

# Web Appendix I: How to Use the CRE Web Resources

The primary purpose of the CRE Web Resources is to serve as an enrichment resource. The benefits of using the CRE Web Resources are fivefold:

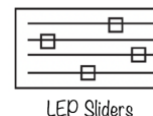



1. To use Wolfram and Python interactive simulations to get an intuitive feel of the reactions and reactors in which they occur
2. To facilitate different student learning styles: <http://www.umich.edu/~elements/6e/asyLearn/index.htm>
3. To provide the student with the option/opportunity for further study or clarification of a particular concept or topic
4. To provide the opportunity to practice critical thinking, creative thinking, and problem-solving skills
5. To provide other tutorial information, such as additional technical materials, homework problems and instructions on using computational software in chemical engineering


## WI.1 CRE Web Resources Components


There are two types of information in the CRE Web Resources: information that is organized **by chapter** and information organized **by concept**. Material in the “by chapter” section of the CRE Web Resources corresponds to the material found in this book and is further divided into five sections.

- **Objectives.** The objectives page lists what the students will learn from the chapter. When students are finished working on a chapter, they can come back to the objectives to see whether they have covered everything in that chapter. Or if students need additional help on a specific topic, they can see whether that topic is covered in a chapter from the objectives page.
- **Living Example Problems (LEP).** These exercises are the *Computer Simulations and Experiments* section for each chapter in which we can use either Wolfram, Python, MATLAB, or Polymath. Polymath is recommended for the homework in the *Problem Section*. The simulations should be worked first (5-10 minutes each) before going to the standard home problems. The LEP programs are provided on the Website so students can download the program to “play” with the problem and ask “What if . . . ?” questions to practice critical and creative thinking skills. Students can change parameter values, such as the reaction-rate constants, to learn to deduce trends or predict the behavior of a given reaction system.



- **Extra Help.** Multiple resources (screencasts, interactive computer games, lecture notes, and extra problems,) that promote a deeper understanding of important concepts. These resources provide links to the LearnChemE screencasts related to the material in each chapter and provide extra explanations, examples, and applications to reinforce the basic concepts of chemical reaction engineering. *Summary Notes* serve as an overview of each chapter and contain a logical flow of derived equations and additional examples.
- **Learning Resources.** The materials in Learning Resources are further divided into Summary Notes, Web Modules, Interactive Computer Games, and Solved Problems.
- **Problem Solving.** Here students can learn different strategies for problem solving in both closed- and open-ended problems. See the ten different types of home problems and suggestions for approaching them. Extensive information on critical and creative thinking can also be found in this section.
 

Solved Problems
- **Syllabi.** Representative syllabi have been included on the **Website**: (1) A 4-credit hour undergraduate course, Chemical Engineering 344 and (2) a 3-credit hour graduate course.
- **Frequently Asked Questions (FAQs).** Over the years that I have taught this course, I have collected a number of questions that the students have asked over and over for years and years. The questions usually ask for clarification or for a different way of explaining the material or for another example of the principle being discussed. The FAQs and answers are arranged by chapter.
- **LearnChemE Videos.** The University of Colorado has a number of 6- to 8-minute videos on some of the concepts covered in the course.
- **Additional Materials.** Multiple resources of new material that is not included in the present text. Web Modules provide more examples for students to use the knowledge gained in each chapter. Computer simulation statements, not in previous editions, for the LEPs that use Wolfram and Python Sliders, Polymath, or MATLAB to vary the parameters to answer the questions or solve the problems can be found here.
- **Professional Reference Shelf.** The Professional Reference Shelf (PRS) on the Web contains two types of information. First, it includes material that is important to the practicing engineer but that is typically not included in the majority of chemical reaction engineering courses. Second, it includes material that gives a more detailed explanation of derivations that were abbreviated in the text.
 

Reference Shelf
- **Self-Tests.** These Self-Tests are found in the **Summary Notes** on the Website. Interactive problems with solutions to provide extra practice of concepts.
 

Summary Notes
- **i>Clicker Questions.** A vast collection of i>clicker questions for each chapter, with answers, are provided for each chapter. These questions should be attempted when studying for an exam or after one has completed all the homework a student want to access their understanding.
- **Is there Entertainment on the Website? Yes, Indeed.** Links to entertaining **YouTube** videos can be found on the Website home page. From the University of Alabama, the most viewed videos are

Chapter 1: *Fogler Zone (you've got a friend in Fogler)*.

Chapter 3: *The Black Widow* murder mystery and *Baking a Potato*.

Chapter 4: *CRF Reactor Video*, Crimson Reactor Firm's video of a "semi batch" reactor with Diet Coke and Mentos.



Chapter 5: Learn a new dance and song, *CSTR* to the tune of *YMCA*, *Chemical Good Time Rhythm* rap song, and the University of Michigan students' *Chemical Engineering Gone Wrong*.

From the University of Michigan, the most viewed videos are

Chapter 3: *Arrhenius Dream*

Chapter 4: *I Just Found X*
















Chapter 5: *Chemical Engineering Gone Wrong; Under Pressure*

- **Visual Encyclopedia of Equipment (<http://encyclopedia.che.engin.umich.edu/>).** This section was developed by Dr. Susan Montgomery at the University of Michigan. Here, a wealth of photographs and descriptions of real and ideal reactors are given. Students with visual, active, sensing, and intuitive learning styles of the Felder/Solomon Index will particularly benefit from this section.
- **Reactor Lab (<http://www.ReactorLab.net>).** Developed by Professor Emeritus Richard Herz at the University of California at San Diego, this interactive tool allows students not only to test their comprehension of the CRE material, but also to explore different situations and combinations of reaction orders and types of reactions.
- **Interactive Web Modules.** The Website includes both Web Games and ICGs. The Web Games use a Web browser for an interface and give examples of how chemical reaction engineering principles can be applied to a wide range of situations, such as modeling cobra bites and cooking a potato. 
- **Interactive Computer Games (ICGs).** The ICGs are games that use a Windows or DOS-based program for an interface. They test knowledge on different aspects of chemical reaction engineering through a variety of games such as basketball and Jeopardy. These Games will help students prepare for the American Institute of Chemical Engineers (AIChE) Student Chapter Jeopardy competition held at the Annual AIChE meeting in the Fall. 

## WI.2 Navigation of the Summary Notes

Students can use the Summary Notes in conjunction with the text in a number of different ways. The Website provides enrichment resources. It is up to each student to determine how to use these resources to generate the greatest benefit. Table I-1 shows some of the clickable buttons found in the Summary Notes within the Learning Resources and a brief description of what the students will see when they click on the buttons.

TABLE WI-1 HOT BUTTONS IN SUMMARY NOTES

<i>Clickable Button</i>	<i>Where it goes</i>
	Solved example problem
	General material that may not be related to the chapter
	Hints and tips for solving problems
	A test on the material in a section, with solutions
	Derivations of equations when not shown in the notes
	Critical Thinking Question related to the chapter
	Web Module related to the chapter
	Chapter objectives
	Polymath solution of a problem from the Summary Notes
	Biography of the person who developed an equation or principle
	Chapter insert with more information on a topic
	Detailed solution of a problem
	Plot of an equation or solution
	Extra information on a specific topic
	Audio clip

The creators of the **Website** tried to make navigating through the resources as easy and logical as possible. A more comprehensive guide to usage and navigation can be found on the **Website**.

### WI.3 How the Website Can Help Learning Style

#### WI.3.1 Global vs. Sequential Learners

See [www.engin.umich.edu/~cre/asyLearn/itresources.htm](http://www.engin.umich.edu/~cre/asyLearn/itresources.htm).



#### **Global**

- Use the summary lecture notes to get an overview of each chapter on the Website and see the big picture
- Review real-world examples and pictures on the Website
- Look at concepts outlined in the ICGs

#### **Sequential**

- Use the Derive hot buttons to go through derivations in lecture notes on the Web
- Follow all derivations in the ICGs step by step
- Do all self-tests, audios, and examples in the Website lecture notes step by step

### WI.3.2 Active vs. Reflective Learners

#### Active

- Use all the hot buttons to interact with the material to keep active
- Use self-tests as a good source of practice problems
- Use *Living Example Problems* to change settings/parameters and see the result
- Review for exams using the ICGs

#### Reflective

- Self-tests allow you to consider the answer before seeing it
- Use *Living Learning Problems* to think about topics independently

### WI.3.3 Sensing vs. Intuitive Learners

#### Sensing

- Use *Web Modules* (cobra, hippo, nanoparticles) to see how material is applied to real-world topics
- Relate how *Living Learning Problems* are linked to real-world topics

#### Intuitive


- Vary parameters in supplied Polymath problems and understand their influence on a problem
- Use the trial-and-error portions of some ICGs to understand “what if . . .” style questions

### WI.3.2 Visual vs. Verbal Learners

#### Visual

- Study the examples and self-tests in the Website Summary Notes that have graphs and figures showing trends
- Do ICGs to see how each step of a derivation/problem leads to the next
- Use the graphical output from *Living Example Problems*/Polymath code to obtain a visual understanding of how various parameters affect a system
- Use the *Professional Reference Shelf* to view pictures of real reactors

#### Verbal

- Listen to audios  on the Web to hear information in another way
- Work with a partner to answer questions on the ICGs