

Probability

Activity 2a - Probability

1. A jar contains 15 ping pong balls, 3 are red, 5 are blue, 7 are green. The red balls are numbered 1, 2, 3 to tell them apart. The blue balls are numbered 4, 5, 6, 7, 8. The green balls are numbered 9, 10, 11, 12, 13, 14, 15.
 - (a) Draw one ball. What is the probability that the ball is red?
 - (b) Draw one ball. What is the probability that it is either red OR blue? Do this problem in a second way.
 - (c) Draw two balls. Pick one ball first, then another ball second (without replacing the first ball). In other words, you can't get the same number twice. What is the probability that both balls are blue? Do this problem 3 ways, first by counting combinations, then by using the probability that the first ball is blue AND the second ball is blue, then by counting the possibilities if the order matters.
 - (d) Draw two balls. Pick one ball first, then another ball second (without replacing the first ball). What is the probability that the first is blue AND the second is red? What is the probability that one ball is red and the other blue? Do this problem using the word 'OR', also do this problem by some counting technique.
 - (e) Draw two balls without replacement. What is the probability that at least one ball is green? Do this in as many ways as possible.
 - (f) Draw four balls without replacement. What is the probability that you get two red, one blue, one green?
2. You roll five six-sided dice, that are five different colors, (blue, red, black, yellow, green) so you can tell them apart. Each dice roll will be listed A-B-C-D-E in that color order, so that, for example, 1-3-4-2-6 means the blue die is 1, red = 3, black = 4, yellow = 2, green = 6. Rolling 3-1-6-4-2 would be a different outcome. (Some terminology in this problem comes from the game of *Yahtzee*)
 - (a) How many total outcomes are possible?
 - (b) What is the probability of rolling 5-5-5-5-5?
 - (c) What is the probability of getting the numbers 2, 3, 4, 5, 6 in some order?
 - (d) What is the probability of getting a large straight (a large straight is five numbers in sequence, so either the numbers 1 through 5 OR the numbers 2 through 6)?
 - (e) What is the probability of rolling 6 on three of the dice (and something other than 6 on the other two)?
 - (f) What is the probability of getting a full house? (A full house is three of one value and two of another)

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3. This problem involves Punnett squares, which are a topic in genetics. There is some useful information here

https://en.wikipedia.org/wiki/Punnett_square

The dominant gene is 'A' and the recessive gene is 'a'. From each parent, one of the two genes (alleles) is chosen randomly, each with probability 1/2.

Find the probability that an offspring is of type 'AA', 'Aa' or 'aa' if the parents are

- (a) One parent = 'AA', other parent is 'aa' (This first problem is done for you.)

	a	a
A	Aa	Aa
A	Aa	Aa

Solution:

$$P(\text{offspring} = \text{'AA'}) = 0/4$$

$$P(\text{offspring} = \text{'Aa'}) = 4/4$$

$$P(\text{offspring} = \text{'aa'}) = 0/4$$

- (b) One parent = 'AA', other parent is 'Aa'

	A	a
A	AA	Aa
A	AA	Aa

Solution:

$$P(\text{offspring} = \text{'AA'}) =$$

$$P(\text{offspring} = \text{'Aa'}) =$$

$$P(\text{offspring} = \text{'aa'}) =$$

- (c) Both parents = 'Aa',

	A	a
A		
a		

Solution:

$$P(\text{offspring} = \text{'AA'}) =$$

$$P(\text{offspring} = \text{'Aa'}) =$$

$$P(\text{offspring} = \text{'aa'}) =$$

- (d) Generation X - both parents are 'Aa'. The offspring are Generation Y. Two Generation Y offspring are chosen at random and become the parents of Generation Z. What is the probability that a Generation Z offspring is 'AA'? 'Aa'? 'aa'? (Hint: The denominators for the Generation Y offspring are 4, so there are $4 \times 4 = 16$ possible pairs of Generation Y parents. For each of these 16 possibilities, there are four possible offspring, so the denominators of the answers will naturally be 64.)