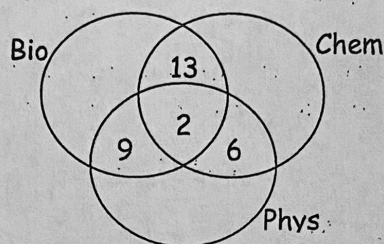# Unit 2: Combinations

1. Venn Diagrams
   a) Create a series of circles to illustrate the different sets of data.
   b) Determine the elements common to multiple sets first. (work from middle outward)
   c) Subtract the common elements from the overlapping ones to determine the data in each.
   d) Whatever is not included in the circles, belongs to the null set. (Belongs to none of the sets)

   Ex/ Of the 140 grade 12 students at Churchill, 52 have signed up for biology, 71 for chemistry and 40 for physics. The science students include 15 who are taking both biology and chemistry, 8 who are taking chemistry and physics, 11 who are taking biology and physics, and 2 who are taking all three sciences.

2. Combinations
   a) $_nC_r = \dfrac{n!}{r!(n-r)!}$

   b) Combinations apply to the situation where a specific number of items are chosen from a larger overall group **in no particular order.** (i.e. top 3 finishers in a race)
   c) If there are n distinct items and **some** must be selected, the total combinations containing at least 1 item from each group is $2^n - 1$.
   d) The total number of selections of **some** items that can be made from p items of one kind, q items of another kind, r items of another kind, and so on is given by $(p+1)(q+1)(r+1)....-1$

3. Binomial Theorem by using combination notation.

$$(a+b)^n = \sum_{r=0}^{n} {}_nC_r a^{n-r} b^r$$

   Ex/ Determine the 6th term of the expansion of $\left(2x^2 - 1\right)^8$

   $= {}_8C_5 \left(2x^2\right)^3 (-1)^5$ **Remember:** the positions start at 0, so the 6th term is r = 5

   $= 56\left(8x^6\right)(-1)$

   $= -448x^6$