BioBuilding for Students

Welcome! We're glad you're here. You've found a place where the most amazing technology, namely biology, is under construction.
The world is filled with examples of robust, self-assembling, self-correcting systems--- you, for example! Imagine all that's possible if we could intelligently apply what we know about the living world to solve its problems.
What would you build from biology if you could build anything? Maybe specialized cells that travel along in your body to diagnose or treat a disease? Maybe some yeast that bake biofuel instead of bread? How about plants that grow into tree houses large enough for people to live in? Or maybe you'd want to purify contaminated drinking water by sprinkling an algae sponge on the surface?
These ideas are more fiction than science. That can change, but before it does, we first have to get much better in the engineering of living systems. Other engineering disciplines have a lot to teach us. Nature has a lot to teach us. With the BioBuilding activities you'll find here, you can start learning.

What is Synthetic Biology

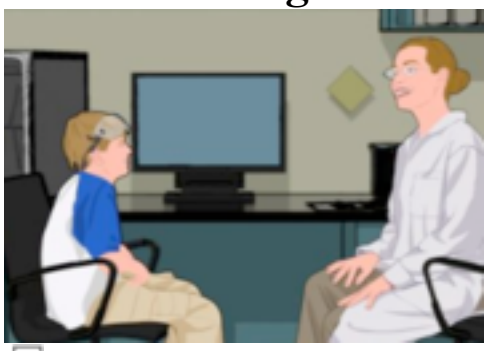
Synthetic biology relies on all the facts from those thick biology textbooks and some of the tried and true principles of engineering. It puts them together to make and model useful living systems. Best case scenario for synthetic biology: we make novel systems that work reliably and address important world problems. Worst case scenario: the systems we build fail the first time…and the second and third… possibly failing in surprising or dangerous ways. So at this early stage in synthetic biology both the successes and the failures have a lot to teach us. And though we still have a long way to go before it's easy to genetically program cells to perform particular tasks, you'll learn a lot by trying. And if you share your successes and failures with our BioBuilding community, you'll advance everyone's understanding—and in this way advance this new field.

What you'll find here

Each of the activities you'll find here focuses on a different, but related, aspect of biology and engineering:

- Eau that Smell asks you to grow some bacterial cells that smell (we hope!) like ripe bananas. You'll generate a bacterial population growth curve to compare the output of the banana-smell designs.
- The iTune device lab asks you to vary the protein output from a series of genetic devices -- you'll see this goal of tuning the system is actually a lot more challenging than figuring out how to get the cells to make the most protein possible.
- Picture This uses the bacterial photography system in three ways. There's a downloadable program to model the genetic system. There are electronic parts and a breadboard to model the same system in a less squishy way. And finally you can send in a stencil that will be turned into a bacterial photograph for you to see.
- What a Colorful World considers the simple idea that bacteria are bacteria are bacteria. You'll learn how to put DNA into cells and then you'll see how the same DNA works differently in related but not identical bacterial strains. Finally, you'll have a chance to think about why that is, what that means for engineering new systems, and how you might study or fix this complex problem.
- The essay challenges you to think about both the risks and the rewards of biology-by-design.
- In the design assignment, you'll choose a real-world problem that you think could be addressed with a biotechnology. You'll design a living system to meet this need, and consider the likelihood of success for your idea. Maybe you've got the next great invention that will change the world forever. We'd love to hear about it!

BioBuilder.org



These challenges have been developed in conjunction with the BioBuilder website. BioBuilder.org provides animations to explore the underpinnings of synthetic biology, with links to the activities you find here. Feel free to look around. All the content is modular and so can be looked at in any order and at any time.

Once you've tried the activities that are here, please share your data with the BioBuilder community! You'll be able to see how your findings compare to other players. It will help us all learn how to better build with biology. Plus, we'd love to hear how your construction projects are going.