Communicating Science in Writing & Pedagogical Settings

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Writing in the Neurosciences Initiative

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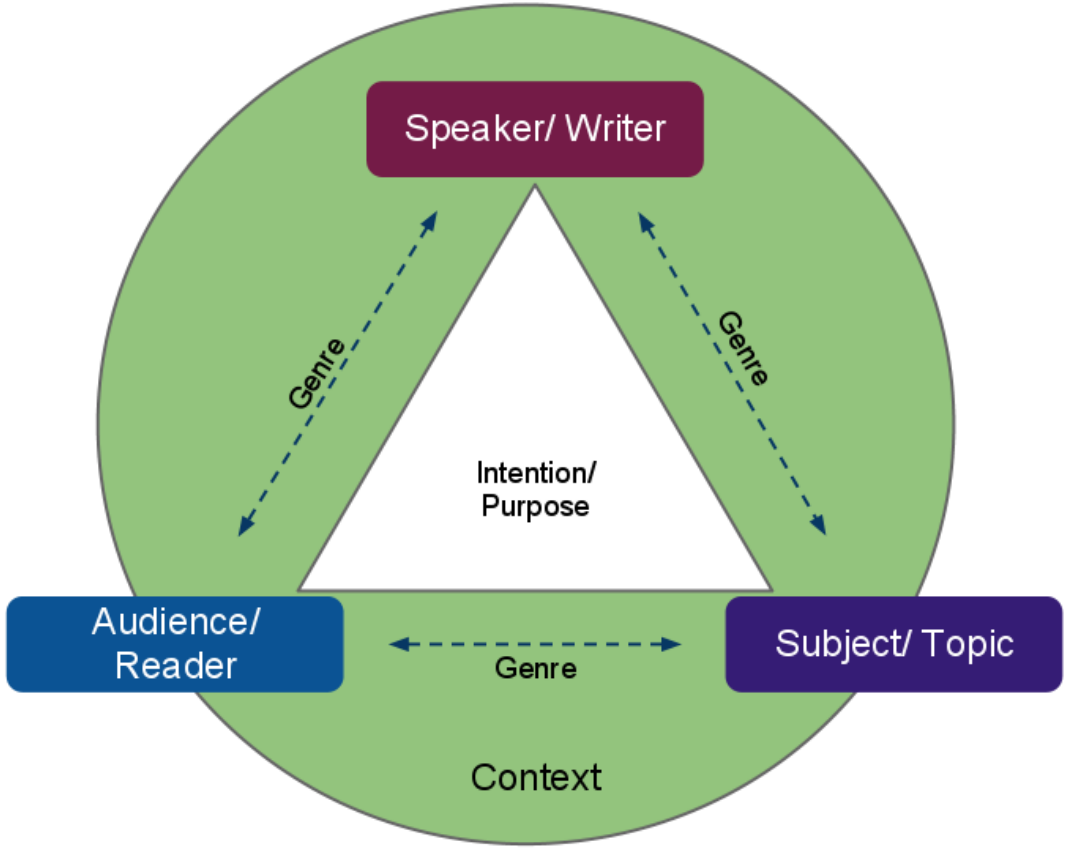
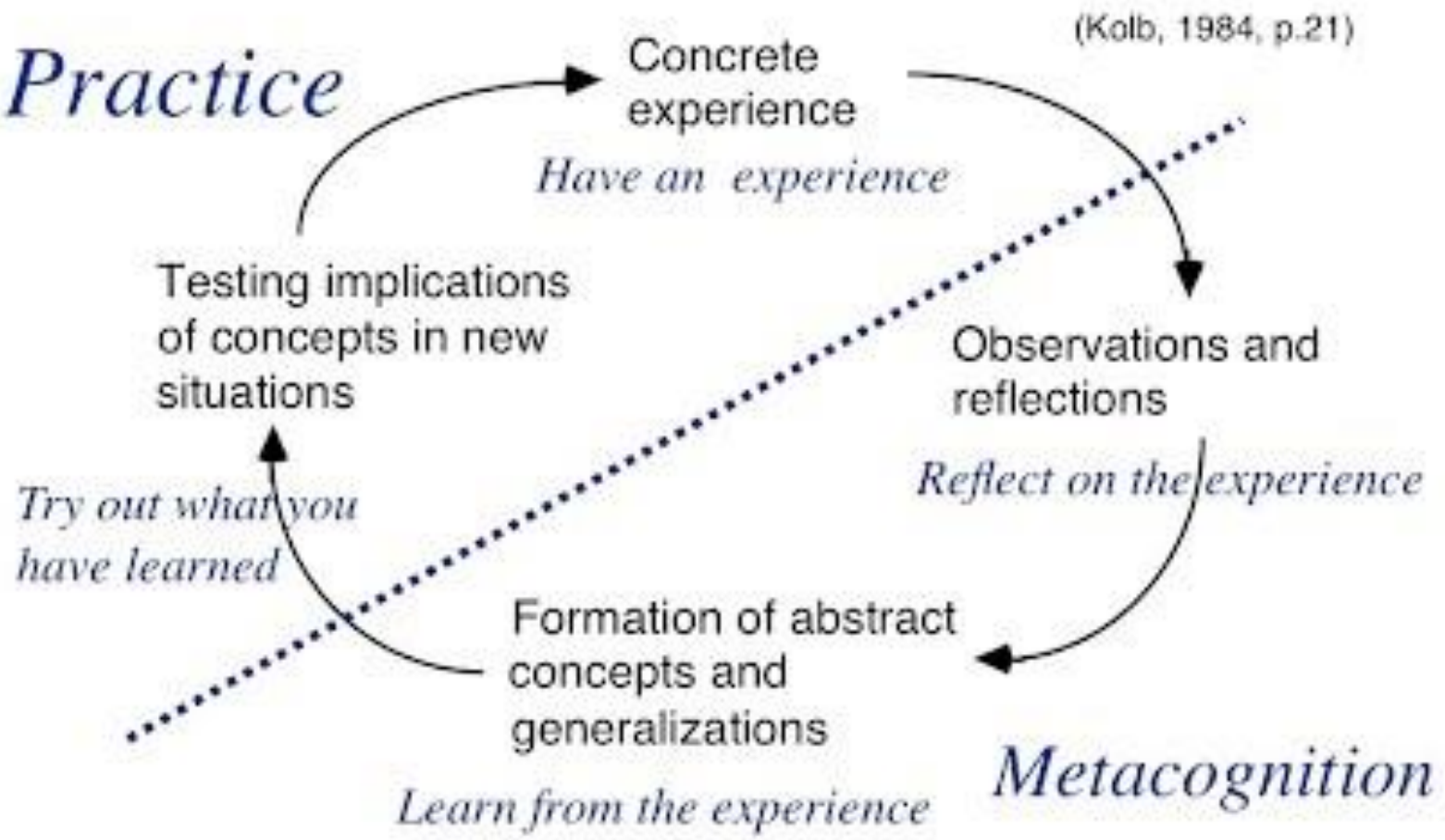
"Scientists are great communicators—with other scientists."
—Roger Aines

SCIENCE IN TEN HUNDRED WORDS: THE 'UP GOER FIVE' CHALLENGE

UP GOER FIVE

Rhetorical Triangle




(Kolb, 1984, p.21)
Practice
Concrete experience
Have an experience
Observations and reflections
Reflect on the experience
Formation of abstract concepts and generalizations
Learn from the experience
Testing implications of concepts in new situations
Try out what you have learned
Metacognition


SCIENTIFIC METHOD
PURPOSE
State the problem.
RESEARCH
Find out about the topic.
HYPOTHESIS
Predict the outcome to the problem.
EXPERIMENT
Develop a procedure to test the hypothesis.
ANALYSIS
Record the results of the experiment.
CONCLUSION
Compare the hypothesis to the experiment's conclusion.


NOVICE LEARNERS
V.S.
EXPERT LEARNERS

Table 1: Summary of key differences between novices and experts, with related teaching strategies

Novice Learning Characteristics	Expert Learning Characteristics	Teaching Strategies That Capitalize on Novice/Expert Differences
Little prior subject knowledge	Extensive prior knowledge	• Remind students of what they already know, even from informal or everyday learning. • Use concrete examples from students' own backgrounds.
Lack of awareness of their misconceptions	Ability to correct their misconceptions	• Uncover and address misconceptions directly by getting feedback from students on their thought process.
Knowledge tends to be organized according to surface features.	Knowledge is organized according to deeper concepts.	• Draw analogies between examples, cases, and problems with common deep concepts but different superficial features.
New material is more difficult to assimilate with superficial organizational structure.	New material is easier to connect to prior knowledge, thanks to deeper organizational structure.	• Use outlines or concept maps that illustrate important structural divisions. • Ask questions that require deep organization ("how" and "why" questions).
Knowledge is considered a bunch of facts—it lacks context.	Context is considered crucial to knowledge—how it works in real situations.	• Change the context of knowledge in class and in assignments in order to encourage students to use what they are learning in novel situations (e.g., tasks from different skill areas combined in new ways; familiar skills applied to new cases).
Lack of internalized problem-solving process; steps may seem arbitrary or rote.	Automatic problem-solving process makes it easy to skip steps and often involves big-picture thinking.	• Make the process explicit; include and highlight all the steps. • Use memory aids to help learners remember important processes. • Provide opportunities for practice, with feedback.

Science writing tips:

Treat writing as a process

Practice!

Be accessible (avoid jargon)

Tell a story

Use hooks

Get vivid

Use "I"

Science teaching best practices:

MEET YOUR STUDENTS WHERE THEY ARE

ORGANIZE KNOWLEDGE AROUND CORE CONCEPTS

SUPPORT METACOGNITION & STUDENT SELF-REGULATION

ENCOURAGE COLLABORATION & ACTIVE LEARNING

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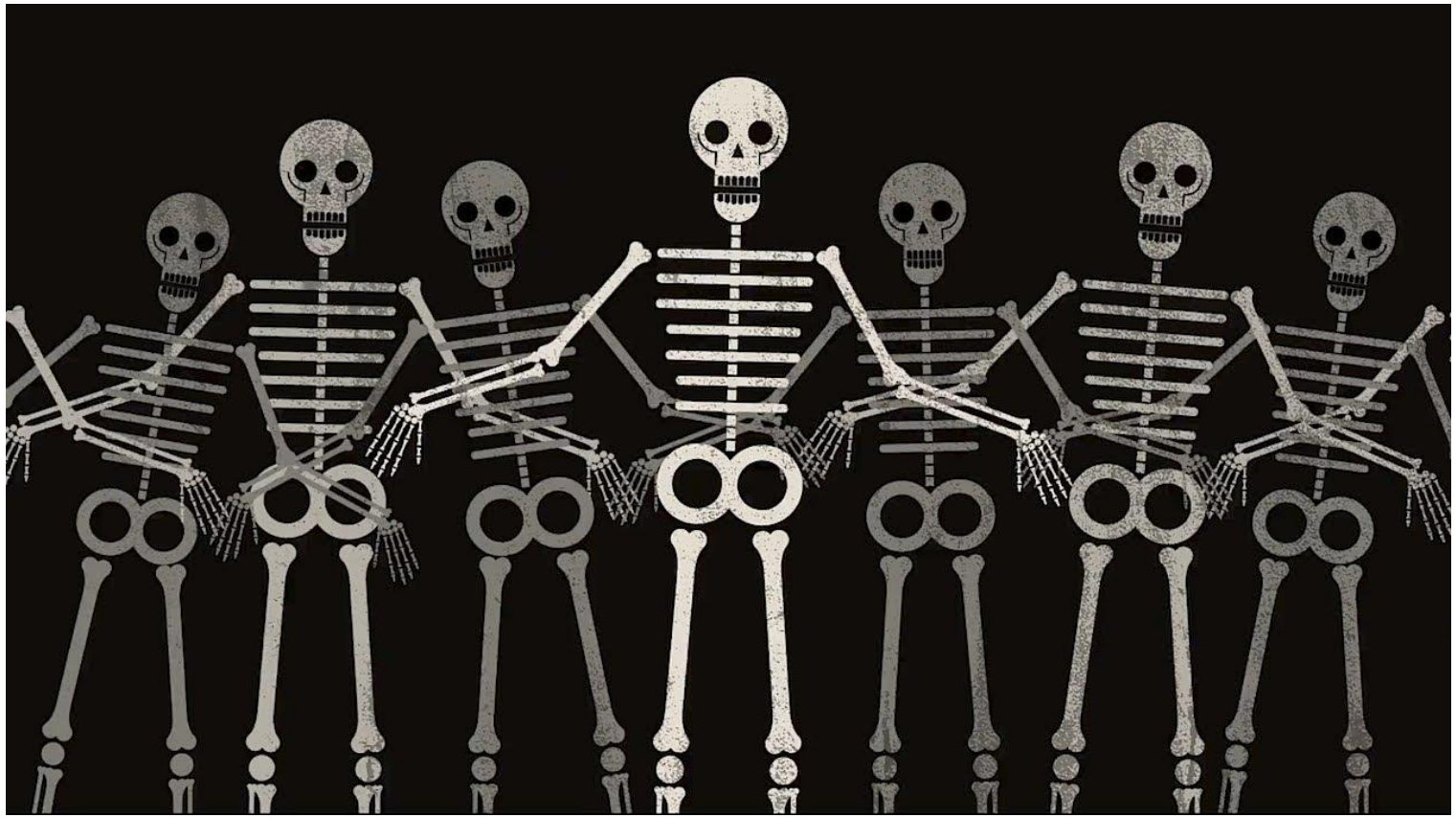
Watch out for zombie nouns!



Thank you!

Questions & discussion...

Selected Resources for Writing & Teaching in the Sciences

Berrett, Dan. "Teaching Science So It Sticks." *The Chronicle of Higher Education.* May 2015: https://www.chronicle.com/article/Teaching-Science-So-It-Sticks/229881

Dirrigl, Frank & Mark Noe. "The Teacher Writing Toolkit: Enhancing Undergraduate Teaching of Scientific Writing in the Biological Sciences." *Journal of Biological Education*, DOI: 10.1080/00219266.2018.1501410

Holstein, Sarah, Katherine Mickley Steinmetz, & John Miles. "Teaching Science Writing in an Introductory Laboratory Course." *Journal of Undergraduate Neuroscience Education*. Vol. 13, no. 2, Spring 2015. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4380299/#b9-june-13-101

Teaching With Writing (UM College of Biological Sciences): https://cbs.umn.edu/info/internal-resources/faculty-staff/undergraduate-teaching-resources/teaching-writing

Waldrop, M. Mitchell. "Why We Are Teaching Science Wrong, & How to Make It Right." *Nature.* Vol. 523, no. 7560, July 2015. https://www.nature.com/news/why-we-are-teaching-science-wrong-and-how-to-make-it-right-1.17963

"Writing in the Sciences & Engineering." UCLA Graduate Writing Center: https://gwc.gsrc.ucla.edu/Resources

Sources & images:

Aines, Roger & Amy Aines. *Championing Science* (book & resource page): https://championingscience.com/

Up-Goer Five: Rowan, Chris. "Science in Ten Hundred Words: The Up-Goer Five Challenge." *Scientific American guest blog,* Jan. 2013: https://blogs.scientificamerican.com/guest-blog/science-in-ten-hundred-words-the-up-goer-five-challenge/?redirect=1

Rhetorical Triangle image: https://www.sophia.org/tutorials/what-is-the-rhetorical-triangle

Kolb Practice/Metacognition image:

http://electronicportfolios.org/academy/reflection4learning/why-reflect/kolb-moon.jpg?attredirects=0/index.html

Novice/Expert Learners image: https://prezi.com/vj8f11myw6ll/novice-learners-vs/

Novice/Expert Learner chart: from Horii, Cassandra Volpe. "Teaching insights from Adult Learning Theory." *Journal of Veterinary Medical Education.* Vol. 34, no. 4, Fall 2007: https://jvme.utpjournals.press/doi/10.3138/jvme.34.4.369

Zombie Nouns (Helen Sword): https://www.youtube.com/watch?v=dNlkHtMgcPQ