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Bridging the Math Gap

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My unit of the Bridge Seminar is the relationship between what is taught in math on the middle grade level, and the possibilities of the applications. The driving force in mathematics as it is presently taught, is the National Council of Mathematics Teachers (NCTM) and each state's own assessment tool. In addition to this, we have our district's mandates to achieve and teach the student. Federal laws dictate students' educational access, which must show that the maximum numbers of students are being serviced in the least restrictive environment. More recently, mathematics is being viewed as an indicator of success. Recent studies have drawn parallels between algebra on the middle school level, calculus in high school level and college graduation. The focal issue is the ability to problem solve. Problem solving is directly tied to critical thinking skills. Because critical thinking is a skill, it can be taught. However, the critical part is the connections, adaptations, and variations of the task at hand to develop a solution.

How often have you heard students say, "I am not good at math, I don't like it". What they are really saying is, their conceptual understanding of math is weak, and they are not able to make the transition, connection, application for math to be useful. That statement is perception. Perception is no more than the way one views a situation, subject, and or events.

When math is taught from one point of view, it is not open to another way of looking at the problem or situation. If the same thought process is not followed then success might be hampered. Yet, if a thorough understanding of the task and the process needed to complete it are gained, so does the rate of success. Understanding of the concept is communicated through clear, concise, logical steps to complete the task.

Success has an affect on how a student view's a task. If the student has been successful at the task or one similar, they perceive success for completing the task successfully. Success has changed their perspective of the task or those similar. What is different? The student's experience has broaden their prior knowledge, this knowledge base provides a point of reference that is easy to recall. But none of this is possible without trying the task, and learning through some form of success. I tell my students, "Even a clock that does not work is correct twice a day." Then we discuss interpretations of the statement. I share my thoughts, which are, you cannot be wrong all the time, and through errors we still learn if you learn from a situation there are no mistakes. The same statement can be said for math, education, sports, hobbies and life. As educators, we must strive to reach them and change that perception. In order to improve yourself you must work at it, the same applies to any skill.

Modality of a lesson becomes very important. Recognizing the various types of learners, and trying to incorporate the chance for success, will encourage them to try. Lessons are designed to incorporate math but not overwhelm the idea of math. Lesson presentation will be of the following nature: mathematical for the concrete, inquisitive learner; spatial for the visual, puzzle, problem-solver, bodily kinetic for the energized, inter-personal allows constructive dialog for the verbal learner, and linguistics for the students whose strength is in written communication. I feel these variations of cross lesson styles allow all students a medium to begin to experience math in a non-threatening manner. Once this is achieved, you are halfway through the task. The task must begin small and increase in difficulty until the final project and culmination of the unit.

This unit tries to incorporate increased opportunities for success that will encourage students to try the lesson. The mathematical goals to be addressed in this unit are number sense, ratio, proportion, scale, blueprint making, design of bridge and variable representation of calculations. This unit will align it's content with NCTM standards and the New Haven Board of Education District's goals. Each test is trying to gauge how well the student can, calculate, interpret, apply and communicate math. The test objective is critical thinking skills. Critical thinking skills are the hardest and most important skill to teach.

Critical thinking will be taught through problem solving driven lessons. Problem solving techniques will be addressed through out the year's curriculum. The seven main steps are stressed and students are encouraged to apply them. Read the problem, re-read for understanding, determine what is being asked, determine the facts, develop a strategy, test strategy and check to see if the solution solves the problem, if not check process used to solve the problem. Students will maintain a notebook, which will become their reference guide. In mathematics and problem solving the process and defending your answer is very important. If you believe that the degree of mathematics has anything to do with life's success, then it is paramount to develop critical thinkers.

Most students develop math phobia at an early age. Many parents will tell you, "They were terrible math students, who did not like math. They never understood it". My interpretation is, the "it" refers to the math concepts being conveyed. The Bridge Curriculum Unit will address the basic skills of number sense through various venues. This unit will help to change how my students view math. Using real world applications solves the questions when will this ever be used and by whom? Through this unit the student will begin to understand the math concepts through application in context.

The stated goals will be achieved through student's participation in the Bridge design unit. There will be a stated problem with parameters that will encourage the student to think of possible solutions and decide on one to try and construct. The model will be tested for strength and weight to load ratio. Lessons are to encourage understanding through math, science exploration and manipulations. If the student develops prior knowledge then that will enhance conceptual understanding.

The connection to mathematics is the big picture, where you can communicate mathematical ideas in a logic coherent manner. The lessons will involve drawing, number line theory, fractions, decimals, ratio, and proportion. Vocabulary is an integral aspect of learning mathematics. Similar to many subjects, math has its own meanings for words; comprehension of the vocabulary may be one of the keys to unlocking mathematical success.

The vehicle that will generate the topics for discussion will be engineering. Engineering is the study of science whose main objective is to make society's endeavors easier. Civil engineering is the discipline that deals with bridge planning and use. Bridges are used to cover gaps, connect communities, environments, and societies.

Why are bridges built? Bridges are built to carry roadways across rivers, valleys and other obstacles. Not all bridges are manmade; some are done by nature. If a tree falls across a stream and it is wide enough and strong enough to carry a live load, it maybe considered a bridge. Why? It allows people or transportation to cross from one side to another. There are many different types of bridges and the type explored in this unit is the Truss Bridge design.

Background on Bridge Type

Bridges are based on one or more of three basic structures that are derived from forms found in nature: beam from a log fallen across a stream, the arch from natural rock formations, and suspension from vines.1 Underneath all concrete and steel that bridges are made of today, the same basic ideas still apply.

Different Types of Beam Bridges:

Beam Bridges:

Types of beam bridges include cantilever bridges, which can extend over long distances. Cantilever bridge is a balanced structure extending out diagonally on both sides of a pier. The sections meet in the middle or are supported by a center span. The cantilever is counterbalanced for added strength, which allows the bridge to cover greater distances. Beam and cantilever bridges can be formed from a truss, a rigid structure usually built from triangles. A simple beam bridge is flat across and supported at two ends. A longer beam bridge may also be held up along its middle by piers that stand in the river. The weight of that bridge by itself, plus any load it carries, plus gravity, are the downward forces that are spread across the length of the bridge. The upward forces that hold the bridge up comes from the pier.

There are several common variations of the beam bridge mentioned above. A Clapper Bridge is simple, shallow kind of Beam Bridge that connects "stepping stones" across the stream. A floating pontoon bridge is another kind of Beam Bridge, supported by upward forces of water. Another type of Beam Bridge is the truss, which is lightweight but strong because of the open, diagonal (or triangular) elements along the sides.

Truss Bridges:

Truss bridges are based on the fact that a triangle cannot be twisted or distorted. And, by putting triangles next to each other, their strength becomes even greater. The most common truss combination is a "king post" which is the vertical support that results when two triangles share the same side. Each length of wood that goes into making a truss is called a member. The long horizontal members are called chords. The vertical members are called the posts. The slanting members are diagonals. Two kinds of stress are involved in truss construction: tension and compression. A member being pulled is under tension; a member bearing weight is under compression.2

Truss bridges can be traced back to Italy when, in the1500's architect Andrea Palladio worked out the principles of wooden trusses in Treatise de Architecture. Italian bridge builders disregarded Palladio's work because they preferred to work with masonry and stone. In 1742 Palladio's ideas made it to America and became very popular. America had plenty of wood and plenty of carpenters who could construct bridges. After 1850, bridge traffic increased, and loads became heavier and truss had to be made stronger. Wood was replaced by cast iron and eventually wrought iron. During the 1870's one in every four wrought iron bridges in America collapsed. Today truss bridges are made from steel or reinforced concrete.

Arch Bridges

There are three types of arches, the false arch, the ribbed arch, and the true arch. The false arch resembles a pair of steps meeting in the middle. If weight were placed on top, the arch would probably not support it. A true arch is made up of wedged bricks (voissoirs) fitted together between vertical supports.3 The ribbed arch is formed as a series of arch openings, sharing a common wall with next arch. True arches are built in from the end, towards the middle, using a wood frame called "false work". The final wedge, known as the keystone, is set in place at the keystone, is set in place at the top of the arch. Then sidewalls (spandrels) are built up between the arches and filled with rubble.

Ribbed arches are actually several rows of arches next to each other. Long, flat stones are laid across the ribs for support. This technique reduces the weight of the arch and cuts construction time and materials. Arch bridges also originated in China, due to its rainy season and the affects on beam bridges. Arch shapes openings were the solution because they allowed floodwaters to flow without taking the bridge with them. An added benefit of an arch bridge was they could be made extremely strong using a minimum of materials. Romans brought arch bridges to Europe. The Romans' most innovative arch bridge wasn't actually a bridge to travel on but to carry water. This type of system is called an aqueduct.

Suspension Bridges

Suspension bridges are capable of spanning great distances using a minimum of material. They can be built high enough to let large ships pass underneath. The result is a bridge with a graceful appearance and a feeling of strength. Years after construction, additional decks can be added to handle increasing traffic. Suspension bridges sag unless the load is distributed along the length of the bridge. A stiffening truss below the bridge's deck helps distribute the load evenly and stabilize the bridge in high winds. The cables of a suspension bridge are under constant tension. Using high-tension steel cables, spans can be increased to 4,200 feet. Parts of a suspension bridge include:

- Towers: bear the weight of the bridge, often made of wood, stone and steel.
- Anchorage: hold the cable ends and are made of stone, concrete or natural rock.
- Cables: support the deck and are made from vines, split bamboo woven into ropes, or steel wire.
- Piers: support the tower, made of concrete. May require caissons (underwater work chambers).

In July of 1940, the unique Tacoma Narrows Bridge opened. At seventy-two times longer than it was wide, and without a stiffening truss, crossing the bridge was like riding a roller coaster. The flexible bridge was quickly nicknamed "Galloping Gertie" and was a successful tourist attraction for four months.4

In November of the same year, a gale wind began to twist the bridge like a ribbon. The bridge was quickly cleared. The wind eventually died down but it was too late. The concrete slabs began to drop out of the center span until the entire center feel down. A professor was there with his movie camera and caught the collapse on film. His film became a valuable tool for bridge builders. It also helped to illustrate the need to test the effects of wind on a model structure. This was a major factor for developing the wind tunnel test now practiced today and which helps to set bridge building standards.

When the George Washington Bridge was completed in 1931 it was the longest suspended span from 1931-1937. It revolutionized long-span design by eliminating the need for heavy costly and stiffening trusses, resulting in a strong bridge that was elegant and economical. Designer/engineer Othmar Herman Amman planned for the bridge's future growth in the original plans. In 1946 the original six traffic lanes were increased to eight, using area left for that purpose; fourteen lanes became available in 1962, when a lower level, also calculated in the original design was added.5

The Verrazano-Narrows Bridge connects New York's borough of Brooklyn with Staten Island. The bridge took seventy years to plan and six years to build. Following completion in 1965, it became the world's longest suspension bridge.6 At 4,260 feet, the bridge is so long that the curve of the earth had to be considered in the design. Though the towers are vertical, they are almost 2 inches further apart at the top than the base. The longest bridge to date is the Akaski Kaikyo Bridge in Japan, built in 1998 and spans 1991 meters or approximately 6,620 feet.

Background on Physical Forces and Bridge Design

The work of a bridge is to support itself and its load against the pull of gravity (stress). Stress on a material usually results in strain or a change in the material's shape. There are two types of stress: compression and tension. In a bridge stress is also caused by the pull of gravity; the amount of stress is determined by the weight of the bridge plus its load.

A member bearing weight is under compression. Hard stone, like granite, can withstand an enormous compressive force before changing shape. A member being pulled is under tension. Granite, under tension, will break apart under a small amount of strain. In fact, a long beam of unsupported stone will crack under its own weight. Compared to the massive amounts of dead weight carried by each pier, the weight of moving objects on a bridge is insignificant. If a diagonal is placed across a rectangular frame, the shape becomes rigid and forms two triangles. Triangles are the simplest figure whose shape can't be altered without changing the length of one or more of its sides.

Engineering Vocabulary:

Force: a push or pull on an object

Loads: creates a force on a structure

Dead Load: weight of the permanent, non-moveable parts of a structure

Live Load: imposed weight on the structure, moveable part, or uses on a bridge

Compression: a pressing or pushing force that squeezes a material together,

Tension: a stretching force that pulls on a material

Deck: platform extending horizontally that often carries the roadway

Girder: a horizontal beam used for support

Span: distance (dimension) of a bridge between two supports

Stress: the force acting on a body divided by the body's cross-sectional area

Torsion: the act of twisting, which can result from unevenly placed loads

Shear: a force that causes one part of a material to slide past another

Bending: a combination of forces that cause one part of a material to be in compression and another part to be in tension

Chords: long horizontal members

Member: each length of wood that combine to make a truss

Diagonal: slanting members

Post: vertical members

Mathematical Vocabulary:

Centimeter: unit of measurement, metric system, has a value of 1/100th of a meter, base 10 relationships to other metric unit of measurements

Measurement: the total distance from one point to another

Meter: the standard unit of measurement in the metric system

Unit of measurement: a specific scale used for measurement, tells what unit being used to measure

Scale: equivalencies between numbers and units, the relationship

Proportion: specific unit/rate relationship, based on equivalency

Kilometer: the largest metric unit, 1000 meters, kilo means one thousand

Foot: standard measurement unit, based on 12 inches as the conversion indicator

Inch: 1/12th of a foot

Fraction: a comparison relationship expressed as one unit being divided into or by another

Diagonal: a line drawn at a slant in a plane surface.

Experiment 1: Understanding Force7 (1 Day)

Experiment to demonstrate force Force is a hard concept to visualize unless you can see or calculate the results. Force is the slightest movement caused by pushing or pulling and object. Force can be in effect with the object appearing still. An example is; a person standing on a floor, the person is the force, the floor is the foundation, and the interforce at the foot is the load's (force's) point of application.

Material: chair, 2 student volunteers

Procedure: Place chair in the middle of the floor. Ask students if there is any force on the chair? Student pushes the chair a short distance. Is there force involved?

(Movement is caused by unbalanced force)

Repeat #2: modification is students are on opposite sides of the chair, each student simultaneously gently pushes chair. What happened to the chair? Is there force involved?

Discuss why when there is no one is touch chair it is stationary. (Gravity pushing down, no movement, reflective forces yield balanced force.)

This is a very simple experiment the students can do and have done countless times. Only this time it is being used to convey the idea of force.

Experiment 2: Name that Load8 (1 Day)

This experiment demonstrate load live verses dead load

Students work in groups of 3, look around the room and make a list of as many different loads affecting the room as they can. Class develops a classroom brainstorm list, divide list into categories of dead and live loads. Students validate the categorizations of list. This will allow the student an opportunity to familiarize themselves with live verse dead loads.

Experiment 3: Feel the Pressure (1 Day)

This lesson demonstrate compression

Students' pair up and put their palms together-gently push to the center. Before experiment begins each student will make a prediction about the results and record it. Students are to record the experiment and results in their project journal. Once this is completed then students are to compare their results to their predictions. What have you learned from this experiment? Was your prediction validated from the experiment?

Experiment 4: Tension (1 Day)

Feel the effects of tension in this experiment

In this exercise the pull, stretching of the fingers indicate the effects of tension. Two students to a group, one student positions their hands over the other student's hands. They are instructed to interlock fingertips, and gently pull apart. Describe what happens, what is the sensation that is felt.

Experiment 5: Sponge Beam (1 Day)

This experiment illustrates how beams react to certain conditions. Foam rubber works best for this experiment, however either material will illustrate the point.

Materials: Soft kitchen sponge, permanent marker

Procedure: Draw a series of equidistance lines horizontally across the sponge. Pass the sponge around and have the students observe what happens when they bend the sponge into a U shape figure. Have them determine where is the sponge in compression and tension. What part of the bridge design may experience bending?

Experiment 6: Toothpick Truss (1-2 Days)

Illustrate the stability of the basic truss design and possible reinforcement techniques. Materials: white beans (soaked overnight), toothpicks (round ones work best), newspaper or newsprint paper

Procedure: students will construct a regular rectangle using the beans and toothpicks. Review the characteristics of a regular rectangle with class, and then instruct them to make one, using the materials stated above. After construction of the shape, it should be tested for strength. This done by pressing on a cross member beam, to determine any give or sag in the structure. Challenge the student to improve the overall stability of their design by adding material. (Students should find that stability increases with the addition of cross members. Also instruct students to extend the truss to see how wide of a gap their designs can span.

Experiment 7: Straw Shape (1-2 Days)

Determine which geometric shape provides the most stability and strength.

Groups of 2 students

Materials: 7 straws, 14 paper clips or toothpicks and soaked white beans

Brainstorm: Adjectives to describe the straw

Ask: How does the straw bend? How useful do you think straws are as building materials? How might the straw's qualities change depending on how they are used?

Demonstrate how to connect the straws and paper clips to form a regular rectangle and a triangle. Push a paper clip into an end of the straw. Attach another paper clip to the one in the straw and push another straw on the paper clip. Complete this process until you have the desired geometric shape. Position shape in a manner where pressure is applied to an endpoint, for the test. Now press the endpoint down slowly. What do you notice? Which members are in tension and which are in compression? What does this information tell you?

Experiment 8: Paper Bridge (1-2 Days)

Using specification design and build a bridge to meet as many specifications as possible.

Materials: 1 sheet of copy paper, 5 paper clips, ruler, 2 books or blocks, at least 100 pennies, metal washers and scissors.

Group Size: 2

Hold up the sheet of paper and ask how many pennies can it hold? Discuss different types of bridges that students have seen. How long were they? How tall? What were they designed to transport? What other consideration went into planning the bridge?

Discuss engineers cannot build full size bridges to test a design. They make smaller versions, a scale model, down sized by proportion. This means if the engineering is designing a bridge that must span 350 feet, a model may be built or designed on a computer to test specifications. In any event it will not be actual size. The bridge model will be down sized to proportion. If the scale is 1cm: 10 feet what does that mean? What is the actual length of the model bridge? If the scale changes to 1 cm: 25 feet what happens to the model? Does it still represent the actual bridge that must be built?

Can you build a paper bridge that can hold 100 pennies?

Bridge is over water, must accommodate boat traffic below, and automotive traffic also. The bridge must support it's own weight as well as anything placed on it. Paper Bridge must span 20 centimeters. The sides of your bridge will rest on two books and cannot be taped or attached to the books or the table.

Test bridge design by adding one penny at a time to see how many pennies can be added to make bridge collapse. Keep track of the number of pennies placed on the bridge. The group who places the most pennies on the bridge is the winner.

Use of math in bridge designs:

Math is used in bridge building from the measurements, projection, cost, estimating completion dates and many more applications. The basic mathematic skills needed to complete this assignment are those, which are fundamental math concepts. Number sense, number line is used to develop the blueprint to scale. Proportion is needed to represent the design specifications to the blueprint. Geometry is needed to understand how and why the triangle is important to bridge building. Algebra can be applied by developing the equations, which represent the bridge measurement, proportions using variables.

Using math to make a scale model bridge.

Many different skills are incorporated to complete the task of building a bridge. Bridges are created as a solution to help meet society's needs. Therefore, it involves problem solving and as with problem solving there are guidelines that should be followed. The first is to understand the question, determine the facts, devise a strategy, test, and determine if the solution answers the question. If not, then revise strategy and continue from there. This assignment will utilize math as a strategy to solve the scale model bridge problem.

The Problem: (10-15 Days)

As an engineer or engineering company you submit bids to secure proposed contracts. A contract represents that two or more people agree to perform specific task for specific consideration at an agreed upon price, before the service is rendered. Only after the deed is satisfactorily completed as agreed to by both parties, is the contract fulfill. Most consideration is monetary, though it can be for other goods or services. A community has decided to build a pedestrian and light traffic bridge. You must determine the dimension from the criteria given in the bid. The bid is for the design and construction of a stationery bridge to span a lake that has small boat traffic already. Boat traffic travels in both directions and it needs a minimum clearance of 25 meters with the maximum of 50 meters.

Actual bridge dimensions have a width maximum of 15 meters and height minimum of 15 meters. The bridge must have one vehicle travel span, break down/bicycle lane, and a pedestrian walkway in each direction. There is to be exactly two pylons, piers and abutments for construction.

The local city ordinance, regarding sidewalks states it must be within these dimensions, a minimum of 1 meter and a maximum of 2 meters in width. Any new road constructed must have a break down lane in each direction measuring 1.5 meters, and travel lane is a minimum of 3 meters. Bridge design must consider the community's needs and the local ordnances for construction.

The minimum model size is 25 centimeter with 40 centimeters as the maximum length. The town has submitted the contract for bids. The bid requirement calls for the solution to their problem, blueprint and model. You must make a model to represent your solution, state the selection and reasons for your design choice.

Refer back to your notes regarding bridge types and the class engineering experiments. For the task at hand, which bridge type would be your solution to this problem? Draw blueprint on centimeter square graph paper. Once the blueprint is completed it should be used to make the bridge. There should be a minimum of two blueprints, one of the structural side view with all indications to scale and the other that shows the front and top views. The blueprint showing the structural view is using isometric paper, this drawing is not required to be a scale drawing.

You must maintain a notebook that shows all preliminary work, calculations, sketches of bridge designs, and a daily log of your activities to complete project. Your logbook, blueprints and model are required as the final report for the problem/solution. This should also help to organize the work and workload.

To make a scale drawing you must first determine a relationship between the actual bridge and the model. This relation is proportional, meaning there is a direct relationship between two units of measure. Remember the relationship of the model is smaller than the actual size. Your conversion must be to a unit smaller than feet. Use centimeters for the scale unit of measure. If the actual length is 500 ft what could the smaller unit ratio be? One way to determine this is to find all the factors of 500. The factors of 500 are: 500, 250, 125, 100, 50, 25, 20, 10, 5, 4, 2, and 1. Determine which of these numbers is the largest, which will divide into each design dimensional number and use that factor and unit measure as the value for one centimeter. In this case the scale should be 1 centimeter equals 20 feet.

Another method is to divide the scale numbers into the actual numbers and determine if this will be sufficient. Since the units are not the same this is considered a rate and not a ratio, a comparison of different units (feet verses centimeter). A ratio is the same idea however the units are the same, a comparison of the same thing.

Using these calculations put each dimensional unit to scale. Draw a straight 25-centimeter line and label the ends 0 and 25 cm. Using the number line theory begin to make the markings for all-important information that relates to the bridge deck, supports and boat clearance. Mark and label all information on the line. Each marking must be measured. Does the marking satisfy the requirements of the community? Check the information before you proceed.

For this project the consideration is for a grade. There are certain aspects that are required in order to validate the contract. A scoring rubric will be used to assess the company's work. Explain rubric and assign numerical point values before project is started. This is the contract for payment/ grade in this assignment.

These conditions are: Scoring Rubric for Project:

Percentage of Project	Description	Numerical Score
__________________	Math Calculations	______________
__________________	Scale Indicator	______________
__________________	Blueprint to Scale	______________

__________________	Isometric Blueprint	______________
__________________	3 Dimensional Model	______________
__________________	Project Journal	______________
__________________	Self Assessment Sheet	______________
__________________	Parent Comment	______________
__________________	Neatness	______________
__________________	Presentation	______________
__________________	3-4 Paragraphs using journal and assessment sheet as evidence for bridge choice	______________

After the grading has been determined regarding what items are required or extra credit then the percentage should be completed. Then a numerical system is determined and letter grades can be derived. An example may be 95% is an A, 85% is a B; maybe the class want the work to be worth 150 points; in this case, 142 is an A. If the project were worth 100 a 95 would be an A. This method of scoring maintains the numerical score description's weighted value remains equal when using the percentage method.

I will determine specific items and assign values, and then the class is given some input into the other items. The parental comment is always a part of my projects, they are always extra credit and the stipulation is that I do not need to agree with the comment, but it must be signed and include a phone number. Usually the value is 10% of the points required to earn an A. I have found this often encourages the parent to offer help to their child and a way for the child to share their schoolwork.

"Bridging the Math Gap" was written with a specific type of math person in mind. Yet, any type of math student could enjoy the lessons. Why do I think so? I think so because if you enjoy doing something then it is not work, tedious. How often are students assessed on things they build? What is the true test of building any structure? When my students are given opportunities to learn as this unit is put together they forget the long-range task until the little ones begin to connect. What I see is an excitement to get to the next part of the lessons. The reason is the hands on approach to learning. The students view this type of learning as fun. I often must remind them it is math they are working on, the focus is math.

This unit is easily adapted to algebra, geometry, and basic engineering principles by changing the expectations of the student. Where I discussed the number system, in geometry the focus may be triangles, in algebra students can derive equations and write in terms of variables. If engineering is the focus there are many variations such as types of engineers who design bridges, some history of bridges and a point of resource information. The experiments can be written in the scientific method. Students can incorporate all aspects of bridge building, as a complete bridge unit.

"Bridging the Math Gap" was meant to be a rich, enjoyable unit for the math student.

(chart available in print form)

Web Site

Eisenhower National Clearinghouse for Mathematics and Science Education - http://www.enc.org/

Download a free demo of: The Geometer's Sketchpad from www.keypress.com

Download of free demo of: West Point Bridge Design from www.westpointbridge.com

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