

### **3.C.3 Sound Machine**

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*Construction of a simple sound machine using the Engineering Design Process*

<b>Grade Level</b>	3
<b>Sessions</b>	(2): 1 at 35 minutes, 1 at 50-80 minutes
<b>Seasonality</b>	None
<b>Instructional Mode(s)</b>	Whole Class, Small Groups
<b>Team Size</b>	2-4 students
<b>WPS Benchmarks</b>	03.SC.TE.01, 03.SC.TE.02, 03.SC.IS.03, 03.SC.PS.08
<b>MA Frameworks</b>	3-5.TE.1.1, 3-5.TE.1.2, 3-5.PS.1.1
<b>Key Words</b>	Pitch, Sound Machine, Volume

### **Summary**

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This lesson introduces students to volume and pitch through the creation of a sound machine. It also allows children to review the Engineering Design Process while strengthening their teamwork and manipulative skills.

### **Learning Objectives**

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*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.IS.03 Keep accurate records while conducting simple investigations or experiments.
4. 03.SC.PS.08 Design and construct a simple sound-producing device that demonstrates how to change the properties of volume and pitch (e.g., home-made instruments).

*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.PS.1.1 Recognize that sound is produced by vibrating objects and requires a medium through which to travel. Relate the rate of vibration to the pitch of sound.

### **Additional Learning Objectives**

1. Students will become familiar with materials used to make a sound machine with variable volume.
2. Students will learn the concepts of “volume” and “pitch.”
3. Students will work with other members of a group to problem-solve, design, and model a sound machine.

### **Required Background Knowledge**

1. The instructor may wish to teach 3.C.1 Materials to Build and 3.C.2 Properties of Materials before teaching the present lesson.

### **Essential Questions**

1. What is a sound machine?
2. What is volume?
3. How can the volume of a sound machine be changed?
4. What is pitch?
5. How can the pitch of a sound machine be changed?
6. What materials can be used to make simple homemade instruments?
7. How is the Engineering Design Process used when designing a sound machine?

### **Introduction / Motivation**

The instructor might begin the lesson by bringing in an instrument of his or her own. (S)he might also review the Engineering Design Process (see Appendix B: Instructor’s Notes).

### **Procedure**

The Instructor will:

Part 1: (35 minutes)

1. Explain to the students the difference between “volume” and “pitch” (See Vocabulary with Definitions).
2. Divide students into pairs or small groups (2-4 students).
3. Show students the materials available (see Materials List) for sound machine design and construction. Each group need not use all materials.
4. Explain to the students that they will make a sound machine capable of changing volume and pitch.
5. Provide each student with a Sound Machine Design worksheet.
6. Lead students through questions 1, 2 and 3 on the Sound Machine Design worksheet. Before the students provide written responses, encourage them to discuss their ideas with each other.
7. Consider showing the students pictures of various instruments from different cultures.
8. Provide each group with a single, medium-sized sheet of paper and lead students through question 4.

Part 2: (50 – 80 minutes)

1. Ask students to reform previous groups.
2. Ask students to look at their previous work on the Sound Machine Design worksheet. They should recall ideas about the sound machine and the materials that they planned to use.
3. Allow groups time to construct and try their model sound machines (See Appendix A” Instructor’s Notes).
4. Ask each group to change the volume and pitch of their sound machine.
5. Discuss with the students which instrument has the highest pitch and which has the lowest pitch.
6. Ask students to finish questions 4 and 5.

## **Materials List**

<b>Materials per class</b>	<b>Amount</b>	<b>Location</b>
Dried Kidney Beans	A few bags	Grocery Store
Paper Plates	One Package	Grocery Store
Rubber Bands	One Package	Convenience Store
Popsicle Sticks	10-20	Craft store
Small Round Cardboard Boxes	~10	Craft store
Staples	One Stapler	Classroom
Wax Paper	One roll	Grocery store

<b>Materials per student</b>	<b>Amount</b>	<b>Location</b>
<u>Sound Machine Design</u> Worksheet	One	End of lesson plan – print or photocopy
Medium Sized-Sheet of Paper	One per group	Classroom

## **Vocabulary with Definitions**

1. *Pitch* – The property of sound that varies with variation in the frequency of vibration; the ‘highness’ or ‘lowness’ of sound.
2. *Sound Machine* – Any instrument that can make a noise when played.
3. *Volume* – The loudness of a sound.

## **Assessment / Evaluation of Students**

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

1. Observe student groups at work and collect student worksheets to determine whether students understand the appropriate use of materials and tools when making a sound machine.
2. Determine whether students understand the Engineering Design Process by reviewing their worksheets.

## **Lesson Extensions**

1. Ask students to measure various parts of their sound machine in inches and centimeters. See WPS Benchmark “03.SC.TE.05 Develop a knowledge and understanding of the metric measurement system.”

2. Have the students graph the differing volumes and pitches.

### **Attachments**

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1. Appendix A: Instructor's Notes
2. Appendix B: The Engineering Design Process
3. Sound Machine Design

### **Troubleshooting Tips**

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1. Students may not choose the correct materials; therefore, the sound machine will not produce any sound (See Appendix A: Instructor's Notes).

### **Safety Issues**

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1. Scissors are sharp and students should use caution.
2. Students should use extreme caution if/when using the stapler. If possible, and adult helper should perform this task for them.

### **Additional Resources**

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None

## **Appendix A: Instructor's Notes**

At least three different types of sound machines may be made using the given materials:

1. Maracas

Materials: Kidney Beans, Paper Plates, Popsicle Sticks and Staples

2. Drums

Materials: Small Round Cardboard Box, Rubber Bands, Wax Paper and Popsicle Sticks

3. String Instrument

Materials: Pieces of Cardboard and Rubber Bands

## Appendix B: 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!”

# Sound Machine 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 type of sound machine do I want to construct that will be able to change volume?

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**2. Imagine –**

Look at the list of materials below. Place a check in the box beside the materials that you will use to create your sound machine.

Kidney Beans	<input type="checkbox"/>
Paper Plates	<input type="checkbox"/>
Rubber Bands	<input type="checkbox"/>
Wax Paper	<input type="checkbox"/>
Popsicle Sticks	<input type="checkbox"/>
Pieces of Cardboard	<input type="checkbox"/>
Small Round Cardboard Box	<input type="checkbox"/>
Staples	<input type="checkbox"/>
Tape	<input type="checkbox"/>
Glue	<input type="checkbox"/>

Why did you pick these materials? \_\_\_\_\_

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Which material(s) will allow the sound machine to change volume? \_\_\_\_\_

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How can you change the pitch of the sound machine? \_\_\_\_\_

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**3. Plan –**

On a separate sheet of paper, draw a picture of the sound machine that you plan to make. Beside each part, write which material you will use to make that part. Use the list above as a guide.

**4. Create –**

Collect the materials that you need and then construct your model. Test your model by changing the volume and pitch.

**5. Improve –**

If you could not change the volume of your model, how can you improve your model so that it will change volume?

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If your model did change volume, how can you improve your model to make it better?

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