Learning objectives

While the goals listed in the handout with course information are quite general, the learning objectives specify what you will be able to do. They are constructed on six levels: (1) listing and defining, (2) explaining and describing, (3) calculating and solving, (4) deriving and analyzing, (5) designing and formulating, and (6) evaluating and choosing. Use these objectives to focus your study.

1. Find journal articles; extract information from journal articles; evaluate and critique arguments and assumptions in journal articles; explain and critique figures; determine effective ways to present information.

2. Derive governing equations using conservation laws; explain the physical significance of the terms in the resulting equations.

3. Decide which of two processes or quantities is more important by formulating a dimensionless ratio; use dimensional analysis to determine relationships between parameters in a problem; simplify a model with rational approximations using dimensionless parameters.

4. Predict concentrations of bacteria in a stream; compute net growth rates; infer resuspension rates from concentration measurements; evaluate effects of interactions with the sediment; explain the effects of lateral inflow.

5. Define incompressible flow; verify that a given flow is valid; compute one velocity component given the others in incompressible flow.

6. Evaluate results by checking dimensions, special cases, boundary and initial conditions, and behavior of the solution.

7. Explain the need for constitutive relations; compute the stress tensor and pressure given other information about the flow.

8. Formulate a mathematical statement of a fluid flow problem with the appropriate equations, boundary conditions, and initial conditions; solve the conservation equations.

9. Identify length, velocity, and time scales in a fluid flow problem; relate velocity scales using conservation of mass; obtain velocity, pressure, length, or time scales by requiring certain terms in the conservation equations to balance.

10. Recognize a pressure-viscous balance; identify conditions under which a pressure-viscous balance holds; explain why other terms in the momentum equations are negligible; solve for the velocities in viscous slot flow; design a flow that satisfies the assumptions of a pressure-viscous balance; explain similarities between viscous slot flow and groundwater.

11. Use scaling to circumvent a full solution of the momentum equations; compute settling velocities; explain deviations from Stokes’s law.
12. Apply conservation laws to a control volume (e.g., a force balance) to compute flow quantities such as stress, fluxes, etc.