Shhhhhh….This Is Your Brain On Sleep

As we struggle to allot enough time to the job, kids, family, friends, Lost, and Joaquin Phoenix message boards, sleep stands out as a suspiciously long block of idle hours. We set the alarm early, stay up late, and order a tall whatever-we-want to help us get by on the minimum. But the fact is: When you lose sleep, you lose your health.

Experts say most of us need about 8 hours of sleep a night, but half of us don't get it. And more than 80 percent of working women report exhaustion. According to the National Sleep Foundation's annual survey, in 2005 U.S. adults got, on average, just 6.9 hours of sleep a night. Now researchers are discovering that a decline in sleep time means a decline in your health. Some examples:

Getting just an hour or two less sleep than needed per night can impair brain function.

Insufficient sleep is associated with cancer, heart disease, obesity, and dia-betes not to mention early death.

It's also a risk factor for depression, infertility, miscarriage, and postpartum depression.

To top it off, sleeping less to do more doesn't even work: People who skimp on sleep may be devoting more hours to getting things done, but they work more slowly and accomplish less. "There really isn't a good substitute for sleep," says Donna Arand, Ph.D., a psychologist and the clinical director of the Sleep Disorders Center at Kettering Medical Center in Dayton, Ohio.

Scientists haven't yet grasped all the functions of sleep, but they know that sleep is needed every bit as intensely as food or water. It enables our bodies to regulate temperature and fight off infection. It may help our brains retain things we learned the previous day. If you take a peek inside your body and brain during a typical night's sleep, you'll find out how it rejuvenates you and why you should care.

Let's start at the beginning, as your day is winding down....

9:34 P.M.
It's been a crazy week, but with your 2-year-old tucked in, tonight you found a much-needed hour to address invitations to your mom's retirement party. Now it's not even 10 o'clock and you're actually in bed, alone, with a mug full of peppermint tea and a new cookbook you've been dying to page through. When you start having trouble grasping the distinction between chiffon and meringue, you realize you're getting drowsy and reach for the light.

10:01 P.M.
At this moment your bloodstream is full of a sleep-triggering chemical called adenosine. Adenosine is created whenever your body does work. So as you went about your day thinking, talking, driving, digesting adenosine was accumulating, gradually telling your brain that it was time to sleep. If you were to drink a cup of coffee right now, it would jolt

you awake because caffeine wedges itself into the places in brain cells where adenosine would normally attach, preventing the fatigue signal from reaching your brain.

10:03 P.M.
When you're awake, the electrical activity in your brain is varied slow, fast, strong, faint. But when you fall asleep, your brain waves slow and synchronize. You initially enter a doze, known as Stage 1 sleep, from which you can be easily awakened. Falling asleep should take at least 5 minutes; tonight it took you 2. According to experts, that's a sign of a problem it means you're overtired. "One of the major misconceptions is that it's a good thing if you fall asleep as soon as your head hits the pillow," says Kathryn Lee, Ph.D., a sleep specialist and nursing professor at the University of California at San Francisco. "Actually, it means you're a sleep-deprived person."

Over the next hour or so, you transition into increasingly intense slumber. Next comes Stage 2. This is "baseline" sleep over the course of the night you'll spend half your time in this state, but not all at once. Right now you spend just 15 to 20 minutes here before entering Stages 3 and 4, known as slow-wave sleep, the deepest and most restorative kind. You're breathing evenly and slowly, the very picture of serenity. Then everything changes. You shift into REM (rapid eye movement) sleep. Your brain emits a cacophony of electrical signals, it's as active as when you are awake. But you're not awake, of course. REM sleep is the phase when most dreaming occurs. Your eyes dart back and forth, and the muscles in your arms and legs are paralyzed. Sleep researchers believe this inertia may have evolved to prevent us from acting out our dreams.

11:38 P.M.
One 90- to 110-minute sleep cycle ends and the next begins. Each of the following cycles will contain a different proportion of light, medium, deep, and REM sleep.

Although experts don't yet fully understand what sleep is for, they know it is crucial: Rats normally live 2 years or more, but when deprived of sleep they die within 3 weeks. If you stay awake for 24 hours straight, you will involuntarily begin undergoing regular bursts of "microsleep" 2- to 3-second intervals in which you essentially lose consciousness. An Australian study published in the journal Nature found that people kept awake for 28 hours did as poorly on a hand-eye-coordination test as did people who were legally drunk (having a blood alcohol concentration of 1.0).

But you don't have to pull an all-nighter to feel the effects of sleep loss. The past few nights, you've stayed up late to work, pay bills, help your husband pack for a business trip. You think you do fine on 6 hours' sleep, but you're actually accumulating a "sleep debt." Recent research shows that spending just a couple of hours less in bed each night for a week or two -- basically your normal schedule lowers your spirits. "Sleep deprivation has significant impacts on mood in healthy individuals," says J. Todd Arnedt, Ph.D., a University of Michigan sleep specialist. "People get more depressed; they may get more anxious." Sleep loss also slows your reflexes and impairs your memory, judgment, and mental acuity. In a landmark 2003 University of Pennsylvania study, people who were limited to 6 hours of sleep per night for 2 weeks did significantly worse on tests of alertness and reasoning than people who got their full 8 hours.

But get this: The subjects in the Penn study had no idea how impaired they were. They reported an initial increase in sleepiness, but as time wore on they did not complain of additional exhaustion, though their test scores continued to decline. "One of the first

things that goes in our brain is our insight," says Joyce Walsleben, Ph.D., a psychologist at New York University's Sleep Disorders Center. "A sleepy person generally does not perceive how badly they are functioning."

Thankfully, your sleep debt can be paid, and you don't have to make up every lost hour. When you're overtired you slip more quickly into slow-wave sleep and stay there longer, which helps you recover faster. But don't make a practice of playing catch-up repaying your sleep debt works only in small doses (and there's no set ratio for how much makeup time is needed). If the deprivation is chronic, catching up won't work. "When you stress the system, you can recover. Will it always recover 100 percent? Some of those problems are more likely to stay with you as time goes on," says Damon Salzman, M.D., director of the Sleep-Wake Disorders Center at New York-Presbyterian Hospital in White Plains, New York.

3:21 A.M.
You're awakened by a noise...Olivia! You grope for your slippers, go into her room, then sit with her as she sinks back to sleep. If only it were that easy for you. Back in bed, you can't stop your mental gears from grinding. Should you ask your sister to chip in for the party expenses? What will you say in your toast?

3:56 A.M.
You glance at the clock for the third time and feel the pressure. Recent research reveals that getting an hour or two less sleep than you need on a regular basis doesn't just slow your brain and make you irritable, it's a risk factor for illness, including heart disease and diabetes. Sleep loss also hampers your immune system, making you more susceptible to colds and the flu. And it might make you fat. People who sleep less than 7 hours a night are more likely to be obese, and in 2004 researchers at the University of Chicago discovered one of the reasons why. In people who had slept just 4 hours for two consecutive nights, they found an 18 percent decrease in leptin, a hormone that tells your brain you're full, and a 28 percent increase in ghrelin, a hormone that triggers hunger.

4:03 A.M.
You happen to be in the second half of your menstrual cycle. That means your body is producing lots of progesterone, a reproductive hormone that in animal experiments has been shown to induce sleep. So you fall back to sleep. If instead you were about to get your period, a time when progesterone levels drop, you might have had more trouble. If this is a monthly problem, experts suggest you take sleeping pills just for those couple of days.

4:25 A.M.
The time between now and your alarm the last few hours of sleep may be especially important: Recent research suggests that this is when your brain rehearses what you learned the previous day. And "sleeping on it" does more than help you remember new things it may make you better at them. In a 2002 study, scientists asked people to type a sequence of numbers over and over. The volunteers got faster with practice, then plateaued. Tested later in the day, they performed no better, but the next day, after the benefit of a good night's sleep, they sped up an additional 20 percent. Curtailed sleep eliminates those sorts of gains.

So as for that cake-decorating class you took yesterday: Right now, your brain is

reviewing how to color the icing and choose the appropriate nib for the pastry bag. Thanks to tonight's sleep, when you bake a cake for your mom's party, you'll fashion sugary roses more expertly than you did in class. "It will feel sort of magical to you, but your performance will have improved," says Robert Stickgold, Ph.D., a Harvard Medical School neuroscientist who coauthored the typing study.

7:00 A.M.
Banh banh banh banh...You fumble for the alarm. You've never been a morning person now it turns out your preference for sleeping in is genetic. Coordinating basic daily needs to earth's 24-hour light/dark cycle is so crucial to survival that even the most primitive creatures possess internal biological clocks. These clocks tell them when to forage for food, when to rest, when to mate, when to migrate. In humans the clock regulates sleep through the release of the hormone melatonin that substance sold as a sleep aid at health food stores.

In recent years biologists have discovered at least 10 "clock" genes, and these genes, it turns out, occur in more than one variety. Some people inherit genes that make them natural early birds; others are born to be late risers. It's biology that makes your inner morning person reassert itself after cramming for a deadline. "When the pressure to change goes away, you're likely to slip back," Dr. Salzman says.

Now that you've showered, though, you're feeling unusually chipper. It's been a while since you felt so rested. You actually have the energy to multitask, scanning the headlines as you make Olivia's lunch. And when you snap her into her car seat to drive her to day care and yourself to work, that extra sleep will make you both safer. The National Transportation Safety Board estimates that driver fatigue causes at least 100,000 auto accidents a year; crashes are more likely in people sleeping less than 6 hours a night.

Maybe, you think, you should try harder to get enough sleep. You make an effort to accomplish so many other things. And what could be more important than your mood, your health, and your family's safety? "It's just a matter of prioritization," says Eric Olson, M.D., codirector of the Mayo Sleep Disorders Center in Rochester, Minnesota. "People have to decide where sleep falls in how they're going to spend the 24 hours we're all limited to."