The Sustainable Architecture of the *Three Little Pigs*

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INTRODUCTION

Contemporary educators teach environmentally-mindful lifestyles to affect change and prepare students to care for our planet responsibly. Most children in America know the importance of recycling, and many schools have recycling programs. These efforts make a difference; however, we must do more. To positively impact our future, we must fashion curriculum that demonstrates effective use of materials and the importance of living a sustainable lifestyle. In *Teaching as Leading* Hannah Arendt says:

> An education, too, is where we decide whether we love our children enough not to expel them from our world and leave them to their own devices, not to strike from their hands their choice of undertaking something new, something unforeseen by us; but to prepare them in advance for the task of renewing a common world. (qtd. in Gordon 53-54).

Humans continue to misuse and abuse our planet's natural resources. We must drastically modify our lifestyles and educate future generations to be stewards of our environment. What we teach our students today directly affects the future of our planet. This is a global issue that faces humankind. We are bombarded by savvy marketing that touts the glories of "green" products because that one word sells the product. Caring consumers want to make a difference, but how does a consumer sift through the recycled, earth-friendly, organic, low carbon emission labeled products to discern truly sustainable alternatives?

Numerous organizations have sprung up over the past decades that promote green technology and sustainable alternative choices. There are a myriad of them and, despite their best efforts, they can add to consumer confusion. Two terms, "Going Green" and "Sustainable Alternatives," permeate our culture. We hear these words but most people could not give a precise definition for either phrase. The Going Green Web Guide, a publication of the Middletown Thrall Library, states that:

> Going Green means to pursue knowledge and practices that can lead to more environmentally friendly and ecologically responsible decisions and lifestyles, which can help protect the environment and sustain its natural resources for current and future generations.

Green Initiatives declares in American Institute of Architects' Green Building Toolkit that:

> Sustainability is when humans use Earth's resources at a rate at which they can be replenished. However, there is now clear scientific evidence that humanity is living unsustainably, and that a collective effort is needed to return human use of natural resources to within sustainable limits.

Many of us attempt to help the environment by recycling our plastic, paper and glass, but these efforts alone are not enough to affect the significant change required to stymie our global warming problem. We, the general population, must enhance our awareness of key contributing factors to greenhouse gas emissions and implement change by making more environmentally-

friendly choices. The average citizen is not cognizant of the fact that commercial and residential buildings contribute to almost fifty percent of dangerous gas emissions that substantially contribute to global warming, with residential buildings accounting for over twenty percent of this staggering building gas emission fact. With this knowledge, it is our responsibility to construct new buildings and renovate old buildings using sustainable building practices and materials.

In 2002 architect Edward Mazria started Architecture 2030, a non-profit organization committed to shifting the building segment from being a major contributor to greenhouse gas emissions to becoming a major partner in solving this plight. This will be achieved through ecologically minded planning, design, and construction of our built environment. One of this organization's programs, the 2010 Imperative Curriculum, began in 2008. The thrust of the initiative is the education of professionals and citizens on ways to reduce or eliminate the use of fossil fuels by using ecologically-friendly design and materials in the construction of residential and commercial buildings.

Instruction pertains to the architecture of *The Three Little Pigs* and will be taught to fifth grade students enrolled in my art enrichment class to add rigor to the gifted and talented art program. Architecture is the marriage of design and function and is the ideal vehicle to explore math and science principles that every fifth grader must know to pass state-mandated tests. It connects these disciplines with world cultures, geography, language arts, and visual arts. With forty-five minute class periods on a six day rotation schedule, it will take a semester to complete all the lessons.

This interdisciplinary unit allows students to reevaluate a story most of us know, *The Three Little Pigs*, and put it in a contemporary setting. The story is about a single mom who is so overwhelmed that she sends her three children out into the world to fend for themselves. In an effort to find shelter, each of the pigs used building materials that were given to them to build their homes. The first pig built his home of straw, while the second pig built his home of wood. Sadly, the pig that built his house of straw and the pig who built his house of wood did not weigh all their options wisely and met their demise at the hands of an overbearing creature that was looking for his next meal. The third pig was more cunning and built his house of brick. Through a series of wily maneuvers, he outwitted the wolf, had him for dinner, and continued to live comfortably in his brick home. The story emphasizes the building materials that each of the pigs chose and implies that the home built of straw and the home built of wood were not as permanent or secure as the brick home. Was it the materials or the ineffective use of the materials that caused the building failure? This is a question we investigate in this unit.

Straw, wood, and brick are materials that past and present civilizations use to construct their homes. All three building materials can be sustainable ones that offer advantages and disadvantages when utilized to create functional, aesthetically pleasing, and ecologically-friendly dwellings. We look at the vernacular architecture of varied cultures to get ideas on ways to build sustainable dwellings.

Many of my displaced and/or suburban elementary students can relate to the plight of the three pigs. They, too, live in homes with single moms who struggle to make ends meet, and they have responsibilities usually reserved for older people. They are limited in their knowledge about architecture, architectural design elements, building materials, and construction methods. Using the story of *The Three Little Pigs*, we explore our school building, our neighborhood-built environment, and the architecture of other cultures.

BACKGROUND

Our School Population

Our student population fluctuates from six hundred fifty to eight hundred students annually. Some of our students were displaced due to a natural disaster and relocated to our area while others were born and raised in our community. Our Pre-K through fifth grade students are zoned to our public school and live in apartments, town homes, and single-family dwellings in a three square mile radius.

Every race and creed attend our school, with an ethnic mix of approximately forty-five percent African American, twenty-five percent Hispanic, and twenty-five percent Asian and White; the balance is classified as Other. The students get along well and share their experiences with their classmates in a real-world setting. Some of our children have had every opportunity life has to offer, while others have not been too far from their immediate surroundings and spend time away from school tending to family responsibilities. The children who live in single-family homes tend to be less transient than those who live in multi-family dwellings.

Our school has been a part of the community for over thirty years, but not in the present building configuration. We had an aging building that did not fit the needs of our students. To compensate for lack of space, temporary buildings were put onsite to supply space for additional classrooms. The temporary buildings were anything but temporary. They remained on property until a citywide bond issue passed that allocated funds to construct a new facility. We have been in the current building for less than two years.

Our New School Building

The new facility accommodates our educational requirements and extends the classroom into outdoor space located on school grounds. The building meets Leadership in Energy and Environmental Design (LEED) standards, and provides a safe haven for our students.

Our elementary school is the first LEED school in a huge school district. According to Noelle Heinze in an article in the January/February 2009 issue of *Texas Architect*, our 84,533 square foot, two-story school meets LEED criteria because:

*Original bricks were salvaged from the old building and used in several areas around school.

*82% of the construction waste was recycled.

*Building materials emphasize local and regional products.

*Low-emitting adhesives, sealants, carpet and paint were selected for interior finishes.

*Lighting

*HVAC systems

*CO2 emissions reduction equals planting ninety-three acres of fully mature trees.

*Existing mature trees were preserved on our five-acre site to provide shade for the school.

*Native plants were planted in select areas.

*A loop drive removes traffic from the street.

*Grounds include three playgrounds, a nature center, and a pond.

*A main corridor and organizing wall create a simple transition into the school and join interior zones.

*A cafeteria and multipurpose rooms are separated from academic areas, allowing after hour community use while the rest of the facility remains secure.

*Nature center uses collected rain water stored in containers to water the beds of indigenous wildflowers, beds of herbs and vegetables, and plants that promote butterflies and hummingbird activity (71-74).

Our Neighborhood Built Environment

Our neighborhood is within seven miles of a major downtown business district in a city that has no zoning. The immediate neighborhood includes single-family dwellings, multi-family/mixed income dwellings, town homes, high-rise office buildings, mid-rise office buildings, strip shopping centers, green spaces, recreational facilities, and two schools. The single-family homes were built in the late 1960s and many have significantly updated their homes to meet current trends and living standards. The neighborhood represents diverse cultures and socio-economic groups and maintains building standards through a strong homeowners association.

Our corporate neighbors understand the importance of maintaining a strong, vibrant school and assist us throughout the year in educational endeavors. They are valuable partners who lend their expertise and resources to benefit our students.

Architecture of Other Cultures

Because we construct buildings made of straw, or wood, or brick in this unit, we examine built environments of other present and past cultures for ideas and information to make our buildings sustainable, functional, and aesthetically pleasing.

OBJECTIVES

All objectives for this interdisciplinary unit are based on the Texas Essential Knowledge and Skills (TEKS) for fifth grade math, science, language arts, and visual arts.

Language Arts

Students read the story of the *Three Little Pigs* and discuss its relevance in today's society. They write about the characters, setting, plot, and morals of the story. They compare and contrast the relevance of the story in contemporary society and apply the gleaned information in their constructions.

Math

Measurement and scale are two key components in building models. Students use architectural tools to draw and build dwelling components using 1" = 1', mostly.

Science

Compression, Tension, Gravity, and Torque are all principles that play on a building. An understanding of these principles and ten other principles is imperative to successfully building a dwelling. Hands-on activities demonstrate these principles.

We will investigate climatic effects on a dwelling through a series of experiments where their structures are subjected to wind, water, and heat.

Earth Science/Ecology

Students research the properties of straw, clay, sand, soil, and timber in determining materials appropriate for their dwellings. Climatic and topographic conditions also weigh on their choice of suitable materials.

Green technology, sustainable materials, and carbon-emissions are terms we will investigate to

ascertain their importance in our building projects.

Architectural Terms

To work in a discipline students must know the vernacular specific to the discipline, so we discuss our environment in terms that are specific to architecture. We discuss the attributes of our school building that make it an LEED school and the importance of the building in our community. Furthermore, students will locate and identify specific materials in our school.

Social Studies

Students learn about African builders who are resourceful and creative in building traditional dwellings called rondavels or roundhouses that are made from available materials: mud and clay, grass or reeds, wood, sun-dried brick, stone, and some of the natural materials they employ. We discuss their communities and those of the Iron Age Celts, who also built large dwellings of grass, mud, animal dung, and clay. We build a dwelling using adaptations to vernacular building practices found in these cultures.

Other builders from varied cultures we discuss are the stone masons of Mesopotamia and of the Incan, Mayan, and Aztec societies, and the dwellings and community buildings they fabricated. We build a dwelling using adaptations to their methods.

We discuss and build a longhouse based on those found in Borneo in Southeast Asia. Many communities have large longhouses built of sticks raised to withstand high water and strong winds. The Iroquois Tribe of North America built longhouses, too.

Technology

Manual architectural tools like a protractor, triangle, architectural scale, and T-square are no longer used in contemporary architectural settings. We use them to assist in learning measurement in a tactile way. After students master using these tools, they try drawing parts of a dwelling on the computer using a simple plan program.

RATIONALE

Many people consider the art classroom to be a place where children make fun projects. That is true. They do make fun projects, but art is much more than that. Art is the integration of language arts, world cultures, math, and science in an applied format. Some teachers sack art in their classroom lesson plans because it may create mess or noise. Other classroom teachers have so much information they need to convey that there is not much time for projects like the ones I propose in this unit. I contend that many of us learn by doing. The art room is the ideal setting for such learning experiences. Projects like this clearly broaden the definition of art in a school curriculum and address visual acuity.

UNIT BACKGROUND

To understand the need for change in our building techniques, we must explore our community and the impact the built environment has on our neighborhood and our way of life. It is imperative to show how choices in building materials and systems we employ affect each individual. After all, is it all about “me”? How does it affect me? When we can discuss large issues on a personal level, then we can begin to make a difference. Unless students see a direct correlation between conservation and maintaining their way of life, they will not make sustained, conscious changes in their actions.

The creativity and resourcefulness of man is endless. If we look at other past and present cultures, we understand their rationale for the locations they selected for their buildings and the framework and materials they utilized. This will broaden perspectives and change perceptions about the intellectual prowess of prior civilizations and contemporary cultures that differ from our

own.

African Roundhouse Dwellings

Sustainable dwellings made from straw, stick, brick, stone, mud, and many other natural materials are all found on the continent of Africa in indigenous architecture. The topography is so diverse that all three building materials that the three little pigs used are present on the continent. The roundhouses of Cameroon and Tanzania are made of mud and straw while the vernacular houses in Mali are made strictly from mud. In Dahomey and Benin raised, thatched stick houses are the style of the vernacular architecture. The Zulus of South Africa build beehive–like structures made from bent saplings with grass plaited in between, while the traditional dwelling of the Sudan is a thatched roundhouse with a cone-shaped roof. Zimbabwe has some remnants of stone homes, towers, and walls from ancient societies. All of these homes are built with local natural materials by individuals or members of the village, the very definition of sustainable architecture.

North American Straw-Bale Homes

One type of construction that was popular in the plains early in the twentieth century is straw-bale construction. People who settled in Nebraska had an abundance of straw and needed to build structures quickly that would withstand harsh temperature extremes. Straw is different from grass. Hay is eaten by animals and straw is not. They used the straw for their homes because it would be thrown away most of the time, and they wanted to save the hay to feed their livestock. The oldest standing straw-bale home in Nebraska dates back to the early 1900s. This type of home is built by first digging a trench around the perimeter of the home that is the width of the straw-bales. Rubble rocks are tamped into the trench to form a solid base. Straw-bales are tightly wrapped with two wires and two lines of barbed wire are put in between the courses of straw-bales to hold them in place. The bales are stacked on top of each other to the desired height. Timber is put around door and window openings and at the top of each straw-bale wall to support the roof. The roof has a timber frame with thatched straw bundled in between.

This construction style is quick and does not require much expertise to build. It costs less than conventional types of construction and has excellent thermal qualities. Pests do not eat the straw, but mildew is a problem if the straw gets wet before each side is coated with a plaster mixture. They do not require much maintenance.

Borneo, Indonesia, and Polynesia Raised Stick Longhouses

People in Borneo, Indonesia, and Polynesia build longhouses raised above the ground on stilts to protect them from floods during their annual rainy season. Many families live under one roof, but each family has its own living quarters. They share some space where everyone eats and plays. Native American tribes in northeastern North America built similar longhouse structures. In these cultures the cooking is conducted in the middle of the house where an opening in the roof acts like a chimney. The Asian longhouses are built using spaced wooden columns that support a roof pole. The walls also have matching wood columns. The roof and walls are joined together by rafters. The entire house is covered with bundles of dried grass and reeds. Many families sharing common space increases security and a sense of community.

Ancient Mesopotamia Dwellings

When towns were small, large homes of wealthy citizens and small homes of poor families clustered around each other and a ziggurat, their communal building. Every family had its own home. Most houses shared walls, like townhouses do today. People built their homes of sun-dried brick because there was not much wood or stone available to use for building materials. Behind the front door was a small family courtyard. The courtyard was the first floor of the three-

story dwelling that served as a garden area, the children's play area, and a home for their domesticated animals. Most homes had three stories of living space. Stairs from the first floor courtyard led up to the second and third floors, and then to the roof, which was a flat roof. Roofs acted like a fourth floor of living space. When weather permitted, they cooked and slept on their roofs. Some built walls around the perimeter of the roof for privacy while others added grape arbors that provided food and shelter from the sun.

Alternative Building Forms and Materials

Buckminster (Bucky) Fuller was an American mathematician and inventor who designed a futuristic home to accommodate the need for quick, affordable housing for soldiers and their families after World War II. The design of the home was constructed of the strongest geometric shape, the triangle. The structure has great environmental benefits, but it never received acceptance from the general public. Many think it was difficult to accept because its design is so different from our concept of "a home." His dome is relevant in today's society and offers an interesting building alternative.

Another creative spirit saw a need for affordable housing in one of the most disadvantaged counties in America. In 1993 Samuel Mockbee left his successful architecture practice to join the staff of Auburn University where he developed a program to bridge educational and community needs. Mockbee began The Rural Studio architectural program at Auburn University. This architectural venture extends education beyond classroom walls and promotes the use of architecture students to design and build homes and community structures for citizens in America in Hale County, Alabama.

The resources that the student architects use are found or given materials that were designed for another purpose. Some of the materials that they have used are carpet tiles, trashed car tires, and car windshields. Although Mockbee died a few years ago, his Rural Studio program continues to change lives. This is an example of an ongoing educational process applied in a real-world setting. In keeping with the philosophies of Mockbee, one lesson encourages students to build with materials designed for another purpose.

Architecture of *The Three Little Pigs*

All three of the pigs took advantage of the materials that they were given. They did the best job they could in constructing their homes and providing for themselves. They were young people who were put into the world without any education, no training, and no means of support. Unfortunately a worldly beast found two of them and ate them for dinner. The story leads the reader to believe that the situation would have been very different if all the pigs had waited and all built their homes of brick.

What could they have done differently with the same materials to build their houses? Past and present civilizations have survived and thrived in homes built of straw and sticks. These civilizations lived in these homes as well as those who live in homes made of brick.

What building features did they employ that would have benefited the pigs when they built their homes? Why do the straw roundhouses of Africa or the raised stick houses of Borneo still continue to provide secure shelter for their inhabitants? These are issues to explore when students determine how to build their homes. These societies and the three little pigs are all on the cutting edge of creating sustainable building. They used recycled materials that were of local origin. They did not use any toxic materials or adhesives. They provided green space around their homes and used plants indigenous to the area.

The third pig got his food from local farmers at the market, and he got his butter churn at a swap meet. They did not adversely impact the environment. The techniques the pigs employed

are the very definitions of green, sustainable living.

CONCLUSION

The three little pigs built their homes of straw, wood, and brick. In the original story the pigs were sent out into the world to fend for themselves. They had to find food, shelter, and water to survive. Each of the pigs encountered people along the way who had materials they thought would be useful to provide shelter, one of the necessities of life. Each of them took advantage of the available materials and built their homes. The first pig built his house with the straw that a man on the street gave him. The second pig built his home of sticks that another man on the street gave him. Unfortunately, a hungry wolf was able to blow their houses over and eat them for dinner. The third pig outwitted the wolf who wanted to eat him for dinner also. The third pig built his home from bricks that a man on the street gave him. We are to derive several morals from this story, but I take exception to their conclusion.

We need to look for better building strategies to improve their construction methods. Many cultural models are available for us to examine, from which we can glean sound, sustainable building practices to replicate or use as examples.

LESSONS

Overview

These lessons are written to ensure success to a wide range of skill levels and students of varied academic prowess. There are numerous lessons included in this unit. They can be taught independently or sequentially, dependent on the knowledge base and skill levels of your students. Because of space restraints only some of the lessons are complete lessons, as they were written for in a class setting. They are included to scaffold learning and allow time for interjection of lessons specific to individual class settings.

Unit Expectations

This unit is designed to span an entire semester based on one forty-five minute class weekly for eighteen weeks. Some key components to explore and discuss in an overview prior to beginning any exploration of the building process include:

* Reading the story of the *Three Little Pigs* and discussing the decisions each of the pigs made; some that were successful and others that were less than successful.
* Creating a definition of architecture and examples of architecture across cultures and historical periods using a Power Point presentation. The images range from culturally rich vernacular dwellings to past and present historically significant buildings. Students interact by reading different portions of the presentation.
* A tactile introduction and examination of built examples of the three little pigs' homes.
* An explanation that building will occur, but first we must discuss building correctly.
* A series of hands-on activities that demonstrate scientific principles that act on a building.
* An introduction and demonstration of the use of architectural tools that include a T-square, architectural scale, triangle, and protractor.
* A display and explanation of elevations, cross-sections, floor plans and scale drawings.
* An introduction of problems that buildings create in our atmosphere.
* A discussion of the meaning of "green" and "sustainable", and the need for significant change by all of us to reduce or stop practices that damage our atmosphere.
* A presentation of building materials to include in our materials wall.
* A tour of our school focusing on the layout of the building and various features that make our school an LEED school. Provide a hand-out that lists our school's green features.
* A walk around our campus pointing out elements in our neighborhood visible from the school

grounds.
* A revisit of the story of the little pigs and ways their buildings serve as models of contemporary architecture.
* A presentation of the materials that we will use for our dwellings.

Lesson One: What is Architecture?

Learning Experience:

This lesson explains the definition of architecture. It mentions different types of architecture from various past and present cultures and common elements found in each building. The lesson explains the distinction between a building and a dwelling and permits students to take a building apart to see four basic building components: foundation, wall structure, cladding, and roof. Houses they examine are African and Celtic roundhouses, a Borneo longhouse, a Mesopotamian brick home, and a European wattle and daub dwelling. After thoroughly looking at all the parts of each of the houses each student answers three questions about the properties of each portion of each home.

All students receive a file folder that serves as the cover of an architecture book that they create during the course. We also make individual boxes from (1) 22" x 28" four-ply sheet of railboard. These boxes keep their folders and all the cut pieces of their projects in one place. The dimensions of the box are 8 1/2"w x 24"l x 2"h.

They receive their first entry, which is a General Architectural Vocabulary Sheet that includes the meanings of architecture, architect, building, dwelling, foundation, wall, cladding, and roof. Objects to see, touch, and feel are excellent learning tools that prompt discussion and address most learning styles. After this discussion they create a simple structure using Legos. Lego buildings include a foundation, wall structure, exterior wall surface (cladding), and a roof just like the buildings they will construct later in this unit.

A sample dwelling was constructed to permit students to take them apart easily and examine each part of the dwelling. After analyzing the scale model dwellings, they discuss similarities evident in all buildings and the importance of each of the four major building elements; the foundation, wall structure, cladding, and roof.

Time required: (1) 45-minute class period

Materials:

* File folders that have been three-hole punched with appropriate fasteners
* Photocopies of different types of architecture
* Photos of houses, floor plans, and elevation
* 22"x 28"posterboard
* Built scale model dwellings

Objectives:

* Begin a notebook of architectural terms and pictures.
* Present architectural styles from various cultures and historical periods.
* Examine parts of the scale model dwelling.

Handout: General Architectural Vocabulary Terms

General Architecture Vocabulary Terms

1. **Architect**-A person who designs the plans for buildings, bridges, and other built structures. An architect also sees that the builder carries out the plans correctly. Within the architectural firm team, members are responsible for specific parts of the project. Some of these parts may be

the outside of the structure, exterior, the inside of the structure, the interior, or the plants in and around the structure, landscaping. The architectural firm, a group of architects and people who work with them, also gets permission from government agencies, permits, and makes sure all parts of the building are completed according to government rules and regulations for that city, county, state, and country. Different types of professionals work on a project and the architect coordinates these contractors until the project is completed.

2. **Architecture**-The work of planning and putting up buildings according to specific requirements. Architecture is also any built structure.
3. **Blueprint**-A reproduction of the drawings of the building.
4. **Building**-A more or less enclosed and permanent structure for housing, business, or industry.
5. **Building Materials**-Any materials used in construction, such as steel, concrete, brick, masonry, glass, wood, or other materials.
6. **Dwelling**-A building or structure where someone lives.
7. **Floor plan**-A drawing of a room or set of rooms that shows the room dimensions; it can also show the arrangement of furnishings and equipment.
8. **General Contractor**-The person who takes the architect's drawings, plans, and works with other professionals to turn the drawings into a building. Some types of professionals a contractor works with are plumbers, electricians, carpenters, roofers, framers, and others who are called **Subcontractors**.
9. **Green Architecture**-Green architecture, or green design, is an approach to building that minimizes harmful effects on human health and the environment. The "green" architect or designer attempts to safeguard air, water, and earth by choosing *eco-friendly* building materials and construction practices.

Green architecture is also known as sustainable, sustainable development, eco-design, eco-friendly architecture, earth-friendly architecture, environmental architecture, and natural architecture. While most green buildings do not have all of these features, the highest goal of green architecture is to be fully sustainable.

10. **Green Building Materials**-A green product is that it takes the entire lifecycle into how and where it was manufactured, transported, installed, used, and maybe re-used and recycled. When looking for green materials look for materials that:
    * Use recycled or renewable materials
    * Use conservation in manufacturing and use
    * Are locally produced
    * Are healthy for occupants (low or no VOC)
    * Are very durable and requiring little maintenance
11. **Job Site-**The place where work is being done to construct a building
12. **Rendering**-A drawing of a building by the architect or a member of the architectural team that is drawn according to floor plans and is a picture of the building after completion.
13. **Scale**- The way that the size of a model or drawing compares with the actual size of the building. Building materials in America are not on the metric system so architects usually work on a 1/8" scale or a ¼" scale, which means that on a plan ¼" equals one foot, or that every 1/8" equals one foot, dependent on the size scale the architect is using.
14. **Structure**-Any building, bridge, or elements put together in an organized way so that they stand on their own.
15. **Sustainable Building**- Also known as "Green Building," this is the practice of making buildings more efficient by using energy, water, and building materials more effectively while reducing the building's impact on human health and the environment during the building's lifecycle through better placement of the building, its design, construction, operation, and maintenance.

Lesson Two: Getting to Know Building Materials

General Information:

Our local home improvement store donated examples of the building materials that are listed below. Additional building materials included in this display were donated by a local builder's home design store and include cotton fiber insulation, petro-free organic insulation, clay, bamboo, porcelain tile, and thermal glass. These businesses also offer educational opportunities to students.

Grade and subjects: 5, Art, Environmental Science

Source: Local home improvement store and home design center

Time required: (1) 45-minute class period

Materials:

*Stone	*Drywall	*Aggregate
*Brick	*Stucco	*Cement
*Wood	*Timber	*Cinder block
*Straw	*Plaster	*Man-made plank cladding
*Mortar	*Masonry	*Fiber board
*Concrete	*Timber	*Glass-block
*Paper Crete	*Steel	*Granite

Objectives:

* Build a wall of building materials that is a simple partition with mini-shelves inserted to keep the materials in place. Leave a space around the shelf to name the material and list the properties.
* Discuss the properties of the materials.
* Match the building material with the printed material name.
* Include a Building Material Vocabulary Sheet into their architectural notebooks.

Learning Experience:

1. Display each building material and allow each student to touch and feel every material.
2. Discuss positive and negative properties of every material.
3. Name each material with a placard suitable for display.
4. Display the properties.
5. Encourage all students to participate in the completion of the wall.

Handout: Building Materials Vocabulary

Building Materials Vocabulary

1. **Adobe –** A heavy soil that is made of clay and has small bits of sand particles in it. Water, straw, and other materials are added to it to make it stronger when it dries in the sun. Many times the mixture is made into brick form.
2. **Aggregate –** Granular materials like sand or gravel which are bound together to make concrete or mortar.
3. **Brick** – A solid piece of masonry that is usually made of clay and dried in an oven to harden it and give it strength. There are many different colors of bricks. In America the current standard size is 8" long, 31/4" wide, and 21/4" thick.
4. **Cement –** A material or a mixture of materials (without aggregate) that is very adhesive when it is in a plastic state, and it hardens in place.
5. **Cinder block –** A masonry unit made of cinder concrete and used for interior and exterior walls and foundations.

6. **Cladding** – A non-structural material used as the exterior covering for the framework of a building.
7. **Clay** – A fine-grained sticky natural earthy material that is even stickier when wet and rigid when dry. When it is fired in an oven, a kiln, it strengthens significantly. It is often used as a mortar type fill in some types of construction like wattle-and daub. It is the daub.
8. **Concrete** – A stone-like material that is formed by mixing an aggregate like crushed rock or stone together with cement and water and allowed to dry and harden.
9. **Dry-wall** – An interior wall that is made from a gypsum board or plywood. It can also be a self-supporting rubble wall that is built without mortar.
10. **Lumber –** Timber that is sawn or split into beams, boards, planks and other types of wooden shapes.
11. **Masonry –** The art of putting stone, brick, building block, or other such materials to form walls and other parts of a building.
12. **Mortar –** A plastic mixture of materials like plaster or cement that is mixed with water and a fine aggregate like sand. It is used in masonry construction to hold pieces of masonry, like bricks or cinder blocks, together to form a wall.
13. **Paper Crete –** A mixture of Portland cement, sand and recycled paper (newspaper and magazines) used as a building material.
14. **Plaster –** A mixture of gypsum or lime with sand and water that makes a paste-like material that is applied in the plastic state onto a surface of a wall or a ceiling or on top of brick. It forms a hard surface when the water evaporates from the mixture.
15. **Steel –** an iron and carbon alloy (mixture of metals) that is strong and insect resistant and is used in building construction instead of wood.
16. **Stone –** any type of rock that has been processed by cutting, shaping or sizing to use in building construction. Some kinds of stone are cobblestone, flagstone, fieldstone, granite, marble, limestone, etc.
17. **Straw** – stalks of grass-like crops that are used to make baskets and to make walls and roofs of structures in many cultures
18. **Straw-bale house –** a dwelling that is constructed using bales of straw as the walls. The walls are usually coated with a plaster mixture after the straw dries completely. These types of walls are very efficient in keeping the home cool and warm. It has excellent thermal properties.
19. **Stucco –** a wall plaster used on interior and exterior walls.
20. **Timber –** wood that has been cut into boards so that can be used to build houses.
21. **Wood –** the hard part of the trunk and branches of a tree that is under the bark.
22. **Parts of a house –** Framing, foundation, insulation, and siding.
(See www.doe.mass.edu/mcas/student/2006/question for a good drawing of the parts of a house.)

Lesson Three: Exploring the Architecture of our Neighborhood

Overview:

In the two blocks around our suburban school, the neighborhood includes high-rise buildings, mid-rise buildings, another school, a retail shopping area, town homes, multi-family dwellings, and single-family homes. Students have the ability to view and investigate these varied structures on a class walk through our neighborhood. Each student gets a line drawing of these structures that are labeled with specific elements on that structure that are important terms for students to incorporate into their architecture vocabulary. Students divide into groups of three or four and are given a digital camera. Their assignment is to photograph the labeled elements of one of the seven building types found in our immediate neighborhood. Each student has the opportunity to photograph some of the labeled elements to include in an architecture notebook that they compile throughout the duration of these lessons. Printouts of their photographs go into their books.

The notebook is divided into sections that include assignments, reference pages, vocabulary

sheets, drawing diagrams, biographies of noted architects, and important structures from around the globe. Reference pages include pictures, descriptions, and definitions of roofs, cladding, columns, windows, doors, other features, and decorative elements found on buildings in our neighborhood. One page defines types of buildings found in our neighborhood that includes high-rise buildings, mid-rise buildings, school, retail shopping area, town homes, multi-family dwellings, and single-family homes.

To assess the experience we create our own BUILD or Concentration Game from their photographs to reinforce the learning experience and give the students an opportunity to compete. In BUILD they match terms with photos.

Lesson Four: Let's Get Physical (Science) into Our Architecture

Overview:

In this lesson we introduce the scientific principles required to build a structure and provide working examples of scientific principles. Using David Macaulay's *Building Big Activity Guide*, we will go through a series of smaller hands-on activities to demonstrate the scientific principles that act on a building.

Grade and subject: 5, Science, Architecture

Time required: (5) forty-five minute classes
Activities one through seven take (2) 45-minute classes
Activities eight through eleven take (1) 45-minute class
Activities twelve through fourteen take (2) 45-minute classes

Objectives:

1. Introduce the scientific principles required to build a structure.
2. Begin building a working architectural vocabulary.
3. Provide working examples of scientific principles.
4. Show the close relationship of function in the design process.
5. Experiment with materials.
6. Gain insight into the use of geometry in design.
7. Start an architecture notebook.

Materials:

Sponges, deck of cards, pencils, soccer ball, backpack with books, softened beans, toothpicks, paper, rubber bands, drinking straws, small paper clips, ceramic tile, chairs, pipe cleaners, string, yarn, cloth, paper towel tubes, toilet paper tubes, clay, craft sticks, sand, flat board

Learning Experience Activities:

Students are grouped according to the activity and enact each scientific principle. The fourteen activities that demonstrate different scientific principles are: Force, Load, Compression, Tension, Bending, Shear, Torsion, Arch, Dome, Cantilever, Truss, Testing the Strength of Materials, Building with Drinking Straws and Paper Clips, and Building with Toilet Paper Tube Columns. The activities use the following format:

Activity: Compression

a. Have students pair up and outstretch their arms putting their palms together gradually leaning in toward each other.
b. Explain that columns and bridge piers are construction elements that are in compression.

Activity: Tension

a. Remaining in pairs have students outstretch their arms with their fingers together in a cupped position.
b. Have the students interlock their fingers and gradually lean away from each other.
c. Ask the students how their arms feel.
d. Explain that cables are examples of elements on a construction that are in tension.

Lesson Five: Draw like an Architect

Overview:

Students work in groups of three with each student drawing a different style of dwelling. Each student draws one working drawing of one scale model of a teacher-assigned dwelling. The scale we use is 1" equals 1'.

Grade and subjects: 5, Architecture, Math, Art

Time required:

Option I: (2) forty-five minute classes
Option II: (4) forty-five minute classes

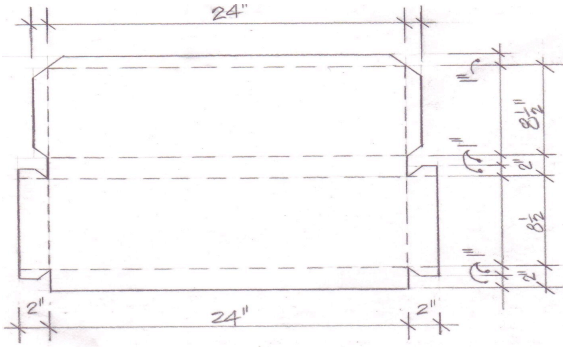
Materials:

* 22" x 28" poster board for Option I
* 18" 24" drawing paper for Option II
* T-square
* Protractor
* Triangle
* Architectural scale
* Drawing pencil
* Eraser
* Masking tape
* **White** glue

Objectives:

* Develop skills in precise measurements.
* Increase working architectural vocabulary.
* Manipulate architectural tools to create elevations.
* Read existing working drawings and draw their own drawings based on the information on the class set of elevations.
* Draw and construct an 8 ½"w x 24"l x 2"h supply box using architectural tools.

Project box drawing pattern with dimensions: ***Fold line -***
Dimensions: 8 ½"w x 24" l x 2"h ***Cut line_____***



Learning Experience:

Option I:

1. Flush the poster board with the edge of the table with the 22" side closest to you.
2. Tape all four corners cross-corner to keep your poster board in place.
3. Place the ruled T-square horizontal on the table with the T edge of the tool riding along the side edge of the table.
4. Measure 2" in from the edge of the poster board with a dot. (2" side)
5. Make another dot at 10 ½" keeping your T-square in the same position. (8 ½" bottom)
6. Continue with the T-square in the same position and mark a dot at 12 ½". (2" side)
7. Mark a dot at 21". (8 ½" box top)
8. Take your T-square and turn it so that the bottom of the T-square is hooked over the table edge closest to you. Glide the T-square down the table edge to make certain it moves freely.
9. Align the ruled edge of your T-square adjacent and touching the first mark you made on the poster board. Draw a line from one end of the poster board to another making certain your T-square remains flush and your pencil mark goes over the mark you made.
10. Repeat this process until lines are drawn through all the marked dots.
11. Mark dots on the 28" side of the poster board at 2" and 26".
12. Make 1"w tabs on each end of the 2" sides of the box template.
13. Check you measurements before removing the tape on the corners and cut off the excess poster board outside the perimeter of the drawn lines.
14. Fold on the lines to form your box.
15. Place glue on the four tabs and adhere the tabs to the inside of the box bottom.

Option II:

1. Use architectural tools to draw each elevation associated with a particular project. The elevations include wall elevations, floor elevation, roof trusses and roof sides.
2. Label each portion of the elevation as it is completed.
3. Check all entries for accuracy.

Evaluation:

* Completion of their supply box
* Completion of the required drawings

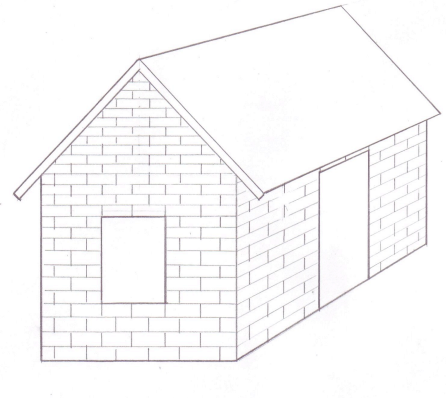
Handouts: Construction Vocabulary Terms and Applicable Dwelling Elevations and Diagrams

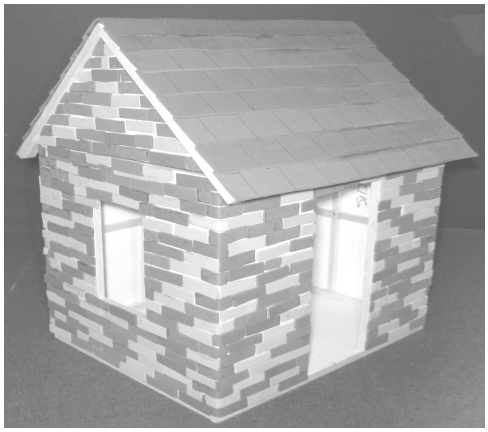
Construction Vocabulary

1. **Brick -** a rectangular block of clay or a similar material that is baked until it is hard and is used in building houses, walls, and other structures.
2. **Ceiling -** the inside top of a room.
3. **Cladding -** the outer layer of a building added to protect and insulate the structure and to make it look better. Wood, brick, stone, and straw are a few claddings.
4. **Common stud -** an upright post in the framework of a wall that supports wallboard.
5. **Corner stud -** a stud at the intersection of two walls.
6. **Course -** one of the layers of bricks with the pieces held together with mortar.
7. **Cripple studs -** a short stud above a door opening or below a window.
8. **Elevation -** an architectural drawing of the side of a building or the side of any wall.
9. **Floor -** the flat horizontal part of a room on which people walk.
10. **Floor section -** a two-dimensional drawing that shows the horizontal view of a floor. It lists dimensions of all the parts of the floor and illustrates the way to put the sections of the floor together to make one large floor.
11. **Foundation -** the part of the building that supports the building and distributes the weight of

the building onto the ground.
12. **Frame -** the wood or steelwork that encloses and supports parts of a building.
13. **Header -** the horizontal support pieces directly above a door or window opening.
14. **Hipped roof -** some call this kind of roof a pyramidal roof because of its appearance. This type of roof slants inward from all four sides of a building.
15. **Jack stud -** a vertical stud that is shorter than other studs and usually fits inside a window opening.
16**. King post -** a vertical piece in a truss that strengthens it and connects the top of the roof to the bottom roof beam.
17. **Lumber -** logs that have been sawed and prepared to use in buildings.
18. **Masonry** - Putting stone, brick, building block to form walls and other parts of a building.
19. **Mortar –** A mixture of materials like plaster or cement that is mixed with water and a fine aggregate like sand. It is used in masonry construction to hold the pieces of masonry together to form a wall.
20. **Pitched Roof -** a gabled roof that looks like a triangle at the end.
21. **Plan -** a two-dimensional drawing that shows the horizontal dimensions of a building. An elevation is a drawing that shows a building's vertical designs.
22. **Post -** a strong, stiff vertical column or piece of wood, brick, stone, or metal that acts as a support for framing pieces above it.
23. **Rafter -** a sloping supporting timber or beam that runs from the ridge row of a roof to the edge of the bottom of the roof.
24. **Raised house -** a dwelling that has one level where the ground acts as the floor. This area is used as an animal shelter, a workshop, or for storage. The upper level is the living quarters. Many times a porch runs alongside the upper level.
25. **Ridge beam -** a beam at the top of the rafters and below the ridge of the roof.
26. **Roof -** the outside covering of the top of a building.
27. **Sill -** a ledge below a window, especially on the inside of a building.
28. **Sole plate -** the horizontal piece at the bottom of a stud and the studs rest on top of it.
29. **Straw -** stalks of grass-like crops that are applied as wall cladding in some cultures.
30. **Structure -** something built or erected.
31. **Stud** - a vertical post that supports a wall.
32. **Timber -** a large piece of wood used in building. A beam is a piece of timber.
33. **Top plate -** the top horizontal part of the frame of a building at the top of the studs and the rafters attach to it.
34. **Trimmer stud -** a piece of wood or steel put into a roof or wall that supports the header.
35. **Truss -** a strong framework usually made up of triangles that adds strength to a roof construction.
36. **Walls -** a flat side of a building or a room that is vertical, either inside or outside.

Lesson Six (A): Let's Build Like the Three Little Pigs – A Brick Dwelling





Teacher instructions:

This lesson takes a lot of teacher preparation initially, but the rewards are great. Look carefully at instructions located in this lesson and on the working drawings. Try it this way first and change it later if another method suites your style better. Scale model dwellings were constructed before finalizing these lessons to avoid any unanticipated problems students may encounter while building. The building procedures are not always according to actual building standards. Construction was simplified to accommodate young minds just starting to learn about architecture and scale model construction.

Thoroughly explain each part of the scale model dwelling and discuss the importance of each element. Take an equal amount of time in explaining architectural tools and the specifics of each elevation. Although we may know terms, do not assume that students have that same understanding. The success of the end product is directly related to an initial thorough explanation of each phase of the project. At first there were many questions, but they abated quickly when students began the process. This project has a medium degree of difficulty.

The drawings that correlate with this lesson were reduced to fit on an 8 ½" x 11" sheet of paper. Enlarge each sheet on a copy machine to fit on an 11" x 17" paper until it is the actual size of the finished model. The scale is 1" = 1'. This is a scale that elementary students can manage effectively. The accompanying drawings include a diagram of the floor framing, and elevations of the front wall, rear wall, side wall with window, side wall without window, and diagram of a roof truss. Students have a choice of building dwellings with windows on one wall, two walls, or no windows at all. Furnish drawings to students as needed to complete their desired model. Be mindful of the fact that walls with windows are more difficult to construct. Supply students with either two copies of side walls with windows, two copies of walls without windows, or one of each side wall. Advanced students may want to draw their own elevations using the accompanying drawings as a reference. Enlarged drawings should be used as a guide to lay out cut pieces and check dimensions before assembly. The parts of the drawings are clearly identified and a cut list is provided for each drawing that states the quantity and dimensions of each piece that is required to complete that portion of the model. Give each student a cut list of each drawing and any germane construction information as handouts.

One major goal of this unit is to increase visual acuity and a student's ability to measure accurately. Computer programs are available where students can draw their working drawings on screen, but that eliminates the development of measuring skills that are required in daily life and on standardized tests. My students are weak in this skill. Because of these reasons we are using architectural tools that include a protractor, (2) kinds of triangles, an architectural scale, and a

ruled T-square to draw their working drawings. The T-square and architectural scale are in inches because building materials in the United States are cut in feet and inches.

If time does not permit or some students are overwhelmed at the prospect of accurately drawing all the elevations required to complete the building process, permit students to use the accompanying elevations to make their dwelling. Put a piece of wax paper and place it over the drawing enlargements on the accompanying elevations. Cut each piece and lay it on top of the drawn piece. Even if a student does not manually draw the initial working drawings this method also involves precise measurement and eliminates the frustration of some students. Students need to feel competent after their initial sally into the project. Use whichever method suites individual students better. More advanced students may want to add to these basic plans.

Using their working drawings or the accompanying elevations, have each student cut and label materials to correspond with specific structural elements on the drawings. Keep a Sharpie handy to mark pieces and sections with their name or initials to avoid getting misplaced. Also write the alphabetical letter on each piece. Wrap loose pieces in a piece of wax paper by elevation to keep all parts together until they are ready to construct the section. Make certain each group of loose pieces is clearly marked and bundled to keep them in place. Construction does not begin until all parts of a drawing are cut correctly and laid out over the elevation. The box students construct from a poster board measures 8 ¼"w x 20"l x 2 ¼"d and stores all the loose pieces and flat built sections.

Some parts of construction need to begin out of order during the construction phase of the project. For example, bricks made from air-dried clay must be made at the beginning of the project to allow time to dry. Foam strips may be cut while you are using the T-square for other tasks. Because of time restraints and ease of construction, I chose not to use clay.

Grade and subject areas: 5, Architecture, Math, Language Arts, Social Studies

Time required: (10) 45-minute classes

Cultural Reference: Homes in Ancient Mesopotamia

When towns were small wealthy citizens in their large homes and poor families in their small homes all clustered together around a ziggurat, their communal building. Every family had its own home. Most houses shared walls, like townhouses do today. People built their homes of sun-dried brick because there was not much wood or stone available to use for building materials. Behind the front door was a small family courtyard. The courtyard was the first floor of the three-story dwelling that served as a garden area, the children's play area, and a home for their domesticated animals. Most homes had three stories of living space. Stairs from the first floor courtyard led up to the second and third floors, and then to the roof, which was a flat roof. Roofs acted like a fourth floor of living space. When weather permitted, they cooked and slept on their roofs. Some built walls around the perimeter of the roof for privacy while others added grape arbors that provided food and shelter from the sun.

Wendy Ennes wrote a lesson entitled "Life in Ancient Mesopotamia" for The Oriental Institute Museum in Chicago, Illinois that describes and illustrates the home of a middle-class family living in the city of Ur circa 4000 B. C.

The website, http://www.oi.uchicago.edu/OI/MUS/ED/TRC/trc_home.html, is an excellent resource that depicts recent findings of contemporary archeologists. This lesson includes a cross-section of the home and compares and contrasts this ancient home with modern structures. ***Source:*** http://mesopotamia.mrdonn.org/homes.html.

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The Oriental Institute Museum in Chicago, Illinois.
http://www.oi.uchicago.edu/OI/MUS/ED/TRC/trc_home.html

Objectives:

* Improve measuring skills
* Demonstrate that art is a process
* Build a framework accurately
* Clad a building framework
* Investigate the home of an ancient civilization
* Compare their dwelling with a contemporary structure and with those of the three little pigs
* Acquire information about another culture
* *Explore* sustainable building materials in a variety of constructions

Materials: This is a complete list of all the materials required to complete this lesson. Not all of materials are needed to complete individual sections. Some are specific to a section.

* Foam Core (on which you build your project)
* Wood glue
* Sand paper (medium grit)
* (1) small cup of water where the glue brush rests
* Glue brush
* Damp paper towel
* Masking tape
* Scissors
* Poster board
* Foam sheets to cut for cladding and roofing materials
* Diagram of each section
* Cutting List for section
* Ruler
* Sharpie
* Wax paper
* (27) ¼" x ¼" x 24" Basswood pieces
* 1" wire brads
* (3) Small paper plates

Tools:

* (1) each Proedge miter box and razor saw set with handle and saw blade #01390
* (1) each Ruler
* (1) each Scissors
* (1) each ruled T-square

General notes:

* Cut and assemble one section at a time.
* The accuracy of measurements and cuts is very important in building a successful model.
* Keep your work area neat and organized so that tools and supplies can be located quickly.
* Stop occasionally to clean and reorganize your work area.
* Keep all cut pieces of wood and finished sections in your project box.
* Keep your glue brush in the cup of water when not in use to prevent the glue from drying on the brush.
* Use the damp paper towel to remove excess glue from pieces and to wipe up any spills.
* Use paper towels to remove excess water from your glue brush when removing it from the water cup to brush on the glue.

* Notice that each piece is labeled with a letter that corresponds to the pieces on the Cutting List for this section. As you cut each piece of wood label that piece with the same letter so you can identify each piece during assembly.

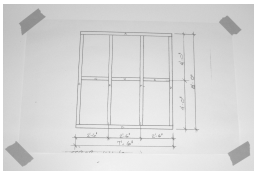
Learning Experience/Instructions for Assembly:

Part I: Construction of Floor and Wall Framing Section

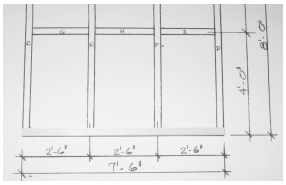
The floor is the first section to construct. The steps used in the construction of the floor are repeated for the construction of each of the wall sections.

Steps for the Construction of Framing Sections:

1. Place the floor diagram on a 16" x 24" piece of foam core.
2. Tape the four corners to hold the diagram in place. Tape cross corner on all four corners.
3. Look at the Cutting List for this section. Identify each piece that you need for this section and locate each piece on the diagram.

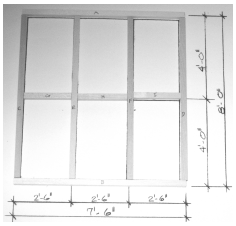


4. Carefully measure and cut each piece on the Cutting List and label each piece with the appropriate letter. Read the page in your architecture notebook entitled "Notes for Cutting Wood Pieces."
5. Sand all rough edges.



6. Place the cut piece on the diagram in its proper location and verify that it was accurately measured and cut.
7. Repeat these steps for every piece needed to create this section.
8. Arrange all the pieces on top of the diagram. Check to make certain all the pieces fit together correctly to construct the section.

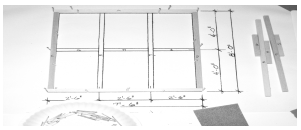
Note: If all the measurements and cuts are accurate, the pieces will fit together easily. If necessary sand, trim, or re-cut any pieces that do not fit properly. Do not glue any pieces until you make certain that all the pieces fit together accurately**.**



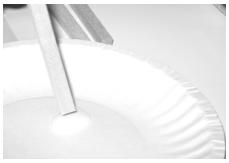
Note: If it is too long, trim or sand one end until it is the proper length. If it is too short, cut another piece. Remember that accuracy is most important. Take your time and check each piece to avoid future problems when attempting to assemble the pieces to construct each section or assemble the sections to create your model. An old carpenter adage says to "Measure twice; cut

once."
9. Begin the assembly of this section. First, move all the pieces aside. Be careful to keep all the pieces together. If you are not organized, it is easy to lose pieces.
10. Cover the diagram with wax paper. This will keep the frame from sticking to the diagram when gluing the pieces together.
11. Set the top piece in place on the diagram. Secure it in place by pushing a few brads (little nails) into the foam core on each side of the piece. Also place one brad at the end to hold it in place.

12. Set the side pieces in place on the diagram and secure them with a few brads on each side.
13. Set the bottom piece in place so that it fits snugly against the side pieces. Secure the bottom piece with a few brads on each side and also at the ends like you did with the top piece.



14. Check to see that all pieces are accurately aligned with the diagram.
15. Remove one side piece and apply glue to both ends. Gluing Tip: The best way to glue the edges is to put a small amount of glue in a paper plate and dip the ends into the glue. This will coat the end with enough glue. It is quick, easy and neat.



16. Set the piece back in place on the diagram and press the glued pieces together lightly. Adjust the position of the brads if necessary to hold the piece together snugly.
17. Remove the other side piece. Apply glue to both ends and place it back on the diagram. Press the glued pieces together and adjust the brads, if necessary.
18. Make sure that all the pieces are in perfect alignment with the lines of the diagram. Note: This is very important because if all the pieces are not aligned with the outside edges of the diagram, you will have a crooked section, and it will cause problems when you are putting your sections together.
19. Allow the glue to dry on these pieces before adding other pieces.
20. After the glue has dried, start adding the pieces in the center of the section. Start with the longest piece and finish by inserting the smallest pieces (like the blocking pieces). Dip the edges of the piece in glue and place it on the wax paper covered diagram carefully aligning it with the lines of the diagram. Secure it in place with brads on each side of the piece as needed. It usually only takes a few brads to hold the pieces in place. This section is now complete. Allow the glue to dry completely before attempting to remove the section from the wax paper. You will destroy the work you just completed if you try to remove the section before the glue is completely dry.
21. Label the section with a Sharpie and draw an arrow to indicate the top.
22. When the glue is completely dry, remove the brads and place them back in the brad plate so you can reuse them for your next section.
23. Lift the section and carefully remove the wax paper that may have stuck to the wood frame.

There shouldn't be too much paper stuck to the wood. If there is then you used too much glue. Use less glue when you construct the other sections. You want enough glue on the ends of the wood to hold them together, but not so much that it creates extra work when removing the wax paper.
24. Use sand paper to remove any excess glue from the wood frame.
25. Place your completed section in your project box. Clean your work area before starting a new section.

You are now ready to begin another section. Repeat steps 1 - 25 for each section. Construct the Rear Wall Section next followed by the Front Wall Section. The two Side Wall Sections are the last walls to construct.

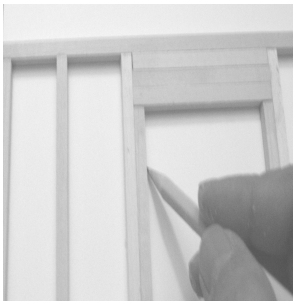
The Front Wall Section has a door opening so there is not a continuous bottom piece. When you get to step eleven of this section, secure the top piece (the top plate) and side pieces (corner studs) with brads. Secure the king studs in place with brads. Add the two bottom pieces (sole plates) and secure them with brads on the sides and at each end like you did before.

Tip: There are headers above the window and door openings that are composed of several pieces of the same length. It is easier to glue these pieces together and let them dry before putting them into the framing section.

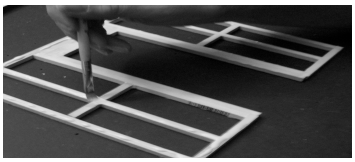
Part II: Steps in Sheathing Floor and Wall Sections

Floor Section Assembly:

1. Place a piece of 14" x 22" poster board on your work surface.
2. Position the floor framing section on the poster board with the labeled side facing you and with the arrow pointing up. Align the bottom edge of the section with the edge of the poster board.
3. Firmly hold the framing section and use a sharp pencil to trace the outline of the other sides.
4. Remove the floor framing section and set it aside.
5. Use a Sharpie to label the poster board piece "Floor" and draw an arrow on it to indicate the top.

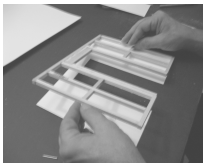


6. Cut out the poster board piece.
7. With the label side facing you, place the poster board cut out on top of a piece of wax paper.



8. Apply glue to the surface of all the wood on the backside of the floor frame. (The front is the side with the label.)
Gluing tip: To apply glue easily and properly put a dollop of glue on a paper plate and use your

glue brush to apply the glue to the surface of the wood.
9. Place the glued frame section (with the glued side down) on top of the poster board piece. Make certain that the arrow on the framing section and the arrow on the poster board are pointing in the same direction.



10. Align all the edges and press them together firmly.
11. Wipe off any excess glue that oozes out with a damp towel.
12. Place a few small pieces of blue masking tape on all the sides to keep the pieces aligned and to hold the framing section and poster board together firmly.
13. Allow the glue to dry.

Part III: Steps for the Assembly of Floors and Walls

1. Cover your work surface with wax paper.
2. Lay the front wall section and one of the side wall sections side by side with the poster board up. Make sure that the arrows on both pieces are pointing in the same direction (away from you) and that the top and bottom edges of the wall are aligned.
Repeat the same steps for the four Wall Framing Sections.

Notes: 1. On the front and rear walls add an extra ¼" tab to the bottom of the poster board piece

2. Cut out the door opening before gluing it to the framing section, and then place a piece of the ¼" x ¼" wood next to the outline and draw a line for the extra ¼" tab.
3. Keep the sides of both pieces together so that they are touching each other. Place a small piece of blue masking tape across the seam near both the top and the bottom of the wall sections.
4. Place a long piece of blue masking tape down the sea m from the top to the bottom of the walls. Make sure that the tape is half on the front wall and half on the sidewall with the seam in the center. This acts as a hinge while you are attaching the walls to the floor section.
5. Turn the wall sections over from top to bottom so that the framing side is facing up. Be careful to keep the two walls taped together as one unit. Note: Now the top arrows of the walls should be pointing toward you.
6. Place the floor section (poster board side up) on a piece of wax paper above the wall unit.
7. Apply glue (using the glue brush) to the bottom of the sole plate and to the surface of ¼ tabs on the front and side wall sections. Also apply the glue to the edge of the corner stud and the surface of the ¼" tab on the side wall that adjoins the front wall. (The edges you taped together.)
8. Lift the wall unit up very carefully, fold the walls at a ninety degree angle, and set them on top of the floor section. Position the walls with the sole plate resting on the poster board of the floor section, and the ¼" tabs covering the side edges of the floor section.
9. Press pieces together firmly to insure that the glued pieces are in contact with each other.
10. Turn the unit over so that the underside of the floor framing is facing up.
11. Apply small pieces of blue masking tape along the edges where the wall sections adjoin the floor section.
12 Clean any excess glue with your damp paper towel.
13. Allow this assembly to dry before adding the back and the other side walls.
14. Clean your work area.

Repeat Steps 1 - 6 using the rear wall and the other side wall. At Step 7 apply glue to the sole plate and the tabs like you did before. Also apply glue to the corner studs and the tabs of the

walls that will connect to the already assembled walls.

Carefully lift, fold and position walls onto the floor and wall unit like you did with the walls in Steps 8 and 9. Now turn the unit upside down (floor framing up) and apply small pieces of blue masking tape to hold the floor and walls together along the new wall seams while the glue dries. After the glue has completely dried, remove all the blue masking tape.

Part IV: Steps for the Construction of Roof Trusses (Two trusses are needed for the roof).

1. Tape the truss diagram on a piece of foam core.
2. Cover the diagram with a piece of wax paper.
3. Cut wood pieces listed on the Truss Cutting List.

Note: Pieces C, D, E, and F have ends that are cut on a forty-five degree angle. It is best to cut the angle end first, then measure from the tip of the angle, mark and cut the other end.

4. Arrange all the pieces on top of the diagram. Check to make certain that all of the pieces fit together correctly.
5. Secure the two roof rafters in place using brads on the sides and the ends of each piece.
6. Remove the shorter rafter (Piece B), apply glue to one end and replace it on the diagram.
7. Glue both ends of the ceiling joist (Piece C) and place it in position on the diagram. Secure it using brads.
8. Check to make sure all pieces are aligned with the lines on the diagram.
9. Glue the ends of the center support (Piece D) and blocking (Pieces E and F). Insert them into the truss fame. Secure with brads. Allow the glue to dry completely. Remove the truss frame from the wax paper and construct the second truss repeating Steps 4 - 9.

Part V: Steps for the Assembly of a Roof

1. Cut a piece of poster board to fit on the outside of each truss.
2. Glue the poster board pieces to the trusses and secure them with masking tape until the glue dries.
3. Cut the wood pieces listed on the Roof Cutting List.
4. Cut two pieces of poster board 7" x 10 1/2".
5. Measure and draw the locations of the trusses, rafters and blocking onto the poster board pieces as shown on the Roof Diagram.
6. Position the poster board pieces so that the ridge beam edges are together.
7. Turn the pieces over and apply a piece of tape across the seam.
8. Turn the pieces back over so that the sides with the markings are facing up.
9. Glue one side of the ridge beam in the proper location along one piece of the poster board.
10. Glue one edge of each truss and position them on poster board. Use masking tape to hold them in place until the glue dries.
11. Glue the other side of the ridge beam and trusses.
12. Fold the other side of the poster board up to the trusses, align the edges and tape the trusses to the poster board until the glue dries.
13. Remove tape and glue rafters and blocking to one side of the poster board.
14. Glue the remaining roof rafters and blocking to the other side of the poster board.
15. Allow glue to dry completely.

The roof section is now complete. Position the roof on top of the wall structure. Do not attach. Make bricks and shingles for the exterior of the house out of foam paper. Measure and cut ¼" strips of foam paper in colors of your choice. Chop the strips into one inch increments and glue them onto the exterior of the house in rows in random color placement. Use foam paper for the roof shingles, also. These strips are 1 1/4" wide. Mark lines on the strips about every 1 1/4" with a ballpoint pen to look like roof shingles.

Handouts:

Learning Experience Assembly Instructions
Tips for cutting wood pieces
(10) Enlarged section elevations/ (9) Have Cutting Lists with each elevation

Tips for Cutting Wood Pieces

1. Place several pieces of wood together so that your ruler rests on top of the piece to be cut.
2. Align the edge of the ruler with the edge of piece to cut.
3. Hold the ruler firmly and find the desired measurement on the ruler. Make a small mark on the wood using a sharp pencil.
4. Double check the measurements on your cutting list and on your ruler. Check the measurement you marked on the piece to be cut.
5. Place the piece to be cut into the miter box. Align the mark you made on the wood piece with the groove of the miter box where the saw will ride.
6. Hold each piece against the back fence of the miter box and place the saw into the grooves of the front and rear fence
7. Rest the saw on the piece to be cut and carefully align the saw blade with the mark on the piece of wood. Adjust the position of the wood so the mark is aligned with the saw blade.
8. Hold the wood piece securely against the rear fence and begin cutting with the saw.
9. Begin sawing by pulling the saw to you as it rides across the top of the wood.
10. Look to see that the cut of the blade is still aligned with the measurement mark.
11. Cut with a steady back and forth movement of the saw while applying a light downward pressure. Do not press down too hard or move the saw too rapidly. A firm, steady movement of the saw will produce a better, more accurate cut. Let the saw do the work.
12. Hold the wood firmly against the rear fence as the saw moves through the cut.
13. When the cut is almost complete slow the cutting movement of the saw. When the cut is complete the loose side of the wood (the side opposite from the side you are holding) will move slightly away from the saw blade. Stop sawing. The cut is complete.
14. Lightly sand the rough edges of the wood.
15. Place each cut piece back on the ruler and check the accuracy of the cut piece. Repeat these steps for every piece you cut.