Activity: Write the Methods Section

FOR THE TEACHER

Summary
In this activity, students will learn how to write and think like a scientist when they complete their lab write ups. This lesson focuses on the materials and methods section of a lab report.

Resource Type: Activity
Grade Level: High school

Objectives
By the end of this lesson, students should be able to
- Write a methods section in either a lab report or for a poster presentation.

Chemistry Topics
This lesson supports students’ understanding of
- Introduction
- How to write in science

Time
Teacher Preparation: 10 minutes
Lesson: 1 hour

Safety
No safety precautions need to be observed.

Teacher Notes
- This isn’t a skill commonly taught in high school.

FOR THE STUDENT

Student Activity Sheet: How To Write the Methods Section

Lesson
The purpose of the methods section is to describe in detail your experimental design—the chemicals used, the experiments, and the analysis techniques so that another scientist could reproduce the work. This section must be written carefully because it must give merit to your results. That is, the experiments that you present lay the groundwork for repetition by other scientists. If the experiment does not have the potential for reproducible results, it is deemed junk science and the value of your paper and your reputation can be damaged.

General Tips
1. Most of this section is written in the past tense.
2. Beware not to include any results in this section.
3. Carefully read all competition paper instructions because important specifics are often detailed there.

4. Ask a peer to proofread this section. Your peer will most likely identify errors that you overlooked because you have been working closely with the work.

The Research Paper Methods Section

Research Paper
A typical oxygen intelligence ink comprised 5 g of a 5 wt% aqueous dispersion of a semiconductor, TiO$_2$ (Degussa P25), 1 g of a 5 wt% aqueous solution of methylene blue, 0.3 g of triethanolamine (TEOA), and 20 g of a 5 wt% aqueous solution of hydroxyethyl cellulose (HEC). The ink components were mixed together by magnetic stirring for 30 minutes and films of the ink were spin-coated on 22 mm diameter glass coverslips, using 2-3 drops of the ink and a spin-coater rotation speed of 6000 rpm for 30 seconds. (Lee, S.-K.; Mills, A.; Lepre, A. Chem Commun. 2004, 1912–1913.)

The order:
Materials:
1. Include the exact technical specifications, quantities, and source or method of preparation.
2. Experimental animals, plants, and microorganisms should be identified accurately, usually by genus, species, and strain designations.
3. Sources should be listed and characteristics such as: age, sex, genetic, and physiological status.
4. If human subjects are used, the criteria for selection should be described and an “informed consent” statement should be included, if required.

Methods:
This portion of the section is sequential from the order in which you conducted your experiments (most of the time).

Exception: related methods should be described together. Example: even if a particular assay was not done until late in the research, the assay method should be described along with the other assay methods, not by itself in a later part of the Materials and Methods.

Headings:
1. In some instances subheadings are necessary.
2. If possible, correlate or “match” the subheadings to those used in the results section.
   a. This internal consistency will guide your reader to correlate between the methodology and the related result.

Measurements and Analysis:
1. Be precise.
2. This is very similar to a cookbook recipe.
   a. If pertinent, give the temperature.
   b. Questions such as: “how” and “how much” should be answered here.
3. Feature and discuss data, not statistics.

Referencing Methods:
1. If your method is NEW, then you must give all of the needed detail.
2. If your method has been previously published in a standard journal, only the literature reference should be given.
   a. Exception: the method derives from an obscure journal.
3. If several alternative methods are commonly used, identify your method briefly and cite the reference.
   a. Examples:
      Good: “cells were broken by ultrasonic treatment as previously described (9)”
      Bad: “cells were broken as previously described (9)”

The Research Poster Methods Section

Unlike a journal article, a poster does not need to describe the experiment in enough detail to reproduce the work. A poster should communicate the very basics of the experiments done. Precise information about reagent amounts, purity, and sources is not necessary. (Visitors can ask the poster presenter for more details if needed.)

Poster:
TiO₂ particles
Methylene blue
Triethanolamine
Hydroxyethyl cellulose

combined in water,
stirred 30 min,
spin coated on glass

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i Adapted from: Varma-Nelson, Pratibha; Bentley, Anne; Weaver, Gabriela; Wink, Donald Center for Authentic Science Practice in Education; Purdue University; 2008 www.caspie.org