

ALCOHOLISM

- ALCOHOLISM AFFLICTS 15 TO 20 MILLION AMERICANS
- ALMOST 40% OF THE TRAFFIC FATALITIES IN THE U.S. ARE ALCOHOL-RELATED
- BECAUSE OF FETAL ALCOHOL SYNDROME, ALCOHOLISM IS THE THIRD LEADING CAUSE OF BIRTH DEFECTS WITH ACCOMPANYING MENTAL RETARDATION
- ALCOHOL IS THE MOST WIDELY USED DRUG IN THE UNITED STATES

Alcoholism is a chronic disease. The risk for developing alcoholism is influenced by a person's genes and his/her lifestyle. Although there is no cure for alcoholism, it can be treated.

ETHYL ALCOHOL



Ethanol, also known as ethyl alcohol or grain alcohol, is a flammable, colorless chemical compound that is the active ingredient in alcoholic beverages. Its chemical formula is C_2H_5OH .

Ethyl alcohol is completely miscible with water. Two liquids are considered miscible if shaking them together results in a single liquid phase with no meniscus visible between layers. This characteristic is due to its hydroxyl (-OH) group, which forms intermolecular hydrogen bonds to water. As a result, ethyl alcohol is readily distributed throughout the body in the aqueous blood stream after consumption. Because of this water solubility, it readily crosses important biological membranes, such as the blood brain barrier, to affect a large number of organs and biological processes in the body.

Once absorbed by the bloodstream, the alcohol leaves the body in three ways:

1. The kidney eliminates 5 percent of alcohol in the urine.
2. The lungs exhale 5 percent of alcohol, which can be detected by breathalyzer devices.
3. The liver chemically breaks down the remaining alcohol into acetic acid.

The breakdown, or oxidation, of ethanol occurs in the liver. An enzyme in the liver called alcohol dehydrogenase strips electrons from ethanol to form acetaldehyde. Another enzyme, called aldehyde dehydrogenase, converts the acetaldehyde, in the presence of oxygen, to acetic acid, the main component in vinegar. The chemical formula for acetic acid is $C_2H_4O_2$.

The liver is able to metabolize about ½ ounce of ethanol per hour. If more alcohol arrives in the liver

ALCOHOLISM—CONTINUED

than the enzymes can handle, the excess alcohol travels to all parts of the body, circulating until the liver enzymes are finally able to process it. The higher the concentration of alcohol in the body, the greater the disturbance it has on body cells. Severe disruption of function can occur and can cause death.

Scientists use animals in alcoholism research to understand the causes of disease and to develop new treatments. Animals are used to model the drinking behavior of human alcoholics, to learn how brain chemistry leads to a drinking behavior, and to study how alcohol damages organs. Additional studies with rats are exploring the processes of alcohol craving, dependency, and tolerance; and the genetic basis for these phenomena. Contributing to the study of withdrawal is a rat strain sensitive to low doses of alcohol. Nutritional studies with pigs may lead to specific dietary recommendations that can prevent malnutrition and liver disease from chronic alcoholism. Although no animal model completely reproduces all the features of the human disease, individual features of alcoholism can be studied in animals in great detail since the researcher has control over experimental conditions such as nutrition, environment, species, and ancestry.

Research shows that the risk for developing alcoholism does indeed run in families. The genes a person inherits partially explains this pattern, but lifestyle is also a factor. Currently, researchers are working to discover the actual genes that put people at risk for alcoholism. Your friends, the amount of stress in your life, and how readily available alcohol is are also factors that may increase your risk for alcoholism.

Researchers hope that findings learned from animal models, behavior studies, and genetics will enable them to determine how to reduce alcohol consumption in persons with a genetic predisposition for heavy alcohol consumption, how to address the alcohol-related organ damage and associated health problems, and how alcohol interacts with the central nervous system and what the specific neurotransmitter systems are.



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ALZHEIMER'S DISEASE

- MORE THAN 4.5 MILLION AMERICANS ARE AFFLICTED WITH ALZHEIMER'S DISEASE
- ONE IN TEN PERSONS OVER THE AGE OF 65 AND NEARLY HALF OF THOSE 85 OR OLDER HAVE ALZHEIMER'S DISEASE
- ALZHEIMER'S DISEASE IS NOT A NORMAL PART OF AGING

Alzheimer's disease is a progressive brain disorder that gradually destroys a person's memory and ability to learn, reason, make judgments, communicate, and carry out daily activities. As the disease progresses, individuals may also experience changes in personality and behavior, such as anxiety, suspiciousness, agitation, delusions, or hallucinations. The diagnosis is made primarily on the basis of

history, clinical observation, and tests of memory and intellectual functioning. No medical tests are available to diagnose Alzheimer's disease conclusively pre-mortem (prior to death).

Alzheimer's disease is named after Alois Alzheimer, a German doctor. In 1906, Dr. Alzheimer noticed changes in the brain tissue of a woman who died of an unusual mental illness.

Alzheimer's disease advances at different rates. The illness may last from 3 to 20 years. The disease attacks the brain's nerve cells, or neurons. The neurons produce a brain chemical that serves as a neurotransmitter. Neurotransmitters relay electrical signals from a neuron to a cell. By attacking the neurons, the connections to certain areas of the brain are lost and the cells ultimately die.

There are two types of Alzheimer's disease – sporadic and familial. Familial Alzheimer's disease is a rare form of the disease that affects less than 10% of the Alzheimer's disease patients. The disease develops before age 65 and is caused by gene mutations.

Sporadic Alzheimer's disease usually develops after the age of 65 and has no known cause. Although genetic factors appear to play a role in late-onset or sporadic Alzheimer's disease, no specific gene has been identified as the root cause of the disease.

Although there is no cure for Alzheimer's disease, biomedical research using animal models has helped scientists learn what factors may contribute to the disease, and to develop medications and new treatments to improve the quality of life for patients are forthcoming.

Researchers continue to study the human brain to uncover the mysteries of this disease, but such

INTELLIGENCE,
JUDGEMENT &
BEHAVIOR

LANGUAGE

MEMORY

ALZHEIMER'S DISEASE—CONTINUED

studies can only be accomplished after a patient dies. Thanks to animal models, significant discoveries and advances continue to be made. The identification of a deficiency in the brain chemical acetylcholine was made through the use of human brain tissue. The importance of this discovery was apparent only because earlier experiments on animals had defined the role of acetylcholine in memory processing. This acetylcholine model provided a basis for the development of the current FDA approved drugs for Alzheimer's disease and will be a key part of new drug development.

Studies involving dogs, which can suffer from a canine version of Alzheimer's disease called canine Cognitive Dysfunction Syndrome, are creating hope for both humans and dogs in the treatment of brain disorders. Through autopsies performed on dogs with canine Cognitive Dysfunction Syndrome, scientists have found the same degenerative brain lesions that are present in humans with Alzheimer's disease. This information can be built on to better understand the disease in humans and in animals and to develop treatments for both.

Researchers realize that personality changes are not part of the aging process and believe through continued research that treatments can be developed to improve the quality of life for humans and their animal companions.



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ARTHRITIS

- ARTHRITIS IS THE LEADING CAUSE OF DISABILITY IN THE U.S.
- MORE THAN 20 MILLION AMERICANS ARE AFFLICTED WITH ARTHRITIS
- MORE WOMEN THAN MEN ARE SUBJECT TO ARTHRITIS

Arthritis is a complex disorder comprising more than 100 distinct conditions and affecting people at any stage of life. Two of the most common forms are osteoarthritis (OA) and rheumatoid arthritis (RA).

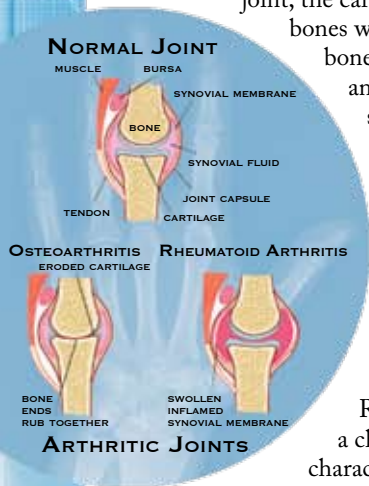
Osteoarthritis is a condition where the cartilage covering the bone ends wears away. In a healthy joint, the cartilage covers the ends of the bones within the joint, allowing the bones to glide smoothly over one another. The cartilage acts as a shock absorber for the joints during physical activities.

Osteoarthritis is the most common form of arthritis. The disease often develops as a person ages, but can occur in younger adults due to injuries sustained in sports or accidents.

Rheumatoid arthritis is a chronic disease, mainly characterized by inflammation of the lining, or synovium, of the joints. It can lead to long-term joint damage, resulting in chronic pain, loss of function, and disability.

Scientists have yet to find an exact cause for rheumatoid arthritis, but they do know that the body's immune system plays an important role. In a healthy immune system, white blood cells produce antibodies that protect the body against foreign substances. People with rheumatoid arthritis have an immune system that mistakes the body's healthy tissue for a foreign invader and attacks it. Rheumatoid arthritis progresses in three stages. Stage one is the swelling of the synovial lining. Second is the rapid division and growth of cells, or pannus, which causes the synovium to thicken. In the third stage, the inflamed cells release enzymes that may digest bone and cartilage, often causing the involved joint to lose its shape and alignment, more pain, and loss of movement.

Since the causes of most forms of arthritis are not known, doctors attempt to treat the symptoms. Treatment options vary based on the form of arthritis. They can include physical and occupational therapy, medications for inflammation, pain, and infection, and occasionally, prosthetic joint replacement. Through additional research, especially research in animal models with forms of arthritis, researchers are working toward an



ARTHRITIS—CONTINUED

understanding of the root causes of arthritis. This critical knowledge is the key to designing better and more effective methods of diagnosing, treating, and even preventing arthritis related diseases.

Significantly, future research into the causes of arthritis will utilize mice to look at how four factors work alone and together to produce the disease. The four factors include how the body contributes to the disease process and the roles heredity, infections, and the environment play.

With this information, scientists may be able to correct malfunctions in the immune system by immunizing people against bacteria or viruses that trigger some forms of arthritis. Researchers may be able to prevent types of arthritis from ever happening by identifying and eliminating those factors that cause them. One of the biggest areas of future research will concern genes and gene replacement. Some forms of arthritis probably result from genes that have the wrong set of instructions.

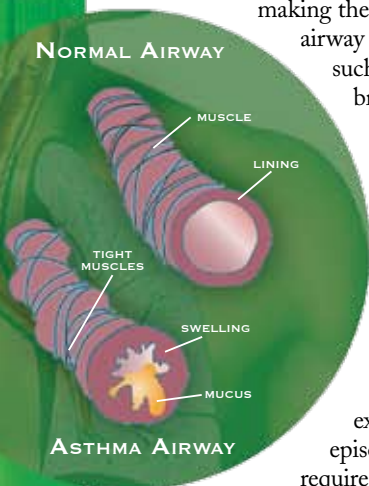


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ASTHMA

- **ASTHMA AFFECTS ALMOST 20 MILLION AMERICANS; NEARLY 9 MILLION CHILDREN**
- **ONE IN FOUR URBAN CHILDREN IN THE U.S. HAS ASTHMA**
- **ANNUALLY, TREATMENT OF ASTHMA COSTS BILLIONS OF DOLLARS IN THE U.S.**
- **MORE BOYS HAVE ASTHMA THAN GIRLS, BUT IN ADULTHOOD, MORE WOMEN HAVE ASTHMA THAN MEN**

Asthma is a chronic disease of the respiratory system where the airways (bronchi) constrict, become inflamed, and are lined with excessive amounts of mucus. The muscles around the airways also tighten, making the airways even narrower. This airway narrowing results in symptoms such as wheezing, shortness of breath, chest tightness, coughing, and difficulty in breathing.



In some people, asthma is a chronic respiratory impairment. In others, it occurs only occasional or episodically with symptoms resulting from a triggering event, like an upper respiratory infection, airborne allergens, or exercise. Whenever an asthma episode is severe, a person may require emergency treatment to restore normal breathing. Without proper medical attention, a person may die of an asthma attack.

There are two types of asthma, allergic and non-allergic. Allergic asthma is the most common form of asthma. Allergic asthma is triggered by inhaling allergens such as dust mites, mold, pet dander, or pollens. Non-allergic asthma is triggered by factors not related to allergies such as anxiety, stress, exercise, medications, cold air, dry air, hyperventilation, or smoke and other irritants. In non-allergic asthma, the immune system is not involved in the reaction.

Researchers have been unable find a cure for asthma, nor have they been able to fully determine what makes the airways of people with asthma become inflamed. Research has shown that asthma runs in families and that a person is more likely to be diagnosed with asthma if another person in the family is an asthmatic. Additional research has shown that exposure to tobacco smoke and other air irritants, infections, and certain allergens early in life may increase a person's likelihood of developing asthma. Obesity has also been linked to causing asthma.

Study of animal diseases that are similar to asthma have helped scientists understand how certain cells entering the lungs during an attack release chemicals that then act on the nerves, muscles, and mucus-

ASTHMA—CONTINUED

secreting cells, causing airway inflammation. Research involving rabbits and guinea pigs has also helped scientists to successfully develop various medications and treatments, including fast acting treatments for use during an asthma attack such as bronchodilators delivered through inhalers, and newer preventative medications that can potentially prevent an asthma attack from occurring. Such research and the resulting treatments have made it possible for many people to control their asthma, treat attacks and restore breathing, prevent asthma attacks, and all and all lead active lives. As research continues, scientists work toward a fuller understanding of how and why asthma occurs, and then subsequently, toward discovering a cure.



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ATHEROSCLEROSIS

- **ATHEROSCLEROSIS IS THE LEADING CAUSE OF DEATH IN THE U.S. AND MOST WESTERN COUNTRIES**
- **EACH YEAR, APPROXIMATELY 750,000 AMERICANS DIE DUE TO ATHEROSCLEROSIS**
- **ATHEROSCLEROSIS IS THE LEADING CAUSE OF CARDIOVASCULAR DISEASE AND HEART ATTACKS IN AMERICAN WOMEN**

Atherosclerosis is a condition where deposits of tough, rigid, fatty materials build up along the walls of medium-sized and large arteries. This increases the stiffness and decreases the elasticity of the artery wall. The continued build up of these deposits results in reduced or blocked blood flow, which can adversely affect the brain, heart, kidneys, other vital organs, and the legs.

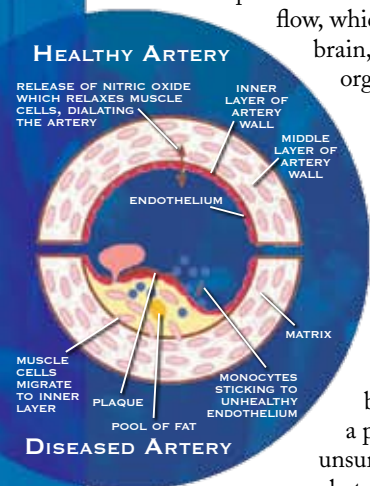
Calcification, sometimes even ossification (formation of complete bone tissue), occurs within the deepest and oldest layers of the sclerosed vessel wall.

Atherosclerosis is a slow, progressive disease that can begin at different stages in a person's life. Scientists are unsure why atherosclerosis begins or what causes it.

The progression of atherosclerosis is clear. When the lining of the artery is injured, certain white blood cells (monocytes) move out of the bloodstream and through the lining of an artery and into the wall of the artery. Inside the lining, the white blood cells are transformed into foam cells, which are cells that collect fatty materials including cholesterol. As time progresses, smooth muscle cells move from the middle layer of the artery wall to the innermost layer and begin to multiply. Cell debris, cholesterol crystals, and calcium may also start to collect at this injured spot in the wall of the artery. This accumulation of cells and other materials is called plaque. As these deposits grow, they can restrict or stop blood flow in an artery.

Risk factors for atherosclerosis include smoking, high levels of cholesterol in the blood, and high blood pressure. Smoking decreases the level of high-density lipoprotein (HDL) – “good” cholesterol – and increases the level of low-density lipoprotein (LDL) cholesterol – “bad” cholesterol. In addition, smoking increases the level of carbon monoxide in the blood, which can increase the risk of injury to the lining of the artery's wall.

Researchers are investigating the process and developing treatment options for containment



ATHEROSCLEROSIS—CONTINUED

or correction of symptoms of atherosclerosis. Additional knowledge of the root causes may someday bring about preventive procedures. More work is needed to learn about the role cholesterol, hormones, and various dietary substances play in the development of atherosclerosis. Uncovering the mechanisms that cause the disease will eventually lead to better preventative measures and improved treatments for atherosclerosis. Scientists have been studying birds, rodents, and monkeys to learn how cholesterol accumulates along the walls of the arteries. Other studies performed by scientists have uncovered possible effects hormones may play in mitigating atherosclerosis.

Currently, surgical procedures to open narrowed arteries and to repair weakened arteries, developed and tested through animal research, remain a treatment option for atherosclerosis. Such surgeries are only a temporary solution and scientists still need to conduct additional research to find out why artery walls become damaged in some people and not in others.



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AUTISM

- **AUTISM IS ONE OF THE MOST COMMON DEVELOPMENTAL DISORDERS, PRESENT IN AN ESTIMATED 1 IN 166 CHILDREN BORN EACH YEAR**
- **AUTISM IS GROWING AT A RATE OF 10-17% PER YEAR**
- **ALTHOUGH AUTISM IS ABOUT 4 TIMES MORE COMMON IN BOYS, GIRLS WITH THE DISORDER TEND TO HAVE MORE SEVERE SYMPTOMS AND GREATER COGNITIVE IMPAIRMENT**
- **WITHIN TEN YEARS, IT IS ESTIMATED THAT ALMOST 4 MILLION AMERICANS WILL BE DIAGNOSED WITH AUTISM**

Autism is a complex developmental disability that typically appears during the first three years of life. It is the result of a neurological disorder that affects the normal functioning of the brain, impacting development in the areas of social interaction and communication skills. Children and adults with autism typically exhibit difficulties in verbal and non-verbal communication, social interactions, and leisure or play activities.

It was not until the middle of the twentieth century that scientists had a name for this disorder that affects individuals differently and at varying degrees.

There is no known single cause for autism, making research imperative in order to understand the reasons for occurrence, and to develop effective treatments. Brain scans show differences in the shape and structure of the brain in autistic versus non-autistic children. Researchers are investigating various theories, including the link between heredity, genetics, and medical problems. While no one gene has been identified as causing autism, in many families there appears to be a pattern of autism or related disabilities. Researchers are also searching for irregular segments of genetic code that autistic children may have inherited. Some children are born with a higher susceptibility to autism, but researchers have not yet identified a single “trigger” that causes autism to develop.

Researchers are investigating the possibility that, under certain conditions, a cluster of unstable genes may interfere with brain development, resulting in autism. Still other researchers are investigating problems during pregnancy or delivery, as well as environmental factors such as viral infections, metabolic imbalances, and exposure to environmental chemicals.



AUTISM—CONTINUED

Thanks to technical advancements made by engineers working in collaboration with researchers using animal models of autism, new tools such as computerized tomography (CT), positron emission tomography (PET), single photon emission computed tomography (SPECT), and magnetic resonance imaging (MRI) have been developed that allow scientists to study the structure and the functioning of the brain, including how autism manifests. Such studies provide data from, and images of, the brain that will help scientists uncover the causes of autism. This knowledge of the basics of the condition is imperative in order to better understand the contributing factors to this disorder, and to allow researchers to further study how autism can be treated or symptoms ameliorated. This could potentially help researchers discover ways to prevent the onset of autism.



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CANCER

- ONE OUT OF EVERY FOUR DEATHS IN THE U.S. IS DUE TO CANCER, MAKING IT THE SECOND LEADING CAUSE OF DEATH AMONG AMERICANS
- ANNUALLY, MORE THAN 1.2 MILLION AMERICANS ARE DIAGNOSED WITH CANCER AND MORE THAN 500,000 WILL DIE FROM THIS DISEASE
- HALF OF THE MEN AND ONE-THIRD OF THE WOMEN IN THE U.S. WILL BE DIAGNOSED WITH CANCER WITHIN THEIR LIFETIME

Cancer is a term for diseases in which abnormal cells divide without control, and the ability of these cells to invade other tissues, either by direct growth into adjacent tissue or by implantation into distant sites through the bloodstream or lymphatic system, called metastasis. There are more than 100 forms of cancer.

Although cells in different parts of the body may look and work differently, most repair and reproduce themselves in the same way. Normally, this division of cells takes place in an orderly and controlled manner. If, for some reason, the process gets out of control, the cells will continue to divide, developing into a lump that is called a tumor.

NORMAL CELLS



CELLS FORMING A TUMOR

In a benign tumor, the cells do not spread to other parts of the body and so are not cancerous. If they continue to grow at the original site, they may cause a problem by pressing on the surrounding organs.

A malignant tumor consists of cancer cells that have the ability to spread beyond the original site. If the tumor is left untreated, it may invade and destroy surrounding tissue. Sometimes cells break away from the original (primary) cancer and spread to other organs in the body along the bloodstream or lymphatic system.

Cancer researchers believe that cancer can be triggered by many factors, such as genetics, diet, lifestyle, and occupation. Cancer is treated through surgery to remove the affected cells, chemotherapy and radiation therapy, and an extensive variety of medications. The approach to treatment is based on the type of cancer, location, and the progression of the disease. A number of experimental cancer treatments are also under development.

Scientists use animals to investigate the causes of cancer, test new treatments, search for and work with new screening and diagnostic tools, and conduct molecular studies that may have a link to

CANCER—CONTINUED

cancer. For example, the first cancer-causing gene was identified in a chicken tumor virus in 1970, and testing in rats revealed exciting new developments in breast cancer research when a new compound, tamoxifen was shown to prevent breast cancer. New advances and new knowledge underlying the causes and effects of cancer continued to be learned.

Many anti-cancer drugs are toxic to normal cells as well as cancer cells and can have toxic side effects. For this reason, scientists must test them on higher-order animals, such as dogs, ferrets, or rabbits, before human beings take the new drug or before drugs can be administered to pets or livestock. If the drug may cause a particular side effect in humans, the researcher picks an animal species to best model that possible side effect. Since almost all animals develop one form of cancer or another under normal conditions, this research is proving important to veterinary care. Domestic pets and wildlife have all benefited from current understandings and treatment of various forms of cancer.

Various new approaches to cancer treatment are under investigation. Researchers are looking for ways to destroy cancer cells and to interrupt the growth and spread of cancer cells without harming healthy cells, such as curing some forms of cancer by blocking the blood supply of tumors based on recent success in mouse cancer studies. Since cancer includes an entire variety of diseases, it is unlikely that researchers will discover a single cure for cancer, but advances in each area of cancer research are important to advancing the general understanding of cancer, the bodies reaction to cancer, and the development of a broad variety of treatments, preventative mechanisms, and cures.




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COMPANION ANIMAL DISEASES

- DOGS CAN DIE WITHIN 48 TO 72 HOURS FROM CANINE PARVOVIRUS WITHOUT TREATMENT
- ABOUT 10% OF THE DOGS THAT CONTRACT CANINE PARVOVIRUS DIE
- FELINE LEUKEMIA VIRUS IS RESPONSIBLE FOR MORE DEATHS AMONG CATS THAN ANY OTHER INFECTIOUS FELINE DISEASE
- MALE CATS ARE 1.5 TIMES MORE LIKELY TO BE INFECTED WITH FELINE LEUKEMIA THAN FEMALES
- FELINE LEUKEMIA VIRUS IS THE MOST COMMON CAUSE OF CANCER IN CATS

Scientists are extremely interested in companion animal diseases. In addition to improving the quality of life for pets, studying companion animal diseases allows researchers to anticipate unusual occurrences of diseases that are transmitted from animals to humans (zoonotic). This research process assists in developing vaccines, and in designing treatment methods in veterinary medicine.



There are three types of feline leukemia virus (FeLV) and each particular type causes a different type of disease. Feline leukemia virus is spread through infected saliva, urine, tears, feces, and through an infected mother to her kittens during gestation and nursing. FeLV cannot be spread to humans since it is a retrovirus. A retrovirus is species-specific and is made up of RNA. In addition, retroviruses are fragile and can be inactivated by ultraviolet light, heat, and detergents. In addition to causing cancer and tumor growth in cats, FeLV can cause severe anemia and impact the immune system so the cat's ability to protect itself against other bacteria, viruses, and fungi that are found in the everyday environment is greatly reduced. The same these secondary infections are responsible for many of the diseases and ill health associated with FeLV.

Lyme disease, a bacterial infection carried by ticks, is found in legions of the U.S. It can infect dogs, cats, goats, cattle, and horses. Since it is a zoonotic disease, it can also be transmitted to humans. Lyme disease can cause fever, lameness, swollen joints, and other symptoms among animals. Infected humans may get a red, blotchy rash, fever, headache, and aching muscles and joints. Some may develop complications including disorders of the heart and nervous system. Most animals and humans treated with antibiotics will recover quickly. An effective vaccine has not been found.

Canine parvovirus (CPV) is a highly contagious virus that affects dogs. The disease, which did not

COMPANION ANIMAL DISEASES— CONTINUED

exist prior to 1976, is spread from dog to dog through physical contact with feces. Although birds, flies, cats, and humans cannot become infected, they can transmit CPV to a dog by transporting the infected feces.

CPV only affects dogs, wolves, and foxes. There are two forms of canine parvovirus: intestinal and cardiac. The cardiac form is rare and affects puppies less than eight weeks old by attacking the heart muscle causing heart failure in the dog.

More than 80% of the dogs that are infected with canine parvovirus will not show any symptoms. Dogs that develop the disease show symptoms such as lethargy, vomiting, and diarrhea (usually bloody) within 7 to 10 days. Although there is no cure, dogs usually recover from the viral infection and associated symptoms within five days. Diarrhea and vomiting lead to dehydration and subsequently secondary infections can set in, causing death even in treated dogs.

The same methods that have been developed to prevent and treat diseases in humans have also been utilized to improve the lives of countless animals. Laboratory studies involving animals have been critical in developing veterinary techniques and pharmaceuticals such as the vaccines that fight such animal diseases as rabies, distemper, feline leukemia, infectious hepatitis virus, tetanus, heartworm; therapies for cholera in hogs; preventive techniques for tuberculosis in cattle; and influenza and encephalitis in horses. More than 80 medicines, vaccines, antibiotics, and medical devices and surgical techniques developed for humans are now used to heal pets, farm animals, and wildlife.

In addition, treatments for cancer, heart disease (including pacemakers), artificial joint replacement, diabetes, and many other ailments and conditions that affect humans and animals are used in veterinary medicine today and have been developed and improved through laboratory animal studies.

Better vaccines and treatments for companion animal diseases are one of the goals of current biomedical research.

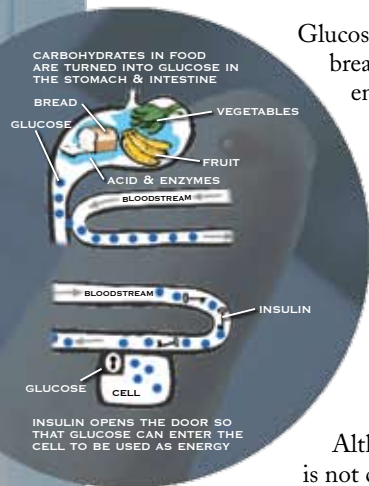


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DIABETES

- MORE THAN 20 MILLION PEOPLE IN THE UNITED STATES (7%) HAVE DIABETES
- ONE THIRD OF THE PEOPLE IN THE U.S. WITH DIABETES ARE UNAWARE THAT THEY HAVE THE DISEASE
- GESTATIONAL DIABETES AFFECTS ABOUT 4% OF ALL PREGNANT WOMEN - ABOUT 135,000 CASES IN THE UNITED STATES EACH YEAR.

Diabetes is a metabolic disease in which the body has trouble regulating its blood glucose or blood sugar levels. Although there is no cure for diabetes, there are ways to control the disease and lower the risk of complications.



Glucose is created when your body breaks down food to use for energy. Your body uses glucose as its main source of fuel with the help of a hormone called insulin. The cells that secrete insulin are grouped in small islands in the pancreas called islets of Langerhans. Insulin acts like a key to unlock the body's cells, so glucose can enter and serve as fuel for the cells.

Although the cause of diabetes is not completely understood, both genetics and environmental factors such as obesity and lack of exercise appear to play roles.

Type 1 diabetes develops when the body's immune system destroys pancreatic beta cells, the only cells in the body that make the hormone insulin needed to regulate blood glucose. Approximately, 5-10% of Americans who are diagnosed with diabetes have type 1 diabetes.

Type 2 diabetes accounts for the majority of all diagnosed cases of diabetes. It occurs from insulin resistance where the cells cannot use its own insulin properly, and when the body doesn't make enough insulin.

There are risk factors associated with diabetes that scientists have found are controllable, while other risk factors cannot be controlled. Risk factors for Type 1 diabetes may be autoimmune, genetic, or environmental. Type 2 diabetes is associated with older age, obesity, family history of diabetes, pregnancy (gestational diabetes), impaired glucose metabolism, physical inactivity, and race/ethnicity. Many of the risks for Type 2 are controllable.

Diabetics must check their sugar levels many times a day to determine how much insulin they need, and then inject themselves with the proper dosage. Even then, they cannot completely control the

DIABETES—CONTINUED

complications of diabetes: blindness, kidney failure, circulatory problems, difficulty healing, nerve damage, and premature death.

Through medical research significant strides have been made in controlling diabetes, and in advancing toward a possible cure. Dogs and humans share similar complications of diabetes and early research involving dogs was instrumental in the treatment of diabetes. The cure and treatment of diabetes has advanced as new technology has become available.

Once scientists discovered the important role of insulin and the pancreas, they were able, beginning in 1922, to isolate insulin from dog, cow, and pig pancreases to treat humans. Later successes in diabetes research included the successful transplantation of islet cells into rats with diabetes, resulting in a cure for the disease in small animals. This work continues in order to translate this important step to human treatment. In addition, researchers have identified the genetic markers for type 1 diabetes and type 2 diabetes.

Future research will focus on ways to restore normal blood sugar levels, preventing and reversing complications, and examining the genetics of diabetes. Engineering and medical advancements ranging from needle-free insulin injection systems to lightweight (3 ounces) external insulin pumps have enabled diabetics to live long, productive lives while carefully monitoring their insulin levels. There are two potential cures for many patients with diabetes: a pancreas transplant or implanting an artificial pancreas. Future developments may result in an insulin patch, implantable insulin pumps, even a cure based on developments in diabetes-associated stem cell research



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HEART DISEASE AND STROKE

- **CORONARY HEART DISEASE IS AMERICA'S NO. 1 KILLER**
- **STROKE IS THE NO. 3 KILLER IN AMERICA AND A LEADING CAUSE OF SERIOUS DISABILITY**
- **OVER ONE MILLION AMERICANS EXPERIENCE A HEART ATTACK EACH YEAR**
- **EVERY 45 SECONDS, SOMEONE IN AMERICA HAS A STROKE. EVERY 3 MINUTES, SOMEONE DIES OF ONE.**

Heart disease is any disorder that affects the heart's ability to function normally. The term "heart disease" can include any of the following: coronary heart disease; ischaemic heart disease; cardiovascular disease; and pulmonary heart disease. Some

heart diseases can be present at birth (congenital heart diseases), others develop as we age, can be caused by life-style, or other factors.

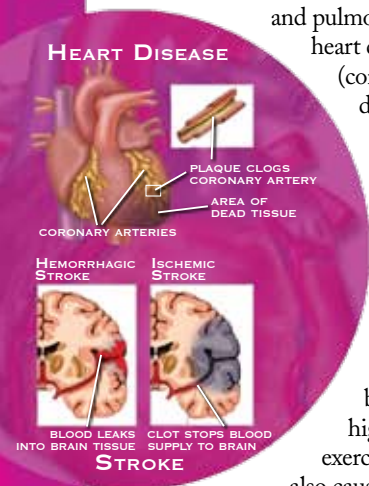
As we age, the heart loses some blood pumping ability. The added stress of health conditions that either damage the heart or make it work too hard contribute to heart failure. High blood pressure, smoking, being overweight, eating foods high in fat and cholesterol, not exercising, and having diabetes can also cause heart failure. In some cases,

though, behavior has absolutely nothing to do with heart failure. For instance, some people who develop heart failure were born with structural heart defects, while in others a virus damaged the heart muscle.

Coronary heart disease is the end result of the degenerative accumulation of lipid-containing plaques within the walls of the arteries that supply the myocardium (muscular middle layer of the wall of the heart). As the plaques grow and obstruct more than 70 percent of the diameter of the artery, ischemic heart disease develops. Ischaemic heart disease is characterized by reduced blood supply to the heart. The symptoms of ischemic heart disease are often first noticed during times of extra work being placed on the heart, like during exercise.

Cardiovascular disease is a class of diseases that involve the heart and/or blood vessel (arteries and veins). Pulmonary heart disease is a failure of the right side of the heart.

Both coronary heart disease and stroke share many of the same risk factors such as cholesterol disorders, high blood pressure, smoking, diabetes, physical inactivity, and being overweight or obese. Stroke is a disease that affects the blood vessels that supply blood to the brain. A stroke occurs when a blood vessel that brings oxygen and nutrients to the brain bursts or is clogged by a blood clot or some other mass. Because



HEART DISEASE AND STROKE— CONTINUED

of this rupture or blockage, part of the brain doesn't get the blood and oxygen it needs. Deprived of oxygen, nerve cells in the affected area of the brain can't work and die within minutes. When nerve cells can't work, the part of the body they control can't work either. The devastating effects of a severe stroke are often permanent because dead brain cells aren't replaced.

There are two main types of stroke. Ischemic strokes are caused by blockage of a blood vessel. Hemorrhagic strokes are caused by bleeding. Bleeding strokes have a much higher fatality rate than strokes caused by clots. Ischemic strokes account for 70-80% of all strokes. This type of stroke occurs when a blood clot forms and blocks blood flow in an artery bringing blood to part of the brain. Blood clots usually form in arteries damaged by fatty buildups (atherosclerosis). Hemorrhagic strokes are classified as being subarachnoid or cerebral hemorrhages. A subarachnoid hemorrhage occurs when a blood vessel on the brain's surface ruptures and bleeds into the space between the brain and the skull. A cerebral hemorrhage occurs when a defective artery in the brain bursts, flooding the surrounding tissue with blood.

Hemorrhage from an artery in the brain can be caused by a head injury or a burst aneurysm. Aneurysms are blood-filled pouches that balloon out from weak spots in the artery wall. They are often caused or made worse by high blood pressure.

Dog and human hearts are very similar and much of our knowledge about hearts was derived from studies of the dog heart. Critically, medical devices used to assist in diagnosis and treatment of heart disease and heart failure, such as pacemakers, article valves, and the defibrillator, were developed through laboratory animal studies. Other significant strides derived from such research include coronary by-pass surgery, artificial heart valves, stents and shunts, or the use of animal-based heart valves, heart transplantation and the necessary associated immunosuppressive and beta-blocking drugs were all developed and improved though laboratory studies of animals and their cardiovascular systems.

Animal studies involving mice have also been critical in developing techniques such as angioplasty, and in developing and improving new methods and drugs to treat and combat heart disease and strokes.



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HIV AND AIDS

- MORE THAN 1.2 MILLION PEOPLE IN THE U.S. – ONE IN 250 AMERICANS – IS INFECTED WITH HIV
- THE U.S. CENTER FOR DISEASE CONTROL (CDC) ESTIMATES THAT CLOSE TO 40,000 PEOPLE IN THE U.S. BECOME INFECTED WITH HIV EACH YEAR
- WORLDWIDE, HIV INFECTS MORE THAN 8,000 NEW PEOPLE EACH DAY
- THE JOINT UNITED NATIONS PROGRAM ON HIV/AIDS (UNAIDS) AND THE WORLD HEALTH ORGANIZATION (WHO) ESTIMATE THAT AIDS HAS KILLED MORE THAN 25 MILLION PEOPLE SINCE IT WAS FIRST RECOGNIZED ON DECEMBER 1, 1981

PARTS OF THE HIV VIRUS

OUTER ENVELOPE PROTEIN
TRANSMEMBRANE PROTEIN
LIPID MEMBRANE
MATRIX PROTEIN
NUCLEOCAPSID PROTEIN
RNA
PROTEASE
REVERSE TRANSCRIPTASE
INTEGRASE



Human Immuno-deficiency Virus or HIV is a retrovirus that is the cause of the disease known as AIDS (Acquired Immunodeficiency Syndrome). It weakens the immune system to the point that the system has difficulty fighting off infections that a healthy immune system could easily control. HIV also directly attacks organs such as the kidneys, heart and brain, leading to acute renal failure, cardiomyopathy, dementia, and encephalopathy.

HIV is transmitted from one infected person to another through blood, semen, vaginal fluids, and breast milk. Research and data analysis indicate that there are no other means of transmitting the virus. Activities that permit HIV transmission are:

1. Unprotected sexual contact
2. Direct blood contact with infected blood through needles and other sharps, blood transfusions and other blood products like plasma, and open wounds.
3. Mother to baby, either before or during birth, or through breast milk.

With HIV, the virus attacks the cells (CD4 lymphocyte) of the immune system. CD4 lymphocyte is a cell of the immune system that coordinates the attack by white blood cells and antibodies on viruses. By attacking these cells, HIV is able to replicate itself while not being detected by the immune system as an enemy. New copies of the virus burst forth from the cell, which then dies, and go in search of other cells to invade. The cycle continues again and again, with up to 10 billion new HIV virus particles produced every day by the commandeered cells.

A positive HIV test does not mean that a person has AIDS. A person with HIV is diagnosed as having

HIV AND AIDS—CONTINUED

AIDS only after the person develops an AIDS indicator illness or based on certain blood tests.

The body needs to have about 2 billion new CD4 cells each day to keep HIV in check. If the body can't keep up production against the virus' attacks on these cells, fewer and fewer CD4 cells are available for dispatching white blood cells. The body becomes unable to protect itself from other viruses, bacteria, and parasites. This is normally the stage at which a person is diagnosed with AIDS.

Over the last few years, scientists have discovered that a combination of drugs can delay the progression of the virus into and through infected cells.

Vaccines have historically been mankind's most effective weapon against viral diseases and animal research has played a key role in the development and testing of every virus vaccine currently in use.

Researchers depend heavily on monkeys for the development of promising strategies to protect people from this disease. Vaccines containing various strains of a simian immunodeficiency virus (SIV), a closely related virus that follows a disease course similar to HIV, or a hybrid human/simian immunodeficiency virus (SHIV) are being tested in macaque monkeys, and several research groups have successfully vaccinated monkeys with viral preparations that reduce viral load and halt disease progression. If these results can be generalized to humans, the vaccines may be used to treat HIV-infected humans. Due to primate studies, significant strides have been made, especially in maternal transmission of HIV/AIDS to fetuses and infants.

Thanks to research using monkeys, an HIV-positive diagnosis is no longer a certain death sentence. More people in the U.S. are living with AIDS and living longer. From 2000 through 2004, the number of people living with AIDS in the U.S. increased to more than 415,000 - a 30% increase while the number of new AIDS diagnoses increased only 8%.

Although research has made some significant strides in the fight against and treatment of HIV and AIDS, more work is needed since the virus can and has mutated thereby rendering past drug treatments ineffective.

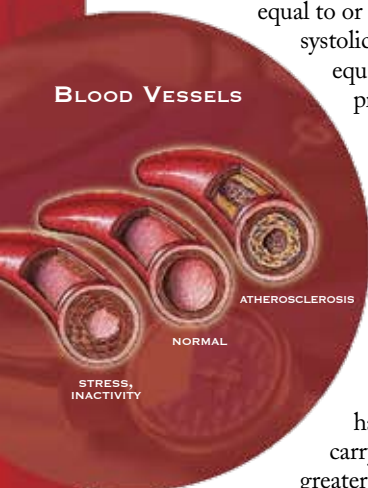


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HYPERTENSION

- 1 IN 4 AMERICAN ADULTS HAVE HYPERTENSION
- THE MORTALITY RATE FOR HYPERTENSION IS 7 IN 100,000 PEOPLE
- UNTREATED, HYPERTENSION CAN AFFECT ALL ORGAN SYSTEMS AND CAN SHORTEN ONE'S LIFE EXPECTANCY BY 10 TO 20 YEARS

Blood pressure is the force in the arteries when the heart beats (systolic pressure) and when the heart is at rest (diastolic pressure). High blood pressure, also called hypertension, makes the heart work harder to pump blood throughout the body and contributes to hardening of the arteries. Generally, physicians define high blood pressure in an adult as a blood pressure equal to or greater than or 140 mm Hg systolic pressure or greater than or equal to 90 mm Hg diastolic pressure. (Blood pressure is measured in millimeters of mercury (mm Hg).



Hypertension is often called the “silent killer” since there are typically no symptoms or signs of the disease. High blood pressure increases the workload of your heart and arteries. Your heart must pump harder, and the arteries must carry blood that’s moving under greater pressure. If high blood pressure

continues for an extended amount of time, your heart and arteries may not work as well as they should. In addition, other body organs may also be affected. Chronic hypertension is one of the leading risk factors for strokes, heart attacks, heart failure, and arterial aneurysm, and is a leading cause of chronic renal failure.

There are two forms of hypertension, primary (essential) and secondary. Essential hypertension accounts for 90 - 95% of hypertension. Several factors and conditions may play a role in its development, including genetics, obesity, lack of physical activity, excessive salt or alcohol consumption, old age, and even stress. Although genetic factors are thought to play a prominent role in the development of essential hypertension, the genes for hypertension have not yet been identified.

In secondary hypertension, the high blood pressure is secondary to (caused by) a specific abnormality in one of the organs or systems of the body. Doctors can usually alleviate secondary hypertension. For example, doctors can repair a narrowed artery that supplies blood to a kidney.

Research has shown that the vast majority of patients with essential hypertension have a particular abnormality of the arteries. This abnormality manifests itself in the form of stiffness or lack of elasticity in

HYPERTENSION—CONTINUED

the arteries that are most distant from the heart (peripheral arteries or arterioles). These arterioles supply oxygen-containing blood and nutrients to all of the tissues of the body. Just what makes the peripheral arteries become stiff is not known, but this increased peripheral arteriolar stiffness is present in those individuals whose essential hypertension is associated with genetic factors, obesity, lack of exercise, overuse of salt, and aging.

Before effective drugs were developed in the 1950s to treat high blood pressure (hypertension) the most severe form of hypertension killed 9 in 10 sufferers within a year of diagnosis. Now both severe and mild cases of hypertension are typically successfully treated by changes in lifestyle and with drug therapy.

Through research with laboratory animals such as rats, rabbits, cats, and mice scientists have been able to better understand the progression of hypertension, and develop drugs to treat hypertension. These drugs either restrict the formation of chemicals that cause the arteries to constrict, reduce the amount of water in the body, affect the response to the nerve impulses in certain parts of the body to decrease the heart's need for blood and oxygen and reduce its workload, or decrease the heart's pumping strength and relax blood vessels. In addition, nutritionists and physicians help those with hypertension develop healthier diets, loose weight, and increase their level of exercise which all significantly help control symptoms and prevent additional damage.

Such developments have extended the lives of humans and animals, which can also experience high blood pressure. More studies, however, are needed to develop better treatments and a cure for hypertension.



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LUNG DISEASE

- LUNG DISEASE IS RESPONSIBLE FOR ONE IN SEVEN DEATHS IN THE U.S.
- MORE THAN 35 MILLION AMERICANS ARE LIVING WITH A CHRONIC LUNG DISEASE SUCH AS ASTHMA, EMPHYSEMA, OR CHRONIC BRONCHITIS
- LUNG DISEASE AND OTHER BREATHING PROBLEMS ARE THE NUMBER ONE CAUSE OF DEATH IN INFANTS YOUNGER THAN ONE YEAR OLD
- ASTHMA AFFECTS ALMOST 20 MILLION AMERICANS; NEARLY 9 MILLION CHILDREN

There are different types of diseases that affect the lungs. Most fall under the category of Chronic Obstructive Pulmonary Disease (COPD),

a group of respiratory tract diseases characterized by partially blocked airways that make it difficult to get air in and out. Typically, these diseases are caused by exposure to airway irritants like coal dust, smoke, or solvents. Others may arise due to congenital defects.

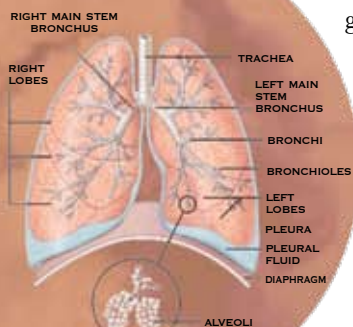
Although they are internal organs, the lungs are unique in that they are constantly exposed to the external environment—a direct interface with the world outside. With each breath, a host of alien substances enter

the body—pollens, dust, viruses, bacteria; the constituents of the air in homes and offices, factories, and workplaces, ranging from animal dander and tobacco smoke to radon and airborne lead; and the toxic chemicals released into the atmosphere by smokestacks and tailpipes. The lungs must play multiple roles—supplier of oxygen, remover of wastes and toxins, and defender against hostile intruders.

COPD is a progressive disease. Early symptoms include shortness of breath, frequent respiratory infections, and a morning cough. As the disease progresses, symptoms increase in frequency and severity. In the late stages, the patient often experiences severe cough, constant wheezing, and shortness of breath with minimal exertion. While medicines and treatments can often control symptoms or reverse acute episodes, COPD is not curable.

Chronic obstructive pulmonary disease can be caused by environmental irritants, and manifest in such diseases as pneumoconiosis, (miner's lung or black lung). This is a serious lung condition caused by the inhalation of dust that results in the formation of nodular fibrotic changes in lungs. Many substances can cause pneumoconiosis besides coal dust including asbestos, silica, talc, kaolinite, and other metal compounds. Another term for pneumoconiosis is pneumonoultramicroscopicsilicovolcanokoniosis,

LUNGS



LUNG DISEASE—CONTINUED

which was developed in 1935 and is the longest word in the English language.

In a patient with COPD and bronchiectasis, infection is the mechanism by which the disease progresses. The more the lungs experience infections, the more lung tissue and alveoli are damaged, and the more inelastic and dilated or inflamed the bronchial tubes become, perpetuating the cycle of the disease. The disease, left untreated, will continue to damage lung tissue and bronchial tubes and cause emphysema and severe breathing difficulties. The most common causes are scarring from tuberculosis, and cystic fibrosis. Smoking can also lead to emphysema, progressing from chronic bronchitis, and then scarring of the bronchi that develops into bronchiectasis. Adults can also have inherited immunodeficiencies that present as recurrent lung infections that ultimately lead to bronchiectasis.

Researchers are studying the many conditions that result from COPD, as well as the causes of the disease. Animal models have, and continue to, provide insight into the mechanisms of lung disease, and new techniques for treatment of lung disease are facilitated through such research. Rodent studies have contributed to better understandings of the effects of inhaling airborne particles and the toxicity of chemicals on lung diseases. Scientists working with laboratory mice are also making progress in their efforts to find a gene therapy for cystic fibrosis, and animal models are being studied to devise new ways of controlling asthma and AIDS-related pneumonia. Studies of emphysema in rabbits and horses - the only species besides humans to develop emphysema spontaneously— have helped researchers understand the stages of development of this disease, and are important in developing new techniques for treatment and prevention.



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PARKINSON'S DISEASE

- APPROXIMATELY 60,000 NEW CASES OF PARKINSON'S DISEASE ARE DIAGNOSED EACH YEAR IN THE U.S.
- PARKINSON'S DISEASE AFFECTS BOTH MEN AND WOMEN IN ALMOST EQUAL NUMBERS
- PARKINSON'S DISEASE AFFECTS 1 IN 100 PEOPLE OVER THE AGE OF 60, WITH THE AVERAGE AGE OF ONSET BEING 60 YEARS
- YOUNG-ONSET PARKINSON'S DISEASE (ONSET AT AGE 40 OR YOUNGER) IS ESTIMATED TO OCCUR IN 5 – 10% OF PATIENTS WITH THE DISEASE

Parkinson's disease is a degenerative disorder of the central nervous system that affects the control of muscles, and so may affect movement, speech and posture.

It was first described in 1817 by James Parkinson, a British physician. The disease results when nerve cells (neurons) in a part of the midbrain die or become impaired.

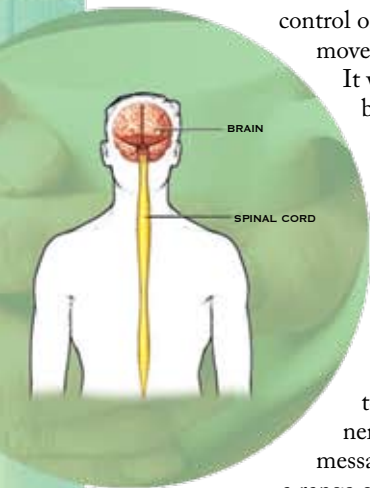
In the brain, two chemical messengers, dopamine and acetylcholine, work together to transmit messages between nerve cells and muscles. The messages enable us to perform a range of smooth, coordinated movements. These nerve cells produce

dopamine, an important chemical that transmits signals from the midbrain to another part of the brain. When 80% of the dopamine-producing cells in the brain are depleted, symptoms of Parkinson's disease develop. Symptoms include muscle rigidity, tremor, a slowing of physical movement, and in extreme cases, a loss of physical movement. The level of dopamine will continue to fall slowly over many years and these symptoms will worsen

Researchers do not know what causes the loss of dopamine in the brains of people with Parkinson's. Many researchers believe various factors play a role in causing Parkinson's. Areas of research into the cause include genetics, environmental factors, and viruses.

Five to ten percent of the patients with Parkinson's disease have a family history of the disease. It may affect people of the same generation (e.g., a brother or sister) or in two generations (e.g., a father and a son).

Studies of identical twins in which one twin developed Parkinson's after the age of 60 showed no increase in the incidence of Parkinson's of the other twin. There is an increase incidence, however in the second twin of the first twin is diagnosed with the disease prior to the age of 50. This data suggests that heredity may play an important role in young onset cases.



PARKINSON'S DISEASE—CONTINUED

Most people with Parkinson's disease are described as having idiopathic Parkinson's disease (having no specific cause). There are far fewer cases of Parkinson's disease caused by other factors, including genetic, toxins, head trauma, and drug induced Parkinson's disease. There is no cure for Parkinson's, but there are many drug treatments available to help control the symptoms and maintain quality of life.

Stem cells have the remarkable potential to develop into many different cell types in the body. Serving as a sort of repair system for the body, they can theoretically divide without limit to replenish other cells as long as the person or animal is still alive. When a stem cell divides, each new cell has the potential to either remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, a red blood cell, or a brain cell. In research studies implanting the inner cell mass from a stem cell into the brain to replace those dopamine producing cells that have died, appears to be an avenue of promise for reversing the effects of Parkinson's.

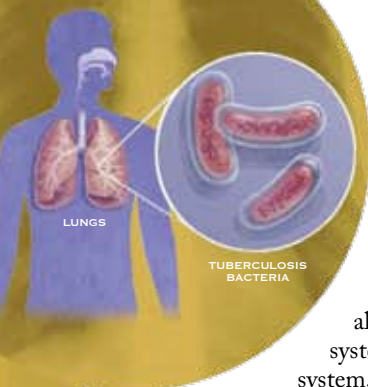
Rats and monkeys have been important in helping scientists understand how Parkinson's disease develops. Researchers transplanting dopamine-producing monkey stem cells into the brains of green monkeys have been able to cure Parkinson's. Researchers in other countries are working diligently to use similar surgical procedures to cure Parkinson's in humans. Without knowing why the disease initially occurs, transplanted cells still risk being destroyed by the disease. Despite setbacks in recent surgical trials, it is still one of the approaches offers early evidence and real hope of a breakthrough in treatment for Parkinson's in the longer term. Due to the complexity of Parkinson's, animals will continue to play a vital role in understanding the development of the disease and in creating treatments, and in finding a cure.



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TUBERCULOSIS

- ACCORDING TO THE WORLD HEALTH ORGANIZATION (WHO), NEARLY 2 BILLION PEOPLE, ONE-THIRD OF THE WORLD'S POPULATION, HAVE TUBERCULOSIS
- TUBERCULOSIS IS THE WORLD'S LARGEST FATAL INFECTIOUS DISEASE OF WOMEN OF REPRODUCTIVE AGE, AND THE LEADING CAUSE OF DEATH AMONG PEOPLE WITH HIV/AIDS
- MORE THAN 23,000 PEOPLE DEVELOP ACTIVE TUBERCULOSIS, AND ALMOST 5,000 DIE FROM THE DISEASE EVERY DAY (ONE EVERY THREE AND HALF MINUTES) WORLDWIDE
- TUBERCULOSIS WAS COMMONLY CALLED CONSUMPTION IN THE NINETEEN CENTURY
- TUBERCULOSIS IS ONE OF THE TOP FOUR FATAL INFECTIOUS DISEASES IN THE WORLD



Tuberculosis (TB) is an infectious disease caused by the bacterium *Mycobacterium Tuberculosis* (MTB), a slow-growing aerobic bacterium that divides every 16 to 20 hours. It is most common in the lungs (pulmonary TB), but can also affect the central nervous system (meningitis), lymphatic system, circulatory system (miliary tuberculosis), genitourinary system, bones, and joints.

TB is spread by aerosol droplets expelled by people with active TB disease of the lungs when they cough, sneeze, speak, or spit. Transmission can only occur from people with active TB disease (not a latent TB infection). A person with untreated, active tuberculosis can infect an estimated 20 other people per year. Only 10% of latent TB infections progress to active TB.

Those at greatest risk of infection include immunocompromised people (e.g., HIV/AIDS), residents and employees of high-risk congregate settings, health care workers who serve high-risk clients, the medically underserved, children exposed to adults in high-risk categories, and people who inject illicit drugs.

Tuberculosis has been present in humans since antiquity. The origins of the disease are in the first domestication of cattle (which also gave humanity viral poxes). Skeletal remains show prehistoric humans (4000 BCE) had TB, and tubercular decay has been found in the spines of Egyptian mummies from 3000-2400 BCE.

The bacillus-causing tuberculosis, *Mycobacterium Tuberculosis*, was identified and described in 1882 by Robert Koch. He received the Nobel Prize in

TUBERCULOSIS—CONTINUED

physiology or medicine in 1905 for this discovery.

Partially due to the increased movement of the population to the cities during the Industrial Revolution, TB spread significantly in the 19th century, with the first TB sanatorium opening in the United States in 1885.

Researchers in the 1940s using animal models of TB, such as rats, mice, and rabbits, developed the first critical step in treating TB with the creation of penicillin and broad-spectrum antibiotics, which revolutionized treatment of bacterial infections in humans and in animals. In 1946, through research with chickens and guinea pigs, researchers began therapeutic use of streptomycin—the first antibiotic effective in treating tuberculosis, pneumonia, spinal meningitis, and typhoid fever.

Further research and the development of additional antibiotics and new forms of TB vaccines gave great hope to scientists and physicians for the eventual elimination of TB. The rise of multidrug-resistant strains of TB (MDR-TB) and the now emerging Extreme Drug-Resistance in Tuberculosis (XDR-TB) have significantly hampered this effort. Researchers continue to search for newer forms of antibiotics and effective vaccines, including a promising recombinant tuberculosis vaccine to treat TB and to prevent initial infection.



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ZOONOTIC DISEASES

- **THERE ARE MORE THAN 200 ZOONOTIC DISEASES**
- **WORLDWIDE, APPROXIMATELY 55,000 PEOPLE DIE EACH YEAR FROM RABIES**
- **THERE ARE APPROXIMATELY 40 CASES OF BUBONIC PLAGUE REPORTED IN THE U.S. EACH YEAR**

Zoonotic diseases are those infections capable of being transmitted from animals to humans. Avian Flu, West Nile Virus, rabies, toxoplasmosis, Ebola, anthrax, E. coli, salmonella, bubonic plague, ringworm, and lyme disease are just a few of the more widely publicized zoonotic diseases. Zoonotic diseases represent a significant public health threat to humans and to animals.



Zoonotic infections can be viral, bacterial, fungal, or parasitic. In many examples of zoonotic diseases, the infection was once limited to animals and only after mutations was capable of infecting humans. With many zoonotic diseases, humans become infected through direct contact with an infected animal. In other cases, a disease carrier, such as an insect or rodent, is necessary to spread the disease from an infected animal to human. In some cases where the disease has mutated significantly, infection is possible from one infected person to another as well. Many diseases now commonly associated almost exclusively with humans originally jumped from other animals to humans. For example measles, smallpox, and influenza, were zoonotic, and HIV, the common cold, and tuberculosis may also have started in other non-human animals.

People with weakened or immature immune systems are most at risk of contracting zoonotic diseases. This includes infants and small children, pregnant women, the elderly, cancer therapy patients, and persons with HIV/AIDS. Also at risk are individuals who are in direct contact with animals, such as veterinarians, zookeepers, wildlife specialists, and other animal health care workers.

Some zoonotic diseases are density dependent – meaning outbreaks can occur whenever animals are gathered in large numbers – and can contribute to infecting humans with pathogens that cause zoonotic diseases. A pathogen is a biological agent that causes disease or illness to its host. Wildlife trade and consumption of wildlife are other conduits through which zoonotic diseases can be transmitted. Since zoonotic diseases can also be

ZOONOTIC DISEASES—CONTINUED

transmitted from one animal to another, wildlife trade can also occasionally cause the infections of domestic animals.

Diseases such as rabies and Ebola are examples of infections that can be transmitted from animals directly to humans. Some zoonotic diseases can only be transmitted indirectly to humans. In these cases, a disease carrier transmits the infection from infected animals to humans. West Nile virus is an example. West Nile virus is an arthropod-borne virus, which is transmitted by blood-feeding insects such as mosquitoes. Direct transmission of the virus from animal to people, animal to animal, people to animal, or people to people are not possible. West Nile causes encephalitis (inflammation of the brain) and most infections have been associated with birds, horses, and humans. Bubonic plague is another example of an arthropod-borne infection. During the Middle Ages, fleas transmitted the disease from an infected animal, such as rats, to humans and other mammals. Today, the bubonic plague can also be transmitted to humans and other mammals by fleas in contact with infected prairie dogs.

Through studying the transmission and progression of such diseases in animals, researchers are better able to understand the mechanisms of the infection, the progression of the disease, the infectious qualities of the pathogens, and means of transmission. Since these diseases are specific to animals and humans, continued medical research using animal models is imperative. Any vaccines or treatments for zoonotic diseases will need to be developed to treat both humans and the animal hosts.

Although most zoonotic diseases affect large masses of people in developing countries, the mobility of people and animals during this millennium, combined with the different and evolving means of transmission of the diseases has resulted in significant outbreaks of zoonotic diseases in more urban areas. The avian flu is an example of how such zoonotic diseases might possibly mutate in their life-cycle and become transmitted to humans.



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