Lesson Plan Template

Name: 408 **Course:** Algebra **Grade:** 8

Unit: Linear Relationships

Big Idea (Key concept): Tables, equations, and graphs all relate the same information about a linear function, and the numbers within equations have meaning

Literacy Strategy(s): Group Discussions, Math Manipulatives, Writing to Learn, Claims & Evidence

Lesson: Barbie Bungee Jumping **Date Taught:** 12/13/10 – 12/16/10

Learning Objective(s):

Students will be able to	Conduct an experiment on linear relationships, graph the data and create an equation from that data/graph.
Students will be able to	Interpret the numbers in an equation, and use that equation (and/or graph) to make predictions

Idaho Standards (or National Standards if no Idaho Standards exist):

Standard 3: Concepts and Language of Algebra & Functions – specifically 3.4, 3.5, and 3.6

Lesson in Context:

Prior to this lesson, students have spent time working with the three views of a function (table, graph, equation) and have learned slope-intercept form. After this experiment (Day 1), students' conjectures were tested by jumping their doll with the appropriate number of bands from the stairway in the main building (Day 2). After the jump, the data from all classes (including equations for each doll for every hour) was put up on the board which was then discussed as a class and as groups (Day 3). Each class was also asked to find and write about the error in one group's data and/or equation that led to "undesirable" results.

Instructional Materials, Resources:

- Enough dolls/action figures so that each group of 3 students can have one doll (I find it leads to better discussion if the dolls have a variety of weights and heights)
- One Barbie Bungee packet per person (could be per group to conserve paper)
- A butt-load of rubber bands, preferably all new so that the varying stretchiness doesn't mess with the students' data
- Meter sticks (1 – 2 per group, depending on the weight of the dolls)
- Graphing calculators (optional)

Procedures:

- **Engage/Introduction:** *(approximate time: 15 - 25 minutes)*
  - Our journal entry consists of students summarizing what they know about linear functions. Table groups share one or two topics from their journals. Before we move on, I make sure all the most important elements are mentioned by at least one group.

- Prior to beginning the lesson, we go over a previous assignment on functions and address any misconceptions that exist.
- To begin the lesson, I introduce students to Barbie and friends, distribute the packet, and read the opening paragraph of the handout. Most of the kids already know about this lesson somewhat and are already excited, so it doesn't take much to engage them.

➢ **Explore/Learning Activities:** *(approximate time: rest of class period to experiment and begin packet, complete packet the next, test jump the 3rd, reflect the 4th)*

Day 1

- I explain the basics of the experiment and encourage students to follow all directions in the Procedure and ask questions as they arise.
- Behavioral reminders regarding proper rubber band and doll usage take place, and consequences for behavioral violations are explained.
- Students form groups of 3 (2 of the 3 classes got to choose groups, while one class was assigned groups)
- Dolls and rubber bands are distributed.
- Groups begin their work. I monitor groups, ensuring their meter sticks are oriented correctly, rubber band knots tied correctly, and safe handling of all supplies. As groups finish collecting data, they begin graphing.

Day 2

- After graphing, groups determine the equation, either using the line of best fit they drew or plugging their data into a graphing calculator (which we have used before).
- Groups analyze the equation and answer questions, including predicting the appropriate number of rubber bands for our test jump (which I refer to as our "action research").

Day 3

- On day 3 at the start of class one student from each group enters their group's equation, height of action figure, and chosen number of rubber bands for the test jump on the class chart. While that is happening, students are building the rubber band chain of the appropriate size for the test jump as well as filling out their individual chart using the information on the class chart. While students are doing that, I am checking that each person completed his/her packet because that is a requirement of participation in today's action research. Students who have not completed their packet are sent to SALC to finish.
- When all the above is done, we discuss procedures and expected behaviors for the main building action research, then head over to the main building to complete our test jumps.
- After all jumps are complete, we head back to class and students update the class chart and their individual charts, as well as undo the rubber band chains. With the remaining time we discuss the results of that hour's action research.

➢ **Explanation/Closure:** *(approximate time:15 – 30 minutes)*

Day 4

- Instead of a journal prompt, we begin our day comparing, writing about, and discussing the results from each hour's action research. This discussion includes "troubleshooting" for the dolls that we've killed (or barely took for a jump at all), how the doll's weight impacts the equations, and any variables we introduced in the way we conducted the experiment. We also look to see if graphing calculators or hand-drawn trend lines provided more accurate results.

Elements of effective instruction: (Describe how the lesson addresses each of the following. If not applicable, explain.)

1. *Describe how the lesson fosters intrinsic motivation to learn.*
   This is my favorite lesson of the year because there is so much intrinsic motivation. Students barely notice all the math they are doing because they are bungee jumping action figures. As a student I never knew Algebra could actually be fun. (And let's face it, a lot of the time it can't…or more likely I haven't figured out how to do it *yet*.) In this activity, students are motivated to collect data, graph, and find their equation accurately because they know it will lead to better performance during our action research. Plus, they get to play with a doll and are semi-trusted with rubber bands. They may be in middle school but that doesn't mean they always want to act adult. ☺

2. *Describe how the lesson elicits students' prior knowledge.*
   Students have to draw on all they have learned about linear relationships in order to answer the questions in the packet. Not only is prior knowledge elicited, but misconceptions and gaps in understanding are found and addressed based on the questions students ask as they work through their packet.

3. *Describe how the lesson intellectually engages the students in making meaning of the targeted math/science content.*
   Questions 6 and 7 are my favorite for this. The kids already knew that the *m* in the equation is the slope and the *b* is the y-intercept, but to connect that information to the specifics of the experiment required students to *really* think about how that equation was built in the first place. It wasn't magic, so all the parts have to relate somehow to our experiment. It was great for kids to have to think beyond what they knew for sure. Not only that, but when students do make big mistakes we get to *see* the result of those mistakes (the doll goes **splat**, for example) so that being wrong leads to learning but not embarrassment.

4. *Describe how students:*
   - *Math*: Explain and justify their reasoning.
     Part of the justification is in the math, part of it is in the written responses, and the other part is in the small group and class discussions. However, I would like to improve the way the packet is written so that more justification is required. The best papers do it anyway, but the students that struggled avoided justification rather than really working to put forth their best ideas even if they weren't sure.

5. *Describe how the students engage in making sense of the material covered in the lesson.*
   - One way I saw students making meaning was when they were required to figure out the meaning of the slope in our equation. In the experiment they added 2 rubber bands each time, so when they looked at the increase in centimeters in the table they couldn't immediately tell the slope was the increase in jump distance. This reinforced that slope was a rate of change and I was able to point them toward the labels on their graphs to help them see that.
   - Also, when groups used their graphs to find slope they tended to initially ignore the increments along the *x*- and *y*-axis. This of course led to a very wrong equation and way too many rubber bands. Nearly all the groups were able to recognize their error when they saw the crazy results they were getting, and with a little help they corrected it. One group did not, however, and that group provided one of the most engaging discussion topics. (The doll was a wrestler that had gold shorts painted on, so we called him gold shorts wrestler. After the action research and the horrific splat, the kids decided to rename him brown shorts … for obvious reasons.)
   - The groups that used both a graphing calculator and found the equation of the trend line they drew by hand seemed to come away with a better analysis than the ones that just did one or the other. So, next year I will adjust the directions to require students to do both.

LIMSST Project Literacy Lesson Reflection Form

Name: 408 **Date lesson was taught:** 12/13/10-12/16/10

Lesson Title/Topic Area(s):

Barbie Bungee Jumping – Linear Relationships (8th Grade Algebra)

Literacy Emphasis:
I'm not entirely confident this lesson uses literacy strategies in the best way possible. I believe the nature of the questions in the packet require them to write to learn, and really think about the meaning of an equation's slope and y-intercept in a concrete way. This lesson lends itself to lots of discussion, and altogether we probably spend a whole class period just discussing all that we learn from this experiment. I would like to think students are using Claims & Evidence but I'm also pretty sure they are approaching this at a surface level and I should find a way to ensure they dig deeper as they analyze.

Student Response to the Lesson:
The students loved the lesson and for the most part they seemed to take a lot from it. I don't actually think they "were making the most of the content presented," but at some point it becomes overwhelming for the kids when they see all the analysis that can be performed just from this one experiment. Perhaps we should do less analyzing, but more deep analysis? I tend to do most of this discussion-style, when perhaps a written reflection would be more meaningful for the kids. Who knows, maybe it's only some of the kids making the connections that the group seems to be uncovering.

Lesson Reflection:
When reviewing the packets to find a high, medium, and low it was difficult to make the distinctions because so many seemed to be in the medium to medium-high range. One thing that surprised me is that when it was time for the students to figure out how many rubber bands they would use for our action research, a LOT of them tried using a proportion rather than the equation they had found. This was really weird to me because on #8 they all used either the equation or the graph's trend line (or both) to answer the same type of question, just with a different distance. I don't understand why, when it came to #13, they wanted to use a proportion. Obviously, this means many of the students didn't completely meet the second objective for this lesson. Perhaps if I worded #13 differently and had students state whether they chose to use their trend line, their equation, or some other method it might require them to put a bit more thought into what will be most accurate. Also, for some unknown reason I didn't ask them to show how they got their chosen number of rubber bands on #13. That will also be a requirement next year, as will a final written reflection (*before* or after class discussions?).

Relationship to Previous Instruction:
I have been teaching this lesson for the past 4 years or so. Based on some of the ideas in LIMSST and some questions I'd been asking myself in past years, I placed the lesson after students learned about slope-intercept form. Before, this lesson was more of a fun introduction to linear relationships. I thought the kids might pull more from it if they had a bit more background knowledge. I always felt in previous years they were overwhelmed by it all because the analysis was not just all the "stuff" mentioned earlier, but more importantly what linear equations are all about. They seemed to make sense of pieces and parts before but this time I think the lesson actually required them to reflect on what they already knew, put it into application, and when things went wrong, analyze what mathematically caused those errors.