Title: Designing Simulations

Brief Overview:

Students will build on their prior knowledge of probability while learning how to design and conduct simulations. Students will use manipulatives and calculator simulators to estimate probabilities and gather data to make inferences and conclusions.

NCTM Content Standard/National Science Education Standard:

Knowledge of Data Analysis, Statistics and Probability

- Design investigations, collect data, and use a variety of ways to display data and interpret data representations that may include bivariate data, conditional probability and geometric probability.
- Draw conclusions involving uncertainty by using hands–on and computer–based simulation for estimating probabilities and gathering data to make inferences and conclusions.

Grade/Level:

Grades 8 – 10, Data Analysis

Duration/Length:

Three 83 – minute lessons

Student Outcomes:

Students will:

- Determine an appropriate method for conducting a simulation.
- Conduct simulations to investigate the probabilities of events.
- Design simulations and conduct trials.
- Display and interpret data.
- Predict possible outcomes of real world situations.

Materials and Resources:

- Overhead spinner with 2–section template
- TI–84 calculator(s) with overhead view screen
- Gallery Walk Posters
- Worksheets:
    - Spin to Win Warm Up
    - Designing Simulations Worksheet
    - True/False Quiz Simulation
    - Random Digits Table

- Designing Simulations Exit Pass
- Simulation Design Warm Up
- Simulation Models
- McDonald's Simulation #3
- McDonald's Simulation #4
- Gallery Walk Activity
- Another Look at Simulations Warm Up
- Simulations Reference Sheet
- Sam's Wholesale Club: Simulation # 5
- Bel Air High: Simulation # 6
- Simulations Quiz
- Simulations Project

Development/Procedures:

Lesson 1

Preassessment – The teacher will begin the lesson by distributing "Spin to Win" warm up to the students. The purpose is to review the concepts of theoretical probability with students.

Launch – Each student should receive a "Designing Simulations" worksheet. Students play "Spin to Win" as a whole class activity, using an overhead spinner. Record the results of each spin on the table provided.

Teacher Facilitation – Using the results of the "Spin to Win" activity, a discussion should take place on experimental vs. theoretical probability. Guide students to think about simulating this situation using a calculator simulation tool as opposed to using the spinner. Introduce the Probability Simulation Application on the TI–84 Calculator and allow students explore possible ways to use the calculator to simulate "Spin to Win."

Student Application –Students will simulate the "Spin to Win" game using the Spinner Simulation on the calculator and discuss results.

Teacher will guide students in a simulation of guessing all responses on a true/false quiz using the "True/False Quiz Simulation" worksheet and a spinner.

Embedded Assessment – Groups of students will select an alternate method to simulate finding the probability of guessing correctly on a true/false quiz. This method will be used on the

following day as students conduct their own simulation of the true/false quiz.

Reteaching/Extension –

- Circulate while students use the random digits table to complete their simulation of the true/false quiz. Answer any questions as necessary.
- Students will complete the "Designing Simulations" exit pass.

Lesson 2

Preassessment – Students will conduct a second simulation of Tommy's true/false quiz problem using "Simulation Design Warm Up", using a random device selected by the group. Each group will share their results with the class.

Launch – Using the "Simulation Models" worksheet, students will work in groups to decide which of the various random devices would be effective in simulating the situations presented. Groups will share their ideas with the class.

Teacher Facilitation – Students will design a new simulation using "McDonald's: Simulation #3" worksheet. Note that this may need whole class instruction to conduct the simulation accurately.

Student Application – Allow students to use their notes and the "McDonald's Simulation #3" to run their own simulation, "McDonald's Simulation #4."

Embedded Assessment – Set up a Gallery Walk around the room. Hang posters containing assorted situations pertaining to simulations on the classroom walls. Students will move from poster to poster answering the questions pertaining to each display.

Reteaching/Extension –

- Circulate while students complete Gallery Walk. Answer any questions as necessary.

Lesson 3

Preassessment – Have students complete the "Another Look at Simulations" warm up.

Launch – With a partner, students will brainstorm the important components of designing a simulation. Allow 5–7 minutes for this activity. Distribute "Simulations Reference Sheet" to students and have them compare their lists with the information on the sheet.

Student Application – Students will work in pairs to complete "Sam's Wholesale Club: Simulations #5" and "Bel Air High: Simulation #6."

Teacher Facilitation – Allow 15–20 minutes for groups to complete their simulations. After the completion of each simulation, have the class share results and compile totals. Make predictions based on the class results.

Embedded Assessment – Circulate while students complete their simulations. Answer any questions as necessary.

Reteaching/Extension –

- Using a statistic from real–life (newspaper, magazine, internet or other media source) students will design a simulation of their own.

Summative Assessment:

Both the Simulations Quiz and Project will measure the student's knowledge and understanding of designing a simulation. The quiz has been written in a format similar to that used in the Maryland High School Assessment.

Authors:

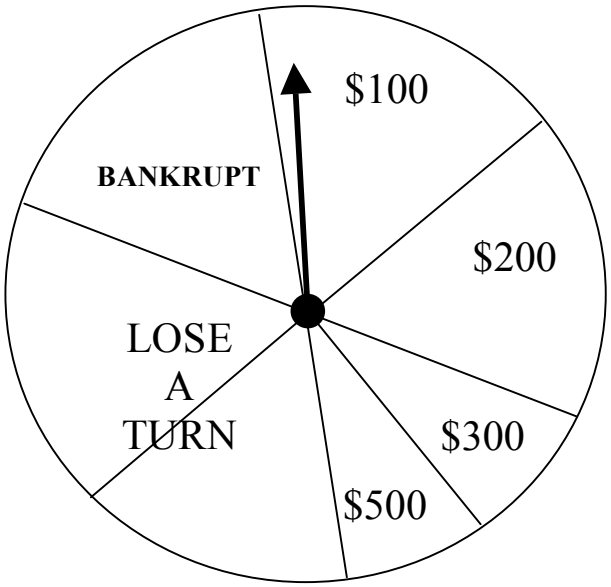
Elizabeth Zader
Bel Air High School
Harford County Public Schools

Pamela Tomczak
Bel Air High School
Harford County Public Schools

Spin To Win
Warm Up

Name: _____
Date: _____

Use the spinner to answer the following questions



1. What is the probability of the spinner landing on $100?

2. What is the probability of the spinner landing on a cash amount?

3. What is the probability of the spinner landing on a section that is <u>not</u> a cash amount?

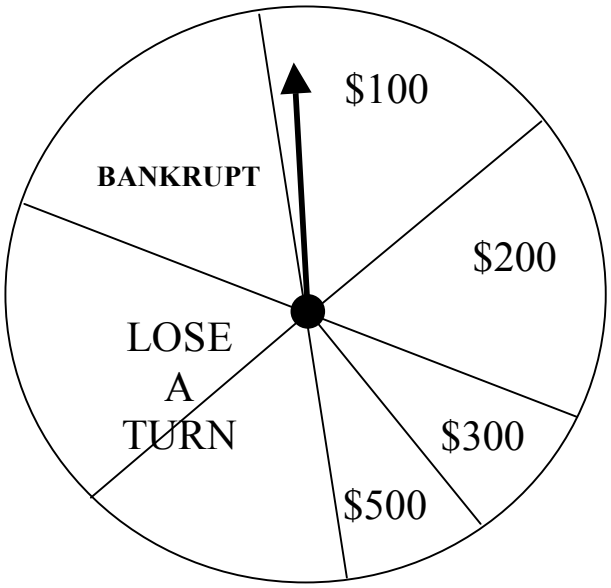
4. What is the probability of the spinner landing on "Lose a Turn?"

5. What is the probability of the spinner landing on an amount greater than $200?

Spin To Win
Warm Up

Name: _____
Date: _____

Use the spinner to answer the following questions.



1. What is the probability of the spinner landing on $100?
   $\frac{1}{6} = 16\frac{2}{3}\%$

2. What is the probability of the spinner landing on a cash amount?
   $\frac{1}{2} = 50\%$

3. What is the probability of the spinner landing on a section that is <u>not</u> a cash amount?
   $\frac{1}{2} = 50\%$

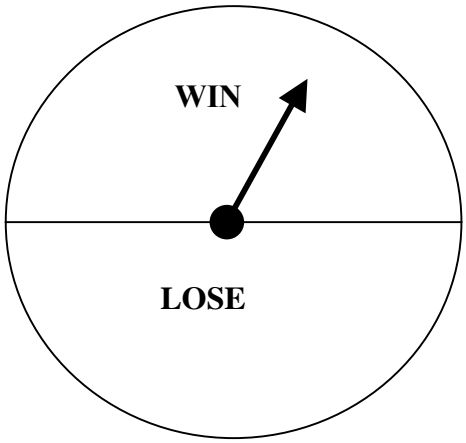
4. What is the probability of the spinner landing on "Lose a Turn?"
   $\frac{1}{3} = 33\frac{1}{3}\%$

5. What is the probability of the spinner landing on an amount greater than $200?
   $\frac{1}{6} = 16\frac{2}{3}\%$

Designing Simulations

Name: _____
Date: _____

You have been selected as a finalist for "Spin to Win". In order to determine whether you win the prize or not, you have to spin the giant wheel. If you land on the green or blue side, you win and if you land on the red side, you lose.



1. What is the probability that you will win a prize?

2. What is the probability that you will NOT win a prize?

3. Record the results of the overhead spinner below. Use *W* to stand for a 'win' and *L* to stand for a 'lose'.

# of Spins	1	2	3	4	5	6	7	8	9	10
Spinner Results										

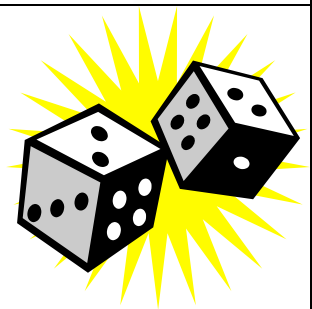
4. What does each spin represent?

5. Perform the simulation again, but this time use the features of the calculator to generate the results.

# of Spins	1	2	3	4	5	6	7	8	9	10
Calculator Results										

6. Based on the calculator results, what is the probability you will when a prize?

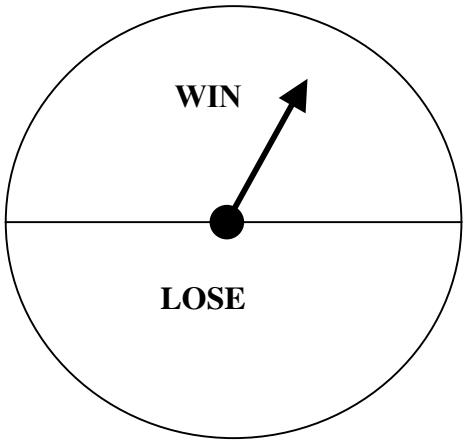
7. Sometimes we do not have a spinner to use. In this case, we would need to simulate the situation using a different device. What random device could we use in place of a spinner?

Name	Device	Characteristics	Disadvantages
Coin			
Spinner			
Playing Cards			
Number Cube			
Random Number Table			
Random Number Generator			

Designing Simulations

Name: __ANSWER KEY_____
Date: _____

You have been selected as a finalist for "Spin to Win". In order to determine whether you win the prize or not, you have to spin the giant wheel. If you land on the green or blue side, you win and if you land on the red side, you lose.



1. What is the probability that you will win a prize? $\frac{1}{2}$
2. What is the probability that you will NOT win a prize? $\frac{1}{2}$
3. Record the results of the overhead spinner below. Use *W* to stand for a 'win' and *L* to stand for a 'lose'. Answers will vary. Below is a sample table.

# of Spins	1	2	3	4	5	6	7	8	9	10
Spinner Results	L	W	W	L	W	L	L	W	L	W

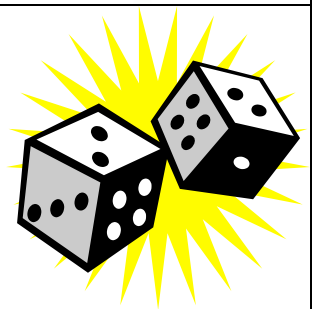
4. What does each spin represent?
   Each spin represents a chance to win a prize on the giant wheel.

5. Perform the simulation again, but this time use the features of the calculator to generate the results. Answers will vary. Below is a sample table.

# of Spins	1	2	3	4	5	6	7	8	9	10
Calculator Results	1	1	1	1	1	1	2	2	1	1

6. Based on the calculator results, what is the probability you will when a prize?
   Answers will vary based on student tables. The sample table answer is $\frac{8}{10} = \frac{4}{5}$

7. Sometimes we do not have a spinner to use. In this case, we would need to <u>simulate</u> the situation using a different device. What random device could we use in place of a spinner? Answers may vary.

Name	Device	Characteristics	Disadvantages
Coin		• 2 sided	• Only useful for 50% 50% situations • Noisy • Time consuming
Spinner		• Multiple sections • Colors and or numbers • Sections of different sizes	• Not always available • Time consuming
Playing Cards		• 52 cards in all • 4 suits • 2 colors • Face Cards Numbers 2–10	• Cumbersome • Time consuming • Not always available
Number Cube		• 6 sides	• Limited numbers • Time Consuming
Random Number Table		• 10 digits • Adapts to any number of outcomes Ex: 0–9, 00–99, 000–999, etc.	• Not always available • Tedious • Difficult to read
Random Number Generator		Same as above	• Not always available • Difficult to read

True/False Quiz Simulation

Name: _____
Date: _____

Sometimes we use a simulation to model situations in real life. Consider the following: In Tommy's science class today, there is a pop quiz consisting of 10 true/false questions. Since he has not done any reading or homework for this class in three months, he plans to randomly guess on each of the 10 questions. We can use a spinner to estimate his chances of passing the quiz.

1. Which sections of your spinner will represent a correct answer? _____

2. Which sections of your spinner will represent an incorrect answer? _____

3. a. Conduct 12 trials using a spinner. Each trial will consist of 10 spins.
   b. Each time your spinner lands on a "correct" answer, place a mark in the "# Correct" column for that trial. If your spinner lands on an "Incorrect" answer, place a mark under the "# Incorrect Column"
   c. Count the number of "Correct" marks for each trial. If you have at least 6 correct answers (60%), place a mark in the "Frequency of Passing Scores – Individual" column.
   d. We will fill in the "Class" column with data collected from all members of the class.

Frequency Table: Ten–Question True/False Quiz

Trial #	**# Correct**	**# Incorrect**	**Frequency of Passing Scores**	
			Individual	Class
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

4. How many passing scores did you have after 12 trials? _____

5. Using your scores, what is the probability that Tommy will pass the quiz? _____

Use the class totals to answer the following questions.

6. How many trials were conducted by the entire class? _____

7. How many passing scores were recorded by the entire class? _____

8. Using the numbers collected by the class, what is the probability that Tommy will pass the quiz?

True/False Quiz Simulation Name: ___ANSWER KEY__
Date: _____

Sometimes we use a simulation to model situations in real life. Consider the following: In Tommy's science class today, there is a pop quiz consisting of 10 true/false questions. Since he has not done any reading or homework for this class in three months, he plans to randomly guess on each of the 10 questions. We can use a spinner to estimate his chances of passing the quiz.

1. Which sections of your spinner will represent a correct answer? _____

   Answers will vary. i.e.1, 2,and 3 represent a correct answer

2. Which sections of your spinner will represent an incorrect answer? _____

   Answers will vary. i.e. . 4, 5, and 6 will represent an incorrect answer.

6. a. Conduct 12 trials using a spinner. Each trial will consist of 10 spins.
   b. Each time your spinner lands on a "correct" answer, place a mark in the "# Correct" column for that trial. If your spinner lands on an "Incorrect" answer, place a mark under the "# Incorrect Column"
   c. Count the number of "Correct" marks for each trial. If you have at least 6 correct answers (60%), place a mark in the "Frequency of Passing Scores – Individual" column.
   d. We will fill in the "Class" column with data collected from all members of the class.

Frequency Table: Ten–Question True/False Quiz

Trial #	**# Correct**	**# Incorrect**	**Frequency of Passing Scores** Individual	Class
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

7. How many passing scores did you have after 12 trials? _____

Answers will vary.

8. Using your scores, what is the probability that Tommy will pass the quiz? _____

Answers will vary. To find the probability, divide the number of passing scores by the total number of trials.

Use the class totals to answer the following questions.

6. How many trials were conducted by the entire class? _____

Answers will vary. To find the total number of trials, multiply the number of students participating in the activity by 12.

7. How many passing scores were recorded by the entire class? _____

Answers will vary.

8. Using the numbers collected by the class, what is the probability that Tommy will pass the quiz?

Answers will vary. To find the probability, divide the number of passing scores by the total number of trials.

Table of Random Digits

Line									
1	21265	26810	00264	93115	59105	11038	92439	94202	00797
2	06960	94142	53813	81802	74430	09838	20729	40293	59497
3	31504	13614	86475	98885	90257	83328	98839	56027	31745
4	72246	60999	65442	60622	82496	78673	35934	49230	27814
5	99551	89597	34571	48599	94791	15772	77290	17687	59867
6	88710	37677	73661	33286	35149	20170	89056	21718	21260
7	06242	49406	71026	70376	97795	66224	72519	51421	27991
8	32279	92225	33234	56097	56680	41699	14595	43766	92961
9	24106	67221	31853	50663	73972	87862	02930	88036	45091
10	16417	34657	46273	48811	64709	37474	36522	34383	08516
11	86971	75557	73474	51637	06986	90224	63563	10078	99682
12	08214	68047	50838	12498	10263	94204	42062	01963	46070
13	78843	99626	63150	54996	48418	45656	45816	08191	75077
14	04433	04927	72273	50982	58022	70262	63184	98328	80167
15	05916	03851	27818	53023	69185	53434	20701	98342	98926
16	03447	89559	38909	56375	64313	36477	05723	46874	22370
17	34040	37836	49754	75009	73087	28956	14573	38701	37364
18	43303	36733	51106	83337	69375	71377	99451	00583	11982
19	74081	66356	39164	65919	50580	92842	89446	01979	44352
20	24834	99106	81335	23243	18630	98839	87682	54381	50074
21	32155	45065	10367	94236	13383	25581	95417	47937	90486
22	35592	12500	84288	62145	74653	56708	57454	48936	81619

Designing Simulations Name: _____
Exit Pass Date: _____

1. What were the results of your true/false quiz simulation?

2. What were the class results?

3. Were you surprised by the results or were they what you predicted?

4. Based on the results of today's simulation, do you think it is a good idea to randomly guess on a test? Why or why not?

5. Consider the following situation:

   "Joe will be taking a multiple choice test in biology later today that he did not study for. The test consists of 8 questions with four possible choices for each question. Joe plans on randomly guessing the answer to each question and wants predict whether he will pass the quiz. A passing score is 60 and above."

   a. Could you use a table of random digits to simulate this situation? Why or why not?

   b. What other random device could you use to simulate this situation? Explain.

Designing Simulations Name: __ANSWER KEY___
Exit Pass Date: _____

1. What were the results of your true/false quiz simulation?
   Answers may vary.

2. What were the class results?
   Answers may vary.

3. Were you surprised by the results or were they what you predicted?
   Answers may vary. For example, 'No, I was not surprised, because I know that if you study for a test, you will have a greater chance of passing it. People that do not study generally do not do well by just guessing."

4. Based on the results of today's simulation, do you think it is a good idea to randomly guess on a test? Why or why not?
   Answers may vary depending on class data. For example, "No, this simulation shows that it is not a good idea to guess on a test. By guessing, you will get about half the questions correct, which is not enough to pass."

5. Consider the following situation:

   "Joe will be taking a multiple choice test in biology later today that he did not study for. The test consists of 8 questions with four possible choices for each question. Joe plans on randomly guessing the answer to each question and wants predict whether he will pass the quiz. A passing score is 60 and above."

   a. Could you use a table of random digits to simulate this situation? Why or why not?
      Answers may vary. For example, "Yes. I use the numbers 0–7. 0 and 1 would represent a correct answer. 2–7 would represent incorrect answers. I would start at a random line and look at 8 single digits between 0–7 at a time, each digit representing a question on the test. If I come across an 8 or a 9, I would skip it and move to the next digit. If I were to conduct more than one trial, I would repeat this process at least 20 times and record my results by keeping track of how many correct responses I had in each 8 digit group."

   b. What other random device could you use to simulate this situation? Explain.
      Answers may vary. For example, "You could use a deck of cards to simulate this situation. Since there are 4 suits, you could designate one suit to represent a correct answer and the remaining three to represent incorrect answers. You would randomly choose 8 cards, with replacement."

Simulation Design
Warm Up

Name: _____
Date: _____

Tommy is scheduled to take a true/false quiz in his History class today. Unfortunately, his dog chewed up his notebook! Since his Internet service was down last night, he couldn't IM his friends for help. As a result, he plans to randomly guess on each of the 12 questions on today's quiz. Use your knowledge of probability to design a simulation to predict the number of questions he will answer correctly.

1. The random device our group chose for this simulation was _____.

2. Conduct 20 trials using the random device listed above. Record your results in the frequency table below in the column titled "Individual". We will fill in the "Class" column with data collected from all groups. You will then compare your results with the results you obtained from the previous true/false quiz simulation.

Frequency Table: Twelve–Question True/False Quiz

Number of Correct Responses	**Frequency** Individual	Class
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Total # of Trials		

Use the class totals to answer the following questions.

3. What is the mean number of correct responses for this simulation?

4. How do these results compare with those using the random digits table?

Simulation Models

Name: _____
Date: _____

Read the following situations and determine which of the devices listed can be used to conduct a simulation.

1. A high school basketball player makes 50% of his shots from the three–point line. If he takes 13 shots during a game predict the number of baskets he will make.

Random Device	**Can it be used? √ or X**	**How?**
Coin		
Spinner		
Playing Cards		
Number Cube		
Random Number Table		
Random Number Generator		

2. In a family of 5, what is the probability that three of the members are male?

Random Device	**Can it be used? √ or X**	**How?**
Coin		
Spinner		
Playing Cards		
Number Cube		
Random Number Table		
Random Number Generator		

3. In a random survey, 68% of high school students report that they have less than an hour of homework on any given night. What is the probability that a high school student selected at random will have less than an hour of homework on any given night.

Random Device	Can it be used? √ or X	How?
Coin		
Spinner		
Playing Cards		
Number Cube		
Random Number Table		
Random Number Generator		

4. The probability that a student gets an A or B on a Chapter Test is $\frac{1}{3}$. What is the probability that a student chosen at random does not get an A or a B on the test?

Random Device	Can it be used? √ or X	How?
Coin		
Spinner		
Playing Cards		
Number Cube		
Random Number Table		
Random Number Generator		

Simulation Models

Name: _____ANSWER KEY_____
Date: _____

Read the following situations and determine which of the devices listed can be used to conduct a simulation.

1. A high school basketball player makes 50% of his shots from the three–point line. If he takes 13 shots during a game predict the number of baskets he will make.

Random Device	**Can it be used? √ or X**	**How?**
Coin	√	EX. Heads = making the shot Tails = missing the shot Flip the coin 13 times
Spinner	√	EX: Designate half the spinner to represent making the shot and half the spinner missing the shot. Spin 13 times
Playing Cards	√	EX: Designate one color to represent making the shot and one color to represent missing the shot OR choose two suits to represent making the shot and two suits to represent missing the shot. Choose 13 cards.
Number Cube	√	EX: Designate three numbers to represent making the shot and three numbers to represent missing the shot. Roll the number cube 13 times.
Random Number Table	√	EX: Using the numbers 0–9, 0–4 would represent making the shot and 5–9 would represent missing the shot. Look at 13 digits at a time. There are a variety of ways students can split the numbers 0–9 into two equal groups.
Random Number Generator	√	SAME AS ABOVE Another example: Evens would represent making the shot and Odds would represent missing the shot. Look at 13 digits at a time.

2. In a family of 5, what is the probability that three of the members are male?

Random Device	Can it be used? √ or X	How?
Coin	√	EX: Flip five coins at once and record results. Heads = Female Tails = Male
Spinner	√	EX: Using a spinner with and an even number of spaces, designate half the numbers to represent female and half the numbers to represent males. Spin the spinner five times.
Playing Cards	√	EX: Designate one color to represent male and one color to represent female. Choose five cards.
Number Cube	√	EX: Designate three numbers to represent female and three numbers to represent male. Roll five times.
Random Number Table	√	EX: Using 0–9, designate half the numbers to represent female and half the numbers to represent male (ie: 0–4 = female, 5–9 = male) Look at five digits at a time
Random Number Generator	√	SAME AS RANDOM NUMBER TABLE

3. In a random survey, 68% of high school students report that they have less than an hour of homework on any given night. What is the probability that a high school student selected at random will have less than an hour of homework on any given night.

Random Device	Can it be used? √ or X	How?
Coin	X	
Spinner	X	
Playing Cards	X	
Dice	X	
Random Number Table	√	EX: Using the numbers 00–99, designate 68 numbers to represent having less than one hour of homework and designate the remaining 32 numbers to represent having more that one–hour of homework. Look at two digits at a time. ie: 00–67: less than one hour of homework, 68–99: more than one hour of homework
Random Number Generator	√	SAME AS RANDOM NUMBER TABLE

4. The probability that a student gets an A or B on a Chapter Test is 1/3. What is the probability that a student chosen at random does *not* get an A or a B on the test?

Random Device	**Can it be used? √ or X**	**How?**
Coin	X	
Spinner	√	EX: Use a spinner with thee sections. Designate one section to represent getting an A or B on the test. The other two will represent NOT getting an A or a B on the test. Spin once.
Playing Cards	√	EX: Disregard one suit. Designate one suit to represent getting an A or B on the test; Designate the other two to represent NOT getting an a or a b on the test. Choose one card.
Number Cube	√	EX: Designate two numbers to represent getting an A or B on the test; Designate four numbers to represent NOT getting an A or a B on the test. Roll once.
Random Number Table	√	EX: Using the numbers 0–5, choose two to represent Getting an A or B on the test; Designate four numbers to represent not getting an A or a B on the test. ie: 0, 1: getting an A or B 2–4: Not Getting an A or B. Look at a single digit number. Disregard digits 6–9.
Random Number Generator	√	SAME AS RANDOM NUMBER TABLE

McDonald's: Simulation #3

Name: _____
Date: _____

Situation: For a limited time this summer, McDonald's is offering eight different Build–a–Bear plush toys with removable mix and match clothing in happy meals. One bear is included with each happy meal. Your little cousin Jenna wants to collect all 8 bears. Design and conduct a simulation that will help you predict the average number of happy meals you will have to buy in order to collect all eight bears.

1. What is the problem that we are simulating?

2. What are the outcomes?

3. What is the probability of each outcome?

4. What are the assumptions?

5. What random device will you use to simulate the problem?

6. How will you use this random device to simulate the problem?

7. What does one trial represent to this problem?

8. How will you conduct each trial?

9. Conduct 20 trials and record each of your trials here.

Trial	Outcomes
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

10. Record the results of this trial in the table below:

Number of Happy Meals purchased	Frequency	Total = Number of Happy Meals x Frequency
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		

11. What predictions can be made based on my results?
    - Find the average number of happy meals that need to be purchased to collect all eight bears.

    - Based on my simulation, the average number of happy meals that need to be purchased in order to collect all eight bears is _____.

McDonald's: Simulation #3 Name: __ANSWER KEY___
Date: _____

Situation: For a limited time this summer, McDonald's is offering eight different Build–a–Bear plush toys with removable mix and match clothing in happy meals. One bear is included with each happy meal. Your little cousin Jenna wants to collect all 8 bears. Design and conduct a simulation that will help you predict the average number of happy meals you will have to buy in order to collect all eight bears.

1. What is the problem that we are simulating?
   We are simulating the purchase of happy meals in hopes to collect all 8 Build–a– Bear plush toys.

2. What are the outcomes?
   Each happy meal will include one of the 8 possible bears.

3. What is the probability of each outcome?
   There is a 1/8 chance of getting each bear.

4. What are the assumptions?
   We are assuming that there are an equal number of each bear packaged in the happy meals and each has an equally likely chance of being chosen.

5. What random device will you use to simulate the problem?
   Random Number Generator

6. How will you use this random device to simulate the problem?
   By using the numbers 1–8, each number will represent a different bear.

7. What does one trial represent to this problem?
   One trial will represent one attempt to collect all 8 bears.

8. How will you conduct each trial?
   By using the random number generator, we will look at one number at a time and collect digits until we have collected all 8 numbers, 1–8 at least once.

9. Conduct 20 trials and record each of your trials here. ANSWERS WILL VARY

Trial	Outcomes
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

10. Record the results of this trial in the table below:

Number of Happy Meals purchased	Frequency	Total = Number of Happy Meals x Frequency
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		

11. What predictions can be made based on my results? ANSWERS WILL VARY

- Find the average number of happy meals that need to be purchased to collect all eight bears.
  Total / Total # of Trials = Average

- Based on my simulation, the average number of happy meals that need to be purchased in order to collect all eight bears is _____.

McDonald's: Simulation #4

Name: _____
Date: _____

Situation: For their holiday promotion, McDonald's is offering six different penguin toys from the "Happy Feet" movie in their happy meals. One toy is included with each happy meal. Your little cousin Jenna wants to collect all 6 toys. Design and conduct a simulation that will help you predict the average number of happy meals you will have to buy in order to collect all six toys.

1. What is the problem that we are simulating?

2. What are the outcomes?

3. What is the probability of each outcome?

4. What are the assumptions?

5. What random device will you use to simulate the problem?

6. How will you use this random device to simulate the problem?

7. What does one trial represent to this problem?

8. How will you conduct each trial?

9. Conduct 20 trials and record each of your trials here.

Trial	Outcomes
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

10. Record the results of this trial in the table below:

Number of Happy Meals purchased	Frequency	Total = Number of Happy Meals x Frequency
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

11. What predictions can be made based on my results?
    - Find the average number of happy meals that need to be purchased to collect all six toys.

    - Based on my simulation, the average number of happy meals that need to be purchased in order to collect all six toys is _____.

McDonald's: Simulation #4

Name: __ANSWER KEY___
Date: _____

Situation: For their holiday promotion, McDonald's is offering six different penguin toys from the "Happy Feet" movie in their happy meals. One toy is included with each happy meal. Your little cousin Jenna wants to collect all 6 toys. Design and conduct a simulation that will help you predict the average number of happy meals you will have to buy in order to collect all six toys.

1. What is the problem that we are simulating?
   We are simulating the purchase of happy meals in hopes to collect all 6 penguin toys.

2. What are the outcomes?
   Each happy meal will include one of the 6 possible toys.

3. What is the probability of each outcome?
   There is a 1/6 chance of getting each toy.

4. What are the assumptions?
   We are assuming that there is an equal number of each penguin toy packaged in the happy meals and each has an equally likely chance of being chosen.

5. What random device will you use to simulate the problem?
   Random Number Generator

6. How will you use this random device to simulate the problem?
   By using the numbers 1–6, each number will represent a different toy.

7. What does one trial represent to this problem?
   One trial will represent one attempt to collect all 6 toys.

8. How will you conduct each trial?
   By using the random number generator, we will look at one number at a time and collect digits until we have collected all 6 numbers, 1–6 at least once.

9. Conduct 20 trials and record each of your trials here. ANSWERS WILL VARY

Trial	Outcomes
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

10. Record the results of this trial in the table below:

Number of Happy Meals purchased	Frequency	Total = Number of Happy Meals x Frequency
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

11. What predictions can be made based on my results? ANSWERS WILL VARY

- Find the average number of happy meals that need to be purchased to collect all six toys.
  Total / Total # of Trials = Average

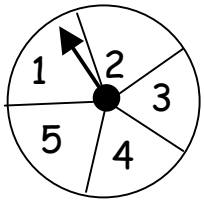
- Based on my simulation, the average number of happy meals that need to be purchased in order to collect all six toys is _____.

Gallery Walk (Student Sheet) Name: _____
Simulation Models Date: _____

1. 0,1,2 3,4,5,6,7,8,9

   These digits could simulate_____
_____

2. The spinner could be used to simulate ___
_____
_____



3. RandInt(1, 5, 6,)
   This array of numbers could be used to model_____
   _____
   _____

4. I predict that the average number of saves the goalie will make in a game where the opponents take 42 shots is _____
   Total #of trials – _____
   Total # of saves – _____
   How did you find the average? _____
   _____

5. 

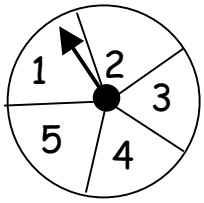
   The coin tosses could be used to model _____
   _____
   _____

Gallery Walk (Student Sheet) Name: __ANSWER KEY___
Simulation Models Date: _____

1. 0,1,2 3,4,5,6,7,8,9

   These digits could simulate a three out of ten chance of scoring a goal during a soccer game.

2. The spinner could be used to simulate
   A situation where one in every five students in a random survey has traveled to New York.



3. RandInt(1, 5, 6,)
   This array of numbers could be used to model a situation where a football quarterback attempts six passes during a game and he makes a completion a certain percentage of time.

4. I predict that the average number of saves the goalie will make in a game where the opponents take 42 shots is ~33.
   Total #of trials – _450_____
   Total # of saves – _14,560_____
   How did you find the average? I divided the class' total number of saves by the total number of trials.

5. 

   The coin tosses could be used to model a situation where a family wants to have three children and they want to find the probability of having a certain number of boys and girls.