

# Tower Challenge

[design challenge to build the tallest tower]



## Key

This activity provides students an opportunity to become more familiar with the stages of the Design Cycle (define, develop, and optimize).

Engineers use “define, develop, and optimize” as a way of thinking as they create the best possible designs. In the case of tall towers, defining the problem involves understanding constraints (of materials, safety, cost, and the needs of the people who will use the building). Developing solutions means working creatively within these constraints to find innovative solutions. Optimizing means making adjustments and modifications to create the best possible design.

In this activity, students will learn more about and then practice these steps by watching two videos about the tallest towers in the world and then designing and building the tallest tower possible.

## Activity Parts

Students watch two videos about the tallest towers in the world, with a focus on the Burj Khalifa in Dubai (currently the world’s tallest tower).

In groups of 2-3, students will compete to build the tallest tower out of the provided materials. Students will be guided through using each step of the Design Cycle (define, develop, and optimize). The teacher will measure the height of the towers, and record them on the front board for all students to see.

# PART A



## Big Idea for Kids

When engineers build towers, they use the Design Cycle. They define the problem (what does the tower need to be able to do), they develop possible ideas and solutions, and then they optimize those solutions so the building is as tall, sturdy, and safe as possible. In this activity, you will watch videos about the tallest towers in the world and learn how engineers have been able to make better and taller towers over time. Then, you will get a chance to engineer a tower. How tall can you build a tower using the materials available to you?

## Getting Ready

### Time Estimate

50 minutes

### Materials

Videos

Worksheet

Meter stick

Popsicle sticks (15 per group)

Pipe cleaners (15 per group)

Golf balls [Easy version: ping pong golf balls (available in most dollar stores), Challenge: real golf balls]

### Preparation

Load videos so they are ready to play

Make enough copies of the worksheet for each student

Count out enough popsicle sticks and pipe cleaners for each group

# Activity Instructions

## 1 VIDEOS (20 min)

Watch the following videos:

How High Can We Build?  
(Vsauce, 10:00) [youtube.com/  
watch?v=GJ4Qp2xeRds](https://www.youtube.com/watch?v=GJ4Qp2xeRds)

Window cleaning the world's tallest building (BBC, 4:00) [youtube.com/  
watch?v=wcRuXrduj6Q](https://www.youtube.com/watch?v=wcRuXrduj6Q)

Ask students to share what they thought about the videos. Did they notice anything cool? Weird? Ask students to raise their hand if they would go to the top of the Burj Khalifa, and if they would wash the windows.

## 2 INTRODUCE ACTIVITY (3 min)

Tell students:

Today we will also be working on designing really tall towers, and you'll get to build them using pipe cleaners and popsicle sticks.

Raise your hand if you've ever been mini-golfing. [Wait for hands] Great! Mini golf is important to the story we'll be working with today. When the Magnificent Mini Golf Course was first built, they had many customers and business was great. Over time, however, many tall buildings were constructed in the surrounding area that blocked the view of the golf course. People had a hard time seeing and finding the golf course, and fewer and fewer customers came to play golf. The owners did some research and learned that building a tall tower would help people find the course. The owners want to do this to get more customers!

You have been hired as an engineer to design a proposal for a tower. The Magnificent Mini Golf Course wants the tallest tower possible. Each group will get 15 pipe cleaners and 15 popsicle sticks. Your tower must be freestanding (not attached to the table in any way) and must support a golf ball. The golf ball must be part of the structure, and can't touch the table. If your golf ball is at the top of the tower, you'll get a bonus 1cm added to your final height. Any questions?



## Open the Window

How does the Design Cycle help engineers build towers? What challenges do you think engineers faced when designing incredibly tall buildings? Could a building ever be tall enough to reach outer space?

### 3 DEFINE (3 min)

While you distribute the worksheet to each student, ask them to come up with a team/company name and write it on their paper.

Ask the students “On your worksheet you are going to define the problem. What is the problem we are trying to solve?” Call on 1+ students until you come to a consensus on the answer. It should be something along the lines of “The problem is that the mini golf course needs more customers” or “The mini golf course needs to build a tower to attract more customers.”

Note: Some students may point out that assuming they need to build a tower isn't getting to the real root of the problem. That is a great observation! However, for the sake of simplicity in this activity, we will assume and trust the research done by the company.

### 4 DEVELOP (5 min)

While students work on developing and sketching their ideas, you can pass out the materials (pipe cleaners and popsicle sticks) to each group.

### 5 OPTIMIZE (15 min)

Students will have 15 minutes to build their tower. We recommend projecting a count-down timer on the board so students know how much time they have left. Make an announcement when there are 5 minutes left and 1 minute left.

Draw a two column chart on the board: first column for company names, second column for tower height (in centimeters). While students are building, rotate around the room and measure the heights of their towers and record them on the board. Even if you measure before students are done, it allows them to see which team is currently in the lead!

### 6 MEASURING! (2 min)

Make any final measurements of towers and record them on the board. Students should write the final height of their tower on their worksheet. If you want, you can award a prize to the winning team (we suggest stickers!).



## View from my Window

How did your final tower compare to your original idea? What was the most challenging part of this process? How did you optimize (make changes to improve) your tower as you were building it?



## 7 REFLECTION (5 min)

Students should sketch their final design and answer the three reflection questions.

## 8 OPTIONAL EXTENSION

Students can study the design choices other teams made, and combine ideas to make a new, even bigger, tower.

Name \_\_\_\_\_

Company Name \_\_\_\_\_

# Tower Challenge

**Goal:** Design a tower that can support a golf ball using only pipe cleaners and popsicle sticks

## **DEFINE** the problem

## **DEVELOP** solutions

Sketch your wild ideas! Discuss with your team members.

## **OPTIMIZE** your solution

### **PROTOTYPE**

Build a prototype (first model) of your design by using the materials provided

### **GET FEEDBACK**

What worked? What didn't work?

### **REDESIGN**

Make modifications to your tower along the way to make it as tall as possible!

**Final Tower Height:** \_\_\_\_\_

**Sketch your final design**

### **Reflection**

1) How did your final tower compare to your original idea?

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2) What was the most challenging part of this process?

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3) How did you optimize (make changes to improve) your tower as you were building it?

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