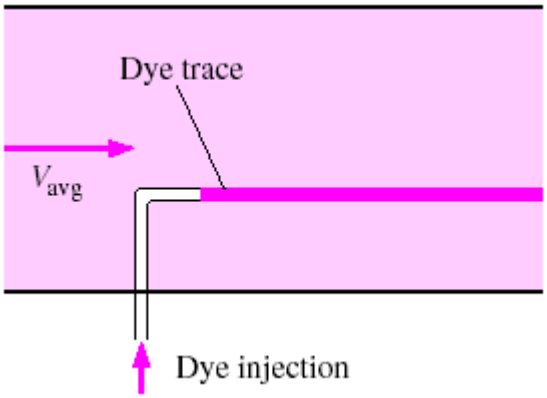
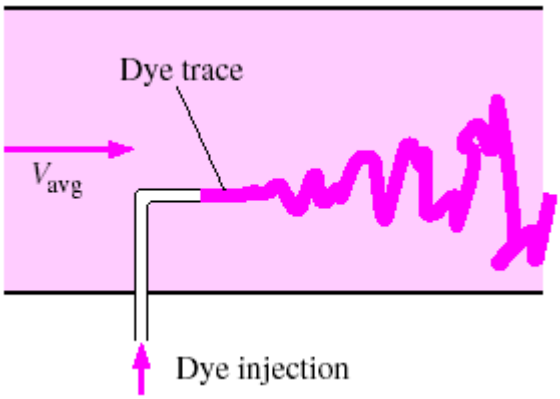
Laminar Versus Turbulent Flow – A Comparison
(Section 8-2, Çengel and Cimbala)

Laminar Flow	**Turbulent Flow**
Can be steady or unsteady.	Is always *unsteady*.
(Steady means that the flow field at any instant in time is the same as at any other instant in time.)	Why? There are always random, swirling motions (vortices or eddies) in a turbulent flow.
	Note: However, a turbulent flow can be steady *in the mean*. We call this a *stationary turbulent flow*.
Can be one-, two-, or three-dimensional.	Is always *three-dimensional*.
	Why? Again because of the random swirling eddies, which are in all directions.
	Note: However, a turbulent flow can be 1-D or 2-D *in the mean*.
Has regular, *predictable* behavior	Has irregular or *chaotic* behavior (cannot predict exactly – there is some randomness associated with any turbulent flow.
	
Analytical solutions are possible (see Chapter 9).	No analytical solutions exist! (It is too complicated, again because of the 3-D, unsteady, chaotic swirling eddies.)
Occurs at *low* Reynolds numbers.	Occurs at *high* Reynolds numbers.