Study Guide 7

This guide covers the last two chapters. First you learn how breathing works and why overbreathing causes real symptoms, how breathing retraining, mindfulness and yoga are practiced, how to adapt yoga safely and what the trials honestly show. Then you meet traditional Chinese medicine, Ayurveda, naturopathy, herbal medicine and forest bathing in their own terms, and you weigh each against the evidence and its risks, especially contamination and herb drug interactions. Work one chapter at a time, do the arithmetic in the worked cases, and finish with the ten board style self-test items for each chapter.

WHAT THIS GUIDE COVERS

- Chapter 13 · breathing mechanics and the phrenic nerve, dead space and alveolar ventilation, chemical control and hyperventilation, dysfunctional breathing and retraining, meditation types, mindfulness, MBSR, MBCT and other programs, brain networks and pain, adverse effects, yoga history and the eight limbs, styles, pranayama cautions, spinal loading and modifications, the evidence, resonance breathing and bringing practices into care.
- Chapter 14 · TCM concepts, the five phases, the four examinations, acupuncture mechanisms, shams and trial results, acupuncture and herbal safety, Ayurveda, doshas and prakriti, Ayurvedic herbs and heavy metals, naturopathy and its principles, plant derived drugs, supplement regulation, herb drug interactions, forest bathing and its theories, and a framework for weighing evidence and safety.

CHAPTER 13

Breathing, Meditation and Yoga

Read it in full: **Chapter 13 in the textbook**. See it in motion: **Breathing, Meditation and Yoga Walkthrough** and **Breathing, Meditation and Yoga Lab**.

What to know

The lungs follow the chest wall through the pleural fluid. By **Boyle's law**, expanding the chest lowers alveolar pressure below atmospheric and air flows in; quiet breathing needs only about 1 to

3 cm of water of pressure difference. The **diaphragm** is the main inspiratory muscle; it arises from the lower six ribs, the xiphoid and the lumbar spine by two crura (right L1 to L3, left L1 and L2) and the arcuate ligaments, inserts on a central tendon and is supplied by the **phrenic nerve (C3, C4, C5)**. So a cord injury above C3 can stop breathing, while one below C5 usually spares the diaphragm.

The dome descends 1 to 2 cm in quiet breathing and up to 10 cm in a maximal breath, pushing the belly forward, then widening the lower ribs (bucket handle) while the upper ribs lift the sternum (pump handle). External intercostals, parasternal internal intercostals and the scalenes (active even at rest) help. Quiet expiration is passive elastic recoil; forced expiration recruits the internal intercostals and abdominal wall, especially the transversus abdominis.

Tidal volume is about 500 mL at 12 to 16 breaths per minute (6 to 8 L/min). About 150 mL fills the **anatomic dead space**. **Alveolar ventilation = (tidal volume − dead space) × rate.** At the same 6 L/min, 250 mL × 24 gives 2.4 L/min of alveolar ventilation, 500 × 12 gives 4.2 and 1,000 × 6 gives 5.1, so slow, moderately deeper breathing is more efficient. Retraining emphasizes a slower rate, not huge breaths.

The rhythm comes from the brainstem (the pre-Bötzinger complex in the ventral medulla), with voluntary override from the motor cortex. **Central chemoreceptors** track CSF pH, which follows arterial CO2; **peripheral chemoreceptors** in the carotid bodies (CN IX) and aortic bodies (CN X) respond mainly to low oxygen. At sea level the drive is set mostly by **CO2**; normal PaCO2 is 35 to 45 mmHg. **Hyperventilation** means breathing in excess of metabolic need so PaCO2 falls, causing respiratory alkalosis: cerebral vasoconstriction (lightheadedness) and lower ionized calcium (tingling around the mouth and fingers, carpopedal spasm), which can feed anxiety.

Dysfunctional breathing produces symptoms without a primary heart or lung disease: frequent sighing, air hunger, upper chest breathing, breath holding, mouth breathing, paradoxical breathing. Upper chest breathing loads the scalenes, SCM, upper trapezius and pectoralis minor; altered breathing is more common in chronic neck and back pain, but cause and effect are not established. Assess by observation, a hand on chest and abdomen, the Nijmegen Questionnaire and capnography. First rule out disease: new breathlessness, chest pain, breathlessness on minimal

exertion, coughing blood, fever, leg swelling or low oxygen saturation need medical evaluation, not exercises.

Breathing retraining aims for a nasal, low, lateral, quiet, regular, slower pattern: diaphragmatic breathing, nasal breathing, slow paced breathing at about 5 to 7 per minute, extended exhalation (in 4, out 6), reduced volume methods such as Buteyko for asthma, and inspiratory muscle training. For asthma, retraining improves quality of life and symptoms but changes lung function little and does not replace medicine. Pursed lip breathing helps people with COPD empty trapped air.

Meditation trains attention; noticing the wandering mind and returning is the repetition. Types: **focused attention** (one object, such as the breath), **open monitoring** (observing whatever arises), compassion and loving kindness, mantra based and movement based. **Mindfulness** (from the Pali sati) is paying attention on purpose, in the present moment, without judgment: self regulation of attention plus curiosity and acceptance. Relaxation, concentration and mindfulness are different; a person can be mindful while tense.

MBSR: eight weekly group sessions of about 2 to 2.5 hours, a day long retreat and about 45 minutes of daily home practice (body scan, sitting meditation, gentle yoga), developed in the late 1970s for chronic pain. **MBCT** adds cognitive therapy to prevent depressive relapse. ACT, DBT and MORE use mindfulness too. Meditation reduces default mode activity and engages salience (anterior insula, anterior cingulate) and attention networks; claims of lasting structural brain change are preliminary. It reduces pain **unpleasantness** more than intensity, and some mindfulness analgesia was not blocked by naloxone. A minority experience anxiety, panic, trauma memories, depersonalization or rarely psychosis, especially on intensive retreats; offer short, open eyed or movement based options and the right to stop.

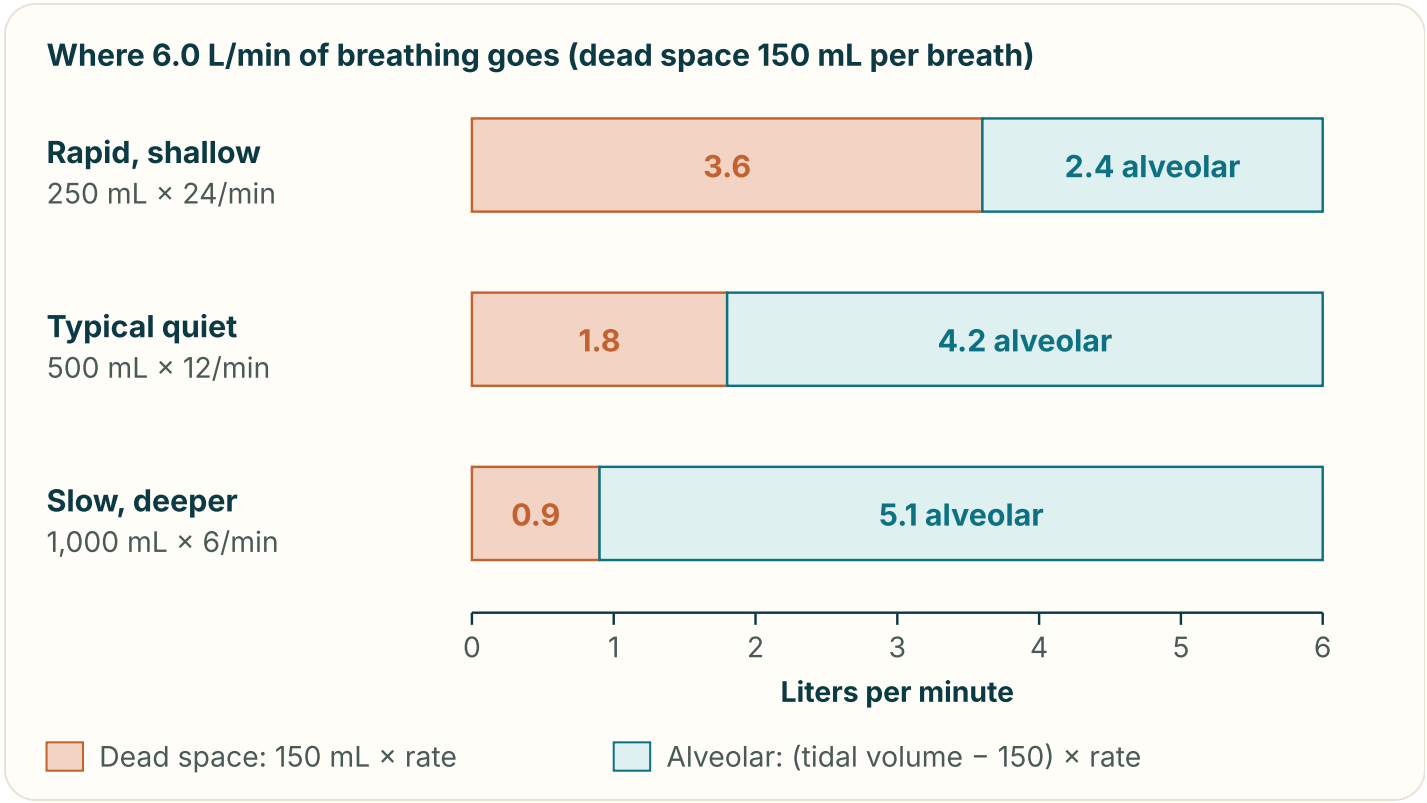
Yoga (Sanskrit yuj, to yoke) is one of the six classical schools of Indian philosophy, mainly a discipline of mind and spirit aimed at liberation. Milestones: the Upanishads (from about 800 BCE), the Bhagavad Gita (karma, bhakti and jnana yoga), Patanjali's **Yoga Sutras** (dating debated), hatha texts such as the Hatha Yoga Pradipika (11th to 15th centuries) and modern postural yoga (late 19th and 20th centuries). The eight limbs: **yama**, **niyama**, **asana** (a steady,

comfortable seat), **pranayama**, **pratyahara**, **dharana**, **dhyana** and **samadhi**. Asana is only the third.

Styles: hatha, Iyengar (alignment, props; used in back pain trials), Viniyoga (used in trials), Ashtanga vinyasa (vigorous; more injury reports), vinyasa flow, hot yoga (about 40°C; heat illness), restorative and yin, chair yoga and Kundalini. Slow pranayama (ujjayi, nadi shodhana) calms; fast pranayama (kapalabhati, bhastrika) can cause hyperventilation and raise abdominal and chest pressure and is usually not advised in pregnancy, uncontrolled hypertension, epilepsy, recent abdominal surgery or hernia and glaucoma; breath retention (kumbhaka) needs caution with heart or lung disease.

Postures load the spine predictably: forward folds add lumbar flexion and disc pressure; backbends compress the facets and narrow the foramina; twists add rotation (only a few lumbar degrees); inversions load the neck axially. Modify: osteoporosis (avoid loaded flexion and forceful twists), stenosis or spondylolisthesis (smaller backbends), neck problems, glaucoma and uncontrolled hypertension (no headstand or shoulder stand; legs up the wall), hypermobility (midrange strength and control). Serious events are rare and adverse event rates are similar to other exercise; ahimsa applies to one's own body.

Mind body trials are hard to blind and very sensitive to the control: against a waitlist most programs look good; against an active control the difference shrinks. Best supported: yoga for chronic low back pain (small to moderate, similar to other exercise; noninferior to physical therapy in one large trial), MBSR for chronic low back pain (similar to CBT, both better than usual care), **MBCT** (relapse risk down by about a third over 60 weeks, about as good as maintenance antidepressants, most for three or more prior episodes) and tai chi for falls. Meditation programs give small benefits for anxiety, depression and pain but are not better than other active treatments; blood pressure effects are small and adjunct only. Breathing at about **6 per minute (0.1 Hz)** aligns respiratory sinus arrhythmia with the baroreflex's roughly 10 second rhythm, creating resonance, the basis of HRV biofeedback (individual resonance 4.5 to 7 per minute). Heart rate rises on inhale and falls on exhale. To bring these into care: screen red flags, precautions and mental health, respect beliefs, start small with specific instructions, stay in scope, refer, and be honest that benefits are real but modest.



Same air in, different air to the alveoli. Every breath spends 150 mL on dead space, so 24 small breaths waste 3.6 L/min while 6 larger breaths waste only 0.9 L/min. That is why retraining targets a slower rate rather than simply deep breaths.

LOCK THESE IN

- Phrenic nerve C3, C4, C5. Quiet expiration is passive recoil.
- Alveolar ventilation = (tidal volume − 150 mL dead space) × rate.
- CO2 drives breathing; normal PaCO2 35 to 45 mmHg. Overbreathing gives respiratory alkalosis.
- Hyperventilation means ventilation exceeds metabolic need, not just fast breathing.
- Focused attention versus open monitoring. Mindfulness: on purpose, present moment, without judgment.
- MBSR: 8 weeks, body scan, sitting, gentle yoga. MBCT: relapse risk down about a third.
- Eight limbs: yama, niyama, asana, pranayama, pratyahara, dharana, dhyana, samadhi.
- Resonance: about 6 breaths per minute = 0.1 Hz, one breath per 10 second baroreflex cycle.

Breathing patterns and ventilation

Pattern	Tidal volume × rate	Minute ventilation	Alveolar ventilation
Rapid, shallow	250 mL × 24	6.0 L/min	(250 − 150) × 24 = 2.4 L/min
Typical quiet	500 mL × 12	6.0 L/min	(500 − 150) × 12 = 4.2 L/min
Slow, deeper	1,000 mL × 6	6.0 L/min	(1,000 − 150) × 6 = 5.1 L/min
Upper chest dominant	Chest and shoulders rise first	Accessory overuse	Neck and shoulder tension
Chronic overbreathing	Sighs, yawns, faster at rest	Low CO2	Dizziness, tingling, air hunger
Paradoxical	Abdomen pulls in on inhale	Inefficient diaphragm	Also seen with diaphragm weakness: evaluate

Evidence for mind body practices

Practice and condition	Strength of evidence	Typical benefit
Yoga, chronic low back pain	Moderate	Small to moderate; similar to other exercise
MBSR, chronic low back pain	Moderate	Small to moderate; similar to CBT
MBCT, recurrent depression relapse	Moderate to high	Relapse risk down about a third
Meditation, anxiety and depression	Moderate	Small; not better than other active care
Tai chi, falls in older adults	Moderate to high	Meaningful reduction in falls
Meditation or slow breathing, blood pressure	Low	Small; adjunct only
Breathing retraining, asthma quality of life	Low to moderate	Better symptoms; little lung function change
Meditation, immune markers	Low	Inconsistent

Worked cases

WORKED CASE 1 · ALVEOLAR VENTILATION AT THE SAME MINUTE VENTILATION

Two patients each move 8 L/min. One breathes 400 mL at 20 per minute; the other 800 mL at 10 per minute. With 150 mL of dead space, who gets more fresh air to the alveoli?

STEP 1 · CHECK MINUTE VENTILATION

400 × 20 = 8,000 mL; 800 × 10 = 8,000 mL. Both are 8.0 L/min.

STEP 2 · SUBTRACT DEAD SPACE PER BREATH

400 − 150 = 250 mL; 800 − 150 = 650 mL.

STEP 3 · MULTIPLY BY RATE

250 × 20 = **5.0 L/min**; 650 × 10 = **6.5 L/min**.

STEP 4 · INTERPRET

The slower breather gets 1.5 L/min more alveolar ventilation, because dead space wastes a larger share of small breaths. Retraining targets a slower rate, not maximal breaths.

WORKED CASE 2 · WHY 6 BREATHS PER MINUTE IS SPECIAL

Explain, with numbers, why slow paced breathing at about 6 per minute produces the largest heart rate oscillations.

STEP 1 · FIND THE BAROREFLEX RHYTHM

Because of its delay, the baroreflex makes heart rate and pressure oscillate at about 0.1 Hz, one cycle every 10 seconds.

STEP 2 · MATCH THE BREATH

60 seconds ÷ 10 seconds = **6 breaths per minute**, which is 0.1 Hz.

STEP 3 · COMBINE THE RHYTHMS

Heart rate rises on inhale and falls on exhale (respiratory sinus arrhythmia). At 6 per minute these swings line up with the baroreflex wave and reinforce it: resonance.

STEP 4 · APPLY IT

HRV biofeedback trains people to find their own resonance, usually 4.5 to 7 per minute. Benefits for stress and anxiety are real but modest, and much may come from relaxation and attention.

WORKED CASE 3 · ADAPTING YOGA FOR OSTEOPOROSIS

A 68 year old woman with osteoporosis wants to join a yoga class. Plan her practice.

STEP 1 · SCREEN FIRST

Rule out red flags, ask about prior fractures, balance, blood pressure, glaucoma and mental health, and ask what kind of practice she wants.

STEP 2 · REMOVE THE RISKY LOADS

Avoid loaded spinal flexion (deep rounded forward folds, plow, sit ups) and forceful twists, which raise compressive force on the front of the vertebral bodies and are linked to compression fractures.

STEP 3 · CHOOSE HELPFUL WORK

Neutral spine, gentle extension within comfort, and balance work; props, a chair or a wall make poses safer.

STEP 4 · SET IT UP

A small Iyengar or adapted class with a qualified teacher, starting small, with review at follow up. Be honest that benefits are modest and real.

TRAPS PEOPLE FALL INTO

- **Defining hyperventilation as fast breathing.** It means ventilation in excess of metabolic need, so PaCO2 falls. A sprinter can breathe fast with normal CO2.
- **Telling everyone to take big deep breaths.** Very large breaths raise the work of breathing and wash out CO2. Retraining targets a slower rate.
- **Equating mindfulness with relaxation.** Mindfulness is nonjudging awareness; a person can be mindful while tense or in pain.
- **Calling asana the heart of classical yoga.** It is one of eight limbs; classical yoga was mainly a discipline of mind and ethics.
- **Prescribing breathing exercises for new exertional breathlessness.** Rule out heart and lung disease first; refer for evaluation.
- **Reading a waitlist trial as proof of a specific effect.** Against an active control the difference usually shrinks.
- **Recommending kapalabhati to everyone.** Fast pranayama is usually not advised in pregnancy, uncontrolled hypertension, epilepsy, hernia or glaucoma.
- **Pushing hypermobile patients to end range.** They need midrange strength and control, not more flexibility.

Chapter 13 self-test · ten items

1. A patient has a complete spinal cord injury at C7. Will the diaphragm still contract?

A. Yes; the phrenic nerve arises from C3 to C5

B. No; the phrenic nerve arises from C6 to C8

C. Yes; but only through accessory muscle drive

D. No; the diaphragm is supplied by T1 to T6

A. Yes; the phrenic nerve arises from C3 to C5 The phrenic roots sit above the injury, so the diaphragm keeps its supply. Intercostal and abdominal muscles below the lesion are weakened.

2. Two people each breathe 6 L/min, one at 24 breaths and the other at 8. Who has more alveolar ventilation?

A. The faster breather, about 4.8 versus 2.4 L/min
B. The slower breather, about 4.8 versus 2.4 L/min
C. The faster breather, because rate drives exchange
D. Both equal, because minute ventilation is equal

B. The slower breather, about 4.8 versus 2.4 L/min At 24 per minute each breath is 250 mL: (250 − 150) × 24 = 2.4 L/min. At 8 per minute each is 750 mL: (750 − 150) × 8 = 4.8 L/min.

3. An anxious patient who overbreathes reports tingling around the lips and fingers. What is the mechanism?

A. High CO2 acidosis raises ionized calcium
B. High oxygen constricts cerebral vessels
C. Low oxygen damages peripheral nerves
D. Low CO2 alkalosis lowers ionized calcium

D. Low CO2 alkalosis lowers ionized calcium Respiratory alkalosis increases calcium binding to albumin, lowering ionized calcium and making nerves excitable. Low CO2 also narrows cerebral vessels.

4. In a healthy person at sea level, what mainly sets the drive to breathe?

A. Blood glucose level
B. Arterial oxygen level
C. Arterial carbon dioxide
D. Core body temperature

C. Arterial carbon dioxide Central chemoreceptors track CSF pH, which follows PaCO2. Breath holding becomes uncomfortable from rising CO2 long before oxygen falls.

5. A practitioner notices worry arising and observes it with curiosity without trying to change it. Which practice is this?

A. Mindfulness
B. Visualization
C. Concentration
D. Relaxation

A. Mindfulness Nonjudging awareness of whatever is present defines mindfulness. Relaxation is a lowered arousal state and concentration is stable focus.

6. Which meditation style holds attention on one object and returns to it when the mind wanders?

A. Open monitoring
B. Choiceless awareness
C. Loving kindness
D. Focused attention

D. Focused attention Focused attention keeps returning to a chosen object such as the breath; open monitoring observes whatever arises without a single object.

7. Where does asana fall among Patanjali's eight limbs?

A. First, before all ethics
B. Third, after yama and niyama
C. Eighth, as the final goal of all
D. Fourth, after pranayama

B. Third, after yama and niyama The order is yama, niyama, asana, pranayama, pratyahara, dharana, dhyana and samadhi. Modern classes focus mainly on the third.

8. A patient with uncontrolled hypertension asks about kapalabhati breathing. What is the best advice?

A. It is ideal for lowering pressure
B. It is required before any asana
C. It is usually not advised for him
D. It is safe if done in a hot room

C. It is usually not advised for him Rapid, forceful breathing raises abdominal and intrathoracic pressure and can cause hyperventilation, so it is usually avoided in uncontrolled hypertension.

9. A trial compares MBSR with a waitlist and finds a large benefit. Why might the effect shrink against an active control?

A. An active control shares the nonspecific effects
B. MBSR has no effect of any kind on pain
C. Active controls are always harmful to patients
D. Waitlist patients always get worse over time

A. An active control shares the nonspecific effects Group support, attention and expectation favor MBSR over a waitlist. An equally engaging control shares those effects, leaving only the specific effect.

10. A patient with chronic back pain asks if yoga is better than physical therapy. What is the most honest answer?

A. Neither has shown any benefit in the trials
B. They help about equally; pick one she enjoys
C. Yoga is clearly superior in every trial so far
D. Physical therapy is clearly superior in trials

B. They help about equally; pick one she enjoys Trials show yoga gives small to moderate improvements similar to physical therapy and other exercise, so access and preference should guide the choice.

CHAPTER 14

Traditional Systems and Nature Therapy

Read it in full: **Chapter 14 in the textbook**. See it in motion: **Traditional Systems Walkthrough** and **Traditional Systems Lab**.

What to know

Traditional Chinese medicine developed over more than two thousand years. Its foundational text, the *Huangdi Neijing* (Inner Classic of the Yellow Emperor), was compiled in roughly the last centuries BCE. Today's TCM was standardized in the mid twentieth century into a unified curriculum that runs alongside biomedicine in Chinese hospitals; related traditions include Japanese Kampo and Korean and Vietnamese medicine. In its own terms, **qi** (vital energy or breath) animates, warms, holds and defends the body; illness is deficiency, excess or stagnation. **Yin and yang** are complementary opposites (yin: cold, rest, moisture, interior; yang: heat, activity, dryness, exterior).

The **five phases** (wood, fire, earth, metal, water) relate through a **generating cycle** (wood feeds fire, fire makes earth, earth bears metal, metal collects water, water nourishes wood) and a **controlling cycle** (wood restrains earth, earth dams water, water quenches fire, fire melts metal, metal cuts wood). Zang fu organs are functional systems (the TCM spleen transforms food into qi and blood). Twelve principal **meridians** plus extraordinary vessels carry qi; classical texts describe about 361 points. Diagnosis uses the four examinations (looking, especially at the tongue; listening and smelling; asking; touching, including pulse at three positions on each wrist) to name a pattern such as liver qi stagnation, so two people with low back pain may be treated differently.

Therapies: acupuncture, moxibustion (burning mugwort; burns), cupping (circular bruises expected), gua sha (petechiae; caution with bleeding disorders), tui na, Chinese herbal formulas and tai chi and qigong. Practitioners seek **de qi**, a dull, heavy, spreading sensation. No distinct anatomical meridian structures have been found, though many points lie near nerves, vessels or fascia. Proposed mechanisms: endogenous opioids (partly reversed by naloxone in animals),

descending inhibition and diffuse noxious inhibitory controls, local adenosine release, brain changes (many also seen with sham) and contextual effects.

Shams include shallow needling at non points, needling irrelevant points and retractable blunt needles; each is imperfect. An individual patient data meta-analysis of about 20,000 patients with chronic back and neck pain, osteoarthritis, headache and shoulder pain found acupuncture better than both sham and no acupuncture: moderate versus no acupuncture, **small** versus sham, with effects lasting a year. Large chronic low back pain trials found about 48% responders with real acupuncture, 44% with sham and 27% with conventional care. Both views hold: point location adds little, and patients still benefit as much as from other accepted care. Guidelines list acupuncture for chronic low back pain. P6 stimulation helps postoperative and chemotherapy nausea; migraine prevention trials suggest it performs about as well as some drugs. For many other conditions evidence is weak or negative.

Acupuncture with sterile single use needles is one of the safer pain treatments; the key serious complication is **pneumothorax** from needling over the chest wall, upper back or lower neck. Infections have followed reused needles. Precautions: bleeding disorders and anticoagulants, pregnancy, electroacupuncture with pacemakers, infected or lymphedematous areas. Dry needling uses a Western trigger point model with similar evidence and the same pneumothorax precautions. Chinese herbs carry more serious risk: an **Aristolochia** substitution at a Belgian slimming clinic in the 1990s caused kidney failure and urothelial cancer; **ephedra** (ma huang) supplements were linked to strokes and deaths and banned in the US in 2004; imported products have contained heavy metals and hidden drugs. Yet **artemisinin** from sweet wormwood, found by studying classical texts, earned a Nobel Prize.

Ayurveda (ayus, life; veda, knowledge) is India's classical system: the *Charaka Samhita* (internal medicine and ethics), the *Sushruta Samhita* (surgery, including nasal reconstruction with a cheek or forehead flap and couching of cataracts) and the later *Ashtanga Hridaya*. It is government regulated in India. Five elements (space, air, fire, water, earth) form three **doshas**: **vata** (space and air; movement), **pitta** (fire and water; transformation) and **kapha** (earth and water; structure). Water appears in both pitta and kapha. **Prakriti** is the constitution at birth; **vikriti** is the current

imbalance. Other concepts: agni (digestive fire), ama (undigested residue), seven dhatus and srotas.

Ayurvedic diagnosis includes questioning, tongue, eyes, skin, nails and pulse (nadi pariksha). Treatment layers diet by the six tastes, daily (dinacharya) and seasonal (ritucharya) routines, herbs (triphala, ashwagandha, turmeric, guggul, boswellia, holy basil), abhyanga oil massage, shirodhara and **panchakarma** (vamana, virechana, basti, nasya and traditionally raktamokshana). **Rasa shastra** deliberately adds metals such as mercury, lead and arsenic as bhasmas. Doshas are not measurable substances, and most research tests single herbs. Turmeric: modest knee OA relief in small trials, poor absorption, rare liver injury, bleeding with anticoagulants. Boswellia: some OA benefit. Ashwagandha: less perceived stress, case reports of liver injury, thyroid effects, avoid in pregnancy. Guggul: no LDL lowering in a controlled trial.

About one in five Ayurvedic products in US studies contained lead, mercury or arsenic, some far above safety limits, from both Indian and American makers. Lead poisoning (abdominal pain, anemia, neuropathy, encephalopathy) has occurred in adults, children and pregnant women; ask about remedies and test blood lead when concerned. Aggressive purging can cause dehydration. Many lifestyle recommendations (regular sleep and meals, plant rich diet, activity, attention to stress) align with mainstream prevention.

Naturopathy grew from European nature cure (cold water, fresh air, sun, diet, herbs; Father Kneipp's hydrotherapy); a German immigrant adopted the name around 1900. It declined after the Flexner era and revived from the 1970s. Six principles: the healing power of nature (vis medicatrix naturae), identify and treat the cause (tolle causam), first do no harm (primum non nocere), doctor as teacher (docere), treat the whole person and prevention, with a therapeutic order. **Licensed naturopathic doctors** (ND or NMD) complete a four year graduate program and board exams and are licensed in roughly half of US states and some Canadian provinces, with varied scope; **traditional naturopaths** are usually unlicensed and unregulated. Homeopathy shows no effect beyond placebo; IgG food sensitivity panels, adrenal fatigue tests and provoked heavy metal tests are not validated; some practitioners are vaccine hesitant.

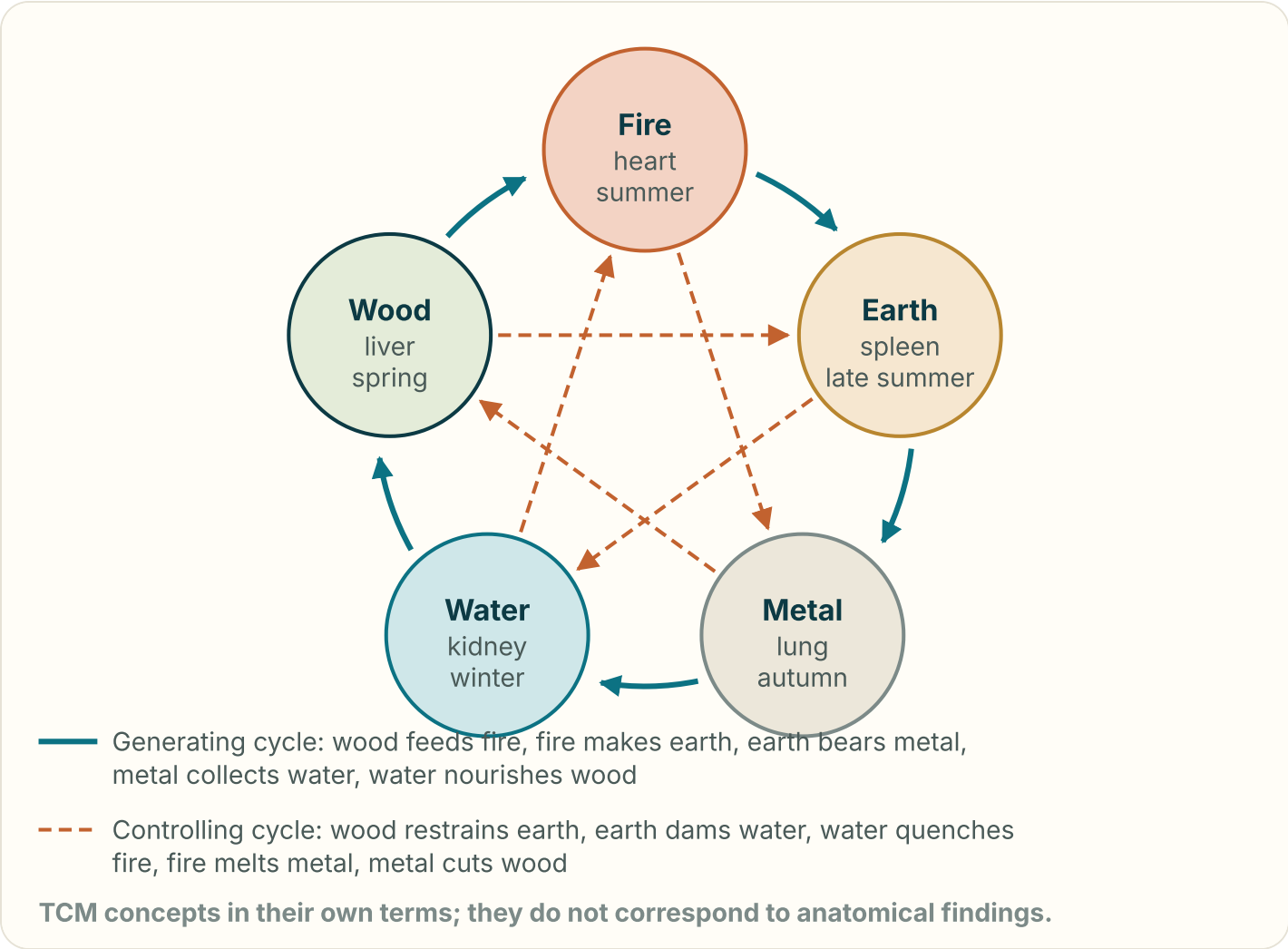
Plants gave us aspirin (willow bark salicin), digoxin (foxglove), morphine and codeine (poppy), quinine (cinchona), artemisinin (sweet wormwood), atropine (deadly nightshade), metformin

(modeled on galegine from French lilac), paclitaxel (Pacific yew), vincristine and vinblastine (Madagascar periwinkle) and colchicine (autumn crocus). Natural is powerful and can be toxic. Under the 1994 US law, herbs are **dietary supplements**: no proof of safety or efficacy before sale, structure and function claims only ("supports joint health" with a disclaimer), limited inspection, and the regulator must show harm to remove a product. Testing finds mislabeling and hidden drugs, most often in weight loss, sexual enhancement and bodybuilding products. Third party seals show content, not effect.

St. John's wort induces **CYP3A4 and P-glycoprotein**, lowering levels of cyclosporine (transplant rejection), oral contraceptives (breakthrough bleeding, pregnancy), warfarin and some HIV drugs, and can add to serotonin syndrome with SSRIs. Ginkgo, garlic, fish oil and high dose turmeric add bleeding risk; licorice causes hypertension and low potassium (it blocks cortisol inactivation in the kidney); kava and concentrated green tea extract can injure the liver; oral comfrey causes veno occlusive disease; goldenseal inhibits CYP; valerian and kava add sedation; ginseng affects warfarin and blood sugar. Evidence: St. John's wort beats placebo for mild to moderate depression; peppermint oil helps IBS; ginger helps pregnancy nausea; topical capsaicin is approved; saw palmetto failed for prostate symptoms; echinacea is inconsistent; devil's claw, willow bark and capsaicin give low certainty short term back pain relief. Inducer lowers; inhibitor raises.

Shinrin-yoku (forest bathing) was named by Japan's forestry agency in 1982: about two hours of slow, sensory immersion over a short distance. **Attention restoration theory**: soft fascination rests fatigued directed attention (being away, extent, compatibility). **Stress reduction theory**: natural scenes quickly evoke positive emotion and lower stress; surgical patients with a tree view had shorter stays and fewer strong pain medicines than those facing a brick wall. The biophilia hypothesis adds an inborn affinity. Forest sessions lower cortisol, pulse and blood pressure and improve mood; natural killer cell and phytoncide findings come mainly from one group; about 120 minutes a week in nature went with better health and well being, though confounding is a concern. Earthing claims rest on weak studies and an unsupported mechanism. Hazards: ticks, heat, allergies, poison ivy, falls; access is unequal. Integrate by asking every patient without judgment, weighing evidence and safety together (recommend, accept and monitor, caution,

discourage) and remembering that indirect harm, such as treating a curable cancer with herbs alone, is often the greatest.



Two cycles among five phases. Around the outside each phase nourishes the next; across the inside each phase restrains another. A common question: water restrains fire, and fire restrains metal.

LOCK THESE IN

- Generating cycle: wood, fire, earth, metal, water. Controlling: wood restrains earth, earth dams water, water quenches fire, fire melts metal, metal cuts wood.
- Acupuncture: moderate benefit versus usual care, small versus sham. Main serious risk: pneumothorax.
- Aristolochic acid: kidney failure and urothelial cancer. Ephedra banned 2004. Artemisinin: a Nobel Prize.
- Vata = space + air (moves); pitta = fire + water (transforms); kapha = earth + water (holds).
- About one in five Ayurvedic products contained lead, mercury or arsenic.
- Licensed ND: four year graduate program, boards, licensed in about half of states.
- Supplements (1994 law): no premarket proof; structure and function claims only.
- St. John's wort induces CYP3A4 and P-glycoprotein: lower cyclosporine, contraceptive, warfarin levels.

Traditional systems at a glance

Item	Core idea	Evidence or safety
Qi	Vital energy; illness is deficiency, excess or stagnation	No measurable substance found
Acupuncture	Needling points along meridians; de qi	Small specific effect over sham; pneumothorax risk
Chinese herbs	Multi ingredient formulas	Aristolochia, ephedra, contamination; artemisinin
Vata	Space and air; movement	Excess: anxiety, insomnia, dry skin, constipation, stiffness
Pitta	Fire and water; transformation	Excess: inflammation, heartburn, rashes, irritability
Kapha	Earth and water; structure	Excess: congestion, weight gain, lethargy
Rasa shastra	Medicines with metals as bhasmas	Lead, mercury, arsenic poisoning
Naturopathy	Healing power of nature; treat the cause	Licensed ND versus unlicensed; homeopathy unsupported
Forest bathing	Slow sensory immersion in nature	Short term stress markers down; confounding in cohorts

Herb drug interactions

Herb or supplement	Main concern	Mechanism or example
St. John's wort	Lowers many drug levels; serotonin syndrome	Induces CYP3A4 and P-glycoprotein
Ginkgo, garlic, fish oil, high dose turmeric	Bleeding with anticoagulants	Antiplatelet effects
Licorice	Hypertension, low potassium, edema	Blocks cortisol inactivation in the kidney
Kava	Liver injury; sedation	Hepatotoxicity reports
Green tea extract	Liver injury	High dose catechins
Comfrey (oral)	Liver damage	Pyrrolizidine alkaloids, veno occlusive disease
Goldenseal	Raises levels of some drugs	CYP inhibition
Ginseng	Warfarin effect varies; low blood sugar	Pharmacodynamic interactions

Worked cases

WORKED CASE 1 · READING AN ACUPUNCTURE TRIAL

A large trial in chronic low back pain reports responders at six months: real acupuncture about 48%, sham acupuncture about 44%, conventional care about 27%. Find the absolute differences and NNTs and interpret them.

STEP 1 · REAL VERSUS CONVENTIONAL CARE

0.48 − 0.27 = 0.21. NNT = 1 ÷ 0.21 = 4.8, rounded up to **5**.

STEP 2 · REAL VERSUS SHAM

0.48 − 0.44 = 0.04. NNT = 1 ÷ 0.04 = **25**.

STEP 3 · INTERPRET

Both needling procedures beat conventional care clearly, so patients benefit. Exact point location adds little, which suggests much of the effect comes from needling in general and from contextual factors.

HOLD BOTH VIEWS

Skeptics note the theory of points is not supported; supporters note the overall benefit is similar to other accepted care. Both observations can be true.

WORKED CASE 2 · A SUSPECTED HERB DRUG INTERACTION

A kidney transplant recipient on cyclosporine starts St. John's wort for low mood. Weeks later, signs of rejection appear. Walk through the reasoning.

STEP 1 · NAME THE HERB'S ACTION

St. John's wort is an **inducer** of CYP3A4 and P-glycoprotein.

STEP 2 · TRACE THE DRUG

Cyclosporine depends on these pathways, so it is cleared faster over days to weeks.

STEP 3 · PREDICT THE EFFECT

Blood levels fall below the effective range and the immune system attacks the graft.

STEP 4 · ACT AND PREVENT

Coordinate with the transplant team, stop the herb under supervision and check levels. Ask every patient about supplements; inducers lower drug levels, inhibitors such as goldenseal raise them.

WORKED CASE 3 · WEIGHING EVIDENCE AND SAFETY

Place four choices on the evidence and safety grid: tai chi for falls in an older adult; forest bathing for general well being; St. John's wort in a patient on several medicines; oral comfrey for joint pain.

STEP 1 · TAI CHI

Safe and well supported for falls: **recommend**.

STEP 2 · FOREST BATHING

Safe, evidence for long term outcomes weak: **accept and monitor**.

STEP 3 · ST. JOHN'S WORT WITH OTHER MEDICINES

Effective for mild to moderate depression but risky through interactions: **caution and monitor closely**.

STEP 4 · ORAL COMFREY

Liver toxicity from pyrrolizidine alkaloids with weak evidence: **discourage**.

REMEMBER INDIRECT HARM

The greatest harm is often what a remedy displaces, such as a curable cancer treated with herbs alone.

TRAPS PEOPLE FALL INTO

- **Putting water in only one dosha.** Water belongs to both pitta and kapha.
- **Reading better than usual care as better than sham.** Acupuncture beats usual care moderately but sham only slightly.
- **Assuming natural means safe.** Foxglove, poppy, nightshade and autumn crocus are poisonous; aristolochic acid destroys kidneys.
- **Reading a structure and function claim as proof.** Supplements need no premarket proof of efficacy or safety.
- **Mixing up inducers and inhibitors.** St. John's wort induces and lowers drug levels; goldenseal inhibits and raises them.
- **Treating all naturopaths alike.** Licensed NDs differ greatly in training and regulation from traditional naturopaths.
- **Swapping the nature theories.** Attention restoration is about directed attention fatigue; stress reduction is about fast emotional and physiological responses.
- **Overlooking lead in a child's anemia.** Ask about imported Ayurvedic remedies and test blood lead.

Chapter 14 self-test · ten items

1. In the five phase controlling cycle, which phase restrains fire?

A. Metal
B. Wood
C. Water
D. Earth

C. Water Water quenches fire. In the controlling cycle fire in turn melts metal; in the generating cycle wood feeds fire.

2. What sensation do acupuncturists seek at the needle site?

A. Complete numbness of the region
B. A warm flush spreading across the whole body
C. Sharp, stabbing pain at the point
D. De qi, a dull heavy spreading feeling

D. De qi, a dull heavy spreading feeling De qi is a characteristic dull, aching, heavy or spreading sensation that practitioners seek during needling.

3. A large meta-analysis compared acupuncture with sham and with no acupuncture for chronic pain. What did it find?

A. Large benefit versus both sham and none
B. Moderate benefit versus none; small versus sham
C. No benefit versus either sham or none
D. Small benefit versus none; large benefit versus sham

B. Moderate benefit versus none; small versus sham Acupuncture beat both controls, but the difference from sham was small, suggesting large contextual and nonspecific effects.

4. A patient develops sudden shortness of breath and one sided chest pain an hour after needling over the upper back. What should be suspected?

A. Pneumothorax from pleural puncture
B. Stroke from needling of the scalp
C. Kidney failure from needle metal
D. Rib fracture from deep needling

A. Pneumothorax from pleural puncture Needles that penetrate the pleura over the chest wall, upper back, shoulders or lower neck can cause pneumothorax.

5. Which plant toxin, substituted at a slimming clinic, caused kidney failure and urothelial cancer?

A. Aristolochic acid
B. Capsaicin extract
C. Ephedrine alkaloid
D. Artemisinin

A. Aristolochic acid An Aristolochia species was substituted for another herb in the 1990s, causing progressive kidney failure and later urothelial cancer.

6. Which dosha is made of earth and water and governs structure?

A. Agni
B. Kapha
C. Pitta
D. Vata

B. Kapha Kapha (earth and water) holds and builds structure. Vata (space and air) moves; pitta (fire and water) transforms.

7. A child has anemia, abdominal pain and irritability, and the family uses imported Ayurvedic remedies. Which test should be considered?

A. A stool culture test
B. Thyroid antibodies
C. A serum vitamin C
D. A blood lead level

D. A blood lead level Studies found about one in five Ayurvedic products contained lead, mercury or arsenic, and lead causes anemia, abdominal pain and neurological symptoms.

8. A patient says her naturopath is an ND who completed a four year graduate program and passed board exams. Which statement about such practitioners is accurate?

A. They are licensed in every single US state
B. They may prescribe any drug in any state
C. They are licensed in about half of US states
D. Their training is the same as a short course

C. They are licensed in about half of US states Licensed NDs complete a four year graduate program and board exams and are licensed in about half of states; traditional naturopaths are usually unlicensed.

9. A patient on warfarin begins high dose ginkgo and garlic. What is the main concern?

A. Added bleeding risk
B. Low potassium
C. Serotonin syndrome
D. Loss of warfarin effect

A. Added bleeding risk Ginkgo, garlic, fish oil and high dose turmeric have antiplatelet effects that add to bleeding risk with anticoagulants.

10. Surgical patients with a view of trees recovered faster than those facing a brick wall. Which theory does this classic study support?

A. The biophilia hypothesis
B. The phytoncide hypothesis
C. Stress reduction theory
D. Attention restoration theory

C. Stress reduction theory Stress reduction theory holds that natural scenes quickly evoke positive emotion and lower physiological stress; the window study is its classic example.

ONE PAGE

Cram sheet

Everything from chapters 13 and 14 in one place. Cover the right column and see if you can rebuild each row.

Numbers and equations

Item	Value or formula	Note
Phrenic nerve	C3, C4, C5	Injury below C5 usually spares the diaphragm
Diaphragm descent	1 to 2 cm quiet; up to 10 cm maximal	Crura: right L1 to L3, left L1 and L2
Tidal volume and dead space	About 500 mL; about 150 mL	12 to 16 breaths/min; 6 to 8 L/min
Alveolar ventilation	(Tidal volume − 150 mL) × rate	250 × 24 gives 2.4; 1,000 × 6 gives 5.1 L/min
PaCO2	35 to 45 mmHg (40 textbook)	CO2 sets the drive at sea level
Slow paced breathing	About 5 to 7 per minute; resonance about 6	0.1 Hz = one breath per 10 s
Individual resonance	4.5 to 7 breaths per minute	HRV biofeedback
MBSR	8 weeks; 2 to 2.5 h sessions; about 45 min daily; one day retreat	Body scan, sitting, gentle yoga
MBCT	Relapse risk down about a third over 60 weeks	Best with 3 or more prior episodes
Hot yoga	About 40°C (105°F)	Heat illness
Acupuncture points	About 361 on the main channels	Twelve principal meridians
Acupuncture trial	Real about 48%, sham 44%, conventional 27% responders	NNT 5 versus usual care, 25 versus sham
Acupuncture IPD meta-analysis	About 20,000 patients	Small effect versus sham
Ayurvedic products	About 1 in 5 contained lead, mercury or arsenic	Test blood lead
Ephedra	Banned in US supplements in 2004	Strokes, heart attacks, deaths

Item	Value or formula	Note
Supplement law	1994; no premarket proof of safety or efficacy	Structure and function claims only
Forest bathing	Named 1982 in Japan; about 2 hour sessions	About 120 min a week in nature linked to well being

Systems, herbs and interactions

Item	Key fact	Watch for
Eight limbs	Yama, niyama, asana, pranayama, pratyahara, dharana, dhyana, samadhi	Asana is third
Fast pranayama	Kapalabhati, bhastrika	Pregnancy, hypertension, epilepsy, hernia, glaucoma
Five phases	Generating: wood, fire, earth, metal, water	Controlling: water quenches fire, fire melts metal
Doshas	Vata space and air; pitta fire and water; kapha earth and water	Water in two doshas
Naturopathy principles	Vis medicatrix naturae, tolle causam, primum non nocere, docere, whole person, prevention	Licensed ND versus unlicensed
Plant drugs	Aspirin, digoxin, morphine, quinine, artemisinin, atropine, metformin, paclitaxel, vincristine, colchicine	Natural can be toxic
St. John's wort	Induces CYP3A4 and P-glycoprotein	Cyclosporine, contraceptives, warfarin, HIV drugs; serotonin syndrome
Bleeding risk	Ginkgo, garlic, fish oil, high dose turmeric	Anticoagulants, surgery
Liver injury	Kava, green tea extract, comfrey, ashwagandha and turmeric (rare)	Ask about supplements
Licorice	Hypertension, low potassium	Blocks cortisol inactivation

Rules that are not equations

Topic	The rule
Hyperventilation	Ventilation above metabolic need so PaCO2 falls, not simply fast breathing.
Disease first	New breathlessness, chest pain, hemoptysis, fever, leg swelling or low saturation need evaluation, not exercises.
Mindfulness	Nonjudging awareness; not the same as relaxation or concentration.
Control groups	Mind body trials shrink against active controls; waitlist comparisons flatter them.
Yoga modifications	Osteoporosis: no loaded flexion or forceful twists. Glaucoma: no inversions. Hypermobility: midrange control.
Acupuncture	Better than usual care, slightly better than sham; sterile needles; watch for pneumothorax.
Interactions	Inducers lower drug levels; inhibitors raise them.
Evidence and safety grid	Recommend, accept and monitor, caution, discourage.
Indirect harm	Delaying or replacing effective care is often the greatest harm.
Talking	Ask every patient about supplements and remedies, without judgment.

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