FAMILY SCIENCE/MATH NIGHT LESSON PLAN

Presenter's name: Jason Laabs
Activity title: Earthquake City!
Age Group: 5-6
Topic: Earthquake Challenge

Lesson Overview: Students will construct small cities made of sugar cubes, bullion cubes, and gelatin cubes. The students will experiment with the cubes in order to determine which materials (i.e. which buildings) hold up the best against a simulated earthquake.

Sources Consulted:

1. Pre K-12 Engineering. Massachusetts Science and Technology/Engineering Curriculum Frameworks © 2001-2003 <www.prek-12engineering.org>
2. USGS (United States Geological Survey) Earthquake Hazards Program. Earthquakes for Kids. <http://earthquake.usgs.gov/learning/kids.php?>

Objectives:
After this presentation, students will be able to:
1. Explain how earthquake magnitude (intensity) is measured.
2. Explain how earthquake damage varies with intensity.
3. Give examples of past earthquakes and the types of damage that they caused.
4. Explain why different materials are used in the construction of buildings or other structures.
5. Give examples of techniques or materials used to make a structure better able to withstand an earthquake.

List of All Materials Needed: (include quantities)

- 5 to 10 - Smooth cardboard platform 25cm x 20cm
- 75 - Sugar cubes
- 75 - Bouillon cubes
- 75 - Gelatin cubes (Use 1/3 as much water as the recipe calls for. Use ice cube trays to chill, then cut into small cubes, apprx sugar and bouillon cube size.)
- Pencils
- (Optional: wood, sponge, plastic cubes as additional building materials)

Room Arrangement or Special Needs: No special needs are required, but the room should be arranged with tables or desks in small groups of three to four with enough room on the desks for the city area.

Advance Preparation:
- Make gelatin squares before class to allow enough time to harden.
- Create a grid on the cardboard by drawing 3 vertical lines and 4 horizontal lines. Each line should be 5-cm apart. Label the vertical lines 1st Ave, 2nd Ave, 3rd Ave, etc. and the horizontal lines A Street, B Street, C Street, etc. This is the earthquake city.

Procedure: (show time for each part of presentation)

Introduction: (2.5 min) (welcome participants, introduce yourself & assistant, intro your topic)
Hi and welcome to Family Science Night! Family Science Night is sponsored by the Western U.P. Math & Science Center. My name is Jason Laabs and I am a forth year Civil Engineering Student at Michigan Tech. This is my last semester here at Tech and when I finish my degree I'm going to work in the transportation field. And what I'd really like to get into is traffic safety, which is taking an existing

road and changing it to make it safer to drive on. Other civil engineers can design and build buildings, roads, airports, or bridges.

Attention-getter: (2.5)

Today we are all going to be structural civil engineers and learn about earthquakes and how civil engineers like me build buildings so they don't fall over when earthquakes occur. I'm assuming that everyone knows what an earthquake is right? Has anyone felt an earthquake in real life? Who can tell me how an earthquake is measured? The **Richter scale**, which measures the earthquakes **magnitude or intensity**, which represents how strong it is! The largest earthquake ever recorded was a 9.5 (out of 10) in Chile. Where an earthquake reaches the earth's surface is call the **epicenter** and is where an earthquake is most intense. During an earthquake what happens to buildings? Right, some fall over! Why? (Show pictures of different earthquakes: Asian Tsunami, Palestine, California earthquakes.)

Activities: (35 min) Earthquake City

Experiment 1
Today we are going to experiment with different materials and find out which ones will better withstand an earthquake. The first set of experiments will first be by type. So first we're going to test the sugar cubes, then the bullion, and then the gelatin cubes separately. The second experiment will let you mix and match the different materials. Lastly, we're going to have a competition to see who can come up with the best building design. So I want you to follow the instructions on your worksheet:

1. Use the appropriate materials listed for your building
2. Place each building at its location
3. Find the location of the earthquake epicenter
4. Begin tapping at the epicenter for the given intensity
5. Record the number of taps it took until each building to falls.

Sugar Cubes: Start with the sugar cubes. After you get done with the sugar cubes we're going to discuss what you found out. So considering proximity to the epicenter, which buildings fell first? As the "earthquake" got stronger (more intense), what happen?

Bullion Cubes: Now run the same experiment, but this time with bullion cubes and again stop when you're done to discuss what you found our about this material. Did you find the same relation between the three buildings and the epicenter? So how many taps did it take to knock down the bullion buildings, more or less than the sugar cubes? Which material would you consider to be better?

Gelatin Cubes: Now do the same experiment with the jello cubes. Did you find the same relationship between the three buildings and the epicenter? How many taps did it take to knock down the jello buildings, *more or less than* the sugar or bullion cubes? Using the materials separately, which one do you consider to work the best?

Experiment 2
For the second experiment I want you to design several different buildings of different materials and compare their performance in an earthquake. T**he building must be 5 cubes tall**. Mix the different materials and see which combination of materials works best. Keep records of your designs and experiments on your log sheet. When you're done experimenting, select one design that you think will perform the best to enter into the competition!

Experiment 3
Now it's time for the competition. Bring up your best building design to compete!

Summary/Assessment of Student Learning: (5 min)

Ask the following questions about their cities and materials used:

- How is the magnitude or intensity of an earthquake measured?
- How does earthquake damage vary with intensity?
- Give examples of past Earthquakes and the types of damage that they caused.
- Why are different materials used in the construction of buildings or other structures?
- Which materials did you find worked best today? Why do you think that was so? What are real life materials are they similar to?

Today, new buildings are built using more flexible materials so that they can bend and sway during an earthquake and don't fall over. **Show examples of different building materials and describe a bit (several sentences) how there is an engineering lab at MTU that tests the strength and other characteristics of different materials for road-building, structures, etc.

I hope you had fun today being engineers! Thank you for coming. Before you leave, please help straighten up your work area and put the supplies back in the baskets.

Filler: Engineering Scavenger Hunt

Take Home Handouts and/or materials: Write on the board:
Visit USGS website: <http://earthquake.usgs.gov/learning/kids.php?> so kids can log on at home to learn more about earthquakes.

Cleanup: Have the students clean up area.

Safety Considerations: Don't eat the sugar, bullion, or gelatin cubes.

Name _____

Earthquake City Testing

1. Construct your building and list the materials used ordered from bottom to top
2. Record the location of your building
3. Record the location of the earthquake epicenter
4. Now start tapping at the location of the epicenter
5. Record the number of taps it took for each building to fall
6. And finally, record how hard you were tapping (how intense the earthquake was)

Experiment with one type of material:

Material of building	Location of Building	Location of Earthquake Epicenter	Earthquake Intensity: Hard, Medium, or Soft	Number of taps until building fell?
5 **sugar cubes** tall	A and 1st	D and 3rd	Soft	
	B and 2nd			
	C and 3rd			
5 **sugar cubes** tall	A and 1st	D and 3rd	Medium	
	B and 2nd			
	C and 3rd			
5 **sugar cubes** tall	A and 1st	D and 3rd	Hard	
	B and 2nd			
	C and 3rd			
5 **bullion cubes** tall	A and 1st	D and 3rd	Soft	
	B and 2nd			
	C and 3rd			
5 **bullion cubes** tall	A and 1st	D and 3rd	Medium	
	B and 2nd			
	C and 3rd			
5 **bullion cubes** tall	A and 1st	D and 3rd	Hard	
	B and 2nd			
	C and 3rd			
5 **jello cubes** tall	A and 1st	D and 3rd	Soft	
	B and 2nd			
	C and 3rd			
5 **jello cubes** tall	A and 1st	D and 3rd	Medium	
	B and 2nd			
	C and 3rd			
5 **jello cubes** tall	A and 1st	D and 3rd	Hard	
	B and 2nd			
	C and 3rd			

Experiment with a variety of materials:

Material of building	Location of Building	Location of Earthquake Epicenter	Earthquake Intensity: Hard, Medium, or Soft	Number of taps until building fell?

What type of building was the hardest to knock down by the earthquake?