Curing Incontinence (Dr. Damaser)
The number one reason for placing an elderly relative in a nursing home is incontinence! Dr. Damaser’s laboratory in the Department of Biomedical Engineering investigates female pelvic floor dysfunction (FPFD), including loss of bladder and bowel control and injuries to the female pelvic organs. These conditions are common among older women, with up to 50% of women over age 50 having one or more types of FPFD. Current noninvasive treatments are limited. Most often, treatment involves surgery, usually a reinforcement of pelvic organ support via implantation of a graft or mesh, but such surgery does not improve the underlying causes of the condition. Also, FPFD surgeries historically have had a 30% “re-do” rate, suggesting that there is an unmet need for therapies that would directly address the causes of the disorder and the changes that arise from it, therefore ensuring a greater success rate.

FPFD often results from injuries affecting the mother during childbirth (maternal injuries), so the team is investigating the nature of such injuries and the post-injury healing process, with the goal of preventing FPFD or improving its treatment. The first year after childbirth may represent a window of time in which doctors could give some kind of therapy to encourage healing and to treat current and prevent future FPFD. To this end, the group has developed experimental models of FPFD that imitate these maternal injuries. The investigators have a theory that competing muscle and nerve injuries during childbirth lead to slower regrowth of nerves and not enough new nerves within the muscles responsible for bladder and bowel control, leading to wasting of the muscles and resulting incontinence. Genetic factors may make recovery more difficult by reducing the repair and regrowth of the “extracellular matrix” – a natural meshlike structure of connective tissue that supports the pelvic organs.

The Damaser laboratory is currently looking at several types of therapy, including treatment with growth factors, that might lead to better healing. They are also studying the use of stem cell therapy to prevention and/or treat FPFD.

Summary: Dr. Damaser is developing new, minimally invasive methods with few side effects or risk factors to treat and prevent bladder and bowel incontinence and female pelvic floor disorders.

Prostate Surgery Sealing Device (Dr Vince)
Radical prostatectomy (RP) is the most commonly performed operation for cure of prostate cancer and requires reattachment of the bladder and urethra (vesicourethral anastomosis or VUA) after the prostate is removed to restore continuity of the urinary tract. Reattachment is currently done by suturing, which is difficult to do precisely and time consuming when done by the robotic approach. In addition, between 10 and 30% of the anastomoses will leak urine into the patient’s abdomen, necessitating surgical re-intervention. In addition to being extremely uncomfortable for the patient, the additional surgery is not covered by the patient or the insurance company and must be absorbed by the medical center. Dr Vince’s team is developing a VUA sealing device which can be placed around the anastomosis to provide a water-tight seal and prevent urine leakage.

Summary: Dr Vince’s team is developing a VUA sealing device which can be placed around the anastomosis to provide a water-tight seal and prevent urine leakage.
Artificial Kidney/Pancreas Development (Dr. Fleischman)

Filtration (filtering out certain harmful particles or substances from outside or within the body) is a common biological and biomedical process. We can address patients’ unmet needs in both these areas by using a simple, specially designed tiny structure called a nano-porous slit pore. Single nano-porous slit pores have higher capacity than traditional round nano-pores, allowing movement of more fluids through the pore at lower pressures than a round one. These nano-scale slit pores allow nutrients and waste to pass through them while blocking the larger molecules associated with the immune response, which defends the body against invading agents. Thus, for example, cells from a pig pancreas, if contained within a capsule of nano-pores and injected or implanted in a patient, could naturally produce insulin for human diabetic patients while preventing their bodies from rejecting these foreign cells. A single nano-pore can be precisely reproduced millions of times using micro- and nano-fabrication approaches. The resulting single nano-porous slit pores can be used for many applications, ranging from implanting a small artificial kidney device in patients to inexpensively purifying water to “medical grade” for use with injections in remote areas of the world far from modern healthcare facilities or energy supplies.

Summary: Dr Fleischman’s team is developing a novel device that can filter more efficiently than common filters and may be applicable to the development of an artificial kidney or pancreas.