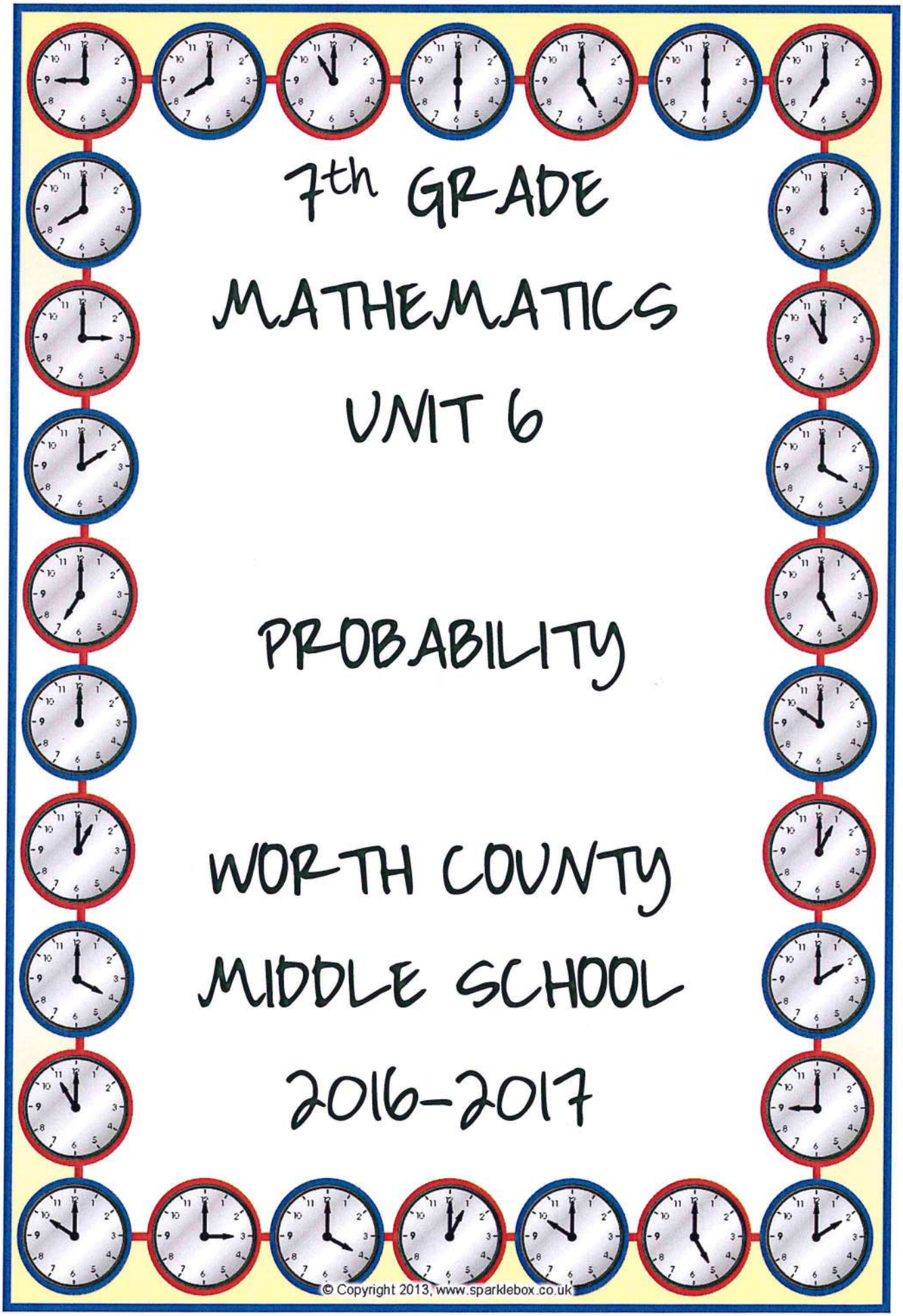


7th GRADE MATHEMATICS UNIT 6

PROBABILITY

WORTH COUNTY MIDDLE SCHOOL

2016-2017

STANDARDS FOR MATHEMATICAL CONTENT

MGSE7.SP.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

MGSE7.SP.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency. Predict the approximate relative frequency given the probability. For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.

MGSE7.SP.7 Develop a probability model and use it to find probabilities of events. Compare experimental and theoretical probabilities of events. If the probabilities are not close, explain possible sources of the discrepancy.

MGSE7.SP.7a Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.

MGSE7.SP.7b Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open - end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?

MGSE7.SP.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

MGSE7.SP.8a Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.

MGSE7.SP.8b Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.

MGSE7.SP.8c Explain ways to set up a simulation and use the simulation to generate frequencies for compound events. For example, if 40% of donors have type A blood, create a simulation to predict the probability that it will take at least 4 donors to find one with type A blood?

Unit 6 Probability: How can you predict the outcome of future events?

Overview	Simple Events	Theoretical & Experimental	Compound Events	Fundamental Counting Principle	Simulations	Independent & Dependent Events
Lesson Essential Question(s)	*Why must the numeric probability of an event be between 0 and 1? *What is the likeliness of an event occurring based on the probability near 0, ½, or 1? *How can you determine the likelihood that an event will occur? *How are the outcomes of given events distinguished as possible?	*What is the difference between theoretical and experimental probability?	*How can you represent the probability of compound events by constructing models? *How do I determine a sample space?	*How can you represent the probability of compound events by constructing models?	*What is the significance of a large number of trials? *How can I use probability to determine if a game is worth playing or to figure my chances of winning the lottery? * What is the process to design and use a simulation to generate frequencies for compound events?	*How can you determine the difference between independent and dependent events?
Vocabulary	Outcome Probability Simple Event Random Complementary Events	Uniform Probability Model Theoretical Probability Experimental Probability	Sample Space Tree Diagram Compound Event	Fundamental Counting Principle	Simulations	Independent Events Dependent Events
Standard	MGSE7SP5, MGSE7SP7	MGSESP7	MGSESP7, MGSESP8	MGSESP5, MGSESP8	MGSESP8	MGSESP8

LESSON 1: SIMPLE EVENTS

Events are subsets of the sample space:

- A **simple event** is an event (subset) containing only one outcome. For example,

$$E = \{(3, 2)\}$$

is a simple event.

- A **compound event** is an event (subset) containing more than one outcome. For example,

$$E = \{(3, 2), (4, 1), (5, 2)\}$$

is a compound event.

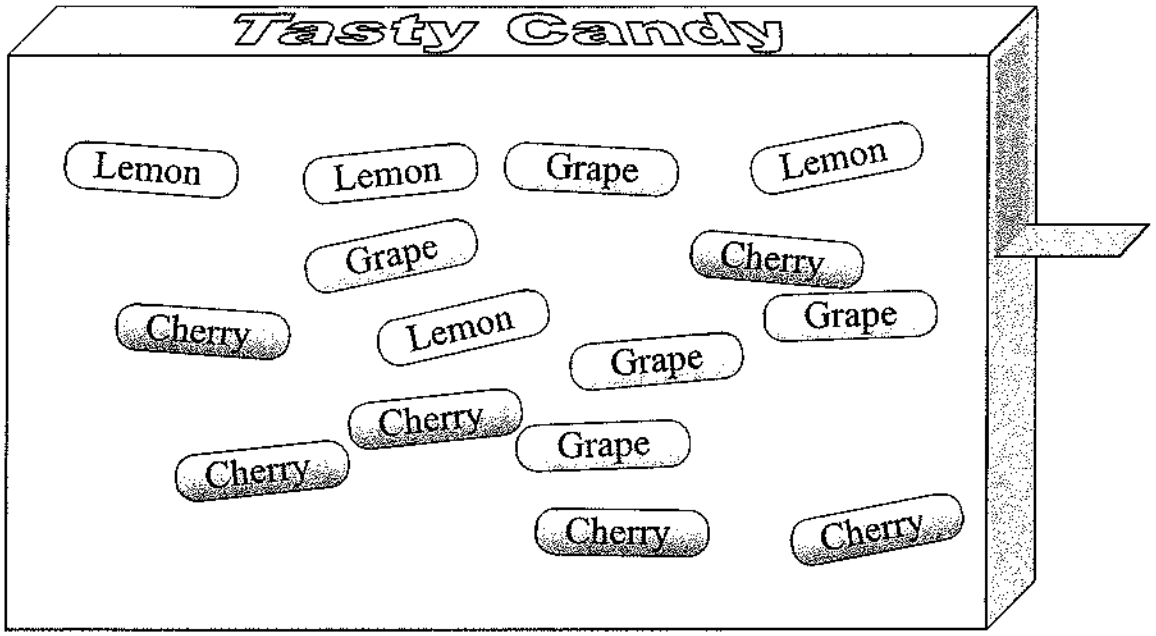
$$\text{Probability of an event} = \frac{\text{number of } \textit{successful} \text{ outcomes}}{\text{number of } \textit{possible} \text{ outcomes}}$$

$$\textit{Probability} = \frac{\textit{number of favorable outcomes}}{\textit{number of possible outcomes}}$$

Determining Probability with Candy

Name:

Use the candy box to solve each problem.



1) How many total pieces of candy are in the box?

2) What is the probability of selecting a cherry piece?

3) What is the probability of selecting a lemon piece?

4) What is the probability of selecting a grape piece?

5) If you picked 1 piece of candy out of the box which flavor would you have the highest probability of selecting?

6) Which flavor has the lowest probability of being selected?

7) If you picked a piece at random would you be more likely to select, a lemon piece or a cherry piece?

8) What is the probability of selecting either a cherry piece OR a grape piece?

9) Your friend wants either a cherry piece or a grape piece. If you picked a piece out randomly, which one would you have the highest probability of selecting?

10) If you ate 2 lemon pieces, 4 cherry pieces and 2 grape pieces, which flavor would you have the highest probability of selecting next?

Answers

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

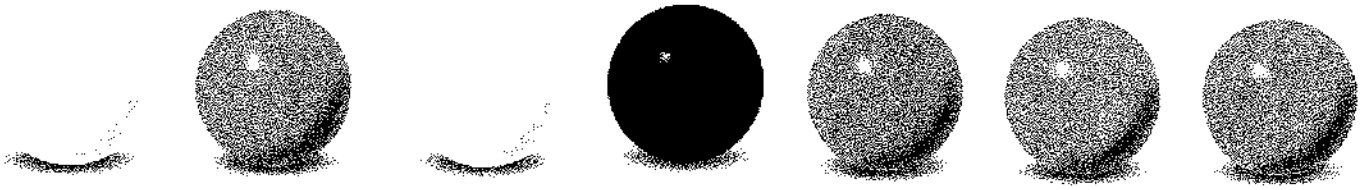
4

1-10	90	80	70	60	50	40	30	20	10	0

Name: _____

Probability

The marbles pictured below are gray, white, and black. They are placed in a bag and one is drawn at random.



1. Which color marble is least likely to be drawn from the bag? _____

2. What is the probability of drawing the black marble from the bag? _____

3. What is the probability of drawing a gray marble? _____

4. What is the probability of the drawing a white marble? _____

5. What is the probability of drawing a marble that is not white? _____

6. Would you be more likely to draw a marble that is not black or a marble that is not gray? Explain your answer.

_____

_____

_____

7. If three more black marbles were added to the bag, what would be the probability of drawing a black marble? _____

Name: _____

Probability

Color 4 marbles red, 3 marbles green, 1 marble yellow, and 1 marble blue.

The marbles you colored above are placed into a bag. One is drawn at random.

1. Which color marble is most likely to be drawn from the bag? _____
2. What is the probability of drawing the green marble from the bag? _____
3. What is the probability of drawing a yellow marble? _____
4. Which two colors have the same probability of being drawn? _____
5. What is the probability of drawing a marble that is not red? _____
6. Would you be more likely to draw a marble that is not green or a marble that is not blue? Explain your answer.

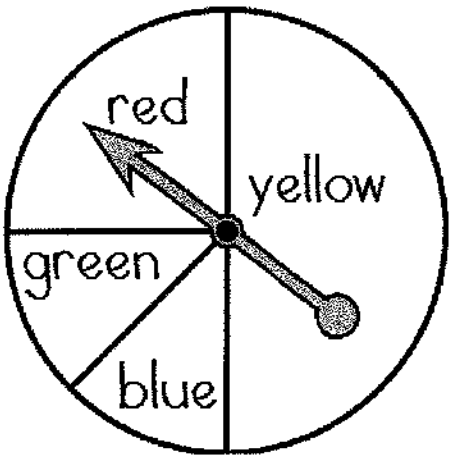
_____

_____

_____

Name: _____

Probability



1. What is the probability of the spinner landing on yellow? _____

2. What is the probability of the spinner landing on green? _____

3. What is the probability of the spinner landing on red? _____

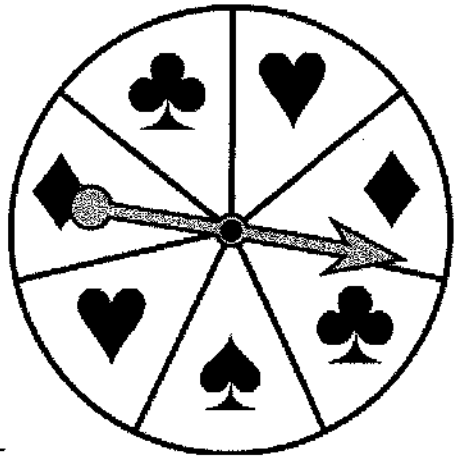
4. What is the probability of **not** spinning blue? _____

5. Ann says if you spin the spinner 80 times, it should land on red about 10 times. Do you agree with her? Explain.

_____

_____

_____



6. What is the probability of the spinner landing on a club? _____

7. What is the probability of the spinner **not** landing on a heart? _____

8. What is the probability of the spinner landing on a diamond or spade? _____

9. Do you have an equal chance of landing on any given symbol? Explain.

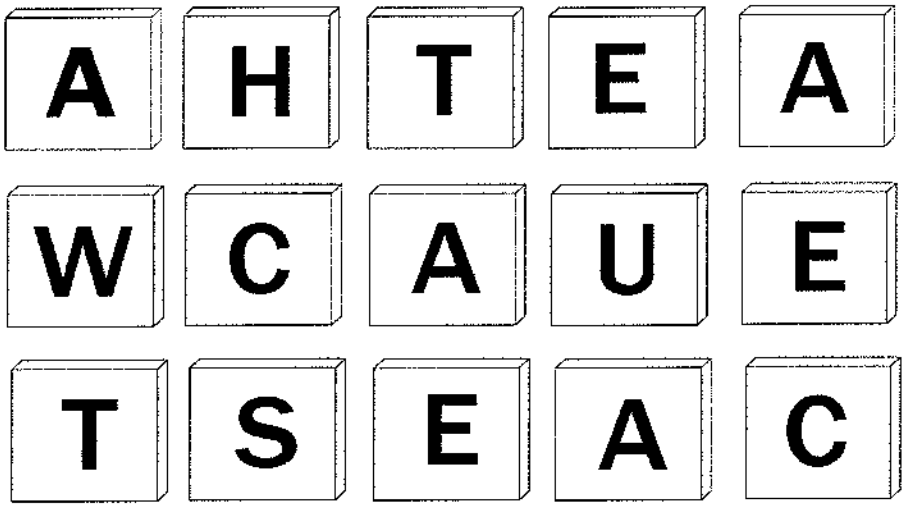
_____

_____

Name: _____

Probability: Letter Tiles

The letters tiles pictured to the right are placed in a bag. Without looking, Zachary draws them from the bag one at a time. Each time he draws one, he writes down the letter and places it back in the bag.



1. What is the probability that Zack will draw the letter T from the bag? _____

2. What is the probability that Zack will draw the letter A from the bag? _____

3. What is the probability that Zack will draw a vowel from the bag? _____

4. Is Zack more likely to draw a vowel or a consonant from the bag? _____

5. What is the probability of Zack drawing one of the letters found in the word cat? _____

6. What is the probability of Zack drawing one of the letters found in the word seat? _____

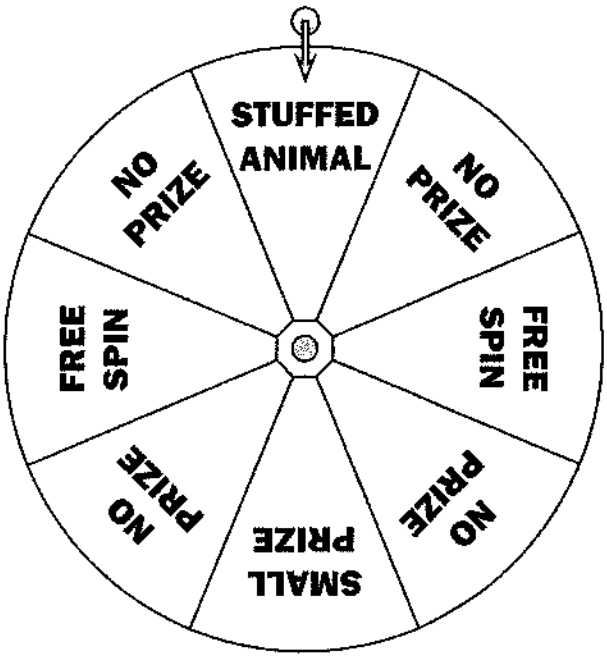
7. What is the probability of Zack drawing one of the letters found in the word cheat? _____

8. What is the probability of Zack drawing a letter that **is not** found in the word sauce? _____

Name: _____

The Prize Wheel & The Letter Cube

1. If you spin the wheel, what is the probability that the arrow will point to "stuffed animal"? _____

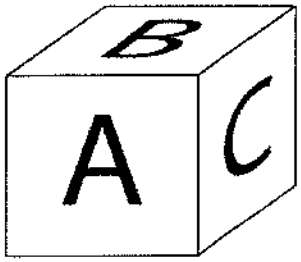


2. What is the probability that the arrow will point to "no prize"? _____

3. What is the probability that the arrow will point to "free spin"? _____

4. What is the probability of rolling a vowel? _____

5. What is the probability of rolling a consonant? _____



This cube has the letters A through F printed on it.

6. What is the probability of rolling one of the first three letters of the alphabet? _____

7. What is the probability of rolling the letter B or D? _____

Name: _____

Probability

The unusual die pictured at the right has 20 sides, numbered 1 through 20.

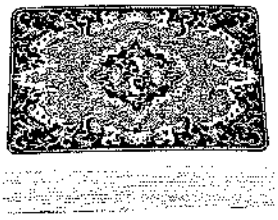
1. If you roll the die, what is the probability of rolling an odd number? _____

2. If you roll the die, what is the probability of rolling the a number greater than 9? _____

3. If you roll the die, what is the probability of rolling the a number less than 4? _____

There are 52 cards in the deck of playing cards pictures at the right. There are no jokers in the deck.

4. If you shuffle the deck of cards, and choose one at random, what is the probability that you will choose the queen of hearts? _____



5. If you shuffle the deck of cards, and choose one at random, what is the probability that you will choose a club? _____

6. If you shuffle the deck of cards, and choose one at random, what is the probability that you will choose a jack? _____

7. If you shuffle the deck of cards, and choose one at random, what is the probability that you will choose a black card? _____

Name: _____

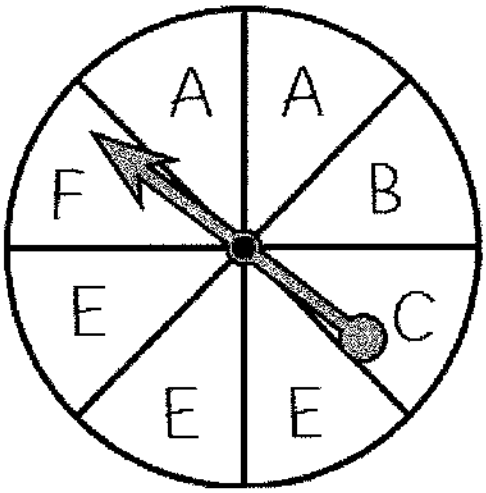
Probability

1. What is the probability of the spinner landing on C? _____

2. What is the probability of **not** spinning an C? _____

3. What is the probability of the spinner landing A or B? _____

4. What is the probability of the spinner landing on one of the first five letters of the alphabet? _____



5. Are you more likely to spin a vowel or a consonant? Explain.

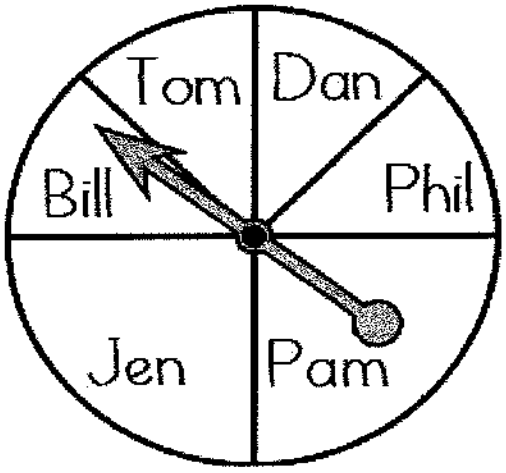
_____

_____

6. What is the probability of the spinner landing on Phil? _____

7. What is the probability of the spinner landing on Pam? _____

8. What is the probability of the spinner landing on a name that ends with the letter m? _____



9. Jen says, "There are 4 boys' names and 2 girls' names on the spinner. It's more likely to land on a boy's name than a girl's name." Is Jen correct? Explain.

_____

_____

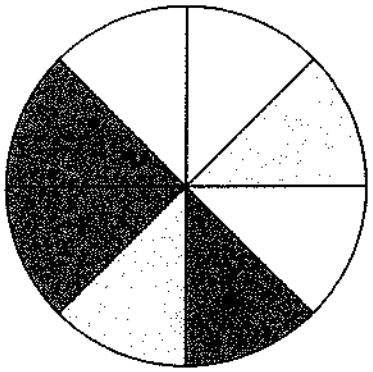
_____

Basic Probability

Name:

Use each diagram to solve the problems.

1) How many pieces are there total in the spinner?

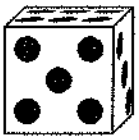


2) If you spun the spinner 1 time, what is the probability it would land on a gray piece?

3) If you spun the spinner 1 time, what is the probability it would land on a black piece?

4) If you spun the spinner 1 time, what is the probability it would land on a white piece?

5) If you spun the spinner 1 time, what is the probability of landing on either a gray piece or a white piece?

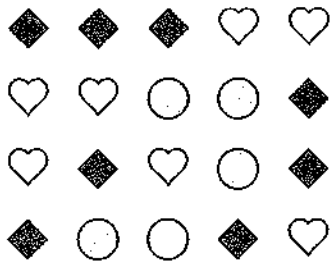


6) If you were to roll the dice one time what is the probability it will land on a 4?

7) If you were to roll the dice one time what is the probability it will NOT land on a 4?

8) If you were to roll the dice one time, what is the probability of it landing on an odd number?

9) How many shapes are there total in the array?



10) If you were to select 1 shape at random from the array, what is the probability it will be a diamond?

11) If you were to select 1 shape at random from the array, what shape do you have the greatest probability of selecting?

12) Which shape has a 35% chance (7 out of 20) of being selected?

Answers

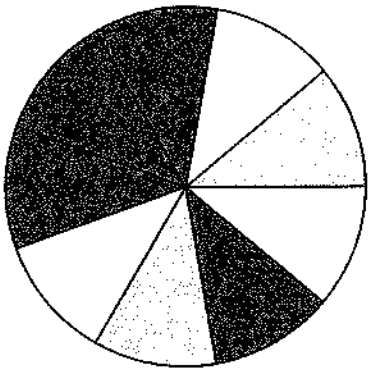
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

12

Math

1-10	92	83	75	67	58	50	42	33	25	17
11-12	8	0								

Use each diagram to solve the problems.



1) How many pieces are there total in the spinner?

2) If you spun the spinner 1 time, what is the probability it would land on a gray piece?

3) If you spun the spinner 1 time, what is the probability it would land on a black piece?

4) If you spun the spinner 1 time, what is the probability it would land on a white piece?

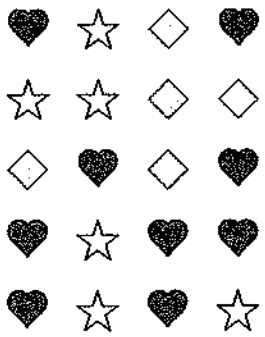
5) If you spun the spinner 1 time, what is the probability of landing on either a white piece or a gray piece?

6) If you were to roll the dice one time what is the probability it will land on a 1?

7) If you were to roll the dice one time what is the probability it will NOT land on a 4?

8) If you were to roll the dice one time, what is the probability of it landing on an even number?

9) How many shapes are there total in the array?



10) If you were to select 1 shape at random from the array, what is the probability it will be a heart?

11) If you were to select 1 shape at random from the array, what shape do you have the greatest probability of selecting?

12) Which shape has a 30% chance (6 out of 20) of being selected?

13

Answers

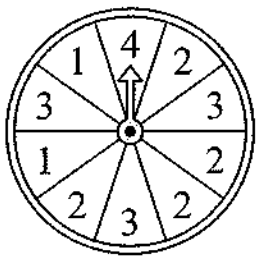
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

1-10	92	83	75	67	58	50	42	33	25	17
11-12	8	0								

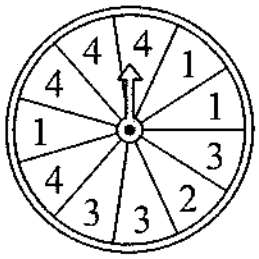
Determining Spinner Probability Name:

Solve each problem.

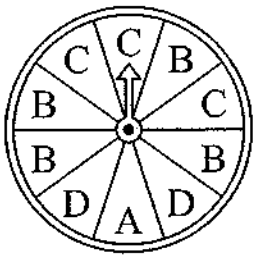
1) Which number is the spinner least likely to land on?



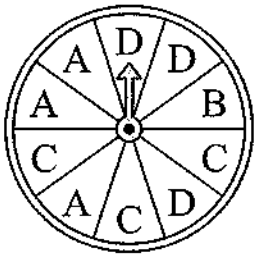
2) Which number is the spinner least likely to land on?



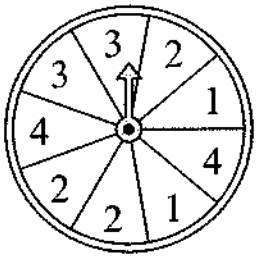
3) Which letter is the spinner least likely to land on?



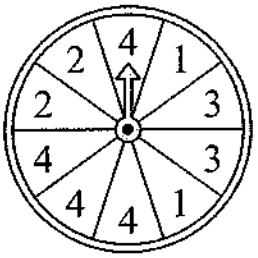
4) Which letter is the spinner least likely to land on?



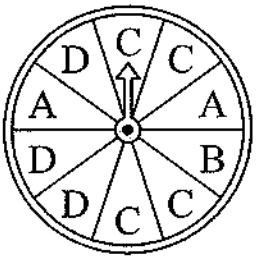
5) Which number is the spinner most likely to land on?



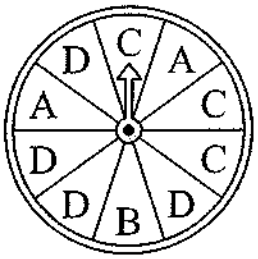
6) Which number is the spinner most likely to land on?



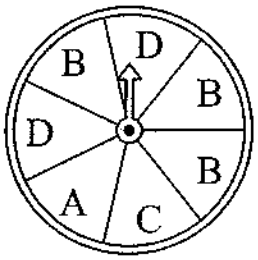
7) Which letter is the spinner most likely to land on?



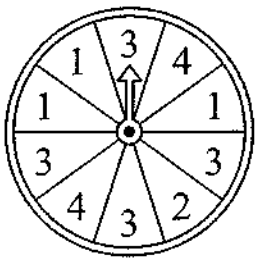
8) Which letter is the spinner most likely to land on?



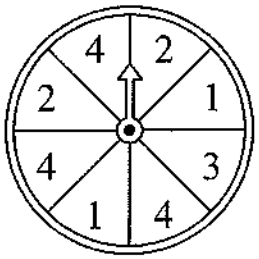
9) Which two letters is the spinner equally likely to land on?



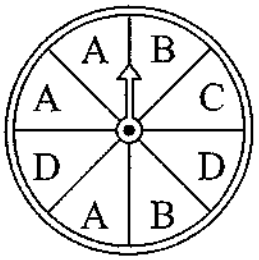
10) Which number is the spinner least likely to land on?



11) Which two numbers is the spinner equally likely to land on?



12) Which two letters is the spinner equally likely to land on?



Answers

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

14

1-10	92	83	75	67	58	50	42	33	25	17
11-12	8	0								

NAME _____

Lesson 1.1 Understanding Probability

An **outcome** is a possible result of an activity or experiment. **Probability** is a measure of how likely it is that a specific outcome will occur. To find probability, create a ratio comparing the number of a specific outcome with the total number of possible outcomes.

$$\text{Probability } (P) = \frac{\text{number of a specific outcome}}{\text{number of possible outcomes}}$$

A bag contains 12 marbles: 7 blue and 5 red. If you choose a marble at random, the probability that it will be red is:

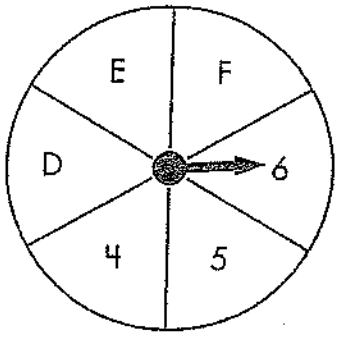
$$\text{Probability } (P) = \frac{5}{12} \begin{array}{l} \leftarrow \text{number of a specific outcome} \\ \leftarrow \text{number of possible outcomes} \end{array}$$

You can express probability as a ratio, fraction, decimal, or percent.

When tossing a coin, what is the probability that it will land on heads?	specific outcome: heads possible outcomes: heads, tails probability of heads: 1:2, $\frac{1}{2}$, 0.5, or 50%

Find the probability. Express your answer as a fraction in simplest form.

If you spin the spinner at right, what is the probability that the spinner will stop on each of the following?



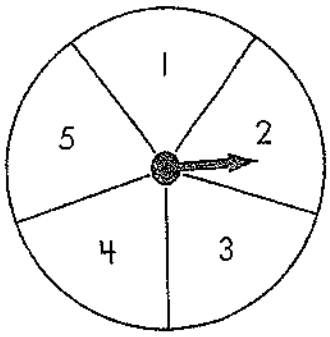
1. a number _____
2. an even number _____
3. an odd number _____
4. a consonant _____
5. a vowel _____
6. the number 6 _____
7. a number < 6 _____
8. a number > 6 _____

Pg 15

NAME _____

Lesson 1.1 Understanding Probability

Solve the problems based on one spin of the spinner. Express each probability as a fraction in simplest form.



1. The number of possible outcomes is _____.

2. The probability of stopping on 4 is _____.

3. The probability of stopping on an odd number is _____.

4. The probability of not stopping on an odd number is _____.

5. The probability of stopping on 5 or 3 is _____.

6. The probability of stopping on a number > 1 is _____.

Solve each problem. Express probabilities as fractions in simplest form.

A bag contains 3 pennies, 2 nickels, and 4 dimes. You will select a coin at random.

7. The probability that you will choose a nickel is _____.

8. The probability that you will choose either a penny or a dime is _____.

9. The probability that you will not choose a penny is _____.

10. The probability that you will choose a coin worth more than 10 cents is _____.

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NAME _____

Lesson 1.1 Understanding Probability

Solve each problem. Express each probability as a fraction in simplest form.

A box contains 3 red balls, 1 white ball, and 3 green balls. You pick one item at random.

11. The probability that you will choose 1 green ball is _____.

12. The probability that you will choose 1 white ball is _____.

The names of 8 girls and 7 boys are written on slips of paper, which are placed in a hat. The teacher will choose names at random to decide the order in which students will present their projects.

13. The probability that a girl will be chosen first is _____.

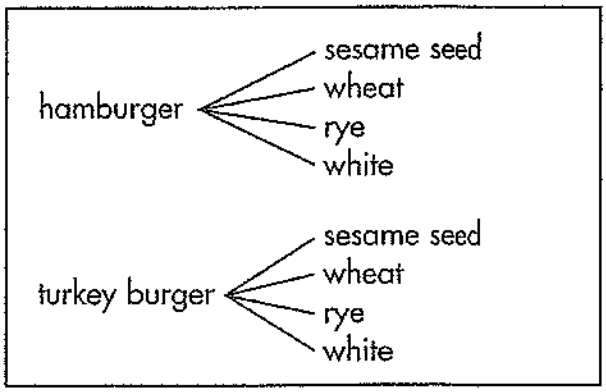
14. The probability that a boy will be chosen first is _____.

A snack shop sells hamburgers and turkey burgers with a choice of buns. The tree diagram shows all possible combinations. Use the diagram to answer the questions.

15. There are _____ possible combinations.

16. If you choose a sandwich at random, the probability that you will choose a turkey burger on a wheat bun is _____.

17. The probability that you will choose a sandwich on rye is _____.



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NAME _____

Lesson 1.2 Calculating Probability

An **event** is a set of possible outcomes from an activity or experiment. **Sample space** is the set of all possible outcomes of an activity or experiment. An event is a subset of sample space. Suppose you roll a 6-sided die once. The sample space is {1, 2, 3, 4, 5, 6}. You might roll a 2. Thus, one event of this experiment is {2}. If you roll the die twice, you might get a 3 and a 6. Thus, the set {3, 6} is one possible event of rolling the die twice.

Mutually exclusive events are events that cannot occur at the same time. If one event occurs, none of the other events will occur. If you roll a die and get a 6, you cannot get a 1, 2, 3, 4, or 5 at the same time.

If Events A and B are mutually exclusive, then the probability of A *or* B occurring is:

$$P(A) + P(B)$$

In one roll of a die, the probability of getting a 3 is $\frac{1}{6}$ and the probability of getting a 4 is also $\frac{1}{6}$. The probability of getting either a 3 or a 4 in one roll is $\frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$.

Complementary events are events that together make up the entire sample space. The probabilities of complementary events add up to 1, or 100%. Complementary events are mutually exclusive, but not all mutually exclusive events are complementary.

If A' is the complement of A, then the probability of A occurring is:

$$P(A) = 1 - P(A')$$

In one roll of a die, the probability of getting a 3 is $\frac{1}{6}$. Therefore, the probability of not getting a 3 is $1 - \frac{1}{6} = \frac{5}{6}$.

Determine each probability. Express your answer as a fraction in simplest form.

1. On one roll of a 6-sided die, what is the probability of getting a 1, 2, 4, or 6?

   The probability of getting a 1, 2, 4, or 6 is _____.

2. A bag holds 3 red marbles, 2 green marbles, and 3 black marbles. What is the probability of not choosing a black marble?

   The probability of not choosing a black marble is _____.

3. Events A and B are mutually exclusive. $P(A) = \frac{3}{10}$. P(B) is $\frac{1}{5}$. What is the probability that either A or B will occur?

   P(A) or P(B) is _____.

4. Events X, Y, and Z are complementary. $P(X) = \frac{1}{8}$. $P(Y) = \frac{1}{2}$. What is the probability that Z will occur?

   P(Z) is _____.

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NAME _____

Lesson 1.2 Calculating Probability

Probability can also be thought of as the ratio of desired outcome(s) to the sample space. It can be expressed as a ratio, fraction, decimal, or percent.

When tossing a coin, what is the probability that it will land on heads?

desired outcome: heads sample space: heads, tails probability: 1:2, $\frac{1}{2}$, 50%, 0.5

Find the probability. Write answers as fractions in simplest form.

A box contains 3 red pencils, 4 blue pencils, 2 green pencils, and 1 regular pencil. If you take 1 pencil without looking, what is the probability of picking each of the following?

1. a red pencil _____

2. a blue pencil _____

3. a green pencil _____

4. a regular pencil _____

If you spin the spinner shown at the right, what is the probability of the spinner stopping on each of the following?

5. a letter _____

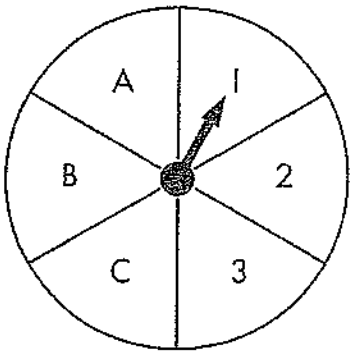
6. an odd number _____

7. an even number _____

8. a vowel _____

9. the number 3 _____

10. a consonant _____



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Name _____ Date _____ Class _____

LESSON 14-1

Experimental and Theoretical Probability

Practice A: Probability

Match each event to its likelihood.

1. rolling a number greater than 6 on a number cube labeled 1 through 6 _____
2. flipping a coin and getting heads _____
3. drawing a red or blue marble from a bag of red marbles and blue marbles _____
4. spinning a number less than 3 on a spinner with 8 equal sections marked 1 through 8 _____
5. rolling a number less than 6 on a number cube labeled 1 through 6 _____

A likely
B unlikely
C as likely as not
D impossible
E certain

Solve.

6. A bag contains 4 red marbles, 3 green marbles, and 2 yellow marbles. The probability of randomly picking a yellow marble is $\frac{2}{9}$. What is the probability of not picking a yellow marble? _____

7. A number cube is labeled 1 through 6. The probability of randomly rolling a 4 is $\frac{1}{6}$. What is the probability of not rolling a 4? _____

Tell whether the event is impossible, unlikely, as likely as not, likely, or certain.

8. Janelle almost never eats beef. On Monday, the school cafeteria offers three main choices. The choices are hamburger, tuna, or a turkey sandwich. Estimate the probability that Janelle will choose a hamburger. _____

9. Tyrone rides his bicycle to school if he gets up by 7:15 A.M. Tyrone gets up by 7:15 A.M. about half the time. Estimate the probability that Tyrone will ride his bicycle to school. _____

Name _____ Date _____ Class _____

LESSON 14-1

Experimental and Theoretical Probability

Practice B: Probability

Determine whether each event is impossible, unlikely, as likely as not, likely, or certain.

1. rolling an even number on a number cube labeled 1 through 6 _____
2. picking a card with a vowel on it from a box of cards in which each letter of the alphabet is written on a card _____
3. spinning a number greater than 2 on a spinner with 10 equal sections marked 1 through 10 _____
4. drawing a red marble from a bag of black, blue, and green marbles _____
5. flipping a coin and getting heads or tails _____
6. rolling a number that is less than three 5 times in a row on a number cube labeled 1 through 6 _____

Solve.

7. A bag contains 3 green marbles, 7 blue marbles, and 2 black marbles. The probability of randomly picking a green marble is $\frac{1}{4}$. What is the probability of not picking a green marble? _____
8. A spinner has 8 equal sections labeled 1 through 8. The probability of spinning a number that is greater than or equal to 6 is $\frac{3}{8}$. What is the probability of spinning a number that is not greater than or equal to 6? _____
9. The probability of randomly drawing a red card from a bag that contains red, blue, and green cards is $\frac{3}{10}$. What is the probability of not drawing a red card? _____
10. Myra almost always spends at least 45 minutes on the treadmill. If Myra got on the treadmill at 5:20 P.M., estimate the probability that she will still be on the treadmill at 6:00. _____
11. Morris rarely arrives home before 4:00 P.M. It is now 3:20 P.M. Estimate the probability that Morris will arrive home in the next 30 minutes. _____

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IB MS II Probability Worksheet #1 Name: _____

1) A bag contains 2 blue marbles and 5 red marbles. Consider drawing marbles (no replacement). Find the probability of drawing

a) a red marble first and then a blue marble second;
b) a blue marble second given that a red marble was drawn first.

2) A sock is drawn from a drawer containing 6 black socks, 4 tan socks, and 2 white socks. Find the probability that a sock drawn at random is

a) either a black sock or a white sock;
b) not a black sock or a white sock.

3) A standard 52-card deck is shuffled and 2 cards are picked from the top of the deck. Find the probability that both cards are diamonds (diamond 1st and diamond 2nd).

4) A class has 12 boys and 3 girls. If three students are selected at random (without replacement) from the class, what is the probability that they are all boys (boy 1st and boy 2nd and boy 3rd)?

5) In a class of 30 students, there are 17 girls and 13 boys. Five of the students are "A" students, and three of these "A" students are girls. If a student is chosen at random, what is the probability of choosing a girl or an "A" student?

6) If one card is randomly picked from a standard deck of 52 cards, find the probability that the card will be a 2, 3, 4, 5, 6, 7, 8, 9, 10 or a heart.

7) A fair, ten-sided die was rolled. Find the conditional probability that the number rolled was less than 5, given that the number rolled was even.

8) Two distinguishable, fair, six-sided dice are rolled.

a) State the sample space.

b) What is the probability of getting a sum of 2?

Let A = sum of dice is 7 and B = at least one of the dice shows a two.

c) Find P(A).

d) Find P(B).

e) Are Event A and Event B mutually exclusive?

f) Find P(A or B).

g) Find P(B|A). Try using a "common sense" approach and a formula.

h) Compare P(B) to P(B|A). Are these events independent?

9) A professor has noticed that even though attendance is not a component of the grade for his class, students who attend regularly obtain better grades. In fact, the probability of attending regularly and receiving an "A" is 0.4, while the probability of not attending regularly and receiving an "A" is 0.1. The probability of attending class regularly is 0.7. Find the probability of

a) a student receiving an "A" <u>given</u> that he/she attends class regularly;
b) a student receiving an "A" <u>given</u> that he/she does not attend class regularly.

10) A basket of fruit contains 3 oranges, 1 apple, and 5 bananas. If two pieces of fruit are selected randomly, without replacement, find the probability of choosing

a) 2 oranges;
b) a banana and then an orange;
c) 2 apples.

*BONUS: Find the probability of drawing an apple and an orange, <u>in either order</u>.

Name : _____ Score : _____

Teacher : _____ Date : _____

Word Problems

1) The sum of three consecutive numbers is 102.
What is the smallest of the three numbers ? _____

2) Sam spent half of his allowance going to the movies. He washed the family car and earned 9 dollars. What is his weekly allowance if he ended with 18 dollars ? _____

3) Sally bought a soft drink for 3 dollars and 5 candy bars. She spent a total of 23 dollars. How much did each candy bar cost ? _____

4) The sum of three consecutive odd numbers is 165.
What is the smallest of the three numbers ? _____

5) On Monday, 254 students went on a trip to the zoo. All 6 buses were filled and 8 students had to travel in cars. How many students were in each bus ? _____

6) Sally sold half of her comic books and then bought 6 more. She now has 11. How many did she begin with ? _____

7) Nancy had 103 dollars to spend on 6 books. After buying them she had 13 dollars. How much did each book cost ? _____

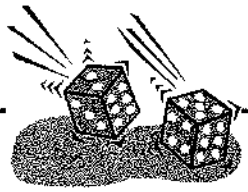
8) Fred bought 4 new baseball trading cards to add to his collection. The next day his dog ate half of his collection. There are now only 35 cards left. How many cards did Fred start with ? _____

9) The sum of three consecutive even numbers is 138.
What is the smallest of the three numbers ? _____

10) Oceanside Bike Rental Shop charges a 11 dollar fixed fee plus 6 dollars an hour for renting a bike. Jessica paid 65 dollars to rent a bike. How many hours did she pay to have the bike checked out ? _____

Name: _____

Probability



1. If you roll a die, what are the chances of rolling a two? answer: _____

2. If you roll a die, what is the probability that you will roll an even number? answer: _____

3. A bag contains 3 red marbles, 3 blue marbles, and 1 green marble. If a marble is drawn from the bag at random, what is the probability that the marble will be blue? answer: _____

4. A bag contains 6 number tiles. The numbers in the bag are 3, 7, 8, 9, 13, and 15. If you randomly draw one tile from the bag, what is the probability of picking an odd number? answer: _____

5. Mr. Jones has a hot air balloon. Because the basket is so small, he can take one child for a ride with him. Mary, Carla, John, Lynda, Peter, and Janessa all want to go. They each write their name on a piece of paper and place them in a hat. Mr. Jones randomly selects one child to go with him.

What is the probability that he will select a boy? answer: _____

What is the probability that he will select a girl? answer: _____

6. John and Jackie are rolling a die. John wins if he rolls a number higher than 4. Jackie wins if the number rolled is 4 or less. Is this game fair? Explain.

_____

_____

_____

Pre-AP Algebra 2
April 16, 2009

Theoretical & Experimental Probability Notes

- **Probability:**
  the measure of how likely an event it to occur
- **Outcome:**
  each possible result of a probability experiment
- **Sample Space:**
  the set of all possible outcomes
- **Event:**
  an outcome or set of outcomes
- **Equally Likely Outcomes:**
  the outcomes have the same chance of occurring
- **Favorable Outcomes:**
  outcomes in a specified event
- **Theoretical Probability:**
  the ration of the number of favorable outcomes to the total number of outcomes

Experimental probability is the result of an experiment or simulation after a large number of times.	Theoretical probability is what is expected to happen based on the possible outcomes, assuming equally likely events.

Theoretical

Theoretical probability is used to estimate probabilities when the outcomes are equally likely (what should happen!)

Example: There are 20 jellybeans in a jar (5 blue, 5 red, 5 orange, 5 yellow). If I pull 4 jellybeans out, what should happen?

Try...
If the numbers 0-9 are written on slips of paper and placed in a hat, what is the theoretical probability of selecting the 4?

When flipping a coin, what is the theoretical probability of it landing on tails?

13-2 Theoretical and Experimental Probability

Check It Out! Example 5a

The table shows the results of choosing one card from a deck of cards, recording the suit, and then replacing the card.

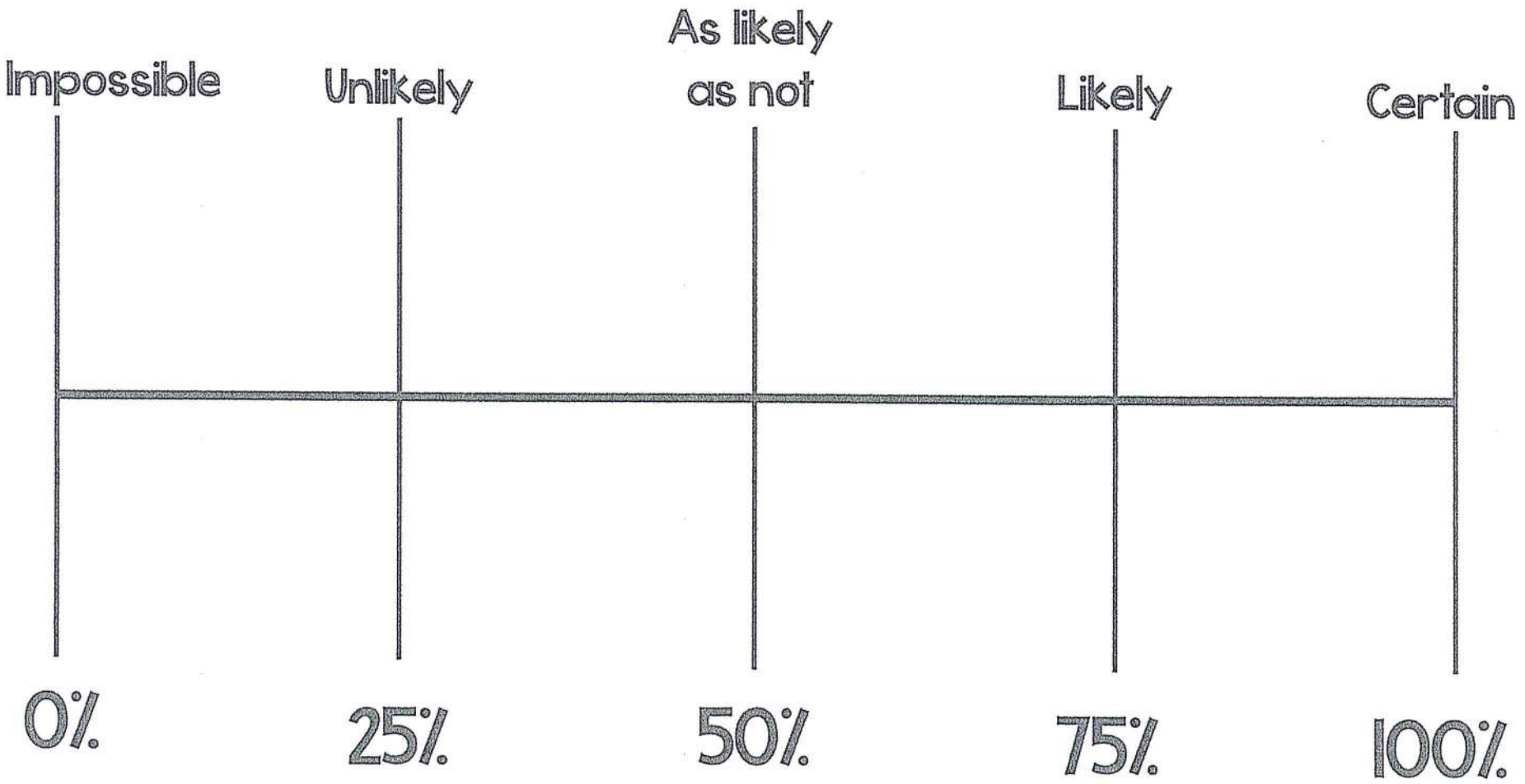
Card Suit	Hearts	Diamonds	Clubs	Spades
Number	5	9	7	5

Find the experimental probability of choosing a diamond.

The outcome of diamonds occurred 9 of 26 times.

$$P(\text{diamonds}) = \frac{9}{26}$$

Probability Anchor Chart



Name _____ Date _____ Class _____

LESSON 14-2

Experimental and Theoretical Probability

Practice A: Experimental Probability

Find the experimental probability in the box. Each answer can be used only once.

$\frac{4}{11}$	$\frac{7}{9}$	$\frac{11}{15}$	$\frac{2}{9}$	$\frac{4}{15}$	$\frac{7}{11}$

1. Jolene is playing basketball. She scores on 11 out of the 15 baskets she shoots.

   a. What is the experimental probability that Jolene will get a basket on the next shot? _____

   b. What is the experimental probability that Jolene will not get a basket on the next shot? _____

2. Jamie is playing baseball. He gets a hit 7 out of 9 times at bat.

   a. What is the experimental probability that Jamie will get a hit his next time at bat? _____

   b. What is the experimental probability that Jamie will not get a hit his next time at bat? _____

3. Lou Ann is practicing for an archery tournament. She hits the target 7 out of 11 times.

   a. What is the experimental probability that Lou Ann will hit the target on the next shot? _____

   b. What is the experimental probability that Lou Ann will not hit the target on the next shot? _____

Find the experimental probability. Write your answer as a fraction, as a decimal, and as a percent.

4. A batter gets 6 hits in 12 times at bat. What is the experimental probability that she will get a hit in her next time at bat? _____

5. A goalie blocks 16 out of 20 shots. What is the experimental probability that he will block the next shot? _____

Name _____ Date _____ Class _____

LESSON 14-2

Experimental and Theoretical Probability

Practice B: Experimental Probability

Find the experimental probability. Write your answer as a fraction, as a decimal, and as percent.

1. Jaclyn is a soccer goalie. If she has 21 out of 25 saves in practice, what is the experimental probability that she will have a save on the next shot on goal? _____

2. If Harris hit the bull's-eye 3 out of 8 times at archery practice, what is the experimental probability that he will hit the bull's-eye on his next try? _____

3. Nathan inspects new pants at a factory. Of the first 56 pairs of pants he inspected 49 were acceptable. What is the experimental probability that the next pair of pants will be acceptable? _____

4. Sara has gone to work for 60 days. On 39 of those days she arrived at work before 8:30 A.M. On the rest of the days she arrived after 8:30 A.M. What is the experimental probability that she will arrive at work after 8:30 A.M. the next day she goes to work? _____

Solve.

5. After a movie premiere, 99 of the first 130 people surveyed said they liked the movie.

   a. What is the experimental probability that the next person surveyed will say he or she liked the movie? _____

   b. What is the experimental probability that the next person surveyed will say he or she did not like the movie? _____

6. For the past 30 days, Naomi has been recording the number of customers at her restaurant between 10 A.M. and 11 A.M. During that hour, there have been fewer than 20 customers on 25 out of 30 days.

   a. What is the experimental probability that there will be fewer than 20 customers on the thirty-first day? _____

   b. What is the experimental probability that there will be 20 or more customers on the thirty-first day? _____

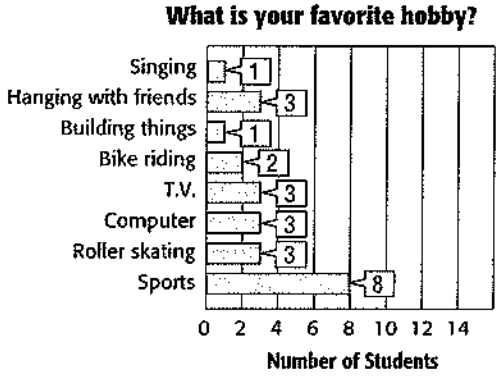
7. For the past four weeks, Nestor has been recording the daily high temperatures. During that time, the high temperature has been below 45° on 20 out of 28 days. What is the experimental probability that the high temperature will be below 45° on the twenty-ninth day? _____

NAME _____ DATE _____ PERIOD _____

Problem-Solving Practice

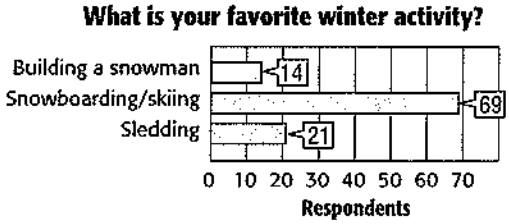
Theoretical and Experimental Probability

HOBBIES For Exercises 1–4, use the graph of a survey of 24 seventh-grade students asked to name their favorite hobby.



1. What is the probability that a student's favorite hobby is roller skating? $\frac{1}{8}$	**2.** Suppose 200 seventh-grade students were surveyed. How many can be expected to say that roller skating is their favorite hobby? **25**
3. Suppose 60 seventh-grade students were surveyed. How many can be expected to say that bike riding is their favorite hobby? **5**	**4.** Suppose 150 seventh-grade students were surveyed. How many can be expected to say that playing sports is their favorite hobby? **50**

WINTER ACTIVITIES For Exercises 5 and 6, use the graph of a survey with 104 responses in which respondents were asked about their favorite winter activities.



5. What is the probability that someone's favorite winter activity is building a snowman? Write the probability as a fraction. $\frac{7}{52}$	**6.** If 500 people had responded, how many would have been expected to list sledding as their favorite winter activity? Round to the nearest whole person. **101**

Name: _____

Section 12.7: Experimental Probability Worksheet

1.) What is the theoretical probability that an even number will be rolled on a number cube?

Number on Cube	Frequency
1	8
2	3
3	9
4	6
5	4
6	6

2.) What was the experimental probability of how many times an even number was actually rolled using the table?

3.) If you roll a number cube 36 times, how many times would you expect to roll the number one?

4.) How many times did you actually roll the number one in the experiment?

5.) What is the theoretical probability for rolling a number greater than 4?

6.) What was the experimental probability of rolling a number greater than 4?

7.) What is the difference between theoretical and experimental probability?

8.) If a car factory checks 360 cars and 8 of them have defects, how many will have defects out of 1260?

9.) If a car factory checks 320 cars and 12 of them have defects, how many out of 560 will **NOT** have defects?

10.) You plant 30 African violet seeds and 9 of them sprout. Use experimental probability to predict how many will sprout if you plant 20 seeds?

Disjoint vs. Overlapping events:

11.) If you are picking a number between 1-20 what is the probability that you will pick a number greater than 14 or less than 4?

12.) If you are picking a number between 1-20 what is the probability that you will pick an even number or a multiple of three?

13.) If you are picking a number between 1-20 what is the probability that you will pick a multiple of two or a number greater than 15?

NAME _____

Lesson 1.5 Comparing Experimental and Theoretical Probabilities

Probability is a number between 0 and 1—written as a fraction, a decimal, or a percent—that gives the likelihood of an event occurring. An event is a situation that can occur in different ways. The possible ways that an event can occur are called **outcomes**. **Theoretical probability** can be defined as $\frac{\text{\# of desired outcomes}}{\text{total \# of outcomes}}$.

Experimental probability is probability that is based on a certain number of events or **trials** that have been conducted in an experiment. **Relative frequency** is the observed number of successful trials divided by the total number of trials. Experimental probability can be defined as $\frac{\text{\# of successful trials}}{\text{total \# of trials}}$. As the number of trials increases, the experimental probability gets closer to the theoretical probability. This phenomenon is called the **Law of Large Numbers.**

For example, the theoretical probability of flipping heads on a coin is $\frac{1}{2}$ or 50%. Suppose you flipped a coin 20 times and 5 out of those times the coin landed on "heads." The experimental probability is $\frac{5}{20} = \frac{1}{4}$. This is smaller than the theoretical probability of $\frac{1}{2}$. The Law of Large Numbers states that as you increase the number of trials, the experimental probability gets closer to the theoretical probability. So for this example, if the number of trials is increased, the experimental probability would get closer to $\frac{1}{2}$.

Find the following experimental probabilities. Express each probability as a fraction in simplest form.

1. Out of 90 raffle tickets for a free visit to a salon, 15 are winners. What is the experimental probability of winning a free visit? _____

2. The experimental probability of an event occurring is 75%. If the number of trials is 120, what is the number of trials for which the event does *not* occur? _____

3. There are 30 people in a movie theater, 18 of whom are male. What is the probability that the next person who comes into the theater will be a woman? _____

Find the following theoretical probabilities. Express each probability as a fraction in simplest form.

4. For a 12-month calendar, what is the probability of turning to the month of February or September? _____

5. If a card is drawn from a stack of cards numbered 1 through 10, what is the probability of selecting a card greater than 6? _____

6. What is the probability of flipping a coin to heads twice? _____

NAME _____

Lesson 1.5 Comparing Experimental and Theoretical Probabilities

Compare the theoretical probability to the experimental probability. Express each probability as a fraction in simplest form.

7. Allison rolls a die numbered 1 through 6. The results are shown in the table below.

Result	Frequency
1	4
2	9
3	7
4	8
5	5
6	3

a. What is the experimental probability of rolling a 6?

_____

b. What is the theoretical probability of rolling a 6? _____

c. Which probability is greater? _____

How much greater? _____

d. What is the experimental probability of rolling an even number? _____

e. What is the theoretical probability of rolling an even number? _____

f. Which probability is greater? _____ How much greater? _____

8. Allison continues to roll the die. The results are shown in the table below.

Result	Frequency
1	23
2	22
3	22
4	25
5	28
6	24

a. What is the experimental probability of rolling a 6?

_____

b. What is the theoretical probability of rolling a 6? _____

c. Which probability is greater? _____

How much greater? _____

d. What is the experimental probability of rolling an even number? _____

e. What is the theoretical probability of rolling an even number? _____

f. Which probability is greater? _____ How much greater? _____

Name _____ Date _____ Class _____

LESSON 14-3

Experimental and Theoretical Probability

Practice A: Sample Spaces

1. Lindsay flips a coin and rolls a 1–6 number cube at the same time. What are the possible outcomes?

_____

_____

2. Jordan has a choice of wheat bread or rye bread and a choice of turkey, ham, or tuna for lunch. What are all the possible choices of sandwiches he can have?

_____

_____

3. Marisol has to decide whether to study Italian, French, or Spanish, and whether to take golf, tennis, or archery in gym class. What are the possible choices that Marisol has?

_____

_____

_____

Choose the letter for the best answer.

4. Chad and Victoria are playing a game with a quarter and a spinner divided into sixths, numbered 1–6. Each player spins the spinner and tosses the coin. How many outcomes are possible in the game?

A 2 C 10

B 8 D 12

5. For a snack, Sophie can choose milk, apple juice, orange juice, or punch. To go with her drink, she can choose a chocolate cupcake, oatmeal cookie, or crackers. How large is the sample space?

F 12 H 4

G 7 J 3

6. Marva has a spinner divided into fourths and a 1–6 number cube. She spins the spinner and rolls the number cube. How many outcomes are possible in the game?

A 4 C 10

B 6 D 24

7. Larry has a choice of vanilla, chocolate, or strawberry ice cream. The choices of toppings are nuts, sprinkles, or coconut. How many one-topping sundaes can he make?

F 3 H 9

G 6 J 12

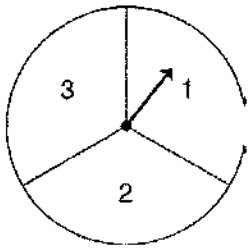
Name _____ Date _____ Class _____

LESSON 14-3

Experimental and Theoretical Probability

Practice B: Sample Spaces

1. Marcus spins the spinner at the right and flips a dime at the same time. What are the possible outcomes? How many outcomes are in the sample space?



_____

_____

2. For lunch, Britney has a choice of a hot dog, a hamburger, or pizza and a choice of an apple, a pear, or grapes. What are all the possible choices of lunch she can have? How many outcomes are in the sample space?

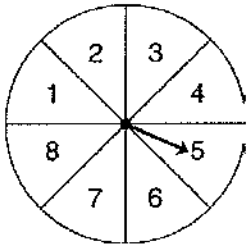
_____

_____

_____

_____

3. Susan and Ryan are playing a game that involves spinning the spinner at the right and flipping a penny. How many outcomes are possible in the game?



_____

4. An Italian restaurant offers small, medium, and large calzones. The choices of fillings are cheese, sausage, spinach, or vegetable. How many different calzones can you order?

_____

5. There are 5 ways to go from Town X to Town Y. There are 3 ways to go from Town Y to Town Z. How many different ways are there to go from Town X to Town Z, passing through Town Y?

_____

6. Rasheed has tan pants, black pants, gray pants, and blue pants. He has a brown sweater and a white sweater. How many different ways can he wear a sweater and pants together?

_____

Name _____ Date _____ Class _____

LESSON 14-4

Experimental and Theoretical Probability

Practice A: Theoretical Probability

Tina has 3 quarters, 1 dime, and 6 nickels in her pocket. Find the probability of randomly choosing each of the following coins. Write your answer as a fraction, as a decimal, and as a percent.

		Fraction	Decimal	Percent
1.	quarter			
2.	dime			
3.	nickel			

Find the probability of each event. Write your answer as a fraction, as a decimal, and as a percent. Round to the nearest tenth of a percent.

4. randomly choosing a red card in a game that has 10 red, 10 blue, 10 green, 10 yellow cards, and 10 orange cards

_____

5. tossing two fair coins and having both land tails up

_____

6. randomly choosing 1 of the 4 S's from a bag of 100 letter tiles

_____

7. rolling a number greater than 4 on a fair number cube

_____

A game has 12 blue disks, 10 red disks, and 8 black disks. Find the probability of each event when a disk is chosen at random.

8. red _____

9. black _____

10. blue _____

11. not red or blue _____

38

Name _____ Date _____ Class _____

LESSON 14-4

Experimental and Theoretical Probability

Practice B: Theoretical Probability

Find the probability of each event. Write your answer as a fraction, as a decimal, and as a percent. Round to the nearest tenth of a percent.

1. randomly choosing a white counter from a bag of 12 red counters, 12 white counters, 12 green counters, and 12 blue counters

_____

2. tossing two fair coins and having one land on tails and one land on heads

_____

3. rolling a number greater than 1 on a fair number cube

_____

4. randomly choosing an orange disk from a bag of 14 black disks, 4 blue disks and 12 orange disks

_____

5. randomly choosing 1 of the 6 R's from a bag of 100 letter tiles

_____

6. spinning a number less than 7 on a fair spinner with 8 equal sections labeled 1–8

_____

A set of cards has 20 cards with stars, 10 cards with squares, and 15 cards with circles. Find the probability of each event when a card is chosen at random.

7. square _____

8. circle _____

9. star or circle _____

10. not circle or square _____

There are 14 girls and 18 boys in Ms. Wiley's class. Ms. Wiley randomly selects one student to solve a problem. Find the probability of each event.

11. selecting a boy _____

12. selecting a girl _____

39

Name _____ Date _____ Class _____

LESSON 14-5

Experimental and Theoretical Probability

Practice A: Making Predictions

Make a prediction based on an experimental probability.

1. A bowler knocks down at least 6 pins 70% of the time. Out of 200 rolls, how many can the bowler predict will knock down at least 6 pins?

2. A tennis player hits a serve that cannot be returned 45% of the time. Out of 300 serves, how many can the tennis player predict will not be returned?

3. West Palm Beach, Florida, gets rain about 16% of the time. On how many days out of 400 can residents of West Palm Beach predict they will see rain?

4. Rob notices that 55% of the people leaving the supermarket choose plastic bags instead of paper bags. Out of 600 people, how many can Rob predict will carry plastic bags?

Make a prediction based on a theoretical probability.

5. Martin flips a fair coin 64 times. How many times can he expect the coin to come up tails?

6. A spinner has five equal sections labeled 1–5. In 60 spins, how often can you expect to spin a 3?

7. Harriet rolls a number cube 39 times. How many times can she expect to roll 3 or 4?

8. A bag contains 6 red and 10 black marbles. You pick out a marble, record its color, and return it to the bag. If you do this 200 times, how many times can you expect to pick a black marble?

Solve each problem.

9. The Arno family is planning a 14-day April vacation. The location they've chosen has 10 rainy days in April. The Arnos would like at least 7 days without rain. Should they keep their current plans? Explain.

10. Advertisements for the train claim it is on-time 90% of the time. The bus has a record of being on-time 56 out of 64 days. Which form of transportation provides more reliable service? Explain.

40

Name _____ Date _____ Class _____

LESSON 14-5

Experimental and Theoretical Probability

Practice B: Making Predictions

Make a prediction based on an experimental probability.

1. A baseball player reaches base 35% of the time. How many times can he expect to reach base in 850 at-bats?

2. Fredericka can make 65% of her shots from the free-throw line. If she shoots 75 times, how many shots can she expect to go in?

3. In 1951, Odessa, Texas had temperatures of at least 95° F 11% of the time. During that year, how many days could residents predict would have highs of at least 95° F?

4. A survey shows that 67% of peanut butter lovers prefer chunky-style. Out of 850 people surveyed, how many can be predicted to say they prefer chunky-style peanut butter?

Make a prediction based on a theoretical probability.

5. Gil rolls a number cube 78 times. How many times can he expect to roll an odd number greater than 1?

6. Jenna flips two pennies 105 times. How many times can she expect both coins to come up heads?

7. A shoebox holds same-size disks. There are 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?

8. Ron draws 16 cards from a standard deck of 52. The deck is made up of equal numbers of four suits—clubs, diamonds, hearts, and spades. How many of the cards drawn can Ron expect to be spades?

Solve each problem.

9. During February and March, Jack is spending 7 days in the Yukon to check on endangered species. The region has snowfall that blocks roads 20 days during these months. Can Jack expect to be able to get around at least 5 of the days? Explain.

10. ABC Airlines has had delays on 18 of 126 recent flights. DEF Airlines has had delays 13% of the time. Which airline would you expect to provide more reliable service? Why?

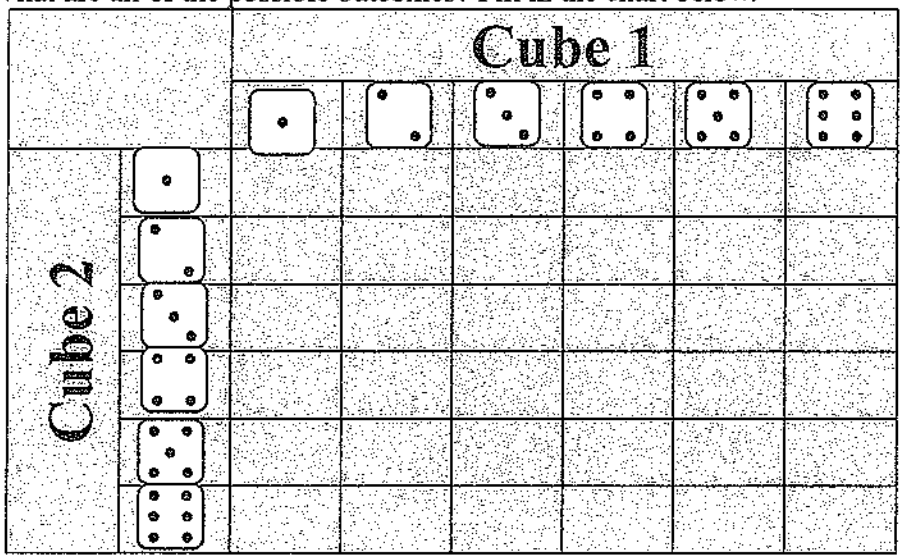
41

SE LEARNING TASK: What's Your Outcome?

This task is from Mathematics Achievement Partnership: Achieve, Inc.

Part 1
You roll a pair of fair six-sided number cube and find the sum of the uppermost faces.

1. What are all of the possible outcomes? Fill in the chart below.



2. How many total outcomes are possible?

3. What is the probability of rolling a sum of 6?

4. What sums have the smallest probability?

Part Two
Suppose you roll two number cubes.

5. Make a table to show all of the possible outcomes (use an another piece of paper)

6. What is the probability that you will roll doubles?

7. Are "rolling a sum of 6" and "rolling doubles" equally likely events? Justify your answer.

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Probability of Compound Events

The probability of compound events refers to the probability of one event or the other occurring as opposed to the probability of just one event occurring. Compound events can be further classified as overlapping or mutually exclusive. If two events are overlapping then they can happen at the same time. If two events are mutually exclusive, they cannot occur at the same time.

Overlapping

Rolling an even or prime number on a die.

Mutually Exclusive

Rolling a 3 or 5 on a die.

P(9 or less than 3) - Find the probability of rolling a 9 or a number less than 3

Step 1: Find the probability of each event independently.

P(9) = $\frac{1}{10}$ There's 1 nine on the die
There are 10 outcomes on the die

P(less than 3) = $\frac{2}{10}$ Two numbers less than 3 (1 & 2)
10 outcomes on the die

Step 2: Add the probability of each individual event.

(9 or less than 3) = $\frac{1}{10} + \frac{2}{10} = \frac{3}{10}$

The probability of rolling a 9 or a number less than 3 on a 10-sided die is 3/10.

NAME _____

Lesson 2.2 Calculating Probability

A **compound event** consists of two or more events. Tossing two coins is a compound event. Tossing a coin and rolling a die is also a compound event.

Compound events are **independent** if the outcome of one event does not influence the outcome of the others. When you flip a coin, there is a $\frac{1}{2}$ probability of heads and a $\frac{1}{2}$ probability of tails. Suppose your coin flip produces tails. If you flip the coin again, there is still a $\frac{1}{2}$ probability of heads and a $\frac{1}{2}$ probability of tails. These events are independent.

If events A and B are independent, then the probability of both occurring is:

$P(A) \times P(B)$

The probability of getting tails in one coin flip is $\frac{1}{2}$. The probability of getting a 5 in one roll of a die is $\frac{1}{6}$. The probability of both occurring, {tails, 5}, is $\frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$.

Determine each probability. Express your answer as a fraction in simplest form.

1. Events E and F are independent. The probability that E will occur is $\frac{2}{5}$. The probability that F will occur is $\frac{3}{7}$. What is the probability that both E and F will occur?

   The probability that both E and F will occur is _____.

2. A nationwide poll found that 3 of 5 voters planned to vote for Candidate X. Jay and Aisha voted. What is the probability that both voted for Candidate X?

   The probability that both voted for Candidate X is _____.

3. You roll a 6-sided die and flip a coin. What is the probability of getting an even number on the die and heads on the coin?

   P(even) and P(heads) is _____.

4. A jar of jellybeans has 6 blue, 2 orange, and 8 red jellybeans. You choose 1 jellybean, put it back, and then choose another. What is the probability that you choose 2 blue jellybeans?

   The probability of choosing 2 blue jellybeans is _____.

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NAME _____

Lesson 2.2 Calculating Probability

Two events are **dependent** if the outcome of one event influences the outcome of the other. If events A and B are dependent, then the probability of both occurring is:

$$P(A) \times P(B \text{ after A occurs})$$

Suppose a bag holds 2 yellow golf balls and 2 white golf balls. Each color of ball has a $\frac{2}{4}$ or $\frac{1}{2}$ chance of being selected. You take a yellow ball out of the bag and do not replace it. Now, there are 2 white balls and 1 yellow ball. The probability of choosing a white ball next is $\frac{2}{3}$. Therefore, the probability of choosing a yellow ball, P(A), and then a white ball, P(B after A occurs), is $\frac{1}{2} \times \frac{2}{3} = \frac{2}{6} = \frac{1}{3}$.

Determine each probability. Express your answer as a fraction in simplest form.

1. A jar of jellybeans has 6 blue, 2 orange, and 8 red jellybeans. You choose 1 jellybean and eat it. You then choose another and eat it. What is the probability that you ate 2 blue jellybeans?

   The probability that you ate 2 blue jellybeans is _____.

2. A bowl contains 20 raffle tickets, including 1 winning ticket. You take 1 ticket from the bowl. Your friend then takes 1 ticket from the bowl. What are the chances that both you and your friend picked losing tickets?

   The probability of both of you picking losing tickets is _____.

3. A box holds 5 electronic games. Two of the games are defective. You take 1 game from the box. Without replacing it, you choose another game from the box. How likely is it that you picked 2 defective games?

   There is a _____ probability that both games are defective.

4. A set of 12 cards contains an equal number of clubs, diamonds, hearts, and spades. You take 3 cards in a row from the set without replacing them. What are the chances that all three are spades?

   The probability of 3 spades is _____.

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NAME _____

Lesson 2.3 Understanding Compound Events

The **Fundamental Counting Principle** states that when an experiment has an event with more than one part, the number of possible outcomes is calculated by looking at the number of possible outcomes for each part. An event with more than one part is considered **a compound event**. The number of possible outcomes for the first element (a) can be multiplied by the number of possible outcomes for the second element (b) to find the total number of possible outcomes (o). So, $a \times b = o$.

There are 3 balls (yellow, red, and green) in one bag and 4 balls (purple, blue, white, and black) in another bag. If a person draws one ball from each bag, how many possible outcomes are there?

Step 1:	Find the number of outcomes for the first event.	3
Step 2:	Find the number of outcomes for the second event.	4
Step 3:	Multiply these together.	3×4
Step 4:	State the number of possible outcomes for the combined event.	12

Use the Fundamental Counting Principle to find the number of possible outcomes for each compound event described.

	a	b
1.	rolling two dice that are numbered 1–6	flipping a coin and rolling a die numbered 1–6
	_____	_____
2.	spinning a 4-part spinner and flipping a coin	pulling a card from a full deck and flipping a coin
	_____	_____
3.	spinning a 6-part spinner and rolling a die numbered 1–6	flipping a coin and rolling two dice numbered 1–6
	_____	_____
4.	spinning a 4-part spinner and pulling a card from a full deck	flipping 2 coins and rolling 2 dice numbered 1–6
	_____	_____

NAME _____

Lesson 2.3 Understanding Compound Events SHOW YOUR WORK

Use the Fundamental Counting Principle to find the number of possible outcomes. Show your work.

1. 3 coins are tossed and two six-sided dice are rolled. How many possible outcomes are there?

   There are _____ possible outcomes.

   1.

2. Jed is shopping. He is looking at 5 different ties, 3 different sweaters, and 4 different shirts. How many possible combinations can he make?

   Jed can make _____ possible combinations.

   2.

3. Miranda's jewelry box contains 8 necklaces, 10 pairs of earrings, and 4 bracelets. How many combinations, which contain all 3 kinds of jewelry, can she make?

   Miranda can make _____ combinations of jewelry.

   3.

4. Robert has to color in 4 different shapes (circle, square, triangle, and rectangle) and has 5 colors to choose from (green, yellow, red, blue, and orange). If he can only use each color one time, how many ways can he color the shapes?

   Robert can color the shapes _____ different ways.

   4.

5. Spencer needs to put on gloves, a hat, and a scarf. He has 5 hats, 4 pairs of gloves, and 9 scarves to choose from. How many combinations of gloves, hats, and scarves can Spencer make?

   Spencer can make _____ combinations.

   5.

6. Pilar wants to cook a meal that consists of a meat, a starch, and a vegetable. At the grocery store there are 8 choices of meat, 8 choices of vegetables, and 3 choices of starches. How many possible combinations can Pilar make?

   Pilar can make _____ combinations.

   6.

7. Jacob must collect a flower, a vegetable, and an herb. In the garden, there are 10 kinds of flowers, 7 kinds of vegetables, and 4 kinds of herbs. How many combinations can Jacob make?

   Jacob can make _____ combinations.

   7.

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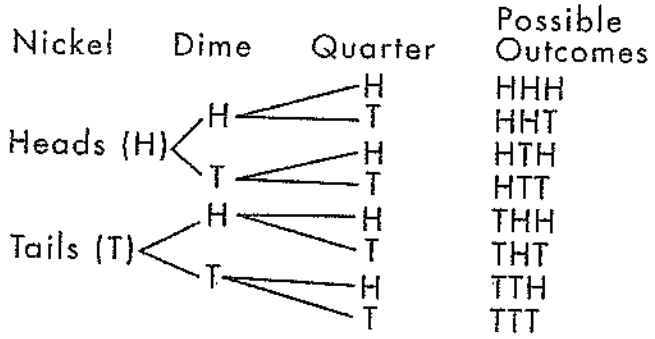
NAME _____

Lesson 2.4 Representing Compound Events

A **sample space** is a set of all possible outcomes (or possible results) for an activity or experiment. To determine the sample space, it is helpful to organize the possibilities using a tree diagram, chart, or table.

Show the sample space for tossing a nickel, a dime, and a quarter, using a tree diagram.



There are 8 possible outcomes or possible results.

Make a tree diagram for each situation. Determine the number of possible outcomes.

1. The concession stand offers the drink choices shown in the table.

Drinks	Sizes
Lemonade	Small
Fruit Punch	Medium
Apple Cider	Large
	Jumbo

There are _____ possible outcomes.

2. The Kellys are planning their vacation activities. On the first day, they can go to the zoo or the museum. On the second day, they can go to the pier or the dunes. On the third day, they have to choose sailing, swimming, or horseback riding.

There are _____ possible outcomes.

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NAME _____

Lesson 2.4 Representing Compound Events

One way to show sample space for compound events is with a chart. What is the sample space if you roll 1 die and flip 1 coin?

Die	Penny: Heads	Penny: Tails
1	H1	T1
2	H2	T2
3	H3	T3
4	H4	T4
5	H5	T5
6	H6	T6

What is the sample space? It is 12, because there are 12 possible outcomes.

Solve each problem.

1. Juan flips a penny, a nickel, and a dime at the same time. How many different combinations of heads and tails can he get?

_____

2. Latisha has red, blue, and black sneakers; blue, tan, and white pants; and black and gray sweatshirts. How many different outfits can she make?

_____

3. Jonathan, Kaitlin, and Ling are trying to decide in what order they should appear during their talent show performance. They made this chart showing the possible orders. Can you show the same results using a tree diagram? (Remember, each person can appear only once in the 1, 2, 3 order.) What is the total number of possible orders?

_____

1	2	3
J	K	L
K	L	J
L	K	J
J	L	K
K	J	L
L	J	K

Pg 49

NAME _____

Lesson 2.4 Representing Compound Events

Tables can be used to represent compound events that have two elements.

John rolls two dice. What is the probability that he will roll a sum of nine?

Step 1: Create a table with rows that match one part of the event and columns that match the other part of the event.

Step 2: Fill in the headers for your table with the possible outcomes for each part of the event.

Step 3: Fill in the table with the possible final outcomes.

Step 4: Find the total number of possible final outcomes (36) and the number of final outcomes with the desired characteristic (4) to calculate the probability.

Possible Outcomes Die #1

Possible Outcomes Die #2	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

The shaded numbers are the final outcomes, or sums, when the outcomes are added together.

The probability is $\frac{4}{36}$, or $\frac{1}{9}$.

Create a table to solve the problems.

1. Erin is getting dressed in the morning. She is choosing from 4 skirts (black, brown, blue, and khaki) and 5 sweaters (black, blue, red, green, and yellow). What is the probability that she will wear both black and blue?

2. Michael is playing a game in which he must spin a spinner numbered 1–8 first, and then roll a die numbered 1–6. What is the probability that he will spin and roll a sum of 10?

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NAME _____

Lesson 2.5 Problem Solving

SHOW YOUR WORK

Solve each problem using a table.

1. A cube with six sides has the letters A–F on it. A spinner has the letters G–L on it. How many letter combinations are there when the cube is rolled and the spinner is spun?

   There are _____ possible letter combinations.

1.

2. A bakery has both donuts and bagels. They are each available in blueberry, chocolate, and plain. What is the probability of choosing at random a blueberry bagel?

   There is a _____ chance of randomly choosing a blueberry bagel.

2.

3. Customers have a choice of thin crust, hand-tossed crust, or deep dish pizzas. They can add a pesto, tomato, or olive oil base. Finally, they can add pepperoni, mushrooms, or onions. What is the probability that a customer will order a pizza with both thin crust and mushrooms?

   There is a _____ chance that a customer will order a pizza with both thin crust and mushrooms.

3.

4. Katie is trying to decide where to go on vacation. She has narrowed it down to Spain, Hawaii, and Puerto Rico. She can take between 7 and 10 days for her trip. How many options does she have?

   Katie has _____ choices for her vacation.

4.

Pg 51

Identifying Combination Amounts

Name:

Solve each problem.

1) A video game lets you choose a characters hair style, hair color and their class. Their choices are listed below.

Hair Style	Hair Color	Class
Short Curly Spiky Long	Blue Brown Blonde	Mage Monk

How many different combinations do you have to choose from?

24

2) At George's Pizza Palace you can order one type of pizza and one drink for $9. Their menu is shown below.

Pizza	Drink
Cheese Anchovies Sausage	Punch Milk Water Juice Soda

How many different combinations of pizza and drink do you have to choose from?

15

3) Robin was allowed to pick one candy and one drink at a Halloween party. The types are listed below.

Candy	Drink
Chocolate Taffy Toffee Jelly Beans	Punch Lemonade Kool-Aid Juice

How many different combinations could she make?

16

4) A baker lets customers pick one type and color of icing and one color of sprinkles. Her menu is below.

Cake	Icing	Sprinkles
Lemon Marble Vanilla	White Yellow Pink Red Green	Rainbow Purple Pink Green

How many different combinations can you choose from?

60

5) At a summer camp a team can choose a name, a color and a mascot. The choices are listed below.

Name	Color	Mascot
Alpha Beta	Red Pink White	Hawk Eagle Pig Lion

How many different combinations are there to choose from?

24

6) Cody was trying to decide what to wear for his first day of school. The clothes in his closet are listed below.

Shirt Color	Bottom
Orange White Green Blue Yellow	Shorts Kilt Khaki

How many different outfits choices does he have?

15

Answers

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

52

Solve each problem.

1) A baker lets customers pick one type and color of icing and one color of sprinkles. Her menu is below.

Cake	Icing	Sprinkles
Chocolate	Red	Purple
Vanilla	Green	Red
Marble	Yellow	Green
Strawberry	Purple	
Lemon	White	

How many different combinations can you choose from?
75

2) A video game lets you choose a characters hair style, hair color and their class. Their choices are listed below.

Hair Style	Hair Color	Class
Short	Red	Archer
Long	Blue	Thief
Curly	Green	
Spiky	Black	
Mowhawk	Brown	

How many different combinations do you have to choose from?
50

3) At a football game Cameron was allowed to get one type of food and one type of drink. The menu is shown below.

Food	Drink
Hotdog	Juice
Hamburger	Soda
Nachos	Water
	Milk

How many different combinations does he have to choose from?
12

4) Will was buying chips and dip for his party. The choices he has are listed below.

Chips	Dip
Square	Onion
Oval	Bean
Triangle	Cheese
Round	

If he gets one type of chip and one type of dip, how many different combinations can he choose from?
12

5) Bianca was creating a card for her friend. She can use one paper color and one sticker from the selection below.

Paper	Sticker
Red	Thumbs up
Green	Balloon
Yellow	Star
Blue	
Orange	

How many different combinations could she make?
15

6) At Cody's Pizza Palace you can order one type of pizza and one drink for $9. Their menu is shown below.

Pizza	Drink
Sausage	Milk
Pepperoni	Water
Cheese	Punch
Bacon	Juice

How many different combinations of pizza and drink do you have to choose from?
16

Answers

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Name _____ Date _____ Class _____

LESSON 15-1

Probability of Compound Events

Practice A: Probability of Independent and Dependent Events

Decide whether each set of events is independent or dependent. Explain your answer.

1. A student spins a spinner and rolls a number cube.

_____

_____

2. A student picks a raffle ticket from a box and then picks a second raffle ticket without replacing the first raffle ticket.

_____

_____

Find the probability of each set of independent events. Choose the letter for the best answer.

3. picking a black checker from a bag of 6 black checkers and 4 red checkers, replacing it, and picking another black checker

A $\frac{2}{3}$ C $\frac{2}{5}$

B $\frac{9}{25}$ D $\frac{3}{5}$

4. rolling a six on the first roll of a 1–6 number cube and rolling an odd number on the second roll of the same cube

F $\frac{1}{12}$ H $\frac{1}{6}$

G $\frac{1}{8}$ J $\frac{1}{2}$

5. flipping a tail on a coin and spinning a 5 on a spinner with sections of equal area numbered 1–5

A $\frac{1}{2}$ C $\frac{1}{7}$

B $\frac{1}{5}$ D $\frac{1}{10}$

6. drawing a 1, 2, or 3 from 9 cards numbered 1–9, replacing the card, and drawing a 7, 8, or 9

F $\frac{1}{3}$ H $\frac{1}{9}$

G $\frac{3}{8}$ J $\frac{1}{12}$

Solve.

7. There are 4 black marbles and 2 white marbles in a bag. What is the probability of choosing a black marble, not replacing it, then choosing a white marble?

_____

Name _____ Date _____ Class _____

LESSON 15-1

Probability of Compound Events

Practice B: Probability of Independent and Dependent Events

Decide whether each set of events is independent or dependent. Explain your answer.

1. A student spins a spinner and chooses a Scrabble® tile

2. A boy chooses a sock from a drawer of socks, then chooses a second sock without replacing the first.

3. A student picks a raffle ticket from a box, replaces the ticket, then picks a second raffle ticket.

Find the probability of each set of independent events.

4. picking a red checker from a bag of 9 black checkers and 6 red checkers, replacing it, and picking another red checker

5. picking a black checker from a bag of 9 black checkers and 6 red checkers, replacing it, and picking a red checker

6. rolling a 1, 2, or 3 on the first roll of a 1–6 number cube and rolling a 4, 5, or 6 on the second roll of the same cube

Solve.

7. Randy has 4 pennies, 2 nickels, and 3 dimes in his pocket. If he randomly chooses 2 coins, what is the probability that both are dimes?

Name _____ Date _____ Class _____

LESSON 15-2

Probability of Compound Events

Practice A: Combinations

Solve each problem in Column A. Draw a line to the correct answer in Column B.

Column A	Column B
1. If you have watermelon, cantaloupe and honeydew, how many combinations of two fruits are there?	A. 20
2. How many three-letter combinations are possible using the letters D, E, F, G, and H?	B. 15
3. How many different two-person debating teams can be chosen from six students?	C. 21
4. On Mondays at Pizza Pan, you can choose two toppings at no extra cost for your pizza. The toppings are mushrooms, sausage, peppers, and extra cheese. How many different pizzas could you order?	D. 10
5. How many different three-person relay teams are possible with four people?	E. 3
6. The students in Mr. Trumbull's English class need to read 2 books from a list of 7 books. How many different combinations of books are possible?	F. 6
7. Erin has 6 colors of ribbon: red, white, gold, green, blue, and purple. She makes bows out of 3 different colors of ribbon. How many different combinations of colors can she choose?	G. 4

Name _____ Date _____ Class _____

LESSON 15-2

Probability of Compound Events

Practice B: Combinations

1. A chef has some broccoli, cauliflower, carrots, and squash to make a vegetarian dish. List the possible combinations if he uses only 3 vegetables in the dish.

2. Lauren, Manuel, Nick, Opal, and Pat are forming groups of two to work on a drama production. List the different combinations of students that are possible using the first initial of each name.

3. Keiko has seven colors of lanyard. She uses three different colors to make a key chain. How many different combinations can she choose?

4. On Sundays at Ice Cream Heaven, you can choose two free toppings for your sundae. The toppings are nuts, hot fudge, caramel, and sprinkles. How many different combinations of toppings can you order?

5. How many different three-person relay teams can be chosen from six students?

6. The students in Mrs. Mandel's class need to choose two class representatives from six nominated students. How many different combinations of class representatives are possible?

7. There are four varieties of muffins available at the Coffee Shop. How many different ways can you choose three different muffins?

8. How many two-person carpools are possible with seven people?

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Fundamental Counting Principle

Fundamental Counting Principle can be used to determine the number of possible outcomes when there are two or more characteristics.

Fundamental Counting Principle states that if an event has m possible outcomes and another independent event has n possible outcomes, then there are $m * n$ possible outcomes for the two events together.

Fundamental Counting Principle

Lets start with a simple example.

A student is to roll a die and flip a coin.
How many possible outcomes will there be?

1H	2H	3H	4H	5H	6H
1T	2T	3T	4T	5T	6T

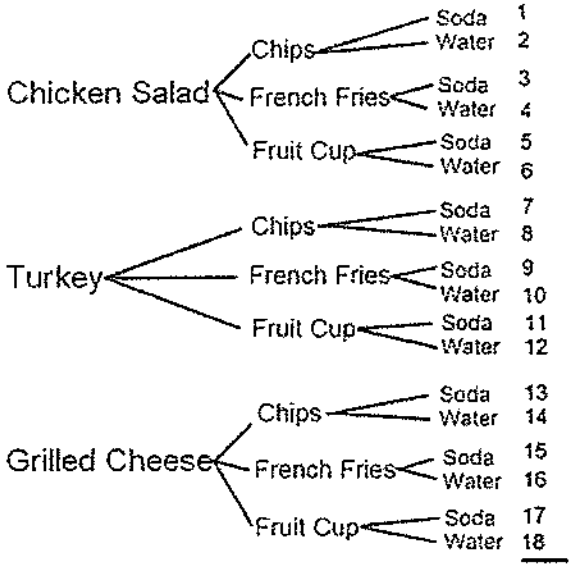
6*2 = 12 outcomes

12 outcomes

A new restaurant has opened and they offer lunch combos for $5.00. With the combo meal you get 1 sandwich, 1 side and 1 drink. The choices are below.

Sandwiches: Chicken Salad, Turkey, Grilled Cheese
Sides: Chips, French Fries, Fruit Cup
Drinks: Soda, Water
Draw a tree diagram to find the total number of possible outcomes.

Solution:



There are 18 total combinations

2-5 The Fundamental Counting Principle

Additional Example 1A: Using the Fundamental Counting Principal

License plates are being produced that have a single letter followed by three digits. All license plates are equally likely.

A. Find the number of possible license plates.

Use the Fundamental Counting Principle.

letter	first digit	second digit	third digit
26 choices	10 choices	10 choices	10 choices

$26 \cdot 10 \cdot 10 \cdot 10 = 26{,}000$

The number of possible 1-letter, 3-digit license plates is 26,000.

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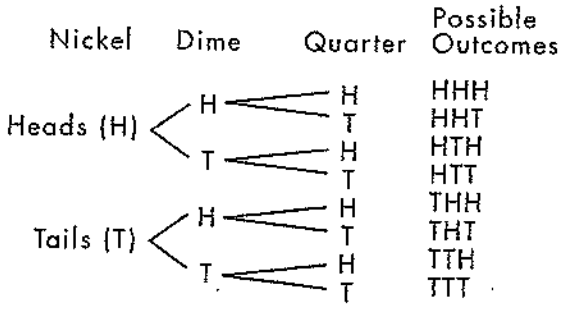
NAME _____

Lesson 2.1 Tree Diagrams

To calculate a probability, you need to know how many outcomes are possible. Recall that the set of all possible outcomes of an activity or experiment is the sample space. To help determine the sample space, organize the possibilities using a list, chart, or tree diagram.

Show the sample space for tossing a nickel, a dime, and a quarter.



There are 8 possible outcomes.

If you tossed these 3 coins once, what is the probability of getting exactly 2 tails? Notice that 3 of the 8 possible outcomes have exactly 2 tails. The probability of getting exactly 2 tails is $\frac{3}{8}$.

Create a tree diagram and answer the question.

1. The chart below shows all possible outcomes of tossing 1 coin and rolling 1 die. In the space provided, create a tree diagram showing all possible outcomes. Begin with the outcomes of the coin toss. Then, connect these outcomes with each possible outcome of the roll of the die.

CHART

Die \ Coin	Heads	Tails
1	H1	T1
2	H2	T2
3	H3	T3
4	H4	T4
5	H5	T5
6	H6	T6

TREE DIAGRAM

Coin **Die**

The number of possible outcomes is _____.

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NAME _____

Lesson 2.1 Tree Diagrams

Solve each problem. Express probabilities as fractions in simplest form.

1. A store sells T-shirts in the colors and sizes shown in the chart. Make a tree diagram.

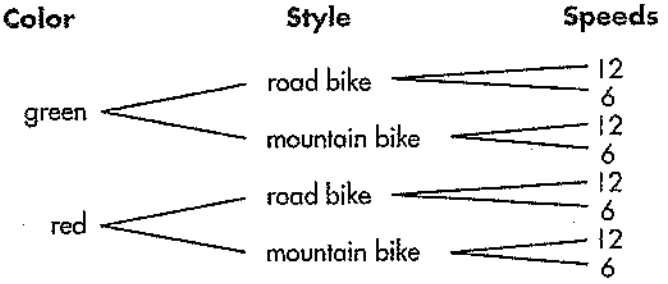
Colors	Sizes
red	small
blue	medium
tie-dyed	large

Tree Diagram

   a. There are _____ possible outcomes, or choices, of T-shirts.

   b. Suppose the store has just 1 of each size and color. If you select a T-shirt at random, the probability that you will choose a large shirt is _____.

2. The tree diagram below shows the combinations of colors, styles, and speeds of bicycles available at a bicycle shop. You select one at random.



   a. There are _____ combinations of bicycles from which to choose.

   b. The probability of choosing a green bicycle is _____.

   c. The probability of choosing a 6-speed mountain bicycle is _____.

   d. The probability of choosing a red, 12-speed road bicycle is _____.

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Name _____ Date_____

Worksheet A2 : Fundamental Counting Principle, Factorials, Permutations Intro

1. A restaurant offers four sizes of pizza, two types of crust, and eight toppings. How many possible combinations of pizza with one topping are there?

2. How many ways can 5 paintings be line up on a wall?

3. Rob has 4 shirts, 3 pairs of pants, and 2 pairs of shoes that all coordinate. How many outfits can you put together?

4. Grace loves to eat salad! How many salads can she put together if she can pick out one type of lettuce from 2 choices, one vegetable from 4 choices and one dressing from 7 choices?

5. PA license plates have 3 letters followed by 4 numbers.
   a. If the same letter or number can be repeated, how many can be made?

   b. If the same letter CANNOT be repeated, how many can be made?

6. How many 5-digit numbers can be formed (using 0 – 9)?

7. How many 5-digit numbers can be formed if each one uses all the digits 0, 1, 2, 3, 4 without repetition?

8. In how many ways can 6 bicycles be parked in a row?

9. Evaluate (show all your work):

a. 6!

b. 9!

c. 10!

10. Rewrite 10! with a factor of 8! (Hint: ____ · ____ · 8!)

11. $\frac{5!}{2!}$

12. $\frac{10!}{8!}$

13. $\frac{25!}{20!}$

14. $\frac{12!}{(12-7)!}$

15. $\frac{12!}{9!3!}$

16. In how many ways can 7 different card be laid out on a table in a row?

Name _____ Date_____

Worksheet B2 : Permutations

1. A lock contains 3 dials, each with ten digits. How many possible sequences of numbers exist?

2. Four students are to be chosen from a group of 10 to fill the positions of president, vice-president, treasurer and secretary. In how many ways can this be accomplished?

3. How many ways can the letters MATH be arranged?

4. A shelf can hold 7 trophies. How many ways can the trophies be arranged if there are 10 trophies available?

5. Bill has three pairs of pants, 5 shirts and 2 pairs of shoes. How many outfits can he make?

Name _____ Date _____ Class _____

LESSON 15-3

Probability of Compound Events

Practice A: Permutations

1. In how many ways can you arrange the letters in the word NOW? List the permutations.

_____

2. In how many ways can you arrange the numbers 4, 5, 6, and 7 to make a four-digit number? List the permutations.

_____

_____

_____

3. Find the number of permutations of the letters in the word FOUR. _____

4. In how many ways can you arrange the numbers 3, 4, 5, 6, and 7 to make a five-digit number? _____

5. Find the number of ways you can arrange the letters in the word *numbers*. _____

Choose the letter for the best answer.

6. What is another way of showing 5 factorial or 5!?

   A 5^3

   B $5 + 4 + 3 + 2 + 1$

   C $5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

   D 5^5

7. How many permutations of the numbers 10 through 14 are there?

   F 10!

   G 5!

   H 4!

   J 14!

8. In how many ways can 5 children be matched with 5 puppies?

   A 5 C 100

   B 25 D 120

9. Six friends are waiting in line at the movie theater. In how many different orders can they be standing in line?

   F 720 H 36

   G 120 J 6

10. How many permutations of the numbers 1 through 9 are there?

    A 9 C 9!

    B 900,000 D 9^9

11. In how many different ways can seven drivers be matched up with seven rental cars?

    F 5,040 H 49

    G 2,401 J 7

65

Name _____ Date _____ Class _____

LESSON 15-3

Probability of Compound Events

Practice B: Permutations

1. Joe has homework assignments for math, Spanish, and history. In how many different orders can he do his homework? _____

2. Find the number of permutations of the letters in the word SMART. _____

3. In how many ways can you arrange the numbers 6, 7, 8, and 9 to make a four-digit number? _____

4. A table has 8 seats. In how many different ways can 8 people sit at the table? _____

5. Nine mountain bikers are on a bicycle trip. In how many possible ways can they follow each other? _____

6. Seven students are waiting in line at the cafeteria. In how many different orders can they be standing in line? _____

7. How many permutations of the letters A through F are there? _____

8. Ed, Martine, Sal, Carl, Paula, Terry, Ken, Leo, Ursula, and Jamie are in a race. In how many different orders can they finish? _____

9. Find the number of permutations of the letters in the word *recognizably*. _____

10. In how many different orders can 11 people stand in line? _____

11. In how many different ways can a librarian arrange eight books on a shelf? _____

12. Melinda has 15 art trophies. Write an expression that shows how many different ways she can line up her trophies on a shelf. _____

Name _____ Date _____ Class _____

LESSON 15-4

Probability of Compound Events

Practice A: Probability of Compound Events

Use an organized list, a tree diagram, or a table to solve.

1. You have 4 tickets to the movies and can take 3 of four friends, Mike, Tom, Eddie, and Chris.

   If chosen randomly, what is the probability that you will take Mike, Tom, and Chris? _____

2. Ten seniors are on Coach Able's basketball team. She is going to randomly select 2 of them to represent their team at a regional all-star game.

   What is the probability that she will select Megan and Jordan to represent the team? _____

3. You are knitting a hat, and you want it to have 2 different colors from the 3 color choices of red, black, and blue. You randomly select the yarn colors while you knit.

   What is the probability that the first color is blue and the second color is red? _____

4. Martin randomly selects 3 days of the week to work at his uncle's farm.

   What is the probability he selects Monday, Friday, and Tuesday in any order? _____

5. You have a bookshelf upon which you want to display your four vases that you purchased while visiting four different European countries. You randomly set them on your shelf.

   What is the probability that you display them in the order in which they were purchased? _____

6. There are 12 students registered for a prize drawing, each of whom has been assigned a number 1-12. Two students will be randomly selected as winners.

   What is the probability that students with the numbers 3 and 7 will be drawn in any order? _____

Name _____ Date _____ Class _____

LESSON 15-4

Probability of Compound Events

Practice B: Probability of Compound Events

Use an organized list, a tree diagram, or a table to solve.

1. Josh and Chris are racing their derby-car models in a boxcar derby. Two of the six racers in each heat are chosen at random to get the outside lanes.

   What is the probability that Josh and Chris will both get an outside lane in the first heat? _____

2. Twelve people are standing in line to buy movie tickets. The theater is running a promotion by giving away 2 concession stand gift cards to the people standing in line.

   What is the probability that the second and third people in line will get chosen for the gift cards? _____

3. Over the next two days, Ava, Ryan, and Zach will present their projects to the class. The order of their presentations will be randomly selected.

   What is the probability that the students will be selected in reverse alphabetical order on the first day? _____

4. A cloth bag holds 4 letter tiles: A, E, S, and T. Elliot selects each tile at random, one tile at a time.

   What is the probability that he selects the letter tiles in the order E-A-S-T? _____

5. For a game show, a contestant will be asked to select three months at random.

   What is the probability that a contestant will select March, July, and November in any order? _____

6. The 15 dogs at the animal shelter are in individual cages labeled A through O. Three dogs will be randomly selected to be featured on a local TV station.

   What is the probability that the dogs selected will be from cages A, B, and C in any order? _____

Simulation

Simulations could include examples such as:

- "How many students need to be chosen for you to expect that each of the 4 school houses is represented?"
- "How many people do you need to choose before you can expect at least 2 of them to share the same birth month?"

To describe a simulation use words and show these steps:

1. Explain what tool you are going to use.
2. Define what represents a successful trial.
3. Give a table of the outcomes of several trials.
4. Show how to calculate required probabilities.

NAME _____ DATE _____ PERIOD ____

14-5 Probability Simulations

The type of probability that you have used so far is **theoretical probability**, which is calculated by dividing the number of favorable outcomes by the number of total possible outcomes. Probability can also apply to the actual data that is collected by conducting an experiment. This type of probability is called **experimental probability**. Experimental probability is a ratio that compares the **relative frequency**, or the number of times a favorable outcome occurred, with the total number of times the experiment was conducted. Performing an experiment many times, recording data, and analyzing results is called an **empirical study**. When conducting an empirical study with an event that may be unrealistic to perform, you can use a **simulation**, or similar experiment with the same probability as the desired experiment.

Calculating Theoretical Probability	$P(\text{event}) = \frac{\text{the number of favorable outcomes}}{\text{the number of possible outcomes}}$
Calculating Experimental Probability	$P(\text{event}) = \frac{\text{the relative frequency of favorable events}}{\text{total number of events}}$

Examples

A Number Cube is Rolled 20 Times	
Number Rolled	Frequency
1	2
2	5
3	3
4	8
5	1
6	1

a. What is the theoretical probability of rolling a 6 on a number cube?

$P(6) = \frac{1}{6}$

$P(6) = 16.\overline{6}\%$

b. According to the data, what is the experimental probability of rolling a 6 on a number cube?

$P(6) = \frac{1}{20}$

$P(6) = 5\%$

Practice

A card is drawn from a standard deck of 52 playing cards. This process is repeated a total of 100 times. The results have been recorded in the table. Use this information for Exercises 1–3.

Clubs	22
Diamonds	17
Hearts	31
Spades	30

1. What is the experimental probability of drawing a club?

2. What is the experimental probability of drawing a diamond or a spade?

3. **Standardized Test Practice** What is the theoretical and experimental probability of drawing a heart or a club?

   A 50%, 53% B 25%, 31% C 25%, 22% D 50%, 48%

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SIMULATIONS WORKSHEET NAME: _____

1) **Three Children Families**

A family doctor is told by a couple that they wish to have three children and that they wonder what the possibility of having all of one sex of a child will be (they think that it will be the same as having 2 girls and 1 boy or having 2 boys and 1 girl). The doctor gives them an assignment to simulate having three children to answer their question. They will record the number of girls in each of their trials

(a) Write instructions for performing 10 trials of the simulation using the section of the TRD below:

(b) Perform 10 trials of the simulation

39634 62349 74088 65564 16379 19713 39153 69459 17986 24537 92740 92438 03957

14595 35050 40469 27478 44526 67331 93365 54526 22356 93208 02847 91374 15374

X = # of girls	Frequency	Experimental Probability
0		
1		
2		
3		
Total Number of Trials		

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2) Having a Boy

Another family has met with the family doctor. They desperately want a boy and are willing to have as many children as possible until they get a son. They will record the number of children they have.

(a) Write instructions for performing 10 trials of the simulation using the section of the TRD below:

(b) Perform 10 trials of the simulation

39634 62349 74088 65564 16379 19713 39153 69459 17986 24537 14595 35050 40469 27478

44526 67331 93365 54526 22356 93208 30734 71571 83722 79712 25775 65178 07763 82928

31131 30196 64628 89126 91254 24090 25752 03091 39411 73146 06089 15630 42831 95113

43511 42082 15140 34733 68076 18292 69486 80468 80583 70361 41047 26792 78466 03395

17635 09697 82447 31405 02857 92348 12485 92837 01937 29034 22347 29847 10836 24782

Number of Children	Frequency	Experimental Probability
1		
2		
3		
4		
5		
6		
7+		

3) **Football**

A quarterback completes 65% of his passes. Suppose he attempts 12 passes in a game.

(a) Write instructions for conducting one simulation trial that shows the results for each of the twelve passes in a game.

(b) Conduct 6 trials using the following table of random digits. Be sure to label your results.

80583 70361 41047 26792 78466 03395 17635 09697 82447 31405 00209 90404 99457 72570

42194 49043 24330 14939 09865 45906 30734 71571 83722 79712 25775 65178 07763 82928

31131 30196 92347 60830 09230 47592 01832 05068 12838 12305 58506 37593 62941 17068

(c) Based on your simulation what is the average number of passes he will make in a game?

4) **Football, part 2**

A receiver on the same team catches the ball 78% of the time. He usually has 9 passes thrown to him in a game.

(a) Write instructions for conducting one simulation trial.

(b) Conduct 10 trials using the following table of random digits. Be sure to label your results.

05409	20830	01911	60767	55248	79253	12317	84120	77772	50103
95836	22530	91785	80210	34361	52228	33869	94332	83868	61672
64628	89126	91254	24090	25752	03091	39411	73146	06089	15630
42831	95113	43511	42082	15140	34733	68076	18292	69486	80468
80583	70361	41047	26792	78466	03395	17635	09697	82447	31405

(c) Based on your simulation what is the average number of catches he makes in a game?

5) Simulating getting Prizes from a Cereal Box

Your favorite cereal is giving out Simpson toys as a promotion. One of six toys will be placed randomly in a cereal box. Assuming that shipment of the boxes is random also how many boxes would you have to buy to get all six toys?

(a) Write instructions for conducting one simulation trial.

(b) Run 10 trials of this simulation and record the results.

95836 22530 91785 80210 34361 52228 33869 94332 83868 61672 65358 70469 87149 89509 72176

18103 55169 79954 72002 20582 72249 04037 36192 40221 14918 53437 60571 40995 55006 10694

41692 40581 93050 48734 34652 41577 04631 49184 39295 81776 61885 50796 96822 82002 07973

52925 75467 86013 98072 91942 48917 48129 48624 48248 91465 54898 61220 18721 67387 66575

88378 84299 12193 03785 49314 39761 99132 28775 45276 91816

Number of Boxes Purchased	Frequency
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16+	

(c) What is the average number of boxes needed to get all six toys?

(d) What is the probability that it would take more than 12 boxes to get all six toys?

(e) What is the probability that it would take less than 10 boxes?

(f) What is the probability that it would take between 8 and 12 boxes to get all six toys?

6) Football Part 3

Back to the receivers on the football team. We are looking at a new receiver, and he only catches 58% of his passes. Suppose his coach tells him that he will bench the receiver if he drops a pass. How many passes are thrown to him on average, before he is benched?

a) Write instructions and then use the TRD below to complete 8 trials.

b) Complete the 8 trials below:

18103	55169	79954	72002	20582	72249	04037	36192	40221	14918	53437	60571	40995	55006	10694
88378	84299	12193	03785	49314	39761	99132	28775	45276	91816	92757	10956	50432	08675	20958
41692	40581	93050	48734	34652	41577	04631	49184	39295	81776	61885	50796	96822	82002	07973
95836	22530	91785	80210	34361	52228	33869	94332	83868	61672	65358	70469	87149	89509	72176
52925	75467	86013	98072	91942	48917	48129	48624	48248	91465	54898	61220	18721	67387	66575

RECORDING CHART:

c) On average, how many passes does he have thrown to him before he is benched?

d) What is the probability that he will get less than 5 passes thrown to him?

e) What is the probability that he will get 3 or more passes thrown to him?

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7) Games

You are playing a game where there is a 4 in 7 chance of getting a prize on any one turn. You win (stop playing the game) when you get 3 prizes. On average, how many turns will it take for you to win the game?

a) Write instructions and then use the TRD below to complete 10 trials of the simulation.

b) Complete the 10 trials below:

18103 55169 79954 72002 20582 72249 04037 41692 40581 93050 48734 34652 41577 04631 49184

91785 80210 34361 52228 33869 94332 83868 88378 84299 12193 03785 49314 39761 99132 28775

36192 40221 14918 53437 60571 40995 55006 10694 07973 39295 81776 61885 50796 96822 82002

95836 22530 61672 65358 70469 87149 89509 72176 45276 91816 92757 10956 50432 08675 20958

48129 48624 48248 91465 54898 61220 18721 67387 66575 52925 75467 86013 98072 91942 48917

RECORDING CHART:

c) On average, how many times do you need to play the game before winning?

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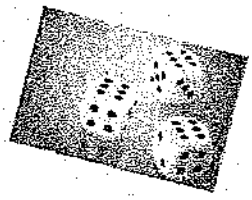
What is an independent event?

- Independent events are events where the outcome of one event **does not affect** the outcome of the other events
  - Example:
  - Tossing a coin and rolling a number cube are independent events.



What is a dependent event?

- If the outcome of one event **affects** the outcome of another, then the events are said to be Dependent Events.
  - Example:
  - Taking out a marble from a bag containing some marbles and not replacing it, and then taking out a second marble are dependent events.

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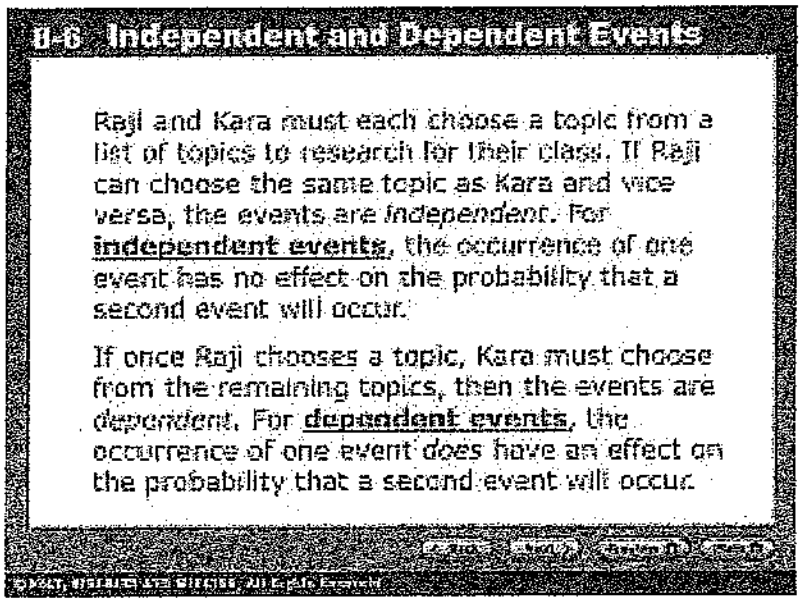

9-7 Independent & Dependent Events

compound event: an event made up of two or more simple events

independent events: one event has no effect on the probability of the second event

dependent events: one event does have an effect on the probability of the second event

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Name _____ Date _____

Determining Dependent and Independent Events - Guided Lesson Explanation

Explanation#1

The events of rolling an **even** number and **5** are independent.

Find P(even). The dice has 6 sides, numbered 1, 2, 3, 4, 5, 6. The even numbers are 2, 4, 6. There are 3 even numbers.

P(even) = $\frac{3}{6}$

Find P(5).

P (5) = $\frac{1}{6}$

Find P(even, 5).

P(even, 5) = P(even) × P(5)

$= \frac{3}{6} \times \frac{1}{6}$

$= \frac{3}{36}$

Write your answer as a decimal. Then convert your answer to a percentage.

$\frac{3}{36}$ = 0.083 = 8.33%

Explanation#2

Two events are dependent if the outcome of the first event affects the outcome of the second event.

These two events are dependent because buying the microwave changed her decision on the necklace. Here the first event affects the second one.

Explanation#3

Two events are dependent if the outcome of the first event affects the outcome of the second event.

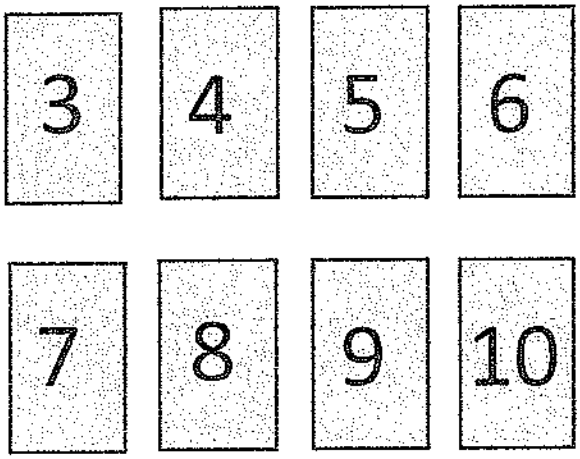
The two events are dependent. Robin does not put the first ball back, so his first pick affects which balls are left for his second pick.

Name _____ Date _____

Determining Dependent and Independent Events - Matching Worksheet

Match the word problems to their answers. Write the letter of the answer that matches the problem.

_____ **1. Martin has 8 cards. He draws a card, puts it back and draws another. What is the probability (as a percentage) of getting an even number and then a 10?**



_____ **2. Rusty has 6 notebooks. He picks 1 of them. Then without putting the first notebook back, he picks the second book.**
Are these two events dependent or independent?

_____ **3. Felipe has 15 t-shirts in his wardrobe. He takes 1 t-shirt at random. Then he puts it back. He takes another t-shirt at random.**
Are these two events dependent or independent?

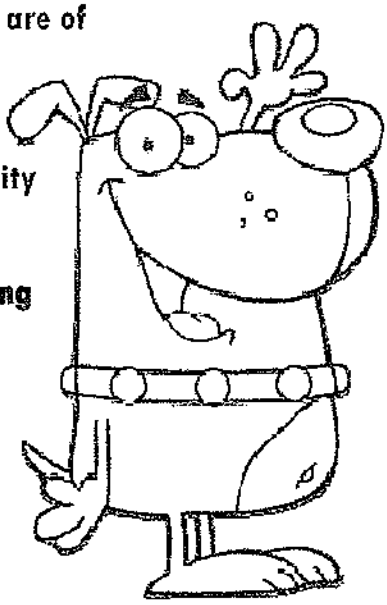
a. Dependent

b. Independent

c. 6.25

Name _____ Date _____

Determining Dependent and Independent Events - Independent Practice Worksheet



1. There are 10 cards. 4 of them are of green color and another 6 are of orange color. Steve picks a card at random. What is the probability of green?

2. Daisy has 5 red roses and 5 yellow roses. What is the probability of picking a red rose randomly from the bunch?

Direction for 3-10: Complete all the problems below by determining if the events described are dependent or independent events?

3. You have a jar with 24 pieces of chocolate candy and 14 pieces of orange candy. We take one piece of candy at random from the jar, put it back, and then take a second piece of candy at random from the jar.

4. Deni has a blue, red, and green tie. He also has a blue and green shirt. Deni chooses a random tie and shirt for work today.

5. Amy plays card games. He picks a card at random. Then without putting the first card back, he picks a second card at random.

6. Juan has 14 coins. He takes 3 of them at random, then he puts these back, and then pick 2 more coins at random.

7. Brett has $4,700 in his bank account. He withdraws $1,200 from his bank account to pay for rent. Brett books a vacation 3-days later that costs $4,000. He withdraws $3,500 from his account and goes on a payment pay for the remainder.

8. Canady has 10 handmade sheets. She takes 6 sheets at random. Then without putting these sheets back, she picks 2 sheets at random.

9. Jeff has 3 children. His first 2 children are boys. His last child is a girl.

10. A tree which has 4 red flowers and 2 blue flowers. Brandy plucks 1 flower from the tree. After some time her sister plucks a flower from the same tree.

Student Name: _____ Score:

Independent and Dependent

A box contains 2 red marble, 3 white marble, 4 green marbles and 1 blue marble. Two marbles are drawn at random without replacement. Find the probability of

Problems	Work Space
Selecting a green marble in a second draw if the first marble is blue. Answer: _____	
Selecting a white marble in a first draw and red marble in a second draw. Answer: _____	
Selecting red marbles in both draws. Answer: _____	
Selecting red or white in a first draw and green or blue in second draw. Answer: _____	
Selecting white marble in a first draw and white or blue in a second draw. Answer: _____	

Student Name: _____ Score:

Independent and Dependent

10 cards are numbered from 1 through 10. Cards are well shuffled and the cards are drawn at random.

Problems	Work Space
Three cards are drawn without replacement. First and the second cards show 4 and 6 respectively. Find the probability of selecting an even number in a third draw. Answer: _____	
If the conditions are same as in question 1, find the probability of selecting an odd number in a third draw. Answer: _____	
If two cards are drawn with replacement, find the probability of choosing prime number in both first and second draw. Answer: _____	
If two cards are drawn without replacement, find the probability of drawing 4 or 5 in a first draw and any even prime in a second draw Answer: _____	

SE LEARNING TASK: Number Cube Sums

Suppose that a friend, Kia, wants to play a game with you. She says, "Let's roll two number cubes 10 times and find the sum of each roll. If the sum is 1, 2, 3, 4, 10, 11, or 12, you win. If the sum is 5, 6, 7, 8, or 9, I win."

A. Would you want to play this game? Why or why not?

B. Roll the number cubes 10 times and record the sums.

C. What are the results of rolling the number cubes 10 times? Record the frequency below:

Possible Sum	Frequency	Total		Possible Sum	Frequency	Total
1				7		
2				8		
3				9		
4				10		
5				11		
6				12		

D. Based upon your results, what did you find?

E. Repeat the game 5 more times and record your results in a frequency table. Were the results the same each time?

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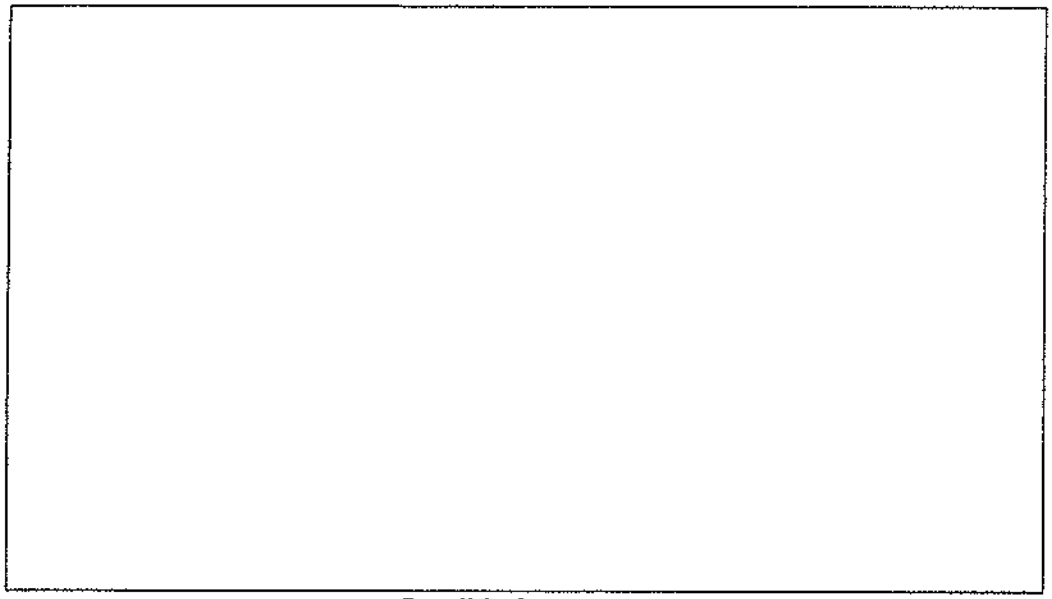

Possible Sums

F. Create a bar chart for the number of times each sum occurred. Are there any patterns?

G. What do you think it would look like if you repeated the game 100 times?

H. Who would win most often, you or Kia? Explain why.

I. Show all possible sums. How many are there?

J. Would you change the rules of the game in some way that makes it equally likely for Player A or Player B to win?

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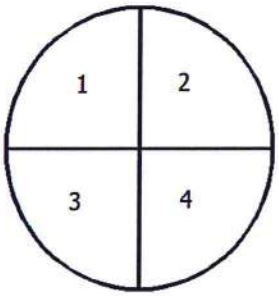
Lesson Summary

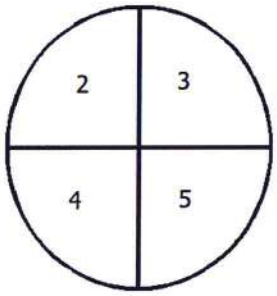
An estimate for finding the probability of an event occurring is

$$P(\text{event occurring}) = \frac{\text{Number of observed occurrences of the event}}{\text{Total number of observations}}.$$

Problem Set

1. Play a game using the two spinners below. Spin each spinner once, and then multiply the outcomes together. If the result is less than or equal to 8, you win the game. Play the game 15 times, and record your results in the table below. Then, answer the questions that follow.





Turn	1st Spin Results	2nd Spin Results	Product
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

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a. What is your estimate for the probability of getting a product of 8 or less?

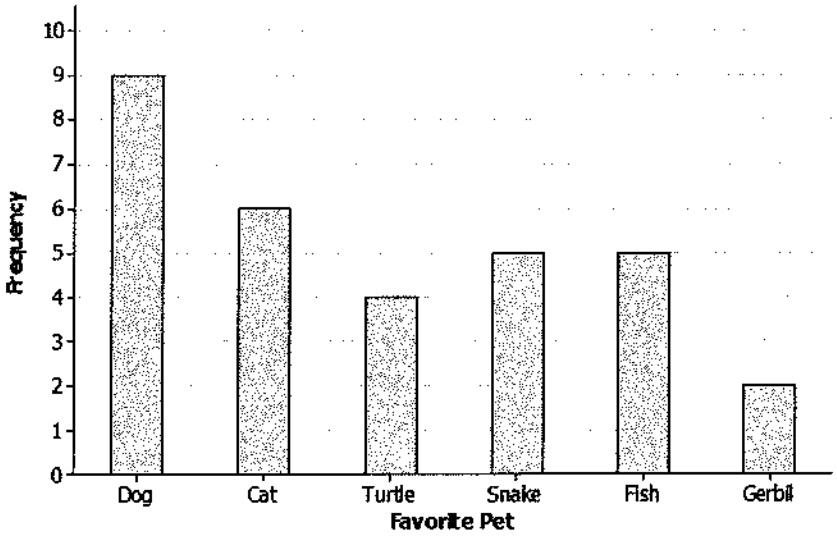
b. What is your estimate for the probability of getting a product of more than 8?

c. What is your estimate for the probability of getting a product of exactly 8?

d. What is the most likely product for this game?

e. If you play this game another 15 times, will you get the exact same results? Explain.

2. A seventh-grade student surveyed students at her school. She asked them to name their favorite pet. Below is a bar graph showing the results of the survey.



Use the results from the survey to answer the following questions.

a. How many students answered the survey question?

b. How many students said that a snake was their favorite pet?

Now suppose a student will be randomly selected and asked what his favorite pet is.

c. What is your estimate for the probability of that student saying that a dog is his favorite pet?

d. What is your estimate for the probability of that student saying that a gerbil is his favorite pet?

e. What is your estimate for the probability of that student saying that a frog is his favorite pet?

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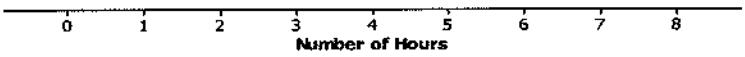
3. A seventh-grade student surveyed 25 students at her school. She asked them how many hours a week they spend playing a sport or game outdoors. The results are listed in the table below.

Number of hours	Tally	Frequency
0	| | |	3
1	| | | |	4
2	𝍸	5
3	𝍸 | |	7
4	| | |	3
5		0
6	| |	2
7		0
8	|	1

a. Draw a dot plot of the results



Suppose a student will be randomly selected.

b. What is your estimate for the probability of that student answering 3 hours?

c. What is your estimate for the probability of that student answering 8 hours?

d. What is your estimate for the probability of that student answering 6 or more hours?

e. What is your estimate for the probability of that student answering 3 or fewer hours?

f. If another 25 students were surveyed do you think they would give the exact same results? Explain your answer.

g. If there are 200 students at the school, what is your estimate for the number of students who would say they play a sport or game outdoors 3 hours per week? Explain your answer.

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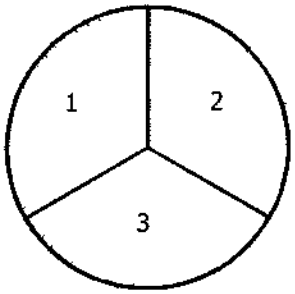
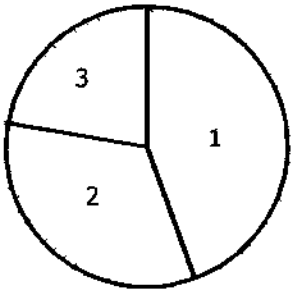
4. A student played a game using one of the spinners below. The table shows the results of 15 spins. Which spinner did the student use? Give a reason for your answer.

Spin	Results
1	1
2	1
3	2
4	3
5	1
6	2
7	3
8	2
9	2
10	1
11	2
12	2
13	1
14	3
15	1

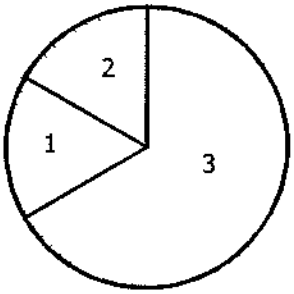
Spinner A



Spinner B



Spinner C



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Example 2: Equally Likely Outcomes

The sample space for the paper cup toss was on its side, right side up, and upside down. Do you think each of these outcomes has the same chance of occurring? If they do, then they are equally likely to occur.

The outcomes of an experiment are equally likely to occur when the probability of each outcome is equal.

Toss the paper cup 30 times and record in a table the results of each toss.

Toss	Outcome
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	

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Exercises 7–12

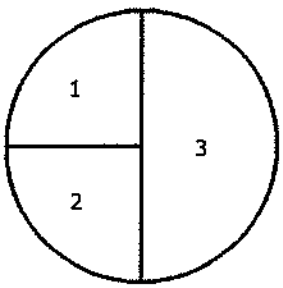
7. Using the results of your experiment, what is your estimate for the probability of a paper cup landing on its side?

8. Using the results of your experiment, what is your estimate for the probability of a paper cup landing upside down?

9. Using the results of your experiment, what is your estimate for the probability of a paper cup landing right side up?

10. Based on your results, do you think the three outcomes are equally likely to occur?

11. Using the spinner below, answer the following questions.



a. Are the events spinning and landing on 1 or 2 equally likely?

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b. Are the events spinning and landing on 2 or 3 equally likely?

c. How many times do you predict the spinner will land on each section after 100 spins?

12. Draw a spinner that has 3 sections that are equally likely to occur when the spinner is spun. How many times do you think the spinner will land on each section after 100 spins?

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Lesson 5: Chance Experiments with Outcomes That Are Not Equally Likely

Classwork

In previous lessons, you learned that when the outcomes in a sample space are equally likely, the probability of an event is the number of outcomes in the event divided by the number of outcomes in the sample space. However, when the outcomes in the sample space are *not* equally likely, we need to take a different approach.

Example 1

When Jenna goes to the farmer's market she usually buys bananas. The number of bananas she might buy and their probabilities are shown in the table below.

Number of Bananas	0	1	2	3	4	5
Probability	0.1	0.1	0.1	0.2	0.2	0.3

a. What is the probability that Jenna buys exactly 3 bananas?

b. What is the probability that Jenna doesn't buy any bananas?

c. What is the probability that Jenna buys more than 3 bananas?

d. What is the probability that Jenna buys at least 3 bananas?

e. What is the probability that Jenna doesn't buy exactly 3 bananas?

Notice that the sum of the probabilities in the table is one whole $(0.1 + 0.1 + 0.1 + 0.2 + 0.2 + 0.3 = 1)$. This is always true; when we add up the probabilities of all the possible outcomes, the result is always 1. So, taking 1 and subtracting the probability of the event gives us the probability of something NOT occurring.

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Exercises 1–2

Jenna's husband, Rick, is concerned about his diet. On any given day, he eats 0, 1, 2, 3, or 4 servings of fruit and vegetables. The probabilities are given in the table below.

Number of Servings of Fruit and Vegetables	0	1	2	3	4
Probability	0.08	0.13	0.28	0.39	0.12

1. On a given day, find the probability that Rick eats:
   a. Two servings of fruit and vegetables.

   b. More than two servings of fruit and vegetables.

   c. At least two servings of fruit and vegetables.

2. Find the probability that Rick does not eat exactly two servings of fruit and vegetables.

Example 2

Luis works in an office, and the phone rings occasionally. The possible number of phone calls he receives in an afternoon and their probabilities are given in the table below.

Number of Phone Calls	0	1	2	3	4
Probability	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{2}{9}$	$\frac{1}{3}$	$\frac{1}{9}$

a. Find the probability that Luis receives 3 or 4 phone calls.

b. Find the probability that Luis receives fewer than 2 phone calls.

c. Find the probability that Luis receives 2 or fewer phone calls.

d. Find the probability that Luis does not receive 4 phone calls.

Exercises 3–7

When Jenna goes to the farmer's market, she also usually buys some broccoli. The possible number of heads of broccoli that she buys and the probabilities are given in the table below.

Number of Heads of Broccoli	0	1	2	3	4
Probability	$\frac{1}{12}$	$\frac{1}{6}$	$\frac{5}{12}$	$\frac{1}{4}$	$\frac{1}{12}$

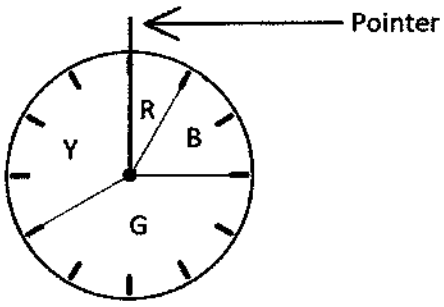
3. Find the probability that Jenna
   a. Buys exactly 3 heads of broccoli.

   b. Does not buy exactly 3 heads of broccoli.

   c. Buys more than 1 head of broccoli.

   d. Buys at least 3 heads of broccoli.

The diagram below shows a spinner designed like the face of a clock. The sectors of the spinner are colored red (R), blue (B), green (G), and yellow (Y).



4. Writing your answers as fractions in lowest terms, find the probability that the pointer stops on the following colors.
   a. Red:

   b. Blue:

   c. Green:

   d. Yellow:

5. Complete the table of probabilities below.

Color	Red	Blue	Green	Yellow
Probability				

6. Find the probability that the pointer stops in either the blue region or the green region.

7. Find the probability that the pointer does not stop in the green region.

Lesson Summary

In a probability experiment where the outcomes are not known to be equally likely, the formula for the probability of an event does not necessarily apply:

$$P(\text{event}) = \frac{\text{Number of outcomes in the event}}{\text{Number of outcomes in the sample space}}.$$

For example:

- To find the probability that the score is greater than 3, add the probabilities of all the scores that are greater than 3.
- To find the probability of not getting a score of 3, calculate $1 -$ (the probability of getting a 3).

Problem Set

1. The Gator Girls are a soccer team. The possible number of goals the Gator Girls will score in a game and their probabilities are shown in the table below.

Number of Goals	0	1	2	3	4
Probability	0.22	0.31	0.33	0.11	0.03

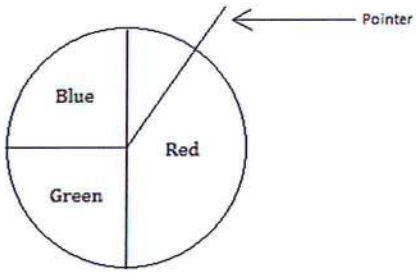
Find the probability that the Gator Girls:

a. Score more than two goals.

b. Score at least two goals.

c. Do not score exactly 3 goals.

2. The diagram below shows a spinner. The pointer is spun, and the player is awarded a prize according to the color on which the pointer stops.



a. What is the probability that the pointer stops in the red region?

b. Complete the table below showing the probabilities of the three possible results.

Color	Red	Green	Blue
Probability			

c. Find the probability that the pointer stops on green or blue.

d. Find the probability that the pointer does not stop on green.

3. Wayne asked every student in his class how many siblings (brothers and sisters) they had. Survey results are shown in the table below. (Wayne included himself in the results.)

Number of Siblings	0	1	2	3	4
Number of Students	4	5	14	6	3

(Note: The table tells us that 4 students had no siblings, 5 students had one sibling, 14 students had two siblings, and so on.)

a. How many students are there in Wayne's class, including Wayne?

b. What is the probability that a randomly selected student does not have any siblings? Write your answer as a fraction in lowest terms.

c. The table below shows the possible number of siblings and the probabilities of each number. Complete the table by writing the probabilities as fractions in lowest terms.

Number of Siblings	0	1	2	3	4
Probability					

d. Writing your answers as fractions in lowest terms, find the probability that the student

i. Has fewer than two siblings.

ii. Has two or fewer siblings.

iii. Does not have exactly one sibling.

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Lesson 6: Using Tree Diagrams to Represent a Sample Space and to Calculate Probabilities

Classwork

Suppose a girl attends a preschool where the students are studying primary colors. To help teach calendar skills, the teacher has each student maintain a calendar in his or her cubby. For each of the four days that they are covering primary colors in class, students get to place a colored dot on their calendar: blue, yellow, or red. When the four days of the school week have passed (Monday–Thursday), what might the young girl's calendar look like?

One outcome would be four blue dots if the student chose blue each day. But consider that the first day (Monday) could be blue, and the next day (Tuesday) could be yellow, and Wednesday could be blue, and Thursday could be red. Or, maybe Monday and Tuesday could be yellow, Wednesday could be blue, and Thursday could be red. Or, maybe Monday, Tuesday, and Wednesday could be blue, and Thursday could be red, and so on and so forth.

As hard to follow as this seems now, we have only mentioned 3 of the 81 possible outcomes in terms of the four days of colors! Listing the other 78 outcomes would take several pages! Rather than listing outcomes in the manner described above (particularly when the situation has multiple stages, such as the multiple days in the case above), we often use a *tree diagram* to display all possible outcomes visually. Additionally, when the outcomes of each stage are the result of a chance experiment, tree diagrams are helpful for computing probabilities.

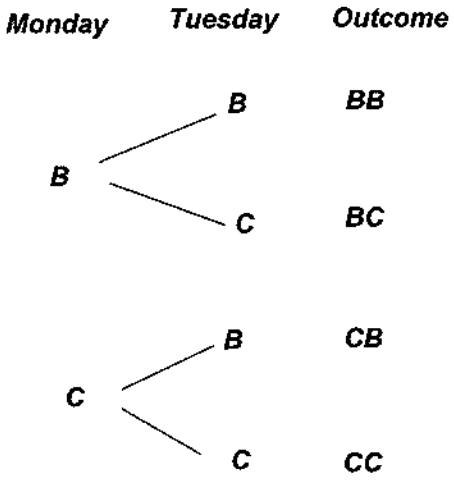
Example 1: Two Nights of Games

Imagine that a family decides to play a game each night. They all agree to use a tetrahedral die (i.e., a four-sided pyramidal die where each of four possible outcomes is equally likely—see image on page S.44) each night to randomly determine if they will play a board game (B) or a card game (C). The tree diagram mapping the possible overall outcomes over two consecutive nights will be developed below.

To make a tree diagram, first present all possibilities for the first stage. (In this case, Monday.)

Monday	*Tuesday*	*Outcome*
B		
C		

Then, from *each* branch of the first stage, attach all possibilities for the second stage (Tuesday).



Note: If the situation has more than two stages, this process would be repeated until all stages have been presented.

a. If BB represents two straight nights of board games, what does CB represent?

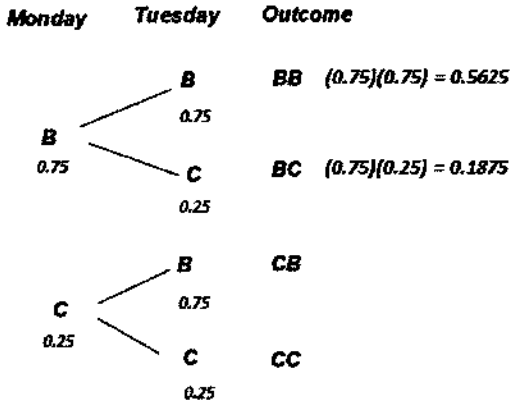
b. List the outcomes where exactly one board game is played over two days. How many outcomes were there?

Example 2: Two Nights of Games (with Probabilities)

In the example above, each night's outcome is the result of a chance experiment (rolling the tetrahedral die). Thus, there is a probability associated with each night's outcome.

By multiplying the probabilities of the outcomes from each stage, we can obtain the probability for each "branch of the tree." In this case, we can figure out the probability of each of our four outcomes: BB, BC, CB, and CC.

For this family, a card game will be played if the die lands showing a value of 1, and a board game will be played if the die lands showing a value of 2, 3, or 4. This makes the probability of a board game (B) on a given night 0.75.



a. The probabilities for two of the four outcomes are shown. Now, compute the probabilities for the two remaining outcomes.

b. What is the probability that there will be exactly one night of board games over the two nights?

Exercises: Two Children

Two friends meet at a grocery store and remark that a neighboring family just welcomed their second child. It turns out that both children in this family are girls, and they are not twins. One of the friends is curious about what the chances are of having 2 girls in a family's first 2 births. Suppose that for each birth the probability of a boy birth is 0.5 and the probability of a girl birth is also 0.5.

1. Draw a tree diagram demonstrating the four possible birth outcomes for a family with 2 children (no twins). Use the symbol B for the outcome of *boy* and G for the outcome of *girl*. Consider the first birth to be the first stage. (Refer to Example 1 if you need help getting started.)

2. Write in the probabilities of each stage's outcome to the tree diagram you developed above, and determine the probabilities for each of the 4 possible birth outcomes for a family with 2 children (no twins).

3. What is the probability of a family having 2 girls in this situation? Is that greater than or less than the probability of having exactly 1 girl in 2 births?