Chemical Engineering Course Packages

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Download the CDF player (http://demonstrations.wolfram.com/download-cdf-player.html)

Open OneNote 2016 (not the OneNote App)

Open www.LearnChemE.com

When you were an undergraduate, how many courses used active learning?

A. 0
B. 1
C. 3
D. 5 or greater

When you are an undergraduate, how many used clickers?

A. 0
B. 1
C. 3
D. 5 or greater

When you are a graduate student how many courses used active learning or clickers?

A. 0
B. 1
C. 3 or greater

Is there a way to teach that is more effective then lecturing?

How do you implement this approach?

How do students respond?

"Why do outstanding scientists who demand rigorous proof for scientific assertions in their research continue to use and, indeed, defend on the basis of their intuition alone, teaching methods that are not the most effective?

Handelsman et al. *Science* 304, p521 (2004)

225 studies were analyzed

compared active learning and traditional lecturing in STEM courses

active learning: students' performance on exams and the concept inventory increased by 0.47 standard deviation (STD)

traditional lecture: students were 1.5 times more likely to fail

Freeman et al., *Proc. Nat. Acad. Sci.* **111**, 8410 (2014)

What routinely goes on in most college classes is not teaching and learning, but stenography

Rich Felder

Goals:

Demonstrate active-learning resources in course packages

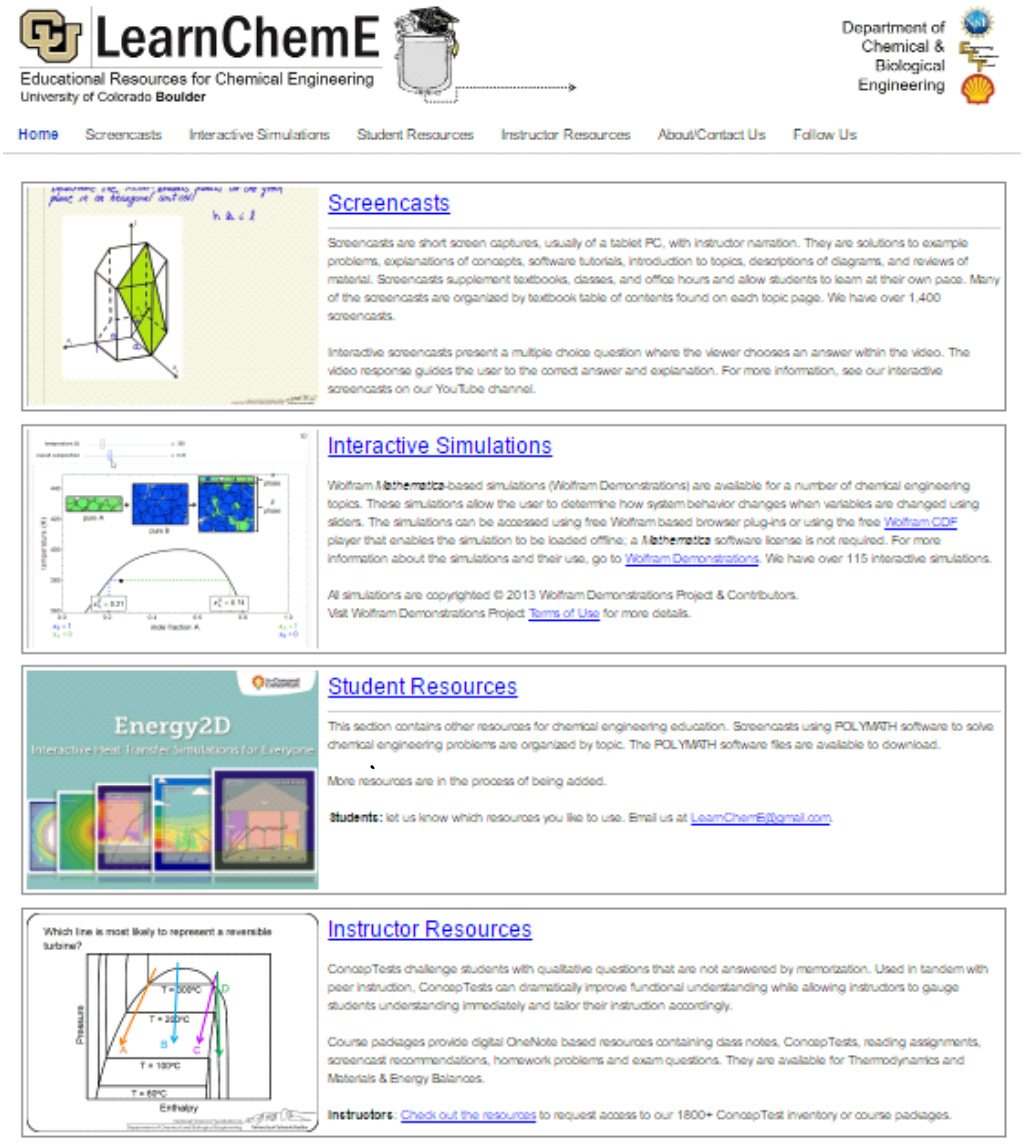
Demonstrate how to use OneNote and course packages

Save significant time in course preparation.

Try course packages, www.LearnChemE.com, screencasts, interactive simulations, ConcepTests

Open the LearnChemE site on your computer

http://www.learncheme.com/home



What is a course package?

Comprehensive set of teaching resources in Microsoft OneNote

- Complete set of in-class materials for a semester class
- Links to screencasts for a flipped class
- Links to interactive simulations
- Multiple years of assignments and exams (with solutions)

Reading quizzes

Learning objectives/exam study guides

Organization materials (syllabi, schedules)

Information on how to use the packages

Open OneNote 2016 on your computer

Open a course package (access from email not website)

Sign in to download notebook (use email address that granted access).

edit in Microsoft OneNote

Thermodynamics

Kinetics

Material and energy balances

Use course package on USB drive or OneDrive

or open from LearnChemE (need access?)

Why OneNote and Tablet PC?

Easy to use in class

Well suited for tablet PC and writing on screen (taskbar on left)

Easy to modify

Easy to learn

Save time- everything in one place for course

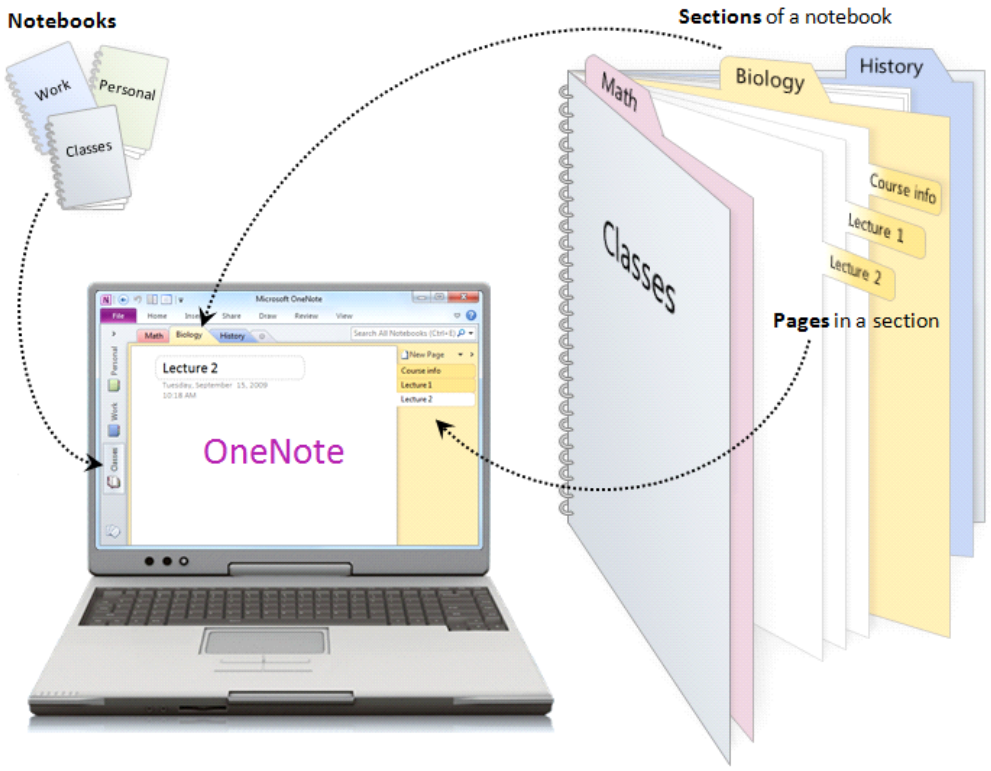
Multiple other uses

Part of Microsoft Office

How are OneNote pages different?

Type anywhere on the page.

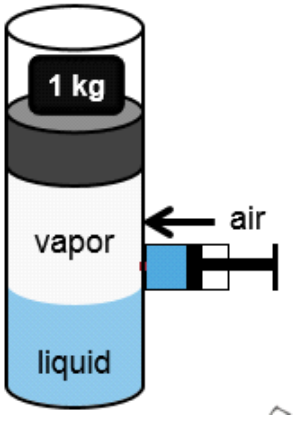
What are the tabs?



Major part of class notes in OneNote: ConcepTests

A piston-cylinder only contains water, which is in vapor-liquid equilibrium at 1.2 bar. When 5 cm^3 of air is injected into the system at constant pressure and temperature, _____ of the water _____.

A. all, vapor condenses
B. some, vapor condenses
C. all, liquid vaporizes
D. some, liquid vaporizes



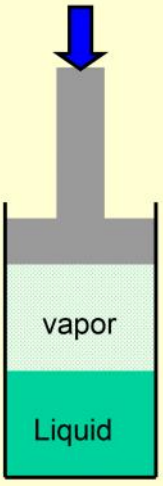
$P_{H2O}^{sat} = 1.2$ atm

$P = P_{H2O} + P_{air}$

1.2 atm = 1.15 atm + 0.05 atm

$P_{H2O} < P_{H2O}^{sat}$

All the water vaporizes



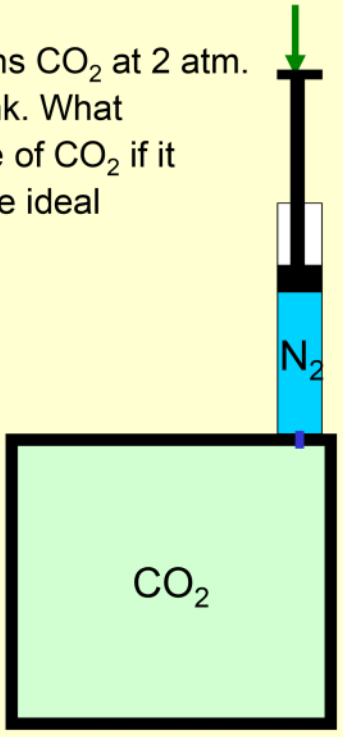
If you gave this problem to your class, what answer do you think they would select?

A constant-volume tank contains CO_2 at 2 atm. Nitrogen is injected into the tank. What happens to the partial pressure of CO_2 if it all remains in the tank? Assume ideal gases.

A. Decreases

B. Increases

C. Stays the same



A constant-volume tank contains CO_2 at 2 atm. Nitrogen is injected into the tank. What happens to the partial pressure of CO_2 if it all remains in the tank? Assume ideal gases.

13 A. Decreases

32 B. Increases

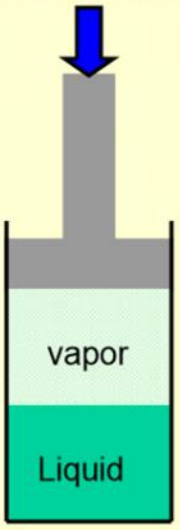
6 C. Stays the same (chance is 17)

Liquid water is in equilibrium with air at 50°C in a piston/cylinder system at 1 atm pressure. The pressure is raised to 2 atm by pushing on the piston. Temperature is constant. At equilibrium, the partial pressure of the water:

A. Decreased

B. Increased

C. Remained the same



Not answered by memorizing answer

Liquid water is in equilibrium with air at 50°C in a piston/cylinder system at 1 atm pressure. The pressure is raised to 2 atm by pushing on the piston. Temperature is constant. At equilibrium, the partial pressure of the water

Answers at beginning of semester

22 A. Decreased

15 B. Increased

14 C. Remained the same (chance is 17 of 51 students)

ConcepTests

- not too easy
- not calculations
- not memorization
- don't contain non-essential information
- emphasize important concepts
- good wrong answers

- challenge students with qualitative questions

Student feedback on ConcepTests

- "I cannot describe how much the active learning helps. I don't think I have ever taken a class where I feel like I fully understand the information as well as I do in this one."
- "Something you are doing that helps me learn are concept questions. They make me think about the problem and clear up concepts. A lot of times I think I will understand something but I don't really understand it and the concept questions help show me that."
- "The clicker concept questions are great because they are interactive, which makes it easier to pay attention, and they are indicative of what you know and what you don't know."
- "I love the way you use clicker questions throughout the entire class rather than lecturing."
- "The way I learn best is by making mistakes, so when I don't know how to do the clicker questions, I end up learning much more than I would have if you ran the class in a lecture style format"
- "I would have to say that the format of your thermodynamics class was the most enjoyable and beneficial to my learning as a student. For the first two years… I became accustomed to the traditional lecture format that most professors utilize. **It is very hard to pay attention and stay motivated in these type of class settings where we just sit for an hour and take notes while the professor rambles on about subjects we know little about."**
- "The interactive learning (clickers, etc.) is super helpful. It really helps me keep my attention in class."

2,000 ConcepTests for 7 courses

AIChE Concept warehouse has more ConcepTests

Use in class, on exams, on HW

Course packages have ConcepTests for given class

plus extras -easy to replace

have 2 copies of OneNote open at the same time

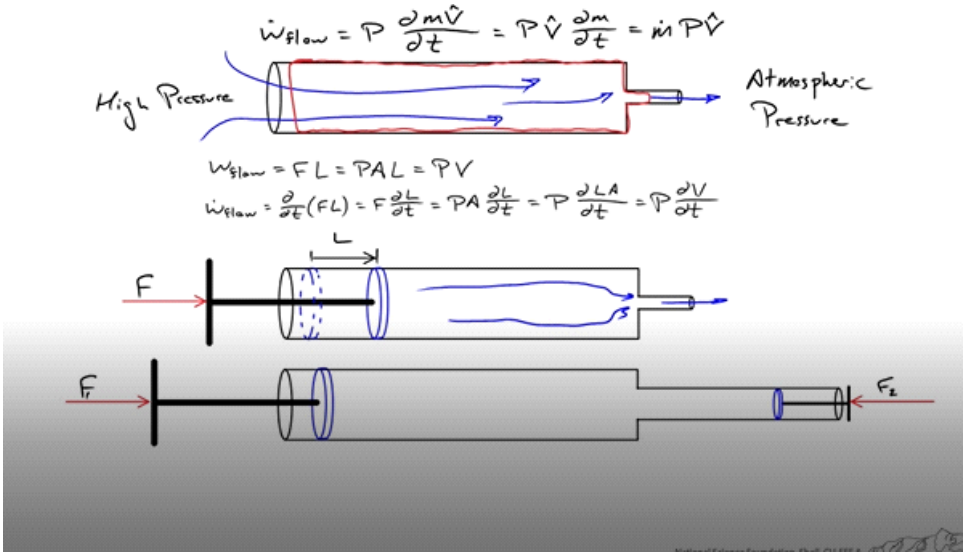
Break: 5 minutes

Screencasts

Introduction to a topic

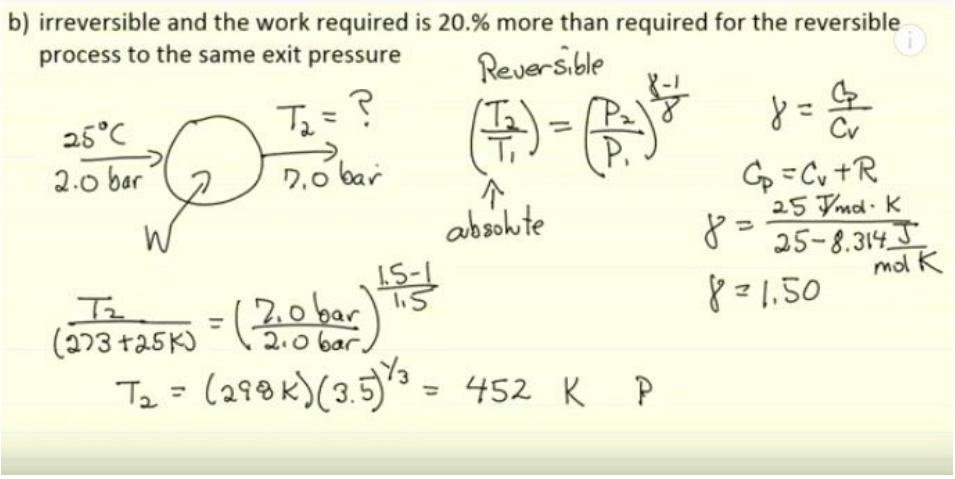
Screencast example: Flow work

YouTube: Flow work



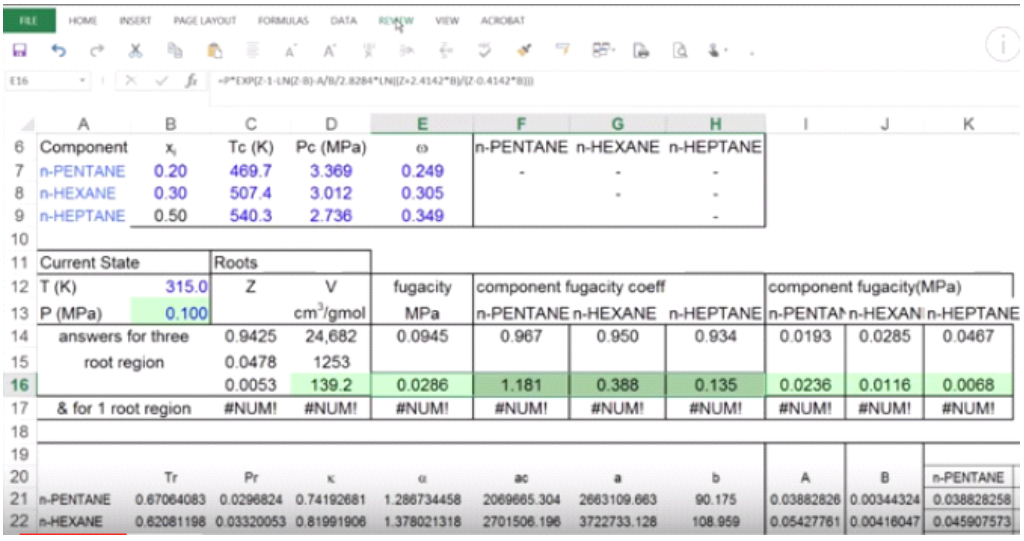
Example problem

https://www.youtube.com/watch?v=Gag_HoWlLnE#t=1m30s



Software tutorial

https://www.youtube.com/watch?v=0QFLng0fz68&feature=youtu.be&list=PL4xAk5aclnUjMQaDPzjOWCkGQORbYDNl5#t=1m0s



	A	B	C	D	E	F	G	H	I	J	K
6	Component	x_i	Tc (K)	Pc (MPa)	ω	n-PENTANE	n-HEXANE	n-HEPTANE			
7	n-PENTANE	0.20	469.7	3.369	0.249	-	-	-			
8	n-HEXANE	0.30	507.4	3.012	0.305		-	-			
9	n-HEPTANE	0.50	540.3	2.736	0.349			-			
10											
11	Current State		Roots								
12	T (K)	315.0	Z	V	fugacity	component fugacity coeff			component fugacity(MPa)		
13	P (MPa)	0.100		$cm^3/gmol$	MPa	n-PENTANE	n-HEXANE	n-HEPTANE	n-PENTA	n-HEXAN	n-HEPTANE
14	answers for three		0.9425	24,682	0.0945	0.967	0.950	0.934	0.0193	0.0285	0.0467
15	root region		0.0478	1253							
16			0.0053	139.2	0.0286	1.181	0.388	0.135	0.0236	0.0116	0.0068
17	& for 1 root region		#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
18											
19											
20		Tr	Pr	κ	α	ac	a	b	A	B	n-PENTANE
21	n-PENTANE	0.67064083	0.0296824	0.74192681	1.286734458	2069665.304	2663109.663	90.175	0.03882826	0.00344324	0.038828258
22	n-HEXANE	0.62081198	0.03320053	0.81991906	1.378021318	2701506.196	3722733.128	108.959	0.05427761	0.00416047	0.045907573

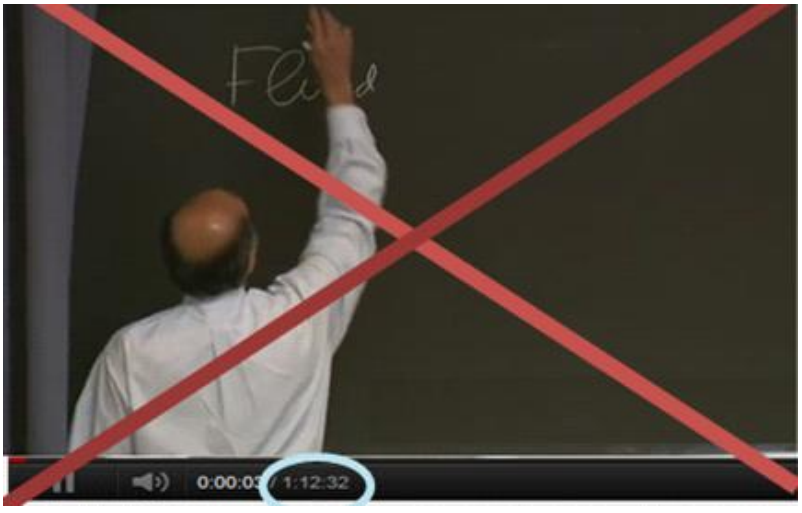
Other types of screencasts

Exam problems

Explain diagrams

Interactive ConcepTests

What is a screencast?



Not video of person & board

Not 50 minutes

Not multiple topics

How is a screencast better than a live lecture?

Students watch on their schedule (24/7)

Students control pace: start/stop/replay

Just-in-time use

Short, modular

Students like them

Students use them (> 4.5 million views in 12 months)

Increase student confidence

Improve student learning

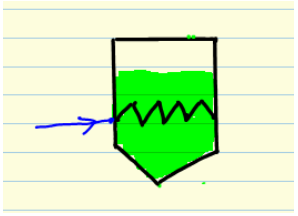
Free class time for active learning

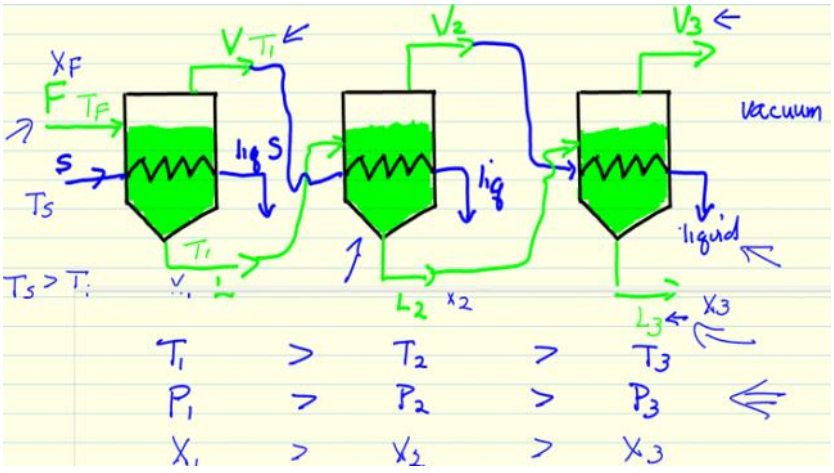
Screencasts minimize cognitive overload

Diagrams and verbal explanation at same time enhance learning (Clark and Mayer, 2011)

More flexibility than textbook

Material sequenced in time, unlike textbook





Survey 440 students about screencasts

- 95%: useful or very useful
- 85%: better than textbook at improving understanding
- 92%: felt more confident about material

Student feedback

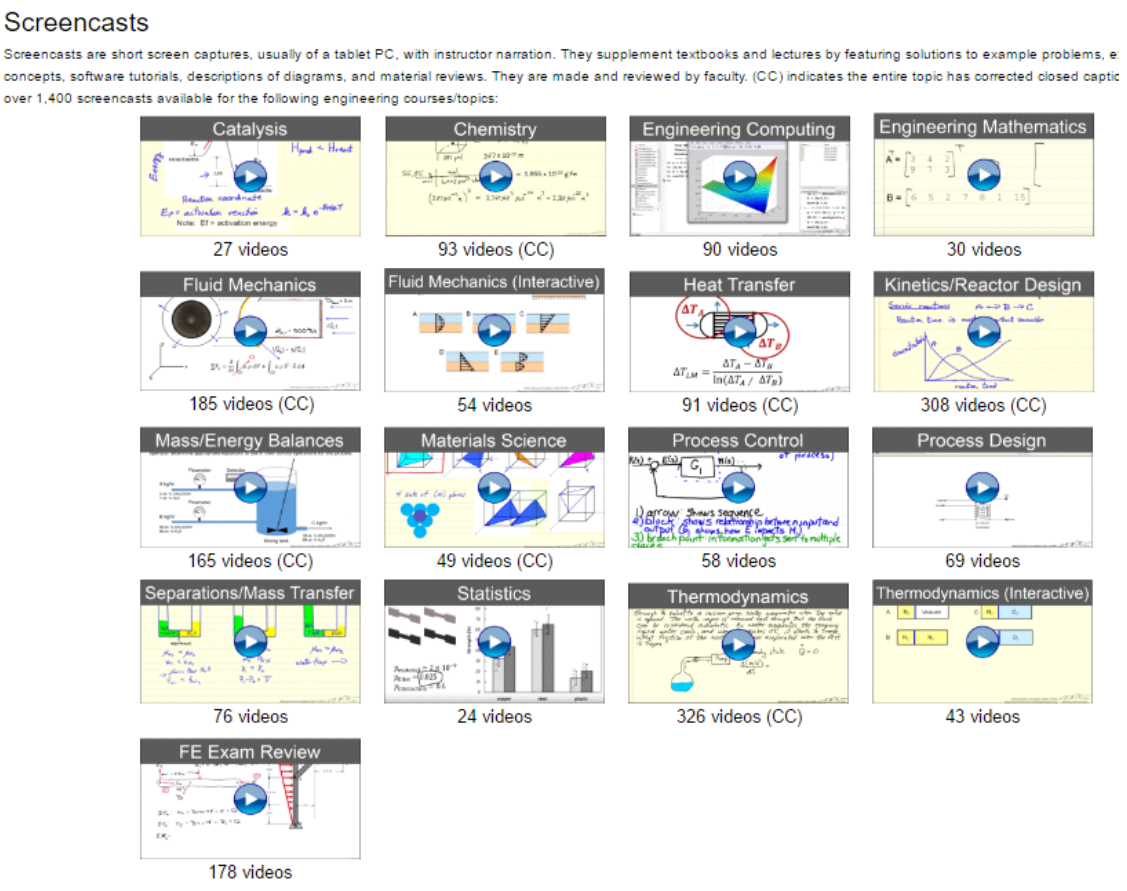
- “Screencasts are fantastic.”

- “Screencasts are amazing.”
- “Super, super, super, super useful.”
- “I love screencasts!”
- “I think screencasts are fantastic and incredibly helpful.”
- “As for screencasts, they are REALLY helpful. It's like office hours available 24/7.”
- “I think screencasts are very VERY helpful,”
- “I think that screencasts were unbelievably effective…..”

screencasts for 14 courses

Open some screencasts to get a better idea

http://www.learncheme.com/screencasts



Interactive simulations

Mathematica

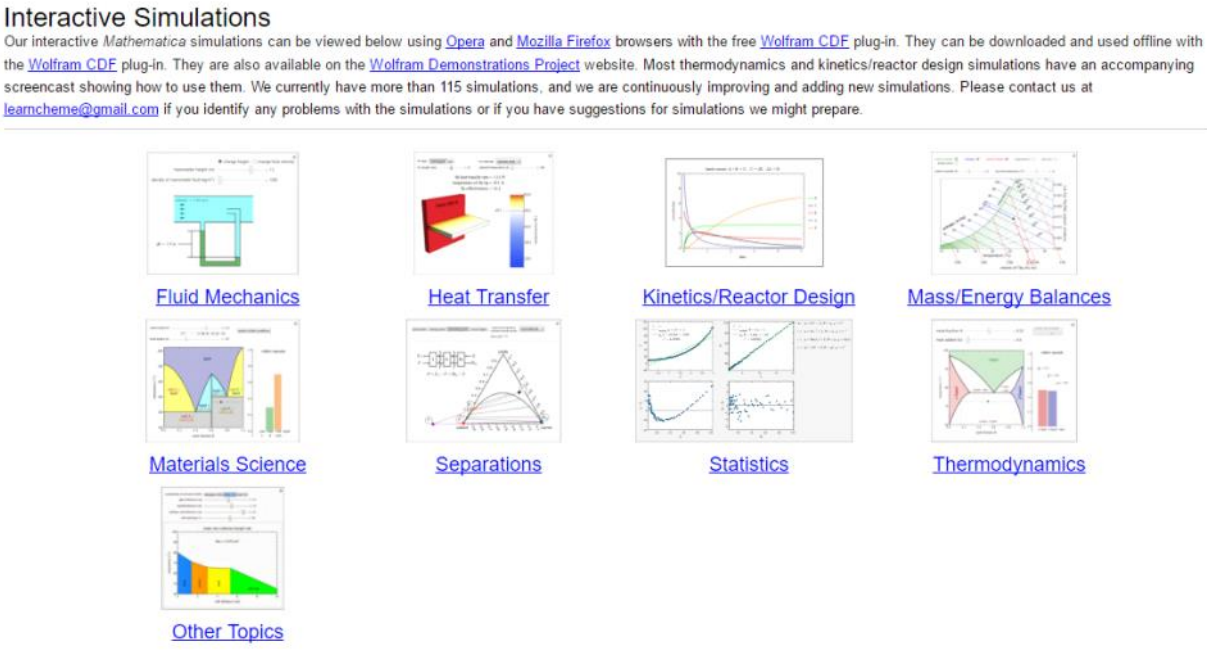
Wolfram Demonstration Project
http://demonstrations.wolfram.com/new.html

CDF files

Download CDF reader
http://demonstrations.wolfram.com/download-cdf-player.html)

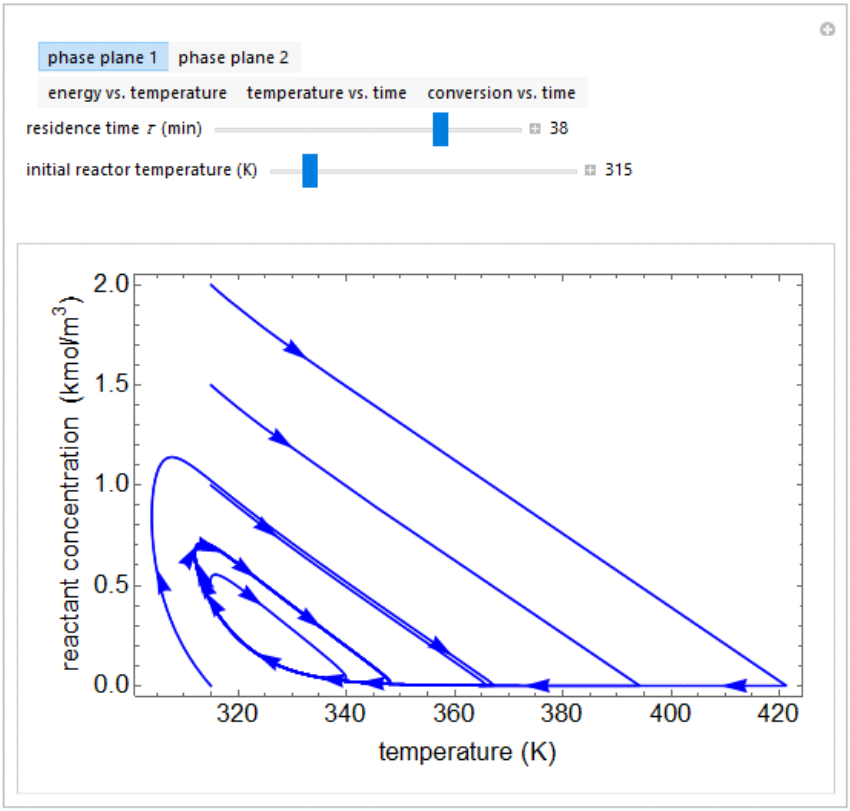
Open one of the simulations

http://www.learncheme.com/simulations



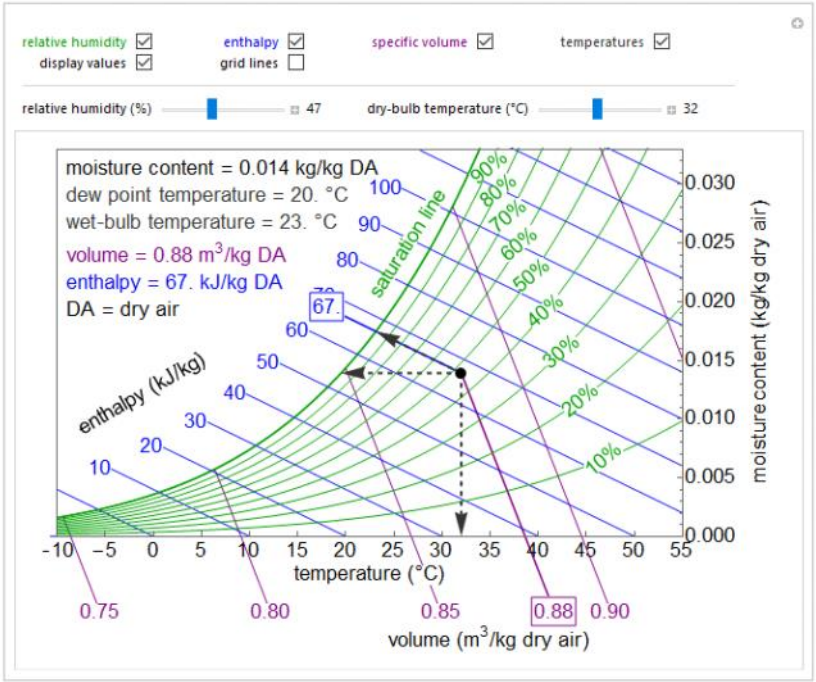
Multiple steady states in nonisothermal CSTR

Multiple Steady States in a Continuous Stirred-Tank Reactor with Heat Exchange

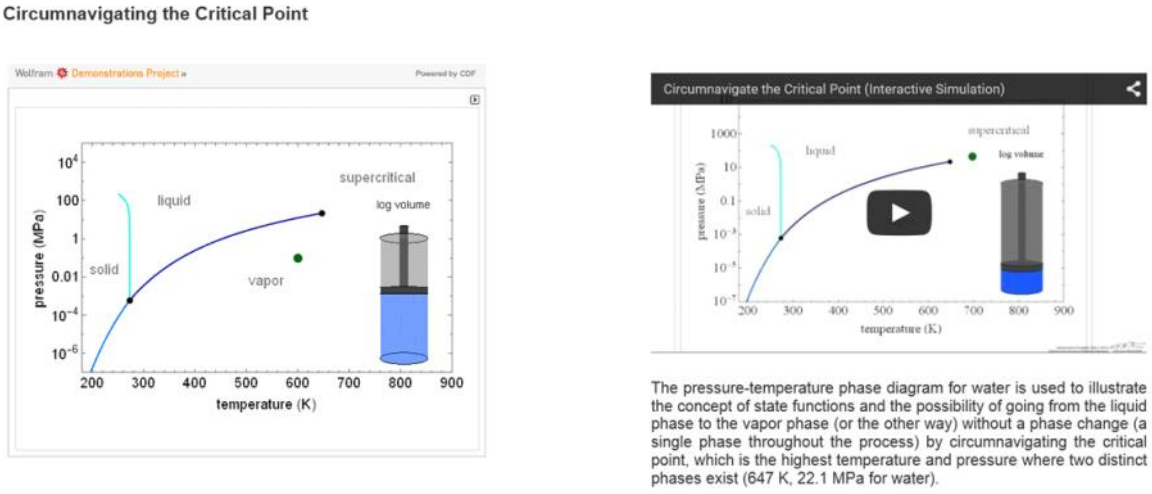


[Reading a Psychrometric Chart]

Reading a Psychrometric Chart



Simulation and short screencast



Interactive simulations

Demonstrate concept or explain diagram

Easy to use- not too many options

Studies show simulations improve learning

Actively engage students

Observe behavior that hard to observe in real time

Students like them

Use with ConcepTests in class (part of course packages)

Use with assignments

Positive feedback from students

"These interactive simulations were **amazing**!"

"Really liked the simulations. You should use more of these"

"The interactive simulations are **extremely useful**."

"The interactive simulations were the **best thing that could even imagin**e."

"The simulations were very helpful to me. I'm a visual learner, so lectures don't always stick but diagrams always have been very helpful.

"The interactive simulations are **incredibly useful** in understanding the material, especially vapor-liquid equilibrium and vapor liquid-liquid equilibrium."

"I **enjoyed using the interactive simulations**. Thought they provided an excellent visual learning tool that added tremendous value to the class."

"The interactive simulations were very useful because **I could test every scenario** on my own rather than just seeing a few general ones."

How to study/How to learn

Which of these would you suggest your students do?

Click A for yes, B for no

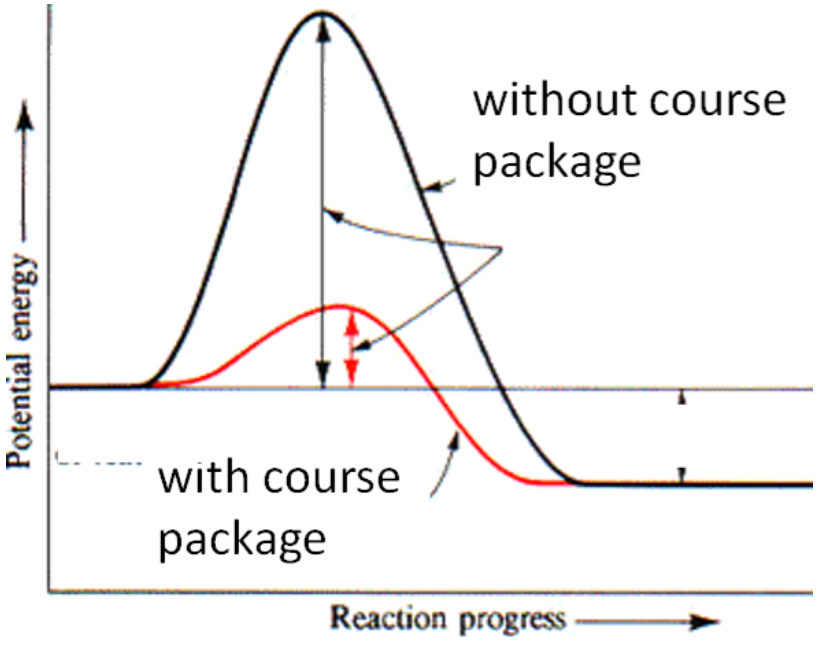
- Re-read textbook
- Underline and highlight textbook
- Review notes before exam
- Reread solutions to HW problems before exam
- Concentrated study on one topic
- Study in the same location
- Study several hours non-stop
- Being persistent: continue trying to solve problem when stuck (e.g., 30 minutes)

Resources on LearnChemE on How to Study

http://www.learncheme.com/student-resources/how-to-study-resources

Summary

Course packages



LearnChemE :

3 course packages (will continue to update)

template for other courses

> 1,400 screencasts

> 130 interactive simulations (150 soon) (on USB)

> 2,000 ConcepTests (on USB)

How to Study/How to Learn Resources

Goals:

Demonstrate active-learning resources in course packages

Demonstrate how to use OneNote and course packages

Save significant time in course preparation.

Try course packages, www.LearnChemE.com,
screencasts, interactive simulations, ConcepTests