	STEM Committee Michigan Crossroads Council	Name:	
	Supernova Activity Topic: Mathematics **From Simulations to Real Life: Modeling Bungee Jumping**	Troop:	Date:

Supernova Activity Topic: Mathematics

This activity requires at least two people and works much better with a group of three to six people.

The scenario: The Acme Daredevil Adventure Company provides rock climbing, skydiving, extreme skiing, and cliff diving adventures to the public. To appeal to a broader market, the board decided to add bungee jumping to its list of offerings. The details of this new venture now need to be worked.

The company has several sites planned for bungee jumping, and each site has a different jump height. Your task is to simulate bungee jumping using rubber bands and an action figure (doll) to determine the ultimate length, or the number of rubber bands to be used with your action figure at any given height to guarantee a safe jump. For maximum thrills, the jump must allow your action figure to come as close to the floor as possible.

Part 1: Set-Up and Simulation

Tape a weight(s) to the doll's back so that it is heavy enough to stretch the rubber band "bungee cord." Tie one or two rubber bands (the unstretched size should be about 4 inches) to the doll's feet and drop it, headfirst, from various heights. Keep raising the jump height until the head no longer hits the floor.

Once you reach this height, perform three trials, measure the height of the drop each time, calculate the average, and calculate the maximum error between the average and the drop heights used to find that average. (Conduct a test drop several times to practice taking readings.)

Trial	Height of drop	Maximum Error
1		
2		
3		

Average:

Continue adding rubber bands to see what the average drop height will be for different numbers of rubber bands. Do the experiment with at least six different numbers of rubber bands. Use a tabular chart to help you organize and record your data. (You may use Excel or create your own tables.)

Trial	# rubber bands	Height of drop	
1			
2			
3			
4			
5			
6			
7			
8			

What Is a Scatter Plot? Scatter plots use horizontal and vertical axes on a graph to plot data points and show how much one variable (or measurable "value") is affected by another. Each variable can be represented on the scatter plot with a dot. Once the scatter plot has been filled in with a number of dots, you should be able to see how the variables are "scattered" to show a trend. For more information about scatter plots, use your favorite search engine on the Internet (with your parent's or guardian's permission), or ask your mentor.

Part 2: Analysis and Report

1. Create a scatter plot of ordered pairs of the type (number of rubber bands, average drop height). You may do this by hand or using data analysis software, such as Excel.
2. Using the scatter plot you have created, determine whether the points appear to lie on or near a line. Find such a line. If your mathematics background is not yet extensive, then find such a line by "eyeballing it" and drawing it onto the scatter plot with a ruler. If your mathematics background is extensive, then use a graphing calculator or data analysis software of your choice to find the line of best fit for your data.

3. Describe to your mentor how to use the line (graphical form or symbolic form) to make predictions. Then complete the following sentence (hypothesis): "If the height of the drop is _____, then I predict that the number of rubber bands needed is _____."
4. Test your prediction and analyze the outcome. Determine whether the prediction matched reality, how far off the prediction was, and what errors or issues arose that may have thrown off the results of your simulation. Test and analyze three more predictions.

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5. Analyze the maximum errors found in your tests. Then find out the height of your favorite location (such as the Statue of Liberty, Eiffel Tower, or Golden Gate Bridge). If you drop your action figure from the top of that location, how many rubber bands would you need for a safe drop from that height? What would you expect to be the maximum error in your prediction?

   _____

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6. Now, consider the realities of bungee jumping with real human beings using real bungee cords and equipment. Discuss the following with your mentor:

    A. The factors that need to be considered when testing this equipment to develop safety protocols

    B. Reliable statistics on the risk of serious injury or death while bungee jumping

    C. Bungee jumping is one of the high-adventure activities that is expressly not allowed by Scouting America. What do you think of this policy?

7. Create a report addressed to the Risk Management Board of the Acme Daredevil Adventure Company. In your report, include the following:

    A. A description of your simulation

    B. Your simulation data displayed in a chart and graph. Attach.

C. How your data led to your ability to make predictions about safe bungee jumping heights

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D. The variables that might have affected your predictions Share your report with your mentor.

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Supernova Mentor: _____Date: _____

Resources

Troy Lanier and Clay Nichols. *Filmmaking for Teens: Pulling Off Your Shorts*. Michael Wiese Productions, 2010.

Richard Rickett. *Special Effects: The History and Technique*. Billboard Books, 2007.

Steve Wolf. *The Secret Science Behind Movie Stunts & Special Effects*. Skyhorse Publishing, 2007.