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Hello! We are iGEM Waterloo and iGEM HHU and today we'll be talking about an exciting application of synthetic biology: co-cultures, or making cells work together.

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Now you may be wondering what a co-culture is or looks like. A co-culture is mix up of different microbes growing together. Different bacteria, fungi and other microorganisms usually don't just live all by themselves. These microscopic communities are all around us! They can be found in your gut, helping in digestion! They also play an important role in food production, helping make things like cheese and yogurt. Moreover, several microbes live in soil and help give plants the nutrients they need to grow! But relationships between microorganisms aren't always great. In the same way that people who don't get along don't make for good room mates, some microbes don't get along with others and therefore are hard to maintain in a co-culture.

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In the laboratory, different bacteria are usually grown in monocultures - which means they only live by themselves - and scientists avoid other bacteria in the monoculture (called contamination) by all means. But we can also make Co-cultures in the lab that intentionally contain different organisms. But keeping a co-culture alive can be quite challenging - every organism wants to get their needs met… As we just mentioned different microbes don't always get along. They may harm one another or compete for food/resources. That's why both our iGEM teams are working on ways to improve co-culturing.

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But why do we care so much about co-cultures? Well for starters, *Co-cultivation is a tool for a better understanding of microbial networks found in nature. While studying organisms independently has taught us a lot, there is still much to learn about how microbes behave when in communities. Bacteria are social creatures. They behave differently depending on who's around them. For example, bacteria that make antibiotics do so when they sense competing bacteria in their surroundings. This knowledge can help us better understand and improve our health among other things. We are covered in microbial communities. Mostly, they don't harm, but actually help us! Yet, these communities, when disturbed can lead to poor health. Co-cultures can help us study what healthy and disturbed microbial communities look like! Co-cultures are also an important tool for discovery. Did you know that even with modern techniques in microbiology, we aren't able to grow most microorganisms in the lab?

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Some microbes can't grow alone. They will only grow if their** friends are there too. They rely on others around them for food or energy. So co-cultures can help us discover, grow, and study exciting new microbes!

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In engineered co-cultures, we can make microorganisms work together to clean up contaminated areas or to produce biofuels, pharmaceuticals, and other products.

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But how exactly do we get microorganisms make these important compounds? Well, their production usually relies on a series of steps and chemical reactions. Many of these can be performed by bacteria. Bacteria are like microscopic machines. They naturally produce useful things like ethanol and antibiotics. We can also engineer them, or give them DNA instructions, to produce other products of interest like insulin. But factories don't only have one kind of machine. Instead, they have an assembly line with different machines, accomplishing different things, but still working together. In the same way, we can create co-cultures or microbial assembly lines to produce important products more efficiently.

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While co-cultures have a lot of potential to advance research and industry, they can also be hard to make/maintain. This can be due to competition between bacterial populations, negative interactions, or contamination. Microbes don't always get along. But what if we could get them to work together? What if we could have more control over growth of bacteria in co-cultures? That's what Dusseldorf and Waterloo iGEM teams are working on this year! Waterloo iGEM is developing a system to fine tune growth of bacteria in co-cultures using light! They are also working on cheap and efficient ways to track different populations within co-cultures. Dusseldorf iGEM is working on an toolbox which makes creating co-cultures easier and accessible to every scientist! To learn more about co-cultures and our teams' projects, visit our wikis!