

CapnoLearning™

CapnoLearning™ is about implementing the basic principles of **behavioral analysis, behavior modification, cognitive learning, CO₂ biofeedback, and awareness training** in the context of self-regulation learning. CapnoLearning™ is about your learning to breathe optimally during daily life, at home and at work, and to do so continuously during rest and challenge. It's not about practicing "good breathing" as an exercise for good health, **it's about learning new behavior.**

CapnoLearning™ includes: (1) evaluating breathing behavior, (2) examining the effects of breathing on physical symptoms, performance deficits, cognition, and emotion, (3) reinstating breathing reflexes based on their strategic role in the regulation of acid-base balance, and (4) learning breathing behavior that may enhance performance, prevent health problems, optimize mental capacity, and support embracing rather than defending lifestyles.

Breathing is a behavior, and as a behavior it is subject to the same principles of learning as any other behavior, including the role of motivation, emotion, attention, perception, and memory. **Overbreathing** is behavior that results in carbon dioxide deficiency, a condition known as **hypocapnia**. Overbreathing behavior, like other behaviors, is tied to specific contexts, states, and stimuli. It comes about by breathing too fast or too deeply, or both. Even, very slow breathing, however, can result in hypocapnia, whereas fast breathing may not.

Breathing behavior during life's daily challenges is necessarily acrobatic, which often includes continuous and unabated conversation, laced with emotion, thoughts, and attitudes. While talking, for example, breathing behavior may be jerky or even, aborted or extended, fast or slow, oral or nasal.....utterly dysrhythmic, but nevertheless, these mechanics must be subordinated to brainstem reflex mechanisms that coordinate rate and depth for healthy body chemistry (acid-base regulation).

Many of us have, unfortunately, learned to disconnect from the experience of our bodies. This disconnection often shows up in our breathing, where "controlled breathing" serves to provide us with a false sense of security, breathing that involves the unnecessary use of accessory muscles. The consequence is often the preempting of brainstem respiratory reflexes that regulate breathing based on pH and CO₂, a consequence that may serve to confirm false beliefs about, and reinforce mistrust of, one's own breathing physiology. Misguided solutions to the physical and mental changes brought on by overbreathing may reinforce self-defeating behaviors, including

- failure to breathe diaphragmatically
- failure to exhale completely
- failure to allow transition time between breaths
- reaching for air through deep breathing
- intentional manipulation of breathing
- mouth breathing
- using accessory muscles, when not required

Overbreathing may feel just like underbreathing. In both cases oxygen deficit is the result. In both cases you may feel breathless, but in the first case, breathing "more" is the solution, whereas in the second case, it is the problem. Unfortunately, the solution to overbreathing is not only counterintuitive but is contrary to cultural myth that speaks to "taking a deep breath" for feeling better. Deep breathing is not a solution to stress or anxiety, but it may instead trigger anxiety and other emotions. Quiet, diaphragmatic breathing is the key. Learn to:

- make diaphragmatic breathing your dominate form of breathing
- allow the exhale to occur on its own accord, without assistance from other muscles
- allow for transition time between the exhale and the inhale
- experience brainstem respiratory reflexes during transition time
- breathe quietly, making the inhale as small as possible while still being comfortable
- maintain the proper range of PCO₂ levels during changes in breathing mechanics.

Key to learning good breathing mechanics is experiencing, identifying, and becoming comfortable with the brainstem reflex for inhalation, which regulates breathing based on PCO₂, pH, and O₂ in addition to a host of other reflex factors. Remember the following:

- Good breathing means proper allocation of carbon dioxide (CO₂).
- Proper allocation of CO₂ is about regulating acid-base physiology.
- CO₂ deficiency can result in profound and immediate physical and mental changes.

Here are some learning objectives:

Make breathing intuitive, not prescriptive.

Learn breathing as behavior, not simply as a healthy exercise.

Learn to breathe based on you, not the tasks, people, and challenges around you.

Identify your breathing patterns. Is your breathing diaphragmatic?

Discover your leaning history. How did you learn to breathe the way you do?

Evaluate your experience of breathing? Is it easy, or is it a struggle?

Observe how breathing affects you. Does it result in physical symptoms or performance issues?

Learn about your misconceptions of breathing, and misinterpretations of your own breathing.

Appreciate how learning and motivation play an important role in your breathing.
Develop awareness of how you change your breathing behavior when you encounter people, places, and tasks.
Reinterpret your experiences of breathing, and its effects on you, in constructive ways.
Talk, think, and feel differently about your breathing, and what it means.
Learn to convert distress (negative stress) to eustress (positive excitement) through breathing.

Develop familiarity with productive and unproductive breathing mechanics (misuse of accessory muscles).
Learn relationship dynamics of breathing mechanics that serve good body chemistry (acid-base regulation).
Learn to allow for passive exhale, transition time between breaths, and quiet inhale.
Learn to be conscious of brainstem breathing reflexes during transition times between breaths.
Reconnect breathing mechanics with brainstem reflexes through awareness learning.
Learn to trust and to be confident in your breathing physiology.

Learn how overbreathing may be deregulating your body chemistry (acid-base balance).
Identify the physical and psychological effects of hypocapnia (carbon dioxide deficit) on you.
Learn how hypocapnia may be triggering and causing unexplained symptoms and deficits.
Discover your learned responses to the effects of hypocapnia, and what to do about them.
Learn about how breathing may be a defensive strategy for avoiding the world and yourself.

Learn specific interventions for changing your breathing behavior during times of crisis.
Make good breathing mechanics an automatic (unconscious) response to the effects of hypocapnia.
Breathe based on internal experience (e.g., clarity of thinking) rather than outside appearances (fast or slow).
Learn to breathe well under diverse circumstances, including challenges of all kinds.
Learn good breathing for enhancing performance and creativity, during work and play.

Here are some common misconceptions:

- Carbon dioxide is poisonous.

No. *Carbon dioxide is a precious substance absolutely vital to healthy functioning.*

- Good breathing mechanics is mostly about maximizing O₂ in, and CO₂ out.

No. *Good breathing is also about the proper allocation of CO₂, retaining the CO₂ we need for acid-base balance.*

- Deep breathing always means getting more oxygen.

No. *Deep breathing can immediately and easily cut off oxygen supply to the brain and to the heart.*

- Underbreathing, with the result of oxygen deficit, is common.

No. *To the contrary, overbreathing is common.*

- Breath-holding means underbreathing.

No. *It usually means overbreathing. It serves as a compensatory reflex for low CO₂.*

- Good breathing means relaxation.

No. *Good breathing is important in all circumstances, whether relaxed or not.*

- Learning good breathing requires relaxation.

No. *This would mean that during most life circumstances, breathing is maladaptive.*

- Diaphragmatic breathing is synonymous with good breathing.

No, *not necessarily. It is easier to overbreathe with the diaphragm than with the chest!*

- Slow breathing is good, and fast breathing is bad.

No. *One is not inherently better than the other. Slow breathing, like fast breathing, can trigger overbreathing.*

- There is an ideal breathing pattern that each of us needs to learn.

No. *Mechanics may look letter perfect, but O₂ distribution and acid-base balance may be poor.*

Play with chest and diaphragmatic breathing and how they affect you.

Developing familiarity and a sense of comfort with, and confidence and trust in, breathing mechanics, is essential to learning good breathing. Learning to make diaphragmatic breathing the dominate form of breathing is fundamental.

Chest breathing is inefficient, labor intensive, and can make breathing seem difficult, even exhausting. It usually requires faster breathing, which may introduce a sense of urgency and anxiety about breathing. It makes completion of exhale difficult, which can trigger breathlessness, chest tightness, and worry about getting the next breath. It may create a sense of feeling confined, restricted, and trapped, setting the stage for feeling defensive and insecure. Chest breathing makes breathing intentional, and “requires” that you “take” a breath! Intentional breathing, conscious or unconscious, interferes with diaphragmatic control. It brings a sense of struggle to breathing, a behavior that should otherwise seem automatic, effortless, and easy.

Chest breathing often triggers muscle posturing, even in muscles entirely unrelated to breathing, which can result in tension and pain, including headache. Muscle posturing based on shifting from diaphragmatic to chest breathing is known as **dysponesis**, and it shows up when people feel defensive in their bodies, e.g., in muscles related to previous injuries. Muscle defensiveness, however, is only the tip of the “defensiveness iceberg,” and is likely to be part of a much larger defensive configuration embedded in other physiology and in personal experience, including emotion and cognition. Experiencing the effects of chest breathing versus diaphragmatic breathing is an important part of learning about your own breathing behaviors and how they affect you.

Respiratory chemoregulation is achieved primarily through diaphragmatic control. Adaptive diaphragmatic breathing simply “happens” in accordance with brainstem reflexes, and doesn’t need your “help.” It is effortless, efficient, quiet, slow, and gentle, but not deep. Self-defeating forms of diaphragmatic breathing, however, may also be easily learned, consciously or unconsciously. Unlearning these forms of diaphragmatic breathing is must also be addressed through mechanics play.

Notice WHERE in your body that you are breathing. Are you breathing in your chest, back, shoulders? If so, you are chest breathing. Put one hand on your chest, the other on your belly. If your belly rises and falls you are using your diaphragm. Change physical posture and see how it affects your breathing, e.g., lying down, sitting, and standing. Remember the following:

- Learn to breathe consistently, in all situations, with the diaphragm.
- Practice chest breathing for learning what it feels like, and learn its identifying qualities.
- Compare the feelings/qualities of chest and diaphragmatic breathing.
- Notice that chest breathing is effortful, intentional, and inefficient.
- Notice that diaphragmatic breathing is easy, automatic, and efficient.

- Allow the diaphragm to connect with brain stem reflex centers.
- Reset your basic respiratory reflexes by allowing breathing “to happen.”
- Breathing with “intentional” muscles” doesn’t allow breathing “to happen.”
- Avoid using muscles other than the diaphragm for normal breathing.

If learning diaphragmatic breathing seems difficult do the following:

- Visualize that breathing is up and down, not in and out.
- See how the diaphragm makes room for your lungs, moving your viscera to the side.
- Lie on your back.
- Breathe through your nose.
- Take quick sniffs with your nose; this often engages the diaphragm.
- Practice breathing diaphragmatically in varying physical postures.
- Use your hands as feedback guides for learning diaphragmatic breathing.

Play with exhale and inhale.

Exhalation and diaphragmatic breathing, acting in concert with one another, are mechanical keys to ensuring breathing for good acid-base regulation, chemoregulation. Not allowing for relaxed and passive exhalation translates into:

- fear of not getting enough air, oxygen;
- worry that the next breath may not come in time;
- hurrying to take your next breath;
- intentional breathing, where breaths must be “taken;”
- self-imposed restricted range of inhalation;
- making it impossible to take a deep breath;
- smaller breaths that necessarily require faster breathing; and
- anxiety between breaths, where transition time between breaths becomes intolerable.

Exhaling is passive, and is about letting go, “allowing.” It does not require muscles. It means “letting” the air out by relaxing the diaphragm. The exhale should not be forced, not “pushed out.” Forcing the air out, may motivate you to “take” a deep breath. Forcing air out, translates into using accessory muscles, which may then lead to overbreathing.

Learning to be comfortable with **transition time** desensitizes you to the waiting period. Vital to success is eliminating emotions triggered during the transition time and thus the motivation for vicious circle breathing behavior (e.g., preempting the brainstem reflex). Key to learning good breathing mechanics is experiencing, identifying, and becoming comfortable with the brainstem reflex for inhalation, which regulates breathing based on PCO₂, pH, and O₂, in addition to a host of other reflex factors. **Convert patience to meditation.**

Inhaling is active. Nevertheless, it too should be “allowed.” The brainstem reflex mechanisms ordinarily do not need your assistance. Being in a hurry usually means “taking” breaths, intentional breathing, and is likely to lead to overbreathing. Play with these breathing mechanics and see how the brainstem reflex engages your inhale, how it happens on its own accord. **See how small the breath can be, and still be comfortable.** Positive experience with small breaths is powerful and generalizes to other situations, times, and places quickly and effectively. It is vital to successful learning.

Allow breathing to happen. Breathing on purpose is not the objective; it will deregulate you. The key to “allowing breathing to happen” is the exhale. **Try the following experiment:**

- Take a deep breath, let only part of it out, inhale, let part of it out, and so on.
- Notice that there is little inhale “room” left after each breath.
- Notice that “getting your breath” may seem restricted.
- Notice that a sense of urgency may arise about getting enough air.

- Take a deep breath and let it all out. But, don’t push it out.
- Or, push it out and see what it feels like.
- See how forcing the breath out motivates breathing that is too deep.
- Don’t be in a hurry to inhale. Let the breath come “on its own.”
- Wait for the breath.
- Notice how different the inhale feels.
- Notice how easy the breath becomes, with lots of room for more air if needed.

Play with fast and slow breathing.

Misinterpreting the experience of breathing behavior can itself increase the likelihood of overbreathing. Fast breathing, for example, is easily misinterpreted, **consciously or not**. Fast breathing is not overbreathing. It is not inherently good or bad by itself. It may, however, lead to overbreathing because of the psychology associated with it:

- It can “seem like” like you are having difficulty getting air.
- It can make breathing seem urgent, which may introduce worry and anxiety.
- It can lead you into chest and mouth breathing, which make fast breathing easier.
- It can make you feel like “something must be wrong, “I’m breathing too fast.”
- It can lead you into negative thinking, “I’m anxious, I can’t get my breath, there’s not enough air in here.”
- It can lead to into a place of distrust of your own physiology.

Learn the following:

- *Desensitize yourself to breath transition time; learn to wait for the breath.
- *Develop awareness of how slower deeper breathing can lead to overbreathing.
- *Learn to be comfortable with variable rates; coordinate rate with depth.
- *Breathe quietly, without intention, effort, and worry. Don’t be in a hurry.
- *Learn constructive self-talk. “I don’t have to “get” my breath. It will come.”
- *Learn to trust you respiratory system by getting to know it.

Play with your chemistry.

The experiential effects of hypocapnia vary greatly from person to person. Learning to physically identify the personal effects of hypocapnia, as in the case of breathing mechanics, is achieved through **chemistry play**. Learn what good and poor respiration feels like. Do some overbreathing on purpose. Don’t be afraid of it. Practice overbreathing and learn to recognize when you are doing it and when you are not. How does playing with PCO₂ feedback specifically affect you? Are there noticeable changes in muscle tension: in the jaws, around the eyes, below the ears, around the vocal chords, across the forehead, and in the upper back, shoulders, chest, and abdomen? Is there spasm or tetany? Is skin temperature changing: in the fingers, hands, feet, face, or ears? Do you feel cold, or hot? Is there numbness, tingling, light-headedness, feeling of being off-balance, blurred vision, dry mouth, stiffness, or forehead pressure? Is there ringing in your ears? Do sounds seem closer or more distant? Do you feel nausea, pain, or cardiac changes?

What does it physically feel like to breathe at 35 mmHg vs. 30 mmHg, or 25 vs. 30 mmHg? Learn by monitoring PCO₂ levels and changing them intentionally, moving down to one level and back to the previous level. If you can overbreathe down to 30 mmHg on purpose, and then know how to get back to 35 mmHg, an awareness of the differences begin to emerge. Ultimately, the result is awareness of even small changes in chemistry along with the mechanical shifts required for restoring good chemistry. Train first with PCO₂ feedback. Then train without it. **If you have a medical condition, first consult with your physician.**

Success factors include learning to:

- regulate chemistry across a wide spectrum of breathing mechanics;
- regulate breathing chemistry under diverse circumstances;
- reinstate brainstem reflex control of diaphragmatic breathing;
- identify breathing triggered physical changes, emotions, thoughts, and images;
- experience the whole body as “breathing,” not just the lungs;
- breathe “inside-out” intuitively, rather than “outside-in” prescriptively;
- think and talk differently about your breathing (stop negative self-talk);

- identify personal signs of deregulated breathing;
- trust your breathing through familiarity with its mechanics;
- breathe diaphragmatically, slowly, quietly, and gently, but NOT deeply.
- allow the exhale, and avoid forcing the exhale;
- allow the inhale to arrive, minimize the amount of air;
- avoid manipulating the breath, intentionality, and “taking” the breath;
- avoid the use of accessory muscles except when they are needed;
- be patient during the transition time between breaths (reducing fear and anxiety);
- breathe through your nose (teaches confidence and patience);
- stop worry about underbreathing, which takes care of itself;
- think about experiences that engage positive feelings; and
- experience breathing as “stream of your consciousness.”

| TRIGGERING FACTORS | PREVENTION FACTORS |
|--|--------------------------------------|
| Worry about breathing | Breathing self-confidence, trust |
| Using accessory muscles (chest) | Diaphragmatic breathing |
| Intentional breathing | Allowing breathing to happen |
| Deep breathing | Quiet effortless breathing |
| Rapid breathing | Slow quiet breathing |
| Failure to exhale completely | Allowing for exhale & its transition |
| Negative self-talk & thought about breathing | Self-affirmations about breathing |
| Misinformation about breathing | Education about the facts |
| Emotional responses to hypocapnia symptoms | Desensitization, counterconditioning |
| Mouth breathing | Nasal breathing |
| Discomfort with breathing sensations | Experiential exploration |
| Anxiety between breaths | Relaxation and imagery |
| Breath holding | Breath consciousness |
| Fight-flight challenges | Breathing inside-out |
| Dissociative thinking | Embracing instead of defending |

Here are some short-term solutions:

Many people become trapped in vicious circle overbreathing behavior. They may misinterpret their symptoms as verification of their misconceptions about breathing in general, and especially of their suspicions, expectations, and beliefs about their own breathing and its consequences. The misconceived solution of faster and/or deeper breathing leads to a self-fulfilling prophecy and a worsening of symptoms, emotions, and deficits. People are often resolute about their “underbreathing,” for example, based on convincing personal evidence: breathlessness, chest tightness, dizziness, and overall struggle to breathe in general. This kind of deregulated pattern may result in episodic crises which may require immediate short-term management:

- Exhale completely, but not forcibly.
- Extend the transition times from exhale to inhale.
- Breathe with your diaphragm, if possible.
- Breathe slowly, but NOT deeply.
- Breathe through your nose.
- Breathe gently and as quietly as possible.
- Stop negative thoughts about your breathing.
- Think embracing thoughts about people, circumstances, and events.
- Translate anxiety into excitement
- Use earplugs, and listen to your breathing. Make it absolutely as quiet as possible.
- Walk hard, or do other exercise, to create additional amounts of CO₂.
- Do the above with a paper bag, if desired. (NOTE: Do NOT use a paper bag if O₂ content is below normal, e.g., anemia.)

**Good respiration requires neither relaxation nor a specific mechanical prescription, save one:
 “The varied melodies of breathing mechanics must ultimately play the music of balanced chemistry.”**