

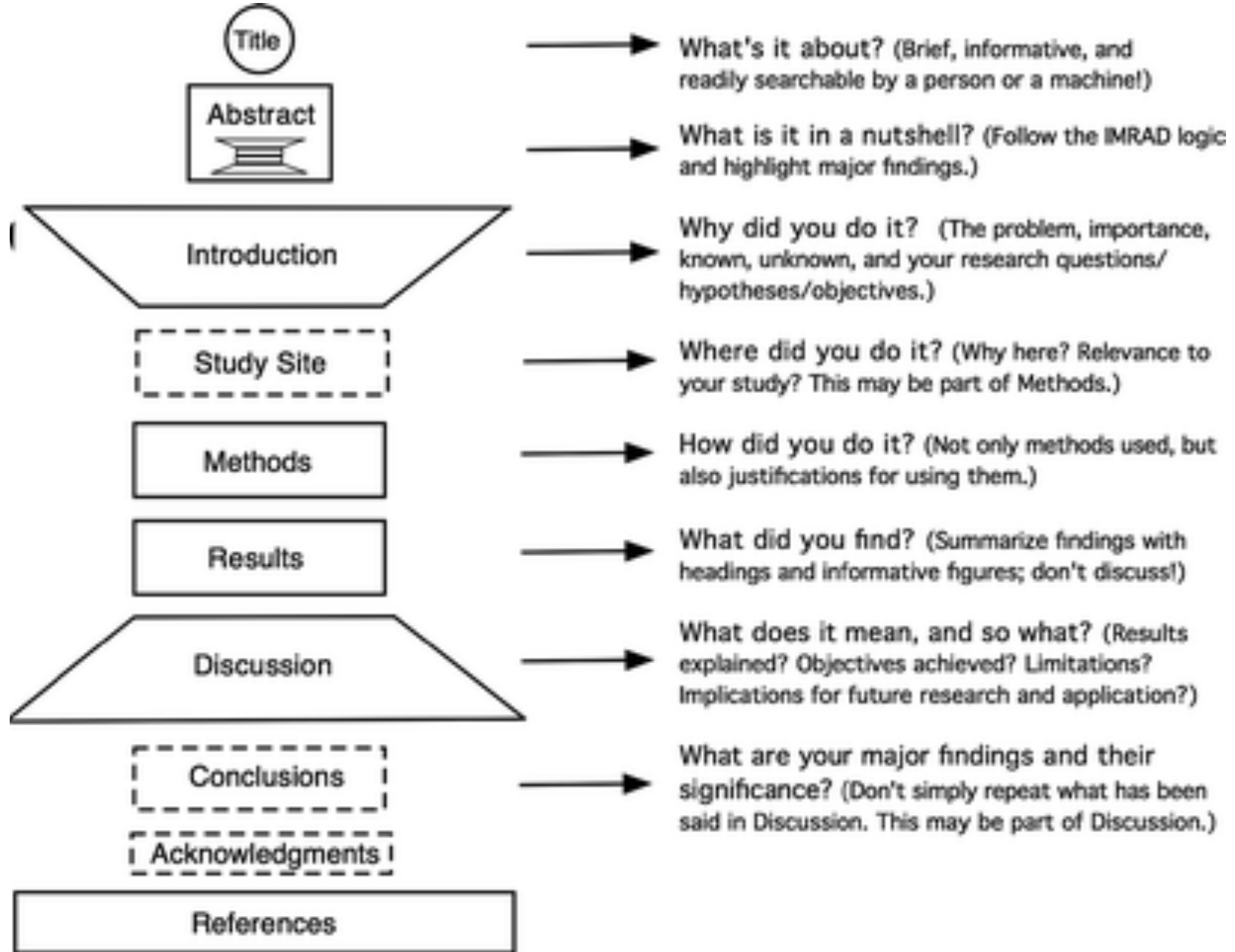
MBIO4030:

Core Molecular Microbiology Lab Techniques

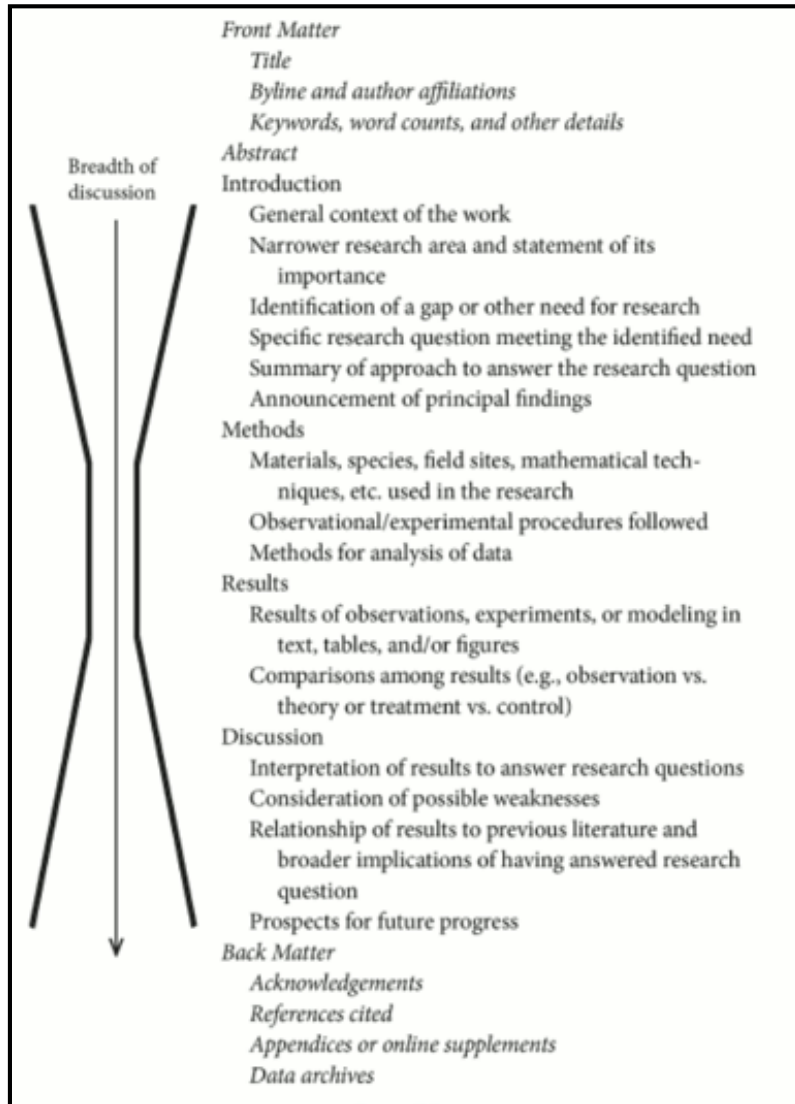
Lab Slot 3, Thursday September 12

“A scientific experiment, no matter how spectacular the results, is not completed until the results are published” (Day and Gestel 2006)

IMRaD (or AIMRaD)



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Width reflects breadth of focus

Note the sub-structure within each Section (often with subheadings)

Common form assists the reader to find desired information efficiently

Non-canonical research paper structures

Methods last

- common in “glam” journals
- increasingly common in molecular biology & microbiology journals

Results & Discussion combined

- can be easier to write but not to read
- can work well for theory papers
- can work well for papers that build to complex stories with multiple lines of evidence

Review papers

- usually don't have methods/results
- many different organizational methods (temporal, methodological, thematic)

Notes (very short, IMRaD structure should still be there)

Comments (critiques or rebut previously-published papers)

Theses

Activity 2.1: Finding IMRaD

In your groups

- 1) Choose one of the available non-IMRaD papers
- 2) Use colour-coded highlighters (or similar) to mark text serving functions of Introduction, Methods, Results, and Discussion
- 3) Decide in your group what are the advantages and disadvantages of this organization. Write down in full sentences in your own words what you discussed.
- 4) Choose one person to speak for the group who will share what you discussed with the class.

Methods

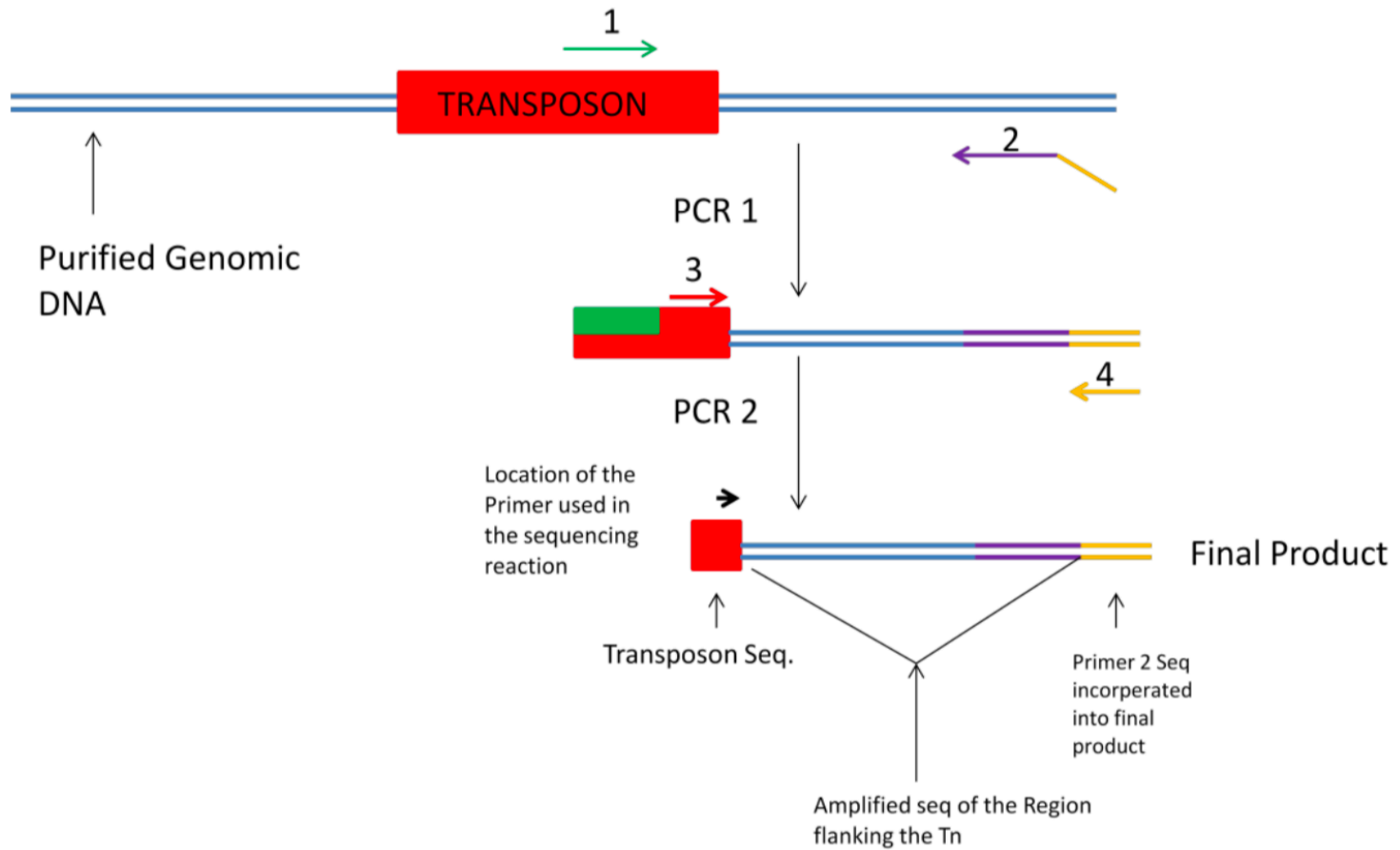


Figure 1: Overview of a Standard Arbitrary PCR.

Methods: “How did you do it”

What you studied, how you studied it, and how you analyzed the data:

- Materials, reagents, study species, etc.
- Experimental & observational methods
- How you analyzed the data

More complex papers may involve multiple experiments, and may therefore repeat the above structure

Methods: How much detail?

A detail goes in if it:

- establishes your sequence of investigative steps
lets reader understand claims to come in Results and Discussion
- establishes plausibility of your approach to the problem
shows you are gathering relevant data and analyzing it to shed light on the research problem
- establishes your credibility as a researcher
shows you know how to use standard methods appropriately

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Include all details that could influence reader's interpretation of your results.

Methods: Self-plagiarism

When you use the same methods twice, you shouldn't cut-and-paste old Methods text

- Reuse may not be legal, often, the journal owns the copyright
- Even if reuse is legal, rephrasing keeps writing fresh and ensures a good fit to the current work
- There is never just one way to write something!

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Solutions

- Rephrase, reorder, substitute synonyms
- Shorten methods and refer reader to previous manuscript

Active and Passive Voice

Active voice: *"We added 10 mL of phosphate buffer and shook the solution."*

Passive voice: *"10 mL of phosphate buffer was added to the solution, which was then shaken."*

You may have been told to write in the passive voice and to avoid using "I" and "we".

Do not follow this advice. Active voice is shorter, simpler, more engaging, and more honest. The majority of journals now prefer active voice *most* of the time.

When to use the passive voice

1) When the agent of the action is obvious, unimportant, or unknown to readers

e.g., Saccharomyces cerevisiae has been studied [by scientists] more extensively than other species of eukaryotic microbes

2) When the object or action itself is more important than the agent performing the action. Passive voice in the Methods and other sections of the manuscript can redirect focus to the work being done (the object of the action or the action itself) and away from the agent performing the work (I/we/the team).

Passive: "The extract from sample A was added to sample B to create a mixture."

Active: "We added the extract from sample A to sample B to create a mixture."

When to use the passive voice

3) When the recipient of the action is the topic of your sentence

Sentence beginning: topic position

Sentence end: stress position.

Active: "Scientists once classified slime molds as fungi, but they no longer classify them as part of that particular kingdom."

Passive: "Slime molds were once classified as fungi but are no longer considered to be part of that particular kingdom."

Activity 2.2: Drafting Methods

- 1) For an IMRaD paper, using your lab manual, draft the start of a methods section from Study I, Step # 1: Growth and Induction of *E. coli* Cultures. This will be edited, please write double-spaced and legibly.
- 2) List 5 methods details that don't appear in the Methods you wrote, and justify each choice.
- 3) Share with your group. What different choices were made?
- 4) Choose one person to speak for the group

Results



This figure is purely diagrammatic. The two ribbons symbolize the two phosphate—sugar chains, and the horizontal rods the pairs of bases holding the chains together. The vertical line marks the fibre axis

Results Formula Approach

WHY? Why was the experiment performed? What question was it trying to answer?

HOW? How was the question approached experimentally? What was actually done?

WHERE? In which figure or table are the data shown?

WHAT? Fully describe the actual results of the experiment.

SO WHAT? Based on the results, what is the answer to the original question?

Results: What goes in?

NOT everything you did!

Work backwards:

- What's the main thing you want the reader to learn?
- What's the major result that establishes this thing?
- What other results are needed to support or qualify the major one?

The Results section may be surprisingly short.

Results: Organization

Two common organizations:

(A) Simple Results: put main result first

(B) More complex Results: put main result last (build up to it)

Use paragraph or subsection structure mirroring Methods

Results: Relating texts to graphics

Text should tell the reader what to look for:

"Black kittens are bigger than white ones (Fig. 1)"

not

"Sizes of black and white kittens are shown in Figure 1"

Good legends/titles help make figures/tables self-contained

For more complex figures/tables, use pointers:

"Black kittens are larger than white ones (Fig. 1, compare left and middle bars)"

Results: Precision and significant digits

Did black kittens weigh 110 g, 111.4 g, or 111.43238722 g?

It depends.

- How precise was your balance? Significant digits
- How precisely does your reader need to know?

Remember your story

This applies to statistics too.

Never write "P = 0.37311002", or even "P = 0.3731"!

Methods vs. Results

Not always 100% separation between sections

- Some methods might be mentioned in the *Results* section as a reminder so the reader can understand.
- Some results might appear in the *Methods* section:
 - When they are needed to justify or explain choice of methods
 - When they don't need to be further discussed.

Results vs. Discussion

Not always 100% separation between sections

- The *Results* section should not *discuss* the data, but may *comment* on it
 - Draw attention to important features of the data (e.g., key results, comparisons)
- Compare experiment to experiment, experiment to model, etc.
 - Save implications of these comparisons for Discussion
 - Save comparisons of experiment to literature for Discussion

Activity 2.3: Application of Results formula

- 1) In your groups, write down a numbered list that identifies each experiment that was performed (i.e., subhead outline, results list).
- 2) Apply the results formula to each experiment; write down each component in your own words.
- 3) Discuss with your group and record in your own words: how much overlap is there in your answers among experiments? Were any of the components missing for any of the experiments? How is the overlap reflected in the structure of the results section?
- 4) Choose one person to share your findings with the class.

Assignment Two

Each student should turn in:

- 1) Methods draft
- 2) Your list of details that weren't including in the methods draft that were in the lab manual
- 3) Your application of the results formula
- 4) Your discussion about overlap and missing components of the results formula

Include your name on each page.