Challenges and Innovations in Civil and Environmental Engineering and Earth Sciences

Fall 2016 Seminar Series

Department of Civil and Environmental Engineering and Earth Sciences

Reinventing the City: Nature as Muse

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129 DeBartolo

Today's cities are diffuse and rely heavily on large inputs, outputs and linear flows of energy and materials. Although these patterns certainly produce value and quality of life, the costs as measured by economic losses due to inefficiencies and resource waste, environmental damage and compromised public health are excessively high, especially when the risks and potentially irreversible changes posed by a rapidly changing climate are included. The sustainable city of the future reduces energy and material inputs and outputs by converting the linear flows of today to diverse and highly coupled cycles that mimic the engineering of nature to meet water, energy and other resource needs and link urban metabolisms more closely to a defined hinterland. The design of sustainable cities of the future will depart greatly from that of the 20th Century urban model. Sustainable urban design incorporates principles of density, diversity and flexibility around the "operating system of nature". Infrastructure is decentralized and integrated with natural ecosystems. Energy is harvested from renewable sources and transmitted along smart grids. The processes that support sustainable urban districts are linked and managed through a "central nervous" or information system, which optimizes resource recovery and maximizes profitability through integration, monitoring, communication and accurate pricing. Sustainable urban development is place-based, reflecting regional conditions and local culture. Sustainable urban districts are walkable and bikeable, diminishing the need for private automobiles, and they are ecologically regenerative, economically vibrant and socially equitable.

Kimberly Gray is a Professor and Chair of the Department of Civil and Environmental Engineering at Northwestern University. She also has a secondary appointment in the Dept. of Chemical and Biological Engineering and is also a member of the Center for Catalysis and Surface Science and the Transportation Center. After receiving her Ph.D. from the Johns Hopkins University she worked as a research engineer for the Lyonnaise des Eaux in Paris, France for 2 years. Her areas of expertise are environmental catalysis and physicochemical processes in natural and engineered environmental systems with particular focus on energy and sustainability applications. She studies the synthesis, characterization and performance of photo-active materials, principally TiO_2-based nanocomposites for solar fuel production and water/air treatment. Work in her group also involves the investigation of chemical fate in natural systems. She probes the role of trophic structure in the bioaccumulation of contaminants in aquatic systems, as well as the influence of various chemical and biological parameters on denitrification in wetlands. She is also studying the ecotoxicological impacts of nanomaterials in aquatic systems. Recent work entails the adaptive design of urban systems to incorporate coupled ecological processes in response to climate change and demographic shifts.