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Complementary Medicine in the Classroom: Is it Science?

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Abstract: This academic essay provides a strategy for teaching complementary and alternative medicine (CAM) in the classroom, a subject typically critiqued as unconventional and non-scientific. It demonstrates how students can enhance their critically reflective skills by examining polarizing and controversial medical topics, which are often considered by conventional doctors and researchers to be on the fringes of credible Western medicine. Included are examples of hands-on CAM experiments that can easily be incorporated in the classroom. It demonstrates how, by using an inquiry-based constructivist pedagogy, examining controversial and sometimes pseudoscientific ideas deepens learning.

Keywords: CAM, complementary medicine, constructivist education, critical reflection, inquiry-based, pseudoscience

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Complementary Medicine in the Classroom: Is it Science?

I searched the juice section of the shelves for something the color of urine. I finally settled on Green Tea, and when watered down in a glass jar, it truly looked like the real thing. Walking into class, I held up the jar, explained that instead of drinking my urine that morning I decided to bring it in, and asked: "Anyone want a hit?" For a moment, I broke through the students' usual blasé haze, and I could hear gasps of surprise as I sipped on my morning libation. Urine is drunk by Americans as part of a routine health regime for cancer treatment, AIDS, and migraines (Gardner, 2001). Drinking urine is widespread in India (where Indians also drink sacred cow urine) and in the middle east (where they also drink camel urine). But in the classroom that day, my "tea" got the students' attention focused on complementary medicine.

When I pitched the course Complementary and Alternative Medicine (CAM) to the science department, I faced mathematicians, a physicist, a chemist, a biologist, and an ecologist—all scientists and research scholars. For years whenever courses came up for our review (e.g., Biology 101 or Anatomy and Physiology), there was no question that the students,

through experiments, mathematical analysis, and research, would be conducting and learning "science." There was never anything contentious about these courses "being science." The only suggestions from faculty involved tweaks to the learning outcomes and assessment. However, when I brought up CAM to this group, someone said: "Frank, how can you teach students about these ideas (e.g., Reiki, Magnet Therapy, Therapeutic Touch, *Chi*) when none of them are supported by scientific evidence? Is it science?"

I replied that the class was not going to teach "about" these topics (i.e., we were not going to learn the techniques of, say, Traditional Chinese Medicine), but we were going to work on understanding *why* these modalities, mostly without accepted scientific credentials, are used so extensively in the US and around the world, even to the exclusion of conventional medicine (National Center for Complementary and Integrative Health, 2016b). The course would be centered on critical reflection but not in the abstract. Instruction would involve applying our studies to real-world medical issues, demonstrated by in-class experiments (Paris, 2016, para. 24). This was pedagogy my scientific colleagues could understand, and the course was approved.

The CAM course always begins by discussing the scientific method, measurement, and a central tool of medical research, Randomized Controlled Trials (RCTs). It turns out that the modalities, medicines, and procedures contained in CAM almost entirely do not pass muster with any of these scientific standards. You could say that CAM is a grouping of modalities that, for the most part, lives outside the Western Biomedical Model (WBM) or Biomedicine (i.e., scientific medicine) and is generally not found in conventional hospitals or the doctors' offices that students normally visit. As opposed to the body of knowledge conventional doctors learn in medical schools, CAM modalities originate from ancient traditions, folk beliefs, traditional and spiritual belief systems, and are passed on by word-of-mouth and (mostly) unlicensed practitioners.

What divides science from not-science is a surprisingly open question (Trocco, 1998). For most people, this is a seemingly easy distinction, but for myriads of philosophers, historians, and anthropologists of science, it is a pivotal yet embarrassing distinction. This is at the root of why CAM is an epistemic gift for students, as they try to determine a clear definition for science and find out that "the devil is in the details." For no lack of trying, researchers have been hard-pressed to say definitively whether something like, for example, the ancient Navajo Nine-Night Nightway Ceremony, which heals "diseases of the head" (Bell's Palsy, headaches, and bad dreams), is medically scientific or not (Francis, 2012; Joe et al., 2016). The CAM course does not argue that CAM treatments actually do what their proponents say they do, only that looking at CAM pushes the boundaries of what we think of as science, what we consider as evidence, and who is in the position to make those choices. An underlying question is what is "legitimate knowledge," how is it determined, and who gets to decide? The surety of Western epistemology is at stake, which is why the confirmation of something seemingly as simple as someone using Reiki, or "energy healing," to help with stress receives a full frontal assault from skeptical opponents (Engler & Mielczarek, 2014). This is why the CAM students need to grapple with critical, constructivist pedagogy and look at ideas that seem firmly set, such as the scientific method, but which may be based on underlying cultural assumptions about what is credible and what is not (Collins & Pinch, 1982; Pinch, 1979). It is why CAM researchers call for a paradigm shift, as even experiments do not always reveal the truth:

> . . . experimental evidence is not unambiguous. It may appear to be unambiguous so long as the assumptions upon which it is based are not examined too radically. One might say that experimental evidence appears unambiguous within a taken-for-granted set of rules of

> induction but that different rules of induction operate in different scientific paradigms. A fortiori we may expect different rules of induction to operate in radically different societies, yielding different, but self-consistent, pictures of the world. (Collins & Pinch, 1982, p. 182).

Sometimes convincing faculty to work with constructivist pedagogy, where students have more control over what they are learning, rather than teaching endless content, can be provocative:

> "I have attended more than one faculty meeting where some version of the question, 'What do we want our students to know?' has led to a curricular rift between the lumpers and the splitters. Typically, the splitters are the most vocal, wanting to add more academic content to the existing courses, and add additional required courses to the curricula covering areas that they see as critical to undergraduate enlightenment. They do not fully grasp Perkins's point: 'Knowledge and skill in themselves do not guarantee understanding. People can acquire knowledge and routine skills without understanding their basis or when to use them' (Perkins, 1993, para. 8).
>
> On one occasion, we divided into groups to address this question, each group reporting out the results of its discussion. I was the spokesperson when it was my group's turn, and I stood up and said: 'We want our students to know how to figure out, in each discipline, what the questions are that interest them most. Our role as teachers needs to be to help them figure out how to answer those questions.' I continued, in response to the splitters' suggestions for new essential coursework, 'There's an endless amount of "stuff" that we can tell them about, but it doesn't mean it leads them into deep understanding.' Some colleagues still believe in Aristotle's *tabula rasa* and what Freire (2018) termed the 'banking model' method of instruction. In this view, students' brains are mostly empty and in order to educate them we have a responsibility to open them up and pour in endless information—sophisticated thinking is then (somehow) an epiphenomenon of this process. In the sciences, this sort of pedagogy is often criticized as a 'cookbook' approach, as students work on experimental problems with known solutions and expected results (Fukami, 2013) [similar to a skeptic's a priori assumptions about CAM being pseudoscience]. The splitters never like it when objections are raised to this instructional narrowness." (Trocco, 2014, p. 1)

The experiences included in this analysis are recounted from over ten years of teaching CAM to undergraduate students. After a decade, I noticed from class discussions and student assignments how similarly their reactions were to both CAM practices and to the intense reactions that skeptical researchers had to these practices. It was after 20 semesters of teaching CAM that I realized certain themes in student attitudes were emerging, as well as the same comments and anxiety with the WBM. I spent three recent semesters soliciting the students' thoughts and feelings through assignments, emails, and interviews, receiving their permission to include their statements in this paper, which have all been marked "personal communication." All the comments in the present paper echo the students' reactions from the previous ten years, although they have only been collected from about three semesters. This paper describes unique CAM experiments the class engages in and includes the results and responses of students performing those experiments.

The CAM classes at a university in Massachusetts are typically composed of 20 predominately white, 18-22 years old, mostly female college students and several Asian and African-American students majoring in psychology, Holistic Studies, and health. They make up a fairly homogenous group of young people, and there are no relevant differences in the students

who provided the interviews which accompany this paper. The demographic of the classes reflects the use of CAM in the general population of US young adults: "In 2007, more than one-third of adults aged 18 to 29 years used any complementary and alternative medicine in the previous 12 months, suggesting that adults are incorporating complementary and alternative medicine into their healthy lifestyle behaviors early on" with the smallest percentage use among African-Americans (Upchurch & Rainisch, 2012, para. 2). Similar results were found by CAM students who surveyed 40+ undergraduate students from a number of universities during a Citizen Science project:

> We found that there are many reasons students choose to use CAM practices rather than turning to conventional medicine. There was a theme throughout the surveys and interviews of strong dissatisfaction with Western medicine, and a mindset of "how can I help myself if no one else is going to help me?" when students felt unsupported by Western practitioners. This led them to seek out CAM modalities instead. By far the most common reason for the switch, cited by 35.29% of students who used CAM, was that students had fewer concerns about side effects and dependence with CAM, whereas they felt that Western Medicine was unhealthy and would lead to those negative outcomes. (Bianco et al., 2022, p. 8-9).

The CAM classes are not lecture-oriented, but based on hands-on, constructivist learning, first-person research, Citizen Science projects, discussions, and experiments. Constructivist teaching starts from the assumption that students can build their own learning and answer the questions that are most important to them if given the proper tools and direction (Hein, 1995). In this educational model, students are given control over what questions interest them and are helped in trying to figure out how to research and answer those questions. As the CAM semesters passed, it was apparent that student learning was built around the discoveries and analysis from the rich results of our experiments. It was clear that the student observations and conclusions described below could eventually be incorporated into the present research report.

A typical class could involve a brief lecture from the instructor, one or two small group discussions analyzing proponent or skeptic approaches to CAM, a discussion of the weekly readings, a student group presentation, and a segment of the experiments outlined below as they can carry over through a number of class sessions. The instructor and the weekly lessons maintain an agnostic and balanced view toward CAM (Trocco, 1998), as many students have deeply held and familial beliefs for and against CAM modalities. Beyond that, there are many potent academic and medical criticisms of CAM, especially since they are seen as non-scientific, distracting, and perhaps dangerous when used instead of conventional medical treatments (Werneke et al., 2004). While there are undoubtedly truly fraudulent CAM practitioners, the entire field of CAM is seen as pseudoscience by an overwhelming number of medical and scientific researchers: "We [skeptics] will confidently stand by our position. CAM proponents, like creationists, have nothing but weak and fallacious—and long-discredited—arguments on their side" (Novella, 2012, p. 25).

The class structure and pedagogy make no attempt to convince students that CAM is the correct choice in medicine, only to complexify the debate between proponents and skeptics, which can initially seem to many students as being black and white. To work with this, the class demonstrates and practices how CAM can be empirically studied (Trocco, 1998).

During the class's study of CAM, the students review the historical successes of the WBM, which has achieved dominance in medical practice throughout the world. Some might say this is because a system of healing developed in Europe and the Near East which is far superior

to any medicine or treatment that evolved anywhere else on Earth. Perhaps this is correct, but through colonialism, conquest, and forced education, cultures throughout the world were coerced into accepting the WBM as the only medicine. In the process, these world cultures neglected, and eventually lost, most of their original ways of knowing, including thousands of years of the nature-based knowledge they had developed about health and well-being. Symbolic healing, spirituality, and herbalism, enacted through mythic ritual and ceremony, constituted the healing focus of most non-western cultures, but were openly denigrated by western colonizers as being primitive and superstitious—public perceptions which remain today. Although the development of the WBM provides critical historical context, the CAM course focuses on what was "neglected and forgotten" as the west reached near total authority and hegemony in world medicine.

Science's Semi-Permeable Membrane

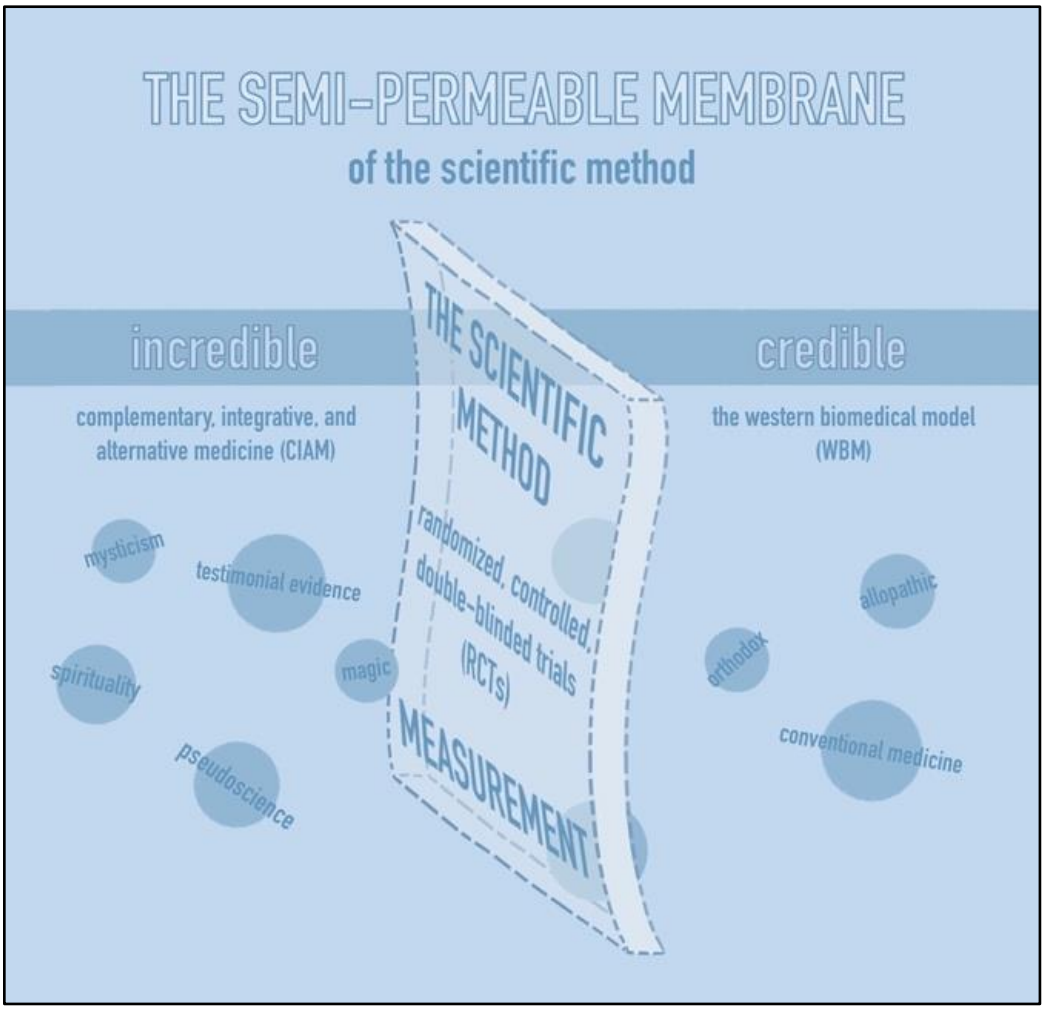
CAM includes medicines and applications not found in (most) conventional hospitals, and even teaching CAM at the university level is contested (Flatt, 2013):

> It is okay to teach about so-called complementary and alternative medicine (CAM) as a sociological phenomenon or even as an example of pseudoscience. Practitioners also need to learn about any method their patients may be using or about which they are curious. Credulously teaching CAM, however, is an endorsement, the granting of the imprimatur of the university. (Novella, 2012, p. 24)

Few CAM modalities are scientifically credible by the standards of the WBM, with its emphasis on measurement and the experimental requirements of Double-Blinded Randomized Controlled Trials (RCTs) (Hall, 2012; Jackson & Scambler, 2007; Verhoef et al., 2005). Over the years, the CAM class has arrived at a working metaphor for distinguishing these two sides and the difficulty that CAM has in becoming validated and certified, especially by hospitals and insurance companies (National Center for Complementary and Integrative Health, 2016a). This metaphor can be visualized as a semi-permeable "Wall" between CAM modalities and the accredited medical modalities which are approved by the WBM. On the left side of this wall is the incredible, and on the right side is the credible (Figure 1).

The Wall is not impenetrable, which is why it is portrayed as semi-permeable. First, ideas about what is considered credible and incredible change with time, experiences, experiments, and the public and scientific ethos. Second, occasionally a CAM modality will make it through the semi-permeable Wall to the other side, as mindfulness has (because neuronal changes as a result of meditation can be measured with an fMRI); and parts of Acupuncture have because some treatments (e.g., for morning sickness) can be measured (Boccia et al., 2015; Smith et al., 2002). For the most part, CAM modalities will not be able to move from the left to the right, from the incredible to the credible, which is why there is a visible distance between the two sides. This includes in classrooms because what counts as "quackery" and what counts as legitimate knowledge is fiercely entrenched (Brosnan, 2015). One possible way through the Wall is by negotiating the methodology of the scientific method itself. Whole Systems Research attempts to develop a scientific methodology and discovery process for medicine, which could show that some CAM modalities can achieve scientific recognition for their healing effects, perhaps without passing RCTs, by examining the whole person's life and their health rather than focusing on specific medical symptoms. From Whole Systems analysis, it might even be possible to convert anecdotal and testimonial evidence into scientific data (Verhoef et al., 2005).

Figure 1
Science's Semi-Permeable Membrane



Note. Illustration commissioned by the author.

CAM researchers on both sides of the Wall take strong positions—does CAM have healing value (Snyderman & Weil, 2002), or is it "flim-flam" (Brosnan, 2015; Engler & Mielczarek, 2014; Huston, 1995; Randi, 1982;), "Quackery" (Barrett, 2021), "magical thinking" (Stevens, 2001), and "snake oil science" (Bausell, 2009)? This means CAM has spectacular value for critical reflection, involving "creativity, great intuition, and deep insights" (AACU, 2009, p. 4; List, 2021, p. 1). Students weigh and analyze polarized opinions, which, because they involve personal and family health care concerns, matter deeply to them. CAM students have no alternative but to practice navigating the territory between facts and fiction (Paul, 2005; Murawski, 2014; Vickers, 1997): "Controversies, it will be seen, are settled in science as they are settled in other walks of life—by negotiation, not revelation" (Collins & Pinch, 1982, p. 6).

Researchers who study CAM mostly fall into being either believers or skeptics, which creates a radical ideological division. Many skeptical researchers are only interested in demonstrating the absurdity of CAM treatments (Randi, 2013), and their lack of credible scientific evidence (Barrett, 2021; Beyerstein & Sampson, 1996; Hall, 2019; McCutcheon,

1996). They are intent on keeping all of CAM on the left side of the Wall, while students frequently point out that collaboration among CAM & WBM researchers would lead to deeper awareness and discovery, as some researchers agree (Vuolanto et al., 2020). An alternative is that some folks turn to CAM only when nothing else has helped, as this student points out:

> In the Western world, everything is all about measurements when it comes to medicine. People only fully believe something works if there is a randomized controlled trial where the results can be properly measured. However, when it comes to CAM, there is not much "proof" that it works; hence, there are no randomized controlled trials that "prove" anything as of yet. Because of this, it is incredibly hard for CAM medicines to be taken seriously in places such as the United States. People do not want to believe that these forms of medicine are real medicine. Everyone is so accustomed to traditional allopathic medicine in the modern day that they really only use CAM as a last resort. It is only when all other hope is gone that they turn to it. (Student #1, personal communication, May 2021).

The skeptical community is populated by researchers, scientists, and theorists who are concerned by what they see as bad science and, in the case of CAM, they see practitioners who take advantage of people who are sick and vulnerable. Much publishing takes place in two central journals, the *Skeptical Inquirer* and *Skeptic*. While the *Skeptical Inquirer* calls itself "The Magazine for Science and Reason," and complains about CAM in the name of science, some sociologists of science have labeled these skeptical communities "scientific vigilante group[s]" (Collins & Pinch, 1982, p. 5). Others have very low opinions of the scientific credibility of the most prominent skeptics (Gale, 2019), which is often echoed by students who use these skeptics as sources in research papers:

> Auras and aura reading have been argued to be fake by skeptics who use historical art and literature examples combined with medical symptoms to prove their points. In comparison, believers in auras and aura reading use historical art and literature along with first accounts to prove their points. I align myself with the skeptics that auras and aura readers are fake, but I disagree with how they argue their points. While researching auras and aura reading, there were many skeptics that were just horrible to the believers. I was not surprised by this; I was just more disgusted by it. Many skeptics claim to be scientists; however, science as a whole is rarely my way or the highway death threats when it comes to analytically arguing their facts. (Student #2, personal communication, November 2021)

One notable skeptic was James Randi, not a scientist but a magician who was an expert at investigating people he saw as charlatans and hucksters—because he knew all the tricks he could easily see when they were making one (1982):

> Wherever we went [in China], Randi helped quickly devise controlled tests so we could see what was going on. The qigong master's powers seemingly to influence the movements of a nearby woman worked at first, when she could see him. When we placed her in another room where she couldn't see him and kept careful records in both locations, their motions went totally out of phase. She had been responding only to what she saw him do; when she couldn't see him any longer, it didn't work. There was no transmission of "qigong" energy. (Frazier, 2021, para. 18-19)

The pedagogical approach used in the CAM class is to show students both sides of the argument and let them make up their own minds. In every assignment, they are tasked with demonstrating that they understand what is being claimed by both proponents and skeptical

researchers. They are assigned to review a number of prominent skeptics and their critique and research of CAM, for example: "Whither Chiropractic?" (Hall, 2019b), "How thinking goes wrong" (Shermer, 1994), *Homeopathy* (Randi, 1982), *Quackwatch: Your Guide to Quackery, Health Fraud, and Intelligent Decisions* (Barrett, 2021), and "Traditional Medicine and Pseudo-science in China: A Report of the Second CSICOP Delegation" (Beyerstein & Sampson, 1996). Although many students come loaded with discomfort about the WBM from their personal experiences, it is important for them to balance that by learning there is deceit and fraud in many places in medicine, including in CAM, and it is important to know how to detect it (Synovitz & Larson, 2018, pp. 263-276). When you go looking for fraud in CAM practices, it is very easy to find claims that most CAM is false and deceitful. This is because many researchers believe CAM is fraudulent from the get-go because of its lack of scientific validity:

> Alternative medicine embraces many things: treatments that have never been tested or have not been adequately tested; treatments that have been tested and shown *not* to work; treatments that are based on nonexistent phenomena such as human energy fields and acupoints; treatments such as homeopathy that if true would violate established scientific knowledge; and treatments that have been proven to work but that mainstream doctors have good reasons not to recommend. (Hall, 2019a, para. 2)

The views on both sides are backed up by volumes of research and testimony and are always being challenged. This means that a convincing adjudication of the "truth" comes under the disciplines of cultural studies or social psychology rather than through determining certain scientific evidential clarity (Collins & Pinch, 2008):

> . . . philosophies of science that depend heavily upon the invocation of experimental evidence to decide between major differences in theoretical perspectives are not tenable. It would seem that evidence is so bound up with the society or social group which gives rise to it that theories held by members of radically different scientifico-social groups cannot be adequately tested against each other by experiment. It matters not whether the evidence is intended to corroborate, "prove," or refute the theories in questions. Similarly, these differences cannot be settled by logical argument. (Collins & Pinch, 1982, p. 184)

What science is and what it is not, what truth is and what it is not, has never been clearly demarcated and is constantly debated. It may be that looking at cultural or psychological influences can offer a better adjudication than the results of contentious scientific experiments.

> [This is because] "there is a basic difference between Western scientific epistemology and all other secular worldviews. The Western analytic approach claims that the reality content of other belief systems can be critiqued and evaluated from within its model: ' . . . science is not only a means of categorizing the world, but of categorizing science itself in relation to other knowledge systems that are excluded' (Nader, 2014, p. 3).
>
> Western science claims to be able to judge how closely other worldviews accurately describe the empirical world of everyday reality, and how close their versions of the world are to the truth. The knowledge of other cultures is evaluated against the criteria of a single belief system. This hegemonic confidence has led to ever-increasing trust in the Western view of reality: ['While there is no a priori reason to expect that knowledge generated out of non-Western paradigms or social processes should be empirically or predictively less adequate, it has been an affect of Western ethnocentrism to construe non-Western knowledge processes as "pseudoscientific," "protoscientific," or merely "unscientific'" (Scott, 2014, p. 69)] The [CAM] pseudoscientists are the ones who have come under the scrutiny of this analytical model. In our tightly dichotomous

> worldview, if the category 'science' exists, the category of 'not-science' is a necessity. Just as the demarcation of sixteenth-century demons indirectly affirmed the existence of God, the accusations against pseudoscience reinforce our trust in contemporary orthodoxy." (Trocco, 1998)

Students come to the CAM course with both believer and skeptical opinions, although all the orthodox scientific evidence is on the side of the skeptics: for most CAM modalities, there is virtually no measurable evidence that, for example, bee stings (for arthritis), Magnet Therapy (for muscle aches), or Chiropractic (for any condition beyond back pain) leads to a cure (although these interventions may provide relief). That said, CAM modalities are paid for out of pocket by countless people because the left side of the Wall is generally not covered by insurance (Levine, 2020; Nahin et al., 2007).

Even skeptical scholars can be persuaded that having students interrogate controversial ideas non-judgmentally and without a priori bias has great value. Although ferreting out the scientific "truth" will not ultimately determine an individual's behavior, students are eager to learn how to follow the data. The important thing is to give them the scholarly tools to determine what is credible and what is incredible, what is possible and what is impossible.

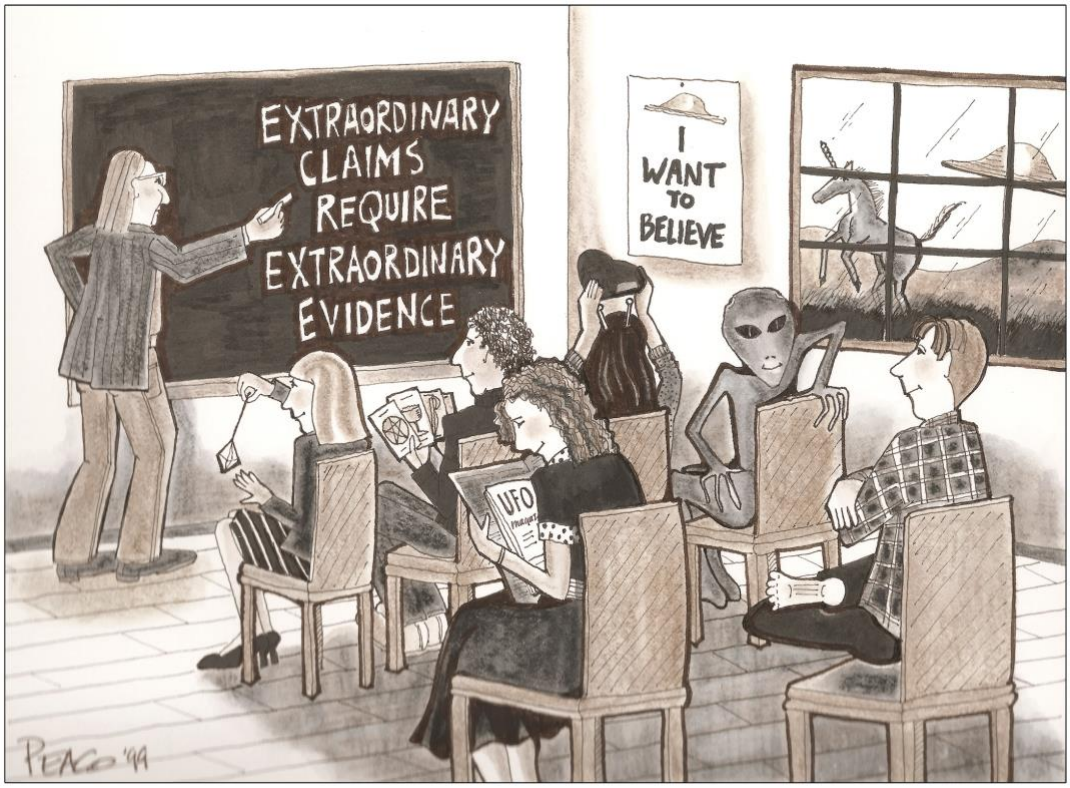
Extraordinary Claims Demand Extraordinary Evidence

Most students come to CAM with a dim understanding of what CAM means: "Complementary medicine is used to describe therapeutic techniques that are not part of conventional medicine. . . they are used as a 'complement' or addition to conventional medicine" (Breastcancer.org, para. 1, 2022). Students arrive holding a range of unchallenged beliefs in CAM modalities. Their understanding is typically based on "testimonial evidence," stories they have heard from friends, relatives, and media that are unsupported by medical science. Testimonial evidence counts for very little in the scientific method (Beyerstein & Sampson, 1996; Hall, 2021). Frustratingly for skeptics, even though students do not reject evidence-based science, they are sometimes willing to *combine* it with testimonial evidence (Vuolanto et al., 2020, p. 518). As skilled learners, they develop their own sense of what it is to think critically from their experiences and local knowledges. This approach should not be discounted out of hand (Irwin et al., p. 48, 2003) simply because it does not fit the standard definitions:

> . . . science has no special status for everyday life but must instead compete with all other sorts of knowledge and understanding (especially those categorized here as "local" knowledges). Very often the "test" for the applicability of these knowledges is the extent to which they assist in the understanding and control of one's life. (Irwin et al., p. 63, 2003)

An underlying mantra of skeptical researchers is that if a healing modality is making a big counterintuitive claim, it needs extraordinary evidence to verify it. In almost all cases for CAM, this evidence does not exist, and most students are unaware of this distinction (Figure 2), rigidly held by CAM critics (NOVA, 1996). At the same time, definitively proving a modality does *not* work is near impossible, which some CAM treatments depend on for unofficial confirmation.

Figure 2
Extraordinary Claims Demand Extraordinary Evidence



Note. Cartoon commissioned by the author.

In practice, deeply held beliefs are seldom changed by evidence (Lambert et al., 2003, p. 81; Snelson, 1992). If we are going to influence the students' understanding of the real and the imaginary, the methodology has to come from a reflective critical pedagogical direction, not from one of outlining undeniable facts. More evidence and more facts will not necessarily convince students to believe one way or the other, as this student insisted:

> When researching an alternative medicine modality, it is extremely important to look at both sides of the argument. Looking at just one side will not give the entirety of the truth because each source has a biased opinion which they are arguing towards. (Student #3, personal communication, May 2021)

What is the fundamental difference between CAM and the WBM, and why do so many people choose CAM in the face of serious illness? The WBM is very good for some things. In the west, we taught ourselves the systems of the body, the Germ Theory of Disease, antibiotics, vaccines, and amazing diagnostic tools. These attributes are what built our metaphorical Wall and what gave us immense confidence that eventually the WBM could cure any disease. Today, sick patients do not have to tell their doctors very much about themselves, but they wait for the blood tests and fMRI scans to come back to be interpreted by the doctor so the doctor can tell them what is wrong (Burke, 2009; Carman et al., 2010; Porter, 1997). The Citizen Science students found this reflected in their study:

> On a related note, the second most common reason students cited for CAM use over Western medical practices, cited by 17.65% of students, was a belief that complementary

> and alternative practices were "more natural" than what they would find with conventional medicine. . . Being able to take charge of their own health, without needing a referral from a doctor, led some students to more feelings of control over their treatment. For example, one student stated that "through conventional medicine, I find I get lost in the illness and symptoms and lose myself in the process." (Bianco et al., 2022, p. 9)

That said, many healthcare practitioners are caring, sympathetic providers (Hall, 2010), doing whatever they can to help their patients (Hall, 2014). Importantly, some physicians have embraced Integrative Medicine, which is a sort of "whatever works" approach, using alternative and complementary techniques along with allopathic treatments (Snyderman & Weil, 2002).

In comparison to most conventional doctors, CAM practitioners focus on lifestyle, diet, exercise, stress levels, an empathic doctor/patient relationship, and an emphasis on "balance" (Samuels & Bennett, 1983; Zollman & Vickers, 1999). This speaks powerfully to patients, and all students are patients at one time or another. The usual impersonal, clinical nature of the WBM does not offer the compassionate care that CAM practitioners do (Rees & Weil 2001), and so people turn to CAM modalities because they provide something more satisfying than surgery, drugs, and 15-minute office visits (National Center for Complementary and Integrative Health, 2021; Rabin, 2014). Students recognize this even if they remain uncertain about the efficacy of CAM modalities:

> Part of the reason why I sometimes dread going to the doctor is because I know when they are busy, I will be rushed in and out of the office without my opinions or concerns being heard--which is ironic considering it is a consultation about my body. I have talked to a few people who feel the same, and why doctors offices shouldn't operate like businesses but healing centers where patients feel like people, not numbers who get checked in and out as fast as possible. (Student #4, personal communication, December 2021)

Chinese *Chi* and American Vitalism

Life is a mystery. Actually, many mysteries, but the one that often concerns students is what makes life, alive? What enlivens our bodies? Is it simply the hamburgers, salad, and beans we eat every day that gives us life, or is there something more? Does life come from some intangible spark or energy? In TCM, this is called *Chi*, or vital energy. A belief in *Chi* and its seamless movement through the body is fundamental in TCM, and is the basis of Acupuncture, Cupping, *Qigong*, and pulse diagnosis (Grippo, 1993). However, *Chi* is problematic because it cannot be measured in any way accepted in the west, with a thermometer, blood test, Geiger counter, x-ray, fMRI—with anything other than the (imagined) testimony of practitioners and patients. But there is something very compelling about the presence of an ineffable life energy, something that is enlivening us beyond burgers and beans. It is so compelling that, at one time, this same belief was widespread among doctors in the US.

Vital energy, the spark that makes us alive, was called Vitalism (Coulter et al., 2019; Greco, 2005; Melzer, 1904). People did not believe that it was all burgers and beans, and for the most part, lay people still do not. However, the WBM could not find any measurable evidence for vital energy and, while it was a central component of medicine in the US in the 19th & early 20th centuries, as we learned more and more how to measure our bodies inside and out, we no longer had a need for Vitalism to explain life. Vitalism disappeared from medical diagnoses and texts. From the point of view of the WBM, life turned out to be just burgers and beans after all:

> Scientists abandoned the notion of life energy over a century ago because there was no evidence that such a force exists (and there still isn't). After figuring out all the basic processes of life, there was essentially nothing left for the alleged life force to do. (Novella, 2012, p. 25)

When students understand the history of Vitalism, it puts skeptical Eurocentric diatribes against *Chi* in perspective (Huston, 1995), as this student remarks:

> I find that there is a pattern with skeptics where no amount of proof or evidence is enough to even open their minds to a new idea, let alone believe it is effective. Those who believe in alternative or integrative medicine do not discredit the effectiveness of "real" medication, rather they aim to expand this field to include other ways of healing. The skeptics do not accept CAM as even a potential option for someone in need of healing. I think to dismiss these studies is a mistake, and I am unsure if any amount of proof will be enough for true skeptics. (Student #5, personal communication, December 2021)

The Hand's-on CAM Classroom

Preparing a Homeopathic Super-Dilution

Maybe experiencing the testing of CAM modalities themselves would deepen students' critical reflection and dissuade them from too-quick judgments about impossible things? Homeopathy is a 1.2 billion dollar industry in the US (Plante, 2019, para. 10) and is used throughout the world (Williams, 2013, pp. 147-49). Its basic principle, developed in the 19th century by Samuel Hahnemann, is to find a substance which *causes* a certain symptom, put a small amount of this active ingredient in a jar, and dilute it with water beyond the existence of the original substance. Then use a few drops of that inert solution to cure the symptom. Thus, counterintuitively, coffee works as a sleep aid, and poison ivy might work to cure a rash. Students can make their own remedy in class, including "potentizing" the solution by "succussing" it—meaning rapping the dropper bottle in their hands 40 times while they hold their intention for the benefits of the remedy (Figure 3). This copies Hahnemann's language and process (Simpson, 2018).

Figure 3
Succussing a Homeopathic Dilution

Skeptics believe this is absurd, and anyone who uses Homeopathy is deluded (Plante, 2019). Curiously, when students go through the process for themselves, most do not find it nonsensical. The drops of the remedy they put under their tongue or rub on a sore knee (100% water) remind them of the *intention* they held while making their remedy, and some report positive results:

> After listening to James Randi's skeptic talk on homeopathy, I can see how scientifically it does not really make sense. Substances are so diluted to the point that there is essentially nothing left but water. When I think of homeopathy in this way, I can see why many people think there is no medical value. On the other hand, my reasoning as to why homeopathic remedies have some medical value is because of the placebo effect. Our mindset can affect our health. (Student #6, personal communication, December 2021)

Students' conclusions in the classroom approximate the reactions to homeopathy in the world outside. Even when CAM classroom experiments following experimental protocol reach inconclusive results, it does not mean students toss out the entire modality. However, a number of students always remain unconvinced because in class, they are encouraged to stay tuned in to their "baloney detection" *à la* Carl Sagan (2011, pp. 201-218):

> Try as I might, Homeopathy is an alternative medicine that I believe is a sham (aside from the ones that are obviously a sham like drinking cow urine). This opinion was further solidified when we were told that the potency of the homeopathic cures was made stronger by hitting the bottle. (Student #7, personal communication, December 2021)

The key point here is the tension between balancing empirical results with personal belief systems. Looking over the results of their experiment, one student remarked:

> I think that homeopathic remedies and placebos have a lot in common. I would say that the success is less about the number of times that the substance is diluted and shaken, and more about the intention and confidence that we put behind it. (Student #8, personal communication, May 2021)

Detecting the Human Energy Field

In 1998 11-year-old Emily Rosa co-authored a paper in the prestigious *Journal of the American Medical Association* (*JAMA*) (Rosa et al., 1998). She completed a class science project that challenged practitioners of Therapeutic Touch (TT) and set off a firestorm of oppositional journalism. TT practitioners believe there is a Human Energy Field (HEF) in and surrounding our bodies (a la *Chi* and Vitalism) and that by using their hands to feel and control the HEF, they can reduce pain and anxiety and help someone who is sick. TT is used in some conventional hospitals, and nurses can receive in-service TT training (Mount Sinai, 2021), which particularly irritates skeptics as this CAM modality is sometimes accepted on the right side of the Wall (Sarner, 1998).

Emily performed a simple, yet ingenious experiment. Setting up a piece of cardboard with holes in the bottom for the practitioners' hands, she sat across from the practitioners and had them put their hands palms up through the holes. Then, on the other side of the cardboard and out of their sight, Emily held a hand randomly above the practitioner's hands and asked 20 times whether her hand was above the practitioner's left or right hand. Emily repeated this with 21 trained TT practitioners. The practitioners "guessed" correctly where Emily's hand was about 50% of the time, no better than chance. Embarrassingly, Emily had explained the experimental protocol to each of them and asked them whether, under these conditions, they would be able to

detect the HEF. They all said yes. Emily reported in her *JAMA* paper that the HEF was undetectable (if it existed at all), and TT was a sham.

For the skeptical community, this was a slam dunk (Sarner, 1998). HEF did not exist, and TT was finished. For practitioners, advocates, and patients, not so much. In fact, the publication of these results did not affect the use of TT in hospitals (Bleske-Rechek et al., 2019). When students perform this experiment in the classroom, and it is easy as all you need is a large piece of cardboard with two holes in the bottom (one student role-playing the practitioner and one role-playing Emily), students get the same results as Emily: about 50% correct guesses (Figure 4).

Figure 4
Detecting the Human Energy Field

Students are assigned Emily's *JAMA* paper, Sarner's skeptical critique, and a contemporary account in *Time* (Lemonick, 1998), to examine the argument. Does this tell them that the HEF does not exist? Does it make them feel that TT is a foolish modality? Not at all. It does lead to an involved discussion on the question of "What's going on here?" This inquiry does not demonstrate analytical naivete on the students' part, but a strengthening of their critically reflective imagination, as the following two statements demonstrate:

> I really enjoyed replicating Emily's Therapeutic Touch and Human Energy Field experiment. This was an awesome and educational way to bring in the assigned readings and alternative perspectives into the classroom. As a spiritual person myself, I found that my perspective around Therapeutic Touch and Human Energy Field was different before and after completing the in-class experiment. If we were only assigned to read the articles instead of completing the experiment ourselves, I do not think that I would have had the ability to change perspectives and really think about Therapeutic Touch and Human Energy Field from a personal point of view (Student #9, personal communication, December 2021).

Here is another student who acknowledged the class had confirmed Emily's results:

> I thought Emily's experiment in class was interesting because none of the students claimed to be able to sense human energy fields. We received the same results as Emily did in her experiment, which I think further proves that her experiment meant bad news for the touch therapists. Even if Therapeutic Touch is a placebo effect, it still manages to help some people live an easier, happier life; why should we try so hard to invalidate that? (Student #10, personal communication, December 2021).

Placebos Without Deception

It is an ongoing mystery as to why people turn to CAM and why many claim it "works." Why should foot massages (Reflexology) or ocean bathing (Balneotherapy) work as cures, against all scientific evidence? We all have an answer for this. When someone recovers from an illness by taking or doing something that is unconventional, it is common to hear, "Well, that's *just* a placebo." Placebos have always gotten a bad rap. They are the sugar pill used to prove the "real" medicine works in an RCT (Collins & Pinch, 2008).

This placebo story is incomplete, as research is continuing to explore how effective open-label placeboes might be, i.e., a prescription that someone takes *knowing* it is a placebo (Feinberg, 2013; Kaptchuk et al., 2010; Robson, 2018). The thinking is that something about taking a placebo pill, especially prescribed from an empathic listener, may amplify the body's "self-healing network" and provide drug-free relief (Silberman, 2010, para. 7).

Students can demonstrate this in the classroom. Divided into pairs, as a Practitioner and Client, the Client comes to the Practitioner with some condition of their choosing, for example, nervousness about an upcoming exam. The Practitioner, suspending their disbelief and listening compassionately, prescribes placebos based on published experimental data (Silberman, 2010), and the Client leaves with a prescription in a "child proof" vial of "pills" (for example, colored beans or lentils) (Figure 5). It turns out that red placebos can be a stimulant, yellow an antidepressant, green can reduce anxiety, and the amounts and sizes of placebos have measurable effects (Silberman, 2009).

Figure 5

A Medicine Bottle of Placebo "Pills"

To begin, the students are assigned a number of readings outlining experiments using open-label placebos. The experiment lasts two weeks, during which time the Clients are asked to swallow the prescribed placebos. (If they cannot manage to swallow the bean pills, then it works just as well for them to make their placebos at home using different colored vegetables.) In the first week, the Practitioner, listening empathically, prescribes placebos based on the "condition" their Client presents them with, usually something having to do with stress, for example, they do not sleep well or are nervous about an upcoming exam or relationship. At the end of the (usually 10-minute) session, the Practitioner hands the Client a written prescription listing the prescribed bean pills.

A week later, during the second consultation, the Practitioner listens carefully to what the Client reports about their use of the placebos and makes a second prescription based on their client's self-report, often different from the first. A week later, the Practitioner meets for the last time with their Client and hears how the placebos worked over the two-week period. Everyone knows that they are "just swallowing beans" and that this is a classroom role-play where they are asked to "suspend their disbelief." Even in clinical situations, placebos do not work all the time, especially for certain aliments (Resnick & Hoddinott, 2021), but the point of this class experiment is not only to see if they "work" for the Client's condition, but for students to experientially explore the potential power of their relationship with the Client and the placebo effect.

For the most part, the students find this experiment exciting, and backed up by substantial reading, are amazed by a placebo's potential, which is seldom realized during the class experiment. The biggest challenge is suspending their disbelief around swallowing "just beans," and for some, they can find it challenging to simply keep taking them! Students are struck by the power of this experiment, and (in some cases) the Clients report positive outcomes from inert pills they know are "just beans," as one student wrote: "It is an amazing discovery that we can train our brain to activate our self-healing abilities through the use of placebos" (Student #11, personal communication, May 2021), and another commented:

> During our placebo experiment, I realized that my negative connotations with placebos had to be uncovered and changed so that I could experience the placebos for what they really were. The legitimacy of placebos is easier to accept when hard science is proving the real and concrete evidence that placebos are altering brain structure (Student #12, personal communication, May 2021).

This student used the research data we read in class to make their prescription:

> The [Kaptchuk] IBS study uses the following contexts to ensure the placebo's efficacy: "1) an accurate description of what is known about placebo effects, 2) encouragement to suspend disbelief, 3) instructions that foster a positive but realistic expectancy, and 4) directions to adhere to the medical ritual of pill taking" (Kaptchuk et al., 2010, p. 6). I believe that my class's assignment successfully covered these four contexts by reading articles about placebos prior to the beginning of the assignment and finding that they have some potential, discussing thoughts and opinions on the matter, and being assigned to prescribe and accept specific times and amounts to take the placebo. I found it fascinating to learn about how effective placebos can be, and how different variables can contribute to their efficacy whether we can see the label on the bottle or not. I think that a lot of their success has to do with confidence, intention, and trust in the person providing the placebo (Student #13, personal communication, December 2021).

All of the experiments reviewed here for the hands-on CAM classroom, the Homeopathic Super-Dilution, Detecting the Human Energy Field, and Placebos without Deception, are meant to give students a direct sensory, somatic, and emotional classroom experience about CAM practices. They are not meant to convince them one way or another as to the efficacy of CAM, and they usually do not. What they accomplish is deepening their interest in CAM while demonstrating that decisions about the efficacy or usefulness of CAM modalities are more complex than either proponents or skeptics claim they are.

Does Critical Reflection Always Lead to a Single Conclusion?

CAM skeptics would like us to believe that science and the "truth" will lead students away from "believing in weird things" (Shermer, 1997). Many faculty have a definite view (or bias as described by students) about what is a reasonable topic to study and what is on the fringe (Trocco, 2000), but if students perceive inflexible cynicism, they are turned off to skeptical arguments. If we move away from the binary choice of science or pseudoscience, students are adept at finding a sensible middle ground. By maintaining an agnostic position regarding truth-claims, they can find credible approaches to investigate seemingly far-out modalities. As Citizen Scientists, CAM students become peer reviewers and community-based investigators, adding to their expertise and the scientific discourse (Collins & Pinch, 2008; Irwin & Wynne, 2003).

Is CAM scientific? Here is a definition of science that CAM students can work with: "Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence" (Science Council, para. 1, 2021). Skeptics think adjudicating the lines between science and pseudoscience is easy. As we have said, for decades, philosophers of science and anthropologists (Nelson, 1993) have protested that the boundaries between science and not-science are not as cleanly demarcated as skeptics would have us believe (Collins & Pinch, 1993; Hepeng and Jiao, 2007; Trocco, 1998). Investigating this liminal tension makes students better scholars, not gullible believers.

Many of the skeptics cited in this paper have an investment in the students' conclusions (e.g., Barrett, 2021; Randi, 2013; Shermer, 1997;). For them, "critical thinking" only leads in one direction. They can be so focused on explaining the silliness of CAM ideas that they skip the step of giving students the interdisciplinary tools to truly examine them. But this approach does not change minds or hearts (inside or outside the classroom) and does not lead to deep critical reflection, as Irwin et al. point out: ". . . if scientists are sincere in their desire to communicate more effectively with the rest of society—then this will involve a willingness to engage with alternative worldviews and 'knowledges' rather than labeling them in advance as emotive and ignorant" (2003, p. 64).

Working with CAM in the classroom, given sometimes impossible and contradictory problems to solve, leads to a path of inquiry-based learning that places students in a "disorienting dilemma" (Mezirow, 1991)—a mismatch between what we think we know and something previously seen as implausible. Students are then compelled to question their assumptions, which can lead to a transformative educational experience (Western Governors University, 2020). The strategy is to position students in learning situations in which they are faced with multiple realities. The process often gets messy before it is resolved as they are pushed to narrow down the choices and edge closer and closer to a solution that makes the most analytical sense.

Is Pedagogy More Important Than the Truth?

The question in this sub-title does not have to be the choice! To deepen thinking skills, we can personally engage students in the problems we give them, even to the point where arriving at a single truth may be unlikely. Aristotle did not believe there could be multiple epistemic truths (see his law of non-contradiction), and, buoyed by the scientific ethos, his belief has seeped into our primary assumptions that two conflicting truths cannot inhabit the same space.

The pedagogical magic is in allowing students to solve tangled problems while the instructor remains unattached to them, arriving at the "right" answer. Most critical thinking seminars involving CAM are deterministic; their goal is to have students achieve a particular outcome. This mimics pedagogy from a banking model of education rather than a constructivist model where students collaboratively build individual and integrated knowledge (Hein, 1995).

The design of these classroom experiments can always be improved by other teachers, as they are meant to fit within a class period. Even more exciting, it would be easy to create simple experiments for other popular CAM modalities in the classroom, for example: Reiki, Acupressure, Coining, Hypnosis, Astrology, and Prayer. These experiments would not reach the level of RCTs, or create any real proof one way or the other, as they are meant as illustrative teaching tools to demonstrate to students the complexity of CAM modalities and why it is difficult for these modalities to move to the "Credible" side of the Wall. The unsolved larger question for CAM is whether it will *ever* be possible for these modalities to achieve scientific credibility without proving themselves against the scientific method and RCTs. It would be intriguing for other faculty to make these experiments into classroom citizen science projects for their students and part of student presentations to their community. There may be further benefits about teaching students about CAM as students interviewing other students discovered:

> When asked about their experience of CAM, one student stated, "I believe the mindset these modalities force you into encourages you to focus on your health in a way you hadn't before." Many students also cited CAM as a way to improve their physical health and reduce/prevent pain or treat injuries. Several students shared with us that they believed CAM practices improved their mental health/emotional well-being, helped them feel more balanced/grounded, gave them a way to express emotions, or helped give them better separation from their thoughts and feelings. (Bianco et al., 2022, pp. 7-8)

As classroom teachers incorporate these experiments and a constructivist pedagogy into their classrooms, it will be apparent that a limitation of the present study was the student population itself, with similar ethnicity, age, and class. It is hard to know how this may have skewed the student responses included here. We do know that healthcare practices are often determined by cultural factors that are stratified along racial lines. It may be that the receptiveness to these class experiments is due to the mostly Caucasian audience; however, significant numbers of African-Americans use CAM modalities, "CAM is substantially used by African-Americans, particularly among those with chronic conditions. African-Americans tend to use CAM for treatment versus prevention" (Barner et al., 2010, p. 2). There is every reason to believe the reception to these classroom experiments would be consistent across student populations.

It is not important that students arrive at the correct (that is, the teacher's) answer, only that they follow an evidence-based process that makes sense to them and their collaborating peers while drawing from the research and data. Unbiased critical reflection means the freedom

to come to any result, as long as students are using all the data and a considered process to arrive at a defensible conclusion—and *that's* science!

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