ASM M(icro)OOC #3:
ASM Curriculum Guidelines for Undergraduate Microbiology – Aligning Concepts, Learning Outcomes, and Assessments

Frequently Asked Questions

Red responses: Sue Merkel, Cornell University, Ithaca, NY
Blue responses: Ann Stevens, Virginia Tech, Blacksburg, VA

Questions re: ASM Curriculum Guidelines for Undergraduate Microbiology

Do you share the Curriculum Guidelines (and the associated Learning Outcomes) with your students? If so, when do you share them?

SUE: Absolutely. I give students learning outcomes for every class/lab/activity. I follow them as best I can, and tell the students to use them as study guides.

ANN: Yes, I also share my learning outcomes with students as the beginning of each course. I also provide them with a study guide for each exam and give them sample practice assessment questions from old exams, so they clearly know my expectations for them.

What advice do you have for people who are struggling to get fellow faculty to buy in to the ASM Curriculum Guidelines?

ANN: If you are lucky, you have colleagues who on a very fundamental level want to do right by their students and are willing to improve their individual teaching and the curriculum overall. Most university administrations are very concerned about reaching accreditations goals. Writing good learning outcomes and assessing student success are a big part of that process and so there is increasing pressure on faculty from above to compel them to engage in these activities.

What is a concept inventory?

ANN: A concept inventory is a tool used for both formative and summative assessment of an individual course or an entire curriculum. These take a while to develop as they are constructed using known student alternative conceptions (misconceptions) of key concepts. Normally, they are administered as multiple choice questions with the alternative conceptions serving as the distractors (incorrect responses). Sometimes they have a second-tier open response where students can explain their logic. Early on in the development process of a concept inventory, these student explanations are critical to defining the most common points of confusion. Due to the amount of time it takes to develop and validate a concept inventory, they are normally maintained in a confidential/secure manner and are not open access to the students. ASM currently has a task force working on development of a concept inventory for General Microbiology. (For more information about biology-related concept inventories, see Biology Concept Inventories.)
Questions re: ASM General Microbiology Learning Outcomes

Should course assessments be linked to the Learning Outcomes or the fundamental statements listed in the Curriculum Guidelines?

SUE: The fundamental statements are broad, over-arching goals for a course. Learning outcomes are more specific, and are easier to assess, so I would align assessments to the learning outcomes. Having said that, I have used the FS as assessments, e.g.: “List an experiment/activity that we did that illustrates the following fundamental statement, and explain why.”

Are learning outcomes and learning objectives the same thing? If not, how are they different?

SUE: Some educators make distinction between these 2 terms; we tend not to.

ANN: Originally, we used the term learning objective, but the term learning outcome seems to be preferred by those with more formal education training. I’m not entirely certain why, but perhaps it is because outcome implies an emphasis on what the students will gain. As we discussed during the webinar, learning outcomes – by definition – should be student-centered.

Is there such a thing as a compound learning outcome, and do you assess it differently than a single learning outcome?

SUE: Learning outcomes should address a single skill or idea. If they express too many ideas, they cannot be assessed easily.

Are there verbs that can be both higher-order and lower-order?

SUE: YES! Whether or not a learning outcome or assessment is higher or lower order is totally dependent on context. For example, if you ask students to predict the outcomes of an experiment they have done, then you are asking them to repeat information they have memorized, which is lower order thinking. If you ask them to predict the outcome of an experiment that is new in some way, you are asking them to synthesize new information, and that is higher-order thinking.

What tips can you offer on writing learning outcomes for higher-order skills?

SUE: Read the article “Biology in Bloom,” review the higher-order thinking verbs, look at examples, and think of authentic, real life examples.

ANN: An ASM task force has generated examples of learning outcomes that have been linked to fundamental statements in the ASM Curriculum Guidelines. This list is NOT meant to be comprehensive, but to provide the community with examples they may use as is, modify for their particular courses, or use as templates to write new learning outcomes.

How do you assess higher-order learning outcomes?

SUE: Seriously—with higher-order assessments. If the learning outcome is written well, you can usually think up a scenario that illustrates it. Keep coming back to the question: what evidence will tell me that
my students can do this? Again, look at examples (see ASM website: ASM Curriculum Guidelines, ASM course design webinar, and ASM's Journal of Microbiology and Biology Education)

Will your formative assessments be different in a large class (>50) versus a small class? Do you approach a large class differently?

SUE: Yes and no. I use formative assessments to give me information, not for student grades. So if I have students in a 200+ class write something out for me, I collect them, but I may only read 20 or so. If I have a class of 20 students, I read them all. Smaller classes allow you to pinpoint who is having trouble. With larger classes often you just know 10 or 50% of students were confused. I also use clickers in large classes because it lets students see where they stand. I have not used them in smaller classes.

ANN: I have used homework assignments in all of my courses, which range from 60-150 students, but I have undergraduate teaching assistants help with grading in the classes with over 100 students.

What are minute papers?

SUE: One of the participants provided a helpful link: http://www.edutopia.org/blog/design-thinking-one-minute-papers-ashley-nahornick.

How many learning outcomes do you recommend for a course?

SUE: I have 1-3 per class; I use some learning outcomes for more than 1 class.

ANN: For development of the ASM concept inventory for General Microbiology, we are aiming for the range of 12-18 learning outcomes that represent the core fundamental concepts we hope the students will retain beyond the course.

Is there an ideal mix of higher and lower order skills to best evaluate a diverse population of learners?

SUE: It depends on the audience. A freshman course may have more lower-order learning outcomes/assessments, while a senior level class may have more higher-order learning outcomes/assessments. However, even a freshman class should be developing higher-order thinking skills.

ANN: I agree with Sue; there needs to be a balance. The higher order skills, which are what we want the students to develop and use, are built upon the lower order skills not just in each course, but across the curriculum.

How do you manage to get at higher-order Bloom’s levels without increasing the amount of grading in the course?

SUE: You can write higher-order multiple choice questions. The SLAMD collection will eventually illustrate this. For example: “Which of the following would be the most likely results of a mutation in X?” (choices A,B,C,D), or “Which conclusion can you make from the data at the right ?” (then show them a bar graph).
Are there any strong patterns you associate between action verbs used in learning outcomes and particular assessment techniques (i.e. summarize = essay)?

ANN: Perhaps some are intuitive (e.g. label = diagram; define = sentence), but it is your responsibility to clearly convey your expectations to the students.

Does ASM provide any help to faculty in writing learning outcomes?

SUE: Yes, the Biology Scholars Program Assessment Residency and the Science Teaching Fellows Program help participants develop measureable learning outcomes and aligned assessment strategies. In addition, ASM provides webinars like this one and online resources such as the ASM General Microbiology Learning Outcomes document. Finally, we hope to continue hosting learning outcome writing workshops at the annual ASM Conference for Undergraduate Educators. In addition, campus teaching and learning centers can be a great resource for training to write effective learning outcomes.
Resources

- Vision and Change report:  
  http://visionandchange.org/

- ASM Curriculum Guidelines for Undergraduate Microbiology and ASM General Microbiology Learning Outcomes: a Working Document:  

- SLAMD:  
  http://www.microbelibrary.org/about/60

- McTighe and Wiggins references:  
  o https://fitnyc.edu/files/pdfs/Backward_design.pdf

- The Development of Curricular Guidelines for Introductory Microbiology that Focus on Understanding:  

- Biology in Bloom: Implementing Bloom's Taxonomy to Enhance Student Learning in Biology:  
  http://www.lifescied.org/content/7/4/368.full

- Practical ideas for teaching science, including assessment strategies:  