

I USED TO HATE WRITING ASSIGNMENTS, BUT NOW I ENJOY THEM.



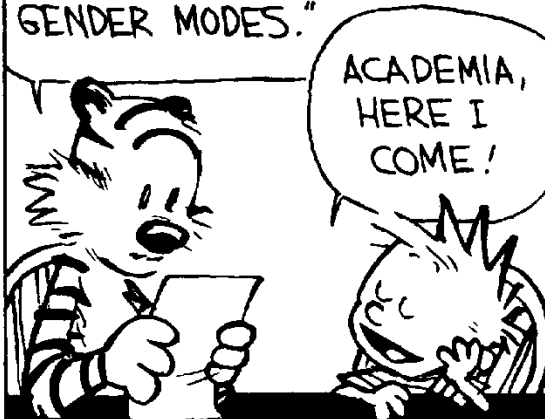
I REALIZED THAT THE PURPOSE OF WRITING IS TO INFLATE WEAK IDEAS, OBSCURE POOR REASONING, AND INHIBIT CLARITY.



WITH A LITTLE PRACTICE, WRITING CAN BE AN INTIMIDATING AND IMPENETRABLE FOG! WANT TO SEE MY BOOK REPORT?



"THE DYNAMICS OF INTERBEING AND MONOLOGICAL IMPERATIVES IN *DICK AND JANE*: A STUDY IN PSYCHIC TRANSRELATIONAL GENDER MODES."



ACADEMIA, HERE I COME!

WATSON

# Writing Across the Curriculum:

## Myths, Challenges, and A Big Idea

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September 17, 2014

Envisioning undergraduate education at  
**The Reinvention Center**



- WTL Working group

- Biology = 2
- Chemistry = 3
- Education = 1
- Engineering = 2
- Physics = 1
- Psychology = 1
- Writing = 2



- Workshop = 80 STEM faculty

	Biology/ Life Sciences	Chemistry	Engineering	Math/Computer Science/ Statistics	Physics/ Earth Sciences
Content knowledge					
Conceptual understanding					
Scientific method					
Critical thinking					
Effective communication					
Metacognition					
Professionalization					

	Biology/ Life Sciences	Chemistry	Engineering	Math/Computer Science/ Statistics	Physics/ Earth Sciences
<b>Content knowledge</b>	Intro Advanced <b>Capstone</b>	Intro Advanced Capstone	Intro Advanced Capstone	Intro Advanced Capstone	Intro Advanced <b>Capstone</b>
<b>Conceptual understanding</b>	Intro Advanced <b>Capstone</b>	Intro Advanced <b>Capstone</b>	Intro <b>Advanced</b> Capstone	Intro Advanced <b>Capstone</b>	Intro Advanced <b>Capstone</b>
<b>Scientific method</b>	Intro Advanced <b>Capstone</b>	Intro Advanced <b>Capstone</b>	<b>Intro</b> Advanced <b>Capstone</b>	<b>Intro</b> <b>Advanced</b> <b>Capstone</b>	<b>Intro</b> Advanced <b>Capstone</b>
<b>Critical thinking</b>	Intro Advanced <b>Capstone</b>	Intro Advanced Capstone	Intro Advanced <b>Capstone</b>	Intro Advanced Capstone	Intro Advanced <b>Capstone</b>
<b>Effective communication</b>	<b>Intro</b> Advanced <b>Capstone</b>	Intro Advanced Capstone	Intro Advanced Capstone	Intro Advanced Capstone	<b>Intro</b> Advanced <b>Capstone</b>
<b>Metacognition</b>	Intro Advanced <b>Capstone</b>	Intro <b>Advanced</b> <b>Capstone</b>	Intro Advanced Capstone	Intro <b>Advanced</b> <b>Capstone</b>	Intro <b>Advanced</b> <b>Capstone</b>
<b>Professionalization</b>	Intro Advanced <b>Capstone</b>	Intro Advanced Capstone	Intro Advanced Capstone	Intro <b>Advanced</b> Capstone	<b>Intro</b> Advanced <b>Capstone</b>

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- Goldberg, R., K. Caves, and J.A. Reynolds, *Improving the quality of writing in a capstone engineering design course*, Proceedings of the ASEE National Conference (2011), American Society for Engineering Education [[fetch](#)] [[abs](#)].
- Reynolds, JA, *When communicating science to the public, use VELCRO to make science stick*, Bulletin of Ecological Society of America, vol. 90 no. 3 (2009), pp. 297-304 [[297](#)] [[abs](#)].
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- Reynolds, JA, and C. Moskovitz, *Calibrated Peer Review™ assignments in science courses: Are they designed to promote critical thinking and writing skills?*, Journal of College Science Teaching, vol. 38 no. 2 (2008), pp. 60-66 [[abs](#)].
- Reynolds, JA, and V. Russell, *Can You Hear Us Now?: A comparison of peer review quality when students give audio versus written feedback*, Writing Across the Curriculum Journal, vol. 19 (2008), pp. 29-44 [[pdf](#)] [[abs](#)].

# **Myths about writing and science**

**Myth #1:  
The last step  
in your research is  
“writing it up”**

**write it up**

**do research**

**formulate  
problems**

**plan and execute  
experiments**

**analyze data**

**draw  
conclusions**





Re-write for another audience

Correspondences

**do research**

Lab notebooks

Incorporate reviewer's comments

**formulate problems**

**submit manuscript**

Drafts

**experiments**

**write it!**

Lab notebooks

**analyze data**

**draw**

Drafts

**conclusions**



# The reality:

- Writing is central to the scientific process
- We often deepen our thinking through our writing
- Writing is so hard because “our ambiguities become starkly revealed”

“I don't know what I think until I write it down.” - Joan Didion

**Myth #2:  
Published scientific  
articles represent  
“good” writing**

*Science* 2006 311(5767):1580 - 1583

“Although nature's choice is to chemically power the diverse muscles of her design with a high–energy-density fuel, humankind has largely taken another route.

*Science* 2006 311(5767):1580 - 1583

“Although **nature's choice** is to chemically power the diverse muscles of her **design** with a high–energy-density fuel, humankind has largely taken another route.

## *Science* 2006 311(5767):1580 - 1583

“Although nature's choice is to chemically power the diverse muscles of her design with a high–energy-density fuel, humankind has largely taken another route. **In those systems,** electrical energy is typically converted to mechanical energy by means of motors, hydraulic systems, or piezoelectric, electrostrictive, or electrochemical actuators (1–9).

## *Science* 2006 311(5767):1580 - 1583

“Although nature's choice is to chemically power the diverse muscles of her design with a high–energy-density fuel, humankind has largely taken another route. In those systems, electrical energy is typically converted to mechanical energy by means of motors, hydraulic systems, or piezoelectric, electrostrictive, or electrochemical actuators ([1](#)–[9](#)). Because of high electrical power needs, some of the most athletically capable robots cannot freely prance around because they are wired to a stationary power source.”

# The reality:

- Good science will be published as long as it is more-or-less readable
- Reviewers are scientists
- Scientists who have an inherent interest in the subject matter will automatically fill in the gaps of poorly written articles



**Myth #3:**  
**Strong students →**  
**strong writers**

# Student writing

“Increased catecholamine outflow from this system induces sustained elevated activation of the  $\beta$ -adrenergic receptor ( $\beta$ -AR) which results in abnormalities in the  $\beta$ -AR signaling system that may ultimately lead to the pathogenesis of congestive heart failure (CHF).”

## Revision

“On the path to congestive heart failure (CHF), the heart attempts to preserve cardiac output by increasing activation of the  $\beta$ -adrenergic receptor ( $\beta$ -AR).”

# The reality:

- Students need guidance regarding the conventions and lexicon of our discipline

**Myth #4:**  
**The best way  
to teach students to  
write is to “fix” their  
writing**

Although some of the loans did achieve their intended aims, many went to the funding of large projects that were not well-matched to the needs of the countries in which the projects were undertaken. Moreover, the funds intended for development projects often were diverted either to local elites or to the operations of military dictatorships. Many of the loans had been made at floating interest rates, so their repayment became very difficult when worldwide interest rates rose circa 1980. Repayment was made even more difficult by falling commodity prices and by the fact that the loans themselves had often not been put to any productive use.

What has to happen for learning to occur?

1. Students must determine why a change was made
2. Students must ask “Does the professor’s choice consider my purpose?”
3. Students must ask “What other choices are there?”
4. Student must extrapolate to another writing context

# The reality:

- Co-authoring takes away students' writing choices

**Myth #5:  
Students readily  
transfer writing skills  
from one context to  
another**

# The reality:

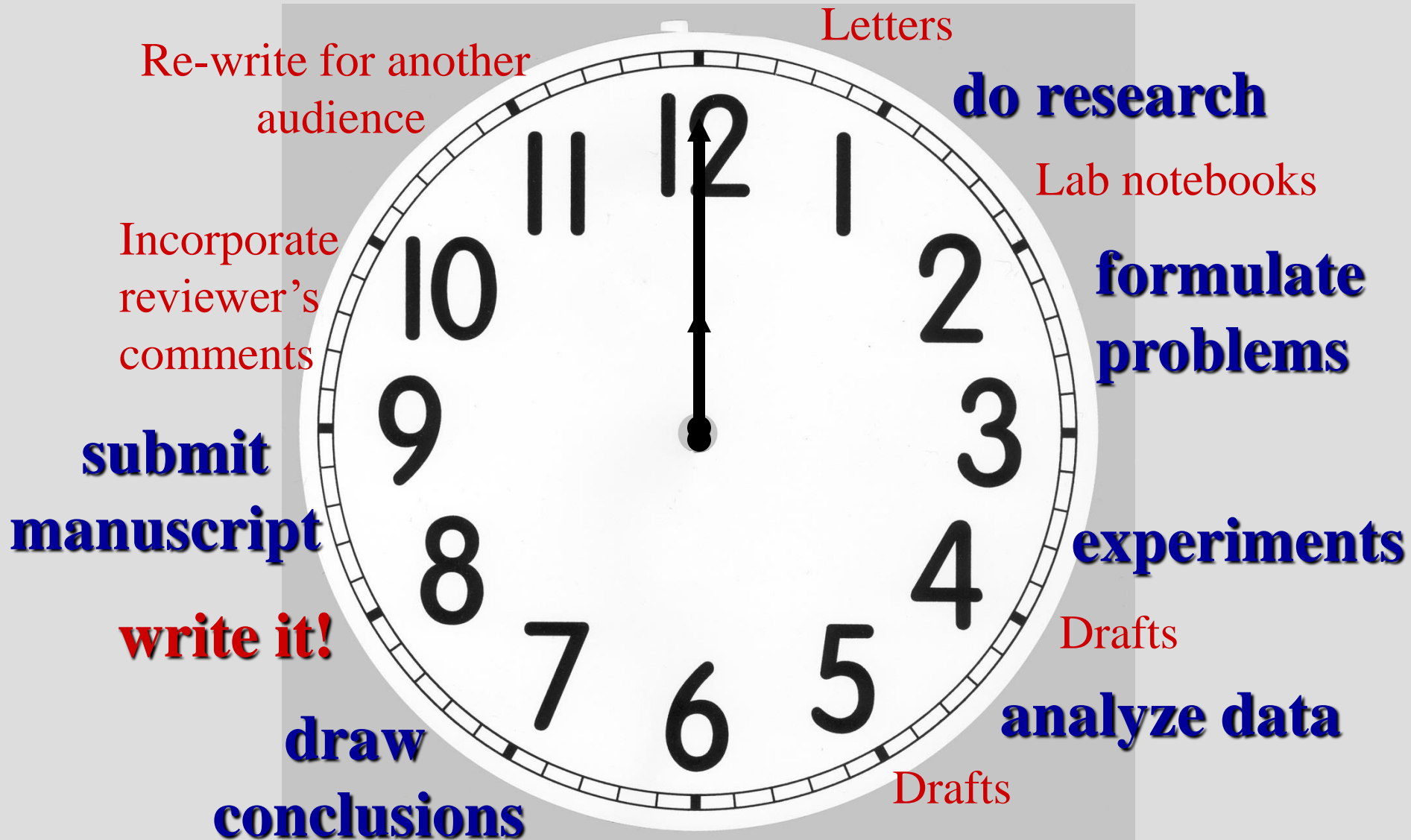
- Unless students engage fully in the writing process, they will not transfer
- The iterative nature of writing deepens engagement and thinking
- Writing triggers underlying mechanisms of effect



# Challenges of writing across the curriculum

**Challenge #1:  
Students need more  
opportunities to write**

# Scientists are always writing...



# ...but are our STEM majors?

**“W” course**

**Freshman writing**



**“W” course**

**Challenge #2:  
Students need exposure  
to different genres of  
writing**

- Abstracts and summaries
- Lab notebooks, field journals, etc.
- Laboratory reports (using IMRaD)
- Supported position paper/opinion piece
- Research proposal
- Reviews
- Journal manuscript, book chapter, etc.

**Challenge #3:  
Students need  
engagement in the  
writing process**

# Writing as a process

Step 1: Pick a topic, audience, genre, style

Step 2: Organize ideas

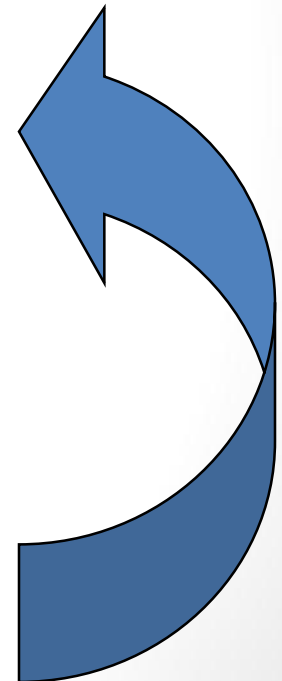
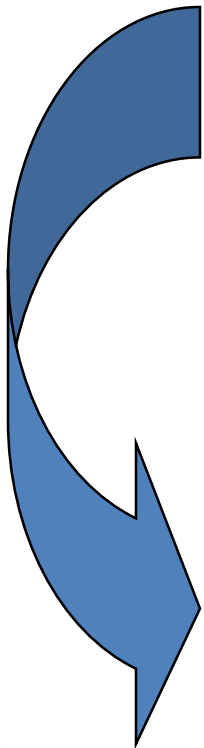
Step 3: Draft sections

Step 4: Solicit feedback

Step 5: Take time away from your writing

Step 6: Re-read with fresh perspective

Step 7: Revise and edit





**A Big Idea:**  
**Writing**  
*throughout*  
**the major**

<b>Writing task</b>	<b>Intro courses</b>	<b>Pre &amp; Co-Requisites</b>	<b>Core Course</b>	<b>Capstone seminar</b>	<b>Honor thesis</b>
<b>Abstracts and summaries</b>	●				●
<b>Lab notebooks, etc.</b>			●		
<b>Laboratory reports</b>		●			
<b>Op-eds/opinion pieces</b>				●	
<b>Research proposal</b>				●	
<b>Thesis, manuscript, book chapter</b>					●

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<b>Abstracts and summaries</b>	●	●	●	●	●
<b>Lab notebooks, etc.</b>		●	●		
<b>Laboratory reports</b>		●	●		
<b>Op-eds/opinion pieces</b>	●	●	●	●	
<b>Research proposal</b>	●			●	●
<b>Thesis, manuscript, book chapter</b>					●

But, we can't just assign  
more writing!

# Writing assignments, defined in their full rhetorical context

- Identifying the topic of the assignment
- Purpose
- Audience
- Feedback opportunities
- Evaluation criteria

# Purpose of assignment

“This assignment allows you to begin to become familiar with the literature in an area of biodiversity that interests you.

Your goal is to identify interesting, unanswered scientific questions that you would like to pursue, if you had the time and funding to do so.”

# Audience

“Your audience is the Duke community – fellow students, faculty and staff. Keep in mind that your audience is probably comprised of people with a wide range of views. Consider whether it makes your argument stronger or weaker to acknowledge multiple perspectives.”

# Feedback

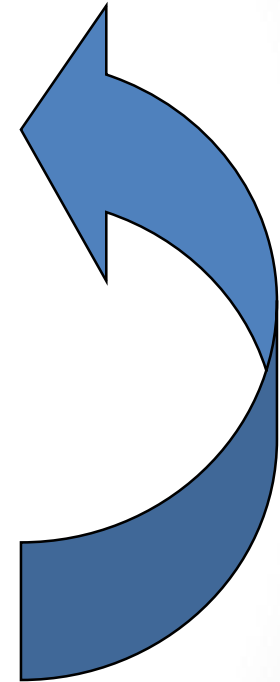
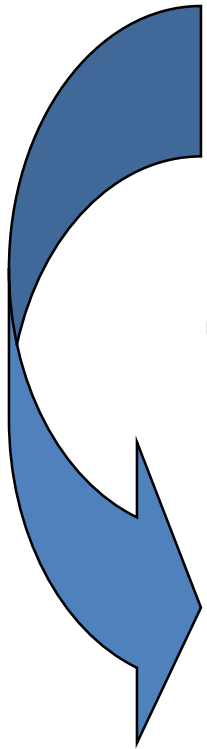
Step 3: Draft sections

Step 4: Solicit feedback

Step 5: Take time away from your writing

Step 6: Re-read with fresh perspective

Step 7: Revise and edit





# Grading rubric

	exceptional	strong	average	weak	missing
Is this author's claim central to this essay, or does the essay focus on someone else's message?					
How effective is evidence used to support this author's claim?					
How well does this author explain, describe, elucidate, and critique the scientific problem at hand?					
Is the scientific information treated fairly and accurately? Is the information communicated without bias? How well does the author balance the problem of oversimplification/ obfuscation?					
Is this piece engaging? Does the author work to keep the reader's interest? Does the author anticipate the reader's questions?					
How well was the essay related to the class's chosen theme?					
Were the mechanics and presentation of this essay appropriate and professional?					

# Modes of response

- Peer review
- Written responses
  - Letter to student
  - Comment boxes
  - AVOID text editors
- Oral responses
  - In-class workshops
  - Conferences
  - Recorded comments

# Letter to student

Dear Carina,

You have a great topic, and one that has a considerable number of complications that make it quite interesting. Your greatest challenge is going to be to communicate this complexity in as simple a manner as possible.

The biggest problem you face right now is that your claim does not match your argument. If, in fact, your claim is “Regardless of whether the Northern Spotted Owl still needs protection, its habitat certainly does, and the ecological benefits of preserving this important ecosystem offset the monetary costs.” (p1), then you don’t need to argue about the status of the Northern Spotted Owl at all! Instead, your argument should focus on why the *habitat* needs protection.

On the other hand, if your claim is that the ESA *did* help protect the NSO, then your argument more closely matches this claim. Your last sentence of the essay states: “U.S. citizens can only hope that the Senate also sees the great ecological significance of this area, and rejects HR 3824.” Is this your main claim? As you have the essay written, this point almost seems like a side point, rather than your main claim. Also, the last two sections of your paper do not seem to be strongly linked to the rest of the essay, making the entire piece seem interesting and informative, but not a strong argument.

The good news is that you have a lot of great material here to work with. I suggest that you use this draft – which is really very good at capturing your ideas in writing – to reframe your argument. Think about the story that you want to tell your readers and let that guide you. Feel free to come to talk to me about this if you get stuck.

Cheers, Dr Reynolds

# Comment boxes (respond, don't fix)

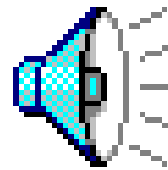
A promising new therapy against [\[JAR1\]](#) cancer is the use of antitumor vaccines delivered in dendritic cells (Gilboa *et al.*, 2004). Dendritic cells (DCs) are the conductors of our immune orchestra, capable of inducing, coordinating, and regulating virtually all the elements of the body's defense system (Banchereau *et al.*, 2005). Given their immunological importance, DCs are attractive [\[JAR2\]](#) vectors for vaccine therapy and are now being investigated as potential antitumor agents against various cancers – including melanoma, renal cell carcinoma, colorectal cancer, prostate cancer, and fatal childhood malignancies (Rosenberg *et al.*, 2004).

[\[JAR1\]](#) Do you mean “to prevent” or “to treat”

[\[JAR2\]](#) another potential misreading - you must mean researchers find DC to be attractive, but as written you are calling DCs “attractive vectors” (this is a passive voice problem)

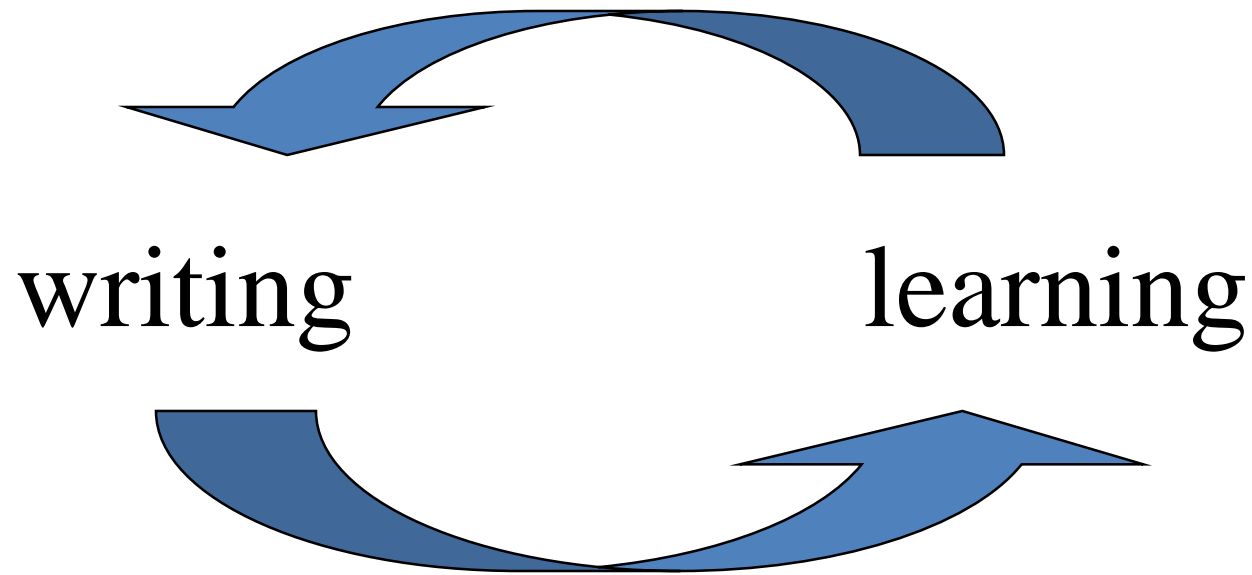
# Audio comments

“Further examination of the  $\text{NO}_3$  concentrations at each site show that the downstream site had the highest  $\text{NO}_3$  concentrations but also had few samples (Figure 3)”.



**How will all this  
improve the writing and  
thinking of STEM  
majors?**

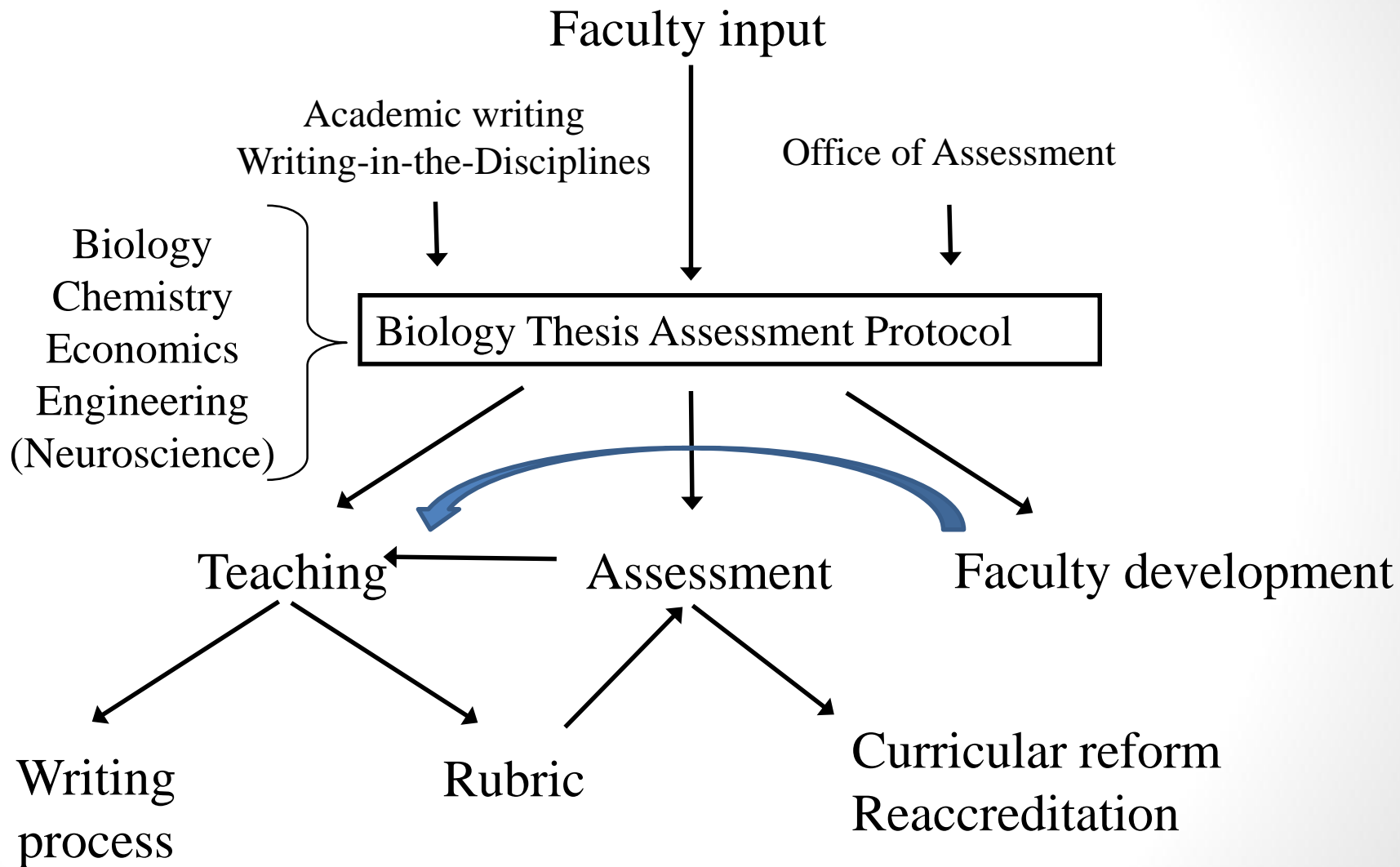
# Sustained writing → Deeper learning

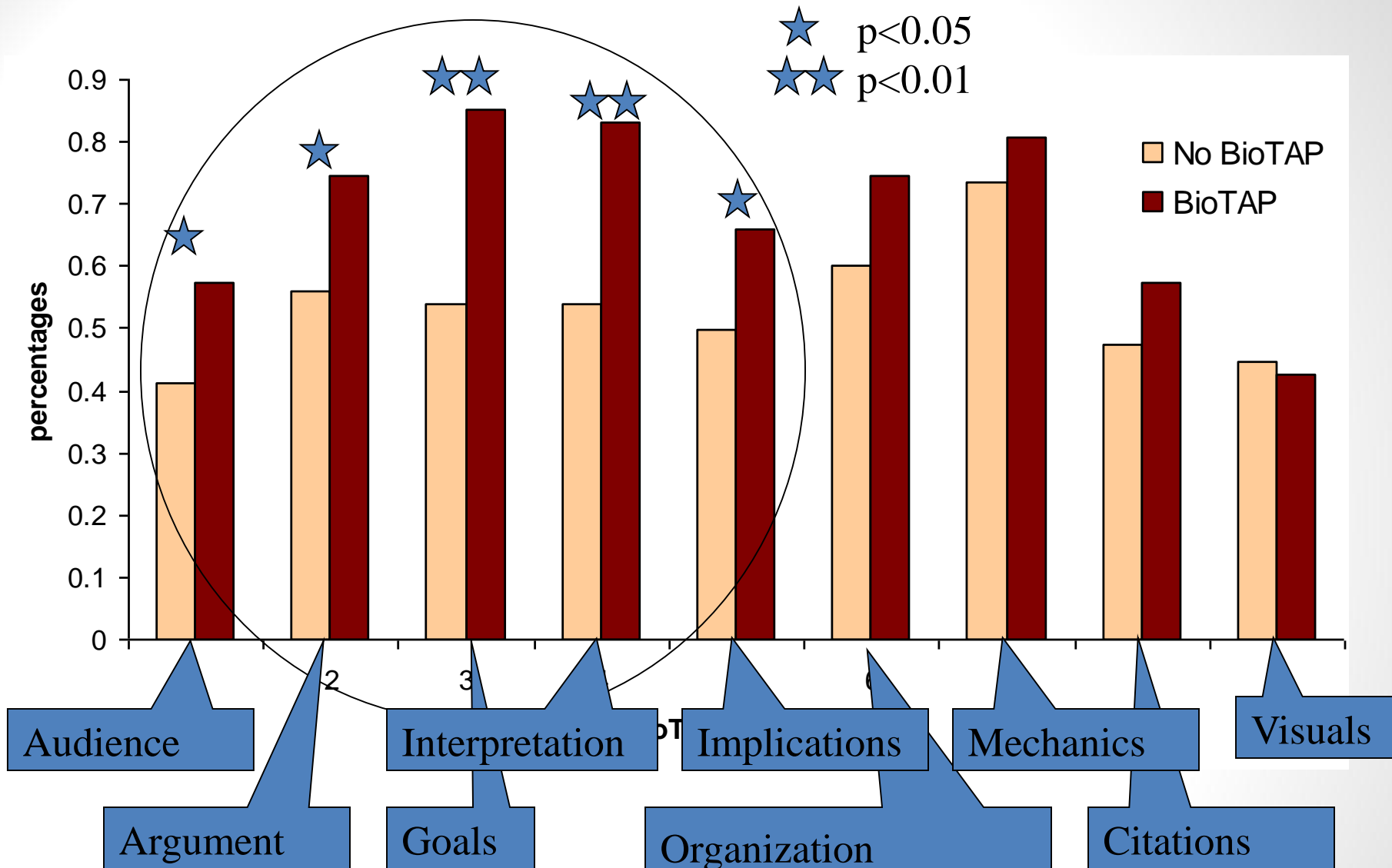


# How are students mentored through the capstone process?









**Figure 1: Using BioTAP significantly improves students' scores on higher-order writing and critical thinking skills.** Two-by-two Chi-square analyses were performed for each BioTAP question, comparing mastery of the standards of excellence (score=5) versus non-mastery of these standards (score<5, only mastery data shown) for BioTAP versus No BioTAP students.