Name _____

Teacher Notes:

- Refer students to "Probability" on page 9 in the *Student Reference Guide.*
- Students require paper, scissors, and a pencil for this Investigation.

page 501

Focus on

• Probability and Predicting

- In everyday life, people use data from real events to **estimate** probabilities.
- Probabilities are also used to **predict** events. Recall that probability tells how likely an event is to happen.
- Probability is shown as a number between 0 (impossible) and 1 (certain).
- A probability can be written as a fraction, decimal, or percent.
- To find the probability of an event:
  1. Write a fraction.
     $$\frac{\text{favorable outcomes}}{\text{possible outcomes}}$$
  2. Reduce if necessary.
  3. Change to a decimal or percent.
- Collected data can be useful in estimating probabilities in such fields as baseball, highway safety, and manufacturing.
- In baseball, a batting average is the ratio of the number of hits to the number of at bats.

  $$\text{batting average} = \frac{\text{hits}}{\text{at bats}}$$

  This ratio appears as a decimal to three places, for example, 0.275.

  When a sports announcer mentions a batting average, he or she drops the zero and decimal point and just says the numbers, as in, "The first baseman is batting two seventy-five."
- Answer the questions in problems **1–10.**

  1. Fernando had 8 hits and 25 at bats. Estimate the probability that Fernando has a hit at his next at bat.

  $$\frac{\text{hits}}{\text{at bats}} = \frac{\quad}{\quad}$$

  $$\overline{)\quad}$$

  0._____ _____ _____

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- Researchers also use ratios to learn about traffic safety. They make ratios that tell the number of accidents that occur per mile on certain sections of highway.

$$\text{accidents per mile} = \frac{\text{number of accidents}}{\text{number of miles}}$$

2. During one year, there were 226 accidents on a 5 mile section of highway. Determine the accidents per mile. Give the answer as a decimal number.

$$\frac{\text{number of accidents}}{\text{number of miles}} = \underline{\quad} \qquad 5\overline{)\quad}$$

_____ _____ . _____

- Quality inspectors use probability to predict how many items in a large batch may be damaged or of poor quality. They use a small sample to predict the amount of damage in the whole supply.

3. Inspectors checked a selection of 50 DVDs from a truckload of DVDs. They found that 8 DVDs were damaged. Estimate the probability that a DVD selected from the truckload is damaged.

Write the probability as a fraction and as a proportion using words.

$$\frac{\text{damaged DVDs}}{\text{total inspected}} = \underline{\quad} =$$

The p_____ that a DVD will be damaged is _____

out of _____.

Is this the true proportion of damaged DVDs in the truckload?

_____, this estimate was based on selecting just _____

DVDs from the whole load.

- Now, try an activity acting out estimating probability for a crate of apples. Work with a partner and use paper, scissors, and a pencil.

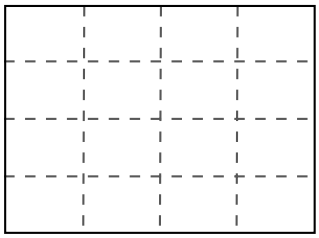
4. An inspector will check a crate of apples for worms. The inspector will estimate the probability that a customer will choose an apple with a worm from the crate. Decide who will be the inspector.

The other team member will create the crate of apples. To make the crate of apples, the crate-maker will:

1. Fold a piece of paper in half lengthwise two times.
2. Fold it in half widthwise two times. This makes 16 rectangles on the paper.

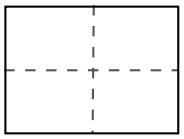
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3. Use the fold lines to show where to cut out the 16 rectangles.



✂ Cut along dotted lines

4. Cut each rectangle into 4 equal small rectangles.



✂ Cut along dotted lines

You now have 64 rectangles. Each rectangle is an apple.

5. Choose between 10 and 40 apples to have worms. Remember the number of apples with worms, because the number will be necessary for secret calculations. Use the pencil to mark these rectangles to show that they have worms.
6. Turn them over to hide the mark and mix them up. The inspector should NOT be able to tell which ones have worms.
7. Secretly write down the number of apples with worms. Compute the probability that a customer will pick an apple with a worm from this crate.

$$\frac{\text{apples with worms}}{\text{total apples}} = __$$

Reduce if necessary.

5. The inspector will now inspect the crate.

1. Choose 20 apples (rectangles) at random.
2. Cut open each apple (turn over the rectangles).
3. Tally the number of apples with worms.

Outcome	Tally
worms	
no worms	

4. Use your tally table to make a frequency table.
Remember: the frequency is the number of tallies for each result.

Outcome	Frequency	Relative Frequency
worms		$\frac{(\quad)}{20} =$
no worms		$\frac{(\quad)}{20} =$

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5. Answer the following questions:

   What proportion of apples picked had worms?

   $$\frac{\text{apples with worms}}{\text{total picked}} = __$$

   What is the probability that a customer will pick an apple with a worm from this crate?

   Multiply the number of apples in the crate by the relative frequency.

   _____ × _____ = _____

6. In question **4,** the crate-maker found the theoretical probability of picking an apple with a worm. In question **5,** the inspector found the estimated probability of picking an apple with a worm.

Compare the theoretical probability and estimated probability.

Theoretical Probability		Estimated Probability
—	◯	—

Are the probabilities different? _____ If yes, explain why.

The estimated probability is _____ than the

theoretical probability because the sample size is so _____.

Why might we need to rely on estimated probabilities sometimes?

It is sometimes impossible or not practical to know the

t_____ probability. For example, we would have to cut

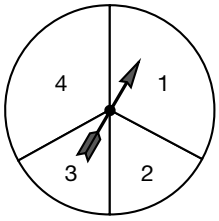
open e_____ apple.

- Probabilities can also give us an idea of what may happen *in the future.* When we toss a coin, we *expect* the coin to land on heads about $\frac{1}{2}$ of the time. If we toss a coin 100 times, we *expect* it to land on heads about 50 times.

  probability of outcome × number of trials = predicted number of times outcome will occur

  $\frac{1}{2} \times 100 = 50$ heads

7. If this spinner is spun once, what is the probability of it stopping on an even number?



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Look closely. Even though the sections are not equal, there is a relation between the evens and odds. What fraction of the circle contains an even number?

$$\frac{\text{even numbers}}{\text{all numbers}} \quad ___$$

If this spinner is spun 30 times, how many times would you expect it to land on an even number?

probability $\times$ trials $=$ predicted outcome

_____ $\times$ _____ $=$ _____

8. For every 1 adult ticket sold, 3 children's tickets were sold. Asia counted 20 adults in the balcony. About how many children were in the balcony?

Set up ratios.

$$\frac{\text{adults}}{\text{children}} \quad \frac{1}{__} = \frac{20}{__}$$

The probable number of children in balcony is _____.

9. Two number cubes are rolled. Complete the grid to list all possible outcomes.

Second Number Cube

First Number Cube	1	2	3	4	5	6
1	1,1	1,2	1,3	1,4	1,5	1,6
2	2,1	2,2				
3						
4						
5						
6						

What is the probability of rolling two 1's (1,1)?

How many times does 1,1 appear on the grid? _____

How many total outcomes are shown on the grid? _____

Remember, when past events **do not** affect the probability of a series of events, the events are **independent.**

When past events **do** affect the probability of a series of events, the events are **dependent.**

Are the events independent or dependent? _____

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What is the probability of rolling doubles: {1,1} or {2,2} or {3,3} or {4,4} or {5,5} or {6,6}?

Number of doubles
Total number of outcomes — = —

Reduce.

The probability of doubles is _____.

10. Cheryl rolls two number cubes 30 times. Predict the number of times she rolls doubles. Use your answer from question **9** to start.

Change the whole number to a fraction.

The probability of doubles as a fraction: —

probability × trials = predicted outcome

— × — = _____

Cheryl should roll doubles about _____ times.

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