

Building Bridges Across Curriculums

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“Without bridges, the Pittsburgh region would be a series of fragmented valleys, hillsides, river plains, and isolated communities. With them, we come together to form a mighty unity.”

Arthur P. Ziegler Jr. – President, Pittsburgh History and Landmarks Foundation

Overview

Bridges are amazing, interesting and beautiful things. The focus of this interdisciplinary curriculum unit is bridges, specifically Pittsburgh bridges. After having just celebrated its 250th birthday, this is a great opportunity to explain to students the relevance of bridges to the development of Pittsburgh. This multidisciplinary unit was originally geared for first grade students, but could be adapted for other grades as well. Bridges affect our daily lives in Pittsburgh and throughout the world, making this an age appropriate topic for my students. In this unit, history of bridges, types of bridges and their significance is fused into the existing Social Studies, Science, Math, Art and Writing curriculums of Pittsburgh Public Schools. The definition of the physical object of a bridge will be explored along with viewing the word bridge as a concept or communications tool to “build bridges” across curriculums. The lessons and activities in this unit compliment the lessons that I’m required to teach. The purpose of this unit is to advance students’ insight into the history of something truly special that plays a huge part of the make-up of the city they live in.

Rationale

In order to provide the background knowledge necessary for the reader to understand bridges, this section is divided into general types of bridges and specific Pittsburgh

bridges, discussing the historical and social aspects of both. Bob Regan tells us that Pittsburgh is called the “City of Bridges” because it has more bridges than Venice, Italy. (Regan 4)

General Types of Bridges: Form and function

In the Oxford English Dictionary a bridge is defined as a structure that allows people and vehicles to cross an obstacle such as a river, canal or railway. It comes from the Norse word *brugga*, which means log or beam. Their purpose is to span a physical object such as a road, valley, river or railroad track while pedestrians, traffic and trains cross over them.

Early bridges had the same purpose that they do today- to get from one place to another. These natural bridges made the trip across water faster whether from rocks, a fallen tree or a natural formation. They were made using nearby materials to cross the span, which rested on supports. Ropes were used in a variety of ways, including two parallel ropes with grass mats in between. Over time, through trial and error, stronger, longer and safer bridges were built. (Caney 178-179)

There are more than a million bridges in America. Steven Caney explains “a span must be at least twenty feet long to officially be called a bridge.”(Caney 177) Most bridges in Pittsburgh are meant to carry roadways. The roadways lie on a deck and the deck lies on a heavier structure of beams which is the floor. The superstructure spans the empty space and supports the floor. This rests on abutments at either end and may rest on piers, bents or towers between abutments. (Kidney 35-36) Although Pittsburgh has around 446 bridges, there are only three basic categories, each having many variations. The most significant difference is the way the bridge displaces force created from both the weight of the bridge and the traffic load. Beam (truss and girder)- in this type of bridge, each end of the beam rests on a pier or on the ground. The forces of compression are straight down. Every truss is made up of triangles. Arch- in this type of bridge a curved structure supports a deck above or below. The force of compression is outward to abutments. Suspension- in this type of bridge a deck is supported by cables. Anchors at the ends of the bridge hold the cables. (Caney 182)

The first American bridges were wooden trusses with wooden roadways. Some needed piers in the middle of the waterway to connect two spans but these had the risk of being hit by boats or swept away. The new design of architect Timothy Palmer used huge logs curved into arches that extended from bank to bank. However, wood rots when not in proper conditions, so Palmer covered one of his bridges with a wooden timber roof that would protect it from the elements. Even though his arch design was unseen, the “permanent bridge” was successful. Theodore Burr improved upon Palmer’s covered bridge concept by inventing a truss that had a flat roadway. Both of these trusses utilized

craftspeople and large timbers. Ithiel Town, who worked on these bridges, found a way to use less timber and the skill of carpenters. The Town lattice truss soon became the most popular type of bridge. William Howe combined the use of iron rods with the wood, which was eventually replaced by steel, concrete and other materials. Without wood the need for a roof cover became obsolete. (Caney 179-180)

Pittsburgh Bridges: Historical and Social Aspects

Walter Kidney explains, “Though many of the bridges in this area are more or less anonymous products of local public works departments, engineers of national reputation have designed bridges for the Pittsburgh area, and have even begun their careers here.” (Kidney 54)

John Augustus Roebling (1806-1869) was a famous civil engineer of the 19th century. An immigrant from Germany, he founded a German farming community in Saxonburg, Pennsylvania. His invention of wire cable was a result of having seen deaths when the hemp rope cables on bridges broke. This wire rope could carry a heavy weight and attributed to his winning of a design competition and changing the future of bridge engineering. He worked through the winter and around the clock to complete this bridge in a six month time period. The Pittsburgh Canal opened to the delight of Pittsburghers in 1844. This wire cable was also used on the Smithfield Street Bridge (Monongahela Bridge) in 1846 and the Sixth Street Bridge (Allegheny Bridge) in 1859. During this time, Roebling gained international recognition when he built a suspension railroad bridge in 1855 across the Niagara River. Roebling went on to design the Brooklyn Bridge from 1869-1883. Although he was injured and died during it’s construction in 1869, his engineer son was able to complete the bridge. (Gangewere 32)

Walter Kidney relates that until 1896, river bridges around here were private and charged tolls and the period of the wooden covered bridge ended locally in 1924 when the Forty-third Street Bridge came down (Kidney 25). Steven Caney reports “Steel is an excellent material for making structural beams because it is much stronger in both compression and tension than stone or wood, which was previously used.” (Caney 65) Steel was produced only in small batches prior to the middle of the nineteenth century. With new methods, architects and engineers were able to utilize large amounts of inexpensively produced high quality steel. The Firth of Fourth railway bridge in Scotland, completed in 1889, was the first large-scale structure built with steel, and is still in use today.

Gustav Lindenthal (1850-1935) the “Dean of Bridge Engineers” was famous for the present Smithfield Street Bridge. He immigrated to the United States in the 1870’s without any formal degrees in engineering and worked for the Keystone Bridge Company. His work on the Smithfield Street Bridge (1881-1883), replaced Roebling’s bridge and became a National Historic Landmark, being the longest existing steel bridge in the United

States. Lindenthal was also known for the Seventh Street Bridge (1884-1927) which used a double set of wire cables. His ambitions led him to design the New York Queensboro Bridge in 1907 and create a “through arch” span for the Hell Gate Bridge in 1916. He worked with Henry Hornbostle on the Hell Gate Bridge and its replica can be found in Pittsburgh at the McKee’s Rocks Bridge. A replica of part of the Hell Gate Bridge can be found at Station Square in Pittsburgh. (Gangwere 32-33)

George S. Richardson (1896-1988) worked as a draftsman for the American Bridge Company prior to joining the County Works Department in 1924. This work contributed to defining Pittsburgh as the “City of Bridges.” Richardson took part in the design or some aspect of engineering for the McKees Rocks, West End and George Westinghouse Memorial Bridges. He was principal designer for the Liberty Bridge, second Point Bridge and the South Tenth Street Bridge while working with Public Works. Working for the Allegheny County Authority he was a bridge engineer who designed the Homestead High Level and Jerome Street Bridges. Richardson went into a private practice and became a consultant with companies that had involvement with Fort Pitt, Fort Duquesne, I-79 and Sewickley bridges. (Gangwere 33)

These men are all namesakes of awards given each year at the International Bridge Conference recognized through the Engineer’s Society of Western Pennsylvania.

Specific Bridges

This section discusses bridges that can be seen from the top of the Duquesne Incline. Further information on bridges can be found at <http://pghbridges.com>. This site explains that there are several different combinations of names one can use when describing a bridge. However there are only four factors that should be taken into consideration, type of span (simple, continuous, cantilever), what type of material it’s made of, (stone, concrete, metal...), location of the travel surface as it relates to the structure (deck, pony, through) and the form (beam, arch, truss...).

These bridges are in view when looking to the right on the Monongahela River from farthest to closest.

Hot Metal Bridge-

Originally called the Monongahela Connecting Railroad Bridge in 1887. The Main Bridge, which was upstream, carried railroad traffic and the Hot Metal Bridge, built in 1900, served a utilitarian purpose carrying steel from the Eliza Blast Furnaces of the J&L Steel Mill. Now the Main Bridge carries vehicles while the Hot Metal Bridge, on the downstream side, converted to carry pedestrians and bicycles. It is a truss with two parallel spans on shared piers.

Birmingham Bridge-

Originally built in 1976 by the city, it replaced the South 22nd Street- Brady Bridge, which was demolished in 1978. With pier reconstruction in 1909 it was set to be demolished in 1969 but concrete bents were put in place in 1970. Parts of the railings of the Brady Bridge are found at the lower station of the Monongahela Incline. The Birmingham Bridge was the first toll-free river bridge in Pittsburgh. The dead end lanes, which lead to ghost ramps, were initially to be part of the city highway system but were rerouted. The bridge was repaired in 2007 after an inspection and bike lanes were added to the existing pedestrian lanes on the downstream side. It was then shut down in 2008 when the deck dropped due to slipping of rockers that supported the beams. It has since been reopened. It has a steel bowstring tied arch design with 6 lanes.

South 10th Street Bridge-

The South Tenth Street Bridge of 1861 was a privately built wooden covered toll bridge. The current bridge, built in 1933, was renamed the Philip Murray Bridge on Labor Day 2007 to honor Philip Murray, the first President of the United Steel Workers of America. Artist Tim Kaulen painted animal figures on south tower which are not official. Repairs in 1994 fixed broken wires of the casting continuous steel cables of the only pure suspension bridge in Pittsburgh. The catenaries are wire cables held down by concrete anchorages. This bridge has the longest span on the Monongahela River.

Liberty Bridge-

It was called for in 1910 and opened in 1928. It had a traffic circle in front of the Liberty Tubes from which a motorist could go through Mount Washington or up the Mount Washington Roadway, now the P.J. McArdle Roadway. In 1983 it was remodeled by widening the roadway and removing the lamps and railings. It links the Liberty Tubes with the Boulevard of the Allies. It is a steel cantilever deck arch truss with concrete piers.

Smithfield Street Bridge-

Built between 1881- 1883 it is the third bridge at this site. Designed by Gustav Lindenthal, it is designated a historic landmark. The 1818 covered wooden Monongahela Bridge designed by Lewis Werwag was destroyed in the Great Fire of 1845. It was the first river crossing bridge in Pittsburgh. The second was a wire rope suspension bridge built by John A. Roebling. It operated as a toll bridge. It has two main spans of 360 feet each and is the oldest steel bridge in the US. Trolley and streetcars used to cross the aluminum painted bridge. It has a lenticular Pauli truss design. Walter Kidney describes this link of downtown to Station Square saying that “the upper chords of the trusses are lit with 313 lights so the bridge is as distinctive by night as by day.” (Kidney xii)

Fort Pitt Bridge-

Opened in 1959, two days before the closing of the previous Point Bridge which was closer to the Point. The Point Bridge was taken down in 1970. The Fort Pitt Bridge has a steel bowstring arch double deck design with eight lanes running parallel. It is known for the view one gets when exiting the tunnels and entering the city. This was the first bridge to use computer aided design.

Wabash Railroad Bridge-

Built in 1904, after collapsing during construction, to carry the Wabash-Pittsburgh Terminal Railroad. This was competition to the Pennsylvania Railroad. In 1948 it was removed. The piers, which used to adorn flags for festivals, can be found at the Gateway Clipper landing and near the end of Stanwix Street. In 1948 it was removed. It had a steel cantilever through truss design. There are many prospective plans for the re-use of the bridge.

These bridges are in view when looking to the left on the Allegheny River from farthest to closest:

Fort Duquesne Bridge-

Built between 1958-1963. It was also called the "Bridge To Nowhere" due to its unfinished ramps. In December of 1964 a University of Pittsburgh student drove over the span that hung in mid-air and landed unhurt. This story is told in the documentary narrated by Rick Sebak, called "Flying Off the Bridge To Nowhere and Other Tales of Pittsburgh Bridges." It was not opened until 1969, the same day the Manchester Bridge, which was closer to the Point, was closed. It has a steel tied bowstring arch double deck design. It is very similar to the nearby Fort Pitt Bridge. A documentary, narrated by Rick Sebak, called Flying Off the Bridge To Nowhere and Other Tales of Pittsburgh Bridges can provide more information.

Three Sisters –

Built from 1924-1928, this trinity of parallel bridges is the only three identical and first self-anchored suspension bridges in the US. Towers hold the cables rather than anchorages. These are some of the few bridges left that use steel eyebars. These bridges are said to be the result of political concerns of the City being that engineers were going around regulations in the construction of prior bridges. The Municipal Arts Commission mandated that these were suspension bridges, which adds to their aesthetic qualities.

6th Street Bridge-

This bridge was renamed the Roberto Clemente Bridge in 1988. Roberto Clemente was a Pittsburgh Pirates baseball player. The bridge closes down for Pirate and Steeler games so fans can walk to the fields. It is the fourth on the site since 1819 and it won a beauty prize in 1929. There has been lighting on the bridge since 2002.

7th Street Bridge-

This bridge was renamed the Andy Warhol Bridge in 2005 as part of a 10th anniversary celebration of the Andy Warhol Museum. It is the only bridge in the US named after a visual artist. This bridge replaces a two span suspension bridge.

9th Street Bridge-

This bridge was renamed the Rachel Carson Bridge on Earth Day 2009. She was a Pittsburgh native and naturalist.

Fort Wayne Railroad Bridge-

Built between 1901-1904 by American Bridge Company on the piers of the former wrought iron lattice truss bridge of 1868. The current bridge's upper deck carries two tracks of traffic while the lower deck is unused. In 1918 it was given orders to be razed by the U.S. Secretary of War. It is a double deck steel Pratt Pennsylvania truss railroad bridge.

Veterans Bridge-

Built between 1986-1987 it required removal of a piece of the roof of the former Pennsylvania Railroad freight building. It is of a steel and welded girder design.

16th Street Bridge-

Built in 1922 and opened in 1923 on the site of a former wooden covered bridge that was burned, rebuilt, then partly washed away and burned again. This was the last covered bridge in the city. The architect chose the design to the dismay of engineers. It is divided into three spans and has Beaux-Art carved piers. It has a steel trussed arch design with the main spans having a through arch with Warren truss arches.

31st Street Bridge-

Built in 1928 it is similar in design to the 40th Street Bridge. It has a steel deck arch design and was built as a requirement for Allegheny River Bridges to provide better river navigation. The piers display a variety of scenes.

40th Street Bridge-

Built in 1923 and called the Washington Crossing Bridge. This bridge is a tribute to George Washington's winter crossing of the river by raft. It was opened on December 29, 1974 on the 171st anniversary of the event. The Pittsburgh Arts Commission entrusted the bridge design to the architect. It has the seals of Allegheny County, Pennsylvania and the Great Seal of the 13 original states. It has a steel deck arch design and was considered and artistic success.

These bridges are in view when looking to the far left on the Ohio River from farthest to closest:

McKees Rocks Bridge-

Built between 1930-1932 consisting of a variety of individual spans and types. In 1988 it was placed on the National Registrar of Historic Places. It is the longest bridge in Allegheny County and has a steel truss crescent through arch design. Most of the bridge is over dry land referred to as the “Bottoms.” There are pedestrian walkways on each side.

West End Bridge-

Built between 1930-1932 mainly by the American Bridge Company and officially named the West End-North Side Bridge. In 1979 it was placed on the National Registrar of Historic Places. It has a steel bowstring arch design, having truss work within the arch and thick piers to support this arch. There are also Warren pony trusses and steel wire cable hangers which support the floor. This bridge is approximately a mile from the Point. There are pedestrian walkways on both sides.

Objectives

There are various goals for this unit. The overall objective is to increase my students’ awareness of bridges. Exploring the types of bridges and the historical and social aspects of bridges is developmentally appropriate for my first grade classroom. It extends and enriches the topic of transportation, which the students are exposed to in their Macmillan Social Studies curriculum. Lessons on geometry and attributes from the Everyday Mathematics curriculum will be extended along with lessons from the Balance and Motion module in the FOSS Science curriculum. In the Art curriculum students are taught how to use different mediums and techniques. These lessons will come into play when students design a blueprint for their bridges. The Writing curriculum

In lesson, “Families on the Move” in the Social Studies Unit on Families, objectives provide for students; to recognize that transportation moves people and things from one place to another, describe how technology has transformed transportation in the past and may change it in the future, and to understand the local, national and global significance of bridges.

Mathematics objectives provide that students will discuss attribute rules and how they play a part in bridge design. Pattern block templates are tools used to describe the attributes of bridges. They will extend their work with polygons, identify basic geometrical and 3-dimensional shapes and investigate some of their characteristics to determine how they are used in bridge design. The symmetry of shapes is explored and it’s relation to forces of compression.

Science objectives for the module Balance and Motion provide that students; investigate materials during free exploration and in a guided discovery mode and solve problems through trial and error. Students begin to develop a sense of variables, which they control to produce desired outcomes. As in the Math lessons, symmetry in relation to forces of compression comes into play. Students will expand their awareness of forces.

Art objectives include developing an aesthetic appreciation of bridges as an art form. Students will build a bridge and gain understanding of the engineering, technology and art fusion.

The writing objectives are participation in shared writing and independent writing activities, selecting a genre so they can convey their new knowledge of bridges. In their writing, they will use robust vocabulary from the word lists and charts they develop.

All objectives aim to promote the interconnectedness of subject areas. These lessons meet the national, state and local standards that all Pittsburgh Public School curricula must meet. The state has developed 62 content standards within 10 Core Curriculum frameworks. In this unit I will focus on the Communications, Citizenship, Math, Science and Writing Standards

Strategies

There will be several strategies implemented in this unit. An interdisciplinary approach will be taken to make connections between subject areas. All of the elements of the curriculum will fuse with the general curriculum so there can be a smooth transition to extension activities. Due to the pacing guidelines we are required to follow, I've found that incorporating units into the existing curriculum leads to successful implementation of the unit. Therefore, elements of this unit will be taught throughout the entire year.

Since students learn in a variety of ways there are activities for all types of learners. Some examples are: Visual learners- pictures of bridges, Auditory/Kinesthetic learners- bridge stories, songs, dances and movements and Tactile learners-making bridges with various materials and the use of manipulatives. Many aspects of this curriculum can be taught using hands-on activities. This will ensure that students learn through their own experiences. In doing this they will gain an increased understanding of bridges.

Differentiated instruction will be used when appropriate. If a certain student or students are having difficulty with a particular concept or lesson they can be given review and practice. If a particular student or students are grasping the material quickly they can be given more rigorous enrichment activities. The books selected are at a variety of reading levels.

Artifacts will be used to make the learning and conversations concrete. Each time there is a discussion, the teacher will chart questions along with student thoughts and responses. This will give students credit for their work and motivate participation in the unit.

The following lessons offer students choices and support their individual interests. This allows them to gain ownership of their learning. The activities and lessons can be made accessible to the struggling learner and more complex for the purpose of enrichment.

Classroom Activities

Bridges unite developments in Science, Art, Economics, Technology and Society. The lessons I've developed reflect those areas.

Lesson 1: Bridges

Day 1: What is a bridge?

After teaching Social Studies Unit 1: Family, Lesson 5: Families on the Move, extend into lessons on bridges. One of the unit words to know is- transportation. It is defined as moving people or things from one place to another. Bridges are not mentioned in this unit even though they are pictured with cars and a train crossing over them. Work with students to develop a KWL chart-what they know, want to know and have learned about bridges. Start an ongoing definition of a bridge. Chart information on paper to be used as an artifact throughout the year. In the American Heritage First Dictionary, the definition of a bridge is- used to cross from one side to the other. Bridges are often built over water. Add this to the chart. Read *Cross A Bridge* by Ryan Ann Hunter. Discuss and develop the definition of a bridge. Restate the definition and ask "What can we add?" Have students agree and disagree until a consensus is made and chart responses. Throughout the year this definition will change and grow. Chart in a format that mimics the span of a bridge to encourage the definition and meaning of the phrases. For example rather than just putting the chart paper on the wall, cut the paper to look like an arch or link pages together to "build a bridge" with a variety of charts

Day 2: Word lists

Students can then develop word lists for bridges with pictures and definitions that can be used in conjunction with the Social Studies words to know. Along with images of Pittsburgh Bridges, I will use pictures I have taken on my travel and include with the word lists and charts. The following word lists are developed with words from *Cross A Bridge*. Bridge words to know: bay, river, stream, puddle, valley and gorge. Place pictures with these words that show how a bridge crosses them. Many other lists or charts can be

started and added to throughout the year. Materials for bridges: rocks, logs, and animal skins. I will show a picture of a rope bridge that I crossed in South Africa at Monkey Land. Show pictures of bridges in Pittsburgh. Ask. “What are they made of?” Add steel to the list and explain that it is stronger than stone or wood. Students are encouraged to share their bridge experiences. A parents letter can be sent home asking for pictures or stories about bridges. What are Bridges Made With: nature-show picture of natural bridge in Aruba. Add people and animals to the list as students explore more resources about bridges. Types of Bridges: stone arch, trestle-patterns, beam-long. Add the three main categories and sort pictures of Pittsburgh bridges that match criteria. Verbs for Bridges: stretch, cross, sit, fish, wish. Adjectives for Bridges: long, flat, tall. Purpose of Bridges-to carry cars, trucks, busses, trains, and people.

Day 3: Bridge: the word

The word bridge as a concept will also be explored. When appropriate to use phrases and metaphors such as: bridge the gap, bridge to nowhere, etc., explain and discuss meanings with the students. Students may also find meanings on their own in different learning situations. Read *Building A Bridge* by Lisa Shook Begaye. Ask students, How is the word bridge is used in this story?” Discuss the difference of using bridge as a noun versus a verb. Have students share stories about a time when they helped to “bridge” a relationship.

Lesson 3: Then and Now

Day 1: Transportation Then and Now

Review the Transportation Then And Now section of Social Studies Unit 1: Family, Lesson 5: Families on the Move. “Why are bikes and cars different now than they were in the past?” Turn this discussion to include the changes bridges have made in our civilization. Discuss early types of bridges made of logs or stones. Show pictures of these early bridges from *Bridges: Three Thousand Years of Defying Nature* by David J. Brown. “Why did people use these types of bridges in the past?” Explain the use of nature and then discuss the significance of the availability and material cost of wood. “Can you connect this with the bikes and cars?” Talk about local engineer John Roebling and his invention of wire cable and use of computers to design bridges. Discuss the change from wood to iron when machinery made it possible to mass-produce steel at a lower price. Show students bridge website <http://www.pbs.org/wgbh/nova/bridge/build.html>.

Day 2: Literature Back Then

Read *Three Billy Goats Gruff* from the Read Aloud Anthology in the Macmillan Language Arts curriculum. “How is the bridge used in the setting of the story?” Using Readers Theatre, act out the story paying special attention to the bridge. “How do the characters use the bridge?” Have students listen to the nursery rhyme *London Bridge Is Falling Down*. Discuss origin and historical significance of the song. Information can be found at: <http://www.rhymes.org.uk/london-bridge-is-falling-down.htm>. Discuss materials that were used and how things change over time. Listen to different versions of the rhyme. Have students play the game that goes along with the song. Two children form an arch with their arms as the other students pass through in a single file line. The arch is lowered as the song is sung and someone is caught.

Lesson 4: The Science of Bridges

Day 1- Beam Strength

After completing Investigation 2 in the Foss Module Balance and Motion extend into lessons on bridges. Read the Science story Push or Pull? Define push and pull as forces that make something move. There are different kinds of force, such as people, wind or gravity. Discuss how this relates to bridges. Ask students, “What makes a bridge strong?” Chart responses. Lead then into a discussion of the design versus the materials.

Try this experiment. Make a bridge by taking a firm piece of cardboard and lay it across two blocks that are the same height. Add weight to the middle using pennies. This acts as the force. Record how many pennies it holds before the collapse. Use the same piece of cardboard and fold sides up into a U shape. This changes the design. Refer to this as a channel, the shape used to make a beam girder bridge. Place across the same blocks at the same distance. Predict if it will take more or fewer pennies to collapse. How many more? Why? Change the direction of the channel. Is there any difference? Take pictures and record data.

Day 2- Technology

This gives students an opportunity to have experience with all types of bridges and use technology at the same time. In the computer lab I will this model this site on a screen: <http://www.pbs.org/wgbh/nova/bridge>. In the each section, arch, beam and suspension, there are experiments. The arch one uses a strip of cardboard to see how the abutments support it. In the beam section they will see the result of compression on the beam. The suspension section explains tests what the abutments are for. Read the facts from each bridge type and view pictures of various bridges. Lastly, play the game. Students will choose which type of bridge would best suit a particular situation. The site <http://www.pbs.org/wgbh/buildingbig/bridge/index.html> shows great pictorial

representation of the forces of the three types of bridges. Look for a review of the forces. Also work with students as a class to take the Bridge Challenge. If you think a student is up for the challenge you can have them do this activity independently for an enrichment activity.

Lesson 5: Bridge Shapes

Day 1: Truss Bridges

After teaching Everyday Math Unit 7 on Geometric Shapes, extend into lessons on the the shapes of bridges. The main areas of focus of this unit: sorting attribute blocks according to attribute rules, extending familiarity with polygons, identifying 3-dimensional shapes and exploring symmetrical shapes, are related to the shapes of bridges. Show students pictures of beam, truss and suspension bridges. Ask “Which shapes do you see?”

A truss bridge is composed of triangles. This type of bridge is used for highways and railroads that cross great spans. Re-define span and refer to previous artifacts. There are different types of spans because each bridge has a unique purpose for carrying light or heavy loads for long or short distances. Look at pictures of bridges and discuss what shapes you see. Chart responses. You should see squares, rectangles, parallelograms and trapezoids. Discuss which shapes are polygons, different kinds of lines-straight, curved and diagonal and attributes of shapes. The triangles are the strongest. The thickness of wire cables being woven together helps to suspend the bridge. Explore concepts of symmetry. “Why are bridges built the same on both sides?”

Day 2: Building a Bridge

Look at three types of pasta and decide what parts of the bridge they can be used for. Lasagna-long flat pieces to make road, roof and sides. Linguine-long and narrow to make struts. Fettuccine- long to make struts, beams, road, roof and sides. Show students pictures of various trusses. A nice selection can be found in Steven Caney’s *Ultimate Bridge Building Book* on pages 280-281. Students will select their individual design. Photocopy the page and enlarge the selected design to fit one per page. Cover the page with wax paper and assemble the pasta on the wax paper. Have students determine how many beams and struts they will need. Mark on pasta where it needs to be broken. Struts can be two pieces together, while beams might need three or more. These can be put together using pasta paste. To make this paste an adult must be present. Dissolve one-quarter ounce packet of unflavored gelatin in water. Add one cup of cold water. Stir in a saucepan until dissolved. Cook until almost boiling and remove from heat. You can use a microwave for cooking at high power for one and a half to two minutes. Let cool about 15 minutes before use. When using the pasta glue apply with fingers, piece of pasta or brush. Apply to one part, touch to other part and hold for one minute. The paste will harden after several hours.

If you think the pasta might be too challenging for your students you can try this same activity with wooden craft sticks, toothpicks or straws. Explain that early bridges were made of wood. Always provide a model so that you can discover any problems that may arise on the model making.

Lesson 6: Beautiful Bridges

Day 1: Architects

Ask students if they know what an architect does. Discuss and chart responses. Read or have a Beyond level student read *Architects* by Meish Goldish. Add new information and vocabulary words; architect, design, clients, blueprints and apprentice to the chart. Do the Literacy Activity with the students replacing house with bridge. Have students list in their sourcebooks materials and designs they want for their bridge. They will make a blueprint for their bridge. Model this for any students who seem unsure of what to do. This list will be used on Day 2 and 3.

Day 2: Field Trip

Take a field trip to the 40th Street-Washington Crossing Bridge, which was considered an artistic success, giving students real life experience and inspiration for their bridges. This is a bridge near Fort Pitt Accelerated Learning Academy that students could walk to or take a short bus ride to. If possible take students on a Just Ducky Tour.

Day 3: Art

Plan with the Art teacher to connect what students have learned about bridges to elements of the art curriculum. Provide students with a variety of art materials that they have used in art this year: Clay, chalk, paint, paper. Read the foreword of *Bridges Are To Cross* by Philemon Sturges. Add to the ongoing bridge definition. Finish reading the book. Discuss the paper cut illustrations of bridges. Have the art teacher explain how this was done. Students might want to mimic or develop their own method of making a paper cut bridge. Tell students that the author is an architect. Refer to the artifacts that were created in Day 1 of Lesson 6. Students will use blueprints from Day 1 and begin to “build” their bridge. As a culminating activity students will submit their bridge artwork to Art All Night in Lawrenceville, a local art show. This will give students the understanding and appreciation of the aesthetics and beautification of bridges.

Lesson 7

Day 1: Write

Since students have been learning a lot about bridges they should use this as an opportunity to write. The required writing genres for first grade in Pittsburgh Public

Schools are: personal and fictional narratives, persuasive, and informational (how-to and report). Give students the choice of any of the genres and connect with their bridge unit. For a personal narrative, students can write about a bridge that they have been on or a “bridge” they have made with someone. Re-Read *Building A Bridge* by Lisa Shook Begaye if students are unsure of this concept. For fictional narrative have them write a make-believe story with a bridge. They can persuade their parents or principal to take them or allow them to go on a field trip bridge. They can write how-to build a bridge after they have made one themselves in Lesson 6. A report on bridges would tell all they’ve learned in the unit.

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Photos, essays and guides to Pittsburgh’s most historic and architecturally impressive bridges.

Kidney, Walter C. *Pittsburgh’s Bridges Architecture and Engineering*. Pittsburgh History and Landmarks Foundation, 1999.
Historical photographs of Pittsburgh bridges along with discussions of each.

Lavin Nancy and Rick Sebak. *Flying Off the Bridge To Nowhere and Other Tales of Pittsburgh Bridges*. WQED 1990.
Documentary in Pittsburgh history series.

Regan, Bob. *The Bridges of Pittsburgh*. The Local History Company, 2006.
Documentation of the area bridges with photos, maps, drawings and tables.

Simpson, John and Edmund Weiner. *The Oxford English Dictionary*. Oxford University Press USA, 1989.
A reference book.

<http://pghbridges.com>

Information about bridges and tunnels of Allegheny County and Pittsburgh, PA.

Student resources:

Begaye, Lisa Shook. *Building A Bridge*. Rising Moon Books, 1999.
Ages 4-8. Story teaches a lesson about building bridges with each other.

Goldish, Meish. Architects. Macmillan/McGrawhill.
A first grade beyond leveled reader from the Macmillan Language Arts curriculum that explains what an architect does.

Hunter, Ryan Ann. *Cross A Bridge*. Scholastic Inc. 1998.
Ages 4-8. A picture book that describes various types of bridges.

Sturges, Philemon. *Bridges Are To Cross*. Putnam Juvenile 1988.
Ages 4-8. Cut paper illustrations along with short descriptions of bridges.

<http://www.rhymes.org.uk/london-bridge-is-falling-down.htm>

History and origin of London Bridge Is Falling Down.

<http://www.pbs.org/wgbh/nova/bridge/build.html>

Survey the sites, do your homework and play the game.

<http://www.pbs.org/wgbh/buildingbig/bridge/index.html>

Learn about bridge basics and take the Bridge Challenge.

Appendix A-Standards

PPS Content Standards for Communications

1. All students use effective research and informational management skills including locating primary and secondary sources of information with traditional and emerging library technologies.
2. All students read and use a variety of methods to make sense of various kinds of complex texts.
3. All students respond orally and in writing to information and ideas gained by reading narrative and informational texts and use the information and ideas

to make decisions and solve problems.

4. All students write for a variety of purposes, including to narrative, inform and persuade, in all subject areas.
5. All students analyze and make critical judgments about all forms of communication, separating fact from opinion, recognizing propaganda, stereotypes, and statements of bias, recognizing inconsistencies and recognizing the validity of evidence.
6. All students exchange information orally, including understanding and giving spoken instructions, asking and answering questions appropriately, and promoting effective group communications.
7. All students listen to and understand complex oral messages and identify their purpose, structure and use.
8. All students compose and make academic presentations for each academic area of study, that are designed to inform, persuade or describe.
9. All students communicate appropriately in business, work and other applied situations.

PPS Content Standards for Citizenship

1. All students demonstrate an understanding of major events, cultures, groups and individuals in the historical development of Pennsylvania, the United States, and other nations and describe the patterns of historical development.
2. All students demonstrate an understanding of themes and patterns of geography, know the locations of major bodies of water, land masses, and nations, and describe the relationships between geography and historical, economic, and cultural development.
3. All students describe the development and operation of the economic, political, legal and governmental systems in the United States.
4. All students examine and evaluate problems facing citizens in their communities, state, nation, and world by incorporating concepts and methods of inquiry of the various social sciences.
5. All students develop and defend a position on current issues confronting the United States and other nations by conducting research, analyzing alternatives, organizing evidence and arguments, and making oral presentations.

6. All students explain basic economic concepts and the development and operation of economic systems in the United States and other nations and make informed decisions about economic issues.

7. All students demonstrate their skills of communicating, negotiating, and cooperating with others.

8. All students demonstrate that they can work effectively with others.

9. All students demonstrate an understanding of the history and nature of prejudice and relate their knowledge to current issues facing their communities, the United States, and other nations.

10. All students demonstrate an understanding of the various roles they can play as citizens through participation in a community service project.

11. All students demonstrate the ability to resolve conflicts in peaceful ways, including but not limited to peer mediation, anger management, interpersonal skills, and problem solving

PPS Content Standards for Science and Technology

1. All students explain how scientific principles of chemical, physical, biological phenomena have developed and relate to them in real-world situations.
2. All students demonstrate knowledge of basic concepts and principles of physical, chemical, biological and earth sciences.
3. All students use and master materials, tools and processes of major technologies which are applied in the economic and civic life.
4. All students explain the relationships among science, technology and society.
5. All students construct and evaluate scientific and technological systems using models to explain or predict results.
6. All students develop and apply skills of observation, data collection, analysis, pattern recognition, prediction and scientific reasoning in designing and conducting experiments and solving technological problems.
7. All students evaluate advantages, disadvantages and ethical implications associated with the impact of science and technology on current and future life.

8. All students evaluate the impact on current and future life of the development and use of varied energy forms, natural and synthetic materials, and production and processing foods of food and other agricultural products.
9. All students demonstrate basic computer literacy, including word processing, software applications, and the ability to access the global information, infrastructure, using current technology.

PPS Content Standards for Math

1. All students use number, number systems, and equivalent forms (including numbers, words, objects and graphics) to represent theoretical and practical situations.
2. All students compute, measure and estimate to solve theoretical and practical problems, using appropriate tools, including modern technology such as calculators and computers.
3. All students apply the concepts of patterns, functions and relation to solve theoretical and practical problems.
4. All students formulate and solve problems and communicate the mathematical processes used and the meaning for using them.
5. All students use and apply the basic concepts of algebra, geometry, probability and statistics to solve theoretical and practical problems.
6. All students evaluate, infer and draw appropriate conclusions from charts, tables and graphs, showing the relationship between data and real world situations.
7. All students make decisions and predictions based upon the collection, organization, analysis and interpretation of statistical data and the application of probability.

Arts and Humanities Standards

1. All students describe meanings they find in various works from the visual and performing arts and literature on the basis of aesthetic understanding of the art form.
2. All students evaluate and respond critically to works from the visual and performing arts and literature of various individuals and cultures, showing that they understand important features of the work.

3. All students relate various works from the visual and performing arts and literature to the historical and cultural context within which they were created.
4. All students produce, perform or exhibit their work in the visual arts, music, dance or theatre, and describe the meanings their work has for them.

Writing Standards

Writing Standard 1: Habits and Processes

Writing Standard 2: Writing Purposes and Resulting Genres

Writing Standard 3: Language Use and Conventions