STEM Department Evaluation Rubric*

	Baseline	Beginning	Developing	Accomplished	Exemplary
Authentic Course-embedded Research[1,2]	Laboratory experiments have known outcomes. Students perceive that experiments have "right" answers and will often attribute unanticipated findings to "human error."	Only a small fraction of students gain practice in authentic, open-ended inquiry, analysis, and evaluation; usually through optional, low enrollment courses. These courses can easily be avoided entirely.	Authentic inquiry occurs in several courses; 50% of students gain some experience applying primary literature, predicting outcomes of open-ended experiments, analyzing data, and interpreting results.	"Accomplished" builds on "Developing" in that **all** students have the opportunity to engage in authentic inquiry, and the majority design and carry out novel, open-ended experiments, often of their own design.	Students are accustomed to predicting outcomes of open-ended research projects (often of their own design) and interpreting results. Articulating probable explanations and ensuing research questions is the norm.
Student Cognitive Skills[3,4]	Across the curriculum, students practice "recall," the lowest-level cognitive skill (LOCS[3,4*]), and assignments/exams target this level. Students' perception is reinforced that learning is limited to memorization of facts.	Students typically practice lower-level cognitive skills (recall, understand, apply), especially in beginning courses. Few instructors consider cognitive level of assignments or exam questions.	Students practice higher order cognitive skills (HOCS; e.g., synthesize, evaluate, create) in some courses, although tests may still assess LOCS. Instructors may find creating HOCS questions difficult.	A majority of courses help students move beyond LOCS by emphasizing the development and regular practice of HOCS. Exams and other high-stakes assignments assess students' ability to utilize HOCS.	Students regularly practice HOCS throughout the curriculum, and instructors are adept at giving students practice in preparing for exams and other graded assignments requiring HOCS.
Student Metacognitive Skills[5,6]	Students are unreflective of their own learning strategies and there is no effort to improve metacognitive awareness and empowerment. Attrition risk of underprepared students is acute due to unfamiliar early failure.	Rarely are students encouraged to reflect on their learning strategies and skills. Study strategies, when discussed, may not be specifically geared to STEM learning or the particular student's needs.	Students are encouraged in some courses (e.g., first year courses) to reflect on their learning skills and encouraged to use appropriate learning strategies[5] that are supported by research.[6]	Instructors typically engage students (esp. first year) in metacognitive reflection and *practice* of research-based, cognitive strategies. A learning center may further support student metacognitive growth.	Instructors regularly integrate practice of effective metacognitive strategies within assignments. Most students become adept at reflecting upon, and improving, their own learning and coaching their peers.
Student Core Competencies[7]	Courses designed around content delivery (e.g., chapter by chapter of text), with no opportunities to practice/build core competencies.	Course descriptions include goal of building students' skills (e.g., use of scientific inquiry), but students rarely practice such skills. Top students who take many STEM courses may build competencies serendipitously.	Attempts to design curriculum around core competencies rather than content coverage yield mixed success and/or face some resistance. Efforts may be limited to first year or senior "capstone" experiences.	Core competencies are targeted learning outcomes practiced in over 50% of courses across all levels, although efforts may still be confined within disciplinary department(s) and not integrated throughout, and beyond, STEM.	Fully integrated curriculum prioritizes competencies (methods of inquiry, quantitative reasoning, modeling/simulation, transdisicplinary thinking, communication, collaboration, applying knowledge to civic problems, etc.) at all levels.
Independent Research[2,8]	Students are unaware of, and don't participate in, independent mentored research.	A few well-prepared students may seek intra- or extramural research opportunities (e.g., REU) on own initiative, but most students are unaware of such opportunities.	*Ad hoc* advising/encouragement is given to top students to consider research opportunities, but better coordination would extend such efforts to more students.	Many students encouraged to seek research opportunities, but earlier preparation would increase acceptance/readiness. Products (e.g., posters) of student research are showcased.	From first year, all students are prepped for mentored research opportunities, and a large percentage participate in one or more. Student research posters and symposia regularly showcase student scholars as role models.

*This rubric was developed for the Partnership for Life Sciences Education (join at www.pulsecommunity.org) for use in workshops led by PULSE Fellows and for use by departments engaged in self-study at their home institution. It is intended to stimulate discussion, identify department strengths and opportunities for improvement, and introduce just a few of the abundant resources about the topics. Help us assess its effectiveness by contacting Ellen Goldey at goldeyes@wofford.edu. PULSE Fellows have also developed a more extensive set of rubrics intended to be used by Life Sciences departments engaged in self-study and interested in possible future certification (see www.pulsecommunity.org).

[1] Wei and Woodin, 2011. "Undergraduate Research Experiences in Biology: Alternatives to the Apprenticeship Model," *CBE-Life Sciences Education*, 10, 123 - 131.
[2] Lopatto, 2010. *"Science in Solution: The Impact of* Undergraduate Research in Student Learning,*"* http://web.grinnell.edu/sureiii/Science_in_Solution_Lopatto.pdf, published by Research Corporation for Science Advancement.
[3] Crowe, Dirks, and Wenderoth, 2008. "Biology in Bloom: Implementing Bloom's Taxonomy to Enhance Student Learning in Biology," *CBE Life Sciences Education*, 7:368-371.
[4] Anderson and Krothwohl, 2001. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*, Longmam Publishing.

STEM Department Evaluation Rubric*

Engaging Pedagogies[9, 10]	Lecturing without student engagement is the norm in courses and labs. Information is passively received, and there is little need to read text or other sources. Instructor is "authority."	Traditional lecturing during class time is the norm, and all engaging activity occurs during laboratory sessions. Information received in class may often be repeated in lab.	Instructor pedagogies fall into teacher-centered or learner-centered categories. Students may pick among instructors who "deliver" information and those that require active learning.	All instructors are attempting to adopt best pedagogical practices, and lecturing for 50% or more of class time is rare. Students actively learn on own and from each other in most classes/labs.	Students are engaged in discussion, guided inquiry, and other activities in classes/labs, and instructors intersperse brief lectures if needed. Knowledge is actively constructed by students. Instructor is "coach."
Faculty Development[11,12]	Faculty members are unfamiliar with STEM/Higher Ed pedagogical research, and there is no structure/support/incentive for development of their knowledge and/or skills.	Some members of the department are seeking new knowledge/skills needed for transforming their program, but they lack support/time/incentive for this work.	Faculty learning community and/or Center for T&L may aid cadre of practitioners in building knowledge, skills, and leadership capacities. Administrative support is minimally sufficient.	Faculty groups discuss pedagogical literature. A few contribute to the scholarship of teaching and learning (SoTL). Incentives available to learn through Center of T&L, attendance at conferences, etc.	Pedagogical excellence is esteemed by the institution rather than perceived to be in conflict with disciplinary scholarship. Contributing to SoTL is highly valued in T&P decisions and supported with incentives.
Assessment[13]	Tools do not assess learning outcomes (e.g., course evaluations judge instructor performance rather than student learning). Assessment perceived as punitive and compulsory.	Novel assessment tools may be used in one or two courses, but there is minimal administrative and/or peer interest for these efforts and findings, and the focus remains on faculty performance.	The assessment portfolio may emphasize quantitative, direct measures (e.g., Major Field Test) and lack insight from qualitative measures (e.g., surveys, interviews).	Periodic (e.g., every 5 years) integration and reflection on variety of direct and indirect assessment evidence inspires episodic reform. Assessment viewed as essential by some, necessary evil by others.	Regular (e.g., yearly) reflection on evidence from diverse assessment tools guides continuous efforts to improve student outcomes. Assessment is perceived as essential and inspiring.
Faculty and Administration Dispositions Toward Change[14]	Faculty is change-averse. There are no safe places for trial and error. Changes in curriculum may be dictated to the faculty and driven by market forces. There may be an ethos of fear, frustration, and/or apathy.	There is no shared vision for change, and/or there are strong voices that resist change, and/or there is poor communication between administrators or faculty members leading to inertia and/or distrust.	Pockets of reform may be under heightened scrutiny, thus increasing anxiety. Retrenchment may occur without encouragement and opportunities to learn from early failures. The ethos may reflect both anxiety and excitement.	A faculty majority is collaborating with administrators to implement reform. Financial/market realities are taken into consideration, but do not dictate approaches. An ethos of pride is developing as learning outcomes improve.	Instructors and administrators are reflective, open to change, appropriately skeptical of change for change's sake, and risk-tolerant. Reflection on assessment evidence drive continuous reform. There is a collaborative ethos of "positive restlessness."
Integration of Department Program with Gen Ed Goals & Institutional Mission[13]	Faculty members (full or part time) are unaware of general education (GE) goals, institutional mission (IM), or how the department supports these broader issues.	The department chair or a committee determines which courses fulfill GE requirements, but instructors may not know, or know how to achieve, GE goals. IM is rarely considered in department's program.	The department's faculty members work to align courses to meet GE learning goals, but IM goals may be overlooked or perceived as outside the department's duties.	GE goals are well integrated, and some courses target the capacities valued in the institution's mission (e.g.., civic engagement, advancement of knowledge; cultural pluralism; social justice).	All full and part time faculty regularly discuss and engage students in practice and development of specific GE learning goals and institutional mission-based outcomes. Department goals are positioned within institutional context.

[5]Hoffmann and McGuire, 2009. "Teaching and Learning Strategies that Work," *Science*, 325:1203-1204.

[6]Dweck, 2006. *Mindset: The New Psychology of Success*, Random House Publishing

[7]For sample discussions of core competencies, see the 2009 reports of the AAMC-HHMI Committee Scientific Foundations for Future Physicians and AAAS' Vision and Change in Undergraduate Biology Education: A Call To Action.

[8]Council on Undergraduate Research (CUR), 2012. Characteristics of Excellence in Undergraduate Research, Nancy Hensel, editor. Available from www.cur.org.

[9]Bean, 2011. *Engaging Ideas: The Professors Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom.* Jossey-Bass.

[10]Smith, Sheppard, Johnson and Johnson, 2005. Pedagogies of Engagement: Classroom-Based Practices, *Journal of Engineering Education*, 94:87-101.

[11]Pfund, Mathieu, Austin, Connolly, Manske, & Moore (2012). Advancing STEM undergraduate learning: Preparing the nation's future faculty. *Change: The Magazine of Higher Learning*, 44(6), 64-72.

[12]Brownell and Tanner, 2012. Barriers to Faculty Pedagogical Change: Lack of Training,Time, Incentives, and. . .Tensions with Professional Identity? *CBE-Life Sciences Education*, 11, 339-346.

[13]Walvoord, 2010. *Assessment Clear and Simple: A Practical Guide for Institutions, Departments, and General Education*. 2nd Edition, Jossey-Bass.

[14]Henderson, Beach, and Finkelstein, 2011. Facilitating Change in Undergraduate STEM Instructional Practices: An Analytic Review of the Literature. *Journal of Research in Science Teaching*, 48(8), 952-984.