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This past summer Elena Katan and I did a summer internship at the Tufts School of Medicine and had the opportunity to work with world-renowned researchers and professors, Ana Soto and Carlos Sonnenschein, as well as other researchers. We were guided through several research experiments to find and scientifically explore environmental causes of breast cancer. Many scientific techniques were taught which added to the depth of the experiments and projects. A main goal was to raise awareness of the risk of certain chemicals in the environment (most predominantly bisphenol-A (BPA).

The Theory that guides the research in the host laboratory regarding cancer disagrees with the commonly known Somatic Mutation Theory. The TOFT theory (tissue organization field theory), proposed by Ana Soto and Carlos Sonneschein, is that proliferation is the default state of all cells and that carcinogenesis represents a problem of tissue organization. The stroma sends signals to the epithelial cells to create organization. According to the TOFT, when the stromal-epithelial interactions are disturbed by chemicals abnormal structures are formed which in turn will develop into cancer. This applies to breast as well as to cancers that originate in other organs and tissues.

My knowledge of the causes of breast cancer and of the hypothesis that fetal exposure to environmentally relevant doses of bisphenol A causes breast cancer was close to nothing before my internship. Every member of the lab was so eager to answer all of Elena and my questions and made both of us feel so comfortable in the lab setting which, for me, was a first time experience. Learning how much preparation goes into just setting up an experiment was a lesson in itself. I've learned that when attempting to

do an experiment, everything must be perfect or else the data will be flawed and inaccurate.

Elena and I were told a very interesting story about the origin of the Escreen assay, a method for identifying environmental estrogens. In the earlier days of the studies of Ana Soto and Carlos Sonnenschein, the data of a project they were working on ceased to be reproducible. The experiment should have had low cell numbers when the cells were not exposed to estrogen, and high cell numbers when exposed to the hormone. All of the sudden, all cultures, regardless of whether or not the researchers had added estrogen had equally high cell numbers. Ana and Carlos performed the assay changing one at a time all the materials they used to run the assay. They found that the "estrogenic activity" originated in the test tubes they were using to store components of the tissue culture medium. They purified the estrogenic activity leaching from the tubes and found it to be nonyl-phenol. This was the first estrogen identified in plastics. This is where the method called Escreen was originated. It is used now to identify new estrogens and to test whether the feed and water used in animal experiments is devoid of estrogenic activity that could interfere with the hypothesis being tested.

Learning about the Escreen assay was such an interesting and unique experience because I have never heard of such a process. Never once did I consider that the equipment or materials used in an experiment can alter the final data. Elena and I were told of an experience where an "accident" such as the presence of a contaminant in the plastic tubes is the basis for a meaningful finding, a discovery, in this case of a plastic-borne estrogen, and of a method that could be used to detect a similar problem. The Escreen assay is a practical tool created by Ana Soto and Carlos Sonnenschein. The length that scientists go to in order to successfully do research is incredible and truly shows the dedication a scientist has to his/her project. At the lab I found that on many an occasion I was faced with a situation that was new to me and really forced me to think outside of my realm of knowledge.

My knowledge of breast cancer has greatly increased due to working with 3D cultures. 3D culture mimics the environment that occurs in the mammary glands of rats and mice. After having observed the preparation of 3D cultures which involved making a gel for

the MCF10a cell line (non-cancerous cells) to live in and adding media for the cells' nourishment, Elena and I had observed the formation of ducts and acini in the 3D cultures. Watching these cells form structures found in a mammary gland had opened my eyes to the intricacy and complexity of the mammary gland. These 3D culture models to create of the structures present in the breast (ducts and acini) will hopefully provide a faithful in vitro model of the functional human mammary gland that could be used to study and directly visualize the process of normal development and carcinogenesis.

Another tedious, but necessary, process that was performed at the lab was the process of hematoxylin and eosin (H+E) staining of tissue slides which is used to assess normal and cancerous tissue. When being placed in stain, the slides are set up back to back so that the tissue doesn't get damaged. In order for the slides to stay in place while in the stain, grooves in the cup keep the slides from moving. Slides are moved from one cup to the next at timed intervals (each cup contains different liquid to complete staining). Keeping track of how long each slide is in each stain is crucial in order for the staining process to be completed properly. The backs of slides are constantly wiped in order to decrease risk of contamination. When the process is complete, cover slips are placed on the slides which are then used for further research.

Other processes Elena and I had performed in order to learn about BPA were ovarian counts and epithelial branch counts. These studies concerned how exposure of excess estrogen (BPA) to a fetus leads to increased risk of infertility and of breast cancer in adult life. The effects of BPA include decreased fertility. The laboratory was assessing the origin of such alterations. Females are born with a specific number of eggs for their entire life. When a female is born these eggs are grouped in structures which are referred to as primordial follicles. The next stage is the primary follicle stage. The laboratory is testing the hypothesis that follicle development is affected by BPA exposure. Elena and I had counted the number of primordial follicles found in ovaries of mice. Elena and I had also used computer software to measure the branches of the ducts compared to the branches of the ducts treated with BPA.

After all of the time I spent at the lab I truly learned to appreciate all the work researchers put into their projects with the purpose of understanding nature and of making the world a safer place. Every researcher I met absolutely loved what he/she does. There was a part of my experience at the lab when Elena and I were working with two post-docs who were working on the same project. It just so happened that at the time that Elena and I were shadowing them something in their project had worked out the way they wanted it to. Their reaction to this was priceless. Both of them wore smiles ear to ear and they were hugging each to no end. To just see someone get so much joy out of doing their job is pretty remarkable and definitely does not happen often.

Science, particularly biology, has always interested me my entire life. All I have ever wanted to do was make some sort of difference in the world. Being at the lab with professors truly was motivational to continue studying and strengthening my skills in biology and to hopefully one day make a difference. Ana and Carlos had so many wise things to say not only about cancer, research, and biology, but also about life. These two people were so willing to welcome Elena and me into their workspace and clearly were so willing teach and extend their knowledge to anyone who would listen.

To be at the Soto/Sonnenschein lab was a once in a lifetime experience that I will remember for the rest of my life. To see what real research is like and to meet people who have created new theories about cancer was a momentous occurrence in my young life. I am so thankful to have been exposed to such a realistic environment where I was able to assist in research that could potentially change lives.