Name _____

Teacher Notes:

- Students require 6 marbles (4 green and 2 white) and a small, opaque bag to complete the activity. (If marbles are not available, use small objects whose color cannot be distinguished by touch, such as different-colored paper clips.)
- Students may complete the Activity without a partner if one is not available.

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Focus on

- **Experimental and Theoretical Probability**

- The **theoretical probability** of an event is found by performing "mental experiments." The problems in recent lessons involving the probability of pulling a marble from a bag are mental experiments.
- Setting up a probability ratio to calculate the probability of rolling a certain number on a number cube is an example of theoretical probability.
- **Experimental probability** applies to real-world situations.
- The experimental probability of an event is found by doing an experiment over and over again, or by performing a **sample experiment.**
- A survey is a type of sample experiment. Here is an example of a survey a pizza company might perform.

  A pizza company wants to know what types of pizzas will be needed for a football game, so they ask 500 customers what type of pizza they would order: cheese, tomato, or mushroom.
- The number of customers who choose each type of pizza is the **frequency** for that type of pizza.

Type	Frequency
Cheese	175
Tomato	225
Mushroom	100

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- Dividing the frequency by the total number of customers gives the **relative frequency.** The relative frequency is either a fraction or a decimal.
- Relative frequency can be used to estimate the probability that a type of pizza will be ordered.
- Showing the relative frequency as a percent gives the **chance** that a type of pizza will be ordered.

Out of the 500 customers, 175 chose cheese, 225 chose tomato, and 100 chose mushroom. The chart shows the frequency, relative frequency, and percent chance for each type of pizza.

Type	Frequency	Relative Frequency	Chance
Cheese	175	$\frac{175}{500} = 0.35$	35%
Tomato	225	$\frac{225}{500} = 0.45$	45%
Mushroom	100	$\frac{100}{500} = 0.20$	20%

From this table, we can see that there is a 20% chance that the next pizza ordered will be a mushroom pizza.

- The sum of the relative frequencies is 1.

  $0.35 + 0.45 + 0.20 = 1$

- The sum of the chances (probabilities expressed as a percent) is 100%.

  $35\% + 45\% + 20\% = 100\%$

- The relative frequency can be used to predict amounts for each category when we are given a total.

Example

- **The company plans to make 3000 pizzas for the football game. How many mushroom pizzas should they make?**

  Multiply the relative frequency by the number of pizzas.

  $3000 \times 0.2 = 600$

  About **600 pizzas** should be mushroom.

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- Apply these ideas to another survey.

A town has 4 markets:

Bob's Market *The Corner Grocery*

Express Grocery *Fine Foods*

A sample of 80 adults were surveyed for their favorite market:

30 chose Bob's Market, 12 chose The Corner Grocery, 14 chose Express Grocery, and 24 chose Fine Foods.

Store	Frequency
Bob's Market	30
Corner Grocery	12
Express Grocery	14
Fine Foods	24

The number of adults who chose each market is the frequency for that market.

To find relative frequency, divide frequency by the total number of adults.

1. Present the data in a relative frequency table similar to the one for pizza.

Store	Frequency	Relative Frequency	Chance
Bob's Market	30	$\frac{30}{80} = 0.375$	$37\frac{1}{2}\%$
Corner Grocery		$\frac{\quad}{80} = ___ . ____$	
Express Grocery		$\frac{\quad}{80} = ___ . ____$	
Fine Foods		$\frac{\quad}{80} = ___ . ___$	

2. Estimate the probability that an adult's favorite market is Express Grocery. Write your answer as a **decimal.** _____

3. Estimate the probability that an adult's favorite market is Bob's Market. Write your answer as a **reduced fraction.** _____

Experimental probability = relative frequency

4. Estimate the chance that an adult's favorite market is Fine Foods. Write your answer as a **percent.** _____

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5. Suppose the town has 4000 adult residents. The Corner Grocery is the favorite market of about how many adults in the town?
Multiply 4000 by the relative frequency for Corner Grocery.

_____

6. Estimate the probability that in this town an adult's favorite market is *either* Bob's Market or Corner Grocery. _____

A _____ the frequency of Bob's Market and the _____ of Corner Grocery. D _____ the sum by total adults to find the _____.

Activity

Probability Experiment

- This experiment will determine the probability that 2 green marbles will be drawn out of a bag at the same time.

Materials:

- 6 marbles (4 green and 2 white)
- Small opaque bag for drawing marbles
- Pencil and paper

7. Complete the steps below 25 times and record your results.

1. Place 4 green marbles and 2 white marbles in a bag.
2. Shake the bag.
3. Without looking in the bag, take two marbles.
4. Tally the results in the table.
5. Place the marbles back in the bag. Go to step 2.

Outcome	Tally
Both green	
Both white	
One of each	

Check to see that you have a total of 25 tally marks.

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8. Use your tally table to make a relative frequency table. (The frequency is the number of tallies for each result. Divide each frequency by 25 to find the relative frequency.)

Outcome	Frequency	Relative Frequency
Both green		$\frac{\quad}{25} =$
Both white		$\frac{\quad}{25} =$
One of each		$\frac{\quad}{25} =$

9. Use the table to estimate the probability that both marbles drawn will be green. Write your answer as a reduced fraction and as a decimal.

Experimental probability = relative frequency

_____, _____

- The more times an experiment is repeated, the more likely the estimate will be close to the theoretical probability.

  To combine results, add everyone's tallies together on a table like the one in problem 8. Then calculate the new frequency.

Outcome	Frequency	Relative Frequency
Both green		$\frac{\quad}{\text{total}} =$
Both white		$\frac{\quad}{\text{total}} =$
One of each		$\frac{\quad}{\text{total}} =$

Total number of experiments performed by the entire class:

_____ + _____ + _____ = _____

10. Calculate the theoretical probability that two green marbles are drawn in this experiment. Compare the theoretical probability with the experimental probability that you found in class.

Theoretical probability:

$\frac{\quad}{6} \times \frac{\quad}{5} = \frac{\quad}{\quad}$

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