Session 5 - Curriculum Structure Models

Three teams were asked to create curriculum models - one based on the Organizing Principles, another built on the existing structure, and a third unconstrained.

**Group A - Curriculum Model Using the Organizing Principles**

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
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</thead>
<tbody>
<tr>
<td>Molecular Transformations</td>
<td>Empirical Kinetics</td>
<td>Engineering PChem</td>
<td>(tech electives)</td>
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<td>[Molecular Theory Fundamental Kinetics</td>
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<td>Molecular Transport Mol. Sept. Principles]</td>
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<tr>
<td>Multiscale (continuum)</td>
<td>Colloidal &amp; Interfacial</td>
<td>Separations</td>
<td>Cumulative Model-building &amp; Solution</td>
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<td>“Existing” (classical)</td>
<td>Existing Transport (Momentum/Energy/Mass, etc.)</td>
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<td>Thermodynamics</td>
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<td>“Existing” (classical)</td>
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<td>Thermodynamics</td>
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<td>Dim. Analysis</td>
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<td>Intro to Separation</td>
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<tr>
<td>Systems</td>
<td>Mass Balances/Problem Solving</td>
<td>Heat Exchangers &amp; Flow Equipment</td>
<td>“Existing” Dynamics &amp; Control</td>
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<td>Integrative II</td>
<td>Reactor Dynamics</td>
<td>Integrative IV</td>
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<td>- case study theme</td>
<td>Reacting Systems</td>
<td>- Cumulative Design</td>
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<td>Integrative III</td>
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<td>Foundation</td>
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<td>Cumulative Lab Experience/Project</td>
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*Real and Virtual Lab Experiences
Communications & Other Professional Skills*
Group B - Curriculum Model based on Current Practice

- What do you mean by “radical curriculum change”?
- We already have changed the curriculum since ~1960
- We cover – systems, multiscale (though not explicitly)
- Improve depth in molecular transformations
- What new fundamentals/knowledge for Bio
  - Electrochemical transport
  - Aqueous-phase reactions
  - Membranes
- Inclusion of Bio is not driving force (?)
- Can we use existing core to get philosophy across?
- What in or out?
- Hypothesis – we can do this (good place to start!)

1. Material & Energy Balances is renamed “Intro to Chem & Bio Systems”
   a. Dynamic system – “draining tank”
   b. Molecular/chemical properties and reactions
   c. Multiscale (?)
   d. Need bio examples (+)
   e. New visual/graphical solution methods

2. CheE Thermo
   a. Physical Chemical (Biochem) Equilibrium
   b. QSPR (+)
   c. Electrolytes (+)

3. Heat and Mass Transfer
   a. Brownian motion (motivate mass/heat transfer coef) (+)
   b. Molecular origin of phenomena. (+)
   c. More room for mass transfer. (+)
   d. Heat transfer emphasis decreased (↓)
   e. Radiation (?) (-)

4. Reaction Engineering
   a. Provide info about molecules in reaction
   b. Bio example of kinetics (+)
   c. Reaction in aqueous systems, ref state (+)
   d. Coupled reactions
   e. Case study – simulation/video (need tool)
   f. ex. EO prod (cat surface → CFD → plant) → multiscales

5. Other
   a. need mass transfer emphasized (teach by “rows”)
   b. separations include mass transfer and bio
   c. use partial semester courses
   d. distribute process control in other courses
Group C - Freestyle Curriculum Model

Yr 1  Mat’l + Eng. Bal + Computation
Yr 2  Eng Sci
Yr 3  Eng Sci
Yr 4  Integrated ChE/Design  Team Leadership
LSI + VLSI  RCADB
Slot for Lab(s)

Eng Sc Block Thermo, Mol Trans, Trans Kin/React
2 streams in parallel
Integrate where possible  small projects  teams
papers/reports

Pedagogical Principles -- Soft Skills
1. Teach in context by doing
2. Bring in many places, repeatedly in Curriculum
3. Active learning
   a. Involvement
   b. Projects, reports in teams
4. Wherever possible
   a. Open-ended problems
   b. Judgment of what is important
   c. Handling missing data

Year 2 – Thermo, Kinetics
   Conduction/Diffusion/Reaction Engineering + Fluids
Year 3 – Reaction Engineering
   Convective Heat and Mass Transfer + Separations

- Timing Issues: Supporting Science and Math
- Motivation – need structure to promote
  o Integration of content
  o Soft skills in context
Discussion following the Presentations

- Like the idea of the year-end multi-year project in the Freestyle structure
- Could have varying levels of credit hours for different years (for example, seniors would receive more credit; they could “outsource” work to sophomores)
- Group A had to force themselves away from Group B
- Practical considerations of schedule could not be sufficiently addressed, and they are significant
- If we change the curriculum, let’s really do it thoroughly - everything what we want to achieve in a curriculum.
- Group A is the basis for jumping off - further curriculum development.