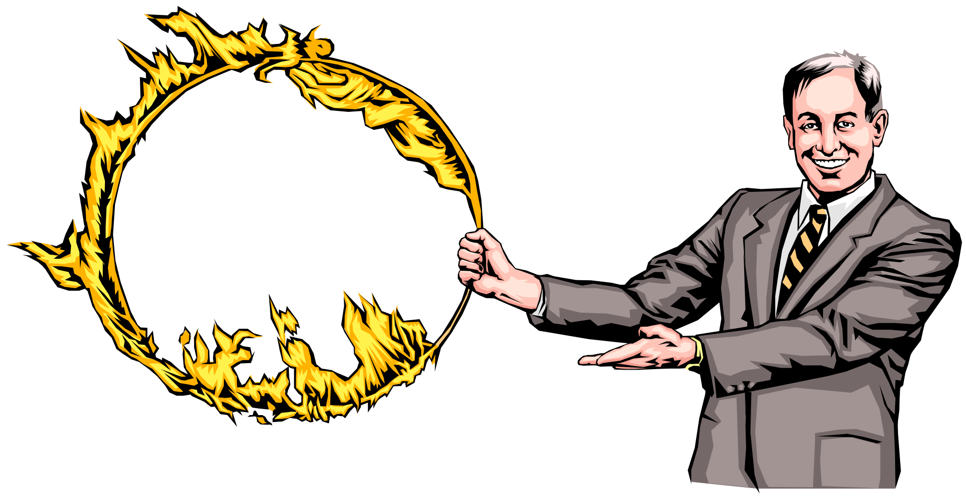
Preparing and Sustaining Teaching Assistants

It's Not TA Training

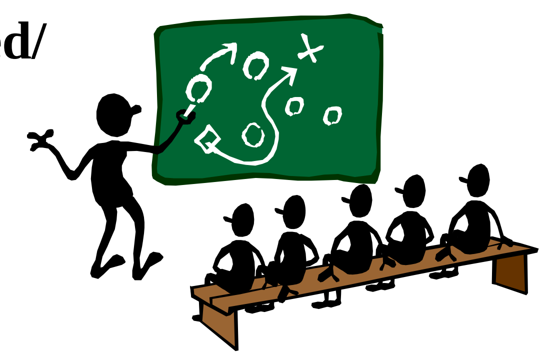


Ken Heller

University of Minnesota

http://groups.physics.umn.edu/physed/

20 years of TA education at University of Minnesota
Many, many people



Funding from DOEd, NSF, mainly U of M

Preparing for What?

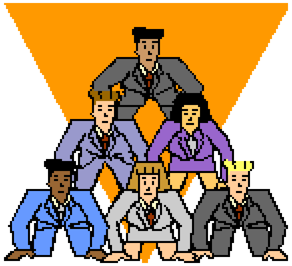
- The TA experience plays an important part in graduate (or undergraduate) education?
  - Learn technical communication skills (talking, listening, reading, writing) – usually small groups
  - Learn basic physics – teaching is the best way to learn
  - Learn what it takes to help others learn

Initial Conditions and Constraints

- Who are the TAs and what can't they do?
- What support are we able to give TAs?
  - Before teaching
  - While teaching
- What do we need TAs to do?
  - How does it match the goals, initial conditions, and constraints?

TA Inventory – Fall 02

- Number = 79
- 76% male 24% female
- 90% physics 10% engineering
- 33% first year graduate students
- 6% undergraduates
- 66% international 34% US



Country	%
US	34
China	32
India	10
Russia	8
Korea	5
Germany	3
Other	8

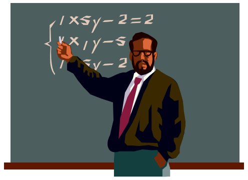
Observation of TA in traditional discussion sections & labs

TAs are not skilled teachers

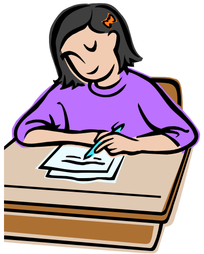
- Cannot present a extended line of thought
- Cannot get students involved in a meaningful discussion
- Do not know student difficulties

TAs do not have an expert understanding of introductory physics

- Physics errors
- Misleading physics



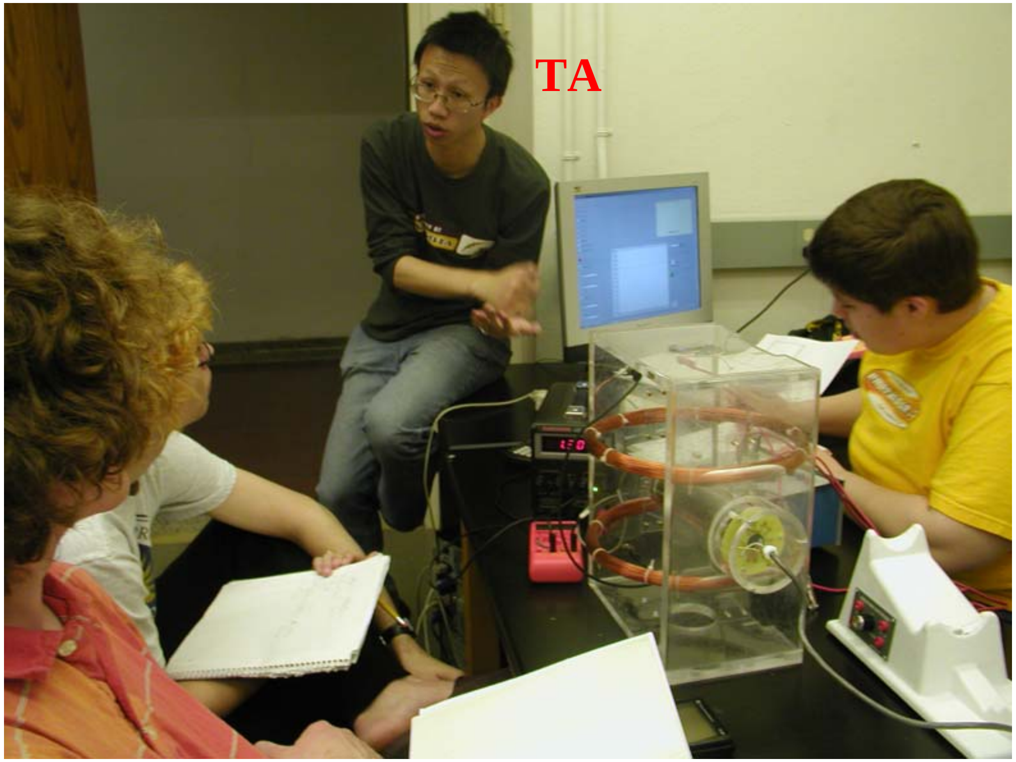
- Unable to unpack complex (for students) thought processes
- Idiosyncratic techniques



Students of the TAs are not skilled learners

- Cannot generalize from someone else's difficulty to their own.
- Want and need help tailored to their individual thought process.

TAs Can Coach Groups if they have Support



- **Average TA can coach up to 5 groups in one class.**
- **Optimal group size is 3**
  - **A group of 4 works but requires more TA effort and skill**
  - **A group of 2 is usually not effective**

A Little Learning Theory

The "Clear Explanation" Misconception

Commonly held by Faculty, TAs, Students, & Administrators

Instructor pours knowledge into students.

Little knowledge is retained.

Student's Fault

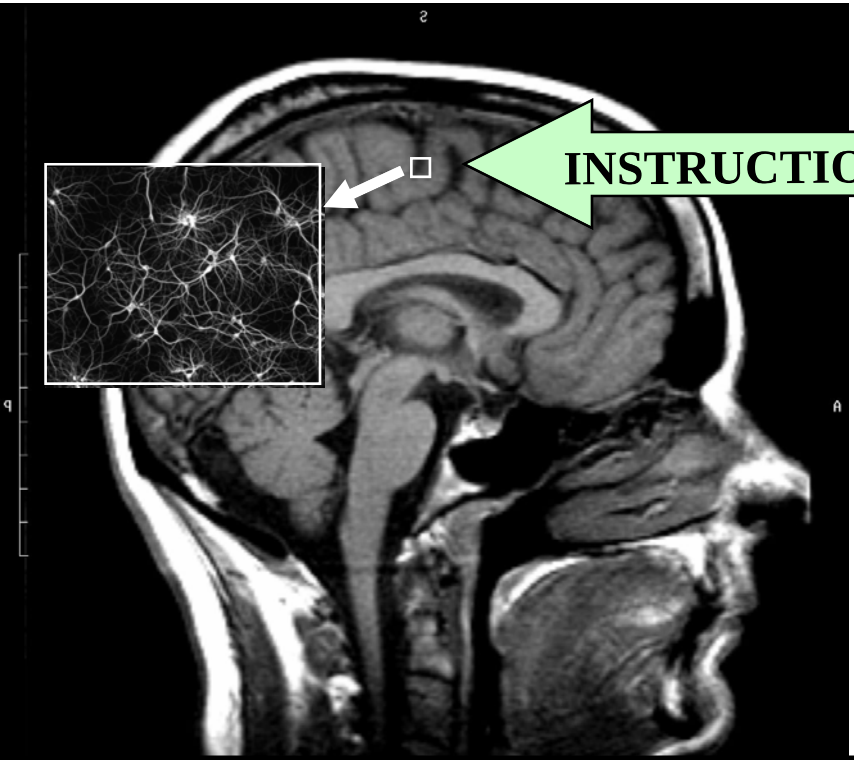
Impedance mismatch between student and instructor.

Instructor's Fault

Learning is much more complicated

Leonard et. al. (1999). Concept-Based Problem Solving.

Learning is a Biological Process



INSTRUCTION

Phenomenological Learning Theory

Apprenticeship Works

Cognitive Apprenticeship

Learning in the environment of expert practice

- Why it is important
- How it is used
- How is it related to your existing knowledge

Neurons that fire together, wire together

Simplification of Hebbian theory:
Hebb, D (1949). *The organization of behavior*. New York: Wiley.

model

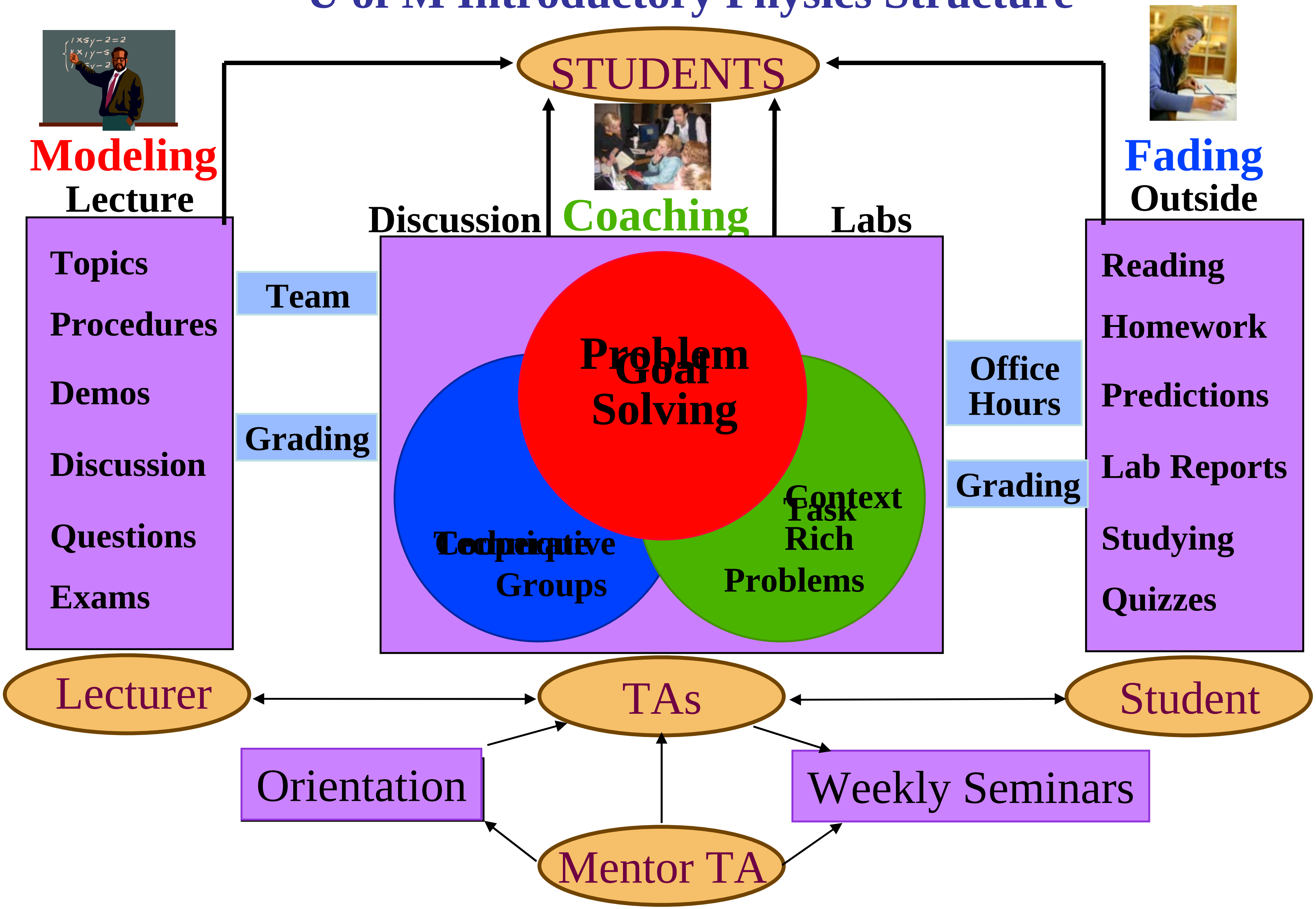
coach

Collins, Brown, & Newman (1990)

fade

Brain MRI from Yale Medical School
Neuron image from Ecole Polytechnique Lausanne

U of M Introductory Physics Structure



Physics Education Research & Development

Course Environment -- TA Success

TAs Know What's Going On:

- **definite course goals that TAs know**
- **definite topic goals that TAs know**
- **TAs know all changes before students**
- **TAs know lecturer's view of the material**

  What are the pitfalls

Students Know What TAs Do is Important:

- **TAs deal with the same content at the same time as the lecturer**
- **TAs deal with the same content in the same format as the lecturer**
- **references to lab and discussion section in lectures.**
- **lecturer knows what TAs are doing and why**

Class Environment -- TA Success

Limit presentations:

- short and planned
- student - student interaction to clarify and correct
- minimize classroom management problems

Limit total number of students:

- same students in discussion section and lab with same TA

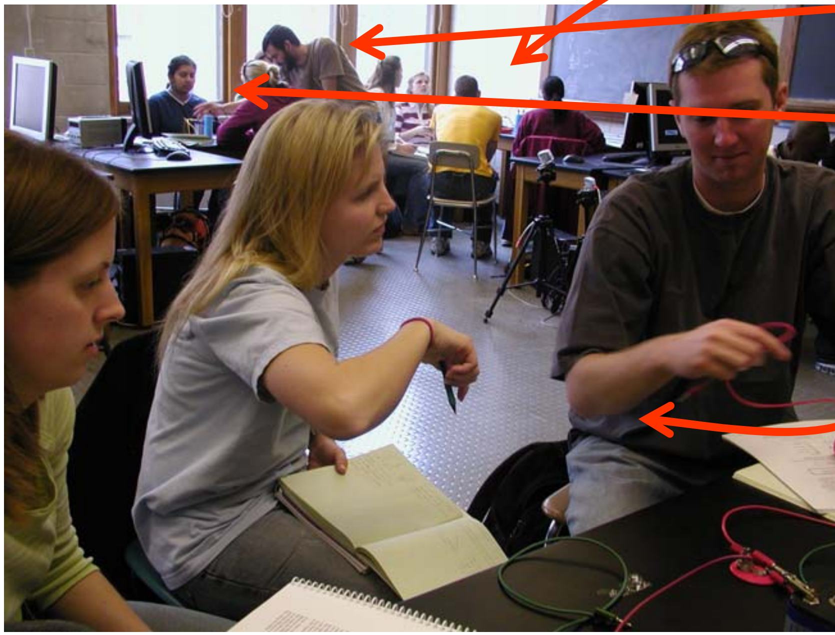
Enhance interactions with individual students

Coaching Using Cooperative Groups

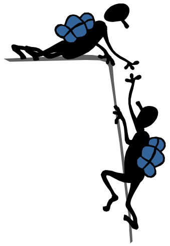
Coaching Environment

TA Coaching One Group

Groups Discussing Physics



TA Coaching a Group



TA Support

Creating a "culture of teaching"

- **While Teaching:**

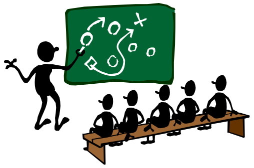
  Lecture section teams meet at least once/wk to coordinate discussion and lab work with lecture.

  1 professor + 6 TAs

  Mentor TAs observe new TAs teach and offer suggestions

  New TAs meet once/wk for teaching seminar

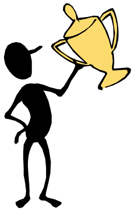
  

  Required – Class Credit with Grades

  Led by Mentor TAs

- **Outstanding TA Awards: ~7/yr**

  Nominated by students, faculty, mentor TAs

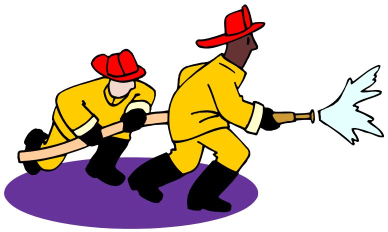
  

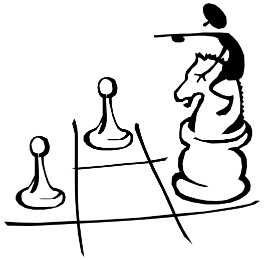
- **Before Teaching:**

  Orientation course for new TAs -- 49 hours (7 days)

Support for ~40 New TAs/year (30 physics grad students)

- 7 day TA orientation before fall term (over an 10 day departmental orientation)
  - TA duties and responsibilities
  - Course structure
  - Reasons for course structure based on learning research
    - Physics concept research
    - Expert-novice problem solving research
  - Introduction to diagnostic tools
  - Introduction to diagnosing student difficulties from written work
  - Introduction to a structured problem solving framework
  - Introduction to student lab manuals and instructor lab guides
  - Modeling of lab coaching
  - Modeling of problem solving coaching
  - Practice teaching (peer teaching)
  - Case studies in teaching difficulties (ethics, appropriate behavior, cheating)
  - Safety
  - First week's lesson plans
  - Expectations for course team meetings
- Weekly teaching seminars while teaching during the year
- Mentor TA observations and feedback during the year





New International TA Support (~15/year)

3 Week TA orientation by University Center for Teaching and Learning (CTL) before department orientation

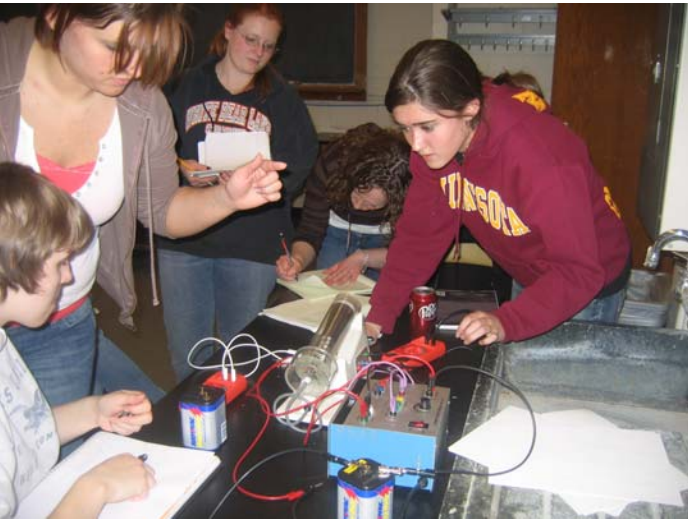
- Orientation to U.S students
- Orientation to U.S. pedagogy
- Practice speaking with coaching
- Practice listening with coaching
- Speaking and listening test - must pass at highest level for full TA duties

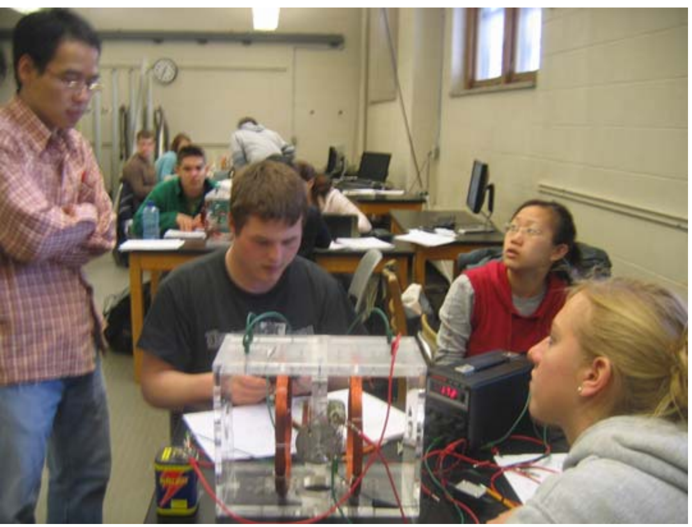
If Test not Passed at Highest Level – During Next Semester

- Work with experienced TA in one lab and discussion section.

- Meet with course team and take regular duties.
- Grade for other classes
- 3 hour/wk class by CTL
- Retake and pass speaking and learning test

2 Semesters of Teaching Seminars





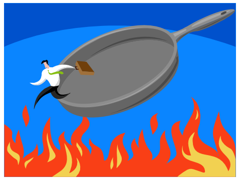
	Hours in Class
1. Lab Preparation	12
2. Problem Solving	5
3. Grading and other Issues	7
	24

Orientation + Seminars =
3 graduate physics credits

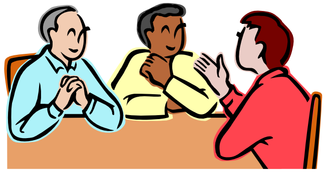
Experienced TA Support (~30/year)

1/2 day TA orientation before fall term

- Review of TA duties and responsibilities
- Leadership and responsibility to new TAs
- Changes in course technology or procedures over the summer
- Review of student results from previous years



- Discussion of teaching difficulties from previous years
- Review of changes to student lab manuals and lab instructor guides.
- Discussion of responsibility to guide course team meeting

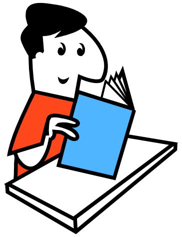


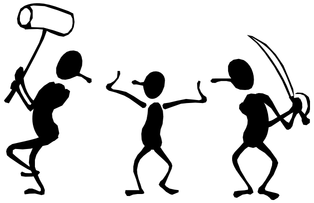
- Use of mentor TAs

All TA Support

During term

- **Course team meeting with lecturer at least once per week.**
- **TA handbook**

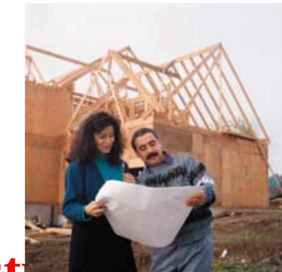




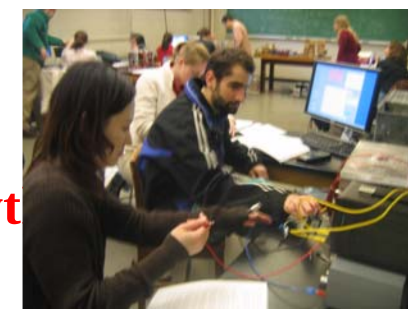
- **Laboratory instructor's guide**
- **Mentor TAs for conflict resolution**

Framework That Supports Lasting Change

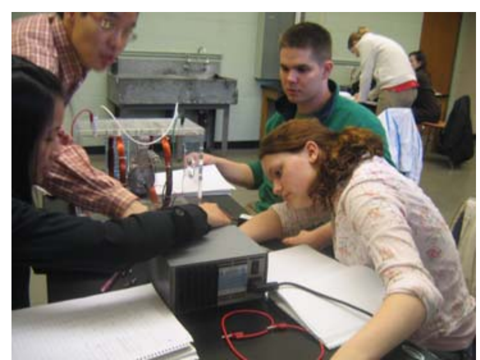
- **New TA orientation and seminars**
  - Prepared for Cooperative Group Problem Solving in discussion sections and laboratories.
  - TAs expect weekly meetings with faculty lecturer



- **Mentor TAs**
  - Available for consultation if difficulties
- **Lab equipment, lab manuals, lab instructor guides, and student problem solving guides.**
  - Modified by graduate students over summer based on feedback from faculty and TAs
  - Labs maintained by a professional laboratory technician

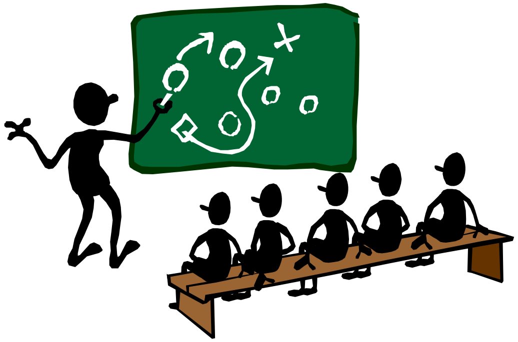


- **Quality Control**
  - Standard pre and post tests (ie FCI, CSEM, BEMA, …)
- **Minimal TA Time – less than 16 hrs/wk including everyt**
- **Student Success**
  - Ability to attack complex problems
  - High pre – post test gains
  - Low drop out rate ~4%
  - Low failure rate ~1%



Faculty Autonomy and Control Supports Lasting Change

- **Each lecturer has own TAs**
  - **All TAs have only sections for a single lecturer.**
  - **Lecturer communicates to TAs the emphasis of the class.**
  - **Weekly meetings with TAs to decide**
    - **laboratory problems**
    - **discussion section problems**
    - **textbook reading quiz**
    - **grading policy.**



- **Course emphasis determined by each lecturer**
  - **Pacing must be common for all multi-lecture courses to match labs.**
  - **Lecturers must cover agreed upon material for common final exam.**

Course will not function optimally unless:
Lectures in multi-lecture courses communicate with each other.
Lecturers communicate with their TAs.

Persistent Systematic Change Depends on the TAs

- **TAs are the primary Coaches**
  - **Department determines the TA preparation**
  - **Department supports the mentor TAs**
  - **TAs can successfully conduct Cooperative Problem Solving Sessions**
- **Faculty Value Prepared TAs**
  - **Students do not complain about TAs (usually)**
  - **TAs know what to do with minimal faculty guidance**
- **The Cooperative Problem Solving pedagogy fails gracefully**
  - **Faculty and TAs do not have to follow the best practice.**
- **A support structure for TAs exists**
  - **Director of Graduate Studies with mentor TAs**
- **A quality control procedure exists**
- **There is a mechanism for individual faculty modifications**
- **It is reasonably successful**
  - **Few student complaints**
  - **Reasonable student success as determined by faculty**
  - **Good student achievement**

What We've Learned About TA Orientation



Teach Orientation using the same techniques as you expect your students to use.

Integrate learning theory with what TAs will be doing (e.g., teaching labs, tutoring, etc.).

Have experienced TAs teach most of the class, particularly modeling how to teach and supervising peer teaching.

Use real examples of students' work and real case studies.

Grade everything you want the TAs to do -- if you don't grade it, they won't do it.

TA positions in Other Classes

15 Experienced TAs

Discussion sections using cooperative group problem solving

- Junior level - Analytical Mechanics, Electromagnetism
- Senior level - Quantum Mechanics
- Graduate level - Quantum Mechanics

Laboratories

- Conceptual physics – Energy and the Environment
- Introductory honors physics
- Sophomore level modern physics
- Junior level experimental methods

Studio

- Physics for future elementary school teacher (PET pedagogy)

Mentor TAs

Additional Teaching Preparation for Future Faculty

- TA an advanced class
- Apprentice with a professor – usually in a summer class (unpaid)
  - Work with professor to organize course
  - Observe professor lecture and organize course
  - Help professor organize course
  - Observe professor lecture and discuss
  - Give set of lectures with feedback from professor
- Teach a course in a local college (paid by that college)
  - Support from that college’s faculty
- University Preparing Future Faculty Course

The End

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http://groups.physics.umn.edu/physed/