# Science and Culture:
# An Emerging Scholarship of Cross-Cultural Engagement

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## RESEARCH

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## ABSTRACT

As every human society has developed its own ways of knowing nature in order to survive, human science professionals may benefit from giving serious consideration to epistemologies that lie outside the a priori of scientific research. Cross cultural engagement (CCE) describes a practice wherein scientists step outside of their habituated "mental models" to temporarily inhabit very different worldview orientations. This practice can offer scientists different epistemic frameworks through which to view issues and gain perspective not afforded by more typical forms of scientific inquiry. First, it moderates the impulse to exclusively consider strange ideas discordant with professional training through the intellectual infrastructure (presuppositions, foundational assumptions) of one's scientific discipline. Such ideas may gain coherence when considered from within the cultural context of their origin. Second, the practice of CCE can reveal aspects of disciplinary intellectual infrastructure that are implicitly taken for granted among professionals, directing attention to tenants seldom discussed in contemporary professional discourse. Third, new forms of intercultural inquiry can begin to emerge in a more expansive and symmetric intercultural field where problems can be reframed with deliberate attention devoted to maintaining the integrity of each different form of human knowledge.

**Keywords:** Culture, cross-cultural engagement, nutrition science, epistemology, diversity.

## INTRODUCTION

"Our moral perils are not those of conscious malice …they are the perils which can be understood only if we realize the ironic tendency of virtues to turn into vices when too complacently relied upon; and of power to become vexatious if the wisdom which directs it is trusted too confidently"

Reinhold Niebuhr, *The Irony of American History*, p 133, 1952.

Today most academic professionals would likely agree that diversity of knowledge and ideas lie at the heart of what it means to be well-educated. But training in many scientific disciplines can still lead members to hold so tightly to western/scientific models for producing knowledge that little room seems available for open-minded consideration of many knowledge assets found in culturally diverse communities [2-4]. The formidable cognitive authority vested in science to define nature, reality and what

constitutes reliable knowledge of how the world works can condition professional scientists to believe that legitimate knowledge can only arise through methods accepted as valid within scientific societies. This stance is reified within many scientific disciplines, becoming self-evident truth for professionals trained to see their research methods as consonant with a wide, if not universal, range of societal problems and contexts (4,5). While such a perspective may be common or simply taken for granted within professional societies, it can be perceived as a monopolistic, even colonizing force by cultural communities who see their own culture and knowledge – originating outside the parameters of valid scientific research - as rich resources in solving the problems they now experience [3, 6-8]. Imposing scientific approaches as exclusively reliable can discourage or suppress community involvement in the naturally human activity of knowledge production [3,8,9]. Scientific authority is often used to summarily – though perhaps inadvertently - dismiss knowledge arising from beyond its parameters of truth without further examination or consideration, effectively silencing or negating the voice of cultural knowledge holders [3,7-11]. Powerful dynamics of peer approval within scientific societies can lead even the most fair-minded of scientists to dismiss cultural knowledge unless it can be tested scientifically, through methods deemed internally valid by professional members.

This article is written for human science and Extension professionals trained in the life or health sciences, natural science disciplines commonly presented as beginning with physical and empirical reality, not mental models or human ideas about reality. In my own experience as a student, science was portrayed as a process of separating oneself from the objects and events under study, positioning oneself as a detached or disinterested observer in order to further objective assessment. Science was presented as a strictly empirical endeavour, somehow acultural, relying upon peer critique and third-party refutation as the system of checks and balances leading to legitimate and authoritative knowledge of the world. Food and nutrition sciences were represented as highly disciplined, rigorous and systematic studies of food, health and disease independent of any underlying metaphysical basis or subjective ideology. Food itself was studied in physical, biochemical and molecular terms, as a materialistic matrix of essential nutrients and bioactive molecules. Nutrition science was taught as processes for discovering and verifying mechanisms of action for the various categories of molecules/nutrients comprising foods. Physiological consequences of food were explained through mechanistic, cause and effect actions. The ubiquitous search for mechanisms of action effectively projected machine-like qualities onto life forms under study, whether cells in culture, laboratory animal models or even human subjects. Such mechanistic views, materialistic orientations and positivist presuppositions were implicitly embedded within my academic training, which was devoid of any larger cultural or historical context of study. Philosophy or history of science generally or of nutrition science specifically was neither required nor recommended. As I stepped into the professional world of nutrition science societies, these basic underlying convictions seemed simply to be taken for granted as self-evident truths within the shared understandings and common reality of the professional community. Of course, perspectives that limit the way food is valued to the physiochemical realm of molecules comprising food, including essential nutrients including many other 'bioactive' substances are certainly valuable but they are also incomplete. Physiochemical orientations to inquiry tend to push into the background sociocultural relationships such as food as meaning, food as memory, food as human connection, food as cultural heritage and food as intimate connection to place. These dimensions of food and health are very real, yet they have been de-valued or dismissed as not congruent with the values and parameters recognized within the more narrow disciplinary or scientific realm. To this day the web of foundational concepts and presuppositions seems to remain virtually unquestioned within professional discourse; there seems to be little predisposition among nutrition scientists to invite inquiry into the fundamental assumptions lying beneath scientific practice.

I later became an Extension Specialist at a Land-Grant research university with explicit responsibilities to traverse the boundaries of science and society. The materialistic orientation of my training both framed and grounded my thinking as I encountered cultural communities with keen interest in food and health issues, including Indian Reservations or clinics practicing classical Chinese medicine [7]. In the course of my work I developed relationships with individuals from these communities who were quite knowledgeable and intelligent, well familiar with the scientific perspective I carried. Despite their sound understanding of what I knew as "science", these individuals did not share my exclusive attachment or devotion, opting instead to place a biomedical science perspective alongside other ways of knowing. They described theories and concepts (Qi, yin/yang theory, elder teachings) that were utterly foreign to my training and understandings of food and nutrition. As a scientific professional and authority figure, I was in a position to expediently to dismiss or disregard these strange ideas, but my growing relationships with a number of individuals from different cultural communities compelled my further consideration. The dissonance I experienced was at once highly unsettling and thought provoking. A divergent learning style combined with a passion for open and critical thinking helped me to hold and internalize this dissonance that I might learn from it. Outside the a priori of scientific research, I saw how local context and knowledge were interwoven, how many communities continue to draw upon their long-held knowledge in solving contemporary health problems [7-12]. I came to understand these foreign concepts as having their own coherence but grounded in very different orientations toward the natural world [3,8,9]. Every human culture throughout history has developed its own knowledge of food and health relationships as a means of survival [10], yet only biomedical perspectives were acknowledged during the course of my training. I became more critically aware of how my formal training could easily dissuade serious consideration for any representations of reality originating outside a biomedical frame of reference. Using critical reflection as a mirror, I began to recognize more fully the extent to which my professional training had conditioned my thinking; that science did not begin with "reality", but was itself built upon a constellation of presuppositions about how the world works. Take, for example, the idea that "effects have causes", or it's more elaborate cousin "physical effects have physical causes". These ideas are absolute presuppositions, metaphysical ideas that are neither questioned nor verifiable, but simply taken for granted by scientists [13]. Collingwood defines metaphysics as the science of absolute presuppositions, claiming that science and metaphysics are inextricably united, standing or falling together [13]. He warns us against confusing presuppositions with reality. Confronting cultural difference in a critically reflective way helped me to gain awareness of these more implicit, taken-for-granted dimensions of my scientific perspective. I began to actively seek out encounters with cultural difference, in part to put into fuller practice making explicit and critically examining the presuppositions and convictions that lie beneath my conceptual understandings of the scientific enterprise. A subtle yet irrevocable shift in my perspective emerged, one with profound implications.

My purpose in writing this article is to stimulate greater professional discourse around issues of culture, knowledge and science. I begin with an example from history to encourage critical reflection on knowledge/culture interrelationships. The concept of paradigms is then considered as an organizing framework with significant influence upon how one perceives issues and frames questions. I introduce a metaphorical model illustrating some of the deeper dimensions of human culture as a broader context for considering the scientific enterprise. The model illustrates visible expressions of culture (cultural foods or food-ways, for example), but also the less apparent, more powerful dimensions of culture, including those lying beneath scientific practice. Examples show how these concepts can be applied pedagogically, pointing to possibilities for broader forms of nutrition education. I also consider how these deeper dimensions of culture are often taken for granted as true (in the case of our own) or go unacknowledged (in cases of cultural

difference). Cross-cultural engagement (CCE) is introduced as a craft that can prepare and orient nutrition researchers to navigate some of the deeper dimensions of cultural difference. My hope is to stimulate more professional discourse around these ideas while suggesting that open and critical engagement with cultural difference might lead to better science and more respectful relationships with holders of knowledge who too often have been overlooked by the scientific enterprise.

## What Counts as Knowledge?

In 1535, the French explorer Jacques Cartier, searching for the Northwest Passage near the site of present-day Montreal, became ice-bound for the winter, stuck in the frozen St. Lawrence River [14]. Isolated by heavy snow and lacking familiarity with the harsh environment, his 110 men were relegated to subsistence on the food provisions stored in their icy ship-holds. Soon, illness was so rampant that by mid-March 25 men had died, and most others were so sick that hope for their recovery was all but abandoned. The expedition might well not have survived if it were not for an encounter with a Huron Indian Domagaia, who knew that the illness could be cured by a decoction of the bark and needles of the white cedar tree. Cartier immediately asked for that drink to be prepared for his men:

"…but at first only one or two would venture to use it, who were followed by the rest, and in a short time they were all completely cured. After this medicine was found to be effectual, there was so much eagerness to get it that the people were ready to kill each other as to who should be first served. Such quantities were used, that a tree as large as a well grown oak was completely lopped bare in five or six days, and the medicine wrought so well that if all the physicians of Montpelier or Louvain had been to attend us, with all the drugs of Alexandria, they could not have done so much for us in a whole year as that tree did in six days". [15]

The Huron People knew of an effective internal remedy for scurvy, which Europeans of the time thought to be caused by bad air [14]. Although the accounts of this episode were recorded in the Cartier expedition journal, for all practical purposes, Europeans largely ignored or forgot Indigenous North American remedies for scurvy. But not everyone. More than 200 years later having read of Cartier's experience, Sir James Lind, a Scottish physician in the British Navy, launched experiments that "proved" the dietary basis of scurvy in a 1753 publication "A Treatise of the Scurvy" [16]. Only Lind however, is generally given credit for providing the first scientific evidence that certain foods are needed to prevent ill health. Virtually without exception, the know-how possessed by Indigenous Peoples goes unacknowledged in contemporary nutrition texts. In this way, biomedical teachings continue to deny a full accounting of the human knowledge and historical contributions arising from a context of cultural difference. Why?

## Academic Culture: Thought Styles and Paradigms

Let us consider how the academic cultural context might influence our ideas about knowledge. The web of well established, often implicit presuppositions, convictions and assumptions supporting a scientific discipline has been referred to as a "thought style" by Fleck [17] and later, a "paradigm" by Kuhn [18,19]. Kuhn uses the term "paradigm" to refer to the shared understanding of rules and standards of scientific practice, including shared models of how the world works that prepares the student for membership in a particular scientific community [19]. He describes a paradigm as important because it exerts a deep, implicit hold on the scientific mind; a powerful influence to think of and perceive issues in one way rather than another. Because a paradigm is shared by a scientific community, certain categories and relationships become especially salient (bioactive molecules), while others are less noticeable or invisible (relational/spiritual dimensions of food). The shared perceptions and understandings of the paradigm greatly facilitate scientific advancement because scientists are freed from justifying basic concepts to solve the many nuanced puzzles left within the theoretical framework of the paradigm [19]. Over time and with

success, paradigms offer a scientific community a great sense of strength, identity and shared understandings.

But paradigms can also be a source of paradox. At the very core of their strength and success lie the seeds of vulnerability. A paradigm is something scientists tend to see through and think with, not about. Precisely because a paradigm is successful, its ideology and presuppositions over time become unconsciously taken for granted [19]. If such presuppositions hold strong and remain unchallenged, members will find ideas based on any other premise almost inconceivable. The paradigm conditions its members to reflexively demarcate "scientific" from "non-scientific" approaches, limiting both the scope and kinds of inquiry deemed acceptable by the scientific community. Regarding paradigms 'When you're a part something this real and this big, it's not like you have any choice in the matter, it is just what you do.' As the world changes over time, unexamined paradigms and presuppositions can eventually become confining and constraining, acting to limit thought. Fleck observed that once a structurally complete and closed system of beliefs [Meinungs system] consisting of many details and relations has been formed, it offers tenacious resistance to anything that contradicts it [17]. These dynamics are often invisible to members within the paradigm but quite apparent to some outside observers:

"Regardless of what Indians have said concerning their origins, their migrations, their experiences with birds, animals, lands, water, mountains, and other peoples, the scientists [i.e., Western academics] have maintained a stranglehold on the definitions of what respectable and reliable human experiences are. The Indian explanation is always cast aside as a superstition" [11, p7].

## The Iceberg Metaphor of Culture

Questions about paradigms, what counts as knowledge and what makes knowledge scientific are epistemological, pointing us toward the deeper dimensions of culture. Understanding culture at different levels is popularized by the "culture as iceberg" model, often used in Peace Corps volunteer training [20]. An adaptation of the iceberg model is depicted in Figure 1. The iceberg metaphor is imperfect in some ways but can be a useful starting point for nutrition science professionals trained in the life sciences. It can offer insights into the subjective realm of human experience that lies beyond and beneath the normative paradigms of nutrition science. Drawing critical attention to the iceberg metaphor could help scientific communities to more carefully consider what they might be taking for granted, overlooking, presuming as universal or imposing through their research methods.

The iceberg exposed above the surface of the water represents those aspects of culture that are physically tangible, apparent and observable by others. This is the artifact dimension of culture, or what we empirically observe when we confront another culture. With reference to nutrition, empirical artifacts would include foods or food components, recipes, ingredients, harvesting, processing, cooking and storage methods, along with eating patterns and observable food-related behaviors. It also includes one's physical appearance, behavior and measurable parameters of physiology such as pulse, blood pressure or biochemical analyses. Because the artifacts of culture can be observed, measured and verified by others, they fit well with a materialist/objectivist approach and are easily accessible as objects of empirical study by scientists. Surface artifacts are quite often manifestations of deeper dimensions of culture that are less visible but very powerful aspects of human experience [21]. In the iceberg metaphor, these so-called "unspoken" dimensions – though not always unspoken – lie below the water surface as less tangible aspects of culture. Included here are concepts of status, decision-making and individuality, along with norms regarding values, justice, leadership, personal relationships and notions of what constitutes success and progress. We also find approaches to defining issues, framing and solving problems, including epistemic dimensions of perceiving, knowing and intuition, notions of logic, philosophy, rationality and awareness. In the case of nutrition science, we often find implicit value orientations where humans are positioned over or against an inanimate, objectified natural world to be understood and used as a resource, subjugating nature for human benefit. As we move deeper, we

encounter the implicit, often sub-conscious thought-styles and paradigms mentioned earlier that govern the production of knowledge. Here, nutrition science embraces subject/object dualistic separation in the realm of mind/body and scientist/nature, to attachments to materialism, reductionism, mechanistic thought and seems averse to serious inquiry into the realm of human subjectivity at the individual or cultural level. The iceberg metaphor attempts to communicate the richness and vastness of the unseen dimensions of cultural diversity that lie beneath physically observable features.

The depth and complexity of culture at deeper levels often governs the overtly observable artifacts that lie above [21,22]. The governing power of such cultural rootedness can be seen clearly when considering how academic paradigms have such a powerful hold on the scientific mind. Human perception and cognitive function were presumed by many professionals to be universal, but recent work shows significant cultural difference in basic human perception and cognition [23,24]. Cultural rootedness helps to explain why it is important for academic professionals to develop the capacity to become sensitive to the deeper dimensions of culture [8,21]. When confronting another culture, it is not uncommon for even well-educated individuals who exhibit extensive knowledge of customs or language artifacts to presume cultural similarity or universality with regard to less visible or less conscious dimensions of culture [21]. The result is imposition of one's own familiar frame of reference (or academic paradigm) as the standard or organizing framework for all other perspectives. This stance maintains what Deloria experiences as "a stranglehold" in that it allows few opportunities for the expression of cultural diversity originating from beyond the parameters of truth set by professional scientists. Openness that allows for diversity of epistemology loosens the stranglehold, creating room to consider diverse organizing frameworks [21] or knowledge systems [8,22] lying outside of the a priori of scientific societies.

The observation above brings us to another important aspect of the iceberg metaphor. Most of the iceberg mass lies beneath the surface, suggesting that the majority of cultural difference lies with the less visible, more subjective dimensions of culture. Three related implications are worth mention. First, the typical realm of empirical study for food and nutrition science (nutrients, bioactive molecules, food-related behaviors, risk factors) by no means represents the complete story with regard to human experience and interaction with food. The model metaphorically suggests that we are studying the tip of the iceberg. Second, as every human society has had to develop its own knowledge of food and health relationships as a matter of survival, the greatest scope and power of cultural diversity might lie with the more subjective, unseen dimensions. Professionals who reflexively impose western science methods as universal organizing frameworks without giving appropriate consideration for diverse ways of knowing risk continuing to exclude or discount most of the richness and power of cultural diversity, as well as to diminish those who hold such knowledge [22]. Third, if professionals become more open to exploring the deeply rooted subjective dimensions of their own culture and scientific practice, they can consider more carefully how the process of scientific inquiry is itself embedded within human subjectivity. Study, critical reflection and collective discourse around the subjective foundations of science may reveal some insights into current limitations and new possibilities.

Ways of knowing, including paradigms of western science are culturally rooted in the still deeper realm of metaphysical worldview. The core beliefs of a metaphysical worldview are represented as the deepest region of the iceberg. As with a paradigm, we usually think with our worldview and because of our worldview, not about our worldview [25]. According to Sire, a worldview represents "a commitment, a fundamental orientation that can be expressed as a web of presuppositions, a master story or narrative about the basic constitution of reality that forms the basis for how people perceive and comprehend the world". As a foundation for our mental models, our worldview represents the "givens" or "reality", implicit ideas that are simply taken for granted and quite often non-

negotiable. A worldview is not consciously learned so much as implicitly absorbed from one's surrounding culture [26]. It represents the least visible, least conscious yet most entrenched aspect of one's thinking.

Encounters with cultural diversity at the worldview level can evoke unsettling dissonance that challenges one's sense of reality. As an Extension nutritionist working on Indian reservations in Northern Minnesota, I was introduced to ideas that spirituality and conscious intelligence are not limited to the human brain, but exist throughout the body, environment and cosmos. I encountered Anishinaabe teachings that refer to humans as "pathetic two-leggeds". The teachings explain humans as the beings most recently created, the most dependent upon on all other life forms for survival and the least in tune with the path of the natural world. Humans can therefore be considered in some ways as the most pathetic or weakest beings in nature. While I could have easily and summarily dismissed these ideas, giving them over to serious consideration and critical reflection forced me to confront the metaphysical nature of my own worldview; in this case convictions that humans are superior to other life forms, and ideas of the human mind as the exclusive source of consciousness and intelligence in an otherwise objective, materialistic, unconscious world. Patience and courage in holding such dissonance can reveal often unconsciously held dimensions of human subjectivity. Vine Deloria Jr. puts it this way:

"The major difference between American Indian views of the physical world and Western science lies in the premise accepted by Indians and rejected by scientists; the world in which we live is alive. Many scientists believe this idea to be primitive superstition and consequently the scientific explanation rejects any nuance of interpretation which would credit the existence of activities as having partial intelligence or sentience. American Indians look at events to determine the spiritual activity supporting or undergirding them. Science insists, albeit at a great price in understanding, that the observer be as detached as possible from the event he or she is observing. Indians know that human beings must participate in events, not isolate themselves from occurrences in the physical world. Indians thus obtain information from birds, animals, rivers and mountains which is inaccessible to modern science. " [11, p 40].

Is it possible to respectfully accommodate diversity of worldview in academic work? Must diverse worldviews be ignored, or stand in conflict over questions of validity? Or is it possible for scholars from diverse traditions to come together to better articulate, comprehend and experience diverse worldviews by exploring them from within?

## Examples from Nutrition Education

Many nutrition scientists are aware of the need to fashion educational approaches that are more appropriate to the cultural context of diverse communities. A typical contemporary approach to this practice is presented in Figure 2. In this depiction, the USDA Food Guide Pyramid has been modified to create a Native American Food Pyramid. The former food-guide pyramid has been adapted for use with Indigenous communities by including traditional Indian foods such as wild rice, rabbit, moose and salmon in the pyramid construct [27].

While the Native American Food Guide represents some improvement over the unmodified food guide pyramid, its cross-cultural dimension is limited to the artifact level. This form of cross-cultural nutrition education extracts Indigenous artifacts into a Euro-American worldview of hierarchical relationships, human pre-eminence and biomedical ways of knowing. These epistemic constructs emphasize food as fuel, food as essential nutrients, food as bioactive molecules, and nutrition in terms of experimentally predictable, observable and repeatable physiological and physiochemical effects. Modified-pyramid approaches may leave nutrition educators with the impression that the prevailing Euro-American worldviews and biomedical epistemologies represent the only conceivable way to gain any legitimate understanding of nutrition [7]. Indigenous knowledge of local foods, seasonal eating patterns, and worldviews that sea food as connection to Mother Earth, as memory, as consciousness and as spiritual nurturance [28] are de-valued or disregarded. So while the Native American Food Guide

Pyramid could well be considered as improvement over the un-adapted USDA pyramid, it represents only an initial "artifactual" step toward the admirable goal of being more culturally appropriate. To take another step, we must tap into cultural diversity that awaits our attention at deeper levels.

What might nutrition education look like if Indigenous communities had free reign to approach nutrition education from within their own worldview orientation? Of course, this will depend upon the unique culture and history of the community. As part of the Woodlands Wisdom Nutrition program, we asked Elders from Lac Courte Oreilles Band of Ojibwe to incorporate their cultural wisdom and knowledge into a symbolic representation that could be used to teach nutrition in their community. With the help of a Tribal College artist, the representation that they developed is shared in Figure 3.

The LCO Elders teach that the turtle at the center of the symbol refers to creation stories of the Ojibwe (Anishinaabe) people, and emphasizes the interrelatedness of all of creation. The circle is a depiction of a medicine wheel, the circle of life which gives reference to the four directions (east, south, west, north), the four seasons (spring, summer, fall, winter), the four stages of life (childhood, adolescence, adulthood, elderhood), the four races of humankind (red, yellow, black, white), the four elements of nature (sun, water, earth, wind), the four aspects of health (mental, emotional, physical, spiritual). Around the outside of the circle are but a few examples of the plants, animals, birds, medicines and foods that are associated with each direction, season, life-stage and health dimension. The symbol brings forth not just knowledge, but ways of living; ancestral teachings for how to live a good and healthy life interdependent with earth, water, plants and animals, with balance and spiritual interrelatedness. It holds many generations of collective knowledge and wisdom, and requires decades of study and life experience to learn and live into this wisdom. The Elders, as keepers of traditional knowledge and understandings, are the experts.

Might we as professionals risk excluding valuable perspectives and insights if we insist upon imposing our academic paradigms as the universal frameworks for teaching and understanding human nutrition? If we reflexively force all ideas to conform to our own paradigms or worldviews, we may be losing much, or perhaps most, of what diverse cultures have to offer. It is often forgotten that, prior to western influences, heart disease, diabetes and cancers were unknown to the Indigenous peoples of the Americas [14]. American Indian Tribes developed sophisticated systems of agriculture that have given us beans, corn, potatoes, pumpkins, squash, tomatoes and over twenty other foods, and more than 200 medicines that have been recorded in the Pharmacopeia of the United States of America since 1820 [14,29]. Moerman [30] reports that of the 31,566 kinds of vascular plants found in North America, American Indians used 2874 of these species as medicines, 1886 as foods, 492 as fibers for weaving, baskets, building materials etc. and 230 as dyes [30]. All told, they found a useful purpose for 3923 kinds of plants. Is it possible to develop academic models that hold more fully the depth and complexity of indigenous worldviews and ways of knowing?

The Woodlands Wisdom Nutrition Project has produced a model for a cross-cultural education program that includes biomedical and indigenous epistemologies. This project was initiated by Tribal Colleges as a proactive approach to address chronic health issues experienced by American Indian communities [12,31]. Woodlands Wisdom offered an opportunity for Reservation communities to express their desire for a nutrition program grounded within indigenous knowledge traditions, while bringing biomedical perspectives needed to articulate with professional nutrition programs. The model depicted in Figure 4 was developed in response to these needs. It positions indigenous perspectives and personal experience as legitimate knowledge paradigms through which to study nutrition and places them alongside a biomedical paradigm. This pedagogical approach presents multiple worldviews and epistemologies, asking learners to actively shift their own frame of reference to experience and think within multiple perspectives. The practice of temporarily shifting one's own frame of reference to accommodate another

worldview is referred to as transformational learning [32]. Figure 4 represents a pedagogical approach that adds transformational learning skills, theory and practice to the more common informational learning dimension. The model begins to accommodate the many voices on Reservation communities asserting that biomedical understandings of nutrition, diet and health in and of themselves are not sufficient for full restoration of the health of Woodlands peoples and their communities [12,31].

## Cross-Cultural Engagement Described

As the examples above suggest, the manner in which academic professionals engage cultural communities will likely influence the extent to which these communities sense opportunities to share knowledge originating beyond the parameters of truth set by academic professionals [4,33]. The term cross-cultural engagement (CCE) represents the craft of engaging individuals and communities who possess knowledge and understandings that are incommensurate with western/scientific or biomedical understandings [33,34]. The practitioner of CCE will seek out such fundamental cultural difference as opportunity to learn through respectful interfacing and critical reflection. By respectful interfacing, I mean taking the time to develop one's capacity to explore a foreign worldview by experiencing and appreciating the foreign terrain, slowly learning how to navigate according to the assumptions inherent in the terrain. This approach represents a stark contrast to the process of imposing a dominant worldview, epistemology or research methodology as an ultimate organizing frame of reference or authority [35]. Time is needed to prepare oneself through mentoring relationships and reflective practice.

In my own development, I have found that two processes to need to occur almost simultaneously: studying myself and shifting my academic identity from a conditioned role of knowledge arbiter toward a more participatory role of co-learner/apprentice [33]. As I shift professional conditioning and identity to co-learner/apprentice, space is opened to begin the process of careful listening to knowledge holders within the context of a culturally different worldview. This change in internal disposition allows for more level and fertile ground – more objective ground? - facilitating the beginning steps into a very different web of presuppositions, a very different way of seeing and understanding. This shift demands that I learn to bring my full humanity, my subjective self including my heart and soul as well as my life as an academic professional. Figure 1 now becomes a tool for self-study through which I also examine my own worldview orientation and academic paradigms that give cognitive support to my vocation. By examining myself at these often implicit depths, my identity as a professional is no longer chained to these ideas, bound by subconscious conditioning. I have room to move toward a more critical and informed relationship with my own worldview and epistemic orientations [8,35]. This self-study process also allows me to interact with people who do not share my worldview orientation without feeling a need to become defensive or protective. I become more aware of the impulse to frame any problem or understand any issue through the lens of my academic training and to become sensitive to how this lens can distort knowledge that is generated from different cultural orientations. It is important to emphasize here that the CCE development process does not ask that I abandon my worldview or uncritically accept or adopt a cultural heritage other than my own. Quite the contrary, by studying and critically reflecting upon my subjective self, I am better grounded culturally and philosophically so that I become more fully open to experiencing the full dimensions of cultural difference without fear of losing my personal identity. I become better prepared to recognize power differentials and to begin to navigate the sometimes unsettling terrain of cultural difference.

A basic protocol for the critically reflective practice of CCE comes from over 25 years of experience and is outlined below.

- Develop ongoing personal (not transactional) relationships with individuals who work within Indigenous cultures and value/hold Indigenous knowledge traditions.

• Maintain an open-minded disposition by suspending any impulse toward preliminary judgments or disbelief regarding the validity or tenability of Indigenous worldviews or concepts.

• Empathically consider Indigenous teachings and worldview orientations by cognitively inhabiting them to the extent possible. The goal of this advanced intercultural practice is to create a different cultural experience by imaginatively constructing a crude facsimile of an Indigenous cultural experience to the extent possible. This crude facsimile can be refined over time; the importance of initial attempts at cognitive frameshifting is that of creating a different cognitive vantage point from which to imagine and construct such a facsimile.

• Use the new cognitive vantage point and cultural experience to reflect upon your own habitual thought patterns and mental models. Try to recognize the culturally constructed nature of your mental models (linear, dualistic, objectifying, materialistic, universalizing, mechanistic, etc.) and value outlook (human control, human ascendency, ideas of success, progress, productivity, aversion to non-material phenomena, etc.).

• Begin to recognize and critically reflect upon your cognitive attachments to your habitual thought patterns, mental models and value outlook.

• Develop a capacity over time to temporarily loosen your attachment to thought patterns and mental models to make more cognitive room to inhabit, experience and refine your imaginative facsimile of an Indigenous worldview and cultural experience.

• Continue to episodically and dialogically dwell for periods of time within your constructed experiential facsimile, using it as a new reference point location for further reflecting upon your habitual/professional background assumptions and mental models. This dialogical moving back and forth between culturally different cognitive frames is the means to further develop and refine your frame-shifting capacity.

• Critically reflect on your experience with each of these steps in an iterative and ongoing process of action/reflection. What begins as cognitive moves become over time more emotive and embodied (visceral) experience.

The CCE preparation and development process will ultimately lead to academic work with a distinctly different stance and feel compared to the scientific inquiry I was taught. Philosophically, CCE shifts away from a materialist/objectivist stance that presumes direct interaction with objective reality toward a constructive realism that recognizes human subjectivity as inevitably involved in participation with the world [36]. From this orientation, the deeper dimensions of culture are recognized and acknowledged as essential to the process of inquiry, including those lying beneath academic research methods. Theoretically, CCE shifts from a mono-cultural stance, meaning that one's own culture (including one's worldview and academic paradigm) is experienced as somehow central to reality, to a multicultural posture, meaning that one seeks deeper subjective dimensions of cultural difference, accepting their importance and adapting one's perspective to take them into account [21]. In the practice of CCE, one resists the temptation to seek understanding through areas of commonality or what is familiar; rather, one seeks out cultural difference and dissonance as a source of learning. One would not attempt to understand indigenous science through the lens of biomedical science, for example, but opt instead to work with Elders to begin to understand indigenous knowledge within the context of its own indigenous worldview orientation. The possibility of multiple truths emerges as a resource for opening new horizons for exploration through the interfacing process (35). Pedagogically, CCE shifts from a strictly informational learning approach (adding to what we know) - to incorporate transformational learning (adding to how we know) [32]. Transformational learning, or critical reflection upon the form of knowing, is seldom attended to in the natural science disciplines. CCE includes materialist/objectivist approaches but its commitments are more expansive than conventional scientific inquiry in the following ways:

• It challenges aspects of scientific and biomedical authority that work to either exclude diverse ways of

knowing, or force unwanted alignment with or assimilation into Eurocentric disciplinary frameworks [3,10,11].

• It welcomes and involves knowledge holders of community-based epistemologies without relying upon academic credentials or scientific validation per se.

• It expands the scope and reach of academic inquiry, respectfully including many knowledge assets that exist beyond the academy.

• It represents a trans-cultural form of participatory action research [37-39].

• Its currency includes wisdom, values and trust, in addition to knowledge and evidence.

• It calls into question assumptions about the extent to which academic progress (validating and authenticating knowledge) leads to societal progress (improving the human condition).

Conducted respectfully, the craft of CCE represents a means to:

• Build long-term, working relationships with communities who may not feel respectfully included in the work of research universities.

• Protect, preserve and advance community-based knowledge without unwanted co-optation or assimilation into predominant Eurocentric epistemologies.

• Enhance inclusiveness, cultural diversity and breadth of perspective at public research universities.

• Enhance scientific inquiry by bringing critical reflection to its implicit metaphysical dimensions.

• Create innovation through diverse understandings that can re-frame pressing societal problems around food, nutrition and health.

Comparing CCE and Materialist/Objectivist Inquiry

Figure 5a and 5b further illustrate the conceptual differences between CCE and materialist/ objectivist scientific inquiry that has prevailed in nutrition sciences.

Figure 5a. Adapted from previous work (Schein, 1992; Hassel, 2006; 2007), aspects of culture can be categorized from highly visible and tangible to progressively deeper, less visible yet more powerful levels. Metaphysical worldview commitments can be seen as the underlying tenets of a culture that represent the “givens” which tend to be taken for granted and are non-negotiable because they are invisible and often subconscious. They are projected onto the world as a framework for perceiving phenomena. A feature of CCE practice is the “tension of epistemology” evoked by challenging entrenched presuppositions on one hand, and the powerful learning opportunities created by considering alternative possibilities on the other.

CCE welcomes and embraces diverse epistemologies and worldviews as resources to be shared, experienced, studied and included in scholarly inquiry (Figure 5a). Materialist/objectivist inquiry upholds a neutral rationality that distinguishes empirical scientific methods from other knowledge systems [6]. As materialist/objectivist traditions rely upon a world of observable experience that claims no metaphysical basis [6], the deeper more subjective dimensions of culture are generally unacknowledged or under-appreciated (Figure 5b). If acknowledged, diverse ways of knowing are often seen as less complex, less “real”, less “valid” or less “rigorous” than professional “research-based” epistemologies [2]. This comparison can be further considered through the intercultural developmental model of Bennet [21]. The Bennet model characterizes stages of development with regard to patterns of how people experience the phenomenon of cultural difference. The stages move from more mono-cultural orientations of “denial” of cultural difference, “defense” of one’s own culture as superior, then “minimization” of cultural difference, to more multi-cultural orientations of “acceptance” of cultural difference, then “adaptation” to cultural difference [21,40]. The depiction in Figure 5b represents a stage of development where a familiar worldview – in this case a Eurocentric worldview - is protected by presuming universality, failing to account for the deeper cultural dimensions of human experience [21]. This stage of mono-cultural development would be categorized as “minimization” because such presumptions tend to minimize or obscure the more subjective and deeply held cultural differences. The minimization stage is commonly experienced as having “arrived” at intercultural

sensitivity by believing that deep down we are all basically alike [21], and because the polarization of cultural "us" versus "them" has given way to a "colorblind" recognition of the common humanity of all people, regardless of culture [40]. The point here is not to debate the importance of human similarities, but to emphasize that over-attachment to the concept of human similarity can obscure recognition, acceptance and appreciation for the deeper, less visible dimensions of cultural diversity [21]. The depiction in Figure 5a recognizes the deeper dimensions of cultural diversity and includes these dimensions as part of the inquiry process. In the intercultural model, CCE would be seen as a transition into multi-cultural stages of development because the deeper dimensions of cultural difference are not only accounted for but seen as opportunities for personal and professional learning and as a source of innovation [40].

## Implications for Research

What are the implications of CCE scholarship for nutrition research? I believe that contemporary nutrition science is perhaps "stuck" in some ways with respect to resolving diet-related chronic diseases. Bringing to the table citizens who see the world differently exposes what academic professionals often take for granted; implicit ideology that frames - and therefore limits - scientific thinking. Despite unprecedented advancements, the recent intellectual progress (understood as advancing scientific knowledge) enjoyed by nutrition disciplines appears less translatable into societal progress (understood as improving the human condition) [41]. Observing this apparent and growing disconnect, Jeffrey Bloomberg recently stated "Something is terribly wrong."[42]. A hard-core empiricist could well argue that nothing is necessarily "wrong", that success or failure of science ought be judged only with respect to the capacity of a discipline to reach its intellectual aims, disregarding questions of whether pursuing these intellectual aims improves the human condition. Yet most research proposals imply at least some connection between stated project objectives and existing social problems as a means to attract public investment. Who benefits from our intellectual progress? Is this question a concern for nutrition scientists? Clearly, many factors that determine societal progress lie beyond the control and responsibility of the nutrition science community. But some epistemological issues may lie squarely at the feet of nutrition scientists.

Consider briefly the "gold standard" of research evidence in much of the biomedical world, the randomized-controlled trial (RCT). RCT methodology is designed to measure common denominator parameters across groups of individuals as treatment effects are compared. Individual differences among human subjects are supposedly "washed out" by selection and randomization strategies, presuming people to be otherwise basically alike. The "gold standard" status persists despite the fact that quite recent developments have begun to elaborate more nuanced human individuality, heterogeneity and genetic polymorphism that are obscured by randomization. Our best methods bracket out the poorly understood sets of relations between the highly complex food matrix on one hand and the intricate nature of human heterogeneity on the other. Indirect effects are labeled "placebo" and taken to be less "real" than the tested treatment effects [43]. Single factor clinical trials increasingly seem inadequate to the task of dealing with the emerging complexity of food and health relationships. Complex, systemic societal problems like diet-related chronic disease are among those proving most difficult for science, owing in part to epistemological and methodological limitations of prevailing scientific inquiry [44].

Only sixty years ago, the biomedical community considered unscientific any ideas that a change in diet could produce health in ways unrelated to essential nutrients. Yet the most ancient text of Ayurveda, the Charaka Samhita, states in translation over 2000 years ago that "The difference between health and disease arises as the result of the difference between wholesome and unwholesome diet…. disease is the result of faulty nutrition" [45]. Biomedical inquiry is only now beginning to reveal the world of highly individualized food and genome response [46]. The ancient sciences, including classical Chinese medicine and Ayurveda, have long-distinguished and highly elaborated

individual diet response patterns for millennia [9,45]. Perhaps engaging those who hold knowledge in systems beyond the a priori of biomedical research can help us to recognize how, epistemologically speaking, there may be more cards in the deck than we have been playing.

As indicated earlier, lying beneath our research hypotheses are largely unexamined foundational presuppositions. We now have no professionally acknowledged means within the food and nutrition sciences for directing critical inquiry into these pre-theoretical presuppositions. Lack of attention to metaphysical presuppositions can create “blind spots” that serve to limit inquiry within scientific disciplines, particularly as problems being investigated evolve over time [47]. Limitations of nutrition science have become more problematic as attention in the field has shifted from nutritional deficiency diseases and nutritionally “adequate” diets to complex chronic diseases and “healthful” diets [16,41]. CCE may therefore help scientific professionals recognize cultural diversity as an opportunity to bring critical attention to the worldview convictions that precede, saturate and drive the methods, trajectory and societal relevance of the scientific enterprise. Symposia could be designed to open these ideas to rigorous and critical thought. Perhaps it is time to infuse more philosophy back into our Ph.D. programs.

As indicated earlier, training in the natural sciences still can lead scientists to dismiss culturally-based processes of knowledge production as non-scientific without giving serious consideration to knowledge assets as they exist within a cultural worldview. Contemporary researchers are likely to see knowledge advancement as something that occurs only within the microworlds of academic disciplines, under the direction of credentialed disciplinary experts. Yet many sectors of society are increasingly speaking back to science. Cultural communities are asserting their right to produce knowledge as part of their people-hood and cultural identity [3,8,35]. Community-based Elders and knowledge-holders have a vested interest in both protecting and advancing their cultural-based healing traditions and epistemologies that in many cases have persisted for millennia. If scholars are not sensitive to the deeper cultural foundations of non-Eurocentric knowledge traditions, problems will likely arise when they engage in academic work with cultural communities, especially in the research enterprise [34]. For example, professional scientists are sometimes surprised when practices considered quite acceptable and perhaps even encouraged within a professional discipline are seen by cultural communities as not only unhelpful, but damaging [3,12,22]. This is partly due to a philosophical legacy presuming the natural sciences to be morally or ethically neutral and dissociated from problems arising from unequal power relationships [48].

By contrast, cultural communities have witnessed exploitation, erosion or fragmentation of their knowledge systems, often from forces of colonization that readily impose Eurocentric science methods while discounting or negating their knowledge and epistemology [3,13]. When professional scholars recognize value in cultural knowledge but without the developmental preparation needed for sensitivity to its deeper cultural context or its fragile state, the door opens to scholarship that represents an ongoing struggle for many cultural communities. In the natural sciences these practices include assimilating or “integrating” practical knowledge (acupuncture or use of herbs into a biomedical paradigm without acknowledgment of underlying theory (qi, yin/yang theory, Figure 5b). Such practices can distort knowledge by dissociation from its deeper cultural context that provides understanding, meaning or significance. The cognitive authority of science easily tears the fabric of knowledge as situated in its appropriate worldview orientation. These consequences often go unacknowledged on campus, flying beneath the radar of institutional review board ethics as they are under-appreciated or invisible to professional scientists who have yet to achieve a threshold of intercultural sensitivity and experience [21]. When viewed from within the context of a cultural community or healing tradition, such practices are perceived as compromising the community’s capacity to maintain, produce or repair its own knowledge [38]. Indigenous communities often experience scientific research as generating a wake of destruction that

contributes directly to the disregard for and erosion of the epistemic and theoretical integrity of community-based knowledge systems [3]. Scholarship that assimilates or co-opts knowledge is still rewarded on campus and within scientific societies, as it is seen within professional circles as contributing directly to the disciplinary knowledge advancement enterprise. Internally-oriented academic norms or campus reward structures can easily perpetuate damaging epistemic consequences in communities unless faculty build the capacity for cross-cultural awareness and sensitivity sufficiently to acknowledge power differential and negotiate these conflicts of interest.

CCE scholarship is clearly not a practice to be expected of every research professional. It can create misgivings among scientists because it challenges ideas that biomedical and Eurocentric epistemologies represent the only reliable means for creating valid knowledge of how the world works. CCE may well be viewed as a step backward by academic professionals who see contemporary science as clearly superior over ancient or other non-western forms of knowledge. From this view, not only is CCE unlikely to offer any significant potential for academic gain, it risks contaminating the purity of the scientific enterprise if the distinguishing characteristics of Eurocentric sciences are somehow obfuscated through CCE. Accordingly, it would not belong within the work scope of the modern research university. These perspectives should be given due respect, as the Eurocentric science traditions have yielded tremendous benefits to society.

My argument here is that because of the remarkable successes owing to scientific progress, we have become too complacent, too attached and too over-reliant upon Eurocentric paradigms and presuppositions as the exclusive means to solve any societal problem. This state of affairs can limit our world of possibility [47].

Seen in this way, cultural diversity is not a matter of political correctness, but cuts to the very core of the academic enterprise in how we see the world, how we make sense of it and how we construct meaning and knowledge about it. If we can learn to embrace our subjectivity rather than deny or struggle against it, perhaps we can position ourselves not only to better understand diverse cultural perspectives, but also to critically explore the foundational convictions upon which our own scientific inquiry is professionally practiced. Public research universities, especially Land-grant research universities, should have a unique niche in being able to respectfully access and participate with the many knowledge assets in society, fully recognizing the rights and capacities of non-academic communities to create and advance their own knowledge as a means of improving their condition [34]. Professional scientists who choose to develop CCE skills will be equipping themselves for new scholarly opportunities and innovation lying at the interface of diverse worldviews. Scholars who are open, sincere and persistent in their efforts will find a very rewarding array of experiences with community partners. The personal reward of long-term relationships not only opens an expansive range of scholarly possibilities as problems are reframed from different cultural orientations, but can be experienced as scholarship with a capacity to bring about healing. The deeper dimensions cultural difference offers the academic scholar terrain to be experienced and navigated in a collective journey of partnership and learning.

I believe the academic work referred to here as CCE has a rightful place within the scope of nutrition research and education. In the third decade of the 21st century, today's students are hungry for a fuller education around the human experience of food and health, seeking to explore implications below the surface of the metaphorical iceberg. Many cultural communities that have been ignored or disenfranchised would welcome the opportunity to work together with faculty who are able to bring the sensitivity, courage and good heart to respectfully navigate deeper cultural worlds. Faculty development programs that cultivate the skills and disposition needed for CCE offer a means for building the institutional capacity for respectful and sensitive intercultural coursework and research. Such development work is not trivial, and will require significant investment of resources with a long-term focus. As the relationship between cultural diversity and academic excellence becomes more apparent, campus

climate and institutional policies will evolve to better accommodate faculty who choose to do this work. Questions remain regarding the depth, sincerity and intellectual integrity of this accommodation and whether such change can come from within campus and academic societies or will be imposed by external forces. Let us use wisely the time now for honest and productive discourse.

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## REFERENCES

1. Nowotony, H, Scott P, Gibbons, M. Re-Thinking Science. Knowledge and the Public in an Age of Uncertainty. Malden, MA, Polity; 2001.

2. Semali L, Grim B, Maretzki A. Barriers to the inclusion of indigenous knowledge concepts in teaching, research and outreach. J. Higher Ed Outreach & Engagement, 2006; 11(2): 73-88.

3. Smith LT. Decolonizing Methodologies: Research and Indigenous Peoples. New York, NY: Zed Books; 1999.

4. Cochran PAL., Marshall CA., Garcia-Downing C, Kendall E, Cook,D, McCubbin M, Gover, RMS. Indigenous ways of knowing: Implications for participatory research and community. Amer J Pub Health 2008; 98: 22-27.

5. Wallace, B.A. (2000). The taboo of subjectivity. Toward a new science of consciousness. New York: Oxford University Press; 2000, pp17-39.

6. Popper K. The logic of scientific discovery. New York: Basic Books, 1959.

7. Hassel C. Can diversity extend to ways of knowing? Engaging cross-cultural paradigms. Journal of Extension 2004; 42(2). http://www.joe.org/joe/2004april/a7.shtml. Retrieved from the web 2/1/2008.

8. Cultural Wellness Center (2008) http://www.ppcwc.org/about_us. Retrieved from the web 2/10/08.

9. Fruehauf H. Chinese Medicine in crisis. Science, politics and the making of “TCM”. Journal of Chinese Medicine, 1999; 61: 6-14.

10. Kiple KF, Ornelas KC. The Cambridge World History of Food. Cambridge UK: Cambridge; 2000.

11. Deloria Jr V. Red earth white lies. Golden, Co: Fulcrum; 1997.

12. Hassel C. Woodlands Wisdom: A nutrition program interfacing indigenous and biomedical epistemologies. J Nutr Educ Behav, 2006; 38(2): 114-120.

13. Collingwood RG. An essay on metaphysics. London: Oxford University Press; 1940, p21-48.

14. Vogel VJ. American Indian medicine. Norman, OK: University of Oklahoma Press; 1970. p. 3-4.

15. Cartier Expedition Journal, Exploration.net trans. http://explorion.net/r.kerr-general-history-collection-voyages-travels-6/page-40.html. Retrieved from the Web 1/15/08.

16. Carr T. Discovering nutrition. Malden, MA: Blackwell; 2003, p4.

17. Fleck, L. Genesis and development of a scientific fact, ed. Trenn, TJ, Merton, RK. trans. Bradley F, Trenn TJ. Chicago IL: University of Chicago Press; [1935] (1979).

18. Kuhn TS. The structure of scientific revolutions. Chicago IL: University of Chicago Press; 1962.

19. Kuhn TS. The structure of scientific revolutions, 3rd edition. Chicago IL: University of Chicago Press; 1996.

20. Clevinger, R. http://www.uop.edu/sis/culture/pub/1.1.1_Activity_The_Iceberg.htm, 1999. Retrieved from the Web 11/25/07.

21. Bennet MJ. Towards ethnorelativism: A developmental model of intercultural sensitivity. In Paige RM, ed. Education for the Intercultural experience, 2nd ed. Yarmouth, ME: Intercultural Press; 1993. p. 21-71.

22. Schein E. Organizational Culture and Leadership. San Francisco, CA: Jossey-Bass; 1992.

23. Nisbett RE, Peng K, Choi I, Norenzayan A. Culture and systems of thought: Holistic versus analytic cognition. Psychological Review; 2001: 108(2), 291-310.

24. Nisbett RE.. The geography of thought. How Asians and Westerners think differently…and why. New York: The Free Press; 2003.

25. Sire JW. Naming the elephant. Worldview as a concept. Downers Grove, IL: Intervarsity; 2004. p.122.

26. Studley J. Dominant knowledge systems and local knowledge Mtn forum on-line library document; 1998. http://www.mtnforum.org/resources/library/studj98a.htm Retrieved from the web 2/10/08.

27. California Adolescent Fitness and Nutrition Program. Native American food guide. 2002. http://www.nal.usda.gov/fnic/Fpyr/NAmFGP.html, Retrieved from the Web 8/18/06.

28. Cajete G. Native science. Natural laws of interdependence. Santa Fe, NM: Clear Light; 2000.

29. Keoke ED, Porterfield KM. American Indian contributions to the world. 15,000 years of inventions and innovations. New York, N.Y: Checkmark; 2002.

30. Moerman, D. Native American Ethnobotany. Portland OR: Timber Press; 1998. p. 11.

31. Gailfus P, Hassel C, O'Kelley K, Brummel A, Ramczyk L, Wold A, Price M. Woodlands Wisdom: Tribal Colleges take action to improve community health across North America. Tribal College: Journal of American Indian Higher Education 2001; 13(3): 36-38.

32. Mesirow J, & Associates. Learning as transformation. San Francisco, CA: Jossey Bass; 2000.

33. Hassel C. The craft of cross-cultural engagement. Journal of Extension 2005; 43:6 #1. http://www.joe.org/joe/2005dec/a1.shtml. Retrieved from the Web 2/1/2008.

34. Hassel C. Can cross-cultural engagement improve the land-grant university? J of Extension 2007; 45(5) http://www.joe.org/joe/2007october/a7.shtml Retrieved from the Web 2/1/2008.

35. Azzahir, Ahmed. Interfacing Culture. Minneapolis, MN, Cultural Wellness Center; 2008.

36. Wallner F, ShenV, Van Doan T. Philosophy of Science and Education: Chinese and European Views, (HTML at crvp.org) Retrieved from the Web, 1/18/08.

37. Greenwood DJ, Levin M. Introduction to action research: Social research for social change. Thousand Oaks, CA: Sage Publications; 1998.

38. Fals Borda O, Rahman MA. Action and knowledge: Breaking the monopoly with participatory action research. New York: Apex; 1991.

39. Hall BL. From margins to center? The development and purpose of participatory research. Amer. Sociologist 1991; 23(4): 15-28.

40. Hammer MR, Bennet MJ. The intercultural development inventory manual. Portland OR; Intercultural Communication Institute; 2001.

41. Olshansky, SJ, Passaro, DJ, Hershow RC, et al. A potential decline in life expectancy in the United States in the 21st century. N. Engl. J. Med. 2005; 352(11):1138-45.

42. Lampe, F, Snyder, S. Conversations: Jeffery Bloomberg, PhD: The nutrition agenda. Alt. Therap 2006; 12(5):65-71.

43. Kaptchuck T. Subjectivity and the placebo effect in medicine. Alt. Therap. 2001; 7(5): 101-108.

44. Lubchenco J. Entering the century of the environment: A new social contract for science. Science, 1998; 279: 491-7.

45. Sharma H, Clark, C. Contemporary ayurveda. Medicine and research in Maharishi ayurveda. Philadelphia, PA; Churchill Livingstone; 1998. p. 57.

46. Tai ES, Sim XL, Ong TH, Wong TY, Saw SM, Aung T, Kathiresan S, Orho-Melander M, Ordovas JM, Tan JT, Seielstad M. Polymorphisms at newly identified lipid associated loci are associated with blood lipids and cardiovascular disease an Asian Malay population. J Lipid Res. 2008 Nov 5.

47. Schon, DA. The new scholarship requires a new epistemology. Change. 1995; 27(6): 26-36.

48. Alexaides MN, Laird SA. Laying the foundation: equitable biodiversity relationships. In: Biodiversity and Traditional Knowledge. London; Earthscan Publications Ltd; 2002. p. 11.

## FIGURES


**Figure 1.** Depiction of the Iceberg Metaphor of Culture (adapted from R.Clevinger by K.Lorenz).


**Figure 2.** Native American Food Guide Pyramid.


**Figure 3**. Artistic rendition of culturally appropriate nutrition education symbol developed by Lac Courte Oreilles (LCO) Elders as captured by artist Anna Martineau-Merritt. The symbol teaches the inter-relationships within nature essential to living a good life, reflecting indigenous worldviews and epistemology.

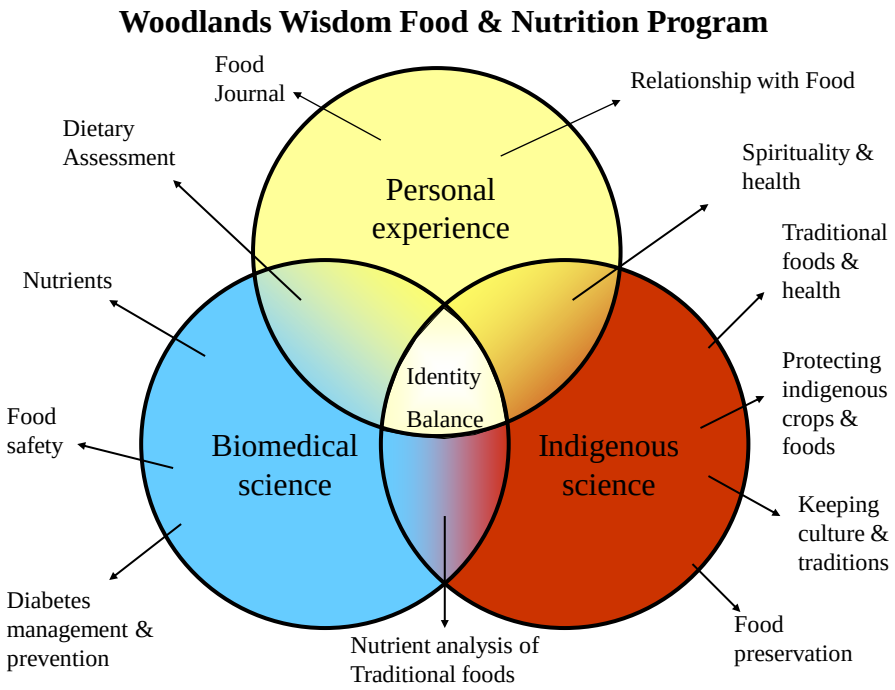


**Figure 4.** The Woodlands Wisdom Food & Nutrition Program (reproduced from Hassel, 2006).

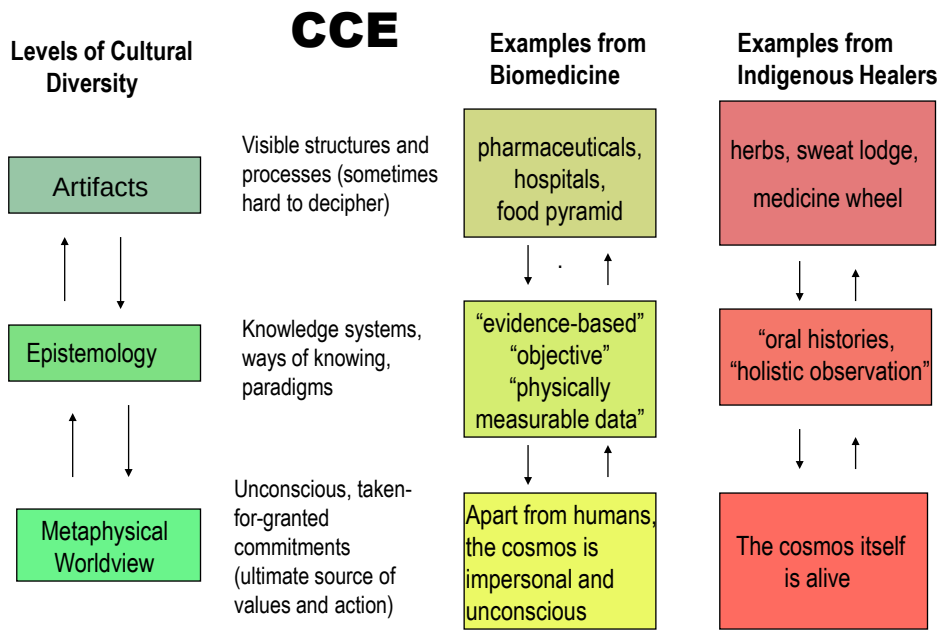


**Figure 5a.** Adapted from previous work (Schein, 1992; Hassel, 2006; 2007), aspects of culture can be categorized from highly visible and tangible to progressively deeper, less visible yet more powerful levels. Metaphysical worldview commitments can be seen as the underlying tenets of a culture that represent the "givens" which tend to be taken for granted and are non-negotiable because they are invisible and often subconscious. They are projected onto the world as a framework for perceiving phenomena. A feature of CCE practice is the "tension of epistemology" evoked by challenging entrenched presuppositions on one hand, and the powerful learning opportunities created by considering alternative possibilities on the other.

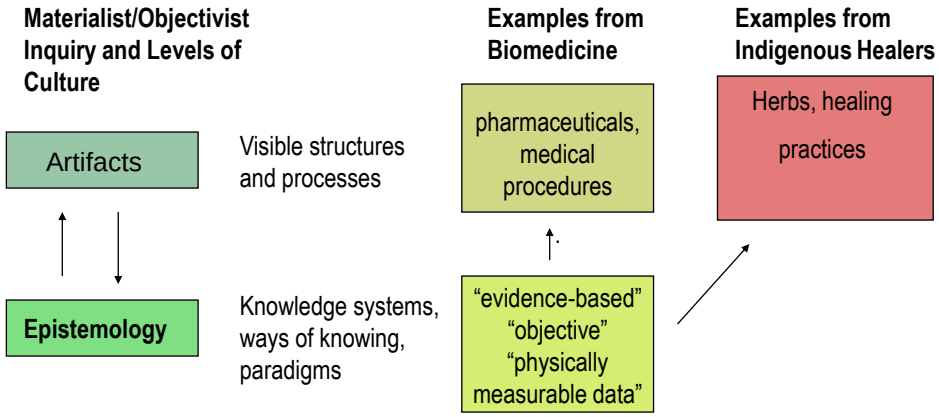


**Figure 5b.** Materialist/Objectivist inquiry investigates observable artifacts through falsifiable hypotheses to be tested empirically by experiment and observation. Metaphysical worldviews and diverse epistemologies are seldom acknowledged or examined, including the presuppositions foundational to scientific methodology.