The Science of FlexAware

Basic Anatomy and Physiology
Basic Neuroscience
Neuroplasticity
Biotensegrity
Applications and a Call for Research

This science is mostly basic, learned in school though perhaps forgotten. Some validates everyday experience. Some is new, even revolutionary.

FlexAware applies the science consistently and explicitly.

Basic Anatomy and Physiology

First: Fundamental to anatomy and physiology – more than that, fundamental to life – is gravity.

Gravity affects the shape of our bones and joints, the size and location and strength of our muscles, and all other aspects of our physical structure. It affects our behavior, too, every movement at every moment. Our heads, hands, feet, and pelvises – every bone, every muscle, and everything else – are constantly falling toward the center of the earth.

Normally, however, we take gravity for granted, neither sensing it consciously nor thinking about it. We also resist it. That's partly because we overlook it, partly from a general lack of awareness, partly just habit. An example of resisting gravity is the way many of us hold our shoulders up near our ears. Fighting or resisting gravity is wasted effort. Gravity always wins. We always lose, and the costs include stress, strain, fatigue, premature aging, and sometimes chronic pain.

Young children naturally align and move with gravity. They don't have habits of resisting it, not yet. Moving naturally with gravity is a key reason they are so flexible, so strong, and have so much stamina.

FlexAware teaches us to be more aware of gravity. With every FlexAware movement in any position, as we return toward the floor, we seek actively to relax and respond to gravity, to surrender to it. Moving away from the floor, we sense and use gravity as a guide to minimizing effort.

In addition, FlexAware uses gravity as a way to understand ideal efficient movement, what it is, what it means, and why it's important. Gravity gives real meaning, experiential meaning, to the concept of relaxation.

Second: When we stop moving, muscles and other tissues start to contract and stiffen. We tend to stiffen whenever we are still. Each of us experiences this every day, though most of us are unaware of how and why it happens and what it means. This stiffening is a fact of physiology.

This is why we sometimes stretch spontaneously; babies and animals do so too. When we stretch, when we do any movement after being still, there's an increase in blood flow and nerve activity. Movement is vital for tissues in and around our joints – cartilage, ligaments, and such – because there's no direct blood supply into the joints; joint tissues are nourished by synovial fluid, which only circulates when we're moving. To prevent and treat arthritis, moving is crucial and this is the reason.

Moving is most beneficial when it feels good. When muscles and other tissues are moving easily, with minimal effort, tissues are most relaxed and circulation is best — more relaxed than when we're not moving. This is also a fact of physiology. This is why young children are rarely still except when they sleep.

FlexAware gives us simple easy effective movements we can do anywhere and anytime to relieve, reduce, or prevent stiffening. The movements are especially good for the joints and muscles in the mid- and upper back, an area that is almost always overlooked.

Third: Every skeletal muscle attaches, either directly or through a tendon, to two or more bones, crossing some joint or joints. When a muscle contracts, it pulls the attached bones toward each other. For either bone to move, other muscles have to lengthen on the opposite side of the bone. Thus, one muscle contracts; some opposite muscle lengthens. But those muscles are not alone. When any bone moves, all the muscles that attach to it participate in some way, lengthening, contracting, or changing tone while maintaining length.

Muscles do not, and cannot, function in isolation. But we tend to overlook these facts when we try to stretch or strengthen specific muscles. Focusing on one muscle at a time, we risk using other muscles inefficiently, ineffectively, even counterproductively.

FlexAware never focuses on individual muscles. Instead, it views the muscles as an elastic suit. Every FlexAware exercise seeks to promote ease, comfort, and skill generally, integrating the action of muscles throughout the body, guiding the whole person to move in ways that are increasingly efficient, effective, and ideal.

Fourth: As with other movements, breathing involves many muscles moving some bones.

Common ideas about breathing focus on the diaphragm, as if it's the only muscle we use to breathe. It's not. The diaphragm attaches to the lower ribs, which move even when our breathing is shallow. Other muscles also attach to the ribs and participate in every breath.

FlexAware movements are designed to improve the action and coordination of all the muscles involved in breathing, most notably the many muscles in back that attach to the ribs. The movements increase the mobility of the ribs as well, particularly at the joints with the vertebrae. This is how FlexAware helps people breathe freely, fully, and effectively, more like healthy children.

<Back to Top>

Basic Neuroscience

First: The brain continuously monitors, coordinates, and directs activity throughout the body. That includes the position and motion of every bone and joint, which muscles are contracting, which muscles are lengthening, the surface of the skin, our orientation to gravity, and our perceptions of what's around us.

This occurs almost entirely in the deepest and oldest regions of the brain, the brainstem and cerebellum. Those regions are also the most rapid and reliable; they have to be, for our survival. Our human consciousness and capacities – language, most notably – are located on the surface of the brain, the cortex, which is more recently evolved and relatively slow and unreliable. Language is particularly slow because it's linear and sequential, one word at a time.

The region of the brain that is most uniquely human, and most recent, is the prefrontal cortex. Neuroscientists see it as the center for executive functions, self-reflection, and awareness.

FlexAware, with its emphasis on awareness of the way we move – how we breathe, how we align with gravity, what's happening with muscles and bones and so on – seeks to and seems to integrate activity throughout the brain, from the newest areas to the oldest. FlexAware is whole brain exercise that continuously integrates moving, sensing, feeling, and thinking.

Second: Scientists long ago divided the nervous system into several subsystems. A main division is between the autonomic and the voluntary. The autonomic subsystem regulates autonomous or self-governing functions that are vital for survival, heart rate, digestion, immune activity, sexual responses, and so on. Voluntary activities are those under direct conscious control. Modern neuroscientists recognize some conscious control over autonomic functions.

The autonomic subsystem has two branches, sympathetic and parasympathetic, and they have distinct nerves and neurotransmitters. The sympathetic is "fight or flight" and arouses to action. The parasympathetic subdues the stress response and promotes rest, relaxation, and healing.

Breathing is autonomic and voluntary. Sympathetic nerves direct it to be faster; parasympathetic, slower and deeper.

FlexAware is based on breathing and seeks to expand the range of comfort and ease. That means sometimes making very slow, very large movements while exhaling fully and inhaling fully. Sometimes breathing quickly while making small fast movements. Sometimes large and fast, or slow and small, or shifting rapidly from one variation to another.

In this way, FlexAware seems to enhance neurological responsiveness and resilience. That includes the capacity to arouse more quickly and powerfully when appropriate. Also the capacity to relax and recover more readily, completely, and voluntarily.

Third: The brain's cortex, the outer layer, has specialized regions on both sides that coordinate sensing and moving. Each region has an image or map of the body's

opposite side. The images are the “somatosensory homunculus” and the “motor (or kinesthetic) homunculus.” These images have huge inflated lips and thumbs, and tiny trunks and thighs. They represent the body as experienced, not the body as viewed objectively. They are personal and slightly different in each of us, reflecting our unique experiences.

FlexAware is designed to refine and enhance the way we experience our bodies. The focus is more on our brains than our muscles.

Fourth: We sense and perceive more accurately when stimuli are less intense. This is called the Weber-Fechner law, named for the two scientists who described it in the mid-1800s. Stated more formally: the ability to perceive differences is inversely proportional to the intensity of the stimulus. This is well-proved, which is why it’s called a “law,” and valid for all sensory activity, weight or effort, vision, sound, taste, and smell. With movement, the law is clear: excess effort impairs sensation.

Suppose you are holding a single piece of paper. Add or remove one paperclip, and you could perceive the change in weight. You couldn’t if you were holding a book. With the effort of holding a book, you might be unable to perceive the change with a few hundred paperclips.

The Weber-Fechner law is the key to understanding exercise-related pain and injuries. When we exercise, the effort and repetition reduces our ability to perceive minor aches and irritations. Willpower and self-discipline further mask, impair, or override our ability to sense changes. Continue to exercise, and a minor ache can become a major pain, with serious tissue damage.

Weber-Fechner also explains why poor posture, shallow breathing, and other movement habits are so persistent. Habits are efficient. They’re all-or-nothing behaviors we form to streamline and simplify our actions. Thus, habits impair our ability to perceive differences. When we can’t perceive differences, we can’t readily make changes to learn new skills. The Weber-Fechner law is more powerful than willpower and self-discipline. Willpower and self-discipline are from the neocortex, which is slow and relatively unreliable; Weber-Fechner operates throughout the brain.

FlexAware respects, obeys, and applies the Weber-Fechner law. It does so by consistently emphasizing awareness and the value of reducing effort and seeking ease — even with advanced exercises, which can be large, fast, powerful, and challenging.

With regard to posture and other movement habits, FlexAware and the Weber-Fechner law remind us that the first step toward any desired change has to involve ease and comfort. Reduce effort. Seek more efficient and effective alternatives. Continue with reducing effort and refining skills. That’s the FlexAware way to better posture, relief from back pain, and better health and fitness overall.

<Back to Top>

Neuroplasticity

Old concepts of the brain considered it to be mostly a product of genetics, hard-wired and relatively unchangeable.

Today, however, based on extensive research with new technologies, functional MRI and PET scans, neuroscientists know that the brain changes with experience. At all ages. Moving in new ways reorganizes or reconfigures the somatosensory and kinesthetic regions of the cortex and other brain regions. Such changes can be significant. For instance, when someone loses an arm or leg in an accident, neurons associated with that limb make new connections and take on new roles.

The brain senses and coordinates movement; movement stimulates the brain's functioning and structure. The relationship is reciprocal. Thus, when we learn to move more skillfully, there are changes in the brain; those changes facilitate even more skillful movement and, potentially, further learning and further changes. Yet the reverse must be true as well. Doing only what's familiar must change the brain, reinforcing habits and impairing alternatives.

Our brains and internal images can change in other ways as well, such as incorporating our use of prosthetic limbs and other tools. The brain can even change itself with and through internal experiences, words and images. Education and meditation and prayer and psychotherapy and similar experiences change the brain. Love and joy change the brain. Learning is organic, and happens in our cells.*

FlexAware consistently incorporates and applies discoveries about neuroplasticity. Through the exercises, it seeks actively to facilitate positive changes by gently guiding people toward more ideal efficient alternatives. It also promotes desired neuroplasticity by explicitly encouraging people to explore and experiment, to learn and be more aware.

* Here are some good popular books on neuroplasticity:

-- *The Mind and the Brain,* Jeffrey M. Schwartz, MD and Sharon Begley (HarperCollins 2002)
-- *The Brain that Changes Itself,* Norman Doidge, MD (Penguin, 2007)
-- *The Body Has a Mind of its Own,* Sandra Blakeslee and Matthew Blakeslee (Random House, 2008).

<Back to Top>

Biotensegrity

Joints as hinges; muscles as cords or elastic bands; movement as levers, fulcrums, resistance, and effort. These are our common concepts and models. They're in online videos and popular books about fitness and exercise. Textbooks, too, including in medical schools.

As with most concepts of anatomy, these models are from dissecting cadavers. Dissection even provided the name; "anatomy" is from Greek words meaning "to separate" and "to cut up or cut open." Cut open a cadaver, and the hinges and cords are easy to see and to manipulate.

But cadavers don't move. We do. Conventional models cannot adequately explain how. Those models have significant problems and anomalies:

- In babies and young children, bones are somewhat soft near the joints, not hard enough to be hinges or levers.
- Our joints are nearly frictionless, far more so than any hinge or similar mechanical device regardless of materials and lubricants.
- While walking, our ankles, knees, and hip joints are fully mobile, yet also stable and reliable, even when we're carrying something extremely heavy.
- We move our fingers using muscles in our forearms; tendons run through our wrists and palms, yet all the joints are reliable, stable, mobile, and nearly frictionless.

Watch a young child, or a dancer, gymnast, or other athlete. It's impossible to describe the movement in terms of hinges, cords, and levers. Everything's moving at the same time.

Scientists and movement educators in increasing numbers are developing and applying a new paradigm:

- Muscles, tendons, fascia, and ligaments function as a continuous tension matrix, an elastic suit.
- Bones are embedded within the tension matrix, and function as the solid structures muscles pull on and from.
- Movement occurs through changing the configuration of the tension matrix and the skeleton; every movement involves the whole person.
- Within each joint, a small gap between the bones allows nearly frictionless movement; the gap is visible on x-rays and CT scans.
- The gaps are formed and sustained by the tension matrix, particularly the ligaments that spiral around the joints.

We can now understand how fetuses and babies move, even though their bones are soft and not fully-formed. We can better explain the performance and power of great athletes, and instances of ordinary folks performing remarkable feats of strength and skill. We also gain insights into the way living beings self-organize at every level, from the single cell, to the bone or muscle or other tissue, to the whole organism. This model has huge potential applications for health, fitness, exercise, and medicine.

"Biotensegrity" is one name for this new paradigm. The pioneer and leading proponent is Dr. Stephen Levin, a retired orthopedic surgeon. "Tensegrity" combines "tension" and "integrity"; design scientist architect R. Buckminster Fuller coined the term to describe principles he used in many structures, most famously the geodesic dome. More obvious examples of tensegrity are the "floating compression" sculptures of Kenneth Snelson. Designer Tom Flemons builds biotensegrity models of the leg, spine, pelvis, and the whole skeleton. Dr. Donald Ingber heads a laboratory at Harvard Medical School that studies tensegrity elements and processes within cells.

FlexAware is a perfect fit with biotensegrity.

<Back to Top>

Applications and a Call for Research

From gravity and basic anatomy, through physiology and neuroscience, to neuroplasticity and biotensegrity, these scientific ideas are harmonious and mutually reinforcing. This is a coherent story about how we function.

A key theme is the way we change throughout our lives. There are changes in our cells and our self-images. Changes in the way we align with gravity as we sit and walk; the way we breathe, particularly the mobility or lack of mobility in our ribs; and the way we sense and feel and think about our bodies.

This science and story can help us understand how and why we change. It can also help us learn with, from, and through changes as they occur, thus enabling and empowering us to change in the ways we desire.

The story is partly about young children. Early in our lives, each of us only knew how to crawl. Over some months of exploring and experimenting, we figured out how to walk. And then to run, and skip and dance and so on.

As young children learn to walk, they leave crawling behind. They outgrow crawling. With similar processes and practices, the story tells us, adults can learn to breathe freely and move easily, to be generally more aware and skillful, and thereby to outgrow back pain, asthma, arthritis, knee and hip joint pain, migraine headaches, depression, and other conditions. Instead of viewing back pain, etc., as problems to be fixed or treated, we might see them as crawling, as conditions to outgrow and leave behind.

This is the logic, potential, and promise of FlexAware. For many currently intractable health conditions, it may be the key to rapid significant lasting progress. And to much lower health care costs. There are enormous possibilities for research.

<Back to Top>

Steven Shafarman, May 1, 2012.