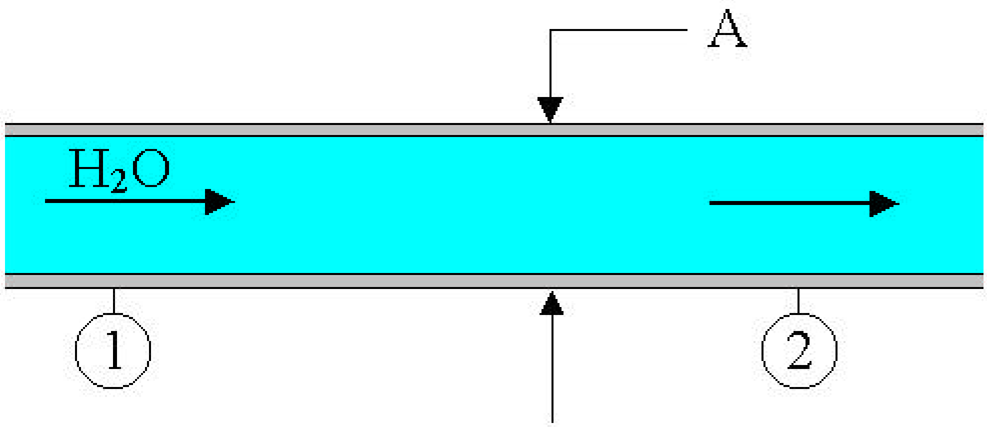
**CONTINUITY**

<u>Case 1: **Steady**, **Incompressible, 1-D** flow through a **Constant Diameter Pipe**</u>

Assume steady $H_2O$ flow through a pipe with constant diameter D and cross-sectional area A.




Since $H_2O$ is a liquid, the flow is incompressible (i.e., $\rho$ = const. everywhere). Expressing conservation of mass between any two stations 1 and 2 along this pipe would give:

$$\dot{m}_1 = \dot{m}_2 \Rightarrow r_1 Q_1 = r_2 Q_2 \qquad (1)$$

The flow is incompressible so $r_1 = r_2 = const.$ everywhere.

Consequently, eq.(1) becomes $Q_1 = Q_2 \Rightarrow V_1 A_1 = V_2 A_2$ (2)

But the pipe has the same diameter along its entire length so $A_1 = A_2$.

Thus, in this simple case, continuity translates into the obvious relationship between the velocities at any two points of the pipe:

Continuity eq. for **steady**, **incompressible, 1-D** flow through a **constant diameter pipe**

$$V_1 = V_2 \qquad (3)$$

Note: $V_1$ and $V_2$ are the average velocities at sections 1 and 2 respectively.