TEAM: DRUG DELIVERY (Artificial Pancreas)
Tech Spec: Strengths/Weaknesses/Opportunities
Grade for Presentation: 97

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

Your team did a great job of identifying and directly addressing many critical aspects of your system. As we mentioned at the 3 ideas presentation, there is a combination of materials and biology at play here. What you did SO well was identify things that are known to ALREADY work (e.g. pyrolytic carbon as FDA approved in heart valves, Candida as already living in body) and then modify these for your purposes to build something new and useful. There are some questions at the very heart of your problem that must be addressed next (e.g. how much insulin can be made by these cells? how will it get out of the cell? will it be trapped in the cluster of cells in the center of the stent?) There are also some potential points of failure for this project: finding the glucose sensor, getting Candida to grow in the blood vessel, and keeping the stent in place. Over the next few weeks you can work to get some clarity and perhaps some "plan B" ideas going. The foundation of this project though, is VERY strong. Congratulations.

1. Strengths
   - *Choice of chassis is very sensible and thoughtful*
   - *Great to think through material that could be used for implant*
   - *Great to consider ways to "hide" cells from immune system*
   - *Great to consider kill switch/mechanism*
   - *Great presentation of your work*

2. Weaknesses
   - *System relies heavily on glucose sensor and it's not obvious how to work around this if you don't find the aptamer you're looking for.*
   - *System will be deployed in an area where yeast will have a hard time growing (high pressure, low O2, irregular supply of nutrients)*
   - *Shape of package needs to be more precisely spec'd out (how much internal volume for cells, shape for blood flow vs escape of insulin, etc)*
   - *Maintenance of plasmids may or may not be possible in which case you might have stent with ineffective cells. Can genetic circuit be integrated into genome? Are the tools for integration into Candida available?*
   - *Mutagenesis of the cells away from responsiveness may derail your plan and there's no "simple" way to know it's working. Can you link proper functioning of the cells to some factor required for growth? Or something easily monitored?*

Some outstanding issues/questions….

- *Why sense glucose with an RNA device? Aren't there other, already existing devices for sensing glucose that you might be able to piggy-back on?*
- *Candida infections may be refractory to antifungal medicines (but it was very wise of you to think of putting a kill switch in)*
- *What can be expected for post-translational modification and processing of insulin by Candida?*
- *Secretion of insulin may need to be active process. Will Candida "secrete" this or will it just ooze out?*
- *Would it be possible to have Candida adhere directly to the material if and only if they are functional?*
- *Not clear how "valve" you described would work*

3. Opportunities

You are so well on your way to an outstanding project! Even partial success in this project will give some very interesting outputs. For example, there may be advances in how to assemble a mashup of a material/living system. There may also be interesting regulatory sensors and cascades that you develop as part of this system. You may learn something about getting cells to grow in environments that are "unnatural" and with this knowledge be able to help understand opportunistic infections. Lots of possible "wins" for the project in addition to the grand goal, which I think is very interesting.

Next steps

1. Find out if constantly reproducing Candida is possible in this environment?
2. You'll need to identify level of glucose in blood and magnitude of fluctuations that may lead to erratic secretion of insulin from the system you've designed
3. Identify how much insulin must be secreted to make difference. Is this level possible with the number of cells you could implant/grow?
4. Consider ways to know the system hasn't mutated away from original design or behavior
5. Consider alternatives if "glucose sensing RNA" doesn't pan out

Candidate consultants:

Candida specialist,
Materials scientist,
Diabetes researcher,
Aptamer designer

Other notes:

- Excellent uniformity of slides style
- Some diagrams on slides themselves would help break up wall of text
- Great pictures on board!
- Some asymmetry in amount the 3 of you talked about the project during the presentation and during Q/A