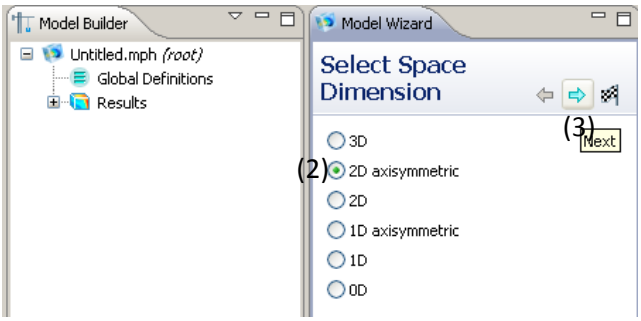
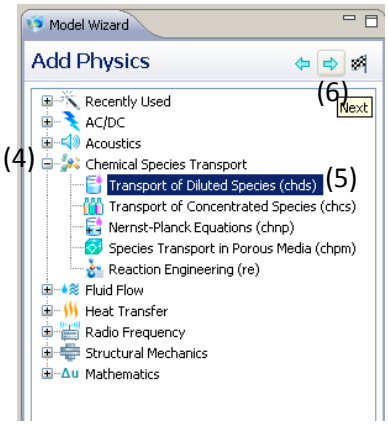
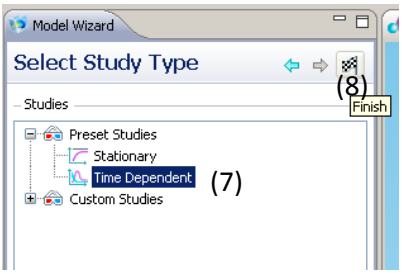
Specifing the problem type

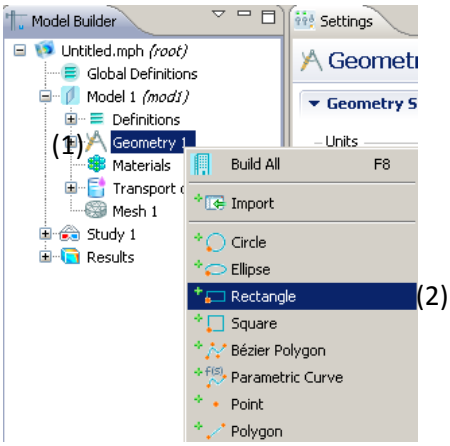




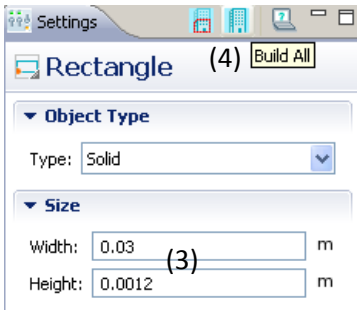


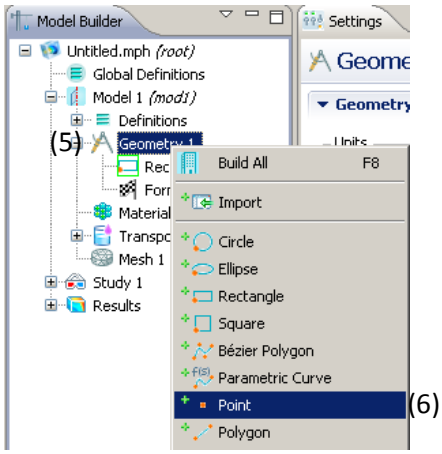
(1) Open COMSOL 4.1 and save file to prevent loss of work.
(2) Under **Select Space Demension**, select 2D axisymmetric.
(3) Click on blue Next arrow.
(4) Under **Add Physics**, expand “Chemical Species Transport”.
(5) Double click on “Transport of Diluted Species (chds)” to add new physics.
(6) Click on blue Next arrow.
(7) Under **Select Study Type**, select “Time Dependent”.
(8) Click checked flag to finish setting up.

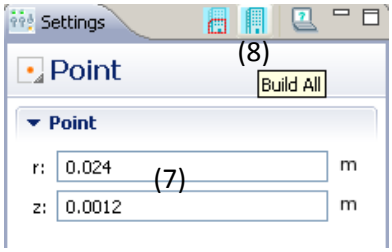
Creating the Geometry

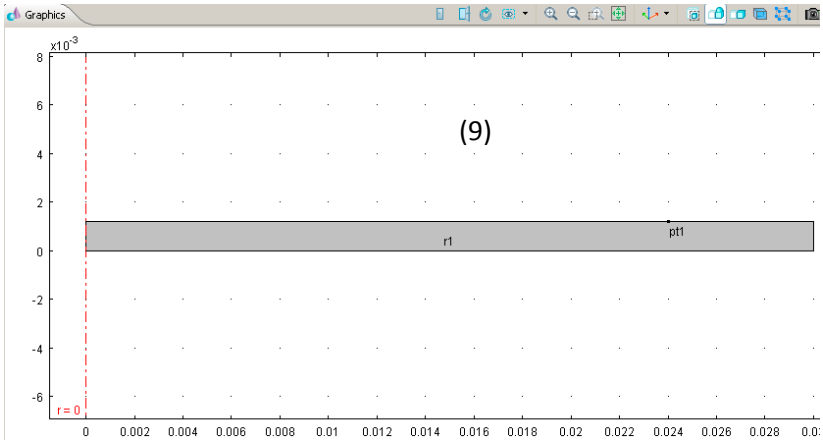


(1) Under **Model Builder**, right click on “Geometry 1”.
(2) Select “Rectangle”.









(3) Under **Settings**, **i**nput 0.03m for width(half of 6cm since we are working with axisymmetric) and 0.0012m for height.

(4) Click on blue “Build All” icon to build the desired geometry.

(5) Right click on “Geometry 1”.

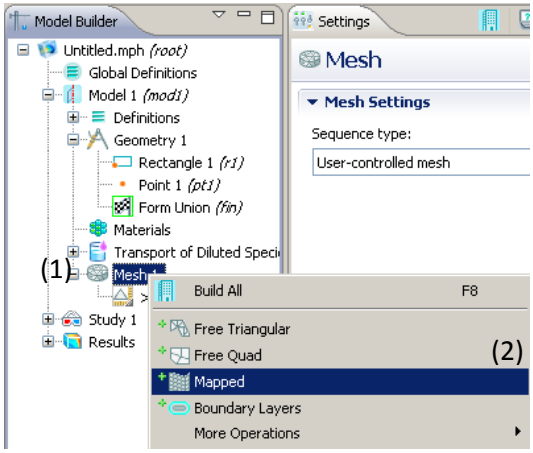
(6) Select “Point”.

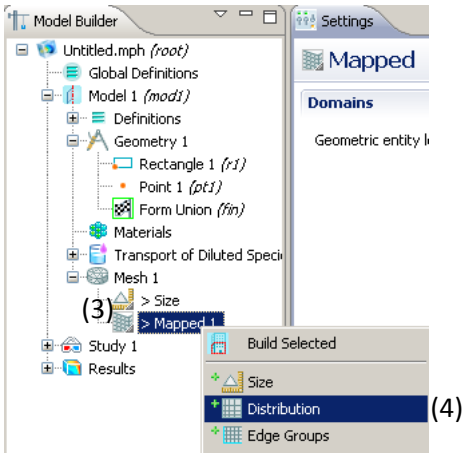
(7) Input polar coordinate (0.024, 0.0012) to mark the boundary of the patch.

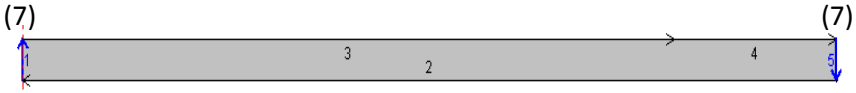
(8) Click on blue “Build All” icon.

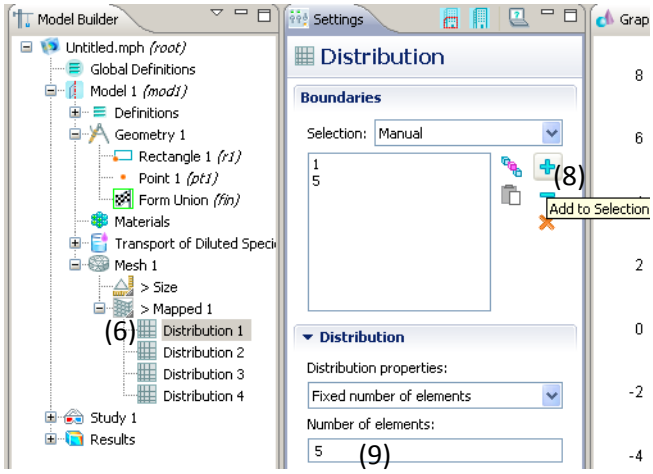
(9) The following geometry should appear in the Graphics window.

Meshing

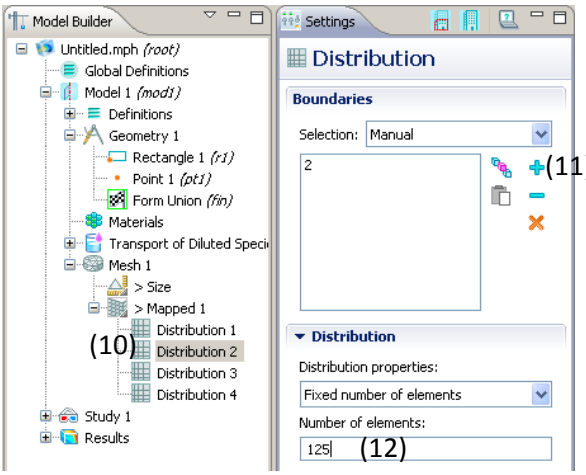


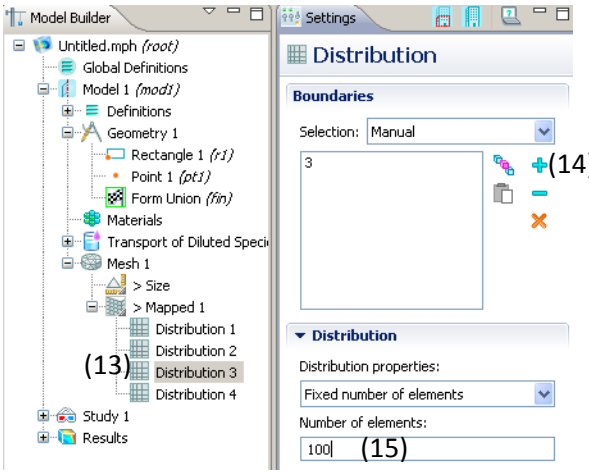


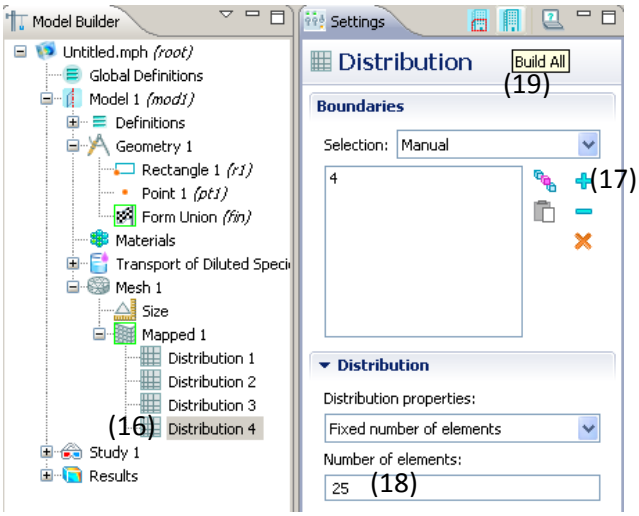




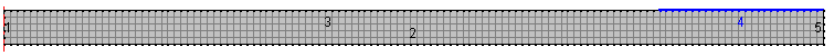
(1) Under **Model Builder**, right click on "Mesh 1".
(2) Select "Mapped".
(3) Right click on "Mapped 1".
(4) Select "Distribution".
(5) Repeat steps (3) and (4) 3 more times to end up with 4 Distributions.
(6) Select "Distribution 1".
(7) Hold CTRL and select boundary 1 and 5 on geometry from the **Graphics** window.
(8) Click blue plus icon in the **Distribution** window to add boundaries to Distribution 1.
(9) Set "Number of elements" to 5.







(20)



(10)Select “Distribution 2”.

(11)Select boundary 2 (bottom boundary), interface between skin and blood, and click on add icon.

(12)Input 125 into “Number of elements”.

(13)Select “Distribution 3”.

(14)Select boundary 3 (top boundary), interface between patch and skin, and click on add icon.

(15)Input 100 into “Number of elements”.

(16)Select “Distribution 4”.

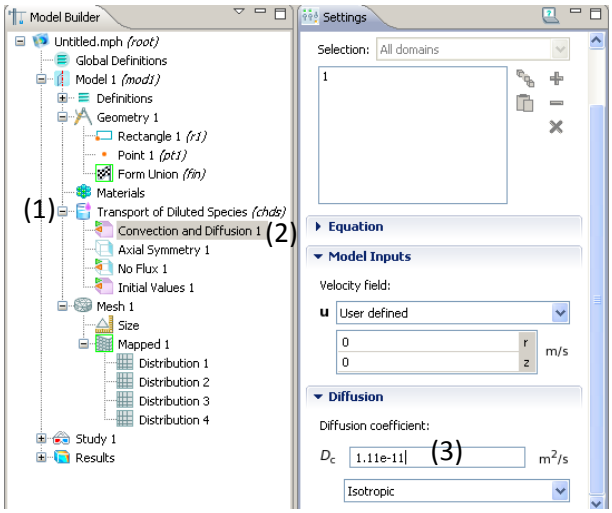
(17)Select boundary 4 (skin not covered by patch) and click on add icon.

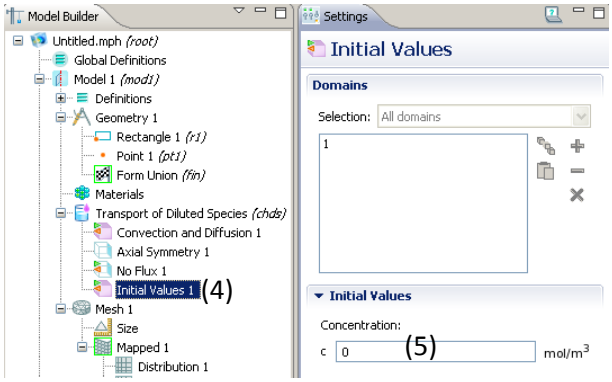
(18)Input 25 into “Number of elements”.

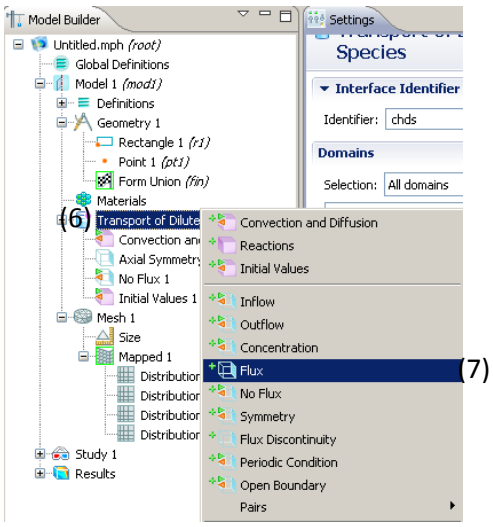
(19)Click on blue “Build All” icon.

(20)The following mesh should result with total of 625 mesh elements.

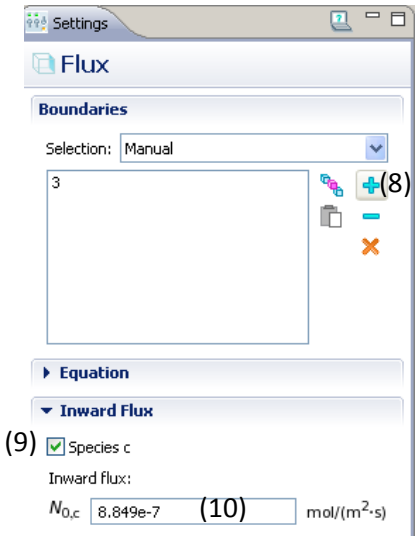
Defining Material Properties and Parameters

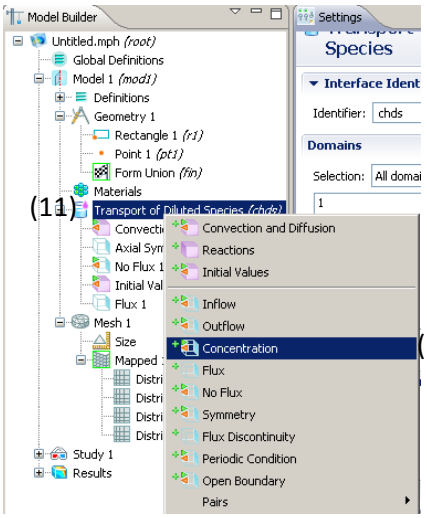


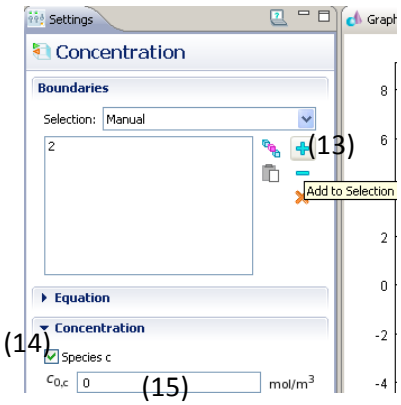




(1) Under **Model Builder**, expand "Transport of Diluted Species (chds)".
(2) Select "Convection and Diffusion 1".
(3) Under **Settings** window, set "Diffusion coefficient" as 1.11e-11 m^2/s.
(4) Click on "Initial Values 1".
(5) Make sure "Concentration" is 0.
(6) Right click on "Transport of Diluted Species (chds).
(7) Select "Flux" boundary condition.







(8) Click on boundary 3 and click on blue plus icon to add boundary.

(9) Under “Inward Flux”, check box for “Species c”.

(10) Set “Inward flux” to 8.849e-7 mol/(m^2s).

(11) Right click on “Transport of Diluted Species (chds).

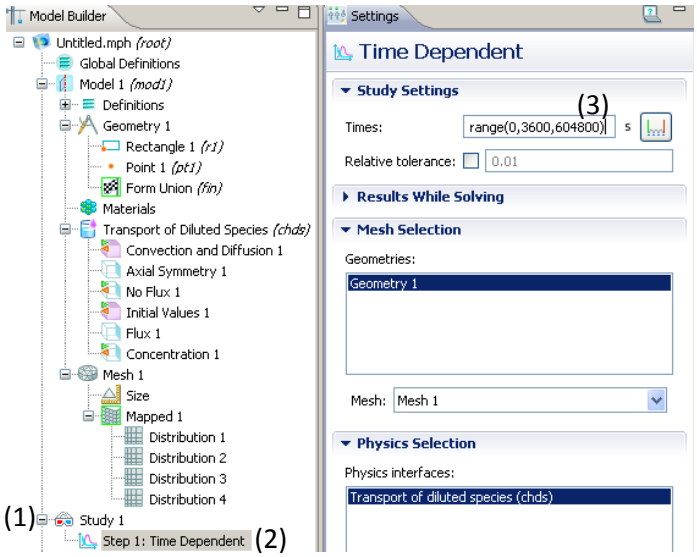
(12) Select “Concentration” boundary condition.

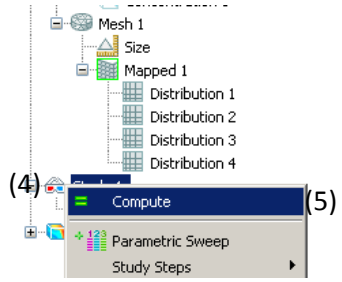
(13) Click on boundary 2 and click on blue plus icon to add boundary.

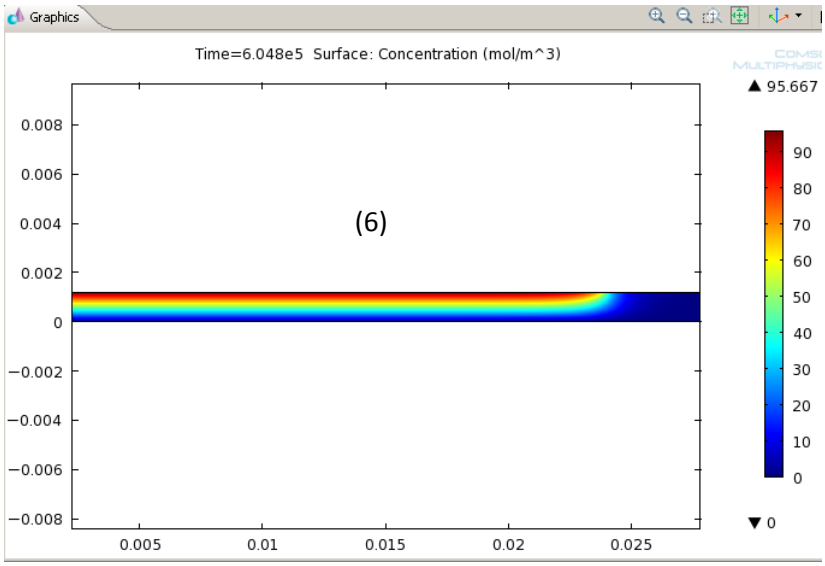
(14) Under “Concentration”, check box for “Species c”.

(15) Set boundary concentration to equal 0 since all drug that diffuses this far will be cleared by blood flow.

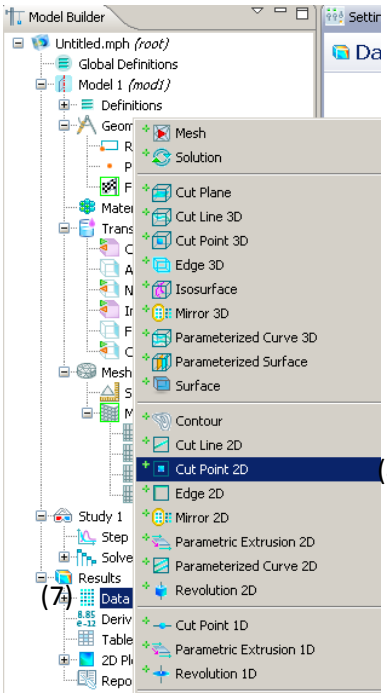
Computation and Post-Modifications

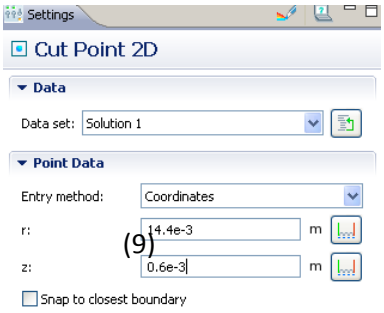


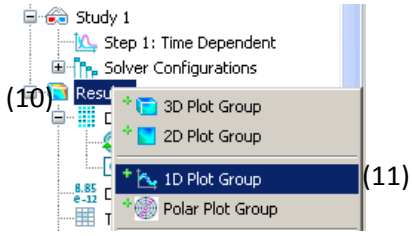


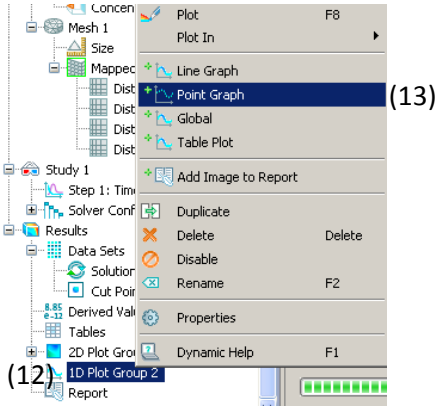


(1) Expand “Study 1”.
(2) Select “Step 1: Time Dependent”.
(3) Under **Time Dependent,** input range(0,3600,604800) for “Times”.
(4) Right click on “Study 1”.
(5) Select “Compute”.
(6) The following surface plot should result for solution at 604800s.

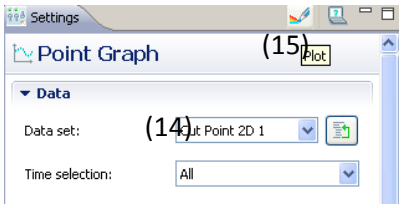


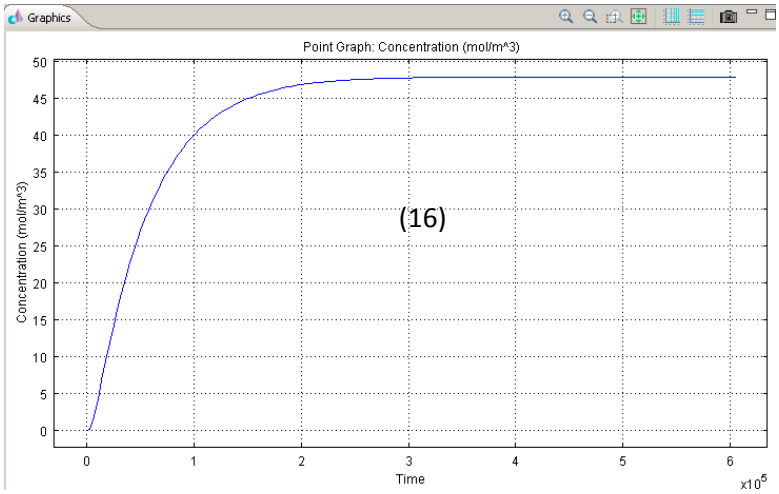


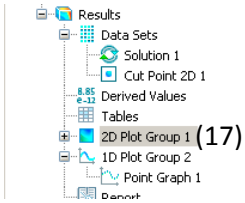


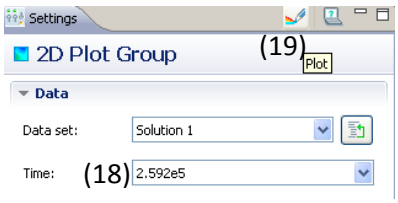


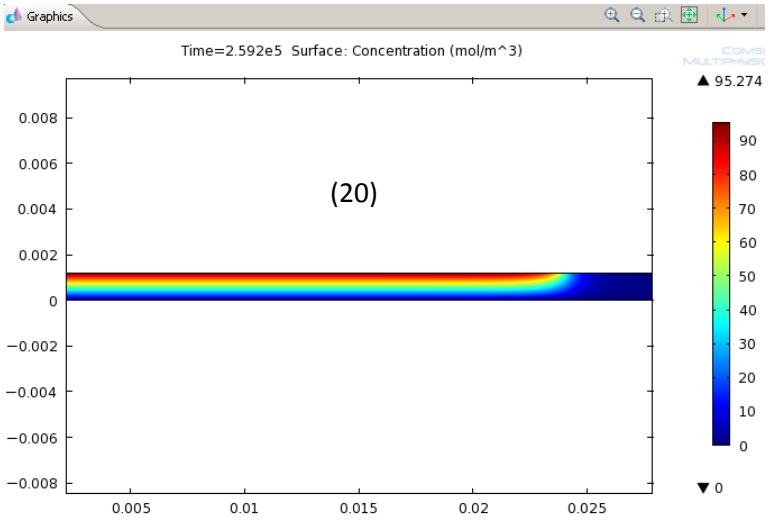
(7) Under “Results”, right click on “Data Sets”.
(8) Select “Cut Point 2D”.
(9) Under Settings, input 14.4e-3 for r-value and 0.6e-3 for z-value.
(10) Right click on “Results”.
(11) Select “1D Plot Group”.
(12) Right click on “1D Plot Group 2”.
(13) Select “Point Graph”.











(14)Under **Point Graph** choose “Cut Point 2D 1” from the drop down menu for “Data set”.

(15)Click the plot icon (rainbow pencil icon).

(16)The following concentration profile should result for polar coordinate (14.4e-3, 0.06e-3).

(17)Under “Results” select “2D Plot Group 1”.

(18)Change “Time” to 2.592e5 using the drop down menu.

(19)Click the Plot icon.

(20)The following surface plot should result of the solution at 2.592e5 seconds.