EXPLORATIONS

Activity 12

Gemini Candy

The students will work in cooperative groups to collect data and draw conclusions from random samples simulated by drawing tiles from a bag. The data collected will be represented in the form of a triple bar graph.

Concept

- Probability and statistics

Skills

- Using fractions
- Using decimals
- Calculating percent
- Collecting and organizing data
- Random sampling
- Calculator skills: [GRAPH], [b/c], [F◂▸D], [LIST]

Materials

- Student Activity sheets (page 67)
- TI-73 calculators
- 5 paper bags per group
- Color tiles (red, blue and green)
- Transparency of **The Problem** (page 68)

Activity

Before using this activity, you should prepare five bags for each group. Label the bags **A**, **B**, **C**, **D**, and **E**, and insert the color tiles into the bags using the table below.

	Red	Blue	Green
Bag A	8	2	0
Bag B	6	3	1
Bag C	4	4	2
Bag D	5	2	3
Bag E	6	3	1

Present students the Problem using the transparency on page 68.

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Before placing the students in groups, ask the following guiding questions:

- *What two bags do you think belong to the twins?*
- *How do you plan to test your guess?*
- *How many draws do you need to take from each bag to come to a conclusion?*
- *Should every group take the same size sample? Why or why not?*
- *What do you need to record and how will you record it?*

Divide the students into cooperative groups of 4 or 5. Pass out the Student Activity sheets and guide them as they devise their plan. Then have them do the experiment in their groups, recording the raw data on the Student Activity sheet under **Tally**.

After the raw data is collected, instruct student to change it into fractions, decimals and percents for each bag.

Ask the students:

- *How this can be done?*
- *How can we turn these tally marks into fractions?*

  (Remind students that a probability fraction is $\frac{\textit{number of desired outcomes}}{\textit{total number of outcomes}}$*.)*

Example:

Bag A $\quad \frac{\text{\# of red tiles drawn} = 25}{\text{total \# of draws} \quad 30} \quad \frac{\text{\# of blue tiles drawn} = 5}{\text{total \# of draws} \quad 30} \quad \frac{\text{\# of green tiles} = 0}{\text{total \# of draws} \quad 0}$

Ask students:

- *Can we compare every group's data using only probability fractions? (No, it would be difficult.)*
- *Why? (Because not every group did the same number of draws, meaning each group would have a different denominator in their data and it would be difficult to compare data.)*
- *How can we solve this problem? (Have each group convert their data to percentages, which can easily be compared.)*
- *How can we change these fractions to percents? (Convert to decimals first and then multiply by 100 to make it a percent.)*

Tip*: If you feel your students are not ready for converting fractions to decimals and percentages, the calculator can convert the data into percent for them when they set up the plot to graph. See the note in the Extension for further explanation.*

To convert the fraction to a decimal, use the [F↔D] key on the calculator.

Example: Press **25** [b/c] **30** [F↔D] [ENTER].

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To make the data easy to compare with other groups, the students will need to convert the decimals to percents. To convert the decimal to a percent, they will multiply by 100 (or use any other method you have taught them).

A Sample Solution

Bags		Tally Marks	Fraction	Decimal	Percent
A	Red	IIIII IIIII IIIII IIIII IIIII	$\frac{25}{30}$	.83	83%
	Blue	IIIII	$\frac{5}{30}$	.17	17%
	Green		$\frac{0}{30}$	0	0%
B	Red	IIIII IIIII IIIII	$\frac{15}{30}$	.50	50%
	Blue	IIIII IIII	$\frac{9}{30}$	.30	30%
	Green	IIIII I	$\frac{6}{30}$	.20	20%
C	Red	IIIII IIIII I	$\frac{11}{30}$	.37	37%
	Blue	IIIII IIIII III	$\frac{13}{30}$	.43	43%
	Green	IIIII I	$\frac{6}{30}$	.20	20%
D	Red	IIIII IIIII IIIII I	$\frac{16}{30}$	.53	53%
	Blue	IIII	$\frac{4}{30}$	.13	13%
	Green	IIIII IIIII	$\frac{10}{30}$	.33	33%
E	Red	IIIII IIIII IIIII II	$\frac{17}{30}$	.57	57%
	Blue	IIIII III	$\frac{8}{30}$	.27	27%
	Green	IIIII	$\frac{5}{30}$	.17	17%

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Questions to ask the students once they have completed their tables:

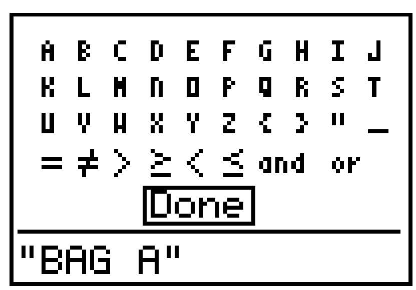
- *How many samples did your group decide to take? Why?*
- *What would have happened if you had taken fewer samples?*
- *What does your group's data show?*
- *How is your data like or different from other groups?*
- *Why did groups get different data if the bag contents were the same?*
- *For each bag, what should the total percentage be if you added all the colors? (100 %)*
- *Why are some bags 99% or 101%? (Because we rounded off to the nearest hundredths place.)*

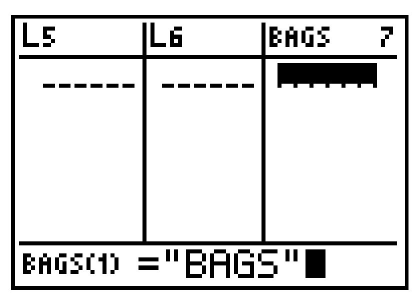
Have the students graph their data in triple bar graphs for each bag to determine which bags belong to the twins. They should enter the data in lists.

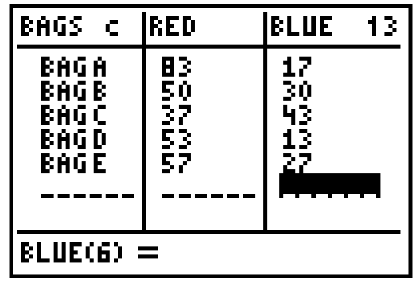
1. Press [LIST] and press [▸] to move to the right of **L6** to the first unnamed list.
2. To name it **BAGS**, press [2nd] [TEXT] and use the arrow keys to spell **B A G S**, pressing [ENTER] after each letter.
3. When you are finished, highlight **Done** and press [ENTER].
4. Press [ENTER] to paste the name at the top of the list.

***Note**: To make this a categorical list, the first item entered in the list must be in quotes. For the remaining entries in that list, quotes are not necessary.*

1. Press [▾] once and press [2nd] [TEXT].
2. Use the arrow keys to spell **B A G _ A** (The _ will leave an empty space.)
3. Press [▾] and [▸] to move to **Done** and press [ENTER].
4. Press [ENTER] to paste it on the list.
5. Enter the remaining bags **B** through **E**, using the same process.



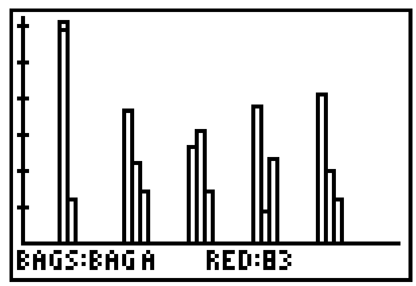




6. Press [▶] and [▶] to move to the next list and name it **Red**.
7. Press [▼] and have each group enter their percentage of reds in **Bag A**, **Bag B**, and so forth, pressing [ENTER] after each percentage is entered.
8. Name the next list **Blue** and have each group enter their percentages for blue.
9. Name the last list **Green** and enter the percentages for green.
10. Now make a triple bar graph by pressing [2nd] [PLOT].
11. Make sure all plots are turned off.
12. Choose any plot. Using the arrow keys, set up the plot to look like the screen at the right.

    ***Tip**: To make the CategList **BAGS**, press [2nd] [STAT] and press the arrows to move down until **BAGS** is highlighted. Press [ENTER]. Do the same to find the appropriate list for DataLists 1, 2, and 3.*

    ***Note**: You do not need to set window values for a bar graph.*



13. Press [GRAPH] to graph the data.
14. Press the [TRACE] key and use the arrows to explore the bar graphs.

Ask the students:

- *Which two graphs look the most similar?*
- *Based on this, which two bags do you think belong to the twins?*

***Tip**: If it is difficult for students to choose the graphs that are the most similar, have them look at their data instead.*

Wrap-Up

Have students compare their results with the rest of the class. Ask the students:

- *Did everyone agree on the two bags that belong to the twins? Why or why not?*
- *Did groups that did more draws from the bag have more accurate data?*
- *What does the combined class data show?*

Show the students the “real” contents of the bags and discuss the actual data compared to the experimental data.

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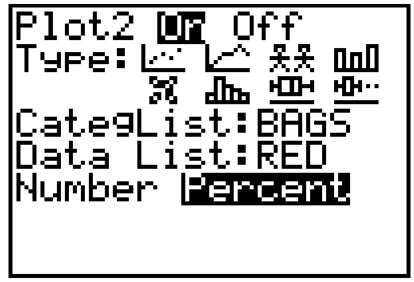
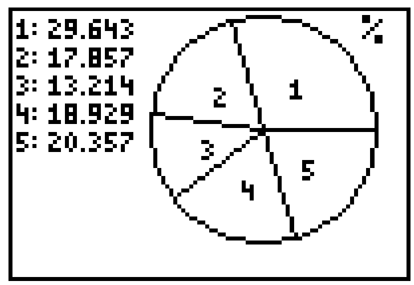
Assessment

Have students make *Candy Found* posters advertising their results.

Extensions

- Have students come up with real life examples in which you might use a sampling procedure similar to the one used in this activity.
- Rather than having students calculate percentages, have the calculator do it by entering the raw data (the number of times color was drawn from bag) and selecting **Percent** rather than **Number** when setting up the plots. When you draw a circle graph using the **Percent** option, the calculator will calculate the percentage for each circle part.





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Student Activity

Name ______________________

Date ______________________

Activity 12

Gemini Candy

Planning:

1. How will we gather our information?

____

____

2. How many times should we draw to get a representative sample?

____

____

3. How will we record our data?

____

____

Collecting the Data:

Bags		Tally Marks	Fraction	Decimal	Percent
A	Red				
	Blue				
	Green				
B	Red				
	Blue				
	Green				
C	Red				
	Blue				
	Green				
D	Red				
	Blue				
	Green				
E	Red				
	Blue				
	Green				

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Gemini Candy - The Problem

Five students went to a candy store on a recent field trip and bought their favorite candy. On the way home, the bags of candy were left on the school bus and the bus driver is trying to determine which bag of candy belongs to which student. The only clue he has is that two of the bags belong to twins and contain the same candy.

Your job is to determine which two bags belong to the twins.

- The candy has been represented by three different colored tiles in five paper bags.
- The bags are labeled A, B, C, D, and E.
- The contents in each bag can only be revealed by pulling out one tile at a time, then replacing the tile in the bag and shaking it before drawing the next tile.

You will design an experiment to determine which two bags have identical contents.

TRANSPARENCY MASTER

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