

## Learning objectives

- Synthetic biology develops tools and knowledge to build new living organisms and materials.
- The ability to modify and build using DNA is essential to synthetic biology.
- Synthetic biology benefits from many different voices.

## Conversation questions

- What kind of instructions do you think the DNA from a wheat plant contains? Would any of these instructions be useful in a different organism?
- Can you think of a change we could make to a wheat plant's DNA to make it more useful to us?

## Materials

For the advance preparation:

- Ice pack
- Raw wheat germ (not processed)
- Hot water
- Meat tenderizer
- Shampoo (or dishwashing detergent)
- Plastic spoon
- Isopropyl alcohol or ethyl alcohol (91%)
- Plastic container
- Dropper bottle

For the activity:

- Cup of wheat germ liquid
- Dropper bottle of alcohol
- 1.5 ml microcentrifuge tubes
- 1 ml pipettes
- Yarn
- Scissors
- Reference sheets: Synthetic Biology and Genes and DNA

Pipettes and microcentrifuge tubes (also called Eppendorf tubes) can be found online from Fisher Scientific ([fishersci.com](http://fishersci.com)). All other DNA extraction materials can be found at a grocery store or discount store. All written activity materials and graphics can be downloaded from [buildingwithbiology.org](http://buildingwithbiology.org).

## Notes to the presenter

### Advance preparation:

Several hours before the activity, put the ice pack in the freezer and the alcohol in the refrigerator.

30 minutes before the activity:

Prepare the cup of wheat germ liquid (enough for 20 visitors):

1. Add  $\frac{1}{2}$  cup hot water to the cup.
2. Add 1 spoon of wheat germ to the cup of hot water.
3. Add  $\frac{1}{2}$  spoon of meat tenderizer to the cup.
4. Add a squirt of shampoo (about a teaspoon).
5. Stir well.
6. Let mixture settle for 15 minutes.

Prepare the dropper bottle of alcohol:

1. Fill the dropper bottle with chilled alcohol.
2. Place the ice pack in the small plastic bin.
3. While you do the activity, keep the dropper bottle of alcohol on the ice pack.

**Safety:** Do not allow visitors to ingest any of the materials! Scissors can be sharp.

**Audiences:** You can adjust this activity to work for different audiences. Children and individuals with limited dexterity might need help manipulating the materials in this activity.

Tailor the amount of information you initially share depending on the age and interest of the visitors. Remember that you can always share more information if visitors ask questions!

**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. Science provides information that can help us form opinions and make choices—but we also consider other perspectives such as cultural traditions and personal values.

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](http://www.nisenet.org)) contains additional training resources to help scientists and educators have conversations with museum visitors about technology and society: [http://www.nisenet.org/catalog/tools\\_guides/nano\\_society\\_training\\_materials](http://www.nisenet.org/catalog/tools_guides/nano_society_training_materials)

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This activity is a modified version of the "Exploring Tools—DNA" activity developed by the Sciencenter in Ithaca, NY, for the NISE Network.

Images of wheat and rose, iStock.com. Stock images are not covered under the terms of Creative Commons.



This activity was created as a collaboration of the Multi-Site Public Engagement with Science—Synthetic Biology project. This project was supported by the National Science Foundation under Award Number 1421179. Any opinions, findings, and conclusions or recommendations expressed in this program are those of the author and do not necessarily reflect the views of the Foundation.