Nanomedicine is a new field that brings together the biologic and physical sciences (physics, engineering, chemistry, material sciences, mathematics and more) in a way not seen before in medicine. It has enormous scientific and practical applications in medicine, especially in biomedical imaging and targeted drug delivery, because it permits the creation of multifunctional nanodevices on the scale of cellular machinery. Other aspects of nanotechnology permit the analysis of very small amounts of human tissue to yield large profiles of the messages, proteins, and metabolic components of the tissues. We will examine some of the potential of nanomedicine and then examine one or two specific nanodevice systems we work with.

Composite NanoDevices (CNDs) are an exciting class of hybrid nanoparticulate materials with several potential medical uses, including cancer imaging and therapy. The first component of the nanodevices consist of poly(amidoamine) (PAMAM) *dendrimer templates* that can be made in discrete sizes, with multiple surface functionalities, and regulated surface charges. The other component consists of *inorganic material(s)*, such as gold (Au) or copper (Cu). Modifiable terminal functionalities of the dendrimer component offer a multipurpose mode to covalently attach drugs, diagnostic/imaging modules and targeting moieties. They can be converted to targeted 'nanodevices' to deliver anticancer drugs to specific organs and tissues.

Over the last several years we have examined the effects of simple modifications of these nanodevices on their interactions with complex biological systems in an attempt to understand the characteristics that govern differential biodistribution of these nanodevices in mouse tumor model systems. We have also developed an angiogenic tumor microvascular *targeted* composite nanodevice, and we will discuss the experiments being carried out to examine the use of targeted nanodevices to greatly improve tumor imaging. We will also discuss our development of these composite nanodevices for novel forms of radiation therapy, both nanobrachytherapy and a systemic targeted radiation therapy (STaRT). Finally we will discuss a new class of nanodevices, with even lower toxicity profiles than the nancomposites that we are beginning studies in.

Objectives:

1) To understand potential applications of nanomedicine to cancer
2) To understand applications of nanodevices to radiation therapy treatment
3) To have an understanding of a few leading nanotechnologies