

A white silhouette of an industrial skyline featuring various structures like chimneys, a large central building, and a cooling tower, set against a dark background with faint geometric lines.

SCIENTIFIC SUPERPOWERS



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INTRODUCTION

WELCOME!

Thank you for choosing Scientific Superpowers! This novel covers advances in science that may one day allow us to do the impossible. Keep reading to learn about interesting discoveries and developments that have the ability to change the world.

SECTIONS INCLUDED IN THIS BOOK:

Create Anything and Make Your Own Gold!

Written by: Kayla Harden

Live Forever and Generate Unlimited Power!

Written by: Chloe Johnson

Have a Higher Quality of Life and Stop Time!

Written By: Veronika Suyupova

Turn Invisible and Manipulate Matter!

Written By: Lourdes Vickers

1

CREATE ANYTHING!



There have been many scientific advancements within the last decade. Surgical procedures due

to evolution in the way temporal bones enhances simulation to better medical practices. Other ways of three-dimensional printing have also inclined. There have been ways to transmute atoms as well; in other words, one atom, such as lead, can be turned into gold.



1.A Science is ever evolving, and grows for the greater good.

Three dimensional printing is unlike other printing. With a 3D printer, the object being produced or printed is developed in three dimensions, built up layer by layer with different types of plastic, all during a process called rapid prototyping, also known as 3D printing.

Before the printing process begins, one needs a digital 3D model. In order to do this, individuals can scan a set of 3D images, or they can draw their object using computer-assisted design or CAD software. This newly designed entity is now saved to an STL (stereolithography) format then sent to the printer to “print”. This then begins the printing process.



2.A There are many types of 3D printers. This is a Voxels Model.

Many different types of printing are used

while printing something in three dimensions. The

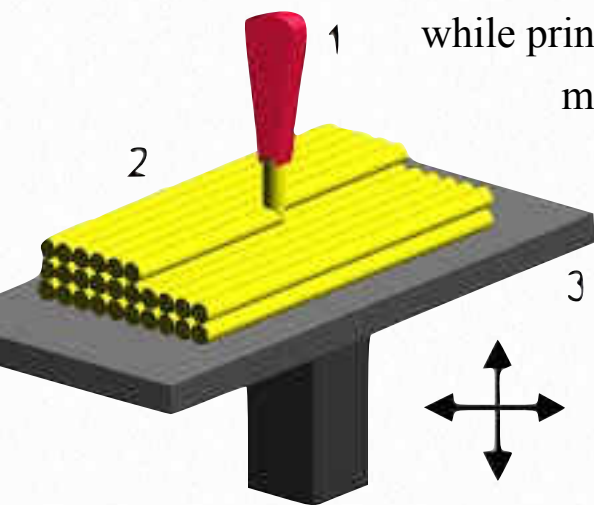
most common type of printing is fused deposition modeling printing, or shortened to FDM. This type of printing uses many different plastics, the most common being acrylonitrile butadiene styrene or ABS, and polylactic acid, PLA. A print from the FDM starts with a thin, single layer on top of the print bed; the nozzle attached to the printer bed

depositing the plastic to the direct spots which they need to be ordered to create the final product. The first layer is simply a base for the object.

Many layers will follow to get the desired depth. For example, if one were to print a 5-cm tall cube, and a single layer averages out to .3 mm, the printer would then do around 167 layers in order to reach the suitable height. There are many factors in

price for FDM printing jobs, mostly determined by size, print volume, or the size of the print bed. The bigger the object is, the more expensive it will cost, as goes for most printers.

Many types of plastics are used for different occasions. All



3.A Layer by Layer, the printer builds the object desired to be printed.



4.A This is a 3D printed cube

of these plastics have both pros and cons to them. The first plastic is ABS or acrylonitrile butadiene styrene. This plastic is the one used in Legos and most commonly used manufacturing industrial and commercial plastic. This particular type of plastic is both strong and slightly flexible. It is also an ideal



5.A The well-known toy Legos uses ABS plastic.

plastic for rapid prototyping. ABS melts and exits out of the printer precisely between 220 degrees Celsius and 240 degrees Celsius. That is between 428 and 464 degrees Fahrenheit. ABS plastic requires a lot of heat to reduce thermal shock from the printing bed. The heating also aids the plastics to attach better with more stability. However, there are many disadvantages to ABS plastics as well. There

have been “potential effects

of off-gassing of the heated plastic and... does produce a stink when printing... and some studies link ABS fumes to olfactory loss,” (Griffey 13). The second most used plastic is PLA or polylactic acid. This bioplastic is made from corn, beets, or potatoes. PLA also can be decayed and used as fertilizer compost facilities. Unlike ABS, PLA plastic melts at a much lower temperature which is 150 to 160 degrees Celsius, or 302- 320 degrees Fahrenheit, however, PLA easily



6.A Surprisingly enough, polylactic acid is a bioplastic that uses different vegetables like corn or beets.

comes out of the printer around 180 to 220 degrees Celsius which is 356 to 464 degrees Fahrenheit. This plastic is not suitable for occasions including high temperature due to its lower melting point. PLA is also more fragile and crystalline so it cracks or shatters under pressure. Many manufacturers are beginning to use PLA more because does not need a heated bed to further adhesion. The only main disadvantage to PLA is the melting point. This plastic is great for public settings, such as a library, because of the fact that it smells of maple syrup while printing. There is also a bigger selection of colors



7.A 3D printers are trying to be put into public libraries.

and opaqueness for this specific plastic, giving more of an option for each

printing job. Though there are many other plastics used, these two are the most common used plastics in 3D printing.

Not only can 3D printing be used for personal uses, but aids in surgery as well. 3-dimensional printing can assist in surgical simulations in order to show a safer way to preform surgery. There is a process to create a 3D model of a temporal bone. The temporal bone is a bone on the side of the head in the middle of a humans skull. Printing this bone in



8.A the temporal bone is a bone in the side of one’s head by the ear.

three dimensions is helpful in surgical simulation. For this, surgical simulation should be realistic to help the surgeons and upcoming surgeons to understand what they are doing. "...[the print of the bone] incorporates a range of color and material properties, represents a significant improvement over previously reported simulated temporal bone models, which have generally been printed in a single material," (531). This could revolutionize surgery because this allows a life size model of the bone. Allowing this could help med students fully understand parts to each individual bone.

2

**MAKE YOUR OWN
GOLD!**



Transmutation is the process of changing atoms from one element to another. This process is, in fact, possible. Russian scientists at the Kurchatov Institute research center had changed lead (Pb) into



9.A Examples of various precious metals

gold (Au). This university was the first to create an atomic reactor in Eurasia, domestic atomic bomb, thermonuclear bomb, nuclear power plant and more. Kurchatov Institute was able to create gold by using nuclear collision-induced reactions in which they removed from six to fifteen neutrons along with four protons. This created a wide range of gold isotopes. Gold 190 was created which included 79 protons and 111 neutrons, along with gold 199 which has 79 protons and 120 neutrons. The amount of gold that was produced, however, were in extremely small quantities. Because of this, scientists had to identify the gold by measuring the radiation given off by the unstable gold nuclei which had decayed over time.



10.A Paul Heroult worked with aluminum

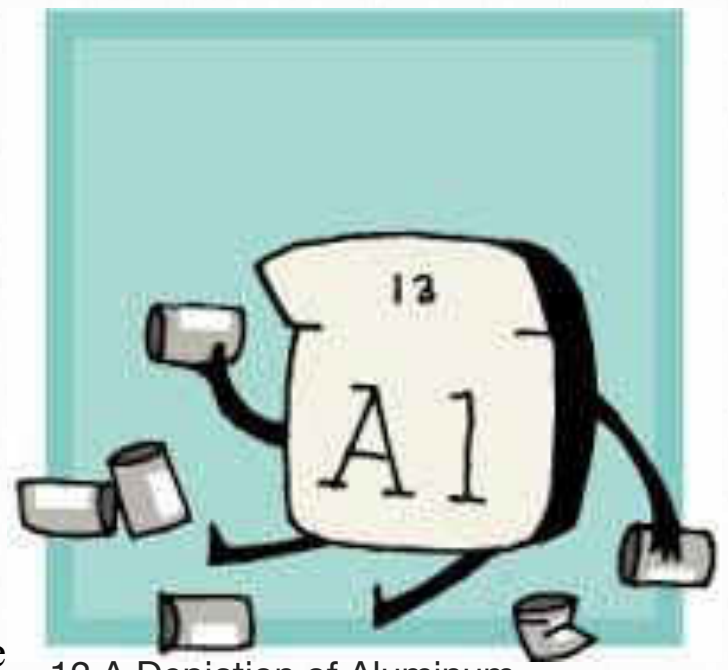
There have been a hand full of scientists that helped with the discovery of creating metals easier. For example, Charles Hall had come up with a way to create a method of manufacturing aluminum inexpensively. Aluminum is the most abundant metal in Earth's crust, however, it is never found freely about the Earth, making it a precious metal. Hall founded the Aluminum Company of America (ALCOA), and by 1914, he has brought the cost of aluminum down by eighteen cents per pound. It was not considered a precious metal anymore due to this discovery. Paul Heroult also created the same thing independently. Both got the answer by electrolyzing a solution of alumina in molten cryolite, this gives a result of a layer of

molten aluminum in the bottom of a metal container. The two processes are nearly identical, however, Heroult used larger anodes and cryolite as the basis only, where Hall used smaller anodes and added a small amount of fluorspar to the cryolite. The two scientists had fought lengthy wars in court to ensure that their patent went first. Hall proved he had found this process first. Evidently, the inventors became good friends and this process is now called the Hall-Heroult process.



11.A Charles Hall manufactured aluminum

Different prices go for each metal. For example, platinum is worth \$15,144 per pound while copper is worth \$2.07 per pound. Nickel \$3.89 per pound, silver is \$244.64 per pound, and gold is \$3,032 per pound. Creating these elements by transmutation could be worth it. It is very expensive to change the elements. In order to change from one element to the other takes lots of energy and expensive machinery. This machinery creates a highly powerful nuclear energy. There is an argument in whether or not transmuting these elements are worth it. Many argue that if there were a cheaper way to be able to transmute elements, it would make rarities become common metals, like aluminum was, therefore, making it less



12.A Depiction of Aluminum

valuable.

Chemistry is ever evolving and changes constantly. The processes are long and could take an entire lifetime. Many scientists devote their entire life for one single discovery, while others spend their life trying to make many discoveries, some discoveries that were never even made.



13.A Photo of a Beaker

SUPPLEMENTAL ARTICLE

The Ethics of Manipulating Atoms

Kayla Harden, SPCHS Student

March 17, 2016

In 2014, the Kurchatov Institute in Moscow, Russia turned the commodity of lead into the rarity of gold. Though this amazing feat produced a faint amount of gold, this sought out goal had been tested for many centuries by desiring alchemists, who not only spent their life trying to break the code for the philosophers stone, but much time and effort to for a discovery that not only seemed far-fetched, but extremely impossible.

Transmutation is the act of changing one element into another by radioactive decay or nuclear bombardment. Because of this, the ethics of doing so became an issue.

The ethics behind manipulating atoms, such as alchemy and transmutation has been disputed for centuries. Arguments have been presented that it is unethical to change elements because they were created as one thing and are not meant to be changed. On the other hand, some say it is completely ethical because it furthers scientific research and possibilities in the world of science.

Rachel Harden, a major in biomedical sciences, believes that transmutation is ethical because “atoms mutate naturally on their own and this process is simply replicating that.” Harden thinks that having the ability to manipulate and change atoms is exciting, but dangerous due to the instability and unpredictability of isotopes, as well as the radioactivity that can be produced.

If the opportunity came by her, she would “probably not” turn lead to gold, Harden explained. “The appeal of manufacturing gold is most likely related to perceiving wealth, however, producing mass amounts of gold could just lessen the overall value.”

Harden believes that considering the time, effort, and money, it does not seem worth it to build one’s wealth, owing to the the fact that the more gold that is made, the lesser it becomes in value. Nevertheless, she feels that research should continue in this field of

study. “Nuclear medicine is an important use of radioactive isotopes, as is nuclear energy. There are beneficial uses to manipulating atoms, and many scientists who want to apply this towards bettering mankind,” Harden clarified.

There have always been pros and cons to discoveries in science. Harden expounded upon the benefit of transmutation. For instance, if at any point, there was a shortage of a certain precious metal, this new found technology could potentially make up for the absence of that metal. Transmutation could also help aid the medical field in building and producing medicine, especially if there is a shortage of it.

Although, there are consequential drawbacks to manipulating atoms as well. Harden explained that the unpredictability of isotopes is a disadvantage that could be hazardous. One cannot be sure if an isotope is completely stable, especially if it is man-made. “[There is] incomplete knowledge of all possible reactions,” specified Harden. Radioactivity can be one possibility with such processes, and can be quite dangerous. Despite the advantages and disadvantages, the ethical issue remains.

“I do understand how this knowledge could be used to manufacture harmful radioactive materials to be used as weapons, but that’s not representative of the process itself, just what is done with the knowledge,” says Harden. “It is not unethical to understand the way atoms react though,” Furthermore, there seems to be no ethical issue presented for Harden. Due to the natural occurring mutations happening to atoms in the “natural” world, changing them in similar processes in a laboratory is not quite different.

The other side of the ethics behind changing elements is the undeniable fact that the technology and processes could potentially be used in the wrong. “Like anything in the wrong hands, it could be used to harm instead of help,” explained Harden, “Certain people may take advantage of this, but research shouldn’t cease based on the worst case scenario. It also could be extremely beneficial if used for good.”

If many people were presented with the opportunity to transmute a metal, most would choose gold, or platinum, or a high priced, precious metal because they could sell it for a high value. Harden, on the other hand, would choose silver, not for the fiscal value, but because “silver has many uses in everyday life and medicine. It is also an antibacterial,” she

specified. She feels like it is the most widely used metal. Though, if the opportunity did, in fact, present itself to make her rich, Harden stated, “As long as I was getting rich by helping humanity, I’d be all for it!”

3

LIVE FOREVER!



Humans have two very fundamental desires, the desire to live forever and the desire to have unlimited power. New innovations in technology may be able to grant access to these innate desires, and their development is crucial to the advancement of the human race. These innovations are incredibly attainable today, and science has already made huge strides in the last 100 years alone. Nuclear power and new studies in aging have been incredibly promising, and both have an impact on quality of life. Aging and the internal mechanisms that control how bodies decay have long been studied in an effort to slow down or stop aging altogether. Looking at everything from diet to specific gene mutations, scientists are coming up with new ways to slow down this process and find the theoretical fountain of youth. Nuclear power and the possibility of a third nuclear option, hybrid energy, have also been developed and have already been implemented in some areas. Nuclear power and the different developments that slow down aging are crucial, and the different aspects of both of these technologies will be discussed in this paper.

Being one of the most elusive mechanisms of life, aging has the ability

to slowly destroy every organism, no matter how healthy. As of today, life spans have been prolonged extensively with the advancements in medical care and treatments. Life expectancy in the United States has grown from 46.3 years old for women and 48.3 years for men in the 1900s to 81.2 years for women and 76.4 years for men today (“Life Expectancy in the USA”). That is a nearly 30-year difference on average, and scientists are hopeful that this gap can be widened even further as they learn more about how aging works and what effects its rate of progression.

Aging is not simply a process that causes wrinkles and impairs memory. It is a very complex side effect of biological function that is dependent on a number of factors. Aging is defined as the “accumulation of damage in the molecules, cells, and tissues over a lifetime,” and this process can decrease an organism’s ability to maintain homeostasis effectively (Rodriguez-Rodero 186). Aging has a very significant effect on DNA, and over an organism’s lifetime, DNA is slowly altered and broken down which negatively impacts cell regeneration and function. This damage can alter the body’s necessary processes, and makes it much more susceptible to diseases

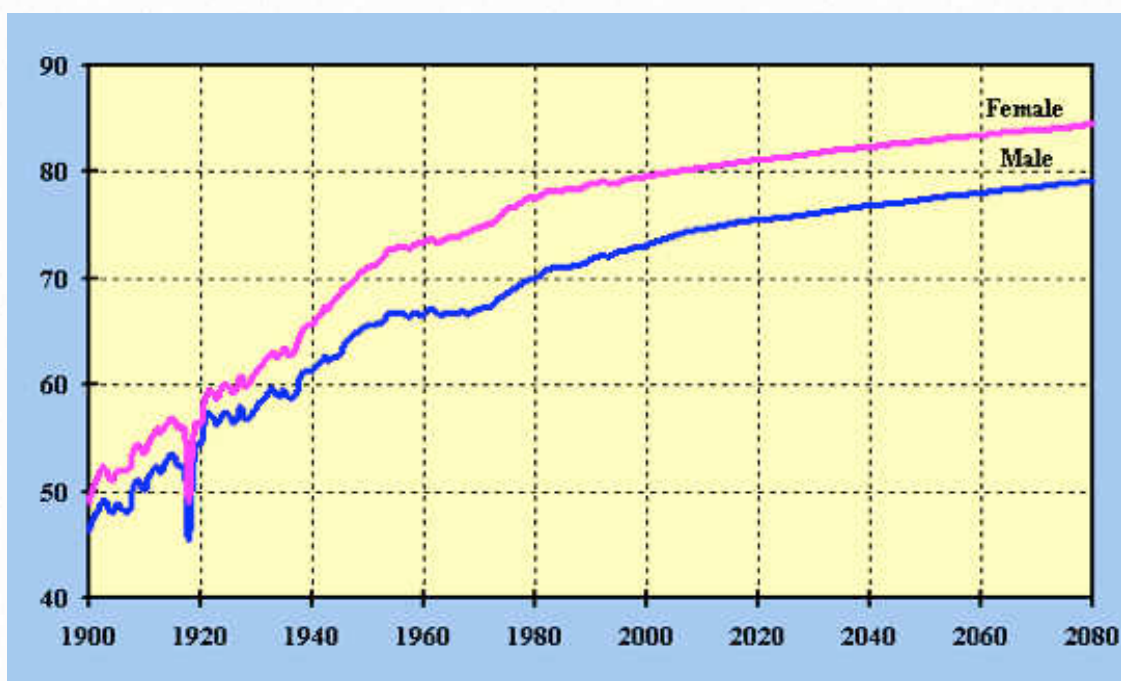
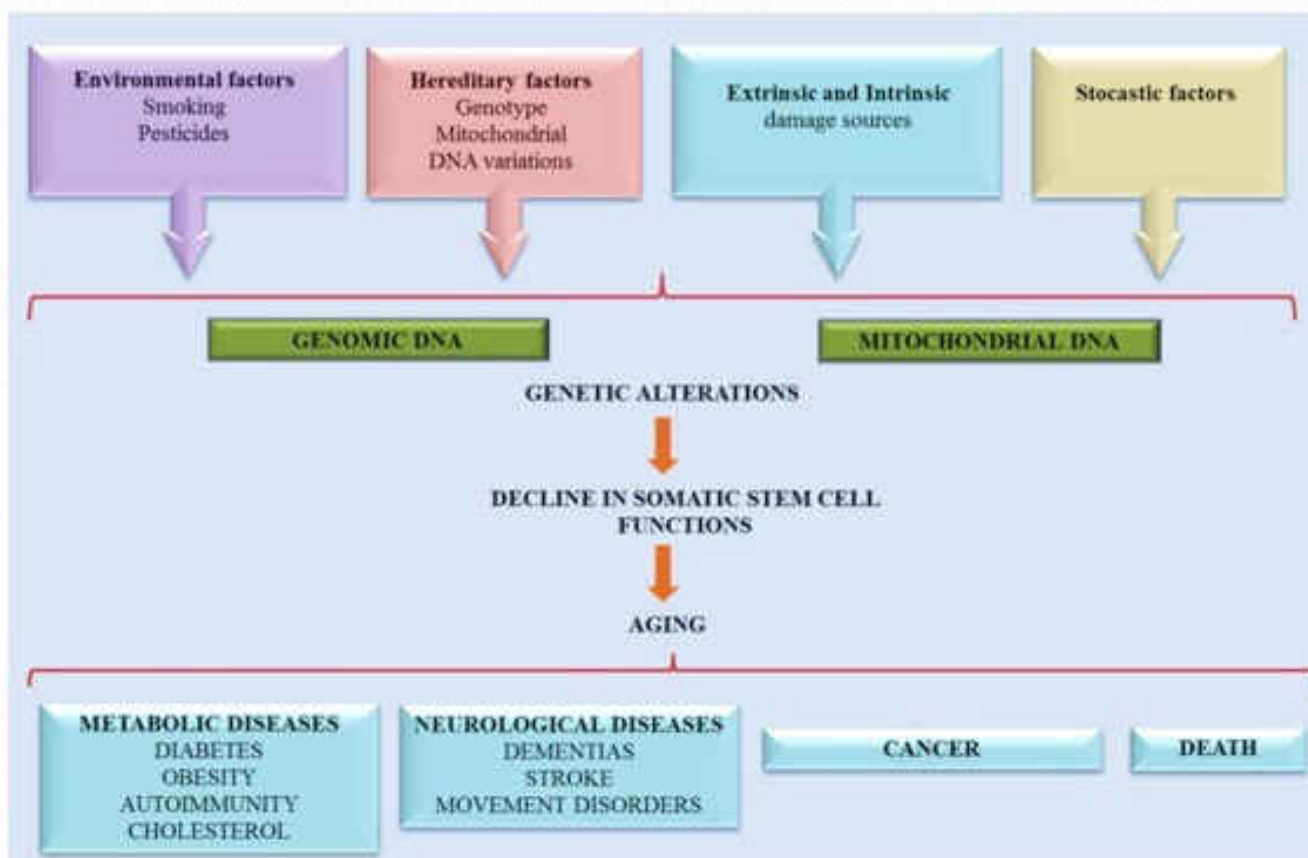


Figure 1.B Increases in Average Age for Men and Women



2.B Chart of factors leading to aging

like cancer. Everyone ages differently due to any number of environmental and genetic factors, and these are being closely examined in order to understand precisely why the rate of aging is different for every individual. Different genotypes, dietary habits, chemicals like resveratrol and

Rapamycin, as well as hormones like DHEA (dehydroepiandrosterone) are all being studied in an effort to alter this process.

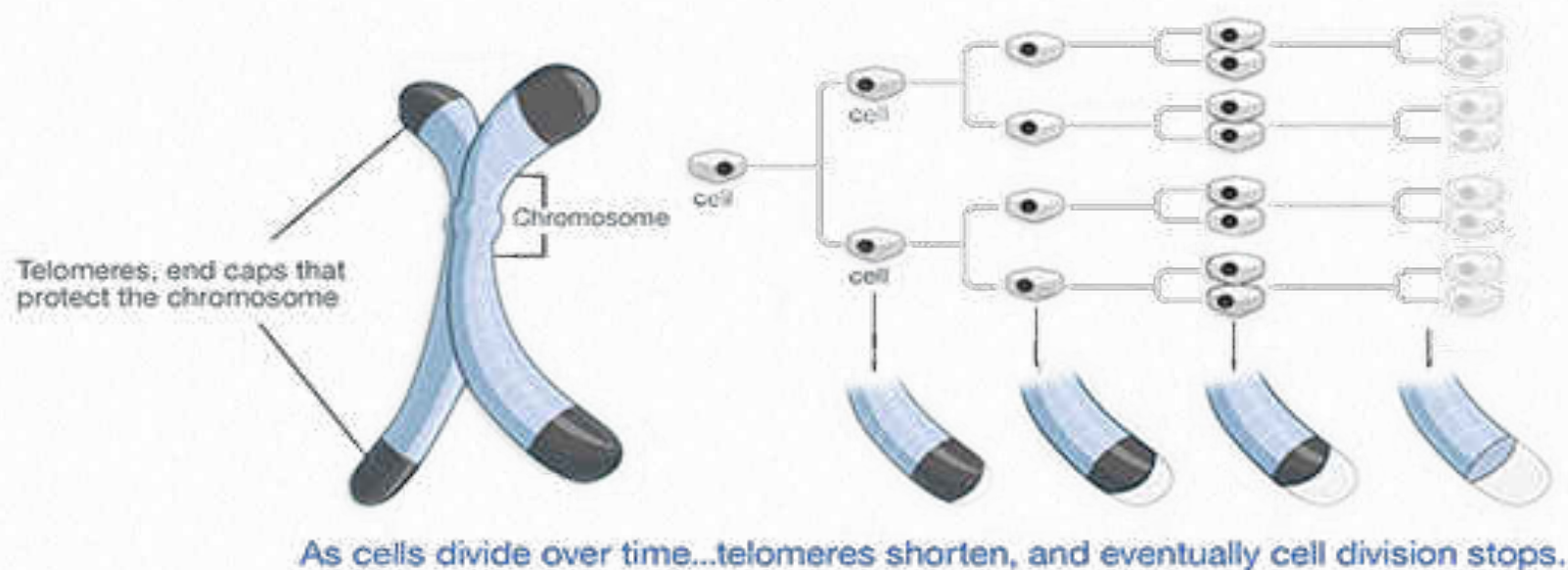
As mentioned before, different genotypes and genetic diseases have been examined in order to observe their impacts on aging. Progerias, a class of

Syndrome	Gene	Function
Cockayne Syndrome	ERCC6(CSA) ERCC8 (CSB)	DNA repair
Fanconi Anemia	FANCA, FANCB, FANCC, FANCD1, FANCD2, FANCE, FANCF, FANCG, FANCI, FANCI, FANCL, FANCM FANCN	DNA repair
Werner Syndrome (WS)	WRN	DNA helicase
Bloom Syndrome	BLM	DNA helicase
Rothmund- Thomson Syndrome	RECQL4	DNA helicase
Hutchinson- Gilford Syndrome	LMNA	Structural Protein

3.B Table of Progeria Related Genes

diseases that cause rapid aging, is one of these genetic deviations and is characterized by the alteration of DNA repair and structure. The DNA helicase is often weakened or altered, or the DNA cannot properly repair itself for any number of reasons. In most of the Progeria diseases, including Hutchinson-Gilford Progeria and Werner syndrome, the mutation of genes that produce the proteins for DNA, such as the WRN (Werner Syndrome RecQ) and LMNA (Lamin A/C) gene,

are responsible for rapid aging (Roderiguez-Rodero 189). This single genetic alteration is solely responsible for nearly every symptom of Progeria. The damage of DNA is not just exclusive to Progeria diseases, and can happen to any adult who has lived for a long period of time. In the average adult, DNA can become damaged as telomeres, the protein that encases the ends of DNA



4.B The effect of telomere shortening on chromosomes

strands, are shortened. Every time a cell divides the telomere is slightly shortened, and it eventually disappears altogether. Without this “cap” the chromosome is unstable and cell function is harmed leading to some of the symptoms of aging. This degradation of DNA, either due to repeated replication or genetic diseases, is one of the central causes of aging as DNA is crucial to maintaining proper homeostasis (Rodriguez-Rodero 187). Although there is no one specific gene alteration that causes aging, there is a common link of DNA damage that eventually leads to an accumulation of errors and therefore damage to reproductive processes, bodily functions, and mental capacity (Rodriguez-Rodero 190). DNA degradation is different for everyone, and is dependent on genetic factors such as protein production and chromosome stability. This is why aging rates are different for every individual, and it is impossible to pinpoint one gene to be solely responsible for aging rates. So far, there is no way to better preserve DNA and stop individual cellular errors, but it is likely scientists may be able to better understand the scientific process of aging in the future.

In addition to studying DNA, scientists have also been investigating the effects of hormones on the aging process. According to the National Institute on Aging, children have high levels of hormones like DHEA because they are going through regular growth periods. It has been hypothesized that reintroducing or increasing these hormones later in life may slow aging, but the

results are incredibly varied. DHEA, testosterone, estrogen, and somatotropin are the most promoted growth hormones. They have been marketed as dietary supplements that can reverse or slow the effects of aging (“Can We Prevent Aging?”). Hormones instruct certain cells to preform varying tasks including replication and protein production. DHEA causes the body to produce other hormones

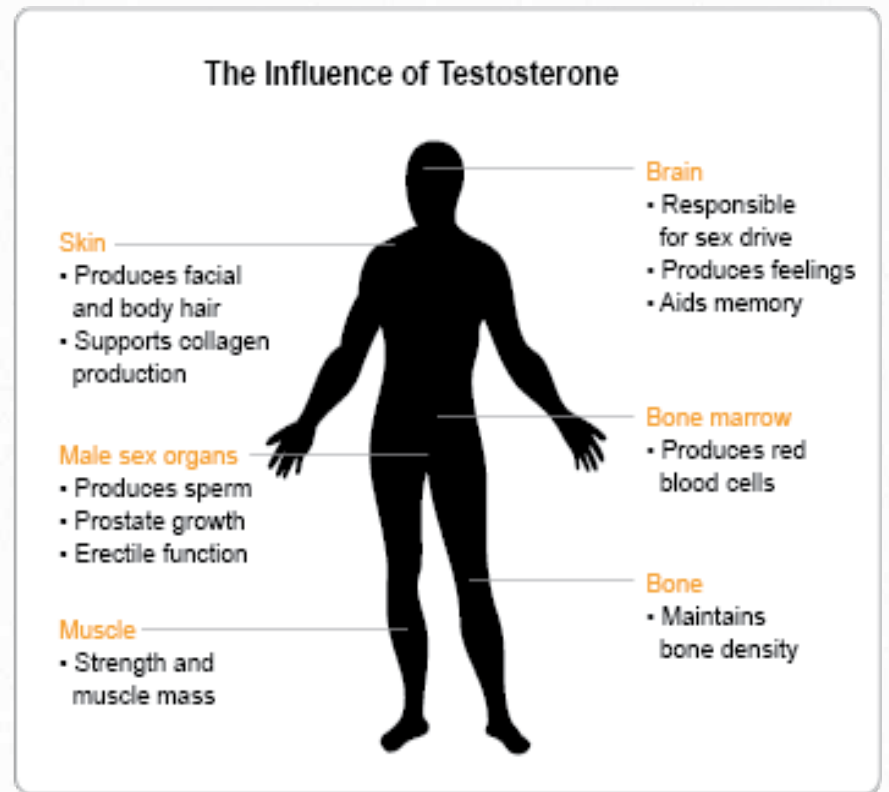


Figure 5.B Effects of Testosterone on the Male Body

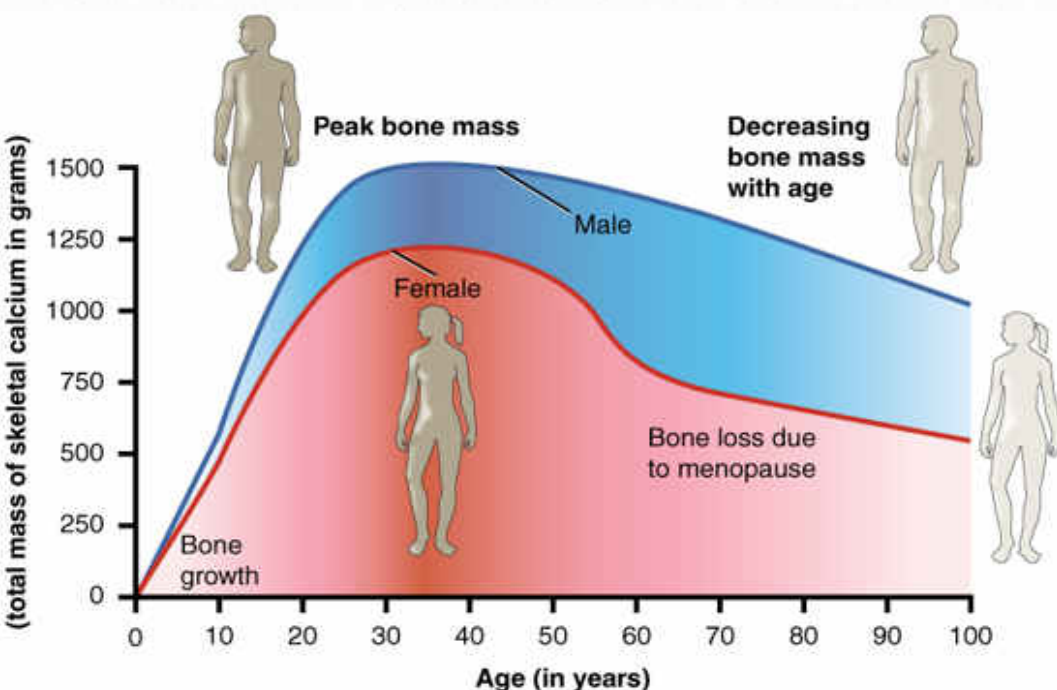
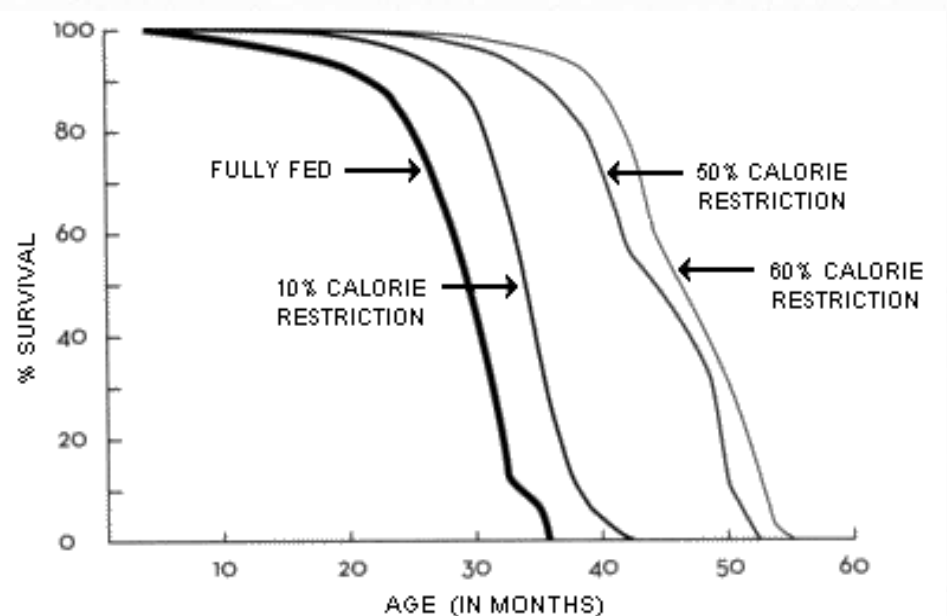


Figure 6.B Loss in bone mass due to aging

especially estrogen and testosterone. DHEA boosts energy, increases metabolism, and strengthens bones; three things that decline with age, but there is no unbiased, conclusive, evidence to back up this claim (“Can We Prevent Aging?”). Somatotropin, or Human Growth Hormone (HGH), have similar issues. The body purposely produces less of somatotropin with age because the body has fully matured, and adding more of it into the human body has not had any

significantly positive effects on the aging processes. These hormones are incredibly lucrative despite the lack of scientific evidence. Anything promoting anti-aging properties is bound to earn money, and HGH shots can cost around \$15,000 dollars a year (“Can We Prevent Aging?”). The companies selling these “supplements” are responsible for most of the reports supporting the aging reversal effects of these hormones.

Although somatotropin and DHEA are not incredibly effective, testosterone and estrogen may be slightly more promising. In addition to sperm production and libido, testosterone regulates red blood cell production, muscle and body fat, and bone mass. Estrogen also effects



7.B Effects of Caloric Restriction on mice

bone mass and strength as well as memory and heart function. Although testosterone does not decline dramatically like estrogen does with age, small increases in this hormone may still be useful to older men. Preliminary studies suggest that testosterone can help delay muscle and bone frailty and decrease in sex drive (*Don't Grow Old Holding Back the Years*). It may also help sharpen memory, but studies on this are somewhat inconclusive. Estrogen does decline significantly with age, and reintroducing higher levels of this hormone has improved bone strength in menopausal women. Research has also indicated that estrogen can reduce heart disease and memory decline ("Can We Prevent Aging?"). Estrogen may protect against Alzheimer's and dementia because of estrogens impact on brain health. This being said, much remains unknown, and these are only a small part of the aging puzzle.

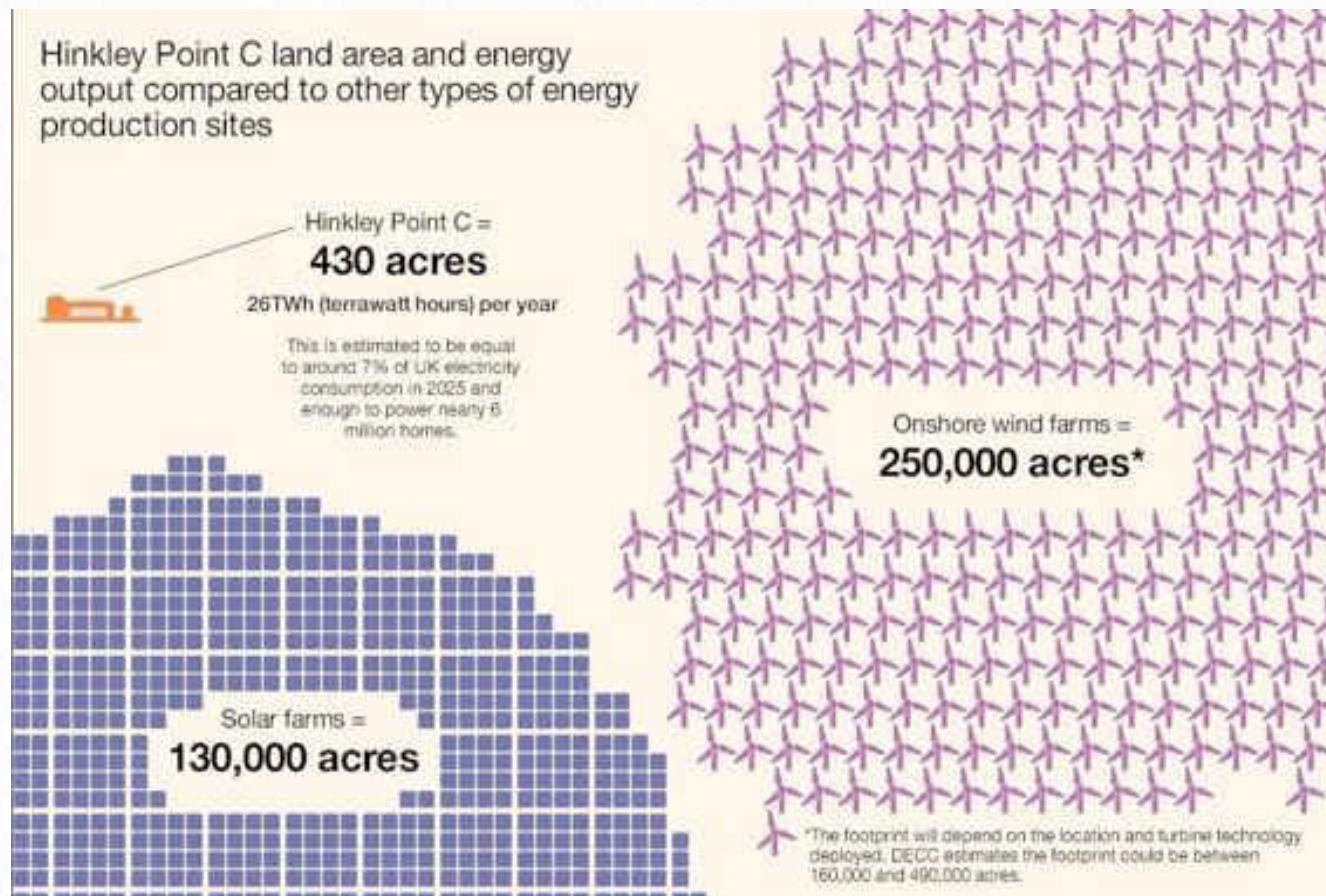
Moreover, while growth hormones may seem like the best way to reduce the effects of aging, the most well researched and effective way to slow aging is by regulating diet. There have been intensive studies in calorie restriction and the health benefits of different nutrients. Reasonable calorie restriction in the average person reduced the risk of heart disease, cancer, diabetes, and many other diseases in addition to improving bodily function. In addition to this, chemicals like resveratrol, which mimic calorie restriction, have been proven to extend life expectancy and overall health for a wide range of individuals (*Don't Grow Old Holding Back the Years*). The effects of long-term usage of a calorie-restricted diet are still uncertain, but recent studies are promising and consistent in both human and non-human studies. The restriction of alcohol consumption and other harmful substances has also proven to be vital in the anti-aging effort because of the damage it inflicts on the body. Diet is central to slowing the aging process because it encourages healthy cell and DNA function, and as mentioned previously this is crucial for longevity.

4

**GAIN ACCESS TO
UNLIMITED POWER!**



Similarly to the problems of aging, power and the dwindling access to it pose another issue affecting quality of life. Natural gas, solar energy, fossil fuels as well as many other methods have and continue to provide power for humans, but none of these power sources are as effective and sustainable as nuclear energy. Nuclear energy can produce power through either fission or fusion, and/or more recently, a hybrid of the two. As of today, the most commonly utilized nuclear power is fusion.



8.B Comparison of Energy Output with Land Area Taken Up

All three of these options are very promising sources of near unlimited power, but they each come with advantages and disadvantages. By exploring the different aspects of nuclear energy scientists able to find ways to produce electricity more efficiently than ever before.

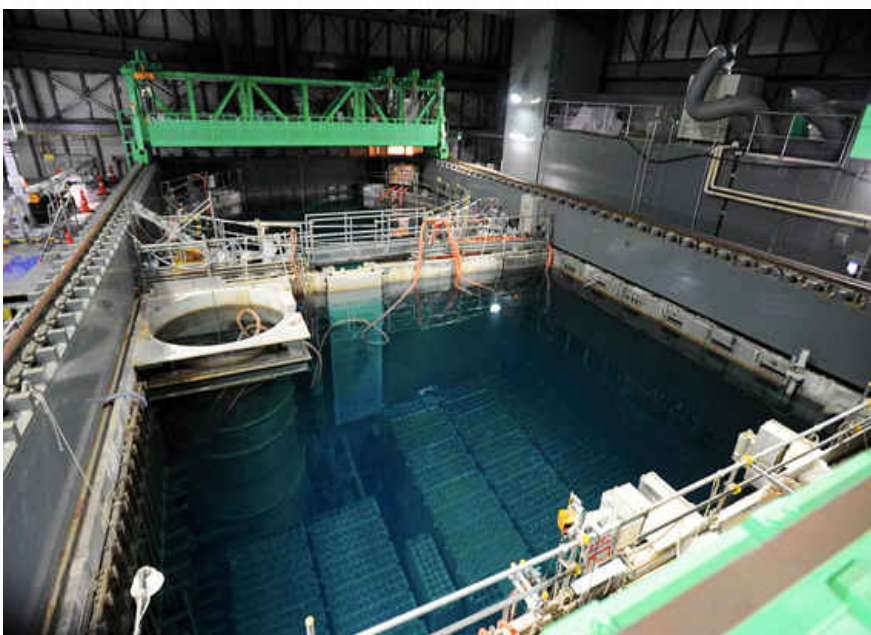


Figure 9.B Example of a cooling pool

The nuclear energy most commonly used today is produced through fission. Fission occurs when the nucleus of an atom is split apart and a chain reaction that splits the surrounding atoms occurs. The forces holding the protons and neutrons in the nucleus of an atom together are incredibly powerful, and the bond between these subatomic particles is seemingly unbreakable. However, if a nucleus is bombarded with a neutron, it can split the subatomic particles apart, and then neutrons from that atom are released. The

released neutrons then bombard other atoms, releasing neutrons from them and creating a chain reaction that gives off immense power. Control rods are used to catch or absorb these now freed neutrons, and they consist of elements that are able to absorb neutrons without causing a chain reaction themselves (Hunt 3). This process is efficient, but it produces an incredible amount of radioactive waste that can take hundreds to thousands of years to fully decay.

Additionally, fusion has also been proposed as a means for nuclear power. Fusion occurs when hydrogen atoms are “fused” and united to form helium. Excess energy is produced when the atoms unite, and that is released as heat. This process would produce a lot less radioactive waste than fission does, but there are stability issues that come with this type of reaction. This process is what occurs on the sun, and it similarly produces incredible amounts of heat. There are no materials currently in existence that can handle this constant release of heat energy, and this process also requires a vast amount of space (Hunt 7). This makes this type of reactor less favored than fission reactors because of the lack of resources to contain them.



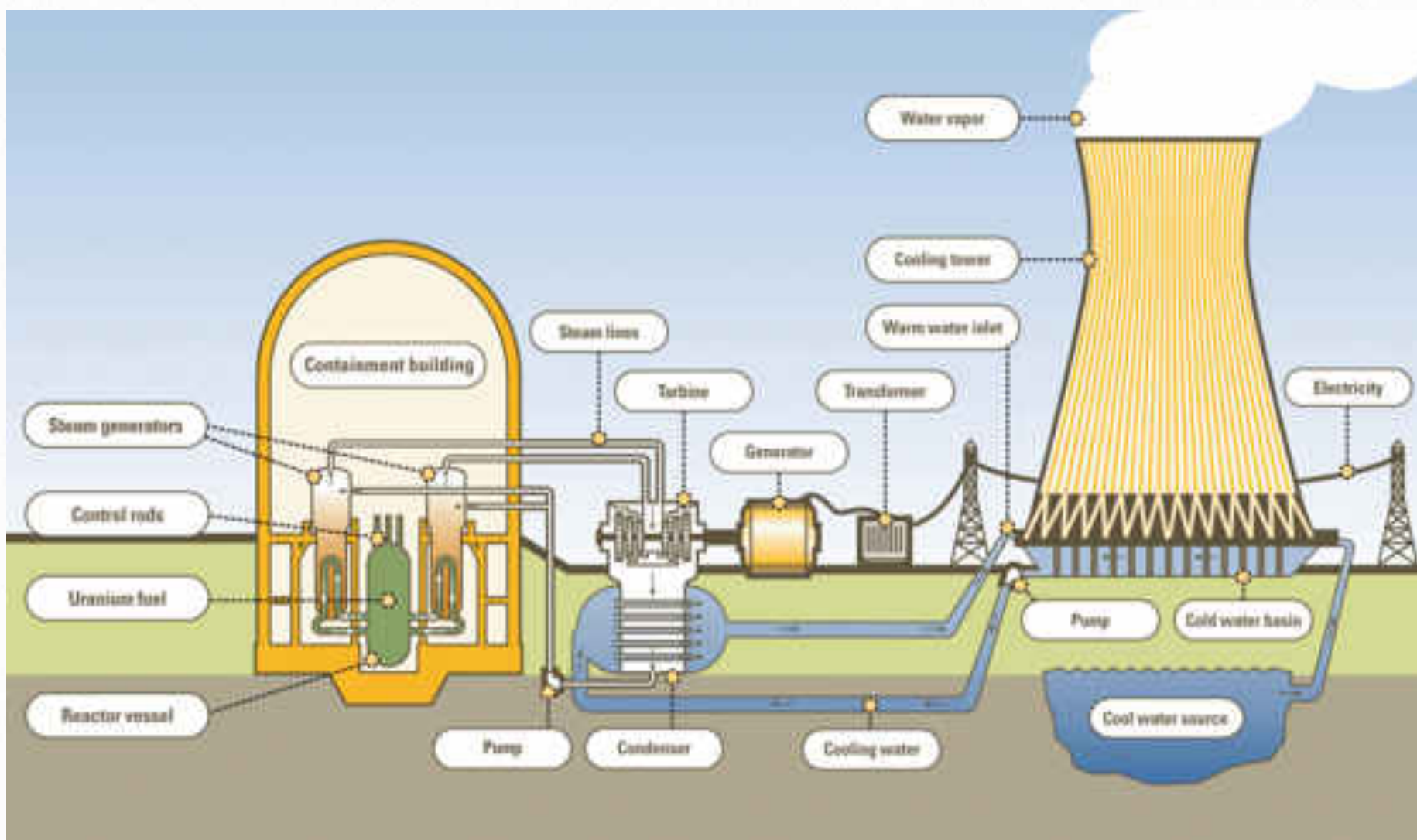
10.B Concrete put over Chernobyl Facility

As stated above, nuclear power produced by fusion and fission can be incredibly dangerous, and a third nuclear option, hybrid energy, may be the solution to this. With fusion, there are dangers in the reaction itself, the fuel used to start the reaction, and the waste produced after the reaction is complete. If there is not sufficient absorption of the neutrons or the cool down mechanism fails, the reactor can meltdown and release radiation. The

waste itself is also radioactive, and there are risks during disposal including possible contamination of ground or water supply. With fusion, the large amounts of heat produced are also a cause for concern. Radioactive waste is also produced, but it has a shorter degradation period. Hybrid nuclear reactors may be able to solve these problems and offer a safer and more effective way to produce energy. Hybrid reactors contain a plasma core that undergoes a form of low energy fusion. The fusion in the core then stimulates fission in the nuclear materials that surround the core (Hunt 10). In this system, the nuclear materials that undergo fission can be reused, so there is virtually no waste created. It also solves the space and heat problems of the fusion model because the type of fusion occurring in the core produces only small amounts of energy. Power output of

the fusion process can also be controlled in the hybrid model, meaning the probability of a natural disaster causing a nuclear meltdown is reduced significantly (Hunt 10). The hybrid model is still in the experimental stages and poses problems just as fission and fusion models do, but in comparison it is much safer.

As mentioned above, every nuclear option poses some risk, but this risk is often accepted because of the benefits nuclear power allows. The cultivation of natural gas, coal, and other fuels pose danger to human life just as nuclear power plants do. Nuclear power plants provide completely clean energy, and the nuclear fuels used are all sustainable and abundant. Nuclear fuel needs replacement only every two years, and the revenue it creates from the energy it produces



11.B Nuclear power generation process in full

outweighs the cost of replacement (Hunt 12). Nuclear power is environmentally friendly, unlimited, and economically practical. With new innovations in safety and the careful casing surrounding nuclear reactions, meltdown incidents are isolated and infrequent. More people die from coal related emissions than they do from nuclear meltdowns. Living next to a nuclear power plant is almost completely safe due to safety measures and concrete shells that absorb the radiation.

Fusion, Fission, have all been proposed in electricity, but the energy processes does not go grid. Once the nuclear a series of systems to turn it into the electricity sockets. The typical contains fuel, control coolant, a turbine, a contain the fuel. The fuel enriched uranium (U-238 because of its ability to Control rods then control the fission reaction moderator surrounds the fuel in order to slow down the release of neutrons, and ensure a chain reaction. The moderator water, and act as the which system

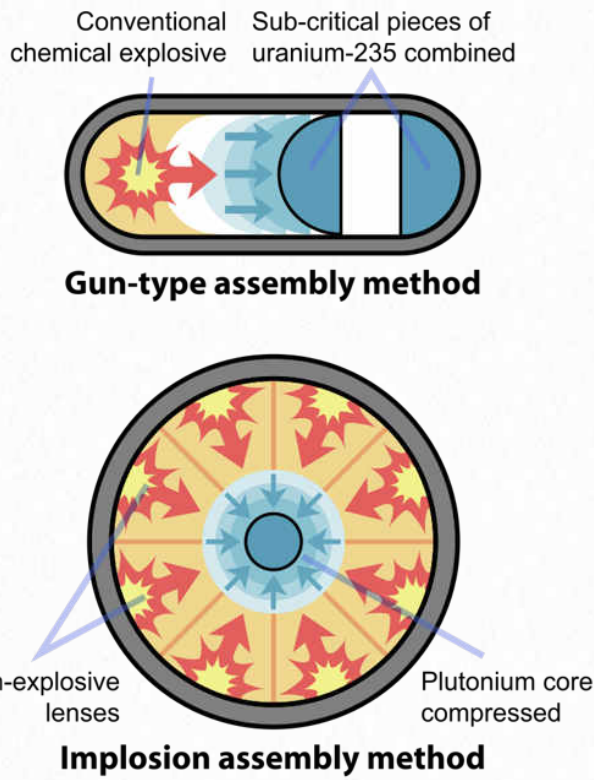


Figure 12.B Comparison of gun and implosion assembly methods

and the hybrid model an effort to provide clean produced in these directly into the power reaction occurs, there are harness the energy and that comes out of power nuclear power plant rods, a moderator, generator, and vessels to cell normally contains or U-235); chosen readily undergo fission surround the cell to and ensure safety. A

The is normally it can also coolant, keeps the from

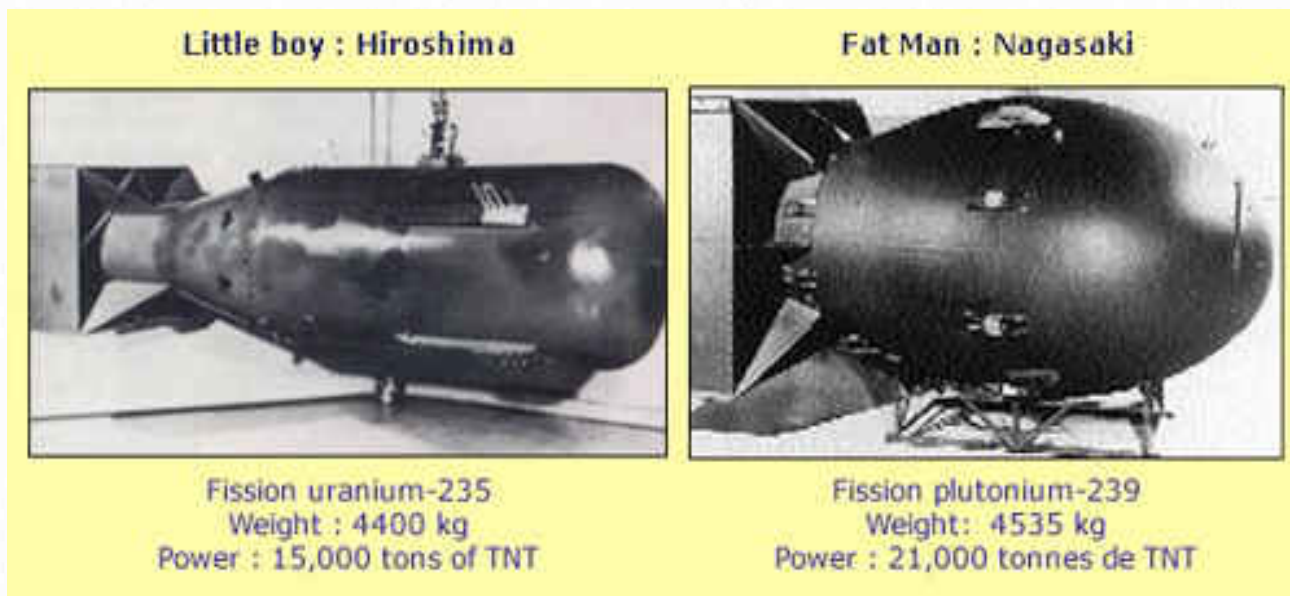


Figure 13.B Little Boy and Fat Man, two of the bombs used in WWII

overheating. The water surrounding the fuel then heats up and turns to steam, which then turns a turbine (“How Nuclear Power Works”). The turbine powers a generator, which then produces the electricity that comes out of power sockets.

Unfortunately, fission is not just used for creating electricity, and a more sinister use of this technology is the nuclear bomb. The nuclear bomb, first developed in the U.S. by the Manhattan project, utilizes fission to create devastating explosions. In nuclear power plants, fission is controlled, and the immense energy it generates is contained. In the atom bomb, the nuclear fuel must only be contained and stable long enough for the bomb to be set off, and once this has occurred the radiation is released, leaving the area in which it was detonated extremely dangerous and radioactive. Nuclear bombs must have sufficient uranium or plutonium (most commonly uranium-235 and plutonium-239) ready to undergo fission in order to ensure the neutrons released in the initial fission produce a chain reaction (“Science Behind the Atom Bomb). Little Boy and Fat Man were the first two atom bombs actually used as weapons. Little boy utilized a gun-type design that fired two masses of uranium at each other in order to combine them and begin fission. Fat Man could not have a gun-type design because of its use of plutonium, which is much more unstable than uranium, and it instead had a plutonium mass surrounded by explosives. When the explosives detonate, the plutonium quickly combines and fission begins. This method produces a much bigger explosion, and it is the kind of explosion most weapons of mass destruction employ today (“Science Behind the Atom Bomb”). Because the atom bomb does not require continuously stable and usable uranium and plutonium, it can operate using nuclear waste. This means terrorists can utilize the unstable nuclear waste to create these devastating weapons, and this is one of the problems with nuclear power.

In conclusion, both nuclear power and efforts to stop aging are essential to the advancement of the human race. Although there is no definitive way to live forever, lifespans continue to increase every decade as new technologies arise. There is access to large quantities of power through the fission nuclear reactors of today, and as hybrid energy is refined, power will become nearly unlimited. Aging rates and nuclear power are seemingly unrelated, but they are two of the most imminent problems the human race needs to solve in order to survive. Without extended lifespans and access to power, the innovation and advancement rates of humankind will be greatly deterred. Even now these findings show promise, with nuclear powered rockets and cryogenic age slowing being proposed as means to get humans into deep space (Hunt 14). Through science, what seemed impossible 100 years ago has now become tangible, and these discoveries continue to unravel nature’s greatest mysteries.

SUPPLEMENTAL ARTICLE

Why are Americans ignoring unlimited power?

Chloe Johnson, SPCHS Student

12 March 2016

In Plymouth, Massachusetts, a once bustling nuclear power plant now stands nearly deserted with a glaring “keep-out” sign. Pilgrim Nuclear Power Station, which once provided nearly half of a million people with power, is the latest victim in a series of nuclear power plant shut downs. The huge grey cylinders, in place to contain any potential nuclear spill, still stand tall and ominous against the blue Massachusetts sky, a frightening reminder of the fate of clean power in this country.

The majority of the population is oblivious to nuclear power, and this vital energy source only makes major headlines when a meltdown occurs or nuclear fuel is involved in a terrorist threat. The perception surrounding nuclear power is an ultimately negative one, despite the fact that, according to the Nuclear Heritage Foundation, uranium-235, the isotope most commonly used in nuclear reactors, can produce 3.7 million times more energy than an equal amount of coal. Nuclear power is cheaper, more efficient and safer than traditional means, but if the negativity surrounding it persists, it could mean the downfall of the entire industry. By exploring the general beliefs held by the public, it is easier to understand the general fears they hold and ultimately educate them on what impacts nuclear power truly has.

The first step to understanding nuclear energy is understanding how it functions. When asked how nuclear power works, those interviewed produced mixed ideas. “Isn’t nuclear power just generated by energy collected from the stuff radiating of the reactor?” Taylor Johnson, a 12 year-old middle school student, asked with apprehension in her voice. Remington Fritz, a high school student four years her superior, had a different but equally wary response. “Nuclear power has something to do with atoms. I’m pretty sure they split, or something along those lines,” Fritz said. William McDonald, a 37 year-old, had one of the most accurate responses. William said, “Nuclear power produces energy by undergoing fission in a core and therefore heating the water surrounding it. That steam turns a tur-

bine and somehow that electricity is transferred to a power grid.” Out of the six asked, only one was somewhat accurate with his response. The lack of knowledge surrounding nuclear power was expected, especially considering there are only 99 nuclear power plants operating in the United States and the topic isn’t often discussed. Nuclear power plants are nearly obsolete as an energy source because the public does not typically favor nuclear power. According to the United States Nuclear Regulatory Commission, the number of nuclear power plants decommissioned has reached nearly 200 in the U.S. alone, especially after the Fukushima disaster, a nuclear meltdown that occurred in Japan in 2011. “Look at Fukushima! Do we really want that happening here?” Jackie Green, a 73 year-old Saint Petersburg resident said. “I wouldn’t want that happening in my neighborhood. I wouldn’t want to live by that.”

Green wasn’t the only one fearful of nuclear power and the possibility of a plant melting down. “[Nuclear power] just doesn’t sound very safe.” Johnson said. “I know there have been incidents with radiation leaking and it causes a lot of serious problems to people’s health.” Every interviewee expressed some kind of fear surrounding nuclear power. “I’ve read in the newspaper where nuclear power plants have had meltdowns that destroyed entire communities,” said Betty Mcgee, a 62 year-old resident of Tampa Fla. “The facility wasn’t handled properly and it destroyed people’s lives. Houses destroyed, people killed and injured, and then the place had to be deserted. Once it’s released it gets into everything: the water, the air, the ground, everything. And then it stays there for decades, not to mention the birth defects it causes.” These fears are legitimate, and there have been horrific disasters such as Fukushima and Chernobyl, a meltdown that occurred in Russia. However, these disasters are incredibly uncommon, and a fuel meltdown may be expected only once in 20,000 years of plant operation, according to estimations by Ohio University. Both the Chernobyl and Fukushima facilities did not have the containment systems required by the United States, and both had operational failure. Additionally, the Federal Energy Regulatory Commission stated that as of now, coal kills 10,000 people per year due to emissions and other accidents and it would take 25 meltdowns each year for nuclear power to be as dangerous as coal.

It isn’t just the fear of a meltdown that concerns people, but also what they don’t know about the long-term effects of living next to a nuclear power plant. “I don’t know enough

on the subject to form a definite opinion,” said Mcgee. “I have fear regarding nuclear power. Why wouldn’t I? What with all the problems and devastation it can bring about. I am uncertain about nuclear power, and it does play a factor in my apprehension.” It is this uncertainty surrounding this energy source that has lead to the public distrust and fear surrounding this power option. Thankfully though, there may still be some hope for nuclear power.

Hybrid nuclear facilities, a type of nuclear system that is much safer than its previous counterparts, tends to be more favorable among American citizens because of the decrease in danger. “It sounds like the perfect solution. If they can develop a system that is safer and less expensive than current systems, I’m all for it,” said Michelle Cupps, a 32 year-old mother of two. All six people interviewed generally agreed that they would be more amenable to nuclear power if it were “safer” and “disaster proof.” Hybrid power is able to achieve higher safety standards because it produces much smaller amounts of radiation, and the nuclear waste can be reused as fuel, reducing the likelihood of leak. By educating the populous on other nuclear alternatives, as well as how safe nuclear power really is, it may be possible to reverse some of the negative perceptions and allow nuclear power to blossom in the United States.

5

**HAVE A HIGH QUALITY
OF LIFE!**



It is a known fact that healthy eating leads to a longer life. Regular physical activity, personal behaviors and day-to-day choices all have a major impact on health and life expectancy, which can result in higher quality of life. Diets and a proper standard of living, including regular sleep and nutrition influence human's mental and physical health. It is one thing to harm the body with high fats intake or smoking, all without working out, and it is the other to eat better and take proper care of the mind and body. Following a healthier lifestyle includes proper diet, exercise, water intake and digestion, along with eliminating smoking, would lead to an extended lifespan.

In order to increase health, start out with these helpful tips to a better lifestyle and more fit daily routine. Number one on the to-do list is to quit smoking. As obvious as it might be, tobacco products filled with copious amounts of nicotine really DO kill. Avoiding tobacco and the continuous consumption of alcohol will increase the number of years a person has of their life. According to Centers



Figure 6.C Comparison of a Smoker's Lung and a Healthy Lung

for Disease Control and Prevention (CDC), “Cigarette smoking causes more than 480,000 deaths each year in the United States” (Health Effects of Cigarette Smoking) which still stands today as one of the highest causes of death in

America. Smoking affects

almost every organ in the body and can encourage viral diseases. It is very common for smokers to develop a heart disease, such as a heart attack or Figure 6.C Comparison of a Smoker's Lung and a Healthy Lung a stroke, as well as lung cancer if smoking too many packs of cigarettes a day. The recent studies show that “each cigarette [people] smoke reduces their life by 11 minutes” (US National Library of Medicine) which, if all the cigarettes a typical smoker were counted, that would round up to an immense number of reduced life span. Smoking causes an increased health risk such as cardiovascular disease, respiratory disease and cancer in almost every part of the body. The adverse effects of smoking can negatively impact heart and blood circulation through the vessels, and can cause asthma and lung cancer. People who smoke get sick more often rather than the people who don't smoke because their health was significantly more affected by the nicotine. If a smoker were to quit smoking, it would drastically lower the risk of other smoking-related diseases and increase lifespan substantially.

Today, the average lifespan of an American citizen (male or female) is approximately 79 years old according to The World Bank statistics for the year of 2013. Women’s life expectancy is often much longer than men’s. The report at Medical News Today states that “in 2012, the life expectancy for females stood at 81.2 years, while the life expectancy for men was 76.4 years” (Whiteman, MNT). Most of these Americans are dying from unintentional injuries, heart disease, cancer or strokes, all of which are increased by poor life choices and diet skills. Lifestyle choices play a central role in the health and well-being of a human. A majority of the people, which are dying from heart diseases and strokes, have failed to properly take care of their body. From years of dietary research and proper care taking skills, fitness and health researchers are certain lifestyle choices can gradually extend life span.

Fitness and nutrient-rich diet plans help regain and maintain



Figure 7.C Exercise and a healthy diet are vital to a long life



Figure 8.C Examples of Processed and Unhealthy

plan on burning throughout the day. For the people that need to watch their weight in order to reduce further body damage and a risk of developing a heart disease, they need to focus more of their daily habits and attitude towards things regarding food. Cutting out fast food restaurants along with sugar, high-fructose syrup and trans-fats (careful about eliminating the good fats) will improve the way a body feels almost instantly. “Three nutrients are responsible for providing your body with energy, or

strength and well-being of humans. With this they will finally be receiving proper blood flow from the workout and beneficial elements, vitamins, and minerals, along with essential nutrients which stimulate the heart and the whole body. An anti-aging diet would encourage a more restricted, lower calorie meal plan, which still includes the same protein and nutrients as the other foods. This diet doesn’t include high fat foods but rather less processed foods. Since people cannot change their genetic appearance, they can in fact change their diet to eating the same amount of calories as they



Figure 9.C Protein is essential to a balanced diet

calories—carbohydrate, protein, and fat” (Haywood, 50). These chemicals are called micronutrients and are proven to fuel up the body by increasing proper organ functions. Simple carbohydrates, also referred to as sugars or glucose, can be found naturally in fruits and juice. However, stay away from cookies, ice cream, soda, candy, etc. Although they are also considered sugars, these sugars are proven to have minimum to no nutritional value and a ton of calories! Nearly any diet can result in weight loss, so there is no reason to utilize a low-carb diet because some of the healthy, beneficial carbs found in



Figure 10.C

Exercising is necessary for the human body to work properly

common foods will actually help maintain

the perfect, balanced regime. Protein should be the number one requested nutrient desired by the body. Protein helps repair damaged tissues as well as propel enzymes in the body. It puts the body together by supporting bones, muscles and tissues. Talking about bones and muscles, daily exercise or work out is an



Figure 11.C

Calorie restriction plays a role in keeping the body healthy

essential part of healthy lifestyle.

By working out the limb in the body, it is gaining strength and power to operate. Running is the most applicable type of exercise because it doesn't require much equipment. Its purpose is to contract and release heart muscles, pumping and circulating blood around the entire body, increasing the flow of blood which expands the vessels.



Figure 12.C A Basic Vegetarian Food Pyramid

By adopting these traits and lifestyle choices, it is possible to live beyond the average life span because as humans will start following these simple beneficial tips, their bodies will soon recover. They will still be receiving valuable body supplements and vitamins attained from better tasting, natural, non-GMO or processed foods. According to Health and Wellness Resource Center and the more recently suggested research, “calorie restriction may increase the maximum human lifespan by about 30%” (Gale

Encyclopedia of Diets). Exercising should become a daily routine in everyone's life; whether it's going to work out at the local gym or walking a mile around the block, it has the same effect on the body and will influence the dedicated, steady mind set.

The key to living a healthier lifestyle is to enjoy it and not feel as though it is torture. Taking things slowly seems to work the best for people rather than changing the whole daily routine in one day. The body needs to slowly adapt to changes in order to adjust to a healthy eating routine. It should be something that people strive for in order to show love to their own bodies by taking good care of it and also to have an overall higher quality of life. Vegetarians may seem like the stars of the show because they eat healthy and restrain from processed foods along with dairy and meat. However, since they practice vegetarianism and the meat and dairy category is vanished from their food pyramid, they now need to regain the same nutrients as the ones they are losing by cutting down their diet plan. It's not as simple as it seems to have the highest quality of life, but the rewards are outstanding.

Supplemental Article

Healthier living in 5 different steps

Veronika Suyupova, SPCHS Journalist

March 20, 2016

Working out at the gym, eating healthy and getting enough hours of sleep sounds like a perfect daily routine! But are there enough hours in a day to complete everything in order to supply the body with proper care?

Regular physical activity, personal behaviors and day- to-day choices all have a major impact on health. Diets and proper standard of living, including regular sleep and nutrition influence both the humans' mental and physical state. Following a healthier lifestyle includes having motivation in order to ensure proper diet, exercise routine, water intake and nutrition, leading to a more extended life and positive humanity.

1. Set aside time

It's important to set some extra time in order to perform all of these steps. Decide whether going to the gym will be easier in the morning or in the afternoon. Maybe it works best to take yoga classes on the weekends. Either way, all activities require time and the responsibilities that come along with it. Remember to squeeze in the schedule some time to spread out the three main courses into six little ones throughout the day and set aside time for sleep. According to National Sleep Foundation, adults need minimum of seven to eight hours of sleep each day. It works best to create a plan in the form of a timetable to keep track of hours spent on selected activities. Now, the key role is to stick to that proper schedule and use the allotted time wisely.

2. Get plenty of sleep

Getting a good night rest every day is an important action proven to energize the mind and body for the day. In order to follow the healthy lifestyle, make sure to get at least eight hours of sleep each day. Sleep should be regulated because it recovers memory, extends life span and is proven to improve grades.

3. Drink lots of water

Keeping the body hydrated at all times will prevent dehydration and regulate temperature. According to Authority Nutrition, the health authorities commonly recommend eight 8-ounce glasses of water per day. Recover the loss of water through sweat and urine by having a larger intake of it. Water increases energy levels in body as well as improves brain function and focus. Drinking water also helps lose weight by recovering body with essential nutrients and vitamins. If water is taken before a meal, it tends to fill up the stomach, tricking the brain to think it's half full, which reduces the number of calorie intake.

4. Eat healthy

Eating and supporting a proper nutrition allows the body to break down foods and provide it with necessary nutrients significant to produce new cells, dispose toxins and give energy to go about the day. Julia Mannella, a Saint Petersburg Collegiate High School health and fitness concerned student, said that in order to sustain a healthy diet, "It's important to follow the food pyramid." The food pyramid is a diagram representing an average serving of basic foods which need to be consumed on daily basis in order to gain proper nutrients.

For the people that need to watch their weight in order to reduce further body damage and a risk of developing a heart disease, they need to focus more of their daily habits and attitude towards things regarding food. Cutting out fast food restaurants, processed foods, refined sugars, high-fructose syrup and trans-fats (careful about eliminating the good fats) will improve the way a body feels almost instantly. It will help if it was replaced with beneficial micronutrients such as carbohydrates, proteins, and fats.

Many people turn vegetarian or vegan to follow a more healthy diet. Malayna Tillis, a proud supporter of veganism, said, "Being vegan is certainly for the best. I try not to eat processed foods and listen more to my body."

5. Exercise

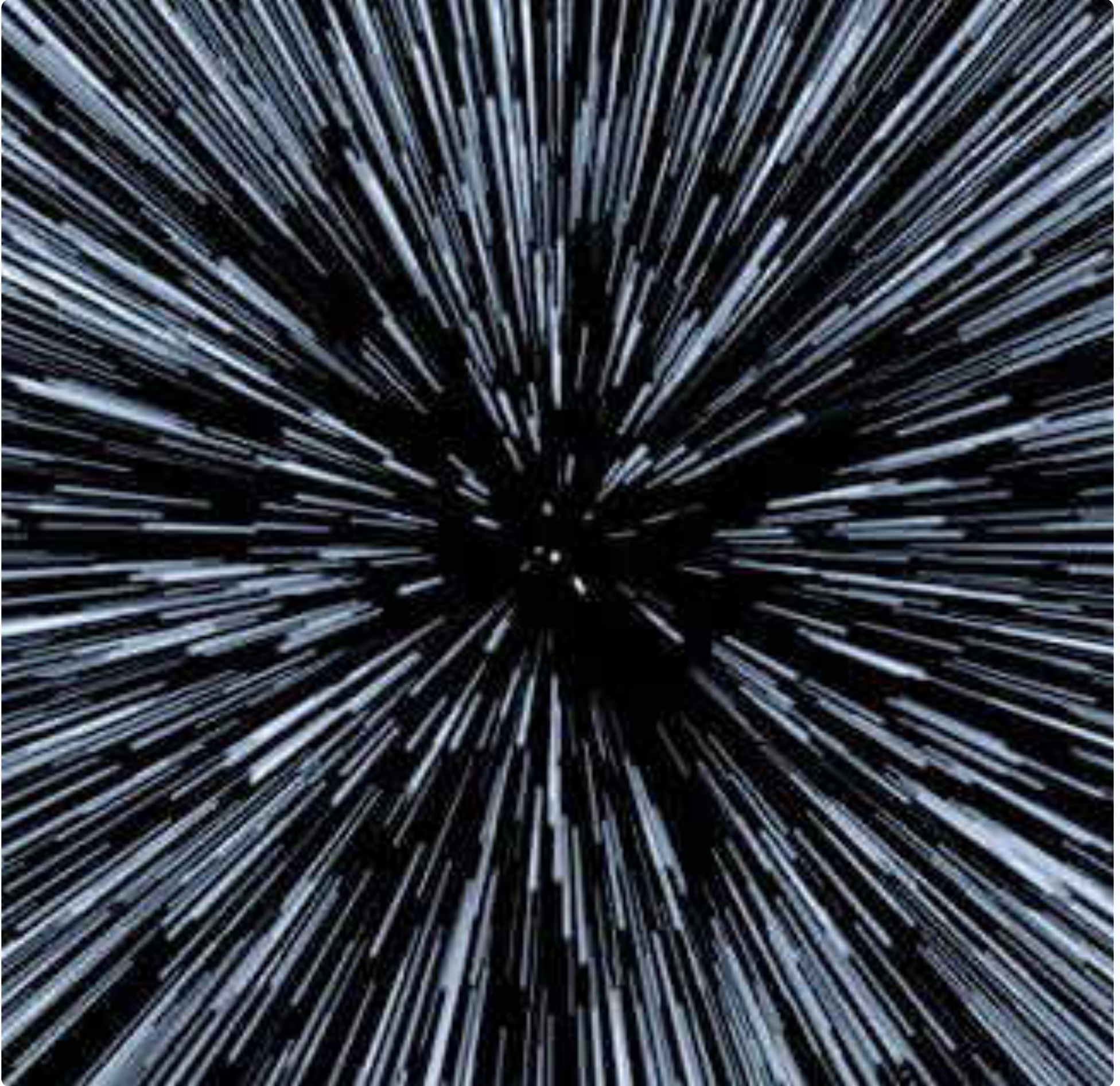
Going to the gym or staying active throughout the day will keep the blood flow pumping.

By working out the limbs and muscles in the body, they gain strength and power to operate. Running is the most applicable type of exercise because it doesn't require much equipment. Its purpose is to contract and release heart muscles, as well as, circulate blood around the entire body leaving it feeling new.

From years of dietary research and proper care taking skills, fitness and health researchers may agree that lifestyle choices can improve physical appearance and gradually extend life span, so why not start now?

6

STOPPING TIME



Other things in the world are just as fascinating as the power of having and maintain the higher quality of life, such as the power to stop time! Scientists and physics are developing possible ways to stopping time, or even traveling in time. Speed of light, gravity and space all have their own contributions of explaining how time travels on Earth and in outer space.

A photon, as stated by its theory of light, is a “discrete bundle (or quantum) of electromagnetic (or light) energy” (Jones). Photons are in constant state of motion, but specifically when they are captured in the outer space, they go at the speed of light, as many scientists and observers state from previous conducted research. The basic properties of photons include that they “move at a constant velocity, $c = 2.9979 \times 10^8 \text{ m/s}$ ” (Jones) which is indeed the speed of light

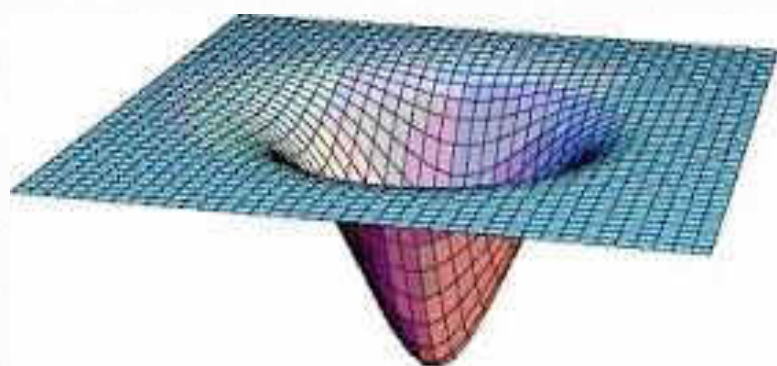


Figure 12.C The “bent fabric” of space

out in space. They have a “zero mass and rest point” of energy at any given time and can also be “destroyed/created whenever radiation is absorbed/emitted” (Jones). The speed of light is “a constant and... nothing can travel faster than the speed of light in vacuum” (Millis). When in space, the light actually slows down as it passes at an incredible speed in vast, space regions. Einstein had an equation of his own,

$E=mc^2$, relating to time. This is the relativity equation which basically states that energy is equal to mass multiplied by the speed of light to the second power. It proves that energy and mass are the same thing because “pure energy in the form of motion can be converted into matter, through the creation of a



Figure 14.C Photo of a Satellite Orbiting Earth

particle, which has mass” (Live Science Staff). Gravity bends space-time especially surrounding planets. The “mass energy of objects distorts the lengths in space-time” (McLaughlin), as observed in Figure 10.C representing the gravitational pull, as the mass of the Earth stretches out across a plane. The pull is not as forceful on Earth, than other planets; therefore, people don’t age as fast.

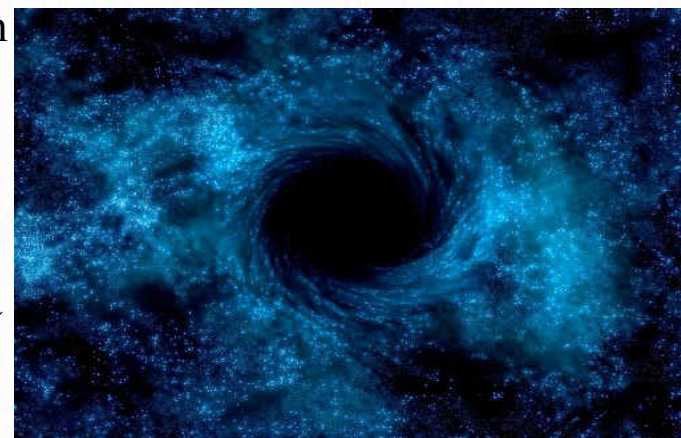


Figure 13.C Black Hole

Black holes, on the other hand, are “places in space where gravity pulls so much that even light cannot get out” (Dunbar). The gravitational pull is insanely strong at this point in space because a

black hole is a tiny created space where all the gravity is pressed into. They are mostly formed after a star dies. Since black holes are... well, black, they match with the surrounding space and are usually very hard to find. Time travels much faster on other planets but especially in black holes. Accurate time is tracked down by GPS satellites in space which contain the atomic clock. “General Relativity predicts that time will appear to run slower under stronger gravitational pull” (How does GPS work?); therefore, the clocks represented by the satellites will run faster than the actual time on Earth. If a person would travel to a galaxy, they wouldn't feel the time lapse; however, as soon as they would return to Earth, people would be much older and this mainly occurs because time travels faster in space. A great representation of this would be the movie, Interstellar. It's possible that one person's aging schedule could be slowed down or sped up compared to another person's just by traveling at different speeds through a vacuum-like space.

Following a healthier lifestyle can possibly extend human life, especially if it is related to other planets and difference in a gravitational pull. The quality of life can be perfected by a proper nutritional diet and exercise, along with quitting poor habits, such as smoking and drinking. Deprived health conditions lead to being more likely to catch diseases and viruses because the immune system is not producing enough antibodies and cells in the body in order to protect against foreign bacteria. Aging and weakness occurs from lack of proper intake of micronutrients, but also time. As long as there is gravity on Earth, people will age at a constant rate. In outer space, time, which is counted in light years, is actually slowed down due to a vast, vacuum space. If astronauts were able to travel to different planets and galaxies, they will feel the same age; however, due to difference in gravitational pull, if they came back, it is possible for them to be younger than other peers of the same age group. Life span not only depends on the time spent living, but also nutritional balance.



7

TURN INVISIBLE



The world is filled with dreamers and believers held back by the realities of modern science. From the magical and fantastical world of Harry Potter (Rowling) to the deep space and scientific capabilities of Star Trek (Star Trek), humanity is always reaching for something more. In the case of Harry Potter (Rowling), he had his invisibility cloak. Invisibility cloaks are seemingly the things fantastical at best, but that has not stopped the scientists of today. In true scientific fashion, they have gone about looking into the technology of fiction. The Invisibility cloak is just one of many technologies being researched and the basic foundations of chemistry have gone onto provide further models, theories, and even other forms of measurement.



Figure 1.D: Bending of light

To begin, Invisibility cloaks, in fiction, are garments that render the user invisible to the naked eye and undetectable to technology, while still leaving the object intact. This presented past scientists with a problem. In theory, they needed technology that had not yet been developed. Thus, the cloaks were simply cast aside as objects of fictional beings. In science, cloaks are devices “that can render objects invisible to incoming waves” (Ni 1310). In this particular instance, it is light waves. Xingjie Ni, Zi Jing Wong, Michael Mrejen, Yuan Wang, and Xiang Zhang published in Science magazine in mid-September of 2015, their findings and creation of an “ultra-thin skin cloak” to combat the limitations of bulky carpet cloaks previously worked with (Ni 1312). The ultra-thin cloak, with a 80 nanometer thickness, diverts the light and makes up for the scattered wavefront by adjusting the difference with resonant elements at the surface of the cloak itself. By recovering the phase, they were able to hide a small 3D object from a certain light polarization.

Furthermore, with advancements made to existing cloaks, it is, theoretically possible to render a person, vehicle, or machine and consider them invisible. The cloak, itself, is comprised of tiny gold and magnesium fluoride bases connected to one another. Resting upon each base rests a gold nanoantenna. According to Ni and his team, the antennas hold the key to potentially covering any object. Due to their unique nature, the nanoantennas allow the cloak to conceal a variety of oddly shaped items. Curves and edges, peaks and dips no longer present as much of a challenge. Theoretically, if the nanometers are made modifiable, they can cover any object, thus possibly having the potential to al-

low cars, people, and machines the ability to go unnoticed. This all still relies on further searches to make the cloak invisible in visible light.

Similarly, scientists over the course of time have come to understand a few key points about light. Light can be bent or deflected and this can be used to speed up the development of Invisibility cloaks. According to Here. Now. Everywhere., which is supported by the National Aeronautics and Space Administration (NASA) and was developed by the Chandra X-Ray Center, light can be distorted and bent in any manner of ways. “‘Refraction’ is the bending of light as it passes from one medium into another”, which is to say, that when light goes from one substance, whether that be space or atmosphere, to another, the light bends it is being refracted (“Bent Light” 23). This means that in various mediums, light can change. The amount of the light being bent is a result of “the angle of the incoming light and the nature of the medium” (“Bent Light” 23).

In addition to bending light, science has proved useful in another light related factor: colored lights. Chemicals and lights are like two brothers in the chemically lit world. When certain chemicals or elements are burned, they give off a certain color. This can prove to be most useful for scientists when making observations about occurrences on Earth and in outer space. For instance, if potassium is burned, it produces a bright lavender-lilac color. If a researcher is looking at a planet that emits a bright lavender-lilac light, then it is a safe guess that the planet is mostly composed of potassium. This can be applied when looking at florescent lights. In a traditional florescent lightbulb, electrical energy is transformed into atomic energy in the vapors inside of the tube, usually mercury vapors. To create different colors, light bulb makers replaced the mercury with other gasses to give off different colors.

When light is being bent, it is being deflected. A light wave travels in a straight line until an object is placed in its path. To understand this concept, throw a bouncy ball at the ground. When the ball hits the ground, at a 90° angle, it bounces right back toward the direction it came. If it is thrown at a 45° angle, then it will bounce off of the ground and should continue on in a 45° angle. A light wave can be compared to that ball. It



Figure 2.D: A Neon Light spelling out Ne

is reflected or deflected in a various motion. However, the image it provides becomes distorted. When viewed, it can change what the human eyes perceive. A round object can be viewed as flat, or an image of something far away can be magnified.

Additionally, the human eyes use light to perceive objects. The anatomy of the human eye is comprised of the cornea, the pupil, the iris, the lens, vitreous humor, rods, and cones among other parts. Put simply, the cornea, which is the clear structure in front of the eye, focuses the light and sends it through the pupil, which is the black adjusting opening surrounded by the iris, the colored part of the eye. Once it goes through the pupil, it is sent through the lens, which is then sent through the vitreous humor, a jelly like tissue, to the back of the eye, where the cones and rods rest. The rods detect the black and white aspects, while the cones detect the frequency and determine which color the object is. It is all sent up to the brain and interpreted, which is how humans see. If the light gets passed around an object, the eyes cannot 'see' it. If the light goes 'through' an object, then the eyes cannot 'see' it. If the human eyes cannot distinguish between an object, that is there, and its surroundings, then they cannot 'see' it.

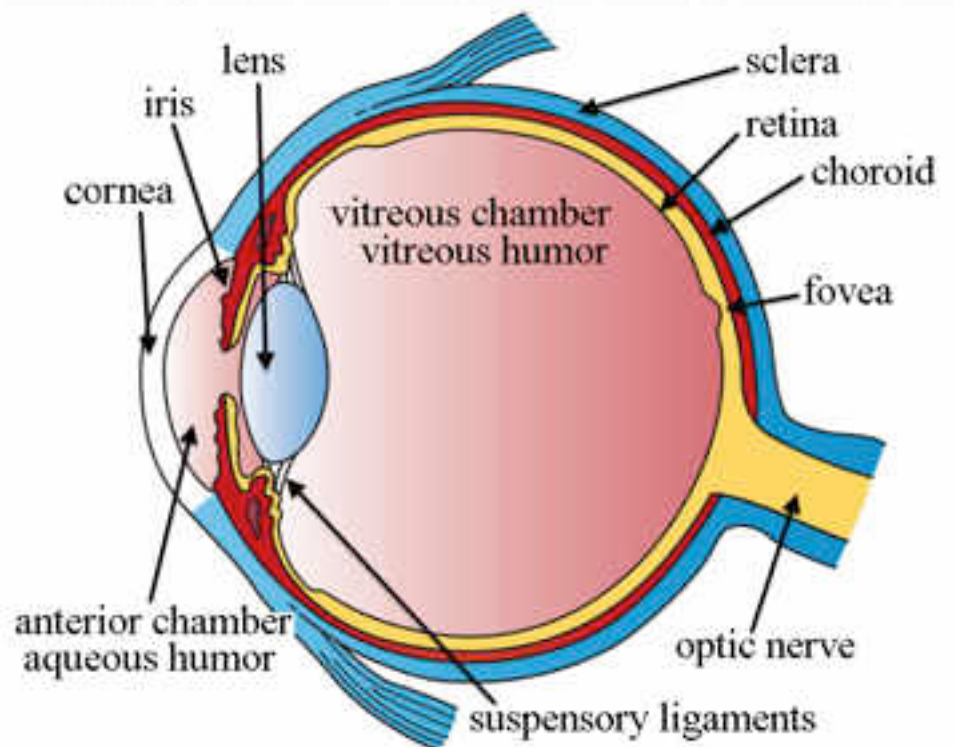


Figure 3.D: A Diagram of the Human Eye

SUPPLEMENTAL ARTICLE

Teenagers and Adults Face the Possibility of Invisibility Cloaks

Lourdes Vickers, SPCHS Student

March 16th, 2016

A young man made his way home, street by street. Over his shoulder he had a black bag and in his hand sat a scrap of fabric. He walked up to his front door and unlocked the three large locks and sensor protecting the building. He sat down constantly on edge, hearing a siren and other sensors go off, until the sun broke through the clouds. He was a man who had been hardened by a world where people could go undetected by machinery, sensors, and even other people. This was a world of distrust and fear, all because of simple invisibility cloaks.

When J.K. Rowling wrote her hit fantasy series “Harry Potter”, her main character had magic, and an invisibility cloak. While magic was impractical to readers, invisibility cloaks turned into something of immense interest because it was possible. Modern science is constantly evolving and growing and eventually an invisibility cloak, an object of fantasy, would be a reality. A few scientists have come up with carpet cloaks, which are large and bulky, but in the September issue Science Magazine, an article was done on an ultra-thin skin cloak. This cloak was roughly 80 nanometers thick and was made up of tiny nano-antennas. To gain a public perspective, a series of people were interviewed and questioned about their feelings on the matter. What the majority said was surprising.

To start, participants were asked about their individual reactions to the idea of invisibility cloaks being available to the public. Reactions ranged from excited to apprehensive disbelief. One participant, Ian Call, said, “My first reaction would be: that is really cool and how could I get one?” Others expressed similar sentiments when questioned about the matter.

The majority of the group expressed an interest in purchasing an item, but one member, Lauryn Maggie Smith said, “Probably not. I’m clumsy. I’d keep running into people and they’d get mad at me.” From those that said they would purchase the cloaks, the an-

swers carried. Chloe Johnson said, “Yes! To do a bunch of different things, like steal a mini taco.”

The group of individuals stated different situations and uses for the cloaks, if they did in fact decide to purchase them. Tosha Marks Vickers, a 45 year-old guidance counselor, said, “I listen to other people’s conversations or listen to how her daughters interact with their friends.” Delaney Staack, a Sophomore at St. Petersburg Collegiate High School (SPCHS), said, “I would use it to sort of get inside information. I’d a spy for what I feel would be good causes.” But, Call was at a loss for words during his answer. He said “I can’t really think of a practical use for an invisibility cloak.”

How ever the optimism for the unique devices started to dwindle as participants were asked about the comfort of other members of society using them. Kayla Harden, also a Sophomore at SPCHS, said “There are a lot of people who would use [the cloaks] for terrible things.” Joey Lee also expressed similar concerns. Lee cited sexual harassment as a major concern. To bring light to a very serious matter, Johnson said “I like people would rob more banks and I don’t want people to have more money than me.”

On the subject of a possible uprising in crimes committed, the entire group was nearly similar in all of their concerns. Smith said, “You can’t see someone. They [could] do remotely anything.” Smith’s sentiments were shared by Johnson, who applied it to the idea of prison breaks. Call, on the other hand, disagreed with the group. He said “as soon as someone invents one, then someone would invent something to overcome the invisibility cloak.”

How would this change the world? Well, it all depends on those who use it. The cloak itself is ethical, but the use of the cloak can go either way. It is up to how those who purchase it. Harden stated that the cloaks would be “negative for society, but positive for science.” Marks Vickers stated “it would make people more untrusting, dishonest, and it would just be the opening for other things science could do...”

8

MANIPULATE MATTER



There are three main states of matter: solids, liquids, and gasses. Solids according to Pearson Chemistry, “a solid is a form of matter that has a definite shape and volume” (Wilbraham 36). The particles that make it up are tightly packed together and kept in a rigid unchanging formation. Solids can still be changed, however. Physically, they can be cut or cracked, but they can also be melted. At the melting point of a substance, matter shifts from the solid state to the liquid state.

Liquids

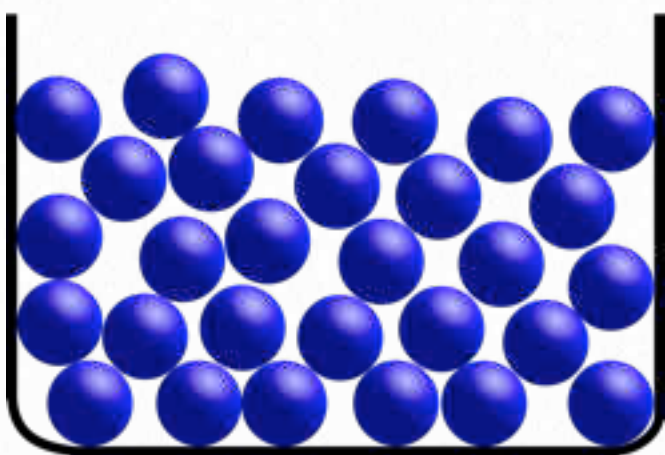


Figure 5.D: The Structure of a Liquid

As the liquid form is boiled, it readily shifts into its gaseous state. In the gas state, the substance can take “both the shape and volume of the container”(Wilbraham 37). Gasses share indefinite shape property with liquids, but they also do not have a definite volume, unlike liquids. The particles in liquids are extremely far apart and move around constantly.

Solids are “a form of matter that” have “an indefinite shape, flows, yet has a fixed volume” (Wilbraham 36). Liquids differ from solids, in the respect of their particles and their shape. The particles of liquids are not rigid. They are close together, but they can flow

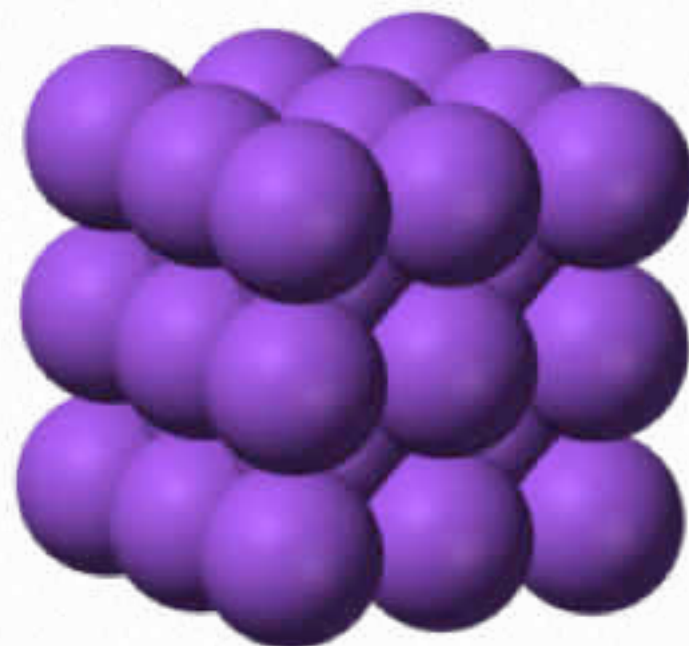


Figure 4.D: The Structure of a Solid

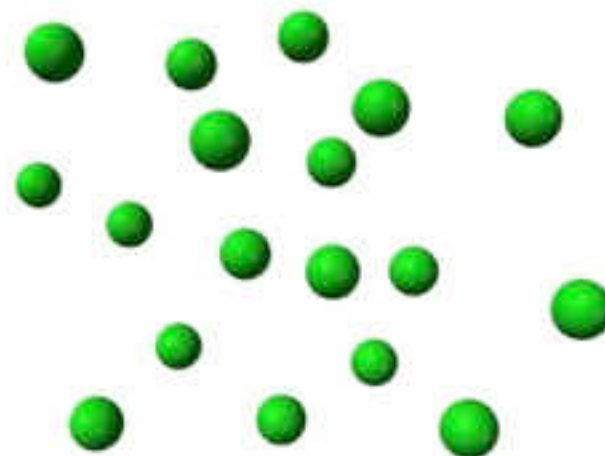


Figure 6.D: The Structure of a Gas

Along with the three main states of matter, there are a few more less discussed states. Among these states are colloids, Bose-Einstein condensates, supersolids, liquid crystals, and plasmas. Arguments can be made that plasmas and gasses are the same state, but this can be disputed. Gas particles are relatively uncharged, while in a plasma some of the electrons float freely and the particles are ionized at extremely high temperatures. Thus, their ability to conduct electricity. They share roughly some of the same qualities, but its the nature that they are formed and their particles that distinguish

them. Supersolids are also another state of matter under experimental dispute. Supersolids have a normal “periodic arrangement in space”, but they flow like fluids (Dhar 1130). Liquid crystals can also be disputed as another state of matter. They flow like fluids, but have a rigid crystalline structure.

Another strange addition to the states of matter are colloids. Colloids are “a mixture whose particles are intermediate in size between those of a suspension and a solution” (Wilbraham 505). The particles in a colloid are spread out in the dispersion medium. The dispersion medium of a colloid can be a solid, liquid, or gas. Examples of colloids include smog, fog, smoke, dust, whipped cream, mayonnaise, milk, paint, ink, marshmallows, cushioning, butter, jelly, and pearls. Colloids can be man-made as well as found in nature. Many of the foods consumed by humans and animals are colloids, in the event of marshmallows, whipped cream, and mayonnaise.



Figure 7.D: Marshmallows are a common colloid

With an even stranger name to be had, is ‘Jellium’. ‘Jellium’ is an electron gas that is uniform, and is a model of interacting electrons in quantum mechanics. This takes place in a solid where it is assumed positive charges are distributed in a uniform arrangement through space. The ‘jellium’ model and super atoms are directly related. In quantum mechanics, the ‘jellium’ model is able to forecast the stability of superatoms. Superatoms are clusters of atoms that instead of just being one singular atom as the base block, its a cluster of them. They display refined stability, unlike clusters that display almost violent instability. Scientists are looking into a variety of materials that use superatoms as their basis. Technology is advancing, but until then they are simply being studied.

In addition, Ice-Ten, or ‘Ice-X’, is the ice that comes after Ice-VII or ‘Ice-Seven’. As ‘Ice-VII’ goes under continuous transformation it shifts into ‘Ice-X’. The ice protons are equally spaced out from the oxygen atoms in the structure. The oxygen atoms are arranged in a way that they have eight surrounding molecules and the hydrogen atoms are placed in what is known as a “body-centered trun-

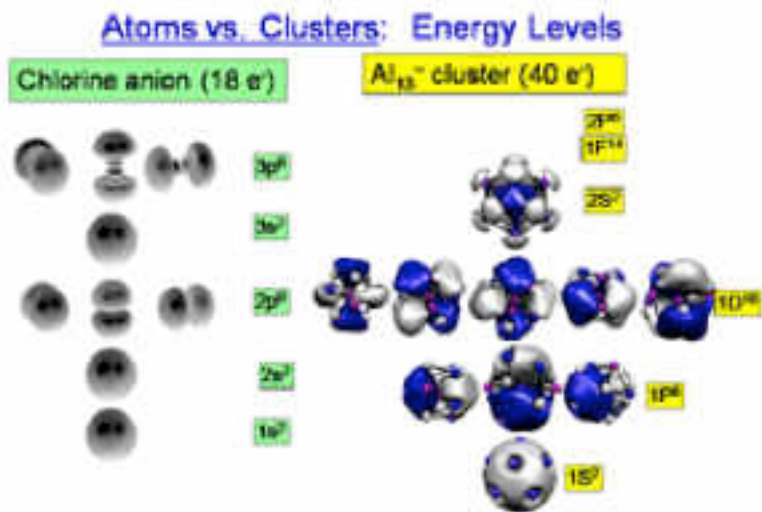


Figure 8.D The picture displays the differences between atoms and superatoms.

cated cubic arrangement”(Chaplain 1). A “body centered truncated arrangement” means it has twelve surrounding molecular neighbors, unlike the oxygen atoms (Chaplain 1). ‘Ice-X’ is believed to melt at a temperature between 1000-2400 K. There are other forms of ice found on other planets and synthetically made. ‘Ice-VII’ is said to possibly be on the ocean floor of Titan, Saturn’s largest moon. Synthetic

ice is commonly used in ice rinks.

According to Pearson Chemistry, absolute zero is defined as “the zero point on the Kelvin temperature scale, equivalent to -237.15°C” (Wilbraham 79). Kelvin is the temperature scale that this is based off of. It has no negative values on it and is used by scientists all over the world. It is named after Lord Kelvin and is sometimes known as the absolute scale. It drops the degree symbol for the most part. It works in tandem with Celsius and to get to Kelvin one must add 273 to the Celsius temperature.

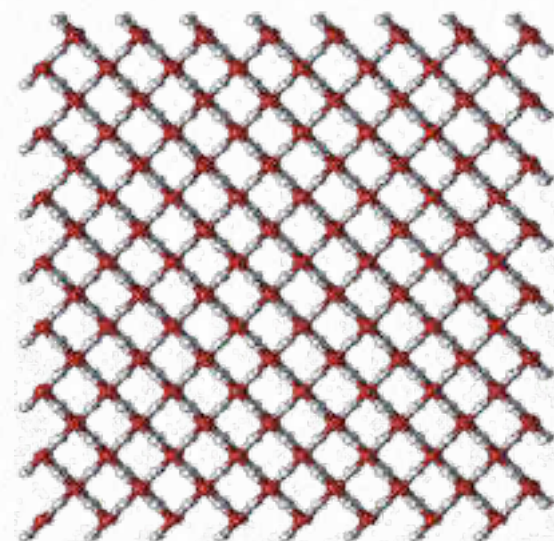


Figure 9.D A view of the structure of Ice X

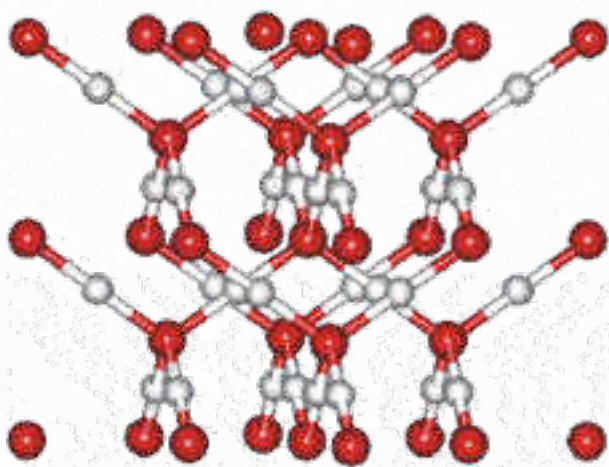


Figure 10.D A different view on the structure of Ice X.

Also in science, scientists have developed superconductors. Superconductors, unlike regular metals, conduct electricity without losing some electricity. They can carry their current endlessly. Another advancement was in frictionless environment. Frictionless environments, hypothetically, are basically what they describe: frictionless. Friction is the resistance of the motion of an object. Basically as the object moves on way, friction is forcing it back in the oppo-

Another advancement was in frictionless environment. Frictionless environments, hypothetically, are basically what they describe: frictionless. Friction is the resistance of the motion of an object. Basically as the object moves on way, friction is forcing it back in the oppo-

site direction. In a frictionless environment, there is no friction. Without friction, an object in motion would just simply continue on without ever stopping. It would just continue on at a constant rate, never stopping unless something intervenes. Not very many advancements could truly come from a frictionless environment. Maybe a never stopping train, but other than that its hard to think of real advancements.

Finally, Bose-Einstein Condensates are when the molecules of an atoms are almost completely stopped and cold. In the twentieth century, Satyendra Bose and Albert Einstein predicted their condensate. Roughly seventy-five years later, it was made possible. In a Bose-Einstein Condensate, the temperature is roughly a few billions of a degree above absolute zero. The atoms begin to group together in clumps, or superatoms, and they do relatively nothing. This distinguishes a Bose-Einstein Condensate from solids due to this grouping.

To round all of this up, is one final definition. This definition is for the word singularity. A singularity, in science, is something that is infinite like a black hole. In a singularity, temperature and density case to be a number and are infinite.

In conclusion, science is fantastic and daunting. With possibilities such as Invisibility Cloaks and various states of matter only recently discovered, its always evolving. Science can range from discussing basic items to discussing things that can mind boggle the human brain and be impossible to wrap minds around.

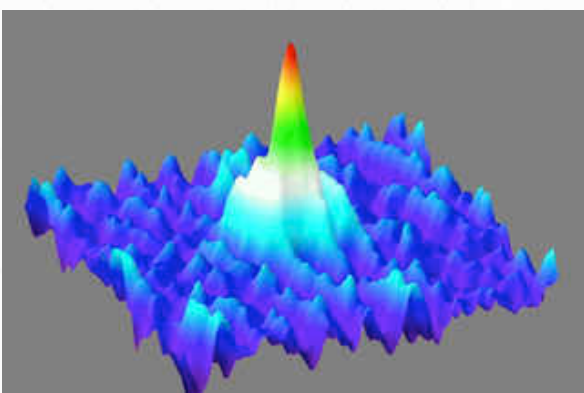


Figure 12.D Bose-Einstein Condensate

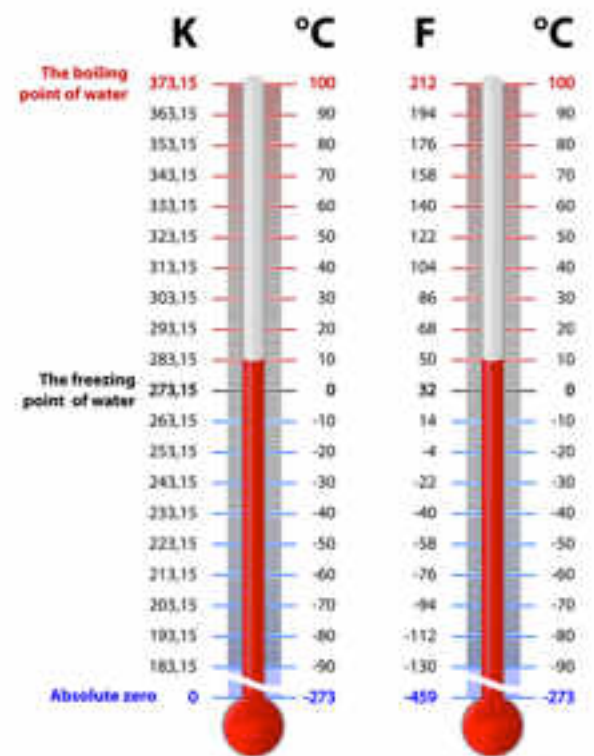


Figure 11.D The picture clearly compares the three common temperature scales.



Figure 13.D A depiction of the Milky Way, where scientists suspect a supermassive black hole resides in the center.

9

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Living Forever and Unlimited Energy:

an Annotated Bibliography

"Can We Prevent Aging?" Health and Aging. National Institute on Aging, Feb. 2012. Web. 22

Feb. 2016.

This article provided a multitude of information on the different aspects of aging, especially hormone therapy. When researching testosterone, estrogen, and other hormones, this resource was the most in depth and it provided the least biased view on the effect hormones have on aging. Testosterone and estrogen are the only two well researched hormones that do have some aspects to them that can reverse and slow the aging process. In addition to information about hormones, this article described exactly how the cells break down during aging. This was vital in the understanding of how humans age and what can be done to prevent it.

Don't Grow Old Holding Back the Years. New York, N.Y.: Films Media Group, 2010. Primo.

Web.

This program looks at discoveries that may mean that the aging process can be manipulated, if not completely switched off. The film looks at diet, and how different calorie and food regimens have affected age. The diet of a couple that have restricted specific foods for 16-years was examined, and the nutrients from their diet did lessen the effects of aging. There was also a discussion around oxidation, and the idea of oxidation levels extending lifespan was disproven and explained. It also discusses molecule resveratrol, which has been found to have life-prolonging effects in mice. Progeria, or rapid-aging disease, is also closely examined, and talks about the different genes that are manipulated by this disease. Age as a "state of mind" is investigated, and how mental state and psychology affect the aging process is proven somewhat valuable. This was an invaluable resource because it looked at so many different angles of aging.

"How Nuclear Power Works." Union of Concerned Scientists. March 26 2015. Web. UCSUSA.

This article was used to get a basic knowledge and understanding of nuclear power. It explained how nuclear power works, and it also explained the different techniques and materials that go into creating a nuclear reactor. There was a lot of information regarding fission and the specific isotopes used during a nuclear reaction, and it provides a step-by-step explanation of how the electricity nuclear power generates makes it to our homes. According to the article, when a neutron bombards a uranium atom it will separate the neutrons from the uranium and that will create a reaction with near infinite power. Uranium is especially effective because of how large the atoms are.

Hunt, Julian. "The Third Nuclear Option." New Scientist 205.2750 (2010): 22. Web.

This article discusses the possibility of using fusion rather than fission, or even possibly a hybrid of the two. Although fission has long been used as the premier way to produce nuclear power, fusion, and even better, the hybrid, may be much more safe and efficient. The possi-

bility of using fusion in a fashion similar to how the sun produces energy is very favorable, but there is a problem in developing a containment system that can withstand the heat. Hybrids seem to have the most potential because they incorporate both extremes, and can be powered by a wide range of fuels including thorium. These systems produce near unlimited power and the decay on the nuclear waste can be reduced to around a 100 year life span due to the fusion aspect.

"Life Expectancy in the USA, 1900-2010." Life Expectancy in the USA, 1900-2010. N.p., n.d.

[Web.28](#) Feb. 2016.

This provided me with the necessary statistics to observe how life expectancy has changed over the last 100 years. This is a primary source and it listed the average ages of both men and women from every year beginning with 1900. When trying to emphasize how vastly different life expectancies are compared to what they were 100 years ago, this website was incredibly useful. This was a vital resource for the statistics I required and it provided more than enough data for each year.

Rodríguez-Rodero, Sandra. *Aging Genetics and Aging*. 1st ed. *Aging and Disease* 2.3 Vol. JK

International LLC, 2011. Print.

Both what aging actually is and how it can be slowed by both artificial and inartificial factors are discussed in this article. The break down of cells is explained, and the causes of aging are thoroughly discussed. How high levels of telomeres can slow down the aging process is central to this article, as well as gene mutations in certain individuals allowing them to live longer than average. Werner syndrome, Progeria, Cockayne syndrome and more are also explained, as well exactly how these diseases effect aging (such as by effecting the DNA structure and repair). Telomeres are central to protecting genetic data, and are found at the end of DNA. They are centrally the casing at the end, and each time a cell divides they are reduced until the cell can no longer replicate. This is one of the major reasons healing takes a longer time in older people, and it is a significant part of the aging process.

Shelton, Jay. "Science Behind the Atom Bomb." Atomic Heritage Foundation. 2002.Web.

This article was used to get a better understanding of fission and the atomic bomb. A brief history of the atomic bomb is discussed, and then an in depth explanation of how the bomb and it's nearly exponential power is created are given. This article was especially helpful in describing the development of the atom bomb and how it functions, and it's relationship with nuclear power. The atom bomb utilizes uranium-253 and plutonium-239 because of they are suitable for fission. The Manhattan project first developed "Little Boy" using the uranium, and one mass of U-235 was fired at another that set off a chain reaction. This was the first of many atom bombs, and they use a similar chain set-off method to nuclear energy, but with less containment.

Invisibility and States of Matter; an Annotated Bibliography

Ni, Xingjie, Zi Jing Wong, Michael Mrejen, Yuan Wang, and Xiang Zhang. "An Ultrathin Invisibility Skin Cloak for Visible Light." *Science* 18 Sept. 2015: 1310-313. Print.

In September of 2015, Scientists published their research on the development of an invisibility cloak. The cloak is roughly 80 nanometers thick and it can only cover small objects. Covered in microscopic nanoantenna the cloak, to cloak tricks your mind into believing that the light is bouncing off of a flat surface. Each nanoantenna is composed of gold and connected to tiny gold and magnesium fluoride bases, which connect to each other. Playing off of other cloaks, called carpet cloaks, this one is called a "skin cloak" and works in open air. However, it is limited to a specific wavelength of red-light.

Douglas, Peter, and Mike Garley. "Chemistry and Light." *Science in School* 14 (2010). *Science in School*. Web. 16 Feb. 2016.

Light and chemicals have been connected since day one. As certain chemicals are burned, certain colors are given off. This can be combined with florescent light bulbs to create bright, colorful lights as seen on signs and some billboards. Florescent light bulbs work due to the conversion of electrical energy into atomic exertion energy. This takes place in the vapor of mercury atoms in the tube. If the mercury vapors are interchanged with other gasses such as neon, different colors can be achieved in the lamps. In the case of neon, the light given off is a bright orange.

"Bent Light." *Here. There. Everywhere*. Web. 16 Feb. 2016 http://hte.si.edu/Activities/light_activities.pdf

When the human eyes see shapes, what they are really seeing is the light reflecting off of a surface. When a light ray's path is bent, the image our mind's create becomes distorted to the eye. Its the same principle that make eyeglasses possible, or why the sun, which is spherical, is seen as flat to us. Light can be refracted, which is when it is bent as impasses from one medium into another. Lenses can distort this light and magnify or reduce the image. Einstein stated that space can be curved by a massive, like a very large star, object.

Dhar, Deepak. "States of Matter." *Resonance* 16.12 (2011-12): 1120-131. *Springer Link*. Web. 15 Feb. 2016.

Deepak views the states of matter as a classification and is very liberal in his classification of certain items. He states that there are solids, liquids, and gasses, but they are just words. Its the idea behind the words that give it meaning and substance. According to Deepak, gasses and liquids are the same state and gasses and plasmas are the same as well. He further goes on to discuss the differences between fluids and solids, but has a bit of a difficulty. Finally, he states that " 'solid-like' and 'fluid-like' behavior is a matter of length and time scales." Deepak goes on to make his case for powders being considered a state of matter due to the dual natures of wet and dry powders. Finally, he goes on to discuss Bose-Einstein condensates.

Chaplin, Martin. "Ice-ten (Ice X)" *Water Structure and Science*. 21 July 2015. Web. 15 Feb. 2016.

Ice-ten, or Ice X, is the state that comes after Ice-seven, when it continuously goes under transition. The Ice protons are equally spaced and bonded between the oxygen atoms. This works to form a molecular crystal that has the oxygen atoms arranged in a body-

centered arrangement and the hydrogen atoms in a body-centered truncated arrangement. The melting point has been proposed to be 1000-2400 K.

Goodstein, David L. *States of Matter*. Mineola, New York: Courier Corporation, 2014. Print.

Goldstein's book discusses the various states of matter in depth and at a textbook view. It gives in depth looks at each, as well as the other states of matter not too commonly discussed. It also goes deeply into what a superconductor is and what superconductivity is.

This book was designed to guide those reading it through an in depth, well discussed world of the states of matter.

Zeiger, Brad. "Superatoms." 28 Oct. 2008. Web. 15 Feb. 2016.

http://www.chemistry.illinois.edu/research/inorganic/seminar_abstracts/2008-2009/Brad_Zeiger_Lit_Seminar_Abstract.pdf

Zieger starts out his discussion by laying the foundation out for his audience. He talks about newer materials, before discussing that certain fields have been researching materials foundational building block is clusters of atoms instead of just one small atom. He then further goes on to discuss that the origin of these clusters is electronic and then he names them. They are known as superatoms. Superatoms are clusters that exhibit enhanced stability. He then further goes on to explain the 'jellium' model and how it is connected to superatoms.

Wilbraham, Anthony C., Dennis D. Staley, Michael S. Matta, and Edward L. Waterman. *Pearson Chemistry (Florida)*. New York City: Pearson, 2012. Print.

The textbook *Pearson Chemistry (Florida)* is a textbook used throughout the state by high schoolers in a chemistry course. It covers a variety of topics not limited to the structure of atoms and the foundations of chemistry. In the back Glossary pages, the definition to a few very important words can be found. It helped clear up just what a Colloid was, as well as it also helped define a few more important words. The textbook is to be utilized as a learning tool and it extremely useful.

Transmutation and 3-D Printing; an Annotated Bibliography

Rose, Austin S., MD, Julia S. Kimbell, PhD, Caroline E. Webster, Ola L.A Harrysson, PhD, Eric J. Formeister, MS, and Craig A.

Buchman, MD. "Multi-material 3D Models for Temporal Bone Surgical Simulation." N.p., 01 July 2015. Web. 11 Feb. 2016.

The main points in this article are 3-D printing, surgical simulation, temporal bone simulation, and safety within the surgical processes of using an artificial temporal bone. This article describes how 3-D image processing software can be used to creating a multicolor, multi-material temporal bone. A temporal bone is a pair of bones that form part of the side of the skull on each side and enclose the middle and inner ear. This can be done by using computed tomography (CT) which is an imaging procedure that uses special x-ray equipment to create detailed pictures, or scans, of areas inside the body. Temporal bones created by this process have potential surgical training.

"The Types Of 3-D Printing." *Library Technology Reports* 50.5 (2014): 8-12. *Library, Information Science & Technology Abstracts with Full Text*. Web. 11 Feb. 2016.

Fused deposition modeling (FDM) is what most people understand to be 3-D printing, as this technology is by far the most common and in many ways the simplest of the possibilities. FDM uses a variety of plastics that fall within a range of melting points and that fuse when melted and resolidified. FDM is an additive manufacturing technology commonly used for modeling, prototyping, and production applications. This source explains the mechanics of printing as well as the amount of money it costs to do this.

"Types Of Plastics." *Library Technology Reports* 50.5 (2014): 13-15. *Library, Information Science & Technology Abstracts with Full Text*. Web. 11 Feb. 2016.

This source talks about the numerous types of plastics used to. The original fused deposition printers almost exclusively used ABS (acrylonitrile butadiene styrene) as their substrate for printing. This plastic is strong and slightly flexible and is the most used for commercial plastic like legos. Other plastics used are PLA (polylactic acid), HIPS (high impact polystyrene), nylon, t-glass, laybrick and laywood, and polypropylene. It speaks of the pros and cons of each of the plastics, which is helpful in deciding in which plastic to use for a certain occasion.

"Turning a Rarity into a Commodity." *Tee* June 2013: 45-47. Web. 15 Feb. 2016.

In "Turning a Rarity into a Commodity", the author speaks about two specific people: Charles Hall and Paul Héroult. The article explains how to turn common elements, like iron and copper into gold. It explains the scientific processes and how each of these two scientists contributed to the ideas of transmutation. These scientists also had other accomplishments that are discussed within the article.

Sliva, Robert J. "Transmutation." *Chemistry Encyclopedia. Chemistry Explained*, n.d. Web. 16 Feb. 2016.

This article discusses the act of transmitting elements. It describes how nuclear decays or reactions help transform one element into another. It talks about how alchemy is now different from transmutation because of the possibilities from nuclear energy.

"What Is A 3D Printer." 3ders.org. N.p., n.d. Web. 22 Feb. 2016.

This website helped me understand exactly what a 3-D printer was and how it works. It explains the process of which it takes to print something in three dimensions as well as touch base with factors, such as the type of plastic, that 3D printing needs.

Flanagan, Bob. "Russian Physicists Turn Lead Into Gold." World News Daily Report. N.p., 06 Sept. 2014. Web. 23 Feb. 2016.

This website explained that transmutation is possible. Russian scientists turned lead into gold by nuclear energy. This fits into my article because I will speak of transmutation among atoms.

Quality of Life and Time Travel:

An Annotated Bibliography

Clegg, Brian. *Light Years and Time Travel: An Exploration of Mankind's Enduring Fascination with Light*. New York: J. Wiley, 2001. Print.

The author examines how time travel is possible by explaining light years and their correlation to how humans view light. Speed of light in vacant spaces involves the study of physics. Scientists and philosophers, as mentioned in the book took years to set up theories based on formulas of figuring out the travel of light and its relation to time. The illustrated novel about time traveling through the darkness also does in depth and explains the optics and vision of time as in relation to the instant vision of the speed of light while stating the physics and its studies to help guide the understanding of the perception of famous scientists and philosophers that have helped shape the way of knowledge about light.

Gale Encyclopedia of Diets, 2nd ed., Detroit: Gale, 2013, pp. 57-60.

Gale Encyclopedia is a leading database which includes fresh research provided by other credible sources. The article discusses an anti-aging diet which helps increase human lifespan. Healthy lifestyle can be easily maintained by following a simple routine such as controlling a nutritious diet along with taking the proper vitamins. The article shows fairly recent research on the percentages of increased lifespan if following the low-calorie diet as well as exercising. It also includes the benefits such as, improvement of health and treatment of diseases, and the precautions of following a strict routine since it can damage physical growth if referred to at a young age.

Gale Encyclopedia of Senior Health, Farmington Hills, MI: Gale, 2015, pp. 749-752.

The Gale database article includes credible sources of finding a purpose of following a healthy lifestyle. Although this article is targeting mainly the senior citizen population, it also includes the proper health benefits of maintain a healthy diet and which can lead to the expanded lifespan. Quality of life is affected by multiple outside sources such as high fat intake, tobacco smoking, alcohol consumption, and long term stress can implicit a negative health outcome both physically and mentally. The article mentions the purpose as well as the risk such as, the quality of life is mainly impacted by the general number of long-term diseases which lead to different illnesses, reducing lifespan.

Haywood, Nicole. *Absolute Beginner's Guide to a Lite and Healthy Lifestyle*. Indianapolis, IN: Que, 2005. EBSCOhost. Web. 13 Feb. 2016.

This novel is written by Nicole Haywood, a wellness coordinator at the National Institute for Fitness and Sport, who dedicates the book to a healthy lifestyle. The tutorial, a how-to improved lifestyle, includes healthy habits which need to be followed in order to live longer by increasing the chances of extended life span. The content includes chapters on a more balanced supplement diet

and nutrition, along with proper exercises able to complete practically on the go. More natural eating which disregards the processed or high fat or sugar foods can instantly increase the life span. Fitness and training are easy to adopt healthy lifestyle choices which have a great outcome on the wellbeing of a person. Having the right mindset and following the given instructions is the easiest way of sticking to the course of a healthier lifestyle.

Time Travel: Is It Possible? Films On Demand. Films Media Group, 2008. Web. 17 Feb. 2016.

The video depicts the truth about time travel and its relation with physics. This video and its concepts of whether time traveling is real or not is depicted by experts such as “Craig Savage from the Department of Physics at the ANU and Stephen Hawkins” (Films on Demand). Atomic clocks have been created to catch a glimpse of time in space to prove the speed of light. They also explain how the light reaches your eye at different times, therefore in space, a gravity-free surrounding nature, light would pass as if one was moving backwards. Space easily depicts how the person’s aging varies at different traveling speeds, which all ties back to having various gravitational pulls throughout the universe.

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(2.B) *Flow Chart of Aging Factors*. Digital image. Rodriguez S, Eriksson M (2010). Web. 20 March 2016

(3.B) *Table of Genetic Factors Associated with Premature Aging*, Digital image. Rodriguez S, Eriksson M (2010). Web. 20 March 2016

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