

# OVERALL AWARD WINNERS

## FIRST PLACE ESSAY

Stephanie Spiekerman  
Washington Middle School ~ Seattle, WA

### Cystic Fibrosis

Approximately 32,000 people in the US today have Cystic Fibrosis. Right now, most of them cannot expect to see age 40. My mom works to help discover a cure for this deadly disease. She analyzes data from studies on mice and people, working to save thousands of lives. I am researching this because I may be interested in a biomedical research career myself.

Cystic Fibrosis (CF) is a genetic disorder that happens when a child inherits defective CF genes from both parents. The defective genes result in the bodding making abnormal thick, sticky mucus. This mucus clogs the lungs and hinders the digestive system from doing its job. CF patients have trouble breathing and are very susceptible to lung infections. In the 1950's, most people with CF died in elementary school. Now, thanks to research the life expectancy is 37 years.

One of the most important events in CF research was the discovery of the CF gene in 1988. Using this discovery, people have made a mouse model for CF. This is a strain of mice that has had the CFTR genes (the CF genes) mutated by scientists, giving the mice a form of CF. This model has greatly helped research on CF, because it enables us to test new treatments on mice to make sure they are safe and effective before giving them to people. Although this is not a perfect imitation of human CF, it is still extremely helpful in predicting how the treatment will work in people.

Recently there has been a new drug invented for CF using the mouse model. This drug causes a certain mutation in the CFTR genes to be ignored, so the CFTR genes can function normally and make CFTR protein. Scientists have given this drug to the CF model mice, and the mice were able to make normal CFTR protein, which seemed to function normally, too. There were no bad side effects observed in the mice. Because of this mouse model result, scientists are able to quickly move forward with a study of this drug in people.

My mom is a biostatistician who works for the Cystic Fibrosis Foundation. She plans studies and analyzes data from studies on animals and people. This includes using probability to make sure enough people or mice are studied to get a reasonably trustworthy result. For example, if a new is given drug to only two people and they both improve, one can't tell if it was just chance that they both

improved due to natural ups and downs in symptoms or if it was the drug doing its job. She uses mathematics to figure out new study procedures that use fewer people but still get the same amount of information. This is useful because the fewer people need for a study, the less the study costs and the faster the results can be obtained. Additionally, she tries to figure out if there are any flaws in experimental plans. Some flaws are hard to find and require knowledge of the disease, experiment procedures and mathematics to figure out.

We have not yet found a cure for CF, but there are many treatments to make the lives of people who have it better. For example, it was recently discovered that breathing in vaporized saltwater helps clear the lungs of CF patients. Also, there is a vibrating vest that CF patients can put on to help clear their lungs. Even though there is no cure for CF yet, studies on animals, especially mice, have greatly helped to advance our knowledge and to bring us closer to a cure. In fact, the new drug talked about earlier that makes the body ignore a certain CFTR mutation might become a cure for the 10% of CF people that have this mutation! This drug is the most promising drug yet for CF and it was discovered thanks to research with mice.

### Reflective Paragraph

I chose to write about Cystic Fibrosis and research on it using mice for many reasons. One was because my mom studies CF, not just to make money but because she wants to help save peoples' lives. I might want to do a job that helps other people be healthier, too, so I decided to find out more about CF research and what my mom does. I wanted to understand more of what she was saying. Also, I feel really badly for the kids who have to live with it. I wanted to know if there was anything I or we could do and see what progress is being made on a cure for it. Another thing I wanted to know how mice and other animals are being used for research. I learned a lot. I learned that there is actually a special kind of mouse made for research on CF and that because of this research we might have found a cure for about 10% of people with CF! This is really cool, and I will stay tuned to see what happens with this. I also found out there are animal models used for research on many other diseases. I never realized just how important these animals are for keeping people healthy. From my reading for this project, I also know more now about what biomedical researchers do, including people besides my mom. I would like to help in making biomedical breakthroughs, and I will definitely be considering a job in biomedical research for my future.

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## SECOND PLACE ESSAY

Jack Swiggett

Washington Middle School ~ Seattle, WA

### Amyotrophic Lateral Sclerosis

Although Amyotrophic Lateral Sclerosis (ALS) is not a common disease, those who are affected by it do not see it as trivial. It begins with small symptoms, such as muscle cramps or weakness, yet in the end, it inevitably leads to death. My Dad's friend Charles McPhee was diagnosed with ALS in mid-2006. While there is no cure for the terrible disease, biomedical research has helped Charles, as well as countless other ALS patients, live longer and happier lives.

ALS, also known as Lou Gehrig's disease, affects nerve cells in the spinal cord and brain, called motor neurons. It is the most common of a group of disorders which creates paralysis (loss of muscle function) caused by the breakdown of the central nervous system. The first symptoms may include muscle weakness, cramps, or problems speaking or swallowing. The symptoms progress over time, at a widely varying speed with different people, until a patient asks a doctor and is diagnosed with ALS. Eventually, breathing becomes nearly impossible, and finally, the patient dies. In most cases, this process takes three to five years, but exceptions occur.

The cause of ALS is unclear, and there are many. One possible cause is a gene mutation which has been linked to the contraction of ALS. The gene manages the body's production of a protein called SOD-1, which cleans cells of waste. Children can inherit this mutation from either parent, which may lead to their affliction with the disease. However, only one or two percent of all ALS patients have the mutation, so other causes must exist. Another theory is that toxins in a person's environment cause the disease, as it is more common in highly polluted areas. A third theory is that *glutamate*, a substance that nerve cells use to communicate, concentrates in parts of the brain and spinal cord and damages the nerve cells. Still, the cause or causes are not known for sure.

Charles McPhee, a friend of my dad's, contracted ALS over two years ago. He has tried many different drugs to help slow the progression or lessen the symptoms, but the one I will mention here is Riluzole. Riluzole is the only ALS treatment found to effectively slow down the progression of the disease in clinical trials. It does this by stopping the buildup of glutamate in the brain and spinal cord. Riluzole was shown to be effective in two human clinical trials. In the first trial, 155 ALS patients in France and Belgium were randomly

chosen to get 100 mg a day of either Riluzole or placebo (a fake, non-beneficial medicine). The results showed that patients taking Riluzole had about a twenty-five percent higher probability of survival after ten months compared to those taking placebo. The second trial, with 959 patients in seven countries, had similar results. Without this biomedical research, Riluzole could never have been used, and Charles McPhee, as well as thousands of other ALS patients, might not be alive today.

Animal models have also contributed significantly to ALS research. For example, there are over one hundred different SOD-1 mutations which have been found to cause ALS, and mice and humans with the same SOD-1 mutation generally acquire very similar symptoms. Using them as a model has led to many important breakthroughs, including recognizing the importance of *free radical* accumulation in motor neurons. They have also been used in over one hundred separate clinical trials, including tests of Riluzole, and continue to be used today.

ALS is a terrible disease, and biomedical research, as well as other scientific research and theories, have helped countless people around the world cope with it. Hopefully, there will someday be a cure, and scientists are trying hard to find one. No doubt, biomedical research will be a part of that cure as well, and I'm sure it will contribute invaluable information to the scientific world.

### Reflective Paragraph

Studying ALS has been incredibly interesting to me. I knew just a little about it before I wrote this paper; it causes you to become paralyzed and eventually die, and there is no cure. Doing this research, I became much more informed about the specifics of the disease, and I found the causes very interesting. However, what I was most intrigued by was the importance of biomedical research in testing and finding cures. The results of the human trials were very interesting, and I was amazed at the studies done in mice, and their similarity to humans.

I am very glad I did this paper. I learned a huge amount, and I have a deeper understanding of ALS, as well as biomedical research in general. Although I've finished this paper, I will probably continue to research ALS in the future, now that my curiosity has been sparked. I hope that a cure is found soon, and with the help of biomedical research, I'm sure one will be.

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## THIRD PLACE ESSAY

Henry Flanagan  
Washington Middle School ~ Seattle, WA

### Non-Hodgkin's Lymphoma

Lymphoma is a deadly blood cancer which kills thousands every year. Thanks to modern medicine and research, my uncle was not one of these people. In January 2003, my uncle Steve was diagnosed with non-Hodgkin's Lymphoma, or NHL for short. An abdominal CT scan showed that my uncle was already in stage IV, the worst most deadly stage. This stage is defined by at least one organ being invaded by the disease, although fortunately it was only in his spine, instead of a critical organ. Many years ago my uncle would have most likely died shortly after his diagnosis, but modern biomedical research has revealed a variety of life-saving treatments and research techniques. Thanks to these treatments, people with Lymphoma can finally expect a brighter future.

Lymphoma is a blood cancer in which a type of white blood cell (T-cell or B-cell), which help prevent disease, mutate. These mutated cells multiply and spread throughout the body and, upon reaching a certain concentration in one area of the body, form a tumor. Although non-Hodgkin's Lymphoma usually occurs in ages 55-85, in rare cases younger people (like my uncle, who was diagnosed at 41) can have Lymphoma as well. Early Lymphoma research occurred in the late 1920's to the early 1930's, although radiation treatment, a critical part of most Lymphoma treatments today, was discovered in the late 1800's. Radiation treatment was first discovered in 1895 by Wilhelm Conrad Rontgen who discovered the x-ray during his research. Early trials of radiation treatment mainly consisted of bombarding animals with radioactive gamma rays, which although often nonlethal, was still usually considered absurd or irresponsible testing by scientists and researchers at the time. The first human test, in 1936, proved successful, and now research has continued since then.

Another part of most modern lymphoma treatment is chemotherapy. Chemotherapy is the administration of drugs or medications to stop the spread of cancer cells. Practical chemotherapy was first invented by Paul Ehrlich. When experimenting with chemical dyes on animal tissue, Ehrlich discovered that some cells would absorb a certain type of dye which other cells did not. This led to the premise of a "magic bullet" or a drug that could target certain cells. Since cancer is only caused by

certain mutated cells, this proved to be an effective technique. However, there are a variety of side effects that can be caused by chemotherapy, ranging from hair loss to a potentially fatal problem in which the drug attacks healthy white blood cells.

Animal research has played a large part in the development of new treatments. For example, in 2001, researchers began mapping out the genome of the Zebrafish, which is similar enough to the human genome that accurate testing can occur. The goal of the experiment was to test how Leukemia (a blood cancer similar to Lymphoma) would develop and mutate in a wide base of subjects. Fish were given a combination of MYC genes, which cause cancer in humans when mutated, and Zebrafish genes that cause the MYC genes to affect only the lymphoid cells, which are the cells affected by Leukemia. These fish were used in testing new methods for treating the cancer, as well as showing new mutations of the disease not occurring in humans. Zebrafish are not the only animals bring used to research blood cancers. An ongoing study is mapping the dog genome, in which natural cancers such as lymphoma are common.

After treatments of radiation therapy, chemotherapy, and other supplementary drugs, my uncle was released from the hospital. Fifty years ago, he probably would have died within months of the initial diagnosis. Biomedical research has done more than improve our understanding of the human body, or improve our knowledge of plants and animals. It has given millions of people a second chance at life.

### Reflective Paragraph

I knew practically nothing about the treatments, or even the symptoms and causes, of cancers such as Lymphoma before this essay. I never really understood how important biomedical research is in the modern world. In less than 50 years, lymphoma survival ratings have gone up by more than a third, and that difference just keeps increasing as new research happens and new medicines are created. These diseases, seemingly indomitable a century ago, are now curable and also understood by the entire medical community. We have the knowledge and the resources to eradicate diseases that had previously devastated entire regions or countries. Without this knowledge, my uncle, and many thousands of others, would not be alive today. Overall, I found this a great opportunity to learn and an insight into the world of modern medicine.