**Core Assumptions for the model**

1. Non-specific in terminology of RNAP will mean that RNAP can go and attach itself to **ANY promoter** DNA sequence. But Non specificity *never talks about*  *the extent to which* the attachment/binding of RNAP occurs with the sequence. Some sequences will have a stronger affinity for RNAP to attach itself, while others wont.
2. RNA Polymerase will have different binding energies for each promoter sequence. The extent to which RNAP attaches itself to the promoter sequence is dependent on the sequence. Thus, the Free energy associated with RNAP binding on P70 promoter sequence will be different to that of P28 promoter sequence.
3. Free energy of RNAP binding on P70 promoter does not depend on the reporter gene sequence. For example, free energy of RNAP binding on P70 promoter containing GntR gene is same as that of P70 promoter containing the S28 gene.
4. Only one sigma factor can bind on to RNAP to form core RNAP holoenzyme at a time. For example- When Sigma 70 (S70) factor finishes binding on to the 5 subunit apo RNAP bound on P70, Sigma 28 (S28) or other sigma factors CANNOT bind on to the RNAP complex.
5. While RNAP is nonspecific in binding to DNA sequence, **for transcription to start**, two other factors are considered.

* First factor is the sigma factor considered. RNAP binding with Sigma 70 factor will have different hill equation constants than RNAP binding with Sigma 28 factor. Ie (n,K) of S70-RNAP will be different from (n,K) of S28 RNAP
* The nature of gene that is transcribed from the promoter. Even though the promoter sequence is the main one that plays a role in Initiation, for elongation and termination, the gene plays a role. Hence, for RNAP binding with S70 or S28, the nature of gene which follows the promoter sequence is also considered for the hill constants.   
  For example: There are two P70 promoters that transcribe GntR and S28 genes respectively. I’m assuming that the hill constants will be different. Ie (n,K) of S70-RNAP of GntR gene will be different from that of (n,K) of S70-RNAP of S28 gene.
* Unlike pre transcription (where only RNAP binds on to the promoter sequence without Sigma factors), transcription initiation is highly specific. So, while we can choose to discard the free energy specifics of promoter reporter gene combo as apoenzyme RNAP doesn’t care about what gene lies past promoter (ie P70-GntR will have the same free energy as that of P70-S28 and so on), we can NOT do the same for the hill equation (HE) coefficients.

1. Individual binding of Sigma factors and RNAPs to promoters are elucidated here
   * 1. *For GntR gene under control of P70 promoter*

This assumes that the transcription initiation takes place with the S70 attached RNAP that binds on to the P70 promoter that is responsible for GntR gene

* + 1. *For S28 gene under control of P70 promoter*

This assumes that the transcription initiation takes place with the S70 attached RNAP that binds on to the P70 promoter that is responsible for S28 gene

* + 1. *For AS28 gene under control of mP70 promoter*

The mP70 promoter attaching to AS28 gene is a bit different. It has the GntR operator sequence embedded in it. Thus, three parts are needed for the initiation. First, the RNAP with S70 binds on to the mP70 sequence. Then the GntR protein formed from GntR gene binds on to the mP70 sequence, inhibiting the transcription. For transcription to start, gluconate (supplied exogenously) needs to bind on to the GntR protein (which is already bound to mP70).

* + 1. *For Venus gene under control of mP70 promoter*

Similar to that of AS28 gene

* + 1. *For BFP gene under control of P28 promoter*

The P28 promoter recognizes RNAP bound with S28 factor (produced from S28 gene). Transcription occurs. However, if AS28 is present, it binds on to S28 factor and inhibits transcription.

**Naming Conventions for the parameters**

1. N,K and f

n\_name1\_name2\_name3= name1 binds to name2, for name 3 gene

eg: n\_S28\_RNAP\_BFP= S28 binds to RNAP on P28 which controls the BFP gene

1. W

W\_name1\_(name2)\_promoter= name1 binds to promoter sequence. Name2 is optional and binds on to name1

e.g W\_RNAP\_P70 means that RNAP binds on to P70

Instructions to run model

For No OXJ model- run include.jl and then updated\_Driver.jl

For OXJ Model- run include2.jl and updated\_Driver\_2.jl

Model Technicalities in terms of code

1. Driver.jl and Updated\_Driver.jl are the