327e Teaching Transport Phenomena with CFD

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Transport Phenomena is one of the cornerstone courses in the Chemical Engineering curriculum, but remains one of the most difficult for students to master. Recent advances in user-friendly CFD packages, however, allow students to visualize solutions and gain insight into various transport processes. Case studies in the Transport Phenomena course here at UMR include flow past a sphere, flow through constrictions, and various problems with convection. Before attempting any CFD model, students are required to perform an engineering analysis on the problem including nondimensionalization and identification of the proper transport equations and relations. One instructive example used in the class involved solving for creeping flow around a sphere. Students were then able to compare and contrast their analytical solution with that obtained through CFD. The working CFD model was then used to explore flow at various Reynolds numbers. Students were able to view the importance of inertial effects and visualize phenomena such as flow separation and vortex shedding. CFD was also used for solving coupled problems in mass and momentum transfer, including a final project that featured designing a MEMS device for kidney dialysis.