

Skyscrapers Lesson Plan

Objectives: Students will learn about skyscrapers and explore various factors considered when building them.

Materials Needed: LCD projector and laptop, uncooked spaghetti noodles, small pieces of a few of the following: wood, steel, concrete, cast iron, plastic, brick, aluminum (whatever we can find)

Activities:

1. Help students brainstorm the names of some famous skyscrapers (Empire State Building, Sears Tower, Petronas Towers, etc.).
2. Have a brief discussion about why people build such giant buildings. For example, they are efficient in crowded cities because they provide maximum office or living space while taking up a small amount of ground. They have also become cultural or industrial icons and a source of pride for the city in which they are found.
3. Briefly discuss the history of skyscrapers. See <http://www.pbs.org/wgbh/buildingbig/skyscraper/basics.html>.
4. Brainstorm the factors that engineers need to consider when designing and building skyscrapers. These could include the weight of the building, things that will be in the building, wind, earthquakes, and temperature. Make a list on the board or computer/projector.
5. The forces that act on skyscrapers are called loads. Explore a few of these loads in greater detail by conducting these activities:
 1. **Dead Load:** the weight of the structure itself is called the dead load. The force that this weight puts on the lower columns of a skyscraper is called *compression*. Demonstrate compression by pressing on the end of spaghetti noodles.
 2. **Wind Load:** wind can cause a skyscraper to bend, causing *tension*. Tension stretches material apart and it may break. Demonstrate tension by bending and breaking a spaghetti noodle.
 3. Reinforce the ideas of compression and tension: Give small groups of students a small bunch of noodles and have them slowly bend them in half. The bottom part of the group of noodles is experiencing *compression* while the top part is experiencing *tension*. Explain that materials used in skyscrapers must be strong in both of these areas to withstand dead load and wind load.
 4. Show the PBS Forces and Loads labs on the projector from <http://www.pbs.org/wgbh/buildingbig/lab/index.html>.

6. Have students pick up the different building materials (wood, brick, concrete, steel, etc.). Ask them to decide which material they think is the strongest in *compression* and which is the strongest in *tension*. Discuss advantages and disadvantages of each type of material.
7. "Test" a few of the materials using the PBS Materials lab (link above).
8. Do the Skyscraper Challenges (or at least Location 1 - Chicago) at <http://www.pbs.org/wgbh/buildingbig/skyscraper/challenge/index.html>. Students will decide on the best materials for a building in Chicago, New York, and Los Angeles.
9. Discuss the factors that may affect a new Roycemore School building (wind?, dead load?, earthquakes?). The group should decide which of the materials studied should be used in the new building. They might also take with them the idea of adding braces or other extras to help the structure.
10. If there is extra time, discuss the questions below or explore the PBS Building Big site further.

Discussion Questions

1. How do engineers make skyscrapers strong enough to withstand earthquakes, high winds, and severe changes in temperature?
2. If you could visit any skyscraper in the world, which one would you pick? Why?
3. How do you think a skyscraper enhances a city? Why does it instill pride in a city's residents? Try to find some evidence to support your ideas.
4. If you could design a new skyscraper for your town or city, what would it look like? What material(s) would you use to create it? What design elements might you use that reflect your town's history, culture, or icons?
5. What are some dangers involved in the construction of skyscrapers? What precautions are taken to minimize the risks?
6. Do you think skyscrapers are a good way to deal with space constraints in urban areas? Do you think the advantages of skyscrapers outweigh the disadvantages? Provide evidence to support your answer.