

ENERGY & STRUCTURES UNIT

Adapted from the University of Northern Iowa's Energy Education Curriculum Project

Overview: In this unit, students will study the history of home design from the 1840's to modern times. This look into structural design will take on an energy perspective in that students will constantly be asked to look at and to create designs that capitalize on energy efficiency, given the available resources of the time period being studied. Students will learn that a lot of buildings were built before people worried about saving energy. As a culminating experience, students will be asked to design an energy efficient dwelling of the future.

Objectives: Students will...

- Demonstrate their knowledge of energy efficient architectural design by explaining the energy efficient features of past and present dwellings;
- Design their version of a home of the future.

Subject: Social Studies

Suggested Grade Level: 4 – 5

Materials: Refer to each lesson

Suggested Teaching Strategies: Before starting this unit, visit the school library to find sources that contain excerpts (and pictures) of log homes and homes from the 1900's. Students may want to refer to these periodically as they progress through the activities. Within each of the four activities comprising this module, suggestions are provided for conducting the lessons.

THE LOG HOME

Objectives:

Students will...

1. Describe log homes and identify the essential items contained in them.
2. Describe how the log home was heated and cooled.
3. Explain the significance of locating the door on the south side of a cabin and of having trees located on the north and west side of a log home.

Time: 1 class period

Grouping: Pairs

Subject: Social studies

Suggested Grade Level: 4 – 5

Materials:

- Log Home Essentials—One set per student group (included)
 - Scissors
 - Blank sheets of typing paper (1–2 per student group)
 - Larger sheets of white paper (roughly 25"x22")
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PROCEDURE

In this investigation students compare and contrast the energy efficiency of a student-designed 1850 log home with information on actual structures of that era. Begin by giving each student a blank sheet of paper. Present the following information to the students.

Log Home Guidelines

- a. The period of time is the 1850's.
- b. You are an early settler in a rural area, (Homesteading).
- c. Available resources include:
 - Tillable soil
 - Nearby source of water
 - Large stones can be gathered from a nearby stream
 - Forested area nearby
 - Necessary tools of the time period (no saw mills)
 - Glass is not readily available
- d. Using the available resources of the time period, design a dwelling for a family of four.

Have students work in pairs for this activity. Give each pair of students a copy of the "Log Home Essentials," found in the Appendix to this lesson. The handouts contain drawings of the items

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typically found in log cabin homes of the 1800's. A sheet of typing paper can be used to represent the relative size of a log cabin home. Ask students to cut out each of the items shown on the handouts. Challenge students to arrange these items in the manner they think best, assuming the cabin is only one room and that all items must be arranged within the one-room cabin. Obviously, the trees and stream can be arranged around the outside of the paper. Each sheet contains a direction indicator. If questions arise as to its purpose, simply ask students to place it near the cabin in the manner they think most appropriate. Be sure to stress to students that they are to come up with their "best guess" as to how a real log cabin was arranged. For now, they will only be setting the items on and around the sheet of paper; they will not be attaching them in place.

Prior to giving students any additional background information on early log homes, allow students time to come up with an initial log cabin design of their own. This will give them a basis on which further discussion may be based.

After students have made their initial arrangements, discuss the student designed log dwellings. Ask students to defend the arrangements of items within and around the cabin. For example:

- Where was the fireplace placed within the cabin? Ask students to give a rationale for the placement of the fireplace.
- Was there a particular reason behind the placement of doors and windows?
- How is their home heated? How is it cooled?
- Is there adequate allowance for light to enter during daytime hours?
- What reasoning was used in deciding upon the placement of each item within the cabin?

Allow students to share their ideas with other members of the class.

Following this discussion, present the background information on the actual dwellings of the time. Challenge students to modify their design based upon the new information presented. What changes would they make in their dwelling to get the most energy efficient design? (This could be started in class and completed as homework.) Once students are satisfied with their revised arrangement, choose one or two typical cabins to display as models. Ask students to glue down the items and perhaps add some color. Display the pictures in the classroom. The remainder of the students' models will be rearranged as part of activity 2, and thus, should not be glued into place.

Background Information

Early pioneer cabins usually had one room with an overhead loft where the children could sleep during warm weather. The loft was reached by a ladder. Most cabins were relatively small, perhaps 10 by 12 feet, although some were larger. Focus on the idea that there was no air conditioning and only one source of heat, the fireplace. The door was typically "to the south" to let light in and to mark the passage of time as the sun moved a shadow farther and farther along the floor. The doorways were made from skins or puncheon slabs. Windows were covered with paper to let light in. The paper was waxed with grease or animal fat to give it a coating for protection against rain and snow.

Pioneer furniture was simple. There were no rugs or curtains. Most furniture was homemade. During winter months, children slept on straw mats next to the fireplace. The spinning wheel held a prominent position in the pioneer home. Spinning, weaving, and dying cloth for the necessary clothing kept women

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and children busy for many hours. Wool and flax (a plant) were also raised for cloth. The lighting was very crude. Most families made their own candles.

The hearth was a very important part of each cabin. It was generally made of flat limestone rocks, found lying along streams. The fire was kept burning day and night. The hearth fire cooked the pioneer meals, consisting of meat, corn meal, salt pork, vegetables, fruits (if in season) and coffee. Wild game was also eaten if the father was a good shot. The fireplace was the central feature of the cabin, providing heat, light, and a place for cooking.

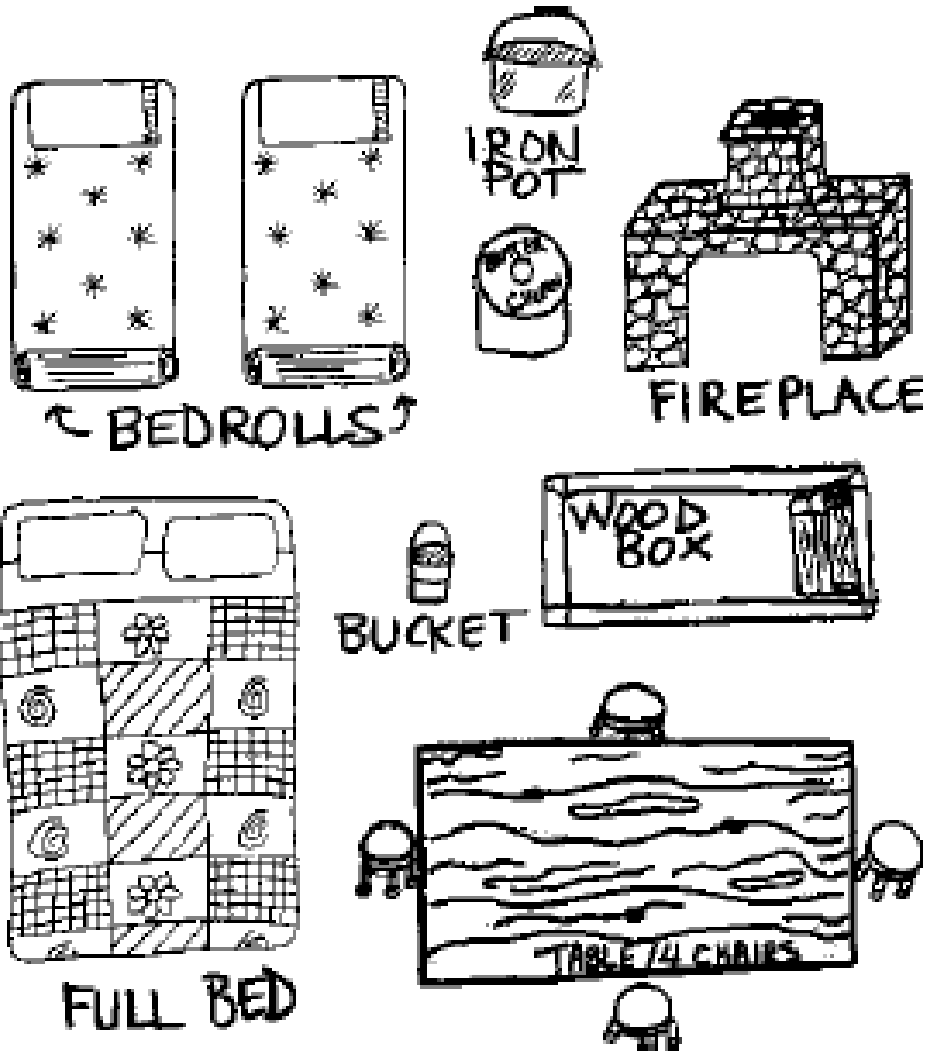
Pioneer cabins were crowded. Most families had 3–4 children and everyone lived in one or two rooms. Not much space was available for furniture. Homes needed to be energy efficient since there was no air conditioning and the only source of heat was from wood. A well-constructed log home would have been relatively comfortable, with its thick walls and its close-to-earth design, although much of the heat from the fireplace escaped up the chimney on windy days.

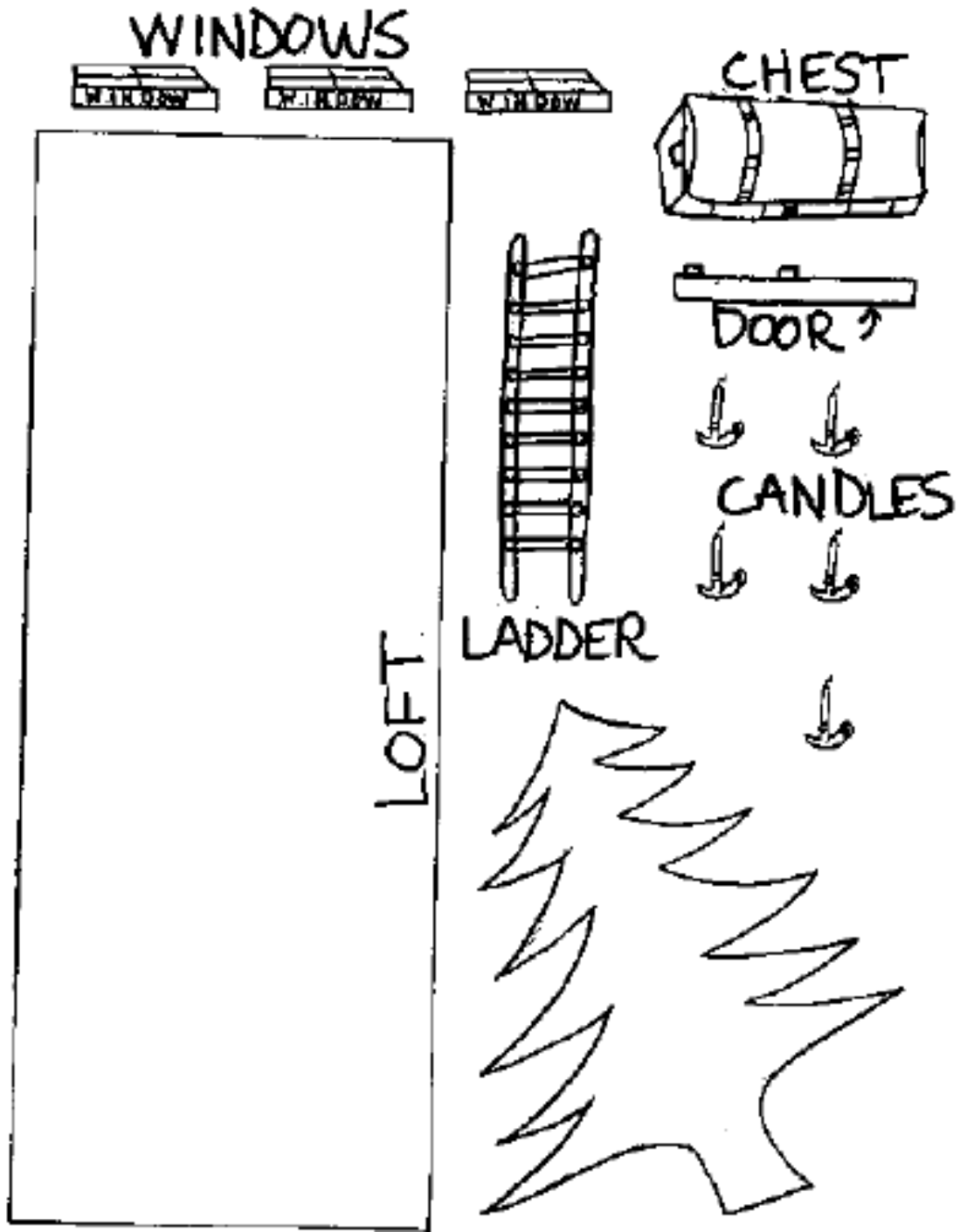
Most cabins were made of logs, notched at the corners and laid one upon another. The roofs were clapboards with the shingles held down by weights. Floors were heavy wooden slabs or split logs with the smooth sides up and were called puncheon floors. The cracks were filled with dirt. Where timber was scarce, cabins were made from sod.

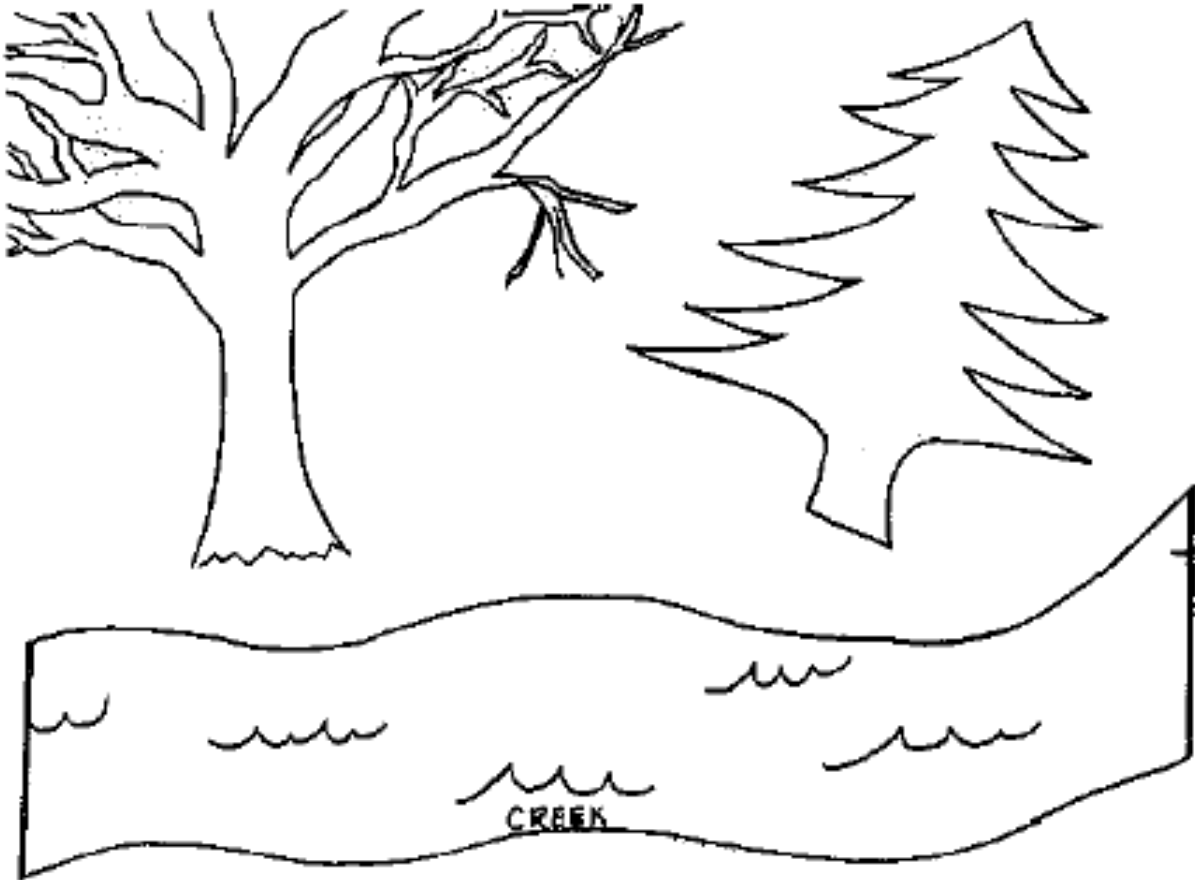
EXTENSIONS

- Ask students to construct a model of their log home. Set up a display area where student-made structures can be viewed by students and faculty in your school. This could even be made into a contest in which the viewer is challenged to identify the most energy efficient home of that time period.
- Some students may be interested in conducting further research into the tools and architectural designs of log dwellings of the 1800's.
- Challenge students to create a window of the 1800's. One type of glass window can be made by chinking jars together. This can be accomplished by packing a mixture of clay, straw and grass in open gaps between glass jars. A greased paper window can be simulated by rubbing vegetable oil on various types of paper. Students can then compare the amount of light penetration for the chinked as well as paper windows. (This would make an interesting school display as well.

Log Home Essentials







HOMES OF THE EARLY 1900's

Objectives:

Students will...

1. Describe homes of the early 1900's and list the essential items contained in them.
2. Describe how heating and cooling was accomplished in homes of the early 1900's.
3. Explain the significance of locating the door on the south side of the home and of having trees located on the north and west side.

Time: 2 – 3 class periods

Grouping: Pairs or small groups

Subject: Social studies

Suggested Grade Level: 4 – 5

Materials:

- Essentials of the 1900's Home—One set per student group (included)
- Scissors
- Glue
- Blank sheets of typing paper (1–2 per student group)
- Larger sheets of white paper (roughly 25"x22")

PROCEDURE

In this investigation students will explore the evolution of architectural design from the mid 1800's to the early 1900's by modifying their 1850 log dwelling to match the new developments and resources of the time.

In many instances, rather than simply building a new house, additions were made to the original log cabin. Discuss the changes in architectural design and home conveniences that have taken place since the 1850's. For example:

1. Stoves have taken the place of the fireplace.
2. Milled lumber is available.
3. Porches and summer kitchens are common place.
4. Two-story construction is available.
5. There is greater availability of glass and hardware.

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6. Landscaping has become more important (location of windbreaks and shade trees).
7. Wells and windmills make water more accessible

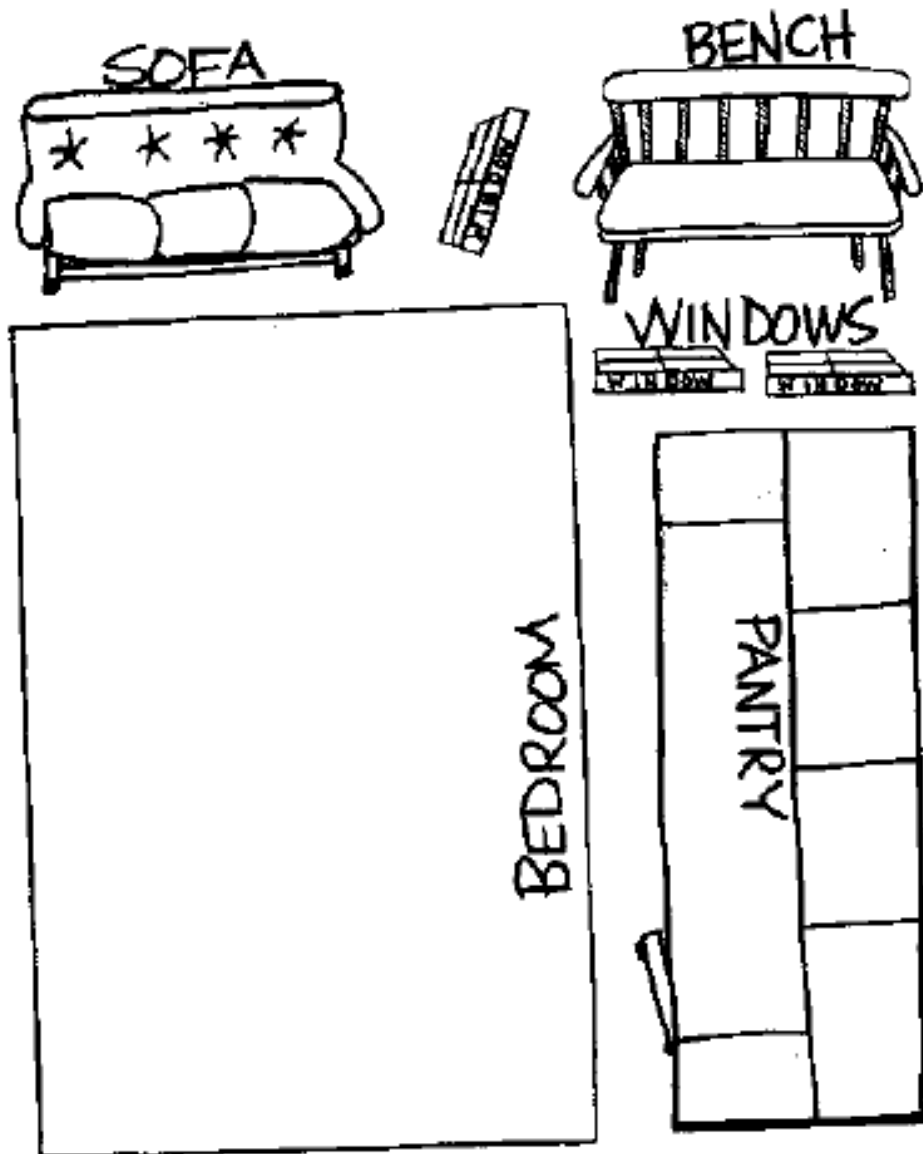
Give each student group a pair of scissors and a copy of the handout entitled *“Essentials of the 1900’s Home.”* Following a discussion of the changes listed above, challenge students to modify their log home design to fit the 1900’s time period. Students must keep their original log cabin room. They may move items into the new rooms and they may divide the original room into smaller rooms. The original 8½" x 11" sheet of paper as well as the items present in the log cabin, with the exception of the fireplace, should be used in the design for this activity. Additional rooms, including a porch, kitchen/pantry and upstairs, are provided in the handouts. The size of the cutouts should provide a good indication of the actual relative size of the new additions.

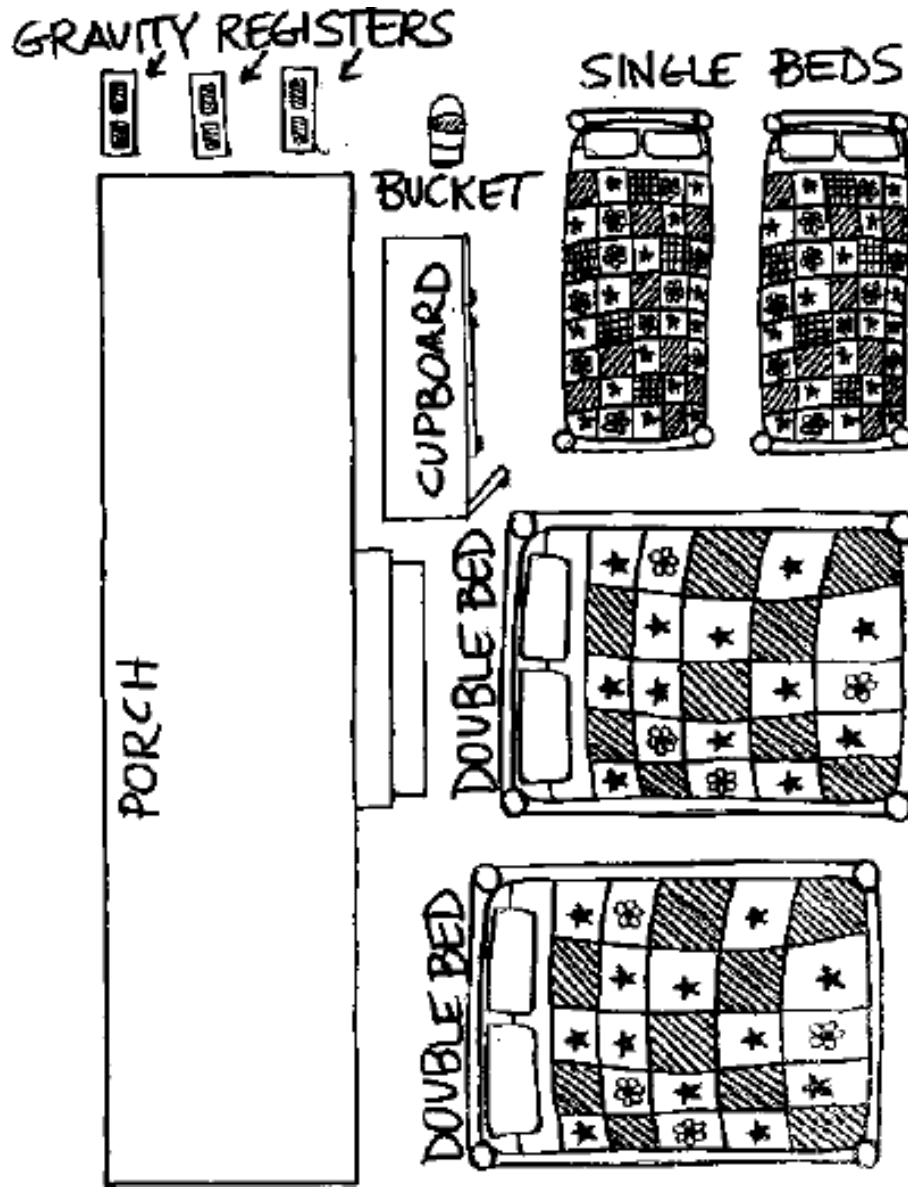
Ask students to share their completed designs with the class. Have students glue their pieces into place once they are satisfied with their arrangement.

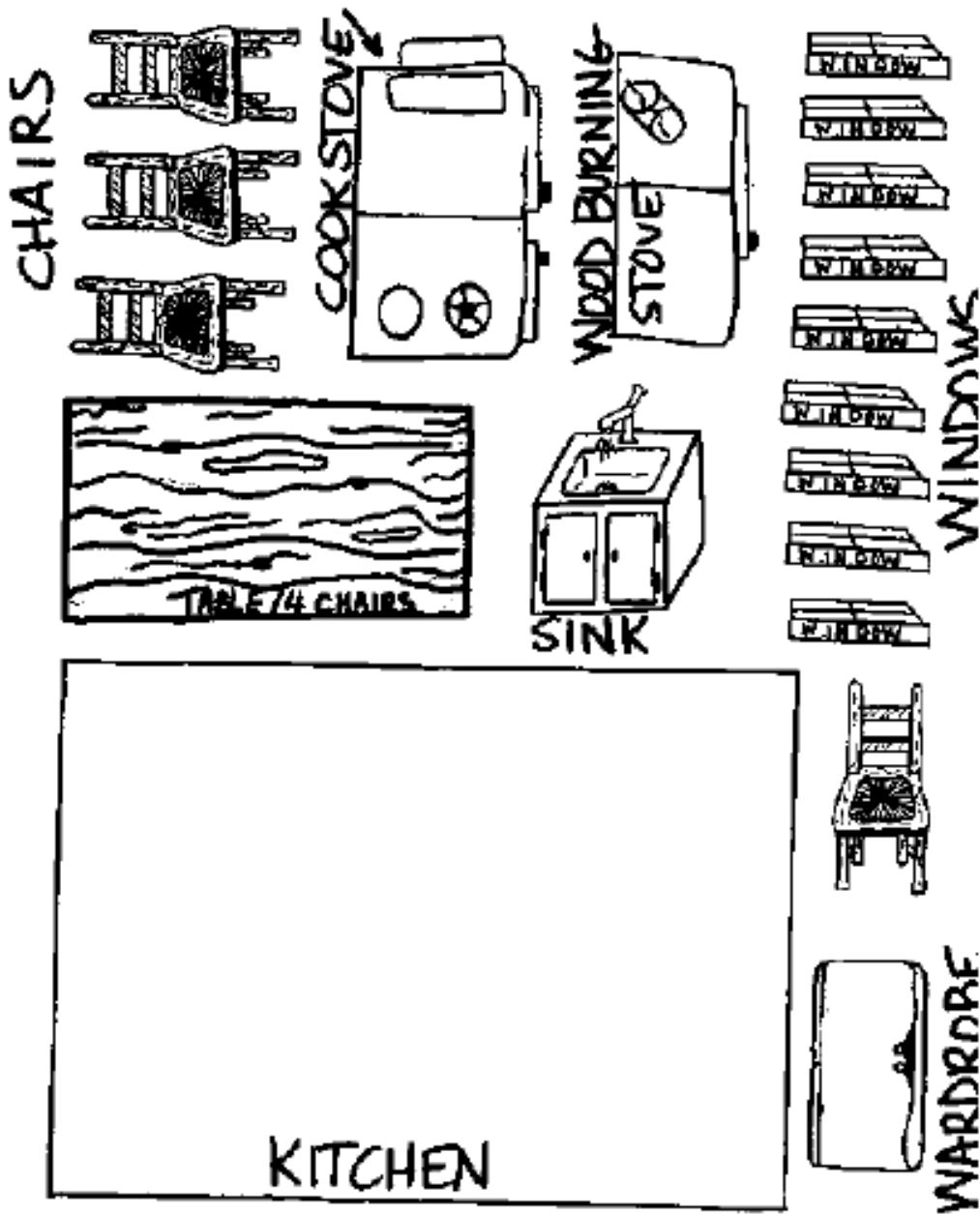
EXTENSIONS

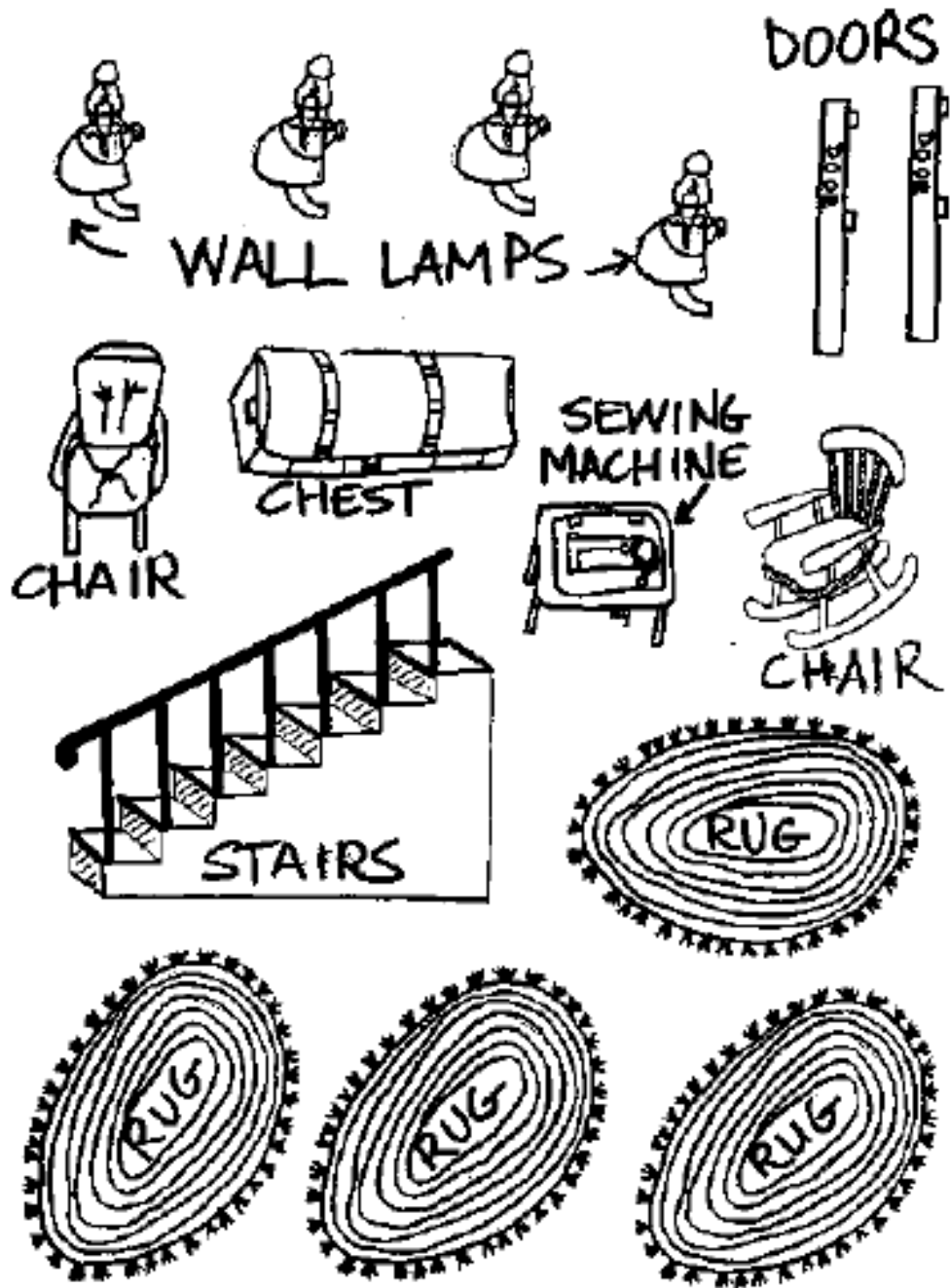
- Use educational technology to research homes of the early 1900’s in your local area.
- Challenge students to make their paper model three dimensional, representing the second floor elevated above the main floor.
- Interview an adult about the types of dwellings in which they lived during their youth. Ask students to compare these ideas to their own 1900’s home design. Grandparents, retirement home residents, and other senior citizens would make excellent interviewees.
- Videotape or photograph dwellings built in the early 1900’s. Prepare a bulletin board display of these dwellings. Photographs can likely be obtained from your library or the local historical society.

Essentials of the 1900's Home









ENERGY & STRUCTURES AT HOME

Objectives:

Students will...

1. Explain how the location of windows can affect efficient heating and cooling of a home.
2. Describe how landscaping can affect a home's energy efficiency.

Time: 2 class periods, plus homework

Subject: Social Studies, Language Arts

Suggested Grade Level: 4 – 5

Materials: Student page (one copy per student), rulers or other straight edge, blank typing paper

PROCEDURE

In this investigation students will gather information from their own homes regarding architectural design and energy efficiency. Give each student a copy of the Energy and Structures Home Survey. Students should be able to complete this assignment during class, although it requires they recall the location of all windows in their home.

Encourage students to share the positives and negatives of the structural and design features found upon completing this assignment. Discuss student answers to the "Summing Up" questions. Be sure to ask students to explain the reasoning behind their answers. Discussion should include home features found that had been present in homes discussed in Activities #1 and #2. Ask students to share the summing up questions and their answers at home.

EXTENSIONS

- Write a letter to your parents explaining the relationship between the location of windows and energy efficiency.
- Draw up a landscaping plan for your home designed to increase energy efficiency. Take the landscaping plan home and discuss with your family.

Energy & Structures Home Survey

In the United States (except Alaska north of the Arctic Circle), the sun is always in the southern half of the sky. This means that windows that face north never let in direct sunlight. In cold weather, north-facing windows are heat-losers. Much heat can also be lost during windy and cold winter months from windows that are hit by prevailing winds. Any landscaping that can serve as a windbreak for prevailing winds will help to save heating energy. Windows facing south can let in direct sunlight and can help heat your home, especially if you cover them with insulation at night.

Let's Investigate

Make a sketch of your home. Label each side of your home with the direction it faces – north, south, east or west. Make a separate sketch for each story (floor) of your home. Count the number of windows on each side of your home. If your windows are different sizes, approximate the size of the larger windows in your drawing. Estimate how many smaller windows it would take to equal the size of your large windows. Be sure to count glass patio and other sliding doors as well. On your drawing, label each side of your house/apartment with the correct number of windows.

During summer months, energy can be saved by shading any windows that let in direct sunlight. What kind of shade (natural or built-in) do your south-facing windows have? Indicate on your drawing where you have awnings, building overhangs, trees or vines which provide shade, or any other shading devices.

During winter months, strong prevailing winds can accentuate heating problems caused by poorly sealed and insulated areas in your home. In Iowa, for example, the prevailing winds come from the northwest, so the north and west sides of the house are considered the “windy” sides of the home. Heating dollars can be saved by using appropriate landscaping. This might include a windbreak consisting of bushes or evergreens. It is also advantageous to have fewer windows on the northwest side of a home. Add to your drawing a sketch of any natural windbreaks present around your home.

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Summing Up

1. Do you think the locations of windows in your home have been well-planned to take advantage of heat from sunlight?
2. Is your home in need of any additional shading? If so, where? Explain your answer.
3. Are the north and west sides of your home designed to save energy during winter months? Explain your answer.
4. Imagine you have a friend whose family is building a new home. Write four suggestions you would give your friend to help ensure the new home has energy efficient design features.

DESIGNING YOUR HOME OF THE FUTURE

Objectives: Students will...

1. Incorporate energy efficient window placements into the design of a “modern” home.
2. Incorporate energy efficient landscaping into the design of a “modern” home.

Time: 1 class period

Subject: Social studies

Suggested Grade Level: 4 – 5

Materials: Drawing paper, straight edge

PROCEDURE

In this investigation students will design and draw a dwelling of the future, applying the knowledge they have gained about energy efficiency and structures. Challenge students to design and draw a family dwelling of the future. In preparing their designs, students must adhere to the following building codes:

- No windows are allowed on the north side of the house.
- Any computerized systems for lighting, heating, cooling, cooking, etc. must be described in the “special features” section.
- Structure must have space for temporary storage of recyclables (paper, cardboard, plastic, glass, metals and compost).
- Proper landscaping must ensure adequate shade for cooling purposes in the summer and shelter from the prevailing northwest wind during winter months.
- Any solar cells or solar panels must be located on the south side of the house.

Students should apply what they have learned about architecture and landscaping design (and solar power applications, if they have studied this).

Ask students to prepare a short presentation for the class in which they will share their futuristic home design, discuss its special features, and point out its energy efficiencies.

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EXTENSIONS

- Design a dwelling for a variety of environments (rain forest, desert, Arctic, marine, outer space, etc.).
- Ask students to research dwellings of other cultures and locations. Prepare a bulletin board display of structures and their energy efficient features.
- Challenge students to build a model of their dwelling.
- Enter students in the School Building Week School of the Future Design competition put on annually by the Council of Educational Facility Planners International (CEFPI)
<http://www.cefpi.org/sbw/sbw.html>.