# ChemRhet: A Canadian WID Approach to Scientific Writing

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# What should we be doing in the organic lab?

- **Techniques**
- **Science**
- **"Lab reports"**
- **Eliminating Lab Reports: A Rhetorical Approach for Teaching the Scientific Paper in Sophomore Organic Chemistry**

Alaimo, P.J.; Bean, J.C.; Langenhan, J.M.; Nichols, L. *The WAC Journal*. **2009**, *20*, 17-32.

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# U of W - 2nd year Organic Chem

- 220 students, 2-4 lecturers, 3-5 graduate student lab instructors (12 lab sections), 1 marker (Chem), 1 marker (Writing)
- Fall (Organic Chem I)
  - One ‘formal’ lab report (follow *JOC*)
- Winter (Organic Chem II)
  - One ‘formal’ lab report (follow *JOC*)

# Prior to 2014

- ‘Diverse’ grad student instructors
- Varying outlines and mostly independent markers from year to year.
- Lab Reports - “D” Average

# Fall exercises – Organic Chem I

- Week 1: **Thin-Layer Chromatography** (Experiment 2A)
  - \- week 2: submit **Experimental** and **Data/Results** sections online for Experiment 2A
  - \- week 3: students take part in a **peer review** and get feedback on these sections. They then receive **marker feedback** on their original submission as well. Hand-out **exemplary** sections.

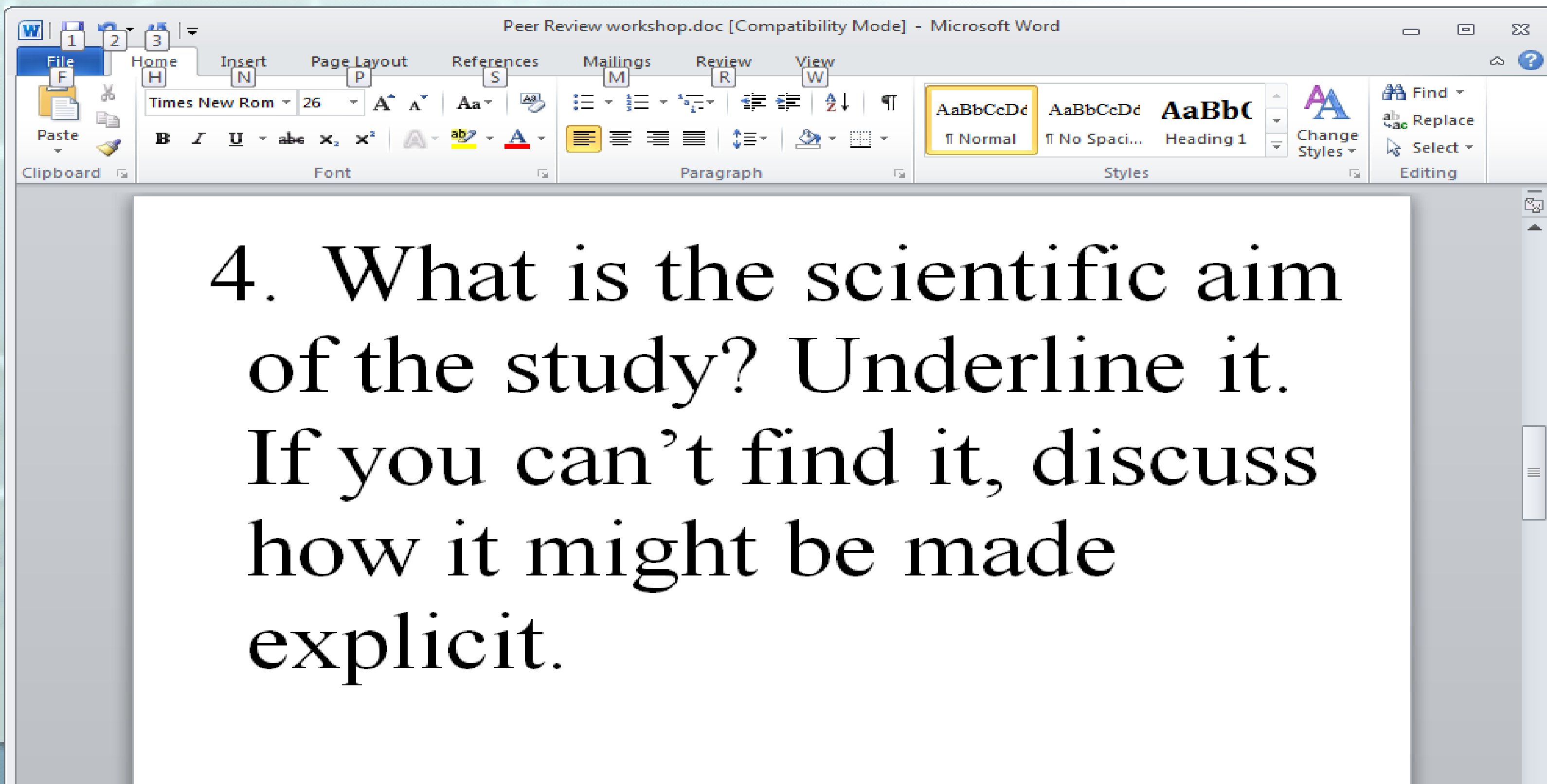
- Week 4: **Column Chromatography** (Experiment 2B)
  - \- Week 5: submit **Introduction, Discussion, Conclusion** on Experiment 2.
  - \- Week 6: peer review on these sections. No marker feedback.
  - \- Week 8: **full report** due.
  - \- Week 11: reports marked.

# Winter – Organic Chem II

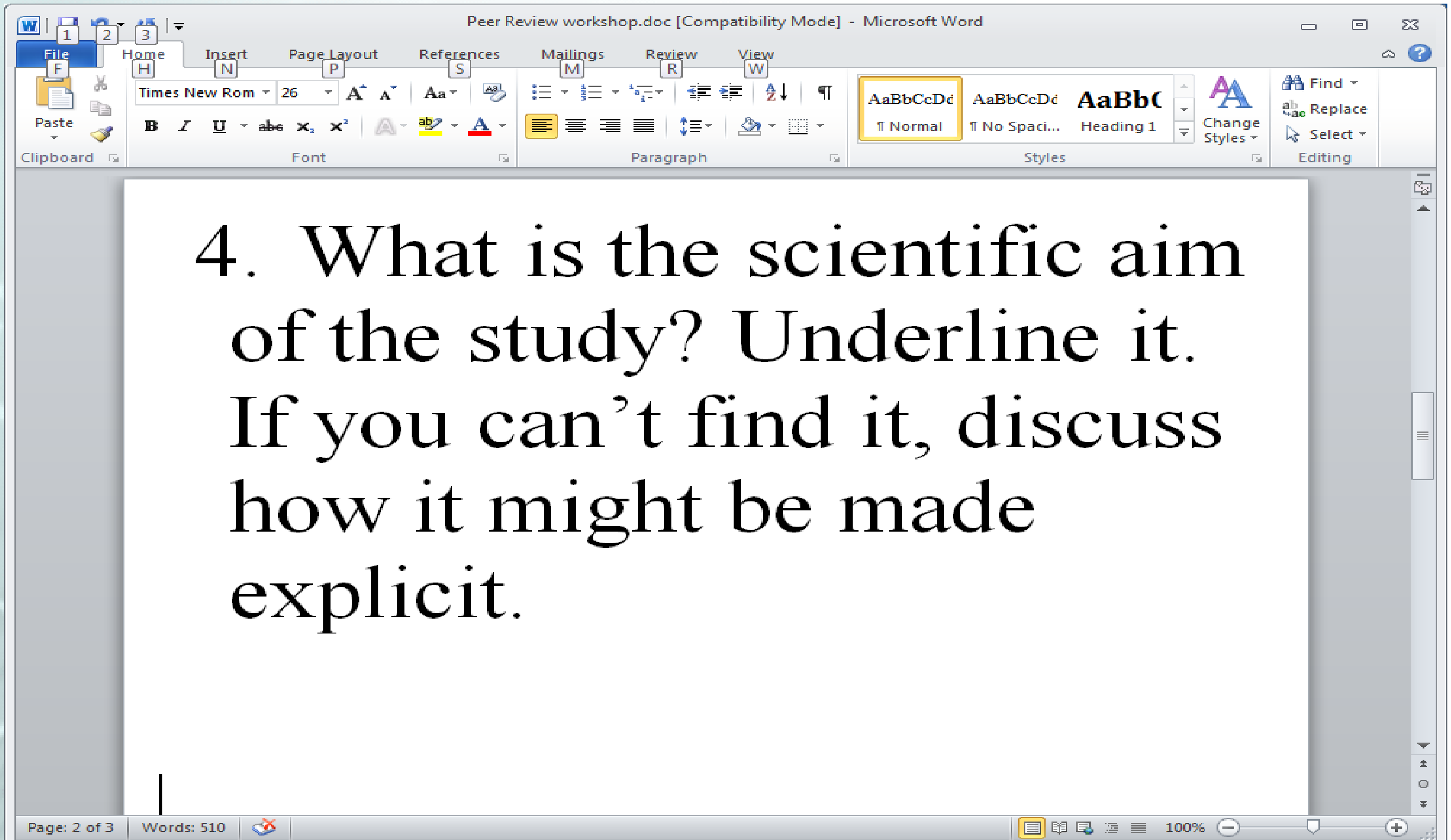
- Winter Report: Stand-alone writing exercise on an advanced reaction and chromatographic technique

# The first two years…

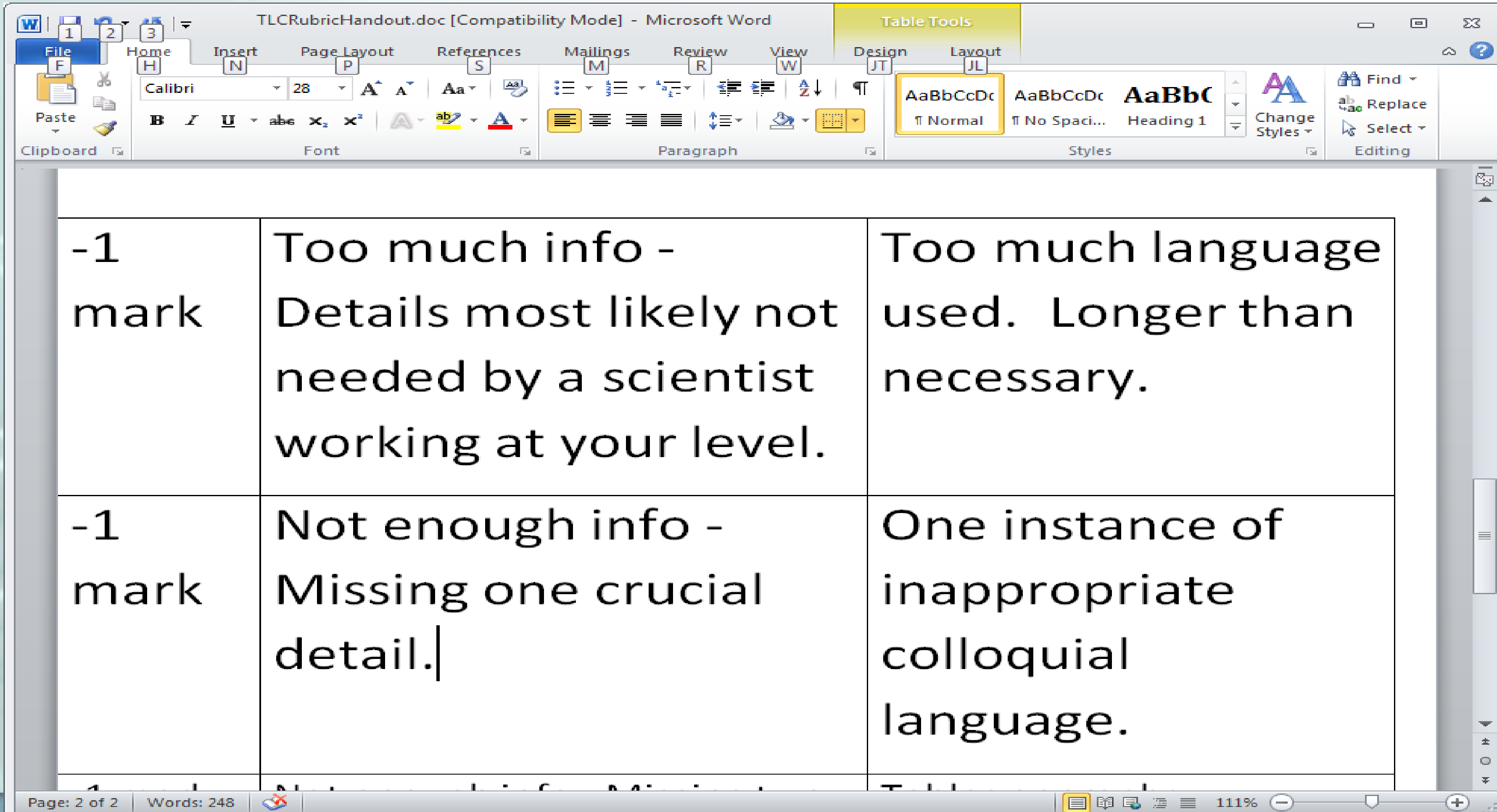
- **Fall 2014 - Alaimo’s writing packet – “Scientific Writing in Organic Chemistry” (38 pages)**
- **Fall 2014 – Faculty, Instructor and Marker supervised workshop and peer reviews**



- **Fall 2015 – Instructor supervised workshop and peer reviews**



- **Fall 2015 – Instructor supervised workshop and peer reviews**
- **Fall 2015 - "How to" guide, Revising and Editing Checklist, Marking rubrics (developed with Rachelle)**




| | | |
|---|---|---|
| -1 mark | Too much info - Details most likely not needed by a scientist working at your level. | Too much language used. Longer than necessary. |
| -1 mark | Not enough info - Missing one crucial detail. | One instance of inappropriate colloquial language. |

# Fall Formal Report Grade Averages

- 2010-2013: **55%**
- Fall 2014: **78-88%**
- Fall 2015: **67-81%** (‘Lab Instructor only’ supervised peer review workshops)

# Final Winter Formal Report Grade Averages

| Year 0 (Winter 2014) | Year 1 (Winter 2015) | Year 2 (Winter 2016) |
|---|---|---|
| 72.3% | 74.5% | 71.1% |

| Year 1 Average (Winter 2015) | Year 2 Average (Winter 2016) |
| --- | --- |
| 74.5% | 71.1% |

## Year 1: Winter 2015

| Introduction | Experimental | Data and Results | Discussion | Conclusion | Total Average |
| --- | --- | --- | --- | --- | --- |
| 84.1% | 57.3% | 77.7% | 85.3% | 49.6% | 74.5% |

## Year 2: Winter 2016

| Introduction | Experimental | Data and Results | Discussion | Conclusion | Total Average |
| --- | --- | --- | --- | --- | --- |
| 82.2% | 75.5% | 84.2% | 67.7% | 55.3% | 71.1% |

# Red flag 1: Evaluation

- Tutor trained in writing pedagogy graded Introductions, Experimental, and Data and Results sections both years.
- A different marker (a Chemistry student) graded Discussion and Conclusion sections in Year 1 and Year 2

Why?

- Because of the nature of the disciplinary specifics (complex organic chemistry)
  - i.e., Chemical reactions

# Red flag 2: Peer Review Facilitation

- In year 1, project leads attended the first peer review. In year 2, they did not.
- In both years, project leads trained lab TAs in peer review, but did not attend
- The attention of the team of expertise was considerably lessened in peer review facilitation of both the Discussion and Conclusion sections

| Year 1 Average (Winter 2015) | Year 2 Average (Winter 2016) |
|---|---|
| 74.5% | 71.1% |

## Year 1: Winter 2015

| Introduction | Experimental | Data and Results | Discussion | Conclusion | Total Average |
|---|---|---|---|---|---|
| 84.1% | 57.3% | 77.7% | 85.3% | 49.6% | 74.5% |

## Year 2: Winter 2016

| Introduction | Experimental | Data and Results | Discussion | Conclusion | Total Average |
|---|---|---|---|---|---|
| 82.2% | 75.5% | 84.2% | 67.7% | 55.3% | 71.1% |

# Discussion Sections Require Scientific Interpretation of Results

From Purdue Libraries:

The discussion section should explain to the reader the significance of the results and give a detailed account of what happened in the experiment. Evaluate what happened, based on the hypothesis and purpose of the experiment. If the results contained errors, analyze the reasons for the errors. The discussion should contain:

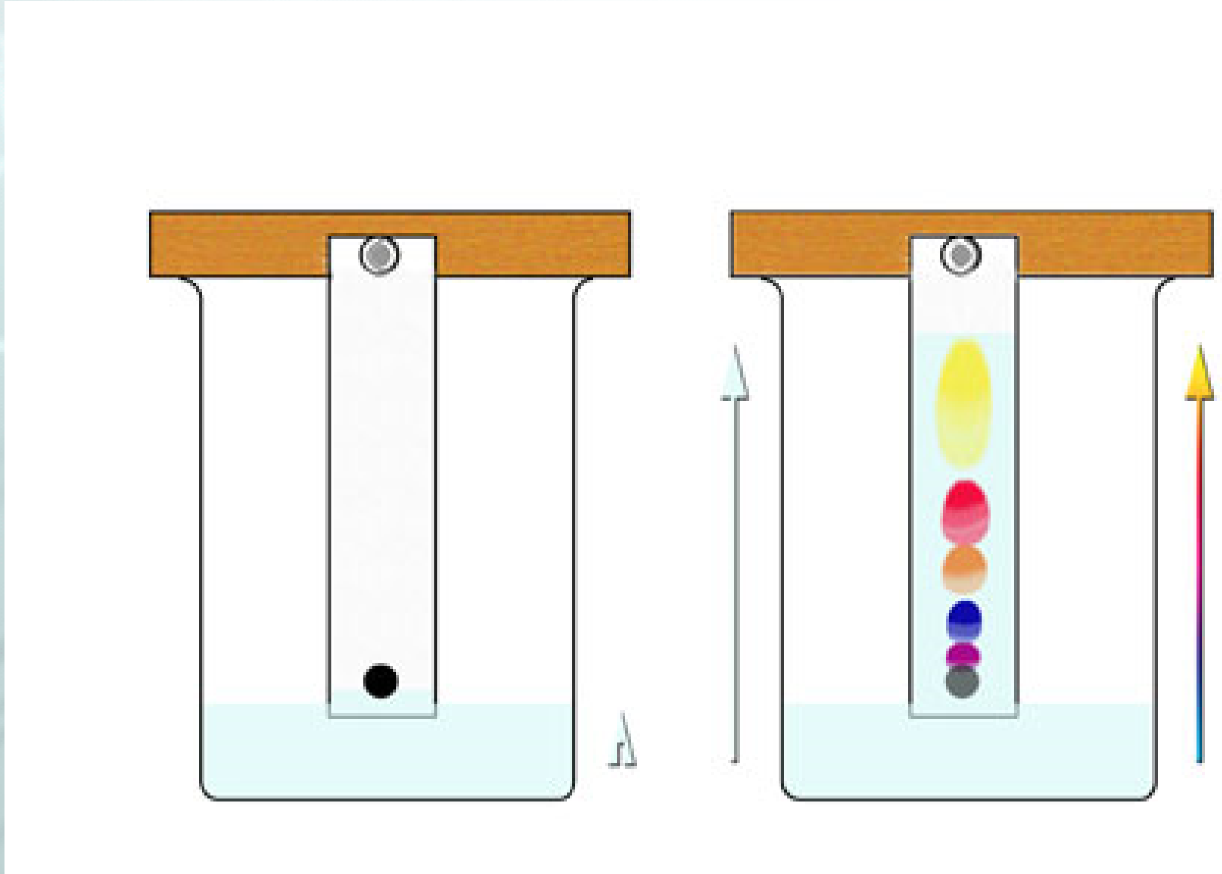
- A summary of the important findings of your observations.
- A description of the patterns, principles, relationships your results show. Explain how your results relate to expectations and to references cited. Explain any agreements, contradictions, or exceptions. Describe what additional research might resolve contradictions or explain exceptions.
- The theoretical implications of your results. Extend your findings to other situations or other species. Give the big picture: do your findings help us understand a broader topic.

http://guides.lib.purdue.edu/c.php?g=352816&p=2377942

# Year 3: plans

- Talk with lecturers about the centrality of communication to science
- Continue to meet (twice) with lab TAs to discuss peer reviews
- Try to retain the same marker for Discussion and Conclusion sections
- Expose students to written models earlier in the Fall
- Station two trained peer tutors in lab classes the days of peer review 1 (Introduction, Experimental, and Data and Results) and 2 (Discussion and Conclusion)

# The science



# Final Report: How to Write an Introduction, Experimental, Data & Results, Discussion, and Conclusion Section

The following information and examples were borrowed from *Scientific Writing in Organic Chemistry*. You may use these examples to help guide how you write your own introduction, discussion, and conclusion. These examples are relatively short and succinct; your own sections may be slightly lengthier in comparison. Nonetheless, your final report should be as concise as possible while addressing all critical information targeted toward an appropriate professional audience.

## Introduction

The purpose of the introduction is to…

(a) provide broad context and relevance for your study
(b) give specific scientific background and theory
(c) communicate the aims of the study

### General organization of an introduction section

1. Start by broadly explaining why the **reaction products** (or the **reactions** themselves) are important.
2. Describe **current methods** for synthesizing the products (or other **related knowledge**).
   a. *Please note that thin-layer and column chromatography are not synthetic studies. Instead, focus on the* ***gap in the literature*** *that your experiment(s) will fill. This may be done by placing the study within the context of the known literature.*
3. Focus the **background** to **convince** the reader the aim is worthy of investigation.
4. Finally, the **experimental aims** of the study are stated clearly and succinctly.

**Background & Theory → Context & Relevance → Aim**
(general) (specific)

Example: An investigative study.

The sugar attachments on biologically important glycosides are often essential to the biological function of these molecules. However, our understanding of the importance of sugars in biomolecules is limited by the availability of convenient sugar attachment strategies. Current sugar attachment strategies, called glycosylation reactions, include total synthesis[1] and enzymatic chemistry.[2] Total synthesis is very labor intensive because it requires many steps, including functional group protecting steps and sugar activation steps. Enzymatic strategies are also difficult; years of research must be spent developing, isolating, and purifying useful enzymes as catalysts. In addition, enzymatic synthesis can be complicated by the generation of byproducts that are extremely difficult to remove.[3]

**Comment [LM1]:** The author started by broadly explaining **why** the **reaction products** (or the **reactions** themselves) are important.

Secondary oxyamine glycosylation chemistry has emerged as a powerful new tool that addresses many of these shortcomings (Figure 1).[4] In oxyamine glycosylation, the molecule to be glycosylated (called an "aglycon") contains a secondary oxyamine, which reacts with *unprotected* and *unactivated* reducing sugars to form the corresponding glycosides in good yields.[5]

**Comment [LM2]:** Acknowledged the **gap in current literature** and placed the study within the **context of known literature**.