TEAM: RUYS
Tech Spec: Strengths/Weaknesses/Opportunities
Grade for Presentation: 90

Each project idea must have

+ A description of your system's design in terms of **devices**
+ A description of your system's design in terms of **parts**
+ A **timing diagram** to show anticipated system operation
+ A plan for **testing and debugging** your first generation system
+ A description of the **impact** you envision for your system
+ A description of any concerns raised and **open issues** within your team
+ A **"GO/NO GO"** decision
+ very nice use of Tinkercell!

Your team has really come together around a very interesting problem and has met the challenges in creative ways. Your goals are well defined and that helps subdivide your project into some clear and distinct tasks. The triggers for your system (= acidity and a small molecule—galactose--that's tolerated in the lungs) are well considered, and the "one two" punch of an antibiotic + a surfactant to clear the bacteria and the mucus is clever. Great to include a growth control mechanism too, though it seems like there will need to be constant dosing with galactose to keep the cells alive at all. This is one particular about your system that you may need to rethink. There are some others you should revisit as you get more clarity about the challenges and opportunities of working in the mucus environment (see "next steps" below).

1. Strengths
   - *Multiple lines of attack on cells and mucus in patient's lungs*
   - *PmxR is a great find for this purpose*
   - *Good to consider population control mechanism for the cells you are developing*
   - *Great to identify what's already tolerated in the lungs (E. coli, galactose, P. aeruginosa)*

2. Weaknesses
   - *System's devices do not seem to be integrated through a single input*
   - *Galactose seems like a requirement for viability of your cell*
   - *Mutation in any of your regulatory components will give rise to incorrect timing of payload delivery or failure to deliver payload, so should consider ways to make system reliable or verifiable*

Some outstanding issues/questions…

Unique ecology of the lung partially but not fully considered/exploited, e.g.
biofilm of P. aeruginosa?
diffusion of antibiotics and surfactant from E. coli into mucus?
Gene transfer of your devices into resident cells?
Escape of cells from lungs to other mucus-rich environments?

3. Opportunities

*Your team has done a great job of subdividing the work into discrete and distinct modules that can be refined as mentioned here. What will be exciting to see is not only how well you polish up these ideas here but also how you **integrate** them into a solid, working system. Your project right now seems like a "concept car" with a well described braking system, door-hinge and stereo system but not a clear vision for how all the cool elements will work together to make the most amazing driving experience ever. Happily, I think as you gain clarity in these next steps, you'll be able to engineer the system as a whole more easily.*

Next steps

1. How to deal with escaped cells that might find their way to other parts of the body?
2. Consider more precisely how much antibiotic must be produced to kill P. aeruginosa when that target grows as a biofilm?
3. Get details on mucus environment as specialized for growth of your therapeutic and diffusion of materials (antibiotic and surfactant)
4. Revisit question of horizontal gene transfer and mutation rates…you'd hate to make the P. aeruginosa resistant to the antibiotic that you're trying to administer

Candidate consultants:

Katarina Ribbeck
BioFilm person (Roberto or Jim?)
Opportunistic infection expert

Other notes:

- Switch axes on timing diagram
- Nice models in Tinkercell!
- Slides could be more uniform in terms of level of detail/reflection of understanding
- Great switch of computers as needed…very smooth handling of this glitch