

CM3110

MichiganTech

Transport Processes and Unit Operations I

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CM3110 - Momentum and Heat Transport
CM3120 – Heat and Mass Transport

www.chem.mtu.edu/~fmorriso/cm310/cm310.html

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Why do chemical engineers need to study transport processes?

Answer:

•Stoichiometry/energy balances can only get you so far.

Why momentum, heat, mass moves down gradients

How chemical differences are manifest in macroscopic phase behavior

How chemical behavior in reactions is reflected macroscopically

Transport, thermodynamics, reaction kinetics

- We need to go into detail to design, optimize equipment - *modeling* detail, not *chemical* detail
- We need to know “the why” of it in order to be able to design new processes (biochemical, nanoscopic)
- Phenomena are driven by adherence to the fundamental laws; when we know these laws, we understand phenomena better

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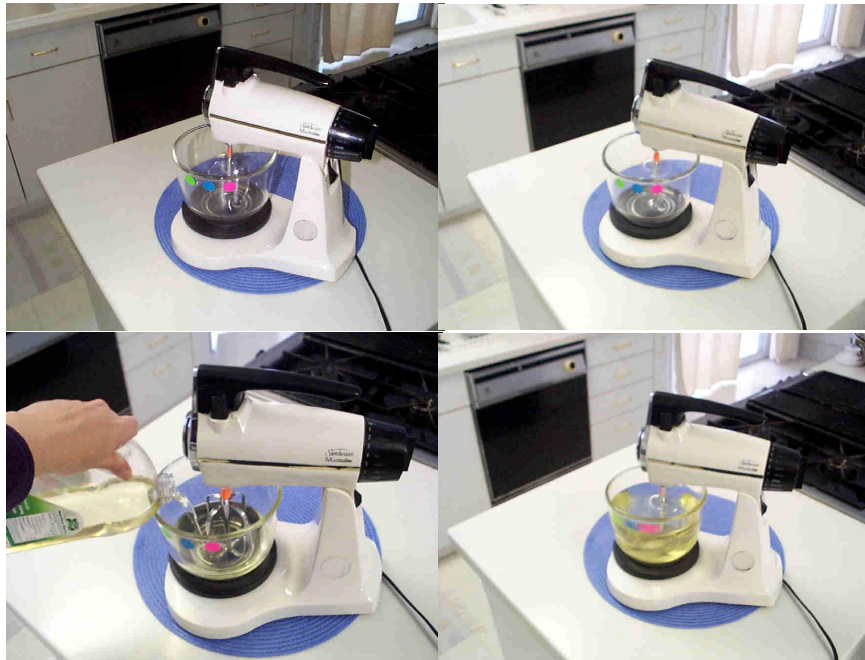
Transport Processes

Momentum
Energy
Mass

} PROPERTIES

Gradients in properties cause FLUX of that property DOWN the gradient in the property.

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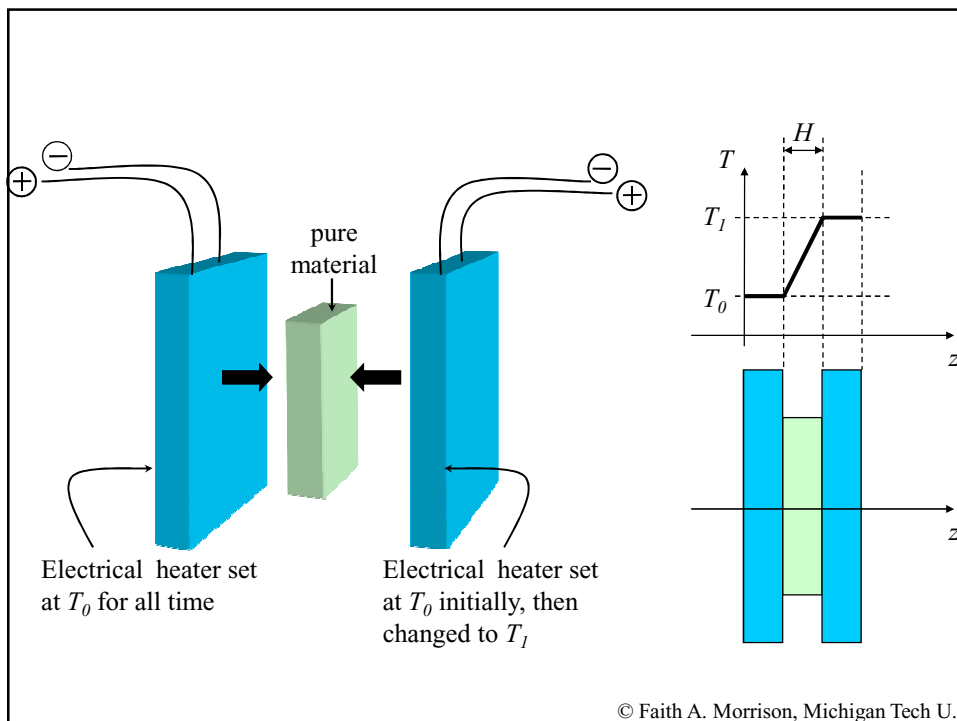
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How do we quantify the amount of a property that transfers?

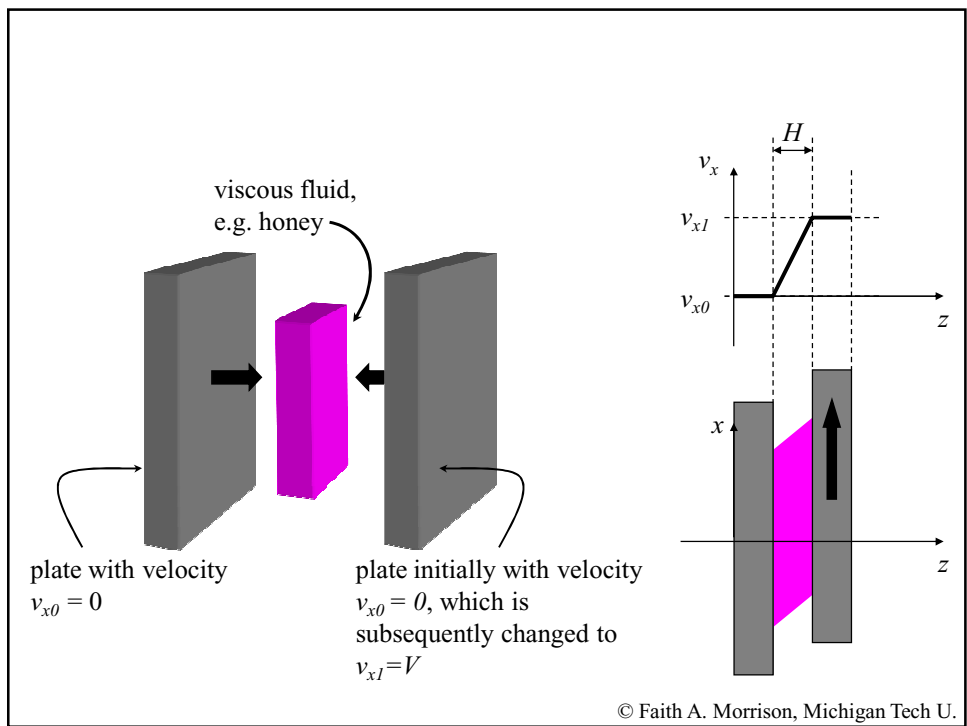
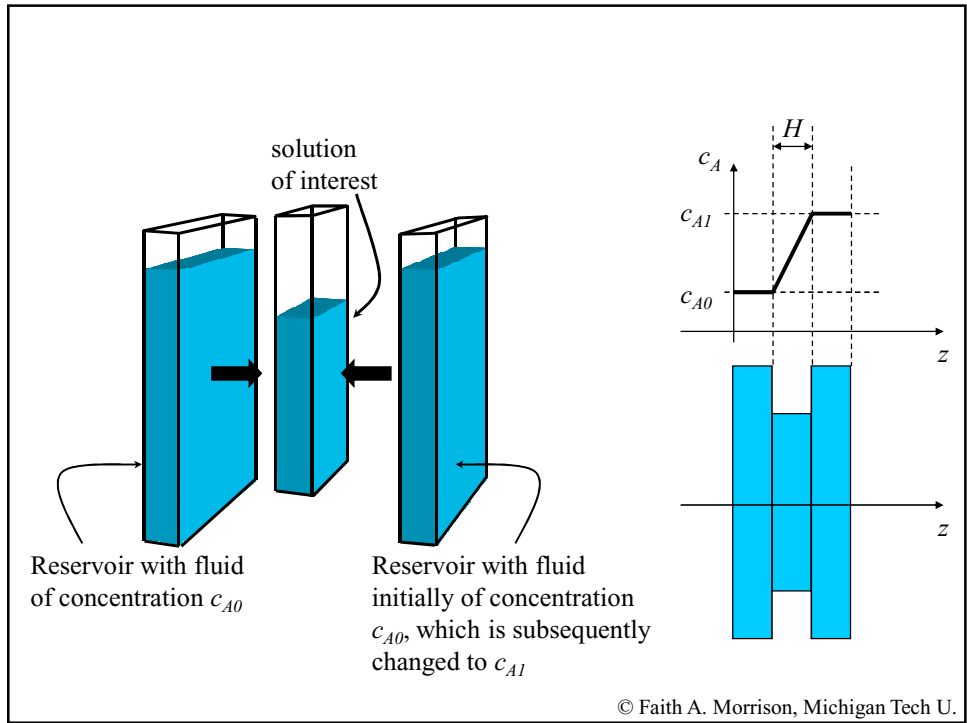
What physical properties govern the transfer of momentum, energy, and mass?

To begin to address these questions, we need to consider very simple cases of transport.

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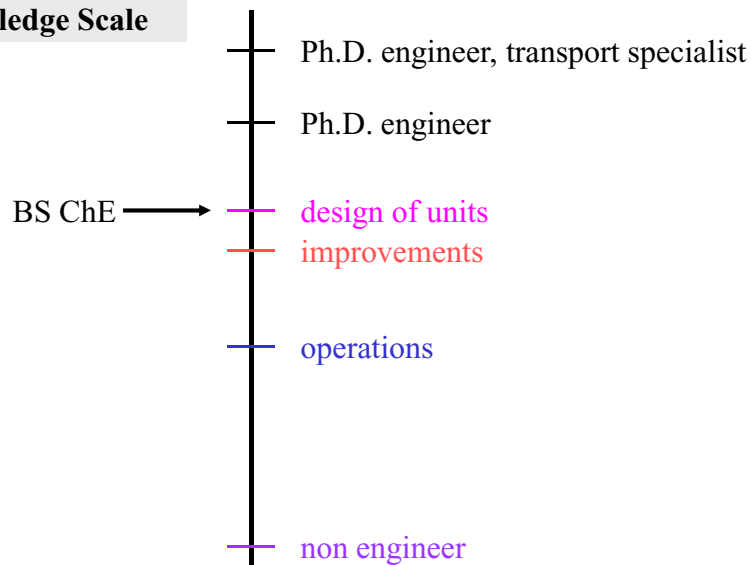
Can be a very complex problem.

Chemical Engineers study transport because the design and operation of chemical engineering unit operations are **highly** dependent on the transport properties of materials.

How much do we need to know?

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Knowledge Scale



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Topics:

TRANSPORT LAWS

Microscopic balances { •Calculate simple profiles of
 $\underline{v}(x, y, z, t), T(x, y, z, t)$

Macroscopic balances { •Understand and use data correlations for complex systems