This Is Your Body on Stress
Stress is just your body's natural response to perceived danger.

But what happens when your stress reaction never shuts off? By Roger Cole

People have struggled with bumps on the path of life since before the dawn of history, but it was not until the middle of the 20th century that physiologist Hans Selye labeled our reaction to life's challenges with a simple word: stress.

Now, 50 years later, there's a conversation you hear so often, it's almost a chorus: You ask a friend, "How are you?" and she replies, "I'm OK, but I'm feeling a little stressed."

You know just what she means; you've felt the same way all too often yourself. For you, the stress shows up as insomnia, while your friend sleeps well but has a lingering stomachache and painful knots in her shoulders. Individual stress symptoms can differ, but all have their roots in the physiological changes that our bodies undergo when we feel we're in danger.

To understand these changes, why they happen, and what you can do to reduce and avoid them, let's consider a day in the life of a typical American working woman.

The Story of Sally Stresscase
For Sally Stresscase, the day went from bad to worse. She awoke with allergies clogging her nose. Work was full of hassles. Her car stalled in rush hour traffic, and other drivers honked and scowled at her, turning her frustration into fury.

Sally picked up her four-year-old, Sara, at day care. That cheered her up, but when they arrived home to a dark house, her heart sank. Her husband, Sam, was not there—again. He had been working late a lot recently, and acting so distant and withdrawn that Sally was feeling insecure and suspicious.

She had just set up Sara with a coloring book in her favorite spot in the living room and started to cook dinner when she heard strange noises coming from the garage. Sally's mind raced; she and Sam never used the garage. Although a door linked it to the kitchen, they always parked in the driveway and came in through the front door. But now someone was out there.

The sounds grew louder. She heard footsteps approaching the kitchen door and realized with horror that it was unlocked. A knot formed in her stomach, her mouth went dry, blood pounded in her temples, and her palms sweated so much that the ceramic bowl she was holding slipped from her hands and shattered.

Sally tried to jam the heavy, iron-framed kitchen table against the door, but it wouldn't fit. In the process, she cut her arm, but she didn't notice it. She dashed into the living room and grabbed the fireplace poker. Placing herself squarely between Sara and the kitchen, she turned to face the intruder. Everything seemed to be going in slow motion as a man emerged from the kitchen.
it—and a big commission. Come to the garage. I bought you a new car!"

Silently, Sally picked up Sara and followed Sam. "Why are you shaking, Mommy?" Sara asked. Sally hugged her tightly and gave her a big kiss.

At dinner, Sally found she had no appetite. At bedtime, she still felt keyed up, so she took a warm bath, where she finally noticed the cut on her arm. Even after her bath, it took her much longer than usual to fall asleep.

**Danger! Danger!**

Stress is a slippery word to define, but most people would agree that Sally felt it that evening. And scientists would concur. In their eyes, all stress, great or small, arises from our struggle to survive and reproduce. We experience it when we sense a threat to ourselves or our children. That's why Sally's reaction reached a crescendo when she stood defending Sara.

A situation doesn't have to threaten imminent death to cause stress. As social creatures, we all instinctively know that we, and our children, depend on others for our long-term well-being. That's why Sally was so disturbed by social threats like job hassles, problems in her marriage, and the angry scowls of other drivers. One key thing to remember about stress is that a threat doesn't have to be real to cause it; we just have to believe it's real. Sally didn't need an actual burglar to get her blood pumping—an imagined one did the job well enough.

Scientists differentiate between short-term (acute) stress and long-term (chronic) stress. Acute stress evokes physical and emotional responses that activate the body and mind to deal with an immediate threat. When the threat passes, the reactions subside. Long-term stress evokes similar responses, usually at a lower intensity, but keeps repeating them day after day without respite. When they repeat too often for too long, the life-saving responses that are so helpful in the short run can actually become life-threatening.

The short-term stress reaction is often called the fight-or-flight response. That's what Sally experienced when Sam opened the door. She perceived danger, so her brain and body automatically readied themselves for intense action, either combat or escape. To do either of these well, our bodies need maximum alertness, powerful muscle action, and the ability to keep going even if injured. Sally's brain activated a boggingly complex set of physiological processes to support these needs. Many of these processes had already started, at a lower intensity, in response to the minor stressors she had endured before Sam came home.

Sally's stress response began with her perceptions. When her car stalled, the reasoning part of her brain (the cerebral cortex) perceived a problem that required quick action but was not a life-or-death emergency. Then the emotional part of her brain (the limbic system, especially an
almond-shaped structure called the amygdala) increased her sense of urgency by responding with fear and anger to the honking horns and hostile faces of passing drivers. Her cortex and her limbic system triggered some responses more or less directly, including increased heart rate and muscle tension, but they delegated most of the responsibility for activating the rest of her responses to a sort of 911 control center located in the rear part of the hypothalamus (a brain area that coordinates basic drives like hunger, sleep, and self-defense). The threat situation was only moderate, so the stimulus to the hypothalamus wasn’t that strong.

But when Sally thought an intruder was entering her kitchen, her cortex and limbic system screamed “Danger!” at the top of their neural lungs. The posterior hypothalamus got the message loud and clear. In a flash, this little complex of brain cells turned on all the physiological systems she needed to get her muscles and mind going at full power, and turned off everything that might interfere. It told her pituitary gland to send out a chemical messenger to her adrenal cortex, the outer layer of her adrenal glands, stimulating it to release the stress hormone cortisol into the bloodstream. It told her brain’s sleep centers to shut off and its wakefulness centers to kick into their highest gear. It activated brain centers that control muscle tone, increasing tension everywhere in her body. It told breathing centers at the base of Sally’s brain to increase respiration to provide oxygen for all the extra muscle and brain activity about to occur. And, most important of all, it cranked her entire sympathetic nervous system up to full throttle.

### When we’re in danger, the brain and body automatically ready themselves for either combat or escape.

### All Revved Up, No Place to Go

The sympathetic nervous system is a network of nerve cells that extends throughout the body. It helps support our normal activities; for example, it makes our heart beat faster when we climb stairs. In an emergency, though, it goes into overdrive — and Sally felt the results. To get more blood to her heart, skeletal muscles, and brain, the sympathetic nervous system widened arteries in those places, narrowed them in others, and started her heart racing and pounding. That’s why she felt a throbbing in her temples. In her digestive tract, Sally’s sympathetic system narrowed arteries and inhibited other functions. That’s why she felt a dry mouth and a knot in her stomach. To help her get more oxygen, sympathetic nerves opened up her air passages. That’s why her nostrils flared, her nose cleared, and her voice faltered when she first saw Sam.

Other sympathetic nerves worked to make sure Sally could see everything going on around her. They dilated her pupils and opened her eyelids so wide that Sam could see the whites all the way around. To keep
her from overheating, still other sympathetic nerves activated sweat glands.

The sympathetic nervous system triggered most of these responses by releasing a major chemical messenger called norepinephrine (or noradrenaline) at nerve endings on target tissues like blood vessels and sweat glands. It also stimulated the adrenal medulla (the core of the adrenal glands) to flood the bloodstream with more norepinephrine plus a second essential chemical, epinephrine (also called adrenaline). These chemicals not only intensified the stimulation of organs directly targeted by sympathetic nerves, they also acted on parts of the body that don’t have these nerve connections. For example, they made Sally’s blood clot faster (so her cut did not bleed much), made her muscle fibers contract more strongly (so she could easily lift an iron table), and made her brain activity speed up (so the world around her seemed to slow down).

The hormone cortisol, acting alone and in combination with epinephrine and norepinephrine, supported Sally’s fight-or-flight response in other ways. It stimulated her liver, muscles, and other organs to release extra fuel (glucose and glycogen) into her bloodstream, contributing to her strength and mental activity. It increased her pain tolerance so she didn’t notice her cut, and it suppressed inflammation and swelling, a response that would have enabled her to keep going even if she had a more serious injury, like a sprained ankle.

Effects from a fight-or-flight response take a long time to wear off. Muscles that have tensed are left shortened and do not automatically go back to their former length. On the contrary, spinal reflexes make them contract if they begin to lengthen. After the danger has passed and the brain lets the muscles relax a little, the spinal cord immediately tells them to tense up again. At first, they go through a very rapid cycle of relaxing a little and then contracting, again and again. That’s why Sally trembled after her scare was over. Eventually, the stretch reflex abates enough for the trembling to subside, but the muscles still don’t settle back to their former resting length. They remain relatively short and tense until the reflex is reset by a relaxing experience, like the gentle, conscious stretching that occurs during a massage or a yoga session.

Muscles aren’t the only part of the body slow to recover from a fight-or-flight reaction. Stress hormones remain in the bloodstream for quite a long time, and more may be released in response to memories of the danger. That’s why Sally was not hungry for dinner after her fright (her digestive tract was still shut down) and why she had trouble falling asleep that evening (her brain was still highly activated).

Sally’s story shows what can happen when we face acute, major stress. But what
happens when we experience moderate stress repeatedly, day after day? Our bodies activate the same emergency systems, although to a lesser degree. Unfortunately, when invoked chronically, physiological responses that help us cope with danger can become dangerous themselves. Suppression of digestion can contribute to gastrointestinal problems, and promotion of high glucose levels in the blood may contribute to diabetes. Constricted blood vessels, a pounding heart, and rapid clotting can eventually lead to high blood pressure, heart disease, or stroke. Suppression of inflammation can also suppress the immune system, making us more susceptible to infection and possibly even cancer. Chronic stress can also lead to infertility, poor healing capability, and exhaustion.

**Stress Busters**

Luckily, there are lots of ways to reduce stress or even to head it off in the first place. They fall into three main categories: changing your situation, changing your attitude, and taking good care of yourself.

Changing your situation—getting a new job, moving to a new neighborhood, or leaving an unhealthy relationship—can be very effective, but it’s often not practical or even desirable. Changing your attitude—deciding you don’t have to knock yourself out working overtime to prove your self-worth, for example, or deciding it’s not your responsibility to make your partner change—can be very powerful, even life-transforming, because it puts you in control. When you realize you can choose how you react, many events you formerly found stressful may lose their power to push your buttons. Taking care of yourself—eating right, avoiding harmful drugs, exercising, making rest a priority, and scheduling time in pleasant environments with nice people—helps you recover from stress and keeps it from building up again.

One of the best stress busters around is yoga. It directly counteracts both the physiological and psychological components of stress, simultaneously helping you take better care of yourself and change your attitude. The stretching you do in yoga relieves muscle tension. Upside-down poses and reclining poses slow the heart, relax the blood vessels, inhibit production of norepinephrine, and calm the brain. Pranayama (yoga’s classic breathwork) slows respiration. As you practice being more aware and mindful, you gain a sense of self-control, equanimity, and peace. Perhaps most important of all, meditation and the teachings of yoga philosophy can help you realize that most of the things that upset you just aren’t worth getting stressed about.

There are three main ways to head off stress: Change your situation, change your attitude, or take care of yourself.

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