
THE EMPIRE STATE BUILDING

EDUCATIONAL MATERIALS

MATH:
GRADES 3-5



THINKING ABOUT HUGE NUMBERS FOR THE WORLD'S MOST FAMOUS SKYSCRAPER!

Exhibit Connections: Model Replica, Construction, Observation Deck

OVERVIEW OF LESSON PLAN

The goal of this lesson for math students in grades 3 to 5 is to build excitement about the upcoming trip to the Empire State Building by thinking about how large it is – and making mathematical connections to large numbers. The lesson will engage students in estimating and calculating some of the incredible numbers -- 102 floors, 1,250 feet, 1,872 stairs to reach the top, and 6,514 windows! Students will learn about some of the large numbers, and then complete some open-ended problem-solving activities that require them to estimate and calculate answers using some of these large numbers. These activities align with many math standards in grades 3 to 5, requiring number sense, estimation, problem solving, and considering real-life applications of multiplication and division.

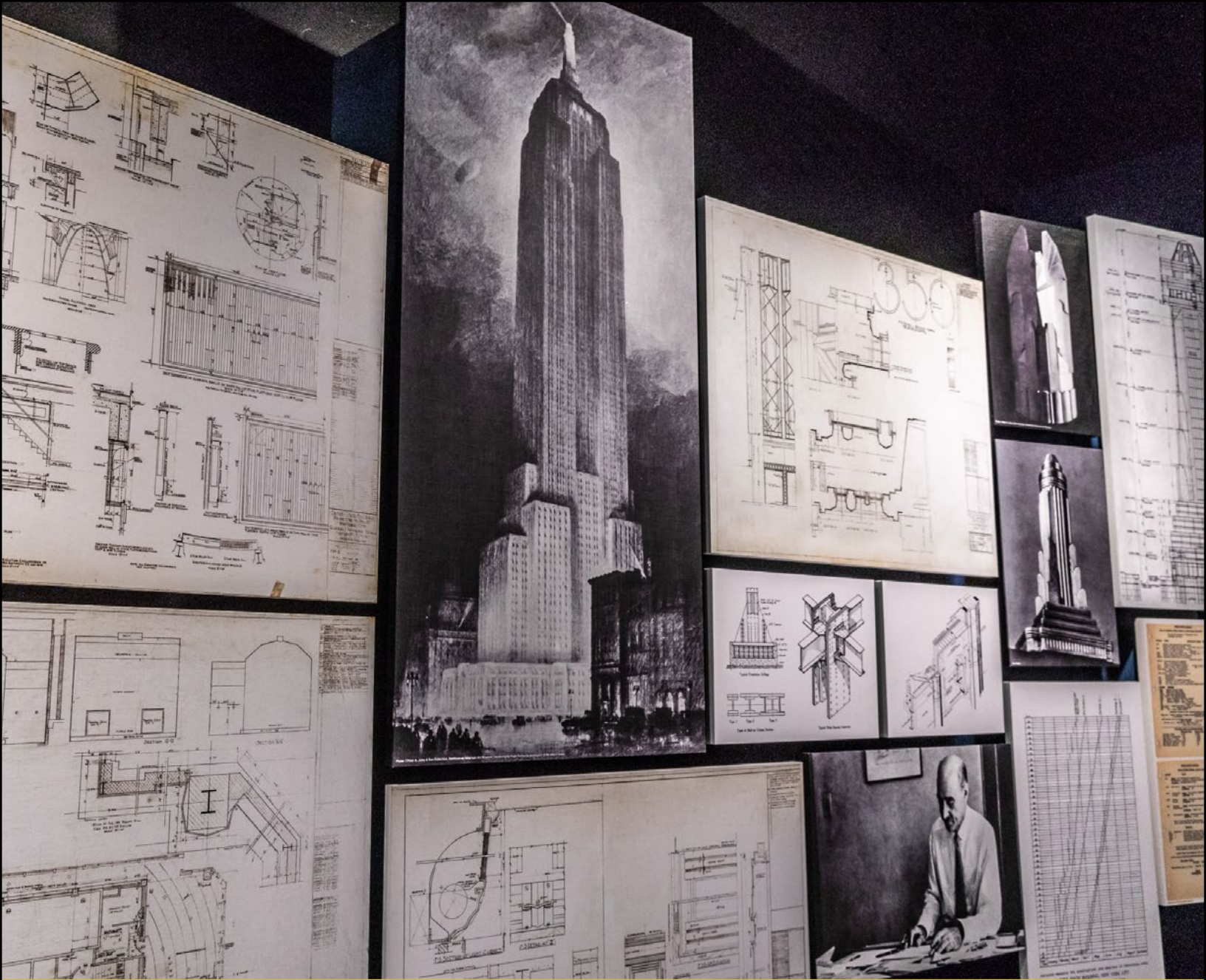
OBJECTIVES

Students will:

- Learn facts about the Empire State Building
- Consider the meaning and scope of large numbers
- Use estimation strategies (and multiplication and division) to predict and calculate the answers to complex problems, such as how many windows and stairs the Empire State Building has

- **SUGGESTED TIME ALLOWANCE:**

One to two hours, depending on teacher's discretion and choices among various activities and problems



RESOURCES/ MATERIALS:

- Pencil
- Calculator
- Provided handouts

ACTIVITIES/ PROCEDURES:

PRE-TRIP ACTIVITY

In preparation for your field trip to the Empire State Building, the class will engage in a discussion about the amazing size and scope of the world’s most famous skyscraper. We’ll begin by asking students to guess some of the most amazing numbers and see how close they are. We will ask students to try to describe what some of the numbers would look like in real life – for example, what does it mean that the Empire State Building is 1,454 feet tall (including the antenna)? How far is 1,454 feet if we walked that far along the ground? The goal is to build “number sense” and estimation strategies for students and make connections to other objects that they can compare as benchmarks. Specifically, there are two “Pre-Trip Worksheets” with tasks for students to complete:

- students make real-life connections to estimate what 1,454 feet would look like as a horizontal distance (comparing it to their own height and to a football field)
- students estimate a series of other values, providing a rationale for their estimates.

After this initial launch, we will ask students to begin problem-solving, by choosing (or at the teacher’s discretion/choice) from a series of four problems about the Empire State Building. Again, these problems will push students to estimate, use number sense, and to consider how we can use multiplication and division to solve problems using large numbers. At the teacher’s discretion, some students might complete multiplication and division by hand, and others may benefit from using a calculator.

Teachers have flexibility to do these problem-solving tasks before, during, or after the trip. The “windows” problem requires them to spend time observing and counting windows while they are on the trip. The other problems can be launched before the trip, then completed before or after the trip.

[See Pre-Trip Worksheets #1-2 and Problem-Solving Tasks #1-4]

ON-SITE ACTIVITIES:

One hour

EXHIBIT: MODEL REPLICA (15 minutes)

Just before entering the main exhibit hall of the museum, students will have the opportunity to view a two-story tall replica of the Empire State Building. On the next floor, view the replica from above and watch the video of Richard Tenguerian building it. Read the signs describing the replica’s proportions as compared to the full-size skyscraper.

Students will complete a worksheet with ideas that they “notice” and “wonder” about the replica. This will also provide an opportunity for them to count the windows they see and work on their problem-solving work.

[See Trip Note-Taking Sheet #1]

EXHIBIT: CONSTRUCTION (15 minutes)

This exhibit will give students an opportunity to learn more about the Empire State Building and observe details that they will use to answer their math problems.

EXHIBIT: OBSERVATION DECK (30 minutes)

On a clear day, you can see landmarks over 80 miles away in all directions from the quarter mile-high Observation Deck of the Empire State Building. First, orient yourself by finding North, South, East, and West. Then, students will use the Observation Deck Note-Taking Worksheet to record things that they “notice” and “wonder” about the view. Teachers can also ask them to draw their favorite landmark on the back of their worksheet.

[See Trip Note-Taking Worksheet #2]

HOMEWORK/FURTHER DISCUSSION/POST-TRIP ACTIVITY

For homework and Post-Trip Activities, teachers have discretion to use more of the problem-solving tasks after the trip has been completed. Specifically, teachers might consider using one or two of the Problem-Solving Tasks before the trip (to excite students and encourage them to predict what they will see), and then complete another one or two problem-solving tasks after the trip, when students have more visual “context” to help them understand the questions. Teachers can lead class discussions about what the students thought about their trip, and whether the size and numbers of windows, stairs, and elevators was larger or smaller than they had predicted before the trip. Students can share their “noticing” and “wonderings” about the visit and consider how their estimates could have been more precise.

EVALUATION AND ASSESSMENT

Teachers can assess students on the writing and discussion that provides a justification for their numerical estimates and on how they showed their mathematical work. Most of the questions in this lesson do not have single “correct” numerical answers, but students should demonstrate logical reasoning, number sense, and a correct use of multiplication (e.g., to change a number of feet into inches, or to use the number of windows on each floor to estimate the total number of windows) and division (e.g., to use the number of visitors to the Empire State Building per year to estimate the number of visitors per day or per hour).



CONNECTIONS TO THE STANDARDS

NEW YORK STATE NEXT GENERATION LEARNING STANDARDS

- NY-3.OA** Understand properties of multiplication and the relationship between multiplication and division
- NY-4.OA** Solve multistep word problems posed with whole numbers and having whole number answers using the four operations; assess the reasonableness of answers using mental computation and estimation strategies including rounding
- NY-4.MD** Know relative sizes of measurement units: feet, inches, meters, centimeters; know the conversion factor and use it to convert units in a larger unit in terms of a smaller unit

PRE-TRIP ACTIVITY

GUESSING & BRAINSTORMING ABOUT THE SIZE OF THE EMPIRE STATE BUILDING!

DISCUSSION TOPIC: Today we're discussing how big the Empire State Building really is... it's huge! The building is 102 floors high. Including the antenna, it is over 1,400 feet tall.

Discuss with your partners – what does 1,400 feet tall mean? What do you think it will look like when you are standing next to it?

Here's your first assignment: Try to describe what you think 1,400 feet would look like if you walked that distance straight on the ground. How long would it take to walk? What would it look like?

Consider this: How many feet tall are you? If you lay down on the ground, can you figure out how many of you & your friends (laying down from head-to-toe) it would take in order to make a line 1,400 feet long? Use a piece of paper, do some math, and try to figure it out.

Another idea: Can you imagine walking all the way on a football or soccer field from one end to the other? A full-size field is approximately 100 yards (which is 300 feet). If we lay the Empire State Building down on the ground (of course it's impossible!), how many football fields would be the same length as the building?

Answer these questions the best you can on another piece of paper, then we'll discuss.



PRE-TRIP ACTIVITY

NAME _____

DATE _____

ESTIMATING LARGE NUMBERS!

TODAY'S MATH CHALLENGE: For each item, guess how many you think there are! Just take a guess... whatever you think might be right... and then try to explain why you chose the number you chose. Are you making a "guess" or an "estimate"?

Item in the Empire State Building	My Guess/ Estimate Number	Why I chose my number...
Number of Windows		
Number of Elevators		
Number of People Who Visit Every Year		
Number of Days It Took to Build the Empire State Building		
Number of People Who Work in the Building		

PROBLEM/TASK

NAME _____

DATE _____

ESTIMATION AND CALCULATING WITH LARGE NUMBERS!

TODAY'S TASK: Would you believe the Empire State Building gets approximately 4 million visitors every year? It's true -- the Observation Deck is open every day of the year, and approximately 4,000,000 people come to see the view from the top.

Your math challenge is to estimate approximately how many people will be visiting the Empire State Building when you visit. Just try to make the best estimate you can and explain how you made your prediction. You don't need to get the answer exactly right -- just make a good estimate and explain it.

Think about some details: How many days are in a year? Can you estimate approximately how many people visit the Empire State Building each day? Are you going to add, subtract, multiply, or divide? You can use a pencil or try a calculator, but you have to show your work and explain how you estimated an answer.

After you estimate the number of visitors who visit the Empire State Building each day, let's think about how many are there every hour. If the building is open for 10 hours every day, and the visitors stay for about one hour, how many visitors do you think are visiting every hour?

Your task is to try to predict approximately how many people will be visiting the Empire State Building when you visit.



PROBLEM/TASK

NAME _____

DATE _____

WHEN DID THE EMPIRE STATE BUILDING OPEN?

PROBLEM-SOLVING WITH CALENDARS

TODAY'S TASK: The Empire State Building was built so fast -- you wouldn't believe that the entire building was built in only 410 days! The construction workers began working on March 17, 1930, and they worked nonstop for exactly 410 days.

Your math challenge is to figure out what day the Empire State Building opened for the first time. What was the exact date that the workers finished the construction? (It opened the next day after the construction finished.)

How will you figure it out? Do you know how many days are in each month of the year? Can you count each month and figure out what date was 410 days after they started? Take your time... show all your work on a piece of paper and ask your teacher for any advice you need.

Good luck!

PROBLEM/TASK

NAME _____

DATE _____

ESTIMATE THE NUMBER OF WINDOWS!

TODAY'S TASK: The Empire State Building is huge! Can you imagine how many windows the entire building has? The building has 102 floors, and windows all the way around all four sides of the building!

First, let's take a guess! What do you think? Can you make an estimate and try to explain why you think your estimate might be close to the real number?

When you visit, your math challenge is to try to make the best possible **estimate of the total number of windows in the Empire State Building.**



How are you going to estimate the total number of windows? It's too many to count them all!

- When you see the building from the outside, could you count how many you see on one floor?
- When you visit and look at the replica of the Empire State Building in the museum, can you count the number of tiny windows on one floor?
- When you are walking around in the museum on the 80th floor, can you count how many windows you see on that floor?
- If you count how many windows you see on one side of the building, do you think the other three sides will be the same?
- If you can estimate the number of windows on one floor, remember that there are 102 floors in the whole building!

You don't need to get the exact answer... but your job is to explain all the work you do to get the closest possible estimate. Then we'll see which of your classmates is closest to the real answer!

PROBLEM/TASK

NAME _____

DATE _____

HOW MANY STAIRS TO THE TOP?

- **TODAY'S TASK:** The Empire State Building is huge! Have you ever wondered how many stairs you would have to climb if you wanted to walk all the way to the top of the building without the elevators? (That would be crazy -- don't try it!)
- **Here's your math challenge:** The Empire State Building is 1,250 feet tall (all the way from the top to the bottom, if you don't count the antenna). **If each of the stairs is 8 inches high, how many stairs are there from the bottom to the top of the whole building?**



How are you going to figure it out?

- Try any strategy you want and show all your work.
- Remember: There are 12 inches in a foot. Can you figure out how many inches tall the entire Empire State Building is? (That's going to be a huge number and it might help you figure out the number of stairs.)
- Use a pencil or a calculator -- just be ready to explain to your teacher what you did to figure out your answer.

Let's see how many of your classmates figure out how many stairs the Empire State Building has from the bottom to the top!

TEACHER ANSWER KEY/DATA

Task #1: Clearly, this task is open-ended with a variety of potential answers that could reflect logical problem-solving.

Specifically, $4,000,000$ divided by 365 days = $10,959$ visitors per day

[Of course, some days in popular tourist seasons might be much more crowded, and others much less crowded.]

If the Observation Deck is open for 10 hours per day, students might estimate that approximately 1,000 (or 1,096) people would be visiting at any given hour. Visitors might be in different parts of the building -- some in elevators, some in the museum, some at each Observation Deck. All of these topics could be interesting discussions for students to consider.

Mathematically, teachers can discuss with students why they used division to help figure out these estimates. Alternatively, some students might have used trial-and-error with multiplication to estimate their answers.

Task #2: This can be a challenging problem-solving task. Some students will begin on March 17, 1930, and understand that 365 days later is March 17, 1931. They might count 14 days from there to get to March 31st. Then 30 more days to get to April 30th. And one more day (construction on April 30th) is the 410 days of construction – and the building opened on May 1, 1931.

If students have a strong understanding of the calendar, they might need to know that 1931 was not a leap year (no February 29th), so there were only 365 days in the year (not 366).

Task #3: Students might approach this problem in different ways. They might count visible windows outside; or using the replica; or when they walk around the museum on the 80th floor. They might estimate or count the number of windows on one side of the building, then multiply by 4. They might consider that some of the floors higher up the building are smaller (with fewer windows). The important thing is not the precise answer, but the use of logical reasoning, estimation, and multiplication.

For the teacher's reference: The Empire State Building has 6,514 windows. Students would be extremely accurate if they estimate approximately 60-65 windows per floor and 102 floors.

Task #4: Again, students might approach this problem in a variety of ways – the important math is not the precise answer, but rather, the logical use of problem-solving, estimation, and figuring out how to multiply or divide to convert between feet and inches.

One method/step is for students to figure out that the building is 15,000 inches high (1,250 feet x 12 inches per foot). If they figure out that they can divide 15,000 by 8 inches (height of each step), that will give them an answer of 1,875 stairs in the entire building. (Officially, there are 1,872 stairs, but these numbers are extremely accurate estimates that do not require decimals.)

TRIP WORKSHEET

NAME _____

DATE _____

Empire State Building Replica – Notice & Wonder

When you see the model/replica of the Empire State Building, look at all the details... It's amazing! On this page, write three things that you notice that you find interesting. Then, write three questions that you are wondering about.

Three interesting things I notice about the model of the Empire State Building are...

1.

2.

3.

Three questions that I wonder about the model of the Empire State Building are...

1.

2.

3.

TRIP WORKSHEET

NAME _____

DATE _____

Empire State Building Observation Deck – Notice & Wonder

When you are looking out from the Observation Deck of the Empire State Building... on this page, write three things that you notice that you find interesting. Then, write three questions that you are wondering about.

Three interesting things I notice on the Observation Deck are...

1.

2.

3.

Three questions that I wonder about at the Observation Deck are...

1.

2.

3.