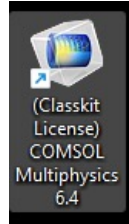


# **ENR145 Computational Methods: What if I want to do a COMSOL application for my final project?**

Xiang Li  
Spring 2026

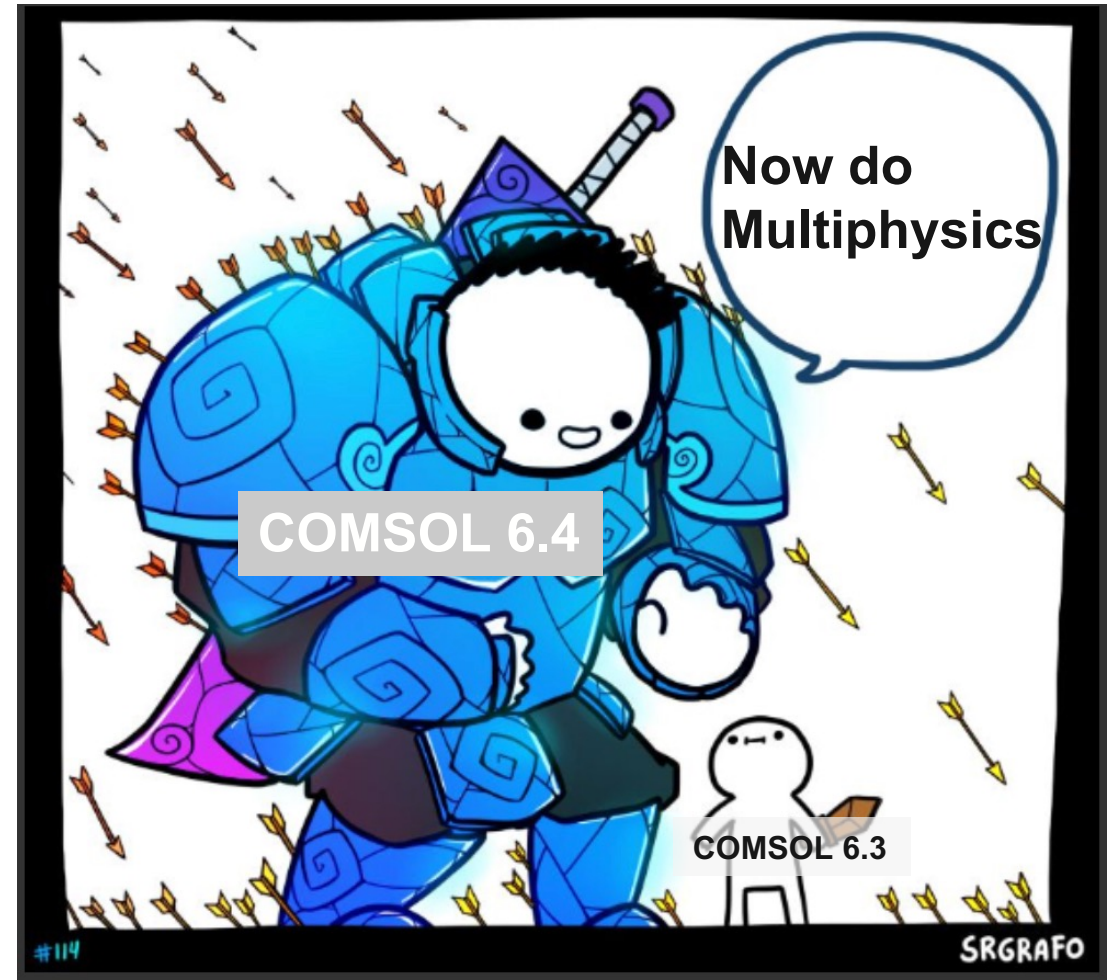
# Good news: we are updating to COMSOL 6.4!

Look for this icon :



We got more models available:

- Structural Mechanics
    - Solid Mechanics (solid)
    - Shell (shell)
    - Membrane (mbrn)
    - Beam (beam)
    - Pipe Mechanics (pipem)
    - Truss (truss)
    - Wire (wire)
  - Explicit Dynamics
    - Beam Cross Section (bcs)
    - Phase-Field Damage
  - Electromagnetics-Structure Interaction
  - Fluid-Structure Interaction
  - Poroelectricity
  - Thermal-Structure Interaction
- Heat Transfer
    - Heat Transfer in Solids (ht)
    - Heat Transfer in Fluids (ht)
    - Heat Transfer in Solids and Fluids (ht)
    - Conjugate Heat Transfer
    - Radiation
      - Heat Transfer with Surface-to-Surface Radiation
      - Heat Transfer with Orbital Thermal Loads
      - Heat Transfer with Radiation in Participating Media
      - Heat Transfer with Radiation in Absorbing-Scattering Media
      - Heat Transfer with Radiative Beam in Absorbing Media
      - Surface-to-Surface Radiation (rad)
      - Orbital Thermal Loads (otl)
      - Radiation in Participating Media (rpm)
      - Radiation in Absorbing-Scattering Media (rasm)
      - Radiative Beam in Absorbing Media (rbam)
    - Electromagnetic Heating
    - Lumped Thermal System (lts)
    - Thin Structures
    - Heat and Moisture Transport
    - Porous Media
    - Bioheat Transfer (ht)



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# Overwhelmed? Find a template!

<https://www.comsol.com/model/protein-adsorption-1397>

COMSOL

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## Application Gallery

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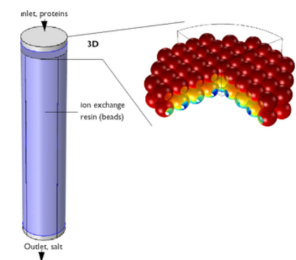
### Protein Adsorption

Application ID: 1397

Ion-exchange is a powerful method to separate proteins from solutions and is today readily used in biotechnological and pharmaceutical industry.

This model simulates an ion-exchange column for protein adsorption. The fluid phase contains four components: two proteins, solvent, and one salt. The adsorption/desorption kinetics is described by two equilibrium reactions where proteins displace ions adsorbed at the surface and vice versa.

The example highlights how reactions at chemical equilibrium can be studied in a 0D reactor system in Reaction Engineering. In addition, it also shows how the kinetics from the 0D setup is exported to a 3D model where the reacting surface in the column can be studied in detail. The 3D model incorporates mass transport through diffusion and convection, and the reactions at the surface of the ion-exchange mass with Transport of Diluted Species, Free and Porous Media Flow, and Surface Reactions interfaces.



The diagram shows a vertical cylindrical column on the left with an inlet at the top labeled 'inlet, proteins' and an outlet at the bottom labeled 'Outlet, salt'. To the right is a 3D model of the ion-exchange resin (beads), showing a porous structure with a color gradient from red to blue, representing the distribution of species within the beads.

# First reverse-engineering, then innovate

Download these as templates for your final project

Download Files | Suggested Products

COMSOL 6.4 | COMSOL 6.3 | COMSOL 6.2

- protein\_adsorption\_v51\_4\_3.pptx - 1.66MB
- models.chem.protein\_adsorption.pdf - 1.2MB
- protein\_adsorption.mph - 296.92MB
- protein\_adsorption\_geom\_sequence.mph - 2.09MB
- protein\_adsorption\_parameters.txt - 0MB

Download this as a starting model for your final project

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Suggested Products

This model example illustrates applications of this type that would nominally be built using the following products:

[Chemical Reaction Engineering Module →](#)

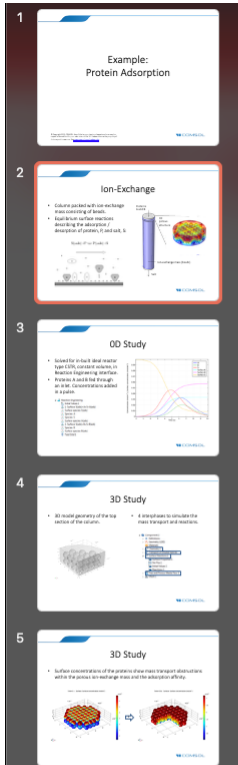
however, additional products may be required to completely define and model it. Furthermore, this example may also be defined and modeled using components from the following product combinations:

- COMSOL Multiphysics® *and*
- either the [Chemical Reaction Engineering Module](#), or [Electric Discharge Module](#) *and*
- either the [Battery Design Module](#), [Chemical Reaction Engineering Module](#), [Corrosion Module](#), [Electrochemistry Module](#), [Electrodeposition Module](#), or [Fuel Cell & Electrolyzer Module](#)



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# No excuse: good model and good-looking slides



## Ion-Exchange

- Column packed with ion-exchange mass consisting of beads.
- Equilibrium surface reactions describing the adsorption / desorption of protein, P, and salt, S:  
$$S(ads)+P \leftrightarrow P(ads)+S$$

- If COMSOL only need 5 pages of slide and 10 pages of report to demo a model, you can pull it off too!
- And if you can impress another professor from another class, you will get bonus points for your final project.