BIG PICTURE of this UNIT:	• How can we visualize events and outcomes when considering probability events? • How can we count outcomes in probability events? • How can we calculate probabilities, given different types of events • Can we predict how likely it is that an event occurs? How can we use that knowledge?

This lesson will be based upon a STUDENT DIRECTED DISCUSSION model ….. in your groups, you should be having DISCUSSIONS about how to think and work through and then present the solutions to the following questions. The questions will involve basic ideas including (i) visualizing the outcomes of probability events/experiments, (ii) determining probabilities of single and compound probability events, (iii) counting outcomes, and (iv). EVERY PROBLEM SET will involve spiralling through these major concepts as you will be given the opportunity to deepen and extend your conceptual knowledge & skill set on these major themes as you see them multiple times in our lessons.

So, in your group, discuss & prepare solutions to the following questions. Record the key ideas of your discussions/solutions in your notebook. Then, once you have had your discussions, present your solutions on the board. Solutions do NOT necessarily NEED to be correct – they simply form the basis for DISCUSSIONS !!!! If your group has (i) multiple solutions that lead to the same answers OR (ii) same/different solutions that lead to different answers, present them ANYWAY!!

1. There are 5 red pens, 3 blue pens and 2 green pens in a box. Ziyad takes at random a pen from the box and gives the pen to his friend, Tamer. Ziyad then takes at random another pen from the box. Work out the probability that both pens are the same colour.

2. The probabilities that John will receive an A, B, C, D, or F on a test is 0.13, 0.26, 0.45, 0.11 and 0.05 respectively. What is the probability that John will get the following result?

   a) An A or B b) At least a D c) Less than A

3. You go to the snack bar to buy a bagel and a drink for lunch. You can choose from a plain bagel, a blueberry bagel, or a raisin bagel. The choices for a drink include water or a sports drink. How many different lunches could be made with these choices?

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

5. In an animal-behaviour study, twenty eight hamsters were tested with a number of intelligence tests, as shown in the table below.

Number of Tests	Number of Hamsters
0	10
1	6
2	4
3	3
4 or more	5

If a hamster is randomly chosen from this study group, what is the likelihood that the hamster has participated in

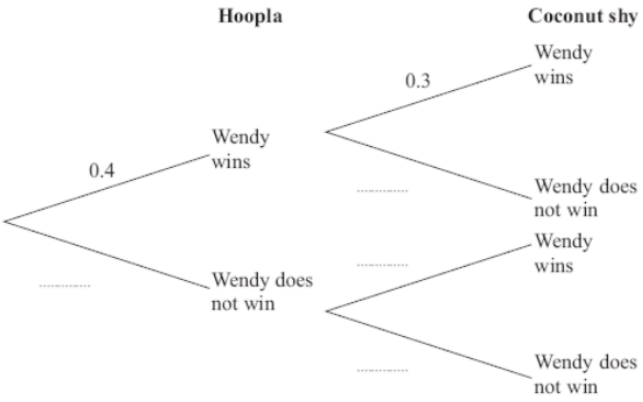
a. Exactly three tests?

b. Fewer than two tests?

c. Either one or two tests?

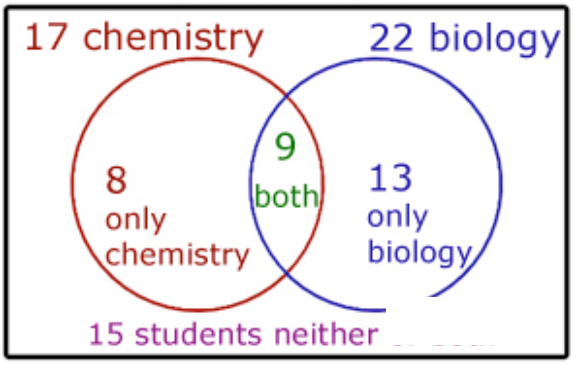
d. No tests or more than three tests?

6. Wendy goes to a fun fair. She has one game at Hoopla. She has one game on the Coconut Shy. The probability that she wins at Hoopla is 0.4. The probability that she wins on the Coconut Shy is 0.3.



a. Complete the probability tree diagram.
b. Work out the probability that Wendy wins once.
c. Work out the probability that Wendy wins at Hoopla and also wins on the Coconut shy.

7. Out of a group of 45 students, 17 are taking chemistry and 22 biology. If 9 students do both chemistry and biology.



   a. How many students are in neither class?
   b. How many are in either class?
   c. What is the probability that of a student is taking only the chemistry class?
   d. What is the probability that a student is taking chemistry given that they also take biology?

8. A box contains 5 purple marbles, 3, green marbles, and 2 orange marbles. Two consecutive draws are made from the box without replacement of the first draw. Find the probability of each event, given the following conditions: (i) the marbles are NOT REPLACED after each draw and then secondly, (ii) the marbles ARE REPLACED after each draw

(i) Not Replaced	(ii) Replaced
(a) P(orange first, green second) =	(a) P(orange first, green second) =
(b) P(both marbles are purple) =	(b) P(both marbles are purple) =
(c) P(the first marble is purple, and the second is ANY color EXCEPT purple) =	(c) P(the first marble is purple, and the second is ANY color EXCEPT purple) =

Higher Level Questions for More Complex Concepts in Probability. Determine the probability of the event described in each exercise. Unless stated otherwise, assume all items of chance (dice, coins, cards, spinners, etc.) are fair.

Problem #1 – Expected Value

1.1 Some Simple Games

Lets say you play a game where you roll a fair die (what does this mean?) and get paid according to your roll:

Roll	Payout
6	\$ 4
5	\$ 2
4	\$ 1
3	\$ 0
2	\$ 0
1	\$ 0

You have to pay \$1 to play this game. Is it worth it? What do you expect to happen in the long run?

Problem #2 – False Positives

Five percent of my students suffer from a terrible malady called Lazybrain(LB). A blood test detects LB accurately 90% of the time. Yusuke is told that his blood test is positive for LB. Yusuke hopes that this is a "false positive" and he actually doesn't have Lazybrain.

i. Draw the tree with all the probabilities. Indicate which branches are the *false positive, false negative, correct positive,* and *correct negative.*
ii. Find the probability that Yusuke is OK even though his blood test was positive.

Problem #3 – Working with Formulas

Suppose you throw a pair of fair 6-sided dice. One is white and the other is black. Let T = total showing on both dice, and let B = number showing on the black die.

a) Find $P(T = 5 \mid B = 2)$ b) Find $P(B = 2 \mid T = 5)$