Nanomedicine: Nanoscale Science- NSTA

**Medical Treatment, Today and Tomorrow**

**Today: Traditional Medical Treatment**

“Sara” has just gone to the doctor and been told her symptoms suggest that she may have cancer. Sara’s doctor orders a series of x-rays to try to detect the cancer. The x-rays have the potential to cause mutations in Sara’s genes but she knows this is the first step in cancer diagnosis. The x-ray shows a suspicious mass and the next step is for Sara to have a biopsy. The biopsy involves having a surgeon stick a long needle into the mass and withdrawing small amounts of tissue to be sent to a histology (tissue) lab. Sara and the physician must wait for the lab to examine the tissue. The lab confirms that Sara has an early stage of cancer and the surgeon recommends having the cancer removed. Sara proceeds and schedules the surgery for three weeks later. The surgery goes well and although the surgeon thinks he may have removed all the cancerous tissue, he recommends radiation therapy to make sure there are no cancerous cells surviving. Sara now must endure the side effects of radiation which include nausea and vomiting, as well as swelling and fluid retention. After the radiation therapy is complete, Sara is left with some damage to the tissue that was irradiated. The good news is that five years after the surgery Sara is still cancer free.

**Tomorrow: Nanomedicine**

Sara’s character is fictional, but the events surrounding cancer diagnosis and treatment are typical. New advances in nanotechnology suggest that a very different scenario may be possible in the near future for people who develop cancer. Imagine “Jacob” goes to the doctor with suspicious symptoms and the doctor suggests a combination of tests and treatment that do not require surgery. Jacob’s doctor injects nanometer- sized gold shells into Jacob’s bloodstream. These minute shells are coated with antibodies that will bind only to antigens on cancer cells and will fluoresce, giving off a brilliant green light when the binding takes place. The nanoshells move through Jacob’s body and adhere to the cancer cells. The cancer cells are in a mass and when the nanoshells attach to the mass, Jacob’s doctor can see the spot of bright green light through his skin. The doctor shines a laser on the green area and because the nanoshells are gold metal- they heat up very quickly and in the process kill the cancer cells to which they are attached. The process simply fries the cancer cells. The surrounding cells are not metallic and do not heat up with the laser. The only tissue that is destroyed is the cancerous tissue. The process takes only a few minutes and Jacob leaves the doctor’s office feeling good knowing that the cancer cells have been eliminated. He has no need for surgery or radiation treatment. The nanoshells that have been injected into Jacob will eventually be eliminated from Jacob’s body as part of the body’s immune system. Jacob’s nanotechnology medical treatment does not exist at this time, but researchers are having success in using gold nanoshells to destroy cancer in experimental conditions. Other researchers have successfully identified tumors with nanoshells that fluoresce. These advances are happening very rapidly and there is widespread hope that nanotechnology will one day eliminate the need for painful surgery and follow-up chemo or radiation therapy.