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2006 Winning Essays - Phoenix

Congratulations to the Phoenix winners of the 2006 Essay Contest!

We know our winners will have an interesting and educational experience in the research laboratory this summer and we encourage them to write another short essay on how they felt about their internship and will post them here later this summer.

The Unexpected Gift of Life

With Animals on His Side
- a Boy's Fight against Aplastic Anemia

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The Unexpected Gift of Life by Rachel from Chaparral High School

For the past twenty-five years, my grandfather's favorite motto has been "I'm on the eighteenth hole and walking towards the clubhouse." In 1980, this was Poppy's humorous defense for dealing with the knowledge that he had but a few years to live. At fifty-five, Poppy had just suffered a severe heart-attack, which ended his business career and confined him to his home for much of the time. His father had died of an unexpected heart attack at age forty-five, his mother of a heart-attack at age sixty-five. In addition, his brother, also only forty-five, died due to cardiac complications of Marfan syndrome, a hereditary disease affecting connective tissues. Clearly, Poppy had not been blessed with healthy cardiovascular genes. But today, although still professing his pessimism, my grandfather, age eight, is alive, active, and relatively healthy.

Over the years, dozens of new cardiac drugs, devices, and techniques have been developed to save patients suffering from cardiovascular problems. Nearly every medication and procedure has been tested on dogs, cats, or rabbits to ensure its safety for the public. Scientists, for example, have known since the 1800s that electrical currents could stimulate an inactive heart to beat. However, the electronic devices were never small enough to fit inside a human being. In 1950, John Hopps built a functioning pacemaker that did indeed maintain a steady heartbeat. However, this device had to be plugged into a wall outlet and was accompanied by many other liabilities, such as not operating during a power-failure. As 1960 approached, Wilson Greatbatch, a brilliant, undiscovered inventor, began building an oscillator to record heart sounds. When he accidentally installed the wrong resistor into his unit, it began to give off a steady electrical pulse. Greatbatch realized that the small device could be used to regulate the human heart and create a stable beat. By testing his device in dogs, Greatbatch was able to make many refinements and produce the world's first successful implantable pacemaker.

Cardiac catheterization, another life-saving aid, was first developed during the first decade of the twentieth century. This procedure, which allows doctors to insert a flexible tube into a blood vessel leading to the heart, is used to inject drugs directly into the heart, to measure blood pressure, and to monitor the functioning of the heart. Doctors first used dogs to practice and master this skill. Anticoagulant drugs, which thin the blood and prevent clots, were developed during the 1930's. For this research, scientists studied cats to test the medication's effectiveness and side-effects. If dogs and cats had been unavailable as means of

experimentation, advancement in cardiac research may have been virtually impossible.

Poppy, then, is a medical wonder, a testimony to the effectiveness of biomedical research using animals. Each of the procedures and medications described above (I believe) has kept his heart functioning and given him his life back. Numerous times over the past twenty-five years, Poppy has undergone cardiac catheterization. During these procedures, doctors have monitored Poppy's blood pressure and examined the blood flow through his heart. Radioactive material and dye have been injected into Poppy's heart through similar procedures, and have allowed Poppy's cardiologists to determine the exact nature of his heart troubles and the necessary treatments. In 1990, Poppy's heart, having endured much stress and trauma, was again unable to function alone. That year Poppy's life was saved by the installation of Greatbach's pacemaker. Electrical currents now run through Poppy's heart and ensure a steady heart beat. Just last month, a defibrillator was installed along with a new pacemaker in Poppy's chest cavity. This new device monitors his heart beat more closely. In the event of cardiac arrest or other arrhythmias, the pacemaker and defibrillator will kick in with more power than ever before. Poppy takes approximately twenty different medications daily to guarantee that his heart continues functioning. These drugs include anticoagulants, which decrease the risk of blood clots, and antithypertensives, which regulate his blood pressure. Thanks to these premiere, high quality treatments, Poppy is alive today.

Each and every one of these procedures and medications would never have been used in human beings if they had not first been tested on animals. I may have never known my grandfather if it had not been for the brilliant scientists and the animals who sacrificed their lives for research. To them all, I am grateful.

Follow up Essay: Rachel - Internship at the Translational Genomics Research Institute (TGen)

This summer I had the opportunity to work in the Neurogenomics laboratory at the Translational Genomics Research Institute (TGen). The Neurogenomics division at TGen is focused on using state-of-the-art techniques derived from the Human Genome Project and applying them to improving diagnostics and therapeutics in human neurological disease. The underlying theme is that most human conditions have a genetic root which can be elucidated. The types of tools that TGen utilizes include genome-scanning strategies which sift though the genetic variable in large cohorts of individuals such as expression profiling, single nucleotide polymorphism tacking, proteomics and others. There are few places in the world which have access to cutting edge medical research tools, and which have spun out so many new clinical options.

Working alongside Alana Bernacchi, a skilled genetic researcher, I was able to learn and utilize many cutting-edge methods and techniques. Over the length of my internship, I became well versed in such procedures as PCR, DNA isolations, and the use of high-density (e.g., 10K, 100K, and 500K) single nucleotide polymorphism (SNP) genotyping microarrays. My acquired skills have led to me contributing to several important projects. For instance, I helped to identify a susceptibility gene TGen has recently found in patients with schizophrenia and alcoholism. I have also contributed to TGen's discovery of the susceptibility gene associated with hearing disorders in adults. Moreover, I helped locate dozens of scientific journal articles that will be the basis of upcoming studies.

The chance to work at TGen was a once-in-a-lifetime experience. I am very grateful for the guidance I received from Dr. Dietrich Stephan, director of TGen's Neurogenomics division, and my mentor, Alana Bernacchi. I'm sure the knowledge and techniques I acquired this summer will prove invaluable throughout my life.

With Animals on His Side - a Boy's Fight against Aplastic Anemia
by Veronica from Corona del Sol High School

Sammy was a cute little boy with big eyes and an infectious smile. His mere presence enthralled everyone around him, brightening even the surroundings. The son of a professional musician, my piano teacher, Sammy had known many classical piano pieces ever since he was a tiny toddler. He would hum along with the tune whenever he heard the music, sometimes even calling out the composer's name. No one could ever imagine that this bright, little boy would be faced with a life-threatening disease and that the world around him would be turned upside-down.

It was shortly before Thanksgiving two years ago that Sammy, only 3 years old at the time, was diagnosed with aplastic anemia. Aplastic anemia is a rare and potentially fatal condition where a person's bone marrow slows or shuts down its function.

Bone marrow contains stem cells, which produce blood cells - red cells, white cells, and platelets. Red blood cells live for about four months, platelets about a week, and most white blood cells a day or less. Because blood cells have such a limited life span, bone marrow needs to continually produce new blood cells of all types to replace the old ones.

Doctors could not pinpoint exactly what caused Sammy to suffer from aplastic anemia. There are certain factors that can temporarily injure bone marrow. These factors include viral infection, autoimmune disorders, or exposure to toxic chemicals. However, in a majority of these cases the exact cause of the disease is idiopathic, or unknown. Typically, the condition arises in individuals who were previously healthy with no evidence of malignant disease or exposure to cytotoxic drugs or radiation.

Sammy's doctor determined that the best treatment for him was a bone marrow transplant. Bone marrow transplantation (BMT) started in laboratory work with animals. Early experiments in the 1950's were conducted by E. Donall Thomas and George Santos in the U.S. and by Derk van Bekkum and George Mathe in Europe. Part of the research involved taking mice, rats, or dogs and irradiating them to various degrees to cause bone marrow failure. Then, bone marrow from a healthy animal would be taken and given to an irradiated animal. Laboratory experiments eventually demonstrated that mice with defective marrow could be restored to health with infusions into the blood stream of marrow taken from other mice. Attempts to convert this into clinical practice were initially hindered by immunological problems of transfer between individuals. With further understanding of the human leucocyte antigen system, rapid clinical progress was made during the 1970's and bone marrow transplantation soon became an established treatment for some immune deficiency and malignant diseases. Between 1981 and 1990, the number of allogeneic BMTs performed annually worldwide grew six-fold, from 875 in 1981 and 5,529 in 1990. Allogeneic BMTs, where the bone marrow donor and patient are two different people, are used most frequently to treat patients with leukemia, aplastic anemia, and immune deficiency diseases.

Sammy was lucky that his older sister was a match for a bone marrow donor. The transplant was successful. Although the recovery of the bone marrow function was slow and at times unsettling, Sammy's blood count eventually bounced back. Doctors said that without the bone marrow transplant, Sammy could have died from infections or uncontrollable bleeding. The bone marrow transplant technique that was started and perfected with animal research saved Sammy's life.

Animal research contributes significantly to the advancement of medicine and is a major reason why we are living much longer than our

great-grandparents. Medicines and surgical techniques developed on animals have saved the lives of countless people who would have otherwise died from bone marrow failure, heart disease, cancer and other conditions.

Once considered nearly always fatal, aplastic anemia has a much better prognosis today, thanks to advances in treatment through animal research. But the challenge is not over yet. If the cause of Sammy's illness were known, he could have been better protected and preventive measures could be adapted to deter any possible recurrence. In recent years, animal models have been developed to understand the cause of aplastic anemia and the mechanisms of bone marrow failure. Someday, animal research may bring future medical breakthroughs and put an end to diseases like aplastic anemia. Sammy and many others may never again have to face the staggering amount of suffering and devastation caused by these diseases.

Follow Up Essay - Veronica, Internship at Barrow Neurological Institute

I had a great experience this summer working in the Laboratory of Visual Neuroscience at Barrow Neurological Institute, under the direction of Dr. Susana Martinez-Conde. Research in this laboratory focuses on understanding the neural mechanisms of vision. Vision is perhaps the most vital sensory function for human beings. Scientists in this lab study various aspects of visual perception, including how neurons in the brain convey the shape, color, or brightness of an object and how these neurons communicate with each other. During my internship, I observed and participated in psychophysics experiments that were designed by Dr. Xoana Troncoso, one of the postdoctoral fellows working in the lab. In these experiments, visual stimuli, usually some type of visual illusion, were presented on a computer screen to human subjects, and these subjects were asked to perform a two-alternative forced-choice brightness discrimination task. The results of these experiments offer insight into the possible neural mechanisms responsible for the effects of these visual illusions. This in turn may help to explain visual perception in general and how the brain processes visual information.

After I had become familiar with the experiment and the procedures, I was able to run the experiments on my own with subjects. Dr. Martinez-Conde and Dr. Steve Macknik gave me some reading material so that I could obtain background information about the functions of neurons and the brain and understand the science behind all the experiments. Equipped with this knowledge, I was able to start setting up my own psychophysics experiment. I chose to base my experiment on a visual illusion known as simultaneous contrast. In the simultaneous contrast illusion, the perceptual brightness of a gray stimulus depends on the background against which the stimulus is presented. For instance, the same gray stimulus will appear light against a black background and dark against a white background. My experiment was designed to test the hypothesis that the perceptual strength of the illusion depends on the width of the stimulus. I plan to continue working in Dr. Martinez-Conde's lab to finish this experiment.

I want to thank SwAEBR for giving me this internship opportunity. I am very grateful to Dr. Martinez-Conde, Dr. Troncoso, and Dr. Macknik for taking the time to explain these in-depth concepts to me, to help me with my experiment, and most importantly, for giving me the opportunity to work in their laboratory. This experience has been invaluable to me, and has strongly reinforced my interest in research and in science.

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