
THE EMPIRE STATE BUILDING

EDUCATIONAL MATERIALS

TECHNOLOGY:
GRADES 6-8



THE EMPIRE STATE BUILDING: A MONUMENT OF SUSTAINABILITY

Exhibit Connections: Modern Marvel and Otis Elevators`

OVERVIEW OF LESSON PLAN

The Empire State Building was, at the time of its construction, a shining symbol of technological achievement for humankind. It is New York City's first super-tall building. Not only was the Empire State Building up to 50% taller than its contemporaries, but it was also more than twice as big in its floor area. Since construction was completed in 1931, the Empire State Building has been retrofitted to be a model of sustainability and energy efficiency. The building's upgrade saves over \$4.4 million in energy-related costs each year. In this engineering and technology-focused unit, students will learn how structures can be designed for energy efficiency and sustainability while providing a comfortable work environment. Students will apply what they learn about the Empire State Building's power, lighting, heating and cooling systems, elevators, windows, and monitors and controls to design a net-zero structure of their choice. Students will apply STEM concepts in a real-world context to design a net-zero structure that meets the needs of humans in a changing climate.

OBJECTIVES

Students will:

- Gain a deeper understanding of the Empire State Building's engineering and design elements that make it a beacon of energy efficiency.
- Explore elements of net-zero design, such as efficient use of power, monitors and controls, water conservation, and reducing waste.
- Design a net-zero structure based on the energy efficiency strategies modeled in the Empire State Building.

SUGGESTED TIME ALLOWANCE:

One hour

RESOURCES/ MATERIALS:



- Article:

Empire State of Green

- Video:

A beacon for energy efficiency

Empire State Building
Becomes Energy Efficient

Inside the Empire State
Building's energy transformation

Inside the
Empire State Building's
21st Century Upgrade

TEDxPresidio - Kevin Surace

The Empire State Building's
Green Makeover

Impossible Science On Location

- Paper
- Pencils
- Colored Pencils
- Cardboard
- Legos or **EverBlock**
- Google Drawings
- Provided worksheets

ACTIVITIES/ PROCEDURES:

PRE-TRIP ACTIVITY

The Empire State Building is a building everyone in the world recognizes. It is also a leader in energy efficiency, building health, and indoor environmental quality. How did a deep retrofit bring an iconic 1931 skyscraper into the 21st Century as a leader in sustainability?

Students will take on roles as civil engineers, energy auditors, architects, construction managers, electrical engineers, mechanical engineers, or facilities managers tasked with designing a net-zero structure for human use. Students may choose to design a net-zero classroom, school, home, or office building based on the energy efficiency principles and strategies modeled in the Empire State Building. Students should be familiar with basic concepts of energy and the difference between renewable and non-renewable energy.

Sometimes when we think about climate change and solutions to mitigate climate change, we think about wind turbines or electric cars, but a big part of the solution is the building you are sitting in right now. Buildings consume about 80% of all energy, including electricity, in a city. We can design and build structures to respond to our changing climate while creating spaces to live, work, study, and play. You are going to be visiting the Empire State Building, which completed a \$31 million energy efficiency retrofit in 2010. How did multiple stakeholders and engineering and technology experts come together to make the Empire State Building more energy efficient? How did they use science and technology to cut the building's energy usage by more than 40%?

Students will complete the pre-trip worksheet to brainstorm answers to these questions and demonstrate their initial understandings about how buildings use energy. Teachers will have students explore career roles they may be interested in taking on during their field trip to the Empire State Building, ex: civil engineers, energy auditors, architects, construction managers, electrical engineers, mechanical engineers, facilities managers, etc. Teachers may choose resources from the articles and videos listed above to share additional information to build student background knowledge prior to the trip.

ON-SITE ACTIVITIES (One hour)

Using the chart from the pre-trip activity, students will visit the Empire State Building through the lens of a particular career. Divide students into groups based on the careers they chose. As students experience the space and explore the exhibit, have them stop, discuss, and answer the prompts in the third and fourth columns of the chart.

EXHIBIT: MODERN MARVEL (15 minutes)

Stop students for discussion by asking, "How did multiple stakeholders and engineering and technology experts come together to make the Empire State Building more energy efficient? How did they use science and technology to cut the building's energy usage by more than 40%?" Ask them to refer to their notes for guidance.

EXHIBIT: OTIS ELEVATORS (15 minutes)

Have students discuss in their career groups the differences they notice in the original and existing Otis Elevator systems.

EXHIBIT: MODERN MARVEL (10 minutes)

Have students discuss in their career groups the ways in which the Empire State Building's green retrofit provides benefits to its many corporate tenants. Teachers may ask, "How does the Empire State Building provide a healthy indoor work environment to the office tenants who work here?"

POST-TRIP ACTIVITY

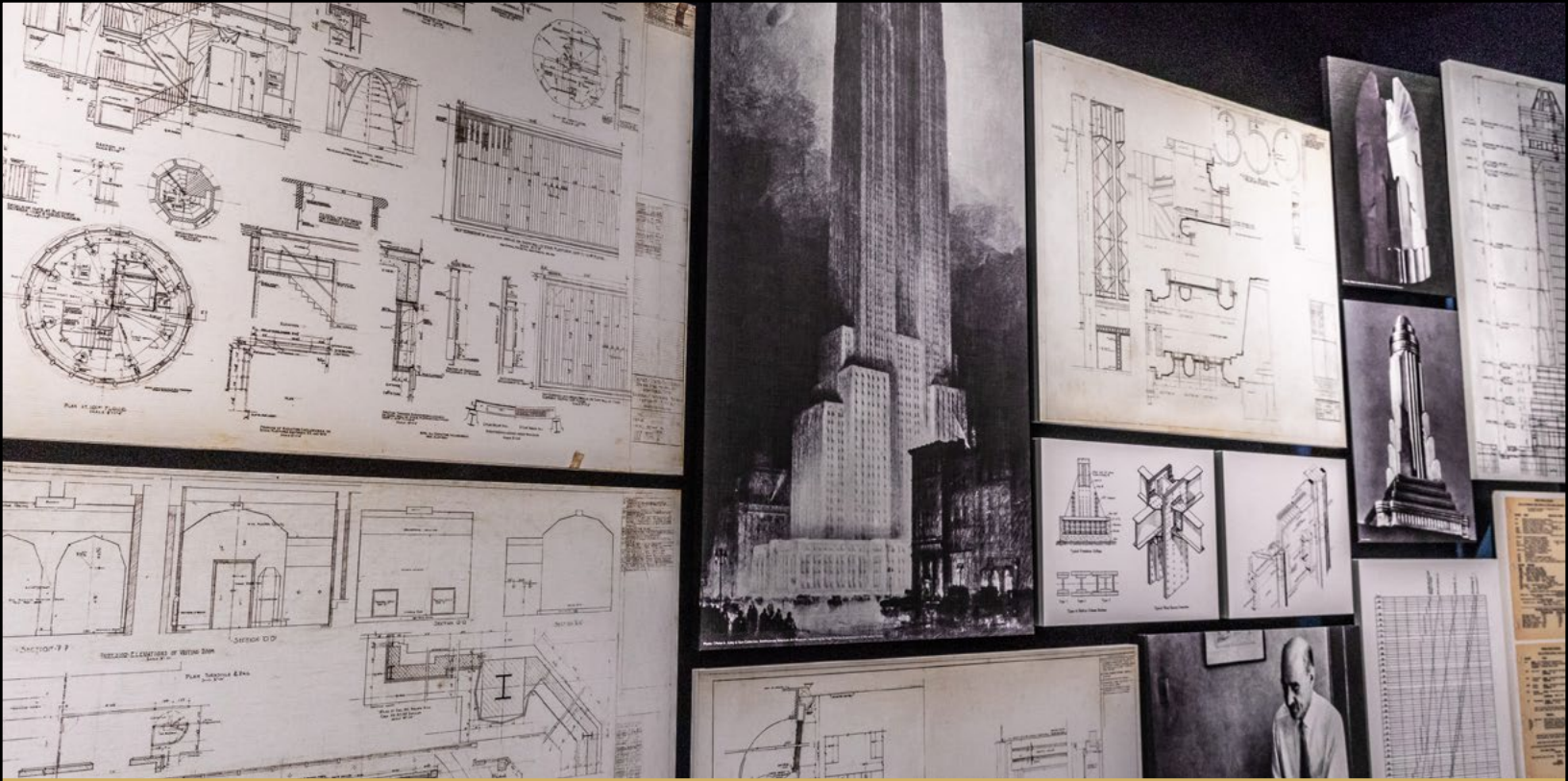
Students will design a net-zero structure of their choice (examples include: classrooms, schools, houses, office buildings, etc.), applying the sustainability principles they explored and discovered at the Empire State Building. They will be tasked with designing and building a model of a net-zero structure using a variety of materials of their choice: paper, cardboard, Legos, **EverBlock**, or Google Drawings. Students must show how their structure meets the needs of the people who will use it, meets its energy needs, recycles its waste, demonstrates thermal efficiency, and illustrates how lost energy will be replaced. They will explain in detail how one energy efficient feature functions in the structure. For example, a student might create an in-depth diagram or model of a triple pane window using sheets of paper or by using a web-based digital tool like Google Drawings.

EVALUATION:

Students will be evaluated using a teacher-created rubric that measures student understandings of geophysical science, living environment, and earth science concepts.

HOMEWORK/FURTHER DISCUSSION

Students will apply what they learned in this unit to design a green retrofit of a room in their home or apartment building. They will present their retrofit ideas to their peers and give and receive critical feedback.



CONNECTIONS TO THE STANDARDS

International Society for Technology in Education (ISTE) Standards

EMPOWERED LEARNER - Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

1d - Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

KNOWLEDGE CONSTRUCTOR - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

3a - Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

CREATIVE COMMUNICATOR - - Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

6a - Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.

6d - Students publish or present content that customizes the message and medium for their intended audiences.

PRE-TRIP WORKSHEET

NAME _____

DATE _____

PREPARING FOR YOUR TRIP TO THE EMPIRE STATE BUILDING

Sometimes when we think about climate change and solutions to mitigate climate change, we think about wind turbines or electric cars, but a big part of the solution is the building you are sitting in right now. Buildings consume about 80% of all energy, including electricity. We can design and build structures to respond to our changing climate while creating spaces to live, work, study, and play. You are going to be visiting the Empire State Building which underwent a \$31 million energy efficiency retrofit completed in 2010. How did multiple stakeholders and STEM career experts come together to make the Empire State Building more energy efficient? How did they use science and technology to cut the building's energy usage by more than 40%?

Directions: Observe photos of the Empire State Building. Consider the following questions then answer them in the first column of the chart. Apply what you already know about energy efficiency. During our trip to the Empire State Building, we will investigate how the building is able to save over \$4.4 million in energy-related costs each year.

	What I Think I Know....	What I Wonder...
How does the Empire State Building use its 73 Otis Elevators to feed energy back into the building?		
How does it use its windows to be more energy efficient?		
How would you be able to tell in real time how much energy a building and its occupants are using?		

TRIP WORKSHEET

NAME _____

DATE _____

WELCOME TO THE EMPIRE STATE BUILDING

As you explore the exhibits and experience the Empire State Building for yourself, take a moment to answer the questions below.

EXHIBIT: MODERN MARVEL

	What I Think I Know....	What I Wonder...
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EXHIBIT: OTIS ELEVATORS

Original Elevator System	New Elevator System

EXHIBIT: MODERN MARVEL

How does the Empire State Building's Indoor Environmental Quality initiative and retrofit provide a healthy work environment to the office tenants who work here?