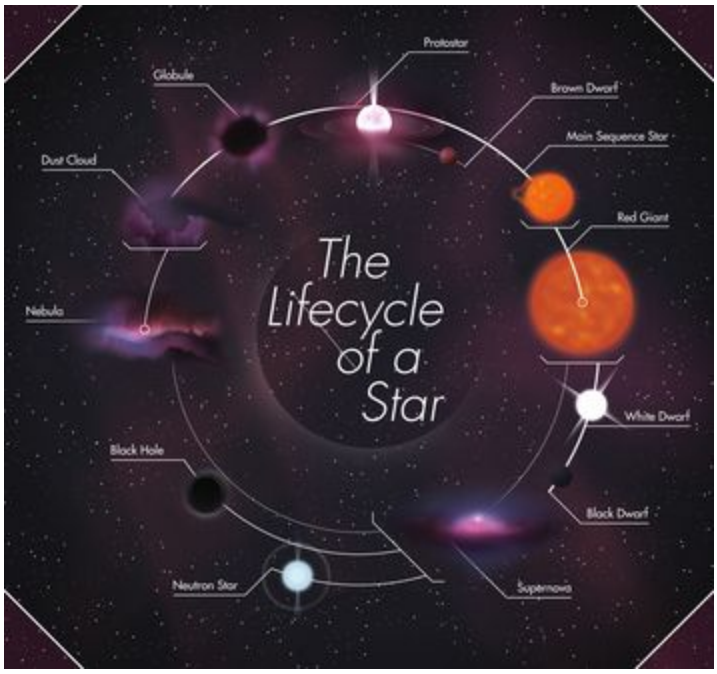
Table of Contents:

*News*

## Supermassive Black Hole Gets A Massive Supper

By Jasmine Zhang




Have you ever wondered what would happen if you fell into a black hole? Of course, you would be ripped into pieces instantly, even if you were as mighty as a star.

Scientists are now able to detect a star in a faraway galaxy being "devoured" by a supermassive black hole. Due to its strong gravitational pull, it was able to hold onto the unfortunate, nearby star, and shred it into pieces.

A study led by Suvi Gezari, an astronomer at Johns Hopkins University, allowed scientists to closely examine the rare event and further improve our understanding of black holes. Gezari and her team used the space-based Galaxy Evolution Explorer (Galex) and the Hawaii-based Pan-STARRS telescopes to view thousands of galaxies in ultraviolet and visible light respectively. The team had spotted a flare from an identified dormant black hole in a galaxy 2.7 billion light-years away by chance.

The flare grew brighter for a month before gradually fading for a year. By calculating the rate by which the star's particles were sucked in, the team was able to ascertain that it was a powerful gravitational field and concluded that it was a supermassive black hole with an estimated mass of 3 million suns that was responsible for the carnage.

Additionally, using the flare of ejected gas, Gezari's team used data from the Multiple Mirror Telescope Observatory to determine that composition of the gas was mostly helium. Since the spectrum of helium wasn't present initially, they were able to deduct that the star was probably surrounded by a hydrogen envelope. The protective barrier was sucked in before the black hole finally ripped apart the helium core.

Although much of the universe is still unknown, Gezari hopes to use these observations to guide them to what evidence to look for in the future. With better telescopes, such as the development of the Large Synoptic Survey Telescope, which can scan half the sky every night, astronomers will better understand the evolution of galaxies over time.

**Toxic Sushi?**

By Alvin Zhu

As our country is becoming more increasingly diversified, food from all over the world becomes almost like a norm to the American consumer. Sushi, for example, was once an exotic dish from a distant corner of the world. Today, it is hard to image our country without the easy access to sushi bars and other Asian restaurants. Recently, however, there have been concerns over the dangers of eating fish. The main culprit behind this issue is the mercury levels found in fish and seafood, whether cooked or raw.

Critics of seafood are entirely justified when it comes to the dangers of mercury. Although the environment and ocean naturally contains mercury, industrialization and manufacturing are causing factories and power plants to release even more mercury into the air. It becomes a major problem when it eventually enters bodies of water. Marine bacteria absorb the mercury and convert it into methylmercury. As a result, methylmercury is now in the food chain. Methylmercury, then, starts accumulating in the bodies of predators feeding on contaminated prey, especially tuna and other top-level predators near the top of the aquatic food chain. As humans fish and sell such animals, methylmercury will eventually end up on our plates and inside our body.

Mercury is especially dangerous because it is very hard to detect. It has no smell, no color, or anything to distinguish it from the fish meat. Inside the human body, it acts as a neurotoxin, which is a chemicals that disturbs the nervous system and brain. In adults, it can cause vision, memory, and hair loss as well as numbness, lower fertility, and headaches. Mercury's damage is much worse for fetuses, infants, and toddlers. High levels of mercury will affect a child's neurological development and may even cause blindness, deafness, and intellectual disability.

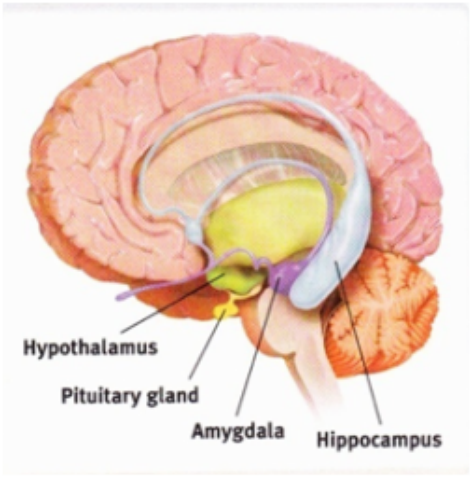
Thankfully, as dangerous as mercury is, fish and sushi are perfectly safe to enjoy for the vast majority of us. Even the fish known for higher levels of mercury, such as tuna, swordfish, king mackerel, and shark, are within government guidelines regulated under the Clean Water Act. A single serving of fish does not have mercury levels high enough to be harmful. However, with that said, it is still possible to overdose on methylmercury. Scientists estimate that around 25 pieces of any type of sushi a week is already too much. In addition, children and women who are pregnant or are planning to become pregnant are especially susceptible to the dangers of mercury. These groups of people should stay clear of high-level mercury fish and seafood to grow up healthily.

Well, what about cooked fish? Sadly, cooking fish does not lower its mercury levels. However, if given a choice between cooked and raw fish, cooked fish is much safer to eat. Other contaminates such as bacteria, parasites, and viruses can also taint fish. It can cause food poisoning, cramps, vomiting, and diarrhea. Thankfully, they are nothing that the pan and the freezer cannot kill.

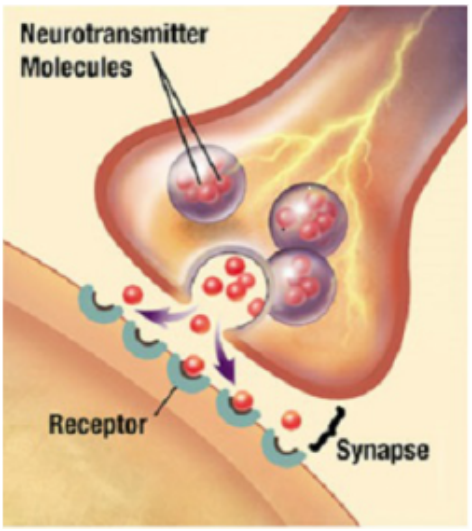
Overall, moderation is key for staying healthy when eating fish. Although, mercury has many formidable effects on your health, it is perfectly safe as long as you do not eat excessively. Furthermore, the FDA even reports how one week's overdose of mercury can be offset by cutting back mercury levels in the following week or two. Therefore, do not suddenly stop eating fish just because of their mercury levels. After all, fish are delicious sources of many nutrients that are extremely beneficial for the human body, such as omega-3 fatty acids and vitamin D. If you are not convinced, choose fish that are lower in methylmercury, such as flounder, salmon, and sardines (which are all great sources of protein!).

**The Science Behind Depression**

By Julia Lu & Jialin Chen




Those who have even the slightest bit of knowledge about what depression is will know that it is a chronic illness that affects millions of people worldwide. It is a mood disorder that is linked to several parts of the brain, such as the limbic, nervous, and endocrine systems. The limbic system is the area where emotions, motivations, and stress responses are regulated. This system can be broken down into several parts, one of which is the hypothalamus, which is located at the bottom of the brain. It controls some of our daily functions such as body temperature, sleep, appetite, and several other activities. The hypothalamus also controls the pituitary gland, which regulates hormones that are essential to a person's emotions. In addition, the limbic system commands other emotion-controlling structures such as the amygdala and the hippocampus, which only add to the importance of the limbic system. Since this system is highly related to the emotions that a person portrays, any disturbance of the limbic system will affect a person's mood and behavior drastically, perhaps even lead to depression.




Neurotransmitters are brain chemicals that allow for neurotransmission. These transmissions enable the brain to send messages all over the human body. In order to understand the science behind depression, it is critical to learn how neurotransmitters function. Simply put, neurotransmitters are small molecules that transmit nerve signals in the form of electrical impulses from one nerve cell, called neuron, to another nerve cell. They are "messengers" that tell other neurons that the neuron had received a signal. This essentially creates an indirect link between all neurons in the brain. We have 100 billion neurons in our brains that are constantly sending out and receiving neurotransmitters from other parts of the brain and the body. The three main neurotransmitters in the brain are dopamine, norepinephrine, and serotonin. Research suggests that the change in the level of neurotransmitters is related to depression. Dopamine is responsible for one's desire for pleasure and reward. When the level of dopamine drops, we no longer wish to participate in activities that we used to find pleasure from. Serotonin controls more physically oriented actions and mood, such as sleeping, eating, and aggression. In some cases, a decrease in the production of serotonin is linked to suicidal behaviors. Finally there is the norepinephrine, which is said to generate depressed feelings in the brain when there are not enough of it. It has been shown that those who are depressed tend to have lower levels of norepinephrine. Moreover, antidepressants work to increase the level of norepinephrine in the brain, which then relieve the symptoms of depression.

**Stem Cell Research and G-protein-coupled Receptors**

By Benedict Ho

Today, many researchers have turned their interests toward stem cells. Stem cells, which are cells found throughout our body, give rise to specialized cells that perform diverse functions. In 2012, remarkable discoveries helped advance the research on stem cells. Sir John B. Gurdon was a Nobel laureate in Medicine who proved that a normal cell could be programmed to become a stem cell. Using this information, Gurdon disproved the idea that a mature cell could not return to an immature form by inserting ordinary gut cells into an embryonic frog.The gut cells developed into different cells during the frog's development.

Then, another Nobel laureate in Medicine, Shinya Yamanaka, further developed Gurdon's ideas. This time, instead of using frogs, Yamanaka and his team tested mice.They were able to identify four chemicals that caused a mature cell to turn into a stem cell. In his first attempt, he tested each of the four chemicals individually, but to no avail. However, when all four of them were mixed together, Yamanaka discovered that the skin cells of the mice became pluripotent stem cells once again. As a result of this accomplishment, the opposition towards stem cell research has decreased. Previously, many people were concerned with the ethics of stem cell research because embryos were sacrificed in order to retrieve the necessary cells for research. Now that Yamanaka found a way to harvest stem cells without harming organisms, research on stem cells will no longer be disputed for unethical reasons. This research is extremely important for curing diseases, especially degenerative diseases like amyotrophic lateral sclerosis (ALS).

Cells need to signal each other in order to perform functions correctly. However, until the work of Nobel laureate in Chemistry RobertJ. Lefkowitz, the receptors that receive the signals were unknown.

Using radioactive tagging, Lefkowitz was able to prove the existence of such receptors, G-protein-coupled receptors, and identify their location and basic structures. Lefkowitz, then. hired Brian K. Kobilka to continue the research. Kobilka decided to research the gene, sequence of amino acids, that would later create the protein receptor. After Kobilka suggested creative techniques, his team was able to understand how the receptor worked. When a chemical messenger or hormone binds to the receptor, its shape changes and sends out a signal that informs the cell about how it should react.

Continuing to research the receptor, Kobilka and Lefkowitz were able to compare the receptor to other receptors found in the eye. They discovered that many of the receptors in the human body have similar structures. By quickly announcing their results, many companies soon developed medicines that targeted these receptors and helped relieve conditions.

Basic research is extremely important because such discoveries can create new techniques for combating illnesses or providing more information about how our bodies work. Especially in the United States, where funding is heavily used for the military, more money could be invested into research projects that will provide us with something better than just weapons and explosive bombs.

Although the techniques used by the scientists seemed extremely simple and basic when they were described in a video, I was surprised to see that the process was not as simple as it seemed. The video did not provide us with the amount of time that it took to complete each experiment and the number of repeated trials that each scientist completed. In the end, the scientists were able to achieve results and allow the rest of the world to benefit from their breakthroughs.

**Long Term Toxicity of a Roundup Herbicide and a Roundup-Tolerant Genetically Modified Maize**

By Kimberly Ho

Genetically modified organisms, GMOs, have been introduced to the United States in the 1900s. In the following years, GMOs has begun to enter the mouths of many people everywhere. However, are GMOs guaranteed safe for consumption? Ongoing research and experiments are still being conducted while the popularity of and profit from GMOs continue to grow.

In 1982, the United State Food and Drug Administration approved the first GMO – humulin. Humulin is modified insulin that was genetically engineered by E. coli bacteria. Its purpose was to treat patients with diabetes. Scientist Dr. Miller tested this GMO on 400 patients all over the United States. The FDA approved of this new "insulin" and thus was expected to be available to patients in 1983.

Studies were conducted during the past two years in the University of Caen, in France, and the University of Verona, in Italy. Lab mice were observed after consuming a GM maize called NK603, which is resistant to the weed killer glyphosate. This GMO was marketed by Monsanto. Scientists observed the lab mice twice per week to monitor clinical signals. Problems and concerns have arisen from the results of these experiments.

Rats and mice fed with GM maize have developed not one, but numerous monstrous tumors. The major damage was present on the metabolic organs. Female mice grew mammary and pituitary tumors while both genders faced chronic kidney deficiencies. The male sex showed more nefarious tumors in the liver and kidney. Thus, animals fed with GMOs grew tumors and lived a shorter life. This was a signal alerting scientists to conduct further studies regarding the safety of consuming GMO.

The female mice (living 701 days on average) that fed on GM maize lived longer than the male mice (624 days). The concentrations of the Agrobacterium tumefaciens 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) were overexpressed to study the effects of GMOs. Nevertheless, scientists drew the conclusion that NK603 and Roundup herbicide disturb the physiological pathway.

Genetically modified crops have not been completely banned just yet. This issue continues to face ongoing criticism and debates in the agricultural and political divisions. Genetic engineering is a new form of technology humans have not completely dominated or grasped. The effects of GMOs on mice may also reflect those of GMOs on the human body. Such a controversial topic should not be overlooked. As a result, a GMO tester prototype that determines whether certain foods are genetically modified was created, giving people the freedom to choose what they consume.

**Do-It-Yourself Biology: Editing the Human Genome and Beyond**

By Sharon Lin

*With the advent of CES 2016 right around the corner, news is abuzz with information about the latest and greatest in technology. From genome editing to ubiquitous networking, there are limitless possibilities for the months – and years – to come. Even among competing industries, the idea of democratizing technology among those with and without the means to afford expensive equipment is becoming a game changer, as well as the hailing mantra for what seems to be the technological revolution.*

Genetic editing has always seemed to be a fearful concept of a far-off science fiction novel, but with the science of biotechnology backing current research, that doesn't seem to be the case anymore. Enter CRISPR, a new genetics tool that allows scientists to edit genomes with unprecedented speed, precision, and flexibility. It was first popularized by a recent study by scientists from Sun Yat-sen University in Guangzhou, China after their successful modification of the human embryo. The controversy that was sparked also opened up conversation for the possible implications of this technology.

Although scientists have been aware of CRISPR for years, only recently has the media picked up on the hype. CRISPR – which stands for clustered regularly interspaced short palindromic repeats – is an ancient defense mechanism found among a wide range of bacteria. Back in the 1980s, scientists first discovered a strange pattern in bacterial genomes – one DNA sequence would continuously repeat itself, a sequence that would eventually become known as CRISPR. They soon realized that the sequence matched that of viruses, specifically those that prey on bacteria. As a matter of fact, CRISPR is a component of bacteria's immune system, which is constantly surrounded by viruses in order to recognize and defend against those attackers the next time they are encountered.

The second part of the defense mechanism is a set of enzymes known as Cas – short for CRISPR – associated proteins. These are able to precisely slice DNA and rid the bacteria of viruses. The sequence that codes for Cas also happens to be close to the CRISPR sequence. The best known of these Cas enzymes is Cas9, which comes from Streptococcus pyogenes, the bacteria known to cause strep throat. Combined, the two components form the CRISPR/Cas9 system, often shortened to just CRISPR.

The exact process by which the CRISPR/Cas9 system operates is a little more complicated. As the CRISPR region begins to collect the DNA of various viruses, it forms a shortlist of viruses to watch for. The microbe is then able to use the viral DNA to form Cas enzymes, which are then employed to destroy any matching viruses encountered. The genetic material in each spacer is copied onto an RNA molecule, which is taken up by the Cas enzymes. The two components are released to drift around the cell. If they encounter any viruses, the RNA latches on and the Cas enzymes slices apart the viruses' DNA, preventing the virus from replicating.

Simply put, the entire procedure required for biologists to utilize the system consists of feeding the correct sequence to Cas9, calling a guide RNA, and using the duo to modify a genome however they want. DNA consists of a string of four different base pairs in various permutations – A,T,C, and G. While other genetic modifiers can only make cuts after encountering a short sequence of four bases, Cas9 is be bettered suited for acting on specific genes because it can recognize up to 20 bases.

The possibilities of CRISPR are practically endless. It could be used to introduce genes to slowly kill off vectors of deadly diseases, such as malaria, or to cure all genetic diseases previously deemed

impossible. It could also be used as a way to eradicate invasive species from overtaking native fauna and flora, or even as a means of enhancing our natural environment.

With the recent media attention circulating about the idea of future medical procedures being circumvented in favor of directly altering DNA to create medical treatments, there is definitely a lot of potential for CRISPR to completely revolutionize the field of biotechnology. However, that isn't to say that there aren't applications to the tool outside of medicine; in fact, it's safe to assume that in just a few years, we might be able to witness the alteration of ecosystems around the world, if not beyond.

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**Increasing Memory Recall by Repeating Words to Another Person**

By Annie Li

Victor Boucher and Alexis Lafleur of the University of Montreal in Canada discovered that communication is beneficial to memory. It is prior knowledge that repeating words aloud increases memory recall, but they discovered that repeating words to another person boosts it even more. The researchers asked 44 French university students to take part in their experiment, which had them read lexemes, words written as how they are found in the dictionary. They were asked to repeat these words in four different ways: in their heads, silently while moving their lips, aloud, and aloud to another person. In each situation, the participants wore headphones that emitted "white noise" to avoid auditory feedback. They were then distracted, and after that, were shown a list of lexemes. Their task was to recall which ones were previously shown and which ones were not. The researchers concluded that repeating words in their heads produced the lowest recall, whereas repeating words to another person produced the highest.

The simple action of repeating the words in the head creates a sensorimotor link. This increases our memory, but the functionality of speech increases it even more. In a second experiment, the participants were put in the same procedure, but with “non-words”, words that do not form lexemes. However, the participants showed no change in memory recall between the different forms of word repetition. The researchers concluded that the brain does not connect non-words with verbal memory. Rather, the use of one or more sensory aspects increases the efficiency of memory. In addition to the sensorimotor parts used in verbal expression, the brain also uses the multisensory information from communication to increase memory efficiency.

**Rapid Colchicine Competition-Binding Scintillation Proximity Assay Using Biotin-Labeled Tubulin**

By Kimberly Ho

Microtubules are intracellular components involved in determining the shape and movement of a cell. When a cell divides, microtubules form the mitotic spindle to align and separate chromosomes. The microtubules are polymers composed of tubulin heterodimers, which are proteins made up of two polypeptide chains. The two heterodimers of tubulin are alpha-tubulin and beta-tubulin. Colchicine is a medication derived from a plant that interferes with cellular reproduction. With the presence of colchicine, cells cannot properly align mitotic spindles and the extension of microtubules is changed. Cells undergo apoptosis if colchicine is detected at metaphase.

A research report from Abbott Laboratories (written by Tahir, Kovar, Rosenberg and Ng) determined the equilibrium constant of colchicine disassociation from tubulin. The research also specified on a newly developed procedure that separates colchicine from tubulin without filtration.

The original method of separating colchicine is to wash and then separate the complex, but this has many disadvantages. The solution to this problem is the colchicine competition-binding scintillation proximity assay (SPA), which can filtrate quicker and with a smaller chance of error since the SPA technique does not require separation procedures.

SPA starts with the incubation of an unlabeled compound with biotin-labeled tubulin at body temperature. Ethanol is then added to the total volume and placed in a centrifuge for evaporation. SPA yttrium beads are added to determine the fixed amount of colchicine and tubulin, which can be determined by stimulating the bead to emit light. As a constant or limit to compare the results, the low nonspecific background (NSB), determines the reliability of colchicine. NSB is about 80% less than the specific count determined by SPA.

A constant value (K) is the equilibrium constant of colchicine dissociation to tubulin. This easier and cheaper assay is used to assess antimitotic compounds. Colchicine was evaluated to determine whether or not the cell had to undergo apoptosis during metaphase. It is also known that tubulin-binding assays help to identify antimitotic compounds that interact with colchicine.

Tubulin interaction with medication, chemicals, proteins, etc. in cells can be useful for determining the nature of other components. The interaction between the microtubule tubulin and foreign components present in cells can be recognized as essential.

*Editorials*

## Should Scientists Try to Beat Old Age to Live Longer Lives?

Considering that the average life expectancy was thirty-four years in the last century, humans have been living longer due to advances in technology developed from the accumulation of knowledge and research. As a result, we use our intellectual capacity to explore various methods of extending our limited lifespans in order to have more fulfilling lives. In the future, we can live to see the changes in society. We can live to see our children, grandchildren, and great-grandchildren grow up. We can live to advise and guide the new generation to prosperity using our experience gained through th years. Thus, those affected by thanatophobia, the fear of death, would be temporarily relieved. Most importantly, however, we would not have a gnawing thought at the back of our minds that death is possible at any given moment. But at what cost?

A commonly accepted belief is that elders are wise. With future developments in the advancement technology, we may be able to keep them with us longer. However, will their advice be truly helpful? According to Ian Ground, a senior philosopher from Sunderland University Centre of Lifelong Learning, old people tend to be more conservative. Therefore, even if they lived longer, there would be less innovation. Rather than propelling the world with their sagacity, old people will hinder the world's growth intellectually.

Although it brings comfort that elders can live to see their great-grandchildren, many have actually expressed their desire to lie down and rest. For instance, an eighty-six year old woman featured on a Humans of New York post said, "I want to see my great-grand children. But I wish to join my husband in heaven." As a grandmother, she feels lonely and abandoned because all her children left home to start their own families.

From a biological standpoint, it is important to note the implications made on society. According to Thomas Malthus's theory of population growth, if the rate of population growth exceeds the rate of food production, humans will die. If people live longer lives, there will be an increase in the competition for resources. Furthermore, people with longer life expectancies will bear more children. This population increase will inevitably exceed the carrying capacity. For example, humans are burning fossil fuels and other nonrenewable resources at an exponential rate. More than half of the freshwater on Earth is already used up. As Earth's population rises, will human species survive 25, 50, or even 100 years from today with such vastly depleted reservoirs and resources? Another ramification is if people lived longer, there are bound to be other organisms that have to be sacrificed. In terms of the human species, the less fortunate would be at a disadvantage due to economic problems. In the end, it would be a lose-lose situation.

Although living longer may seem like an appealing choice now, our perspective will change as we age, allowing us to observe our effects on society. Technology shouldn't buy us time to reap the benefits of living. Instead, we should focus on the present and fulfill our lives before time ultimately runs out.

## When Does Life Lose Meaning?

The only possible absolute statement is that all people will die. Death could be the result of a malignant disease, warfare injury, or etc. It is an inevitable stage in the circle of life. Nobody could possibly cheat death or live for eternity. But who would want to live forever?

Today, death takes many people by surprise because the world's standards of living have greatly improved. Yet many lives are cut short with terminal diseases such as cancer. Life practically ends when the traumatic news is delivered since depression and painful treatments usually follow. But what if the pain is more unbearable than the eternal darkness of death? Brittany Maynard, a young woman diagnosed with brain cancer in January 2014, wished to die on her own terms. Three months later, her stage two tumor translated into a malignant stage four. Maynard was to succumb to even more surgical procedures and undergo chemotherapy radiation. In other words, she would gradually decay, lose to the cancer, and suffer a torturous death. She said in an interview with People, “I’m dying, but I’m choosing to suffer less … to put myself through less physical and emotional pain and my family as well.” She and her family moved to Oregon where there was legal access to death with the Death with Dignity Act. She felt as if she had made the right decision because her pain increased as time passed. Maynard eventually passed away on November 1, 2014 alongside her mother, husband, and best friend.

During Marnard’s last few days, she advocated the right for terminally ill patients to die on their own terms. Her last impression on society was to defend the Death with Dignity Act, which gives people a choice that they can make for themselves. Dr. Daniel Swangard, an anesthesiologist diagnosed with cancer, sued California in order to legalize aid in dying. If he had an option, he would like to spend his last moment in someplace familiar, surrounded by his loved ones, rather than die in a hospital. This choice, however, is not readily available to Swangard. As the one enduring the agony, Swangard feels that he should have the right to the end-of-life option. Doctors need not feel an obligation to cure the patients' illnesses. When the pain from fighting for survival outweighs imminent death, there is no real reason to live.

Many doctors adopt the paternalistic approach in their practice. Dr. Daniel Mirda, an oncologist, stated during an interview with Time, “Prescribing a patient life-ending medication is like saying, ‘I don’t have a chance of helping you.’” However, the doctor’s job is not to persist with agonizing treatments at the expense of the patient’s torment. The doctor only alleviates the pain, becoming an understanding healer that can fulfill the wants of the patient. If a patient was to choose death, it is the patient’s every right and not the doctor’s inability to heal.

Underprivileged family members who cannot afford costly treatment may also favor the end-to-life option, which suggests that many impoverished people might choose to end their lives. However, the Death with Dignity Act is limited to patients whose illnesses lead to death within six months. The law further requires the patients to be capable of making the decision themselves. Advocates believe that it should be legal in all states to relieve the incurable disease.

If suicide devalues life, then Death with Dignity is not suicide. People like Maynard and Swangard advocate that terminally ill patients deserve the respect in making their final choice. If people can live on their own terms, people can also die by their own desires. It would be their last taste of freedom.