Teaching STEM at the University of South Florida

Edited by Amanda Helip-Wooley

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STEER

Systemic Transformation of Education through Evidence-Based Reforms, or STEER, is an NSF funded partnership between the University of South Florida (USF) and Hillsborough Community College (HCC). The goal of STEER is to create a student-focused culture of evidence-based teaching in Tampa Bay's public post-secondary institutions. This culture leads to the successful recruitment, retention and graduation of diverse students who are prepared for life, citizenship, and careers in Science, Technology, Engineering and Mathematics (STEM). The STEER leadership includes:

Gerhard Meisels, Director of the Coalition for Science Literacy, Professor of Chemistry

Robert Potter, Associate Dean of the College of Arts and Sciences, Professor of Chemistry

Jennifer Lewis, Director of the Center for the Improvement of Teaching and Research on Undergraduate STEM, Associate Chair and Professor of Chemistry

Peter Stiling, Special Assistant to the Provost, Professor of Biology

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Learning Science
Life Skills for Student Success
Backward Design
Effective Presentations
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The Importance of Successful Teaching in STEM

STEM Teaching in Perspective

The President's Council of Advisors on Science and Technology (PCAST) issued a report in 2012 outlining the need to produce 1 million more Science, Technology, Engineering and Mathematics (STEM) professionals in the U.S. during the next decade than would be produced at current rates. Nationwide, completion rates are significantly lower in STEM disciplines than in other majors, particularly for students from underrepresented racial and ethnic groups (Kober, 2015). This suggests that one way to address the goal of increased STEM professionals is to retain more students in STEM majors and guide them to successful completion of their degrees. For graduate teaching assistants and faculty in STEM this means teaching in a way that motivates, engages, and supports the learning of all students.

Evidence-Based Instruction

Discipline-Based Education Research (DBER) studies indicate that evidence-based instruction, including student-centered instructional strategies, are more effective in improving students' conceptual understanding, knowledge retention, and

attitudes about learning than traditional lecture-based methods. Student-centered instruction is such that learners are actively engaged and apply the methods and principles of a discipline to build their understanding. Usually this occurs through interactions with fellow students under the guidance of an instructor. Though the terms are not interchangeable, there are several terms that are used almost interchangeably for this type of instruction, including: active learning, student-centered instruction, research-based instruction, evidence-based teaching or evidence-based pedagogy. These strategies have been shown to be effective across all STEM disciplines (Kober, 2015).

As described by Kober (2015) effective instructors approach teaching as they would research. In general this involves:

- Changing a mindset on what constitutes teaching. Moving from a traditional transmission of information towards helping students acquire a certain level of understanding and skills.
- Establishing learning outcomes that define what students should know and be able to do by the end of a unit, course, or lesson.
- Designing or adapting curriculum materials and instructional strategies that will help students achieve these outcomes.
- Collecting evidence to determine how well these outcomes are being met. Evidence can be traditional assessments (quizzes and exams), pre- and post-instruction surveys of students, and reflection and note-taking after each class on what worked and what didn't.

- Using the evidence collected to guide teaching and subsequent improvements to the course.

Evidence-Based Teaching Resources

- Center for the Integration of Research, Teaching, Learning (CIRTL): http://www.cirtl.net/
- Science Education Resource Center (SERC): http://serc.carleton.edu/index.html
- STEER Transforming STEM Education: http://www.usf.edu/atle/steer/#
- STEM Central: https://stem-central.net/
- STEMEdhub: https://stemedhub.org/
- Student-Centered Active Learning Environment with Upside-down Pedagogies (SCALE-UP): http://scaleup.ncsu.edu/
- The Process Oriented Guided Inquiry Learning (POGIL) Project: https://pogil.org/

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Role of the STEM Teaching Assistant

Introduction

Welcome to the University of South Florida! We are grateful you have decided to pursue your academic career here and help our students grow into global citizens. We are convinced the experience you are about to begin will be an extraordinary one and one that will also help you develop as a teacher and scholar. While you may find teaching to be challenging at times, it can also be very rewarding to watch your students learn and mature.

Since you are also a student, it is important to balance your responsibilities well. When in doubt as to how to handle conflicting priorities, consult with more experienced teaching assistants, coordinators, and your professors. Maintain regular contact with your direct supervisor to ensure you are advancing at the appropriate pace. If you wish to improve your teaching skills, feel free to contact the Academy for Teaching and Learning (ATLE) and we will help you become the best teacher you can be.

We wish you all the best in your new position.

Professionalism

You will probably be the first point of contact many students have with your department and your discipline and it is essential to behave with professionalism. Students learn from you, from your demeanor, to the way you interact with them, to the feedback you provide them on their work. We encourage you to share with students your passion for your discipline and your enthusiasm for learning. In all your interactions with students, keep in mind you represent the university and are the ambassador of your discipline. The following are three keys to fulfilling your responsibilities that will ensure your success at the university:

1. **Be prepared and professional**
   Being prepared means not only being familiar with content, but also carefully considering how the material is presented, anticipating areas of difficulty, and synthesizing alternative explanations and activities. Being a professional means coming to class on time, holding scheduled office hours, responding to student messages, grading assignments within a reasonable period of time, and clearly defining your expectations about assignments, classroom behavior and grading.

2. **Treat students with respect**
   Students of all backgrounds have a right to be treated with respect and to be evaluated fairly. Be mindful of how your conduct or comments might be interpreted, especially by students from different cultures and circumstances.

3. **Be an ally, not a friend**

   The teacher-student relationship is professional and formal. You are first and foremost an ally for the students' learning. Students quickly lose respect for instructors who seem more interested in making friends than doing their jobs.

Teaching and Learning in STEM

Introduction

There are hundreds of books available on teaching and learning. Since it is unlikely you will be able to read them all before the semester starts, we will attempt to convey, as concisely as possible, some of the wisdom, tips, and tricks most relevant for teaching undergraduates. No matter what the subject, effective teaching boils down to a few simple things:

1. **Begin with the end in mind** - What do you want the students to know or be able to do by the end of the course, unit, class period, lesson or activity? How is that information best learned?

2. **Know your audience** - What knowledge, skills, misconceptions, and challenges do your students bring with them? Learning cannot occur if you are teaching too far above or below their level. How do you know? How does that effect your teaching?

3. **Engage them** – There is no learning without attention. Get it and keep it. Interactive activities and discussions that keep students actively participating naturally increase engagement.

If you lecture, think about how to be an engaging speaker and how to break up lectures to maximize audience participation.

4. **Assess learning** – How do you know if they're "getting" it? Constant feedback on student learning can be gathered through interactive activities, discussion, written or oral output, tests and quizzes, and simply listening in on group discussions. If the only feedback you receive is the final exam scores, it is a missed opportunity for both you and your students.

Each of these topics will be discussed in greater detail in the sections that follow. Before we discuss teaching, however, it is important to summarize what is known about how the brain learns.

The Science of Learning

What do we know about how students learn and how can we apply this knowledge to our teaching? The lessons from learning science literature can be boiled-down to six principles about learning that are relevant to every teacher. The mnemonic "ANSWER" helps to summarize these six principles: Attention, Novelty, Spacing, Why, Emotion, and Residue. Below is a brief explanation for each of these six principles and how they might apply to your teaching.

A = Attention - Memory formation requires focused attention

- Multitasking yields up to 50% more errors
- The brain is plastic and rewires itself, but ONLY if attention is paid
- Primacy-recency effect: use the first and last part of your class for high impact

N = Novelty - The brain is attracted to novelty

- Brain seeks stimuli and has built-in curiosity
- Attention wears down over time; take breaks and reset
- Novelty increases motivation and interest
- Practice should be varied
- Multisensory input is better than unisensory
- Dual encoding (asks students to visualize a concept heard verbally, or verbalize something only seen) creates additional hippocampus pathways and increases chance of survival
- Images and imagining promote novelty and increase retention

- Mystery drives novelty (and the corollary: visible lecture notes decrease novelty)
- Implicit learning can add fun and novelty
- All learning is initially episodic – this provides context clues to make the recall easier once it (later) becomes semantic; thus, wackiness stands out

S = Spacing – Distributed or spaced practice works best for the long term

- Massed practice (including cramming) is poorly productive for long term memory
- What works best for *short* term memory doesn't work for *long* (and vice versa)
- Distributed practice yields best results
- Mixed practice (interleaving) brings positive benefits
- Retrieval practice (practice testing, self-quizzing) interrupts the forgetting process
- Reflection is a form of retrieval practice
- Wait time is crucial to allow for student recall to occur

W = Why - Meaning helps retention

- Meaningful learning occurs when students select, organize, and integrate information, either independently or in groups (the basis of active learning)
- The brain actively seeks to make sense of new knowledge by connecting it with prior knowledge and experience
- Prior knowledge shapes learning
    - Accurate prior knowledge is the foundation for new learning
    - Incomplete knowledge is a gap that must be filled in or bridged

    - Incorrect prior knowledge makes it difficult to integrate new knowledge and hinders learning
- High perceived utility increases retention and motivation
- Cognition is fundamentally different early and late in training
- We solve new problems better when we understand the underlying principles or 'rules'
- Elaboration connects to contexts and builds on underlying principles
- Transference (use it in a new application) demonstrates real learning
- Students who can transfer their knowledge to new situations learn more readily
- If students learn a concept mostly by working on problems and examples that are similar in context their knowledge can become "context-bound"
- Predicting-and-failing is better than watching a presentation; make them guess!
- Metacognition (mind's ability to monitor and control its own activities) helps learning
    - students with greater metacognitive capacity are better learners overall, monitor their comprehension as they learn
    - metacognitive strategies can be included in coursework, for example, incorporating reflection steps and self-explanation prompts

E = Emotions - Memory formation involves the limbic system, which is associated with emotions

- Working memory is housed in the hippocampus

- Cortisol (stress) is bad for the hippocampus's optimal functioning
- Emotions can impact perception of teacher AND subject matter
- Memory is associative (more like a reconstruction than a true recall). "Fire together, wire together"
- The brain is an organ: nutrition, hydration, sleep, exercise matter (the brain uses up to 25% of the body's energy)
- Memories are made during sleep – the cleaning out of toxins
- Read notes JUST before sleep to aid consolidation

R = Residue - Memory is the residue of thought

- There is no learning without memory
- Learning is effortful (makes it deeper/durable; challenging is better)
- Laptop notes discourage thought
- Proficiency requires practice
- Learning styles are not supported by the literature
- Factual knowledge precedes skill
- Chunking creates patterns, patterns are easier to remember – chunking increases cognitive capacity
- Short Term Memory stays in hippocampus; without encoding, it doesn't become stored in larger lobes

Life Skills for Student Success

Grit: Five characteristics: courage, conscientiousness, follow through, resilience and excellence, shared by individuals who succeed in the face of obstacles. Angela Duckworth: *Grit: The Power of Passion and Perseverance* (2016). https://www.ted.com/talks/angela_lee_duckworth_the_key_to_success_grit

Growth Mindset: Individuals with a growth mindset believe that intelligence is malleable and are more motivated to learn and exert effort, as opposed to the fixed-mindset in which intelligence is perceived as an inborn trait and deviation from perfection reflects poorly on their inherent intelligence. Carol Dweck: *Mindset: The New Psychology of Success*. (2008). https://www.ted.com/talks/carol_dweck_the_power_of_believing_that_you_can_improve?language=en

Aspects of Learning Central to STEM

Experts organize knowledge and approach problems differently from novices (students). The continuum of novice to expert understanding in a discipline extends to more than just content. In STEM, an expert's deep understanding of concepts and principles leads to a framework for organizing this knowledge and enables them to notice patterns, relationships, and discrepancies or make inferences and draw conclusions. Students need to acquire foundational knowledge in a discipline as well as a coherent mental framework. There is strong evidence that collaborative activities enhance the effectiveness of student-centered learning over traditional instruction, improve retention of content knowledge, and help to build this framework (Kober, 2015 and Singer, 2012).

The majority of DBER studies focus on three aspects of learning that are central to developing competency in STEM disciplines at the undergraduate level (Kober, 2015):

1. Understanding and applying the fundamental concepts of a discipline
2. Framing and solving problems with greater expertise
3. Using visual and mathematical representations, such as graphs, models, and equations, of important ideas and situations in a discipline

Understanding and Applying the Fundamental Concepts of a Discipline

It is essential to assess students' conceptual understanding. What they know, what they understand incompletely, and where they have misconceptions. Assessments can be via formal concept inventories, quizzes, and exams or informal classroom assessments (clicker questions, "muddiest point' reflections, etc.). Misconceptions and the underlying reasoning that causes them must be addressed. A variety of approaches helps students to refine or replace misconceptions. Students will need multiple exposures to the same concept in different contexts. For example:

- Interactive Lecture Demonstrations (ILDs): physical demonstrations of scientific phenomena that the instructor conducts in class. Students first predict what will happen before the instructor does the demonstration, then discuss their predictions in small peer groups and explain their predictions to the whole class. Then the class observes the demonstration. In the final stage, students compare their observations to their predictions. Research shows that demonstrations must be conducted in the context of asking students to make predictions beforehand for learning to occur.
- Bridging analogies: connect a situation that students understand correctly with another situation about which they have a misconception.

- Scaffolding: start with what students know and provide them with successive levels of temporary support to move them toward more accurate understanding. Support is then gradually removed.

Framing and Solving Problems with Greater Expertise

To solve problems effectively, students must not only have conceptual understanding, they must be able to apply those concepts correctly. Students typically focus on the superficial features of a problem (specific objects, terms, and phrasing) whereas experts look at the deeper structure of the problem (the underlying principles required to solve it). By focusing on superficial aspects, students miss the essence of a problem, making it harder to solve, and more difficult to transfer knowledge to other problems or contexts. Strategies for moving students from novice toward expert problem-solving approaches (Singer, 2012) include:

- Teaching specific, organized methods for solving problems
- Explaining the different problem types
- Providing examples of problems with the solutions worked out
- Providing guidance and greater classroom interaction
- Having students solve problems in collaborative groups
- Making symbols more transparent to students by using more explicit labeling

- Assigning authentic (real-world) problems
- Assigning open-ended problems that encourage students to invent and test various models to solve them
- Incorporating prompts for students to reflect on and explain their approaches to solving problems

Using Visual and Mathematical Representations

Novices often have trouble seeing beyond superficial but irrelevant features of a visual representation to grasp the abstract idea being represented. When students construct their own representations or when modeling is explicitly taught, in addition to interpreting representations produced by experts, students are often more engaged and learn better (Kober, 2015). Students may need more explicit introductions to the conventions of various kinds of representations and may require extensive opportunities to practice interpreting and producing multiple types of representations. Students have often have difficulty with:

- Processing diagrams that violate familiar conventions, such as left to right visual processing (the direction in which text is read)
- Seeing similarities among different representations that describe the same phenomenon
- Spatial thinking – visualizing a 3-dimensional structure from a 2-dimensional drawing

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Backward Design

Think of backward design as starting at the end of the semester, and looking back toward the beginning. If you know what students should be able to do by the end of the semester this will tell you several things:

a. What content and skills they need to learn

b. When and how they will acquire this knowledge and refine these skills

c. How to assess that they can do it

Taken together, the work of the teacher can be thought of in the simple formula:

$$T = C\ P\ A$$

Teaching = Content | Practice | Assessment

All three of these components (content, practice, and assessment) can be thought of in terms of learning outcomes. At USF the terms OBJECTIVES and LEARNING OUTCOMES are used and it is important to make a distinction between the two. Objectives are big, broad, and not easily measured. For example, one of USF's institutional objectives is to create "well-educated and highly skilled global citizens." Since objectives defined in this way are difficult to measure, we

create smaller, achievable, and measurable sub-goals that we call learning outcomes. That way, once it can be demonstrated that these learning outcomes have been achieved, the implication is that we are moving closer to our overall objective. Understanding how to write learning outcomes can be very helpful in designing a course or interpreting a course that has been designed for you to implement.

Outcomes should be written with ACTION verbs, must be measurable, and should focus on what students can do by the end of the semester. The usual format is to begin with the phrase "By the end of this course, students will be able to..." and then supply action verbs. Here are some examples:

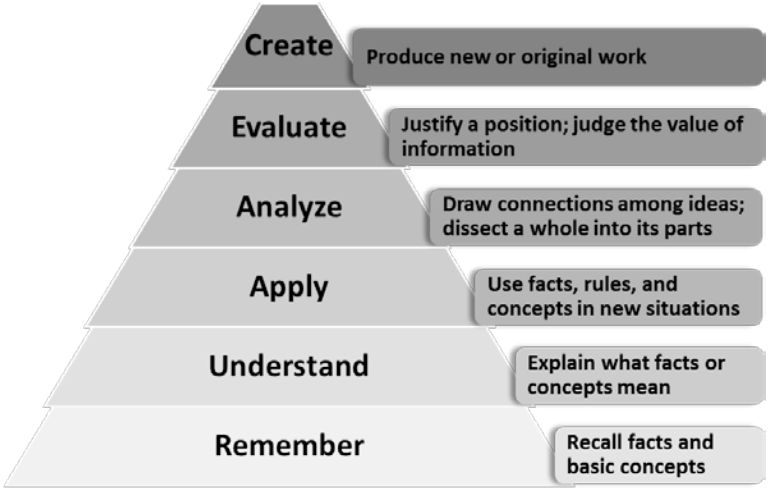
By the end of this course, students will be able to

1. define artificial selection.
2. summarize natural selection.
3. calculate the coefficient of linkage disequilibrium in a given population.
4. contrast natural selection with artificial selection.
5. predict the effect of a close friendship between Charles Darwin and Gregor Mendel on Darwin's *On the Origin of Species.*
6. construct a phylogenetic tree given morphological or sequence data for sample taxa.

One useful tool for designing learning outcomes is Bloom's Taxonomy, as will be described in the next section.

Bloom's Taxonomy

Bloom's Taxonomy lists six levels of cognitive skills, from basic remembering and understanding to higher-order tasks like evaluating and creating. It is often depicted as a pyramid, to show that the higher order processes build on the foundation provided by the lower levels.



Bloom's taxonomy is a useful tool for guiding discussions (see Facilitating Discussions section) and for thinking about what you want students to achieve. The accompanying list of action verbs for each level of Bloom's Taxonomy can be helpful when writing learning outcomes.

Cognitive Levels	Action Verbs
Remember • recall information • memorize facts	arrange, define, describe, designate, duplicate, enumerate, identify, indicate, know, label, list, match, name, recall, recite, recognize, record, repeat, reproduce, select, state
Understand • grasp meaning • explain in other words • interpret facts	alter, change, cite, convert, demonstrate, describe, discuss, estimate, explain, express, extrapolate, generalize, give examples, identify, illustrate, indicate, interpret, paraphrase, predict, recognize, report, represent, restate, revise, rewrite, simplify, summarize, translate
Apply • use information • solve problems using skills/ knowledge • identify relationships • transfer to new situations	apply, articulate, calculate, chart, collect, compute, construct, contribute, demonstrate, derive, determine, develop, discover, dramatize, employ, establish, extend, illustrate, implement, include, investigate, manipulate, operate, organize, predict, prepare, preserve, produce, project, provide, relate, schedule, show, sketch, solve, transfer, translate, use, utilize, write
Analyze (higher level) • see patterns • organize parts • identify components	analyze, break down, categorize, compare, contrast, correlate, determine, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, induce, infer, inspect, outline, prioritize, question, recognize, relate, select, separate, subdivide, solve, test

Evaluate (higher level) • compare and discriminate • assess value of theories • verify value of evidence	appraise, argue, assess, conclude, contrast, criticize, critique, decide, defend, estimate, evaluate, grade, interpret, judge, justify, predict, rate, reframe, revise, score, select, support, value, verify
Create (higher level) • use old ideas to create new • generalize from given facts • synthesize knowledge from several areas • predict, draw conclusions	assemble, build, collaborate, collect, combine, communicate, compile, compose, construct, create, design, devise, develop, facilitate, formulate, generate, incorporate, integrate, intervene, manage, model, modify, negotiate, organize, perform, plan, prepare, produce, propose, reinforce, relate, reorganize, revise, set up, structure, substitute, synthesize, unite

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Effective Presentations

We know an effective presentation by how engaged we feel during it. A good lecturer creates and sustains a powerful relationship between the audience and the subject of the presentation. The key to building such a relationship is interaction. The students must experience a need or desire to enter into this relationship and to remain *engaged*. Many effective presentations begin with a "hook," something that grabs attention and leaves us wanting to know more. This can be a driving question, one that isn't easily answered and evokes curiosity and desire, a problem to solve, or a demonstration. The end of the presentation should then come back to this "hook" in a way that allows students to reflect and demonstrate their understanding of the content and its relevance. General tips for presentations are below and a good series of YouTube videos on the topic of how to speak can be found at: https://www.youtube.com/watch?v=RjbmPuhuFv0&list=PL9F536001A3C605FC.

Best Practices in Presentations

- **Maximize clarity and organization.** Announce your daily outcomes on the board and make transitions between segments of your lesson explicit.
- **Require students to become active learners.** Combat student anonymity and passivity, two features which

work against learning, by requiring students to participate and engage with the material.

- **Use a variety of classroom interactive techniques.** These activities keep students actively involved and give you feedback on their level of understanding. Be sure to switch it up and use different techniques to keep them from getting boring. A list of techniques is included in the following section.
- **Be conversational**. Don't lecture AT them, just talk WITH them. Don't simply READ your presentation. Attempt to approximate the feel of a one-on-one conversation.
- **Use your voice effectively**. Speak clearly and project. Vary the speed, loudness, and tone of your voice while making sure everyone in the room can hear you. Do not use a monotone voice. These variations can be used to great effect to signify important material.
- **Achieve eye contact with ALL parts of the room**. Consider dividing the room up into quadrants and vary where you direct your gaze.
- **Circulate.** Don't become stuck behind the podium, move around the room.
- **Gauge audience reaction and adjust accordingly**. Bored audiences can be brought back with voice variation and suddenly energetic presentations. Watch your audience to know when it's time to shift gears.
- **Promote real-world application of the learning.** Student learning is multiplied when they perceive relevance to the material. Try to start with a real-world problem and work backward to the concept/formula/etc. underlying it.

- **Come across as enthusiastic and energetic**. Allow your passion for the subject and for teaching to shine through. A study of effective presentations found these facets important in establishing believability:
  Verbal (words you say): 7%
  Vocal (how you sound when you say them): 38%
  Visual (how you look when you say them): 55%

- **Use boards effectively**. Write down important material that you want students to write in their own notes. Write legibly and in large font. Do not speak when facing away from the class.
- **Create pictures verbally or use visuals**. A mental image enables you to hold attention longer and can convey information in different ways.
- **Tell stories**. Students react particularly well to teachers who rely upon their own character and history to illustrate examples from the subject matter.
- **Tailor your presentations to appeal to this specific audience**. Undergraduates often react more enthusiastically to word problems or examples that use relevant cultural references.
- **Demand involvement from students in their seats**. Problem-solving or brainstorming can occur individually or in groups; if possible, build the PowerPoint presentation AROUND these problems rather than vice-versa.
- **Reflect on the experience after class.** Were the majority of students engaged? Do the students' performances on the activities, assignments, and assessment suggest they were

able to achieve the day's outcomes? What worked? What didn't work? What should you do differently next time? Write it down immediately after class before you forget.

The Naked Presenter's 10 P's

The 10 P's of presentation: Preparation, Punch, Presence, Projection, Passion, Proximity, Play, Pace, Participation, Power, from Garr Reynolds, *The Naked Presenter* (2010).

1. **Preparation:**
   - Identify your purpose and understand your audience: where is your audience *before* the presentation and where would you like them to be *after*
   - Think of your talk as a story: identify the problem, identify causes of that problem, show how and why to solve it
   - Day of: arrive early, setup the room and test the technology, encourage people to sit in the front, mingle before you begin
2. **PUNCH:** PUNCH is an acronym: Personal, Unexpected, Novel, Challenging, Humorous
3. **Presence:** presentation is a conversation or dialogue, be sincere to your audience
4. **Projection:** not just the content, it's the way you look, the way you move, and the way you sound

5. **Passion**: You can't fake it! Think: How can I demonstrate why this topic or information is important and how can I show why it matters to them.
6. **Proximity:** shorten the distance between you and the audience, bring individual audience members closer to each other while still being sensitive to local perceptions of personal space, remove any barriers between us and the audience
7. **Play:** spirit of play—feeling of exploration and discovery—improves learning and stimulates creative thinking
8. **Pace:** change the pace every 10 minutes or so, remove excess words, slow down when you are nervous
9. **Participation:** ask questions, show a video clip, do role-playing, have a discussion activity, use an inviting and conversational tone
10. **Power:**
    - Create a "sticky" ending (SUCCESs): Simplicity, Unexpectedness, Concreteness, Credibility, Emotions, Stories
    - Do not retreat from your audience and end on a positive note

PowerPoint Tips and Tricks

PowerPoint has become a fixture in many lecture-oriented classrooms. And while this tool can be incredibly useful to assist you in the classroom, it should only be relied on to supplement your delivery of content and engagement with students. Here are a few "DOs" and "DON'Ts" regarding the development and delivery of PowerPoint presentations:

DO:

- Follow the 6 x 6 rule (no more than 6 lines per slide, 6 words per line)
- Choose templates, colors, & fonts carefully
- Use grammatical parallelism
- Use visuals to simplify or reinforce message
- Use section dividers to chunk content

DON'T:

- Cram in too many slides and rush (or skip slides)
- Overpower content with animations & sound effects
- Use generic / poor quality / too many images
- Use complete sentences or long passages of text
- Use transitions between slides of same style

Resources and Further Reading

Dunlosky, J., Rawson, K.A., Marsh, E.J. & Nathan, M.J. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, (14), 4-58.

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Felder, R.M. and Brent, R. (2016). *Teaching and Learning STEM: A Practical Guide*. San Francisco, CA: John Wiley & Sons.

Kober, N. (2015). *Reaching Students: What Research Says About Effective Instruction in Undergraduate Science and Engineering.* Washington, D.C.: National Academies Press.

McKeachie, W.J. and Svinicki, M. (2006) *Teaching Tips: Strategies, Research, and Theory for College and University Teachers.* Boston, MA: Houghton Mifflin.

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Interactive Techniques

Interactive techniques are brief activities that can be strategically incorporated into a lesson plan. These techniques have multiple benefits: 1) breaking-up a lecture and refocusing waning student attention, 2) providing opportunities for students to retrieve and apply content (keys for long-term memory formation), 3) forcing students to be actively engaged, and thus more likely to learn the material, and 4) allowing the instructor to quickly and easily assess if students have mastered the material (and plan to dedicate more time to it or move on). Not all techniques listed here will have universal appeal. Factors such as your teaching style, personality, and the physical classroom constraints may influence which choices are right for you.

Instructor Action: Lecture

1. **Picture Prompt** – Show students an image with no explanation, and ask them to identify/explain it, and justify their answers. Or ask students to write about it using terms from lecture, or to name the processes and concepts shown. Also works well as group activity. Do not give the "answer" until they have explored all options first.
2. **Think Break** – Ask a rhetorical question, and then allow 20 seconds for students to think about the problem before you go on to explain. This technique encourages students to take part in the problem-solving process even when discussion isn't feasible. Having students write something

down (while you write an answer also) helps assure that they will in fact work on the problem.

3. **Choral Response** – Ask a one-word answer to the class at large; volume of answer will suggest degree of comprehension. Very useful to drill new vocabulary words into students.
4. **Instructor Storytelling** – Instructor illustrates a concept, idea, or principle with a real-life application, model, or case-study.
5. **Empty Outlines** – Distribute a partially completed outline of the day's lecture and ask students to fill it in. Useful at start or at end of class.
6. **Classroom Opinion Polls** – Informal hand-raising suffices to test the waters before a controversial subject.
7. **Total Physical Response (TPR)** – Students either stand or sit to indicate their binary answer, such as True/False, to the instructor's questions.
8. **Hand Held Response Cards** – Distribute (or ask students to create) standardized cards that can be held aloft as visual responses to instructor questions. Example: green card for true, red for false. Or hand-write a giant letter on each card to use in multiple choice questions.
9. **Student Polling** – Select some students to travel the room, polling the others on a topic relevant to the course, then report back the results for everyone.
10. **Quote Minus One** – Provide a quote relevant to your topic but leave out a crucial word and ask students to guess what it might be: "I cannot forecast to you the action of _____; it is a riddle, wrapped in a mystery, inside an enigma." This engages them quickly in a topic and makes them feel invested.

11. **Everyday Ethical Dilemmas** – Present an abbreviated case study with an ethical dilemma related to the discipline being studied.
12. **Polar Opposites** – Ask the class to examine two written-out versions of a theory (or corollary, law of nature, etc.), where one is incorrect, such as the opposite or a negation of the other. In deciding which is correct, students will have to examine the problem from all angles.
13. **Pop Culture** – Infuse your lecture, case studies, sample word problems for use during class with current events from the pop culture world. Rather than citing statistics for housing construction, for instance, illustrate the same statistical concept you are teaching by inventing statistics about something students gossip about, like how often a certain pop star appears in public without make-up.
14. **Make Them Guess** – Introduce a new subject by asking an intriguing question, something that few will know the answer to (but should interest all of them). Accept blind guessing for a while before giving the answer to build curiosity.
15. **Make It Personal** – Design class activities (or even essays) to address the real lives of the individual students. Instead of asking for reflections on Down's Syndrome, ask for personal stories of neurological problems by a family member or anyone they have ever met.
16. **Read Aloud** – Choose a small text (500 words or less) to read aloud, and ask students to pay particular attention during this phase of lecture. A small text read orally in a larger lecture can focus attention.
17. **Punctuated Lectures** – Ask students to perform five steps: listen, stop, reflect, write, give feedback. Students become self-monitoring listeners.

18. **Word of the Day** – Select an important term and highlight it throughout the class session, working it into as many concepts as possible. Challenge students to do the same in their interactive activities.
19. **Recall, Summarize, Question, Connect, and Comment** – This method of starting each session (or each week) has five steps to reinforce the previous session's material: recall it, summarize it, phrase a remaining question, connect it to the class as a whole, and comment on that class session.
20. **Focused Listing** – List several ideas related to the main focus point. Helpful for starting new topics.
21. **Background Knowledge Probe** – Use questionnaire (multi-choice or short answer) when introducing a new topic.
22. **Goal Ranking and Matching** – Students rank their goals for the class, then instructor combines those with her own list.
23. **Interest/Knowledge/Skills Checklist** – Assesses interest and preparation for the course, and can help adjust teaching agenda.
24. **Documented Problem Solutions** – Keep track of the steps needed to solve specific *types* of problems. Model a list for students first and then ask them to perform similar steps.

Instructor Action: Lecture (Small Class Size)

25. **Pass the Chalk** – Provide chalk or a soft toy; whoever has it must answer your next question, and they pass it on to the student of their choice.
26. **Quaker Meeting** – Students highlight key passages of the reading, and there is silence (like a Quaker meeting) until someone wants to read his/her passage out loud, and

others follow. End with brief writing about what they learned from the sentences.

27. **Town Hall Meeting** – Abdicate the front of the room for a student willing to speak out on a controversial subject, and when she is done with her comment, she selects the next speaker from the hands raised.
28. **The Half Class Lecture** – Divide the class in half and provide reading material to one half. Lecture on that same material to the other half of the class. Then, switch the groups and repeat, ending with a recap by pairing up members of opposite groups.
29. **Tournament** – Divide the class into at least two groups and announce a competition for most points on a practice test. Let them study a topic together and then give that quiz, tallying points. After each round, let them study the next topic before quizzing again. The points should be carried over from round to round. The student impulse for competition will focus their engagement onto the material itself.

Student Action: Individual (many of these can be used as partnerwork or groupwork instead; or may escalate to that after some individual effort)

30. **One-Minute Papers** – Students write for one minute on a specific question (which might be generalized to "what was the most important thing you learned today"). Best used at the end of the class session.
31. **Muddiest Point** – Like the Minute Paper, but asks for the "most confusing" point instead. Best used at the end of the class session.

32. **Misconception Check** – Discover class's preconceptions. Useful for starting new chapters.
33. **Drawing for Understanding** – Students illustrate an abstract concept or idea. Comparing drawings around the room can clear up misconceptions.
34. **What's the Principle** – After recognizing the problem, students assess what principle to apply in order to solve it. Helps focus on problem TYPES rather than individual specific problems. Principle(s) should be listed out.
35. **Haiku** – Students write a haiku (a three-line poem: 5-syllable, then 7, then 5) on a given topic or concept, and then share it with others.
36. **True or False?** – Distribute index cards (one to each student) on which is written a statement. Half of the cards will contain statements that are true, half false. Students decide if theirs is one of the true statements or not, using whatever means they desire. Variation: designate half the room a space for those who think their statements are true, and the other half for false.
37. **"Real-World"** – Have students discuss in class how a topic or concept relates to a real-world application or product. Then have students write about this topic for homework. Variation: ask them to record their answers on index cards.
38. **Concept Mapping** – Students write keywords onto sticky notes and then organize them into a flowchart. Could be less structured: students simply draw the connections they make between concepts.
39. **Advice Letter** – Students write a letter of advice to future students on how to be successful students in that course.
40. **Tabloid Titles** – Ask students to write a tabloid-style headline that would illustrate the concept currently being discussed. Share and choose the best.

41. **Bumper Stickers** – Ask students to write a slogan-like bumper sticker to illustrate a particular concept from lecture. Variation: can be used to ask them to sum up the entire course in one sentence.
42. **One-Sentence Summary** – Summarize the topic into one sentence that incorporates all of who/what/when/where/why/how creatively.
43. **Directed Paraphrasing** – Students are asked to paraphrase part of a lesson for a specific audience (and a specific purpose).
44. **Word Journal** – First, summarize the entire topic on paper with a single word. Then use a paragraph to explain your word choice.
45. **Truth Statements** – Either to introduce a topic or check comprehension, ask individuals to list out "It is true that…" statements on the topic being discussed. The ensuing discussion might illustrate how ambiguous knowledge is sometimes.
46. **Outcome Check** – Students write a brief essay in which they evaluate to what extent their work fulfills an assignment's outcomes.
47. **Opposites** – Instructor lists out one or more concept, for which students must come up with an antonym, and then defend their choice.
48. **Student Storytelling** – Students are given assignments that make use of a given concept in relation to something that seems personally relevant (such as requiring the topic to be someone in their family).
49. **Application to Major** – During last 15 minutes of class, ask students to write a short article about how the point applies to their major.
50. **Pro and Con Grid** – Students list out the pros and cons for a given subject.

51. **Harvesting** – After an experience/activity in class, ask students to reflect on "what" they learned, "so what" (why is it important and what are the implications), and "now what" (how to apply it or do things differently).
52. **Chain Notes** – Instructor pre-distributes index cards and passes around an envelope, on which is written a question relating to the learning environment (i.e., are the group discussions useful?) Students write a very brief answer, drop in their own card, and pass the envelope to the next student.
53. **Focused Autobiographical Sketches** – Focuses on a single successful learning experience, one relevant to the current course.
54. **Course-Related Self-Confidence Surveys** – Simple questions that measure how self-confident students are when it comes to a specific skill. Once they become aware they can do it, they focus on it more.
55. **Profiles of Admirable Individuals** – Students prepare a brief profile of an individual in a field related to the course. Students assess their own values and learn best practices for this field.
56. **Memory Matrix** – Identify a key taxonomy and then design a grid that represents those interrelationships. Keep it simple at first. Avoid trivial or ambiguous relationship, which tend to backfire by focusing students on superficial kinds of learning. Although probably most useful in introductory course, this technique can also be used to help develop basic study skills for students who plan to continue in the field
57. **Categorizing Grid** – Hand out rectangles divided into cells and a jumbled listing of terms that need to be categorized by row and column.

58. **Defining Features Matrix** – Hand out a simple table where students decide if a defining feature is PRESENT or ABSENT. For instance, they might have to read through several descriptions of theories and decide if each refers to behaviorist or constructivist models of learning.
59. **What/How/Why Outlines** – Write brief notes answering the what / how / why questions when analyzing a message or text.
60. **Approximate Analogies** – Students provide the second half of an analogy (A is to B as X is to Y).
61. **Problem Recognition Tasks** – Offer case studies with different types of problems and ask students to identify the TYPE of problem (which is different from solving it)
62. **Switch it up**! – Ask students to work on one problem for a few minutes and intentionally move to a second problem without debriefing the first one, then solve the second one and only then return to the first one for more work. A carefully chosen second problem can shed light on the first problem, but this also works well if the problems are not directly related to each other.
63. **Reading Rating Sheets** – Students fill out a ratings sheet on the course reading, on how clear, useful, and interesting it was.
64. **Assignment Assessments** – Students give feedback on their homework assignment, and evaluate them as learning tools.
65. **Exam Evaluations** – Students explain what they are learning from exam, and evaluate the fairness, usefulness, and quality of tests.
66. **Group-Work Evaluations** – Questionnaires asking how effective group-work has been in the class.
67. **Teacher-Designed Feedback Forms** – Rather than use standardized evaluation form, teachers create ones tailored

for their needs and their classes. Especially useful midway through the term.

68. **Writing Fables** – Students write an animal fable (or at least sketch its outline) that will lead to a one-sentence moral matching the current concept discussed in class. May be done verbally instead.

Student Action: Pairs

69. **Think-Pair-Share** – Students share and compare possible answers to a question with a partner before addressing the larger class.
70. **Pair-Share-Repeat** – After a pair-share experience, ask students to find a new partner and debrief the wisdom of the *old* partnership to this *new* partner.
71. **Wisdom of Another** – After any individual brainstorm or creative activity, partner students up to share their results. Then, call for volunteers of students who found their partner's work to be interesting or exemplary. Students are sometimes more willing to share in plenary the work of fellow students than their own work.
72. **Forced Debate** – Students debate in pair, but must defend the opposite side of their personal opinion. Variation: half the class take one position, half the other. They line up and face each other. Each student may only speak once, so that all students on both sides can engage the issue.
73. **Optimist/Pessimist** – In pair, students take opposite emotional sides of a conversation. This technique can be applied to case studies and problem solving as well.
74. **Peer Review Writing Task** – To assist students with a writing assignment, encourage them to exchange drafts with a partner. The partner reads the essay and writes a three-paragraph response: the first paragraph outlines the

strengths of the essay, the second paragraph discusses the essay's problem, and the third paragraph is a description of what the partner would focus on in revision, if it were her essay.

75. **Invented Dialogues** – Students weave together real quotes from primary source, or invent ones to fit the speaker and context.
76. **My Christmas Gift** – Students mentally select one of their recent gifts as related to or emblematic of a concept given in class, and must tell their partners how this gift relates to the concept. The one with a closer connection wins.
77. **Psychoanalysis** – Students get into pairs and interview one another about a recent learning unit. The focus, however, is upon analysis of the material rather than rote memorization. Sample Interview Questions: Can you describe to me the topic that you would like to analyze today? What were your attitudes/beliefs before this topic? How did your attitudes/beliefs change after learning about this topic? How will/have your actions/decisions altered based on your learning of this topic? How have your perceptions of others/events changed?

Student Action: Groups

78. **Jigsaw (Group Experts)** – Give each group a different topic. Re-mix groups with one planted "expert" on each topic, who now has to teach his new group.
79. **Pick the Winner** – Divide the class into groups and have all groups work on the same problem and record an answer/strategy on paper. Then, ask groups to switch with a nearby group, and evaluate *their* answer. After a few minutes, allow each set of groups to merge and ask them

to select the better answer from the two choice, which will be presented to the class as a whole.

80. **Lecture Reaction** – Divide the class into four groups after a lecture: "questioners" (must ask two questions related to the material), "example givers" (provide applications), "divergent thinkers" (must disagree with some points of the lecture), and "agreers" (explain which points they agreed with or found helpful). After discussion, brief the whole class.
81. **Movie Application** – In group, students discuss examples of movies that made use of a concept or event discussed in class, trying to identify at least one way the movie-makers got it right, and one way they got it wrong.
82. **Student Pictures** – Ask students to bring their own pictures from home to illustrate a specific concept to their working groups.
83. **Definitions and Applications** – In group, students provide definition, association, and applications of concepts discussed in lecture.
84. **TV Commercial** – In group, students create a 30-second TV commercial for the subject currently being discussed in class. Variation: ask them to act out their commercials.
85. **Blender** – Students silently write a definition or brainstorm an idea for several minutes on paper. Then they form into group, and two of them read their ideas and integrate elements from each. A third student reads his, and again integration occurs with the previous two, until finally everyone in the group has been integrated (or has attempted integration).
86. **Human Tableau or Class Modeling** – Groups create living scenes (also of inanimate objects) which relate to the classroom concepts or discussions.

87. **Build From Restricted Components** – Provide limited resources (or a discrete list of ideas that must be used) and either literally or figuratively dump them on the table, asking students in groups to construct a solution using only these things (note: may be familiar from the *Apollo 13* movie). If possible, provide red herring, and ask students to construct a solution using the minimum amount of items possible.

Interactive Techniques Adapted in part from:

Thomas A. Angelo/K. Patricia Cross, Classroom Assessment Techniques. 2nd Edition. Jossey-Bass: San Francisco, 1993.

Alison Morrison-Shetlar/Mary Marwitz, Teaching Creatively: Ideas in Action. Outernet: Eden Prairie, 2001.

Silberman, Mel. Active Learning: 101 Strategies to Teach Any Subject. Allyn and Bacon: Boston, 1996.

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Evidence-Based Teaching Strategies

Evidence-based teaching places less emphasis on the instructor transmitting factual information by lecturing and more emphasis on students building their own understanding with careful structuring and guidance from the instructor. More time is spent engaging students in active learning during class and assessing students' conceptual understanding. This section (including examples) is summarized from Kober (2015) and provides a brief explanation of some of the most common evidence-based strategies for promoting active learning through student collaboration, peer interactions, and making lectures more interactive. Additional specific examples from Kober are summarized in Appendix A.

Flipped Classrooms: students are responsible for learning most of the basic course content through out-of-class reading, research, or pre-recorded video lectures. Class time is freed up for problem solving and other interactive activities. Flipped classroom models vary in the extent to which they use student-centered approaches or rely on lectures (albeit, prerecorded) to convey information.

Interactive Lectures: Research-based strategies intersperse brief (10 to 12-minute) periods of lecture with shorter (3 to 4-minute) student-centered activities, such as:

- **Think-Pair-Share:** engages every student in talking out loud about her or his ideas. The instructor follows these basic steps (Allen and Tanner, 2002):

1. Pose a question during class, often one with many possible answers.
2. Give all students one or two minutes to THINK about their individual answer and jot down their ideas on a piece of paper.
3. Give all students a chance to discuss their answer and ideas with a neighbor in a PAIR or a small group. (The instructor can listen in on their discussions to assess what students do and do not yet understand, identify misconceptions.)
4. Invite pairs to SHARE what they discussed with the whole class. (Consider noting students who use insightful explanations in discussions and ask them to share with the whole class.
5. Wrap up with a summary that emphasizes the main learning points.

Example Questions:

- Biology: What is the basis of making a "designer baby"? Think about the biology of DNA, genes, and traits. What are the advantages and disadvantages? Do you agree or disagree with the idea of a designer baby? Why?
- Geosciences: Put yourself in the mind of a scientist seeing a graph of satellite measurements of ozone concentration above Antarctica from 1979–1992 for the first time. What complexities, patterns, or trends would be important to develop a theory for how this pattern has been generated?

- Astronomy: Rigel is much more luminous than Sirius B. Rigel and Sirius B have the same temperature. Which star has the greatest surface area: Rigel, Sirius B, or do they have the same surface area, or is there insufficient information to answer this question?

The use of Think-Pair-Share and similar types of informal groupings has been associated with: improved achievement, critical thinking, and higher-level reasoning; better understanding of others' perspectives; and positive attitudes about their fellow students, instructors, and the subject matter at hand (Johnson, Johnson, and Smith, 2007).

- **Peer Instruction and ConcepTests:** Students are expected to complete a reading assignment on the topic before class. This technique is suitable for large courses in a lecture auditorium (Crouch and Mazur, 2001).

1. The instructor gives a short presentation then asks all students in the class a multiple-choice question, or ConcepTest.
2. Students are given one minute to arrive at an individual answer and report their responses to the instructor. Students respond with: clickers, colored cards, or other means.
3. Students discuss their answers and their reasoning with their peers in adjacent seats and try to convince each other why their answer is correct.

4. At the end of the peer discussions, students are again polled for their answers, which often have changed based on the discussion.
5. The instructor reviews the correct answer and addresses questions that arose during discussion, and then moves on to the next topic.

Peer interaction is crucial. Simply asking students to respond to clicker questions loses the benefits of having students articulate a rationale for their answer, listen to their peers' reasoning, and try to reach consensus. Evaluations show improvements in students' understanding of the course material as measured by their performance on the ConcepTests and on two standardized tests.

Example Question:
Imagine holding two identical bricks under water. Brick A is just beneath the surface of the water, while brick B is at a greater depth. The force needed to hold brick B in place is: (A) larger than (B) the same as (C) smaller than the force required to hold brick A in place
(correct answer is B)
Good ConcepTest questions:

- focus on important concepts
- include incorrect answers based on common student misunderstandings

- challenge students, such that between 35 percent and 70 percent of the students answer correctly before the peer discussion
- use multiple-choice questions (easiest type to administer in a large class), open-ended questions, or quantitative problems

- **Just-in-Time Teaching (JiTT):** Students do homework in the form of written responses to questions about reading assignments or solutions to problems, and then submit their work via the Web, in time for the instructor to review it before the next class. The instructor can then modify the next lecture to clarify common misunderstandings or accommodate students' interests (Novak, 1999).
- **Just-in-Time-Teaching with Interactive Learning (JiTTIL):** Expanded on JiTT by adding interactive classroom exercises and fast and frequent feedback. Students spend much of the class time working in small groups at round tables on activities based on real-world situations. Inclusion of "muddiest point" reflections for instructor feedback (Krause, Kelly, and Baker, 2012b).
- **Mini-Labs or Other Hands-on Activities:** lectures alternated with mini-lab activities which are collaborative and encourage student discussion.
- **Clickers:** handheld individual reporting devices. The efficacy of clickers depends on how they are used. This includes designing questions to improve student

engagement and interactions with each other and the instructor.

- Focus on particularly important concepts
- Use questions that have multiple plausible answers and will reveal student confusion and generate spirited discussion
- Don't make clicker questions too easy. Students learn more from challenging questions and often learn the most from questions they get wrong
- Give students time to think about the clicker question on their own and then discuss with their peers
- Listen in on the student discussions in order to understand how students think, and address misconceptions on the spot

Group Activities: Students learn from interacting with each other; build on one another's knowledge, ask questions and provide explanations, and come up with ideas that might not occur to an individual working alone. These activities can also develop the kinds of teamwork, decision-making, and interpersonal skills that are integral to the practice of science and engineering. Research has shown that activities in which students collaborate with each other can be more effective than traditional instruction and can improve students' retention of content knowledge (Singer, 2012). Results depend greatly on how these activities are implemented. Here are some general guidelines for group activities:

- Activities can be as brief as 10 or 15 minutes or can last an entire class period or even longer.

- Group work can be integrated into a lecture format or can serve as the predominant form of instruction.
- Group activities can be done in classes of any size and configuration – in large classes, groups typically consist of students seated next to each other; in smaller classes, instructors use a variety of options to group students.
- A variety of activities such as answering questions, solving problems, or conducting investigations can be involved.
- Some form of individual assessments are required to ensure that each student learns; basing a small portion of a student's grade on group performance can be beneficial if done carefully.

Types of Group Activities:

- **Cooperative Learning**: Students work together in small groups to accomplish a common goal. Activities foster interdependence by requiring the cooperation of all members of the group and hold both the individuals and the collective group accountable for completing the work.

- **Collaborative Learning:** Assumes that students learn best by constructing knowledge within a social context and encourages students to coalesce into a "learning community." Intended to foster interdependence among students, but it is less structured than cooperative learning and does not necessarily combine individual and collective accountability.

- **The Jigsaw Technique**: Each student member of a learning group is responsible for learning a portion of the material and teaching it to the rest of the group. The instructor chooses the material, structures the groups, provides

guidance about student roles, monitors their functioning, and helps students summarize, synthesize, and integrate the material. Both individual accountability and achievement of group goals are emphasized.

- **Process Oriented Guided Inquiry Learning (POGIL)**: Students are presented with data or information, followed by leading questions designed to guide them in formulating their own conclusions. Students work in small groups as the instructor observes and facilitates, stepping in as needed to address questions and provide guidance. Detailed information and examples can be found at: https://pogil.org/

- **Cooperative Problem Solving:** Working in small groups, students use a specially designed strategy to solve context-rich problems. These are real-world problems that would be difficult to solve by applying a few equations and plugging in numbers. As students work in groups to solve the problem the instructor observes and listens, diagnosing students' difficulties and occasionally interacting with groups that need help. One member from each group then puts part of their solution on the board, students in other groups examine the solutions on the board and compare them to their own group's result. The instructor then leads a class discussion of the possible solutions. The complete correct solution is given at the end of class. These problems often require students to consider what they know and do not know and are best solved by analyzing the situation, perhaps using a visual

representation, and logically constructing a path to a solution.

Example Question: A helicopter is hovering 235 feet above the road, and the bed of a truck is 3 feet above the road. The truck is traveling down the road at 40 miles/hour. You must determine when to tell the helicopter to drop the package so it lands in the truck.

- **Problem-Based Learning (PBL):** Students learn disciplinary knowledge by working through real-world problems in the form of "ill-structured" question. These are designed to reflect the complex and tentative nature of many problems in science that have no simple, formulaic "right" solutions. Groups are presented with contextual situations and asked to define the problem, decide what skills and resources are necessary to investigate the problem, and then pose possible solutions. PBL activities can take up most of the teaching and learning time in a classroom or can be combined with a lecture. One example is the SCALE-UP (Student-Centered Active Learning Environment with Upside-down Pedagogies; https://www.ncsu.edu/per/scaleup.html) model. In a SCALE-UP classroom, the lecture and lab components of a course are combined. Students do hands-on activities, problems, simulations, and experiments that challenge them to think deeply. Brief intervals of lecture provide motivation and link the collaborative activities to the bigger course content. Students learn some of the basic content through readings and homework before and after class. The main learning occurs through interactions with peers and through classroom discussions under the guidance of the instructor.

Example Questions/Activities:

- "predict-observe-explain" model – groups are given the task of rolling a racquetball through a curved path between a pair of concentric quarter-circle arcs drawn on a piece of paper. Through Socratic dialogue, the instructor eventually gets students to see that the force is always directed toward the center of the concentric arcs which students recognize as a centripetal force.
- How far does a bowling ball travel down the lane before it stops skidding and is only rolling? This problem requires estimation, but it provides students with insights about frictional force. When they have developed an answer, they can check it against a simulation of this scenario.

Resources and Further Reading

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Teaching Techniques

Experienced teachers develop techniques to achieve richer learning experiences and greater classroom interaction for all of their students. With practice, these tested techniques will increase your teaching effectiveness.

	Circulate https://www.youtube.com/watch?v=Nmm3XbVs084	Move among the students, own the room, use proximity to engage and interact with students
	Cold Call https://www.youtube.com/watch?v=UEOx5dQuEIg	Randomly choose students to answer, do not just call on those with raised hands. Keeps all students engaged
	Wait Time https://www.youtube.com/watch?v=lecW6Ie9dVo	Wait 5-10 seconds after asking a question before calling on a student to answer
	Normalize Error https://www.youtube.com/watch?v=-X4HNp14LNY	Getting it wrong and then getting it right is a normal part of learning, don't make too big a deal of either
	Precise Praise https://www.youtube.com/watch?v=Ad7rR4TQRak	Use positive reinforcement in positive ways: be specific, focus on effort

Adapted from Lemov, D. (2015). *Teach Like a Champion.* San Francisco, CA: Jossey-Bass.

Facilitating (Inquiry) Labs

As a laboratory Teaching Assistant you may be required to do a little bit of everything: facilitate discussions, manage group work, give presentations, and conduct assessments. As such, all of the content of this handbook is likely to be relevant for you. This particular section, however, focuses on responsibilities unique to the lab TA.

General Guidelines

- Attend the required safety training from Environmental Health and Safety. Your primary responsibility in all labs, at all times, is the safety of your students
- Attend all required meetings for lab TAs or discuss with your lab coordinator how to make-up for missed material
- Be prepared. Rehearse new procedures before each lab and try to identify potential pitfalls or safety concerns
- Require that students strictly adhere to the dress code and explain the reasons for the rules
- Discuss procedures thoroughly, repeat as often as necessary if safety is concerned
- Demonstrate proper technique and correct students when necessary
- Circulate around the lab, make yourself visible and available to all areas of the lab
- Have students keep the lab as clean as possible

- Assure that students come to class prepared, if there is pre-reading required hold them accountable
- Encourage questions, especially with regard to safety and proper procedures

Traditional vs. Inquiry Labs

Traditional labs, sometime referred to as "cookbook" labs because students follow a recipe and specific steps to complete them, are designed to promote mastery of content and development of skills relevant to the discipline. Inquiry labs, also referred to as inquiry-guided or inquiry-based, share these goals while also emphasizing critical and analytical thinking, problem solving, communication, teamwork, management, and assessment. For example, in Process-Oriented Guided-Inquiry Learning (POGIL), students work in teams to perform a structured inquiry activity, respond to predesigned questions, reflect on what they have learned, and assess how well they have done. In general, these labs take what we know about how students learn (learning science, discussed previously) and incorporate it into laboratory design, such that students are:

- Actively engaged and thinking in the laboratory
- Drawing conclusions by analyzing data, models, or examples and by discussing ideas
- Working together in self-managed teams to understand concepts and solve problems

- Reflecting on what they have learned and on improving their performance
- Interacting with an instructor as a facilitator of learning

Lessons from POGIL

There are some lessons from Process-Oriented Guided-Inquiry Learning (POGIL) that apply whether you are teaching a traditional lab, an inquiry lab, or some combination thereof. Rather than dispensers of knowledge, POGIL instructors view their role as facilitators of learning. Here are some recommendations for doing this effectively.

- Intervene with respect to process rather than content or product. Focus on the steps or procedure used to arrive at an answer, rather than on whether the answer is right or wrong
- Ask questions to help teams understand (rather than telling them) why they are having difficulty and what they need to do to improve
    - Start with open-ended and general questions: Where are you stuck? What progress have you made? What do you find confusing?
    - Then move to more directed and specific questions: What are you asked to find in the problem? How is what you need to find connected to the information that you are given? What did you learn previously that is relevant here? Can

you draw a diagram to represent what the problem is asking?

- Try to interact with the teams in ways that encourage deeper thought
- At the end of the intervention, ask teams to reflect on the process

The steps for creating an inquiry activity are sometimes referred to as the "7E's." POGIL activities follow a similar series of steps. Both the POGIL and corresponding 7E steps are described in the table that follows. Even if you are not responsible for creating this type of activity, if you are teaching this type of lab it is helpful to understand the thinking behind it. The following is adapted from Hanson (2006), *Instructor's Guide to Process-Oriented Guided-Inquiry Learning.*

Steps	7E Equivalent	Component of the Activity
Identify a need to learn.	Engage	An issue that excites and interests is presented. Learning outcomes and success criteria are defined.
Connect to prior understandings.	Elicit	A question or issue is raised, and student explanations or predictions are sought.
Explore.	Explore	A model or task is provided, resources identified, and students explore in response to critical-thinking questions.
Concept invention, introduction, and formation.	Explain	Critical-thinking questions lead to the identification of concepts and understanding.
Practice applying knowledge.		Exercises involve application of the knowledge.
Apply knowledge in new contexts.	Elaborate & Extend	Problems and extended problems require synthesis and transference of concepts.
Reflect on the process.	Evaluate	Problem solutions and answers to questions are validated and integrated with concepts. Learning and performance are assessed.

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Felder, R.M. and Brent, R. (2016). *Teaching and Learning STEM: A Practical Guide*. San Francisco, CA: John Wiley & Sons.

Hanson, D.M. (2006). *Instructor's Guide to Process-Oriented Guided-Inquiry Learning.* Lisle, IL: Pacific Crest.

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Facilitating Discussions in STEM

Many evidence-based, student-centered approaches in STEM teaching rely on asking questions to build understanding. These pedagogies require the facilitator to develop effective questioning and discussion leading strategies. To successfully facilitate a discussion you must know where you eventually want it to lead (the learning outcome), guide it with carefully placed and well-crafted questions, and find ways for all students to contribute. In addition, you are responsible for maintaining a classroom community and physical environment that are safe and conducive to learning. The following strategies and tips will help.

Tips for Facilitating a Discussion

- **Lay ground rules.** Be clear and consistent with your rules and expectations and/or consider developing discussion rules together with the students so they have a sense of ownership.
- **Create a safe classroom community**. When students experience support, belonging, and empowerment in class, they feel comfortable participating. Learning student's names, encouraging them to use each other's names, and introducing yourself can help build a sense of community.
- **Teach discussion skills.** Lead a discussion on what a good discussion is, including courtesy and respect.
- **Wait.** Ask one question at a time and WAIT for students to formulate an answer (5-10 seconds). Additionally, wait

until several students seem ready to answer (judging by their facial expressions or raised hands).

- **Call on students.** There are a number of approaches to calling on students; be strategic about how you use them.
  - **Raised hands:** creates a relaxed class feel, but does not really increase participation; some students may monopolize the conversation.
  - **Cold calling:** ensures participation and encourages students to prepare. Pay attention to non-verbal clues (some students' faces might indicate they are ready to answer) from shy students.
  - **Random calling:** adds the feel of being fair and not subject to instructor bias to basic cold calling. Examples include: shuffle index cards with student names, pick names out of a hat, or assign numbers and roll dice to determine who goes next.
- **Include the entire class.** Repeat individual student's responses/questions so everyone will hear them.
- **Model careful listening skills.** Take notes, and show your students how to listen and record key concepts. Use these notes to periodically summarize main points, or have students do so.
- **Counterpoints.** Ask students to up come with counterpoints or choose someone to play the devil's advocate at times, or do so yourself.
- **Make connections.** Tie student comments together with explicit connections. Don't assume they completely understand a point or see the deeper relationships.

- **Wrap-up.** Conclude the discussion with enough time to summarize and connect the discussion to a previous class lesson and to the learning outcomes.

Questioning Strategies

The inquiry process is facilitated by skillful questioning; however, it can be difficult to know what questions to ask and when to ask them. Bloom's taxonomy of six cognitive processes (seen in the earlier section on Backward Design) can also be used here to structure a discussion and design appropriate questions.

In order to encourage participation, and build confidence, start with lower level questions and move on to more complex ones. Note that the higher level questions tend to be open-ended, thus lacking a single "yes" or "no" answer. You can model your questions on the following examples:

Cognitive Level	Questions
Remember	• What do you know about the problem? • What are you being asked to find? • What is the formula for _____? • What is the definition of the term _____? • What procedure/steps did you use? • What happened when you _____? • What does it say in the text about _____?

Understand	• How would you explain _____ in your own words? (or to a fifth grader)? • Draw a diagram of _____. • What formula would you use here? • What science concepts does this problem relate to?
Apply	• What would be an example of _____ in the real world? • How would you solve this problem? • What additional information is needed? • How would you apply _____ in this situation?
Analyze	• How is _____ related to _____? • How does this compare to … (other students' findings, other experiments or procedures)? • What type of _____ is this? How would you classify it? • What evidence does the author/researcher provide?
Evaluate	• Given ____, what would you predict would happen? • How would you revise the experiment to improve the results? • What _____ (samples/conditions/controls) would you choose and why? • Why do you think the conclusions are valid or invalid?

Create	• What conclusions can you come to about _____? • How would you design an experiment to test _____? • How can you resolve the differences between _____ and _____? • What new model would accommodate these disparate findings?

*Adapted from Nilson, *Teaching at its Best*, 2010 and Penick (1996).

Strategies for Handling Difficult Situations

- **Silence:** If you ask a question and are greeted with silence NEVER give in and provide the answer yourself. Students will become conditioned to you providing the answer and happily wait you out. Instead, consider the following:
  - Wait at least 10 seconds - actually count slowly in your head; it's longer than you think.
  - Rephrase the question – don't just repeat it. Often by altering your word choice you can solicit responses.
  - Break it down – the question may be too broad or too complex. Break it down into smaller "bite-sized" chunks. Be sure to only ask one question at a time.
  - Insert a brief activity – give students 1 minute to brainstorm possible answers or write down their own definition of a relevant term; conduct a think-pair-share activity. At the conclusion of this activity,

simply call on students to read what they wrote or report on their discussion.

- **Wrong Answers:** Dealing with incorrect answers is an important, and often uncomfortable, part of teaching. Here are some ideas:
  - Make a habit of gathering multiple answers to any one question. For example: "What other results/data/ answers did you get?" or "What other approaches could be used?" The correct answers should become evident among the responses, without embarrassing the student who was wrong. Be sure to close with a clear assertion of what the correct answer is and why. If multiple interpretations are correct, say so.
  - Do not interrupt students before they finish when they answer incorrectly. Instead, think of incorrect answers as learning opportunities. "What might have caused this result?" or "Why do you suppose these data are so different?" These can lead to discussions on the importance of converting units or proper pipetting technique.
  - Normalize error, for example "that's a common point of confusion" and recognize that other students likely share this misunderstanding.
  - Don't accept answers that are close, but not quite there. Instead consider following up with "Almost there, how can we refine that?" or "Very close, what other factors should we consider?"
- **Lack of Individual Participation:** Be aware of common reasons for student nonparticipation (peer pressure, needing time to think, lack of preparation, unfavorable

class dynamics, shy students, outside/personal issues) and explore ways to address them. For example, sharing in small groups or pairs first can help shy students feel safe and gain confidence to participate in the larger class discussion. Make it clear to students that discussions will play a role in their learning process and their grade (if such grading policies exist). If appropriate, post participation grades throughout the semester and share with students the rubric or system you are using.

- **Disruptors:** Try ignoring them; call on other students to respond as if the disruptive behavior did not exist. Call on the disruptive student with a constructive question or ask them to cite evidence in support of their position.
- **Whisperers/Cell Phone Users/Newspaper Readers:** Humans do not focus on multiple sensory data simultaneously, in other words, there is no such thing as multi-tasking. Make it a rule that there is only one conversation allowed at a time and blatant displays of inattention will not be tolerated. If necessary, address these students directly; if they refuse to stop, ask them to leave.
- **Discussion Hogs/Show Offs:** Emphasize the importance of hearing different points of view. Limit the number of times any student can participate before everyone else has a chance to participate (colorful sticky notes can help keep track of how many times a student participates). When students go beyond being eager and monopolize class time, meet with them privately and address inclusiveness.
- **Side-Trackers:** Begin with a reminder on the subject of the discussion and ask students how this point relates to it.

Try creating a "parking lot" on the white board of additional topics that you will address if time allows.

Resources and Further Reading

Felder, R.M. and Brent, R. (2016). *Teaching and Learning STEM: A Practical Guide*. San Francisco, CA: John Wiley & Sons.

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Facilitating Laboratory Group Work

In the right context, group work carries numerous benefits relative to solely individual work. For students, peer learning improves content mastery and can result in deeper learning. It also creates accountability for preparation outside of class and models soft skills needed in life outside the classroom (e.g., time management, communication, working with those with whom you disagree). Moreover, it exposes members to new perspectives and can create a sense of community, which, in turn, increases expectations for performance and retention. For instructors, it allows assignment of more complex, authentic problems that can be solved in novel and interesting ways and reduces the number of projects to grade.

Tips for Facilitating Group Work

- Be explicit about the purpose of group work from day one
- Take a role in establishing teams' social norms. Students should feel comfortable challenging one another, but must be respectful
- Form teams intentionally (randomly, separating particular students, etc.) considering how it will affect the groups' inner workings
- Require some individual accountability, for example assign individual tasks such as scribe, reporter, skeptic, and fact-checker
- Provide immediate, meaningful feedback, especially in comparison to other groups. If done appropriately this

shows each group examples of high and low performance and provides a spirit of competition, which improves intra-group cohesion

- Explicitly reward high levels of performance
- Assign tasks that:
  - Cannot be completed by 1 – 2 team members alone
  - Require members to reach a consensus
- Assess group work effectively, evaluating both process (e.g., peer evaluations) and product
- Keep an eye out for:
  - Group "circles" that are stretched out or have students stuck outside of the main group
  - One or a few individuals dominating the discussion, whether through their own eagerness or the loafing of other members
  - Groups getting sidetracked on unimportant details

Resources and Further Reading

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Classroom Management in Science Courses

The largest and most often cited fears of new instructors are problematic student situations. The kinds of situations we fear most very seldom materialize, however, it's wise to prepare for them by learning required codes of conduct and appropriate strategies to diffuse situations rather than enflame them.

Five Basic Principles

Be friendly but firm. Students seeking an exception just for them should never get the impression that your policies are subject to interpretation (be firm), but neither should you have to resort to a raised voice or too-harsh tone (be friendly). Balance authority, being strict enough that policies are followed, with approachability, not so strict that you become unapproachable.

Position yourself as an ally for their learning. An antagonistic relationship helps no one, yet a purely "on your side" attitude might encourage students to consider you a "pal" who ought to raise the grade. Thus, be an ally FOR THEIR LEARNING specifically; seek ways to help them study better, get access to ancillary material, etc.

Craft realistic syllabus policies. Some classroom management problems are avoidable if there is merely a realistic policy in the syllabus. Note that realistic doesn't always mean strict - in fact, an overly-strict policy may do more harm than good. If you have a syllabus provided for you by a course coordinator or supervisor review it carefully and implement the policies equitably and diligently. If you disagree with or are confused about a policy discuss it with your coordinator or supervisor, do not share your dissent with students. If students sense there is flexibility in some of the policies they will argue for revisions to all of the policies.

De-escalate rather than become defensive. When confrontations eventually arise, it is human nature to react defensively. Yet this will quickly turn counterproductive; don't make the argument about winning. Instead, make it your job to de-escalate the situation, and calm everyone down. Talk about how things can be fixed going forward rather than focusing on what's already done.

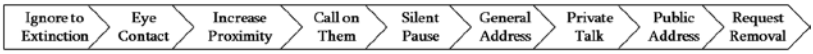
Fairness rules. When in doubt, refer a complaining student to the fairness principle. Anything you do for him/her, you'll have to do for the others... and what they are asking is often not fair to those who did the work on time or studied as they were supposed to.

Helpful Tips

- Build good rapport with students early to help head off angry confrontations
- Start with an assumption of honesty—don't believe the worst in students
- Model correct behavior, and reward it in students
- Be aware of your voice and non-verbal communication
- Ratchet up response only as needed
- Keep your cool – don't respond instantly and don't be baited
- Consult with problem students in private whenever possible
- Remember that students are human who need sympathy and help

Spectrum of Response

When dealing with classroom management or behavioral issues it is often helpful to think of the spectrum of responses available to you. Be mindful of where you start. Too easy and you then have to over-compensate to 'catch up' to lessened expectations. Too strict and you may lose the opportunity to connect with that particular student. Choose wisely to start with and recall the five basic principles previously mentioned.



1. Ignore the behavior and hope for extinction
2. Make eye contact – subtly make them aware that you notice and disapprove of the behavior
3. Increase proximity – stand nearby them as you circulate around the room
4. Call on them – directly ask them a question in the context of the discussion, to bring back on task
5. Pause meaningfully – use silence as a tool to quiet side conversations
6. General (plenary) address – remind the entire class what the rule is regarding this behavior
7. Private talk – call out the individual, but show respect by having a discussion in private
8. Public direct address – call out the individual in front of the class
9. Request removal (kick them out) – when all else fails, ask for the student to leave

Proactive and Reactive Strategies

Classroom Disruption	Proactive Strategies	Reactive Strategies
• Side conversations • Texting • Using social media • Combative/ hostile to instructor or other students • Frequently leaving and entering the classroom without authorization • Dominating class discussion and refusing to defer to instructor, or listen to others.	• Be clear about course policies and expectations (Syllabus) • Define learning community standards early as a group • Set tone of group accountability & personal responsibility • Be aware of & share campus resources with students (Counseling Center, Veteran's Services, Victim's Advocacy, etc.) • Have a technology policy • Set Clear Standards of Behavior	• Range of responses spectrum (Ignore-->Remove) • Refer students when appropriate (Students of Concern Assistance Team--SOCAT)

Academic Dishonesty

The Center for Academic Integrity (Duke University) reports that "on most campuses, over 75% of students admit to some cheating. In a 1999 survey of 2,100 students on 21 campuses across the country, about *one-third* of the participating students admitted to serious test cheating." With cheating so prevalent, at least according to national statistics, it behooves us to do all we can to prevent it (minimize its presence), or failing that, to detect it (minimize its effectiveness).

When it comes to preventing cheating, which ought to be the real goal, much of the advice depends upon proctors being constantly alert and roaming the test room frequently. Detecting student cheating is often a matter of being extremely aware of where the students are looking, which implies a need to watch their eyes almost constantly. This may also prove to be the most effective method of prevention, as they will be aware of the extra attention.

Proctors need to use their ears as well as their eyes. While whispering may be one of the most common forms of cheating, it's hardly the most intricate. Smart phones raise the ante, but the other methods involve misdirection and multiple students forming a distraction. Any sound disruptions in the room should heighten the proctor's sense of alertness.

Proctors are highly advised against bringing along any work of their own to the exam or being distracted by cell phones. Proctoring is a full-time activity that requires complete concentration to be done effectively. Any suspicions of academic dishonesty should be reported to the program

coordinator or professor immediately. Other proactive strategies to discourage academic dishonesty are included below.

Academic Dishonesty	Proactive Strategies
• Cheating on tests & exams • Recycling own papers • Buying papers • Plagiarism	• Educate students about academic integrity and plagiarism • Know your departments' procedure for handling academic dishonesty • Make assignments unique and include an element of personal reflection • Do not use same assignments in consecutive semesters • Use Respondus Lockdown Browser for quizzes in Canvas • Use Turnitin for writing assignments in Canvas • Provide "cheat sheet" with info that is not central to the type of task/assessment • Encourage students to make their own cheat sheets • Make exams low-stakes, participation hi-stakes

Student Referrals

When students come to you with personal problems, it is often because they trust you and because they may not feel comfortable talking to anyone else. You need to refer students when their needs lie outside of your legal and ethical terrain. You are not a mental health counselor, disability expert, or doctor. Consult with your coordinator or supervisor on the appropriate course of action stipulated by your department. Some departments require you to discuss any student issues with them and, depending on the severity, will take care of it from there. They will then take responsibility for contacting the appropriate offices and/or refer the students as necessary.

In other cases, you may need to refer a student directly to the appropriate office. For example, without written instructions from Students with Disabilities Services (SDS), you should not make adjustments to accommodate a student who informs you of their special needs. You should politely refer them to SDS, who will then instruct you how to proceed. Also, you should know that if a student becomes distraught in your class or your office, you have the right (and responsibility) to refer them to the Counseling Center. Here are some additional links to a variety of USF campus student services:

- The Counseling Center: http://usfweb2.usf.edu/counsel/
- Testing Services: http://uc.usf.edu/testing/
- International Services: http://global.usf.edu/is/
- Multicultural Affairs: http://multicultural.usf.edu/
- Student Activities: http://involvement.usf.edu/

- Student with Disabilities

  Services: http://www.sds.usf.edu/
- Student Health Services: http://www.shs.usf.edu/
- Veterans' Services: http://www.veterans.usf.edu/
- Writing Center: http://www.lib.usf.edu/writing/
- Tutoring and Learning

  Services: http://lib.usf.edu/tutoring/
- Student of Concern Assistance

  Team: http://studentsofconcern.usf.edu/

The First Day

- **Bring materials.** Do not assume that your room will contain dry erase markers or erasers, pens, etc.
- **Dress up.** New instructors are advised to dress up slightly, especially on the first day of class. You need not wear a suit, but your attire should be professional in style.
- **Arrive early.** Use the extra time to set up your technology or presentation, or to meet students who have questions before class begins.
- **Start on time.** Nothing sets a precedent like the first day. If you start late, even if your intentions are good, it will send a signal that students need not worry about arriving on time for subsequent days.
- **Use the board.** Write your name, course title and number, and section on board. Also, write your agenda for the first-day on the board; this will help manage students' expectations about getting out early.
- **Introduce yourself.** You can talk about your educational and/or professional background, future aspirations, even passion or interest in the course topic. This helps students relate to you as a person and will help establish a sense of accountability and approachability. Talk to students about your interests outside of the classroom, but be sure to keep it professional.
- **Learn names and establish community quickly.** No matter the class size, you should start learning names, and it's always valuable for the students to learn each other's names as well. Icebreakers and other short games, even if

not directly relevant for the content of your course, will give participants a sense of ownership in the class.

- **Review the syllabus.** Discuss the syllabus with students. Don't read every page; just the highlights and the policies you consider very important. Clearly communicate the course expectations, requirements, and prerequisites.
- **Conduct an activity.** While students might expect (and even welcome) a "wasted" day of nothing but a syllabus discussion, you are better served by beginning the first class with some sort of activity or learning experience. That sets the tone of your class from the very beginning.
- **Take attendance.** USF has a mandatory first-day attendance policy. Use the First Day of Attendance (FDA) tool in Canvas to record attendance electronically during class or as soon as possible afterward. Don't take attendance projected on the screen because student ID #s will be visible to other students in the class; this is a FERPA violation. The link is found in the Navigation Menu of each course in Canvas. For instructions on how to use the FDA tool visit: http://usfweb.usf.edu/courseresources/tutorial/canvas/attendance/attendance.html or contact Information Technology at (813) 974-1222.

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Assessment and Grading in STEM

Assessment in Evidence-Based Courses

Most people hear the word "assessment" and think instantly of tests or quizzes. While these are undoubtedly assessments, they are not the only kind. Tests, quizzes, and other graded instruments are often used primarily as summative assessments, which means they exist only to evaluate, to give a grade. Less heralded, but equally important are ungraded formative assessments, so named because they help the teacher "form" an opinion of the students' level of understanding, which are used to elicit feedback and to facilitate learning. The students themselves can also "form" an opinion about whether they really know the material. In a student-centered classroom, many of the learning activities themselves are a form of assessment that provide instructors with more information about students' understanding than they could obtain from traditional assessments and lecture-based instruction. It is important to align assessment with instruction and content. Information on both formative and summative assessment follows.

Formative Assessment

Formative assessments are used to obtain feedback about what students know, how well they are learning, and where they are having difficulties. This feedback can then be used to modify teaching to enhance student learning. Some formative assessments used by STEM instructors (Kober, 2015) are listed below.

- Using a variety of interactive techniques (discussed in a previous section) such as clicker questions or think-pair-share
- Listening in on group discussions
- Assigning collaborative group work on a whiteboard so it can be readily observed
- Using open-ended discussion questions
- Conducting student surveys
- Administering concept inventories – multiple choice assessments, often administered as pre- and post-tests, to assess students' understanding of the core concepts of a discipline
- Using ConcepTests – brief formative assessments of a single concept
- Using short writing assignments to develop students' metacognitive skills and assess understanding, such as:
    - Reading reflections
    - Muddiest points
    - Writing prompts
    - Minute papers

Summative Assessment: Test Writing

Summative assessments are used to evaluate students' performance against a standard or benchmark at the end of a unit, in midterm, or at the end of a semester, traditionally to assign a grade.

General Assessment Tips

- Mix item types
- Start with easy items and progress to more difficult ones
- Take the exam yourself and/or have someone else proofread the exam
- Create items, or use test bank items, that reflect course outcomes and activities
- Evaluate each test and save valid and reliable items to create your own test bank
- Avoid items that link to each other: the answer to one question should NOT depend upon another
- Explain procedures and criteria in advance
- During the exam, write last minute changes or answers to questions on the board
- To keep students on track, write remaining time on the board rather than calling it out

Constructing Multiple Choice Test Items

Multiple choice items consist of a stem and a set of possible answers or alternatives. The stem is the beginning part of the item that asks a question, presents a problem, or provides an incomplete statement to be completed. The correct answer is called the key and the incorrect answers are called distractors.

- Eliminate excessive wording and irrelevant information
- Include in each stem any word(s) that might otherwise be repeated in each alternative
- Use negative stems sparingly and underline and/or CAPITALIZE the negative word
- Avoid beginning with the blank space when using incomplete statements
- Make sure there is one correct or best response
- Make all alternatives plausible and equally attractive to both less-knowledgeable and skillful students
- Minimize the use of the "all of the above" and "none of the above" alternatives
- Avoid asking for a series of multiple true-false answers (eg. "Which of the following is true about…?")
- Use between three and five alternatives for each item
- All alternatives should be approximately equal in length
- When possible, present alternatives in some logical order (eg. most to least and chronological)
- Make the alternatives mutually exclusive
- Avoid language that may offend or exclude a particular group of individuals
- Randomly distribute the correct response items among the alternative positions throughout the test, having approximately the same proportion of *a's, b's, c's, d's,* and *e's* as the correct response

Constructing True/False Test Items

- Avoid complex statements that test reading skills
- Make positive statements
- Avoid double negatives
- Don't try to trick the students
- Make sure the statements are entirely true or entirely false
- False = all, always, never, every, none, only

- True = generally, sometimes, usually, maybe, often
- Use precise items: (i.e., 50% of the time) rather than several, seldom, frequently, etc.
- Use more false items since they tend to discriminate more than true ones

Constructing Matching Items

- Make directions clear: can responses be used more than once? Where does the answer go?
- Each stem should have only one response (but responses can be used more than once in some cases)
- Don't let grammatical cues such as tense signal the correct response to a stem
- Keep like items in the same set (events and dates belong together, dates and places do not)
- Give more information in the stem (left hand column) and keep matches short
- Keep a set together on a single page to avoid wasting time in flipping back and forth
- Keep sets short
- Give more responses than stems to minimize guessing

Constructing Completion Items

- Use original questions
- Make questions clear through the use of concise clues and familiar vocabulary
- Provide grading criteria in advance so students will understand what you are looking for in each item
- Establish a grading strategy (i.e., use a computer form, fill in a grade sheet)
- Provide enough context so only one word fits
- Avoid grammatical cues when testing information recall

- If items may be ambiguous, add an explanation area

Constructing Essay Test Items

- Decide what level of Bloom's cognitive domain you will address
- Provide clear instructions
- Indicate for each question the number of points earned for a correct response
- Give students grading criteria (rubric) in advance (i.e., points for accuracy, completeness, creativity, etc.)
- Consider going over key words in advance (i.e., how to approach questions that begin with "analyze" versus "describe")

Assessment of Group Work

In student-centered STEM courses, especially laboratories, students often work in groups resulting in the need to incorporate a group dimension into assessments. Group assessment can be challenging and instructors can take different approaches. One is to include assessments of individual, as well as group performance, even in a cooperative learning environment. Another approach is the "two stage" exam, in which students first complete the assessment individually and then retake it collaboratively. The individual component in one example (Kober 2015) accounts for 75% of the student's grade and the collaborative portion

25%. Proponents of this approach feel that the value of the exams as a learning experience is increased by engaging students in active learning and critical thinking during the exam.

Technology for Assessment and Instruction

Technology has particular relevance to STEM teaching. Not only have many technological tools been expressly developed or adapted for use in evidence-based STEM teaching, becoming adept at using the technological tools of a discipline is a necessary component of STEM education. Research on the use of learning technologies suggests that it can enhance students' learning and retention, however, the presence of learning technologies alone does not improve outcomes. Learning outcomes appear to depend on how the technology is used.

Before using technology in a course it is important to have a clear set of learning goals and assessments. Then consider how technology can assist in meeting these goals and assessing students' progress.

Tips for including technology (adapted from Kober 2015):

- Consider low-tech or basic technologies like whiteboards and clickers (discussed in the section on Evidence-Based Teaching Techniques)

- Don't be awed by visually impressive technology or use technology for its own sake – does it serve a purpose?
- Some technologies may be more effective than others in achieving learning goals – don't be afraid to abandon or revise
- Technologies can change how students interact with each other and with the course content – be alert to changes
- Possibilities for adapting new technologies to meet specific learning needs will become more apparent with experience – continue to learn and adapt
- Weigh the costs of a technology against its benefits for student learning. Expensive, time-consuming, or complicated technologies may not be worth the cost or effort

Some things to consider when using simulations, animations, and demonstrations in STEM classrooms and laboratories:

- Interactive simulations are most effective when they are used in ways that encourage students to predict and discuss possible outcomes or "what if" scenarios
- Simulations that allow students to change different variables can be useful in developing and testing conceptual understanding
- Simulations and interactive demonstrations can be *ineffective* for learning if an instructor's demonstration omits opportunities for student predictions, discussion, and suggestions, or if an instructor discourages student exploration by being too prescriptive about what to do

Resources and Further Reading

Davis, B.G. (2009). *Tools for Teaching*. San Francisco, CA: John Wiley & Sons.

Felder, R.M. and Brent, R. (2016). *Teaching and Learning STEM: A Practical Guide*. San Francisco, CA: John Wiley & Sons.

Kober, N. (2015). *Reaching Students: What Research Says About Effective Instruction in Undergraduate Science and Engineering.* Washington, D.C.: National Academies Press.

McKeachie, W.J. and Svinicki, M. (2006) *Teaching Tips: Strategies, Research, and Theory for College and University Teachers.* Boston, MA: Houghton Mifflin Company.

Nilson, L. B. (2010). *Teaching at Its Best: A Research-Based Resource for College Instructors*. San Francisco, CA: John Wiley & Sons.

Singer, S.R., Nielsen, N.R., & Schweingruber, H.A. (Eds.). (2012). *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering.* Washington, D.C.: National Academies Press.

Grading

Grading isn't merely marking red ink on a page, but a process of sending subtle messages to students about what you value as a teacher. Grading serves multiple roles including *evaluation, communication,* and *motivation.* We *evaluate* student work, providing them with feedback about the quality of their work. Grading also *communicates* to students, as well as advisors, parents, future employers and other important groups that have a stake in student success. Grading can also *motivate* students, often determining the extent to which a student participates in a course. Steps for effective grading include:

Step 1: Create Effective Assignments

Effective course design leads to effective assignments. Making sure that assessment tools fit learning outcomes and are feasible in terms of workload. Ensure assignment and test instructions are clear to students; if they can't decipher the questions, they are unlikely to give you the answers you are expecting. Students may have learned the material but are unable to *show* you they've learned it.

Step 2: Teach to the Test

If your assignments are created from well-constructed learning outcomes and are feasible, then teaching to the test isn't a problem, as you are in essence teaching to the outcomes.

Step 3: Determine Criteria and Grading Schema

Assignment criteria and grading schemas may be determined by the professor. In some situations, you may be establishing criteria or schema in concert with a professor, or determining grading on your own. In either case, communicate and be clear on what the criteria and schema are and how to apply them. Creating and using rubrics (discussed below) can be extremely effective.

Tips for Grading and Communications with Students

The two most challenging aspects of grading reported by instructors are the time it takes to grade and the difficulty in communicating grades in such a way to encourage reflection and further learning by the student. Below are hints for both.

Making Grading More Time-Efficient

- Separate commenting from grading, and use them singly or in combination according to your purpose
- Use technology to save time and enhance results
- Don't give all students what only some need
- Use only as many grade levels as you need
- Frame comments to your students' use
- Do not waste time on careless student's work
- Use what students know
- Ask students to organize their work for your efficiency

Communication with Students about Their Grades

- Assume the best, assume students want to learn
- Use the syllabus to show students how tests and assignments serve course goals
- Inquire, reinforce, and remind students about course goals
- Discuss the role of grades and explain what each grade represents
- Reinforce that students "earn" grades, you do not "give" grades
- Discuss fairness
- Speak to the learning, not the error
- Save your comments for the teachable moment
- Communicate priorities
- Avoid surprises

Rubrics

Scoring rubrics can be used to communicate clear expectations for particular assignments, give feedback to students, and encourage a minimum level of quality for their work. Additionally, rubrics can help to create fair and consistent standards or grading norms and reduce time spent determining a grade. Rubrics can be holistic (describe a student's work as a single score) or analytic (provide a separate score for each criterion). In either case, constructing a rubric is useful for both the instructor and the student as it explicitly

states the teacher's criteria, thus making the expectations clear to students and grading more objective. To construct a rubric:

1. *Identify* the traits or characteristics that you are looking for in student work. Refer back to your learning outcomes for that unit: What expectations do you have for performance?

2. *Build* a scale for scoring the student's performance on that trait. What would a more polished assignment look like? What are the gradations of performance that you expect on the assignment . . . simply pass-fail, or could students be assessed up to five distinct levels of performance for an assignment?

3. *Evaluate* the student's performance based on the traits and your scales. Of course, revision should be expected. You may not be comfortable with your initial results after using the scale, but just revise it until you are satisfied with its performance.

After developing your rubric, try it out with a sample of student work or review with colleagues and revise. You may be unhappy with the results the first time using it, so do not be afraid to make adjustments.

Laboratory TAs should consult their coordinator for specific instructions on grading lab reports and the standardized grading system they require. Below is an example of a rubric one might encounter for grading lab reports.

Example Rubric for Lab Reports

Category	Score=4	Score=3	Score=2	Score=1	S
Abstract	Clear, concise, accurate abstract of experiment and results	Clear and concise, but incomplete abstract	Unclear or incomplete or too long	Inaccurate or illegible	
Background	Relevant background clearly summarized in students' own words; appropriate sources cited correctly	Background reasonably summarized in students' own words; appropriate sources mostly cited correctly	Inadequate but original background summary or questionable sources or incorrect citations	Illegible or directly copied background summary and/or few or no citations	
Experimental hypotheses	Hypotheses clearly stated and logically justified	Hypotheses clearly stated but inadequately justified	Hypotheses stated but not justified	No hypotheses stated	
Experimental setup and procedure	Setup and procedure clearly and accurately described	Setup and procedure adequately described	Setup and procedure poorly described	Inaccurate or unreadable description	
Data	Professional looking and accurate presentation of data in labeled tables and graphs	Accurate presentation of data in labeled tables and graphs	Accurate presentation of data in written form with no tables or graphs	Illegible presentation of data	

Data analysis	Data analysis (including error analysis) performed correctly	Data analysis with a few minor mistakes	Data analysis with many or substantial errors	Data analysis incorrect or illegible	
Data interpretation	All relevant concepts correctly applied	Most relevant concepts correctly applied	Limited application of relevant concepts	No application of relevant concepts	
Conclusions	Everything learned accurately stated; hypotheses convincingly supported or rejected	Everything learned accurately summarized; hypotheses inadequately addressed	Conclusions not clear from results	No conclusions included in report	
Summary	Experiment, data analyses and interpretation, and conclusions completely and clearly described	Experiment, data analyses, interpreta-tion, and conclusions described with minor omissions	Important information poorly described or omitted	No summary included in report	
Writing	Correct grammar and syntax; clear and concise style	Correct grammar and syntax; awkward or unclear writing	Numerous mistakes in grammar and syntax	Almost unreadable	

Adapted from Felder and Brent (2016).

References and Further Reading

Walvoord, B. and Anderson, V.J. (2009). *Effective Grading: A Tool for Learning and Assessment in College*. San Francisco, CA: John Wiley & Sons.

Felder, R.M. and Brent, R. (2016). *Teaching and Learning STEM: A Practical Guide*. San Francisco, CA: John Wiley & Sons.

Grading System

A+		4.00
A	Excellent performance	4.00
A-		3.67
B+		3.33
B	Good performance	3.00
B-		2.67
C+		2.33
C	Average performance	2.00
C-		1.67
D+		1.33
D	Poor performance	1.00
D-		0.67
F	Failure	0.00

Other Grades

E	Course repeated, not included in GPA
FF	Failure/academic dishonesty
I	Incomplete
IF	Incomplete grade changed to Failure

IU	Incomplete grade changed to Unsatisfactory
M	No grade submitted by instructor
MF	Missing grade changed to Failure
MU	Missing grade changed to Unsatisfactory
N	Audit
S	Satisfactory
U	Unsatisfactory
W	Withdrawal from course without penalty
WC	Withdrawal for extenuating circumstances
Z	Indicates continuing registration.

Please note that the grade of C- will satisfy specified minimum requirements of the Gordon Rule courses and the common prerequisites unless otherwise specified in the Catalog.

Extra Credit and Grading on a Curve

Refer to your department or course coordinator for policies on extra credit and grading on a curve.

Turnitin.com

USF uses turnitin.com as a plagiarism detection (and prevention) service. It can be found within Canvas. It can be ideal for essays, though other forms of writing (lab reports, presentations, theses) are possible as well. The service will scan the entire Internet as well as its own database of anything ever turned in to turnitin to search for duplicated phrases and words. The teacher can log in to see an originality report, where the problematic areas are highlighted. It is important to review the report and highlighted problem areas and not just rely on the number returned by turnitin.

Canvas

Canvas is the Learning Management System (LMS) in use at USF. All instructors are required to use Canvas at least to record First-Day Attendance, Midterm Grades (if teaching 1000-3000 level courses), and end-of-semester E-Grades. Teaching Assistants should consult with their supervisor and/or Lab Coordinator to determine what they should and should not modify in Canvas and what practices are expected of them for reporting grades and interacting with students. A brief overview is given below. For specific questions or guidelines consult your course coordinator or supervisor.

For more information, consult the Instructor Guides and FAQs from the manufacturer, Instructure, at: http://guides.instructure.com/m/4152. Additional USF specific information can be found at: http://www.usf.edu/atle/technology/canvas.aspx.

Getting Started

- Locating your Canvas courses: http://www.usf.edu/atle/documents/video-accessing-canvas.mov
- First-Day Attendance: https://www.youtube.com/watch?v=pcNoMJwFTuY&feature=youtu.be
- Midterm Grades (if teaching 1000-3000 level courses): midterm grade reports are submitted soon after the

midpoint of the course. The purpose of the midterm grades report is to inform students as to whether or not they are meeting the basic or core competencies of the class. http://www.registrar.usf.edu/cms/page.php?story_id=534

- E-Grades: http://usfweb.usf.edu/courseresources/tutorial/canvas/egrades/egrades.html

Common Uses

- Creating and using “Modules” in Canvas https://guides.instructure.com/m/4152/c/23855
- Creating a simple layout for students via "Pages” or "Modules”: https://www.youtube.com/watch?v=D05i_F5dLoI&feature=youtu.be
- Storing the course syllabus, PowerPoints, or other files via the "Files" button: http://guides.instructure.com/s/2204/m/4152/c/23847

Other Functions

- **Adding TAs:** TAs are typically added to a course through the department. However, should you need to be added to a course have the instructor of record click on People and then the Add People button on the top right. Type a student email address (or NetID) and click on the Role pulldown to switch it to TA. Then click the NEXT button.

The system will verify that it knows the user you indicated, but the person is not actually added until you click the ADD USERS button at the bottom. http://decade.it.usf.edu/education/to101/navigation/people.mp4

- **Cross-listing courses:** Identify one of your courses to act as the master course. In each of the other courses you want to combine, click on "Settings" then "Sections". Click on the section that is full of students and has an SIS ID, (the one created automatically). Then look to the right and click "CrossList this section with another class". Search for the class you identified as the master, and then click "crosslist". Don't create new sections; the Master course must be one automatically created by Banner and not one you manually created yourself (otherwise, it won't be compatible with First Day Attendance or eGrades).
- **Customize Navigation/Menu:** To hide tools, click SETTINGS and then NAVIGATION and you can drag tools to the bottom, which will hide them from students.
- **Student View:** Access the student view under SETTINGS (look on the right side menu).
- **Polls for Canvas:** A free-for-everyone Apple/Android app that lets you poll students with no need for a dedicated clicker. It does not presently integrate with the Canvas gradebook or provide reports on individual student responses, but can be useful for engagement. Use usflearn.instructure.com as your "Canvas URL" when prompted.
- **Gradebook Columns:** You add columns to the gradebook by clicking the button for Assignments. On the right side, click Add Assignment and give it a name. Suggestion: do

add "points possible" on the first screen. If this is meant to be a letter grade (or ungraded) instead, click Options (twice) until you see "Grading Type" that you can switch.

- **Release Date:** You can't selectively release items in the Files button. Instead, upload them to Files, hide the Files button from students, and create Modules that contain links to your uploaded items. Each module can have its own release date (click the gear-icon for each module). Note: the COURSE release date can also be customized under Settings.
- **Sending email:** Click the "inbox" link in the top-right of the screen. To create a new email, click into the "to" field and start typing the name of your course, then select it when it appears. Put a checkmark in the box next to "Students" and then type your message.
- **Change the Home Button:** By default, the "Home" button shows updates. Click "change home page layout" at the top to select "a page I'll design myself" if using Pages, or "the course modules/sections" if you are using Modules to organize and display information to students. There is no option for "files" if you are using only the Files button.
- **Grade Essays by Clicking Rubric Fields:** If you set up a rubric and click to "use rubric for grading," then clicking each cell in a rubric cell will assign the score indicated and automatically add up the grade in the Speedgrader.
- **Remove Yourself from a Course:** The USF tool https://decade.it.usf.edu/canvas/admin/deleteme.php will allow you to remove yourself as a student/participant from any course or organization (note: if you are enrolled via Banner and the class is held this term, you will be automatically re-added in the same role the next day).

- **Recover Deleted Material from a Course:** Whenever anything is deleted from a course shell (document, file, assignment, discussion board, etc), it can be restored later. Simply click into the course and add "/undelete" to the end of the URL (for example: https://usflearn.instructure.com/courses/555844/undelete) and hit ENTER to see a list of things that can be restored.

Important University Policies

Academic Calendar:
(http://www.registrar.usf.edu/enroll/regist/calendt.php) The Registrar's Office at USF provides access to academic calendars.

Academic Dishonesty:
(http://www.ugs.usf.edu/catalogs/0102/adadap.htm) USF considers any form of cheating on examinations or plagiarism on assigned papers to be unacceptable deceit and dishonesty. USF Academic Dishonesty policy defines plagiarism and cheating and explains punishment guidelines.

Academic Freedom:
(http://www.usf.edu/atle/teaching/academic-freedom.aspx) refers to the full right of faculty to research, publish, and teach without fear of institutional censorship.

Classroom Emergencies: In an emergency, dial 911 to reach USF Police (or on their non-emergency number, 813-974-2628). The Faculty & Staff Emergency Reference Guide outlines how to help students with guidance and advice, behavioral concerns, and immediate action. It also provides phone numbers and office locations. (http://www.sa.usf.edu/main-resources/docs/SA_Alert%20Guide_2013_WEB.pdf)

Copyright: (http://guides.lib.usf.edu/c.php?g=5784&p=25775) The USF Library offers a Copyright LibGuide that provides

information on copyright and issues pertaining to copyrighted material.

EthicsPoint:
(https://secure.ethicspoint.com/domain/media/en/gui/14773/index.html) EthicsPoint hotline is a third-party hosted hotline to enable the safe, secure, and anonymous reporting of activities which may involve misconduct, fraud, abuse, and other violations of USF policies.

Faculty Handbook:
(http://www.usf.edu/provost/documents/faculty-forms/usf-faculty-handbook.pdf) The online Faculty Handbook, maintained by the Office of the Provost, contains links to important regulations, policies, procedures, and guidelines (including the collective bargaining agreement) at USF. There are also sections on evaluations, tenure, instructional policies, and sabbaticals.

Fair Use:
(http://guides.lib.usf.edu/ld.php?content_id=15008723) The fair use exception to the current copyright laws permits the reproduction of portions of copyrighted works without the owner's permission. Section 107 of the Fair Use Doctrine lists the following purposes for which the reproduction of a particular work may be considered fair: criticism, news reporting, teaching, scholarship, and research.

FERPA:
(https://www.registrar.usf.edu/presentation/ferpa_quiz/62) is the acronym for the *Family Educational Rights & Privacy Act*

of 1974, as amended. It is also known as the "Buckley Amendment." Essentially, this law protects the privacy of student educational records and affords students the right to refuse to permit USF (and other educational institutions) from releasing or disclosing any information about them. The purpose of FERPA is to identify the rights students have pertaining to their educational records. The primary rights afforded to students include the right to: Inspect and review their educational records, Seek to have their records amended, and Control the disclosure of information from their records.

Final Examinations:
(http://www.registrar.usf.edu/ssearch/search.php) Find the assigned time for your class published on the Class Schedule page.

First Day Attendance: In order to retain eligibility to distribute Department of Education Title IV HEOA funds, the University requires faculty to report whether students are present or absent at the first class meeting. Use the First Day of Attendance (FDA) tool to record attendance electronically during class or as soon as possible afterward. The tool is available in Canvas. The link to it is found in the Navigation Menu of each course in Canvas. For instructions on how to use the FDA tool visit: http://usfweb.usf.edu/courseresources/tutorial/canvas/attendance/attendance.html or contact Information Technology at (813) 974-1222. Teaching an online course? If so, you will also utilize the FDA tool once you prescribe how students must signify that they are present. For example, students must login

and email you a form, turn in a first assignment or otherwise contact you. Teaching an Alternative Calendar Course? If so, you will utilize the FDA tool to submit your first day attendance rosters within 10 days from the first class meeting. If your course meets for a shorter period of time; e.g. only 10 days, your roster is due at the 30% mark (day 3). Have students who registered late? If students appear on your roster after the first week of classes but fail to actually attend, please contact the Registrar's Office at tellltheregistrar@usf.edu to request the students be dropped.

Grade Policy:
(http://www.ugs.usf.edu/catalogs/0102/gradetc.htm) USF has enacted a system of grading and policies of Academic Probation and Academic Dismissal to make students aware of their academic progress.

Grade Record Retention: You should retain your gradebook and student graded material for one year after the expiration of the appeal window - to be safe, keep graded materials and detailed gradebook records for 1.5 years after the end of the term.

Last Day of Attendance: To comply with federal regulations regarding student attendance, faculty are required to enter students' the last date of attendance for all students receiving an F, I, or U grade. The last date of attendance is defined as the last date a documented academic related activity was completed by the student for the course. In the event of a Federal audit, you may be asked to provide documentation

(e.g. grade book entry, exams dates, submission of papers, etc.) to support the last date of attendance reported.

Personal Relationships with Students: (http://regulationspolicies.usf.edu/policies-and-procedures/pdfs/policy-1-022.pdf) USF Policy 1-022 provides detailed information on university guidelines for consensual relationships.

Religious Holidays: (http://regulationspolicies.usf.edu/policies-and-procedures/pdfs/policy-0-602.pdf and http://regulationspolicies.usf.edu/policies-and-procedures/pdfs/policy-10-045.pdf) The holidays of several religious faiths occur throughout the academic year. Religious observance accommodations for employees and students should be provided as per USF System Policies #0-602 and #10-045. The following link contains a list of major religious observances: http://www.interfaithcalendar.org.

Students with Disabilities Services (SDS): (http://www.usf.edu/student-affairs/student-disabilities-services/) The University of South Florida is committed to providing equal access to students with disabilities. SDS strives to create partnerships with faculty and staff to promote self-advocacy, accessible education, and appreciation of varied abilities at USF. Information about classrooms, course load, exams, and other accommodations can be found on the SDS website or by contacting SDS at (813) 974-4309 or sa-sds-information@usf.edu. See the SDS Student Handbook for more information about SDS, American with Disabilities Act, and instructor responsibilities. The ATLE syllabus template

(http://www.usf.edu/atle/documents/handout-usf-syllabus-template.doc) includes a default policy statement you can include on your syllabus regarding accommodation requests.

Technology Policies: (http://www.usf.edu/it/about-us/policies-and-standards.aspx) USF Information Technology (IT) maintains the policies and standards held by the university. IT also provides technology support for MyUSF, email accounts, connecting from home, and work orders. IT can be reached at (813) 974-1222 or help@usf.edu.

Teaching STEM in the American Classroom

Students

There is no such thing as the typical student, American or international. It is always best to treat students as individuals and not to make assumptions based on their apparent race, gender, ethnicity, cultural, or socioeconomic background. However, there are some very general differences to be aware of in dealing with students whose background is different from your own.

American students

- Many are non-traditional (not between ages 18-22), they may be part-time students, students who return to school later in life, support families, or are military veterans
- Include different races, sexual orientation, ethnic groups, language backgrounds, etc.
- Have widely varying degrees of preparation for college
- Often independent
- Place great emphasis on extra-curricular activities, on involvement with student groups
- Do not necessarily form friendships with their classmates
- To international students, American students may seem to be competing and not cooperating (in many parts of the world, it is common to shares notes)
- May be reluctant to appear overeducated
- Can be overly sensitive to criticism

- Appear too religious or not religious enough (Western Europeans surprised at the presence of chapels either on campus or very near campus)
- Assertive
- Place great emphasis on regional differences
- Patriotic, many see the U.S. as superior to other countries and foreigners with condescendence
- Gesticulate (but not too much), gestures are different
- Make eye contact
- Maintain a certain distance when speaking
- Try to avoid silence at all costs, small talk is common

International students

- May hold a distorted view of Americans
- May feel frustrated, confused, lonely, isolated, misunderstood
- Some are better academically prepared than American students
- Generally have studied fewer subjects – and in more depth – than American students
- Find it more difficult to approach professors
- Might seem too deferential to American faculty
- May struggle with plagiarism, grading on a curve, the need to always back an idea with academic writing, and the informal familiarity between professors and students
- Struggle with American students' view of privacy, personal belonging, excessive directedness
- Some place great emphasis on modesty
- Respect for authority (e.g., the written text, the professor); reluctance to critique it
- For some, arguing is a favorite national pastime and they might seem aggressive

- For some, a bad grade is shame brought on the whole family
- Some international students might have the tendency to disrespect rules
- Students from societies where women lack power might struggle with seeing women in a position of power
- Depending on the political situations in their home countries, international students might not want to engage in political discussions
- Often stick together

Atmosphere

The American classroom and laboratory atmosphere may be substantially different from what you or your students are familiar with. Here are some generalizations:

Authority

- The teacher does not necessarily have the same position of formal authority
- Often the teacher is more a discussion leader that guides students toward knowledge rather than serving as the repository of knowledge
- This concept can be difficult to accept both by international faculty and international students
- American students can be expected to challenge the information they are being presented and how it is presented. This is not a personal attack or a lack of respect.

Formality

- Less formal than you may be accustomed to (eating in class, reading in class, arriving late, sloppy dressing, not greeting the teacher upon arrival)
- Calling teachers by their first name
- Social interactions between teachers and students (going to a restaurant with a teacher or at a teacher's home)

Expectations from teachers

- Office hours
- A lot of contact with students, personalized interactions, emails
- A lot of feedback (affirmative and non-authoritative)
- Make-up exams, extra credit, grading on a curve, not telling students they are wrong, and other practices that may appear lenient
- "Entertain" students – in most other countries, learning is not supposed to be fun. It may be helpful to view it as motivating students
- Letting students know from the beginning what the course expectations are (other countries – no syllabus, no idea what students might be graded on)
- If students did not understand a concept, it is usually considered the instructor's fault, rather than the student's

Grading

- Not one single assignment or exam at the end of the course, but multiple throughout
- Students might challenge their grades or require explanations of their grades and papers
- Students should only see their own grades (FERPA, a federal regulation)

Tips for International TAs

- Be patient, have a sense of humor and a high tolerance for ambiguity
- Speak English as often as possible
- Learn as much as possible about the local community
- Read the student newspaper and watch the local news
- Get familiarized with the popular culture (it will allow you to relate to your students better)
- Ask questions whenever something is not clear
- Do not assume your students learn the same way you learned
- Talk to your colleagues to get a good understanding of your students (their levels, expectations, their apprehensions, etc.)
- Ask colleagues to allow you to observe their labs
- Observe how others around you interact with students
- Talk to your students informally before and after lab
- Acknowledge that English is not your first language – do not apologize for it
- Encourage students to ask questions if they have problems understanding you
- Do not hesitate to offer personal information about yourself (e.g., where you are from, where you studied, why you are teaching at USF, what you like about Florida, etc.)
- Ask your students why they are taking this class
- Talk to other more experienced international faculty
- Do not take students' apparent disinterest in your course personally

- Be aware of the tendencies in your own culture that might appear offensive to American students (e.g., lack of eye-contact with women)
- Avoid your discipline's jargon as much as possible
- Use midterm evaluations

Language Tips

Slow down and prepare in advance

- Speak slowly and enunciate clearly
- Be well prepared for the lesson; be organized
- Practice difficult words ahead of time
- Avoid words you know you tend to mispronounce (have a list of synonyms in mind)
- Move your mouth differently; consider "warm ups"

Write it down

- Write important terminology, homework assignments and your own name on the board
- Write in block letters, not cursive

Be aware of your voice

- Don't talk to the board
- Your voice = more than words! Tone, animation, energy, loudness
- Word emphasis: place no stress on multisyllabic words like "city hall"

Ensure student comprehension

- Provide multiple explanations and examples

- Repeat student questions in your own words to make sure you've understood
- Ask them to "rephrase", not "repeat" questions you don't understand (or ask a different student to rephrase it)
- For key concepts, lay emphasis by: repetition, paraphrasing, pausing
- Pause often, and encourage questions
- Importance of daily classroom assessment

Tips for Teaching International Students

- Avoid generalizations (read about your students' educational system, but do not assume all international students of a certain nationality will behave the same)
- Overemphasize academic integrity rules
- Get to know international students (make an effort to pronounce their names correctly, learn about their home countries)
- Help them feel they belong by frequent interactions, foster inclusion
- Encourage students to come see you during office hours
- Help them achieve academic self-efficacy (the belief they can achieve their academic goals)
- Do not use idioms or assume international students understand references to American popular culture
- Include references that international students might relate to
- Make your expectations and policies clear (explain even what appears excessively obvious)

- Be consistent in how you present information (e.g., write the day's agenda on the board, explain how it fits with the rest of your material, etc.)
- Allow students to record your lectures
- Acknowledge additional time for reading assignments
- Explain your policies on deducting points for English mistakes
  - Place more emphasis on global writing issues than on common mistakes
  - Differentiate between assignments where the thinking process matters most from those where the style is more important
  - Edit solely one paragraph and ask students to correct the rest of the paper
  - Encourage them to use the writing center (http://www.lib.usf.edu/writing/) and the tutoring center (http://www.lib.usf.edu/tutoring/)
- Assign groups
- Be aware that some international students might be uncomfortable to work in mixed gendered groups
- Use the board: if they don't know a word by the way it sounds (and this is more common than you think), it will help them to see it.
- Face the audience: if they can't see your mouth, it's harder for them to make sense of the words
- Tell the student to "rephrase" rather than "repeat": a student told to repeat will just say it louder; but rephrasing will force them to think of a different way to ask their question
- Lay emphasis with repetition and pauses: students will know a key concept when you pause or duplicate your sentence

- Explain it twice: providing a second explanation (or a second example) will increase the odds they will understand
- Do not allow isolation: enforce interaction among and between all people in the class; students who normally might be shy by nature should be 'forced' to take part; this will boost their interest level in the course, and in participating; make sure they learn each other's names
- Go slow on calling shy students: people from some cultures are unused to speaking up in class. Many will not pose questions because they've been taught that is a sign of rudeness to the teacher (it implies the teacher didn't explain it right). Do not "force" participation early in the term. However, work your way up to it later. Make the participation as non-threatening as possible (e.g., group work rather than speaking in plenary)
- Role play in pairs and groups: non-native speakers are reluctant to speak up in plenary but most are more willing to become involved at a "table" level
- Give advance notice for who is the secretary: if group work is to be followed by a plenary debrief (as it should), then elect a spokesperson early in the process so they can prepare (non-native speakers elected at the last second may struggle and resent being put "on the spot")
- Use a variety of methods for posing questions: not every question should start as a plenary topic; make some for individual reflection, others for partner work, others for group work (plenary discussions work best when done last)

Professional Development

The Academy for Teaching and Learning Excellence (ATLE) serves full-time faculty, adjunct instructors, and graduate teaching assistants on the USF Tampa campus in the following colleges: Arts and Sciences, the Arts, Behavioral and Community Sciences, Business, Education, and Engineering. ATLE provides "office hours for faculty," supporting faculty and TAs in their roles as teachers and mentors to students. This support includes providing consultations, training, and just-in-time aid both in person and delivered asynchronously through the Web. Some of the professional development opportunities provided by ATLE include:

Preparing for College Teaching Course

The Preparing for College Teaching (PCT; IDS 5922) is a zero-credit, ten-week program that will guide participants through the process of designing, building, and instructing college classes effectively. This course will also help you build your teaching portfolio for future employment! The class is delivered in a face-to-face setting and includes discussions, participation, and individual presentations called micro-teaching. The micro-teaching sessions will give each student the opportunity to present a short (7-10 minute) lecture from their discipline to fellow classmates and receive informal

feedback on their delivery. The major topics of this course include:

- Syllabus considerations; the FIRST day of teaching
- Classroom communities
- Critical thinking pedagogy
- Course design
- Assessment
- Interactive techniques
- The science of learning and effective lectures
- Discussions and active learning strategies
- Classroom management
- Last day of class
- Academic job search and teaching portfolios

Workshops

ATLE offers hour-long workshops year round for faculty, instructors, and graduate teaching assistants. Previous workshop topics include: Applying for the TA Teaching Award, Brain-Based Learning, Classroom Management, Confidence in the Classroom, Interactive Teaching Techniques, and Writing Effective Learning Outcomes. Workshop availability changes each semester, to see current offerings and to register visit: http://www.usf.edu/atle/events/workshops.aspx.

Consultations

ATLE offers a confidential, collegial environment for consulting about pedagogy, instructional design, and any teaching-related concerns, including topics such as improving student evaluation scores, handling problematic students, adjusting the curriculum to introduce innovations, and finding new technologies that offer promise in the college classroom. Our consultation services are open to all faculty, instructors, adjuncts, and graduate teaching assistants. We value your privacy and do not report consultations to anyone.

Teaching Observations

Teaching observations are offered only if the instructor requests it directly. These are collegial consultations, not evaluative, and the results are not shared with anyone but the faculty member. ATLE can also videotape your class session so that you can watch yourself in action—always an instructive thing to do!

The Academic Job Search

It is recommended that you begin your academic job search a year before you want the position. It's important to keep in mind when universities post positions, conduct interviews, and make decisions. In many cases, universities begin their searches for new faculty a year before the position begins. However, each discipline has nuances to the hiring process. Your best bet is to be proactive and seek advice from your dissertation chair/committee. While there is no one right way to go about conducting an academic job search, the following information represents best practices as summarized from several publications. First, some things to consider before you apply:

- Institutional characteristic – are you interested in a private or public university, do you want to work at a large or small institution, are you looking for an emphasis on research or teaching or both?
- Departmental characteristics – are you among many in your field of research or an in-house expert, does the department focus on graduate or undergraduate teaching, or are there opportunities/expectations that you socialize regularly with the people in the department?
- Geography – do you want to be in a city or rural area, are you willing to relocate and where, will you consider working outside the U.S.?
- Competition – how competitive are you, are you willing and capable of writing grants or obtaining outside funding?

Application Materials

Although each academic discipline may request the submission of a variety of documents with your application, there are three documents that are requested across the board: a C.V., cover letter, and letters of recommendation. You should create your application materials early since many deadlines are in October/November.

The Curriculum Vitae

A curriculum vitae or C.V. is the academic version of a resume. It details your academic achievements and educational background. The length of your C.V. is determined by content. The average C.V. is more than two pages and as your career develops, could be in the twenty page range. A C.V. starts with contact information, however, the proceeding sections vary in title and order. The following is a list of the most commonly included sections in a C.V.

- Education – begin with your highest degree earned or in progress
- Dissertation – include anticipated completion date, title, and name of advisor
- Teaching and research experience – include position title, name of the institutions, responsibilities, accomplishments, and dates for each position held; you may want to subdivide this section into teaching experience and research experience

- Honors/Awards/Fellowships – include the date, title, and if possible, the degree of competitiveness
- Publications – include academic and relevant non-academic publications; it is often suggested that you place your publications section on the first page of your C.V.
- Presentations – include the title of the paper and the name, location, and date of the conference/meeting where you presented your work
- Grants received – list the funding agency and the project for which the grant applies. Dollar amounts for major grants may also be included
- Skills/Certifications – this section is especially important for those fields, such as nursing and education, that have a certification process
- Professional memberships/leadership – this section should list professional memberships and committee work. This is also the best place to put conference organization and/or moderation
- Related/Non-traditional work experience – include this section if you are applying to a professional school and have experience working in that profession
- References – list the names of the people who write letters of recommendation for you including their title, institution, telephone number, and email address

For additional material, see Steve Joy's Academic CVs: 10 Irritating Mistakes found at http://www.theguardian.com/higher-education-network/blog/2013/nov/01/academic-cv-job-10-mistakes

The Cover Letter

This is usually the first document read by search committees. It should be tailored to the position you are applying for and be no longer than one page. The following is a list of common elements included in a cover letter.

- Contact information
- A clear statement with the exact title of the position you for which you wish to be considered
- Research interests
- Teaching areas
- Dissertation and methodology
- Grant/funding experience
- Highlights of critical, interesting, or groundbreaking findings
- Connection between dissertation and the current position
- Summary of publications, grants, teaching experience, and other important academic accomplishments

For more information on the general do's and don'ts of writing a cover letter, visit USF's Career Services at http://www.usf.edu/career-services/students/cover-letter-dos-and-donts.aspx

Letters of Recommendation

Letters of recommendation are best when written by someone who knows you, your research, and your character. Letters from well-established or well-published scholars in your field

are impressive and can help you make the short list. A favorable letter from you dissertation chair is expected and any application without it is considered suspect.

Additional Materials

In addition to a C.V., cover letter, and letters of recommendation, some institutions may require one or more of the following materials.

- Dissertation Abstract
- Dissertation Chapter or Other Writing Sample
- Research Statement – a statement that discusses your plans for future research and gives context to your research interests.
- Teaching Philosophy – this is a statement, no longer than a paragraph, which expresses your pedagogical approach. It is usually the first part of a teaching portfolio that others will read.
- Teaching Portfolio – a series of documents that recreate your teaching strengths, accomplishments, and goals. It is worthwhile to create a teaching portfolio while creating other application materials because it can be utilized to present you as a well-rounded candidate.

Interviews

Regardless of the type of institution, in an interview you must be prepared to discuss your dissertation, future research interests, teaching, and your interest in the institution. Be prepared to answer a variety of questions regarding your teaching and research agendas. Be able to place your dissertation and future research interests within the department, suggest courses you can develop and teach including reading materials with assignments, and situate your research and teaching philosophy in the overall institution's mission and goals. The best way to prepare for a campus interview is to:

- Practice your job talk with an audience – if possible, schedule a practice job talk session with your department inviting both faculty and students. You will be able to practice your job talk and your ability to field questions as well as receive feedback on your presentation and responses.
- Practice interview questions – it is important to practice answering interview questions out loud. Practice with your dissertation chair, advisor, trusted colleague, or friend.
- Study your audience – find out as much information as possible on the institution and department. You want to know and understand the growth, challenges, reputation, culture, and focus of the institution and hiring department. Also, remember to keep the opinions of individuals in perspective.

Job Talks

A job talk is an opportunity for you to showcase your research project, skills as a researcher and presenter, ability to answer impromptu questions, and your professionalism under pressure (Barnes, 2007). The following should be included in your job talk: an informative title, purpose of your research, theoretical framework, research question(s), data and methods, major findings, summary, links to broader issues, future research, and conclusion.

Interview Questions

In an interview, questions should run both ways. In other words, once you've answered all the search committee's questions, you should be prepared to ask some of your own. Common topics are students, funding opportunities, expectations for faculty in regards to teaching load and advising, university and department committees, collaborations, and tenure expectations/requirements. The following lists of questions that might be asked during an interview were taken from Vick & Furlong (2008, 184-186).

Examples of questions that might be asked about your research:

- Why did you choose your research topic?
- Could you tell us about your current research?
- If you were to begin again are there any changes you would make to your dissertation?

- I see you have very few publications…
- What are your plans for applying for external funding over the next few years?
- How do you see your research fitting in with the department?

Examples of questions that might be asked about your teaching:

- What is good teaching? Are you a good teacher? Why?
- How do you motivate students?
- How do you feel about teaching a required course?
- What is your approach to teaching introductory ___?
- What is your teaching philosophy?
- If you could teach any course you wanted, what would it be?

Examples of other types of questions that might be asked:

- Can you summarize the contribution you would make to our department?
- What do you think is the optimal balance between teaching and researching?
- Why should we hire you?
- Are you willing to become involved in committee work?
- What do you do in your spare time?
- How would moving to our university affect you and your family personally?

Resources and Further Reading

Barnes, S.L. (2007). On the market: Strategies for a successful academic job search. Boulder, CO: Lynne Rienner Publishers.

Career Center for Science and Engineering University of Minnesota. (n.d.). Academic job search guide. Retrieved from http://ccse.umn.edu/wp-content/uploads/2012/08/Academic-Job-Search-Guide.pdf.

Career Services Center at University of California, San Diego. (n.d.). The academic job search survival handbook: Especially for graduate students. Retrieved from http://career.ucsd.edu/_files/GAcadJobSearchHandbook.pdf.

Coghill-Behrends, W. & Anthony, R. (2012). The PhD handbook for the academic job search: An owner's manual for finding jobs. USA: PhD Books, LLC.

Cordell, R. (2012, September 26). Useful resources for the academic job market. The Chronicle of Higher Education. Retrieved from http://chronicle.com/blogs/profhacker/useful-resources-for-the-academic-job-market/42892.

First time on the market. The Chronicle of Higher Education. Retrieved from http://chronicle.com/section/First-Time-on-the-Market-/146.

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Miller Vick, J. & Furlong, J.S. (2008). The academic job search handbook (4th ed.). Philadelphia, PA: University of Pennsylvania Press.

Office of Career and Professional Development at University of California San Francisco. Getting a job in academia. Retrieved from http://career.ucsf.edu/grad-students-postdocs/career-planning/academic-jobs.

Smith, J. & Johnson, M. (2003). Academic job search guide. Yale Graduate Career Services. Retrieved from http://www.yale.edu/graduateschool/careers/forms/Academic%20Job%20Search%20guide.pdf.

Resources at USF

USF Offices and Contact Information

Academic Success Center (http://www.lib.usf.edu/asc/) oversees the:

- Writing Studio (http://www.lib.usf.edu/writing/) where students can work on improving their writing skills
- Tutoring Center (http://www.lib.usf.edu/tutoring/) where students can get help in many disciplines such as math, sciences, business, languages, and depending on the semester and student need in additional disciplines
- Smart Lab (http://www.lib.usf.edu/smart-lab/) where students can work on improving their performances in SMART Lab courses and get tutoring in calculus, statistics, and physics.

Advising Offices (http://www.usf.edu/undergrad/students/advising-offices.aspx) are specific to each college; students can schedule consultations before registering for classes or choosing majors.

Bull-to-Bull Financial Services (http://www.usf.edu/financial-education/our-services/index.aspx) is a peer-to-peer financial education program designed to enhance the financial wellness of USF Tampa's undergraduate students.

Campus Recreation Department (http://usfweb2.usf.edu/CampusRec/) offers numerous recreational programs, activities, and services.

Career Center / Internships (http://www.usf.edu/career-services/) offers assistance to students on a walk-in-basis in career planning and job search.

Center for Leadership and Civic Engagement (http://leadandserve.usf.edu/) helps students discover their passion and talents and develop their skills and understanding of leadership and active citizenship.

Center for Student Involvement (http://involvement.usf.edu/) offers students opportunities to get involved and engage in transformational experiences that foster a connection to the USF, greater Tampa community, and State of Florida.

Center for Victim Advocacy and Violence Prevention (http://www.sa.usf.edu/advocacy/page.asp?id=72) helps survivors of crime, violence, and abuse and works to create a safe university environment.

Counseling Center (http://www.usf.edu/student-affairs/counseling-center/) provides students high quality, culturally competent counseling, mental health education training and outreach in collaboration with the university community.

Digital Media Commons (http://www.lib.usf.edu/digital-studio/) is a multimedia production area that provides equipment, instruction, creative space, and assistance to students in class assignments or personal projects.

The Learning Academy at USF (http://learningacademy.fmhi.usf.edu/) assists in preparing young adults diagnosed with Autism Spectrum Disorder for employment.

Living Learning Communities (http://www.housing.usf.edu/experience/llc/) are residential communities with a special emphasis on an academic major or an area of interest.

New Student Connections (http://newstudent.usf.edu/index.php/first-year/get-connected) can guide students through their first year and help them be as successful as possible.

Office of Multicultural Affairs (http://www.usf.edu/student-affairs/multicultural-affairs/) coordinates educational, cultural, and social programs to foster experiences which create mature global citizens who are prepared to thrive in diverse environments.

Office of Parent and Family Programs (http://www.usf.edu/student-affairs/parents/index.aspx) offers programs in order to support and engage all family members of USF Bulls.

Student Government (http://www.sg.usf.edu/) aims to be the voice of the students and offers opportunities to become involved.

SOCAT (http://studentsofconcern.usf.edu/) works with students who may be troubled or whose behavior is of concern to others.

Students with Disabilities Services (http://www.usf.edu/student-affairs/student-disabilities-services/) offers services and reasonable accommodations to students with disabilities.

The Student Support Services Program (http://www.usf.edu/undergrad/sss/index.aspx) is a federally funded retention program that provides academic and personal support.

Undergraduate Research (http://www.lib.usf.edu/undergraduate-research/) is a project that enables individual students or groups of students to pose or work from a defined research question, apply methods of inquiry to generate findings, and share the findings with others through presentation and publication.

University Scholarships & Financial Aid Services (http://www.usf.edu/financial-aid/) provides answers to most frequently asked financial questions and offers students the opportunity to consult with a financial aid advisor.

Textbook Affordability Project (Library) (http://tap.usf.edu/) provides informative, effective and active solutions to the

rising cost of textbooks, such as electronic textbooks, textbooks on reserve at the library, the USF bookstore's textbook rental program, and course packs available through Blackboard.

USF Honors College (http://honors.usf.edu/) provides exceptional educational opportunities to the most highly motivated, intellectually curious, and academically accomplished students at USF.

USF World (http://www.usf.edu/world/about/index.aspx) offers information on overseas academic programs offered at USF and helps international students transition to USF.

Veterans Services (http://www.usf.edu/student-affairs/veterans/) provides specialized programs and services to veterans, eligible dependents, active duty service members, and members of the Selected Reserve

Wellness Education (http://www.usf.edu/student-affairs/wellness-education/index.aspx) provides services and resources to help students develop life-long healthy habits, stay well-balanced, and be successful in college.

Glossaries

USF Specific Glossary

- **AAU** – Association of American Universities, an elite group with roughly 60 members. USF aspires to be AAU-eligible in all metrics and parameters.
- **ALC** – Academic Learning Compacts; written "contracts" with students that explain, by major/program, what each student will be able to know and perform by the end of the program.
- **ARC Portal** – Applications for Research Compliance; this portal serves as the entry point to create and update IRB applications.
- **ASC** - Academic Success Center; the tutoring office on campus, located in the Library
- **ATLAS** – Advanced Tracking leading to Academic Success; an electronic tracking system used by advising to determine if students are on-schedule to graduate.
- **ATLE** – Academy for Teaching and Learning Excellence; the teaching center on campus.
- **Atomic Learning** – Video tutorials available from the library for free that show how to use software in small, granular doses.
- **Auxiliary** – A type of budget account that does not fit the other types (Foundation or the E&G "spending" account); has fewer restrictions on usage. Many departments have no auxiliary account.
- **AV Services** – Checkout desk from IT for audiovisual resources, especially classroom technology.
- **Banner** – The software underlying OASIS; an Oracle database that is the main Student Information System (SIS) and enterprise software for student records.

- **BOG** – The Board of Governors is a state-level governing body for the Florida public universities (State University System).
- **BOT** – The Board of Trustees is a governing board for USF. Half the BOT is designated by the BOG and the other half appointed by Florida's governor.
- **Bright Futures** – The state of Florida administers this merit-based scholarship program. It is separate from the Florida Pre-Paid plan.
- **Canvas** – The learning management software at USF, hosted by a company called Instructure.
- **Canvas Camp** – A free late-summer program for faculty, adjuncts, and graduate students to learn more about tips and best practices to teaching with Canvas.
- **Carry Forward** – A type of budget account that is unspent money from the previous year's budget (the fiscal year ends June 30).
- **CITI Modules** – Collaborative Institutional Training Initiative; online training about responsible conduct of research, and required of all researchers at USF.
- **CLEP** – College Level Examination Program; like AP courses, CLEP exams can be used to bypass college requires and earn credits toward graduation without additional coursework.
- **CMS** – Content Management System; the website hosting system in use by USF to present a common look/feel to USF websites (some departments may not yet be using the CMS).
- **Collaborate** – A product by Blackboard, available within Canvas for hosting webinars and synchronous online classes with students.
- **DegreeWorks** – A tracking system like ATLAS that shows progress toward degree completion, but DegreeWorks is student-facing (ATLAS is for advisors).

- **DLS** – Digital Learning Studio; a student-facing computer lab that provides software and training so students can make multimedia projects.
- **E&G** – "Educational & General" type of budget account that is provided by the university annually to each department; this is the "spending money" of a unit. Cannot be used to purchase food.
- **eDisclose** – An online program from MyUSF that allows faculty to submit their annual conflict-of-interest (and alternate employment) declarations.
- **eGrades** – Electronic grades as submitted by instructors to the Registrar at the end of each term. Submitted through dedicated tool in Canvas.
- **eTG** – E-Technology Group; former name of OFD (Online Faculty Development) group in Innovative Education.
- **eXplorance Blue** – The brand name of the software used to collect student evaluations of teaching each semester, a process done completely online via student login to MyUSF.
- **Faculty & Staff Campaign** – This is a fundraising effort to encourage USF employees to contribute to USF.
- **Faculty Voices** – A newsletter distributed by ATLE twice a year with articles "by faculty, for faculty."
- **FAIR** – Faculty Academic Information Reporting System; a program in MyUSF that faculty use to submit annual reports, update vita, and report annual FTE "effort".
- **FAST** – Financial Accounting System. Everything associated with university money (purchasing, grants, billing, budgets) lives in FAST. Faculty are likely to visit FAST for purchasing cards, if they are issued them, and the Travel and Expense center for travel authorizations.
- **FERPA** – Family Educational Rights and Privacy Act. This act of Congress dictates that student records (including grades) are to be kept confidential. In practice, this means grades and other

records should never be posted, displayed, or made available in a way that one student can learn another student's grade. See **http://www2.ed.gov/policy/gen/guid/fpco/ferpa /index.html**.

- **FF Grade** – An "F" grade that also marks academic misconduct / cheating. The second "F" (for cheating) can be added to any grade at the instructor's discretion.
- **First-Day Attendance** – USF has a policy that all students must attend the first day of class (or equivalent, if online) and this attendance is recorded via a dedicated tool in Canvas.
- **FKL** – Foundations of Knowledge and Learning; the branded name of General Education courses at USF.
  See **http://www.ugs.usf.edu/gec/FKL/FKLhome.html**.
- **FLC** – Faculty Learning Community; a voluntary group of faculty members learning about, reading about, or researching common topics related to teaching. Several run simultaneously each Fall, and are coordinated by ATLE.
- **Forest** – The computer network "domain" for most of the Tampa campus--though there are some exceptions.
- **Foundation** – A type of budget account (in this case, USF Foundation) that takes in money from donations. Some offices and colleges have unit-specific Foundation accounts. Foundation accounts can be used to purchase food.
- **FTE –** Full Time Equivalent. This is shorthand for the percentages/components that make up a faculty member's job. FTE always equals 1.0 (example: research 0.6, teaching 0.3, service 0.1).
- **FTIC** – First Time in College (previously called "freshmen").
- **GEMS** – Global Employment System. This is the "front end" of the employee-facing software, where sick leave, direct deposit, W-4, and other HR related functions are available via employee self-service.

- **GEP** – General Education Program. These required, lower-division classes are sometimes called "core" courses at other colleges. They are often high-enrollment lecture classes.
- **Gordon Rule** – A term retired in 2014, Gordon Rule referred to classes that have a writing component under strictly-defined definitions provided by the State of Florida (including a cap of 30 students per teacher/grader). Students were required to take at least some Gordon Rule courses to graduate.
- **Help Desk** – The faculty and student-facing office of IT that is the starting point for any help with computers, network, email, or telephones. See **http://www.usf.edu/it/about-us/helpdesk.aspx**.
- **HR** – Human Resources.
- **IE** – Institutional Effectiveness; an office that collects and reports data at a summary level.
- **InfoCenter** – This online portal provides public-facing data and reports about USF students, classes, and progress. See **http://usfweb3.usf.edu/infocenter/**.
- **In-Unit** – Regular positions at USF classified as "in-unit" are part of a "bargaining unit" and are therefore covered by a Collective Bargaining Agreement, a contract that lays out certain terms and conditions of employment between the university and the faculty union. Most 9-month faculty members are in-unit. Adjunct and TA contracts are not part of collective bargaining.
- **Innovative Education** – The office on campus that coordinates distance education and extension courses.
- **INTO USF** – A for-profit academic program that provides a way for international students who don't meet the language criteria for direct USF admission to a program to have a path leading to USF matriculation.
- **IRB** – Institutional Review Board; the ethics panel that must approve any research involving human subjects – including new

teaching methods, if intended for publication – before the research is carried out.

- **IRG** – Instructional Resource Guide; an online website about teaching and USF-specific policies maintained by ATLE and Innovative Education.
- **IT** – Information Technology; the support office for network, computers, and phones.
- **ITD** – International Teachers' Day; an ATLE event about teaching as an international instructor.
- **LMS** – Learning Management System; at USF we use Canvas.
- **MIT** – Media Innovation Team; this unit in Innovative Education provides video services for fully-online courses.
- **MyUSF** – Also called the "portal," this site allows users to login just once and access several different business systems without need of logging in again.
- **NetID** – Network ID; the primary login to computers and MyUSF, which has its own password. Often the same as the email address (without the @usf.edu portion).
- **NFO** – New Faculty Orientation; organized by the Provost's Office.
- **OASIS** – Online Access Student Information System; the primary access point for students to register for classes and see transcripts.
- **OCEP** – Office of Community Engagement and Partnerships; an office in Student Success that coordinates service-learning, internships, and other community partnerships.
- **OFD** – Online Faculty Development, or the unit in Innovative Education that supports teaching fully online classes.
- **Orbitz for Business** – Normally the only authorized means of making airplane and hotel reservations; accessed at MyUSF.
- **OUR** – Office of Undergraduate Research.
- **P-Card** – Purchasing card, which uses departmental E&G funds to pay for purchases. Not issued to most faculty members.

- **Panopto** – A lecture-capture system available via Canvas (one of multiple options for lecture capture).
- **Patel** – Shorthand for Patel Center for Global Solutions, which is used as the administration building for USF, along with a few other offices.
- **PCT** – Preparing for College Teaching; an optional 8-week program offered by ATLE for graduate students in learning how to build a college class.
- **PeopleSoft** – While student information is held in Banner, employee information is contained in PeopleSoft, a separate system.
- **Performance-Based Funding** – A model for distributing money to universities by the State of Florida that rewards favorable graduation rates, student debt ratios, and several other factors.
- **Physical Plant** – USF's term for the facilities office, which handles such services as housekeeping, maintenance, and postal services on campus.
- **QEP** – The Quality-Enhancement Plan is a multiyear effort to focus campus energy, resources, and attention on a particular curricular matter to improve overall learning among students. The topic shifts every few years; starting in 2014, the QEP is "global citizenship."
- **Respondus** – Free **software** that enables easy upload of quizzes and tests into Canvas.
- **Religious Holidays** – For specific policies, see **http://usfweb2.usf.edu/eoa/holydays.asp**.
- **RIA** – Research Initiative Accounts; a type of budget account. For policies, see **http://www.usf.edu/research-innovation/about-usfri/policies.aspx**.
- **Rocky** – The USF mascot (a Bull). Rocky's image appears on class photo rosters when students have no ID card picture.
- **SACS** – Southern Association of Colleges and Schools; the main accrediting body for USF. Some individual colleges within USF

has their own separate accreditation as well, such as business (AACSB), engineering (ABET), nursing (CCNE), and medicine (LCME).

- **SDS** – Student Disability Services.
- **SI** – Supplemental Instruction; a version of peer tutoring coordinated by the **Academic Success Center** in the Library.
- **SIS** – Student Information System; at USF we use Banner as the SIS to hold enrollment, transcript, and grade data.
- **SMART Lab** – Science, Math, and Research Technology lab; 300 computer stations variously used for synchronous class work ("flipped model") or open-use for students with no instructor present.
- **SOCAT** – Students of Concern Assistance Team; office that works with students who are troubled or whose behavior concerns others.
- **Student Success** – An initiative of USF to raise six-year graduation rates and accomplish goals in similar metrics.
- **STS** – Summer Teaching Symposium; a multi-day program offered by ATLE with workshops and roundtables designed to provide best practices in teaching and other means of renewal.
- **Sunshine Laws** – State of Florida-level laws about the release of public records (in short, almost everything can be requested by any member of the public, including private notes. This includes almost all emails sent and received).
- **SUS** – State University System; the collective name for 11 public universities in Florida.
- **T&P** – Short for Tenure and Promotion.
- **TA Training** – A required one-day event for new graduate teaching assistants and graders, which occurs on the Friday before the start of classes in Fall and Spring.
- **TAR** – Travel Authorization Request; this document needs to be created and approved BEFORE reservations are made for upcoming university travel.

- **Teaching Essentials** – An online program of varying lengths to introduce the basics in how to teach face to face classes. The only version required is the one for graduate student teachers/grades, which is expected to take 8 hours to complete.
- **Teaching Squares** – An informal grouping of new faculty across disciplines in their first year at USF.
- **Tech Camp** – An optional one-day event from ATLE that introduces various instructional technology in 15-minute bursts.
- **Tech Fee** – A required fee students pay with registration that is then redistributed by committee on projects across campus that are submitted for consideration.
- **TER** – Travel Expense Report; a report that is appended to a TAR upon completion of university-authorized travel.
- **TO-101** – Teaching Online; an online module and four-week course that Innovative Education requires before it certifies faculty to teach fully-online courses.
- **Turnitin** – A plagiarism-detection service, accessible from **within** Canvas.
- **UCM** – University Communications and Marketing; the media relations team for USF.
- **UFF** – United Faculty of Florida; the union which bargains for in-unit faculty at USF.
- **University College** – Old name for Innovative Education.
- **U-Number** – The employee number first assigned upon hire; it contains a "U" at the start. Less frequently used than the NetID in most software.
- **USF Health** – USF Health has a separate budget line and reporting structure from the Tampa campus. It includes Medicine, Nursing, Public Health, Physical Therapy, Biomedical Sciences, and Pharmacy.
- **USF System** – There are multiple institutions that carry the USF name. The Tampa campus is sometimes referred to as USF-Tampa. Physically located on the same plot of land as the

Tampa campus, but separately accredited, is USF-Health. USF-St. Petersburg and USF-Sarasota-Manatee are also part of the USF System. The College of Marine Science, though housed in St. Petersburg, is part of USF-Tampa.

- **USF World** – An office on campus that coordinates study abroad, international services, and various education and research goals related to global and international issues.
- **WRIN** – Writing Intensive. Shorthand for a USF-specific requirement for graduation. WRIN courses emphasize process writing and meet a minimum word count.
- **Writing Studio** - The writing center on campus, located in the library.

U.S. Higher Education Glossary

- **ABD (All But Dissertation**) – a title used to describe a doctoral candidate that has completed all their coursework and exam requirements, but still needs to write their dissertation.
- **Academic Advisor** – a member of the faculty who provides advice and guidance on academic matters such as course selection.
- **Academic Honesty** – is the expectation that student's work is their own and based on their own knowledge, ideas, and thoughts. It is the absence of cheating and plagiarism. USF takes this seriously and a student found guilty of academic dishonesty receives an FF on their transcript and it can never be removed. For more information, visit the following link: http://www.ugs.usf.edu/catalogs/0001/adadap.htm.
- **Academic Year** – the academic year is broken into fall, spring, and summer semesters and runs August to July. To see USF's academic calendar, visit http://www.registrar.usf.edu/enroll/regist/calendt.php.
- **Accredited/Accreditation** – the official recognition that a college or university meets the standards of regional or national organization.
- **ACT – American College Test –** a standardized test administered to students who want to be admitted into a college or university. It is designed to assess a student's readiness for college-level academic work.
- **Add/Drop –** a process that allows students to change their course schedules by adding or dropping courses.
- **Adjunct Faculty** – part time-instructors at colleges and universities that are hired as needed (usually semester by semester) with no guarantees of continued employment.
- **AP (Advanced Placement)** – a national program of standardized classes offered to high school students. AP courses are college-

level courses that allow students to earn college credits with a qualifying score on the end of course AP exam.

- **Assistant Professor** – untenured faculty on a tenure track. This is usually an entry-level position with a probationary period of approximately 5-6 years following the completion of a doctorate program.
- **Associate Professor** – tenured faculty at the intermediate level. Many faculty stay at this rank throughout their careers once it's achieved. However, some strive for the rank of full professor.
- **Associate's Degree** – a degree that requires 60-80 specified credit hours which breaks down to approximately two years of study. It is awarded as Associate in Arts (AA) or Associate in Science (AS). Typically, associate degrees are awarded by community colleges.
- **Asynchronous Learning** – a type of distance learning offered through online courses with no requirements for students and instructors to interact face-to-face.
- **Audit** – taking a class to gain knowledge about a subject, without receiving a grade or credit toward a degree.
- **Bachelor's Degree** – a degree that requires 120+ specified credit which breaks down to approximately four years of study. It is awarded as Bachelor of Arts (BA), Bachelor of Science (BS), or Bachelor of Social Work (BSW).
- **Book Order** – the process of choosing a textbook for a course and placing the order with the university book store. Book orders must be submitted no later than 30 days before the start of the semester. USF's bookstore requires professors/instructors to use FacultyEnlight to place their book orders.
- **College** – the generic term that is used to refer to any post-secondary institution. Typically a college only provides an undergraduate education. College can also refer to an academic division of a university like College of Education. Click here to see a list of Colleges at USF.

- **Commencement** – a graduation ceremony that takes place in August, December, and May at USF. Click here for more information on USF commencement ceremonies.
- **Community College** – a public two-year postsecondary institution that offers two programs: a transfer program which consists of the first two years of a bachelor's degree and a terminal program which consists of vocational training resulting in an associate's degree.
- **Comps** – short for a comprehensive exam that is usually taken at the end of a Master's degree program or at the end of coursework for doctoral students. The content, length, and time are determined by each department.
- **Core Requirements/Core Curriculum** – Mandatory general education, usually interdisciplinary, course requirements needed for the completion of a degree.
- **Course** – regularly scheduled class on a particular subject.
- **Course Load** – the number of courses/credit hours a student takes during a specific semester.
- **Course Number** – every course has an identification number that distinguishes it from other courses in a particular subject. Course numbers increase as the difficulty of the course increases. For example, at USF, PSY 2012 is an introductory psychology course and PSY 3213 is a higher level psychology course.
- **Course Offerings** – a list of courses offered during a specific semester.
- **Credits/Credit Hours** – units used by institutions to record the completion of courses (with a passing grade) in a degree program.
- **CRN (Course Reference Number)** – a unique number assigned to a course that is used by students to register for the course.
- **Curriculum** – a program of study made up of a set of courses offered by a degree program.

- **CV (Curriculum Vitae)** – a document that details your accomplishments similar to a resume, but longer. It is usually requested at academic institutions when applying for an academic position.
- **Dean** – the director or head of a division of a certain professional school or college of a university.
- **Degree** – a diploma or title awarded by a college or university to students after they have successfully completed a program of study.
- **Department** – the formal division of a school consisting of faculty and support staff responsible for instruction in a subject area.
- **Discipline** – an area of academic study.
- **Dissertation** – an in-depth thesis on an original topic of research that is typically submitted and presented in the final stage of earning a doctorate.
- **Doctorate** – the highest degree awarded by a university after the successful completion of an advanced graduate program of study. It usually requires three or more years of study beyond the master's degree. Also referred to as a PhD.
- **Drop** – refers to the withdrawal of a student from a course that must be completed in a specified period of time depending on the college or university. Click here to read the guidelines specific to student drops at USF.
- **Dual Degree** – a program of study that allows a student to concurrently earn two degrees from the same college or university.
- **Electives** – are courses students can take for credit toward their degree, but are not part of the required course list.
- **Enroll** – to register or enter a school or course.
- **Exempt** – not required to do something that other students may be required to do.
- **Faculty** – the instructional staff of an educational institution.

- **FAFSA (Free Application for Federal Student Aid)** – the application used by the US government to determine the amount of financial aid a student will receive in a given year. Students must reapply every year they attend a college or university. International students are not eligible.
- **Fees** – an amount of money charged by schools, in addition to tuition, to cover institutional costs.
- **Fellowship** – a study grant or financial assistance awarded by varying institutions such as educational institutions, the government, research centers, and hospitals. They are usually awarded to graduate and doctoral students and are based on academic achievement.
- **Final Exam**- a course based assessment taken at the end of a semester or term during finals week. See USF's academic calendar for specific dates.
- **Financial Aid** – a general term that includes all types of money offered to students to help them pay tuition, fees, and other educational expenses.
- **Freshman** – a student in their first year of attendance at a high school or college/university.
- **Full Professor** - refers to the rank of a tenured faculty member that has advanced beyond the associate professor level.
- **Full-time Student** – a student taking 12 or more credit hours at the undergraduate level and 9 or more hours at the graduate level.
- **GA (Graduate Assistant)** – a graduate student employed part-time to assist faculty in teaching, grading, and meeting with students.
- **GMAT (Graduate Management Admissions Test)** – a standardized test required for admission into graduate programs in business.
- **GPA (Grade Point Average)** – a system of recording a student's overall academic performance as a numerical average. A GPA is

on a 4.0 scale and calculated at the end of each term/semester with an overall GPA calculated upon graduation.

- **Grades** – a score or mark (ie. A,B,C,D,F) indicating a student's academic performance on an assessment, paper, or in a course.
- **Graduate Course** – a credit course that is applied toward a graduate degree like a master's or doctorate.
- **Graduate School** – the division of a college or university which offers graduate programs that result in a master's degree, doctorate, or graduate certificate.
- **Graduate Student** – a student that already has an undergraduate degree and is enrolled in an advanced studies program leading to a master's or doctorate degree.
- **Grant** – a type of financial aid that does not require repayment and is given to students by the federal or state government, company, school, or charity.
- **GRE (Graduate Record Examination)** – a standardized test that is required for admission into a graduate degree program. The exam measures verbal, quantitative, and analytical writing skills.
- **Independent Study** – a course that allows students to earn credit toward their degree for work with a faculty member outside the traditional classroom setting.
- **Interlibrary Loan** – a system offered through the USF library that can get access to materials that the Tampa campus library does not have.
- **Internship** – supervised professional training designed to provide students with experience in the work place.
- **Junior** – a student in their third year of high school or college/university.
- **Letter of Recommendation** – a letter written on behalf of a student that assesses their qualifications and skills. They are usually required for admission to a program of study or as part of the application process for a fellowship, internship, scholarship, etc.

- **LSAT (Law School Admission Test)** – a standardized test required for admission into law school. The exam measures reading comprehension, analytic reasoning, and logical reasoning skills.
- **Major** – an area of specialization, consisting of a number of courses in a discipline of study, chosen by undergraduate students. Students are usually required to choose their major before the end of their sophomore year.
- **Major Professor** – a professor that serves as an advisor and mentor for students at the graduate level. The student is typically responsible for choosing their major professor, but the preferred professor must agree to the arrangement.
- **Master's Degree** – a degree awarded after the completion of an advanced program of study at a college or university. A master's degree program typically requires one to two years of study past the bachelor's degree. It is awarded as a Master of Arts (M.A.), Master of Science (M.S.), and Master of Business Administration (M.B.A.).
- **Matriculated** – enrolled in a program of study leading to a degree at a college or university.
- **MCAT (Medical College Admission Test)** – a standardized test required for admission into medical school. The exam measures verbal reasoning, writing skills, and physical and biological sciences knowledge.
- **Midterm Exam** – an exam given in the middle of an academic term that covers all the material studied in a particular course to that point.
- **Minor** – a secondary area of specialization chosen by undergraduate students.
- **Noncredit** – a course taken that does not apply to a degree program. Noncredit courses are taken by students who need developmental work in order to be accepted into a program of study. Noncredit courses can also be taken for one's own professional development or interest.

- **Nonresident** – a student that does not meet a state's requirements for residency. Colleges and universities usually have higher tuition rates for nonresident students. A nonresident student can also refer to a student that does not live on campus or in campus housing.
- **Non-traditional Student** – a student that enters a college or university a year or more after high school graduation, pursues their college education while working full time, returns after a number of years away from formal education, and/or attends college while raising a family.
- **Open Admissions** – a college or university's non-selective policy to accept all students who have completed high school regardless of their grades and/or standardized test scores.
- **Orientation** – a college or university's official process of welcoming new students to campus and providing them with relevant information on campus policies, financial aid, housing, dining, courses, etc.
- **Part-time Student** – a student that is enrolled in 12 credit hours or less per semester.
- **Pass/Fail** – a grading system that results in a pass or a fail and not a traditional letter grade. At USF, this system results in an S (satisfactory) or U (unsatisfactory).
- **PhD Candidate** – a student who has completed all their coursework, passed their qualifying or comprehensive exam, and is in the dissertation writing process.
- **Plagiarism** – the illegal use of another person's words or ideas as your own without acknowledging that person through an academically accepted citation process. Many colleges and universities have strict policies and punishments for plagiarism.
- **Postdoc (Postdoctoral scholar)** – a recent PhD recipient engaged in a temporary period of mentored research, scholarly training, or teaching in order to acquire professional skills.
- **Prerequisite** – a required course that must be completed before a student is permitted to enroll in a more advanced course.

- **Probation** – a status given to students with a low GPA and unsatisfactory academic work as defined by their college or university. The probationary period requires students to improve their performance or be dismissed from school.
- **Promotion** – the process of gaining tenure and moving from assistant professor to associate professor to full professor.
- **Provost** – the chief academic officer at a college or university responsible for overseeing academic policies and curriculum-related matters.
- **Qualifying Exams** – similar to the comprehensive exam taken by students at the conclusion of a master's program or following the completion of doctoral coursework.
- **RA (Research Assistant)** – a graduate student employed part-time to assist faculty with research.
- **Registration** – the process in which students choose and enroll in courses for an academic term.
- **Reserves** – refers to course items like textbooks and additional research material placed on reserve by a professor at the library for student use throughout the academic term.
- **SAT (Scholastic Assessment Test)** – a standardized test required for admission into a college or university and is usually taken in the junior or senior year of high school. The exam measure reading, writing, and math skills.
- **Scholarship** – a type of financial aid that consists of free money given to a student by a school, individual, organization, company, charity, or federal/state government to help pay for college tuition and expenses.
- **Section Number** – a number that is used to distinguish between multiple classes of the same course.
- **Semester** – an academic year that is divided into two equal segments of 15 to 18 weeks.
- **Seminar** – a small class focused on specialized topics discussed in depth with a professor.

- **Senior** – a student in their fourth year of study at a high school or college/university.
- **Social Security Number** – a unique nine digit number issued to people eligible to work and collect benefits in the US such as US citizens, permanent residents, and temporary (working) residents by the US government.
- **Sophomore** – a student in their second year of study at a high school or college/university.
- **Syllabus** – a document distributed to students enrolled in a course that outlines the material a course will cover, instructor expectations, assignments, due dates, instructor contact information, and relevant university policies. USF has specific guidelines for a course syllabus.
- **TA (Teaching Assistant)** – a graduate student employed part-time to assist faculty with teaching an undergraduate course.
- **Tenure** – a status earned by faculty members at a college or university after demonstrating a strong record of research, publishing, and teaching.
- **Term** – a period of study such as a semester.
- **Thesis** – a formal piece of writing on a specific topic required for a degree.
- **TOEFL (Test of English as Foreign Language)** – a standardized exam that determines English proficiency in reading, listening, speaking, and writing. The exam is required for international student admission to a US college or university.
- **Transcript** – an official record of a student's performance at an academic institution.
- **Transfer Credit** – credit awarded toward a degree on the basis of studies completed at another college or university.
- **Tuition** – the amount of money an academic institution charges its students for attendance.
- **Undecided** – a student that has not chosen or declared their major field of study.

- **Undergraduate** – a post-secondary program leading to a bachelor's degree. The term also refers to a student attending such a program.
- **Visa** – an official mark or stamp in a passport that allows someone to enter a country for a specified amount of time. The US government issues the following types of visas for students and scholars: F-1 (student visa) and J-1 (exchange visitor visa).
- **Work-study** – a financial aid program funded by the US government that allows students to work part-time on campus.

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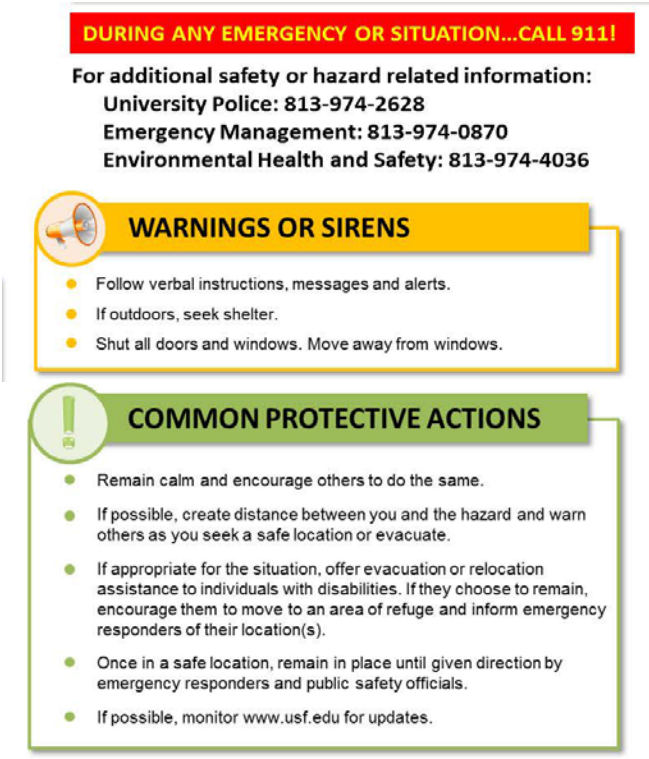
Emergency Situations and Lab Safety

If you are in a classroom or laboratory with students during an emergency you are in a position of authority. Students will look to you for direction. Refer to the following protective actions and contact the appropriate department or call 911. After the appropriate emergency personnel have been contacted, contact your lab coordinator or supervisor.



HAZARDOUS MATERIALS

- If a hazardous material release poses a danger to building occupants, notify others to leave immediately. Activate the building fire alarm as you evacuate.
- Contact Environmental Health and Safety or the University Police for assistance with clean up of extremely hazardous materials or materials of unknown hazard.
- If you come into contact with hazardous materials, rinse the contaminated area with copious amounts of water. Do not rub the substance if it is on your skin. Seek medical attention.
- Notify emergency personnel if you have been exposed to a hazardous material or have information about the release.
- If directed to **SHELTER-IN-PLACE**, stay where you are. Close all doors and windows. If possible, try to create a tight seal around door jambs and ventilation ducts.

FIRE or SMOKE

- Activate the nearest fire alarm and call 911 if possible. If there are no fire alarms, knock on doors and yell **FIRE** as you exit the building.
- Evacuate the building during every alarm.
- Do not use elevators! Assist disabled individuals to safe refuge areas.
- Close doors as you leave.
- Feel closed doors with the back of your hand. Do not open if doors are hot.
- Move well away from the building when evacuating.
- Do not re-enter the building until the **ALL-CLEAR** is issued.

POWER OUTAGES

- If possible, turn off and unplug computers and other sensitive equipment.
- Move cautiously to a lighted area. Exit signs will be illuminated if the emergency power is operating.
- Occupants should evacuate buildings and seek alternative shelter when power outages exceed 30 minutes.

ACTIVE SHOOTER

- If you cannot safely evacuate because the shooter is in the area, lock the doors and windows if possible, lower the blinds and turn off the lights. Remain out of sight and away from the doors and windows.
- Do not let anyone enter a locked room.
- Have ONE person from the room call 911 to give details and information. Remain quiet and turn cell phones to silent mode.
- Remain in place until authorities give an **ALL-CLEAR** notification.
- When directed, move with hands open and elevated to show law enforcement you are not a threat.
- If outside, stay alert and take cover behind vehicles, thick walls and trees.

SEVERE WEATHER & TORNADOES

- Move to an interior room on the lowest level of the building.
- Stay away from doors and windows.
- If possible, monitor weather broadcasts.
- Remain in place until the severe weather passes.

BOMB THREAT or EXPLOSION

- Evacuate immediately and move away from the hazard. Bring your purses and/or backpacks with you.
- Notify the USF Police Department. Call 911.
- As you evacuate, look around for anything suspicious.
- Do not touch or disturb any objects while evacuating the building.

SUSPICIOUS PERSON or ITEM

PERSON

- Do not physically confront the person or block the person's access to an exit.
- Do not provide unauthorized individuals access into buildings and offices, or allow them to follow you into controlled access areas.
- Call 911 and provide as much information as possible about the person and his or her direction of travel.

ITEM

- Do not touch or disturb the object. Call 911.
- Notify others in the immediate area. Be prepared to evacuate.

Emergency Contacts At-a-Glance

EMERGENCY	**911**
USF Information Hotline (Recorded Message)	(800) 992-4231
Campus Resources:	
SOCAT (Students of Concern Assistance Team)	(813) 974-6130
Counseling Center	(813) 974-2831
Dean for Students Office	(813) 974-6677
Office of the Provost	(813) 974-2154
Student Affairs Administration	(813) 974-5533
Student Health Services	(813) 974-2331
Student Rights & Responsibilities	(813) 974-9443
Students with Disabilities Services	(813) 974-4309
University Police Department	(813) 974-2628
Victim Advocacy & Violence Prevention	(813) 974-5756
After Hours Resources:	
Counseling Center	(813) 974-2831
University Police Department	911
Victim Advocacy & Violence Prevention	(813) 974-5757

Appendix A

Examples of Evidence-Based Teaching in STEM

The following examples are summarized from Kober, N. (2015). *Reaching Students: What Research Says About Effective Instruction in Undergraduate Science and Engineering.* National Academies Press. To read them in their entirety this text can be downloaded in pdf format for free at: http://www.nap.edu/catalog/18687/reaching-students-what-research-says-about-effective-instruction-in-undergraduate

Example 1: Students Become Reflective Learners—and So Does the Instructor (Geology, Kraft, p 6)
In this example from a community college geosciences course students use reflection notebooks and work in small groups on case studies. Reflection, problem-based study, and jig-sawing are used.

Example 2: Peer-Led Team Learning (PLTL): Modest Changes in Course Structure Yield Major Changes in Student Learning (Chemistry, Gosser, p 18)
Weekly workshops in general chemistry are led by trained undergraduate peer-facilitators. Peer-facilitators meet weekly with faculty to coordinate lectures and workshops then work with students on collaborative problem solving and modeling.

Facilitators use Socratic questioning to draw out problem-solving and critical thinking skills in small groups.

Example 3: Six Hundred Students, One Big Auditorium, and Minimal Lecture?: The Evolution of an Introductory Biology Course (Freeman, Biology, p 22)
A large introductory biology course that meets in a lecture hall environment is flipped. This means that basic content is learned outside of class (assigned reading) and assessed with online quizzes and practice exams. In class, activities are highly structured, there is no lecture, and clickers and active learning (such as think-pair-share) are used.

Example 4: Learning Goals "Drive Everything" (Geology, McConnell p. 37)
In this geology course learning outcomes are on screen at the beginning of every class and are posted online. There are clear learning outcomes matched with clear assessments. Interactive strategies such as clickers, one minute paper, think-pair-share, learning journals, group activities, and ConcepTests (Mazur, 1997) are used.

Example 5: Bringing the Rigor of Research to Science Teaching at the National Academies Summer Institute (p. 47)
At the Summer Institute for Undergraduate Education in Biology sponsored by the National Academies and HHMI faculty participate in a wek-long experience with workshops that model scientific teaching. They work in small groups to develop instructional materials with clearly defined learning

goals, which they can use right away. Participants focus on active learning, methods for assessment of student learning and instructional strategies that engage a diverse group of students. In an impact study it was found that more than 75 percent of participants reported frequent use of learner centered strategies via survey, however observational data found the majority of study participants still used mainly lecture-based instruction (Ebert-May et al., 2011)

Example 6: Helping Students Become Intentional Learners
(Wirth, Geosciences, p. 55)
Activities are incorporated into geosciences courses to develop students' skills in metacognition, or thinking about their own thinking and learning. Students complete "reading reflections" and "learning reflections" with questions like: What is the main point of this reading? What did you find confusing and why? What are the three most important things you have learned? Why? Describe the learning strategies that you are using. How might they be adapted for more effective learning? These metacognitive activities allow students to monitor their own learning and provide feedback to the instructor. The class is held in a studio format that makes no distinction between lecture and lab. Hands-on lab activities and problem solving are conducted in a two hour block (for example: M&M® magma chamber).

Example 7: Clarifying the Muddiest Points in an Engineering Class (Krause, p. 67)

Students are asked to identify the "muddiest point" or least clear concept discussed in class (originally put forth by Cross and Angelo, 1988). Krause calls his approach Just-in-Time Teaching with Interactive Learning (JiTTIL). It involves gathering feedback, with worksheets or online, from students to identify the concepts they had trouble understanding and to rate the degree of difficulty they experienced with it. The first 5 or 10 minutes of the next class is used to address the most common muddiest points. This technique is also useful to connect content from one class session to the next and provide a segue into the next section. YouTube tutorials were also created to address some of the most common "muddiest points"

Example 8: Modeling in the Broadest Sense (Ebert-May and Long, MSU Biology, p. 86)

A practice-based approach to instruction in ecology and biology to help students conceptualize and reason about complex biological systems. Students construct, apply, and evaluate scientific models, including visual representations like graphs, diagrams, and box-and-arrow systems models This model-based instructional approach addresses the three main aspects of learning emphasized by DBER studies: (1) building conceptual understanding, (2) solving problems, and (3) interpreting, constructing, and understanding representations

Example 9: Shifting Instruction from What Chemists Know to How Chemists Think (Talanquer and Pollard, 2010)

In this chemistry course, the Process Oriented Guided Inquiry Learning (POGIL) approach, in which students work in small groups, was adapted to large introductory courses with enrollments of 300 students. The curriculum, Chemical Thinking (2012), was designed to "promote deeper conceptual understanding of a minimum core of fundamental ideas instead of superficial coverage of multiple topics." Instructors still lecture for short periods, but also have students create their own simulations and models. Students work in pairs on "Let's Think" activities that require them to make observations, build models, make predictions and decisions, and construct explanations. Learning modules conclude with problem solving activities called "Let's Apply." On a traditional standardized exam, their students perform the same as those in a traditionally taught class, but on an assessment of conceptual understanding, their students do significantly better (Talanquer, 2012).

Example 10: Putting Together the Pieces of a Geosciences Puzzle (Tewksbury)

In this jigsaw activity in a geosciences course students actively construct conceptual knowledge by analyzing data, seeing how it fits into a larger framework, and reaching conclusions. Students take control of their learning by doing advance reading, studying a variety of information, and explaining what they learned to their peers. The interactive element

provides students with an incentive to do the work so they will not let down their peers or themselves. Students use the tools and practices of geology by analyzing maps and data. The activity has relevance to the real-world problem of global climate change.

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STEER

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