PART ONE

The Better Baby Plan

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You Are a Cocreator: The Better Baby Plan

There's still much we don't understand about how the wonderful, amazingly complex little beings called babies develop and grow, even though we've been trying to figure it out from time immemorial. As part of this effort, researchers were trying to understand the role that genes play, and in the 1990s they set out to sequence the human genome. Their work led to today's understanding that our genes don't have the final word on who we are or what our children will be. Instead, our children's biological prospects are the result of a delicate interplay of environment and parental genes. This intricate dance determines which genes will be "turned on," or expressed, then passed on to the next generation, at which stage the interplay of heredity and environment again affects which genes will be turned on.

The study of the complex interaction of genes and environment is called *epigenetics*, a new field of study that, as of this writing, is only fifteen years old. New as it is, we believe it is going to forever change our

basic understanding of human development and prove to be an even more exciting discovery than the decoding of the human genome.

As prospective parents who inevitably worried about the worst while hoping for the best, we had mixed feelings when we learned about early epigenetic discoveries. We were relieved, because the discoveries meant our genes would not necessarily curse our children with our shortcomings, but at the same time we were concerned that epigenetics meant we would not necessarily give our children our talents, either. The more we learned, however, the more we realized that it would be possible to tip the scales toward our "good" genes and away from our genetic weaknesses.

Countless factors can cause any of a baby's genes to turn on or off during the time in the womb. Even a mother's thoughts and feelings during pregnancy can play a significant role in determining what personality traits, characteristics, and behaviors her child may inherit. The three most common things that affect gene expression are the mother's diet and nutrition, her environment, and her emotions. Having a healthy father also has a big effect on a baby's genes, much more than many people realize.

Once we understood the implications of the new epigenetic discoveries, we decided to combine Lana's medical training with Dave's expertise in nutrition to create a program to try to turn on the healthiest genes in our children. We maximized our exposure to health-enhancing activities and substances and minimized our exposure to substances that could be harmful. We even did this before Lana got pregnant so that the womb environment would be as welcoming as possible once it was time to start our family.

So, like most health-conscious prospective parents, we exercised, got extra sleep when possible, and spent hours finding out about everything from the best crib mattress to the least toxic paint for the nursery. Beyond this, we did the in-depth medical research described earlier in order to be sure we had the best and the most current information.

Once we put our research into action, the science proved itself over and over. Lana got pregnant quickly and easily. This was a great relief, because her previous ob-gyn thought that Lana's advanced age

(thirty-nine) and the fact that she had polycystic ovary syndrome made it unlikely that she would be able to get pregnant without hormone treatments or in vitro fertilization. During her pregnancy, Lana never had any morning sickness, unlike other women in her family who were so badly affected by morning sickness some had to be hospitalized.

When Lana got pregnant with our first child after six months on our program, the results of her prenatal quadruple screen blood test—which tests for four major factors in the blood that indicate neural tube defects, genetic disorders such as Down syndrome, and other chromosomal abnormalities—were better than average for her age and showed a small risk of birth defects. Naturally, we were very pleased, and the follow-up ultrasound indicated that our daughter was perfectly healthy—which proved to be the case when she was born.

With our second baby, after more than two years on the program, it was a different story.

Lana again had the early pregnancy blood tests, and this time the lab technician called our midwife to ask about what he thought was a mistake on the paperwork. He said that Lana had scored "negative times four," which is the best result possible, but that someone must have written Lana's birthday down wrong. He said, "Surely Lana is in her early twenties, not in her early forties, right? We have never seen a woman over forty with results that great." When our midwife confirmed that Lana was over forty, the lab technician's comment was "Whatever you guys are doing, keep doing it, because it's working!" Our midwife agreed (in fact, it was she who eventually convinced us to write this book). Having attended more than seven hundred births in twelve years of practice, she said that Lana was one of the healthiest pregnant women she'd ever seen, regardless of age, and that our babies were as healthy as they could possibly be.

According to Lana, who as a practicing physician has also delivered babies, both of her pregnancies were "textbook" easy. In our midwife's words, "There is very little for me to do, other than sit back and enjoy this journey with you and Dave." Our ob-gyn, who practices at Stanford Hospital in Palo Alto, California, and saw us through both pregnancies, was equally pleased and encouraging. The Better Baby Plan, which we created for our own use and now offer to you, boils

down to the following four simple principles, which we call the four pillars of this book:

1. Eat the right foods.
2. Take the right supplements.
3. Detoxify your body before, during, and after pregnancy.
4. Minimize stress.

Of course, many pregnancy books tell you to eat healthy food, take a prenatal vitamin, and reduce stress. This is good advice, but there is a lot of confusion about what a healthy diet really is, which of the hundreds of prenatal vitamins on the market is best, and how to minimize stress. As you read on, you'll see that our Better Baby Plan uses the latest scientific findings to shed light on all of these issues.

The rest of this chapter will provide you with some background on the new science of epigenetics. You'll learn more about what happens at conception, how DNA actually works, and what the critical epigenetic factors are that influence your baby's development.

What Happens at Conception

Once an egg and a sperm come together, the mother's and father's genes unite to form a new cell called a *zygote*. The zygote begins *mitosis*, or cell division, and in seven days grows into a collection of cells called a *blastocyst*, which then travels down the fallopian tube and tries to attach to the wall of the uterus. If the blastocyst is successful, its cells begin to multiply and specialize. During specialization, as the cells begin to form the different parts of the baby's body, they take instructions from both their DNA and (as epigenetics has revealed) the environment.

Among the first differentiated parts to form is the neural tube, which later develops into the baby's brain and spinal cord. A newborn baby's brain contains an estimated hundred billion neurons (nerve cells), a level of complexity too high to be determined by our genetic code alone. In other words, the complexity of the brain far exceeds the capacity of its own genetic blueprint. This seems impossible, but the missing link, according to the new science of epigenetics, is the environment, which influences the genetic code and affects its interpretation.

Since primary brain structure develops in the womb, it is in the womb that environment has the most profound impact on the brain. Although DNA may dictate the basic structure for nervous-system building blocks like neurons and ganglia (nervous system tissues), the connections and relationships between neurons, which are critical to brain function, are at least in part determined by the early womb environment. So building a better brain must start in the earliest days of life.

This gives us a new perspective on the impact of toxins like cigarette smoke or alcohol during pregnancy. If these toxins damage neural networks in the early phase of a baby's brain development, they can cause birth defects to begin to form and can have lifelong effects on brain structure. As you read through this section, you'll see how even a mother's mood can have an effect on a baby's fundamental neurological makeup. The influence of the womb environment on gene translation and cell growth is responsible for many of the infinite gradations of difference that make each person unique.

It's not just your genes that make you you; it's your environment, too.

Sending Your Baby Growth-Mode Messages

To understand how the womb environment affects development, let's look carefully at DNA and its role in growth. Inside cells, genes act like an instruction manual. They contain information that teaches the cell how to build proteins, the building blocks of nearly every cell and organ in our bodies, such as muscle tissue, cell membranes, digestive enzymes, and the hormones that regulate critical body functions like sleep and wake cycles, body temperature, and weight. Proteins are also the building blocks of the signaling substances in the brain that help us to lay down memories, process information, or pull a hand away from a plate that's too hot.

Yet of all the genes in the human genome, only about 5 percent actually give instructions. The other 95 percent are *noncoding genes*; they act as on-off switches that change how the remaining 5 percent should be interpreted. Robert Sapolsky, a professor of biological sciences and urology at Stanford University, likens the human genome to a hundred-page book in which the first ninety-five pages are instructions on reading the last five pages. It is these switches that are continually turned on and off

by our food, thoughts, experiences, and environment. In other words, our first ninety-five pages are rewritten on an ongoing basis!

Every time a switch is flipped, your DNA is translated just a bit differently. Sometimes these switches are changed by messenger molecules like hormones, which in turn are affected by your thoughts and emotions. Sometimes these switches are flipped by toxins or carcinogens. For example, a certain toxin may be capable of flipping a switch that results in the uncontrolled cell proliferation that turns into a cancerous tumor.

Bruce H. Lipton, a cell biologist and the author of *The Biology of Belief: Unleashing the Power of Consciousness, Matter, and Miracles*, describes a fetus as continuously "downloading" genetic information from its environment so it can develop accordingly. He notes that cells have a group reaction to the environment in which they operate together in one of two basic modes: growth or defense. When an organism is in growth mode, it absorbs nutrients, reproduces, rests, or engages in activity that enhances itself or its species. When an organism is in defense mode, however, it emphasizes processes that protect it from perceived threats, at the expense of the energy that goes into growth-mode processes.

Like every living organism, the cells that make up the child in your womb will select either growth or defense mode based on the messages they receive from the environment. Before birth, almost all of the knowledge that a baby receives about the outside world is filtered through the mother's body. This is, in effect, the baby's environment, and the baby's cells will select gene programs that the environment signals are best suited to survival. This is nature's way of preparing your baby for what he or she will face after birth.

Hormone levels have an enormous influence on the messages your baby receives and are responsible for many aspects of development. For example, having enough testosterone in the womb at a specific moment during fetal development can change your baby's life. Peter Lovatt, a psychologist at Britain's University of Hertfordshire, has found that men who were exposed to higher levels of testosterone in the womb are judged by women to be better dancers. Such men have greater control over their bodies and are more attractive as prospective partners—not just for a dance or two, but for life. In other words, the "dance floor" is tilted in their favor, and the band is playing their song!

Other desirable traits that are tied to prenatal testosterone levels—for babies of *both* sexes—are athleticism, musical ability, and facial symmetry. Studies show that facial symmetry has more of an effect than any other physical attribute on a person's appeal to prospective mates.

The body needs healthy fats to create hormones and maintain them at proper levels, which is one of the most important reasons our recommended diet is high in healthy fats.

As the prospective parent of a Better Baby, your goal is to use nutrition, environment, and stress-control techniques to send your unborn baby the message to remain in growth mode. That's what the rest of this book is about. Keeping your baby in growth mode and out of defense mode is central to a healthy pregnancy and a healthy baby, and it will affect your child's entire life. If a baby goes into defense mode, the steps that must be taken to ensure protection always come at a price. No matter how minor the defensive reaction is, it diverts energy from growth and development. Since your baby is so sensitive during critical growth phases in the womb, a defensive reaction may deprive your baby of the only chance to develop certain abilities and attributes.

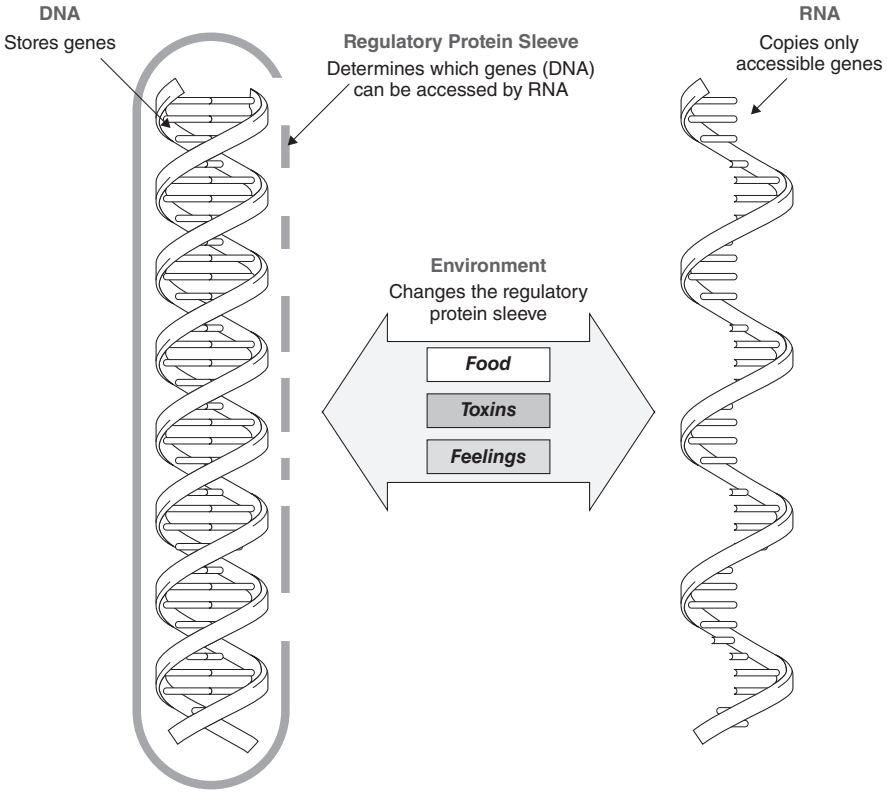
The Power of Epigenetics: Our DNA Is Not Set in Stone

Scientists define epigenetics as the study of heritable changes in gene function that occur without a change in the DNA sequence. In plain English, this means that the environment affects gene translation without changing the original DNA gene sequence inside the cell. In even plainer English, it means that what we do can cause our baby's genes—and our own—to switch on or off.

There's an important type of molecule inside our cells that works with DNA called *ribonucleic acid* (RNA). DNA is an instruction manual, and RNA is responsible for reading the instructions from DNA and communicating them to other parts of the cell. These instructions control what sorts of proteins the cell will manufacture and use. Cells create protein only when RNA goes to the correct DNA strand, gets instructions from the DNA, and carries these instructions to the cell's protein-manufacturing area, known as the RER (*rough endoplasmic reticulum*).

Here's where epigenetics comes in. Think of the DNA double helix as encased in a "sleeve" of regulatory proteins, and if that sleeve allows RNA through to read the genes, those genes will be turned on. If the sleeve of regulatory proteins blocks RNA from reading the genes, those genes will be turned off. Since the environment has a large say in how the sleeve is configured, it also influences which genes RNA can get through to read.

Many different signals from the environment affect the regulatory sleeve. These signals can be chemical or electromagnetic, they can come from inside the body or outside it, and they can come from our emotions. For example, many genes in the human body are turned on or off by a person's thoughts, feelings, and experiences. These genes have a profound effect on immune function and resistance to disease. They can be activated in as little as three seconds. Holistic doctor Deepak Chopra



The environment controls which genes RNA can replicate (conceptual model only).

recently publicized a study showing that a short period of meditation directly affected the expression of more than five hundred genes.

Unfortunately, epigenetic effects don't always make things better. Sometimes they promote genetic programs for defense instead of genetic programs for growth. Poor habits on the part of mothers and fathers can turn on harmful genes, which are then passed on to the children. This can occur, for example, if the parents are overweight. A 2010 study at Boston's Children Hospital found that children of overweight mothers were more prone to being overweight than children of mothers with average body mass index. The older the children got, the more overweight they became.

Another example is undernourishment. If a parent is malnourished, disorders can develop that sometimes affect not just his or her children but also her children's children and beyond. Thus, a Dutch famine at the end of World War II led to higher schizophrenia rates in later generations. In the United States, researchers blame malnourishment in Southern women during the Civil War for the unusually high incidence of stroke that persisted among their descendants for several generations.

Epigenetic factors have a greater influence in the womb than at any other time in a person's life. Such factors, which include the mother's diet, environment, stress level, and emotions, can send various kinds of signals to the protein sleeve surrounding an unborn baby's DNA. Some of these signals are helpful and some are harmful, and they have a tremendous effect right after fertilization. They don't change your baby's genetic makeup, but they do (at least in part) determine which of the genes in a baby's DNA sequence will become functional. This is why we emphasize creating good health in the mother (and the father) even before conception.

To see epigenetics in action, we can look at the results of a famous Duke University study, published in *Molecular and Cellular Biology* in 2003. In this study, specially bred mice that were bright yellow and genetically susceptible to obesity, diabetes, and cancer were fed certain vitamins before and during conception and pregnancy. The resulting baby mice were healthy, natural brown-colored mice with no tendency toward obesity or disease. The vitamins and supplements given to the mother mice suppressed the bad genes that would have caused the yellow color and all the associated disease susceptibilities in their offspring.

The vitamins given to the mice included choline, trimethylglycine, folic acid, and vitamin B12—all are what are called *methyl donors*. Methyl donors can change the sleeve of proteins around the DNA in a recently fertilized egg, causing RNA to read DNA differently and have a big effect on which genes will be expressed. That's why we focus not just on food but also on prenatal supplements, and it's why we stress the importance of trying to conceive when the mother's body is optimally nourished and healthy.

Ideally, parents should also choose to conceive when the mother is not under a lot of stress. If certain stress hormones like cortisol are present in high quantities or are elevated for long periods, it can cause the body to go into the defense mode we discussed earlier. This helps cells to respond to threats more quickly, but it uses energy the body needs for other processes. Remember we said that functioning in defense mode always comes at a cost? In the long run, this faster response and higher energy use wears cells out.

In contrast, physical exercise, yoga, meditation, and prayer are all known to reset cell activity, slowing it down to its normal, more sustainable pace. Breathing exercises, relaxation training, meditation and other mindfulness techniques, good relationships with family and friends, group support, and even a healthy expression of aggression have the same reset effect. This is why they promote health and longevity. There's a good biological reason behind the advice to "take a deep breath" when you're upset—you're actually slowing your cells down and helping them to return to growth mode.

What happens in the womb isn't the only thing that has an effect on gene expression. Studies have shown that a mother's (and presumably a father's) touch and nurturing after birth can cause different genes to be turned on or off. An experiment was done with rats in which the pups of calm mothers were swapped with pups from anxious mothers, each mother raising the other's pups. The pups from anxious mothers were genetically predisposed to anxiety. The calm mothers, who licked and groomed the pups, were much better nurturers than the anxious mothers, who paid little attention to the pups. The amazing result was that the anxious pups became calm under the care of the calm mother rats. The pups' cognitive test results showed that they were more curious and that

they explored new environments with less fear and hesitation. The scientists performing the experiment noted that the calm mothers' behavior caused permanent changes in the way the anxious pups' genes were translated. Based on this and other studies, there is ample evidence that a wide range of social interactions affects gene translation, especially during critical childhood development phases.

If gene translation can change after birth, imagine the power of this effect in the womb, during the most critical stages of development!

In *The Prenatal Prescription: A State-of-the-Art Program for Optimal Prenatal Care*, Peter Nathanielsz, a Cambridge University–educated doctor and expert in fetal development, gives an excellent practical example of epigenetics at work. He tells a story about two brothers.

The first brother, James, was born on a warm Southern California evening at a low-stress time in his parents' lives, when things were going well for them. Later, the father, Michael, was injured, became disabled, and lost his job as an engineer. The family moved back to its original home in Pittsburgh to be near family and old friends. The mother, Alice, kept food on the table by working at a large commercial laundry. This was a stressful environment full of noise and chemicals, and she worked there six days a week, including during her pregnancy with her second son, William, until the very day she went into labor.

James and William both grew up eating a diet typical of the Pittsburgh area: high in starch, sugar, carbohydrates, and unhealthy fats and low in proteins, healthy fats, and fresh vegetables—the same diet that causes so many health problems today. Nonetheless, James enjoyed good health, whereas William was diagnosed with high blood pressure at forty years old, contracted diabetes at fifty, and died of a stroke in his early sixties. James lived well into his eighties as a healthy man before dying of old age. The different womb environments that James and William were exposed to during critical stages of fetal development affected their whole lives.

According to Nathanielsz, how we leave the world is mostly determined by how we enter it. What happens in the womb environment can largely predict your baby's cardiovascular health, eating patterns, tendency to gain weight, emotional resilience, intelligence, susceptibility to

cancer, resistance to infection, and even blood pressure. The blood pressure of women during pregnancy has been shown to correlate directly with the blood pressure of their children in adulthood.

More on Growth Mode and Defense Mode

The cells in our bodies work together in systems at least as complex as human society. Cells continuously communicate with one another, signaling other cells to either increase or decrease activity for the common good of the whole body.

If the cells of a baby in the womb face a shortage of oxygen or nutrients, they may be forced to allocate their limited resources in ways that can affect the health of that baby after birth and throughout life. This would be analogous to a farmer who harvests the corn crop and uses all of it to feed the family during a winter of severe food shortages. This helps the family to survive the winter, but afterward there is no corn to sow, and the next winter is likely to be much harder.

Similarly, if adverse conditions in the womb force a fetus to focus on short-term survival, it may have to forgo what is truly a once-in-a-lifetime opportunity for optimal development. For example, if there are inadequate supplies of nutrients or oxygen, a fetus will devote more of its resources to brain development, a shift that may come at the expense of other organs and tissues, which will no longer have an opportunity to grow properly.

The circulatory system is one of the possible victims of the shortage of resources in defense mode. If this system doesn't develop properly, there will be too few blood vessels supplying one or more of the baby's organs. A diminished blood supply means that these organs will receive less oxygen and nutrients throughout life and may not perform as efficiently as they should.

Another possible result of being in prolonged defense mode is an underdeveloped liver or digestive system. While a baby is in the womb, the mother performs all digestive and detoxifying (liver) functions for the fetus. Since these systems aren't used in utero, most fetuses give them the lowest priority if environmental factors have caused a shift into defense mode and a consequent rationing of resources. The result is that

these organs may not have a chance to develop normally, eventually causing problems that cannot be reversed. No known food or supplement given to the baby after birth will be able to change the structure of an underdeveloped liver. This is why keeping your baby in growth mode and out of defense mode is so critical.

Just as babies in the womb respond to how much oxygen and nutrients cross the placenta, they are also sensitive to their mothers' stress levels, which are signaled by changes in heart rhythm, blood pressure, and sounds, as well as by certain hormones like cortisol that cross the placenta. If there are heavy loads of cortisol over a prolonged period, the message to the baby is that the outside world is a dangerous place, and the baby's whole body may enter defense mode and not develop as it should. This underdevelopment sometimes comes with lifelong effects.

Many people have heard the old saying "You are what you eat." Epigenetics shows us that you are also what you breathe, feel, and think, and these factors have a profound effect on your children, too. Epigenetics is groundbreaking because it proves once and for all that we as parents have more control over the health of our unborn children than we ever dreamed possible. The knowledge that we have this control brings with it an obligation to use that opportunity to pave the way for maximal good health in our children—starting even before conception, if possible.