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Rolling Cubes

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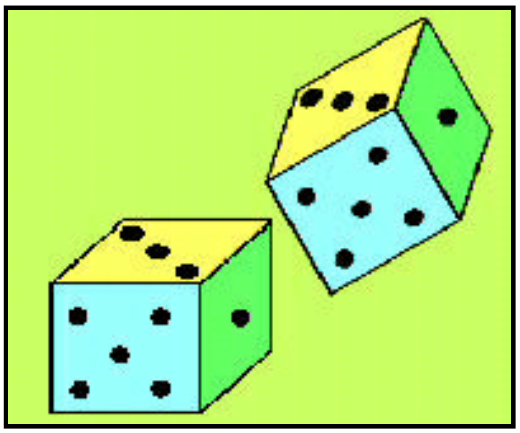
Rolling Cubes Introduction

Discovery Question: What sums are possible when I roll two numbered cubes?



This activity will allow you to investigate the probability of different sums of rolling numbered cubes.

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Thinking About the Question

What sums are possible when I roll two numbered cubes?

Probability is the branch of mathematics concerned with analyzing the chance that a particular event will occur. The basic purpose is to predict the likelihood that something will or will not happen. Probability can be calculated on the basis of observing the number of actual outcomes and the number of possible total outcomes.

Sometimes without even thinking we make decisions based on our ideas about the likelihood of an event happening. For example, if a weather forecast tells you that there is a 90% chance of rain, you might decide to carry an umbrella. On the other hand if you know that the risk of an airplane crash is maybe one in a million, you might decide that is a risk worth taking. Understanding how probability works is important so that we can make informed decisions.

Many of you may have first hand experience with a friend being injured while participating in a sport. If your were considering participating as well, what evidence would you want to consider in making your decision? Would you decide not to participate based on the one case of your friend? Discuss this situation with your group and be prepared to discuss your reasoning.

In many areas of science, such as genetics, scientists have to collect a lot of data and apply probability to help predict an outcome. The Law of Large Numbers predicts that a small number of trials will yield a wide range of results, which may or may not be close to the expected probability. It also predicts that a large number of trials will yield results closer to the expected probability. Numbered cubes in various forms are found in many parts of the world and have been used in both ancient games of chance and modern games like Monopoly. You can use your computer and numbered cubes to test whether the Law of Large Numbers seems to hold true.

Rolling Cubes Materials

- numbered cubes
- ClarisWorks
- small berry or fruit basket (optional)

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Rolling Cubes Safety

No specific safety instructions are needed for this activity.

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Rolling Cubes Investigation I

List the possibilities

How many different possible sums can you make by rolling two cubes? How many possible combinations are there for each sum? For example, the possible combinations for a sum of seven are: 1+6, 6+1, 3+4, 4+3, 2+5, and 5+2. Therefore, there are 6 possible ways to get a sum of 7.

Make a histogram or frequency distribution graph to show your work. If necessary, review with your teacher how to make a histogram or frequency distribution graph.

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Rolling Cubes Investigation II

Simulate random rolls

Rather than taking the time to roll the cubes many times yourself and record the results you can use the spreadsheet capabilities of your computer to create simulated rolls.

Use a spreadsheet to create random rolls of a pair of numbered cubes. Refer to Technical Hints to use a spreadsheet.

Create random rolls of each numbered cube in the first two columns. Refer to Technical Hints on how to create random numbers for each of the six possible rolls for each die.

Create a sum of the first two columns in the third column. Refer to Technical Hints on how to create a sum.

In the fourth column, recopy the numbers in column three and sort the numbers. Refer to Technical Hints on how sort.

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Rolling Cubes Investigation III

Create your own experimental data

Open a second spreadsheet without closing the original one. Refer to Technical Hints to see how to open a new spreadsheet while another is open.

Roll the numbered cubes ten times. You may choose to roll your numbered cubes into a berry basket.

Record and compare your results on a spreadsheet. This time manually place the sum of the rolls in column A.

You can sort the numbers directly in the same column. Review how to sort using a spreadsheet in Technical Hints.

Answer Questions 1 in the Analysis.

Go back to your simulated roll spreadsheet. Follow the same procedure to create a total of 100 random rolls. Using the "fill down" procedure to create sums for all 100 rolls. Refer to Technical Hints to see how to fill down. In the next column recopy all the sums. Refer to Technical Hints to see how to create sums. Sort the sums.

Answer Question 4 in the Analysis.

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Rolling Cubes Technical Hints

- Opening spreadsheet
- Entering headings in spreadsheet
- Creating random rolls
- Filling down columns
- Creating sums of columns
- Sorting columns
- Opening a second spreadsheet
- Making a distribution bar graph

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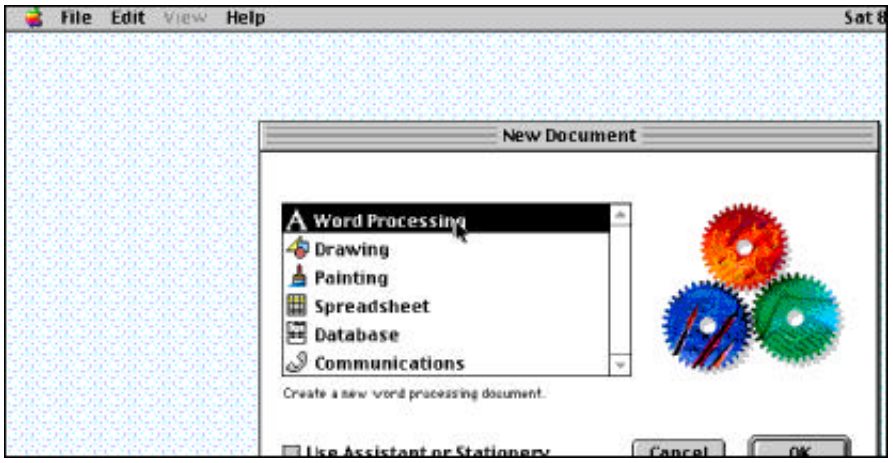
Rolling Cubes Technical Hints

To open spreadsheet:

1. Select the spreadsheet option in ClarisWorks.



2. Spreadsheets are similar to databases for storing, sorting, and displaying information. Spreadsheets are often used to do computations and graphical displays.

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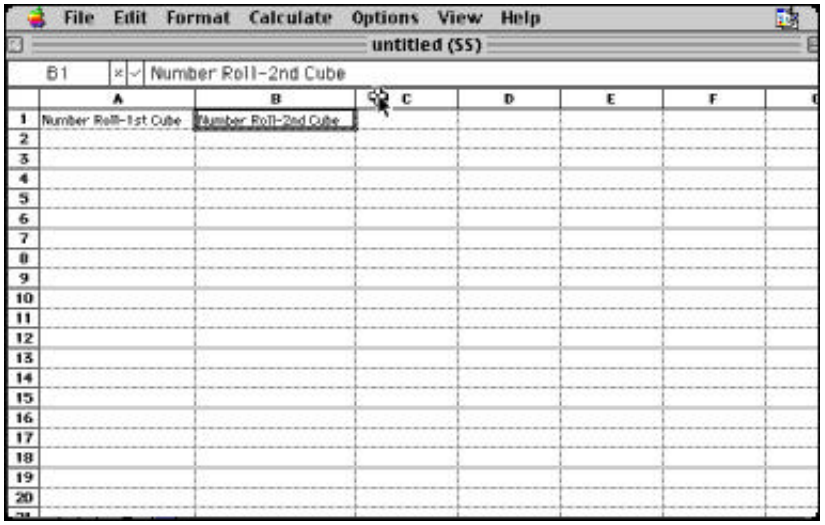
Rolling Cubes Technical Hints

To enter headings in spreadsheet:

1. Click on cell A1 and enter the heading of Number Rolled-1st Cube either in the entry bar or the cell. Click the check mark to confirm the entry.

2. Head the second column with Number Rolled-2nd Cube.

3. Label the third column as Sum of Two Cubes.



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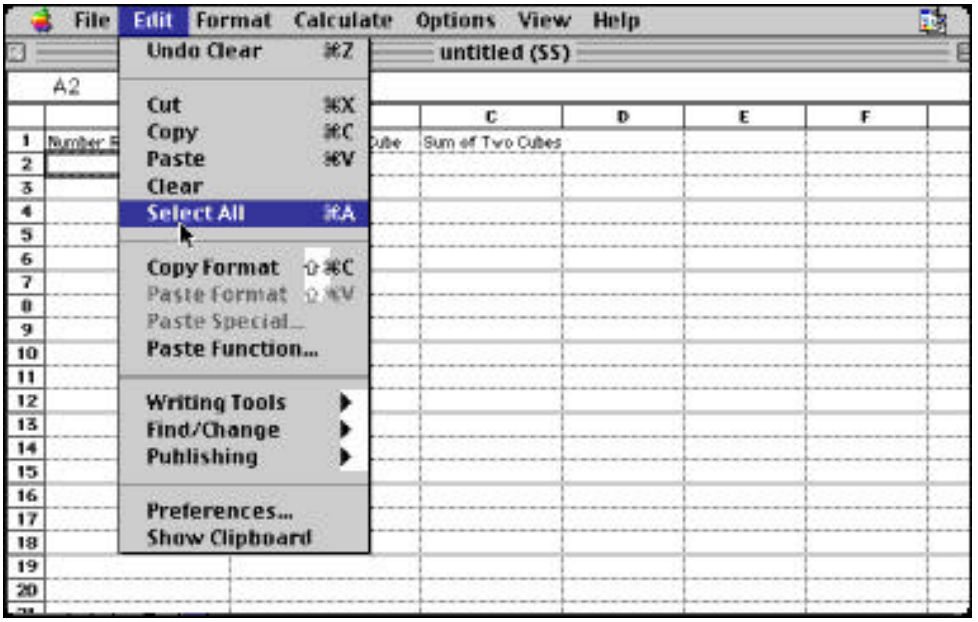
Rolling Cubes Technical Hints

To create random rolls:

1. Click in A2 and select the Paste Function from the Edit menu.
2. Choose Random from the submenu.
3. After clicking OK, =RAND(NUMBER) will appear in the entry bar. Highlight NUMBER and enter the number of sides (6) of the cube. Click the check mark to confirm the entry.
4. Repeat the process for B2.



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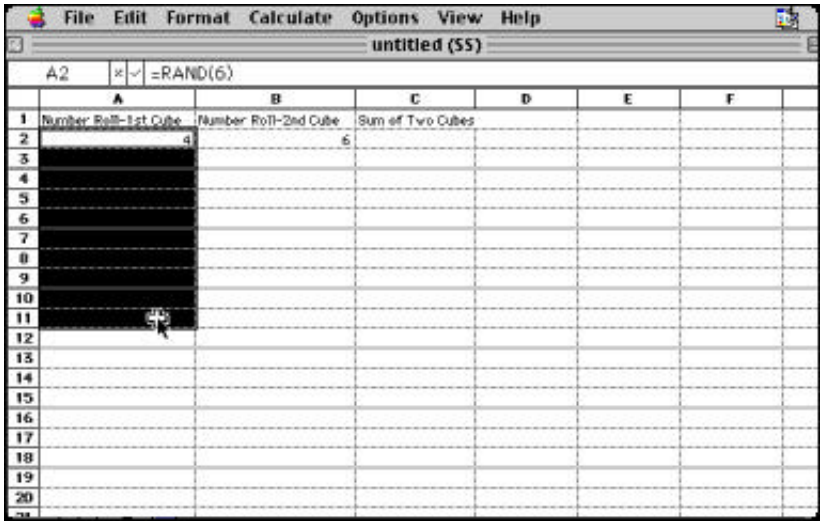
Rolling Cubes Technical Hints

To fill down columns:

1. Click on A2 and drag down to A11.
2. Under the Calculate menu, select Fill Down. Random numbers will be generated down the column.
3. Repeat the procedure for Column B.



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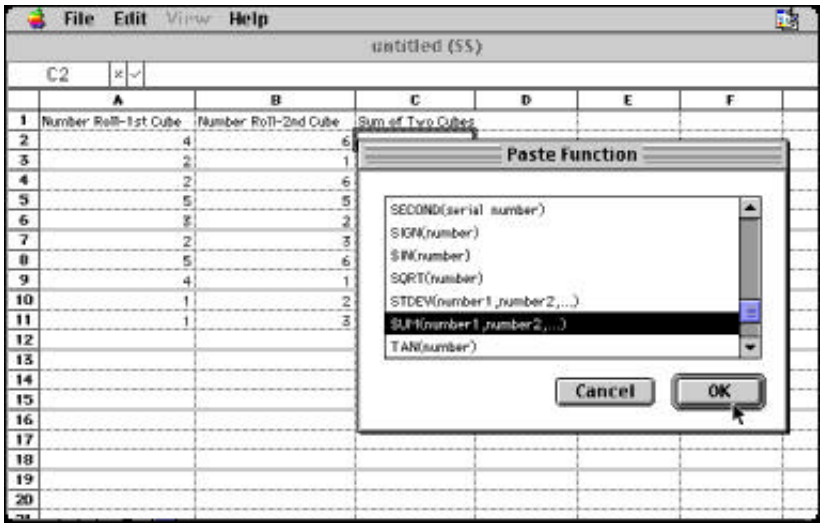
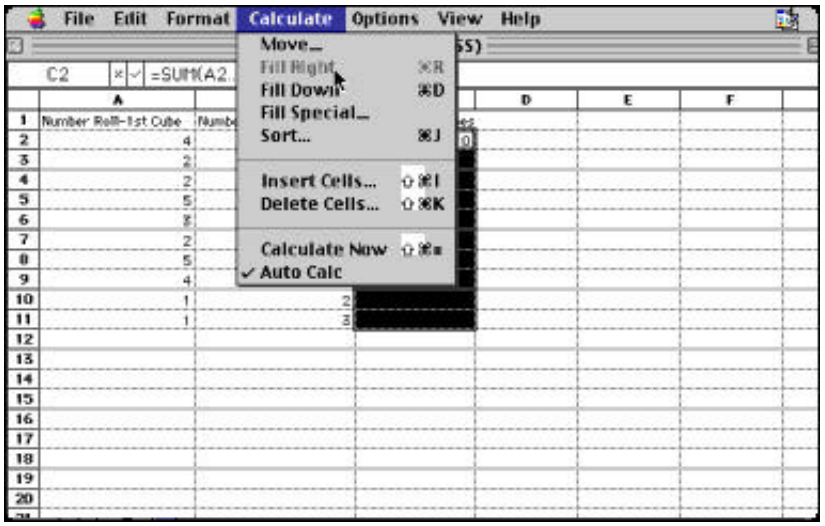
Rolling Cubes Technical Hints

To create sums of columns:

1. Click in C2 and select Paste Function from the Edit menu. Choose Sum from the submenu.
2. After clicking OK, =SUM(NUMBER1, NUMBER2,...) will appear. Highlight inside the parentheses and click and drag across A2 and B2. Click the check mark to confirm the entry.



3. Click on C2 and drag down to C11. Under the Calculate menu, select Fill Down. Sums will be generated.



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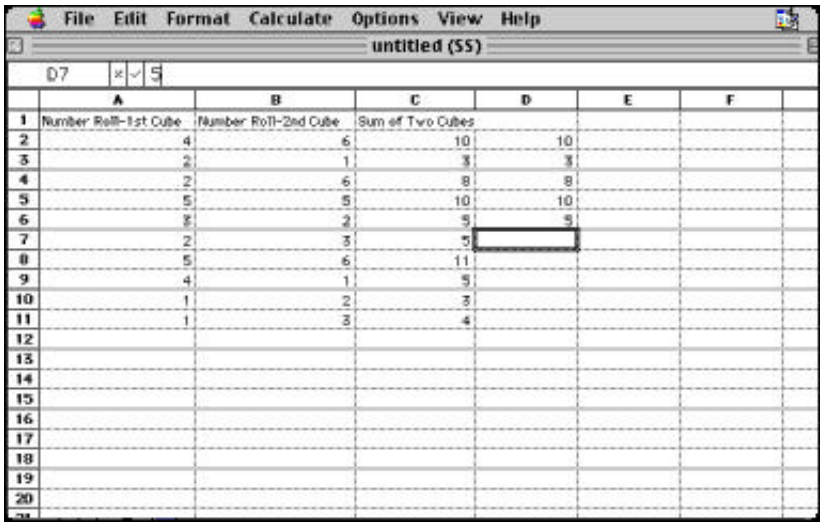
Rolling Cubes Technical Hints

To sort columns:

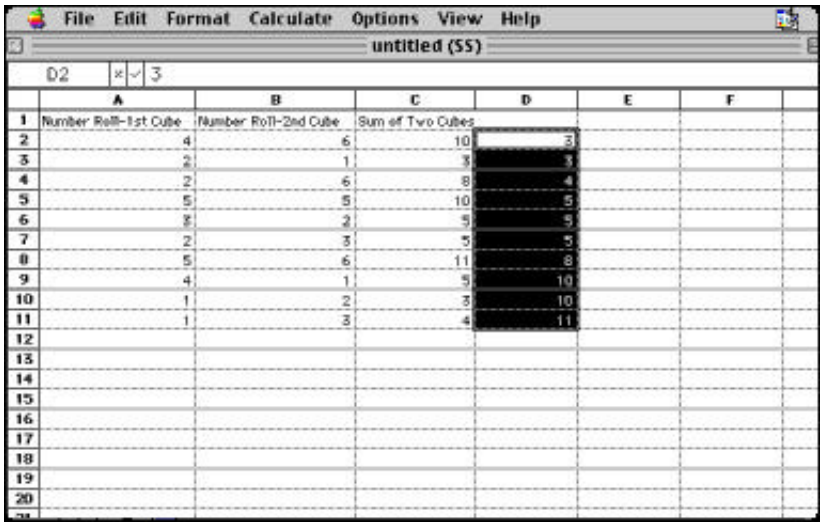
1. Manually enter the numbers from Column C in Column D.



	A	B	C	D	E	F
1	Number Roll-1st Cube	Number Roll-2nd Cube	Sum of Two Cubes			
2	4	6	10	10		
3	2	1	3	3		
4	2	6	8	8		
5	5	5	10	10		
6	3	2	5	5		
7	2	3	5			
8	5	6	11			
9	4	1	5			
10	1	2	3			
11	1	3	4			

2. Highlight the numbers by clicking and dragging across the numbers.

3. Select Sort from the Calculate menu. Make sure that ascending is activated. The numbers will be sorted from smallest number to highest.



	A	B	C	D	E	F
1	Number Roll-1st Cube	Number Roll-2nd Cube	Sum of Two Cubes			
2	4	6	10	3		
3	2	1	3	3		
4	2	6	8	4		
5	5	5	10	5		
6	3	2	5	5		
7	2	3	5	5		
8	5	6	11	8		
9	4	1	5	10		
10	1	2	3	10		
11	1	3	4	11		

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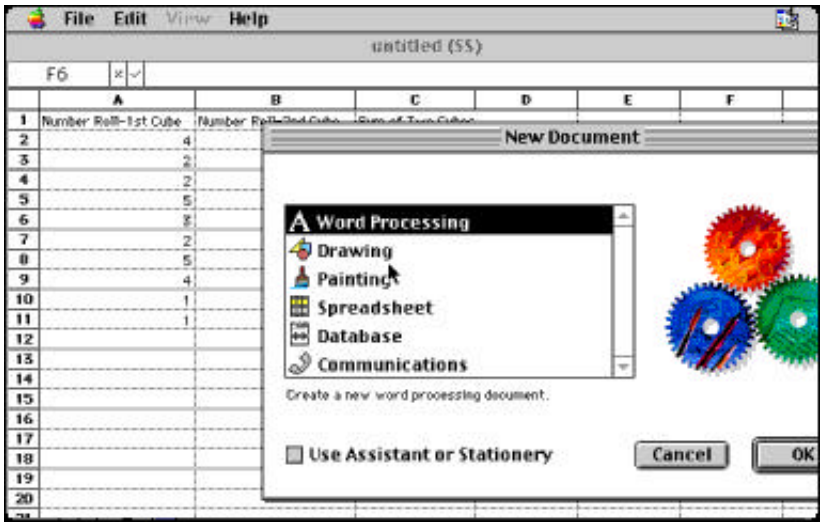
Rolling Cubes Technical Hints

To open a second spreadsheet:

Open another spreadsheet by selecting New under the File menu.



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Rolling Cubes Technical Hints

To make a distribution line graph:

1. Label column E as Possible Numbers and column F as Occurances.
2. Manually list the numbers 2 through 12 in column E. The number 1 is not included since the sums of the numbered cubes needs to be larger than 1.
3. In Column F, count the number of times that numbers in Column D occur. Record these counts in Column F. The spreadsheet shown is for 100 rolls.

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F9 1

	A	B	C	D	E	F	G	H
1	Roll 1	Roll 2	Sum	Sorted Sums	Possible	* Occurances		
2	3	1	4	2	2	2		
3	5	2	7	2	3	5		
4	5	4	9	3	4	8		
5	6	4	10	3	5	9		
6	4	2	6	3	6	21		
7	4	6	10	3	7	14		
8	4	3	7	3	8	11		
9	3	3	6	4	9			
10	1	1	2	4	10			
11	5	4	9	4	11			
12	4	4	8	4	12			
13	1	5	6	4				
14	2	3	5	4				
15	2	2	4	4				
16	5	3	8	4				
17	4	2	6	5				

4. Highlight the title and numbers in Column F by clicking and dragging over the title and the numbers.
5. Select Make Chart form the Options menu. Click on the Axes button. Select the X-axis and title Possible Sums, 2-12. Select the bar graph.

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	A	B	C	D	E	F	G	H
1	Roll 1	Roll 2	Sum	Sorted Sums	Possible	* Occurances		
2	3	1	4	2	2	2		
3	5	2	7	2	3	5		
4	5	4	9	3	4	8		
5	6	4	10	3	5	9		
6	4	2	6	3	6	21		
7	4	6	10	3	7	14		
8	4	3	7	3	8	11		
9	3	3	6	4	9	10		
10	1	1	2	4	10	5		
11	5	4	9	4	11	8		
12	4	4	8	4	12	5		
13	1	5	6	4				
14	2	3	5	4				
15	2	2	4	4				
16	5	3	8	4				
17	4	2	6	5				

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Rolling Cubes Analysis

Using the data on your spreadsheet, answer the following questions on paper:

1. How do the results of your simulated roll and experimental roll compare?
2. Do you think the computer-based roll provides an accurate simulation of actual rolls?
3. Make a bar graph of the sorted rolls from both the 100 sorted randomly generated rolls and the 10 experimental rolls. Refer to Technical Hints on how to make a distribution bar graph.
4. Which sum occurred most frequently when you rolled 10 times? Which occurred most frequently when you rolled 100 times? If they are different, how can you explain the difference.
5. How do each of the graphs you made compare to your histogram of possible rolls? Do they reflect the results you expected?
6. How do the graphs for 10 rolls and 100 rolls compare? What conclusions can you make about how well the Law of Large Numbers applies to rolling number cubes? If necessary, refer back to "Introduction" for an explanation of the the Law of Large Numbers.
7. Did your data for 100 rolls match the theoretical probability exactly? If not, what do you think would happen if we combined the results of the class so that there were1000 rolls? Open a new spreadsheet. Refer to Technical Hints on how to use a spreadsheet. In Column 1 list the possible sums for rolling two cubes, 2-12. Now, using data collected from each class group list the number of times each sum occurred in Column 2. Following the same procedure you used earlier use the data in Column 2 to make a bar graph for 1000 rolls.
8. In Column 3 calculate the probability of each sum occurring.
9. Compare the experimental data for 100, 1000 rolls, and the theoretical probability. Write a paragraph that describes your analysis and conclusions.

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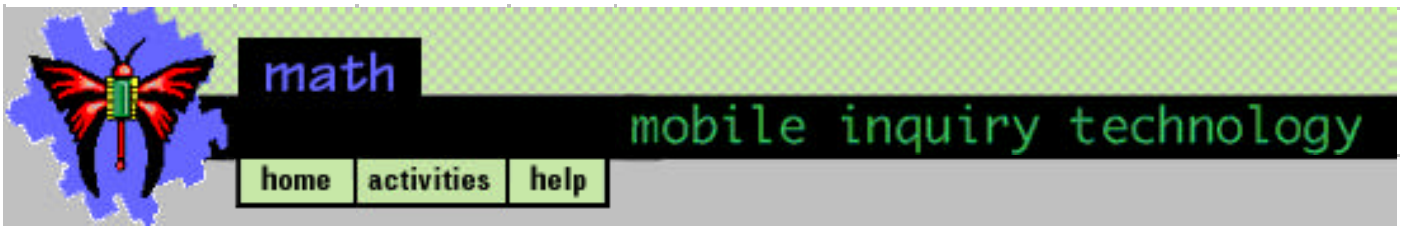

Rolling Cubes Further Investigation

You can use a spreadsheet to record, calculate and graph data for any probability question. Pick a question of your own. Design a survey or other data collection method that entails at least 100 entries. Calculate the percentage probability for each outcome. Graph your results. Prepare a presentation for your class on your results.

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