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# The Write Stuff: A Stations-Based Activity to Teach Scientific Reading, Writing, And Revision

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How do we induct our students into the culture of scientific reading and writing? In this lab activity, students move through stations to work on each component of a lab report, some through peer review and some through analyzing primary sources. Three stations incorporate a heuristic that students use to review their partner's writing, while three other stations ask students to review their knowledge of appropriate scientific titles, abstracts, and introductions. The activity also includes time for targeted instructor feedback on student writing.

**Keywords**: writing, primary source, lab report, peer review, revision

## Introduction

If students are not required to turn in a draft of their writing, often their "final draft" is in fact their first draft. In an introductory-level class, students often do not see the value in revision and may not have a clear idea of how to revise a draft. Based on Harris (2006), revision stations were developed for several sections of a scientific paper. The principle behind the revision stations is to have students use the revision heuristic to examine each other's papers critically. The students also gain direct exposure to the grading rubric at the revision stations, which helps them identify weaknesses in their own papers.

Introductory-level students also struggle with primary literature. The challenging vocabulary, concepts, and style of writing combine to make primary literature inaccessible to many students. Therefore, the primary literature stations in this activity are designed to reduce students' fear and increase their confidence in being able to get the main ideas from a scientific abstract. It also gives them practice in creating titles and in deciding what information would be important to include in an introduction.

Finding time in the classroom context to give students targeted feedback on their work is difficult. Therefore, this exercise incorporates a station where the instructor can answer student questions in small groups. The students must prepare their questions in advance so that the time is used wisely.

This exercise incorporates a station format, in which groups of students rotate among stations that have been set up in the classroom. A timer is used to keep track of when students should rotate. Why have the students move from station to station instead of sitting in one place for the whole activity? First, it breaks up the activity into more manageable pieces. Students get distracted more easily with a longer task, and some students have poor time management skills and will not finish the task in the time allotted. If students have a limited amount of time in which to complete each part, they stay on task better and complete the activity in a timely manner. Furthermore, students' attention is refocused every time they have to get up and move to the next station. This can be observed in the classroom, as after each rotation, the room gets quiet as students concentrate on their next task. Finally, the physical rotation with a timer prepares the students for the format of lab practicals, which feature stations through which the students must rotate with a time allotment at each station.

The abstracts used in this activity were all from BIOS, and were therefore written by undergraduates. I chose them for two reasons: one, they were slightly more accessible than many abstracts I found in the more formal scientific literature, and two, I found it helpful to point out to my students that these texts were written by people their age (and that the goal is therefore attainable). However, not all scientific papers are well-written! Good discussion can be generated by showing students examples of poorly written work and asking them to analyze why it is difficult for the reader to decipher.

According to post-lab survey results (N=99), over 88% of students reported learning tools to improve their

own writing and to read abstracts, and 85% reported being more confident in their ability to edit their own writing and read scientific literature after this lab. 98% reported that it was helpful to have small group time with the instructor to ask questions. Overall, although this was not the students' favorite lab exercise, both students and instructors agreed that it was helpful in teaching scientific writing.

## The Challenges of Peer Review

Peer review can be a challenging process to incorporate into paper writing. One major concern of instructors is that students will not give meaningful feedback to their friends, either because they do not know enough about writing or for fear of being "mean." At Washington College, we address these concerns in several ways. First, we have a peer review process followed by revision and instructor comments before the final draft is due. Because the instructor will comment on the paper, our instructors have less concern about students giving incorrect feedback or missing critical issues. Students are capable of basic feedback on items such as missing elements in a rubric, and in fact leaving the simpler feedback to peer reviewers allows the instructor to focus on deeper issues.

Second, we encourage peer reviewers to respond as readers rather than as writers. That is, we encourage their responses to focus on identifying writing that is difficult to understand. Instead of telling their peer how to rewrite their paper (which the reviewer may not know anyway!), the reviewer tells their peer which sections are murky. It's the writer's job to clearly convey their thoughts, it's the peer reviewer's job to tell the writer when their writing is unclear, and it's the instructor's job to inform the writer if the content of the writing is incorrect.

Third, we practice peer review on a near-weekly basis in the first semester of introductory biology, and we reinforce the concepts above. We peer review individual sections of a scientific paper, which takes up little time, while the instructors circulate and encourage dialogue before, during, and after this process. We also switch partners regularly so that students get feedback from multiple partners and can read many different students' papers. The peer review process is certainly not perfect, but the dialogue and learning generated by the process are powerful.

### *Learning Outcomes*

1. Introducing the difference between revising and editing, and giving students structured experience in reviewing other students' papers.
2. Exposing students to abstracts of primary literature articles and reducing fear and confusion over interpreting such articles.
3. Reviewing the title, abstract, and introduction portions of a lab report and what information belongs in each.
4. Giving the students an opportunity to ask targeted questions of the instructor and receive individual feedback.

### *Level and Time Required*

This exercise was designed to be used in an introductory biology class, when students are in the process of learning the format and requirements of a scientific paper.

Depending on the time allotted for each station, this activity can take 80-90 minutes (10 minutes per station) up to 140-150 minutes (18 minutes per station). If students are already somewhat familiar with the sections of a lab report and the process of peer review, the time can be shortened. If the students are less familiar with lab reports and peer review, more time is recommended.

Another possible way to use this activity is to do each station's activity as a portion of another lab exercise. The entire class could do a single station activity in 10-15 minutes with their small groups and discuss their findings.

*Note:* To do this activity, the students need to come to class with a draft of the Materials and Methods, Results, and Discussion sections of a scientific paper.

# Student Outline

## Science Writing Lab

Framing Question: How can you refine your science writing skills?

Guiding Questions:

I. (Reading/Writing) What is the difference between revising and editing?
II. (Reading/Writing) Peer review your materials and methods, results, and discussion sections.
III. (Reading/Writing) Practice writing titles, abstracts, and introductions.

### Introduction

I. WHAT IS THE DIFFERENCE BETWEEN REVISING AND EDITING?

Fill out the chart below based on your instructor's presentation.

| **Revising** | **Editing** |
|---|---|
| | |

II. PEER REVIEW YOUR MATERIALS AND METHODS, RESULTS, AND DISCUSSION SECTIONS.

Instructions: Stations 1, 3, and 5 will guide you through peer reviewing the sections of the paper you have written so far. At station 7, your instructor will give you feedback on your lab report so far. Before you begin the stations, write down 2-3 specific questions you have for your instructor below: (e.g.,Should I discuss _____ in my Materials and Methods?)

III. PRACTICE WRITING TITLES, ABSTRACTS, AND INTRODUCTIONS.

Instructions: Stations 2, 4, and 6 will guide you through some practice in writing.

*Lab 2 Assignments*

You will turn in and peer review a ROUGH DRAFT of your title, abstract, and introduction during the next lab; you will then have an additional 10 days to get feedback from your instructor and improve your draft. The rubric below will be used to evaluate your final draft.

| Title | | | | | |
|---|---|---|---|---|---|
| Title uses the format "The effect of (independent variable) on (dependent variable) in (scientific name of organism including strain or subspecies; other identifying info)" | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Abstract | | | | | |
| Hypothesis, prediction and reasoning are clearly stated | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Methods are 2-3 sentences, but detailed enough to get a strong sense of the experiment | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Results are briefly summarized including numbers to back up statements | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Conclusion states a plausible and factually correct biological explanation for the results | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Abstract is 200-250 words and word count is included | | | 2-Completely | 1- Partially | 0- Not at all |
| Introduction | | | | | |
| Paraphrases brief overview of biology concepts from lab manual to provide context for experiment; lab manual is cited. | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Explains why the organism(s) used in the experiment were appropriate | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Hypothesis stated (general relationship that is being explored) | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| 1 sentence summary of techniques or methods used including mention of specialized equipment | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Experiment-specific prediction and reasoning stated; reasoning makes sense and is biologically correct | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Materials and Methods | | | | | |
| Gives complete taxonomic information (including genus and species, relevant strains or subspecies) of organisms used in the study | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Is completely written in past tense and in the student's own words; lab manual is cited as appropriate | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Describes procedures in sufficient detail that could be replicated, including statistical methods and any tools used | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |

| | | | | | |
|---|---|---|---|---|---|
| Results | | | | | |
| Text in results summarizes important trends, but does not interpret or explain them | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Data analysis table properly formatted, units identified, columns labeled, matches data collection table if present | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Table title is "The effect of (independent variable) on (dependent variable) in (organism)"; includes a table number and number of replicates; title above the table | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Figure legend-Title "The effect of (independent variable) on (dependent variable) in (organism)"; has number of replicates and figure number; legend below figure | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Figure properly formatted, no gridlines, axes labeled, appropriate data | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Figure legend-methods are brief, but descriptive of how data was obtained | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Figure legend- important trends are identified | | | 2-Completely | 1-Partially | 0-Not at all |
| Discussion | | | | | |
| Each result is explained fully and separately | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Explanation of results is based on correct biological principles | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Experimental weaknesses are discussed in 1-2 sentences and solutions are suggested | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Author concludes by suggesting applications or implications of this research (why should we care?) | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Literature Cited section | | | | | |
| Lab manual is cited; CSE formatting is used correctly | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Writing | | | | | |
| Style is appropriate to a scientific paper-formal tone, careful and correct use of terminology | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Typos, misspellings, grammar and usage errors minimized in the text | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Effectively used and incorporated revision suggestions in the final draft | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Sentences and paragraphs flow well and help the reader to follow the paper | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Overall, this work is at a sufficiently high level for an introductory biology class | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |

## Materials

- Copies of the student handout for each student
- Copies of the revision sheets (Appendix A), 1 per student, each placed at the appropriate station
- Signs with station text and abstracts (Appendix B); 8.5 x 11 clear stand-up photo frames work well as station signs
- If using electronic discussion boards, 1 laptop each at stations 2, 4, and 6; large chart paper and markers if not using electronic discussion
- A timer (projecting an online timer is an easy way to keep students on task)

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## Notes for the Instructor

### Summary

This is a stations-based activity to help students with revising, editing, and writing science lab reports. Students go through 7 stations. 3 stations involve structured peer review of Materials and Methods, Results, and Discussion sections that the students have already written. 3 sections use primary literature and involve analyzing an abstract, generating a title, and deciding what information should be in an introduction. The final station gives in-class time for the instructor to answer targeted student questions about their drafts. Students also post to online discussion boards at the stations about primary literature and discuss other groups' answers to finish the activity.

### Outline of the Activity

1) Introduction (5-10 minutes)
   a) Instructor introduces the difference between revision and editing; students add this information to the table in their handout. The information is as follows:
   b) Revising is:
      i) Rearranging, adding and subtracting ideas to make your writing better and clearer
      ii) Asks:
         (1) What's the project?
         (2) What works?
         (3) What else might be said?
         (4) What's next?
      iii) Done throughout the writing process
   c) Editing is:
      i) Fixing errors in grammar, spelling, punctuation
      ii) Fine-tuning and proofreading
      iii) Mostly done at the end of the writing process
   d) Instructor introduces the stations and the goals of the lessons.
   e) Instructor reviews strategies for reading primary source articles:
      i) DON'T PANIC!
      ii) Take it sentence by sentence. Try rephrasing each sentence in turn (or rewriting in your own words).
      iii) Look up words you don't know.
      iv) Don't worry about getting all of the details, worry about getting the big picture.

2) Stations (bulk of the time, total time depends on time per station)
   a) Set up the 7 stations around the room with signs denoting each one. Set up the appropriate matching handouts at the peer review stations. At the other stations, set out either chart paper and markers for students to answer questions, or a computer for students to answer on an online discussion board.
   b) Show students how the rotation of stations will progress.
   c) Students spend 10-18 minutes per station (shorter if your students are more familiar with peer review, longer if it's their first time, also depends on the length of your lab period. An 18-minute station length will just barely fit in a 2.5-hour lab period with introduction and conclusion time)
3) Wrap up/processing (10 minutes)
   a) Combine groups at stations 1/2, 3/4, and 5/6. Group 7 can be split up or choose a group to join.
   b) Student groups read the answers on the chart paper or discussion board
   c) Students discuss with their group:
      i) Which are the best answers and why?
      ii) What challenges did you face at this station?
      iii) What did you learn from this station that will help you in your own writing?
   d) Choose a spokesperson to share.
   e) (If using online discussion boards, you can project and discuss, or have groups discuss the station where they ended)
4) Instructor can collect or make copies of the students' peer review worksheets if desired.

## Helpful Hints and Possible Modifications

There are several ways in which this activity can be modified to suit the conditions of different institutions. First, the time needed can be modified simply by changing the available time for each station and, if needed, omitting a question or two from the station. If each station takes 10 minutes, the total activity will take about 85-90 minutes. Shortening the time is more feasible if students are more familiar with the processes of peer review.

Another answer to the question of time is to do the activity spread out among several labs, so that one or two stations are done and discussed by the entire class. Hence, one could integrate this content without giving up an entire lab period to the exercise.

This activity was designed in a situation where student teaching assistants are available to help answer questions at the stations, because the instructor must stay at the instructor station throughout the activity. If student teaching assistants are not available, one possible solution is to cut the instructor station from the activity. Another possible solution is to partner with the campus writing center and have a writing tutor attend the class to help facilitate student discussions.

Simply having a writing tutor visit your lab to introduce themselves (especially if they are a biology major) can greatly increase the number of students who use this important resource. After having tutors visit our classes, the number of visits to our Writing Center from biology students increased from 7 to 30 to 75 over 3 years.

If this is the first time the students have done peer review, they will need some coaching in the process. Knisely (2017) provides a good framework for students to understand the peer review process. The primary goal here is not to have perfect inter-rater reliability, but rather to expose students to the rubric and give them practice in looking for elements that should be included in their own papers. For some of them, it is the first time that they have truly examined the assignment rubric in detail. For further experience in giving and receiving feedback, students could take the time to review multiple other students' papers.

This activity gives students some experience in analyzing primary source abstracts. A further addition or modification to this activity would be to have students compare multiple abstracts side-by-side—perhaps a stronger example and a weaker example—to help them understand the factors that make writing better.

For further reading on teaching writing in general and in the science classroom, see Bean (2011), Knisely (2017), Schimel (2012), and Walvoord and Anderson (1998).

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## About the Author

Suzanne Thuecks received her B.A. in Interdisciplinary Science: Biology/Chemistry and French from Lawrence University and her Master of Arts in Science Education from the University of Iowa. After 11 years teaching science in grades 8-12, she became an Instructor and Lab Coordinator for the introductory

sequence for majors at Washington College. She was the recipient of an ABLE Charlie Drewes grant in 2015. Her interests include the teaching of science writing and college-level teacher training and mentoring.

# Appendix A
# Student Handouts for Stations

Station 1: Materials and Methods and Citations review
Reviewer: _____ Paper written by: _____

Give your partner a score in each category AND a rationale for your score.

| Materials and Methods | | | | | |
|---|---|---|---|---|---|
| Gives complete taxonomic information (including genus and species, relevant strains or subspecies) of organisms used in the study | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Is completely written in past tense and in the student's own words; lab manual is cited as appropriate | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Describes procedures in sufficient detail that could be replicated, including statistical methods and any tools used | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Literature Cited section | | | | | |
| Lab manual is cited; CSE formatting is used correctly. | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |

1. What's the project? Summarize the basic materials and methods of this report or write down 1-2 sentences from the report that summarize the methods well.

2. What works? Provide some comments about what is good in this section.

3. What else could be said? Do you agree with the way the writer has presented the critical details? Are there other details you expect to see that the writer should consider?

4. What's next? Help the writer prioritize 1-2 things to work on for the next draft.

5. What did you learn from reading your partner's paper that will help you in revising your own paper?

Station 3: Results review
Reviewer: _____ Paper written by: _____

Give your partner a score in each category AND a rationale for your score.

| Results | | | | | |
|---|---|---|---|---|---|
| Text in results summarizes important trends, but does not interpret or explain them | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Data analysis table properly formatted, units identified, columns labeled, matches data collection table if present | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Table title is "The effect of (independent variable) on (dependent variable) in (organism)"; includes a table number and number of replicates; title above the table | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Figure legend-Title "The effect of (independent variable) on (dependent variable) in (organism)"; has number of replicates and figure number; legend below figure | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Figure properly formatted, no gridlines, axes labeled, appropriate data | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Figure legend-methods are brief, but descriptive of how data was obtained | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Figure legend- Important trends are identified | | | 2-Completely | 1-Partially | 0-Not at all |
| Rationale: | | | | | |

1. What's the project? Summarize the main points in your partner's results section.

2. What works? Provide some comments about what is good in this section.

3. What else could be said? Do you agree with the way the writer has presented the critical details? Are there other details you expect to see that the writer should consider?

4. What's next? Help the writer prioritize 1-2 things to work on in this section for the next draft.

5. What did you learn from reading your partner's paper that will help you in revising your own paper?

Station 5: Discussion review
Reviewer: _____ Paper written by: _____

Give your partner a score in each category AND a rationale for your score.

| Discussion | | | | | |
|---|---|---|---|---|---|
| Each result is explained fully and separately | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Explanation of results is based on correct biological principles | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Experimental weaknesses are discussed in 1-2 sentences and solutions are suggested. | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |
| Author concludes by suggesting applications or implications of this research (why should we care?) | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Rationale: | | | | | |

1. What's the project? Summarize your partner's Discussion section below.

2. What works? Provide some comments about what is good in this section.

3. What else could be said? How might someone argue with this person's interpretation of their results?

4. What's next? Help the writer prioritize 1-2 things to work on for the next draft.

5. What did you learn from reading your partner's paper that will help you in revising your own paper?

# Appendix B
# Station Text

## Station 1—Materials and Methods

1. Read each other's Materials and Methods section while completing one of the review sheets at this station. (Do not write on your partner's paper!) Remember to revise, not edit.
2. Discuss your ratings and your review with your partner.

## Station 2—Titles

1. Read the abstract at the station.
2. Together, discuss the experiment using these questions:
   a. What was the goal?
   b. What did the experimenters do?
   c. What did they find out?
   d. What is the significance?
3. Without looking at previous groups' work, write on the chart paper or online discussion board a list of key words that should appear in the title. Think about what someone might use in a search if they wanted to find this article.
4. Write a title for this article on the online discussion board or chart paper, using the list of key words that you have written. If on chart paper, fold the paper so that your title is hidden.
5. With any remaining time you have at this station, write a title for <u>your</u> paper following the title guidelines in the rubric below. Discuss with your partner.

| Title | | | | | |
|---|---|---|---|---|---|
| Title uses the format "The effect of (independent variable) on (dependent variable) in (scientific name of organism including strain or subspecies; other identifying info)" | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |

*Abstract for Station 2*

Create a title for the following abstract from Blankinship and Bullard-Burchim (2015).

*Clostridium difficile* is a gram positive spore forming bacteria that is the primary cause of antibiotic associated diarrheas in the United States and Europe. The prevalence of *C. difficile* infections (CDI) in hospitals and long term care facilities has increased over the past decade and now represents a serious threat to patient health. Because *C. difficile* infections are caused by antibiotic therapy, alternative means of treatment are of interest. This study investigates the prevalence of *C. difficile* infection in three community hospitals and one research hospital and compares hospital prevalence data to state averages for Alabama and Mississippi and the national average. It was found that one community hospital exceeded the national average while two community hospitals and the research hospital were less than the national average of CDI. Both the standard infection ratio for *C. difficile* for Alabama and Mississippi were less than the national average. Data for January 1, 2013 – June 3, 2013 are included. To better control CDI, the Centers for Disease Control and Prevention (CDC) recommends better antibiotic stewardship, training for clinical pharmacists, and limited prescription of antibiotics for hospital and long term care facility patients. Alternative treatments for recurrent or non-responsive *C. difficile* infections include transplantation of fecal microbiota and probiotics. Several vaccines for *C. difficile* are currently under development or in clinical trials.

## Station 3—Results

1. Read each other's Results section while completing one of the review sheets at this station. (Do not write on your partner's paper!) Remember to revise, not edit.

2. Discuss your ratings and your review with your partner.

## Station 4—Abstracts

1. Read abstract at the station.
2. Together, discuss the experiment using these questions:
   a. What was the goal?
   b. What did the experimenters do?
   c. What did they find out?
   d. What is the significance?
3. Write your group's answers to the questions above on a chart paper page.
4. Flip the chart paper.
5. If you have additional time at this station, begin to write your abstract for your paper. Remember the criteria for your abstract as stated below:

| Abstract | | | | | |
|---|---|---|---|---|---|
| Hypothesis, prediction and reasoning are clearly stated | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Methods are 2-3 sentences, but detailed enough to get a strong sense of the experiment | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Results are briefly summarized including numbers to back up statements | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Conclusion states a plausible and factually correct biological explanation for the results | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Abstract is 200-250 words and word count is included | | | 2-Completely | 1- Partially | 0-Not at all |

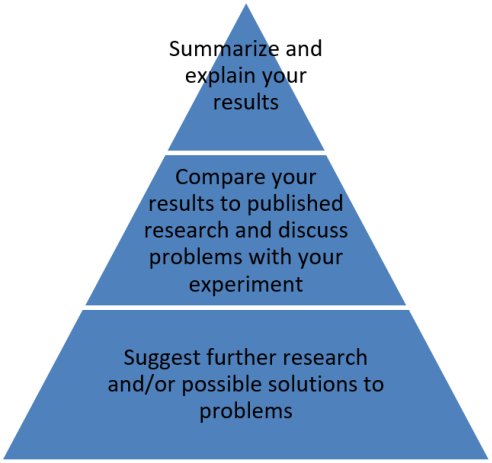
### *Abstract for Station 4*

Summarize the main points in this abstract from Hutchinson and Kellam (2015).

Anting is a curious behavior that has been recorded in over 200 species of songbirds. While anting, a bird will wipe several ants throughout its plumage. It has been proposed that birds select ants for their ability to spray formic acid, a chemical that is known to have antibacterial properties at high enough concentrations that may help to limit the growth of feather bacteria. To test this hypothesis, two blue jays (*Cyanocitta cristata*) were provided with daily rations of either ants capable of ejecting formic acid (black carpenter ants, *Camponotus pennsylvanicus*) or ants incapable of ejecting formic acid (Western harvester ants, *Pogonomyrmex occidentalis*). After 26 daily sessions, it was found that a significantly higher percentage of black carpenter ants were used for anting when compared to the percentage of Western harvester ants. In the second part of the study, feathers inoculated with the common feather bacterium *Bacillus licheniformis* were treated with black carpenter ants to determine if the formic acid contained within these ants was at a high enough concentration to inhibit bacterial growth. A comparison between the mean number of *B. licheniformis* colonies on treated feathers with the mean number of *B. licheniformis* colonies on untreated feathers did not indicate that the formic acid sprayed by the ants had a significant impact on the growth of the bacteria. In conclusion, it appeared that formic acid is the trigger for the anting behavior but formic acid sprayed by ants does not have a significant antimicrobial effect against *B. licheniformis*. This suggests that there must be another function for the anting activity.

### Station 5—Discussion

1. Read each other's Discussion section while completing one of the review sheets at this station. (Do not write on your partner's paper!) Remember to revise, not edit.
2. Discuss your ratings and your review with your partner.

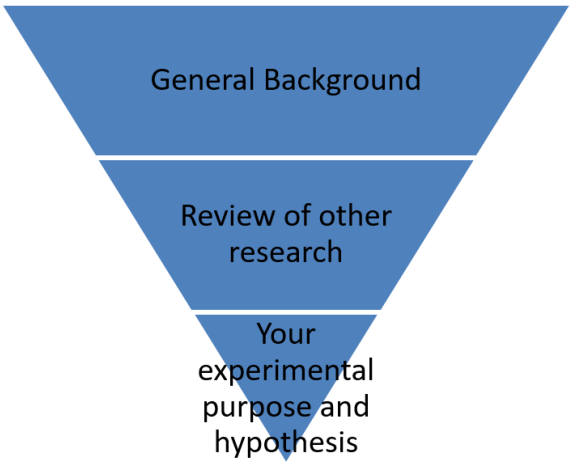



**Structure of the Discussion**
**Specific to General**
**(Knisely, 2017)**

### Station 6—Introductions

1. Read and discuss the abstract at the station.
2. Make a list of what you think should appear in the introduction to this paper:
   a. What was the goal of the experiment?
   b. What biology concepts or key terms would need to be explained for the reader to understand the experiment?
3. Write your answers on a piece of the chart paper and flip the paper to the next page.
4. If you have extra time at this station, brainstorm with your partner what ideas should be included in the introduction to the paper you are writing; begin writing if you have time. Remember the criteria as stated below:

| Introduction | | | | | |
|---|---|---|---|---|---|
| Paraphrases brief overview of biology concepts from lab manual to provide context for experiment; lab manual is cited. | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Explains why the organism(s) used in the experiment were appropriate | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Hypothesis stated (general relationship that is being explored) | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| 1 sentence summary of techniques or methods used including mention of specialized equipment | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |
| Experiment-specific prediction and reasoning stated; reasoning makes sense and is biologically correct | 4-Completely | 3-Mostly | 2-Somewhat | 1-Very little | 0-Not at all |




**Structure of the Introduction General to Specific (Knisely, 2017)**

*Abstract for Station 6*

What should be in the introduction to this paper from Gerber *et al.* (2015)?

Controversy exists in the clinical setting as to whether blood pressure (BP) should be taken on only the left arm. It is also not known whether inter-arm BP differences exist when subjects are in varying static body positions. The purpose of this study was to examine whether BP differences exist between right and left arms when male or female subjects were in different static body positions. Young (18-29 years old), healthy, athletic male (n = 10) and female (n = 10) subjects were used to obtain BP using standard auscultation in the right and left arms in the following different body positions: standing, sitting, and supine. Respiratory rate was set at 17-23 bpm for each subject and heart rate was monitored using a pulse transducer. Neither body position nor arm used influenced systolic BP in males and females, and the diastolic pressure in females ($p > 0.05$). However, in males, the diastolic BP in standing position was significantly higher ($p < 0.05$) than in supine position both in the right arm ($85 \pm 3.3$ mmHg vs. $74 \pm 2.0$ mmHg) and in the left arm ($88 \pm 3.0$ mmHg vs.$75 \pm 2.0$ mmHg). Our findings suggest that young, healthy, and athletic adults do not experience inter-arm BP differences and that the effect of body position is sex specific.

### Station 7—Instructor feedback

At this station, the instructor will answer your questions about your draft.

## Mission, Review Process & Disclaimer

The Association for Biology Laboratory Education (ABLE) was founded in 1979 to promote information exchange among university and college educators actively concerned with teaching biology in a laboratory setting. The focus of ABLE is to improve the undergraduate biology laboratory experience by promoting the development and dissemination of interesting, innovative, and reliable laboratory exercises. For more information about ABLE, please visit **http://www.ableweb.org/.**

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## Citing This Article

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