Science of Yoga Class 4: Asanas and Homeostasis
Recap from Last Week

- Meditation is good for the brain
  - Brain activity tends towards relaxed, creative states; increased concentration helps create a sense of well-being
  - Decreases the reactive process, helps us live in the present, creates emotional balance
  - Reduces age related thinning of grey matter; increases grey matter several areas of the neo-cortex
  - Breathing techniques (pranayama), gestures (mudras) and locks (bandhas) prepare us for meditation
    - Diaphragmatic breath helps increase RSA, decrease heart rate and promotes efficient oxygenation and decarbonization.
    - Kapalabhati calms the breath and gives us a taste of what breathlessness feels like.
    - Mudras (gestures) and Bandhas (locks) have deep physiological effects on heart rate, blood pressure, and other homeostatic mechanisms.
The whole purpose of true exercise is to awaken that inner source of energy which we have ignored all of our lives. (Sri Yogananda).

- Asanas purify the body of toxins, releasing tension, and deepen the breath
- **Good Circulation** is vital to optimal health. Asanas improve circulation by:
  - Muscular relaxation
  - Squeeze and Soak effect on internal organs
  - Aiding in Venous Blood return
- **The Lymphatic System** is critical to detoxification and immunity. Yogasana and Energization Exercises (EE):
  - Promote Lymphatic Circulation by engaging the muscle pump the respiratory pump.
  - Inverted asanas drain the Lymph due to force of gravity.
  - Produce moderate activation of the sympathetic nervous system, increases innate immunity
  - Reduce levels of Cortisol in the blood. High levels of Cortisol can weaken the immune system.
So Asanas detoxify and strengthen the body…

• But their deeper purpose is “even-ness” or “balance”
• In science, this concept is called “Homeostasis” – the body is wired to maintain balance
• In their most subtle form, asanas help keep the body in balance.
• As Krishna says in the Gita (2:48):

> Perfect evenness of mind and feeling is itself the definition of Yoga
> What meditation does for the mind (chitta vritti nirodh), asana does for the body (homeostasis)
Inflammation

- An infected finger or an overused back swells up
- This is called Inflammation
- Inflammation is a “call to action”, which occurs without our conscious control.
- It is a life saving component of our immune system
- It helps fend off bacteria, viruses, fungi, and other invaders.
Physiology of Inflammation

Suppose your finger is poked by a nail. Then:

- Skin cells release chemicals called Chemokines, which sound an alarm bell in the body.
- Mast cells release Histamine, which causes the capillaries to dilate (vasodilation)
- Vasodilation releases neutrophils (killer cells), B-cells and T-cells (responsible for antibodies)
- Together, they neutralize the invader
Chronic Inflammation

- When there is persistent stimulus to the immune system, we experience chronic inflammation.
  - Allergy
  - Low grade, lingering infection from an old root canal
  - Preservatives and other chemicals found in preserved food, etc.
  - Free radicals

Recent research, especially that done in the last decade, has linked Chronic Inflammation to various diseases like Diabetes, Heart Disease, certain type of cancers, arthritis, etc.
Example: Chronic Inflammation and Diabetes

When we eat more than necessary, esp. large quantities of sugar and fat, it causes inflammation in fat storage cells:

- Extra sugar causes insulin to be released
- Insulin tells the fat cells to store excess energy as triglycerides
- Over time, the fat cells become “full”. When insulin asks them to store more, they become “inflamed” that is,
- They release pro-inflammatory chemicals into the blood stream: Tumor Necrosis Factor (TNF) α, Interleukin (IL) 6, and others.

The net result is that fat cells begin to say “No” to insulin. This is called Insulin Resistance, and is the first symptom of (type 2) diabetes.
Yoga and Chronic Inflammation

Result of a Study done by Ohio State University, Jan 2014

• Researchers wanted to test the effects of Yoga on Inflammation

• 200 Breast Cancer survivors studied
  • None of them had done Yoga before
  • Half of them did Yoga for 90/session, twice a week; the other half didn’t do yoga

• 12 weeks total duration

• After 12 weeks, the Yoga group reported:
  • Lowered levels of inflammation markers in the blood: TNF-α, IL-6, and IL-1β
  • Higher vitality and lower fatigue
  • More frequent practice produced larger changes
Conclusions of the Study

Chronic Inflammation may fuel declines in physical function, leading to frailty and disability. If yoga dampens both fatigue and inflammation, then regular practice could have substantial health benefits.
The Science of Stress

What Happens during Stress?

Stress response is built around the fact that muscles need to work like crazy to avoid the threat. Therefore:

• Glucose, some simple proteins, and other nutrients come pouring out into the blood stream
• Heart rate, blood pressure, and breath rate increase. Blood vessels get wider (vasodilation). All of these aid in getting nutrients to the muscles quickly and in copious quantities.
• Stop long term activities: digestion, ovulation/sperm production, growth, muscle repair, etc.
• Inhibit immune response in the short term, but increase it in the medium term
• Decrease pain sensitivity
• Heightened senses and improvement in certain types of memory
Mechanism of Stress Response

Chemical messengers:
1. Are carried along tracks in the outer edge of the brain to the hypothalamus, which acts as a switching station and activates two separate tracks.

2. Hypothalamus, which acts as a switching station and activates two separate tracks.

3. The first track goes to the Pituitary, which sends a chemical messenger called ACTH.

4. Which enters the bloodstream and reaches the outer layers of the Adrenal gland. In response, Adrenal Gland produces Cortisol, which increases blood sugar and speeds up metabolism.
Mechanism of Stress Response

6. On the parallel track, the **Hypothalamus** sends electro-chemical impulses down the **brainstem**.

7. The **brainstem** activates **sympathetic nerves** which enervate the deeper layers of the adrenal gland, called **Adrenal Medulla**.

8. Adrenal Medulla responds by releasing **Epinephrine (Adrenaline)** which

9. Supplies extra glucose for the muscles and the brain. It also releases **Norepinephrine**, which speeds up the heartbeat and increases the blood pressure.

10. Both tracks feed back into the **pituitary**, which monitors the levels of these hormones in the blood, and regulates the stress response further.
Chronic Stress

This is a magnificent mechanism for handling acute stress
- Being eaten by a lion
- Serious physical Injury
- Starvation

But the same thing happens during chronic stress
- Deadlines
- Traffic
- Family relationships
- Money problems

Two Yuppies Contesting the Last Double Tall Mocha At Starbucks
Effects of Chronic Stress

STRESS

Stress Contributes to:

* Heart Disease
* Strokes
* High Blood Pressure
* Colitis
* Irritability
* Rheumatism
* Depression
* Migraines
* Diabetes
* Hardening-of the Arteries

* Insomnia
* Fatigue
* Sex Problems
* Skin Diseases
* Allergies
* Overeating
* Asthma
* Kidney Disorders
* Ulcers
* Breathing Problems
* Increased Smoking
Example: Chronic Stress and Heart Disease

Chronic Stress increases heart rate:

- Over time, this results in Hypertension
- Hypertension causes blood vessels to become damaged
  - The inner lining begins to tear
- This triggers an inflammatory response
  - Over time, this inflammation causes plaque build up (Atherosclerosis)
- If Atherosclerosis occurs in cardiac arteries, it’s called Coronary Heart Disease
- Sometimes, clogged arteries can form a blood clot (thrombus), which can become dislodged
  - If it makes its way to the narrower arteries of the heart, then it causes a heart attack
  - If it makes its way to the brain, then it causes a stroke
Yoga and Chronic Stress

Yogic Practices are one of the best methods of reducing and effects of chronic stress

• Yoga activates the parasympathetic nervous system
  • This induces the relaxation response, reducing the effects of chronic stress
• Several yoga postures like Sarvangasana (shoulder stand), Setubandhasana (bridge pose), etc. help reduce chronic hypertension
• Yoga has been shown to reduce cortisol levels in the blood. Increased cortisol levels are a marker of chronic stress
• Yoga increases heart-rate variability (due to Respiratory Sinus Arrhythmia – RSA). Heart rate variability is a key marker of good health
Blood Pressure (BP)

- Brain has many mechanisms to keep BP in a narrow range
- 3 variables control BP:
  - **Heart Stroke Volume**: if the heart pumps more blood with every contraction, then BP increases
  - **Arterial width**: If the arteries (and arterioles and capillaries) are wide, BP is less; if they constrict, BP increases
  - **Blood Volume**: if the amount of water in the blood is increased, then there is literally more blood in the system, causing high BP.
- Combination autonomic nervous system and chemical action (through kidneys, hypothalamus, pituitary, and adrenal glands) control these variables.
Baroreflex and BP

Baroreceptors are present within the aortic arch and the common carotid artery. Firing of Baroreceptors lowers the heart rate thru the activation of the parasympathetic Vagus nerve. It also inhibits sympathetic tone.

Sometimes the baroreflex goes out of “calibration”
When coupled with Chronic Stress, this can cause high BP.

Yoga and Blood Pressure

- Resetting the Baroreflex Mechanism
- Decrease in Sympathetic Tone