**Breathing With Mindfulness**

Anapanasati (ah-nah-pah-nah-sah-tee) is the core practice of Buddhism, with the exception of some sects that primarily use chanting for spiritual development. *Sati* translates as *mindfulness,* which can also be understood as *non-judgmental present-moment awareness*. *Anapana* translates as *inhalation/exhalation*.

The Anapanasati Sutta is one of the core teachings of Theravada Buddhism. It organizes a progressive development of 16 contemplations, sometimes simplified as 4 tetrads of 4 contemplations. Here are the 16:

"**[1]** Breathing in long, he discerns, 'I am breathing in long'; or breathing out long, he discerns, 'I am breathing out long.'

**[2]** Or breathing in short, he discerns, 'I am breathing in short'; or breathing out short, he discerns, 'I am breathing out short.'

**[3]** He trains himself, 'I will breathe in sensitive to the entire body.' He trains himself, 'I will breathe out sensitive to the entire body.'

**4]** He trains himself, 'I will breathe in calming bodily fabrication.' He trains himself, 'I will breathe out calming bodily fabrication.'

"**[5]** He trains himself, 'I will breathe in sensitive to rapture.' He trains himself, 'I will breathe out sensitive to rapture.'

**[6]** He trains himself, 'I will breathe in sensitive to pleasure.' He trains himself, 'I will breathe out sensitive to pleasure.'

**[7]** He trains himself, 'I will breathe in sensitive to mental fabrication.' He trains himself, 'I will breathe out sensitive to mental fabrication.'

**[8]** He trains himself, 'I will breathe in calming mental fabrication.' He trains himself, 'I will breathe out calming mental fabrication.'

"**[9]** He trains himself, 'I will breathe in sensitive to the mind.' He trains himself, 'I will breathe out sensitive to the mind.'

**[10]** He trains himself, 'I will breathe in satisfying the mind.' He trains himself, 'I will breathe out satisfying the mind.'

**[11]** He trains himself, 'I will breathe in steadying the mind.' He trains himself, 'I will breathe out steadying the mind.'

**[12]** He trains himself, 'I will breathe in releasing the mind.' He trains himself, 'I will breathe out releasing the mind.'

"**[13]** He trains himself, 'I will breathe in focusing on inconstancy.' He trains himself, 'I will breathe out focusing on inconstancy.'

**[14]** He trains himself, 'I will breathe in focusing on dispassion *[literally,* fading].' He trains himself, 'I will breathe out focusing on dispassion.'

**[15]** He trains himself, 'I will breathe in focusing on cessation.' He trains himself, 'I will breathe out focusing on cessation.'

**[16]** He trains himself, 'I will breathe in focusing on relinquishment.' He trains himself, 'I will breathe out focusing on relinquishment.'

These steps describe a progression of more and more subtle insights regarding the human condition. After these 16 stanzas, the focus of contemplations includes the Four Foundations of Mindfulness more specifically. The first 4 stanzas involve mindfulness of the body, the next 4 stanzas investigate the specifics of the Four clinging), cessation (of clinging) and relinquishing any belief in an enduring/autonomous self.

**Functional Advantages Through Mindfulness of Breathing Meditation**

The sensation of breathing is with us throughout life, so it is always available as a stabilizing point of reference. It is one of the few bodily functions that operates through both the voluntary and autonomic systems—we can consciously control the frequency and duration of each breath, but when we are unconscious, we will continue to breath. The affective tone of breathing is neutral, neither pleasant or unpleasant, therefore we must intentionally direct focused attention on the sensations associated with breathing in and out. The longer we can maintain persistent investigation of breath sensations, the physiology of the body is balanced—not agitated or sedated—and yet the quality of consciousness associated with that persistent observation is emotionally calm and cognitively alert. Any deviation away from the neutrality of breath awareness has some degree of excitation, either slight or strong in its strength; being able to be aware of the changes in the mind when these distractions occur is an essential skillset for the practice of vipassana, insight into the transient and fabricated nature of self-state organizations. This introspective awareness also is able to notice the initiation of craving and clinging sooner before the initial impulse takes over consciousness. A simile for this is the stillness of the surface of a pond (comparable to persistent and pure breath awareness)—when a pebble falls into the water, the ripples are clearly noticeable, and the pebble can be clearly known as soon as it strikes the surface. As persistent breath awareness develops, the sensations and rhythms of breathing become softer and more subtle, providing opportunities for developing greater sensitivity to smaller and smaller “pebbles” that occur.

All of these functions actually occur through changes in the inner structures of the brain, and these changes ripple throughout physiology of the body, much like the way ripples move across the surface of a quiet pond—you can analyze the shapes of the ripples and discover where the pebble entered the water. The following provides some research results that just barely indicate the dynamic complexity regarding the interactions of the billions of neurons in the brain.

**What Happens to the Brain with Anapanasati?**

There has been a great deal of research over the last 30 years investigating how the structures and functions of the brain are modified through the practice of anapanasati. The protocol is typical for investigating psychological functions—there is a control group of subjects who are either completely without any suggestion for paying attention, another group of subjects who are provided with a non-meditative suggestion, and a group of subjects who are either well-trained in a particular task (like anapanasati) or are willing to begin practicing anapanasati during that research period. I will report on the significant changes in brain structures among the well-trained subjects.

There are key areas of the brain that process emotionally charged events and impose meaning on the raw sensory data of life, such as seeing, hearing, etc. These areas are dynamically functioning, constantly transforming energy into information. Through the process of long-term potentiation (LTP), involving clusters of neurons firing synchronously, that is, at the same frequency (times per second) and amplitude (strength of the neural firing), patterns are established that are enduring and which affect areas throughout the brain and body. As the various neural networks are activated, energy is channeled to and through them (glucose and oxygen, mostly) and the networks become more strongly interconnected and easier to activate.

These neural pathways have been extensively researched and revealed areas of the brain that are associated with various emotional, cognitive, and behavioral functions. There are a multiplicity of these pathways in the brain; here are the ones that are most important for the process of awakening:

**THE AMYGDALA**: The amygdala system includes two nodes—one in each hemisphere. Research indicates that the amygdala in the right hemisphere predominantly processes fear and sadness, while the left hemisphere amygdala processes both fear, sadness, and happiness, and is more directly associated with motivational impulses. The amygdala sends affective alerting signals to other areas of the brain, inducing stress; the stress can either be pleasant (eustress) or unpleasant (distress). When the amygdala is overstimulated through distress, the body generates cortisol, which is important for effectively responding to circumstances, but becomes toxic when chronically active in the brain and body. Additionally, the amygdala becomes “predisposed” to alarm, because of the close proximity of the hippocampus and the synchronistic interaction between the various neural pathways.

**THE HIPPOCAMPUS**: The hippocampal system also is found in the right and left hemispheres. The function of the right hippocampus seems to be strongly coordinated with the right amygdala and relates the emotional impulse of stimulation to prior emotionally potentiated episodic memory. The left hippocampus is also associated with the right amygdala, but its function is more related to associating episodic memory and language. Perhaps this is why, in psychotherapy, there is a benefit to being able to use words to describe emotional experience; in this way, the synchronistic linking process is more accessible to awareness.

**THE NUCLEUS ACCUMBENS**: These nuclei are also bilateral, with one in each hemisphere. In both hemispheres, the function seems to be oriented towards reward, that is, motivation for action to experience pleasure or to avoid pain. The nucleus accumbens has been researched extensively, which reveals that that system, which is strongly linked with the amygdala and hippocampus neural projections, becomes “stuck in the on position”. The hyperaroused system can be associated with any other neural pathways that nurture distraction or pleasurable feelings. Of course, this could involve substance abuse; current research also supports how this is associated with what are called “process addictions”, that is, repetitive, compulsive interactions with processes not involved with intoxicating substances. Examples would include extensive, detrimental access to internet opportunities, tv “binge watching”, overspending with credit cards, sexual hyperactivity, and binge eating.

These areas are found in what is called the limbic area of the brain and are mostly involved in how the mind perceives “friend or foe?, food or poison?” regarding environmental stimulation. We could say that the amygdala and nucleus accumbens are most associated with the Buddhist concept of *craving*, while the hippocampus, which has extensive connections to the areas of the brain where associational memories are stored, represents Buddhist *clinging*.

The awareness of these areas and the ability to regulate responses to their productions involves other locations in the brain; contemporary research suggests that these locations are beneficially affected by mindfulness of breathing and lovingkindness meditative training. Here are some of the areas most often referred to in the research:

**ANTERIOR CINGULATE CORTEX (ACC)**: This area represents the “seam” between the left and right lobes of the cerebral cortex, particularly the frontal area, beginning at the top of the forehead and extending toward the rear. The anterior cingulate is associated with conscious awareness and “error detection and conflict monitoring”. This suggests that the function of the ACC is involved with mindfulness and vipassana, that is, the ability to investigate what is emerging in consciousness and discern whether the emerging self-state organization is wholesome or unwholesome. The ACC is strongly connected to areas in the brain associated with the limbic area, including the amygdala, hippocampus, insular cortex and nucleus accumbens. The function of the ACC is enhanced among trained meditators.

**INSULAR CORTEX**: This area of the brain is the interior lining of the temporal lobe of the cerebral cortex, above the ears, and is next to the limbic system, close to and strongly connected to the amygdala and hippocampus. There is a similarity in some cellular structures in the insula and the ACC, and both areas seem to be associated with conscious awareness; the insular areas are associated with interoceptive awareness, that is, awareness of internal processes. The insula also associates internal bodily awareness (mindfulness of the body, including breath awareness) with higher cognitive functions. Among these higher cognitive functions are emotional awareness, interpersonal awareness (through the function of mirror neurons, which are associated with mimicry and empathy) and experiences of spiritual communion. The strength of connections and enhanced functioning of this area among well-trained mindfulness meditators is observed through fMRI (functional Magnetic Resonance Imaging) research. The interactions between the Insular Cortex, the PFC and the ACC represents what is called the Salience Network (SN), which functions to determine the relative importance of neural processes that integrate one’s consciousness and behaviors.

**PREFRONTAL CORTEX (PFC)**: This is one of the most interconnected areas of the brain. It can be subdivided into the orbitofrontal cortex (OFC), located just above the eye sockets, the ventromedial cortex (vmPFC), just behind the OFC, and other neural locations in the front of the brain. Research suggests that the functions of these areas is to monitor and regulate emotional and cognitive processes. It is well known that when a person is chronically stressed or depressed, the right prefrontal cortex has a stronger “signal strength” and is therefore dysfunctional. Conversely, when a person is unstressed and happy, the left prefrontal cortex is activated. When the limbic system is highly activated, there is a conflict between the “upward push” of emotionally driven urgency and the “downward regulation” of that impulsivity. When a person’s PFC is functioning appropriately, the regulatory process channels energy away from the escalating emotional pressure by sending a neural impulse to the limbic areas of the brain that would otherwise be attuned to the upward push, thereby “down-regulating” the emotional systems. The practice of anapanasati strengthens the functioning of the PFC. When practicing mindfulness of breathing, any distraction represents the “upward push” function, and intentionally redirecting attention back to the breath activates a “downward regulation” function. The repeated activation of the PFC operates to not only set aside distractions, but also develops the characteristics described in the 4th tetrad of the Anapanasati Sutta: *inconstancy, dispassion, cessation and relinquishment*.

**TEMPEROPARIETAL JUNCTION (TPJ)**: This area is situated above and behind the ears and is the crease where the temporal and parietal lobes join. The left temporoparietal region (lTPJ) functions in the process of understanding the speech of others and the ability to infer what another’s intentions might be (another process involving mirror neurons). The right temporoparietal junction (rTPJ) functions to pay attention to mental processes, particularly as related to emotional empathy. There is an emerging field of research regarding what is called “Theory of Mind”, which is a person’s ability to “think about thinking” in regard to one’s own internal processes, and, by inference, the mind and intentions of others. In this regard, the rTPJ and surrounding temporal areas are strongly connected to the medial prefrontal cortex (mPFC), which, in turn is strongly connected to the insula. This whole system seems to cooperate in producing the process of mindfulness.

**DEFAULT MODE NETWORK (DMN):** There is research on what is called the “Default Mode Network” (DMN), which is associated with theory of mind. This network consists of strongly connected neural pathways involving the temporoparietal, prefrontal, cingulate gyrus, insular and hippocampal regions of the brain. The DMN is involved with mind-wandering, which is typical of the normal function of anyone’s brain. Mind-wandering is diminished in its presence and potency among well-trained mindfulness meditators.

The impact of mindfulness meditation training on the functions of the brain and consciousness can be summarized as the increased interactions between the various neural networks briefly described above. This is kind of awareness similar to the process called “metacognition” and seems to be synonymous with vipassana practices. Anapanasati practice is straightforward: We cultivate an intentional focus of attention somewhere around the nostrils, either at the upper lip, rim of the nostrils, or just inside the rim. We then intentionally maintain a focused attention during the in-breath, sensitive to the changing texture of any sensations noticeable. These two behaviors activate the PFC, insular cortex and TPJ areas of the brain. The ACC is in “standby mode”, that is, alert for *error detection and conflict monitoring*. The “error detection” alerting process can monitor for anicca, *any change in either the physical sensations associated with breathing*, *any changes in peripheral awareness*, or *any changes in the quality of available attention*. This represents the onset of training for vipassana, insight into the three characteristics, anicca (ah-nee-chah), dukkha (doo-kah), and anatta (ah-nah-tah). Upon noticing distractions from investigating breath sensations, the insular cortex and ACC processes stimuli generated by the amygdala, hippocampus and nucleus accumbens, and then the “course correcting” actions of the PFC redirects the energy of attention back to the simplicity and neutrality of breath sensations.

The primary motivation for contemporary research on the benefits of mindfulness meditation are not spiritual, but psychological and medical, as preventative of physical or mental health, or to mitigate the effects of illness or injury. Here is a quote from a Nature article from February, 2022 entitled “Mindfulness meditation increases default mode, salience, and central executive network connectivity” by Benno Bremer, et al.:

Thus, in the face of rising demands for mental health care, mindfulness meditation might provide a customizable, easy to use, and remotely practicable method to increase mental resilience and overall quality of life. In order to optimize its application, vigorous efforts have been made to untangle the mechanisms which mediate the benefits of mindfulness meditation. conceptually, mindfulness meditation is believed to primarily act over three axes: Attention control, emotion regulation, and self-awareness, all of which are cognitive qualities which can be enhanced through regular practice. Changes in these domains were found to go along with extensive functional and structural alterations in the brain: the most consistent observations were made in the anterior cingulate cortex (ACC), prefrontal cortex (PFC), posterior cingulate cortex (PCC), insula, and subcortical structures such as the amygdala and striatum. The interplay of these structures allowed for initial insights into possible neural pathways underlying mindfulness meditation: while the ACC and the PFC are known to play a fundamental role in conflict monitoring and other attentional processes, these brain areas have also been found to be more active after mindfulness meditation practice or in experienced meditators. Repeated findings attribute these regions as having a mindfulness-mediated modulatory impact on observations of the amygdala, where responses to emotional stimuli diminished after mindfulness-based interventions. Expressions of self-awareness, such as mind-wandering and self-referential processing, have been mostly ascribed to the PCC and medial PFC, which are areas that form key regions of the default mode network (DMN). Abnormalities in DMN function have been associated with a variety of neuropsychiatric disorders, particularly rumination, which is a core symptom of depressive disorders, was found to increase as a function of DMN activation. These key regions of the DMN were observed to be relatively less active in experienced meditators, indicating a potential pillar of the anti-depressant effects of mindfulness meditation. Deactivations within the DMN were accompanied by a stronger coupling of these areas with the ACC and PFC, suggesting a mechanism over which attentional control is established over a diverted mind.

How does this relate to the process of Awakening, described in the 4th tetrad of the Anapanasati Sutta? Once the mind has developed “attentional control”, that is, the quiet, tranquil, and alert characteristics of consciousness unburdened by the hindrances, vipassana practice investigates the *transient* nature of consciousness—internal narratives become nonexistent or faded in awareness, which is characteristic of *dispassion*. This dispassion allows for *cessation* to be realized, which is an increasing disinterest and disregard for any notions of an enduring/autonomous self. Ultimately, when conditions of consciousness are suitable, *relinquishment* occurs, which is the doorway to Nirvana, the unconditioned nature of reality.

In the book “Breathing Like A Buddha” by Ajahn Sucitto, he has this to say about the practice of anapanasati on pages 19-20:

“…I don’t see the pursuit of anapanasati as something that a beginner can fulfill without other forms of mind-cultivation. It is not a matter of doggedly fixing attention on the breath—this approach can actually intensify rather than correct mental imbalances. Wisely used, anapanasati comprises one theme in a mental cultivation that should encourage ethical orientation, careful attention, goodwill—and a turning away from worldly aims and values. Guiding mental behavior in line with these themes, one can return to in- and out-breathing over the years as a regular meditation practice. Certainly, cultivate spacious awareness; relax goal-orientation and self-criticism—yes, of course. But the cultivation of breathing as pana within a safe and grounded embodiment offers something to come back to and work at; it will be a practice that is enriched by all the skills you cultivate.”

We all have to breathe throughout the course of life—why not enhance the quality of lived experience with this time-tested, insightful discipline?