Scientific Writing in Medical Sciences

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Research Output

- Three different research output are expected from research proposals:

  1- Paper

  2- Patent

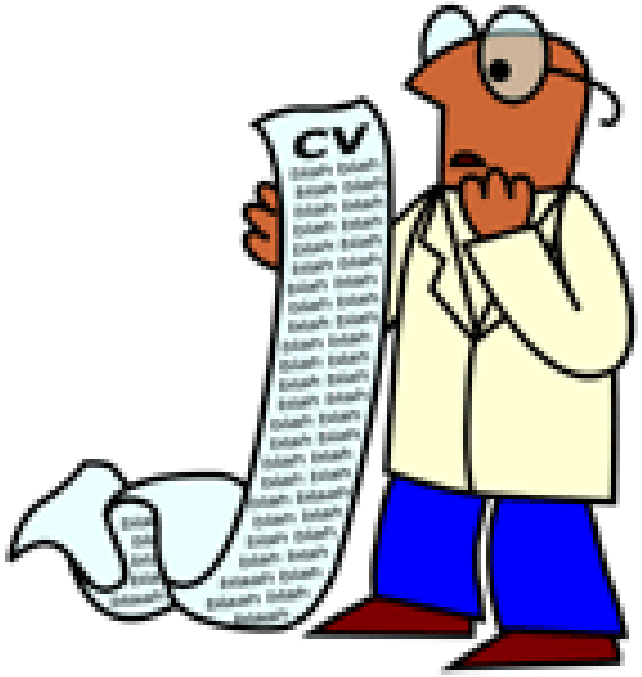
  3- Change

Why Publish?

- Knowledge contributions
- Ensures scientific rigor
- Allows feedback (improves work)
- Promotes career
  - Document productivity
  - Document impact on field/reputation
  - Advertises your lab for future trainees
- Improves chances of funding
- Fulfills an obligation (public monies)

Evaluating an Academic Person though his/her CV Papers

- Number of papers
- Rate of publication
- Quality of journals
- Position in list of authors
- Focus



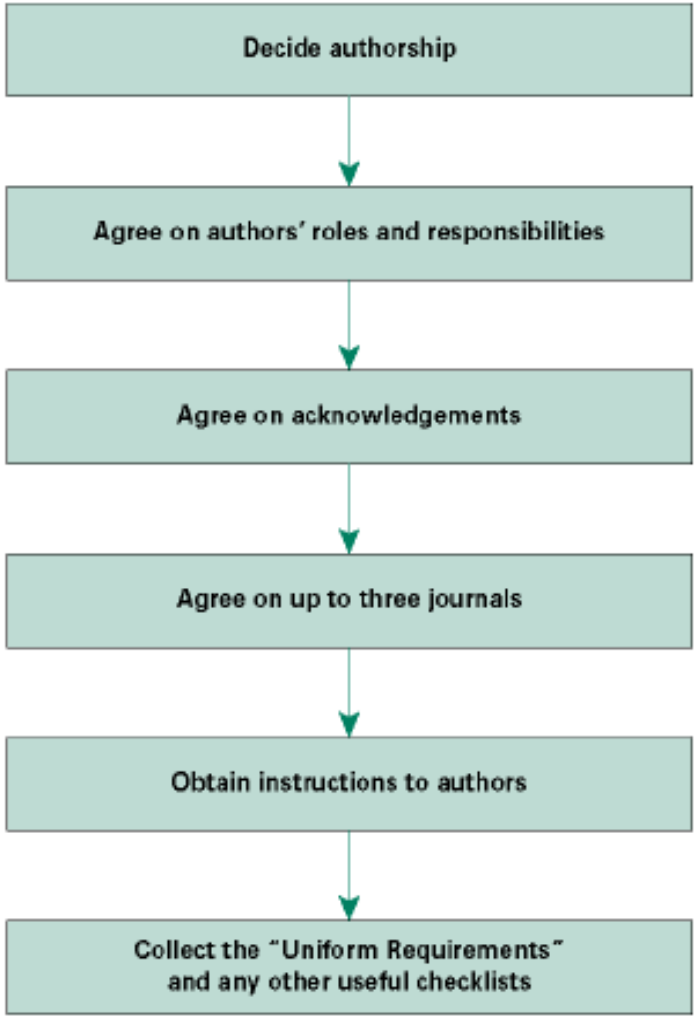
The Art of Scientific Writing

- ✓Publish or Perish!

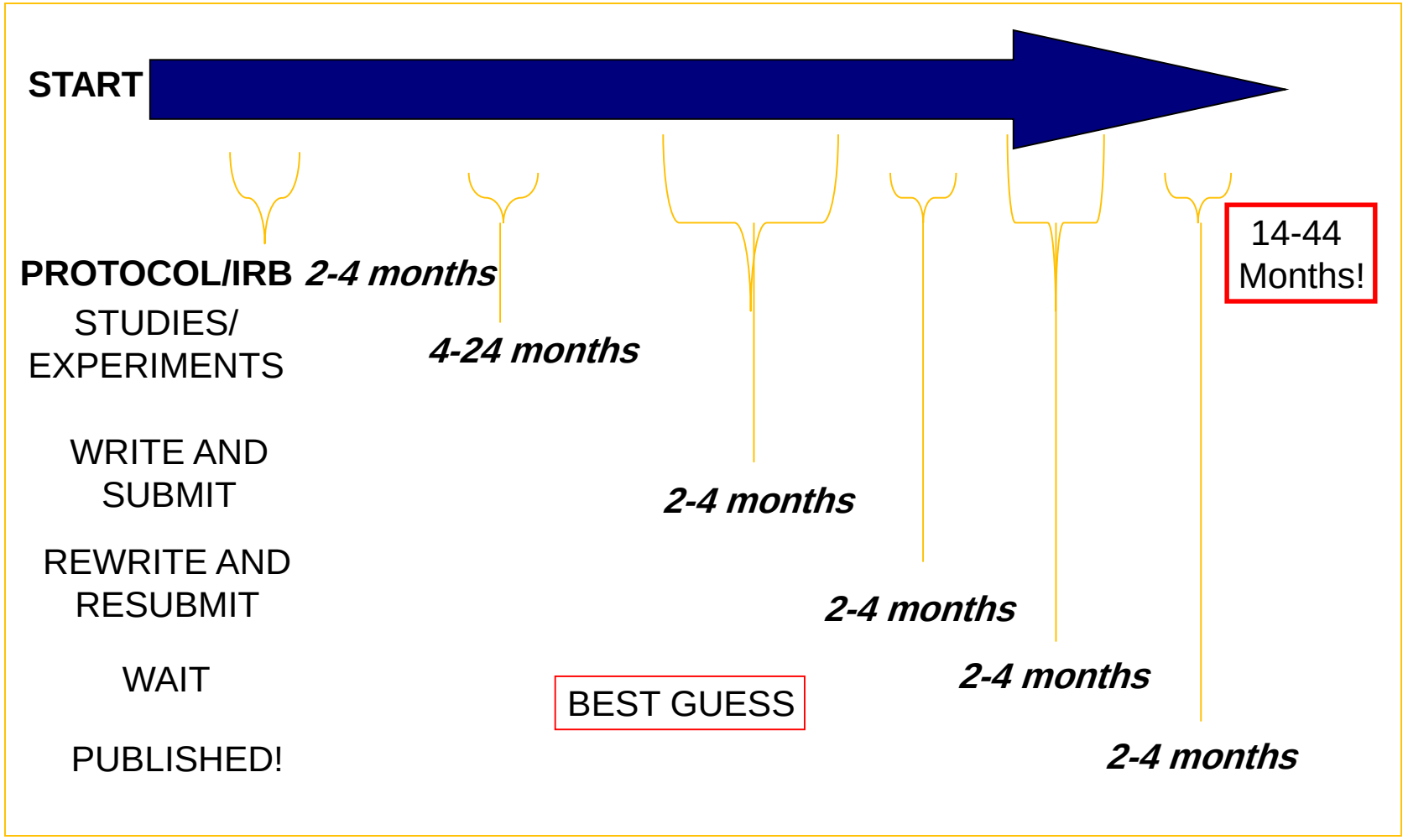
Steps in Scientific Writing

- Design well
- Decide politics
- Choose journal
- Read instructions to authors/papers
- Set framework
- Prepare drafts
- Distribute
- Polish
- Submit

Politics first!



What is the gestational period for a clinical science publication?



Types of Medical articles

- Original Article
- Review Article
- Case Reports
- Editorial
- Short Communication (short papers)
- Letter to Editor
- Personal Views

Letter to Editor

- Stick to the point
- State the problem, issue or hypothesis
- Give the context
- Outline your comment, solution, viewpoint
- Give a strong conclusion
- Note limitations

Editorial

- Write for your readership (broad?)
- Be controversial and thought provoking
- Being subtle is often more powerful

Short communication (paper)

- Increasingly common
- Concise introduction
- Present data and discuss it shortly
- Only a few tables or figures
- Number of words limitations

Is your paper a paper, a brief or a research letter?

- Easier to get letters & briefs accepted .
- They make you indexed easier !
- Decide whether you should submit it as a brief or letter firstly.

Case Reports

- Medical history of a single patient in a story form.
- Lots of information given which may not be seen in a trial or a survey.
- Often written and published fast compared to studies
- To be used as an educational source & tool.
- e.g. Thalidomide

The Traditional IMRaD

- Introduction
- Methods
- Results
- Discussion

The Basic Structure of an Article

TITLE

(S)Summary (Structured Abstract)

(I) Introduction (What Question was asked?)

(M)Methods (How was it Studied?)

(R)Results (What was Found?)

(A)Analysis (How data was analysed?)

(D)Discussion (What Do the Findings Mean?)

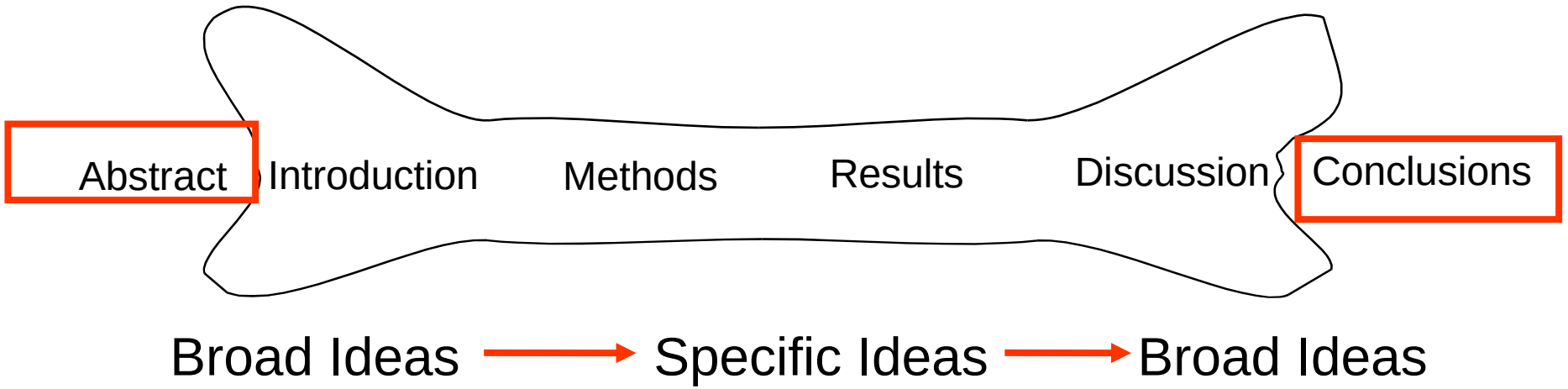
Acknowledgements

References

Main Components of an Article

- Introduction: Why did you start?
- Methods: What did you do?
- Results: What did you find?
- Discussion: What does it all mean?

“Bowtie” Model For a Scientific Paper



A full paper may contain:

- Title
- Authors and Affiliation
- Abstract
- Keywords
- Introduction
- Methods
- Results
- Discussion
- Acknowledgments (optional)
- References

Initial steps

1-Understand the type of manuscript you are writing.

2-Re-evaluate your project.

3-Plan the sections and subsections you need.

4-Match your content to your readers’ knowledge.

5-Keep information specific rather than general.

6-Write in plain language. Keep your sentences short.

7-Use tables, diagrams, flowcharts and graphs.

Order of writing?

1. Results
2. Methods
3. Introduction
4. Discussion
5. Abstract
6. References

Order of writing?

1. Methods
2. Results
3. Introduction
4. Discussion
5. Abstract
6. References

More Reading

- Hall GM, ed. **How to write a paper.** London: BMJ Publishing Group.
- **Advanced Writing**, Floresita V.Bustamante, SAMT
- **Essentials of Writing Biomedical Research Papers**, Zeiger
- **Scientific Writing Easy when you know how**. Peat J. BMJ Publishing Group. 2002.
- The Vancouver Group. **Uniform requirements for manuscripts submitted to biomedial journals.** www.icmje.org

Questions

Abstract

Abstract

- As its name suggests, abstract *(ab,* out + *trahere,* to pull) should select (pullout) the highlights from each section of the paper.

The Abstract

- The function of the abstract is to provide an overview of the paper.
- The overview should present the main story and a few essential details of the paper for readers who read only the abstract and should serve as both a clear preview and a clear, accurate recapitulation of the main story for readers who read the paper.
- Thus, the abstract should make sense both when read alone and when read with the paper .

Different Types of Abstract

1. Structured Abstracts
2. Unstructured Abstracts

Abstract

- Summarizes the major findings in the broad context of the work
- Consists of two or three sentences of topic introduction
- Selected results (not all but the most important)
- Concludes with implications of work

Abstracts

The abstract of a results paper should state concisely:

- the question that was asked,
- what was done to answer the question,
- what was found that answers the question, and
- the answer to the question.

Abstracts

- Most journals limit the length of the abstract (usually to 250 words or less) “Uniform Requirements for Manuscripts Submitted to Biomedical Journals”
- For un-structured abstracts, limit the abstract to 150 words or less.
- If no limit is stated, make your abstract no longer than the abstracts in recent issues of the journal.

In summary:

- The abstract should provide an overview of the main story and a few essential -details.

- The abstract should be clear both to readers who read the paper and to readers who do not read the paper.

Abstract Writing

- Write the abstract as one paragraph.
- Use the techniques of continuity to make the paragraph flow. Use signals to indicate the parts of the abstract:
- Signal what you found by "We found that" or something similar.

Abstract Writing

- Signal the answer by "We conclude that" or "Thus" or something similar. Signal implications by "We suggest that" or something similar.
- The question and what was done can usually be written in one sentence in “the form "To determine X, we. ..." If the question and what was done are in separate sentences, use signals such as "We asked whether. .." (question) and "To answer this question, we. .." (what was done).

Abstract Writing

- Use present tense verbs for the question and the answer.
- Use past tense verbs to state what was done and what was found.
- Use a cautious present tense verb for implications (for example, "may mediate").
- Be careful not to omit the question, not to state the question vaguely, and not to state an implication instead of the answer .

Abstract Writing

- Write short sentences.
- Avoid noun clusters.
- Use simple words. Avoid jargon. Avoid abbreviations.
- Keep the abstract short.
- Omit less important information.

Abstract Writing

- Omit details [unnecessary details of methods, exact data (give percent change), *p* values, "significantly"].
- Avoid repetition (use a category term in what was done and name the variables in what was found; state "mean ::t SD" only once).
- Use active voice instead of passive voice.

Keywords

- Select terms that you would look up to find your own paper and that would attract the readers you hope to reach.
- Select current, specific terms, preferably medical subject headings (MeSH), that name important topics in your paper .
- Use phrases as well as single words.
- If the journal asks you to supply only terms that are not in the title of the paper, do so
- If necessary, include a term as an indexing term even if the term does not appear in your paper .

Check list for Abstract

- Background, methods, results, discussion?
- Key features mentioned?
- Anything that does not appear in full text?
- Results in words?
- Conclusion: justified? objective?
- Meaningful interpretation
- Follows the guidelines

Notes About Titles

عنوان مقاله

- عنوان مقاله را هزاران نفر می‌خوانند، درحالی که تعداد اندکی کل مقاله را بررسی می‌کنند. عنوان مقاله در صفحه محتوای مجله و نیز در اندکس‌های پزشکی توسط بسیاری خوانده می‌شود.

- عنوان مانند تابلوی یک مغازه است و یا محصول یک کارخانه یا مزرعه است و لذا باید جذاب باشد، تا افراد را برای خواندن مقاله جذب کند.

Title

- First & most of the times the only part of an article that readers and editors see and read.
- Key elements that advertises the paper's contents
  - Informative and Specific
- Maybe helpful to choose the title when the paper is complete

عنوان مقاله

عنوان مقاله باید با حداقل تعداد کلمات و درعین‌حال به‌طور کافی بیان‌گر محتوای مقاله باشد:

- کلمه‌های کوتاه انتخاب شود.
- مبهم نبوده، دقیق باشد.
- کلمه‌های اختصاصی بکار رود.
- کلمه‌ها آشنا باشد.

Some exceptions!

Neurology® Widely Accepted Abbreviations

The following abbreviations should be used without definition in *Neurology* title and text

AIDS	acquired immunodeficiency syndrome
ApoE	apolipoprotein E protein
APOE	apolipoprotein E gene (usually as *APOE* gene; italicized)
CI	confidence interval
CNS	central nervous system
CSF	cerebrospinal fluid
CT	computerized or computed tomography
DNA	deoxyribonucleic acid
EKG	electrocardiogram (ECG may mean electrocorticography)
EEG	electroencephalogram
ELISA	enzyme-linked immunosorbent assay
EMG	electromyography

Title

- Short and simple
- State subject, not conclusion
- Include study design
- Include time and place if necessary
- Begin with a keyword
- Avoid abbreviations
- Remove empty phrases such as “ A study of…”
- Use Subtitles (notice number of words) “Exercise and Coronary Heart Disease: Framingham Offspring Study”

عنوان مقاله

- بهتر است که عنوان با کلمات کلیدی و اصلی (Keyword) شروع شود. به‌عبارت دیگر بهتر است که عنوان شامل کلمات کلیدی و اصلی باشد که بوسیله تعدادی حروف ربط درکنار یکدیگر قرار گرفته‌اند.

1- Aortic Stenosis ,Von Willebrand Factor, and Bleeding.

2-"Acquired Von Willebrand syndrome in Aortic Stenosis.

3-"Risk of Bacterial Meningitis in Children with Cochlear Implants.

عنوان مقاله

- گاهی اوقات بهتر است که عنوان مقاله به صورت سوالی مطرح شود که باعث ترغیب خواننده گردد. اصولا طرح عنوان مقاله به صورت سوال، یکی از الگوهای عنوان نویسی می‌باشد.

1-" Do Bisphosphonates Make Children’s Bones Better or Brittle ?"

2-" Use It or Lose It –Do Effortful Mental Activities Protect against Dementia?"

3-" Behind the Research : Death by Voluntary Dehydration –What the Caregivers Say ?"

Titles Guidelines

1- New England Journal of Medicine:

Concise and descriptive (not declarative)

2- Lancet:

Concise but informative

3- Annals of Internal Medicine:

As brief as possible while conveying essential features of the article's content

4- BMJ:

Keep them concise

Welcome Again !?!

Another Example !!!

How to Write Introduction Section?

Introduction

- General, concise description of problem
  - background to the work
  - previous research
- Where that work is deficient
  - how your research will be better
- State the hypothesis
- About 3 to 4 paragraphs

Paragraph1:
What we know

Paragraph2:
What we don’t know

Paragraph3:
Why we did this study

Introduction

1. Existing state of knowledge
2. Gaps in knowledge which research will fill.
3. State what you Intend to do & the purpose of article
4. Give pertinent references
5. Summarize the rationale for study or observation
6. Define specialized terms or abbreviations you want to use

Shall we cite anything?

- Common knowledge: knowledge that you find in several sources that are not themselves depending on a single earlier source.
- Common knowledge is ‘common’ and known to many, it is not subject to copyright.
- You don't have to cite “Common Knowledge”.
- Facts that are widely known.

Dealing with Common Knowledge

- In general, facts and information in common use, which can be verified from several places and are known by many people, are regarded as *common knowledge*.

- This usually includes facts available from various secondary sources such as textbooks, handbooks, manuals, dictionaries, directories, or encyclopedias.

Examples of Common Knowledge

- Diabetes is related to insulin function.
- Cholesterol is a risk factor for Myocardial Infarction.
- If you see a fact in three or more sources, and you are fairly certain your readers already know this information, it is likely to be “common knowledge”.
- But when in doubt, cite!

How to deal with Citation?!

- You are discussing your own findings, experiences, observations, results, methods or opinions.
  - *You don't need to give references & citations.*
- Bringing the results of original research, methods, opinions, … from other scientists' experiments, etc.
  - *You must give references & citations.*
- You are using *common knowledge.*
  - *You don't need to give references & citations.*

Inverted pyramid

Oxidative stress plays an important role in....

When LDL particles are oxidized ...

Antioxidants are important...

...Paraoxonase...

Introduction

- Don’t make it a review article
- Don not include methods, results and discussion
- Don’t put down every all previous studies & their data gaps
- Don’t explain pathophysiology irrelevant to your study

Check list for Introduction

- Is it clear why you did the study?
- How does your study add to knowledge?
- Is criticism justified and gentle?
- What can be left out?

How to Write Material & Methods Section?

Methods

- Allows reader to judge the quality of the work
- Identifies weaknesses
- Allows repetition of the study
- State the study design & specifications

Methods

- WWWWWH (what, who, where, when, why & how?)
- Define variables
- Patient/Participants inclusion
- Dates
- Randomisation/Placebo/Blindness
- Ethics/consent
- Treatments
- Outcomes and endpoints
- Statistical methods & power

Check list for Methods

- Study design mentioned?
- Who, what, where, why, how, when?
- Inclusion/exclusion criteria?
- logical & chronological order?
- Measurements defined? justified? detailed? referenced?

Check list for Methods

- Sample size justified?
- Transformations and statistical analyses clear?
- Any special features?
- New techniques validated properly?

Check list for Methods

- Could the reader reproduce your study from the details provided?

How to Write Methods for Interventional Studies?

Methods

- What subjects/patients/animals/specimens techniques were used?
- Reason for selecting the experimental design of the study.
- Statistical methods used for analysis
- The section should be called "Material and Methods" only if inanimate specimens have been used.

(continue)

Methods

Patient / Animals / Specimens

- Numbers
- Selection Criteria
- How are they grouped (cases /controls)
- Informed consent obtained

Techniques

- Give enough details for readers to assess the validity of the results, and repeat the study
- If standard techniques is used, give appropriate reference, any modifications should be clearly explained
- If drug trial, clear description of trial of Dose, Shape & Route of Administration

Abbreviations and Symbols

- Use abbreviations and acronyms only if they are widely known and not using them could make reading tedious.
- Write in full in the first instance and follow it immediately by the abbreviated version or acronym in brackets.
- For example,“We contacted the World Health Organization (WHO). The WHO provided the relevant information.”

Writing and Reporting Styles

- Be consistent with punctuation, use e.g. or eg (and use the same style for ‘ie’).
- Standard unit abbreviations need not be defined (eg mL and mg).
- Use one space either side of the symbol (eg > 100 participants). There should be no space either side of / (eg 10/51).
- Insert one space between a number and the unit (eg 0.4 mg)

Active and Passive Voice

- The active voice (eg “two authors extracted data”) is preferable to the passive voice (“data were extracted by two authors”).

General Points

Some other notes:

- p value (not P-value)
- SPSS 15 (not version 15)
- Website (not web site)

Numbers

- Spell out numbers less than 10 in full, unless used with units (eg 5 mL) or in a list with other numbers (eg 6,12, and 24 months).
- Write the number out in full if it is at the start of a sentence.

Dates

- Spell months out in full to avoid confusion between different regional date formats (May 2000; 1 May 2000), and express decades as, for example, 1960s (no apostrophe).

Pharmaceutical Drugs

- Use the recommended International Non-proprietary Name (rINN) for all pharmaceutical drugs (and put the specific brand name in brackets if needed).

Databases

- Name DATABASES in CAPITAL:

  MEDLINE (not Medline)
  SCOPUS (not Scopus)
  EMBASE (not Embase)
  PsycINFO (not Psychinfo)
  CINAHL (not Cinahl)

Presentation of Data

- Different ways to present summary statistics
  - Risk ratio (RR) was 0.14 (95% confidence interval (CI) 0.08 to 0.24) (use this option if the RR and CI have not been abbreviated earlier in the text.)
  - Mean difference 1.11 hours (95% CI 0.98 to 1.20)
  - (Rr 1.02, 95% ci 0.87 to 1.19)

Presentation of Data

- Present results with two decimal places (eg p value = 0.05) unless the number is very small (eg p value = 0.005).

CONSORT Statement

- CONSORT stands for Consolidated Standards of Reporting Trials.
- It is developed by the CONSORT Group to alleviate the problems arising from inadequate reporting of randomized controlled trials (RCTs).
- The website: http://www.consort-statement.org

Reporting Guidelines Available:

www.equator-network.org

equator network

Enhancing the QUAlity and Transparency Of health Research

EQUATOR resources in German | Portuguese | Spanish

Home | About us | Library | Toolkits | Courses & events | News | Blog | Librarian Network | Contact

Your one-stop-shop for writing and publishing high-impact health research

find reporting guidelines | improve your writing | join our courses | run your own training course | enhance your peer review | implement guidelines

Library for health research reporting

The Library contains a comprehensive searchable database of reporting guidelines and also links to other resources relevant to research reporting.

- Search for reporting guidelines
- Not sure which reporting guideline to use?
- Reporting guidelines under development

Reporting guidelines for main study types

Randomised trials	CONSORT	Extensions
Observational studies	STROBE	Extensions
Systematic reviews	PRISMA	Extensions
Study protocols	SPIRIT	PRISMA-P
Diagnostic/prognostic studies	STARD	TRIPOD
Case reports	CARE	Extensions
Clinical practice guidelines	AGREE	RIGHT
Qualitative research	SRQR	COREQ
Animal pre-clinical studies	ARRIVE	

Writing Results

Results

Simple → Complex

Positive → Negative

- Describe the population
- Establish how comparable your groups were
- Use a mixture of text, tables and figures
- Mention units of measurement
- Mention what numbers, brackets, etc. refer to
  - 9±4, 854 (12.3)
- Bring the p values

Results

Provide only enough interpretation to lead the reader from one experiment to the other

- Avoid lengthy analysis and comparison to the work of others

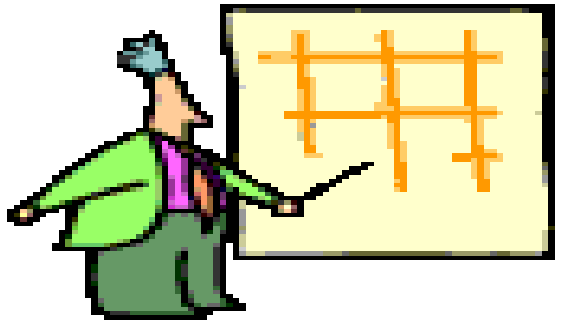
- No need to follow chronology of study
  - Rather, provide a logical progression and tell a story

Results

1. Start with positive findings.
2. Do not compare the present data with previously published results.
3. Write the text of the Results section concisely and objectively.
4. The passive voice will likely dominate here, but you can use the active voice also.

Sample

- "Males (180.5 ± 5.1 cm; n=34) averaged 12.5 cm taller than females (168 ± 7.6 cm; n=34) in the AY 1995 pool of Biology majors (two-sample t-test, t = 5.78, 33 d.f., p < 0.001)."



Tables and Figures

- Consider using a table to present large amounts of data/results.
  - Must refer to all tables in text.

- Use figures to graphically represent *significant* results.

Results

- Use the “Stand alone” tables
- Make sure totals would reach to 100%
- Do not repeat the Tables and Figures in text
  - Summarize: e.g., there were no significant associations…
  - Describe: e.g. there was a three fold increase in the risk of ..

See this table in a real paper!

جدول شماره ۱ - توزیع فراوانی ضرورت آموزش استفاده از کتابخانه طبق نظر دانشجویان بر حسب جنس

جنس / ضرورت آموزش	زن		مرد	
	فراوانی	درصد	فراوانی	درصد
خیلی زیاد	۲۴	۵۸/۵	۳۳	۶۴/۷
زیاد	۱۶	۳۹	۱۸	۳۵/۵
کم	۱	۲/۴	۰	۰
به هیچ وجه	۰	۰	۰	۰
جمع	۴۱	۱۰۰	۵۱	۱۰۰

Tables and Figures Titles

- Each Table or Figure must include a brief description of the results being presented and other necessary information in a Titles & legend.
- Table Titles go above the Table; as tables are read from top to bottom.
- Figure Titles go below the figure; as figures are usually viewed from bottom to top.

Tables and Figures

- Tables and Figures are assigned numbers separately and in the sequence that you will refer to them from the text.
  - The first Table you refer to is Table 1, the next Table 2 and so forth.
  - Similarly, the first Figure is Figure 1, the next Figure 2, etc.

Tables and Figures

- When referring to a table *from the text*, "Figure" is abbreviated as Fig.,e.g.,
  Fig. 1.
- Table is never abbreviated, e.g., Table 1.

Figures

- Used when we want to distinguish a result & make it prominent into readers view
- Figures are visual presentations of results, including graphs, diagrams, photos, drawings, schematics, maps, etc.
- Graphs are the most common type of figure.
- Graphs show trends or patterns of relationship.

Figures

- ✓Avoid clutter (too many numbers or symbols)
- ✓ Should provide a clear statistical message
- ✓Vertical (“Y”) axis: outcome/dependent variable
- ✓Horizontal (“X”) axis: exposure/independent variable
- ✓Name & define each axis
- ✓Give the measurement unit of each axis

Results

- Common mistakes
  - Raw data
  - Redundancy
  - Discussion and interpretation of data
  - No figures or tables
  - Methods/materials reported

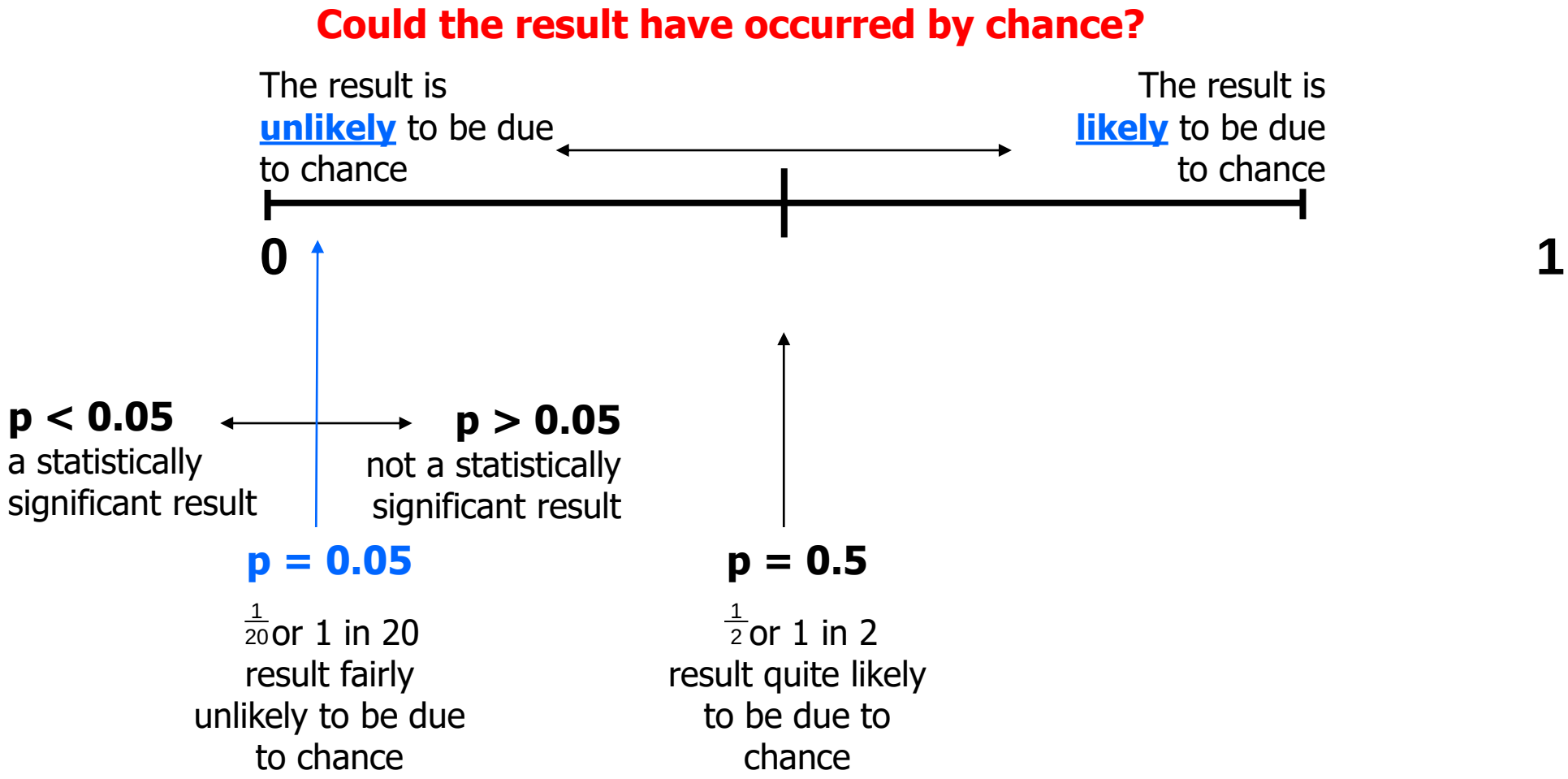
گزارش نتایج آماری

- نوشتن تعداد فراوانی همراه با درصدها وقتی تعداد نمونه اندک است.
- عدم نیاز به نوشتن فرمول‌های حجم نمونه و آزمون‌های آماری
- ارائه پارامترهایی‌که آزمون شده‌اند مانند میانگین, نسبت یا درصد, ضریب همبستگی, حتی اگر آزمون‌ها معنی‌دار نشده باشند.
- نوشتن شاخص آزمون و مقدار آن همراه با درجه آزادی و p value
- نوشتن مقداردقیق p value برای آزمون‌های معنی‌دار وغیرمعنی‌دار (تا دو رقم اعشار)

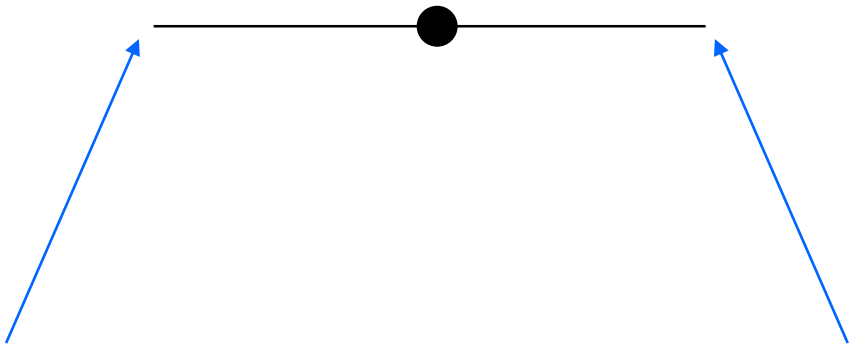
گزارش نتایج آماری

- تعریف کردن علائمی که برای نتایج معنی‌دار به‌کار می‌رود (مانند ستاره) و به‌کار بردن علائم مشابه
- نوشتن اعداد به‌صورت گرد شده با درنظرگرفتن دقت داده‌های اولیه (میانگین تا یک رقم اعشار و انحراف معیار و خطای معیار تا دو رقم اعشار بیشتر از داده‌های خام)
- درج درصدها تا یک رقم اعشار (گاهی حتی نیاز به ارقام اعشاری هم نیست).
- نوشتن شاخص‌هایی مانند r, t تا دو رقم اعشار

The p-value in a nutshell



Confidence Interval (CI)



Is the range within which the true size of effect (never exactly known) lies, with a given degree of assurance (usually 95%)

Check list for Results

- Baseline data provided?
- Primary and other endpoints clear and complete?
- Does the text complement figures and tables?
- Are measures of uncertainty mentioned? (SD, SE, CI)

Writing Discussion Section

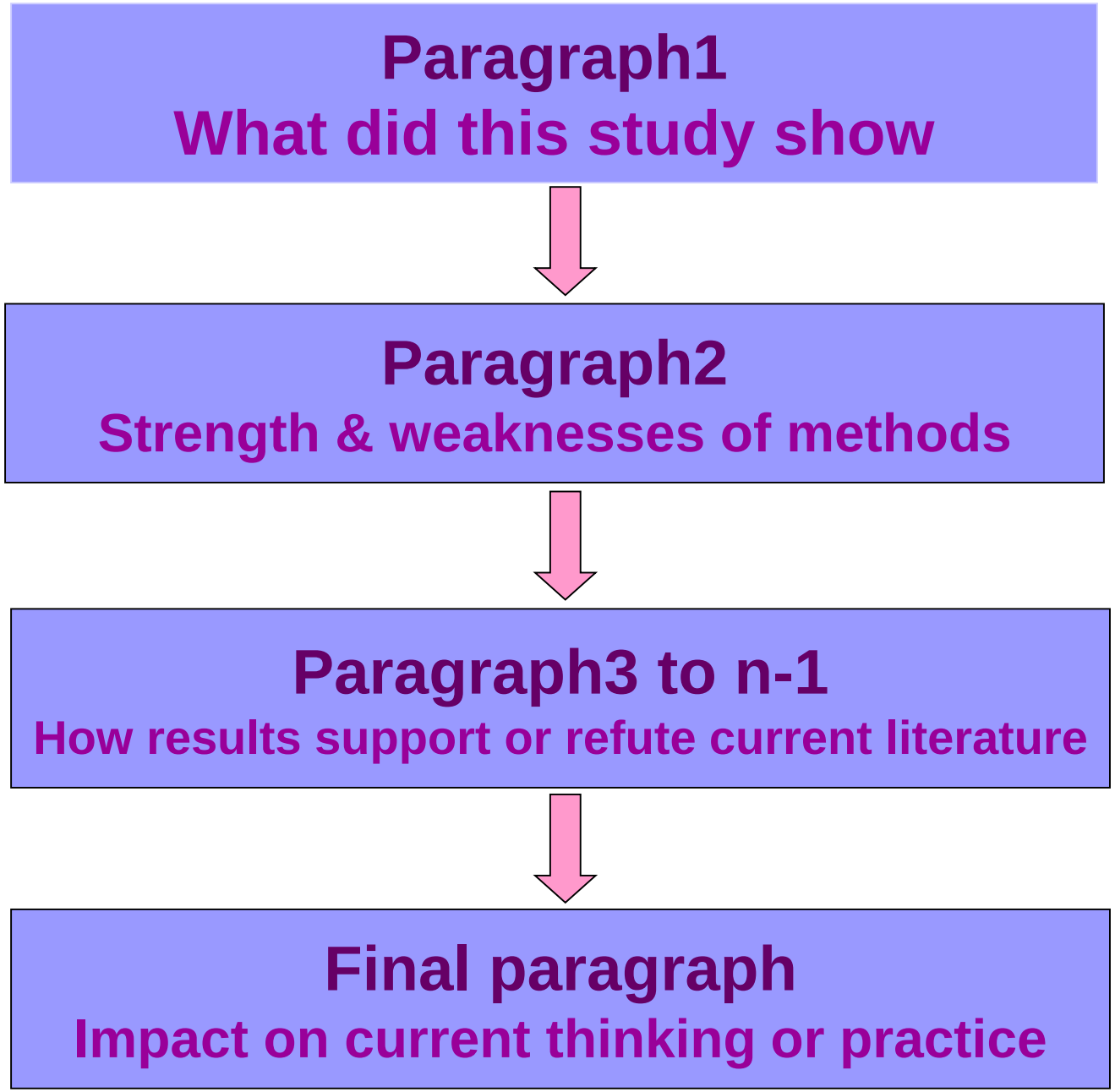
How to Write Discussion

The function of Discussion is:

- To write Briefly & summarize your principal finding
- Implications of your results for other researchers
- Interpret findings in light of the literature
- Reconcile findings with the literature
- Limitations of your study
- Conclusions

Paragraphs in Disscussion

- 1st paragraph
  - Introduce broad Idea
  - State major findings
- 2nd paragraph
  - Explicit rationale
- Last paragraph
  - Conclusion
  - Sugesstions


Paragraph1
What did this study show
Paragraph2
Strength & weaknesses of methods
Paragraph3 to n-1
How results support or refute current literature
Final paragraph
Impact on current thinking or practice

Paragraph1:
What did this study show

- A brief summary of what you really found and why it was important
- Explain how it will add to current knowledge or change health care
- Good phrases to begin with are:
  - *The results from this study showed that …*
  - *Our results indicate that …*
  - *and we found that …*

Paragraph 1:

Do not waste entire sentences restating your results; if you need to remind the reader of the result to be discussed, use "Bridge Sentences" that relate the result to the interpretation:

"The slow response of the lead-exposed neurons relative to controls suggests that...[interpretation]".

Paragraph 2:
Strength & weaknesses

- Be honest
- No research is ever perfect
- How chance, bias, or confounding may have influenced your results
- How you minimized this possibility
- How your research is better than what has gone before

Paragraph 3 to n-1:
Compare with current literature

- How your results agree or disagree with other studies and with other related theories
- Compare with highly relevant and scientifically valid studies
- References to the literature need to be both focused and brief

Final paragraph: Implication of your findings

- Never generalize your results beyond the bounds of the type of participants included in your study
- The most disappointing papers are those in which the conclusions are not backed up by the data
- Do not be too tentative if you found a strong association between the exposure and outcomes that you were investigating:
  - *Our results suggest that vitamin consumption could be associated with a decreased risk of respiratory illness…*

Length

- Make the Discussion no longer than necessary to state, support, explain, and defend the answers to the questions and present any other necessary information.
- 7 or 8 paragraphs maximum of three or four sentences each

Discussion

- Construct parallel to results
- Relate your results to the findings of other investigators
- Summary paragraph at end - include significance of results
- Avoid redundancy with results and introduction sections

Summary

- Be consistent with target journal’s style
- Write about main findings
- Summarize relevant important previous work
- Put your results in context
- Mention doubts, weaknesses, and confounders

Mechanics of Writing- Discussion

- Construct parallel to results
- Interpretation of data
- Relate your results to the findings of other investigators
- Summary paragraph at end - include significance of results
- Avoid redundancy with results and introduction sections

Discussion

- Do your results provide answers to your testable hypotheses?
- If so, how do you interpret your findings?
- Do your findings agree with what others have shown?
- If not, do they suggest an alternative explanation or perhaps a unforeseen design flaw in your experiment (or theirs?)

Discussion

- Given your conclusions, what is our new understanding of the problem you investigated and outlined in the Introduction?
- Explain weaknesses, shortcomings. Be fair: this will build trust. Don’t over-criticize yourself, don’t go to unnecessary details.

Discussion

- If warranted, what would be the next step in your study, e.g., what experiments would you do next?

Discussion

- Reverse of Introduction (pyramid)

Good discussions …

- Address every key finding of the study
- Present the finding in terms of what is known
- State why this study is different
- State why the results concur/ disagree with current knowledge
- Justify differences
- Point out future directions/ continued knowledge gaps

Style

- Use the active voice whenever possible in this section.
- Be concise and make your points clearly.
- Use of the first person is okay, but too much use of the first person may actually distract the reader from the main points.

Some notes

- How would you change your experiment to make it better?
- What new questions did this experiment make you think of?
- If you made mistakes in your experimental design, did you discuss them and how to fix it for next time.

Questions

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