

Liberty Science Center
Discovery ChallengesSM

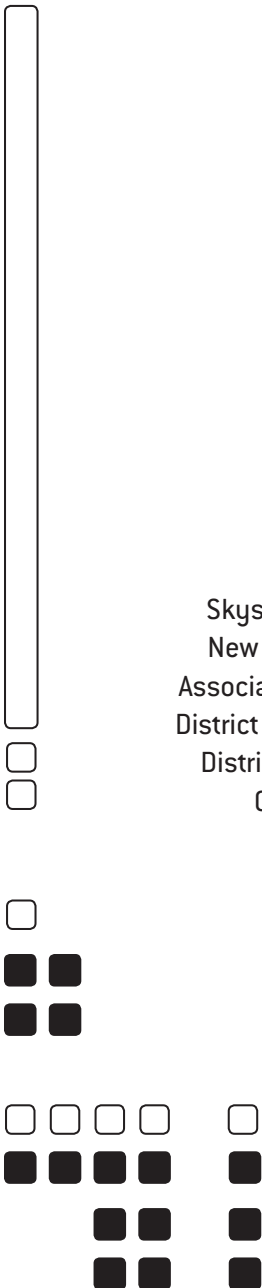
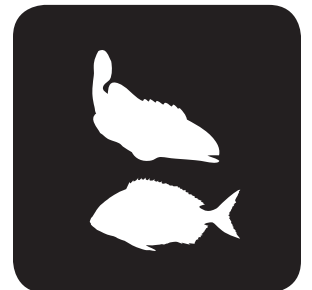
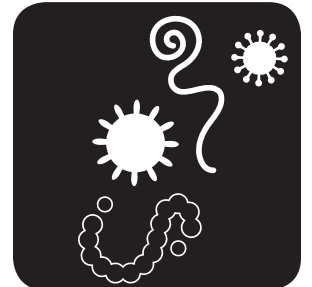
Skyscraper!

Achievement and Impact:
Design a Skyscraper
Grades: 3-5



Skyscraper! is made possible by the generosity of The Port Authority of New York & New Jersey; the National Science Foundation; International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers District Council of New York City, District Council of Northern New Jersey & District Council of Philadelphia and Vicinity, and IMPACT; the New Jersey Carpenter Contractor Trust; the Construction Industry Advancement Program of New Jersey; and Komatsu.

Additional support by *Johnson & Johnson*



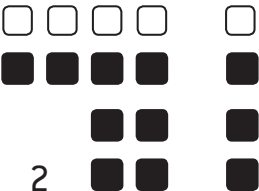


Skyscrapers are perhaps the ultimate expression of human engineering. A little more than 100 years ago, a 10-story building was considered an impressive feat. Today, towers under construction in several parts of the world are expected to reach more than half a mile high. In this Discovery Challenge, students will learn about the characteristics of skyscrapers and design their very own!



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Teacher Overview

What is a Discovery ChallengeSM?

A Discovery Challenge:

- Forges connections between Liberty Science Center’s exhibitions and classroom studies.
- Focuses and leverages student learning during visits.
- Encourages inquiry and critical thinking.
- Is aligned to national, New Jersey and New York science standards.

Before Your Visit:

- Complete the pre-visit lesson with your class to get students primed and ready for what they will discover at Liberty Science Center.
- Copy the Exhibit Challenge Booklets and distribute them to your students and chaperones.

During Your Visit:

- Encourage students to visit at least three Exhibit Challenge locations to help structure their exploration. Students should record observations by writing and drawing in their booklets.

After Your Visit:

- Complete the post visit wrap-up with students to foster continued discussion and discovery back in the classroom. Career Quest extensions can be used to introduce students to career options related to their favorite exhibitions.
- Use the suggested list of resources to design additional relevant and engaging learning experiences for your students.

Liberty Science Center Discovery Challenges are available on our website at www.lsc.org.



Technology Tie-Ins

Look for **SNSE Spots!**—**SNSE (Science Now, Science Everywhere)** allows you to use your phone to get extra information about exhibitions while on site and also allows you to learn more about the exhibitions you enjoyed after your visit.

Go to www.lsc.org/interactive/snse for more information.

Major funding provided by National Science Foundation 



Curriculum Standards Alignment

Topic: Skyscraper! Achievement and Impact

Grade Levels: 3–5



National

Unifying concepts and processes

Science as inquiry

Physical science

Science and technology

Science in personal and social perspectives

History and nature of science

New Jersey

5.1 - Scientific processes

5.2 - Science and society

5.3 - Mathematical applications

5.4 - Nature and process of technology

5.7 - Physical science – physics

5.10 - Environmental studies

New York

1 - Mathematical analysis, scientific inquiry, engineering design

2 - Using appropriate technology

3 - Mathematics: integration and application

4 - Science: integration and application

5 - Technology: integration and application

7 - Problem solving in the real world



Your Challenge: Design a Skyscraper!

Exciting news! A design competition has just been announced by a company building a brand new skyscraper in New York City. This new skyscraper will be built in a neighborhood that has other skyscrapers, a historic firehouse, a hospital, a school, apartment buildings, and a variety of stores and restaurants. It will need to contain a mixture of offices, homes, and retail shops. You are an architect who would like to submit a design. Your task is to create a drawing or model of your design to present to the client. At the end of this competition, the client will select a skyscraper design to build. You will work with a large number of people in related jobs while you're designing your skyscraper. Keep track of the various occupations you learn about.

About Skyscrapers

Throughout the ages, people have been inspired to build structures that would allow them to "touch the sky." Pyramids, castles, cathedrals, and towers are all evidence of our desire to build big.

During the 1800s, as cities became more and more crowded, architects and engineers had more practical reasons for building upwards. They needed to design buildings that would get the most use out of limited amounts of space on the ground.

The first skyscrapers were only a few stories tall, but as knowledge about building grew, so did the skyscrapers! Eventually buildings got so tall that elevators were needed to get people to the top floors. The first safe elevators were installed in tall buildings in the mid 1800s.

Tall buildings were first described as "skyscrapers" in the 1880s, but the word originally referred to tall ship masts that seemed to "scrape the sky." Today's skyscrapers are not only taller than ever, but also smarter than ever! There are skyscrapers that are powered by wind, can stay balanced during an earthquake, and will soon even be able to change shape!

What are the basic parts of a skyscraper?

Foundation

The underground part of the skyscraper which supports the building. The foundation is built upon ground known as bedrock.

Frame

The skeleton of a skyscraper is usually constructed of steel or concrete which has been strengthened by metal. The frame is made of horizontal beams and vertical columns.

Stories

The floors within a skyscraper.

Curtain Wall

The outside walls of a skyscraper, which may be made of metal, glass, and stone.



Pre-Visit Lesson: Straw Structures

Objectives

Students will be able to:

- Design and build a tall structure using simple materials.
- Identify the four characteristics of skyscrapers.
- Differentiate skyscrapers from other tall structures.

Materials

- Plastic drinking straws
- Index cards
- Tape
- Rulers or measuring tape
- Gummi bears

Procedure

- Invite students to brainstorm about some tall structures they know. Do they think any of these structures are skyscrapers? How can we tell a skyscraper from other types of structures?
- In small groups, using the materials provided, invite students to design and build the tallest structure possible that can support ten gummi bears on its roof.
- After building their structures, students should answer the following questions:
 - How tall is your structure? At a scale of 1 inch: 20 feet, how tall would your structure be?
 - What parts of your structure support it the most? Walls? Floors? Beams?
- Does your structure have more than one story {floor}?
- If this were a real structure, what might it be used for?
 - Discuss the four characteristics that set skyscrapers apart from other structures [see background below].
 - Ask students whether they think they created a skyscraper.

Extensions

Play a game of Skyscraper Sleuths! Print out pictures of different tall structures, and see if students can identify which structures are skyscrapers. Students can gather more information on the Internet.

Background

Skyscrapers possess four characteristics that set them apart from other types of buildings:

1. Skyscrapers are extremely tall. You can usually pick skyscrapers out from among the other buildings on the horizon. The tallest skyscraper in the world is the Burj Dubai in Dubai, United Arab Emirates, which is still under construction but will be about 2684 feet or 818 meters tall!
2. Skyscrapers contain many stories or floors, requiring elevators to go up and down. Some skyscrapers, like the Empire State Building, have over 100 floors!
3. Skyscrapers are usually supported by strong frames made out of steel or concrete. Buildings that are not skyscrapers typically rely on their walls for support.
4. Skyscrapers are places where people live, work and play. They can be home to businesses, condominiums, stores, gyms, pools or playgrounds.



Post-Visit Wrap-Up: Design Time!

Discussion of Findings

Encouraging students to communicate observations in their own words is key to developing understanding. After your visit, bring students together so they can share what they discovered (observations, notes, drawings) while exploring Liberty Science Center’s exhibitions.

Development of Projects

Students can draw designs or use simple materials such as shoe boxes, milk cartons, toilet paper rolls, paper cups, etc., to create models.

Presentation of Projects

Provide students with time to present their skyscraper designs to their classmates.

Extensions

To extend learning across the curriculum, students can:

- Draw cross sections of their skyscrapers to show what people will be doing inside.
- Create blueprints for one floor inside their skyscrapers.
- Calculate the scale of their drawings/models.
- Create an elevation map for their skyscrapers.
- Create a real estate ad for apartments or condominiums in the skyscrapers.
- Design a city or a skyline by combining the class’s models or drawings.

Career Quest

Here are some suggestions about exposing students to careers related to this Discovery Challenge:

- Have students share the different careers they learned about while exploring Liberty Science Center’s exhibitions.
- Allow students to use the internet to research these and other careers related to this Discovery Challenge, including what the jobs entail, the education and special skills needed, and where someone would work in this capacity.
- Invite a guest speaker/parent/guardian to come in and share his or her related career experiences. Some examples may include engineers, construction workers, architects, real estate agents, developers, etc.



Resources

Liberty Science Center Programs

For more information about Liberty Science Center's exciting educational offerings please visit www.lsc.org

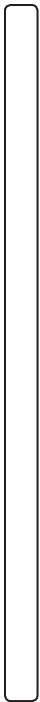
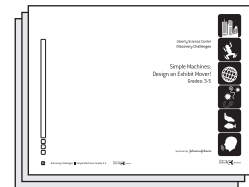
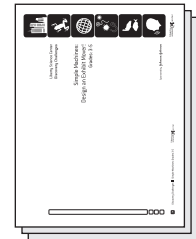
Websites

- www.evolo-arch.com
- <http://science.howstuffworks.com/skyscraper.htm>
- www.pbs.org/wgbh/buildingbig/skyscraper/index.html
- www.skyscraper.org/
- www.greatgridlock.net/NYC/nyc.html



Preparing Your Booklets

1. Remove the next 10 pages from this packet. **DO NOT** re-arrange the placement or order of these pages.
2. Photocopy the pages so they are double-sided. Make as many copies as you need.
3. Fold each booklet in half.
4. Give one booklet to each student and chaperone in your group.



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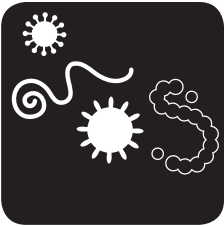
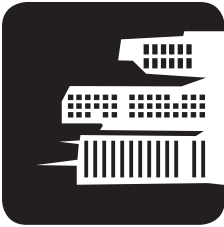


Exhibit Challenge Booklet

Your Challenge:

Design a Skyscraper!

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SKETCH PAD

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SKETCH PAD

We Suggest:

- ✓ Visit at least three of the Exhibit Challenge locations. If one is unavailable, move on to another.
- ✓ Use the booklets to record your observations and create drawings of what you see.
- ✓ Think about how you can apply what you have learned to your challenge project.

1. Skyscraper World

WHERE TO GO

First Floor, Skyscraper Exhibition, Skyscraper World Exhibits

WHAT TO DO

- Read and observe some of the panels highlighting different skyscrapers.
- Sketch two skyscrapers that interest you.
- Compare and contrast them!

CONSIDER THIS

- What shapes, colors and materials do you observe in these skyscrapers?
- What features will you include in your skyscraper design?

OTHER THINGS TO TRY

- Can you find the oldest skyscraper? The tallest? The greenest? The one with the fastest elevator?
- Check out the nearby Sky-High Style panel to learn about different styles of skyscrapers such as the Chicago School. What style will your skyscraper be?

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2. Architect & Engineer

WHERE TO GO

First Floor, Skyscraper Exhibition, Architect & Engineer Exhibit

WHAT TO DO

- Read the Architect & Engineer panel to learn more about each job.

CONSIDER THIS

- What are the similarities/differences between what an architect and an engineer does? Create a T chart comparing the two jobs!
- Write a to-do list covering the things you will be responsible for as the architect on this project.

OTHER THINGS TO TRY

- Watch the Architect and Engineer videos at the touch screen to the right to hear more from architect Dan Kaplan and engineer Douglas Mass.

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6. Skyscraper: Life at the Top



WHERE TO GO

First Floor, Skyscraper Exhibition, Life at the Top Exhibit



WHAT TO DO

- Take a seat on one of the sofas and listen to the stories of people who live in skyscrapers.



CONSIDER THIS

- Architects need to think about how to design skyscrapers for the people living in them. What do people like about living in a skyscraper? What do people dislike?
- What kinds of features will you include for people living in your skyscraper?
- Where will you place the offices, homes, and stores in your skyscraper?



OTHER THINGS TO TRY

- Look at drawings by architects such as Helmut Jahn at the Visions of the Future Exhibit (behind the sofas) to see how the spaces in some skyscrapers are organized.

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3. Skyscraper: City-Friendly Designs

WHERE TO GO

First Floor, Skyscraper Exhibition, Skyscraper Lineup Exhibit

WHAT TO DO

- Read the graphic panel describing how architects and engineers try to create city-friendly skyscrapers.

CONSIDER THIS

- What kinds of problems do skyscrapers sometimes cause in a city?
- How will the shape of your skyscraper impact people who live there?
- How will the materials you choose affect noise levels in the surrounding area?

OTHER THINGS TO TRY

- Play with the blocks at the Designing for a City exhibit (behind you) to observe how the shadow of a skyscraper is cast on the ground below. Experiment with different heights, shapes and widths

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SKETCH PAD

5. Skyscraper: Curtain Wall Test



WHERE TO GO

First Floor, Skyscraper Exhibition, Curtain Wall Test Exhibit



WHAT TO DO

- Sign up for the curtain wall test demonstration (if available).
- Experience how the curtain wall of a skyscraper is tested to stand up to forces such as wind and rain.



CONSIDER THIS

- Which test do you think is the toughest on a skyscraper?
- How will you design the curtain wall of your skyscraper to stand up to these tests?



OTHER THINGS TO TRY

- Read the Curtain Wall panel to the left to learn about the different parts of the curtain wall.
- Go to the Material Table (near the staircase next to the elevator) to learn about different types of building materials.

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4. Skyscraper: Wind Tunnel

WHERE TO GO

First Floor, Skyscraper Exhibition, Wind Tunnel Lab Exhibit

WHAT TO DO

- Architects need to work with engineers to see how their designs will stand up to forces such as high winds.
- Go to the Wind Tunnel Lab and try different building shapes and styles to see how they stand up!

CONSIDER THIS

- Which designs worked best? Worst?
- How will you design your building to stand up to high winds?

OTHER THINGS TO TRY

- Visit the Computer Versus Nature panel (near the elevator) and try the Wild Forces touch screen to learn how architects use computers to test building designs?

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