

# SBOLCanvas: A Visual Editor for Genetic Designs

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## 1 INTRODUCTION

Synthetic biologists often use diagrams to visualize the structure and functionality of genetic designs due to their complicated nature. The *Synthetic Biology Open Language Visual* (SBOLv) [1] is a standard for these diagrams. This standard provides a set of glyphs for synthetic biology components and how they can interact. These visual designs also have a complementary data standard, the *Synthetic Biology Open Language* (SBOL) [3], which represents the structural and functional information for genetic designs.

When a synthetic biology designer is developing a genetic circuit with SBOL and SBOLv, they have three main objectives: 1) an ergonomic way to create and edit visual diagrams, 2) an ability to associate these diagrams with genetic part information, and 3) a means to share their designs with others. One such tool that can assist with these objectives is SBOLDesigner [4], a graphical schematic editor for DNA-level design. This tool has many useful features including the ability to construct a DNA sequence from SBOLv glyphs, import DNA part information from the SynBioHub repository [2], and share resulting designs by uploading them to SynBioHub. However, SBOLDesigner does not support the latest features in SBOLv Version 2. SBOLv2 allows for the inclusion of non-DNA components (RNAs, proteins, small molecules, etc.), as well as a way of representing interactions between them. Furthermore, SBOLDesigner requires local installation to use.

This paper describes SBOLCanvas, an updated web-based genetic design editor that can create visual diagrams using all features of SBOLv2. Specifically, in addition to features supported by SBOLDesigner, SBOLCanvas has the ability to:

- Create designs composed of multiple DNA sequences.
- Add non-DNA components to these designs.
- Link components via interactions such as genetic production, repression, and activation.
- Markup the designs with colors and text annotations.
- Undo and redo designs edits.

Therefore, SBOLCanvas provides a new way for synthetic biologists to specify and visualize the structure and function of their designs.

## 2 SPECIFIC FEATURES

### Multiple Strands & Molecular Species

The SBOL data standard supports more than just single DNA circuits in a design. It allows for multiple circuits as well as denoting interactions between those circuits and other molecular species. Figure 1 demonstrates multiple circuits, interactions, and molecular species.

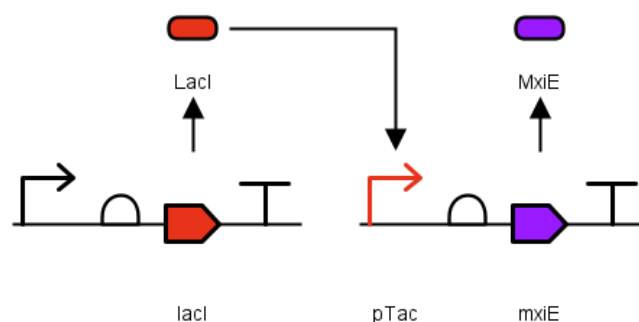


Figure 1: An image exported from SBOLCanvas.

### SynBioHub integration

SBOLCanvas allows for direct access to designs stored on SynBioHub. Making it easy to integrate the parts you need into your design. It also allows for saving your own designs to SynBioHub for later access. SynBioHub has a feature that allows you to store commonly used parts in a collection making them easier to access within SBOLCanvas. In the future, we plan to make this even easier by allowing users to import this collection into the part menu, enabling the ability to drag and drop these parts into a design.

### Image Exporting

If a researcher wants to build and share a diagram of their biological circuit, they currently have to use some graphical editor, such as Adobe Illustrator. This takes significantly more time than it should. SBOLCanvas lets you export images (.png, .jpeg, .svg, and .gif) of your design, merging visual and informational design into one task.

### Ease of Use

SBOLCanvas lowers the barrier to entry by enabling anyone with access to a web browser to visually design synthetic

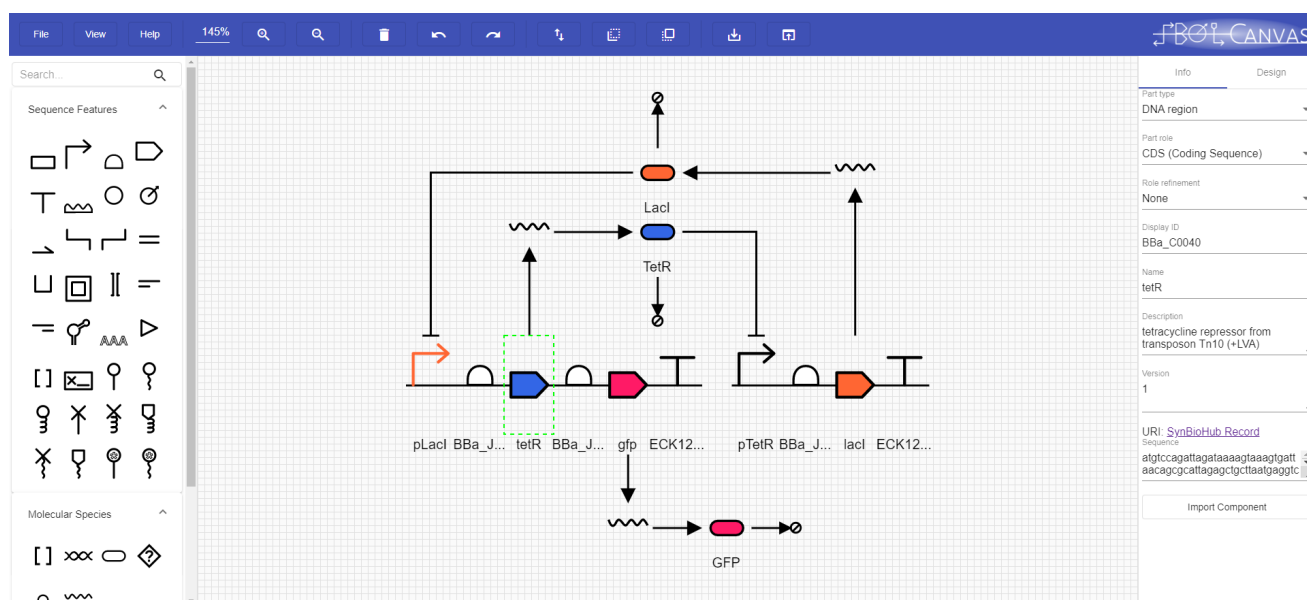


Figure 2: SBOLCanvas' graphical user interface.

genetic circuits. SBOLCanvas' graphical user interface (GUI) is shown in figure 2. The primary way to interact with SBOLCanvas is to drag and drop items from the part menu on the left. If a user has a strand selected, the user can also click on a glyph, and it is added to the end. Interactions can be added by selecting the two items to link, and then clicking the interaction to add from the part menu, or by moving the ends of existing interactions. For graphical work, SBOLCanvas has a visual design menu similar to those found in image editors.

### 3 DISCUSSION

SBOLCanvas is being built from the ground up with these new features in mind. It is a completely new code base, making it as easy as possible to add new features. It is built with Angular, MxGraph, and uses a stateless back-end that leverages libSBOLJ 2 [5]. SBOLCanvas is under active development, and there are some enhancements that are planned in the near term, including:

- Support for combinatorial design to create many designs from variant libraries of parts and devices.
- Tighter integration with SynBioHub to search for parts and as a means to store designs during their development life cycle.
- Improvements in support for hierarchical design including Modules and Interactions.
- Support for automated addition of sequence tags and scars for a variety of assembly methods.
- Use of parametric SVG to allow glyphs to be added more easily and be easier to modify.

- Development of an SBOL layout Standard for exchange with other tools such as VisBOL.

To request a feature or report an issue, please visit: <https://github.com/SynBioDex/SBOLCanvas/issues>.

### Acknowledgements

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