CTE Lesson Plan

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Pathway: Science, Engineering & Technology	**Cluster:** Manufacturing	**Course:** Principles of Manufacturing	**Grade Level:** *(type an X in the bracket for all that apply)* [ ] **6** [ ] **7** [X] **8** [ ]**9** [ ] **10** [ ] **11** [ ] **12**

Project Name: Skyscrapers

Objective(s): Students will discover and analyze civil engineering by researching skyscrapers and drawing a famous skyscraper. Students will:

1. understand some of the building basics used by engineers and architects to design some of the world's largest skyscrapers,
2. identify unique features of at least one skyscraper, and
3. explain the different responsibilities of architects and various engineers who design and build skyscrapers.

Primary Unit of Study (from Scope & Sequence): History and Development of Technology
Secondary Unit of Study (if applicable):

College & Career Readiness Standards:

Software: Internet Access

Materials Required: See material list under each specific project.

Prerequisite Skills: None

Time Required: 10 class period (45 minutes each)

Essential Questions: Why do we build skyscrapers? How high is too high? What engineering challenges are faced in building a skyscraper?

Key Vocabulary: Compression, Concrete, Foundation, Steel, Superstructure, Wind Load

Procedure/Instruction:

Day 1 – Materials Needed: spaghetti, marshmallows, tape measure

Spaghetti Towers - In teams of 3, build the tallest, freestanding tower using 10 noodles and 4 marshmallows

1. In your notebook, label a page Spaghetti Towers

2. In teams of 3, you have 2 minutes to create a rough sketch and plan for your structure.

3. You have 5 minutes to build your tower.

Grading: The tallest tower receives a 100, then 95, 90, etc. No grade will be below a 70.

Reflection: In your notebook, answer these two questions in complete sentences:

1. Was your tower successful?

2. If you did this again, what would you do differently?

Day 2

1. Vocabulary - write the following words and definitions in your notebook. *You do NOT have to write the context sentence.*

Click on any of the vocabulary words below to hear them pronounced and used in a sentence.

compression

Definition: A pressing force that squeezes a material so that it becomes more compact.
Context: The lower columns of a skyscraper are squeezed by compression.

concrete

Definition: A mixture of water, sand, small stones, and cement.
Context: The sidewalk near my school is made of concrete.

foundation

Definition: The part of a building that's below the ground.
Context: Before construction on the skyscraper began, the engineers figured out what kind of material to use for the foundation.

steel

Definition: An alloy of iron and carbon that is hard, strong, and malleable.
Context: The Sears Tower contains enough steel to build 50,000 automobiles.

superstructure

Definition: The part of a skyscraper that is above the ground.
Context: The superstructure of that skyscraper is 1,200 feet tall.

wind load

Definition: The force of wind blowing against the sides of a building.
Context: In skyscrapers more than 40 stories tall, the wind load has a tremendous impact on the building.

2. Watch the **video *Size and Scale: Skyscrapers from Discovery Education***.

During the video, listen for answers to these questions and write your answers in your notebook:

1. List at least one special engineering challenge of building skyscrapers.
2. Why do we build skyscrapers?
3. How high is too high?

Day 3
1. Read the career handout. Which job do you think sounds more interesting and why?

2. Watch the presentation to identify the tallest skyscrapers.

2. Growth Graph - How much have skyscrapers grown in the past century?
3. How do real-life conditions, such as temperature, wind and vibration, affect structures and how do reinforcements stabilize these

structures? Go to this website: http://www.pbs.org/wgbh/buildingbig/skyscraper/index.html.

Read *Skyscraper Basics* to learn about the history of skyscrapers.

Go to *Loads Lab* to learn how skyscrapers stand up and keep from falling down.

Go to the *Skyscraper Challenge* to repair three troubled buildings.

Day 4- Tribute to 9/11

Video: RISING: Rebuilding Ground Zero: Reclaiming the Skyline: Part 1 (from Discovery Education)

Goes inside the rebuilding site at Ground Zero to find out what it really takes to complete this historic effort. The program highlights the philosophies of World Trade Center master planner Daniel Liebskind and designer of Tower One David Childs and their desire to create a place that honors the memory of the old buildings and the victims while offering a state-of-the-art facility that reclaims the skyline and offers a feeling of hope and peace moving forward. The presentation introduces the vertical factory, consisting of ironworkers, concrete teams, and glass installers, who are leading the charge into the sky and details the challenges they face while keeping to a demanding schedule.

Days 5- 8
Major Project: Amazing Skycrapers

Research a famous skyscraper and build a skyline of skyscrapers in the hallway. Teams will create an illustration, drawn to scale, of its skyscraper. Using QR codes, teams will direct others to their websites to identify basic facts about the building.

Rubric **- One individual (Daily grade) and One Team Grade (Test grade)**

Print instruction handout ***This will be turned in for an individual daily grade.***

Your team can choose a skyscraper from any of the top skyscrapers we've discussed (see the PowerPoint presentation). No two groups can choose the same skyscraper.

Phase 1: Research - Follow instructions on the handout.

The following Web sites are good sources of information about these buildings:

Famous Skyscraper Web Sites
Petronas Towers
Link 1
Link 2

Sears Tower
Link 1
Link 2

Chrysler Building
Link 1
Link 3

Empire State Building
Link 1
Link 2
Link 3

General Skyscraper Web Sites

World's Tallest Buildings

Reaching New Heights: The History of Skyscrapers

World's Tallest Towers (chart/bar graph)

Phase II: Build

Materials Needed: butcher paper, rulers, markers, index cards

Create a skyline in the hallway of your skyscrapers. Follow the instructions on the handout.

Phase III: Facts on Website

Each person will put information about their skyscraper on student or teacher websites. Follow instructions on the handout.

Phase IV: QR Code (optional activity)
Each person will create a QR code to post on the skyscraper in the hallway.

What is a QR Code? http://en.wikipedia.org/wiki/QR_code

QR Code Generator: http://qrcode.kaywa.com/

Instructions for creating a QR Code (print and display a copy)

Follow the additional instructions on your handout to put the QR code in Microsoft Word.

Day 9 - Assessment

Notebook Grade: Individual Daily Grade for the following completed in your notebook: (40 pts.total)

- Spaghetti Tower sketch (5 pts.) and 2 reflection questions answered (4 pts.)
- 6 Vocabulary Words and Definitions (12 pts.)
- 3 questions answered from video (9 pts.)
- Growth Graph (handout) (10 pts.)

Written Test & Rubric: Individual Test Grade; Follow instructions on handout.

Closure: What do you think our cities will look like in the future? What challenges will engineers continue to overcome in order to build?

Evaluation/Assessment: Use attached rubrics. When grading the QR component of the student skyscrapers, you will need to install a QR reader on an iPhone or iPad to check the links created from the QR code.

Differentiation Strategies: Students can work in teams, partners or individually. Any part of the lesson can be reduced, modified, or extended as necessary. The assessment can have a vocabulary definition part added or require vocabulary words to be used in the essays themselves. A multiple choice test could be substituted for the essay writing.

Additional Resources: This lesson was adapted from a variety of resources from Discovery Education United Streaming, BrainPop, and PBS.org. All of these resources have additional skyscraper and engineering activities that can

be added to the lesson.
Additional Files: Career Handout, Tallest Skyscrapers presentation, Growth Graph, Skyscraper Rubric, Skyscraper Instruction Handout, QR Code Instructions, Unit Test and Rubric