THE HUNGER GAMES

PROBABILITY

TOPICS COVERED:

- Basic probability
- Simple Events and Expected Outcomes
- Experimental and Theoretical Probability
- Tree Diagrams
- The Counting Principle
- Independent Events
- Dependent Events
- Odds

A PROBABILITY UNIT BASED ON THE BEST-SELLING BOOK SERIES

Created by Lance Mangham, 6th grade math, Carroll ISD

74th Annual Hunger Games Tributes

District	Name	Gender	Age	Train. Scores	Days Survived	Eliminated by
District 1 – Luxury	Marvel	Male	17	9	9	Katniss
District 1 - Luxury	Glimmer	Female	17	10	5	Katniss
District 2 - Masonry	Cato	Male	18	10	17	Mutts
District 2 - Masonry	Clove	Female	15	10	12	Thresh
District 3 – Technology		Male	14	10	8	Cato
District 3 - Technology		Female	13	4	1	5 Male
District 4 – Fishing		Male	12	9	1	Cato
District 4 - Fishing		Female	16	8	5	Katniss
District 5 – Power		Male	15	3	1	8 Male
District 5 - Power	Foxface	Female	15	5	15	Nightlock
District 6 – Transportation	Jason	Male	16	7	1	Cato
District 6 - Transportation		Female	17	4	1	Glimmer
District 7 – Lumber		Male	17	5	1	Clove
District 7 - Lumber		Female	16	4	1	Marvel
District 8 – Textiles		Male	14	3	1	Thresh
District 8 - Textiles		Female	13	5	2	Careers
District 9 – Grain		Male	14	4	1	Clove
District 9 - Grain		Female	14	5	1	Marvel
District 10 – Livestock		Male	18	4	8	Careers
District 10 - Livestock		Female	16	7	1	Glimmer
District 11 - Agriculture	Thresh	Male	18	10	14	Mutts
District 11 - Agriculture	Rue	Female	12	7	9	Marvel
District 12 – Mining	Peeta	Male	16	8	20	Winner
District 12 - Mining	Katniss	Female	16	11	20	Winner

Created by Lance Mangham, 6th grade math, Carroll ISD

HEADLINES – "DISTRICT 12 REAPING BEING HELD TODAY"

May the odds be ever in your favor…will they be today????

In the book The Hunger Games, 24 contestants compete for the title of Hunger Games Champion. The contestants are from age 12 to age 18. In their country of Panem there are 12 districts. One boy and one girl from each district are chosen to attend the Hunger Games. They are called tributes.

Below is a summary of the tributes.

DISTRICT											
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
BOY	BOY	BOY	BOY	BOY	BOY	BOY	BOY	BOY	BOY	BOY	BOY
GIRL	GIRL	GIRL	GIRL	GIRL	GIRL	GIRL	GIRL	GIRL	GIRL	GIRL	GIRL

Use the table above to answer the following questions. Write probabilities as simplified fractions.
For #1-10, you choose one of the 24 contestants at random.

1.	P(boy) [What is the probability you will choose a boy?]	
2.	P(a person from district 12)	
3.	P(a girl from district 11)	
4.	P(a person not from district 2)	
5.	P(either a boy or a girl)	
6.	P(a person from district 13)	
7.	P(a person from a prime numbered district)	
8.	P(a boy from a composite numbered district)	
9.	P(a girl from district 4, 5, or 6)	
10.	P(a person from a district that is a multiple of 3)	

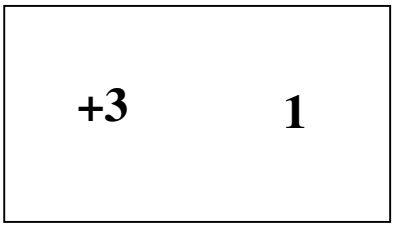
11.	Assume each contestant has an equal chance of winning. What is the probability the girl from district 12 will win?	
12.	If the Hunger Games were played 96 times, how many times would expect a boy from district 6 to win?	
13.	The final four contestants are the boys and girls from districts 3 and 4. Use a tree diagram to list all the possible orders the next two contestants may be eliminated.	

+1 0	+1 1	+1 0
+1 1	+1 0	+1 1
+1 0	+1 1	+2 0
+2 0	+2 0	+2 1
+2 0	+2 1	+2 0
+2 1	+3 0	+3 0

+3 0	+3 1	+3 0
+3 1	+4 0	+4 1
+4 0	+4 1	+5 0
+5 0	+5 0	+5 1
+6 0	+6 0	+6 0
+6 1		

The Hunger Games Reaping Simulation

You received a piece of paper when you walked in to class today.



The **first number** (+1 to +6) represents how many years you are going to add to your current age for today's lesson.

My current age: _____ + my first number _____ = my age for this project _____

Members of my family: _____ (current members living in your house, including yourself)

The **second number** represents whether you received tesserae or not. In the Hunger Games, tesserae represents additional food resources for families in need.

0 = you are not starving and you did not receive tesserae
1 = you are starving and your family has received tesserae each year since you were 12

Directions for determining your entries into the reaping

PART 1: AGE
Age 12 = 1, Age 13 = 2, Age 14 = 3, Age 15 = 4, Age 16 = 5, Age 17 = 6, Age 18 = 7

PART 2: TESSERAE

You must add 1 extra entry for every family member (including yourself) that received tesserae. These extra entries are cumulative.

For example, if you are 14 years old, your baseline number of entries would be 3 (for age). Added to this number would be your tesserae. For example, if you have 5 members in your family, the entries for tesserae at age 14 would be 5x3=15.

Portions of this first project taken from: Hunger Games: What Are the Chances?, Sarah B. Bush and Karen S. Karp**,** *Mathematics Teaching in the Middle School*, Vol. 17, No. 7 (March 2012), pp. 426-435

1.	On the basis of your age and your tesserae status, determine the number of entries you will have in the reaping lottery this year. Show all work here:
2.	Place your entries in the boy drawing or girl drawing using the small pieces of paper. Then write your number of entries in the correct column on the board.
3.	Given the grand total number of entries in our district (class) and for your gender, what is the probability that your name will be selected? Express your answer as both a fraction and a percentage round to the nearest hundredth (ex. 5.82%). **Calculator**
4.	Suppose you were a student in another class period. Would your chances (or probability) of being selected for the Hunger Games be the same? Why or why not?
5.	Write an algebraic equation representing a person's total number of entries, E, for a given year if you did not receive tesserae. Define your variables and write your equation below.
6.	Write an algebraic equation representing a person's total number of entries, E, for a given year if you did receive tesserae each year, starting at age 12, for all family members. Define your variables and write your equation below.

7.	Katniss had 20 entries in the reaping, Peeta 5, Gale 42, and Prim 1. If there were 4,144 boy entries and 4,060 girl entries in District 12, what is the probability that each name would be drawn for the Hunger Games? (percentage, round to the nearest hundredth) **Calculator**
8.	What is the probability that both Peeta and Prim are drawn at the reaping? To determine to probability of both of these two events happening, you multiply each individual probability together. Show your expression and answer below. **Calculator**
9.	How many entries would you have if you were 18 years old, had 9 family members, and received tesserae for each of them every year since you were 12?
10.	Suppose you were in a math class of 24 students and each student randomly draws the name of a contestant from the Hunger Games. If your contestant wins the Hunger Games, you win a prize. Is this a fair game? Why or why not? Can you determine the probability of your contestant winning the Hunger Games? If so, write it as a fraction.
11.	How many orders are possible for the first, second, and third person eliminated?
12.	During the Hunger Games in the book, 24 contestants compete until one person is declared the winner. How many orders are possible in which the contestants could have been eliminated (assuming 1 contestant eliminated at a time)? **Calculator**
13.	Suppose as the Hunger Games tributes arrive at the capitol they each greet every other contestant one time. How many total greetings would there be? Use drawings or lists to help organize your thoughts. Show all your work.

Activity 12-5: **Probability Vocabulary** Name:

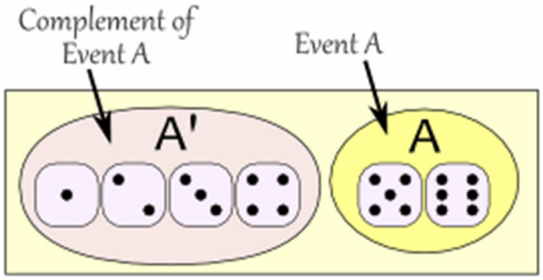
Determine something that has a probability of…

0%		**50%**	
10%		**75%**	
25%		**100%**	

Probability	the chance that some event will happen
Outcome	one possible result of a probability event For example, 4 is an outcome when a die is rolled.
Sample space	the set of all possible outcomes For example, rolling a die the sample space is {1, 2, 3, 4, 5, 6}
Theoretical Probability	the ratio of the number of ways an event can occur to the number of possible outcomes (You are solving it mathematically.)
Experimental Probability	an estimated probability based on the relative frequency of positive outcomes occurring during an experiment (You are conducting an experiment.)
Random	outcomes occur at random if each outcome is equally likely to occur
Simple	A simple experiment consists of one action.
Composite	A composite experiment consists of more than one action.

The probability of an event is the ratio of the number of ways the event can occur to the number of possible outcomes.

$$P(event) = \frac{\text{number of ways an event can occur}}{\text{number of possible outcomes}}$$



The probability of rolling a 5 or 6 above is $\frac{2}{6}$. $P(A) = \frac{2}{6}$

The **complement** of an event is all the outcomes that are not the event. It is represented with the prime symbol. $P(A') = \frac{4}{6}$ because rolling a 1, 2, 3, or 4 is the complement of rolling a 5 or a 6.

$P(A) + P(A') = 1$ **always.**

HUNGER GAMES COMPETITION

The chart below shows how many tributes were left at the end of each day of the 74th Annual Hunger Games.

	Tributes remaining		Tributes remaining		Tributes remaining
Start	24	**Day 6**	10	**Day 12**	5
End of Day 1	13	**Day 7**	10	**Day 13**	5
Day 2	12	**Day 8**	8	**Day 14**	4
Day 3	12	**Day 9**	6	**Day 15**	3
Day 4	12	**Day 10**	6	**Day 16**	3
Day 5	10	**Day 11**	6	**Day 17**	2

Assume that all of the contestants have equal abilities to win the Hunger Games. Use the table above to answer the following questions.

	Name	**Fraction**	**Percent (nearest whole percent)**
1.	Before the Hunger Games begin what is the probability that Katniss will win?		
2.	Before the Hunger Games begin what is the probability that Katniss won't win?		
3.	After day one, what is the probability that Katniss will win?		
4.	After day one, what is the probability that Katniss won't win?		
5.	At the end of day 5 what is the probability that Katniss will win?		
6.	At the end of day 8 what is the probability that Katniss will win?		
7.	At the end of day 14 what is the probability that Katniss will win?		
8.	At the end of day 16 what is the probability that Katniss will win?		
9.	At the end of day 16 what is the probability that Katniss won't win?		
10.	***Why does Katniss' probability become greater as she gets farther into the Hunger Games?***		

If the Hunger Games were played 84 times, about how many times would you expect a tribute from District 11 would win? [Assume equal chances for all districts.]

To figure out about how many times without doing the experiment, you can just multiply. First, you must determine the probability District 11 will win. That would be $\frac{1}{12}$. Multiply the probability times the number of events.

$$\frac{1}{12} \bullet 84 = 7$$

Therefore, you would expect District 11 to win 7 times.

Suppose 24 tributes compete in a Hunger Games simulation.

1.	How many equally likely outcomes are there for the winner?	
2.	If there is one simulation, what is the probability of a tribute from District 12 winning?	
3.	If you run the simulation 96 times, about how many times would you expect the boy from District 1 to win?	
4.	If you run the simulation 120 times, about how many times would you expect a tribute from a prime district to win?	
5.	If you run the simulation 80 times, about how many times would you expect a girl tribute from district 4, 5, or 6 to win?	

In the Hunger Games simulation the final four tributes consist of two from District 12, one from District 2, and one from District 5.

6.	If there is one simulation, what is the probability that district 12 will win?	
7.	If you run the simulation 92 times, about how many times will district 2 win?	
8.	If you run the simulation 144 times, about how many times will district 5 not win?	
9.	If you run the simulation 80 times, about how many times will a person from a composite district win?	

Cinna puts the following color cards (in equal quantities) in a bag for Katniss to choose one for her next dress: green, yellow, orange, red, purple.

10.	If Katniss draws 65 times, about how many draws would be green?	
11.	If Katniss draws 180 times, about how many draws would not be orange or red?	
12.	If Katniss draws 640 times, about how many draws would be green, red, or purple?	
13.	If Katniss draws 36 green and yellow cards, about how many total cards are there?	

Activity 12-8: **Expected Outcomes** Name:

Make a prediction based on the probability. Show all work on a separate sheet of paper. Round answers as appropriate.

<table>
<tr><td>1.</td><td>President Snow loves to bowl. He knocks down at least 6 pins 7 out of 10 tries. Out of 200 tries, how many times can you predict President Snow will knock down at least 6 pins?</td><td></td></tr>
<tr><td>2.</td><td>In the Hunger Games arena it rains about $\frac{4}{25}$ of the time. On how many days out of 400 can the tributes predict they will get rain?</td><td></td></tr>
<tr><td>3.</td><td>In The Capitol Effie notices that 9 out of 20 people leaving the supermarket choose plastic bags instead of paper bags. Out of 600 people, how many can Effie predict will carry plastic bags?</td><td></td></tr>
<tr><td>4.</td><td>Haymitch loves to play baseball. He reaches base 35 percent of the time. How many times can he expect to reach base in 850 at-bats?</td><td></td></tr>
<tr><td>5.</td><td>Katniss loves to play basketball and she can make 13 out of 20 free-throws. If she shoots 75 times, how many shots can she expect to make?</td><td></td></tr>
<tr><td>6.</td><td>A professor in The Capitol predicted that at least 78 percent of residents prefer getting their news from a digital source rather than from a print source. He polled 3 different groups. The results are shown in the table below.
<table><tr><th></th><th>Group 1</th><th>Group 2</th><th>Group 3</th></tr><tr><td>Digital</td><td>20</td><td>14</td><td>30</td></tr><tr><td>Print</td><td>5</td><td>10</td><td>7</td></tr></table>In which group(s) did his prediction hold true? Explain.</td><td></td></tr>
<tr><td>7.</td><td>Cato flips the coin 64 times. How many times can Cato expect the coin to land on heads?</td><td></td></tr>
<tr><td>8.</td><td>A spinner is divided into five equal sections labeled 1 to 5. What is the probability that the spinner will land on 3? If the spinner is spun 60 times, how many times can you expect the spinner to land on 3?</td><td></td></tr>
<tr><td>9.</td><td>If Rue rolls the die 39 times, how many times can she expect to roll a 3 or 4?</td><td></td></tr>
<tr><td>10.</td><td>A bag contains 6 red and 10 black marbles. If Foxface picks a marble, records its color, and returns it to the bag 200 times, how many times can she expect to pick a black marble?</td><td></td></tr>
<tr><td>11.</td><td>Glimmer rolls a number cube 78 times. How many times can she expect to roll an odd number greater than 1?</td><td></td></tr>
<tr><td>12.</td><td>A shoebox holds colored disks: 5 red, 6 white, and 7 blue disks. You pick out a disk, record its color, and return it to the box. If you repeat this process 250 times, how many times can you expect to pick either a red or white disk?</td><td></td></tr>
<tr><td>13.</td><td>Clove flips two pennies 105 times. How many times can she expect both coins to come up heads?</td><td></td></tr>
</table>

Activity 12-9: **Theoretical vs. Experimental Probability** Name:

Theoretical probability – determined mathematically
Experimental probability – determined by conducting an experiment

CELEBRITY HUNGER GAMES EXPERIMENT

Based on the book, a tribute has a bit more than a 50% chance of advancing to Day 2. After the first day a tribute's chance of advancing any given day rises to about 85-90%.

ROLL TWO DICE	*Eliminated*	*Survived*
Day 1	8, 9, 10, 11, 12	2, 3, 4, 5, 6, 7
After Day 1	3, 11, 12	2, 4, 5, 6, 7, 8, 9, 10

If the final tributes are eliminated on the same day, re-roll for that day.

Simulate the 12 person Celebrity Hunger Games five times.

Player	Example	1st Simulation	2nd Simulation	3rd Simulation	4th Simulation	5th Simulation
Justin Bieber	Day 1					
Taylor Swift	Day 4					
Katniss Everdeen	Day 7					
Harry Potter	Day 1					
Batman	Day 1					
Darth Vader	Day 5					
LeBron James	Day 2					
Michael Jordan	Day 1					
Shannon Shabanaj	Day 10					
Maureen Fauatea	Day 1					
Olaf	WON					
Nemo	Day 2					
WINNER	Olaf					

1.	What was the theoretical probability Nemo would win?	
2.	What was the experimental probability Nemo would win?	
3.	What was the theoretical probability Darth Vader would not win?	
4.	What was the experimental probability Darth Vader would not win?	
5.	What was the theoretical probability a two-name character would win?	
6.	What was the experimental probability a two-name character would win?	
7.	Why are theoretical and experimental probabilities not necessarily the same?	

Activity 12-10: **Experimental Probability** Name:

Record all answers as both fractions and percentages. Round to the nearest whole percent.

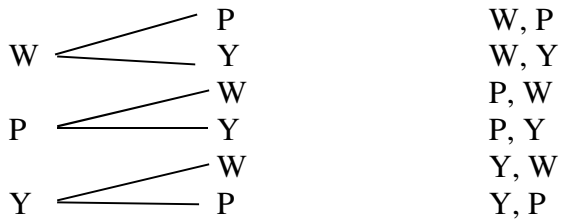
Solve.

<table>
<tr><td>1.</td><td>Katniss is playing basketball. She scored 11 baskets in 15 free throws attempts. What is the experimental probability that she will score a basket on her next free throw?</td><td></td></tr>
<tr><td>2.</td><td>Gale has gone to work for 60 days. On 39 of those days, he arrived at work before 8:30 A.M. On the rest of the days he arrived after 8:30 A.M. What is the experimental probability he will arrive after 8:30 A.M. on the next day he goes to work?</td><td></td></tr>
<tr><td>3.</td><td>For the past four weeks, Prim has been recording the daily high temperature. During that time, the high temperature has been greater than 45°F on 20 out of 28 days. What is the experimental probability that the high temperature will be below 45°F on the twenty-ninth day?</td><td></td></tr>
<tr><td>4.</td><td>After the movie The Hunger Games, 99 out of 130 people surveyed said they liked the movie. What is the experimental probability that the next person surveyed will say he or she liked the movie? He or she did not like the movie?</td><td></td></tr>
<tr><td>5.</td><td>For the past 40 days, Katniss has been recording the number of customers at The Hob between 10:00 A.M. and 11:00 A.M. During that hour, there have been fewer than 20 customers on 25 out of the 40 days. What is the experimental probability there will be fewer than 20 customers on the forty-first day? 20 or more customers on the forty-first day?</td><td></td></tr>
<tr><td>6.</td><td>Peeta was bored so he tossed a coin and spun a spinner with 3 equal sections. The results are shown in the table.
<table>
<tr><th></th><th>Heads</th><th>Tails</th></tr>
<tr><td>1</td><td>53</td><td>65</td></tr>
<tr><td>2</td><td>49</td><td>71</td></tr>
<tr><td>3</td><td>54</td><td>62</td></tr>
</table>
What is the experimental probability that the next toss and spin will result in Tails and a 3?</td><td></td></tr>
<tr><td>7.</td><td>The tributes stopped at the Sandwich Shop for lunch. They can choose the bread and meat they want. The table shows the sandwiches that were sold on a given day.
<table>
<tr><th></th><th>White Bread</th><th>Wheat Bread</th></tr>
<tr><td>Ham</td><td>22</td><td>24</td></tr>
<tr><td>Turkey</td><td>21</td><td>22</td></tr>
<tr><td>Tuna</td><td>25</td><td>23</td></tr>
</table>
What is the experimental probability that the next sandwich sold will be tuna on wheat bread?</td><td></td></tr>
</table>

Activity 12-11: **Tree Diagrams** Name:

You can draw a tree diagram to find the number of possible combinations or outcomes.

Example Haymitch will wear either a white, purple, or yellow tie with a white, purple, or yellow jacket. The tie and jacket cannot be the same color. How many different choices does Haymitch have?



There are 6 possible outcomes.

Create a tree diagram with titles or create an organized list/table of the outcomes possible. Then give the total number of outcomes.

1.	Katniss bought 3 pins: one with a star, a butterfly, and a mockingjay. She has a blue dress and a green dress. How many dress/pins combinations are possible?
2.	Cinna is trying to figure out what Katniss should wear for the interview. She can wear a blue, pink, purple, or red dress. Then she can either wear gold, silver, black, or white high heels. What are all the different combinations?
3.	The Final Four tributes in the Hunger Games were: Foxface, Cato, Peeta, and Katniss. What are all the possible combinations of first place and second place?
4.	Katniss and Gale take a quick trip to the Hob. Katniss has a choice to buy a rabbit, a leg of a wild dog, or a bowl of meat soup. She also has a choice of a free item with the meat: a district 12 token, an arrow, or a knife. What are all the combinations?
5.	Caesar Flickerman is making his yearly Hunger Games interview with the tributes. Caesar can dye his eyebrows mockingjay blue, amber red, or mockingjay pin gold. He can dye his hair President Snow white or Capitol rainbow. What are the combinations for Caesar?
6.	Katniss is at the cornucopia. She can get a square of plastic, a backpack, some bows and arrows, or a tent. Then she can either run the opposite direction of either Cato, Thresh, or Peeta. Next, she can be allies with the Careers or Rue. List all the possible outcomes.
7.	Katniss wanted to get rid of the Careers by throwing a tracker-jacker nest on them, destroying their food supply, or singing for them and damaging their ears. After this she is going to either leave them, throw them in a river, or go find Peeta. List the outcomes.
8.	The people who live in the Capitol are betting on who will win the Hunger Games. The tributes are Beth and Liz. After one wins, she will either be famous and rich, become known as the greatest person in the world, or be forgotten in a week. During the Games she would have run away, tried to fight, or lived in the trees. What is the probability of Liz winning, being known as the greatest person in the world, and living in the trees?

Activity 12-12: **Tree Diagrams and Outcomes** Name:

Create a tree diagram with titles or create an organized list/table of the outcomes possible. Then give the total number of outcomes.

1. Katniss has 3 bows to choose from: bronze, silver, and gold. She also has 3 arrows: sharp, pointy, and dull. How many different combinations can she make?

2. Katniss Everdeen is in the Hunger Games and needs to choose an ally and a bow. She's decided either Peeta, Rue, Foxface, or Thresh will be her ally. She will use either a longbow, crossbow, or a recurve bow. How many different combinations can she make?

3. Katniss and Peeta are at the training center for the Hunger Games. They can visit archery, knot tying, or camouflage before lunch break. Afterwards, they can go to spear throwing, knife throwing, or weight lifting. How many different ways can they visit the stations?

4. Katniss has to choose between marigolds, zinnias, roses, and tulips to adorn Rue. She also has to choose if she wants red, white, black, or gold. If she chooses zinnias she can't choose black or gold. She can't choose roses with gold. How many choices does she have?

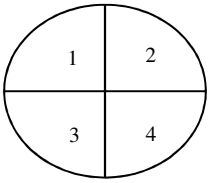
5. In the Hunger Games Katniss has 3 possible sponsors: a rich man, a Capitol woman, or anonymous. They can buy either a knife, a lamp, bread, or an exploding pineapple. What is the probability Katniss' first gift is an exploding pineapple given from an anonymous person?

6. Peeta Mellark has three different types of icing that are chocolate, cream cheese, and butter crème. He needs cake batter to go with the icing. His choices are red velvet, birthday cake, and strawberry. How many possible icing-batter outcomes are there?

7. If a coin is tossed three times to help determine which animal to unleash in the arena, which lists all the possible outcomes?

A HT, TH, HH, TT
B HHH, TTT, HHT, HTT
C HHT, HTH, HTT, THH, THT, TTH
D HHH, HHT, HTH, HTT, THH, THT, TTH, TTT

8. Cinna spins the spinner below to choose which dress for Katniss to wear. He will then flip a coin to determine which pair of shoes to go with it.



Which shows all the possible outcomes that could result?

A.

Spinner	1	2	3	4	1	2	3	4
Coin	H	T	H	T	H	T	H	T

B.

Spinner	1	2	3	4
Coin	H	T	H	T

C.

Spinner	1	2	3	4	1	2	3	4
Coin	H	H	H	H	T	T	T	T

D.

Spinner	1	2	3	4	1	2	3	4
Coin	H	H	T	T	H	H	T	T

Activity 12-13: **The Counting Principle** Name:

The Counting Principle uses multiplication to find the number of possible outcomes.

Event M followed by N can occur in $m \bullet n$ ways.

Example: The Capitol's Best Pizza serves 11 different kinds of pizza with 3 choices of crust and in 4 different sizes. How many different selections are possible?

Apply the Counting Principle: $11 \bullet 3 \bullet 4 = 132$ 132 pizza selections

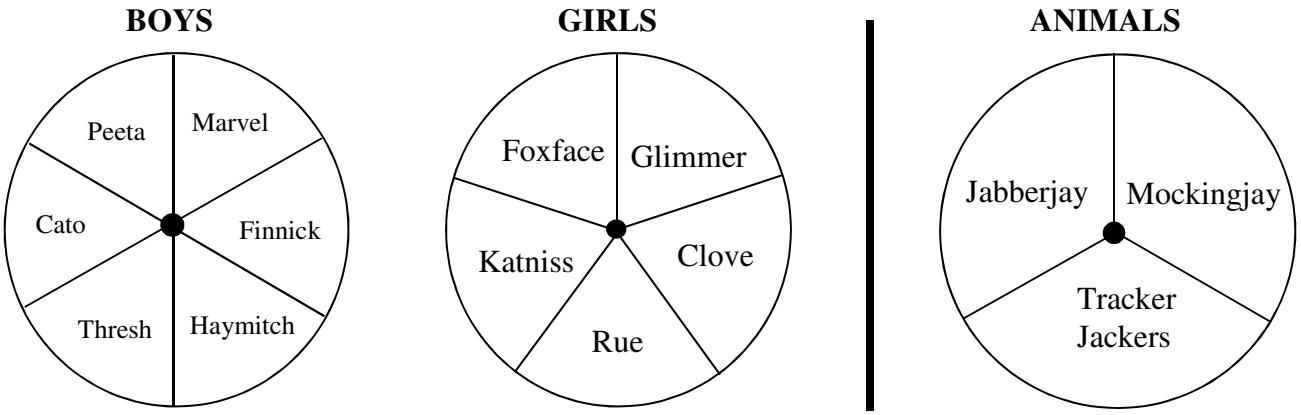
Use the Counting Principle to find the total number of outcomes in each situation.

1.	The Hob nursery has 14 different colored tulip bulbs. Each color comes in dwarf, average, or giant size. How many different kinds of bulbs are there?	
2.	The type of bicycle Prim wants comes in 12 different colors of trim. There is also a choice of curved or straight handlebars. How many possible selections are there?	
3.	At a tribute banquet, guests were given a choice of 4 entrees, 3 vegetables, soup or salad, 4 beverages, and 4 desserts. How many different selections were possible?	
4.	Gale is setting the combination lock on his briefcase. If he can choose any digit 0-9 for each of the 6 digits in the combination, how many possible combinations are there?	
5.	Mrs. Everdeen choosing a paint color from among 6 color choices, and choosing a wallpaper pattern from among 5 choices	
6.	Clove flipping a penny, a nickel, and a dime	
7.	Marvel choosing the last three digits in a five-digit zip code if the first digit is 6, the second digit is 1, and no digit is used more than once	
8.	Glimmer choosing one of three science courses, one of five math courses, one of two English courses, and one of four social studies courses	
9.	Rue choosing from one of three appetizers, one of four main dishes, one of six desserts, and one of four soft drinks	
10.	Cashmere choosing a book with a mystery, science-fiction, romance, or adventure theme, choosing one of five different authors for each theme, and choosing paperback or hardcover for the type of book	
11.	Brutus is choosing a 7 digit phone number if the first three-digit combination can be one of 8 choices and if the last four digits can be any combination of digits from 1 to 9 without any repeated digits	
12.	In the 1980's telephone area codes in the US contain three digits, they did not begin with a 1 or 0, and the middle digit was always a 0 or a 1. Mags said, "If that is true, each state in the USA could have less than 5 area codes and yet all the area codes could be used up." Is Mags correct?	

Activity 12-14: **Independent Events** Name:

HUNGER GAMES INDEPENDENT EVENTS

If the outcome of one event does not affect the outcome of a second event, the two events are **independent**. The probability of two independent events, A and B, is equal to the probability of event A times the probability of event B. $P(A, B) = P(A) \bullet P(B)$



1.	How many outcomes are possible when you spin all three spinners (hint: Counting Principle)	
2.	If you made a tree diagram showing all these outcomes, how many branches would show landing on Peeta, Foxface, and Mockingjay?	

For #3-10, the first two spinners above are spun. **Find the probability of each event.**

3.	P(Peeta, Katniss)		4.	P(Cato, Clove)	
5.	P(boy, girl)		6.	P(contains an E, starts with R)	
7.	P(ends with H, has exactly 2 vowels)		8.	P(double letters, double letters)	
9.	P(ends with consonant, Rue)		10.	P(not Cato, not Foxface)	

A third spinner is now added. **Write the expression and find the probability of each event.**

11.	P(Peeta, Katniss, Mockingjay)		
12.	P(Marvel, Glimmer, ends with "jay")		
13.	P(not Thresh, not Rue, not tracker jackers)		
14.	P(boy, girl, animal)		
15.	P(contains H, contains E, contains Y)		
16.	P(contains E, contains A, contains R)		
17.	P(not Marvel, Clove, not jabberjay)		

18.	If a 4th spinner was added above, would the probabilities of the four events happening increase or decrease? Why?	

Created by Lance Mangham, 6th grade math, Carroll ISD

Activity 12-15: **Independent Events** Name:

Show work on a separate sheet of paper.

A quarter and a dime are tossed. **Find the probability of each event.**

1.	P(T, H)		2.	P(both the same)	
3.	P(T, T)		4.	P(at least one head)	

Suppose you write each letter of "Effie Trinket" on a separate index card and select one letter from each name without looking. **Find the probability of each event.**

5.	P(vowel, vowel)		6.	P(consonant, vowel)	
7.	P(F, E)		8.	P(T, K)	

Peeta's bakery offers 5 kinds of muffins, one of which is blueberry. The bakery also offers 5 kinds of beverages, one of which is orange juice. **Find the probability of each event.**

9.	P(blueberry muffin)		10.	P(orange juice)	
11.	P(blueberry muffin and orange juice)		12.	P(blueberry muffin, some beverage other than orange juice)	

Suppose you toss a coin and pick a card from a pile of 16 cards, each printed with a letter from the name "Caesar Flickerman" **Find the probability of each of the following.**

13.	P(heads, M)		14.	P(tails, A)	
15.	P(tails, E)		16.	P(heads, vowel)	
17.	P(tails, consonant)		18.	P(heads, a letter in "wiress")	

President Snow spins a spinner with 4 equally likely outcomes: blue, red, yellow, and red. He will also roll a die. **Find the probability of each of the following.**

19.	P(blue, 2)		20.	P(blue, not 2)	
21.	P(yellow, even)		22.	P(red, even)	
23.	P(not blue, 5)		24.	P(not blue, odd)	

A bag contains 6 marbles: one black, 2 white, and 3 striped. Seeder picks one marble, replaces it, and then picks a second marble. **Find the probability of the following.**

25.	P(white, striped)		26.	P(not white, striped)	
27.	P(black, black)		28.	P(striped, striped)	
29.	P(white, not white)		30.	P(not white, not white)	

Activity 12-16: **Independent and Dependent Events** Name:

If the outcome of one event affects the outcome of a second event, the events are dependent.

The probability of two dependent events, A and B, is equal to the probability of event A times the probability of event B. However, the probability of event B now depends on event A.

$$P(A, B) = P(A) \bullet P(B)$$

Example: There are 6 black pens and 8 blue pens in a jar. Plutarch takes a pen without looking and then takes another pen without replacing the first, what is the probability he will get 2 black pens?

$$P(\text{black first}) = \frac{6}{14} \text{ or } \frac{3}{7} \qquad P(\text{black second}) = \frac{5}{13}$$

$$P(\text{black, black}) = \frac{3}{7} \bullet \frac{5}{13} \text{ or } \frac{15}{91}$$

Tell whether each event is independent or dependent.

1.	Haymitch (not good at fashion) selecting a sweater, selecting a shirt	
2.	Madge choosing one card from a deck then choosing a second card without replacing the first	
3.	Gale's wallet contains two $5 bills, two $10 bills, and three $20 bills. Two bills are selected without the first being replaced.	
4.	Alma Coin rolls two dice.	
5.	Annie choosing two cards from a deck so that they make a "pair".	
6.	Beetee selecting a DVD from a storage case and then selecting a second DVD after replacing the first	
7.	There are 20 letter tiles face down on the table. Prim knows that there is one X-tile and one J-tile. Prim picks two tiles at the same time. What is the probability that she will pick the X-tile and then the J-tile?	
8.	Squad 451 has 12 CD's in their car. They select one of the CD's while also selecting a beverage to drink at Starbucks.	

86% of Texas' 12th graders missed this STAAR problem.

9. Winners from the math club fund-raiser randomly select a gift-certificate from Box A and from Box B. The boxes are shown below.

BOX A	BOX B
5 dinner certificates	4 CD certificates
4 DVD certificates	3 camera certificates
3 movie certificates	5 amusement certificates
5 T-shirts certificates	5 TV certificates

What is the probability that the first winner will randomly select a DVD certificate and an amusement certificate?

A $\frac{20}{289}$ B $\frac{9}{17}$ C $\frac{9}{289}$ D $\frac{1}{19}$

F	I	N	N	I	C	K

Mags places the seven cards above into a box. She draws one card, does not replace it, and then draws another card. **Write both the expression and the answer.**

1.	P(N, N)		2.	P(C, F)	
3.	P(I, K)		4.	P(N, I)	
5.	P(C, D)		6.	P(N, not K)	

Wiress draws three cards and does not replace them. **Write both the expression and the answer.**

7.	P(F, I, N)		8.	P(N, I, N)	
9.	P(K, C, F)		10.	P(N, I, not F)	
11.	P(vowel, vowel, consonant)		12.	P(N, N, N)	

Beetee draws four or five cards and does not replace them. **Write both the expression and the answer.**

13.	P(F, I, N, N)		14.	P(N, I, C, K)	
15.	P(N, N, I, not I)		16.	P(K, C, F, I)	
17.	P(F, I, N, N, I)		18.	P(K, C, F, I, not N)	

Peeta and Katniss are both very hungry and could use a little snack. Use the table of probabilities to answer questions 1–3.

	Burrito	**Taco**	**Wrap**
Cheese	$P = \frac{1}{9}$	$P = \frac{1}{9}$	$P = \frac{1}{9}$
Salsa	$P = \frac{1}{9}$	$P = \frac{1}{9}$	$P = \frac{1}{9}$
Veggie	$P = \frac{1}{9}$	$P = \frac{1}{9}$	$P = \frac{1}{9}$

19. List the members of the sample space that include a taco. Use parentheses.

20. List the members of the sample space that include cheese. Use parentheses.

21. What is the probability of choosing a burrito with cheese or a taco or a wrap with salsa? Explain.

Based on historical records of the Hunger Games, the chance of getting a gift from your mentor any day is 20 percent. The simulation below models the experimental probability of getting a gift from a mentor in at least one of the next 5 days. The numbers 1 and 2 represent getting a gift. The numbers 3–10 represent not getting a gift.

Here is the table created. Fill in the missing data.

Trial	Numbers Generated	Gifts Received	Trial	Numbers Generated	Gifts Received
1	7, 3, 2, 7, 10		6	8, 4, 7, 6, 5	
2	2, 4, 5, 3, 10		7	6, 10, 1, 7, 6	
3	9, 9, 7, 6, 6		8	7, 9, 8, 3, 8	
4	7, 9, 6, 6, 4		9	1, 4, 4, 8, 9	
5	10, 6, 4, 6, 4		10	7, 8, 9, 5, 3	

1.	According to the simulation above, what is the experimental probability that a tribute will be receive a gift in at least one of the next 5 trials?	

2.	You have two six-sided dice. The first one contains the numbers 1, 4, 4, 4, 4, and 4. The second one contains the numbers 2, 2, 2, 5, 5, and 5. The dice are rolled and the highest number wins. Who is more likely to win and what is the probability of winning for that player?	
3.	Consider the following four dice and the numbers on their faces: Red : 0, 1, 7, 8, 8, 9 Blue: 5, 5, 6, 6, 7, 7 Green: 1, 2, 3, 9, 10, 11 Black: 3, 4, 4, 5, 11, 12 These are used to play a game for two people. Player 1 chooses one of the die to use for the game. Then player 2 chooses a die. Now each player rolls their die. The player with the highest number showing gets a point. The first player to 7 points wins the game. If you are player 1 which die should you choose? If you are player 2 which die should you choose?	
4.	The Monty Hall Problem: You have been selected to participate in a game show that offers you the chance to win a new car. The car is behind one of the three doors. A goat is behind each of the other two. You chose door #1 and that door stays closed for now. The host (who knows where the car is) does what he always does: he opens an unpicked door, in this case door #2, to show a goat. He then offers you a choice: Stay with door #1 or switch to door #3. Based on probability it is better to stay, switch, or it doesn't matter?	

Activity 12-19: **Odds** Name:

HUNGER GAMES ODDS

Based on past results, one can make an educated guess at the odds the boys and girls coming from each district have of winning. Boys tend to win more than girls and Districts 1, 2, and 4 win the most often.

Odds against winning the Hunger Games

[Odds against = number of failures to number of successes]

District Number	Male Odds	Female Odds	District Number	Male Odds	Female Odds
1	7-1	18-1	7	25-1	50-1
2	8-1	15-1	8	30-1	45-1
3	25-1	70-1	9	40-1	60-1
4	7-1	14-1	10	35-1	50-1
5	20-1	40-1	11	25-1	60-1
6	24-1	70-1	12	37-1	74-1

1.	Which tribute(s) has the best odds of winning?	
2.	As a fraction, what is the probability this tribute will win?	
3.	As a decimal, what is the probability this tribute will win?	
4.	Which tribute has the worst odds of winning?	
5.	As a fraction, what is the probability this tribute will win?	
6.	As a decimal (nearest thousandth), what is the probability this tribute will win?	
7.	Write your answer to #6 as a percentage.	
8.	Which tribute has a probability of winning of $\frac{1}{15}$?	
9.	Which female tribute has the best odds of winning?	
10.	Which tribute(s) has about a 5% chance of winning?	
11.	Which tribute is closest to a 2% chance of winning, without going under 2%?	
12.	Which tribute has a probability of losing of $\frac{35}{36}$?	
13.	List all of the tributes in order from most likely to win to least likely to win.	

PROBABILITY GAME

Mr. Mangham and Mrs. Fauatea are trying to come up with a new game for their students. In this particular game they want to use 3 dice and 2 quarters.

Eventually they come up with the following instructions:

1. Roll all three dice and find the sum.
2. Add an extra point for each heads when you flip the coins.
3. The highest sum is the winner.

After playing a few times they realize some of the problems with this game:

- The game only lasts 10 seconds and then it is over.
- The game is designed at the level of a first grader and not at the level of a sixth grader.
- In the game the dice are way more important than the coins.
- The game is boring because the players never get to make any decisions – it is 100% chance.

Luckily, Mrs. Fauatea and Mr. Mangham have creative, energetic students who will be able to come up with a much better game than the one above.

Your task is to **design a better game that solves the problems listed above.** The game should only use the 3 dice and 2 quarters, no additional objects (other than paper/pencil to keep score). The game should be able to be played with anywhere from 2 to 4 people.

What will you submit?

The next page with your directions and a gameplay example.

BONUS: A brief video of you playing your game with someone else (or you taking the role of both people) and explaining the rules/scoring.

Your grade is mainly based on this question, "Did you improve the 4 problems with the game listed above?"

The name of my new game: _____

Game Rules:

Example of a round of game play…show what players roll, flip, reroll/reflip (if part of your game), and then how they get their final score.

PLAYER 1	PLAYER 2
PLAYER 3	PLAYER 4