

**Introduction to Engineering: 1.A.II**

Civil Engineering

<b>Grade Level</b>	1
<b>Sessions</b>	Session I: What do civil engineers help make? – 10 minutes Session II: Gum drop domes (think and design) – 15 minutes Session III: Gum drop domes (create) – 25 minutes Session IV: Gum drop domes (test) – 10 minutes
<b>Seasonality</b>	N/A
<b>Instructional Mode(s)</b>	Whole class
<b>Team Size</b>	2 students per group
<b>MA Frameworks</b>	<u>Skills of Inquiry</u> 1. Ask questions about objects, organisms, and events in the environment. 2. Tell about why and what would happen if? 3. Make predictions based on observed patterns. 5. Record observations and data with pictures, numbers, or written statements. 6. Discuss observations with others. <u>Technology/Engineering</u> 1. <i>Materials and Tools</i> 1.3 Identify and describe the safe and proper use of tools and materials to construct simple structures
<b>WPS Benchmarks</b>	01.SC.IS.01 01.SC.IS.02 01.SC.IS.03 01.SC.IS.05 01.SC.IS.06 01.SC.TE.03
<b>Key Words</b>	Civil engineer, dome, support

**Summary**

This lesson will teach students about civil engineering. The students will work in teams to create domes out of gum drops and toothpicks. The domes will then be tested to see how many books they can support. It is up to the students to decide how many domes are needed to support the books.

**Learning Objectives**

*Massachusetts Frameworks for Grades Pre K-2*

Skills of Inquiry

1. Ask questions about objects, organisms, and events in the environment.
2. Tell about why and what would happen if?
3. Make predictions based on observed patterns.
5. Record observations and data with pictures, numbers, or written statements.
6. Discuss observations with others.

## Technology/Engineering

### 1. *Materials and Tools*

1.3 Identify and describe the safe and proper use of tools and materials to construct simple structures

#### *2002 Worcester Public Schools (WPS) Benchmarks for Grade 1*

01.SC.IS.01 Ask questions about objects, organisms, and events in the environment.

01.SC.IS.02 Tell about why and what would happen if?

01.SC.IS.03 Make predictions based on observed patterns.

01.SC.IS.05 Record observations and data with pictures, numbers, or written statements.

01.SC.IS.06 Discuss observations with others.

01.SC.TE.03 Identify and describe the safe and proper use of tools and materials (e.g., glue, scissors, tape, ruler, paper, toothpicks, straws, spools) to construct simple structure.

### **Additional Learning Objectives**

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1. Understand what civil engineers help to make.
2. Know what a dome is.
3. Understand how it is necessary that building be able to support weight.

### **Required Background Knowledge**

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1. Introduction to engineering – Sparky’s Engineer 1.A.I

### **Essential Questions**

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1. What is a civil engineer?
2. Why are the domes able to support the books?

### **Introduction / Motivation**

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Ask students if they can remember what a civil engineer is. See if any of the students can give examples of what civil engineers do.

### **Procedure**

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**Session I: What do civil engineers help make? – 10 minutes**

***Instructor preparation:***

1. Print out the attached pictures of the bridge, skyscrapers and roads prior to teaching the lesson.
2. Fill out take-home letter for parents regarding supplies found in attachment section and photocopy for students to take home to gather materials for making the gum drop domes.

***The instructor will:***

1. Show the attached pictures of a bridge, skyscrapers, and roads. For each picture have the students identify what the object is and what it is used for. Explain that civil engineers design all of these structures.
2. Explain to the students that part of a civil engineer's job is to make sure that each structure is able to support weight. For example, explain to the students that if a building does not have enough support that it may collapse when there is more weight in it. Make sure that the students understand what support means.

**Session II: Gum drop domes (think and design) – 15 minutes**

***Instructor preparation:***

1. Print a copy of "Engineering Design Process of Gum Drop Domes" for each student.
2. Print out the attached picture of the dome.

***The instructor will:***

1. Explain to students that they will be making domes out of gum drops and toothpicks. Make sure everyone understands what a dome is. Explain to the students that a dome is able to hold heavier objects because the weight is spread out more than it is on a square or rectangle. Show them the attached picture of the dome.
2. Distribute copies of "Engineering Design Process of Gum Drop Domes" to each student.

3. Split students into groups of two. Have the students think about how many domes they need to make to support the books.
4. Instruct the students to draw what their domes will look like and how many they will have.

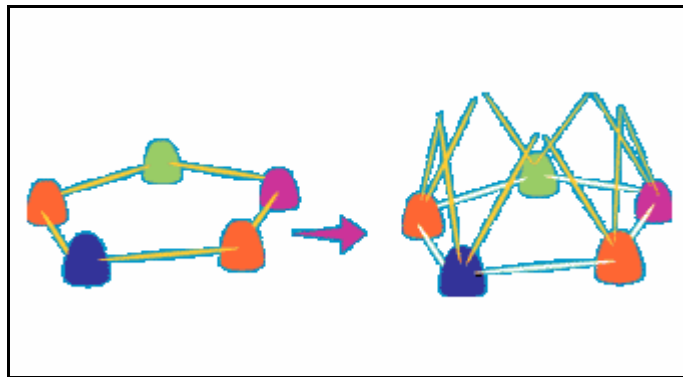
**Session III: Gum drop domes (create) – 25 minutes**

***Instructor preparation:***

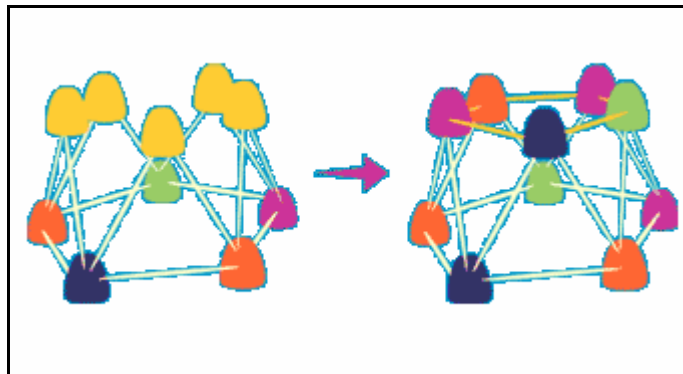
1. Have gum drops and toothpicks that the students brought in ready to build the domes.

***The instructor will:***

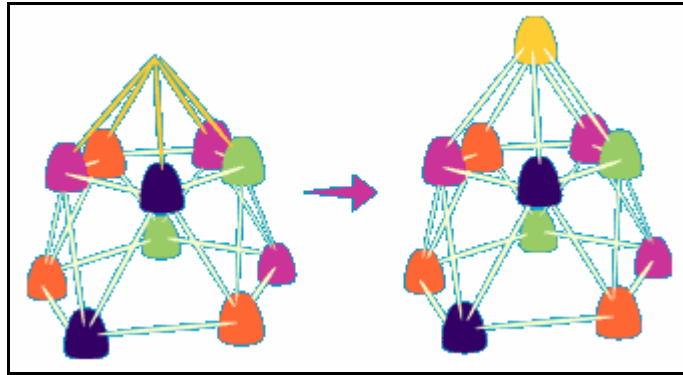
1. Distribute the gum drops and toothpicks to the students.
2. Instruct students to make a circle out of 5 gum drops and connect them with toothpicks for the base.



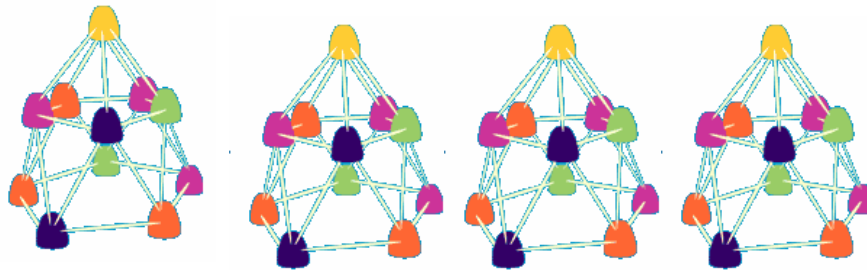
3. Use 2 toothpicks and 1 gumdrop to form a triangle on each side of the base. Repeat all the way around the base until there are 5 triangles.
4. Connect the gum drops at the top of the triangles with more toothpicks.



5. Push 1 toothpick into each of the 5 gum drops. Make sure that the toothpicks are angled in towards the center.
6. Use 1 more gum drop to connect the toothpicks at the top.



7. Have the students make as many of these domes as they designed (as long as there are enough supplies to make as many as they wanted.)



**Session IV: Gum drop domes (test) – 10 minutes**

***The instructor will:***

1. Put a small book on each group's domes. Add small books to see how much weight the domes are able to support.



2. Have the student's observe which group's domes supported the most weight and why they thought it did.

## **Materials List**

<b>Materials per class</b>	<b>Amount</b>	<b>Location</b>
Pictures of bridge, skyscrapers, roads, and dome	1 per class	Attachment section
Books	As many as necessary	Classroom

<b>Materials per student</b>	<b>Amount</b>	<b>Location</b>
Toothpicks	~25 per dome	Grocery store
Gum Drops	~11 per dome	Grocery store
Engineering design worksheet	1 per student	Attachment section

## **Vocabulary with Definitions**

1. *Civil Engineer* – a person who uses wood, steel, cranes, trucks, and many other tools to build tunnels, roads, buildings, and bridges.
2. *Dome* – an object or building that looks like half a circle. It is much stronger than square buildings.
3. *Support* – to hold an object in place without falling and be able to withstand weight.

## **Assessment / Evaluation of Students**

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

1. Ask questions about what civil engineers do.
2. Ask students why the domes were able to support the books.

## **Lesson Extensions**

None

## **Attachments**

1. Bridge picture
2. Skyscraper picture
3. Road picture
4. Picture of dome to show students
5. “Engineering Design Process of Gum Drop Domes”
6. Take-home letter for parents regarding supplies

**Troubleshooting Tips**

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None

**Safety Issues**

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Students should be supervised at all times.

**Additional Resources**

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None

**References for Lesson Plan Ideas**

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Gum Drop Dome

<http://pbskids.org/zoom/activities/sci/gumdropdome.html>

**References for Pictures**

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Gum Drop Dome

<http://pbskids.org/zoom/activities/sci/gumdropdome.html>

Books

Microsoft Word - Clip Art

Bridge

<http://www.balsabridge.com/images/clipart/bridge.gif>

Skyscraper

Microsoft Word – Clip Art

Road

Microsoft Word – Clip Art

Dome

Microsoft Word - Clip Art

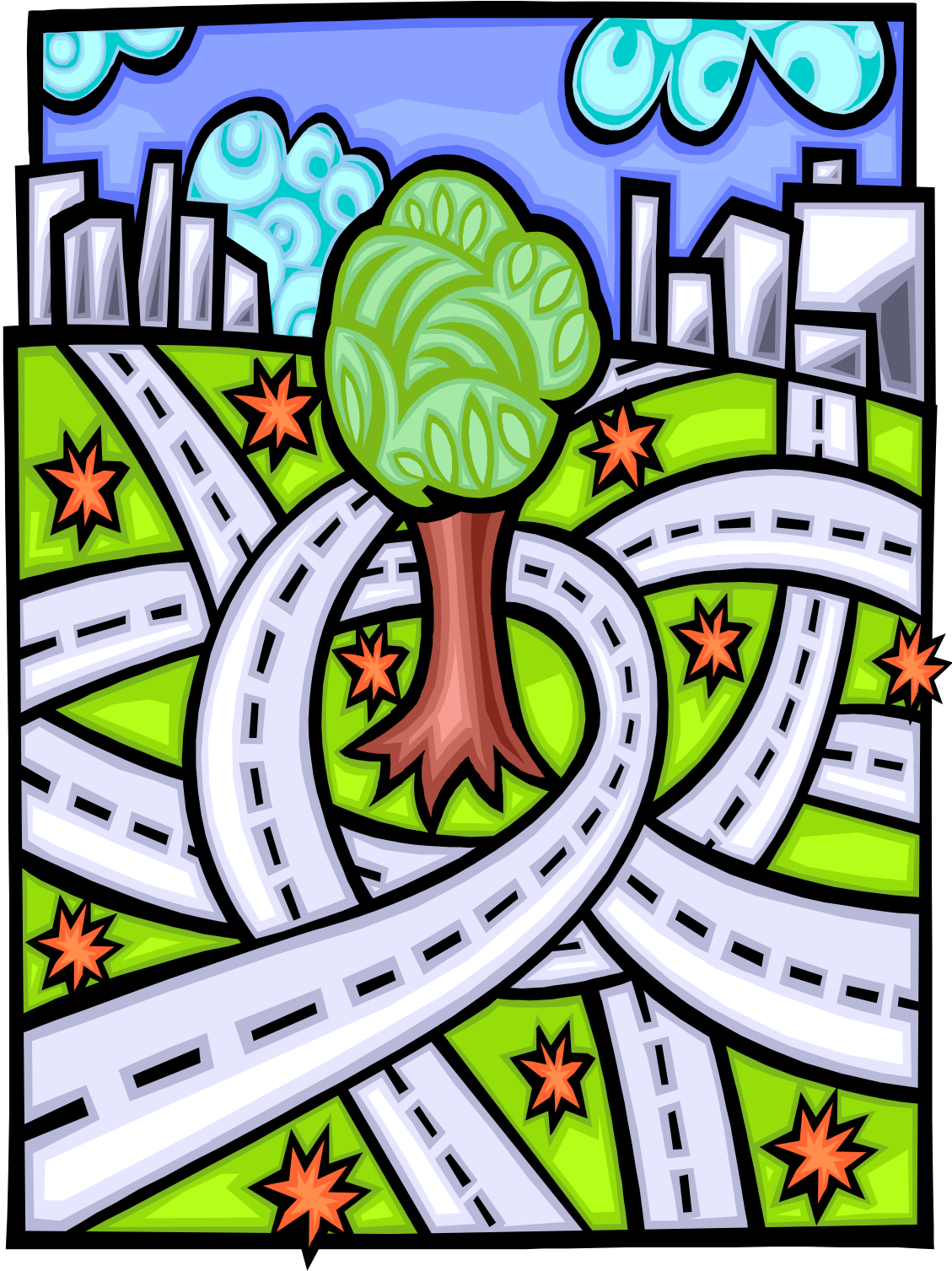
**Key Words**

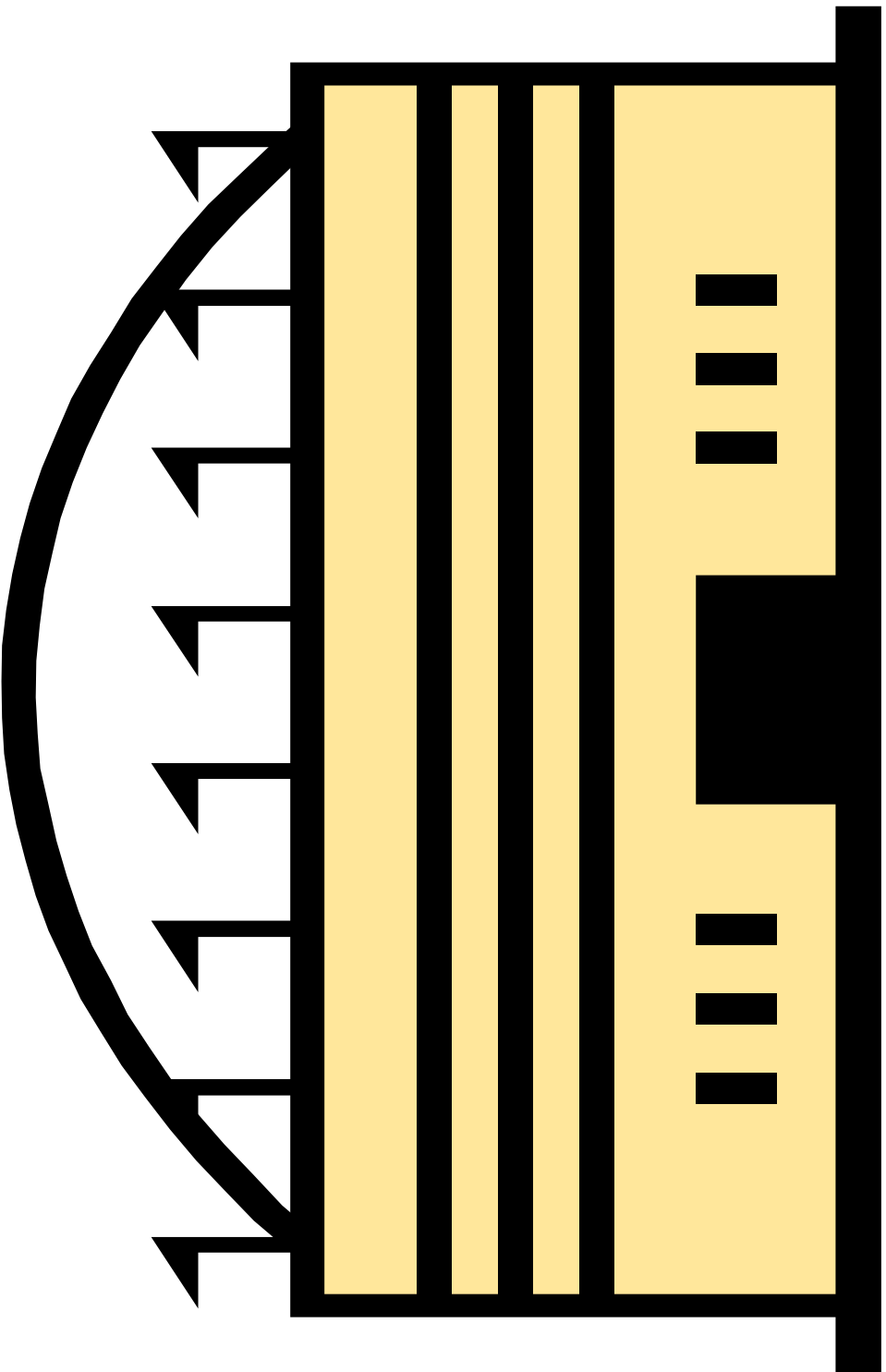
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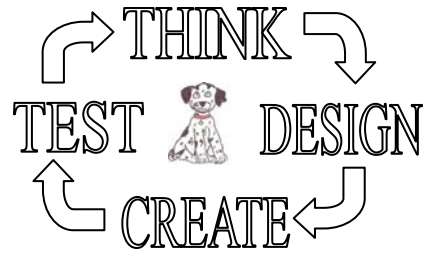
Civil engineer, dome, support











Name \_\_\_\_\_

**THINK:** How many domes does it take to hold a stack of books?:

\_\_\_\_\_

**DESIGN:** My domes look like: I will make \_\_\_\_\_ domes

**CREATE:** Time to make our domes!

**TEST:** My domes supported \_\_\_\_\_ books?

**Partnerships Implementing Engineering Education**  
Worcester Polytechnic Institute – Worcester Public Schools  
Supported by: National Science Foundation

Date\_\_\_\_\_

Dear Parents,

As part of our Technology/Engineering curriculum, students are learning about civil engineering and how structures must be made to support weight. Students are designing and making domes and then testing them to see how much weight they can hold

The students will be making the domes out of gum drops and toothpicks. If you could help your child gather these materials and then have your child bring them to school on \_\_\_\_\_ it would be greatly appreciated.

Thank you for you support!

Sincerely,

Partnerships Implementing Engineering Education