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. 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.

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

3. Verify that a given flow is valid; evaluate results by checking dimensions, special cases, and behavior of the solution.

4. Predict concentrations of bacteria in a stream; infer resuspension rates from concentration measurements; evaluate effects of interactions with the sediment.

5. Define incompressible flow; compute one velocity component given the others in incompressible flow.

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

7. Identify length, velocity, and time scales in a fluid flow problem.

8. Relate velocity scales using conservation of mass; obtain velocity, pressure, length, or time scales by requiring certain terms in the conservation equations to balance.

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

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; 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.