**Project Title:** Reflective Writing Tools: Building Skills and Habits of Thinking in Becoming a Scientist

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**Keywords:** Reflective writing, independence, perseverance, ambiguity, mentorship, STEM Education

**Description:** Being able to recognize when learning occurs, both for the scientist and for the scientist’s learners, and what helps and hinders learning is a critical skill for the developing scientist. Reflective writing tools are intended to help students better connect current learning experiences to prior learning, engage the role of emotion in current and future learning, and assess learning experiences to improve future learning.

The reflective writing tool encourages student engagement and perseverance, helps students better manage ambiguity as part of developing independent thinking, and helps students understand the value and nuances of peer collaboration. The tool supports the development of scientific thinking by prompting students to think critically, through protocols and training, as they troubleshoot problems.

Instructor feedback enables the instructor and graduate or undergraduate teaching assistants to provide mentorship and guidance that responds to the student reflection.

**Learning objectives:**

After completing this module, students should be able to:

* Increase self-awareness of their conceptual understanding, gaps in knowledge, and the value of learning strategies,
* Strengthen emotional connections and responses to learning experiences and be able to describe that connection,
* Uncover key learning insights, reinforce strategies that work, and apply such strategies to situations beyond the classroom, including future learning, and
* Gain an appreciation for reflective writing as an effective learning strategy.

**How is the module structured to promote student development as a scientist?**

Scientists' habits of thinking enable them to troubleshoot, manage ambiguity and persist in the process toward scientific output. This module supports the development of scientific habits of thinking while affirming self efficacy, science identity and community values.

The [Introduction to Reflective Writing](https://drive.google.com/file/d/10ayIhjY19Caj_YR_g5HXNFJyPLkmkMVT/view?usp=sharing) shows what reflective writing is, why it is important and how to do it. [Reflective Writing Prompts](https://docs.google.com/document/d/1UnnIBgeGKboBDa8KIRFltbK7X9zmJbwKBeYPIGgfBJE/edit?usp=sharing) ask learners to think about their perceptions of learning and what they will do to improve their learning. The prompts encourage independence by providing a systematic way of thinking through problems and ambiguity that all scientists encounter. The [Effective Feedback Guide](https://drive.google.com/file/d/1hCc8HoAg68Ffj2K4tQPQU11rf8wHWSPI/view?usp=sharing) provides feedback suggestions to help instructors normalize setbacks, increase perseverance and tolerance of self doubt. Feedback builds the instructor mentor relationship through honest, respectful and supportive prompting.

All of the tools contribute to becoming a scientist by helping students: face ambiguity, develop independence, express engagement and enthusiasm, persevere and model scientific thinking. Instructor feedback and mentorship reinforces these learning components, thus fostering project ownership, self efficacy and professional formation.

**Intended Teaching Setting**

**Course level:** for all students, particularly novice learners

**Instructional Setting:** in-person or online

**Implementation Time Frame:** 15-30 minutes

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**Project Documents**

**Facilitator document:** Instructor Guide

**Learning activity document(s):** Reflective Writing Prompts, Effective Feedback Guide, Jenny-Moon-Resource-for-Writing Reflections, Five Elements of Effective Thinking

**Assessment document(s):** Reflective Writing Rubric,Reflective Writing Feedback Planning Document

**Instructor Supports:** Making Use of Peer Mentors and Teaching Assistants, Laboratory Notebook Template, Sample Syllabus Language for Reflective Language