Facilitator Guide: Kit of Parts

Learning objectives

- Synthetic biology develops tools and knowledge to build new living organisms and materials.
- Synthetic biologists can create and use standardized parts made of genes.
- Synthetic biology may provide solutions to problems in areas such as food security, healthcare, energy, and the environment.

Conversation questions

- Why might a standardized kit of genetic parts be a promising approach to engineering biological cells? Who should own or be able to patent parts of the toolbox?
- With a real toolkit of parts do you think everyone should be able to use it for anything they want? Or should we limit its use?

Materials

- Activity and facilitator guides
- Activity sign and holder
- Challenge cards
- Sorting and stacking toy and sticker
- Graphic mat: Toolkit of Biological Parts
- Reference sheet: Synthetic Biology

The sorting and stacking toy can be found online at melissaanddoug.com (item #379). All written activity materials and graphics can be downloaded from buildingwithbiology.org.

Notes to the presenter

Preparation: Before beginning this activity, take some time to become familiar with the challenge cards, the graphic mat, the pieces in the sorting and stacking toy, and the way the toy is used as a model of the different biological parts in a cell. Each time you play, you'll want to set up the "toolkit" with all the colored blocks placed in the right spots on the mat.

Show visitors the front side of the challenge cards (with the large photo) and let them choose a problem. The back sides of the cards have more details you can share that will help visitors solve the challenges. Tailor the amount of information you share depending on the age and interest of the visitors. Remember that you can always share more information if they ask questions. Some visitors may prefer to read the back side of the cards themselves.

Explain that the sorting and stacking toy is a model for creating a modified biological system. Visitors engineer a pretend biological cell to perform new functions by combining multiple parts. Allow visitors to choose which parts they want to use to "program" their organism. They can stack whichever blocks they like onto the posts.

You can use the analogy that a cell is like a computer that can be programmed with different parts based on what you want it to do. For example, to solve the challenge of the "Treat cancer" card, the functions of movement, sensing, production, and control can be used together. It is less important that visitors choose all of the "correct" components than for them to see that the cell needs multiple tools working together to solve a problem.

After the visitors have built their organism, share some of what is actually happening in current research to help solve these problems in the real world. This information can also be found on the back of each card. Synthetic biologists are currently working on all of these challenges.

Next, let the visitor choose to try to solve one or more additional challenges. When they choose to use the same components for a new challenge, you can note that the same gene can be inserted into different cells. Which components might be very commonly used in synthetic biological systems? Which components are much more particular to specific challenges?

Audiences: You can adjust this game to work for different audiences. For families with young children, you might need to demonstrate how you would choose to solve a problem and then invite them to try a different challenge.

Conversation: This activity is designed to promote back-and-forth conversation about ways that technology is interconnected with society. You can help encourage visitors to develop and share their own ideas by referring to the **Tips for Conversations** guide.

You can use the **"Talk about it…"** questions in the activity guide to get visitors started. (These are also summarized in the list of "Conversation questions" above.) Be sure to listen to visitors' thoughts and opinions, and feel free to share your own opinions as well. As your group talks, help everyone to remember that there is no right or wrong answer to the questions this activity raises. As you build the biological cell, you can ask open-ended questions about what the visitors know about cells, synthetic biology, and the current state of the problem they choose to solve.

If visitors seem uneasy or have questions regarding the safety and security of synthetic biology systems, you might respond that these are serious factors that scientists—and we as a society—need to consider. As with many new technologies, there are important ethical and social questions surrounding research in synthetic biology. Government regulations, biosafety committees, scientific transparency, and informed citizens help to make sure that these technologies maximize benefits and minimize risks. Together, we all have a role in shaping how technologies are developed and used.

Passports: In your activity box, you'll find a marker stamp. This stamp is for the Building with Biology event passports. Each facilitator will need to be prepared to stamp visitors' passports if guests ask them a question and/ or share what they think about synthetic biology. Facilitators who are scientists should wear "I'm a scientist" stickers at the event and should be ready to stamp passports if guests talk to them. Your event may choose not to use the passports, and that's fine, too.

Related educational resources

The NISE Network website (www.nisenet.org) contains additional training resources to help scientists and educators have conversations with museum visitors about the relationship between technology and society:

http://www.nisenet.org/catalog/tools_guides/nano_society_training_materials

Credits and rights

This activity is a modified version of the "Kit of Parts" activity developed by The Franklin Institute for the Building with Biology pilot project.

Card images:

- Cancer biopsy, KGH, https://commons.wikimedia.org/wiki/File:Oral_cancer_(1)_squamous_cell_carcinoma_histopathology.jpg.
- Mosquito, Wild Turkey, https://commons.wikimedia.org/wiki/File:Mosquito_bite_from_Flickr.jpg.
- Paints, United Soybean Board.
- Soil, Elvis Ripley, https://www.flickr.com/photos/elvisripley/251586878.
- Donated blood, iStock. Stock images are not covered under the terms of Creative Commons.

Illustration of standardized parts, Emily Maletz for the NISE Network.

SEM image of *E. Coli*, Public Domain, https://en.wikipedia.org/wiki/Escherichia_coli#/media/File:EscherichiaColi_NIAID.jpg

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