the Classroom

Amount of funding requested from NEF: $3331.44

Applicant name(s) and association with school(s):
Chris Dancy, Jen Grant, Steve Miller and Jon Wettstone
Pollard Middle School 6th grade science department

School based partner (if applicant is not a Needham Public School employee):
n/a

School(s)/groups targeted for grant:
All 6th grade students

Approx. # of students impacted: 400 students annually

Project Leader(s): Chris Dancy, Jen Grant, Steve Miller, Jon Wettstone

Grant Manager/Contact person: Steve Miller
Email Address: steve_miller@needham.k12.ma.us

Secretary/Bookkeeper with access to Town's financial system (usually one of the school secretaries or Department secretaries.)
Dianne List, Pollard Middle School Main Office

Abstract of Grant:

Following the new district-wide goal of incorporating technology and engineering into the classroom, and in an effort to better align ourselves with the Technology/Engineering strand of the Massachusetts Curriculum Frameworks, this year Needham's sixth grade science department will begin teaching a new unit entitled "Bridges and Structures". After detailed discussions about what the unit should include and what the lessons should cover, the sixth grade science teachers developed a unit designed to fit within our existing budget.

While this does allow us to include the classic "popsicle stick bridge" exercise, we feel there are a number of limitations to having this be the only design section of this unit. Because students design and build only one popsicle stick bridge, it does not allow students to experiment with different designs or create prototypes. Also, since the popsicle bridge exercise is typically performed as a competition, whose rubric includes maximizing the load the bridge can carry, students tend to use only one design, the truss bridge.

If approved, this grant would allow us to purchase reusable kits which allow student teams to create seven different bridge prototypes and 5-6 foot long replicas of real world bridges. Through experimentation, the student teams will be able to investigate the load capacity of the different style bridges and analyze the strength and stability of each bridge style.

Benefits

The materials requested in this grant are designed to develop practical building skills and the hands-on component will allow students to make real connections to the curriculum. Building a number of different style bridges will make the vocabulary (and the entire unit) more memorable for the students, who will be tested on this material two years later in the 8th grade MCAS. Since different students can be assigned different roles, it allows for differentiated instruction, and fosters teamwork between partners. Because the models are made using magnetic balls and rods, they are reusable year after year, and are easy to break down again for storage. Most important, however, is that we will be able to address additional standards using these kits. These standards are discussed in the *Details* section of our application.

Since the Bridges and Structures unit has already been approved, all sixth grade science teachers will teach it every year, beginning in this 2006-2007 school year. If funded, this grant will impact all sixth grade students (approximately 370 per year), both this year and in years to come.

Details of Proposed Project

As stated earlier, this project is directly related to the district's goal of incorporating technology and engineering into the classroom. It will provide a hands-on focus to our new curriculum unit on bridges and structures. All sixth grade science teachers will be involved with the materials as a central part of their instruction.

Use of the materials will have the following goals:

1. To expose students to physical representations of the different types of bridges.
2. To allow students to interpret diagrams in the construction of prototypes of different bridge types.
3. To allow students to test different styles of bridges for load, stability, and strength.
4. To allow students to investigate tension and compression of different style bridges.
5. To allow students to develop teamwork and other interpersonal skills.

The small kits will allow students to work in pairs to construct 7 different bridge models, one at a time. The kits allow students to perform experiments to compare the load bearing, stability, and strength of each bridge type. The large kits will allow each cluster to make 5-6 replicas of real world bridges. Within each cluster, each science class will be divided into six 4-students groups, each of which will be assigned a specific bridge type to build. As classes rotate, new student groups will continue the work of the class before them until the bridges are completed. Once completed, the bridges can be tested in individual classes to evaluate load bearing, stability and strength.

We have included a sample unit plan which includes the use of the materials requested in this application (see attached).

Below is a listing of the Massachusetts Curriculum Frameworks (Technology and Engineering Strand) directly addressed by the use of these materials:

[118STE] 2.1 Identify and explain the steps of the engineering process, i.e., identify the need or problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.

[120STE] 2.3 Describe and explain the purpose of a given prototype

[338STE] 1.5 Interpret plans, diagrams, and working drawings in the construction of a prototype.

[135STE] 5.4 Describe and explain the effects of load and structural shapes on bridges.

Proposed Schedule

We anticipate starting the Bridges and Structures until in mid-May, and would therefore order the materials as soon as funding became available. The materials would then be used annually by all sixth grade teachers during this unit.

Specific Methods of Evaluation

The teachers would use observation of student involvement, as well as class discussion and specific written assignments, to ensure the activities translate into better understanding of the unit's essential questions. Sixth grade teachers would meet after completion of the unit to evaluate the benefits of the materials, and discuss ways they may be used most effectively.

Budget

Project Title: Bridge Building in the Classroom

Total Project Budget: $3331.44

Total NEF Funds Requested: $3331.44

Expense Category	Detailed description of Expense (use separate sheet if necessary)	Amount(s) Requested from NEF	Amount(s) Requested from Other Sources	Total Project Funding
Stipends				
Materials		$3331.44		$3331.44
Equipment				
Fees				
Other (Specify)				
Total				

DETAILED MATERIALS LIST
(use additional sheets as necessary)

Item name	#	Price	Total
Intro to Structures: Bridges	48	22.50	1080.00
Shipping & Handling			73.44
Real Bridge Building	12	165.00	1980.00
Shipping & Handling			198.00
Total Materials			**3331.44**

Bridges & Structures

Lesson Sequence (1.5 Week Unit)

** All articles, handouts, activities, and guides can be found in the packet provided. **

Day 1: Bridges & Structures Introduction

1. Essential Questions – ask for student input and possible answers
2. Bridges Vocabulary – have students search and generate their own definitions using the packets provided.
3. Homework: complete vocabulary & make flashcards

Day 2: How Bridges Work

1. Check & Review Bridge Vocabulary
2. Read – "How Bridges Work"
3. Bridge Types – ask students for examples of each type in their own neighborhood or area.
4. Homework – review vocabulary flashcards

Day 3: Bridge Type

1. Read pages 4-12 on bridge types & complete the "Types of Bridges" sheet.
2. Homework – complete "Types of Bridges" if needed.

Day 4: Bridge Type Review

1. Check & Review "Types of Bridges" sheet.
2. Read and discuss The Roman Arch – page 18
3. Bridge Challenge – page 13-14 (or online)
4. Vocabulary Flashcard Challenge

Day 5: Bridge Forces

1. Read "Additional Bridge Forces" sheet & answer questions on corresponding page.
2. Homework – complete "Bridge Forces" question sheet if needed.

Day 6-12: Small Bridge Building

1. Choose one of the 7 small kit bridge designs
   - Create a construction plan
   - Assign tasks for group
   - Carry out construction of bridge type
   - Test for load, strength, and stability
   - Self-reflection

Day 13-15: Large Bridge Building

1. Students are assigned one of 6 different real-world bridges
   Create a construction plan
   Assign tasks for group
   Carry out construction of bridge type
   Self-reflection

Day 16-17: Testing Loads, Strength, Stability of Large Bridge Designs

1. With assistance, students create data tables to record information
2. Students conduct individual tests for strength, stability, and load of different bridge types constructed on days 13-15
3. Class discussion of findings.

Day 18: Bridge Building Overview

1. Check & review "Bridge Forces" question sheet.
2. Bridge Building Project Guidelines – page 15
   - Discuss partner and bridge guidelines
   - Show students the internet resources available
   - Demonstrate how to connect sticks with glue
   - Demonstrate how they will test their bridges w/ a sample bridge
3. Have students obtain their group materials and begin building

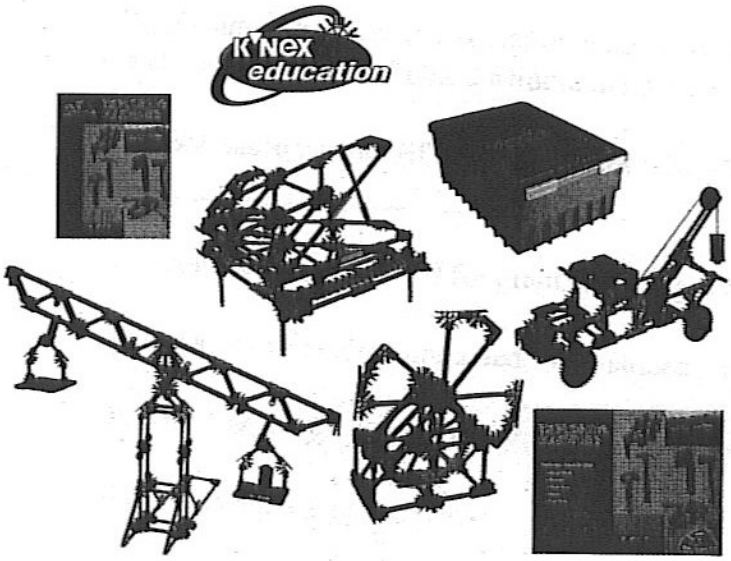
Day 19-20: Bridge Building Work Days

1. Students work with partner to build their bridges
2. Remind students of qualification requirements in length and mass.

Day 21: Bridge Testing

1. Students will test their bridges for mass qualifications – less than 100 grams
2. Students will test their bridges for length qualifications – at least 40+ cm long
3. Students will test their bridges for load capabilities – whose can hold the most pennies?

K'NEX Activity Sets



Exploring Machines

Explore Gears, Levers, Pulleys, Ramps, Wedges, and Wheels

A comprehensive set of 1460 K'NEX pieces that lets up to four simultaneous student groups explore simple machines. The teacher's guide is written to help teachers meet NSES standards and contains both key facts and inquiry-based lesson plans. Four copies of the master building book are included to allow 12-16 students to work on each project. 30 models demonstrate 1st, 2nd, and 3rd class levers, fixed, movable, compound, and block & tackle pulley systems, wheels and axles, inclined planes, screws and wedges, and 5 different gear systems.

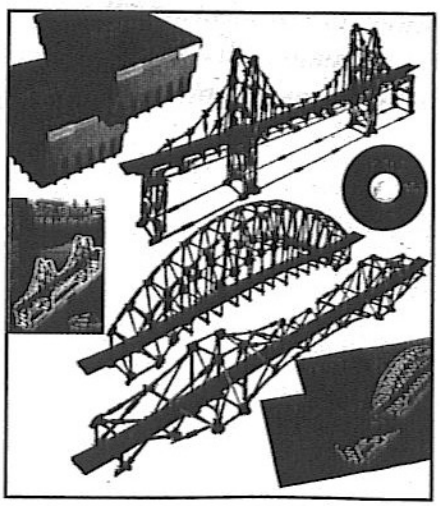
WL7605K **$125.00**

Forces, Energy & Motion

Students Build Powered Vehicles to Investigate Potential and Kinetic Energy

Using the 790 pieces of this kit, students build 6 different designs of rubber band and spring powered vehicles. They include a rubber band roller, 2 different rubber band racers, and 3 different spring motor turbo racers. Up to 4 of any one model can be built simultaneously, allowing 12–16 students to participate. Instructions for each model, and an 80-page Educator Guide with 8 extensive lesson plans suitable up to grade 9, are included. The investigations relate to mass & weight, Hooke's Law and elasticity, inertia & friction, energy conversion & conservation, and more. Set includes reproducible student worksheets and a plastic storage tub.

WL7605E **$125.00**



Real Bridge Building

Build Five-Six Foot Replicas of Seven Real World Bridges

This 2282-piece K'NEX set supports two simultaneous groups of 3-4 students building large models of seven different kinds of famous real-world bridges. Suitable for grades 5-8, the set includes a teacher's guide, building instructions on a CD-ROM and in printed copy, and two large customized storage trays with transparent lockable lids. The set focuses on design briefs, the exploration of tension and compression, and the stress aspects of large structures.

WL7605L **$165.00**

Stackable Storage Cases

Compartmented plastic storage trays with dividers and lockable lids.

Red	17 x 12 x 4.05"	**WL7605R**	**$8.00**
Silver	17 x 12 x 4.05"	**WL7605T**	**$14.50**