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BACTERIUM WEEKLY

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Just a word from the magazine staff...basically, so that you, the reader can know where we're coming from, and see where we're going with this magazine.

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How come with, all of the medicines and all the times we've been sick in our life already, we keep getting sick? It's because of mutation, and your body's ability to fight back.

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In a duel of the wits, bacteria seem unarmed. But these little "bugs" may be a much better adversary than we thought. Will antibiotics be able to compete?

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Could what happened to those infamous turtles ever happen to any of us? We explored the fascinating world of mutations and mutagens.

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An in depth look at how to protect yourself, your family and your home from dangerous bacteria and their many mutations. We've covered everything from the market to the laundry.

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All the sources you'll ever need...Look no further than this oh-so-interesting back page of the magazine!

Personal Statement

Dear Reader...

I would like to thank you for picking this issue of *Bacterium Weekly* off the newsstand—okay, okay we realize that this is just for a grade, and that you are probably only reading this because it is part of your final exam. Right? Right!

But, there really are a lot of interesting things in here that you should know about. The thing we have tried to stress with this magazine is that bacteria come in a variety of different shapes and sizes, they change constantly, and they surround us in our everyday lives.

Now, before you tune us out saying that this issue does not affect you, we would like to invite you to think back a little. Think, for example, of all of the things that you have touched today. Every single one of them were coated in bacteria! In fact, we live in a sea of bacteria in which everything—including ourselves, is covered in it.

Do not panic! Most of the bacteria we encounter has no effect on us. We even have bacteria living inside of us, helping us. The only bacteria we should be concerned about are the harmful kinds and their mutations. The entire medical industry is today being faced with a crisis. These harmful bacteria are mutating faster than modern medicines can keep up. In fact, if things remain unchanged, within the next two decades, our entire army of current antibiotics could be completely useless!

Still think you don't need to care about this? Well, if you're smart, and we know you are (you chose to read this magazine didn't you?) then we know that you will read on to find out all of the interesting aspects of the world of *Bacteria Mutations*.

Welcome
To the
Chilling
World of
Bacteria

What are Bacteria?

All about those Bacterium.

So, what are those bacteria and why is the name *anti-bacterial* on every soap bottle in the country? Well that is a good question, one that we will answer by covering the actual structure of most bacteria and what their function is. Most people think, when they hear the word bacteria, of very tiny microscopic monsters that tear away at flesh and spread nasty diseases. First, let's make sure we know the

like little sticks. Spirillum (sing.), spirilla (pl.) look spiral shaped. (spiro = spiral, coil). While many bacteria live sin-

can). It does not effect human cells because of our flexible plasma membrane. After a while, the bacterium bursts because of excess growth and no cell wall. So why are we so worried about these puny microscopic organisms? The answer to this is that they can change, or become resistant to antibiotics, and it is quite shocking how easily it can occur. So here is the scary part.

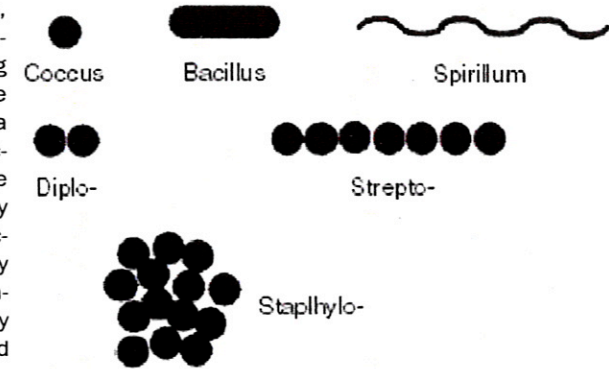


Diagram of the shapes of bacteria. (Figure 1) Carter, J. Stein

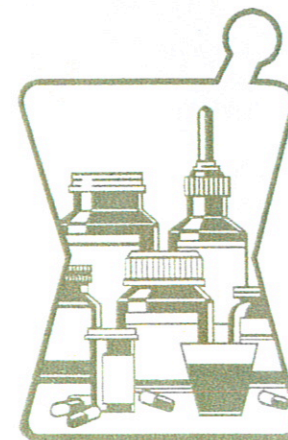
Fact Corner:

- Bacteria belong to the kingdom Monera.
- Bacteria can be producers, consumers, or decomposers.
- Bacteria can be immune from antibiotics in four main ways. A:) They do not absorb the antibiotic. B:) They expel the antibiotic. C:) They degrade the bacteria (break down). D:) They alter the usual target for the medication, which then has no effect.

basics. Bacteria are actually single celled organisms that are about one-thousandth of a millimeter wide. This is actually five hundred times smaller than the average human cell. As we have studied in class, bacteria are prokaryotes, which means they don't have a nucleus. So what kind of junk is inside a bacteria? The organelles that a bacteria contain are Chromosomes, Plasmids, Cytoplasm, a Plasma Membrane and a rigid cell wall. Bacteria can take on three different shapes. The picture above (Figure 1) gives a general idea of these three main shapes. Coccus (sing.), cocci (plural) are spherical. Coccus look like berries. Bacillus (sing.), bacilli (pl.) are rod-shaped (bacill(um) and look

gly, others are found in aggregates or clusters. These aggregates are named based on the arrangement of the bacterial cells of which they are composed. Here are other examples. Diplococcus: like Pneumococcus are in sets of two (diplo = double, two; pneumo = lungs), streptococcus: are in long chains (strepto = bent, twisted, pliable), and staphylococcus: are in clusters (staphylo = a bunch of grapes). Okay, so we know what they look like and how big they are. How do we kill them? This is where the lovely medicine called penicillin comes in to play. This drug works to kill bacterium by preventing it from making a rigid cell wall (the fancy name for this is peptidogly-

The bacteria carries all of it's reproduction information in it's DNA. It does, however, contain extra strands of DNA in it's plasmids that code for resistance to antibiotics. Doctors worry about this quite often because it is so easy for bacteria to spread this DNA within the plasmids to other bacterial cells. This leads us to the first method of resistance, called conjugation. This is basically the transfer of plasmids, with anti-penicillin instructions, to and from bacterium by way of a small tube like structure called a pilli. The next way in which bacteria can transfer this nasty little coding is through a virus, or bacteriophage (see figure 2). The last way in which we see bacteria pick up DNA is called



Transformation. This is basically as simple as it sounds. Bacteria are actually smart enough to pick up stray pieces of DNA that are found in its environment and use them to its advantage! This is probably one of the easiest ways that bacterial cells can become immune to medicine and one of the worst ways we as humans must deal with.

Okay, so what can we do? Well, the solutions are quite simple. There are three main ways we can keep bacteria under control and slow the process of mutations of DNA.

1. We must be prudent with the selection and usage of bacteria for certain illnesses.

This is the most prominent reason for prescribing the

right medication for the right problem. We must make sure we are not using antibiotics for just any kind of illness we may get.

2. Vaccines can prevent the bacteria from even infecting a human in the first place.

Vaccinations can stop the problem before it starts. More often, major diseases that are spread through bacteria can be stopped with a simple vaccine. Provided that it is introduced before a widespread case occurs.

3. Controlling the spread of infectious diseases and bacteria by household means.

This is a simple prevention method that includes washing your hands more frequently,

making sure dishes and other utensils are clean, and the proper disposal of dirty materials such as Kleenex and cotton swabs.

One method not mentioned in this list is the invention of new antibiotics. This is actually a longer and more drawn out process than the previously mentioned ideas. The production of new medications takes years, whereas it only takes less than a year for bacteria to become immune to certain penicillin's. These simple methods of disease prevention will not only help you from becoming sick, but also keep bacteria from helping themselves become immune to medications.

"We must make sure we are not using antibiotics for just any kind of illness we may get."

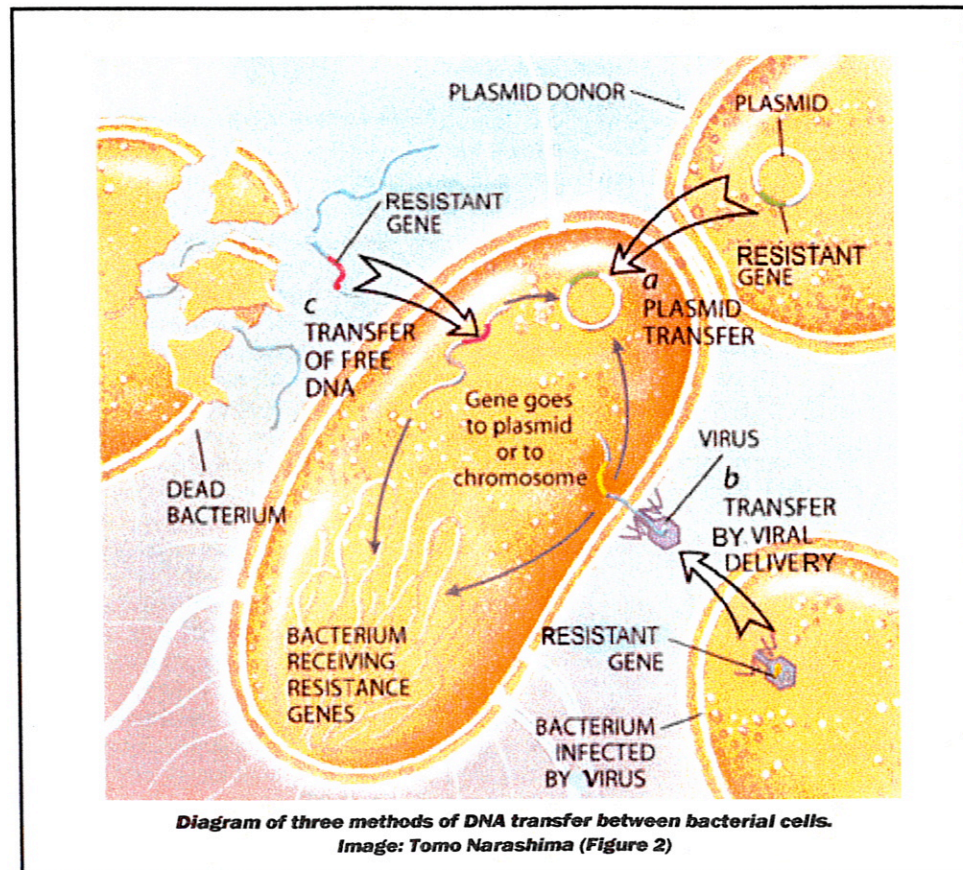
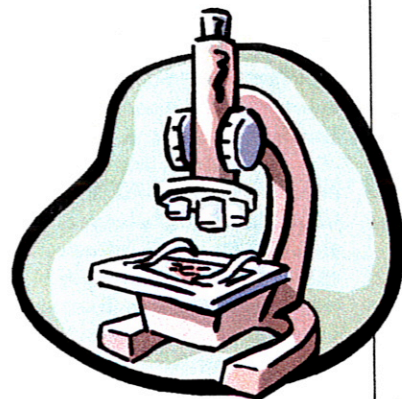


Diagram of three methods of DNA transfer between bacterial cells. Image: Tomo Narashima (Figure 2)

Blood, SNOT, and Other Nasty Things

Let's get Nasty!



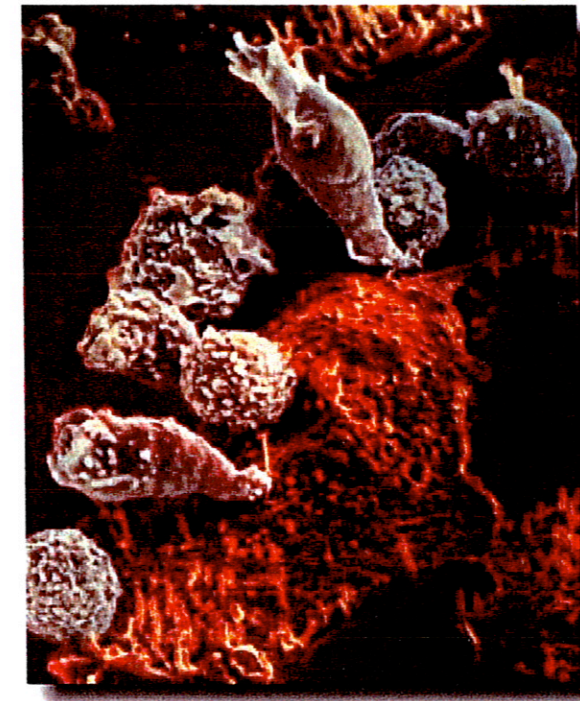
- White blood cells engulf a foreign body and bombard it with sulfuric acid, breaking its membrane.
- Most pathogens can't penetrate the best barrier we have ...the skin.

To put it simply, I was a sickly child. It seemed like I was in the doctor's office every other week with some sort of nasty cough or other malady. I had enough basic knowledge of immunology to know that once you got an illness, you could never get that illness again. So I really didn't know why I kept getting sick with strep throat and the flu. When I finally realized how I kept getting these same illnesses, I really began to hate natural selection. Mutation is the cause of the numerous cases of flu, colds, and streptococcus that are reported every year.

My first question going into this article was, "How can our immune system be so stupid so that it can't see the small genetic difference that exists between mutated viruses?" The answer according to *Scientific American On-*

line is that our immune is not stupid, but actually the exact

body. Our skin is the biggest barrier we have. Most pathogens are unable to penetrate the dense layers of dead cells and the low pH that the skin possesses. The nose possesses hair and mucus that prevent some pathogens from entering the body. Even our stomach contains several types of bacteria that aid in the reduction of pathogens.



Cancerous Cells: by Dorling Multimedia

Along with having a protective barrier, we also have several internal preventive measures. The most memorable is the white blood cell. These huge cells engulf pathogens, inject them with sulfuric acid and cause the opposite. Our body possesses a very advanced immune system. Basically, our body has three types of defenses that prevent us from being taken over by pathogens. The first protective measure is the membrane to burst. We also possess the ability to cause inflammation and other increases of temperature. This causes the body to become a very inhospitable and causes some illnesses to die. The inner body also has what *Biology: Concepts and Appli-*

"Pathogens exploit the fact that most of the internal responses are geared to a specific species of illness."

cations: calls a complement system. This is the antibody system that exists in the blood. Antibodies attach themselves to a pathogen, and wait for it "activated compliment" to attach itself to the antibody. The compliment then acts as a spear and pierces the membrane. This process is done throughout the surface of the bacteria, and it causes the membrane to collapse.

So, that was our immune system and it seems pretty great. Yet, we still get sick. I still wonder, "How can we become ill if our immune system is so wonderful?" Well, the answer to my question is pretty simple. The answer is that no system is foolproof, and modern pathogens aren't making the job of the immune system easy. Pathogens exploit the fact that most of the internal responses are geared to a specific species of illness. For example, there are certain types of white blood cells that only attack the Chinese flu. If a slightly different type of flu were to enter the body, these cells would be worthless. The activated complement system also only works

on a specific basis. The antibodies only attach themselves to a pathogen if they know that it is a pathogen. The proteins that cause the penetration are also genetically specific. So basically, if a mutated form of a virus that we have already had enters our body, odds are we will get sick again.

Our immune system is a

great thing., but it does have its flaws that lead to us being sick. I personally believe that it is worth being sick once and never having to worry about a pathogen again. I guess sickness is the price we pay for a lifetime of health.



T-Cell antibody:
by Berkeley University



They're **BACK!**

Did you Know?

- 1.7 billion people world wide are infected with Tuberculosis. This is almost 2/5 of the worlds population.
- Mutations lead to new dangers such as a new airborne form of aids.

"These killers are new mutations of bacteria, one of the most feared things in recent medical history."

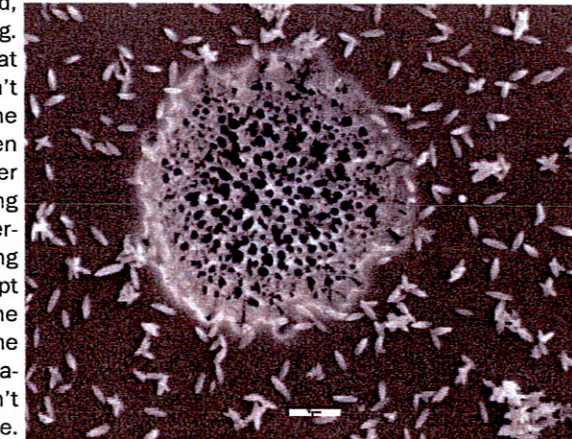
It is just like some bad sequel to a very cheesy 80's horror movie. It is the part in the movie where the music becomes ominous and the perky co-ed is walking into a darkened room. She isn't afraid because she knows that the killer from the first movie is dead, but boy is she wrong. Just as you think that the tension couldn't mount any more, the closet flings open and the masked killer jumps out wielding some sort of dangerous object screaming "I'm Back!" Except now it is real. The killers aren't some scarred freaks of nature. They aren't scary in appearance. However, the threat is there, and they can

slaughter thousands in a few months. What is really horrifying is that you can't even see them before they strike. These killers are new mutations of bacteria, one of the most feared things in recent medical history.

One of the most feared bacteria in history is making a resurgence, which may again lead to the death of thousands. In the nineteenth century, Tuberculosis (TB) was one of the most feared illnesses known to man. When vaccines emerged, TB was thought finally to be destroyed. What scientists failed to realize was that the bacteria strain, through mutation and adaptation was

becoming almost untreatable.

According to National Institute for Allergy and Infectious Diseases, the Tuberculosis bacteria are mutating at an alarming rate. Already drug resistant strains have been found in over ten mil-



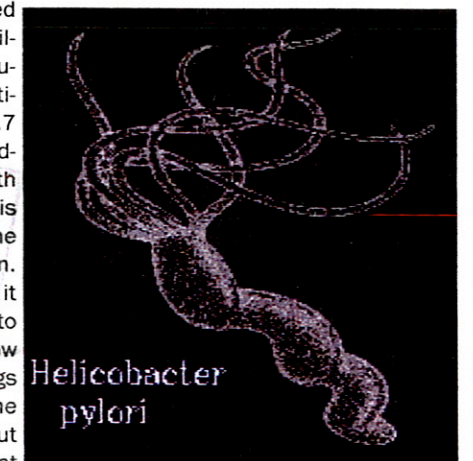
Bacterium: by Healthtouch

lion people in the United States alone. Dr. Gregory Young stated that New York City barley contained one of the most resilient strains of tuberculosis known. It is estimated that over 1.7 billion people worldwide are infected with tuberculosis. This is over one third of the world's population. Scientists fear that it will just continue to get worse. Right now there are still drugs that will cure the dreaded disease, but if measures are not soon taken, the bacteria will become im-

mune to all treatment.

Tuberculosis is not an isolated incident. Mutated strains of influenza attack yearly. There is even a type of AIDS virus that is airborne. Though contained right now, if that airborne virus were to be exposed to the populace, we would have a bubonic level plague.

Only by constantly researching and developing new types of treatment can we even hope to find a way to curb the resurgence of these illnesses. We must also learn from our mistakes. Defeating an illness does not mean that it will never come back. Bacteria and viruses are just like horror movie villains; they never seem to



Helicobacter pylori

by Peter Erskine

Are We Being Outsmarted by Bacteria?

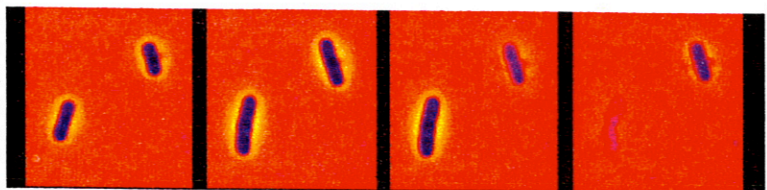
Special points of interest:

- In May 1998, a patent was given to Raul Cano that covered the recovery of bacteria and other ancient organisms found in petrified amber.
- Yes, just like in Jurassic Park.

Humans have an obvious size advantage against bacteria being billions times their size. On the other hand, bacteria outnumber us by an immeasurable number. It seems like a fair matchup that can only be decided by one factor, intelligence. So, who is smarter, humans or bacteria? Most people would consider this a "no-brainer," simply for that reason. These bacteria are one-celled organisms while we have the most complex brains of all living things. But, it is fact that bacteria are nullifying our man-made antibiotics. The medicines that save our lives are no longer killing the bacteria they are supposed to.

Antibiotics are products of certain microorganisms that kill or inhibit the growth of other microorganisms. These once called "miracle drugs" were introduced in the 1940's. Since then, they have controlled death, disability, and sickness caused by numerous diseases. Over the years, antibiotics have saved millions of lives, but they are no longer as productive. Due to antibiotic resistance, certain bacteria are overcoming the antibiotics that used to kill them. This is becoming an even bigger

problem than expected when antibiotic resistant bacteria were discovered. Without our antibiotics, common infections could turn fatal. Also, certain diseases currently can only be treated with antibiotics. So, why are bacteria becoming more resistant, prevailing, and widespread? This is primarily due to their overuse. Doctors prescribe them unnecessarily, but medical reasons are not the only uses for antibiotics. Farmers also use them to promote and improve live-

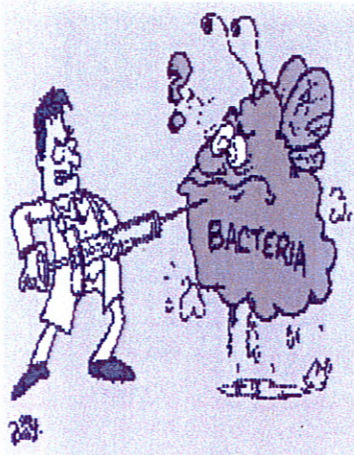


Penicillin rupturing cell wall of E. coli. James A. Sullivan

stock growth. About half of all antibiotics are used in this fashion. If overuse and misuse continues, resistance will only become more of a problem. This resistance is caused by many factors. Bacteria have a tremendous ability to adapt, which involves the three main factors; selective conditions, genetics, and mutations. To adapt to an environment that includes antibiotics, bacterial clones are spread that develop resistance. Bacteria also exchange genetic information among each other, which creates a survival of the fittest that eventually leads to strengthening resistance.

Finally, mutations extend the variety of bacteria so that not all bacteria are destroyed by the antibiotics. Environments that we create promote this resistant surge. Without these environments, the mutated bacteria would not survive.

The question still remains. Who is smarter, humans or bacteria? Bacteria's resistance to our antibiotics does not answer this question entirely. We may have been outsmarted once, but there is still great hope. New research is continuously taking place to develop new methods of fighting disease. Phages, the most abundant organisms on Earth, can also be used to fight bacterial infection. But, the final answer to this question has not been answered. It depends on how we use antibiotics in the future. Some tips to smarter use follow, Never share antibiotics with anyone. When prescribed to you, take them completely and as recommended. Most importantly, only use antibiotics for bacterial infections and when truly needed.



Battling those "Bugs". b4-u-buy

Could This Happen To You?

When I think of Mutation, which is not very often, I think of the Teenage Mutant Ninja Turtles. Although these heroes in a half shell are near extinction in the public's eye, I feel that they may be useful in explaining DNA Mutation.

genesis, defines it, "a mutagen is an agent that leads to an increase in the frequency

Can Mutations Occur Naturally: The answer is Yes, but 97% of the time the mutations are either harmful or neutral. Typically, the changes that do occur in a positive way, are slight changes that barely effect the organism. Mutations can occur several different ways in DNA.



If exposed to mutagen, could Turtles really become super-duper crime-fighters?

Could what happened to the Ninja Turtles happen to me or my pet turtle: Well, the answer is no. Even if this miracle mutagen is invented, we and our pet turtles would have to be extremely lucky. If only 3% of all mutations are for the better the chances of this happening are nearly impossible. Until this miracle mutagen is found, you might want to watch where you and your turtle step while walking through sewers.

IMPORTANT FACTS About DNA Mutations

- 97% of all mutations occur in a manner that produces either harmful or neutral effects on the individual afflicted
- Mutagen is an ugly word...you don't hear of too many super-models that devote their success to a mutation.

So what exactly happened to the Ninja Turtles besides overexposure and loss of popularity: As the story is told, a chemical lab dropped a container of mutagen down a sewer. The container broke open and sure enough, four certain turtles (Leonardo, Donatelo, Michealangelo and Raphael) crawled into this puddle and mutated into those loveable crime-fighters we know today.

of occurrence of mutations." This exposure to a mutagen, basically, upped the turtle's chance of changing into an "Amphibious Crime-Fighter." The mutagen changed the DNA code of the turtles to make enhancements on their existing traits.

What exactly is Mutagen: As the book, DNA Repair and Muta-



The Good The UGLY The BAD of Genetic Mutations

The Good: Mutations that occur naturally for a favorable outcome can be seen in nature. The Ninja Turtles, became bigger, stronger, smarter, and other positive things. Changes we see are on a smaller scale such as changes in immediate environ-

ment or a species changing color. The Bad: Sometimes we do see changes that have lethal results. For example, a mutation in coding region of DNA can cause an allergy to common food! The Ugly: The word mutat-

ion is, itself an ugly word. Some of the "ugly" things we see would be an unpleasant change in features such as a pigmentary disturbance that causes an individual to have spots of pigmented skin and others without. Mutation is rarely something nice.

BACTERIA

Safeguarding Your Family From

KILLER

- 79.7% of staphylococcus epidermis bacteria, which causes skin infections was resistant to the antibiotic methicillin in ICU's.
- 39.4% of staphylococcus aureus, which causes blood infections was resistant.
- 7.7% of enterococcus bacteria, one cause of blood infections, was resistant to the antibiotic vancomycin in ICU's.

G. 1

THE MEAT WE EAT

- A typical hamburger contains meat from 80 cattle.
- E.Coli Bacteria will survive long term freezing.
- 90% of all broiler-house chickens now carry salmonella bacteria.
- Salmonella is now present inside eggs.

G. 2

Although Bacteria Mutations may sound like nothing but a lot of scientific babble, it is a subject on which everyone should be informed.

What is Bacteria Mutations?

Antibiotics attack bacteria by destroying part of their protective cell wall, but bacteria fight back by changing the cell wall so the antibiotics can't get in. They also know how to pass on their new defenses to other bacteria, rendering the latest generation of antibiotics useless over time.

Reasons To Safeguard?

One of the main reasons to practice prevention is the appearance of drug resistant bacteria. These strains usually result due to the misuse of products. People do not use a large enough dose to kill the bacteria, just enough to immunize it. In the 1990's, drug resistant bacteria has become an emerging public health issue.

Another reason is Bacterial Diseases. One example of this is Hepatitis C. This strain is believed to cause between 150,000 and 250,000 new cases in the US each year. Anyone is at risk of getting this disease. It can be acquired simply by using the same razors, nail clippers, scissors, tooth-

brushes, tampons, or sanitary napkins.

But perhaps the most frightening reason to safeguard is that today, hospitals



It is absolutely vital to safeguard you, your family, and your home against bacteria.

are of little or no help.

"The ICU (Intensive Care Unit) is the single most infectious place in the world when it comes to antibiotic-resistant bacteria," Dr. Alexander Tomasz said.

For more statistics on the unsafe conditions of the ICU see graphic one (G.1).

Safeguarding Outside the Home?

A major place to be wary of is the supermarket, especially the meat aisle.

"Supermarket meat cannot be considered safe for human consumption," according to GAP (Government Accountability Project in 1997).

This is mainly caused by unsafe conditions at the meat plants. Documented reports by GAP and other organizations like it have

recorded instances where abscesses and digestive organs are punctured during slaughter, releasing pus, fecal material and ingesta all over carcasses. The meat is the rinsed instead of trimmed, forcing bacteria into the porous skin. In some instances diseased, cancerous, and tuberculoid animals are often sent to slaughter in spite of the law. Some utilities even use large plastic tubes to transport quantities of rancid or abscessed meat that are not sanitized before transporting

clean product. For more statistics see graphic two (G. 2).

There are ways to safeguard against bad meat. One option is to buy from small, local butchers who butcher for small suppliers. Or, find people who butcher their own livestock and see what they feed their animals. Make a deal to buy from them (you will need freezer space.) A third option is for poultry. Make arrangements to purchase from small farmers who keep only grain-fed, free range chickens.

It is possible to safeguard your life from harmful bacteria, as long as you know what to look out for. In the next two articles, you will see why it is important to take extra care when buying any meat products, and protecting your home.

Ways to Safeguard Yourself, Your Family, and Home

"It is possible to safeguard yourself, your family, and your home as long as you know what to look out for."



A bacteria-free home, is a happy home.

There are several important aspects one needs to consider when protecting themselves from bacteria.

Housekeeping...

Routine cleaning and removal of soil is a necessity. Horizontal surfaces should be cleaned on a regular basis. As for vertical surfaces, it is recommended that they be cleaned only if they are visibly soiled. Never ever use sponges, and disinfectant fogging is also not recommended.

Recommendations...

For a cleaning agent, any hospital grade disinfectant-detergent registered by the EPA may be used for cleaning environmental surfaces. The instructions should always be closely followed.

For horizontal surfaces such as uncarpeted floors, counters, etc. You should clean them regularly and also if spills occur. Carpeting should be vacuumed regu-

larly with units designed to efficiently filter discharged air, cleaned if spills occur, and shampooed whenever a thorough cleaning is indicated.

For vertical surfaces such as walls, blinds or curtains, they should be cleaned only if visibly dirty, and then with a disinfectant as described previously.

Laundry...

This is an area that is usually safest, but there are still steps that can be taken to ensure safety.

Although containing pathogenic microorganisms, the risk of actual disease transmission from soiled linen is negligible. Common sense procedures in the storage and processing of clean and soiled linen are advised.

Soiled linen should be handled as little as possible due to possible air contamination. Linen with blood, or body fluids should be transported in bags that prevent leaking and washed immediately. If laundry chutes are

used, linen should be bagged, and chutes should be properly designed and cleaned.

In cleaning linens, if hot water is used, linen should be washed with a detergent in water at least 71 degrees Celsius for 25 minutes. If cold water is used, water temperature should not exceed 70 degrees Celsius, and chemicals suitable for low temperature in proper concentration should be used.

When transporting clean linen, they should be removed and stored by methods that ensure cleanliness.

Personal Hygiene Tips...

Regular hand washing is the most important factor in the prevention of spreading bacterial diseases. When cleaning soiled objects always use gloves that are disposable. And always wash regularly with a disinfectant soap and rinse.

Following these steps will promote a bacteria free life for you and your family.

Why YOU Must Be Careful With The Meat You Buy

There are thousands of reasons to care about the conditions your meat went through before it got to you. But now you're going to see a couple of the main ones.

These two diseases are completely untreatable. The first always leads to the immediate death of the infected person, and the second is currently being researched as to its applications to the meat industry.

The first of these harmful diseases is known as:

Mad Cow Disease...

The scientific name for this disease is BSE (Bovine Spongiform Encephalopathy) or CJD (Creutzfeldt-Jakob Dis-

ease) when infecting humans.

Perhaps the most frightening aspect of this disease is the way it jumped from infecting only cows, to humans in the first place.

The cause is due to recycling diseased meat into meat by-products, through these means, the disease jumped to the ability to infect humans.

The disease literally kills the brain and eventually, with lack of brain power the body stops functioning all together.

The second disease may seem unusual, but many researchers are seriously con-

sidering its cause to lie in the food we eat due to several key factors.

Alzheimer's Disease...

According to scientists and historians, this disease was virtually unknown at the turn of the century, and today it is immediately affecting the lives of eight million people in the US alone.

All research into the disease points directly to diet and nutrient deficiency as the leading cause of this unique form of dementia.

As you can see, what you don't know can hurt—kill you.

MAD COW DISEASE



ALZHEIMER'S DISEASE



Two Concerns Involved in the meat that you buy everyday