TITLE: R.I.P. M&M's

Cube Fellow: Josh Roberts

Teacher Mentor: Jolanta Sacewicz

Goal: The goal of this lesson is to illustrate to the students the differences in experimental and theoretical probability. The students should also recognize how the Law of Large Numbers relates the two types of probability.

Grade and Course: 9th, 10th grade Algebra classes

KY Standards: MA-HS-4.3.1 (Data Analysis and Probability: Experiments and Samples)
MA-HS-4.4.1 (Data Analysis and Probability: Experiments and Samples)

Objectives: The students will be able to:

1. Solve simple theoretical probability problems
2. Apply probability calculations to solve read world problems
3. Collect data and use these data to calculate experimental probability
4. Recognize the effect of the Law of Large Numbers on experimental probability

Resources/Materials Needed: Approximately two large bags of M&M's (enough to give each group about 100 M&M's), a cup for each group, data sheets, worksheets, calculator with "coin toss" simulator

Description of Plan: Have the students divide into groups of 3 or 4 and begin by distributing the handouts and cups. Explain to the students that we will be doing a lesson on experimental probability and the procedure involved. The experiment will be pouring M&M's out of a cup and checking to see if the "m" is facing up or down. If the "m" is facing up, then the M&M lives, if face down, it dies. When an M&M dies, the students get to eat it.

Explain the first two questions on the worksheet and have the students solve these in groups. While the students are working on these, distribute the M&M's. Go over problems 1 and 2 with the students. Now have them pour the candies on the table. Have them count the candies and, at the same time, check that each one of them has an "m" printed on one (and only one) side. Defective candies are "dead" and can be eaten. Record the number of candies under "total number" for trial 1 on the data sheet.

Now run the experiment. The students pour the candies out, check how many live, record that number, and the eat the dead ones. Record these numbers and repeat until all candies are dead. It's a good idea to have the students do the experimental probability calculations after all of the candies have died.

As the different groups finish killing their M&M's, have them begin to work on the other questions on the worksheet. For the final question, demonstrate to the students the effect of having a large number of M&M's on the probability by using the coin toss application on calculators. When a coin is tossed, heads has the effect that the candy has died and tails has the effect that the candy lived. Lead the students in noticing that as the number of coins tossed increases, the number of heads and tails get closer and closer.

Lesson Source: The lesson is adapted from an activity in which the cube participated in an undergraduate mathematical modeling class.

Instructional Mode: Group Activity

Date Given: 3/07/07 **Estimated Time:** 40 minutes

Date Submitted to Algebra-Cubed: 4/19/07

R.I.P. M&M's

Each group will be given a handful of M&M's and a cup. First check them all to make sure that the "M" is printed on one side. Everyone in your group takes turns dumping the M&M's onto the table. After being dumped on the table, see which M&M's have landed with the "M" facing up. These M&M's live, but all the others die (that means you eat them). Before you get started, answer the questions below.

1. What is the theoretical probability that a single M&M will live if it is dumped out of the cup.

2. According to the theoretical probability above, if you start with 50 M&M's, how many M&M's will live after one trial?

Now we will do the experiment. Count how many M&M's you have and write that information down. Put your M&M's in the cup, shake them around, and pour them (gently!) on the table. Count the number that live and the number that die. Record that information on the Data Sheet. Repeat.

After completing the trials, calculate the Experimental Probability of an M&M living at each step. Now answer the following questions.

3. At which trial was the experimental probability the highest for an M&M living? At which point the lowest? Why do you think this was?

4. Describe how the experimental probability changes when the number of M&M's is larger? Why do you think this happens?

5. What do you think would happen if more and more M&M's were added to the cup? Verify this by using the "coin toss" application on your calculator.

Data Sheet

Trial Number	Total Number	Number that Live	Number that Die	Exp. Prob. an M&M lives (%)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				