BUNGEE BARBIE AND KRAZY KEN

SETTING: Your team has been hired to work for the Greenhills Daredevil Entertainment Company. Your company provides rock climbing, sky diving, deep sea adventures, and cliff diving to interested customers. In order to boost sagging sales, the company has decided to add bungee jumping to its list of available adventures. As part of the assignment, the board of directors decided that several teams will undertake the task of working out the details of this newest adventure. Because the bungee jumping will take place at several different locations, it will be necessary to find a way to determine how much bungee rope will be needed for any given height. A successful bungee adventure will maximize thrills but still be safe; therefore the jumper must come as close as possible to the ground without hitting it. This will take some precise planning.

PROBLEM: The task is to determine the maximum length (expressed in terms of the number of rubber bands used) that can be used at any given height without causing any type of injury/fatality, while still giving maximum thrills. Your first clients will show up on Thursday March 17 (they are not leprechauns) and tell you from what height they want to jump. You will then have to decide how many rubber bands to provide for their jump.

MATERIALS: Doll (appropriately dressed), tape measure, calculator w/ regression function, rubber bands.

GOALS: Gather & graph data, determine a function that models data, test the model, make predictions.

SOLUTION REQUIREMENTS:

1. Your doll will start from a standing position, tip over the edge, and freefall head first to thrills or kills.

2. Your team will gather data about the length of fall corresponding to different lengths of bungee cord. You will make certain assumptions about the rubber bands, weight of jumper, etc.

3. Your team will determine a formula/mathematical model to predict the number of rubber bands (excluding the one attached to the feet) needed at any given height. You will consider more than one possible model, and you will be able explain how you decided which of the models considered gives the best fit. Remember that an accurate model is most likely to result when you gather data over a wide set of domain values. Consultants have suggested a *minimum* of 7 data points. Of course, the more data you collect, the more accurate your model will be. Become familiar with the regression feature on your calculator!

4. You should test your model before the final “live jump”. NOTE: Testing your model means using a jump height different than any you used to create your model. If you use one of your original data points, the model will, unsurprisingly, work almost perfectly! The idea is to *test* it, by using a different input and seeing if it gives an appropriate result. Again, consultants suggest that you test your model with a few different values. You may need to “tweak” the model a bit.

5. Your formula will be subjected to a "live testing." You will be given a “jump height” and asked to give your doll an appropriate number of rubber bands. Then we’ll see how good your model is!!

6. Each group will prepare a written report (word processed – yes, including equations) that includes:

    a) An introduction describing the project.
    b) A detailed description of the method used to gather data.
    c) Graphs and data tables, including a scatter plot of your data points with your best fit equation showing on it. (Yes, on a computer.) Make sure your tables and graphs are appropriately labeled.
    d) A description of the method and criteria used to find the final math model (function). (How did you decide among different possible models – linear, quadratic, logarithmic etc?) (What does your model say about the relationship between the variables?) Discuss at least one other possible model and why you rejected it.

e) A discussion of whether your particular model makes sense in the "real world". Why does your graph have the shape it does? Do you know anything about an ideal model for this physics experiment? What is that model like?
f) Any problems encountered by your team.
g) A description and justification of all assumptions made during the project.
h) A description of your team's live demonstration and possible sources of error (if appropriate).
i) A conclusion discussing whether you were successful.

The report should be understandable by someone not familiar with the activity.

Note: This project based on an activity included in *Stepping Stones to Mathematical Modeling.*

TIMELINE:

Monday, March 19 and Tuesday, March 20:
Collect data, develop math model, test math model, revise if necessary.
Remember that you want your equation to predict the necessary number of rubber bands for a given height, so consider carefully which variable is independent and which is dependent.

Thursday, March 22:
The "live jump". Your team will have up to two chances to prove that your model works. Adjustments can be made after the first jump if you so desire, assuming your test subject survives the first jump.

Friday, April 13:
Final report is due at the beginning of your class period. This will count as a test grade, so plan accordingly!

REPORT GRADING RUBRIC:

Introduction and assumptions	_____ / 5
Description of data collection	_____ / 5
Description of model testing	_____ / 5
Data display (tables, graphs)	_____ / 5
Description of model development and choice of best fit equation	_____ / 10
Discussion of why equation does/ does not make "real world" sense	_____ / 5
Live jump results (Extra Credit)	_____ / 5
Discussion of live jump and sources of error	_____ / 5
Conclusion	_____ / 5
TOTAL	_____ / 50