

# Reproducibility Handout for the Life Sciences Version 2

Lenny Teytelman

## Abstract

This handout is based on the Caltech Reproducibility resource that was created by Code Ocean, Addgene, and protocols.io. It is extended to cover more tools and resources for biomedical scientists specifically.

Please feel free to clone and modify it. If you do, would be wonderful to see you share the new resource in this group. Also, please suggest other useful resources.

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## Guidelines

Practical tips for reproducibility

### 1. Plan for reproducibility before you start

- **Write a study plan or protocol** and track new versions.
- **Set-up a reproducible project** using an electronic lab notebook to organize and track your work. Avoid saving proprietary file formats.

### 2. Keep track of things

- **Preregister** important study design and analysis information. Free tools to help you make your first registration include [AsPredicted](#), [Open Science Framework](#), and [Registered Reports](#). Clinical trials use [Clinicaltrials.gov](#).
- **Track changes** to your files using version control.
- **Document** everything done by hand in a README file and data dictionary. **Karl Broman's Data Organization module:** <http://kbroman.org/dataorg/pages/dictionary.html>

### 3. Report your research transparently

- **Share your protocols and interventions** explicitly and transparently.
- **Write a transparent report.** Guidelines from the [Equator Network](#) or processes like [Registered Reports](#) can help.

### 4. Archive + share your materials

#### i. Data

- Avoid supplementary files, licence, and share your data using a repository. **How to License Research Data:** <http://www.dcc.ac.uk/resources/how-guides/license-research-data>.

#### ii. Materials & reagents

- Licence your published materials so they can be reused. **Creative Commons License Picker:** <https://creativecommons.org/choose/>
- Deposit reagents with repositories like [Addgene](#), [The Bloomington Drosophila Stock Center](#), and [ATCC](#) to make them easily accessible to other researchers.

#### iii. Software

- Licence your code using [Code Ocean](#) or [Github](#). **Open Source Initiative: About Open Source Licences:** <https://opensource.org/licenses>.

### 5. Further reading:

- **Ten Simple Rules for Reproducible Computational Research:** <http://journals.plos.org/ploscompbiol/article?>
- **Reproducibility in Science:** <http://ropensci.github.io/reproducibility-guide/>
- **Open Science MOOC:** <https://opensciencemooc.eu/>
- **Tools and Resources for Reproducibility Series at protocols.io:** <https://www.protocols.io/groups/tools-and-resources-for-reproducibility>

## Protocol

### Reagents, general

#### Step 1.

**Addgene** [addgene.org](https://addgene.org) (nonprofit plasmid repository)

**ICLAC** [iclac.org](https://iclac.org) (registry of false or misidentified cell lines)

**Quartzy** [quartzy.com](https://quartzy.com) (manage lab inventory)

**RRID** [scicrunch.org/resources](https://scicrunch.org/resources) (persistent and unique identifiers for referencing a research resource)

## Reagent search engines

### Step 2.

**BenchSci** [benchsci.com](https://benchsci.com) (antibody search engine with published figures)

**Bioz** [bioz.com](https://bioz.com) (search engine for life science reagents, tools, kits, instruments)

**CiteAb** [citeab.com](https://citeab.com) (antibody search engine with results sorted by citations)

**antYbuddy** [antybuddy.com](https://antybuddy.com) (antibody & protein review platform)

## ■ ANNOTATIONS

**giancarlo barone** 07 Feb 2018

<https://www.antybuddy.com/> ( an independent antibody & protein review platform )

Thanks Lenny:-)

**Han Xie** 08 Feb 2018

Hi, Lenny. Can you include Labome? [www.labome.com](https://www.labome.com). A curated database of antibodies, including knockout-validated antibodies curated from formal publications.

## Experiment help

### Step 3.

**Elemental Machines** [elementalmachines.io](https://elementalmachines.io) (sensors and monitoring of lab equipment)

**Opentrons** [opentrons.com](https://opentrons.com) (liquid handling robot, for \$3K-\$4K)

**ScienceExchange** [scienceexchange.com](https://scienceexchange.com) (marketplace of research outsourcing providers)

**TetraScience** [tetrascience.com](https://tetrascience.com) (sensors and monitoring of lab equipment)

**NC3Rs**: [nc3rs.org.uk/experimental-design-assistant-eda](https://nc3rs.org.uk/experimental-design-assistant-eda) (free online experimental design assistant)

## ■ ANNOTATIONS

**Malcolm Macleod** 08 Feb 2018

Dear Lenny,

Section 3 Experimental Help could include the NC3Rs Experimental Design Assistant: details at <https://www.nc3rs.org.uk/experimental-design-assistant-eda>, descriptors [here](#) and in greater detail at <https://doi.org/10.1371/journal.pbio.2003779>

#### Electronic Lab Notebooks

##### Step 4.

**Benchling** [benchling.com](https://benchling.com) (free)

**Evernote** [evernote.com](https://evernote.com) (most popular with biologists but not designed as an ELN)

**Labguru** [labguru.com](https://labguru.com) (\$)

**sciNote** [scinote.net/](https://scinote.net/) (open source, free)

**Open Science Framework** [osf.io/](https://osf.io/) (free)

#### Methods

##### Step 5.

**Bio-Protocol** [bio-protocol.org](https://bio-protocol.org) (A peer-reviewed protocol journal; free to read & publish)

**protocols.io** [protocols.io](https://protocols.io) (an open access repository of science methods; free to read & publish)

#### Code

##### Step 6.

**Github** [github.com](https://github.com) (code repository; free for public repos)

**Jupyter Notebooks** [jupyter.org](https://jupyter.org) (open source web-app for creating & sharing live code, equations, and more)

**Code Ocean** [codeocean.com/](https://codeocean.com/) (computational reproducibility platform; free to upload, share & publish executable code with DOI; pay for more computing time over freemium limit)

#### Data

##### Step 7.

**DataDryad** [datadryad.org](https://datadryad.org) (curated digital repository; free to access, \$120 to publish dataset up to 20GB)

**Figshare** [figshare.com](https://figshare.com) (free digital repository, 5GB per file limit)

**Zenodo** [zenodo.org](https://zenodo.org) (free digital repository; 50GB per dataset limit)

#### ■ ANNOTATIONS

**Thomas Morrell** 05 Feb 2018

CaltechDATA <https://data.caltech.edu> is another option for anyone at Caltech (free digital

repository, no fixed storage limits)