

## Using iPads in the chemistry classroom: Steps toward a fully paperless classroom

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## What was behind my idea to go paperless

- January, 2010 - Was asked to sit on a Budget Planning committee
- Idea of reducing college printing costs were being discussed
- I said “Why don’t we just print less?”
- ...There was stunned silence

## How the idea became a reality

- February 2010 – Asked my chair for funds to purchase an iPad
- ...There was stunned silence
- I told him that I knew I could find a way to use it in my classes if I had one to experiment with
- Again, stunned silence.
- iPad was purchased in February, 2010.
- April, 2010 – Planning for a paperless summer course began...(Me and head of SOS IT)

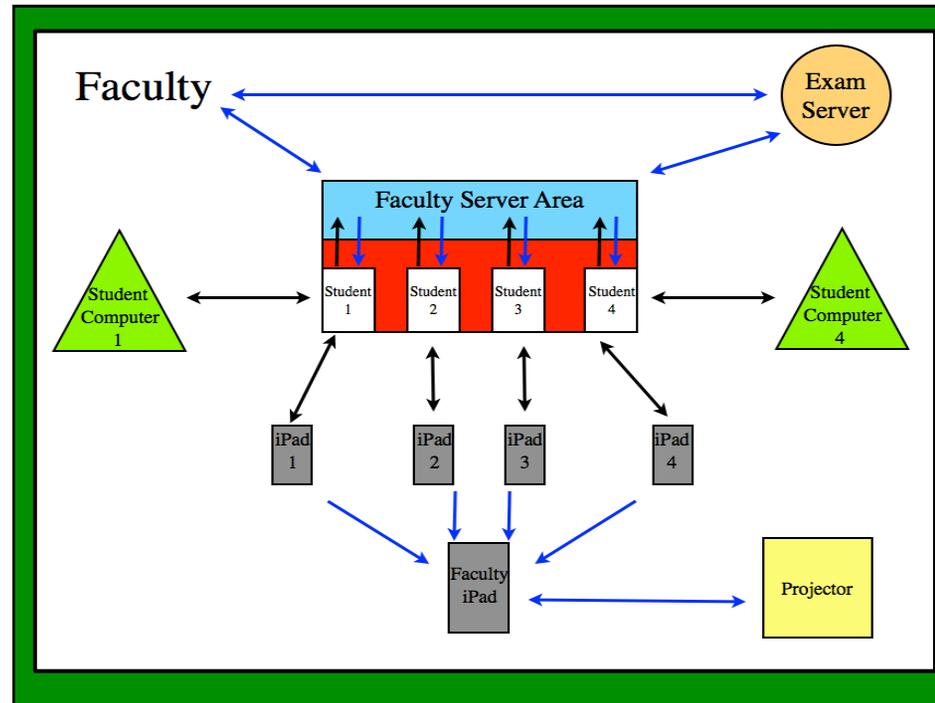
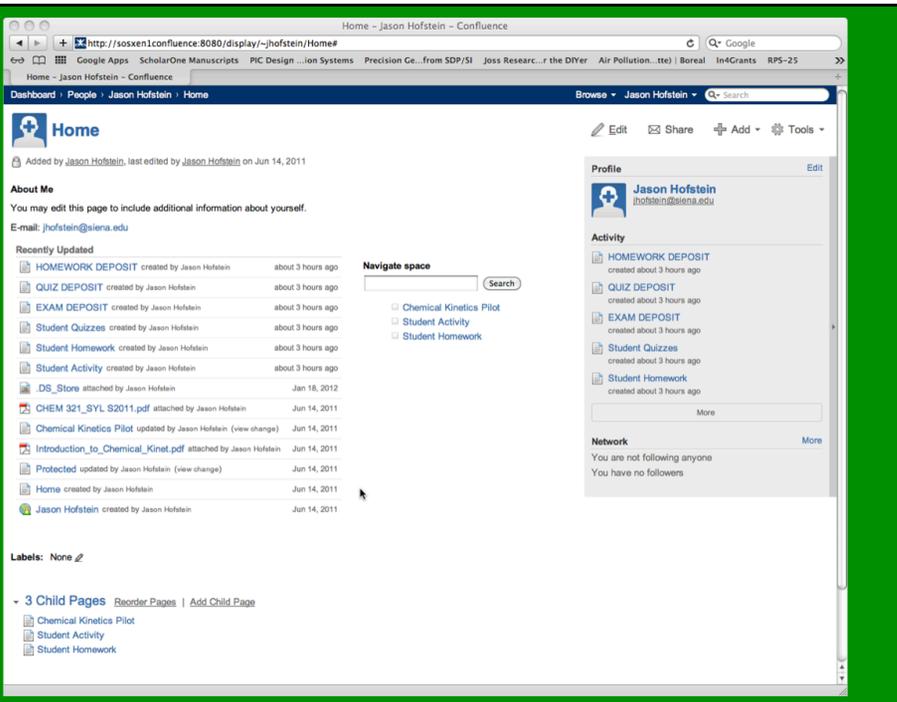
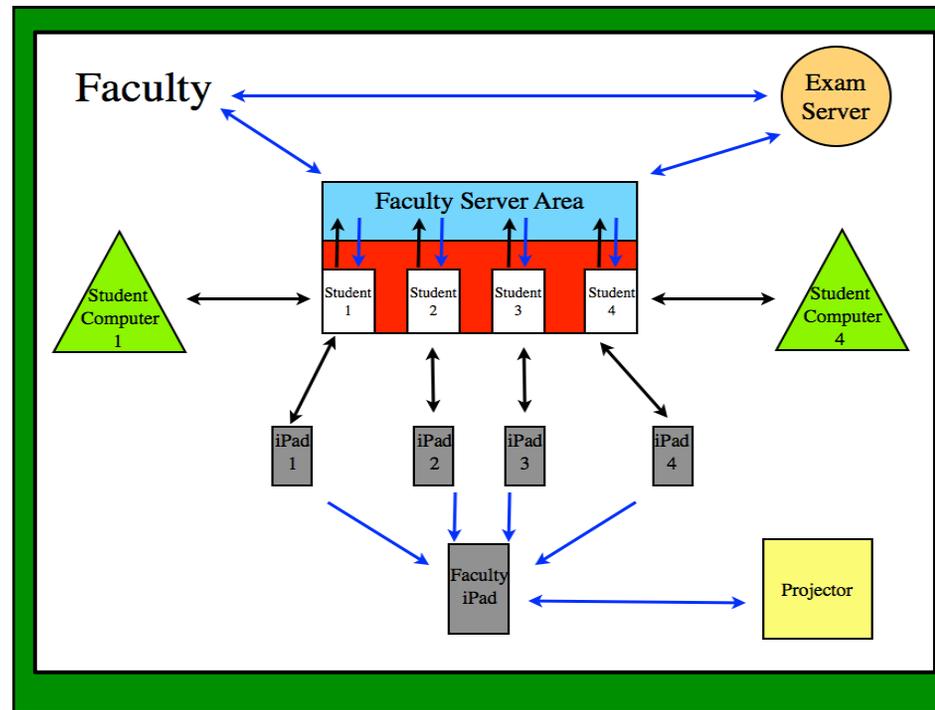
## Summer-Time Chemical Kinetics

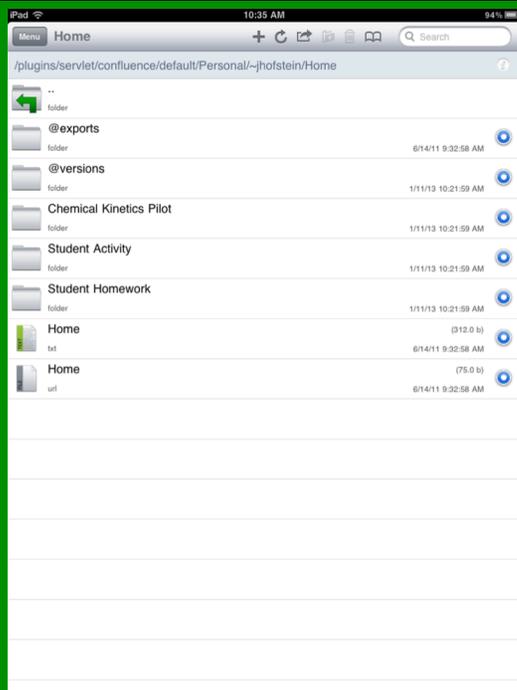
- As a pilot program, twelve iPad 2’s were purchased during the summer of 2010, as well as a secure server software.
- Two apps were preloaded to expedite the paperless aspect of the course: **iStorageHD** and **Noterize**, chosen specifically to easily interact with our secure server.
- Students went through a two-day iPad bootcamp, and then began their ten-week chemical kinetics course.
- Course material was presented to the students through the server, and all work (note-taking, quizzes and exams, as well as virtual office hours were performed using the iPad.

# Server Software = CONFLUENCE

## File Transfer Protocol

- Black Arrow → Student data transfer
- Blue Arrow → Faculty data transfer
- Faculty area server accessible to students
- Exam server accessible by Faculty ONLY
- Each student has their own area on the server which is password protected, but faculty can access these areas for document collection.





## Results

- Student “Ownership” of iPads **critical**
- Preloaded apps were successful, but better choices were made later on in the summer, fall, and subsequent spring
- Class average in the chemical kinetics was 8.2 points higher than the highest previous fall/spring course offering.
- Exit surveys of the students were positive, but pointed out several **deficiencies** in the (then) current implementation.
- OUTCOME: An entire chemical kinetics course was run without using any paper

## Implementation Assessment and Improvement: Testing the Secure Server; Using Dropbox

- During the course of the summer, many of the iPad apps that the students and instructor used turned out to be more convenient than iStorageHD and Noterize
- Students were asked to use both iStorageHD and Dropbox, and report how each fared with respect to ease of use, overall functionality, and security
- Quiz and exam implementation were not tested for security
- Dropbox was easier for the students to use, but more difficult to manage on the faculty end
- Exit surveys of the students on the issue of iStorageHD versus Dropbox for course management resulted in Dropbox being the student's choice.

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## Skeleton notes – Lessons Learned

- Use of a stylus allows for faster and more accurate note-taking
- Preparation of Powerpoint slides requires planning ahead
  - Detailed equations/ figures, structures on slides
- Since no paper was used by students to print out lecture slides, more white space was left for annotating
- Exit surveys of the students on the use of skeleton notes were almost unanimously positive in that the lectures were (1) easy to get, (2) easy to read/follow, and (3) easy to annotate.

## Example of note-taking on a pdf

### THE THERMODYNAMICS OF MIXING

Writing  $x_j$  for the mole fraction of component  $J = \frac{n_j}{\sum n_j} = \frac{n_j}{n}$

$n_j = x_j n$  and  $p_j/p = x_j$ , so

$$\Delta_{\text{mix}}G = nRT(x_A \ln x_A + x_B \ln x_B)$$

which is negative

### The Entropy of Mixing

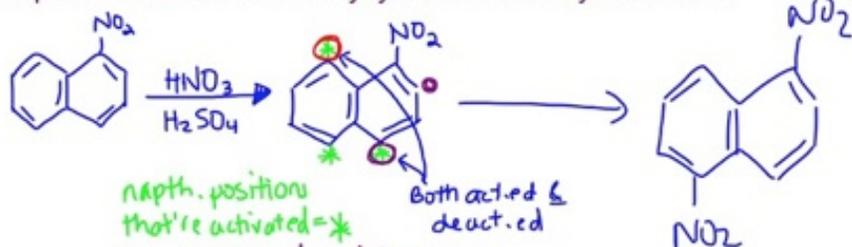
$$\Delta_{\text{mix}}S = -\left(\frac{\partial \Delta_{\text{mix}}G}{\partial T}\right)_{p, n_A, n_B} = -nR(x_A \ln x_A + x_B \ln x_B)$$

which is positive

What About the Enthalpy of Mixing?

Chapter 5, Slide 16

### Sequential Reactions of Polycyclic Benzoid Hydrocarbons

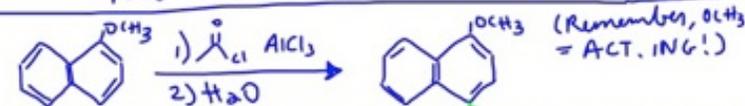


naph. position that're activated = \*

NO<sub>2</sub> deactivated positions = 0

deactivated by Sterics = 0

∴ expect prod. at only green \* left because = most activated positions



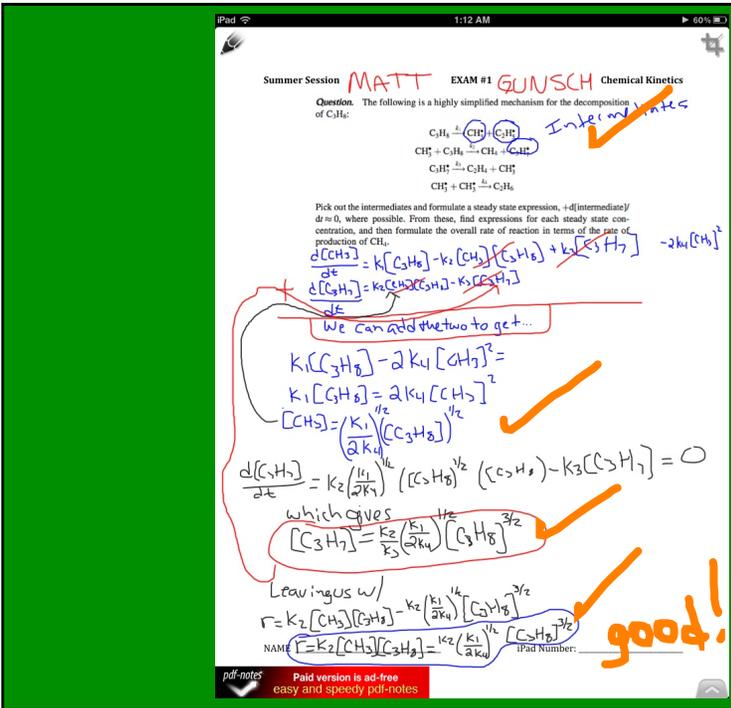
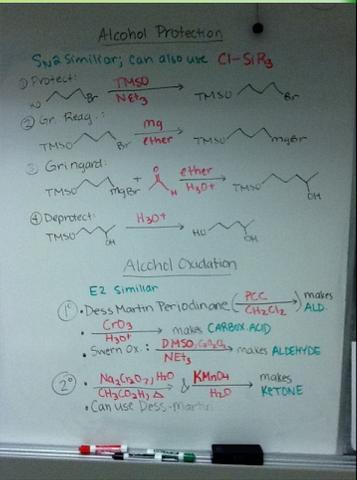
In substituted naphthalenes, the nature of the substituent determines which philic substitution ⇒ Regioselective

## Note-taking and Voice Recording

- **Noterize** used by most students for pdf markup
  - Allows user to mark up pdf files
  - Allows user to record lecture while taking notes
  - Other pdf markup apps: **Penultimate**, **neu.Annotate** (free), **pdf-notes** (free), **GoodNotes** (free)
  - There are many free annotating apps to choose from
- Other voice recording apps used: **Dragon Dictate**, **Evernote**, **Notability**, **NotesPlus** (many are free with “Pro” upgrades)

# Office Hours/Problem Solving

- Student use iPad to take photos of board work to email to instructor (real-time feedback)
- Use **GroupBoard** for virtual office hours
  - Students can interact with instructor
  - (Free) up to 5 other people
  - 15- and 50-user Groupboards \$
  - More advanced features \$\$



# Scientific Calculators

- Many calculators are available with most offered as Free/Pro
- Most used by students: (Free) neu.Calc, m48, HiCals, FreeGraCalc, powerOne SL, slcalc, cmpxRPN
- Other choices for a easy-to-use calculator: i41CX RPN calc, Epx 11C, PocketCAS, 15C, GO-25, GO-21
- More robust apps: MathStudio (formerly SpaceTime), PocketCAS, MathPad, CalcPro HD, GraphingCalc HD
- If you are partial to HP calculators...



- ACS mobile - <https://itunes.apple.com/us/app/acs-mobile/id355382930?mt=8>
- ChemDoodle - <https://itunes.apple.com/us/app/chemdoodle-mobile/id435468742?mt=8>
- ChemSpider - <https://itunes.apple.com/us/app/chemspider/id458878661?mt=8>
- Goodnotes - <https://itunes.apple.com/us/app/goodnotes-free-notes-pdf/id483679173?mt=8>
- Groupboard - <https://itunes.apple.com/us/app/groupboard-collaborative-whiteboard/id364049817?mt=8>
- iMolview - <https://itunes.apple.com/us/app/imolview/id431002306?mt=8>
- Insensitive - <https://itunes.apple.com/us/app/insensitive/id385275424?mt=8>
- IR Spec Check - <https://itunes.apple.com/us/app/ir-spec-check/id306365373?mt=8>
- iStorage HD - <https://itunes.apple.com/us/app/istorage-2-hd-for-ftp-webdav/id379870459?mt=8>  
 (a review is available at <http://www.best10apps.com/apps/istorage-hd-file-manager-and-document-viewer-for-ftp-sftp-webdav-dropbox-cloud-379870459.html>)
- Keynote - <https://itunes.apple.com/us/app/keynote/id361285480?mt=8>
- MathStudio (previously called Spacetime) - <https://itunes.apple.com/app/mathstudio/id439121011?mt=8>
- MolPrime - <https://itunes.apple.com/us/app/molprime/id437087077?mt=8>
- neu.Annotate - <https://itunes.apple.com/us/app/neu.annotate+pdf/id478313705?mt=8> (a review is available at <http://vidaru.com/neuannotate-for-ipad-review/64419944>)
- neu.Notes - <https://itunes.apple.com/us/app/neu.notes+/id433254101?mt=8> (a review is available at <http://www.plugmobi.com/review-of-the-neu-notes-for-ipad/>)
- Noterize - <https://itunes.apple.com/us/app/id364906681?mt=8> (a review is available at <http://www.ipad-application-reviews.com/2010/09/ipad-app-review-noterize/>)
- OCE - <https://itunes.apple.com/us/app/organic-chemistry-essentials/id390821660?mt=8>
- organicRxns - <https://itunes.apple.com/us/app/organic-named-reactions/id417058076?mt=8>
- pdf-notes - <https://itunes.apple.com/us/app/pdf-notes-free-for-ipad-pdf/id391487223?mt=8>
- Pennultimate - <https://itunes.apple.com/us/app/pennultimate/id354098826?mt=8>
- Pure NMR - <https://itunes.apple.com/us/app/pure-nmr-lite/id482489554?mt=8>
- Reagents - <https://itunes.apple.com/us/app/reagents/id453336174?mt=8>
- Responseware - <https://itunes.apple.com/us/app/responseware/id300028504?mt=8>
- RSC mobile - <https://itunes.apple.com/us/app/rsc-mobile/id459371444?mt=8>
- Whiteboard Free - <https://itunes.apple.com/us/app/whiteboard-free/id321406760?mt=8>