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Analogies: Inspiration, Perspiration, and the Creative Process in Materials Teaching and Research

Connections between ideas can catalyze understanding and promote efficient learning. Examples in the teaching of Materials Science and Engineering include analogies between (i) the laws of diffusion and the laws of heat flow, (ii) the energy balances that describe critical nucleus size in a phase change and critical flaw size for crack propagation, (iii) particle-in-a box quantization of energy and the Fourier description of transport phenomena, (iv) the topology of magnetization vectors around defects in a magnetic material and the topology of molecular alignment around defects in a liquid crystal, (v) the Avrami equation and the Weibull equation, (vi) time-temperature-transformation diagrams and time-concentration-transformation diagrams, and (vii) natural materials and biomimetic materials.

Materials Science and Engineering research can benefit from recognizing the creative processes and tools that it shares with Art, and the problems and solutions that it shares with Nature. Several examples of these interdependencies will be considered, with an emphasis on the presenter's own experiences in discovering the attractions and limitations of biomimicry — a journey that leads to at least a partial answer to a difficult question that the presenter was asked at a job interview many years ago: "Tell me, Dr Viney, what *do* you think is the proper role of analogy in a lecture?"

Christopher Viney earned a BA (1980) and PhD (1983) in Metallurgy and Materials Science at the University of Cambridge. He has held academic appointments at the University of Cambridge (Materials), the University of Washington (Materials, Bioengineering), the University of Oxford (Materials), Heriot-Watt University (Chemistry), and UC Merced (Engineering). His interdisciplinary research focuses on topics in biomolecular materials, polymers, and phase transformations. As one of UC Merced's eight First Founding Faculty, he led the establishment of degree programs in Bioengineering and in Materials Science & Engineering, and co-developed the inaugural General Education curriculum. From 2008 to 2010, he served as UC Merced's first Vice Provost for Undergraduate Education. From 2014 to 2021, he served as the first Undergraduate Program Chair and then the first Department Chair for Materials Science and Engineering. He is a Fellow of ASM International, the Royal Society of Chemistry, and the Institute of Physics. His wider interests include professional photography, wilderness hiking, history, spicy cuisine, and science outreach.

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