

Finley Elementary Design Challenges- Washington STEM Grant

STEM Design Challenge developed for : <u>5th Grade Math Class</u>
STEM Design Challenge Project Title: <u>Tall Towers</u>
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STEM Design Challenge Project Placement and Pacing Placement: After review of CCSS 5.NBT.7 – Add and subtract decimals to hundredths Pacing: One week – (5 days) 60-minute time periods
Overview: Student teams build the tallest, strongest, and most cost effective tower possible. Objectives: Math – <ul style="list-style-type: none">• Keep running total on cost sheet (CCSS 5.NBT.7)• Stay within budget (\$1.00)• Measure height of tower in centimeters• Measure length of time tower stands (duration in seconds) Science – <ul style="list-style-type: none">• Determine most effective building materials to purchase• Analyze design based on height and standing duration• Modify tower and/or building materials• Evaluate height and standing duration
STEM Design Challenge Problem: <p>The Super-Fast Computer Company needs to build a warehouse in Tokyo, Japan to store and distribute its new SF-12 computers. The market demand for these computers is high, and the shipments require a large warehouse, built on a medium-sized lot. The tower must be strong, able to withstand natural disasters such as earthquakes and tsunamis.</p> <p>The design team that builds the tallest, strongest, and most cost effective tower will be awarded the winning contract and 100 Grand!</p>
Materials List: <ul style="list-style-type: none">• Books from library (tall towers and natural disasters)• Sheets of newspaper (2 sheets per team)• Tape (1 roll scotch tape per team)• Scissors (1 pair for each team)• Money tray (dollar bills, quarters, dimes, nickels)• Craft sticks (50 per class) (“Wood beams”)• Flexible straws (50 per class) (“Flexible steel poles”)

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- Paperclips (1 box per class) (“Steel wire”)
- Super-Fast Computers memo
- Expense Claim
- Tall Tower Procedure and Conclusion handout
- Clock with second hand or stopwatch
- Rubric (*Paper Tower Points*)
- 100 Grand Certificate and 2- 100 Grand candy bars (for winning team)

Preparation:

1. Check out available books from school library on tall structures and natural disasters. Set out for students on table or counter.
2. For each pair of students, copy one of each:
 - Super-Fast Computers memo
 - Tall Tower Procedure and Conclusion handout
 - Expense Claim
3. Read and understand *Engineering Scoop* (in Resources section of this document)
4. Set up *store area* where students will purchase building materials (money tray, straws, paperclips and craft sticks)
5. Lay out newspaper and tape dispensers

Procedure:

1. Create partner teams.
2. Distribute Super-Fast Computers memo to teams. Using document camera or overhead projector, read memo to class.
3. Using document camera or overhead projector, show the Data table and discuss how the team earning the most points the contest.
 - a. Tower height (1cm = 1 pt.)
 - b. Time standing (1sec. = 1 pt.)
 - c. Expense points (10¢ = 1 pt.)
4. Partner teams research tall structures and natural disasters using books from library, and the internet. Students take notes, looking specifically for
 - a. What do tall structures have in common?
 - b. Do you notice any geometric shapes in the construction of tall structures?
 - c. What materials are used to construct tall structures?
 - d. What tall structures withstand earthquakes and tsunamis?

*Brainstorm with the class additional questions that make their research valuable.
5. Distribute Tall Tower Procedure and Conclusion handout. Together, partner teams select a name for their company, and complete the Problem and Prediction section. Successful completion of this is their “ticket” to move to the design phase of the lesson.
6. Distribute the Expense Claim, explaining that they will be given \$2.00 per team for materials. It is mandatory that each team spend \$1.00 on 2 pieces of newspaper and a tape dispenser. Walk students through correct completion of the expense claim. Explain

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that with their remaining \$1.00, teams may purchase then return items and repurchase as they revise their tower structures, staying within their budget. Remind students that for every 10¢ not spend will earn them 1 point!

7. Open the Store. Partner teams purchase mandatory newspaper and tape, and whatever remaining materials they chose.
8. Partner teams begin the design process, testing and revising throughout the process.
9. Prior to testing the towers, allot a time block to allow partner teams to complete the Procedure section, and the Data table *Expense Pts. section of the Tall Tower Procedure and Conclusion handout.
10. Contest time. Each partner team will measure their tall tower in cm and record its height in the Data table (part of the Tall Tower Procedure and Conclusion handout). Then when the Time Keeper (teacher) says, "3-2-1-begin", the partner teams remove their hands from their towers, allowing the tower to stand independently. The Time Keeper keeps track of the seconds it remains standing. Partner teams record the time standing in the data table. Partner teams determine their Total Points and enter this into their Data table. A winning team is announced, and award their certificate and 100 Grand (candy bar)!
*Use a digital camera to take pictures of the process for a Tall Towers bulletin board!
11. Finally, students finish the Conclusion section of the Tall Tower Procedure and Conclusion handout. The handout and Expense Claim are submitted to the teacher for review.

Resources:

- Books
- Websites

www.pbs.org/wgbh/buildingbig/skyscraper/basics.htm |

<http://science.howstuffworks.com/engineering/structural/skyscraper4.htm>

www.technologystudent.com/struct1/frame1.htm

www.pennridge.org/works/beamstruct.html

www.pennridge.org/works/otherstruct.html

www.skyscraper.org/EXHIBITIONS/SUPERTALL/intro.htm

- **Engineering Scoop:**

How can you make a **weak** material like newspaper **strong** enough to stand up? One way is to **change its shape**, like rolling it into a tube, crumpling it, or pleating it with folds. You also need to think about the different **forces** that are acting on it. The tower's **weight** is pulling the tower down. The **surface** on which the tower is resting is pushing back up. Small **air movements** are also pushing from the side and can blow the tower over. If you build a **wide base** at the bottom, this distributes the weight over a wider area and makes the tower more **stable**.

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Evidence:

- Tall Tower Procedure and Conclusion and Expense Claim

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Memo

To: Finley Elementary 5th Grade Design Teams

From: Super-Fast Computers

Date: 29 November 2012

Subject: New Skyscraper Needed

After our new computer the SF-12 hit the market the demand from buyers has been unreachable in our small warehouse. We have purchased a medium-sized lot in Tokyo, Japan, where we are challenging designers to build a skyscraper that has as much space as possible. We are not concerned about how it looks; we want a building that is tall and gives us more space to store and distribute our amazingly fast computers. Our biggest concern is to protect our products. We want our building to be able to withstand natural disasters such as earthquakes and tsunamis. Our challenge to you, the designers, is to build the tallest and strongest building possible. Our new product has been very profitable so we will pay a steep price to the design team that can build the best building.

Each team will have \$2.00 to buy materials to build their skyscraper. The two pieces of newspaper and tape are mandatory and they cost \$1.00. This leaves each team with \$1.00 to buy additional supplies. There are metal wire, flexible steel poles, and wood beams to choose from.

Metal Wire	Flexible Steel pole	Wood Beam
\$.10	\$.20	\$.30

Our company will choose the tallest, strongest, and most cost effective building.

Good Luck to all....

Thank You,

Super-Fast Computers



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Expense Claim

Date: _____			Name: _____		
Company: _____			Name: _____		
Item	Qty.	Amount	Beginning balance: \$1.00 Show your remaining balance:		
Balance:					