Experimental Design Checklist

Before starting a study, make sure that your experimental design minimizes bias, avoids p-hacking, and correctly identifies an adequate sample size.

Reproducibility

- ☐ Did you run the experiment (e.g. apply the treatment) multiple times with consistent results?
- ☐ Did you test the hypothesis with multiple organisms/cell lines or with orthogonal methods?

Randomization and Independent Samples

- ☐ Are the "experimental units" that contribute to sample size (for calculating p-values, etc.) independent?
- ☐ Have you randomized which of these samples receive the treatment(s) of interest?

Reducing Bias

- ☐ Did you blind or automate your data acquisition?
- ☐ Did you blind or automate your data analysis?

Reducing Experimental Error

- ☐ Did you consider "blocking," or subdividing samples into similar groups (e.g. split one flask of cells into treatment and control wells)?
- ☐ Did you otherwise take steps to reduce confounders and experimental noise?

Power and Statistics

- ☐ Did you decide on the number of samples or times you will run your experiment *before* starting the study?
- ☐ Did you consider running a power analysis to determine an appropriate sample size?
- ☐ Can you plan to increase the number of samples (instead of the number of measurements per sample)?
- ☐ Did you decide on any statistical tests you will use before running any?
- ☐ Have you qualitatively or quantitatively determined the variability sample-to-sample to know whether your assay will pick up your expected result?

Controls

- ☐ Can you run internal or concurrent controls?
- ☐ Have you determined your "assay window," or the range between the maximum expected signal (positive control) and the baseline (negative control)?

Resources

Stanley Lazic, "Experimental Design for Laboratory Biologists"
Stephen Royle, "The Digital Cell: Cell Biology as a Data Science"
Alex Reinhart, "Statistics Done Wrong"