

**COUNTING TREES, SAMPLE SPACES, AND PROBABILITY**  
**ALGEBRA 2 WITH TRIGONOMETRY**

Probability is the measurement of chance, the likelihood that something will happen. Its basic definition is given below and should be clearly understood.

**PROBABILITY'S BASIC DEFINITION**

In an **experiment** with a set,  $S$ , of **equally likely outcomes**, the probability of an **event**  $E$  is

$$P(E) = \frac{n(E)}{n(S)} = \frac{\text{The number of outcomes in } E}{\text{The total number of outcomes}}$$

We begin with a problem that will review many of the probability techniques you saw in Algebra 1.

**Exercise #1:** Scientists are trying to determine how likely it is that a mouse will correctly maneuver through a simple maze to obtain food. The mouse must make three turns, either right or left, to get through the maze but will only get cheese at the end if it makes two lefts and a right, in any order.

- (a) Draw a tree diagram to illustrate all of the possible routes the mouse could take through the maze.
- (b) Summarize these routes by listing the sample space in terms of ordered triples.
- (c) List the routes from part (b) that would result in the mouse getting cheese.
- (d) What is the probability that a mouse will get cheese if all of the possible routes from part (a) are equally likely?

**Exercise #2:** Carlos is trying to grab two dimes out of his pocket, which contains the two dimes and a penny. Assuming that Carlos randomly grabs two coins without replacement, what is the probability he got the two dimes? Draw a tree diagram or list a sample space to justify your answer.



Probability can become more complex if the sample space gets larger. The last exercise in this lesson is an extended problem that involves playing a game called **Three Person Rock-Paper-Scissors**. In normal, two-person, rock-paper-scissors, two people throw out a hand signal (rock, paper, or scissors). Rock beats (crushes) scissors, scissors beats (cuts) paper, and paper beats (covers) rock. This game is often used to break ties. In the three person version, each player throws out a hand signal. Player A wins if all three hands are the same, Player B wins if all three hands are different, and Player C wins if two hands are the same and one different.

**Exercise #3:** Students will need to work in groups of at least 3 for this exercise.

(a) Play the game 50 times and record the number of wins below.

	Tally	Total
Player A		
Player B		
Player C		

(b) Calculate the empirical probabilities for each player to win based on your data from (a).

	Probability
Player A	
Player B	
Player C	

(c) Create a tree diagram for the sample space of outcomes to this game. This is a fairly large tree diagram.

(d) List the outcomes of this sample space that result in Player A winning and Player B winning.

Player A:

Player B:

(e) How many outcomes are there in the sample space in total? How many of these outcomes result in Player C winning?

(f) Find the theoretical probabilities of winning.

	Probability
Player A	
Player B	
Player C	



Name: \_\_\_\_\_

Date: \_\_\_\_\_

**COUNTING TREES, SAMPLE SPACES, AND PROBABILITY  
ALGEBRA 2 WITH TRIGONOMETRY - HOMEWORK**

**APPLICATIONS**

1. A standard coin is tossed and then a standard six-sided die is rolled.
  - (a) Draw a tree-diagram or create a list of ordered pairs that represent the sample space of this experiment.
  - (b) How many total outcomes are in this sample space?
  - (c) Determine the probability of getting a head and an even.
  - (d) Determine the probability of getting a head and an even or a tail and a number less than three.
  
2. A four-sided die, in the shape of a tetrahedron, is rolled twice and the number rolled is recorded each time.
  - (a) Draw a tree-diagram that shows the sample space of this experiment.
  - (b) Write down all ordered pairs that would result in an odd product if the two numbers were multiplied.
  - (c) What is the probability that the two rolled numbers have a product that is odd?
  - (d) What is the probability that the two rolled numbers have a product that is even?



3. Three children are born in a family. Assume that the likelihood of a child being born male is the same as it is for being born female. What is the probability that the three children born will be all girls or all boys? Draw a tree diagram or list a sample space that justifies your answer.
4. Samuel pulls two coins out of his pocket randomly without replacement. If his pocket contains one nickel, one dime, and one quarter, what is the probability that he pulled more than 20 cents out of his pocket? Justify your work.
5. Janice, Tom, John, and Tamira are trying to decide on who will make dinner and who will wash the dishes afterwards. They randomly pull two names out of a hat to decide, where the first name drawn will make dinner and the second will do the dishes. Determine the probability that the two people pulled will have first names beginning with the same letter. Assume the same person cannot be picked for both.

