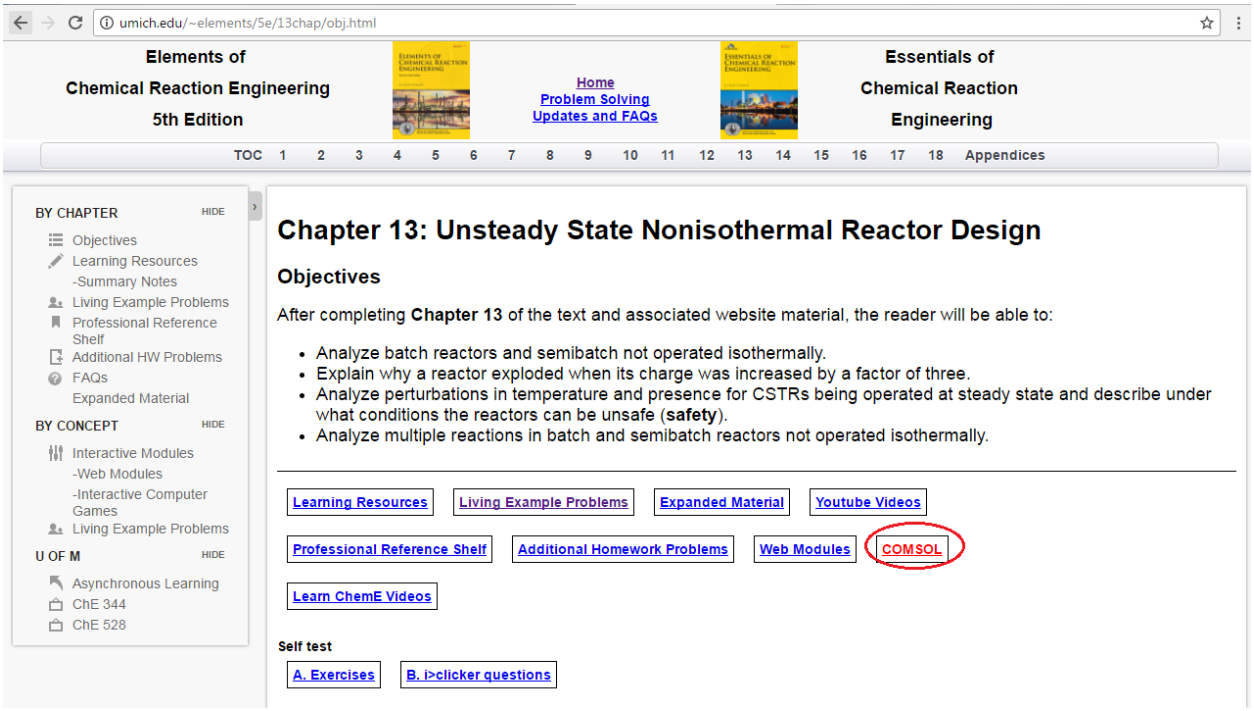
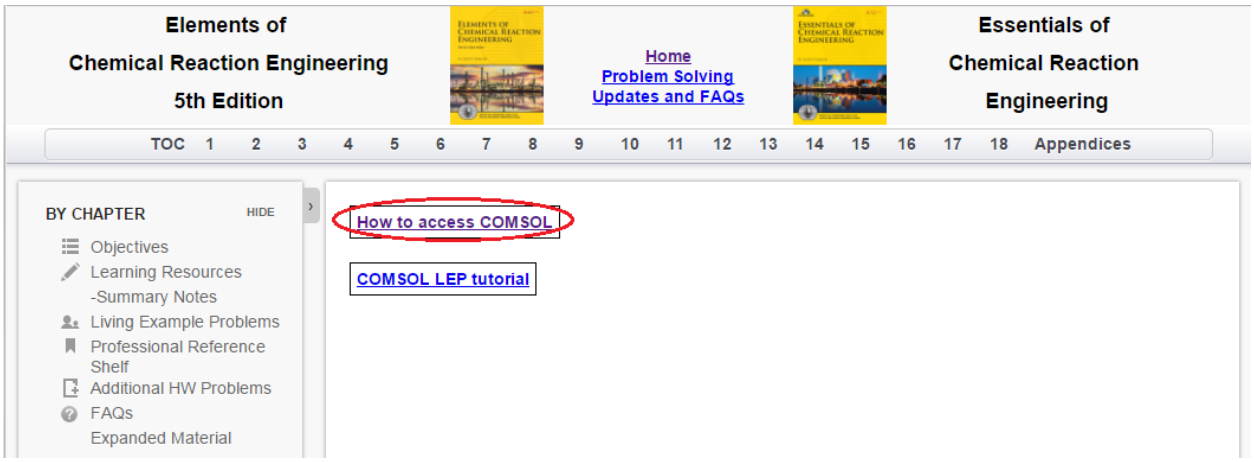
COMSOL LEP tutorial for Startup of a CSTR (*Chapter-13*)

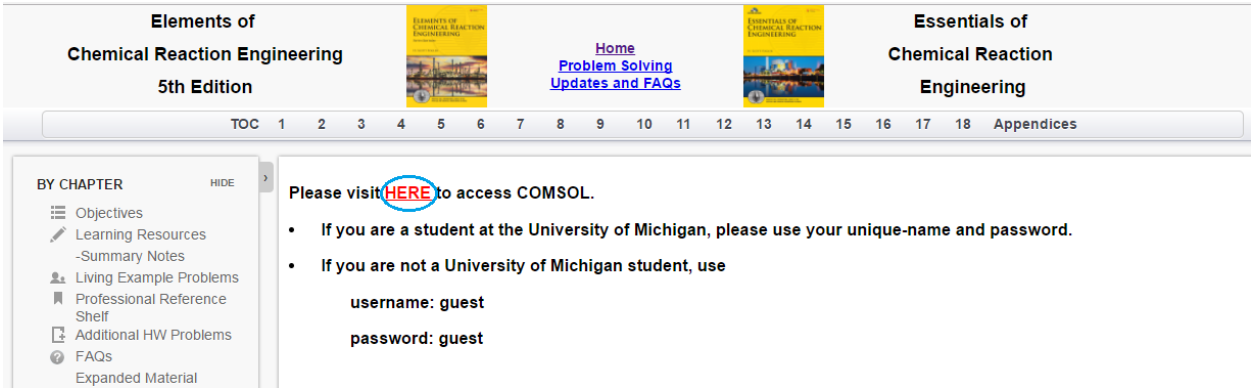
Step 1: Open chapter 13 and click on COMSOL tab present in the bottom of the page



Step 2: The following page will open. Click on "How to access COMSOL"



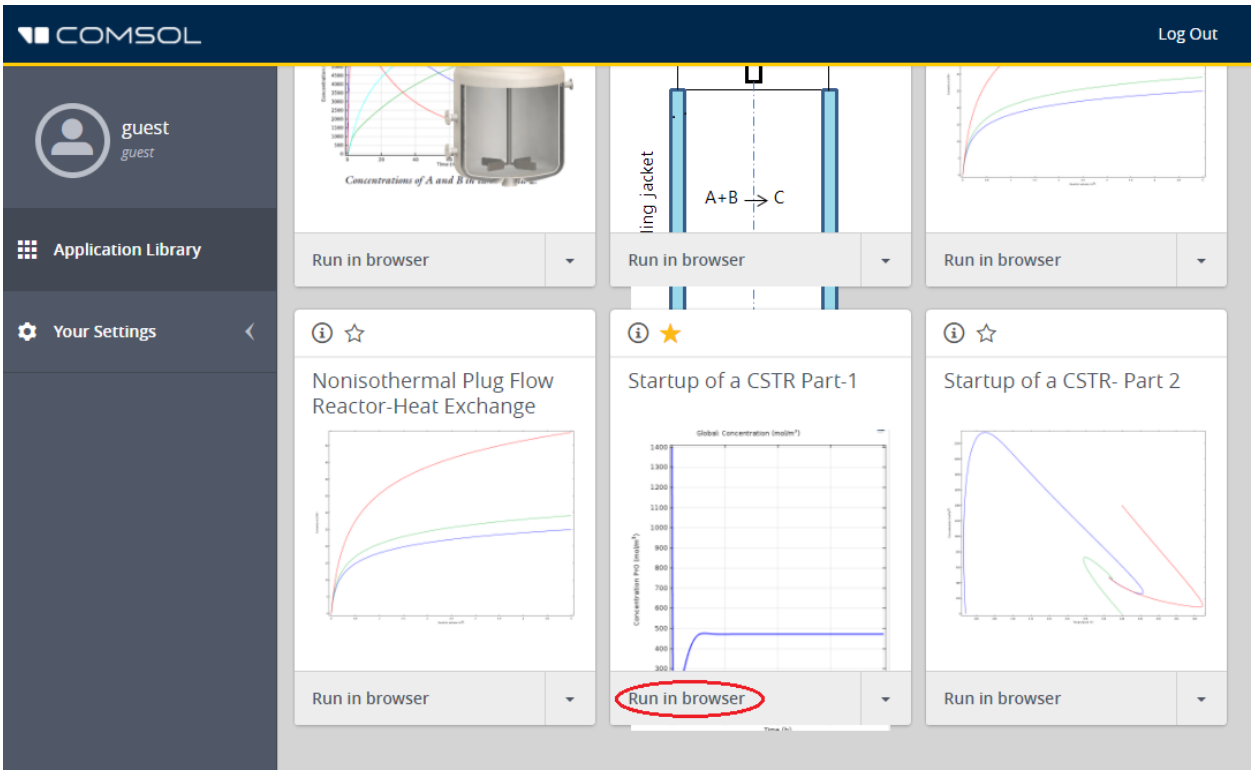
Step 3: You will see a new page with instruction on how to access COMSOL library. Click "Here"



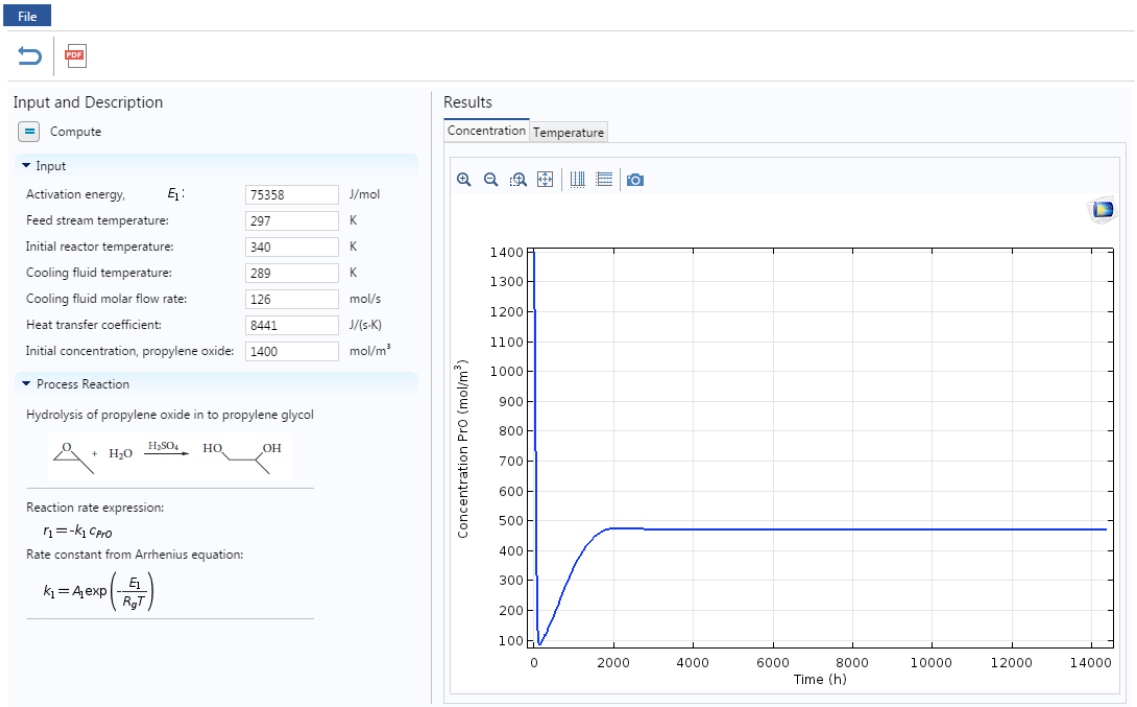
Step 4: This will take you to COMSOL Server. If you are a student at the University of Michigan, please use your Uniqname and password. If you are not a University of Michigan student, use

username: guest
password : guest

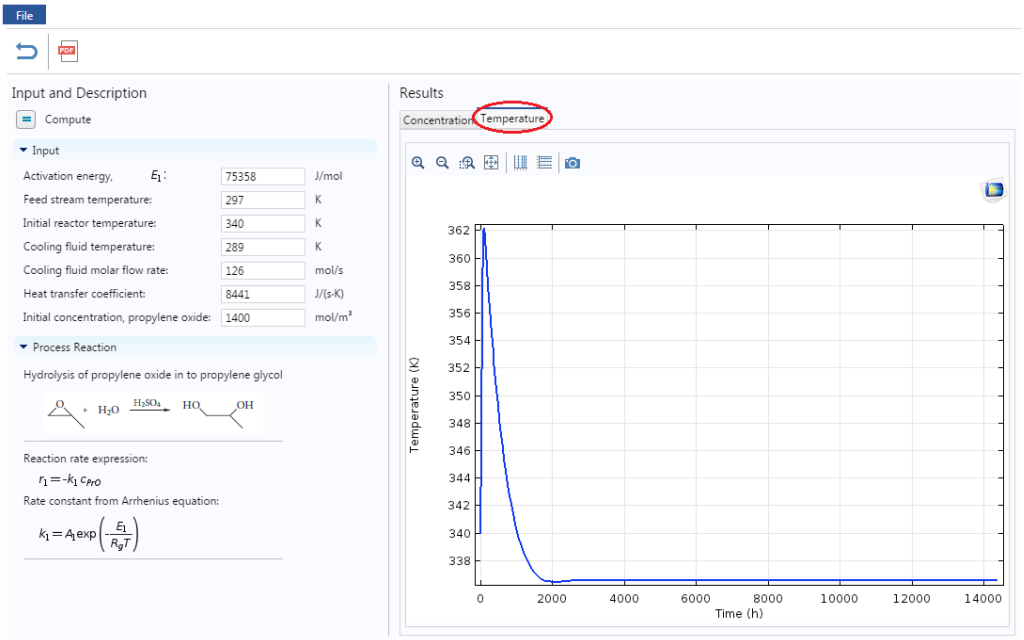
Step 5: This will open up COMSOL library where you can see many COMSOL files to solve chemical reaction engineering problems. *Find* "***Startup of a CSTR Part-1***". Click on "Run in browser" to start the application



You will see that following window opens which has input parameters, description, graphical features (Concentration and Temperature profiles) and a few buttons. Currently Concentration profile is visible.

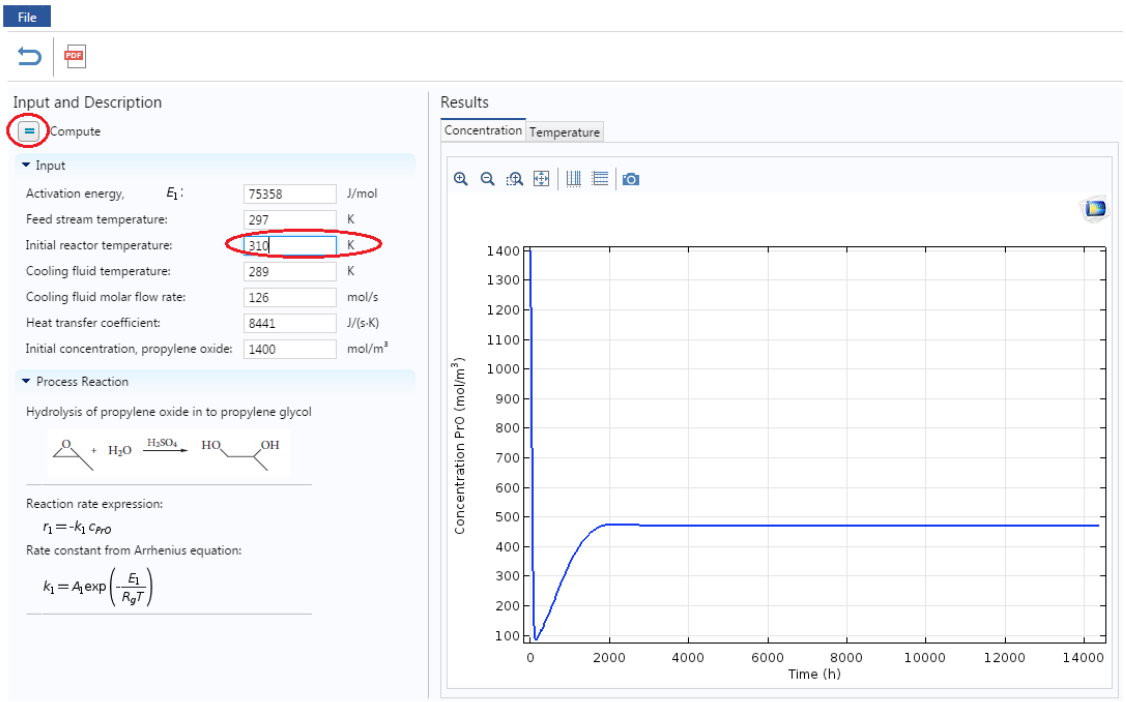


Step 6: Click on Temperature tab to view Temperature profile

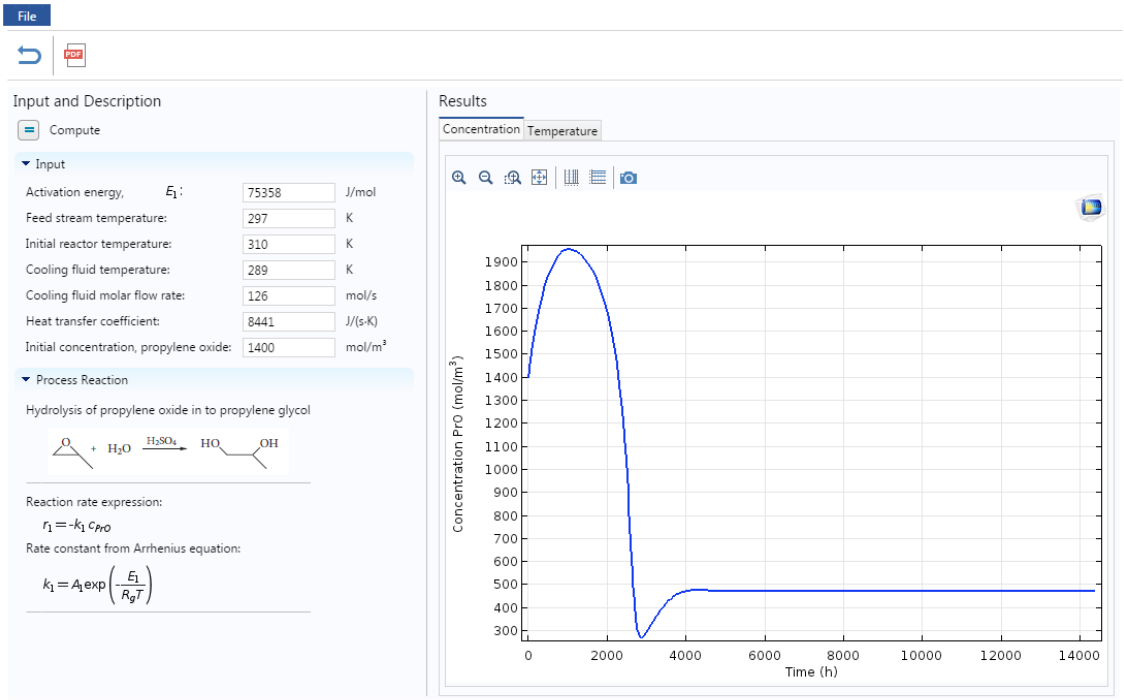


Step 7: Under Input section on the left hand side, you can view and change any parameter values. Let's change a parameter and see the effect on the profile. Change the Initial reactor temperature from 340 K to 310 K. After you are done, click on Compute button (=) present above the Input parameters

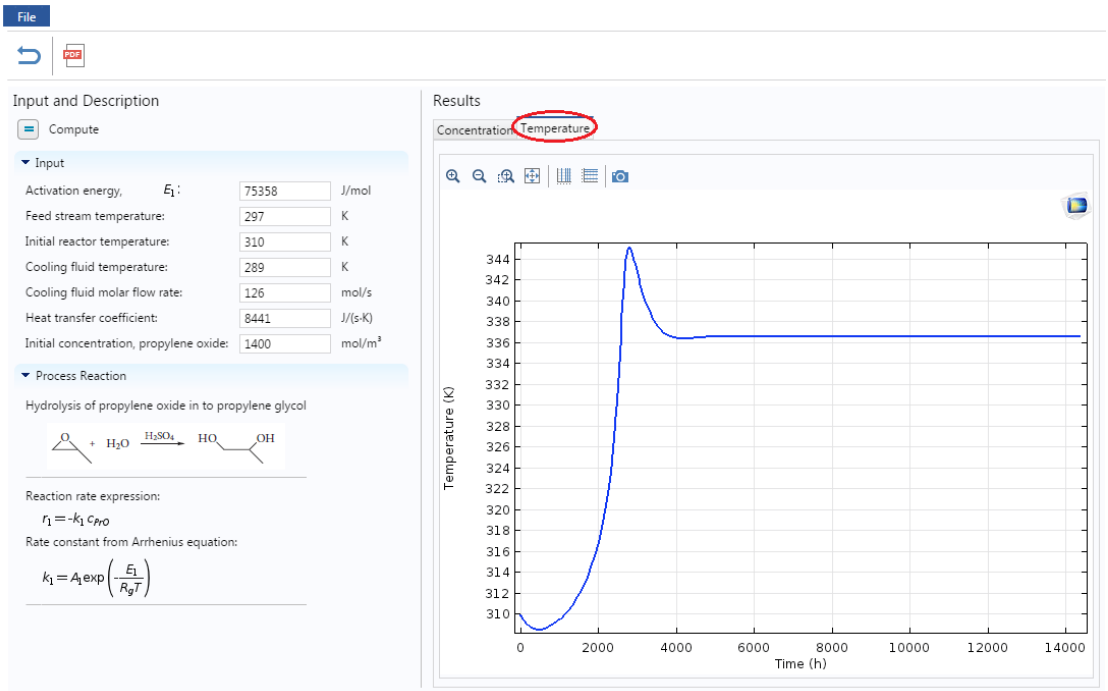
Caution: The y axis is dynamic and scale changes with respect to the values. Make sure to look at both scale and graph



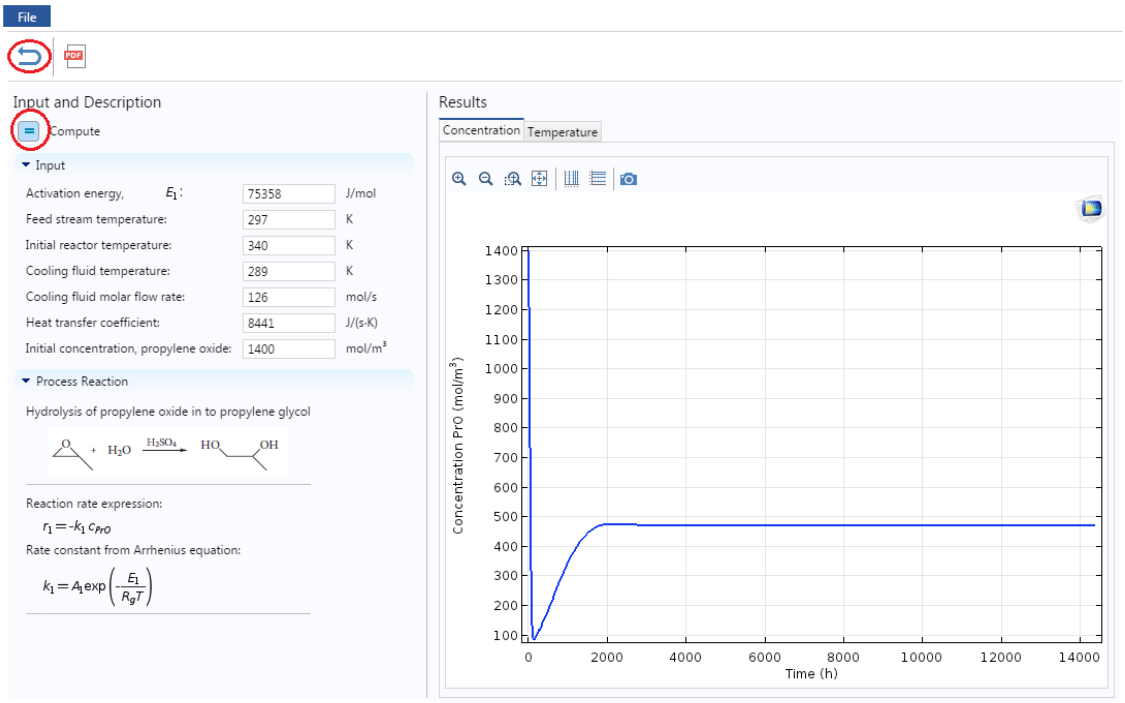
Step 8: Now check the Concentration and Temperature profiles. The following graphs will be obtained. You can check that the concentration profile now has more oscillations before reaching steady state



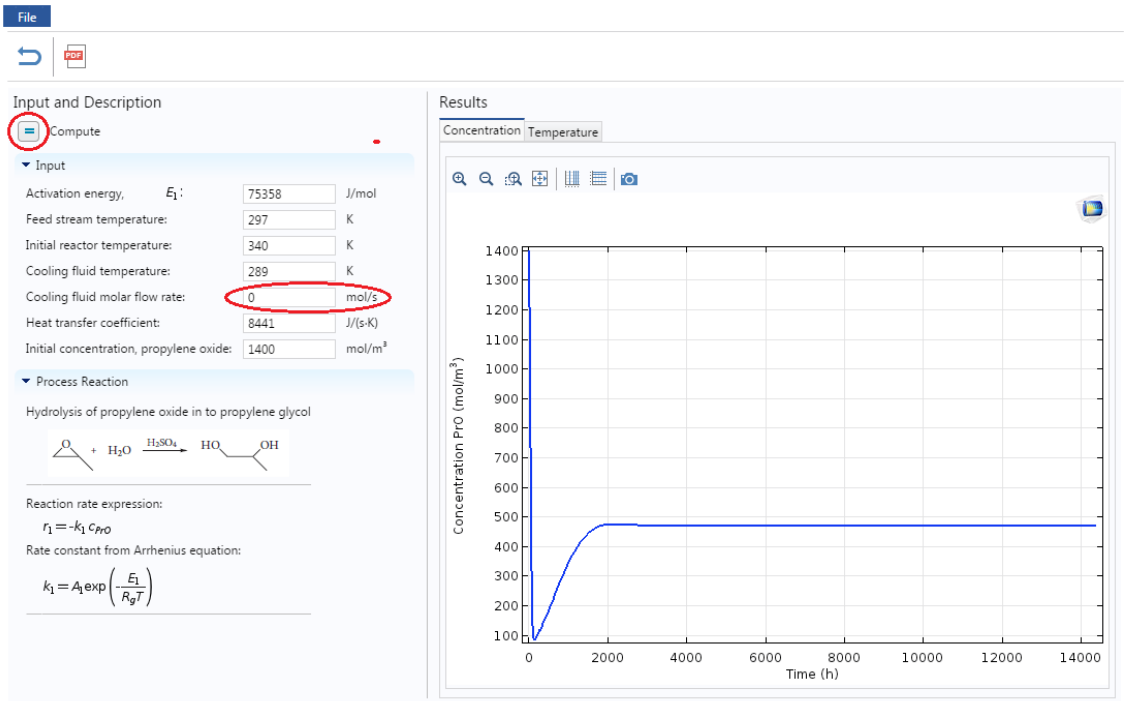
The following is the temperature profile that you will obtain. You can see that at lower temperature, it takes more time to reach the steady state value



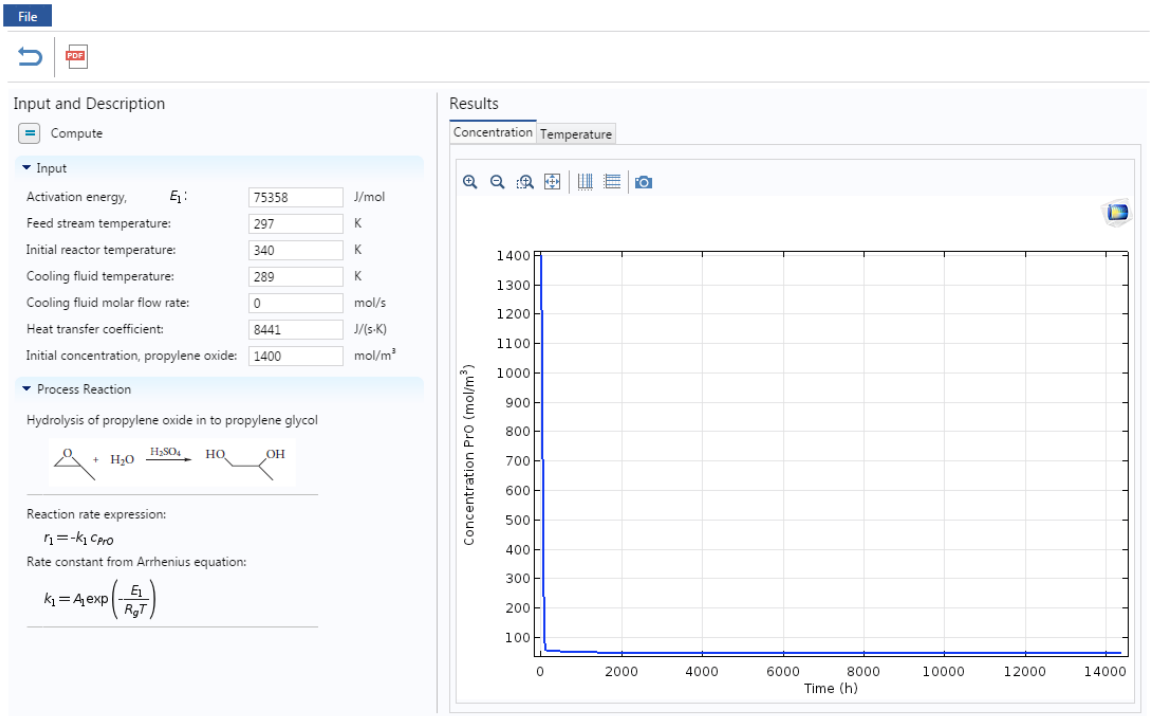
Step 9: Now if you want to re-set all the parameter values to its initial values, click on "Reset to Default button( ) present on the menu bar . Click on this button to reset the value of Temperature. To update the graph, click on Compute button. Each time you change a variable, click Compute



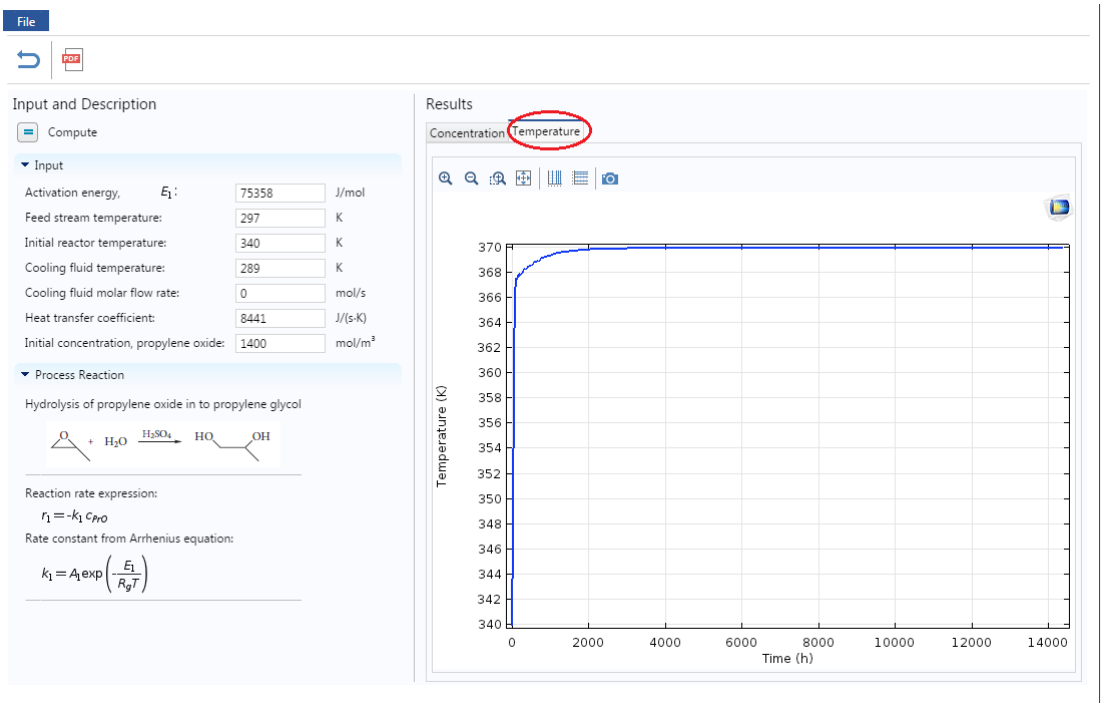
Step 10: Now let's consider a case where there is no coolant flow. Enter the Cooling fluid molar flow rate to be 0 mol/s and click compute to see its effect on profile



The following graph will be obtained for Concentration profile. You can see that reactant concentration drops instantaneously without coolant flow



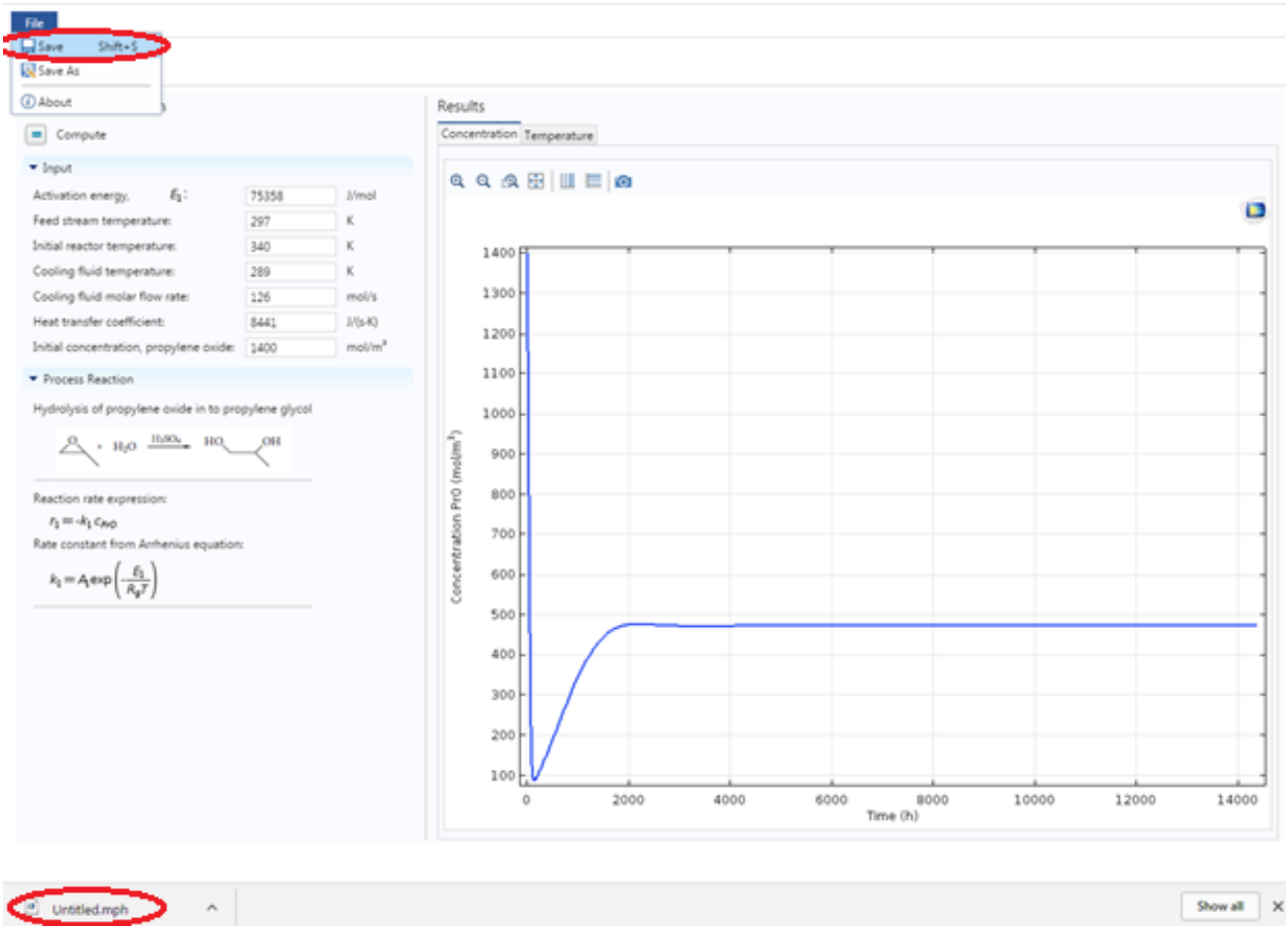
Following is the temperature profile you will obtain. It can be seen that temperature also rises suddenly without coolant flow



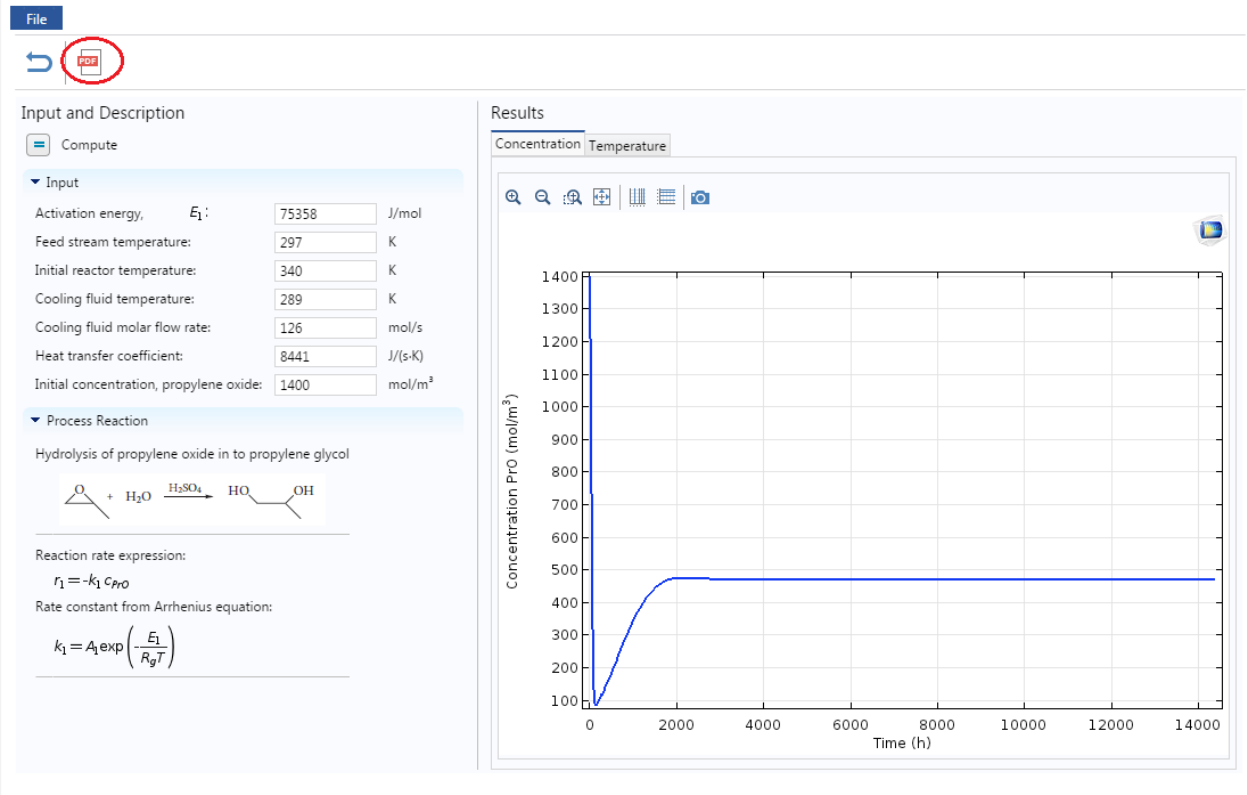
Step 11: Now, you can change any listed parameter value and check its effect on profiles. Make sure to click Compute button after you change a variable.

Step 12: If you have COMSOL installed on your computer, then you can also download the complete COMSOL file (with user interface)

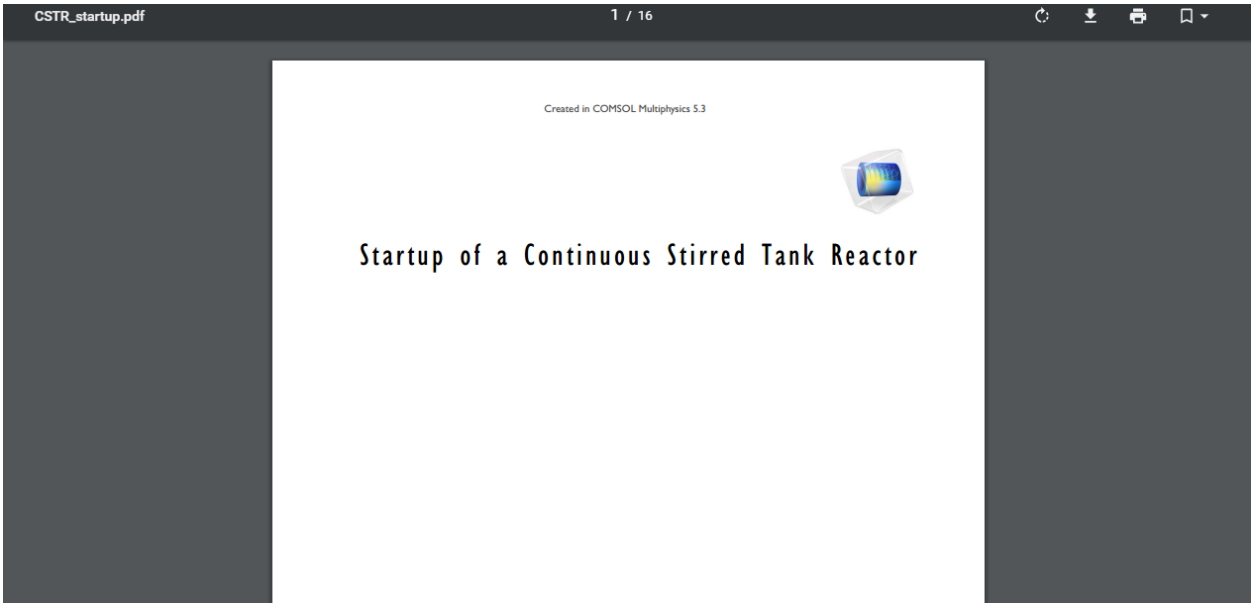
a) Go to file on toolbar and click on Save button. This will download the file at the bottom of the browser (if you are using Chrome)
b) Click on the downloaded file to open the application



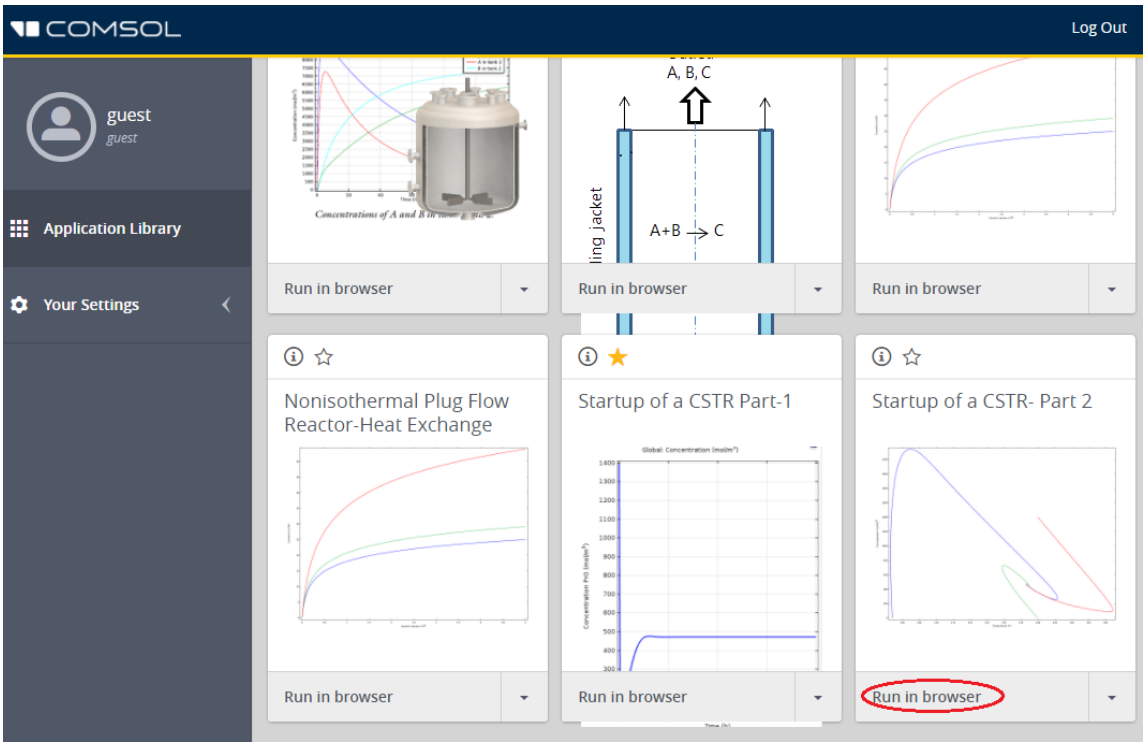
Step 13: You can also open a pdf documentation which details the reactor model and a step-by-step-procedure to create this COMSOL module from scratch. Click on PDF button present on the menu bar



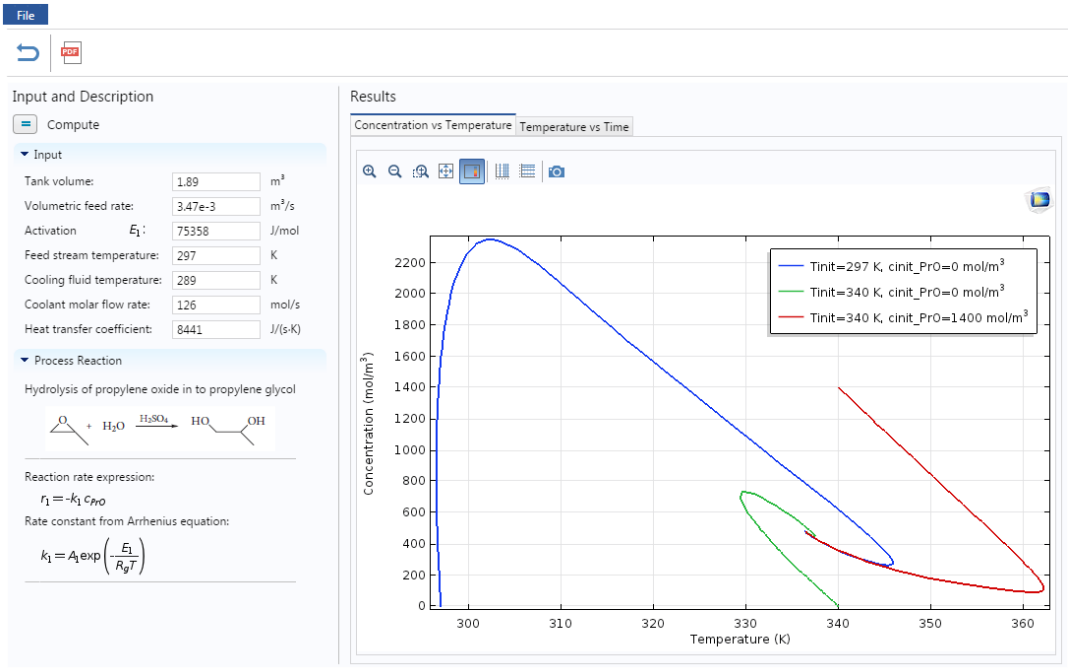
This will open up a new tab with PDF file which you can also download



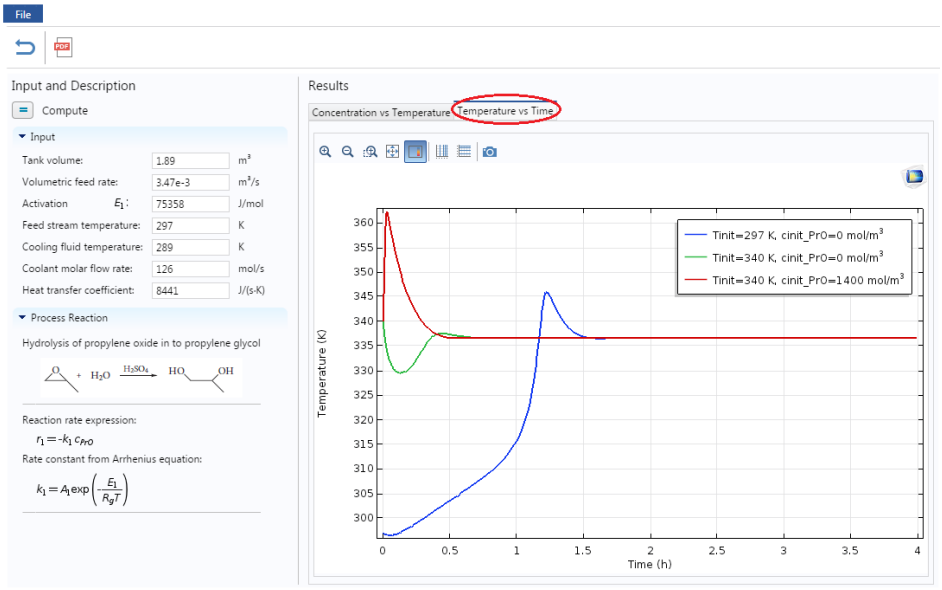
Step 14: Now go back to Library and Find "***Startup of a CSTR- Part 2***". Click on "Run in browser" to start the application. This application contains parametric graph of Concentration vs Temperature



The application will look like this when it opens. Again you can see that there are Input parameters, buttons and graphs. Currently the graph shows parametric plot of Concentration vs Temperature at different initial values of PrO concentration and Reactor temperature

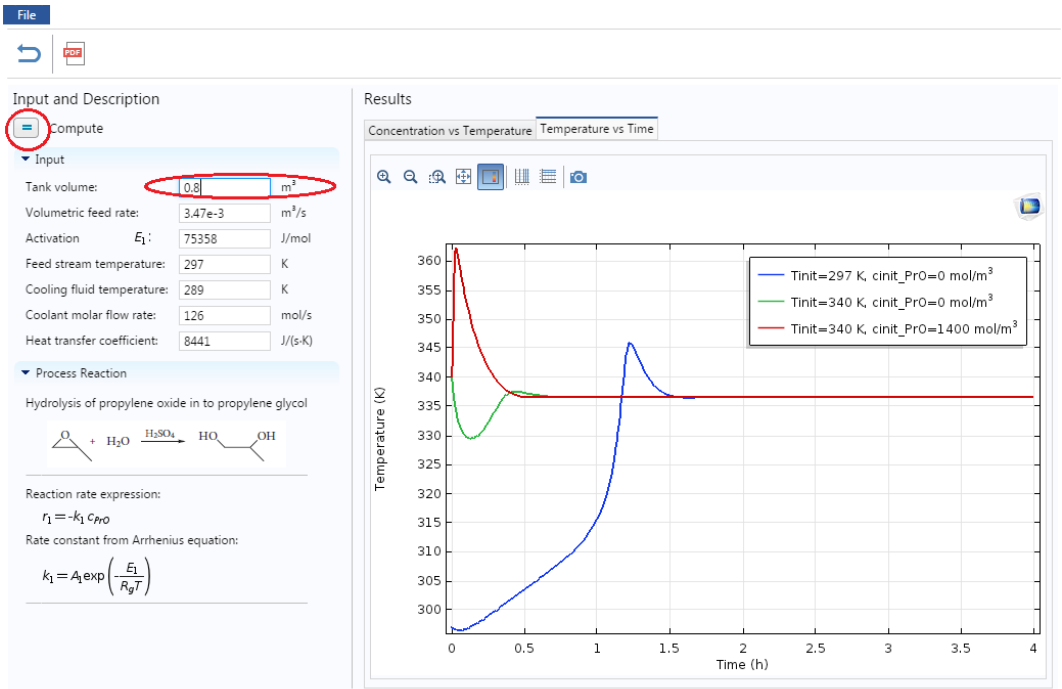


Step 15: Click on "Temperature vs Time" tab to obtain Temperature profile at different initial conditions of PrO concentration and Reactor temperature

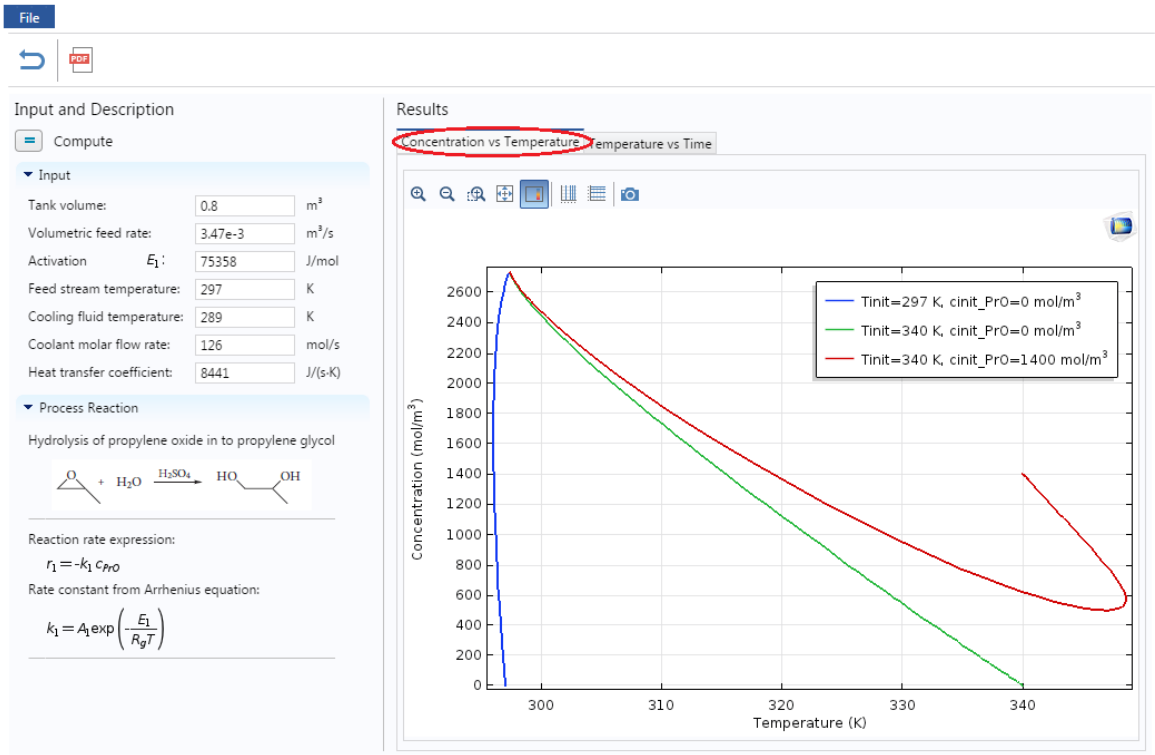


Step 16: Let's change a parameter and see the effect on the profile. Suppose Practical stability limit is 350 K and you want to size the reactor so that maximum reactor temperature is below this limit. Change the Tank volume to 0.8 m^3 from 1.89 m^3. After you are done, click on Compute button (=) present above the Input parameters

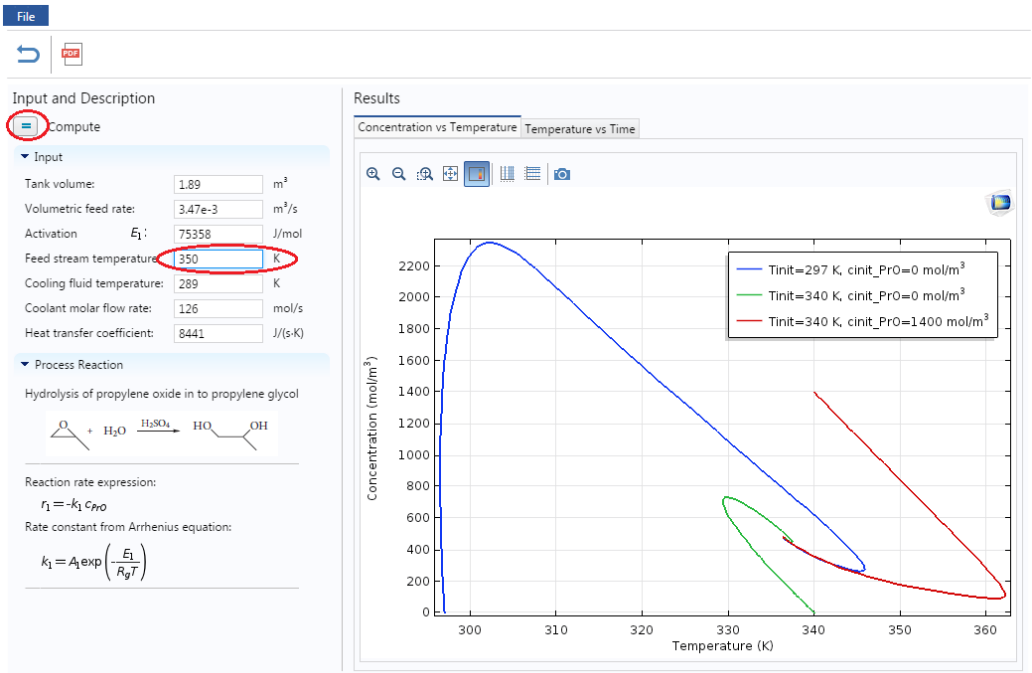
Caution: The y axis is dynamic and scale changes with respect to the values. Make sure to look at both scale and graph



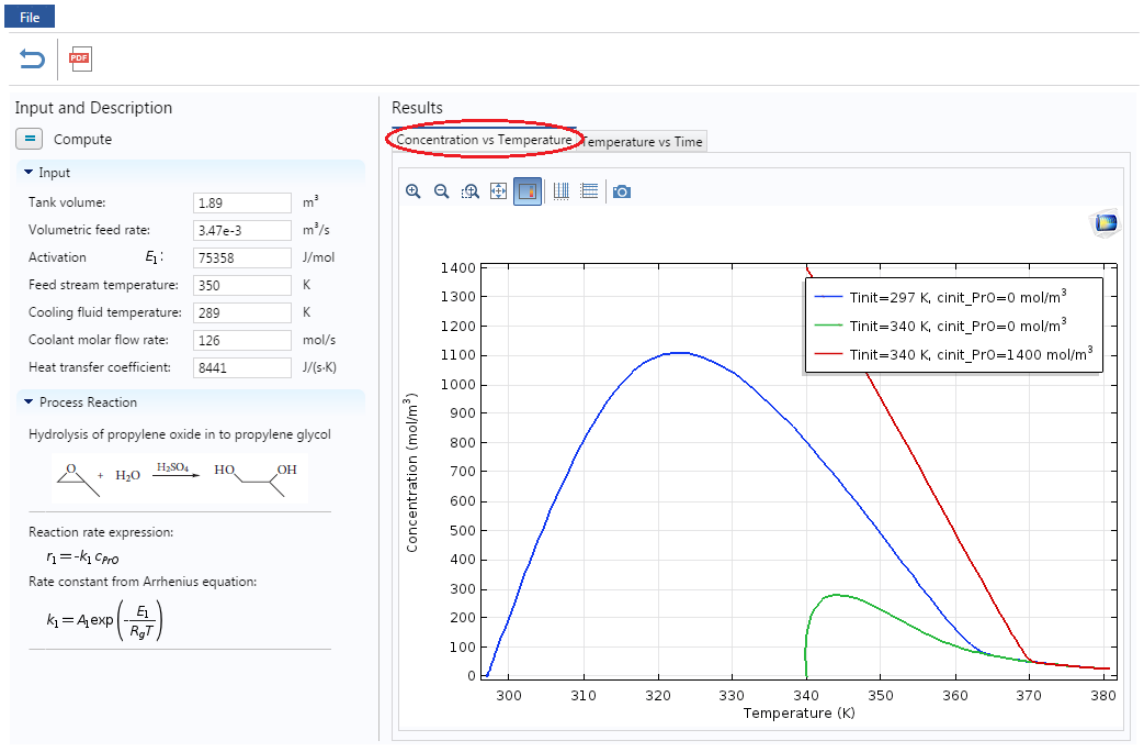
The following graph will be obtained for “Concentration vs Temperature”. It can be seen that reactor temperature doesn’t cross the Practical stability limit at Tank volume=0.8 m3



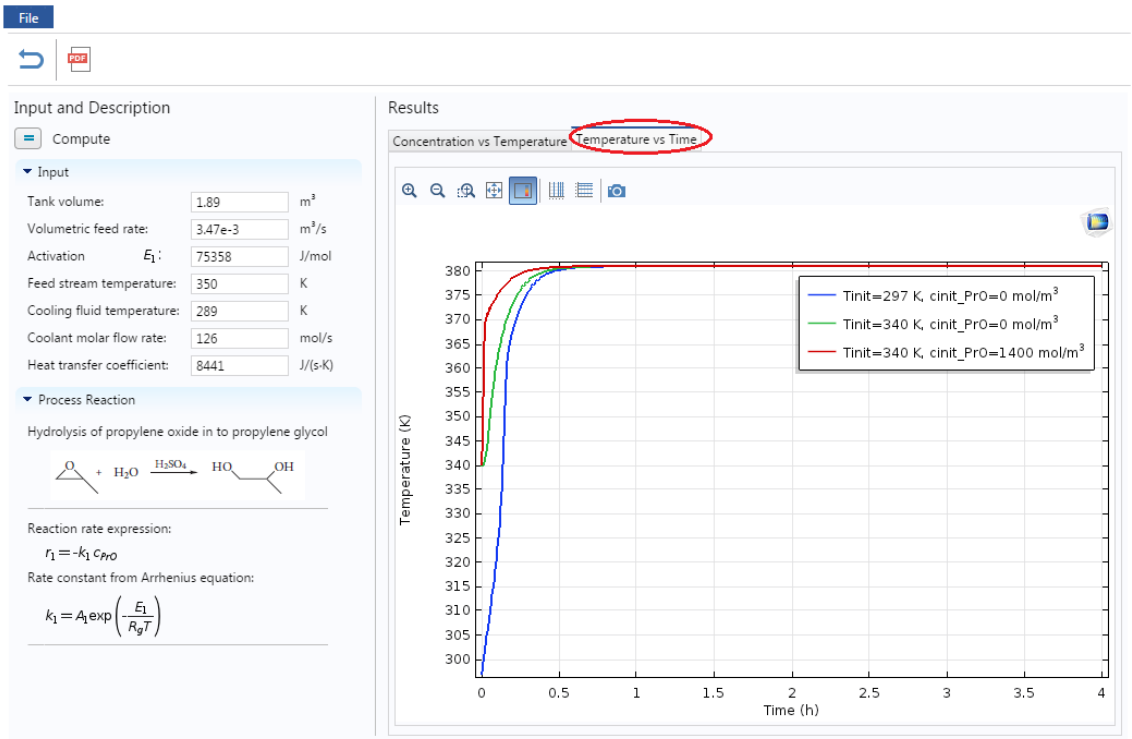
Step 17: Now let’s change another variable and see the effect on profiles. Change the feed stream temperature to 350 K from its initial value of 289 K and then click Compute



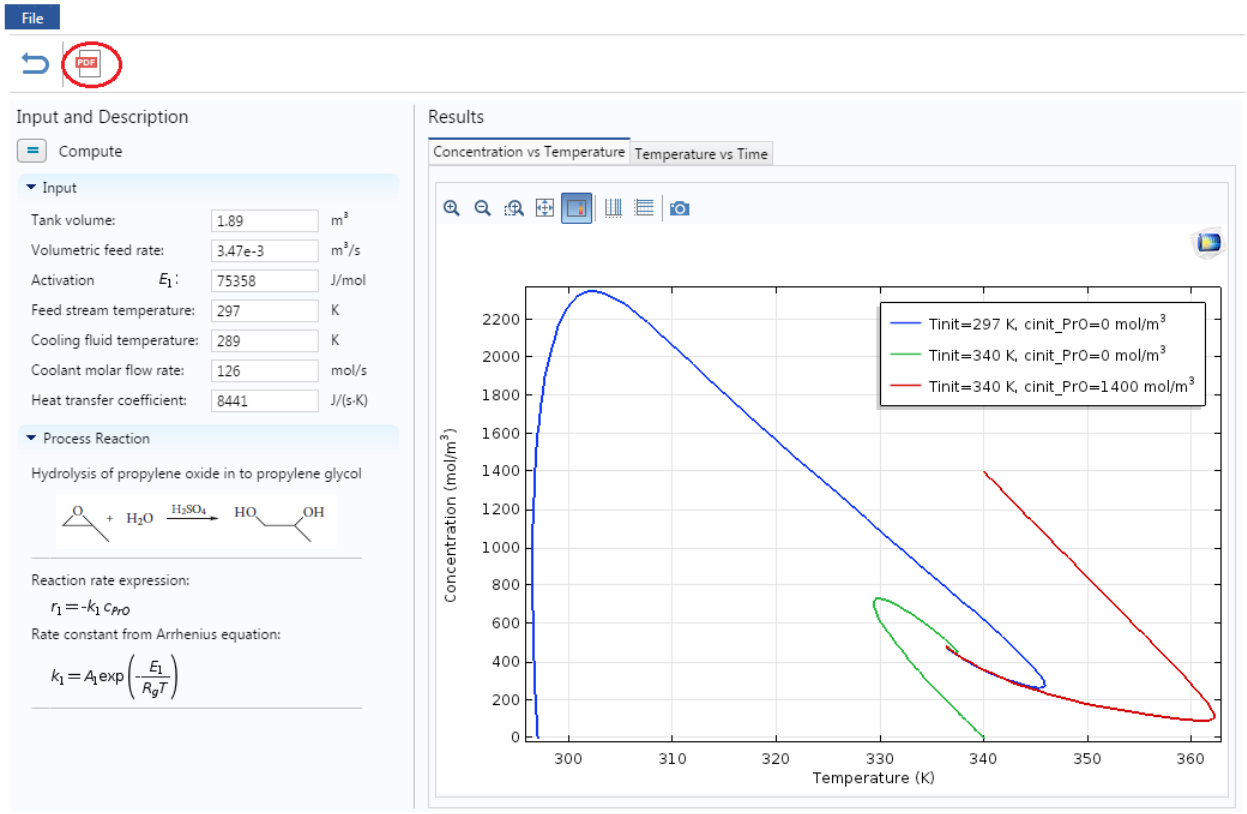
The following graph will be obtained for Concentration vs Temperature



The following graph will be obtained for Temperature vs Time



Step 18: Again, you can download the COMSOL file as was shown in **Step 12**. To open PDF documentation to view the detail of the COMSOL modeling steps, click on PDF button as shown below



This will open up a new tab with PDF file which you can download also