Promoting course alignment: Developing a systematic approach to question development

Françoise Bentley, M.S. and Teresa Foley, Ph.D.
Integrative Physiology Dept., University of Colorado-Boulder

When students cannot easily determine the connection between assessments in a course, they often complain that such assignments or activities are "busy work" and "do not help in preparing for the upcoming exam." In order to avoid such discontinuity, it is important that every element of a course be aligned with a set of well-defined learning goals. Using the following systematic approach, faculty can develop a bank of questions that align with a single learning goal. These so-called "suites" of questions can then be used in different settings to measure student learning. For example, one or more questions could be used for formative assessments (e.g., a clicker question, quiz, or homework), while a variation of the question(s) could be used on a summative assessment (e.g., a final exam). This systematic approach to question development helps faculty focus on their primary educational goals, while it allows students see that the practice they are receiving from assessments is measuring and improving their learning. As an added bonus to using this approach, course exams can be written well in advance of the exam date!

Steps for developing "suites of questions"

1. Start by choosing a learning goal that you would like to assess.

2. Determine the settings where you would like to assess your students (i.e. during lecture, homework, exam, recitation/tutorial, or lab).

3. Develop an initial question for this goal. An application-type question where the students have to predict the outcome of a change in a scenario works best for creating a suite of questions.

   For example, you could create a clicker question that has the students predict the result of increasing a certain variable.

4. Identify what aspects of your question have differing variables/factors that can be changed over a series of questions.

   Using the example above, a related homework question would have students predict the result of decreasing that same variable.

5. Depending on the nature of the question, you can develop at least one exam, one clicker, and one homework question aligned to the same learning goal.

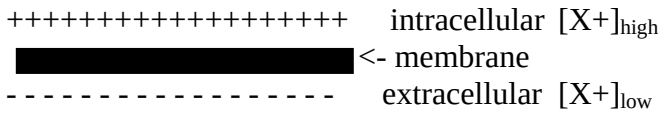
   For example, the corresponding exam question would have students read the scenario and predict if a variable increases, decreases, or causes no change in a particular output quantity.

Example "suite of questions" for a common learning goal

Learning goal: Predict whether a molecule will move across a cell membrane and by what mechanism; explain how concentration and/or electrical gradients influence its movement.

Homework question:

Below is a depiction of a portion of the cell membrane that is positively charged on the intracellular side and negatively charged on the extracellular side. Further in this cell, the concentration of ion X^+ in the intracellular space is high and in the extracellular space is low.



Use the figure above to determine what gradients play a role in the movement of ions.

1) Does an **electrical gradient** exist for X^+? If it exists, what is the direction?
   a) No. b) Yes, inward. c) Yes, outward.

Clicker question using the same scenario as the homework question:

2) Does a **concentration gradient** exist for X^+? If it exists, what is the direction?
   a) No. b) Yes, inward. c) Yes, outward.

In these examples, the homework and clicker questions are assessing the same concept (electrochemical gradients and ion flow), but in multiple ways. For an exam question, you could use a different ion and have the students predict the electrical and concentration gradients of a related scenario.

Exam question:

Consider a typical cell that is temporarily hyperpolarized to -100mV.

What would be the direction of the chemical and electrical forces acting on K^+ while the cell is hyperpolarized?

a) chemical in, electrical in
b) chemical in, electrical out
c) chemical in, no net electrical
d) chemical out, electrical in
e) chemical out, electrical out
f) chemical out, no net electrical
g) no net chemical, electrical in
h) no net chemical, electrical out
i) no net chemical, no net electrical