



Methods: A Recipe for Science

Methods sections (also called materials and methods or experimental) are often difficult to write because of the temptation to include too many details or too few details about the experiment. This handout includes an activity where you can use the information below to effectively critique an example (provided on the back of the handout).

1.) Why Describe the Methods?

Readers use the methods section as a way to ascertain that sufficiently analytical methods were used, making the results meaningful. It can also serve as a historical marker, denoting the technology available at the time. Finally, it provides readers with a way of testing your results; they should be able to reproduce the results you obtained by following your methods.

2.) What Should You Include in the Methods?

The methods section should list chemicals, instruments, and special equipment used. It should provide a step-by-step procedure. Sometimes a diagram of an apparatus or a flowchart of the procedure can be used to clarify complicated methods. (See the graphics handout for advice on how to incorporate graphics.) If a procedure was changed or adapted during the experiment, this section can reveal that change. However, it should not waste space with menial mistakes (e.g., “spilled flask so refilled”). Those details stay in your notebook.

3.) Necessary information:

There should be just the right level of detail so that a scientist in the same field could reproduce the experiment or study and obtain the same results.

Names	Measurements	Descriptions
Chemicals	Concentrations	Procedures
Procedures	pH	Statistical analysis
Special equipment	Temperature	Instruments
Equations	Wavelength	Study Sites:
Instruments:	Time intervals	Topography
Model #	Number of samples	Vegetation
Manufacturer	Volumes	Climate
	Weights	Ecology

4.) Unnecessary information:

There should not be unnecessary details that distract the reader and waste space. These include names that are vague, unofficial, or names of typical laboratory equipment (gloves, stirrers, pipettes). Measurements of amounts where concentrations suffice are unnecessary. Descriptions of items or procedures that are common knowledge are also unnecessary.

5.) Activity: Critiquing Methods

Read the example on the back. Make two lists: one of necessary details that have been left out, and one of unnecessary details that can be removed. Think about the level of information in the example. Could you, given the background knowledge and the right equipment, reproduce this experiment?



Example of a Materials and Methods Section:

Materials and Methods

The hydrolysis of ONPG took place in four pre-prepared solutions: 20mM KCl; 2mM MgSO₄; 100 mM B-mercaptoethanol, and a 200mM buffer at five different pH values varying from 4.0 to 9.0. Each solution was added in 0.75ml amounts to 0.3mL ONPG to a concentration of 4mg/ml. These were incubated in shaking water baths for 5 minutes at the selected temperature. When pH was varied, temperature was held constant; when temperature was varied, pH was held constant (tables 1&2). To this mixture was added 0.03ml β-gal at a concentration of 5.5×10^{-5} mg/ml. The reaction proceeded for 5.10 minutes, then was terminated by addition of 0.75ml of sodium bicarbonate. Absorbance was read in a blanked Oceanoptics spectrophotometer at a wavelength of 420 nm. Results were reproduced twice. Specific activity was calculated with the provided equation (figure 1).

In the second part of the lab, ONPG concentration was varied between 2 and 0.1 mM. This variation was achieved by adding ONPG in decreasing amounts and water in proportionally increasing amounts. The same procedure was followed as above. Temperature was held at 37 degrees Celsius, and pH was a constant 7.5. Two reproducible results were obtained for each variance. Then, 0.3ml of lactose were added to the reaction, with each varied amount of ONPG. The standard assay was repeated twice.

This example is taken from an anonymous student paper in Molecule to Organism.

Necessary:	Unnecessary:

Could you reproduce this experiment? Why not? What would you improve to make this Methods section work?