Conducting Forensic Science Research Projects

INTERNATIONAL ASSOCIATION FOR IDENTIFICATION
Minneapolis, MN

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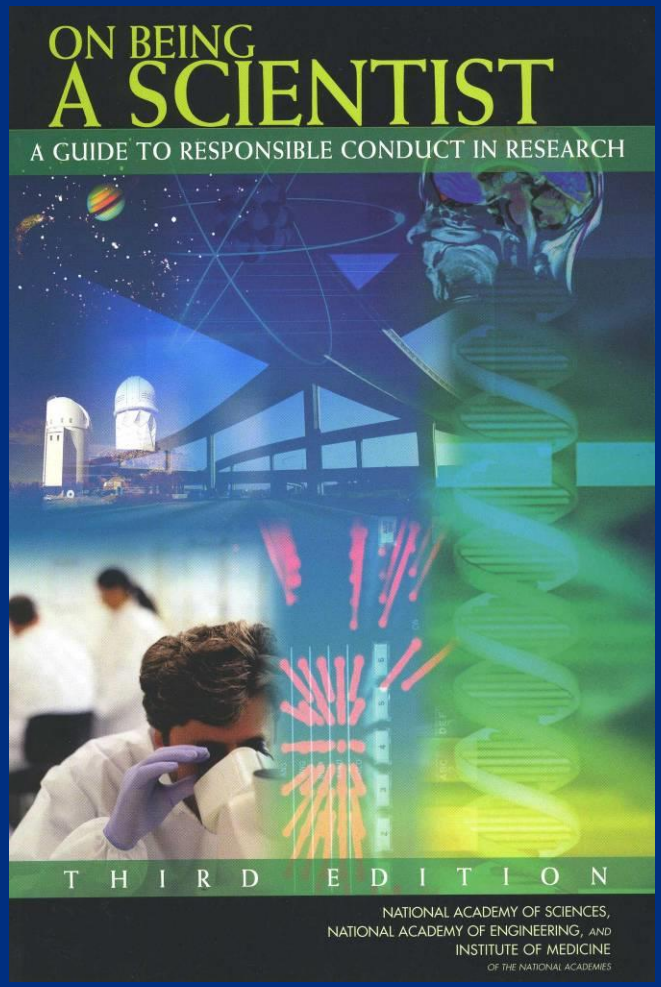
U.S. Department of Homeland Security

United States Secret Service

Scientific Ethics Guidelines

- Scientific misconduct is defined as the violation of the standard codes of scholarly conduct and ethical behavior in professional scientific research.[1]
- Some of the motivational factors for scientific misconduct include: career pressure; laziness; the ability to “get away with it”; money; ideology; publicity.
- Unacceptable conduct includes: fabrication; plagiarism; self-plagiarism; ghostwriting; misappropriation of data.

[1]http://en.wikipedia.org/wiki/Scientific_misconduct



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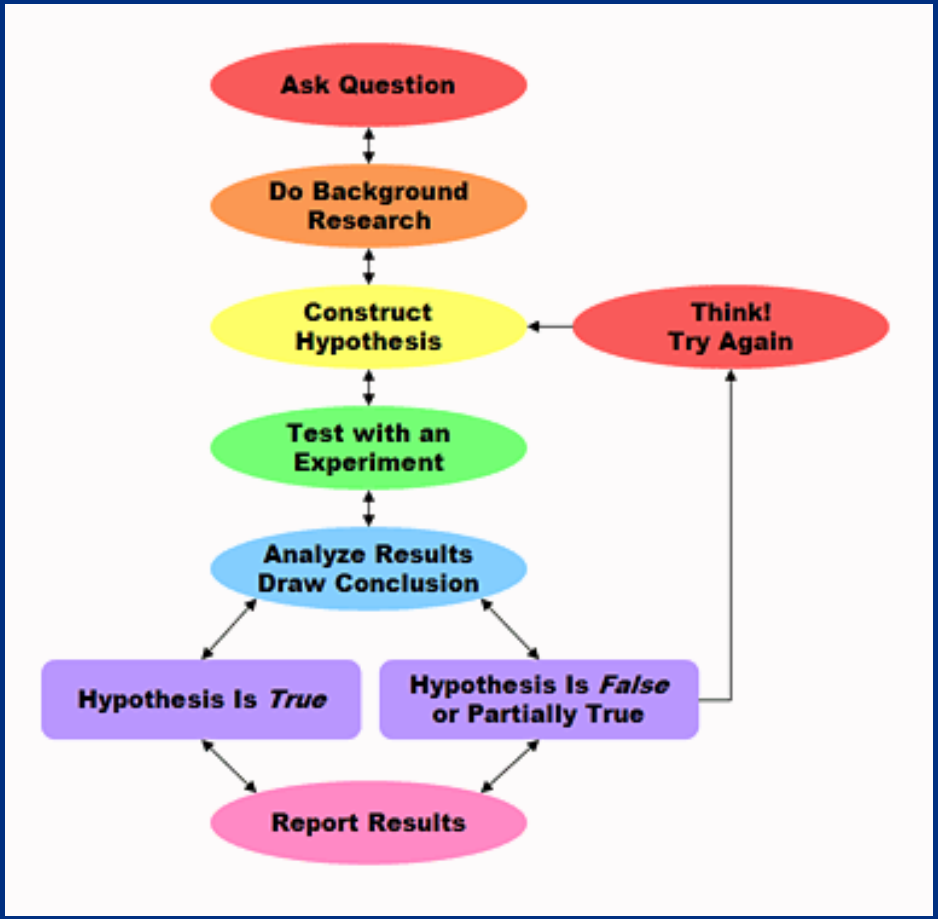
The Scientific Method



From Where Do Ideas Come?

- Casework
  - LaPorte GM. The Use of an Electrostatic Detection Device to Identify Individual and Class Characteristics on Documents Produced by Printers and Copiers – A Preliminary Study. *J Forensic Sci*. 2004; 49(3):610-620.
  - Ramotowski RS, Regen EM. The Effect of Electron Beam Irradiation on Forensic Evidence. 1. Latent Print Recovery on Porous and Non-porous Surfaces. *J Forensic Sci.* 50(2):298-306, 2005.
- Literature reviews
- Ideas generated by lectures at conferences and meetings, training
- Research ideas can have a basis in a recent, critical operational need within the laboratory.

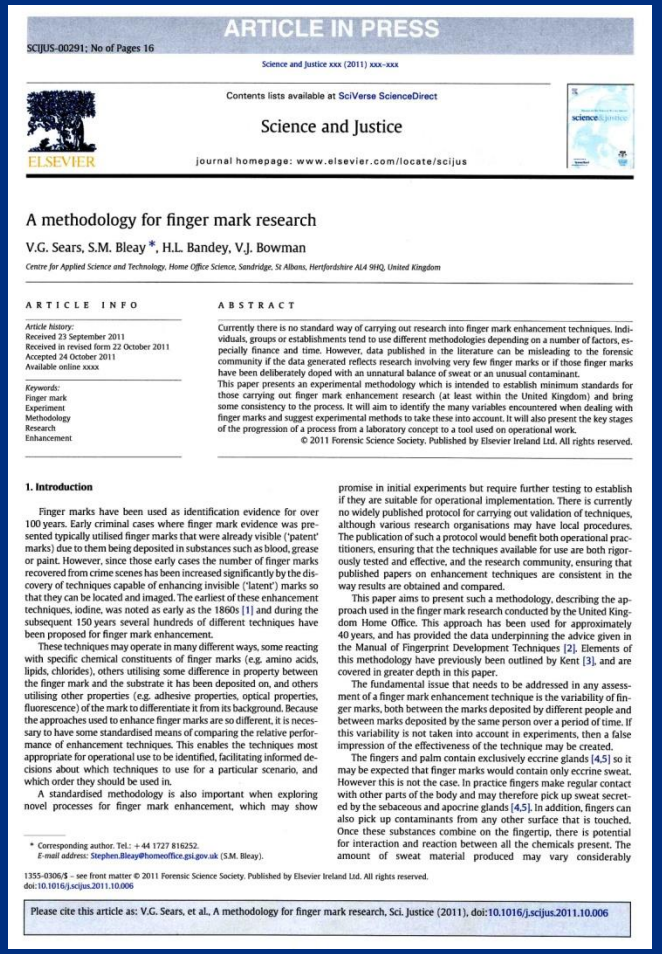
Literature Search

- The literature search is one of the most important aspects of the overall research process.
- Its purpose is to educate the prospective researcher as to the state of the art of the work done in a particular field or area of study.
- It is an iterative process (a procedure in which repetition of a sequence of operations yields results successively closer to a desired result).*
- Failure to conduct an adequate literature search can lead to charges of plagiarism and/or rejection of manuscripts.

*http://www.merriam-webster.com/dictionary/iteration

Experimental Design

- Sears VG, Bleay SM, Bandey HL, Bowman VJ. A Methodology for Finger Mark Research. Sci Justice 2012;52:145-160.
- Protocol developed by scientists at UK Home Office CAST.



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A methodology for finger mark research

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ABSTRACT

Currently there is no standard way of carrying out research into finger mark enhancement techniques. Individuals, groups or establishments tend to use different methodologies depending on a number of factors, especially finance and time. However, data published in the literature can be misleading to the forensic community if the data generated reflects research involving very few finger marks or if those finger marks have been deliberately doped with an unnatural balance of sweat or an unusual contaminant.
This paper presents an experimental methodology which is intended to establish minimum standards for those carrying out finger mark enhancement research (at least within the United Kingdom) and bring some consistency to the process. It will aim to identify the many variables encountered when dealing with finger marks and suggest experimental methods to take these into account. It will also present the key stages of the progression of a process from a laboratory concept to a tool used on operational work.

1. Introduction

Finger marks have been used as identification evidence for over 100 years. Early criminal cases where finger mark evidence was presented typically utilised finger marks that were already visible ('patent' marks) due to them being deposited in substances such as blood, grease or paint. However, since those early cases the number of finger marks recovered from crime scenes has been increased significantly by the discovery of techniques capable of enhancing invisible ('latent') marks so that they can be located and imaged. The earliest of these enhancement techniques, iodine, was noted as early as the 1860s [1] and during the subsequent 150 years several hundreds of different techniques have been proposed for finger mark enhancement.

These techniques may operate in many different ways, some reacting with specific chemical constituents of finger marks (e.g. amino acids, lipids, chlorides), others utilising some difference in property between the finger mark and the substrate it has been deposited on, and others utilising other properties (e.g. adhesive properties, optical properties, fluorescence) of the mark to differentiate it from its background. Because the approaches used to enhance finger marks are so different, it is necessary to have some standardised means of comparing the relative performance of enhancement techniques. This enables the techniques most appropriate for operational use to be identified, facilitating informed decisions about which techniques to use for a particular scenario, and which order they should be used in.

A standardised methodology is also important when exploring novel processes for finger mark enhancement, which may show promise in initial experiments but require further testing to establish if they are suitable for operational implementation. There is currently no widely published protocol for carrying out validation of techniques, although various research organisations may have local procedures. The publication of such a protocol would benefit both operational practitioners, ensuring that the techniques available for use are both rigorously tested and effective, and the research community, ensuring that published papers on enhancement techniques are consistent in the way results are obtained and compared.

This paper aims to present such a methodology, describing the approach used in the finger mark research conducted by the United Kingdom Home Office. This approach has been used for approximately 40 years, and has provided the data underpinning the advice given in the Manual of Fingerprint Development Techniques [2]. Elements of this methodology have previously been outlined by Kent [3], and are covered in greater depth in this paper.

The fundamental issue that needs to be addressed in any assessment of a finger mark enhancement technique is the variability of finger marks, both between the marks deposited by different people and between marks deposited by the same person over a period of time. If this variability is not taken into account in experiments, then a false impression of the effectiveness of the technique may be created.

The fingers and palm contain exclusively eccrine glands [4,5] so it may be expected that finger marks would contain only eccrine sweat. However this is not the case. In practice fingers make regular contact with other parts of the body and may therefore pick up sweat secreted by the sebaceous and apocrine glands [4,5]. In addition, fingers can also pick up contaminants from any other surface that is touched. Once these substances combine on the fingertip, there is potential for interaction and reaction between all the chemicals present. The amount of sweat material produced may vary considerably

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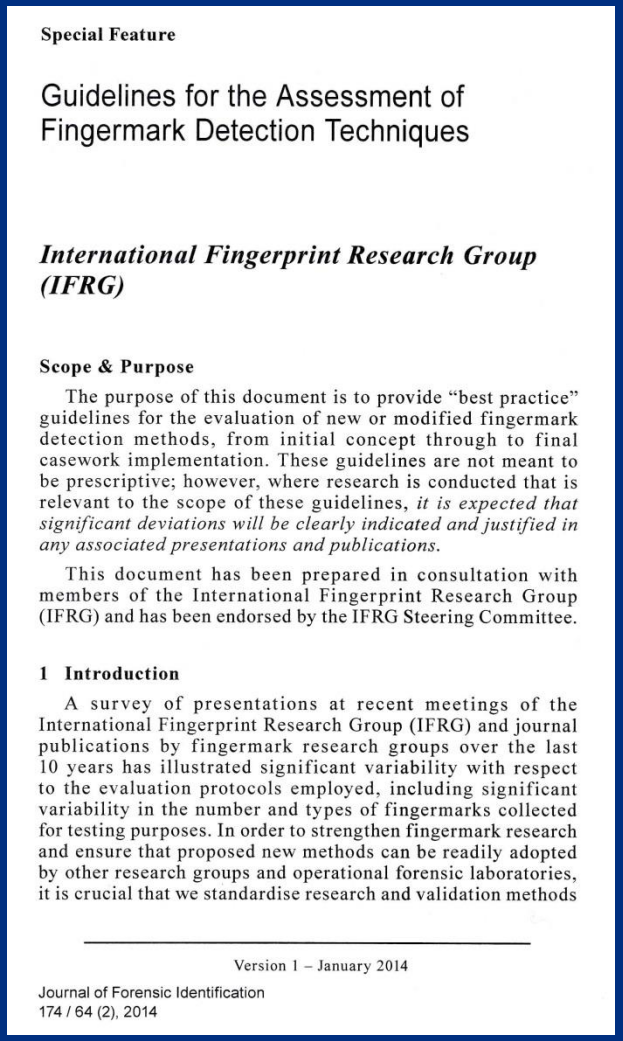
Experimental Design

- Another more detailed approach was published in 2014 by members of the International Fingerprint Research Group.
  - Phase 1 (Pilot Studies)
  - Phase 2 (Optimisation & Comparison)
  - Phase 3 (Validation)
  - Phase 4 (Operational Evaluation & Casework Trials)



Special Feature

Guidelines for the Assessment of Fingermark Detection Techniques

International Fingerprint Research Group (IFRG)

Scope & Purpose

The purpose of this document is to provide "best practice" guidelines for the evaluation of new or modified fingermark detection methods, from initial concept through to final casework implementation. These guidelines are not meant to be prescriptive; however, where research is conducted that is relevant to the scope of these guidelines, *it is expected that significant deviations will be clearly indicated and justified in any associated presentations and publications.*

This document has been prepared in consultation with members of the International Fingerprint Research Group (IFRG) and has been endorsed by the IFRG Steering Committee.

1 Introduction

A survey of presentations at recent meetings of the International Fingerprint Research Group (IFRG) and journal publications by fingermark research groups over the last 10 years has illustrated significant variability with respect to the evaluation protocols employed, including significant variability in the number and types of fingermarks collected for testing purposes. In order to strengthen fingermark research and ensure that proposed new methods can be readily adopted by other research groups and operational forensic laboratories, it is crucial that we standardise research and validation methods

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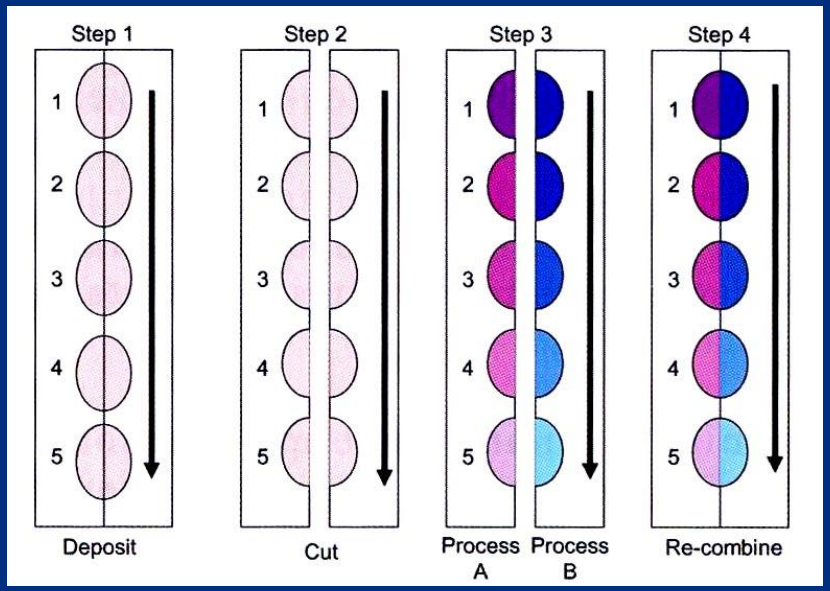
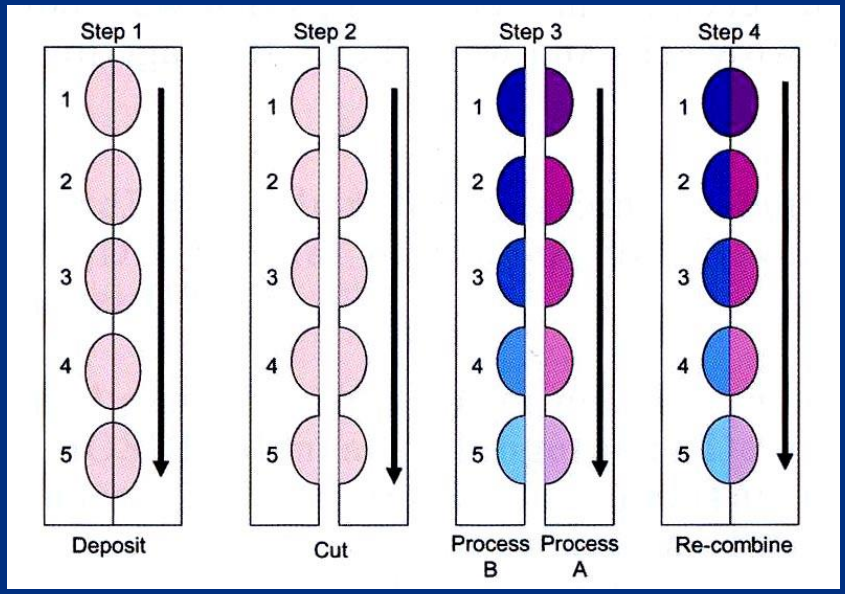
Factors to Consider

- Paper types? How many types?
- Male/Female donors? Young/Old? How many donors?
- Age of prints? Minimum/Maximum?
- Depletion series used? How many?
- Environmental conditions
- What equipment will be used (e.g., CA fuming in a fish tank vs. controlled chamber; what kind of oven; etc)
- Chemicals used (purity of reagents; grade of solvent)

Split-Depletion Series



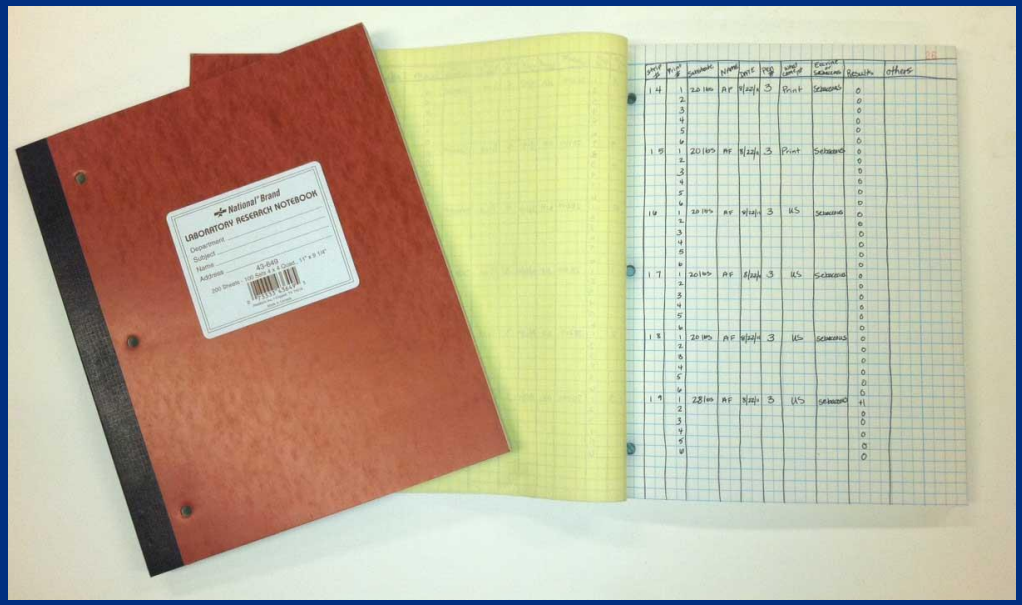


Fingerprints are deposited in a rapid fashion without replenishing and then allowed to age – they are then split in half to evaluate two different processes*

*Lee JL, Bleay SM, Sears VG, Mehmet S, Croxton R. Evaluation of the Dimethylaminocinnamaldehyde Contact Transfer Process and its Application to Fingerprint Development on thermal Papers. *J Forensic Ident.* 2009;59(5):551.

The Research Notebook

- Complete, contemporaneous documentation is essential.
- Similar requirements for forensic examinations due to ISO 17025 requirements.
- Failure to sufficiently document observations, measurements, etc. can lead to financial loss (private industry) or exclusion of evidence (criminal/civil litigation).



Pseudo-operational Trials

- The objective is to simulate evidence as closely as possible – material should have been handled in a normal manner (no “planted prints”)
- Some research groups have used old fraudulent checks from banks (naturally handled)
- Envelopes that have been sent through the mail (naturally handled)
- Random trash/recycled materials from around the office (porous/non-porous)

Assessment

- Pick a scale to judge the latent print development
- Scale size can vary; however, the more grades you have the more difficult it is to distinguish between grades (e.g., 7 vs. 8 in a 9-point scale)
- “Identifiable” vs. “non-identifiable” (choose a threshold value for the amount of ridge detail needed to qualify as an “identification”, e.g., “12”)
- Note the clarity (i.e., quality) of the developed ridge detail (is third level detail present?)
- Quantification using instrumentation can be done
- Layperson vs. expert
- Absolute vs. comparative assessments (IFRG Guidelines)

Writing Up Your Results

- What format will the manuscript be?
  - Article
  - Technical Note
  - Case Report
  - Commentary
  - Letter to the Editor
- Use previously published articles as a guide for formatting

Writing Up Your Results

- Introduction
  - Give a history of the previous work (the bulk of references are cited in the Introduction)
  - Briefly discuss the purpose of the study
  - Lay the foundation for how the work proposed differs from the work previously cited
  - Do not present any results, data, or conclusions in this section

Writing Up Your Results

- Materials and Methods
  - Specify chemical grades (ACS grade? Technical grade? HPLC grade?)
  - Specify chemical manufacturers
  - Specify equipment (model/type/manufacturer)
  - Specify samples used and methodology for testing them (e.g., ASTM 1422-05)
  - Specify environmental conditions (e.g., temperature, RH, dark/light, outside/inside, outside weather conditions, etc.)
  - Number or donors, age, sex, and collection protocol
  - Methodically describe all analytical procedures in a logical order (e.g., Experiment A, Experiment B, Experiment C)

Writing Up Your Results

- Results
  - Discussion should flow in the same order as materials and methods (e.g., Results of A/Discussion of A, Results of B/Discussion of B, etc.)
  - Do not discuss results of experiments or tests that have not been described in the materials and methods section (e.g., Results of Q)
  - Present images, graphs, charts, etc. to aid in data interpretation (this section should be image and data rich – but not excessively – be judicous)
  - If charts and/or tables are extensive – consider appendices
  - Use the least compression possible for images (some publications require .tif format)
  - Avoid the use line art – most publications require computer generated drawings (no photocopies)

Writing Up Your Results

- Discussion
  - Discuss possible explanations for results obtained (especially unexpected ones)
    - Why were 1,2-indanedione-zinc results affected by humidity?
    - Why does addition of zinc chloride increase fluorescence?
    - Why does addition of acetic acid increase fluorescence?
    - How do results from laboratory samples (split depletions) compare to results from the field study (with mailed envelopes)?
  - Do not introduce new material of any kind in this section (results of Q/Discussion of Q)

Writing Up Your Results

- Conclusion
  - Briefly summarize the overall results from each experiment.
  - Highlight any major significant finding (whether or not it agrees with the initial hypothesis).
  - Do not introduce new material of any kind in this section (results of Q/Discussion of Q).
  - This section should be kept as short and succinct as possible.

Writing Up Your Results

- References
  - Make sure you references follow the proper format (refer to the IAI Publication Guidelines – see www.theiai.org).
  - Use only the references that are relevant to your topic.
  - For a list of proper journal abbreviations see the following website: http://www2.bg.am.poznan.pl/czasopisma/medicus.php?lang=eng.

Why do Manuscripts Get Rejected?

- There are a number of significant common reasons why manuscripts can be rejected:
  - Bad experimental design
  - Describing only one technique without comparing it to other standard processes (lack of context)
  - Self-plagiarism – submitting the same manuscript to multiple journals
  - Non-original/duplicative work – mostly due to a failure to conduct an comprehensive literature search
  - Manuscript was poorly translated from the original language
  - Testing only a small set of samples (not enough inter- and intra-variation)

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