

Balloon Construction: Up, Up, and Away or Here to Stay

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INTRODUCTION

Meaningful integrated curriculum and service are paramount in developing units to present to the gifted and talented students in our small, specialized middle school located in the Galleria area of the fourth largest city in the United States. We differ from neighborhood schools in that no one is zoned to our school, and all students meet specific admission criteria. We are unique in our student population make-up because we have five distinct programs under one roof. Although I deal primarily with the gifted and talented middle school population there are four other viable programs on campus. These other four programs are designed to meet the needs of elementary gifted and talented students, elementary and middle school deaf students, multiply impaired hearing and multiply impaired deaf students, and early childhood students. It is a constant challenge to institute programs where diverse student populations interface in memorable ways. In past years our gifted and talented seventh grade art students created a product for second graders that teach a specific art concept. One year the students made books introducing the color wheel and presented them to our gifted and talented second graders. Last year we inaugurated our seventh grade architecture course. During the semester we researched a dwelling, made a presentation board, rendered a working scale drawing with floor dimensions and wall elevations, and constructed a dwelling using natural materials. The dwellings styles included a kiva from Pueblo Bonito, a roundhouse from Africa, a mud dwelling from Djenné, an English wigwam, a Japanese Gassho-Zukuri farmhouse, a geodesic dome, a Texas log cabin, a prairie dugout, a Navajo hogan, and a Texian jacal. The seventh graders presented their constructed dwellings to the second graders to enhance a world cultures unit and reinforce vertical curriculum alignment. In preparing their presentations the students learned about the importance of environment in the selection of building materials and the formation of building styles. Furthermore, they learned that the built environment of people throughout history is a direct result of social, religious and cultural demands, and building styles remain constant throughout centuries if society does not dictate change. This year I want to expand this building unit and focus on Native American dwellings and the building styles brought to our North American shores through European colonization. Furthermore, I want the students to understand the architectural changes that have taken place between early colonization and the present with special emphasis on a framing construction method known as balloon construction.

Four major traditions of building in wood have developed throughout American history: log construction, timber framing, balloon framing and platform framing. The first colonists, and their successor immigrants and settlers brought timber-framing traditions from Europe. During the Colonial period in America building characteristics varied from one colony to another; however, most buildings were constructed using first

the post-and-girt framing method of construction and then braced-frame construction until the mid 1800s. The *Braced-Frame (Post-and-Girt) Construction* method of the eighteenth and nineteenth centuries was used along the East Coast to construct America's first large wood-frame buildings. This type of wood-frame structure has a braced framework of vertical timbers called "posts," which are positioned at each of the four corners of the building, and horizontal timbers called "girts," which are found at each floor level. These large timbers reinforce the entire two-by-four-inch wood-frame structure and are connected together by mortise-and-tenon joints.

As the population moved westward in the nineteenth century, the need for housing increased, and cut, finished large timbers and skilled craftsmen became scarce. A lightweight, quickly assembled wood structure, which needed no large timbers, called balloon frame construction replaced the eastern braced-frame method of constructing wood structures. Changing technology played a major role in shaping building techniques during this period. In the 1830s, George Washington Snow developed *Balloon Frame Construction* in Chicago. The balloon frame consisted of individual, closely spaced studs that extended the full height of the structure. All the wooden members were nailed together using inexpensive, mass-produced nails. With this type of construction four wood exterior walls are constructed flat on the ground and then lifted upright from the ground and connected at the corners. This type of construction quickly took the place of the post-and-beam framing construction method because it was an easier and less expensive building method.

Many recognized housing styles used balloon construction. Some of these styles include:

- 1) A four-square house, a home which featured large front and back porches, a hipped roof, louvered vents, and lots of large windows and doors.
- 2) A French Colonial house, a housing style developed by French settlers in the Louisiana Territory. This housing style features a steeply pitched hipped roof and a raised basement that was often used for commercial purposes. A balcony supported by posts or columns surrounds the upper story and the posts extend to the ground. Original French Colonial houses would have been timber-framed.
- 3) A Greek Revival house, an architectural style using Greek influences in building treatments. Houses of this style have a symmetrical, columned façade constructed of stone, brick or clapboard. The porch of the gable roof structure is sometimes prominent and supported with Doric columns. The front entrance is often flanked with sidelights and a transom light above.
- 4) A Folk Victorian home, a symmetrical façade with jigsaw cut trim, and bracketed porches with spindlework detailing.

- 5) A Craftsman style home, a low-pitched, gabled or hipped roof with eave overhangs and decorative, exposed roof rafters and porches with tapered square columns. The Prairie School style of housing is closely related to the Craftsman style.

Balloon construction was used until modifications produced another framing method called platform framing. The *Platform construction* method requires that a structure be built one level at a time. One complete level of two-by-four-inch wood enclosing walls are raised and nailed together; the floor beams and deck for the next level are placed on top of these walls. The next levels of two-by-four-inch wood enclosing walls are constructed on top of exterior walls.

Over the past two hundred years, the four most widely used methods of wood frame construction are braced-frame (post-and-girt), balloon and platform.

AN OVERVIEW OF THE UNIT

During the semester the students will construct a Native American dwelling using natural materials and then build and embellish a simple birdhouse using balloon frame construction. Their final construction project is to build and paint a small, simple, dollhouse-sized cottage or bungalow with some groups utilizing platform framing construction while others use balloon construction framing. All of the birdhouses will be donated to the campus gardening committee, and the dollhouses will be given to classrooms in our elementary unit. This will continue our efforts to demonstrate the importance of an individual's contribution to make his/her community better while maintaining a challenging curriculum that meets or surpasses mandated educational objectives.

In the first construction unit of the semester we will research Native American built environments including pole and sapling framed dwellings, gable-roofed timber and plank houses, and mud, clay or stone earthen homes. Specific Native American dwellings to investigate include the Algonquian wigwam, the Iroquois longhouse, the Plains Indians tipi, the Seminole chickee, the wattle-and-daub house of the Southeast, the Navajo stone hogan, the Mohave mud house, the Alaskan Tlingit plank house, and the Southwestern Pueblo.

These home styles preceded the arrival of European settlers, and some are still used today. Using natural materials to build the structures will familiarize the students with the properties of the materials and help them understand the difficulties of building with these materials. This will also give the students time to learn the importance of each person's part in a group project's success.

Vocabulary is an integral part of the curriculum, and it is stressed throughout the semester. It is imperative that the students have a working vocabulary of the discipline

because a working vocabulary helps to build a firm foundation for and create a better understanding of architecture.

After concluding the Native American dwelling building project, the students will build a simple birdhouse. This small-scaled transitional project introduces basic building concepts, gives a format for rendering an elementary floor plan and wall elevations, and demonstrates the importance of planning and precise measurement in creating a successful structure. On this project students must adhere to the rigid measurements provided. All of the semester's major projects are conducted in groups, with each member having specific responsibilities. Still working in a group, one member will embellish the birdhouse while the others go on to the next building project, which is to construct a dollhouse-sized cottage or bungalow using styles brought to North America by European settlers.

Beginning in the seventeenth century, persecuted Europeans came to the New World to make a better life for themselves and their families. Although they had the opportunity to create new societies different from what they had left behind, they brought many of their traditions with them including building styles. Englishmen, Germans, Scotch-Irish, Dutch, Spanish, French, and men and women of countless other nationalities brought with them concepts of domestic housing which varied by nationality. Specific architectural elements and styles that persist today can be traced to their countries of origin. As time went on and nationalities melded, they created a hybrid architectural style that represented this changing society. Although the structures we build are very simple, they still resemble varied housing styles. The building styles for the dollhouse balloon construction homes are Four-square, French Colonial, Greek Revival, Folk Victorian, Queen Anne, and Craftsman.

Today, our home building styles are representative of all past cultures and represent an evolution of construction practices. Since the early times of colonization in America, there have been significant trends in building, but none of these exceeds the one George Washington Snow developed in 1833. We call this building structure balloon framing, and it was the method that first required two-by-fours. This was the major departure from the old European system of heavy timbers and heavy masonry construction, and it was influential in turning the United States into a nation of homeowners.

SAM HOUSTON PARK

Sam Houston Park showcases many architectural changes in Texas housing styles from the early days of European settlement through the early twentieth century. For this unit we are exploring the structures of Sam Houston Park and thinking of the park as an architectural museum. The park gives us the opportunity to see the architectural terms we discuss in class. It also allows each student to engage in the community on a different level and gain a better appreciation for the history of our community.

The structures at Sam Houston Park to investigate are:

- 1) Staiti House—This home was built in 1905 and purchased by Henry Staiti. The Prairie Style influenced home was originally located in the Westmoreland Addition subdivision, but was moved to Sam Houston Park in 1986. It is a seventeen-room house that includes modern features such as electricity and professional landscaping. Alfred Finn, a well-respected Texas architect, redesigned the home in 1915.
- 2) Nichols-Rice-Cherry House—This Greek Revival house was built around 1850 by Ebenezer Nichols and was moved to Sam Houston Park in 1959. William Marsh Rice, the financier whose estate helped create Rice Institute (now Rice University) in 1912 lived in the home from 1856 to 1873. Emma Richardson Cherry saved the house from demolition in 1897 and moved the house from its downtown location.
- 3) San Felipe Cottage—This six-room typical Texas cottage of the 1870s was built in 1868 by German immigrants at the southwestern edge of Houston on old San Felipe Road. The house became a part of Sam Houston Park in 1962 and has been completely restored.
- 4) Yates House—Jack Yates, a freed slave, began construction of his home in 1870. Rev. Yates was a prominent Houston religious leader and an advocate of education for the people of his race. His home reflects the opportunities available in the Houston community for all people. The house was originally a part of Fourth Ward. It became a part of Sam Houston Park in 1994. This house, a Greek Revival house according to the Heritage Society, is constructed using balloon framing.
- 5) The Old Place—This house predates all of the other structures in the park. It was originally located on the west bank of Clear Creek, and moved to Sam Houston Park in 1973. It is reported to be the oldest remaining structure in Harris County.
- 6) Pillot House—Eugene Pillot built this Folk Victorian house in 1868. It was continuously occupied by members of the Pillot family until 1964 and given to Sam Houston Park in 1965. This home has an attached kitchen, which is very modern for its time.
- 7) Kellum-Noble House—This house was built by a Virginian, Nathaniel Kellum, who moved to Houston in 1839. In 1847 he built this home, which is reported to be the oldest remaining brick house in Houston. In addition to this house, which remains at its original location, Mr. Kellum operated a tannery, a sawmill, and a brick kiln on the property. During the 1850s Mrs. Noble ran one of Houston's first private schools in this house. In 1954 Houstonians organized the Heritage Society to save this home from demolition.

My goals in teaching this unit are to:

- 1) Introduce historical architectural references as they relate to contemporary construction.
- 2) Investigate various elements required and/or evident in building construction.
- 3) Explore Houston dwellings as represented at Sam Houston Park.
- 4) Identify the standard types of building construction.
- 5) Identify and explain how a column, wall, arch, or beam supports a load.
- 6) Demonstrate how to read and interpret basic construction plans.
- 7) Describe the following types of construction:
 - a. Balloon frame
 - b. Platform frame
 - c. Post-and-Girt (Braced) frame
 - d. Wooden truss
- 8) Demonstrate a fundamental knowledge of a working scale drawing.
- 9) Divided into groups build a structure using one of the above referenced construction methods.
- 10) Render various architectural elements including but not limited to (3) column styles, (4) arch types, (3) roof styles, etc.
- 11) Demonstrate an understanding of the effects of the scientific principles of tension, compression, torsion, and gravity on built structure.
- 12) Develop a working architecture vocabulary.
- 13) Research a housing style and
- 14) Develop a floor plan and wall elevations from this research.
- 15) Use these elevations as templates for construction of their structures. The same process is in place for building the birdhouse and the dollhouse.
- 16) Forecast changes in building techniques based on societal, environmental and technological changes.

Past cultures have shown us that change and adaptation are part of our heritage. While maintaining a keen understanding and appreciation of construction methods of our ancestors, we will learn what methods are available to this generation for constructing environmentally friendly, structurally sound structures within budgetary restraints. Future builders must find ways to fully utilize the tools of technology to improve our built environments and press on toward the future to create habitats suited to our ever-changing society.

LESSON PLANS

Lesson One: Introduction into Architecture

Subject: Architecture

Grade Level: Seventh grade

Objectives

This lesson is designed to show the students many different styles of architecture from around the world that bridge centuries of architecture. Objectives include the introduction of specific forms of architecture that represent varied cultures so that the students can see the importance of environment on architecture. The lesson is also designed to show a progression in architecture based on technology and available materials. In this lesson, basic terms are introduced to begin the students' immersion into the vocabulary of architecture, and architectural elements are identified. At Sam Houston Park the students see examples of architecture from Houston's past, which reinforces class lessons.

Time Allotment: Eight forty-five minute classes

Activity One

As the students enter the classroom, each should be given a binder, which will be his/her class notebook for vocabulary, research, and fieldtrip information. Included in the notebook on this day should be the first page of vocabulary words. After all students receive their class notebooks, we will look at a slide presentation, which includes slides of the following:

- A Prehistoric cave dwelling
- A loosely thatched hut
- A mud dwelling from Djenne
- An African roundhouse
- Stone dwellings
- Wattle-and-daub structures
- Timber homes
- Reed and leaf dwellings
- A Pueblo
- A Teepee made of animal skin
- A dugout
- A masonry dwelling
- A log cabin
- Homes built in the mountains, tropics, rain forests, deserts and prairies
- Homes built in the traditions of South American, Asian, and Middle Eastern cultures
- Homes in North America, past to present
- Homes and buildings designed by contemporary well-known architects
- The Sydney Opera House
- A geodesic dome

Activity Two

Glossary of Terms

1. *Architect* – A person trained and experienced in the design of buildings and the coordination and supervision of all aspects of the construction of buildings
2. *Intern Architect* – An architect-in-training
3. *Building Artifact* – An element in a building that shows human workmanship, such as a stained glass window
4. *Building Reconstruction* – Reproduction by new construction, following the exact form and details of a no longer existing building or artifact as it once appeared
5. *Mechanical drawing* – A precise drawing, produced with the aid of instruments such as compasses, triangles, T-squares and scales
6. *Dwelling* – A building designed as living quarters for people
7. *Structure* – Any building
8. *Masonry* – Any construction using materials like brick, stone, glass, or clay which are set in mortar
9. *Wattle-and-daub* – A wall construction building form where upright wood poles are interwoven with branches between them and then covered with a clay, straw, plaster mixture to fill-in the spaces for better insulation
10. *Thatch* – A covering of a roof or wall usually made of straw or clay and similar materials put together to provide a measure of insulation and protection from the elements
11. *Lean-to* – A small, sloped roof extension to a building whose supports lean against the building.
12. *Load bearing walls* – A wall capable of supporting a load in addition to its own weight

Activity Three

In this activity we will thoroughly investigate architectural elements of a Victorian dollhouse. This is to help prepare the class for our fieldtrip to Sam Houston Park. Our dollhouse is becoming an antique rather quickly because my husband and I built it when our daughter was five years old. She is now twenty. It is a great example of Victorian architecture and has the following architectural elements:

Glossary of Terms

1. *Clapboard* – A primarily exterior wood siding applied horizontally and overlapping, with the grain running lengthwise and the lower edge of each board usually thicker than the upper.
2. *Balcony* – A projecting platform on a building either supported or cantilevered.
3. *Double-hung windows* – A window that has two operable vertically sliding sashes, each closing a different part of the window.
4. *Double doors* – Two doors placed side-by-side within the same door frame.
5. *Brackets* – Any overhanging part that project from a wall to support weight. Some are very decorative and others are plain.

6. *Gingerbread* – Very decorative, cut-out woodwork often found to the sides of columns on a Victorian or Queen Anne style home
7. *Asymmetrical architecture* – A way of putting architectural part together in a less formal, mirror-image form of balance.
8. *Columns* – Cylindrical, usually vertical supports that consist of a shaft, capital, and base. Doric columns do not have a base.
9. *Transom* – An operable window above a door, or a horizontal piece of wood or stone above an opening.
10. *Sidelights* – A framed glass that does not open; usually found beside a door and often are divided into smaller panes with mullions.
11. *Etched glass* – A design placed in glass with acid to alter the surface of the glass.
12. *Dormer* – A structure, usually with a window in it, which projects out from a sloping roof. Sometimes they are shaped like a traditional dog house.
13. *Balustrade* – An entire railing system which includes a top rail, balusters, and a bottom rail. The bottom rail is sometimes omitted. Balustrades are often seen on a balcony or porch.
14. *Railings* – A hand support along a stairway, or the framework of a window sash
15. *Newell Posts* – A slightly taller post at the end of a handrail or the bottom of the stairway. It may or may not be more decorative than the rest of the stairway.
16. *Gable Roof* – A roof having a single slope to each side of a central ridge.
17. *Fascia Board* – A board that is nailed vertically at the end of a roof and sometimes supports a gutter.
18. *Shutters* – A moveable panel used to cover an opening. They are often found beside windows and are designed to provide a measure of protection from weather; they also provide privacy and insulation.
19. *Louvered* – A series of fixed or operable horizontal slats which slope and overlap and are designed to let air and light in and to keep rain and such out. They are used over doors and windows in particular.
20. *Victorian* – An architectural style of the nineteenth century named for Queen Victoria. It encompasses many different styles of architecture used during the century. Queen Anne is considered by many to be a form of Victorian architecture because it was built during the correct time frame and has many architectural elements that are characterized as Victorian.
21. *Divided Pane* – Glass in a window or door that is divided into smaller panes by muntins.
22. *Windowsill* – The horizontal bottom part of the window frame.
23. *Cedar Shake* – A thick wood shingle, usually for roofs or exterior walls, which is made from the soft wood of a Cedar tree, cut or hand-split into small tapered rectangles, and applied in an overlapping staggered method.
24. *Shingles* – An individual roofing unit made of asphalt, slate, or other material to cover the exterior of a sloping roof. They are applied in an overlapping, staggered, rowed method.
25. *Pediment* – A triangular gable usually above a door or window

26. *Widow's Walk* – A flat roof deck or platform at the top of a hipped roof
27. *Queen Anne* – An asymmetrical style of architecture that was dominant in the late nineteenth and early twentieth centuries. It blends many styles together and has decorative shingle treatments, gingerbread, turrets, and facing gable roofs
28. *French Colonial* – A form of architecture brought to America by French settlers and is characterized by a raised basement which was often used for commercial ventures. They usually had a steeply pitched hipped roof and a gallery or porch across the front of the house or that went all around the house.
29. *Lintel* – A horizontal structural piece over an opening which carries the weight of the wall above it.
30. *Quoins* – A brick or stone used in masonry construction to reinforce exterior corners. They are usually raised from the masonry plane and are sometimes used as a decorative treatment.
31. *Gutter* – A shallow channel, usually metal, designed to catch and carry off rainwater from the house. They are found under the overhang or eaves of houses.
32. *Balloon Frame Construction* – A system of framing a wooden structure where all the vertical supports are single studs for the exterior load-bearing walls and extend the full height of the structure.
33. *Craftsman Style* – An American architectural movement in the first few decades of the twentieth century that was influenced by the Arts and Crafts Movement. Houses of this style usually did not have a symmetrical façade and were normally constructed of stucco, wood clapboard, or wood shingles. Many had a gabled porch with exposed rafters and double-hung windows.
34. *Relief* – Carving or sculptured work that is raised above the background plane
35. *Fluted* – Parallel grooved or channeled sections usually carved out in a semi-circular way and found on columns
36. *Capital* – The topmost part of a column or pilaster
37. *Log Construction* – A form of construction using either round logs with the bark off and laid horizontally and connected at the corners, or logs that have been hewn, cut into square pieces, and then put together to form the structure. In both the logs are notched at the corners to hold the structure together and add strength and rigidity. The cracks between the logs are usually filled in with mud, straw and other available materials to add insulation.

Activity Four

After defining these terms and pointing them out on the dollhouse, the students will be divided into groups of four. Each group will be told to go to a specific part of the building where a laminated drawing of a Victorian house is taped to the wall. Along with the house will be tape, a Sharpie, and a box with laminated blank strips of paper. Each group will be given fifteen minutes to name as many parts of the house as possible and label them using the tape and blank strips. At the end of the fifteen-minute period each group will return to the classroom. The group that identifies the most elements will receive some sort of prize (probably Jolly Ranchers). During this exercise most of the

architectural elements seen at Sam Houston Park will be covered; however, not all will be introduced.

Activity Five

Each student should be given a teacher-drawn crossword puzzle which points out specific architectural elements evident in the structures located at Sam Houston Park. The crossword puzzle clues also directly relate to the vocabulary words we studied in class prior to the fieldtrip. The puzzle did not scan to disk correctly, but is available upon request.

Activity Six

When we return to class, we will discuss our fieldtrip experience and then repeat ***Activity Four*** to evaluate the fieldtrip learning experience. This will let me know if the students are prepared for a building project.

Lesson Two: Building is More than Meets the Eye

Subjects: Architecture, Physics

Grade level: Seventh Grade

Objectives

Before we begin any building project, each student must understand some of the scientific principles that are at work when anything is constructed. There are several principles to consider, but understanding the principles of tension and compression is paramount in building because every structure, large or small, is either in compression or tension. If a student understands how compression and tension work, he/she will be more likely to construct a structure that will stand up. To address different learning styles, we will discuss tension and compression, demonstrate the principles through simple participatory learning segments, and build a simple tent with everyday materials. This lets the students know that more thought is required to build successfully than merely putting sticks, stones or other building materials together in a haphazard manner.

Time allotment: Five 45-minute class sessions

Activity One

In this lesson each student will be given a simple sponge and a rubber band. Holding one end of the rubber band with their left index fingers and the other end of the rubber band with their index finger, they will pull the rubber band apart and stretch it out as far as they safely can. This is an elementary way of demonstrating tension. The best way to effectively illustrate the idea of compression is for each student to press down on a dampened sponge using the palm of his/her hand. The sponge becoming a third of its original size demonstrates compression. At this age the students do not always readily

apply information to different applications. To reinforce this new information, we will employ another way of showing the same principles. Each student will get with another student of about the same height. They will face each other, outstretch their arms, and place the palms of their hands against those of their partners. With their hands still together, they will move their feet back a step of two until their hands are pressed together. This also demonstrates the principle of compression. To show tension, have the students remain standing facing each other. After locking their hands together have each member of the couple lean back. Then, the students should sit down as a suspension bridge and a Roman aqueduct are displayed. These are still other examples of tension and compression.

Activity Two

To further the learning experience, each student will build a tent using a drinking straw for the center pole, a square piece of wood for the slab, four push pins to insert in the corners of the slab, and two pieces of yarn, each three times as long the straw. To complete this assignment each person needs paper, glue, and scissors. The center beam and string strung from corner to corner is the support system of the structure. Like the skeleton of the human body, it allows the structure to stand up. The covering around the built support structure is like skin, and it protects the structure's contents. To build the tent, the students should first cut four equally spaced notches in the top of the straw. Then, they should put the middle of one string into two notches across from each other. Next, they should take the other piece of yarn and repeat the process. After this, they should take the square piece of wood and put a pushpin into each corner and then wrap each end of the yarn around a pushpin so that there is no sag in the yarn. To complete the projects, they should cut out four triangles and glue them to the yarn. In one of the paper triangles they should cut a slit and fold it back so that their tents have doorways. The teacher should ask various students why the structure is successful. How are the principles of tension and compression used in this construction project?

Homework Assignment

After this classroom assignment, the students should be given a homework assignment due by the end of the week. Using a scale of $\frac{1}{2}$ inch equals one foot, students are to measure their bedrooms or other significant rooms of their home. They should indicate furniture placement with rectangles, squares, or circles. They should show light fixtures by drawing a circle with an X in it and indicate ceiling fans in a like manner with teardrop shapes added to show the fan blades. Lastly, they should "guesstimate" the weight of each piece of furniture placed in their floor plans.

Activity Three

This activity involves building a simple triangular truss with hinges to demonstrate load and tensile strength and the power and strength of the triangle. For this activity, each student will need tongue depressors that have been drilled at each end to accommodate a two-legged brass fastener, four brad fasteners, a two inch spool or the like, a large paper clip, and a piece of yarn about eight inches long. The purpose of this activity is to show

the strength of the triangle and its vertex. First, each student should join the three drilled tongue depressors together, fastening them with brads to form a triangle. Next, they should put a piece of yarn through the center hole of the spool. After that, they should suspend the paper clip from one of triangle's brad fasteners, and then put the other end of the paper clip through the yarn on the spool. Then, they should put that triangle down for a moment.

With the fourth drilled tongue depressor, students should attach each end of the yarn into each hole of the tongue depressor. They should tie one end of the yarn around the piece of dowel and the other end in the middle of one of the triangle sides. Then they should take the spool off the truss built with the three tongue depressors and attach it to the bottom of the yarn using the paper clip. They should hold the tongue depressor up and suspend the spool. The students will be asked, "What differences do you see structurally between the two trusses you have built?"

Now, working in pairs, the students should connect their trusses. Are they stable? What would it take to make them stable? Now they should put four triangles together to make a truss. While the students are working on building their truss, a projection of a truss-supported bridge on the monitor will illustrate this concept in action. The teacher will have each group build a truss. To add to the adventure, they should place a flat piece over the top of the truss and then add weight to the structure. The teacher will find out which group's truss will hold the most weight. First, the teacher should display the trusses and ask the class to guess which truss is the most structurally sound in their opinion. Why do they feel a particular truss will be more successful than another? The teacher will conclude by showing other examples of triangles in construction. He/She should project a geodesic dome and tell the history of Buckminster Fuller and his vision of this environmentally friendly, affordable housing option. Why aren't geodesic domes built more often? Do society's perceptions of housing enter into why there are not more geo domes in our society?

Lesson Three: Building a Native American Dwelling

Subjects: Architecture, World Cultures

Grade level: Seventh grade

Objectives

This unit is designed to allow the students to research Native American societies and their architecture. It will demonstrate the importance of environment and society in the development of building styles. It also allows time for the students to get into a group-work thinking mode. After using a color analysis of personalities to determine group members, the members will delegate responsibilities in organization, research, collection of materials, working drawings, dwelling construction, presentation board, and presentation to class members. Each project must meet teacher-provided minimum

standards regarding research, organization, working drawings, construction and presentation.

Time allotment: Twenty-seven 45-minute class sessions

Activity One

This activity introduces the unit, outlines the scope of work, and gives students the opportunity to assess their own personalities and determine the people with whom they should work to establish the most productive group dynamics. The first seven class sessions are dedicated to project research and preparation of preliminary drawings. The next five classes are devoted to finalizing working drawings, collection of appropriate materials and cutting the materials to size, and work on the presentation board. The next ten classes are actual dwelling construction; three classes are for presentations, and two days are for presentation to the second grade class. The handout for this lesson can be found in Appendix A. It describes various Native American dwellings in detail and instructs the students on how to go about building their dwellings.

Personality Analysis for Group Member Selection

This analysis is based on a simplified version of the Meyers-Briggs Personality test known as the Keirsey Temperament Theory. This theory states that there are four main personalities and that the most effective working group has one of each type. In order to create this environment in the classroom, each student is given four printed sheets of paper in four different colors. The colors are blue, green, gold and orange. Each of these colors represents a different personality type. Various characteristics are listed on each sheet. The students put the colors in order with the color on top that best describes their individual personality. The color on the bottom is the personality least like their personality. For the most productive group there will be at least three colors represented with one person having strong leanings in the fourth color choice. Gold represents the organized personality; green the methodical thinker; orange is the quick idea person and blue is the peacemaker. The students will have fun earning a bit more about themselves.

Lesson Four: Spanish Influence on Texas Architecture

Subjects: Architecture, Texas history, World Cultures

Grade level: Seventh Grade

Objectives: This series of activities allows the students to see the impact of the Spanish on Texas culture and architecture. These lessons also draw parallels between the Roman villa and the floor plan of Spanish homes and our current housing.

Time allotment: Seven forty-five minute class sessions

Activity One

Students will use the Internet to research the Roman villa. Specific elements to include in their research are the floor plan of the villa, the water source, kitchen facilities, bath facilities, dining and living area, recreational areas, doors, windows, and roofing. In addition, they should include interior and exterior wall treatments, interior flooring and window treatments, and recreational areas. How did the Roman people address home security? What does the Roman villa tell us about everyday Roman life? Keep this information in your class notebook for future use.

Activity Two

This activity involves a trip to two missions in San Antonio. A handout for this activity can be found in Appendix B.

Activity Three

Upon returning to class, group photographs are distributed, and each group is instructed to make a one-day presentation board explaining each of the photographs. Then, they will look at their Roman villa information. They should compare and contrast Mission de San Jose and other Spanish missions with the Roman villa. What architectural elements link back to the Greek and Roman cultures? They should look at the mission layouts in addition to the actual building elements.

Activity Four

For homework over the weekend, students will draw a floor plan of their homes and bring them to class to include in their class notebooks. They should be prepared to discuss the similarities and differences between their homes' layouts and the layout of the Roman villa. How does everyday Roman and Greek life compare with Mission life, and how do these two cultures compare with ours? What similarities and differences do you see between these cultures? How are our houses alike and how do they differ?

Lesson Five: Balloon and Platform Construction

Subject: Architecture

Grade: Seventh Grade

Objectives

Although we have seen many different styles of architecture during this semester of work, this will be the first time the students see the skeleton of the buildings we have been studying. New home construction is ongoing in our immediate area, and we are taking advantage of this opportunity by taking a neighborhood walking tour to explore a house during the construction phase. The houses are using platform construction, and the builder is allowing us on the job site. Seeing the construction is more meaningful than seeing the construction through slides, but we will use both out of necessity. This will bridge our architectural experiences to prepare for our future building projects using these

two building construction methods. The two building construction methods are balloon framing and platform framing.

Time allotment: Three forty-five minute class sessions

Activity One

A slide presentation showing the steps in framing a home will prepare the students for a neighborhood fieldtrip to a housing construction site. Students will be allowed to ask questions as we go through the steps of building construction.

Activity Two

We will visit a neighborhood construction site. These homes are three-story homes using platform construction framing method. This enables students to see actual framing, which they will then apply to their small, one-room construction projects.

Activity Three

Students, in groups of two, will make a birdhouse with an 8" x 10" base. The front and back of the house will be shaped to accommodate a gable roof, and should be 12" from the bottom to the center point of the side. The sides are 8" in height. The most important part of this activity is drawing an accurate working drawing to follow. All cuts for the construction pieces will come from the precise measurements indicated on the drawing. The materials required for this building project are 1/4" square Balsa wood pieces, wood glue, an Exact-o knife and blades, (2) 4" x 36" x 1/16" thick Balsa wood.

Activity Four

Each member of the group will cut and construct a side with a top and bottom cross-member and upright supports every 2". Each member will place structural supports between the uprights as indicated on their working drawings. They will then raise the sides and join them together to form the skeletal system of their birdhouses. Next, they should repeat the building process for the two portions of the roof and the foundation of the house, and should include a minimum of two rafters in their working drawings and subsequent constructions. The exterior wall treatment of the birdhouse is designed to resemble clapboard. To achieve this look, we will use Balsa wood cut into 1" strips. From the foundation, students should mark 1" at the corner. From that 1" mark, they will indicate 3/4" from that point up to the top of the front, back and two sides. These marks indicate placement of the 1" clapboard strips with each strip overlapping 1/4". Students should remember to make a template for the opening for their birdhouses. They should be prepared to brace the birdhouses around the opening. For the roof covering they will first cut a single piece of Balsa wood to cover and overhang the birdhouse walls according to their working drawings. They will mark these two roof pieces at 1/2" on each sloped side. These markings indicate placement of their wooden shingles. The shingles are made from the Balsa remnants and are 3/4" in length and 1/2" in width. Students will secure all pieces with wood glue. Once all pieces are glued and allowed time to dry, they will paint the walls using one of the appropriately provided brushes. The roof will be

stained using a brush-on stain. After these steps are complete and everything is dried thoroughly, students will brush on a water-based clear polyurethane finish to add a weather-resistant finish. Lastly, they will secure the hangers.

Consider presenting them to your gardening committee chairperson.

APPENDIX A

Native American Construction Project: Dwelling Description and Selection Listing

The following is a description of Native American dwellings. After reading the descriptions, select one dwelling to construct. The total size of the dwelling and landscaping is 16” x 20”. Make two selections in case another group has already selected your first choice. Selections are on a first come, first served basis.

Algonquian Wigwam

The Algonquians are a Native American tribe who lived primarily in what is now the Northeastern area of the United States and in the Great Lakes area. As with all the Native American tribes this tribe used available materials to construct their dwellings.

The structures are domed shape constructed of small indigenous trees bent to form the dome. This construction framework style is called “pole and sapling framing”. Cross members are thatched to these saplings, and grasses and bark are lashed onto the support system to form the exterior wall surface. Each one room home has a window, a doorway, and a smoke hole.

Iroquois Longhouse

The Iroquois are a Native American tribe who lived primarily in what is now the Northeastern area of the United States and also in the Great Lakes area. The longhouse is an inverted “U” shaped elongated dwelling. It has a pole and sapling frame construction covered with bark and reeds thatched to the structure. There is a smoke hole and a doorway. Storage and sleeping platforms were built into the house and the dwelling was traditionally divided into two rooms.

Plains Indians Tipi

The Plains Indians include, but are not limited to, the Cree, Crow, Cheyenne, and Blackfoot tribes. Because these tribes were more nomadic they required a simple, easily constructed, lightweight, portable dwelling. This dwelling is a three or four pole that were joined at the top and placed to form an oval at the base. This framework was covered with hides to protect them from the elements. Additional poles were put outside the exterior walls to control a moveable portion of the hide that served as a smoke venting system and/or provided additional needed light. The exterior hides were embellished with religiously symbolic designs. Each tipi had a doorway with a rolled hide flap and a smoke hole.

Seminole Chickee

The Seminole Indians lived in the southeast United States and particularly in Florida. The Seminoles had their own written and spoken language and had a largely agricultural society. Their homes had pole supports and rafters with a gabled roof covered with cross thatched reed roofs. A raised, half-log platform floor provided a dry, safer area for living. There were no walls. The Seminoles who lived in other Southeastern states constructed other different types of homes including wattle-and-daub houses.

Wattle-and-Daub Constructed Dwellings

A trench was dug and a vertical pole support structure was formed for the exterior wall structure system. Each home had a pitched, gable roof on which cane was thatched. The side wall poles were woven with twigs and sticks, wattle, and then covered with a mud plaster, daub, to protect them from the elements and add a measure of security. Cooking was in the house so a smoke hole was required and there was a doorway.

Alaskan Tlingit Plank House

This house is a gabled Pine or Cedar plank sided exterior wall home with a Cedar log frame support structure. Each home had a vertical plank door and was embellished with vivid iconography.

Navajo Stone Hogan

The Navajos of the American Southwest had several forms of housing. They called their homes hogans and they were constructed of many different materials. Some were constructed using mud plaster for the exterior wall covering while others used saddle notched logs. The one we are interested in for this project is the Hogan constructed of stone. The stone Hogan was round in shape with a sod, domed roof. Cooking took place in the Hogan so each home had a center smoke hole. The stone walled, round home had a vertical plank door.

Mohave Mud House

The Mohave lived in the Colorado River area of Southwestern United States. The early Texas housing structure called a jacal is closely linked to the Mohave Mud House. There is a crude, small, closely placed, vertical stick support structure with grass put in between the vertical sticks to add protection from the elements. A mud was packed on top of these thatched pieces to form an adobe plaster. The roof was only slightly pitched and covered with any available brush from the surroundings. The door was a horizontal plank door. Homes had small square windows.

Pueblo House

The Pueblos of the Southwestern United States were advanced in their architecture, and like all the Native American tribes, took full advantage of available materials. The homes were constructed using support posts with cross beams that rested in a fork at the top of the vertical posts. Roof rafters were placed on top of the cross members and small

sticks were placed on top of this rood structure to form the base of the roof. The roofs were flat and rainspouts were always placed in the roofing system to allow water run off and eliminate additional weight on the roof. A baked, mud plaster called adobe was packed on top of this stick structure. Many times homes were stagger stacked on top of each other. There were small windows in the homes and many of the windows had small vertical sticks spaced across the window opening. Many times there was a roof opening in which a lashed ladder was placed allowing inhabitants to move from one home to another more easily. Cooking took place in each home in a corner adobe fireplace.

Minimum Project Standards

- A. In your research identify your Native American tribe(s). Tell about their environment, their society, their religious traditions, and any other pertinent information regarding their lives.
- B. Draw a rendering of your dwelling. In this portion of your project make certain you tell who built the structure, if applicable.
- C. Does history give us any indication how long these tribes have used this type of construction?
- D. Include a working drawing of your dwelling which includes a floor plan and wall elevations for construction purposes.
- E. Make a presentation board using the provided board. Use only rubber cement to mount your materials, and back all materials. The dwelling title must be clearly visible and prominent on your presentation board. Required information for your presentation is a rendering of the exterior of the dwelling and a floor plan of the dwelling. Include a description of the materials used for building their homes and explain how these tribes adapted to their environment. List the group members and their role in your construction project. Sub titles must also be clearly marked. Explain the significance of any iconography. List the steps you used in constructing your structure, and tell us about any successes, or areas of concern in building your dwelling
- F. All dwellings are on a baseboard of 16" x 20" and must include an appropriate landscape on the surface of the baseboard.
- G. A one-page synopsis of your presentation must be provided for each member of the class to include in their architecture notebooks. Make a teacher copy also.
- H. Plan a ten-minute oral presentation to the class with each group member participating in the presentation.
- I. Journal daily activities of each member for the duration of the project, clearly state each group member's area of responsibility, and identify any successes and/or problem areas in your construction process.
- J. List and define architectural terms germane to your structure. Provide a copy of this glossary of terms for each class member notebook and also a teacher copy.

APPENDIX B

This activity takes us all to the two missions in San Antonio. On our trip we visit Mission de San Jose, The Alamo, and the Institute of Texan Cultures. Although Texas has a rich architectural history and the origins of the architecture are as varied as the numerous ethnic groups found in Texas, on this trip we explore the Spanish influence on our architecture and lifestyle; however, we do not stop there. Because we are studying architecture and architectural blends, please include information about architectural components that your specific cultural heritage group brought to Texas. Each student should draw one or more sketch to showcase these architectural elements. Specific required information to get at the missions is as follows:

A. At Mission de San Jose

1. Draw a rough sketch of the mission layout.
2. Using your disposable camera, photograph:
 - a. You and your group members (so I'll know who took the photos)
 - b. (3) building materials
 - c. One way the inhabitants made themselves feel more secure
 - d. Kitchen facilities
 - e. Water source(s)
 - f. Religious aspect of the community
 - g. Available tools
 - h. Architectural elements to include a dome, a relief, an arch, and a cantilevered area
 - i. (3) prominent buildings that remain on site. Why do they still remain? What does it tell you about the culture of the people?
 - j. What is the rose window? Why is it called the rose window?
3. Write a brief description of how you felt as you entered the sanctuary of the church. What are a few of the sights, sounds, and/or smells that you are aware of. Remember the mission is a working church. Regardless your personal religious affiliation, be reverent! It is a place of worship.
4. Tell me about the people who lived at the mission, and explain the responsibilities of the men and women in the mission.

B. At the Alamo

1. First, photograph you and your group somewhere in the mission. Photograph (3) interesting architectural elements and explain why they are of interest to you.
2. Put yourself in the place of one of the people in the mission on the day of the final battle. If given the choice to stay or leave, what do you think your decision would have been?
3. Before returning to school on Monday, write about your impressions of the people who lived and died at the Alamo. Did any one person's efforts

during the last days at the Alamo leave a lasting impression on you? If so, how and why?

C. At the Institute of Texan Cultures

Learn about the contributions of many ethnic groups who settle in Texas. Some are indigenous, but most are not. Learn about their struggles and triumphs to create a better life for themselves and their families. Their contributions remain. Identify with one ethnic group that best represents your heritage or one that you find interesting. Write a one-page essay about them and their input into our society. What was life like for them? Did they bring things from their native land to our world? What are some of them? What architectural elements are attributed to your ancestor's heritage?

ANNOTATED BIBLIOGRAPHY

Carley, Rachel. *The Visual Dictionary of American Domestic Architecture*. New York: Henry Holt and Company, 1997.

This book provides illustrations and descriptions about Native American dwellings in America, and dwellings of European settlers from early colonization through the present. The language and illustrations are concise and easy to understand.

Cyril M. Harris, Ed. *Dictionary of Architecture and Construction, Third Edition*. McGraw-Hill, USA, 2000.

This dictionary provided all necessary definitions and clarified any ambiguities.

Dietsch, Deborah K. *Architecture for Dummies*. New York: Wiley Publishing Company, 2002.

Architectural terms and methods of construction are defined and illustrated in an elementary way. This book helped me to devise an architectural course that middle school aged students can understand.

Kirby, William, Lynn Kirby, et al. UWSP. *True Colors*. June 2003. <<http://www.uwsp.edu/education/wkirby/pluralis/colors.htm>>.

This site simplifies the Myers-Briggs personality theory. In this theory all people are divided into four different groups. They outline a method of determining your personality type.

MacAvoy, Margaret, et al. *Birdhouses*. New York, Michael Friedman Publishing Group, Inc., 2002.

Birdhouse examples are displayed in this book. Although they used a different method of construction from the one I used, I at least got the easier building structure concept from here. It also gave me the idea to allow the students to paint the exterior walls of their birdhouses in less traditional ways.

McAlester, Virginia and Lee McAlester. *A Field Guide to American Houses*. New York: Alfred A. Knopf, 2000.

This book details many housing styles and discusses in detail various origins or architectural styles. This is a wonderfully written and illustrated book.

Salvadori, Mario. *The Art of Construction*. Third Edition: Chicago. Chicago Review Press, Incorporated, 1990.

This book shows many, many construction possibilities as well as detailed illustrations and descriptions for each stage or phase of construction.

Thallon, Rob, and Anthony Baron (Ill.) *Graphic Guide to Frame Construction*. Newtown, CT: The Taunton Press, 2000.

This book gives hundreds of detailed illustrations and written text regarding frame construction.

Natural Building Museum - Exhibitions - Past 2000-1996. "Wood: An American Tradition." June 2003. <http://www.nbm.org/Exhibits/past/2000_1996/Wood.html>.

This site showcases buildings built during the late nineteenth century and the twentieth century. It explains some of the technological and social reasons why building changes occurred.

Balloon Framing. 1993. Iris Communications, Inc. June 2003. <http://oikos.com/esb/27/balloon_framing.html>.

This site shows and tells you all about balloon framing construction.

I & M Canal History-Cities and Towns. "Architecture". Canal Corridor Association. June 2003. <<http://www.canalcor.org/hiscities.html>>.

Here there are photographs showing Midwestern America during the time of the Industrial Revolution. The site shows the rapidly changing face of America and its housing needs.

Just the Arti-FACTS: Balloon Frame Housing. 2001. Chicago Historical Society. June 2003. <<http://www.chicagohs.org/AOTM/jan00/jan00fact2b.html>>.

This site further explains the how and why of balloon framing.