

3.B.1 Tree House

Model tree house construction and selection of appropriate materials and tools

Grade Level	3
Sessions	(5): 1 at 35 minutes, 4 at 50-80 minutes
Seasonality	Recommended for autumn
Instructional Mode(s)	Whole Class, Small Groups
Team Size	2-4 students
WPS Benchmarks	03.SC.TE.01, 03.SC.TE.02, 03.SC.TE.03, 03.SC.TE.04, 03.SC.TE.05, 03.SC.IS.03
MA Frameworks	3-5.TE.1.1, 3-5.TE.1.2, 3-5.TE.2.1, 3-5.TE.2.2, 3-5.TE.2.3
Key Words	Engineering Design Process, Material, Model, Structure, Tool, Tree House

Summary

The five parts of this lesson introduce children to the idea of “structure”. They provide an opportunity for students to design and construct a model tree house, and to select and use appropriate materials and tools. Additional objectives include the strengthening of teamwork and manipulative skills and the provision of a context in which students use the Engineering Design Process.

Learning Objectives

2002 Worcester Public Schools (WPS) Benchmarks for Grade 3

1. 03.SC.TE.01 Identify materials used to accomplish a design task based on a specific property, e.g., weight, strength, hardness, and flexibility.
2. 03.SC.TE.02 Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.
3. 03.SC.TE.03 Identify a problem that reflects the need for shelter, storage, or convenience.
4. 03.SC.TE.04 Describe different ways in which a problem can be represented, e.g., sketches, diagrams, graphic organizers, and lists.
5. 03.SC.TE.05 Develop a knowledge and understanding of the metric measurement system.

6. 03.SC.IS.03 Keep accurate records while conducting simple investigations or experiments.

2001 Massachusetts Frameworks for Grade 3

1. 3-5.TE.1.1 Identify materials used to accomplish a design task based on a specific property, i.e., weight, strength, hardness, and flexibility.
2. 3-5.TE.1.2 Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.
3. 3-5.TE.2.1 Identify a problem that reflects the need for shelter, storage, or convenience.
4. 3-5.TE.2.2 Describe different ways in which a problem can be represented, e.g., sketches, diagrams, graphic organizers, and lists.
5. 3-5.TE.2.3 Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem.

Additional Learning Objectives

1. Students will learn that materials can be manipulated to make use of their inherent properties.
2. Students will improve fine-motor skills through construction of functional structures.
3. Students will work with other members of a group to problem-solve, design, and create a model structure.

Required Background Knowledge

None

Essential Questions

1. What is a structure (see Vocabulary with Definitions)?
2. What properties or characteristics are important when selecting a material for a specific purpose?

3. How does one apply the Engineering Design Process to a particular design challenge?

Introduction / Motivation

The instructor might begin the lesson by asking students to recall various engineering professions, explained in the children's book Sparky's Engineer. Students may share their knowledge of tree houses in general, and more specifically, of the types of materials appropriate for building a tree house. A visible "KWL" chart, or a "What do we **Know**, What do we **Want** to know, What did we **Learn**" chart (see Appendix A: Instructor's Notes), may help students conceptualize the idea of a model tree house.

Procedure

The instructor will:

Part 1: (35 minutes)

1. Lead students through the "K" and "W" portions of a KWL chart.
2. Read the children's book Tree House aloud to students.
3. Encourage student involvement throughout the reading by asking them to relate previous knowledge to the idea of building a model tree house.
4. Complete the "L" portion of a KWL chart.

Part 2: (50 – 80 minutes)

1. Divide students into pairs or small groups (2 to 4 students).
2. Show students the materials and tools available (see Materials List) for tree house design and construction.
3. Provide each student with a worksheet (see Tree House Design).
4. Explain the "Engineering Design Process" (see Appendix A: The Engineering Design Process).
5. Lead students through the Tree House Design worksheet, questions 1 and 2.
6. Consider bringing students outdoors to look at trees, focusing on those suitable for building a tree house.

Part 3: (50 – 80 minutes)

1. Ask students to reform previous groups.
2. Ask students to look at previous work on the Tree House Design worksheets; they should recall ideas about structure design and materials.
3. Allow students time to complete question 3; they should focus on *why* each selected material is the best for a given part of their model.
4. Provide each group with a large sheet of paper and lead students through question 4.

Part 4: (50 – 80 minutes)

1. Ask students to reform previous groups.
2. Ask students to look at previous work on the Tree House Design worksheets; they should recall ideas about structure design and materials.
3. Allow student groups/pairs time to construct their models.

Part 5: (50-80 minutes)

1. After all teams have built models, allow students to test the models using the water test, the wind test, and the drop test (see Appendix B: Instructor's Notes).
 - a. Consider conducting the tests group-by-group, in front of the class, so that all students can observe the results of the tests.
2. Ask students to verbally describe the results of each test.
3. Ask students to complete question 5.
7. After testing, allow students to revise their models, or simply write about how they might revise the models (question 6).
8. Allow students time to measure various parts of their tree houses in centimeters and to complete the worksheet titled The Metric System.

Materials List

See attached prototype letter to parents to ask for assistance in collecting materials.

Materials per class	Amount	Location
Spray bottle with water	One	Gardening supply store, grocery store
Fan	One	Classroom, home
Meter stick	One	Classroom, office supply store
Lightweight cardboard	As needed	Recycle bin (cereal boxes, etc.)
String	One roll	Craft store
Plastic wrap	One box	Grocery store
Aluminum foil	One box	Grocery store
Popsicle sticks	100-300	Craft store
Clear tape	Two rolls	Craft store, drugstore, grocery store

Materials per student	Amount	Location
Ruler – inches/centimeters	One per group	Classroom
Glue	One bottle per group	Classroom
Scissors	One pair per group	Classroom
<u>Tree House Design</u> worksheet	One	End of lesson plan – print or photocopy
<u>The Metric System</u> worksheet	One	End of lesson plan – print or photocopy

Vocabulary with Definitions

1. *Civil Engineer* – designs tunnels, roads, buildings, bridges, and dams using various materials such as soil, rocks, and concrete.
2. *Material* – the substance used to make another product; it can be described by its properties.
3. *Model* – a small object, usually built to scale, that represents in detail another, often larger object.
4. *Structure* – an object made up of a number of parts that are held or put together in a particular way.
5. *Tool* – an object used to do work or to make work easier.

6. *Tree house* – a house built among the branches of a mature tree.

Assessment / Evaluation of Students

The instructor may assess the students in any/all of the following manners:

1. Observe student groups at work; assess group work skills, understanding of materials selection, and understanding of the engineering design process.
2. Collect student worksheets; assess understanding of materials selection, engineering design process.
3. Listen to oral responses and class discussions.

Lesson Extensions

1. Read The Indian in the Cupboard by Lynne Reid Banks: main characters build model Native American structures (longhouse, igloo, etc.).
2. Allow students to construct another model structure, such as a tent or doghouse.

Attachments

1. Appendix A: The Engineering Design Process
2. Appendix B: Instructor's Notes
3. Tree House Design
4. The Metric System

Troubleshooting Tips

1. Consider grouping students with different talents and interests together to facilitate peer-learning.
2. Circulate through the classroom during all sessions. Leading questions, such as *Why would you select that particular material...?*, seem to help students focus on construction of a working model.
3. Allowing student groups to manage themselves as much as possible, especially in the areas of dividing tasks, selecting materials, physically constructing the model, and managing their time.

Safety Issues

1. Scissors should be used with caution.
2. The edges of aluminum foil and plastic wrap boxes are quite sharp; the instructor should be responsible for passing out these materials.
3. Use caution when spraying the water in the “Water Test”; ensure that the water is sufficiently far away from the electric fan to preclude electrical problems.

Additional Resources

1. The Engineering Design Process for Children: <http://www.mos.org/doc/1559> (accessed 7 October 2005).

Appendix A: The Engineering Design Process

“The Engineering Design Process for Children” and associated text comes directly from:
<http://www.mos.org/doc/1559> (accessed 2 February 2006).

The Engineering Design Process



“The Engineering Design Process is a series of steps that engineers use to guide them as they solve problems. Many variations of the model exist. While having a guide is useful for novices who are learning about engineering, it is important to note that practicing engineers do not adhere to a rigid step-by-step interpretation of the process. Rather there are as many variations of the model as there are engineers. Because our curriculum project focuses on young children, we have created a simple process that depicts fewer steps than other renditions and that uses terminology that children can understand. The engineering design process is cyclical and can begin at any step. In real life, engineers often work on just one or two steps and then pass along their work to another team.”

“A few questions can guide students through each of the steps:

“ASK

- What do I want to do?
- What is the problem?
- What have others done?

“IMAGINE

- What could be some solutions?
- Brainstorm ideas.
- Pick one to start with that you think will work the best.

“PLAN

- Draw a diagram of your idea.
- Make lists of materials you will need to make it.
- Decide how it works. How will you test it?

“CREATE

- Build a prototype.
- Test it.
- Talk about what works, what doesn't, and what could work better.

“IMPROVE

- Talk about how you could improve your product.
- Draw new designs.
- Make your product the best it can be!”

Appendix B: Instructor's Notes

KWL Chart

What do we Know ?	What do we Want to know?	What did we Learn ?

Create the Water Test: Simulates Rain

1. Fill a plastic spray bottle (see Materials List) with water.
2. Spread paper towels on a small desk or table at the front of the classroom.
3. Allow students to spray their model tree houses (suggested: 15 squirts per model).
4. Students should first describe verbally, and then use their worksheets (question 5) to note the effects of water on their models.

Create the Wind Test: Simulates Wind

1. Locate a small electric fan (see Materials List) and place it on a desk or table, away from the water test. ***Water and electricity should never mix.***
2. Invite student groups to the front of the classroom and allow them to hold their models in front of fan for a pre-selected amount of time (suggested: 5 seconds).
3. Students should first describe verbally, and then use their worksheets (question 5) to note the effects of wind on their models.

Create the Drop Test: Tests Strength and Flexibility

1. Tape a meter stick (see Materials List) vertically against one of the classroom walls. The bottom of the stick should be on the floor.
2. Explain to students that they will hold their model tree houses level with the top of the meter stick, and will then drop the models, allowing them to fall to the ground.
3. When student groups return to their seats, they should quietly write their observations in the chart found in question 5 of their worksheets.

Dear Parents,

As part of our Technology/Engineering curriculum, students are designing and constructing model tree houses. Students are working with materials to identify those most appropriate for model building.

We ask that you please save a small number of boxes made from lightweight paperboard (cereal, toys, tissues, etc.) and send them to school with your child this week.

Thank you for your support!

Sincerely,

Tree House Design

Name: _____

Date: _____

The Engineering Design Process



The Engineering Design Process for Children: <http://www.mos.org/doc/1559> (accessed 7 October 2005)

1. Ask –

What structure do I want to build? _____

Aluminum Foil

Lightweight Cardboard

Glue

String

Plastic Wrap

Popsicle Sticks

Clear Tape

2. **Imagine –**

Imagine that you are a civil engineer. For what purpose would you use your tree house?

How will your tree house protect you from the rain? What materials will you use to build the model? _____

Aluminum Foil
Plastic Wrap

Lightweight Cardboard
Popsicle Sticks

Glue
Clear Tape

String

How will your tree house protect you from the wind? What materials will you use to build

the model? _____

How will your tree house stay in a tree? What materials will you use to build the model?

Read the list of materials below. Think about which materials you would like to use. Beside the materials that you **will** use, write **why** you will use them.

Material	Why will you use the material to construct your tree house?
Aluminum Foil	
Lightweight cardboard	
String	
Plastic Wrap	
Popsicle Sticks	
Clear Tape	
Glue	

3. Plan –

On a separate sheet of paper, draw a picture of the model tree house that you would like to create. Label the parts of the tree house (wall, window, door, roof, floor, etc.). Beside each part, write which material you will use to make that part of the model. Use the chart of materials above when you plan.

4. Create –

Collect the materials that you need and then construct your model. Test your model with the Water Test, the Wind Test and the Drop Test. Can you think of other tests?

The Test	What happened?
Water Test: 15 Squirts!	

The Test	What happened?
Drop Test: 1 Meter!	
Wind Test: 5 Seconds!	

5. Improve –

What can you do to your tree house model to make it better?

[illegible]

The Metric System

Name: _____

Date: _____

The Metric System – In many parts of the world, people use a system for measuring called the “Metric System”. The metric system uses meters, centimeters (cm), and millimeters (mm) to describe the length of an object. Use the metric side of your ruler, marked with centimeters (cm) to answer the following questions.

1. How **tall** is the tallest part of your model tree house? _____ centimeters
2. How **wide** is your model tree house? _____ centimeters
3. How **long** is your model tree house? _____ centimeters
4. What is the **perimeter** of your model tree house? _____ centimeters