Neuroscience and Biotechnology
Welcome to the Issue!
Healing the Central Nervous System

Your brain and spinal cord, which make up your central nervous system, are in charge of your body. When you walk across the street or pet a soft kitten or take a test—nearly everything you consciously do—your central nervous system is at work.

But what happens when the central nervous system has a problem? When injuries and diseases, some of which are inherited, affect the brain and spine, all sorts of unwanted symptoms can take place. Some are psychological—such extremely short attention span. Some might seem minor, such as a tremor that can come with Parkinson’s disease. Others are life-threatening. Many get worse over time; these are called neurodegenerative.

Using biotechnology, people are working to figure out the cause of these neurological problems—and looking for ways to fix them.

In this issue, we discuss diseases of the central nervous system. We also take a closer look at a sample of the tools and technology scientists are using today to address the various ways your brain and spinal cord can go haywire. We hope you’ll find this issue interesting—and perhaps interesting enough to consider a career in the field!

Sincerely,

Paul A. Hanle
President
Biotechnology Institute

Photo credits
p. 3 Spine: SPL/Photo Researchers
p. 4 Dust bunny: Sharon Williams
p. 4 Stem cell: SPL/Photo Researchers
p. 7 Brain lesions: SPL/Photo Researchers

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Any gymnast, cycler, or football player knows the importance of protecting your head and neck. In order to flip, pedal, or throw a pass you have to send instructions from your brain to your muscles. These instructions pass through specialized cells called neurons that relay information from your brain to other parts of your body. Neurons pass from your head to your body through a structure called your spinal cord. The spinal cord is 1.5 feet long in humans and up to 8.5 feet long in giraffes!

The brain and spinal cord make up your central nervous system.

Not surprisingly with a system that covers so much territory, the problems can be many and varied. No doubt you’ve heard of some neurological disorders, such as Alzheimer’s and attention-deficit disorder, epilepsy, perhaps Parkinson’s. Others might be new to you, including fibromyalgia, dementia, narcolepsy, memory problems, diabetic neuropathic pain, and restless legs syndrome.

In addition to diseases that attack the central nervous system, injuries can damage the brain or spine. For examples, explosions can cause traumatic brain injury (TBI). And if you damage your spinal cord and your neurons are cut or injured, the instructions from your brain cannot reach your muscles and you will become paralyzed below the area of damage.

In addition to wanting to treat people who have neurodiseases now, one concern is that as the population ages, even more people will be afflicted.

Biotechnology is being employed to deal with CNS disorders, such as genetic sequencing to discover genetic causes and the use of stem cells.

Spinal cord injuries are one of the most common severe injuries in teenagers, with 6,000 new cases per year in the United States. Neurons of the central nervous system (neurons found in the brain and spinal cord) do not re-grow if cut or damaged, so the majority of spinal cord injuries are permanent. Due to recent advances in stem cell biotechnology, there is hope for new therapies to treat spinal cord injuries and other diseases of the central nervous system (see story on page 6).
1. Stem Cells

See that dust bunny hiding under your bed when you clean your room? Where did it come from? Did you know that dust bunnies are often made from our dead skin cells that fall off when we move around? Our hair grows, our nails get longer, and our red blood cells get replaced every four months. What is responsible for all these areas of growth in our bodies?

Stems cells in each of these areas produce the cells needed to grow these structures. In some ways, stem cells are like factories that can mass produce different types of cells. Stem cells in your skin produce enough cells to replace your skin every four weeks. Stem cells in your blood produce 2.5 million red blood cells a second! In teenagers and adults, stem cells are found in practically every tissue in the body and are used to build tissues that are growing and maintain tissues that have cells that are continually replaced.

Stem cells are even found in our brains, and they usually form cells called astrocytes and oligodendrocytes (cells that support neurons and cells that wrap around neurons and insulate them so they can send information over long distances). Researchers are studying what neural stem cells (stem cells of the central nervous system) do in normal brains and after injury and disease.

Stem cells have a couple of unique properties that make them unlike any factory we know. It’s possible for a stem cell to divide with one daughter cell becoming a specialized cell and one daughter cell being a copy of the original stem cell.

Stem cells of a particular tissue can become any cell in that tissue. For example, blood stem cells can become any kind of cell in the blood. Neural stem cells can become any type of cell in the central nervous system. This ability is called multipotency.

The ability to become all the different types of cells in various tissues is called pluripotency. Most stem cells in adults are multipotent, but embryonic stem cells are an example of pluripotent cells.

Researchers are interested in certain kinds of stem cells as an endless source of cells for various medical therapies. See “Stem Cells” on p. 6.

2. Catching a Brainbow

Have you ever tried to unplug your computer and weren’t sure of which one to disconnect among the tangle of cords for your alarm clock, cell phone, TV, and lamp all crammed into the same power strip? Now imagine instead of just five cords, there were thousands! That is a glimpse into the challenge faced by neuroscientists as they try to figure out how different nerve cells—called neurons—that send signals throughout your brain and body are connected in the brain.

A single neuron makes thousands of connections to other neurons so we can think, breathe, eat, and remember. Your brain can be thought of as a mass of billions of wires creating pathways for information to travel. Many neurological disorders, such as autism, schizophrenia, and disorders of early development, are thought to be caused in part by faulty wiring of these pathways. When certain neurons are not connected correctly to other neurons, information gets lost or garbled.

If the circuits and pathways that neurons make are important in studying disease, how can scientists make sense of this jumble of wires when each neuron looks similar to other neurons?

Jeff Lichtman and Joshua Sanes at Harvard University recently developed an amazing way to look at how neurons are connected and the circuits that they form. This biotechnology breakthrough has been named “Brainbow” because it
3. Breaching the Brain-Blood Barrier

Another challenge facing scientists and doctors is how to get medicine into the brain. Our bodies create a blood-brain barrier between the blood vessels that travel through the brain and the neurons and other cells of the brain.

This barrier keeps bacteria and toxins out of the brain but allows oxygen and carbon dioxide to pass freely. Unfortunately, it keeps out many medicines that might help treat neurological disorders.

Scientists are learning how nanocarriers can help us sneak medicine past the blood-brain barrier. Nanocarriers are extremely small particles that are 10 to 1,000 nanometers in diameter, and a nanometer is one billionth of a meter. If a nanometer was represented by a marble, a meter would be the size of the earth!

Therapeutic drugs are placed inside these nanocarriers, then the nanocarriers are coated with proteins that let them slip past the blood-brain barrier. In addition, the nanocarriers protect the drug so that it is not quickly broken down by the body. Nanocarriers can slow the release of medication so it is delivered to the brain over time.

Other Techniques

You might hear about “gene therapy” as a biotechnology process. This term refers to changing genes in specific ways to help people fight diseases. By manipulating genetic material, it’s possible to produce healthy genes in place of damaged or missing genes.

In this issue, we have two examples of that. In “Stem Cells,” the iPSC process includes gene therapy—making cells express (or activate) four genes they don’t usually express. In the same article, it’s gene therapy when stem cells are made to produce more neurotrophins than they would if left on their own.

Using technology to benefit biological beings—us!—is what biotechnology is all about.

In spring 2010, 18-year-old Sheryl Wolfe, who was Miss Hawaii Teen United States and Miss Hawaii Teen Princess, died after a hemorrhagic stroke. This type of stroke is usually the result of a blood vessel rupturing into the brain or a rupture in the lining of the vessel that leads to a blood clot blocking blood supply to the brain. Children most at risk for hemorrhagic strokes are those with badly formed blood vessels, damaged or weak vessels, blood disorders such as leukemia, or brain tumors.

Learn More!

To Think About . . .

Ethicists have pointed out that research is being targeted at relatively rich patients in industrialized countries where people have health insurance to help pay for treatment. How might such treatments benefit third world populations?
Embryonic stem cells are stem cells found in an embryo that can become all the different types of cells in an embryo. Just as important, scientists can add chemicals into the dish of embryonic stem cells and instruct the cells to mature and become specialized cells of the body. For example, researchers have made embryonic stem cells become heart cells that can beat, pancreatic cells that can release insulin, and neurons that can send and receive electric signals!

Human embryonic stem cells are taken from embryos five days after conception and the embryo is destroyed during the collection procedure. Researchers use embryos that are discarded after in vitro fertilization procedures and are not destined to become people; however, there is still much debate about whether the creation of embryonic stem cells is ethical.

Fortunately, a biotechnology breakthrough in 2006 has allowed the creation of cells that seem to retain many of the qualities of embryonic stem cells. A scientist from Kyoto, Japan, named Shinya Yamanaka, realized that by having a cell express just four different genes, he could reprogram a mature, specialized cell back into an immature, embryonic stem cell–like cell. This technique created induced pluripotent stem cells (iPSCs) that seem to act like embryonic stem cells but can be made from any mature cell type. The implications of this biotechnological advance are tremendous. Potentially any cell from a patient can be used as a source to make that person’s own pluripotent stem cells, without the need for embryonic stem cells.

Whenever cells, tissues, or organs are transplanted into a person, doctors need to be sure that the person’s immune system does not attack the donated cells. When blood is transfused into a person, technicians make sure that the blood type donated is compatible with the patient’s blood type. When bone marrow, a heart, or a kidney is transplanted into a patient, doctors need to match the donor and recipient as closely as possible or the new cells will be attacked and the transplant will be rejected. The same is true with stem cells. For any stem cell therapy to be successful, the donor stem cells need to match the patient. The biotechnology breakthrough of iPSCs circumvents this problem. In theory, a doctor could take skin cells from a patient, create iPSCs from the mature skin cells, and instruct these iPSCs to become any cell type the patient needed!
iPSC Stem Cells

Using iPSC technology will allow researchers to better study the mechanism and causes of different diseases. For example, amyotrophic lateral sclerosis (commonly known as ALS, or Lou Gehrig’s disease) is a condition in which motor neurons die, so a person with the disease loses the ability to move his or her muscles. Currently no one knows all of the causes of this disease and whether it is due to a problem with motor neurons or a problem with support cells of the brain (astrocytes and oligodendrocytes). Through iPSC technology, researchers have taken skin cells from a person with ALS and created an iPSC cell line. They have instructed these immature embryonic stem cell-like cells to become neurons or astrocytes and have studied these cells in a dish. These neurons and astrocytes are considered to be ALS-derived neurons and astrocytes because they came from a person with ALS. Scientists have also created neurons and astrocytes from healthy individuals who did not have any disease. How could we use these different types of cells to study whether the disease is caused by defective neurons or defective astrocytes? Can you design an experiment using healthy neurons, healthy astrocytes, diseased neurons, and diseased astrocytes? Take a moment to see if you can figure out ways to combine these types of cells to determine what might be the cause of ALS.

In an elegant experiment, researchers have combined healthy astrocytes with ALS neurons to see if this helps or hurts the disease process. Similarly, researchers have combined healthy neurons with ALS astrocytes to see if this causes the healthy neurons to become sick with ALS. In this creative manner, scientists are discovering whether ALS is a problem inherent in neurons, or if astrocytes are part of the problem too.

The ability to create stem cells from any patient will allow researchers to create models of various diseases. Not only will these cell-based models be useful for studying the mechanisms of the disease, but they will also allow for the testing of new drugs in a cell-based manner. Through these biotechnological advances, new drug therapies will be found more efficiently.
Stem cells to treat diseases

Currently there are no effective therapies for spinal cord injuries. Neurons in the central nervous system do not grow back if they are cut. Without neurons to send signals between the brain and body, there is no way to move muscles, and this causes permanent paralysis below the injury. How might stem cells be used to treat spinal cord injuries? To understand the ways stem cells might be used to treat spinal cord injuries, we need to learn about the mechanisms of spinal cord damage.

After spinal cord injury, neurons and support cells that are cut or badly damaged die immediately. Neurons near the injured area lose their myelin and are susceptible to death. Myelin is insulation that surrounds a neuron and allows it to send signals quickly, just as insulation surrounding an electric wire allows electricity to flow without short circuiting.

The loss of myelin is a significant contributor to the paralysis following spinal cord injury. Astrocytes become bigger, multiply, and wall off the injured area. These astrocytes form a scar around the injured tissue. This is needed to contain the damage, but it is detrimental for regeneration and repair later.

Finally, the immune system becomes activated after injury and releases many signals that cause the death of various cells. How might stem cell biotechnology be used to address these problems following spinal cord injury?

Stem cells to save damaged neurons and reinsulate neurons

Stem cells have the surprising ability to locate and go to areas of damage. Using various molecular approaches, scientists have developed stem cells that will secrete helpful signals called neurotrophins that can protect and repair damaged neurons. These stem cells act like neurotrophin factories that set up shop next to areas of damage and help repair sick neurons. In addition, scientists have created oligodendrocytes from embryonic stem cells and injected these cells into the injured spinal cord in rats. These oligodendrocytes have remyelinated (reinsulated) damaged neurons and have increased the ability of the rats to move after injury. In July 2010, the FDA approved the first phase of a clinical trial in humans using embryonic stem cell–derived oligodendrocytes.

Learn More!
MIT's Short Course in Neuroscience
http://mitworld.mit.edu/series/view/42
Stem cells to replace neurons

If we could take stem cells and instruct them to become neurons, couldn’t we inject new neurons into a person’s brain and spinal cord to replace those that were lost after injury?

While this seems like a great idea, it has many problems. Neurons are connected within a network of neurons that talk to each other. In fact, an average neuron has connections with thousands of other neurons! Having new neurons connect correctly into this network and grow to the appropriate target would be very difficult. In addition, neurons grow at a rate of 1 to 3 mm per day, so it would take months for the treatment to have beneficial effects.

Challenges with stem cell therapies

Stem cell therapies hold much promise to treat various neurological diseases such as spinal cord injury, ALS, and Parkinson’s disease. Although the Internet is full of companies offering stem cell treatments at clinics around the world, much of this hype needs to be taken cautiously. Many of these claims are based on unproven stories, and no one really understands the risks involved with these treatments.

Researchers need to address many challenges, including: (1) If stem cells are used to deliver helpful signals or drugs to the injured or diseased environment, how do we control the amount of signal or drug delivered? (2) Since stem cells can divide and multiply forever, how do we ensure that they do not multiply in the recipient’s brain and create brain tumors (cells multiplying out of control)? (3) Will the reprogramming done during iPSC formation lead to problems in these cells as the disease develops in the patient? Moving stem cell research from animal models into humans should be done cautiously until these challenges are addressed.

It is still important to wear a helmet to protect your brain, but biotechnology advances with stem cells may lead to new medical therapies to treat neurodegenerative disorders.

Stem cells to calm detrimental inflammation

The immune response and astrocyte activation are important steps to initially wall off and isolate the area of damage; however, this scar forms a barrier to regeneration, and prolonged inflammation leads to the death of even more cells. Researchers have found that injecting various stem cells into the brain calms inflammation, reduces scarring, and decreases the tissue lost after injury.
Kristin’s Grandmother

What We Know about Parkinson’s Disease

By Bryan D. White

“We had such a fun time at camp, Grandma,” my friend Kristin said to the gray-haired woman sitting across the kitchen table. “I learned how to make rainbow-colored candles and leather belts, and my softball swing got much better. I even hit a home run!”

“Wow, that is wonderful, dear,” Mrs. Johnson said softly, her voice a bit hard to hear. “What did you learn at Camp Stevens, Julie?” she asked turning toward me.

I barely listened to her quiet words, as my eyes were drawn to her unusual movements. Why were Mrs. Johnson’s hands shaking so much? It was as if she was moving to some internal pendulum. That, along with how stiffly she walked to get cookies from the cupboard earlier, made me wonder if something was wrong.

“I passed the deep-water swim test for the first time,” I stammered, putting those thoughts to the back of my mind, “so I was able to dive off the diving board in the middle of the lake.”

Before Mrs. Johnson had time to respond, Kristin jumped up out of her chair. “Sorry, Grandma, we’ve got to run if we are going to make the seven o’clock show. It was really fun telling you about camp.”

As we walked to the bus stop, I couldn’t stop thinking about how different Mrs. Johnson seemed from the times I had met her before. “Kristin, is your grandma sick or something?” I asked. “Did her hands always tremble like that?”

Kristin looked at me and paused before she answered. “I was wondering if you would notice this time. My grandmother has Parkinson’s disease. It has gotten worse lately.”

“Aww,” I said, kicking a rock along the sidewalk. “That’s so sad!”

I seemed to remember hearing something about Parkinson’s, but I couldn’t quite place it. “What kind of disease is that?”

“It’s where the nerve cells in your brain that help you make smooth, coordinated movements die. People with Parkinson’s disease usually move stiffly, have tremors, move slowly, and have a hard time keeping their balance. They start talking more softly, too.”

“Don’t some famous people have it?” I asked.

“Yeah. Michael J. Fox, the actor from a lot of movies, and Muhammad Ali, one of the greatest boxers ever. Because they’re famous, they help raise money to study the disease and try to find a cure,” Kristin said.

“What causes it?”

She sighed. “Scientists are still trying to figure it all out. Right now, biotechnology researchers have found that certain varieties of genes make some people more likely to get the disease. They have also found some helpful genes that can help fight the disease and its symptoms.”

I remembered learning about genes in biology class last year. What I learned in class was helping me now. Amazing! “If genes are the instructions in our DNA to make proteins,” I asked, “can’t we use genes to get our bodies to make the proteins that Parkinson’s patients need?”

“Wow, Julie, you sound just like a scientist!” Kristin exclaimed. I looked over quickly to see if she was making fun of me, but she wasn’t. “That is what researchers are trying to do. Gene therapy is when scientists instruct the body to read DNA instructions and make specific proteins. Researchers hope that gene therapy will help protect the neurons that are dying in Parkinson’s disease or provide dopamine, this chemical that Parkinson’s patients start losing.”

Dopamine, gene therapy, Parkinson’s disease, biotechnology … There were a million thoughts going through my head as I thought about the possibilities. “Let’s go see the science fiction flick,” I said as we boarded the bus. Maybe I could become a science researcher, so I can help people like Kristin’s grandma and make today’s science fiction become tomorrow’s reality.
I am currently professor of neurology at Ohio State University, in Columbus. I chose the field of neuromuscular disease, which involves the study of diseases affecting the peripheral nerve, muscle, neuromuscular junction, and motor nerves. I chose it for two main reasons. The first is that it was one of the few areas in neurology where one could go from the clinical presentation of the patient and then look at the physiology of their problem (through EMG studies) as well as the patho-anatomy (through nerve and/or muscle biopsy). This ability to look at all three aspects of a patient’s case is extremely rewarding.

The second reason is that I simply found the relationship that a physician has with neuromuscular patients to be very special, requiring a combination of neurologic, psychologic, orthopedic, rehab medicine, and general medical skills. I follow many of my ALS and muscular dystrophy patients from diagnosis to death, and develop an extremely close relationship with most of my patients.

Typically, I will be in the clinic for at least half, and sometimes the whole day in an outpatient setting. On months when I am “on-service,” I also have to visit the patients in the hospital or do consultations for other medical providers. I usually try to do some academic work as well (writing grants or papers, participating in clinical trials, teaching students or residents, etc.). It makes for a busy, but extremely varied and rewarding, day!

The rewards of academic neurology are too numerous to mention! Every day is different and an intellectual challenge. You are never bored, and you are doing your part to advance our knowledge base and improve lives for your patients. There is nothing more rewarding than participating in a study that provides new insights into the cause or manifestation of these terrible diseases, and how we can better treat patients suffering from them.

It is very ironic that when I was a beginning third-year medical student, I decided to do my neurology rotation first to get it out of the way, since it was the ONLY specialty that I was absolutely CERTAIN I would NOT go into! I was immediately struck, however, by the team approach taken to most neurologic disease and the very special relationship that develops between neurologists and their patients. Neurologic disease affects the things that make us most human, like cognition, speech, moving around, walking, and the ability to care for ourselves. When diseases threaten these basic aspects of life, patients need a physician with unique skills and a caring, professional approach!
Epilepsy

An Electrical Storm in the Brain

By Lois M. Baron

When my sister Wanita was 11, she woke up in the middle of the night, screaming that worms were crawling under her skin. We had a little house. We had two sets of bunk beds in one room, and another set one room over. Trust me, we all woke up when she started shrieking and crying.

Worse, it kept happening. Everyone has nightmares sometimes, but this was horrible. Even though she was the little sister I ignored a lot, I felt bad for her.

It took a long time for doctors to figure out she had something called epilepsy. It sounds simple enough: if you have seizures repeatedly, you have epilepsy. But in reality, epilepsy can act differently from person to person. A seizure is a “change in sensation, awareness, or behavior brought about by a brief electrical disturbance in the brain,” says the Epilepsy Association. Seizures may be convulsions, short periods of unconsciousness, distortion of the senses, or loss of control over movement. It can last a few seconds or several minutes.

Some people seem to “go blank” briefly. Others suffer “grand mal” seizures that involve their whole body and include convulsions. (See the box of information on p. 13 to see what you should do if someone has a seizure.)

For my sister, one hand goes numb, then tingles, but with medication, she no longer feels as if something is crawling into her skin.

Epilepsy may develop because of an abnormality in brain wiring, an imbalance of nerve-signaling chemicals called neurotransmitters, or some combination of these factors. During a seizure, electrical pulses get fired off at a rate many times faster than normal. The kind of seizure a person has depends on the part of the brain affected by the injury.

The doctors thought Wanita’s epilepsy might have been caused by her brain being injured in a fall off the top bunk. (To prevent head injuries is one reason bunk beds now come with guard rails.) Soldiers involved in bomb blasts sometimes end up with epilepsy.

We didn’t know it at the time, but about 2 million people have it and nearly 140,000 Americans die from it each year. One in 100 teenagers have it.

Daily medication can help people, and for some, epilepsy affects them for a time and then disappears. My sister’s epilepsy has stayed with her. It’s hard enough to be a teen, but she always worried about what others would think. Doctors have had to adjust her dosage over the years. She can go a long time without any seizures and then be hit with a cluster of them. To drive a car, she had to have the doctor certify that the medicine had her epilepsy under control.

Researchers are trying to find a way to prevent seizures. It would be a huge relief to my sister if she didn’t have to worry about when the next seizure might strike.

According to National Institute of Neurological Disorders and Stroke (NINDS), scientists are studying potential antiepileptic drugs with goal of enhancing treatment for epilepsy. Scientists continue to study how neurotransmitters interact with brain cells to control nerve firing and how non-neuronal cells in the brain contribute to seizures. One of the most-studied neurotransmitters is GABA, or gamma-aminobutyric acid.

Researchers are working to identify genes that may influence epilepsy. This information may allow doctors to prevent epilepsy or to predict which treatments will be most helpful.

Doctors are now experimenting with several new types of therapies for epilepsy, including transplanting fetal pig neurons into the brains of patients to learn whether cell transplants can help control seizures, transplanting stem cells, and using a device that could predict seizures up to three minutes before they begin. In addition, researchers are continually improving the tools used to scan the brain.

Epilepsy shows up in many forms, but scientists are trying to solve the basic problem so that those affected can be freed from this condition.
WHAT IS EPILEPSY?
Epilepsy is a brain disorder in which clusters of nerve cells, or neurons, in the brain sometimes signal abnormally. In epilepsy, the normal pattern of neuronal activity becomes disturbed, causing strange sensations, emotions, and behavior or sometimes convulsions, muscle spasms, and loss of consciousness. Epilepsy is a disorder with many possible causes. Anything that disturbs the normal pattern of neuron activity — from illness to brain damage to abnormal brain development — can lead to seizures. Epilepsy may develop because of an abnormality in brain wiring, an imbalance of nerve signaling chemicals called neurotransmitters, or some combination of these factors. Having a seizure does not necessarily mean that a person has epilepsy. Only when a person has had two or more seizures is he or she considered to have epilepsy. EEGs and brain scans are common diagnostic test for epilepsy.

FAST FACTS …
❚ People with epilepsy can play sports and participate in activities like everyone else.
❚ Epilepsy is not contagious.
❚ Doctors have identified about 20 kinds of seizures.
❚ About 65 percent of patients have partial seizures.
❚ More people die from epilepsy than from breast cancer.

First Aid for Seizures
First aid for seizures involves responding in ways that can keep the person safe until the seizure stops by itself. Some guidelines for someone having a grand mal seizure:

■ Clear the area around the person of anything hard or sharp.
■ Ease the person to the floor and put something soft and flat, like a folded jacket, under his head.
■ Remove eyeglasses and loosen ties or anything around the neck that may make breathing difficult.
■ Time the seizure with your watch. If the seizure continues for longer than five minutes, call 911.
■ Do not hold the person down or try to stop his movements.
■ Do not put anything in the person’s mouth. Efforts to hold the tongue down can injure the teeth or jaw. It is not true that a person can swallow his or her tongue during a seizure.
■ Turn the person gently onto one side. This helps keep the airway clear.
■ Don’t attempt artificial respiration unless a person does not start breathing again after the seizure has stopped.
■ Stay with the person until the seizure ends naturally and he is fully awake.
■ Do not offer the person water or food until fully alert.
■ Be friendly and reassuring as consciousness returns.
■ Offer to call a taxi, friend, or relative to help the person get home if he seems confused or unable to get home without help.

To help someone who is having a seizure that appears as blank staring, loss of awareness, and/or involuntary blinking, chewing, or other facial movements:
■ Stay calm and speak reassuringly.
■ Guide him away from dangers.
■ Block access to hazards, but don’t restrain the person.
■ If he is agitated, stay a distance away, but close enough to protect him until full awareness has returned.

Source: Centers for Disease Control and Prevention
Ugly Melons Can Fuel Trucks

Twenty percent of watermelons have blemishes or are too misshapen to take to market. Farmers call these a loss and plow them back into the ground. But U.S. Department of Agriculture researchers in Oklahoma have shown that the juice from these melons can easily provide fermentable sugars—exactly the thing needed for ethanol biofuel production.

In 2007, these watermelons (“culls”) amounted to 360,000 tons of waste. Given that more than half of a watermelon is readily fermentable liquid, it’s enough to justify trying to get something useful out of that fruit. At the least, the grower could get on-farm fuel or sell the watermelons on the ethanol biofuel market.

In addition, watermelon contains two nutritional compounds that could be extracted before the liquid was sent on to juice up vehicles. Lycopene, which make watermelon flesh red, has been shown to be important to prostate health. L-citrulline is an amino acid indirectly involved in the control of blood vessels.

Check out the details at the online journal Biotechnology for Biofuels (www.biotechnologyforbiofuels.com/).

Squashing Mosquitoes

Smack! Another mosquito bites the dust.

Biotechnology might provide a newer, better bug killer to take the sting out of evenings outside.

A team of researchers at Kansas State University have used nanoparticles to feed mosquito larvae double-stranded ribonucleic acid (dsRNA). This molecule can keep specific genes from working (known as “gene silencing”), which in turn kills the developing insects outright or makes it easier to kill them with pesticides.

Gene silencing triggered by dsRNA is known as RNA interference, or RNAi.

In this case, researchers used RNAi to interfere with the genes that produce chitin, the main ingredient in insect exoskeletons.

The researchers say the silencing is not complete, but it leaves the mosquito more vulnerable to pesticides, which penetrate insects’ hard outer body.

Using nanoparticles to carry dsRNA is useful because mosquito larvae live—and eat—in water. Unfortunately, dsRNA dissipates quickly in water. Fortunately, nanoparticles don’t dissolve in water. Bait containing dsRNA-based nanoparticles could be developed for pest control.

Another plus: the nanoparticles are formed from chitosan, which is virtually nontoxic and biodegradable. Bye, bye, nasty bugs!
But Will It Smell Like Coconut?

Ivy nanoparticles may do a much better job protecting skin than current metal-based sunscreen, says an associate professor of biomedical engineering at the University of Tennessee, Knoxville.

Tiny particles secreted by ivy rootlets can be used in such wide-ranging applications as medical adhesives, drug delivery, and sunblock.

Mingjun Zhang had heard a talk at a conference about concerns that metal-based nanoparticles used in sunscreens might prove toxic to human. Some studies have shown that the metal oxides in sunscreens end up in the liver or brain. Right now, titanium dioxide and zinc oxide are used for sunscreens because nanoparticles have unique physical and chemical properties that allow them to absorb and scatter light.

The discovery was triggered by Zhang idly wondering why the ivy in his backyard clung to the fence so tightly.

When he put the yellowish material ivy makes for surface climbing under a microscope, Zhang was surprised to find an abundance of nanoparticles. These are 1,000 times smaller than the diameter of a human hair. They are tiny, but make it possible for the vine to hold almost 2 million more times than its weight.

The study by Zhang and his research collaborators shows that ivy nanoparticles are four times better than metal-based particles at absorbing sunburn-producing ultraviolet light.

In addition, ivy nanoparticles are less toxic to the cells of mammals, are less likely to penetrate human skin, and biodegrade easily. The virtually invisible ivy-based sunscreen might not need to be reapplied after swimming because the plant’s nanoparticles cling a bit better than traditional sunscreens.

Genetics might play a part in how much you’re influenced by others when it comes to social drinking.

Research has suggested that carrying a particular form of a specific gene might have something to do with how different people react to cues to drink.

Dopamine is a brain chemical that makes people feel pleasure. Drinking alcohol increases levels of dopamine. Studies have shown that a gene called the dopamine D4 receptor is involved in prodding people to seek out rewards. A researcher and her team in the Netherlands wanted to see if they could figure out whether a form of DRD4—one that has seven or more repeats of a specific section of the gene—has something to do with how people respond when they see alcohol advertisements, have drinks placed in front of them, or see others drinking, and so forth.

After watching and rating a number of commercials in a room set up to look like a Dutch pub, volunteers were given a 30-minute break and told they could help themselves to any of the alcoholic and nonalcoholic drinks available at the bar. Participants who knew what the study was about were told to order drinks immediately. The researchers observed who did likewise. Researchers took saliva samples from everyone for DNA analysis.

Results? When in the company of someone who was seen drinking three or four glasses of alcohol, people who carried the seven-repeat form of the gene drank more than twice as many glasses of booze than people who didn’t have the gene. However, in the company of someone who had only one drink, carriers of the gene didn’t drink more than noncarriers.

Bottom line: If you’ve got the DRD4 seven-repeat genotype, it looks as if you’re more at risk for alcohol abuse if you hang out with friends who drink heavily.
Neuroscience for Kids
Learn about the nervous system and get the link to Treasure Trove of Brain Trivia
http://faculty.washington.edu/chudler/neurok.html

The Scientific Challenges of Human Stem Cells
http://stemcells.nih.gov/info/media/challenges.htm

National Institute of Neurological Disorders and Stroke
www.ninds.nih.gov/index.htm

Careers in Neurology
www.aamc.org/students/cim/pub_neurology.htm

Career in Child Neurology
www.childneurologysociety.org/

Learning Stroke Symptoms Can Save Lives

Neurology’s Wide Reach
Disorders of the nervous system include diseases of the brain, spinal cord, nerves, and muscles such as the following:
- ADHD
- Autism
- Epilepsy (seizures)
- Headaches/Migraines
- Behavioral/School problems
- Cerebral palsy
- Dizziness
- Learning disabilities
- Neurometabolic disorders
- Brain tumors
- Neuromuscular disorders (affecting the nerves in muscles that you control)
- Neurocutaneous diseases (abnormal growth of tumors in various parts of the body)
- Neuropathy
- Spina bifida
- Spinal cord injuries
- Guillain-Barre syndrome
- Tics/Tourette’s
- Tremors
- Vertigo

Look up the words you don’t recognize on this list!

Disclaimer: The views expressed by the authors are not necessarily those of the Biotechnology Institute or UCB.