

# Experimental Design

## *Experiment*

**Function:** noun, transitive verb

**Etymology:** Middle English, from Middle French, from Latin *experimentum*, from *experiri*

**Date:** 14th century

**Usage:** (a) test, trial (b) a tentative procedure or policy (c) an operation carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate a known

(source: Merriam-Webster dictionary)

### **Before you start designing an experiment, you need to:**

- ask a specific question
- make a hypothesis

*It may be helpful to write them down. A good experimental design starts from being able to articulate the motive of your test.*

### **Things to consider when designing an experiment:**

#### **1) Decide on the parameter you want to change.**

This is the independent variable, the effect of which is what you are interested in.

#### **2) Decide what parameter to measure.**

This is the dependent variable.

#### **3) Decide what parameters to keep constant so they won't affect your results**

#### **4) Plan out how you change the independent variable**

What values do I test?

- You can do a literature search to determine a reasonable test range. One place to start is to pick the lowest, average, and highest values. You can refine the range later. Think about how many values you need to (and be able to) test. How you space them would depend on the degree of linearity of the relationship.

#### **5) Include controls in your experiment**

Controls set reference points to compare data against.

Negative control:

- A factor known to have no effect on the parameter you measure.
- Purpose is to determine the baseline of your measures.

Positive control:

- a factor known to cause a change in what you measure
- Purpose is to confirm your protocol works.

**6) Decide how many replicates you need**

Experimental results should be reproducible. Decide the number of times you need to repeat the experiment to obtain statistically significant results.

**7) Determine the reagents and equipment you need. Check their availability.**

You may need to place an order or sign up for equipment in advance. So plan ahead.

**For example:**

You want to find out if your favorite gene (Yfg) is involved in apoptosis after DNA damage.

*You may want to ask:* does X-irradiation lead to Yfg-induced apoptosis?

*You may make this guess:* if Yfg is knocked down with RNAi in S2 cells, fewer cells will die after X-irradiation.

One way to set up your experiment:

*Independent variable:* amount of X-irradiation

*Dependent variable:* amount of cell death

*Constants:* time, amount of starting cells, amount of dsRNA against Yfg etc..

*Negative control:* dsRNA against GFP

*Positive control:* dsRNA against caspase