**Title of Problem:**

- Socks in the Dark.

Discussion of – or Defining the Problem:

- This is a logic puzzle that determines the reader’s comprehension of the basics of algebraic substitution with letters. 2(n-1). In this problem – we are not allowed to know the results of individual actions – only the upper-limit-potential of those actions. In other words, we know the total number of the final result; but we don’t know what results we will receive on the way there.

The overall goal is to locate both singular pairs of socks, as well as pairs of socks by color-attributes.

Simply Put: Match socks in the shortest time (evaluated by attempts) possible.

Breaking Apart the Problem:

* The Constraints:
  + Whereas in problem 1 – we knew all of the variables and outputs in advance: here we only know the variables, not the outputs.
  + We may only pull (action) one sock at a time, and evaluate our results based on one sock at a time.
* Insight: Knowing that there are 20 total socks in the drawer – when we are also told the # of pairs and colors – is useless and trivial data; except to define that there are ADDITIONAL socks beyond the colors mentioned. In other words, this only serves to provide clarity to those who may “over-read” the problem.
* The Sub-Goals:
  + We need to acquire a single pair of socks. This pair must be a matching (attribute: color) pair.
  + We need to acquire a set of socks – one pair of each color. (Three colors = six total socks.)
  + We need to determine the minimum number of steps to accomplish this task.

Identifying Potential Solutions:

* The first question we can ask is “how” would we identify potential solutions. A great way – but, long and involved method would be to create an environment where one could test and postulate a theory in a literal fashion (such as actually empty a drawer, and placing in the appropriate socks.) This, however; is long and tedious.
* Another method is to create a mathematical expression to determine the answers.

Evaluating Solutions:

* The problem with the first solution – even if we simplify the idea by simply putting random objects into a bag is the chance for making a basic, human-error mistake and not annotating results properly.
* The problem with the second solution is that the equation may require several revisions in order to solidify – however; math equations can be easily tested, so let’s use that.

Implementing a Solution:

* We know that there are only three colors. We know that there are only ten total pairs of socks. Creating an equation 2(n-1) = X, where n = number of colors, and X = number of “pulls” needed to acquire a single pair of socks works abundantly well.
  + Let’s try:
  + 2(3 for # of colors - 1) = 2 (3-1) = 2(2) = 4 pulls.
  + Why did we create the “-1”? Because we know that any time a SINGLE sock duplicates – this achieves success, thus you can’t possible pull more than # + 1 of colors.
  + What does this really mean? That the above expression is far too complicated. We know that **# + 1 = number of pulls.** In other words, in order to *guarantee* that you pull the correct number of socks – you always have to assume that you always fail until you cannot possibly fail: i.e. pull one more sock than there are colors.
* Unfortunately, all of the information-above does not evaluate well for the next part of the problem.
  + For the second-part of this problem we are trying not to pull a single pair – but a # of pairs EQUAL to the # of colors – and guarantee that we will get that many full pairs.
  + The difficulty here lies in the fact that we switch from being concerned about number of colors – to the highest numbers of pairs.
  + Thus in order to solve this – we need to remember that you could potentially pull ALL five black socks, long before you even got to a single brown sock.
    - 2((X+Y))+2= Pulls
    - In this instance X and Y represents the colors with the highest number of pairings. +2 represents the fact that even after we have pulled ALL the other colors – we still need to pull two pairs of white socks.
    - Why do we double the X and Y values – because we must remember (and not make a false assumption) that we have to pull each sock individually.
    - This expression can be used even if we had 4 pairs of grey socks – by simply adding another variable. Always drop the pair with the lowest number and simply replace it with “+2”, as our lowest-chance socks need only a single pair.
    - Thus: 2 ((X)+(Y))+2 = 2(5+3)+2=2(8)+2= 16+2 = 18 pulls.