Rigorous Experiment Planning Checklist

A checklist to aid researchers designing an experiment to ensure robust results.
Based upon Drs. Arturo Casadevall and Ferric C. Fang "*Rigorous Science: a How-To Guide*"

Experimental Redundancy

Confirm findings using independent experimental techniques. Examples include:

- ❑ Replication – independent replicates provide data on the variability of the results
- ❑ Validation – validate results using independent methodologies. Validate key resources.
- ❑ Generalization - determine generalizability of results by using different conditions, reagents, etc.
- ❑ Perturbation – gain an understanding of the experimental boundaries by changing the system
- ❑ Consistency – determine if the observations are consistent

A well-designed study should use several of the above elements

Probability and Statistics

- ❑ Understand p-values and avoid misusing p-values
- ❑ Determine if the planned statistical analyses are appropriate. Seek consultation with statisticians
- ❑ Perform power calculations to determine the number of samples and replicates for an observed effect

Error Analysis

Consider all possible sources of error and ways to eliminate them

- ❑ Systematic error
  - ❑ Instrumentation
  - ❑ Contamination of reagents
- ❑ Random error
  - ❑ Perform replicates
  - ❑ Apply principles of sensitivity analysis

Consideration of Biases

- ❑ Recognize where potential biases can be introduced and how to avoid them
- ❑ Systematically challenge and disprove hypothesis

Be Honest

- ❑ Design and carryout experiments ethically
- ❑ Acknowledge when results do not fit hypothesis

Resources
ReaDI Program
Experimental Design
Statistical Analysis

Rigorous Science: a How-To Guide
Arturo Casadevall, Ferric C. Fang
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