

MARCH 6, 2021

# THE SEVEN “Cs” OF SCIENCE WRITING: AN ACT-SO WORKSHOP

CHERYL DRUGAN

KEVIN A. BROWN

JARED SAGOFF

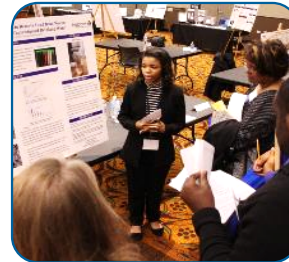
Argonne National Laboratory



# WELCOME!

During today's workshop, our goal is to help you:

- Plan your report.
- Meet report requirements.
- Learn tips to improve your writing.
- Locate resources for additional help.
- Prepare you to work with our team on your draft report.



# SETTING THE STAGE



J'Tia Hart  
Program Lead  
Strategic Security Sciences  
Argonne National Laboratory

#BlackHistoryMonth



Your weaknesses are your strengths applied to the wrong problem / setting. To truly achieve professionally, you need to know yourself.

Argonne  
NATIONAL LABORATORY

# BEFORE YOU START WRITING: ASK THE BIG QUESTIONS!





# “SAILING THE SEVEN Cs”

## of Quality Writing

1. Concrete
2. Clear
3. Concise
4. Compelling
5. Context
6. Correct
7. Consistent



# CONCRETE, CLEAR, CONCISE

## Help your readers understand by making your writing:

- **Concrete:** Write with precision (heat to 350°F vs. heat as long as needed).
- **Clear:** Present information so all readers can understand.
- **Concise:** Focus on “word economy” – find simpler ways to write what you need to say (“Because” is better than “Due to the fact that...”).

**Pop Quiz:** *Is the quoted text – which is REAL – concrete, clear, and concise?*

*“This is explained by the fact that the heat exchanges convectifs internal in the Sensor between air and the cells improved, when the distance between absorber and insulating plate, decreases.”*

# COMPELLING

## Engage your readers by making your writing:

- **Compelling:** Make your writing interesting – understand what your readers need to know and write to them.
- Readers want to find information **QUICKLY**, and so if you make it easy for them, they will be more compelled to read your report or paper.
- **Active vs. Passive Voice:** Use active voice wherever possible. There is no universal rule; follow guidelines set by the publisher or your school/organization.
  - **Active:** Direct accountability and is natural, vigorous, emphatic; sometimes viewed as breaking with scientific tradition (*“We prepared samples by...”*).
  - **Passive:** Indirect accountability; sometimes viewed as less credible (*“Samples were prepared by...”*).

# CONTEXT

Help your readers appreciate the value of your research by providing context.

- In the abstract, summary, and introduction, state the impact of the research on your research field, the scientific community, and society.
- Answer the questions: Why did I do the research? Why is it relevant to my readers?

**Pop Quiz:** *Does the quoted text provide context?*

*“The objectives were to determine the extent to which changes in fuel composition affect emissions.”*



# CORRECT AND CONSISTENT

Focus on quality by ensuring your writing is:

- **Correct:** Check spelling, grammar, punctuation – ask others to read your paper.
- **Consistent:** Focus on format, font, tables and figure style, reference callouts and lists, abbreviation/acronym use, spelling, capitalization, hyphenation, units, messaging.



**Key Takeaway:** *Your report represents you and your organization, so it pays to invest in preparing a quality document.*

# READY TO WRITE



**Kevin Brown**  
Postdoctoral Appointee  
Leadership Computing Facility  
Argonne National Laboratory

#BlackHistoryMonth

“There IS something you can do better than everyone else. Seek help when you must, but keep moving forward until you find it. Never stop trying to realize the full awesomeness of who you are and what you can do.”

Argonne  
NATIONAL LABORATORY



Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

# STRUCTURE OF A SCIENTIFIC PAPER

Relates your experiments to something that others can understand, repeat, and expand on with future work.

Experimental process	Section of Paper	
What did I do in a nutshell?	<a href="#">Abstract</a>	
What is the problem?	<a href="#">Introduction</a>	Purpose
How did I solve the problem?	<a href="#">Materials and Methods</a>	Procedure
What did I find out?	<a href="#">Results</a>	Data, Analysis
What does it mean?	<a href="#">Discussion</a>	Conclusions
Who helped me out?	<a href="#">Acknowledgments</a> (optional)	
Whose work did I refer to?	<a href="#">Literature Cited</a>	References Bibliography
Extra Information	<a href="#">Appendices</a> (optional)	

<http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWsections.html>

# ABSTRACT (SHOULDN'T BE “ABSTRACT”)

An abstract is a one-paragraph summary of an entire report or paper that provides a quick look at your research. An abstract typically includes:

- Introduction – objective(s)/goal(s); context/background
- Methods
- Results
- Key conclusions/recommendations
- Exemplifies the 7 “Cs”



**Note:** *Although found in all major research papers/journals, an abstract is not required for ACT-SO papers, but it should be included in your scientific poster.*

# ABSTRACTS ARE ALL ABOUT...

- Concisely introducing your research.
- Helping readers understand your research and what they can expect to find in the full document.
- Engaging readers so they will want to learn more.
- Setting the stage for the main document.

Why?

Who  
Cares?

What am I  
doing?

What did I  
find?

What's  
Next?

# PURPOSE OR INTRODUCTION

- Provides the background and CONTEXT needed for your reader to understand your paper.
- Explains why this topic is important and interesting to study, i.e., is COMPELLING.
- Helps the reader understand the connection between your particular research question and a larger issue facing science or society.
- Uses references to cite information.

**Tip:** *Cite books and journal articles more often than websites or personal communications.*



# ACT-SO SCIENCE GUIDELINES: HYPOTHESIS

- A hypothesis ***MUST*** be included in your research report and on your science project presentation board. A hypothesis is a term that means making a prediction. It's an educated guess about the outcome of your experiment.
- You must state your hypothesis in a way that you can readily measure:
  - **State why you think your hypothesis is correct.**
    - Use the “if, then” format.
    - Say why you believe your prediction will be correct.
- Include the hypothesis in the main text of your purpose section, or put it under its own heading.

# MATERIALS AND METHODS/PROCEDURE

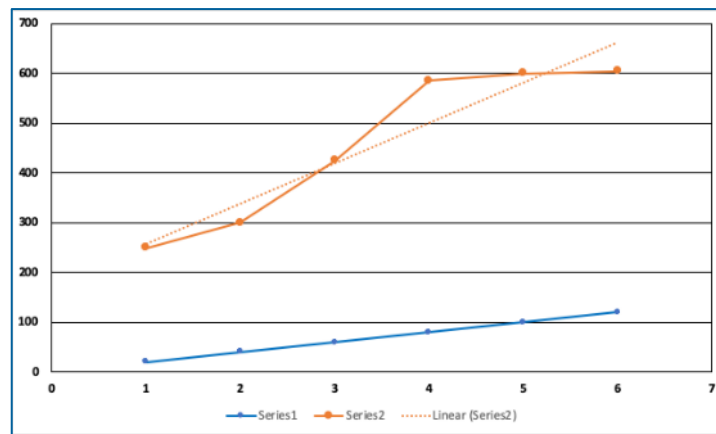
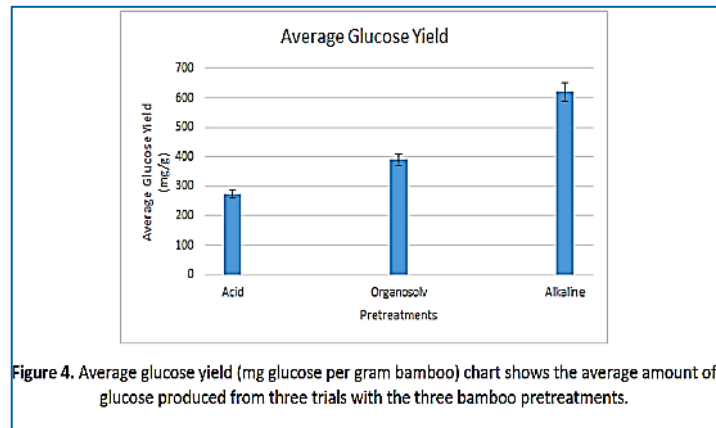
- Materials:
  - Include all the supplies used in your experiment.
  - Can be a list or table format.
  - Use metric system.
- Methods/Procedure:
  - What did you do in your experiment?
  - Should be written in sentences.
  - Should be clearly written and provide sufficient detail so that others can reproduce your work.

# DATA OR RESULTS

- Include your most important results in a summary format.
  - More detailed results can be included in **Supporting Documents**.
- Can include tables, graphs, charts – give them titles, figure legends, etc.
  - ***Always, always, always specify your units on any chart, table, or graph you present.***
- Should also include statistical analyses, calculations, or other direct analysis of data.

# DATA TIPS

- **DO** label graphs appropriately.
  - Title
  - Axes
  - Units
- **DO** use error bars.
- **DO** provide a descriptive figure caption.
- **DO** refer to figures within the body of your paper.
- **DON'T** forget to label axes or provide a title and figure caption.
- **DON'T** use trend lines that don't make sense.
- **DON'T** leave in the default data labels from your graphing program.



# RESULTS AND ANALYSIS OR DISCUSSION

- Written section to elaborate on interesting findings from your data:
  - Use statistical analysis to guide discussion when possible
  - Consult your mentor to discuss results
- Discuss the general trends, exceptions, and reason for exceptions in your data.
- Explain why you think these exceptions may have happened.

# CONCLUSION

- Summary of results:
  - Not meant to repeat your discussion section.
  - Tells why results are significant – again provides COMPELLING CONTEXT.
- Hypothesis check – allows you to evaluate whether you proved or disproved your hypothesis.
  - Very important in ACT-SO papers.
- Ideas for future experiments, improved project design, etc.



# SUPPORTING DOCUMENTS

- Maintain same standards as you used in the main paper.
- Put all the extra data that you have collected and elaborate on procedures and experimental details in this section.
- Use tables, figures, graphs, etc.
- Give everything an organized flow with labels, figure legends, and titles.

# SUMMARY: PAPER WRITING DO'S AND DON'Ts

## ▪ DO

- Find the larger context for your research question.
- Develop a strong hypothesis.
- Write CLEARLY – short declarative sentences are typically better.
- Avoid overly technical words if possible (jargon).
- Stay focused on your particular research question – be CONCRETE.
- Keep the length of the main paper to 5 pages.

## ▪ DON'T

- Go into detail about materials and methods in abstract or introduction.
- Assume your readers know if your hypothesis is validated.
- Lose sight of the ultimate impact of your experiment, even if it seems insignificant at this point.

# PAPER WRITING REFERENCES

- <http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWsections.html>
- <https://www.elsevier.com/connect/infographic-tips-to-writing-better-science-papers>
- <http://www.columbia.edu/cu/biology/ug/research/paper.html>
- [http://www.sciencebuddies.org/science-fair-projects/project\\_final\\_report.shtml](http://www.sciencebuddies.org/science-fair-projects/project_final_report.shtml)
- <http://dupageact-so.org/olympics/Guidelines/Science.pdf>

***Always proofread your paper—and each other's papers!***



# FINAL THOUGHTS



Argonne National Laboratory is a  
U.S. Department of Energy laboratory  
managed by UChicago Argonne, LLC.

# Q&A/DISCUSSION

- Any questions?





# AN INVITATION

## Need Help?


For further guidance and review of your report, send us your draft by March 19<sup>th</sup>.

- Cheryl Drugan ([cdrugan@anl.gov](mailto:cdrugan@anl.gov))
- Jared Sagoff ([jsagoff@anl.gov](mailto:jsagoff@anl.gov))
- Kevin A. Brown ([kbrown@anl.gov](mailto:kbrown@anl.gov))

Writing Center of Excellence  
Communications and Public Affairs

## SCIENTIFIC WRITING


Useful tips to help you write better research papers



---

### Title


Keep the title simple and specific to describe the content — but not so technical it cannot be easily understood. Try to be concise.



---

### Abstract


The abstract is short, but remember not to cram as much detail into it as possible. You want to grab the reader's attention with the first statement.



---

### Introduction


When writing the introduction, pick out the things that are most relevant to your work and explain why. Present the background of your work while focusing on the most important issues.



---

### Results and Discussion

- ✓ Make your R&D concise but informative.
- ✓ Focus on the important parts, not the small details.
- ✓ Remember that discussion of unexpected results is often as valuable as focusing on the expected findings.



---

### References

- ✓ Make sure that your reference section is up to date by including current literature.
- ✓ Make use of reference management software! It will save you much time.

