Backward Design

Example – Solid State Diffusion (intro level)

1. Establish Learning Outcomes

- *Understand and be able to predict the influences of a range of variables (T, size of diffusing atoms, bulk crystal structure, diffusion mechanism) on the diffusion rate of atoms in a crystalline solid.*
- *Develop a working understanding of flux at both the continuum and atomistic length scales*

2. Develop meaningful homework problems

Identify/predict the diffusion mechanism responsible for the room temperature growth of an Al_2O_3 film on Al.

- Give students data on the rate of growth at room temperature of an Al_2O_3 film on an Al surface.
- Provide data (D_o, Q) for the diffusion of Al through Al_2O_3, and for O through Al_2O_3
- Ask students to identify any other information necessary to solve the problem
- Ask students to consider effects of oxide crystal structure, and temperature on their answers.
- Link/relate the homework problem to the active learning activity (ask students to consider differences and similarities).

3. Active Learning activity

Group demonstration of vacancy diffusion.

- Each students is assigned a number and 1 of 2 atom types
- Atoms are positioned on a 2-D cubic lattice and are initially segregated by type on either side of an "interface"
- Vacancies are introduce (empty lattice sites)
- An atom may diffuse only when 1) its number is called, and 2) there is an adjacent vacancy.
- After multiple loops through numbers – examine atom distribution.
- Ask students to consider how variables like: temperature, crystal structure, and the operation of alternate diffusion mechanisms might be modeled, and their effects on the final atom distribution

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