Tissue engineering and regenerative medicine treatments have the potential to improve the lives of patients suffering from a wide variety of conditions. To successfully translate these approaches to the clinic, the complex and dynamic array of cell-material interactions must be carefully orchestrated to direct cell fate and function. Controlled delivery of bioactive factors (proteins, nucleic acids, drugs) is one key strategy to direct cell behavior, with recently developed nanocarriers improving delivery. However, significant clinical challenges remain due to rapid clearance from circulation and low targeting efficiency. Substrate-based delivery strategies localize and prolong delivery and can be applied to a wide range of scaffold and implant architectures, thus leading to reduced off-target effects, increased therapeutic efficacy, and greater design flexibility. However, diverse material cues, including mechanical properties, topography, architecture, wettability, and surface chemistry, have been found to influence cellular behavior, understanding the interplay of these varied cell-material interactions will be crucial to designing clinically successful substrate-based delivery systems. This seminar will discuss key issues in engineering the cell-material interface in the context of the development of surface modification approaches that enable spatially and temporally controlled delivery of nanotherapeutics, with a focus on nucleic acids. Applications in bone tissue engineering for spinal fusion will be presented, with an emphasis on translational animal models.
Dr. Christina Holmes

Dr. Holmes is currently a Postdoctoral Fellow at Johns Hopkins School of Medicine working under Dr. Timothy William since 2013. Her research focuses on developing and utilizing animal models to study various strategies for improving spinal fusion outcomes. This includes: delivery of various growth factors and biological agents; stem cell therapies; and tissue engineering approaches. She earned her Ph.D. in Biomedical Engineering from McGill University, and her Master’s Degree and Bachelor’s Degree from the University of Toronto in Biomedical Engineering. She was awarded the A. Earl Walker Outstanding International Fellow Award at Johns Hopkins University in 2017, and has broad research experience with embryonic and mesenchymal stem cells, biomaterials characterization and development, tissue engineering, biomedical imaging modalities, biomechanical testing and drug and gene delivery.