Work Group #4

Big Idea: Self-Assembly

- Undergraduate course/module for science and engineering majors
- Pre-requisites: thermodynamics (entropy, enthalpy, free energy, surface vs. bulk energy), chemistry (bonding, hydrophilic/ hydrophobic, kinetics)

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- **Questions**: What is it? How does it occur? Applications?
- **Critical concepts**: Surface vs. bulk energy, driving forces (chemical interactions), geometrical considerations, e.g., SA process involving geometric and energetic considerations
- **Illustrative examples**: self-assembly of nanowires/nanoparticles, block-copolymers, micelles, bio-objects/tissues

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Student difficulties:

- Counterintuitive: goes against 2nd law of thermodynamics, increase of surface area
- One can get *any* structure by self assembly
- Misconception about the strength of the forces, surface adhesion
- Difficulty to visualize
- Why it happens one way and not the other
- Not very many examples on the macro-scale
- Nucleation phenomena

Big Idea: Self-Assembly

Learning outcomes; students should be able to:

- Define SA
- Identify underlying physical and chemical factors
- List and classify examples
- **Contrast underlying physical and chemical factors, contrast SA vs. non-SA processes**
- **Design an SA process and/or application (product)**

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Learning Outcomes:

- **Contrast underlying physical and chemical factors, contrast SA vs. non-SA processes**

Learning Evidence; student work will contain:

- Analysis of competing forces responsible for SA
- Comparison of SA vs. non-SA driving forces

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Learning Outcomes:

- **Contrast underlying physical and chemical factors, contrast SA vs. non-SA processes**

Assessment Tasks/Tools (a choice of a):

- Open-ended written exam/quiz
- Oral exam/interview
- Term paper
- Report on a specific theoretical/experimental problem/observation

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Learning Outcomes:

- **Contrast underlying physical and chemical factors, contrast SA vs. non-SA processes**

Instructional Activities:

- Lecture: SA vocabulary, SA examples (web-based, in class demos); student response system
- Web-based pre-quiz (just-in-time teaching)
- Small group interactions/peer instruction
- Lab (hands on)

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Learning Outcomes:

- **Design an SA process and/or application (product)**

Learning Evidence; student work will contain:

- Simulation of a specific SA process
- A design of a SA process/application

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Learning Outcomes:

- **Design an SA process and/or application (product)**

Assessment Tasks/Tools (a choice of a):

- Group project/presentation (e.g., case study)
- Combination of term paper/interview
- Prototype of a lab demo for a specific SA process
- Lab report on the lab demo

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Learning Outcomes:

- **Design an SA process and/or application (product)**

Instructional Activities:

- Model elements of design (examples, including prior student work)
- Define group assignment/expectations clearly
- Provide background reading
- Presentation and discussion of progress reports (with peer and instructor feedback)
- Final presentation with peer and instructor assessment