1 Assumptions and Questions

1. A: All cells initially express RFP
2. A: Oxygen below 10 mmHg turns off expression of RFP, turns on expression of GFP
3. Q: What's a time scale for protein synthesis? (Early on, it's time to transcribe RNA, then synthesize protein. Later, it's time to just synthesize protein from already existent RNA.)
4. Q: What's the time scale for protein degradation?
5. Q: In 10 mmHg, does RFP gene get snipped out immediately and GFP gene enabled, or is there a mean time delay?

2 Model

2.1 Gene - Protein network

We will model a set of genes **G** that encode proteins **P** with the following model:

$$\frac{dP_i}{dt} = \alpha_i G_i - \beta_i P_i, \qquad i = 1, 2, \ldots \tag{1}$$

where α_i is a protein creation rate, and β_i is a protein degradation rate. (Notice that this skips modeling RNA transcription.) Here, we will model the following genes:

index	protein	notes
0	RFP	default fluorescence
1	GFP	activated at $pO_2 = 10\,\text{mmHg}$

Gene expression can be modeled in any way. Here, we use

2.1.1 Parameter estimates