

# Threshold Concepts: Engineering Examples – November 14, 2012

**WATERLOO**  
**ENGINEERING**

[engineering.uwaterloo.ca](http://engineering.uwaterloo.ca)

Gordon Stublely  
Associate Dean – Teaching  
[stublely@uwaterloo.ca](mailto:stublely@uwaterloo.ca)

# Outline

- General Engineering
- Introductory Fluid Mechanics

# System Concept

**WATERLOO**  
**ENGINEERING**

[engineering.uwaterloo.ca](http://engineering.uwaterloo.ca)

# 1: System Definition

- Isolate a portion of reality (focus of problem ) from surroundings
  - Free body diagram
  - Control mass
  - Control volume
  - Mathematical solution domain
  - Financial accounts

# 2: System Definition

- Replace the effects of surroundings on the system by boundary interactions
  - Surface forces
  - Flows across surfaces
  - Boundary conditions

# Student Difficulties

- ME student application of free body diagrams on midterm exams:
  - *Grade 10 Science, Grade 11 Physics, Grade 12 Physics, Phys 115*
  - **ME 219 (2A): 50% show no understanding**
  - *ME 220 (2B), ME 321 (3A)*
  - **ME 322 (3B): 20 – 30% show no understanding**

# ME 351: Fluid Mechanics 1

**WATERLOO**  
**ENGINEERING**

[engineering.uwaterloo.ca](http://engineering.uwaterloo.ca)

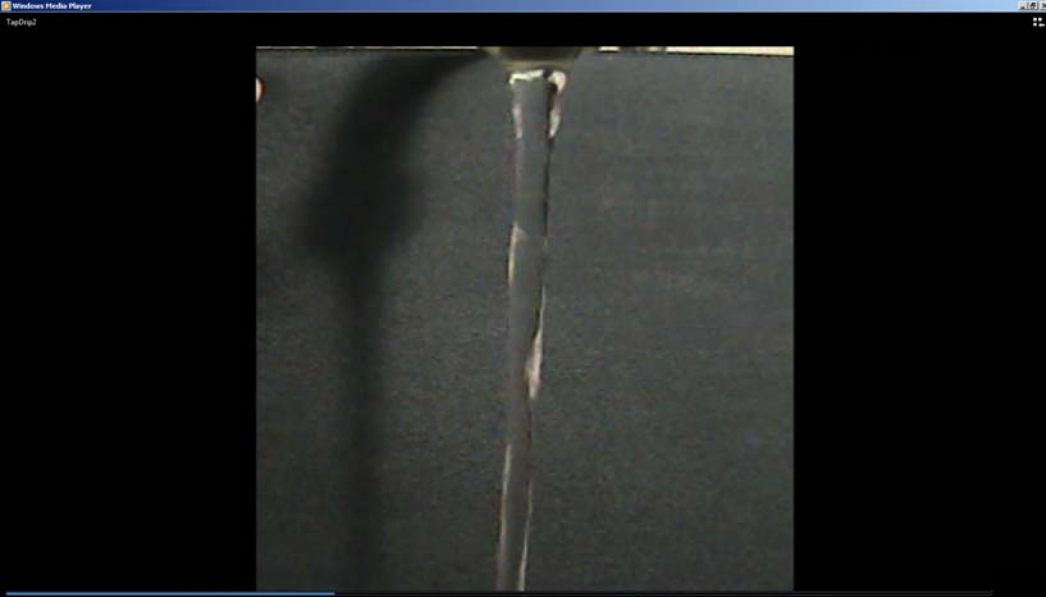
# Action of Pressure - I

- Balances:
  - Friction (resistance)
  - Gravity
  - Acceleration



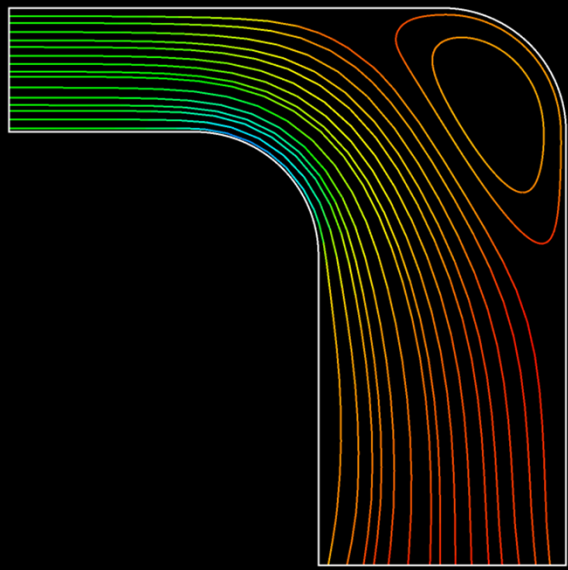
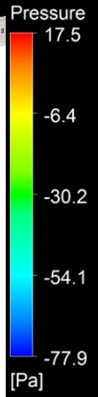
# Action of Pressure - II

- Acts uniformly in all directions
- Varies spatially
  - Streamwise (acceleration, friction, gravity)
  - Cross-stream (acceleration, gravity)
- Role of mass conservation
  - Fluid is not contained (high school chemistry model of pressure)



<http://en.rct-online.de/laboratory-plastics/containers/measuring-beakers-and-measuring-flasks/6581/pp-measuring-flask>

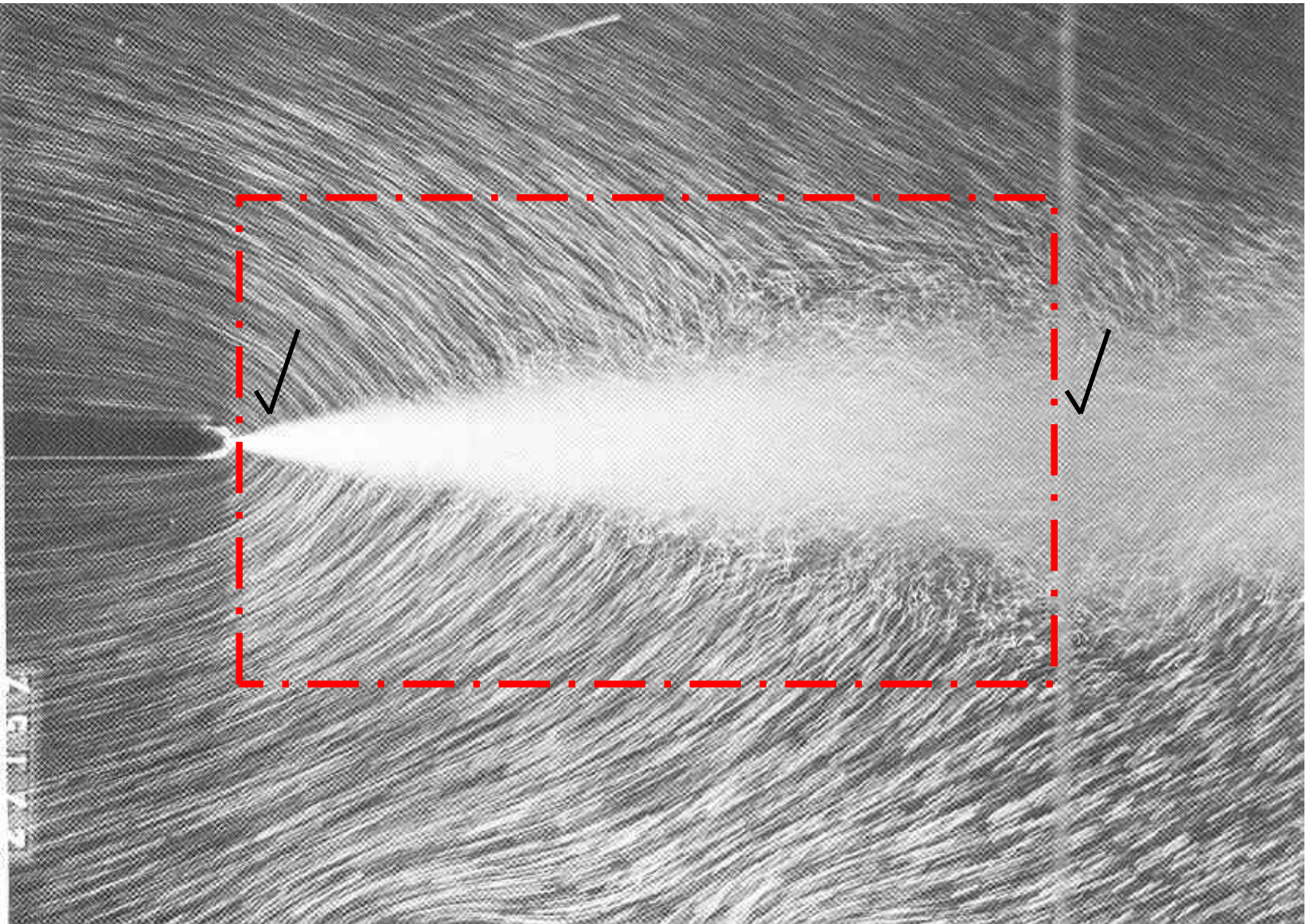
**WATERLOO**  
**ENGINEERING**



**ANSYS**  
Noncommercial use only

# Dual Role of $\vec{V}$

- Mass carrying: surface normal component (1D vs. 2 and 3D)
- Specific vector property: linear momentum (3 components)



Scanned from Van Dyke, M, 1982, An Album of Fluid Motion, Parabolic Press Image 169

# Strategies to Promote Breakthroughs

- Grounding in real flow behaviour
- Class exercises: predict – observe - explain
- Alignment: introduce early – practise in class and homework – mastery for midterm and final exams



?

**WATERLOO**  
**ENGINEERING**

[engineering.uwaterloo.ca](http://engineering.uwaterloo.ca)

# Closure

**WATERLOO**  
**ENGINEERING**

[engineering.uwaterloo.ca](http://engineering.uwaterloo.ca)

# “Parts” of a Teacher

