

Science exams don't have to be demoralizing: A practical guide

The perils of curving.

It can be hard to write an exam that targets precisely the level of knowledge and skill your students should have; questions may be harder than we intend or the exam may be too long for the allotted time. It's therefore common to curve, that is, to adjust the exam average at a B or a B-. The intention is positive, but curving can decrease student trust in the meaning of grades as well as student motivation (Wolfe and Powell, 2015; Seymour and Barrie, 2019).

In interviews with 346 undergraduates, Elaine Seymour and Anne-Barrie Hunter found that 29% of students who left intended STEM majors and 24% of those who persisted in STEM majors cited curving as problematic, saying that it decreased their trust in the grading process, reduced their motivation to learn, and promoted a competitive environment. If curving has these impacts, we would be wise to avoid it.



You are just inflating the test scores to make it look like someone has a higher understanding than they actually do.

The test score becomes 'How did I do compared with other students?' The average for our last test ranged from 40-60, so I don't think anyone knows what they are doing, but they are content because they did well compared to others.



(Talking About Leaving Revisited, p 203)

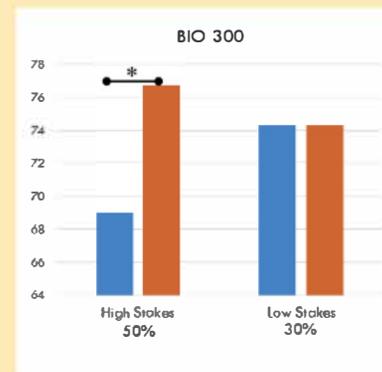
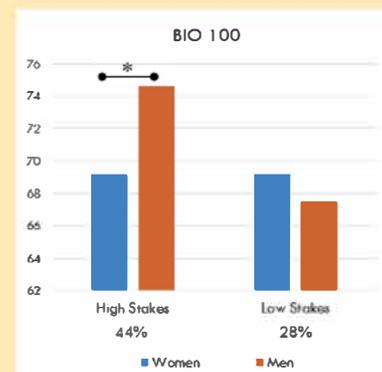
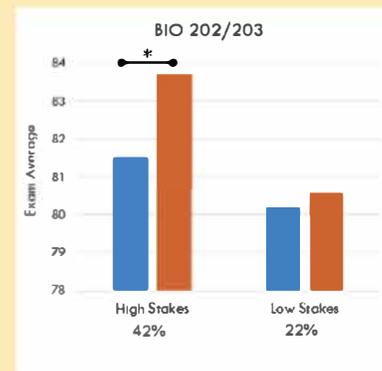
Class structures that minimize anxiety about exams.

Consider modifying exam frequency and weight. One of the more straightforward options to reduce exam-related stress and anxiety is to have more frequent and smaller point value exams, allowing students more opportunities to succeed in the class. This has been shown to make classes more equitable by reducing the gender gap in cases where exams were 50% or less of the total course grade (Cotner et al 2017; figures at right derived from this paper). Cotner and colleagues' study included an analysis of classes where the exams counted for different percentages of the class in separate semesters. In the three classes analyzed, women's performance on exams was depressed in courses where exams comprised a higher percentage of the total class grade.

Clarify your expectations. A common student complaint is that they are unsure of what material is important in a class, and what depth level they need to answer questions on an exam. Make your expectations clear by using learning objectives in class and by discussing example questions and responses with students.

Use pre- and post-test prompts that promote student metacognition. Use approaches that help students plan their study (e.g., the [Strategic Resource Use exercise](#)) and that promote student reflection on exam performance.

Introduce approaches that can mitigate test-related anxiety, such as [expressive writing](#) and [values affirmation](#) exercises.



Good test-writing practice.

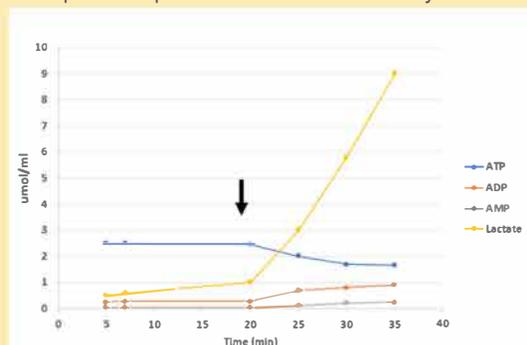
Use test blueprints. A test blueprint, also known as a table of specification, is a way to systematically plan your exam, considering what content it should cover, what skills students should demonstrate, and what fraction of your test should require higher order thinking vs. basic knowledge (see example). A test blueprint can help you stay on track as you write the test, making sure that you test the content and ways of thinking that matter to you.

Include opportunities for partial credit that are easy to grade. Examples include question clusters like the examples shown from chemistry and physics courses and multiple T/F like the example shown from a biochemistry course.

Sequence questions intentionally. Sequencing questions according to the order in which topics were covered in class or from less-to-more difficult can have benefits for students (Hauck et al., 2017; Weinstein and Roediger, 2010; Jackson and Greene, 2014).

Use good practice in question writing. In brief, for multiple choice questions, be attentive to two things: 1) questions that are difficult to read (e.g., due to wordy alternatives or answers like A only, A and B, A and C but not B); and 2) questions that inadvertently tip off test-wise students to the correct answer (e.g., such as a longer correct answer than distractors). For free response questions, define the question or task clearly so that students know what they're supposed to do as shown in example at right. More in the full guide!

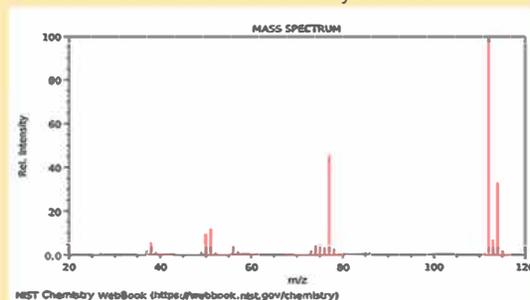
Multiple T/F question from biochemistry course



The figure shows the effect of a poison (added at time indicated by ATP, ADP, and AMP concentration in cultured rat cells. Which poisons could produce the effect shown? Mark each answer as true or false.

- Antimycin A, which inhibits electron transfer at Complex 3
- CN⁻, which inhibits reduction of O₂ at Complex 4
- Fluoroacetate, which inhibits aconitase
- Oligomycin B, which inhibits ATP synthase

Question cluster from chemistry course



The Mass Spectrum below is for a substituted hydrocarbon.

- Identify the substituent
- Identify the molar mass of the compound
- Label the following peaks
 - Molecular ion peak
 - M+1 or M+2, if either exists
 - Base peak
- What is the molecular formula for this substituted alkane?
- Predict the structure of this molecule.

Test blueprint

Content area	Number of class sessions	Percentage of points on exam	Distribution across types of questions	
Introduction to metabolism	1 of 10	10%	Understand	5%
			Higher order	5%
			Total	10%
Glycolysis	2 of 10	20%	Remember	5%
			Understand	5%
			Higher order	10%
			Total	20%
Citric acid cycle	2 of 10	20%	Remember	5%
			Understand	5%
			Higher order	10%
			Total	20%
Electron transport & oxidative phosphorylation	5 of 10	50%	Remember	10%
			Understand	20%
			Higher order	20%
			Total	50%

Free response question describing expectations

The sliding clamp and the DNA helicase that function at the replication fork both have three-dimensional structures resembling a ring with a central hole through which DNA is threaded. Which of these proteins, the clamp or the helicase, do you think has a wider hole in its structure? *Your answer must include a brief statement about the function of each protein and how that function affects your answer (1-2 sentences for each).*

Question cluster from physics course

- (5points) A light wave is propagating in air at an angle of 30° from vertical. It is then incident on a horizontal air/oil interface where some of the light is reflected and some is transmitted into the oil. What happen to each of the following characteristics of the light wave once it passes into the oil?

Please circle an option for each characteristic.

Characteristic	increases	decreases	unchanged
Angle of propagation with respect to vertical			
Speed			
Wavelength			
Frequency			
Energy per photon			