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Toqwa'tu'kl Kjijitaqnn / Integrative Science

ThoughtTraps ∞∞

SCIENTIFIC PURSUIT OF KNOWLEDGE

for: MSIT 101/103, 201/203, 301/303, and 401/403

MSIT Course Manual
Version 2.5 (TEACHING DRAFT 2001-2002) by
TEAM UCCB MSIT 2001

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* some inserts and articles will be handed out in class

ELEMENTS IN THE PURSUIT OF SCIENTIFIC KNOWLEDGE

What is science?

Science is a human "way of knowing"
... about the world of Nature, in which ...

asking questions,
making observations,
constructing tentative answers,
testing answers against reality, and
communicating formal answers to other humans

... are all of central importance.

Some more thoughts about science:

- **L. Smolin ... a modern cosmologist, Pennsylvania State University:**
  Science is a search for an understanding of our relationship with the rest of the universe.

- **G. Cajete ... a modern Native American scientist and educator at the University of New Mexico:**
  Science is a story of the world and a practiced way of living that story.

- **Tibetan Book of the Dead:**
  Science is an organized discipline for seeking knowledge about the universe in an exact manner.

- **J. Lee ... a modern geographer at Texas Tech University:**
  Science is a way of learning about things; it is a process we use to improve our understanding of the universe and all that is in it.

- **J. Lovelock ... a modern scientist and proponent of the "Gaia Hypothesis":**
  Science is an activity carried out by people who have the time and inclination to wonder about the natural world and who then express a personal view ... these theories and ideas can be tested by the accuracy of their predictions.

- **E.O. Wilson ... a modern biologist, Harvard University, and proponent of the "Biophilia Hypothesis":**
  Science is an organized, systematic enterprise that gathers knowledge about the world and condenses it into testable laws and principles.

- **M. Shermer ... the publisher of *Skeptic* magazine:**
  Science is a process of inquiry aimed at building a testable body of knowledge about the world and which is constantly open to rejection or confirmation ... its "truths" are provisional, fluid, and changing.

- **F. Capra ... a modern physicist and Director of the Center for Ecoliteracy, California:**
  Science is a path (or method) to the understanding of reality based on experience that involves:
  - → collecting data via ... organized and systematic observation ("empirical data" = data based on observation), and
  - → explaining data via ... construction of models or theories to represent the results of observations (i.e., connecting the data into logical thought patterns).

- **K. Wilber ... a modern American philosopher who proposes "Integral Psychology":**
  Science follows the same basic three steps in its validation claims as do *all authentic knowledges*:

1. injunction (question)	..... if you want to know this, do this	a practice or paradigm
2. observation	get experience, apprehension, or evidence	collect data
3. comparison	exchange and testing of data among those who have also done the first two steps	accept or reject data

☺ Toqwa'tu'kl Kjijitaqnn / Integrative Science ... recognizes that the acquisition of **scientific knowledge** is essential to human survival — it is a practical engagement with the real world — and the **scientific pursuit of knowledge** must, therefore, be as old as the consciousness of our human species. It is most definitely part of both Western and Aboriginal knowledge systems.

Saying that **science,** or **scientific inquiry**, is a **pursuit,** emphasizes that it is not just a "method". It is much more than that — it is a "way of knowing" that involves awareness and wonder and curiosity ... in combination with observing events and objects, recognizing patterns, asking questions, thinking creatively and logically and critically, constructing tentative explanations to questions, testing those explanations against current knowledge, modifying or discarding explanations in the face of new evidence, formalizing explanations as models or theories, communicating formal ideas to others, and acknowledging basic assumptions in one's thinking (i.e. one's world view).

Scientific pursuit:

- involves asking questions about Nature in a *reality-based* and *reality-tested* manner (i.e. via a practical engagement with the physical world),
- acknowledges the presence of patterns in Nature and our human ability to recognize them, and
- seeks to describe patterns and come to an understanding of their natural causes, while often also using this knowledge to predict future events.

The question, again: What is science?
Short answer: Science is a <u>human</u> "way of knowing".

GOAL: Science, as a way of knowing, attempts to:

- **recognize <u>patterns</u> in Nature, and**
- **understand and work with the <u>natural causes</u> of the patterns recognized.**

In working towards this goal, science has five <u>core activities</u>:

☺	**questioning**
☺☺	**observing**
☺☺☺	**constructing tentative answers (hypotheses) to questions**
☺☺☺☺	**testing tentative answers against reality (and revising them if the results are a poor match)**
☺☺☺☺☺	**communicating "good" answers to others in a formal manner**

The core activities can also be portrayed as two <u>levels of definition</u>:

- ☺ **collecting data (which includes questions and observations)**
- ☺ **explaining data (which includes constructing, testing, and communicating answers)**

Key types of thinking employed … throughout all of science as "a way of knowing" are:

- ☺ **reflective thinking**
- ☺ **creative thinking**
- ☺ **logical thinking**
- ☺ **critical thinking**

Western and Aboriginal views of science as a "way of knowing" … both emphasize its:

- ☺ creative aspects
- ☺ empirical aspects

Aboriginal views of science as a "way of knowing" … also emphasize its:

- ☺ experiential aspects

QUESTIONS ... are "thought traps" (ThoughtTraps©) ... they reflect human wonder and curiosity about observations and experiences and relationships

☺ MAKE AN OBSERVATION

- Look up into the night sky ... and *become aware* of what you see, i.e. "observe" don't simply look.

a "good" observation

→ The values that are used to determine or judge if an observation is a ***good one*** (i.e. if the data are true, accurate, or real) are part of what, in Philosophy, is called the epistemology of knowledge. More on epistemology later!

☺ THEN ... BE CREATIVE ... USE YOUR CURIOSITY, AND AWE, AND WONDER, AND IMAGINATION TO ...

☺ ASK A QUESTION

- What is the relationship between me, as a human, and the stars?

We humans have probably asked this particular question throughout the millennia.

An answer: Within the last 100 years, Western science has discovered that all the chemical elements that make up humans and everything else on Earth, originated as "star dust", i.e. as material spit out of exploding stars billions of years ago.

When we use our curiosity, awe, wonder, and imagination to **ask questions** about Nature in a *reality-based* and *reality-tested* manner (where reality is considered to be the physical world), we are engaged in the **scientific pursuit of knowledge**. This pursuit is undoubtedly as old as the consciousness of our species — for the acquisition of scientific knowledge is essential to human survival ... it reflects a practical engagement with the real world.

☺ Modern Western science ... in its efforts to understand "things" (structures and processes) in Nature, is based entirely on **asking questions** in a *reality-based* and *reality-tested* manner. Indeed, the type of question asked is what drives the design and, therefore, potential success of entire research projects.

☺ Aboriginal knowledge (= Native knowledge, Indigenous knowledge) ... in its efforts to ensure that humans participate responsibly and meaningfully with Nature, involves considerable **asking of questions**. Because of this ethical dimension (i.e. participation in a "responsible

and meaningfully manner"), the ***context of the question*** can involve, but also go beyond, the mere physical world. Thus, in addition to a strong scientific dimension (understandings about the physical world), Aboriginal knowledge often links the scientific to an ethical (or moral) dimension.

⇨ Traditionally, Aboriginal knowledge recognizes the interconnectedness of Nature, or as Cajete (2000) says "the laws of interdependence" in Nature ... in which humans are but one participant among many. Thus, Aboriginal knowledge tends to involve much more complex concepts than does Western science — understandings that speak to personal and/or tribal consciousness by seeking to engage one's strong emotions, mobilize one's deep life energies, and/or provide one with a sense of history, purpose, and place in the world (including "right relationship" or respect for all things in Nature). These understandings, in that they speak to personal and/or tribal consciousness, can be referred to as "sacred truth", since they often have a timeless dimension, i.e. are as true today as a thousand years ago. For example, with respect to the question "What is the relationship between me, as a human, and the stars?", many Aboriginal people have legends that speak of kinship between humans and stars; indeed, the stars may be considered to be ancestors (science also says this) and the Milky Way to be a spirit walk.

⇨ Because of the connection with legends (or stories, or *myths*), the sacred truth within Aboriginal knowledge is sometimes referred to as "mythical truth". When used this way, the term "mythical truth" conveys deep respect. However, in our modern societies, the word "myth" has come to be used in a different way wherein it denotes fiction, fantasy, nonsense, or even lies rather than respect. Be aware of this! "Sacred truth" is, therefore, the preferred term. "Mythical truth" risks considerable confusion.

It is important to be able to recognize* context *in the questions that people ask, and also in the answers that are offered for them ... such that you are able to differentiate "scientific truth" within "sacred truth", or by itself.

⇨ It is preferable to use the term "scientific understandings", rather than "scientific truth" ... because science as "a way of knowing" is "dynamic", which means its understandings are changed or modified as new information is acquired. Thus, the goal of science is "accuracy" in the match between hypotheses and reality, not "truth" ... since "truth" may mean one thing to one person and something very different to another person.

- **Scientific understandings** can be tested in a "here and now" manner (they are *reality-based*, where "reality" is considered to be the physical world). Thus, science attempts to speak to the world at large ... not to one's personal and/or tribal consciousness. This is the only "truth" recognized by Western science, but it may be just one dimension in Native knowledge.

  ✺ Western science claims all of its understandings can be tested in a "here and now" manner.

- **Sacred truth** cannot be tested in a "here and now" manner (and neither is it intended to be). It speaks to one's personal and/or tribal consciousness ... and thus, belongs to a particular group of people (i.e. a tribe), not to the world at large (although there may be many shared understandings among different peoples). Sacred truth is an important dimension in Aboriginal knowledge, as are scientific understandings.

  ✺ Because of the multi-dimensional nature (i.e. scientific understandings plus sacred truth) of Aboriginal knowledge, the term "knowledge" rather than "science" is preferred. If you use the term "Native science" or "Aboriginal science" you need to be acutely aware of the inclusion of the scientific understandings within a more complex knowledge system — a system in which there will be some understandings that can be agreed upon by everybody (i.e. "scientific understandings"), and others that are "sacred" to a particular group of people.

QUESTIONS are ... THOUGHT TRAPS (ThoughtTraps©)

☺ The **asking of a question** ... can be considered as a **thought trap**.

☞ It is essential to understand that to "catch a thought, you have to set a thought trap" just like to "catch a rabbit, you have to set a rabbit trap".

QUESTIONS must be ... TRAPS THAT ARE READY TO GO

☺ "Natural learning" requires that the question be "held" in the forefront of the mind ... i.e. that you are constantly aware of it, just like the rabbit trap must be constantly "ready to go" if you expect to catch a rabbit when it passes by. As stated by the well known French scientist of the 1800's: "chance favours the prepared mind".

GOOD QUESTIONS require ... WELL-CONSTRUCTED TRAPS

☺ Asking **questions** and making **observations** go hand-in-hand.

☞ A good or sensible question needs to be based on good observations and then meaningful reflection upon those observations.

☞ Reflection should always include **creative, critical, and logical components**.

BIG QUESTIONS are ... useful for ORIENTATION PURPOSES (knowing the overall of where you are or where you are going, so you don't feel hopelessly lost)

☞ The "Big Questions" asked by cognitive science in its studies of consciousness ... and their answers ... are considered in MSIT 101/103.

☞ The "Big Questions" asked by the Western science disciplines of cosmology, physics, chemistry, geology, and biology ... and their answers ... are considered in MSIT 201/203.

☺ **QUESTION:** What is "reality"? One really ought to consider this question, if one claims to be able to answer questions in a "*reality-based* and *reality-tested* manner". This question falls

into an area in Philosophy known as “metaphysics”. More on metaphysics later!

ANSWERS ... are "thought patterns" ... they reflect the human tendency to *connect the dots* in an effort to see the bigger picture, i.e. in an effort to *understand*

The **answer** to a question ... can be considered as a **thought pattern**. A "thought pattern" can also be called:

- an idea
- a concept
- a theory or model
- a big picture
- an understanding

a "good" answer

An answer can be judged to be "true" or accurate or real ... and then integrated into everyday life in different ways by different peoples.

→ The values that are used to determine or judge if the answer is a ***good one*** (i.e. "true", accurate, or real) are part of what, in Philosophy, is called the epistemology of knowledge. More on epistemology later!

WORLD VIEWS

☺ From our perspective at the beginning of a new millennium, we acknowledge that different **world views** have emerged over the ages among humans living in different regions of the Earth (the "world") ... and that within these different world views, people may have different ways of determining or judging if an answer is a ***good one*** (i.e. "true", accurate, or real). Thus, different world views may have different epistemologies. More on epistemology later!

QUESTION: What is a world view?

ANSWER: A world view is an "outlook on life and reality" (i.e. a view on the world); it has various parts, and these parts may differ among different groups of people.

☺ An important thinking tool: the realization that a WHOLE is made up of PARTS.

☺ Leroy Little Bear's story is an attempt to illustrate world views, and their different parts.

PATTERNS ... are everywhere and all important

Patterns are everywhere ... as part of human consciousness (ideas, concepts, theories), throughout the human brain and body, and in Nature.

Pattern ... is central to the way the human brain works at various levels ... an understanding that comes from recent and extensive research in neuroscience, cognitive science, and psychology. Note the centrality of "pattern recognition"and a "pattern of connectivity", for example, in the quotes below:

> From a psychological perspective, a theory [or model] is not only a systematic set of ideas and evidence; it is also a perceptual heuristic, a way of **recognizing patterns —** something people do automatically and nonconsciously. (from Grigsby and Stevens, 2000, *Neurodynamics of Personality*)

> It is not the number of brain cells that we have that determines our mental characteristics, rather it is how they are connected to each other. And, learning can be defined as the establishment of new neural networks composed of synaptic connections and their associated information molecule receptor patterns ... new synapses occur after learning. It is the density of the brain, as determined by the number of synaptic connections, that distinguishes greater from lesser mental capacity. Thus, knowledge can be defined as the "**pattern of connectivity**" between brain cells, and learning as modifications to this pattern. (from Howard, 2000, *The Owner's Manual for the Brain; Everyday Applications from Mind-Brain Research*)

Pattern awareness ... arises by "connecting the dots" ... to "see".

☺ We "see" the constellations of stars in the night sky, for example, by connecting the dots (stars) into patterns ... to "see" (become aware of) such things as bears, water dippers, or hunters ... depending upon our familiarity with them in our everyday lives, including how they may have been explained to us and how they are relevant to our cultures.

Understandings about pattern ... can be transmitted in several different ways.

☺ As humans, we transmit (convey or tell) our understandings of pattern to each other in different ways. These include, for example:

- simple stories ... where we connect the dots in *time*
- maps ... where we connect the dots in *space*
- science ... where we connect the dots* (of energy and matter) in *time and space*
- deep stories ... where we connect the dots in *time and space* with an overall understanding of *the reality and potential of human consciousness* beyond the memory of our own

previous and personal experience (i.e. deep stories involve spirit)

* **Data** ... are the ***dots*** of science that can be connected to make the big picture or ***pattern***, i.e. the model or theory. (Note: "data" is a plural word, its singular is "datum".)

Pattern ... is an important tool in analytic, synthetic, critical, creative, and intuitive thinking.

dots ⇨ **pattern**
parts ⇨ **whole**

☺ **Network-logic** is a dialectic (discussion back and forth) of whole and parts (i.e. pattern and dots). As many details (parts, dots) as possible are checked, then a tentative big picture (whole, pattern) is assembled. This is checked against further details, and the big picture is readjusted if necessary. And so on indefinitely, with ever more details constantly altering the big picture, and vice verse (Wilber 2000).

☺ **Vision-logic** is the ability to see not only the trees (parts) but also the forests (wholes) (Wilber 2000).

Pattern awareness ... is key in the traditional ways of learning among Aboriginal peoples, spirituality, genuine understanding, mathematics, and the pursuit of scientific knowledge.

→ **Aboriginal people** ... traditionally were experts at observing patterns in Nature and living within the context of their interpretations and meanings. Furthermore, understandings about natural patterns are deeply embedded in Aboriginal languages.

→ The **spiritual relationship** between Nature and humans draws upon natural patterns and the bringing of one's consciousness into creative partnership with this relationship.

→ **Learning towards genuine understanding** ... requires that one consciously "sees the pattern" ... to the extent that the "pattern talks" ... as, for example, in The Periodic Table of the Elements (otherwise, only memorization of facts is likely occurring). Furthermore, as stated in Howard (2000), knowledge can be defined as the "pattern of connectivity" between brain cells, and learning as modifications to this pattern.

→ **Mathematics** ... is a symbolic language of relationships within patterns.

→ **Science** ... employs a "way of knowing" that is centred upon making systematic observations (collecting data) that lead to the recognition of patterns in Nature ... followed by attempts to determine the natural causes of the patterns detected.

Patterns ... and the scientific pursuit of knowledge

Patterns ... and creativity

☞ The ability to be creative ... requires abilities to **see pattern** and **work with pattern.**

✳ The pursuit of scientific knowledge ... draws heavily upon creative abilities ... because ... creative thinking, creative learning, and creative relationship are required any time when, and any place where, one must do something innovative or for the first time.

Creativity is needed for new ways to:

- ask questions
- make observations
- collect data
- test data
- explain data
- see how new ideas mesh with the old

The ability to become patternable, i.e. sensitive to the patterns displayed in Nature such that one is able to incorporate and adapt them to one's own or one's community's needs, as appropriate, is part of the secret to crossing the barrier of fear encountered as one attempts to move from the domain of the known to the domain of the unknown (Cardinal 2000).

Patterns ... and empirical data

☞ Data are the "dots" that, when connected, **make a pattern**.

✳ The pursuit of scientific knowledge ... collects data in a reality-based manner via observation, and/or experiment, and/or measurement. Such data is called "empirical".

Patterns ... and experience

☞ The pursuit of scientific knowledge is a human way of knowing. Thus, at some point in the history of the pursuit, somebody has to have done, i.e. experienced, the observation, and/or experiment, and/or measurement ... and then interpreted the data within a **context of pattern**.

✳ In the Aboriginal pursuit of scientific knowledge, great value is placed on first hand, i.e. direct, experience ... me (I) as the source of the knowing, the collector of data and the weaver of pattern.

✳In the Western pursuit of scientific knowledge, great value is placed on a so-called "scientific source" for information ... i.e. data that has been collected in a scientific way, accepted through a peer-reviewed process in the scientific community, and published in a scientific journal. The source of the knowing (i.e. the original collector of data or weaver of

pattern) does not need to be me (I) ... indeed, the vast majority is indirect.

☾ Little Bear's Story: the chase, or "The Pursuit"

Leroy Little Bear is a member of the Blood tribe of the Blackfoot Confederacy, a lawyer, J.D. (for "Juris Doctorate"), the former Director of the American Indian Program at Harvard University, and Professor Emeritus of Native Studies at the University of Lethbridge where he was Department Chair for 25 years.

Little Bear tells a story that can be useful in the effort to grasp the nature of different world views. It was told at the Aboriginal Education Symposium "*Decolonizing Canadian educational foundations: a post-colonial challenge in the new millennium*", in February 2000, at the Banff Centre for Management, and again at UCCB on April 19, 2001 at a ceremony celebrating Toqwa'tu'kl Kjijitaqnn / Integrative Science as a newly approved program within UCCB's Bachelor of Science Community Studies four year degree.

<u>The story</u>

- a village ... with a main street
- two sides of the street ... representing two different cultures, or "ways of life"
- houses on each side ... and, the dogs associated with the houses
- a pick-up truck going down the street ... and the response to it
  - as exhibited by young dogs from the one side of the street ... polite barking and watching
  - as exhibited by young dogs from the other side of the street ... exuberant yapping and chasing
- the MOU between the dogs: response always to include exuberant chasing by both sides, plus alternation between barking and yapping provided by one side or the other every other time the truck passes by
- the new, MOU-sanctioned response when the truck passes by:
  - the young dogs
    - both sides of the street ..... YEAH!!!!!!!!!!
  - the wise old dogs
    - from the side of the street where the young ones originally only yapped and chased
      - chasing and yapping ..... YEAH!!!!!
      - chasing and barking ..... HHMM!?
      - barking alone ..... WHAT????

World views ... different embodiments of "The Pursuit"

... the "chase" or pursuit ... i.e. one's way (or a culture's way) of acting in and looking at the world = the embodiment of a "world view"

⇨ A **world view** can be considered as a "whole" made up of different "parts", each of which contributes some influence to the overall.

Some of the parts in a world view include:

⇨ **metaphysics** ... basic belief about the *whole* of reality (the Universe), especially with regard to what might exist *in addition to physical reality* (note: "meta" means over, or beyond)

⇨ **ontology** ... basic assumptions about the *physical parts* that make up reality in the Universe

⇨ **epistemology** ... basic assumptions about the values to use in judging or determining that answers to questions are "true", accurate, or real ... i.e. how to "know"

Note: In science, the word "true" is not a particularly good or useful word for this concept (and thus, it is enclosed in quotation marks) for the following reason: Science as "a way of knowing" is "dynamic", which means its understandings can be changed or modified as new information is acquired. Thus, the goal of science is "accuracy" (with respect to the match between hypotheses and reality), not "truth" ... since "truth" may mean one thing to one person and something very different to another person.

⇨ **perspective** ... where one is "coming from", mentally

⇨ **language** ... e.g. Mi'kmaq, or English, or French, or Russian ... or even mathematics

☺ Most world views contain some degree of logical thinking. Analytic and synthetic thinking are parts of logical thinking.

☺ An important **analytic thinking and learning tool** is the realization that ... a WHOLE is made up of PARTS.

☺ An important **synthetic thinking and learning tool** is the realization that ... the PARTS relate to each other to form the WHOLE.

☺ **Logical thinking** is the effort to understand the ordered relationships among things

(whether these "things" be objects or processes).

Aboriginal world views (introduction): scientific pursuit embracing interdependence in Nature, including a moral code for humans

☺ I participate, therefore we are.

Metaphysics:	Nature, or the Universe, is both physical and spiritual.
Ontology:	The physical is made of matter and energy, infused with Spirit. The spiritual is sacred. Change and renewal are the most fundamental processes in Nature, and there is a creative force in Nature.
Epistemology:	Experience is a major epistemic value (indicator of what is real). Thus, both objectivity and subjectivity are valued — indeed, they are embraced.

Aboriginal world views are considered to be a holistic "way of knowing"... which means they involve or consider the insights from all different dimensions of what makes a human a human (physical, mental, emotional, and spiritual), plus what makes a human a responsible and caring participant within a community and within Nature (ethics). In other words, there is a place for both objectivity (consensus or group knowledge about the *physical characteristics* of things and processes) and subjectivity (one's or the tribe's *experience*, or knowledge about the *personal and cultural meanings* of things and processes) ... and both are valued.

Important components in most Aboriginal world views generally include the following:

- Humans are participants in Nature, and are to respect the laws of interdependence which characterize Nature and which are at play in all dimensions of a human being (physical, mental, emotional, spiritual).
- **Scientific pursuit** is a practical engagement with reality — a reality that traditionally was directly related to human survival and participation within Nature.
- Traditionally, answers to questions were tested by both the immediate reality and the long term sustainability of life.
- Knowledge increases through the ages ... and traditionally was transmitted from generation to generation through story and ritual within the context of living communities.
- Elders are the holders of both knowledge and wisdom, which are interconnected.
- There is little tendency to detach oneself from the knowledge ... i.e. to talk about a "knowledge system" as separate from one's self or one's community. There is also little tendency to "cut up" or "fragment" the knowledge ... i.e. to make isolated or independent studies of various "parts" of Nature ... understandings are within the context of the "whole" and go as far as necessary.

⇨ Aboriginal knowledge contains an ethical dimension (i.e. participation in a "responsible and meaningfully manner") in addition to a strong scientific dimension (understandings about the physical world) (see also section entitled "Questions ... are thought traps ").

☺ One of the major objectives of Toqwa'tu'kl Kjijitaqnn / Integrative Science is to help students understand the interdependencies of all things and all processes in Nature, as perceived by Aboriginal people.

❒ Read: essay by Clifford Paul, MSIT student and member of the Membertou First Nations ... Mi'kmaq contributions to the scientific community

☞ For an excellent outline comparison of the major components in Aboriginal knowledge and Western science, as well as their Common Ground, consult the table entitled "Seeing Common Ground" developed by the Alaska Rural Systemic Initiative & Alaska Native Knowledge Network (from "Handbook for Culturally Responsive Science Curriculum" by Sidney Smith; www.ankn.uaf.edu/UNITS/index.html).

Western world view (introduction): scientific pursuit prizing objectivity and detachment

☺ I think, therefore I am.

Metaphysics:	Nature, or the Universe, consists of only a physical dimension.
Ontology:	Nature, being entirely physical (or material), consists of "fields" of matter and energy dancing in spacetime. "Spirit" is a construct of human consciousness, as is any "sacred" aspect of Nature. There is a small but growing acknowledgment of the creative ability within Nature (albeit as a "self-organizing principle", not a force).
Epistemology:	Measurement is a major epistemic value (indicator of what is real). Thus, objectivity is prized, and subjectivity (and along with it, experience) is devalued.

The Western world view (sometimes also called the Eurocentric world view) is considered to have differentiated "ways of knowing" ... which means that scientific, aesthetic, and religious understandings are to be considered as separate from one another. The scientific "way of knowing" emphasizes objectivity, i.e. attempts to focus only on *physical characteristics* of things and processes, especially characteristics that can be measured.

- It is assumed that, ideally, the human "knower" can be an "observer" who can detach or separate himself or herself from the things and processes being observed in Nature (although physics research has shown that this assumption is wrong at the quantum level, and Western science needs to reconcile this fact with its overall view of Nature).

- **Scientific pursuit** is a practical engagement with reality — a reality that is related to human survival, but a pursuit that may be driven more by human *curiosity* about reality, or even *monetary gain* in capitalistic society, than by direct survival issues.

- Questions are asked in formal ways, and answers to these scientific questions are generally (and ideally) tested in artificial situations (experiments), and communicated as formal written communications.

- Knowledge increases through the ages ... with the conventional belief that it is transmitted from generation to generation mainly in written form, although recent sociological research points to the critical involvement also of the living community as formed, especially, by groups of researchers working in particular laboratories.

- It is considered possible, and academically desirable, to separate knowledge and wisdom.

  ⇨ Philosophers talk about knowledge systems, including the philosophy of science. And, unfortunately, most scientists tend to consider "the philosophy of science to be as relevant

or important to doing science as birds would consider ornithology to flying".

- There is an intentional effort to elevate the objective perspective to the highest intellectual level (i.e. to "prize" it) and to eliminate the experiential perspective (the subjective, participatory, sensual, and/or spiritual aspects ... which are most often relegated to the arts or religion). It is felt that stepping back, or detaching oneself from the immediate scene, enables one to more easily become an effective critic (or sceptic), and that it also facilitates being able to cut up (fragment) the whole to produce different parts or pieces for subsequent analysis, i.e. more detailed and thorough investigation.

  The word "discipline" illustrates this point, namely the tendency of Western knowledge to study the parts rather than the whole. The parts become the so-called "academic disciplines" ... i.e. various topics or study areas separated by boundaries. For example, the five major disciplines in Western natural science are *cosmology, physics, chemistry, geology,* and *biology*. Western science is sometimes referred to as "fragmented" because of this separation of Nature into different parts, and then the study of the parts in a disconnected way.

  Because Western science has developed separate disciplinary lines, it sometimes faces a peculiar challenge when entering a new subject area where "parts" must be brought back together, as for example, in the study of consciousness. When this happens, "multidisciplinary studies" often emerge whereby the older, traditional boundaries are crossed. Sometimes these efforts develop into a new discipline, e.g. *Cognitive Science*.

☺ One of the major objectives of Toqwa'tu'kl Kjijitaqnn / Integrative Science is to help students see how to put the fragments, the parts ... back together again ... i.e. to "connect the dots" ... and thus, arrive at an overall understanding of Nature as established by modern scientific inquiry. This endeavour, to put scientific understandings of the natural world back together as a whole, is increasingly being referred to as **integrated science**. When it also involves understandings from cognitive science (especially consciousness studies), it becomes **integrative science**.

We realize that this is an ambitious objective ... and encourage students to be patient with themselves, to give their understanding time to grow and their consciousness time to unfold.

☞ For an excellent outline comparison of the major components in Aboriginal knowledge and Western science, as well as their Common Ground, consult the table entitled "Seeing Common Ground" developed by the Alaska Rural Systemic Initiative & Alaska Native Knowledge Network (from "Handbook for Culturally Responsive Science Curriculum" by Sidney Smith; www.ankn.uaf.edu/UNITS/index.html).

Comparing Aboriginal knowledge and Western science

⇨ Table: Seeing Common Ground ... developed by the Alaska Rural Systemic Initiative & Alaska Native Knowledge Network (from "Handbook for Culturally Responsive Science Curriculum" by Sidney Smith; www.ankn.uaf.edu/UNITS/index.html)

→ see insert

⇨ Table: Tenets of Indigenous and Western scientific knowledge and management systems (from: Berneshawi, S. 1997. Resource management and the Mi'kmaq Nation. The Canadian Journal of Native Studies 17: 115-148).

→ see insert

Metaphysics ... asking the question: What is the whole of "reality", i.e. Nature or the Universe?

The question "What is the whole of reality?" is, in the academic discipline of Philosophy, called "the metaphysical question". It really asks if there is anything to Nature other than the physical dimension ... i.e. is there anything beyond, or outside of, physical reality?

Metaphysical refers to that which is *not able to be decided by experiment.* Something that cannot be tested is, according to Western philosophy, defined as a *belief.*

☞ Metaphysics is the basic assumption about the whole of reality in a world view.

Today (and beginning mainly with the scientific revolution in Europe in the 1600's) the tendency in academia (the universities) is to downplay or dismiss this question.

⇨ The question has become somewhat of a "non-issue" largely because Western science views the whole of Nature as physical, and because this science view has become the world view of modern society (however inadvertent or unintentional this tendency to adopt the view of science so broadly that it now domineers as a "world view" may, or may not, have been).

⇨ However, with the return of "consciousness" as an acceptable topic for study in modern Western science, the acceptability of the metaphysical question has returned, albeit in a somewhat different fashion. In its renovated form, it focuses on the basis and origin of "mental phenomena" ... i.e. mind or consciousness. More on this later, in the section entitled "Consciousness: Where does it fit, since it is not in the Standard Model of Physics in Western science?".

The question "What is the whole of reality?" has, in Aboriginal world views, a deceptively simple answer: Nature, or the Universe, is both physical and spiritual. (Note: "Deceptively simple" means simple only at a quick glance, and not at all simple once you start to try to understand in depth.)

⇨ The spiritual, as recognized by Aboriginal people, comes from and is part of the land, the sky, the waters, and the language ... i.e. Spirit comes from and is within the whole of Nature (the natural environment) and the people ... it infuses the physical. In this sense, spiritual is *natural* not *supernatural* (where "supernatural" is taken to mean "outside or beyond nature" as, for example, the realm said to be occupied by the Christian God).

⇨ "Spiritual", in Aboriginal world views is extremely complex, and there are no quick and easy ways ("methods") to develop one's understandings. Moreover, the challenge to develop spiritual understandings is considered a personal one, in which an individual may

choose to seek, or not to seek, spiritual knowledge as part of his or her life path or journey — thus, personal experiences (as an individual and as part of a family and as part of a community and as part of a natural environment ... and it must be all) are critically important. Spiritual knowledge is most highly developed in Elders, and among gifted members of the community such as spiritual leaders, shamans, or medicine men.

⇨ The spiritual, in Aboriginal world views, is sacred (and speaks to personal and/or tribal consciousness) and involves a creative force (which may be called the Creator).

QUESTION: Does modern Western science recognize a creative ability within Nature?

ANSWER: Yes ... but ...

It is referred to as a "self-organizing principle" in *complex systems science*, which is an approach that looks for the major organizing principles throughout the cosmos (i.e. across all the scientific disciplines).

Complex systems science is somewhat controversial within modern Western science ... and few modern scientists are familiar with, let alone well versed in, its understandings. This is slowly changing, however. It is also important to note that systems science recognizes a creative ability, not a creative force, in Nature.

MSIT 301/303 explores some of the ideas in modern complex systems science.

Ontology … asking the question: What are the parts that make up "reality", i.e. Nature or the Universe?

As with questions about our place as humans in the Universe, the above question has probably also been asked for 1000's of years. In the academic discipline of Philosophy, it is called "the ontological question".

Ontology considers the question "What are the parts that make up reality?", and its answer.

- Ontology's question can be asked in different ways, such as:
  - What is there in Nature?
  - What is the essence (the basis) of reality in Nature, the Universe?
  - What is it that we think the world is?
  - What is it in Nature that is ultimately real?
  - What are the characteristics of real things (reality) in the natural world, i.e. in Nature?
  - What kinds of real things are there in Nature?

⇨ Different world views may have different answers to the ontological question.

Aboriginal world views
Ontology: Nature is made of physical matter and energy, infused with Spirit. The spiritual is sacred (and speaks to personal and/or tribal consciousness).

Western science world view
Ontology: Nature, being entirely physical (or material), consists of "fields" of matter and energy dancing in spacetime. "Spirit" is a construct of human consciousness, as is any "sacred" aspect of Nature.

→ In Western science, the ontological question can be asked at different levels or for different topics of academic study. For example:
- What exists at the most fundamental (basic) level, in Nature?
  ... is a question for physics
- What are the fundamental units of life on the Earth?
  ... is a question for biology, especially for biodiversity
- What exists as a fundamental unit of memory?
  ... is a question in several different areas ... e.g. neuroscience, computer science, evolutionary biology, anthropology, sociology

Epistemology ... asking the question: How are we to decide what should be accepted as "true" or real, i.e. as accurate knowledge?

Epistemology considers this question, and its answer.

- Epistemology's question can be asked in different ways, such as:
  - How do we know, what we claim to know?
  - What is knowledge?
  - What can we know?
    - How can we adequately investigate Nature?
    - How can we come to know the fundamental nature of the world?
    - What constitutes an observation?
  - How do we know what we know?

- Epistemology is:
  = the theory of knowledge
  = the process of knowing, i.e. how we come to know things
  = how we interpret our observations, so as to determine that our conclusions are "true", accurate, or real

- The "things" or criteria that we use to help determine that our observations are, indeed, "true", accurate, real, believable, or valid are called ***epistemic values***.

⇨ Different world views may have different epistemic values.

Aboriginal world views
A major epistemic value: experience ... which influences personal and/or tribal consciousness (subjectivity)

Western science world view
A major epistemic value: measurement ... which everyone can agree on (objectivity)

- A **knowledge framework** ... is an organizational scheme (a "schemata") in which to place one's knowledge.
  → a ***model*** or a ***theory*** is a knowledge framework ... which you could also think of as a **"thought pattern"**.

- **Data** ... are the ***dots*** that can be connected to make the bigger picture or ***pattern***, i.e. the model or theory. (Note: "data" is a plural word, its singular is "datum".)

Perspective ... asking the question: Where are you "coming from", mentally?

☺ It is sometimes said, by deep thinkers, that "**epistemology reflects ecology**".

- e.g. That which is valuable to humans differs from that which is valuable to coyotes ... because humans and coyotes have different ecologies, or "places in Nature".

- e.g. That which is valuable to humans who are concerned about environmental sustainability differs from that which is valuable to humans who are concerned only about dollars ... because each has different ideas about the place, the "ecology", of humans in today's world.

⇨ Conclusion: ***Perspective***, including the life needs of the observer (namely, values), is an important issue in epistemology.

perspectives and world views

☪ Here's a helpful story that Tonia Sylliboy found:

Three baseball umpires are discussing balls and strikes.

The first umpire says:	I call `em like I see `em.
The second umpire says:	I call `em the way they are.
The third umpire says:	They ain't nothing til I call `em.

The first perspective or attitude reflects a world view based on the primacy of sense experience.

The second perspective represents Einstein's faith [as well as the reductionist paradigm in Western science] in the existence of an underlying objective reality.

The third perspective represents Bohr's philosophy of nature [as well as the holistic paradigm in Western science, also an autocreative paradigm] ... i.e. the importance of the observer, of consciousness.

"isms" used to label various perspectives

▸ objectivism

= personal detachment from the activity or the observation
→ 3rd person perspective .... sensory, but without direct participation

- **"objective understandings":** are understandings that are said to be as free as possible from the influence of societal and personal interests, opinions, emotions, prejudice ... i.e. attempting to be free of value and quality judgements

Modern Western scientific inquiry is said to strive to generate objective explanations as answers to the questions it asks. This leads to the so-called *Principle of Objectivity* in Western science: the features (i.e. mind set) of the observer (questioner, thinker, or interpreter) shall not enter into the description of his or her observations. Some reflection will, however, reveal that this is quite impossible ... although it can still remain a worthy guiding principle (see "subjectivism").

▸ subjectivism

= personal involvement with the activity or the observation
→ 1st person perspective ... sensory, with sensual participation

- **"subjective understandings":** are understandings that are influenced by societal and personal interests, opinions, prejudices, emotions

☞ It is naive to believe that any type of thinking, including scientific thinking, is or even could be, totally free of subjectivity, i.e. be totally objective. Consider, for example, what what the poet **William Blake** (1757-1827) said: "Every Eye sees differently. As the Eye, such the Object."

Or: We are prone to see what lies behind our eyes, rather than what appears before them.
We "see" with our consciousness, not our eyes.
We experience with our consciousness, i.e. our mind.
We "see" it, when we believe it.

Therefore: It is not possible for humans, who are animals with consciousness, to be completely objective ... and since science is conducted by humans, it cannot be totally free of subjective influence or bias ... and neither, therefore, can scientific understandings be totally objective.

▸ various person viewpoints

a) 1st person ..... I, = subjective perspective
b) 2nd person ..... you
c) 3rd person ..... it, = objective, or Western scientific perspective
d) other person ..... 4th or 5th person (with 1st + 3rd → potentially leads to spiritual perspective)

⇨ Mi'kmaq has 4th and 5th person, English does not.

▸ empirism

= the dependence or reliance, when gathering data and constructing theories and models to explain them, on:
- observation (the senses)
- measurement
- experiment

✳ Bacon: "the repeated testing of knowledge by experiment is the cutting edge of learning"
✳ observation is one of the *levels of definition* in Western science

▸ reductionism

• reductionism: emphasizes the ***parts*** of a system
→ said to characterize the "**Cartesian paradigm**" of Western science

= reduction ... the study of the world as an assemblage of physical parts that can be broken down and analyzed separately; the whole can be understood based on properties of the parts
= reduction ... an attempt to explain the largest number of "things" with the fewest assumptions
= reductionist models of physical phenomena are generally assumed to be linear, or nearly so, allowing advantage to be taken of the convenient but often unrealistic property that **complicated causes can be resolved into more simple components, the effects of which are treated separately** (Scott, 1999. Nonlinear Science)

☞ with a **linear system** ... it is possible to project backwards in time and reconstruct the initial conditions at some previous time, i.e. the dynamics of the system have not forgotten the past (Scott, 2000. Modern Science and the Mind)

= in reductionist thinking ... the laws of physics provide the most fundamental description of reality in the Universe

→ a reductionist explanation is one in which ... there is a deductional procedure (an algorithm) that leads us from something basic (and well known) to the new thing (Bass and Emmeche 1997)

▸ holism

• holism: emphasis on the ***whole*** of a system
→ said to characterize systemic or holistic science
→ essentially is the emerging "**systemic** or **organismic paradigm**" in Western science

= study of the world as an interconnected assemblage, the whole of which cannot be understood from the properties of its parts
= models of physical phenomena are generally assumed to be non-linear, with the understanding **the whole is greater than the sum of its parts**, leading to emergence of new structures that are spatially or temporally coherent (Scott 1999, Nonlinear science)

☞ with a **non-linear system** ... an entity emerges that exists as a dynamic entity that is independent of its past (Scott, 2000. Modern Science and the Mind)

= in holistic thinking ... the laws of biology, not physics, provide the most central description of reality in the Universe, and these laws are not always reducible to those of physics and/or chemistry

▸ emergentism

= the understanding that complex phenomena emerge at higher levels of system organization and cannot be discerned or analyzed at the level of the system's elemental building blocks

▸ naturalism

= a scientific account of Nature in terms of causes and natural forces
[☹ notice how this definition brings the inquiry right back to the ontological question of "what is there in Nature?"]

see section on "consciousness" for:
▸ materialism
▸ dualism
▸ idealism
▸ panpsychism

Language / Tli'suti

Stephanie Inglis (linguist and faculty member in Mi'kmaq Studies at UCCB) offered the following basic thoughts about language to the MSIT 101 class, in a lecture delivered on 12 and 14 September 2001.

• Language is a system of communication using sounds that are put together in a meaningful way according to a set of rules. As with any system, it has many subsystems (just like the brain, biology, etc.).

• Words give form ... and form gives the function of describing or "framing" a reality.

• The world you move in (your culture and language) structures how you see that world.
  → North American pop culture focuses on people ... especially gender, physical appearance, and self.
  → Mi'kmaq culture focuses on pattern ... i.e. details about space and time. The language is filled with this pattern.

• "conceptual structuring" ... a table showing the dynamics of English and Mi'kmaq

	English	Mi'kmaq
somewhat like	Greek, Latin	Maliseet, Passamaquoddy
origin	Europe	east coast of North America
structural type	inflectional	polysynthetic (= one word is a sentence)

• There are three major structural types in the languages of the world:

1) isolating structure ..... (basically is Chinese) — for every idea, there is one symbol or character ... the symbol exists by itself, i.e. it is isolated

2) polysynthetic structure ..... (example is Mi'kmaq) — complicated word patterns and simple sentence patterns; words in the sentence can go in just about any order but parts within words are very important; language is verb focused (centers on the action being discussed); words can be verbs, nouns, pronouns, participles

3) inflectional structure ..... (example is English) — complicated sentence patterns; order of words in the sentence is very important; simple word patterns; language is noun focused (centers on the object being discussed)

Difference in focus:
1) English focuses on ..... direction, location, and position ..... of the **object**.
2) Mi'kmaq focuses on ..... direction, location, and position ..... of the **action**.

Difference in how "an answer" is to be obtained:
1) within the Western science world view (which follows Platonic thought):
- → a "scientific method" of asking questions is employed ... inquiry is framed in terms of "event-time"
- → to know ... is to question
- → to get the answer to a question ... is to gain information about something

2) within the Mi'kmaq world view:
- → a "teaching / learning" method is employed
- → the response to a direct question ... may be to:
  - change the subject
  - tell you another time when the time is right (i.e. they want you experience it yourself)
- → the above way of responding can also be found in the language

Difference in emphasis
1) event-time
- most European languages are built on event time ... they emphasize placing the event in time
  - → is it finished, or not?
  - → when, time wise, did it occur?
- the event is the key thing ... but it must be placed in time (using time grammar)
  - → completing the event makes it real

2) experience
- all of the Algonquian languages are experience driven (are about experience)
  - → structure of the languages are based on evidentiality (the way you came to know things)
    - path of experience
    - by the way, you know the knowledge
    - with notions of accuracy, proof, experience ... you must always defer to the knowledge of the other
  - → to know as "truth" is to experience
    - versus ... you can read about it, gossip about it, or measure it ... wherein you defer to the event and not the experience of it

✶ In her PhD research on the dynamics of Mi'kmaq linguistics, Stephanie Inglis used evidentiality, not the scientific method that her supervisory committee wanted.

❒ Read: *Learning the world's languages — before they vanish* (by Wuethrich 2000)

Paradigm shifts: when changes occur in major knowledge frameworks

☺ A "paradigm" is a "big pattern of understanding" ... almost a "world view".

☺ It is sometimes said, by deep thinkers, that a "**paradigm shift**" is occurring in Western science. Briefly, this shift is:

- ☞ from the older ... *Cartesian paradigm* ... which does not include considerations of consciousness
- ☞ to the new ... *holistic, organismic,* or *systems paradigm* ... which does include considerations of consciousness.

■ Conclusion: ***Perspective*** of the observer (namely, depth of, and importance attributed to, consciousness) is important in considerations of <u>both</u> epistemology and paradigm shifts.

Change and human consciousness

? What are the barriers to "change" in human consciousness?
? Will our modern, collective "mind set" change ... as it becomes conditioned by the new paradigm that is emerging in modern Western science?

CONSIDER the thoughts of Grigsby and Stevens (2000) with respect to ***the significance of pattern recognition in human consciousness*** [MSŁT 101 /103]:

- a systematic set of ideas and evidence (i.e. a theory, a model, or a theoretical framework) is a perceptual heuristic, a way of ***recognizing patterns — something people do automatically and nonconsciously***

- the downside to our natural human tendency to recognize and work with pattern ... is that it is not just a desire for any pattern but rather for *familiar* pattern ... and thus, changing our familiar habits of thinking and doing can be difficult ... and new ideas may be hard to accept.

  As one learns to navigate within a theoretical framework, developing habits of thinking and perceiving, it becomes a relatively effortless matter to find one's way around (☺ good).

  At the same time, it may be more difficult to get one's bearings by means of a different theory (☹), since the ***patterns*** one has already learned to recognize are easy to see, while those ***patterns*** that may become apparent through the medium of an unfamiliar model require deliberate consideration and somewhat effortful application if they are to be useful.

☹ The shifting paradigm in Western science, from reductionistic to holistic thinking, troubles many modern scientists.

? Why?

1) One major difficulty is that it explicitly includes a "spiritual element" that immediately tends to provoke a negative "knee jerk" response in those who, out of intentional or unintentional misunderstanding, see in it an attempt to insert a supernatural element (whether this be a divine being like "God" or some other form of higher intelligence) into scientific understandings of the Universe. Such a supernatural element was effectively excluded from Western science in the 17th Century (see section on "Western science and the Cartesian split").

   However, in the quotation below from Capra (1996), one of the more prominent advocates of the new paradigm, it is clear that "spirituality" is to be considered a dimension of human consciousness, not a supernatural element. And, it is a ***sense of human connectedness with the Universe*** (cosmos), not a higher intelligence within or without that Universe, that is intended. A valid scientific basis for human connectedness with the Universe should not present any challenge to scientific understanding for those familiar with the Big Bang theory of modern, scientific cosmology. Whether an individual can "sense", feel, or live this is, however, very much a matter of individual or cultural consciousness and world view.

   > "When the concept of the human spirit is understood as the mode of consciousness in which the individual feels a sense of belonging, of connectedness, to the cosmos as a whole, it becomes clear that ecological awareness [≈ holistic or systemic awareness] is spiritual in its deepest essence. It is, therefore, not surprising that the emerging new vision of reality based on deep ecological awareness is consistent with the so-called perennial philosophy of spiritual traditions, whether we talk about the spirituality of Christian mystics, that of Buddhists, or the philosophy and cosmology underlying the Native American traditions." (Capra, F. 1996. *The Web of Life; a new scientific understanding of living systems*. Anchor Books Doubleday, New York.)

2) A second major difficulty lies with our current, very incomplete, scientific understanding of "consciousness". Some scientists feel that this is not an appropriate topic for scientific exploration at all. Among those who hold that it is appropriate (and many prominent scientists do, as for example Crick who discovered the 3-D structure of DNA), some liken the current state of understanding to that of the Earth by Europeans at the time Columbus discovered the Americas. Needless to say, consciousness studies (e.g. cognitive science, neuroscience) are one of the hottest frontiers in modern Western science. And, at any scientific frontier, there will be competing hypotheses, as well as ideas that more orthodox colleagues might consider fall into the categories of "fringe science" or even "pseudoscience" (but never "junk science").

WESTERN SCIENTIFIC WORLD VIEW

⇨ For an excellent outline comparison of the major components in Western science and Aboriginal knowledge, as well as their Common Ground, consult the table entitled "Seeing Common Ground" developed by the Alaska Rural Systemic Initiative & Alaska Native Knowledge Network (table from "Handbook for Culturally Responsive Science Curriculum" by Sidney Smith; www.ankn.uaf.edu/UNITS/index.html).

⇨ **Also, re-read the section entitled "Western world view (introduction)".**

Metaphysics

The metaphysical belief of Western science is that Nature is entirely physical ... i.e. material.

- Metaphysical refers to something that is *not able to be decided by experiment.* All world views contain some metaphysical beliefs.

General comments about the Western scientific world view

☞ a world view that has, in the past but still in many aspects today, emphasized: dominion over Nature ... with the associated ideas of control, prediction, exploitation, manipulation, improvement, and progress

☞ a world view that reflects the dominant, academic and mainstream interest in *materialism* and in *third person objectivity*
- → materialism = everything in the universe is reducible to matter and energy forces
- → third person perspective = it, he, she (not me, not you)

☞ a world view in which the "big questions" are about origins, evolution, composition, structure, and prediction in Nature

☞ a world view that equates *understanding* with the idea of *explanation*
- if you claim to fully understand a phenomenon or a pattern in Nature, you are thought to possess an explanation of it in terms of some mechanism that can be shown capable to generate (in the explanation) the phenomenon in question (Bass and Emmeche 1997)

☞ a world view that considers scientific *explanation* to have *two levels of definition* ... which are stated in:
- observational terms ... where we think we can observe what we are talking about (data)
  - → "observing" ... to collect data
- theoretical terms ... where we construct a model or theory about what we think we observed
  - → "constructing" ... thought patterns (models, theories) from data

✺ There is a difference between *looking* and *observing*.
- → looking ..... done in a casual, unstructured, unlearned manner
- → observing ..... done in a formal, structured, and learned manner

✺ *Predictions* can be made from *scientific theories*.
- → Thus, scientific theories can be *tested*.

☞ a world view that claims that, overall, Nature is:
- material, orderly, and intelligible ... and thus ... *Western scientific reasoning* looks for logical and natural explanations for the **PATTERNS** observed in Nature ... for relationship, structure, and organization ... and assumes that:
  - → Nature can be explained by:
    - natural laws,
    - historical contingency, and
    - the rules of self-organization
  - → Nature can be broken down into entities that:
    - can be measured
    - can be arranged in holarchies and heterarchies (see ThoughtTraps I, building block on perception)

☞ a world view that sees causes linked to effects ... which is the same as saying that natural events (causes) lead to natural results (effects) ... this is known as **natural causation**
- therefore ... things do not occur spontaneously in Nature
- therefore ... there is no "free will" (= goal directed activity, teleology) in Nature

→ however, in Western science the statement about free will becomes problematic and needs to be qualified (= to have limits or conditions set on it) ... if "human consciousness" is considered a natural process as modern neuroscience proclaims it to be ... because:
- humans do exhibit free will ... they are very capable of goal directed behaviour ... indeed, "volition" is one of the building blocks of consciousness in MSɬT 101 /103
- humans do exhibit free will ... they have some capacity towards "mind over matter" thinking with respect to functioning of the body ... consider, for example, the "power of positive thinking"

☺ **Thus, a controversial topic in Western science today is the reality and/or extent of "consciousness as causal" ... i.e., consciousness being able to affect matter.**

?? ... and discussion about it **("consciousness as causal")** involves issues such as:
- "action at a distance"
- "cosmic connectedness"

!!! .... furthermore, most discussion and inquiry about this topic is considered **frontier** or fringe science ... and, it occurs under various labels, such as:
- parapsychology, psi, ESP, subtle energy, spirit

✍ an excellent journal to read, if you are interested in this field and wish to stay true to the rigor of Western science ... is the *Journal of Scientific Exploration*, published by the Society for Scientific Exploration (www.scientificexploration.org)

✳ causal knowledge is indispensable to Western science (Stehbens W. 1992. *Perspectives in Biology and Medicine* 36: 97-119)

☞ a world view that has, traditionally, involved inquiry done within the context of an overall approach and mind set (a *paradigm*) referred to as both reductionistic and mechanistic

☞ a world view that intends that its "way of knowing" be *dynamic*, not a dogmatic
- → dynamic = able to be adjusted or modified in the light of new evidence ... capable of changing to incorporate new attitudes, new approaches, and new understandings
- → dogmatic = rigid and unchangeable regardless of new evidence

⇨ Many philosophers and other scholars today suggest that a major change ... a *paradigm shift* ... is occurring in Western science. This change (shift) involves moving from the older mechanistic world view which is largely reductionist to a newer organismic world view which adds a holistic approach while still recognizing the value of reductionism.

☺ MSIT students should be familiar with this shift because the older, mechanistic paradigm offers much less potential for recognizing Common Ground between Western science and the Mi'kmaw world view (as per the objectives of Toqwa'tu'kl Kjijitaqnn / Integrative Science) than does the newer, organismic view.

☞ a world view that considers *scientific genius* to be the ability to "**see**" further than anyone else ... as to the patterns and the explanations for them
- → Why use the word "**see**" in the statement "*scientific genius* is the ability to "see" further than anyone else"?

☺ It is because **vision** is the dominant sense in humans and thus, to understand something is to "**see**" it.

☞ a world view that holds that there is no "*proof*" (or "truth") in the experimental sciences ... unless you are talking in terms of *logic* or *mathematics*.

☞ a world view that holds *scientific definitions* to be extremely important ... they are precise, and we are not at liberty to change them.

☞ a world view that finds it sometimes easier to say what something is not, than to say what it is

☞ a world view that has no place for *dogmatism*

Additional key understandings about the world view of Western science

1) Modern Western science involves questions about natural origins.

During the "**Age of Faith**" in Europe (prior to 1250), there was no incentive to "examine Nature" ... i.e. there was no effort to look for logical and natural explanations for the **PATTERNS,** relationships, structures, and organizations observed because everything was "the way it was" due to the will of God.

? How, when, and why did Western civilization change its approach?

☞ The "**Age of Rebirth**" (starting around 1250) saw a recognition of the difference between *deep faith* (in God) and *intellectual curiosity* (about Nature). As a result, the "asking of questions" in a reality-based and reality-tested manner thus became an essential part of the intellectual activity involved in doing science.

2) In the knowledge system of modern Western science, the concept of "hypothesis" plays a central role. Note the differences in the following key concepts for this knowledge system:

- **fact:** something known with certainty ... which means that is has been objectively verified, that it has a real or demonstrable existence

- **hypothesis:** a postulated (tentative) explanation consistent with available information, subject to test

- **theory or model:** an hypothesis that has been tested many times and is well supported by the outcomes of these tests, and thus unlikely to be disproved by additional testing ... and is also of a general or broad nature

Ontology of Western science

Overall, the ontology of Western science holds that Nature is:

- physical, or material ... which means it manifests as *matter* (with different states: solid, liquid, gas, plasma) and *energy forces* ... that can be measured
- orderly ... which means it is structured and organized
- intelligible ... which means its structure and order can be understood, in rational terms, by humans

✴ When consciousness is included, some variation in ontology may need to be considered.

The Standard Model of Physics

... is an answer, in Western science, to the ontological question when it is asked with respect to the most fundamental, or most basic, level in Nature

- The Standard Model of Physics is an inventory (or list) of "what Nature is", in terms of fundamental "parts", i.e. fundamental matter particles and fundamental energy forces. It is considered in detail in MSŦT 201/203, but in brief consists of:
  - ☞ fundamental matter particles: leptons and quarks
  - ☞ fundamental energy forces, and their associated force particles:
    1) gravity → particle: graviton
    2) electromagnetism → particle: photon
    3) strong nuclear force → particle: gluon
    4) weak nuclear force → particle: W and Z bosons

In the world view of Western science, it is from these fundamental particles and energies coming together (as time unfolds after the Big Bang), that everything else in Nature has emerged. And, we live today in an *evolutionary Universe*, i.e. one which is still changing (however fast or slow that change may be at different levels).

⇨ Note that the primary focus, for consideration of what is "fundamental", is on objects or entities (not processes or actions). The English language is similarly focused on objects, i.e. it is "noun-based". In contrast, mathematics is much more similar to Aboriginal languages in that it is based on *action and relationships*, not objects.

In Western science, the story of the evolving Universe is part of the discipline of Cosmology. Overall, the "big story" of Cosmology is one of inanimate (non-living) to animate (living) to conscious matter ... in which human beings are formed from stardust. Questions about the parts in this story are among the "big questions" that other disciplines in modern science ask. For example:
- What is energy? (is asked by physics)
- What is life? (is asked by biology)
- What is consciousness? (is asked by cognitive science)

It is important to realize, however, that *scientific research proceeds by asking very small and quite specific questions* ... but that they fit within the big questions.

Epistemology of Western science

In Western science, epistemology involves considerations of:
- What makes a claim "scientifically valid"?
- What counts as "scientific evidence"?
- What criteria are acceptable as the basis for "scientific models and theories"?

☞ ***Observing (to collect data)*** and ***constructing models or theories (from the data)*** ... are of utmost importance in Western science — indeed, they are considered the two levels of definition in science as a way of knowing.

☞ In particular, the validity of models and theories in Western science is said to manifest in their *predictability* and *application.*

Modern Western science ... in its efforts to understand "things" (structures and processes) in Nature, is based entirely on **asking questions** in a *reality-based* and *reality-tested* manner. Indeed, the type of question asked is what drives the design and, therefore, potential success of entire research projects (see section entitled: Questions ... are "thought traps").

Collecting data ... within the context of specific questions

Great epistemic value is placed on ***data that is gathered or collected*** via:
- observation (use of the senses)
- measurement
- experiment

⇨ data gathered via these means are referred to as "scientific results", and also as "empirical"

Constructing theories or models ... using data to answer questions

Great epistemic value is placed on ***models or theories*** that have ***maximum***:
- consistency
  ... ability to fit with as much of the former system of concepts as possible (external fit)
- coherence
  ... ability to fit t pieces together in a logical manner (internal fit)
- repeatability
  ... ability to produce the same results again
- fertility
  ... ability to generate new predictions
- predictive power
  ... ability to tell in advance what will happen
- simplicity
  ... ability to be stated in an overall simple way
- modesty

... ability to have its claims as narrowly drawn as possible

definition: a ***model*** or a ***theory*** is a **systematic or organized set** of ideas based on data (on evidence) ... a way of recognizing and showing **a thought pattern**

Note: Pattern recognition is something humans tend to do automatically and nonconsciously (Grigsby and Stevens 2000), although the "pattern" so constructed may or may not be "true", i.e. accurate or real. See more on "**pattern**" in section on: perception ... a building block of consciousness

- Scientific ***models and theories*** attempt to provide ever more accurate approximate descriptions of reality ... and thus must be dynamic ... i.e. which means they are subject to change, revision, or discarding when new evidence becomes available

Some thinking tools ... for constructing models and theories

■ Construction of models or theories requires ***thinking tools*** ... and Western science relies most heavily on:

- *reductionism*
  = explaining the largest number of "things" with the fewest assumptions
- *analysis*
  = taking something apart in order to understand it, or
  = emphasizing the examination of the parts of a system (rather than the whole)
- *mathematics*
  = the preferred language in which to express or represent understanding

■ Other important intellectual tools that allow one to reach conclusions or see "the pattern that connects":

a) inductive thinking ... or, **induction**

- induction ... can be referred to as Francis Bacon's method of investigation ... Bacon was a prominent English thinker in the 17th Century (1600's) ... the century that encompasses the so-called Scientific Revolution when modern Western science was emerging

  Bacon attempted to clarify how 'scientific thinking' differed from other thinking. He said that humans, rather than relying on pure reasoning (i.e., classical Greek thinking) as the source of fact, should obtain facts by "reading the *Book of Nature*" and using *experiment.*

- induction ... is defined as reaching a conclusion by reasoning from the particular (parts, or specific understandings) to the general (whole, or overall understanding)
  = the gathering of large numbers of facts (data, parts), followed by the **detection of pattern**
  1) start with an unbiased description of phenomena
  2) collect common traits into an intermediate level of generality
  3) proceed to higher levels of generality

- induction ... is a way of thinking in which one assumes that: if the premises (starting points) are true, then the conclusion must be true

→ induction ... seems natural, in that the human brain works on the basis of **pattern recognition** ... yet this approach *by itself* does not include the methods of formulating and testing hypotheses and theories that form the core of modern Western science

  - Popper [one of the most influential modern philosophers of science] dismisses induction as an acceptable scientific way of thinking ... because it lacks both hypothesis formulation (proposing of tentative answers) and error searching via testing of those hypotheses (Miller, D. 1999. Being an absolute skeptic. *Science* 284: 1625-1626)

- **induction** ... if the premises are true, the conclusion must be true

b) deductive thinking ... or, **deduction**

- can be referred to as René Descartes' method of investigation ... Descartes was a prominent French philosopher and mathematician in the 17th Century (1600's) ... which is, as mentioned previously, the century that encompasses the so-called Scientific Revolution when Western science was emerging

- deduction ... is defined as reaching a conclusion by reasoning from the general (whole, or overall understanding) to the particular (parts, or specific understandings)
  = cutting to the quick of each phenomenon, followed by an attempt to skeletonize it, or
  = perceiving an orderly relationship (pattern), and then attempting to provide an orderly explanation for it in terms of "rules, regulations, or laws"

  → and then, preferably using the logic and language of mathematics to describe the "skeleton" or "pattern"

- deduction ... is a way of thinking in which one assumes that: the conclusion does not necessarily follow from the premises (starting points), although the premises may support the conclusion; OR, on the other hand, the conclusion may not be true

  ✺ *Modern scientific inquiry* is said to be characterized by a deductive method of thinking and, more specifically by a hypothetico-deductive method.

- deduction ... is reasoning from the general to the particular
  = cut to the quick of each phenomenon and skeletonize it

- **deduction** ... the conclusion does not necessarily follow from the premises, although the premises support the conclusion; or, the conclusion may not be true

☞ *deduction* is combined with the concept of *hypothesis formulation* (proposing tentative

answers, or conjecture) and *hypothesis testing* (prediction) ... in the so-called ***hypothetico-deductive methodology*** ... which the philosopher of science Karl Popper enshrined as the hallmark of mature, Western science ... under the name *falsification*.

- ***Hypothetico-deductive methodology*** is the epistemological approach that many current science textbooks point to as the "scientific method" ... it conceives of science as proceeding under the rules of logic in which:

  - first, a theory is conjectured (as a hypothesis ... a tentative answer to a specific question)
  - second, an observational prediction is deduced
  - third, an experiment is designed to show that the prediction will not be fulfilled (and thus, the so-called "null hypothesis")
  - then, if the experiment

    a) succeeds (i.e. the prediction is not fulfilled)
    ... the hypothesis is said to be not confirmed ... theory must be adjusted

    b) fails (i.e. the prediction is fulfilled)
    ... the hypothesis is said to corroborated ... theory receives some support to survive to another test

☹ However, there is increasing recognition among some philosophers of science that Popperian falsification (i.e. hypothetico-deductive methodology) is not a plausible model of how science works.

Philosophers who disagree with Popperian falsification envision science as working in a more *holistic* manner ... in which meaning and theoreticalness are *spread throughout the entire theory*, and *every term is interconnected to some network of other terms in the theory*. Thus, there can be no crucial experiment (test) that makes or breaks a particular theory.

Perspective in Western science ... objectivity and subjectivity

The acquisition of factual knowledge (scientific knowledge) is essential to human survival ... and thus, the *scientific pursuit* or *scientific inquiry* is as old as the consciousness of our species.

- Science involves a practical engagement with external physical reality, which demands a skillful combination of *doing* and *thinking*.

- Science probably began with the assumption that our senses give an accurate picture of external reality. **Thus, the importance of the observer and of observations in science,**

  ... and the necessity of understanding objectivity and subjectivity.

☺ ☺☺☺ ☺☺☺☺☺

Where is the pattern: in Nature ... in your mind ... or in both?

☞ Modern scientific inquiry strives to generate **objective** explanations as answers to the questions it asks ... these explanations are referred to as *scientific information* ... and are called *facts, theories, and laws* ... which collectively make up the *scientific knowledge base*. The study of science requires, therefore, an understanding of the words "objective" (and "objectivity") and "subjective" (and "subjectivity").

- ***objective:*** as free as possible from the influence of societal and personal interests, opinions, emotions, prejudice ... i.e. value neutral

  ☞ *Principle of Objectivity* in Western science: the features (i.e. mindset) of the observer (questioner, thinker, or interpreter) shall not enter into the description of his or her observations

- ***subjective:*** influenced by societal and personal interests, opinions, prejudices, emotions

☹ **It is misleading to believe that science is, or even could be, totally objective.**

Francis Bacon was an English philosopher (1561-1626) who attempted to clarify how scientific thinking differed from other thinking ... especially "objective" vs "subjective" ... and his name is often associated, incorrectly, with the claim that scientific thinking can be totally objective.

☺ It is equally important to understand that, in some regards, science thrives on subjectivity ... but at the end of the day, a scientist must strive to clarify his or her conclusions such that they are as objective as possible. Read: Root-Bernstein, R. 1997. Art, imagination, and the scientist. *American Scientist,* 85: 6-9.

Consciousness & Western Science

☹ As late as 1986, an expressed interest in "human consciousness" could lead one to be ostracized (ignored as some sort of flake or looney) by the Western scientific community (see statement in article on Kristof in Scientific American, June 2001).

☺ Now, however, consciousness studies are one of the hottest frontier areas in neuroscience and cognitive science.

☺ Consciousness is briefly considered here because it adds a number of "isms" to the discussion on perspective and Western science (consciousness is considered in detail in MSIT 101/103).

QUESTION: Where does consciousness fit in Western science, since it is not in the Standard Model of Physics?

If you read widely, you will encounter considerable discussion about ontology **when consciousness is an issue**. Four variations are outlined below ... pay particular attention to their different starting points (i.e. what is considered basic, or elemental ... their "metaphysics").

a) materialism ... mainstream Western science is anchored here

- consciousness is considered an *emergent property* ... from matter and energy forces
  - → this ontology gives primacy and universality to matter and energy forces (as in the Standard Model of Physics), and the physical laws governing them; these are elemental

    - the standard view is that consciousness is an emergent property in living organisms ... a world view referred to as *monism* ... i.e. consciousness and physical "things", or mind and brain "things" are considered the same "thing". Conscious "things" simply have more sophisticated combinations of the fundamental particles and energies than do non-consciousness "things".

      ☹ A challenge facing the materialistic view is that modern neuroscience is only just beginning to understand the connections between physiology (or, the living body) and psychology (or, mind / consciousness) ... i.e. the connections between living matter and conscious matter.

      ✍ Nevertheless, scientific ideas are beginning to accumulate ... and possible explanations (hypotheses, models, theories, paradigms) have been suggested.

    - a much, much broader view (and one that is not widely held in science because of the restriction, by science, of consciousness to a brain) is that consciousness can be a trait of even inanimate objects, as for example, rocks and minerals ... because it is an elemental property of <u>any correlational mechanism</u> ... thus, any objects that change their informational state dynamically are capable of *some* degree of consciousness (Hobson 1999

[p. 18] referring to ideas in Fred Alan Wolf's *The Dreaming Universe*)

b) dualism

- consciousness exists independently and separately from matter
  - → this ontology considers consciousness and matter ("mind stuff" and "matter stuff", i.e. mind and brain) as both elemental and mutually alien substances ... thus, their relationship poses a problem (e.g. Descartes' problem)

  - one suggestion towards resolution of this problem is that the relationship is achieved by supernatural intervention, such as a miracle

c) idealism

- consciousness has primacy and universality ... matter emerged from it later
  - → this ontology considers consciousness as elemental

d) panpsychism (a very few Western scientists and philosophers are willing to consider, or as one might say, to "entertain" this view)

- → this ontology considers physical things (matter and energy) and consciousness as both elemental

- consciousness and matter have always existed together ... i.e. been co-extensive, co-eternal, and (in some way) co-creative ... thus, matter is intrinsically sentient or experiential "all the way down"

- also: *double-aspectism* ... ultimate reality is considered to be intrinsically mental and physical

e.g. **information** is *truly fundamental* (it is the *universal vocabulary*) and thus is intrinsically both: phenomenal (experiential, subjective) and physical (material, objective)

And, maybe ... in a highly innovative, or even radical, effort to understand the relationships between consciousness and matter, Western science may need to start to recognize that energy converts from one mode or form (information state) to another in accordance with fundamental ***psychophysical laws***, not just physical laws (Chalmers 1996)

? Do the above thoughts echo with F.A. Wolf's suggestion that consciousness is an elemental property of any correlational mechanism ... where objects change their informational state dynamically?

QUESTION: What perspectives are considered in consciousness studies?

☞ *3rd person perspective:* characterizes Western science
- the way to investigate consciousness is to study objective things such as brains, nervous systems, computer models, or quantum level events ... i.e. 3rd person objects or "its"
- this approach is favoured by neuroscientists, cognitive scientists, quantum theorists

☞ *1st person perspective:* characterizes those who feel that the most salient feature of consciousness is its subjectivity (what it feels like from within)
- the way to investigate consciousness must include 1st person perspective with a focus on "I's" rather than "its"
- this approach is favoured by phenomenologists and meditator-investigators

☞ *intersubjective perspective:* this under-acknowledged perspective goes beyond 1st or mere 3rd person perspective to also include 2nd person
- the way to investigate it must recognize consciousness as a lived, creative process involving interpersonal relations and intersubjective experience ... consciousness is neither "it" nor "I" but also involves "you" or some other 2nd person

New areas in the scientific pursuit of knowledge

! ! From the material on the last few pages, do you find it at all surprising that attempting to understand "consciousness", and then work with these new understandings, poses a major challenge today?

Can new scientific understandings about consciousness be completely accommodated by the "standard model of physics" together with the assumption that consciousness is an "emergent property" in an evolutionary universe?

Maybe the "standard model" is OK ... and our scientific understandings of natural processes, of constant change and flux in the Universe, are on the right track but not complete.

Western science does not claim to know all the answers ... nor even how to ask all the questions. But it is a wonderfully exciting time in science to be wondering and asking, to be trying to discover new understandings ... scientific pursuit! At the same time, we certainly need to apply new understandings to some of the miserable problems we face.

As mentioned earlier, the type of question asked is what drives the design, and potential success, of entire research projects in science. And, the ability to think creatively, as well as critically, is essential in the scientific pursuit.

☺ There are, undoubtedly, numerous insights that Aboriginal world views can bring to these scientific pursuits, be they new efforts to gather understandings or new efforts to act upon understandings ... Common Ground <u>is</u> important.

The Aboriginal way of life has always involved scientific pursuit, has always assumed constant change and flux in the Universe (something Western Science has only embraced in the last half century), has always seen itself as a participant in natural laws of interdependence in the Universe, and has languages that are based on relationship and action (i.e. are verb-based, whereas English is noun-based).

Do you hear past echoes of Leroy Little Bear's story?
Do you hear future echoes of Douglas J. Cardinal's thoughts on creativity?
Do you sense the challenge in being part of Toqwa'tu'kl Kjijitaqnn / Integrative Science's leading-edge pursuit into the unknown?
Do you see why the Mi'kmaq language is a major component of MSIT?

• only when knowledge is conditioned by respect can it be truly shared •
• consciousness is conditioned by environment •

Distinguishing Western science from pseudoscience

☞ The diagnostic features of science that distinguish it from pseudoscience are, according to Wilson (1998, *Consilience, the unity of knowledge*. Alfred A. Knoff, Inc. New York.), the following:

1) **repeatability** ... same phenomenon is sought again, preferably by independent investigation, and the interpretation given to it is confirmed or discarded by means of novel analysis and experimentation

2) **economy** ... abstract the information into the form that is both simplest and aesthetically most pleasing — while yielding the largest amount of information with the least amount of effort

3) **mensuration** ... measurement, using universally accepted scales [if the thing CAN be measured]

4) **heuristics** ... its new knowledge:
   a) stimulates further discovery, often in new directions
   b) provides an additional test of the original principles that led to the discovery

5) **consilience** ... explanations of different phenomena most likely to survive are those that can be connected and proved consistent with one another

☞ the true natural sciences vs. pseudosciences: (Wilson E.O. 1998)

- The true natural sciences lock together in theory and evidence to form the ineradicable technical base of modern civilization.

- The pseudosciences satisfy personal psychological needs, but lack the ideas or the means to contribute to the technical base.

☞ checklist of characteristics that tend to separate **science rules** from the pretenders:
(Casti, J.L. and Karlqvist, A. 1996. *Boundaries and Barriers; on the limits to scientific knowledge.* Addison-Wesley Publishing Company, Inc., Reading Massachusetts. 262 pp.)

- explicit ... no ambiguity and requires no private interpretation

- public ... in the open literature and can be tested by anyone

- reliable ... succeed in predicting and/or explaining and variety of phenomena over a substantial period of time

- objective ... relatively free of investigator bias, i.e. rule is independent of the social position, financial status, or cultural background of the investigator

- rules generated by "scientific method" (i.e. process by which science distinguishes itself from other reality-generation schemes)

  → principal steps ... three stages:
  1) observation
  2) hypothesis ... note: in a field that is already well developed, the process may be entered at this step
  3) experiment

☞ Miller (1999, Being an absolute skeptic. *Science* 284: 1625-1626): Scientific hypothesis, by themselves, have no more claim on our credulity than have the fancies of pseudoscience. BUT, science is more than the sum of its hypotheses, its observations, and its experiments — ***science is above all its critical method of searching for errors***. This is what differentiates it from pseudoscience. What is wrong with pseudoscience is the way in which it handles its hypotheses, not normally the hypotheses themselves.

  ▫ and ... it took Popper's genius to realize what is central to rationality is criticism, not justification or proof; and to scientific rationality, empirical criticism

Comparing reductionistic and holistic approaches

	REDUCTIONIST SCIENCE	HOLISTIC SCIENCE
system property (and thus, name)	• complicated causes can be resolved into more simple components, the effects of which are treated separately (i.e. the whole is the sum of the parts)	• the whole is greater than the sum of its parts, leading to the emergence of new structures that are spatially or temporally coherent
other names	• generally **"Western science"** • mechanistic • Cartesian • analytic • orthodox / mainstream • atomistic	• sometimes **"non-Western science"** • systemic or organismic • • synthetic or integrative • alternative ... NOT 'pseudoscience' • contextual
primary focus	• parts • objects as primary (= empirical focus) → substance - matter - structure - quantity → meaning is considered irrelevant	• whole • relationships as primary (= organizational focus) → form - pattern - order - quality → meaning is considered relevant
primary metaphor	• machine	• web
models of physical phenomena	• assumed to be linear, or nearly so	• assumed to be non-linear
knowledge	• considered objective • complete & definitive • metaphor: foundation	• acknowledged to be epistemic • limited & approximate • metaphor: network
consciousness	• considered irrelevant to observations	• considered relevant to observations
spiritual element	• absent	• present → sense of a subtle world, i.e. a sense of the of human connectedness with the Universe, in both cosmological and ecological terms, as well as the creative dimension in Nature which includes humans
negation	• concept philosophically significant	• concept not philosophically significant
cultural emphasis	• self-assertive / individual	• integrative / community

☞ "Western science" took the lead in the world largely because it cultivated **reductionist thinking** and **physical law** to expand the understanding of space and time beyond that attainable by the unaided senses.
(Wilson, E.O. 1998. Consilience, the unity of knowledge. Alfred A. Knoff, Inc. New York.)

Organizing principles in complex systems science

Complex system science has numerous other names or concepts associated with its overall concept ... a few of which include:

- complexity science
- non-linear dynamics
- chaos theory
- fractals
- self-organization theory
- emergence theory

Complex systems science is an interdisciplinary and emerging approach within science that attempts to develop a general conceptual framework (i.e. unified framework, or big knowledge pattern) for making sense of Nature ... one that is equally useable in a variety of different disciplines in science, and by non-scientists as well. Indeed, some of its main ideas have been transferred into the realms of business organization and institutional management, as organizational science and managerial science.

The New England Complex Systems Institute (http://necsi.org/guide/whatis.html) at MIT describes complex systems science "as a new field studying how parts of a system give rise to the collective behaviours of the system, and how the system interacts with its environment. Social systems formed (in part) out of people, the brain formed out of neurons, molecules formed out of atoms, the weather formed out of air flows ... are all examples of complex systems. The field of complex systems cuts across all traditional disciplines of science, as well as engineering, management, and medicine. It focuses on certain questions about parts, wholes, and relationships. These questions are relevant to all traditional fields."

Indeed, Cajete (1999, *Igniting the Sparkle; an Indigenous Science Education Model*, and 2000, *Native Science; Natural Laws of Interdependence*) points out that there is significant overlap between the "way of thinking" in complex systems science and Aboriginal world views.

- Within this Common Ground theme, John Briggs and F. David Peat (1999) wrote a book entitled *Seven Life Lessons of Chaos; Spiritual Lessons from the Science of Change*.

  ✴ Briggs (1992) also wrote the book *Fractals, the Patterns of Chaos; Discovering a New Aesthetic of Art, Science, and Nature.*

  ✴ Peat (1994) also wrote the book *Lighting the Seventh Fire; the Spiritual Ways, Healing, and Science of the Native American.*

In introducing the field, the New England Complex Systems Institute's web site also states:

- The study of complex systems is about understanding indirect effects. Problems that are difficult to solve are often hard to understand because the causes and effects are not obviously related. Pushing on a complex system "here" often has effects "over there" because the parts are interdependent. This has become more and more apparent in our efforts to solve societal problems or avoid ecological disasters caused by our own actions. The field of complex systems provides a number of sophisticated tools, some of the concepts that help us think about these systems, some of them analytical for studying these systems in greater depth, and some of the computer based for describing, modeling, or simulating these systems. Thus, the field has been described by some as both new and the ultimate in interdisciplinary fields ... that breaks down the barriers between physics, chemistry, and biology and the so-called soft science of psychology, sociology, economics, and anthropology. There are a few excellent books, albeit they are heavily mathematical in content.

- There are three interrelated approaches to the modern study of complex systems, (1) how interactions give rise to patterns of behaviour; (2) understanding the ways of describing complex systems; and (3) the process of formation of complex systems through pattern formation and evolution.

Yaneer Bar-Yam is the author of the above statements found on the New England Complex Systems Institute's web site. He has also written (1992) one of the few textbooks available on the field of complex systems science ... entitled *Dynamics of Complex Systems.* The entire introductory chapter (*Overview: the dynamics of complex systems - examples, questions, methods, and concepts*) is available at http://necsi.org/guide/.

The New England Complex System's Institute also provides, on its web site (http://necsi.org/guide/concepts/), a "concept map" for the field in which the following key words are found (many annotated):

- system
- description
- information
- pattern
- collective
- interdependent
- indirect effects
- dynamic response
- feedback
- linear and non-linear chaos and fractals
- scale
- randomness
- evolution
- selection
- self-organization
- replication
- development
- ecosystem
- network
- boundary
- environment
- adaptive
- observer
- complexity
- emergence

In spite of the positive impression given above, many academic say there is still little agreement on what the field is ... i.e. what its knowledge framework is ... and point out that suggestions abound, with no one particular framework* yet fully accepted by mainstream academia. Indeed, many in mainstream academia have difficulty with the credibility of the concept altogether. The article (http://members.aol.com/notate/ICCS_Paper.htm) *Why we don't understand complex systems*, by Jeffrey Long, presented at the International Conference on Complex Systems in May 2000 is somewhat informative.

* The knowledge framework used will influence one's way of thinking ... and thus how one asks questions (or doesn't ask them), how one tries to answer them, and how one weaves answers into existing patterns of understanding.

With regard to the contentious nature of complex systems science, a January 2001 article in *The Economist* describes the field as having "made a big noise in the early 1990's ... but cast little light. Now its chastened practitioners are having another go". The article points out that:

- In the early 1990's considerable work in the field concentrated on computer based experiments that were novel, but not clearly relevant to the real world. It promised much, but delivered little ... and subsequently was dismissed by many as largely handwaving.
- This tarnished image may be changing now that some researchers have focused on the complexities of relatively simple systems. The article goes on to describe some examples.

Informative web sites for complex systems science include:

- New England Complex Systems Institute: http://www.nesci.org/
- Significant points in the study of complex systems: http://www.nesci.org/projects/yaneer/points.html
- National Training Program in Complex Systems and The Brain Sciences at Florida Atlantic University: http://www.ccs.fau.edu/PROGRAM.HTM
- Institute for the Study of Coherence and Emergence: http://isce.edu/site/welcome.html
- Complex Systems Links in the WWW: http://www.cea.uba.ar/aschu/links.html
- Society for Chaos Theory in Psychology & Life Sciences: http://www.societyforchaostheory.org/tutorials.html

Some of the characteristics, expressed in non-mathematical language, of a possible knowledge framework for complex systems science are listed below ... as developed for a project in a Biology 367 class at Bryn Mawr College in the United states, by Paul Grobstein and colleagues, entitled *Insights from complex systems* ...can be found at:

- http://serendip.brynmawr.edu/complexity/complexity.html

Insights from complex systems

http://serendip.brynmawr.edu/complexity/complexity.html (accessed 12 January 2000)

1. Many (all ?) interesting phenomena can usefully be described as "orderly ensemble properties" and productively understood in terms of the properties and interactions of sub-phenomena ("elements").
   ⇨ wholes are made up of parts

2. Ensemble properties are permitted by, but not determined by, element properties.
   ⇨ wholes are more than the sum of their parts

3. The behaviour of ensembles is both influenced by, and influences, the behaviour of elements.
   ⇨ there is a reciprocal causal relationship between parts and wholes

4. Orderly ensemble properties can and do arise in the absence of blueprints, plans, or discrete organizers.
   ⇨ interesting wholes can arise simply from interacting parts

5. Ensemble properties may be largely unaffected by variations in the properties and behaviour of elements.
   ⇨ holistic properties may appear resistant to changes in parts

6. Ensemble properties may be highly sensitive to variations in the properties and behaviour of elements.
   ⇨ holistic properties may suddenly and apparently mysteriously change

7. Ensemble properties can be dramatically changed by modifying the nature of the interaction among elements.
   ⇨ enumeration of parts cannot account for wholes

8. Ensemble properties may be dynamic for reasons entirely internal to the ensemble.
   ⇨ change does not necessarily indicate the existence of an outside agent or force

9. The same change in element property or behaviour may have a small effect on ensemble order at one time and a large effect at another time.
   ⇨ the relationship between parts and whole may itself change for a given whole

10. Disorderly variations in element properties or behaviour may be the driving force for ensemble order.
    ⇨ interesting wholes can arise from chaos or randomness

11. Deterministic systems will not explore all possible ensemble states.
    ⇨ randomness plays an important role in the exploration of possible wholes

Parts in Western science's "way of knowing"

*1) **methodological starting point*** (≠ metaphysics ... which is a philosophical starting point)

- observations and musings ... thinking and wondering about Nature, reading the *Book of Nature*

*2) **creative aspects***

- is there **pattern ... structure, order, and relationship** (i.e. "story") in what is observed?
  - generation of ideas and questions re structure, pattern and order ... by way of creative, innovative, imaginative, and/or logical thinking
  - fundamental importance and value of:
    - acknowledgment and recognition of pattern
    - awareness of "the unusual" or "facts that don't fit" or "mystery" (problems)
    - rational & imaginative / intuitive modes of thinking
    - holistic & reductionist thinking
    - metaphoric thinking ... multidimensional & relational
    - open-mindedness
    - READING!!!! ... within the discipline and outside

3) formal process ... **The Scientific Method (hypothetico-deductive method)**

- putting together a formal proposal re an idea or possible explanation
  - hypothesis formulation or conjecture
    - → reliance on: logical thinking

- testing the hypothesis
  - making and testing predictions ... to collect new or additional information (data)
    - → requires: logical and analytical thinking
    - → involves: observation and/or experimentation ... to collect empirical data
      - may generate qualitative data (descriptive)
      - may include measurement to generate quantitative data (numerical), which can be evaluated using statistical analysis

- new or additional information (data) gathered may:
  - support hypothesis OR disprove hypothesis
    (note: "support" is not the same as "prove")

4) formal communication of new discoveries

- as research papers, generally written in the rigorous format of "Introduction, Methods & Materials, Results, Discussion" and published in peer-reviewed, scientific journals

5) desired end product: an **objective knowledge base**

- facts, models, theories, laws

Outline of major disciplines in Western science

natural sciences	↔	***cognitive science***	↔	***social sciences***
- cosmology		*consciousness studies*		- anthropology
- physics		*neuroscience*		- sociology
- chemistry		"mind"		- economics
- geology		- interdisciplinary -		- some psychology
- biology				

☞ overall assumption of modern Western science: *energy* dancing in *fields* of *spacetime* in *matter* and *forces*

☞ preferred metaphor of description in modern Western science: language of mathematics

☞ the natural sciences are "empirical" ... they focus on things that can be observed and measured

☞ science, as a "way of knowing", advances by asking questions about Nature ... and by presuming that where ordered relationship [pattern] is perceived (seen), it should be possible to provide an orderly explanation for it [the pattern]

Big Questions about Nature in the five major natural science disciplines

☺ ThoughtTraps 2 ... for MSłT 201/ 203 ... considers these "Big Questions" (plus many little ones associated with them) ... and their answers.

- **Cosmology** ... Big Bang Theory
  - How did our Universe originate?
  - How did our Universe evolve?
  - What is the overall structure of our Universe today?
  - What is the destiny our Universe?
  - As humans, what is our place in the Universe?

- **Physics** ... Building Blocks of Matter and Fundamental Forces of Nature (The Standard Model)
  - What is the Universe made up of?
  - Do "basic building blocks" of ordinary matter exist? What are they?
  - Do "fundamental particles" of ordinary matter exist? What are they?
  - Do "fundamental forces" of energy exist? What are they?

- **Chemistry** ... Periodic Table of the Elements
  - What different kinds of atoms (i.e. elements) are there in the Universe?
  - What properties and relationships exist among different elements?
  - Why do atoms become ions, or come together to form molecules?
  - What happens when particular types of energy conversions occur?

- **Geology** ... Planet Earth
  - How is the matter of the Universe arranged in planet Earth?
  - What are the Earth's building blocks?
  - What are minerals? How do they originate?
  - What are rocks? How do they originate?
  - How do continents form? ... Plate Tectonics Theory

- **Biology** ... Life
  - What is life?
  - What are the major categories of life on Earth? ... Biodiversity
  - How did life originate?
  - How did life diversify? ... Theory of Evolution
  - Do "basic building blocks" of life exist? What are they? ... Cell Theory
  - Where in the cell is the information for life stored, and how is it accessed and used?
  - How do living organisms convert energy?

Some important historical players in Western science

• Isaac Newton

- achieved first great breakthrough in modern science, when he showed that the planetary orbits postulated by Copernicus and proved elliptical by Kepler could be predicted from the first principles of mechanics (equally applicable to all inanimate matter ... from solar system to grains of sand)

→ universe is BOTH orderly and intelligible
1684: mass and distance laws of gravity
1687: three laws of motion

• Francis Bacon

☹ Bacon's name is often wrongly associated with the claim that scientific reasoning can be totally objective.

☺ Bacon's name is correctly associated with early efforts towards objective reasoning in science. It is important to note that he was well aware of the social and personal biases introduced by human society and individual consciousness ... and he understood that human reasoning could never be totally free of these subjective biases or limitations, which he called "idols", identifying four in two categories.

a) those that enter our minds from outside ("attracted" idols)
1) idols of the theater ... limitations imposed by *old, non-productive* ways of thinking

2) idols of the marketplace ... limitations imposed by *false* ways of thinking

b) those that belong to the very nature of human intellect ("innate" idols)
3) idols of the cave ... limitations inherent in the *temperament* of the individual

4) idols of the tribe ... limitations inherent in the *structure* of the human mind

☞ a good article: Gould, S.J. 2000. Deconstructing the "science wars" by reconstructing an old mold. *Science* 287: 253-261.

• **René Descartes**
= showed how to do science with the precise aid of **deduction** ... cut to the quick of each phenomenon and skeletonize it
- the world is three dimensional ... so let our perception of it be framed in three coordinates (today = Cartesian co-ordinates)
- founder of algebraic geometry

- Descartes' overarching vision:
  1) knowledge as a system of interconnected truths that can ultimately be abstracted into math
  2) universe is both rational and united throughout by cause and effect
  3) systematic doubt is first principle of learning
     → today = system of Cartesian doubt thrives in modern science ... in which all assumptions that can be are systematically eliminated, so as to leave only one set of axioms on which rational thought can be based and experiments can be rigorously designed
  4) concession to metaphysics (believed in God, as a perfect being, manifested by the power of the idea of such a being in his own mind): argued for complete separation of mind and matter ... a stratagem that freed him to put spirit aside and concentrate on matter as pure mechanism

Western science ... and the so-called "Cartesian split"
René Descartes is the name of a prominent French philosopher and mathematician from the17th Century ... the century that encompasses the so-called Scientific Revolution when Western science was emerging. Among other things, he stated that the physical world is materialistic and three dimensional ... therefore, our perception of it should be framed in three mathematical coordinates: length, breadth, and height ... today these are known as the ***Cartesian coordinates.***

Descartes made a fundamental concession to metaphysics ... he believed in God as a perfect being whose manifestation was the power of this "God" idea in his own mind

☞ ***physical matter*** ↔ ***soul*** ... Descartes' two mutually alien substances, where the causal relationship between them is considered miraculous

• **the "split":** Descartes argued for complete separation of matter and mind ... a strategy that freed him to put spirit aside and concentrate on matter as pure **mechanism**

☞ subsequent suggestions that emerged from Descartes' mechanistic approach ... are referred to as *Cartesian*

☞ and, the *split* ... leads to so-called ***dualism*** ... with its two basic foci
• outward: ***environment*** ... matter ... material elements
  - perceptible by the physical senses, augmented by instruments
• inward: ***mind*** ... mental and spiritual elements (the latter being a sense of connectedness of the whole)

- not perceptible by the physical senses

Thus:

- ☞ ***environment ↔ mind***
  - make the mind fit the environment ... wisdom traditions and Perennial Philosophy
  - make the environment fit the mind ... modern Western Philosophy
- ☞ ***body ↔ mind (consciousness)***
- ☞ ***objective ↔ subjective***

Cartesian Doubt: the 'first principle of learning' ... is often said to thrive in modern science ... all assumptions that can be eliminated, are *systematically* eliminated ... leaving only one set of axioms (fundamental assumptions) on which rational thought can be based and experiments can be rigorously designed

However, Smith (1999) pointed out the following with respect to perception & **new paradigm thinking in science:**

- there is no direct "photographic" impression conveyed from the retina to the brain as Descartes assumed ("mirroring")
- rather, in the 20th century we have arrived at a much more participatory view
- perceptual systems are never passive receivers ... they actively search the environment for biological relevant change ... of that which affords the possibility of action
- this view ... part of whole post-Darwinian movement toward a vision of man as part of Nature
- it is tempting to see late 20th century cognitive science as involving mind within the natural process instead of, as with Descartes, reserving it as something definitively separate, untouchable by the categories of natural science ... the recent upsurge in "consciousness studies" is perhaps indicative of this ongoing revolution

(Smith, C.U.M. 1999. Descartes and modern neuroscience. *Perspectives in Biology and Medicine* 42: 356-371.

ABORIGINAL WORLD VIEWS

⇨ For an excellent outline comparison of the major components in Aboriginal knowledge and Western science, as well as their Common Ground, consult the table entitled "Seeing Common Ground" developed by the Alaska Rural Systemic Initiative & Alaska Native Knowledge Network (table from "Handbook for Culturally Responsive Science Curriculum" by Sidney Smith; www.ankn.uaf.edu/UNITS/index.html).

⇨ **Also, re-read the section entitled "Aboriginal world views (introduction)".**

Metaphysics

The metaphysical belief of Aboriginal world views is that Nature is both physical and spiritual. The spiritual may be referred to as the Creator, or as a creative force within the natural world, i.e. as natural (not supernatural).

- Metaphysical refers to something that is *not able to be decided by experiment.* All world views contain some metaphysical beliefs.

General comments about Aboriginal knowledge

☞ First Nations' perspectives on the environment reflect consciousness and therefore create attitudes. (from: calendar description for MSIT 101/103)

☞ Aboriginal science is embedded within a holistic way of thinking that recognizes change (flux or movement) and renewal as the most basic features in Nature, and that considers humans as an integral part of Nature. High value is placed on humans striving to be a harmonious part of Nature, rather than striving for control over Nature.

Because of the multi-dimensional nature (i.e. scientific understandings plus sacred truth) of Aboriginal knowledge, the term "knowledge" rather than "science" is preferred. If you use the term "Native science" or "Aboriginal science" you need to be acutely aware of the inclusion of the scientific understandings within a larger, more complex knowledge system — a system in which there will be some understandings that can be agreed upon by everybody (i.e. "scientific understandings"), and others that are "sacred" to a particular group of people or an individual. And, in view of the multi-dimensional nature of Aboriginal knowledge, students should realize that many people in the mainstream of society will object to recognizing Aboriginal science as just "science". A major understanding to keep in mind is that Aboriginal science is embedded within (is part of) Aboriginal knowledge.

Native science

❒ Read: *Native Science; Natural Laws of Interdepedence* (Cajete 2000)

❒ Read: *Native science* (insert, from *Sharing our Pathways*)

An alliance between humans and creatures

❒ Read: *An alliance between humans and creatures* (insert, from *Sharing our Pathways*)

Ontology of Aboriginal knowledge

Nature is made of physical matter and energy, infused with Spirit. The spiritual is sacred (and speaks to personal and/or tribal consciousness). Change and renewal are the most fundamental processes in Nature.

⇨ Note that the focus, for consideration of what is "fundamental"in the Aboriginal world views, is on processes or actions (not objects or entities). A similar focus is found in most Aboriginal languages, i.e. they are "verb-based". Mathematics, which is the language of Western science, is similarly focused on *action and relationship*. In contrast, the English language is "noun-based" (focuses on objects).

❒ Read: *Native Science; Natural Laws of Interdepedence* (Cajete 2000)

Epistemology of Aboriginal knowledge

Experience is a major epistemic value (indicator of what is real).

The spiritual imperative of native epistemology

❒ Read: *The spiritual imperative of native epistemology* (by Hanohano 1999)

❒ Read: *Native Science; natural laws of interdependence* (by Cajete 2000)

Cajete's "Foundations of Indigenous Education"

Consciousness, or the finding of Self (i.e., an individual's *Sense of Place, Emergence, and Participation* ... as found in the title for this course), requires the cultivation of a direct awareness of one's natural environment and the involvement of all of one's senses, responsibilities to Self and community, and sensitivities to spiritual essences.

☺ **Education can nurture this consciousness**.

The making of an Indigenous teacher: insights into the ecology of teaching ... ❒ read this article by Cajete 1999 (insert, from Kane 1999)

❒ Also, read: *Native Science; Natural Laws of Interdependence* (Cajete 2000)

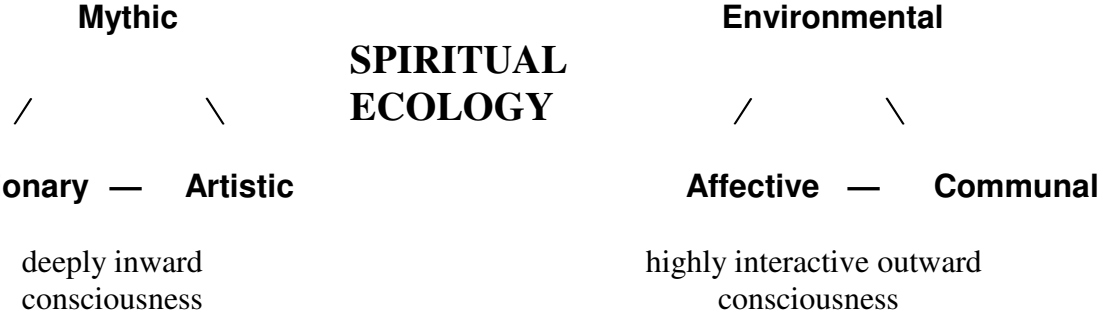
Gregory Cajete, a Tewa Indian from the Santa Clara Pueblo in New Mexico, and educator, scientist, and Assistant Professor in the College of Education at the University of New Mexico, has researched and written on this very point — namely, **that traditional Indigenous education nurtured this multidimensional consciousness**. The Toqwa'tu'kl Kjijitaqnn / Integrative Science. program (especially the first year courses) considers his work, as published in:

- *Look to the Mountain; an Ecology of Indigenous Education*, 1994
- *Igniting the Sparkle; an Indigenous Science Education Model*, 1999
- *Native Science; Natural Laws of Interdependence*, 2000

In *Look to the Mountain; an Ecology of Indigenous Education*, Cajete explains traditional education within the context of seven elemental and highly integrated foundations:

- Spiritual Ecology ..... considered in MSIT 101/103
- Environmental Foundation ..... considered in MSIT 101/103
- Mythical Foundation ..... considered in MSIT 101/103
- Visionary Foundation ..... considered in MSIT 201/203
- Artistic Foundation ..... considered in MSIT 201/203
- Affective Foundation ..... considered in MSIT 201/203
- Communal Foundation ..... considered in MSIT 201/203

Figure: ***The ebb and flow of tribal education*** (p. 38, Cajete, 1994, *Look to the Mountain; an Ecology of Indigenous Education*)



(winter) (summer)

Aboriginal knowledge … some important resources

Articles and resources relevant to discussions of Common Ground and differences in Aboriginal Knowledge and Western Science

☞ The Toqwa'tu'kl Kjijitaqnn / Integrative Science program at UCCB has assembled an extensive collection of articles and resources relevant to discussions on Common Ground and differences in Aboriginal Knowledge and Western Science.

In addition, a computerized and annotated bibliography of this assemblage has been created.

The articles, resources, and bibliography are available in the Biodiversity / MSIT Lab at UCCB. Contact Professor Cheryl Bartlett for access.

Mi'kmaq Resource Centre

☞ The **Mi'kmaq Resource Centre** at UCCB contains a wealth of resources pertaining to Aboriginal Knowledge, with a particular focus on Mi'kmaq First Nations. The Centre is open to the public. Contact the Mi'kmaq College Institute at UCCB for details, or the web site:

http://mrc.uccb.ns.ca/

Mi'kmaq world view

Mi'kmaq Resource Centre

☞ The **Mi'kmaq Resource Centre** at UCCB contains a wealth of resources pertaining to Aboriginal Knowledge, with a particular focus on Mi'kmaq First Nations. The Centre is open to the public. Contact the Mi'kmaq College Institute at UCCB for details, or the web site:

http://mrc.uccb.ns.ca/

Insert
❒ Read: *Rich research resources* (article from *Cape Breton Post*)

Mi'kmaq contributions to the scientific community

❒ Read: essay (insert) by Clifford Paul, MSIT student and member of Membertou First Nations

Resource management and the Mi'kmaq Nation

❒ Read: article (insert) entitled *Resource management and the Mi'kmaq Nation* by Berneshawi 1997

Student research projects

❒ Read: section in ThoughtTraps ∞ entitled *Student Research Projects*

"THINGS" IN MODERN SOCIETY CALLED "SCIENCE" (RIGHTLY OR WRONGLY)

"Science": different names for different contexts and pretexts

There are a variety of activities in modern society called "science" of one sort or another. However, many of these are **not** genuine science.

- What are they?
- Why is it important to be aware of them?
- How does one recognize genuine science?
- Is there such a thing as "Western science"?
- Is there such a thing as "Native science" or "Aboriginal science"?

In the annotated list below, note where the words *search,* or *research*, or *inquiry* are replaced by *way of life* or *belief*. "Search, research, and inquiry" denote largely a mental or cognitive approach to knowledge acquisition, whereas "way of life" denotes a more holistic approach (inclusive of the mental plus the emotional, spiritual, and physical dimensions of a human). "Belief" means acceptance without questioning, i.e. taking on faith.

To begin .... consider some already mentioned

- **science** ... the search for an understanding of our relationship with Nature ... through a practical engagement with physical reality ... that involves:
  - → asking questions and observing ... what Nature is and how it works, including humans
  - → constructing tentative answers (hypotheses) ... i.e. possible explanations
    - → thinking reflectively, creatively, logically, and critically
    - → recognizing pattern
  - → testing tentative answers against reality
  - → changing or discarding answers if they are a poor match with reality, or if new evidence becomes available
  - → open communication of answers ... as models or theories

- **reductionist science** ... inquiry based on considerations of Nature as an assemblage of physical parts that can be analyzed separately and understood on the basis of the parts; explanations tend to preclude a role for human consciousness. This approach is the one most widely held throughout modern society, especially in universities and industries ... and is

also referred to as **mainstream science**.

- **holistic science** ... inquiry based on considerations of Nature as an interconnected assemblage which cannot be understood only by the analysis of its parts in isolation from the whole (wholism, holism); explanations tend to include a role for human consciousness. The paradigm that accommodates this approach is also sometimes referred to as **systemic science** or **organismic science**.

- **Western science** ... inquiry that has traditionally been grounded in the reductionist paradigm but that is increasingly beginning to acknowledge, and in some cases incorporate, insights and approaches from the organismic or holistic paradigm

  ⇨ **Re-read the section entitled "Western world view (introduction)".**

- **Aboriginal science** ... a holistic way of knowing that embraces interdependence ... and recognizes change (flux or movement) and renewal as the basic features in Nature of which humans are an integral part and should strive towards being a harmonious part. This can also be referred to as **Native science**.

  Students should realize that many people in the mainstream of society will object to recognizing **Aboriginal or native science** as "science" *per se.*

  - Many objections will be based on a misunderstanding of "spiritual" ... and there may be some confusion with "creation science" which is not genuine science.

  - Other objections will be based on the claim that a "way of life" is too broad to be considered on par with a "way of knowing". People who object to a "way of life" are apt to overlook the large scale influence of science [mechanistic and reductionistic] in modern society, and thus the conditioning of their own mind set by science, and consequently also their own way of life. Nevertheless, it does sharpen one's thinking and understanding to ponder the similarities and differences between "way of knowing" and "way of life".

    ? ☺ ☹ How many times has someone told you to "practice what you preach"?

    ? ☺ ☹ How many times have you heard someone say "do as I say, not as I do"?

❒ Re-read the section entitled "Aboriginal world views (introduction)".

❒ Read: Native Science; Natural Laws of Interdependence (Cajete 2000).

❒ Read: Native science (insert, from *Sharing Our Pathways*)

❒ Read: An alliance between humans and creatures (insert, from *Sharing Our Pathways*)

Next .... some new twists ... but still readily acceptable in the "genuine" category

- **journeyman prospector science** (normal science) ... research related to providing precision or details for topics that are otherwise relatively well understood ... generation of data that are generally highly collaborative of existing theories

- **discovery science** ... research related to topics that are not well understood, as for e.g. particular small anomalies uncovered by normal science ... generation of data that lead to novel insights and new theory

Now .... some that are getting closer to the edge ... but still acceptable ... to broad minded thinkers who recognize the value, and risk, inherent in leading edge knowledge and discovery

- **frontier science** ... research related to topics that represent broad new territory, especially for mechanistic or reductionist science (e.g. consciousness studies)

- **fringe science** ... research that challenges understandings of Nature that assume the current knowledge of physical forces and particles in the universe is more or less complete

And .... one ... that is not totally "genuine" science, but has parts that are:

- **quasi science** ... explanations based on a combination of *acceptable, current knowledge* about physical forces and particles and natural laws and *speculative assumptions* about presumed others

Also .... some odds and ends

- **pathological science** ... explanations that contain self-deception, wishful thinking, and/or selective use and negligence of evidence (data) ... and that, therefore, lead scientists astray

- **junk science** ... explanations based on preliminary or thin data that are used to suggest a particularly desirable scenario, generally within the context of a high stakes legal case that carries the possibility of a huge monetary award or major regulatory policy decision. Also, **agenda science**.

- **popular science** ... explanations of scientific theories that are provided in language that the

common person (a non-scientist) should be able to understand

Last .... some ... that are not "genuine" science in any sense of the word

- **pseudoscience** ... explanations that strive to satisfy personal psychological or religious needs (e.g. astrology) but that do not meet the minimum conditions for being a coherent science (although some scientific concepts may be mixed in)

- **creation science** ... belief that the Christian Bible is a literal and complete account of the creation of Nature ... that has been divinely revealed
  - ✂ note, that *belief in divinely revealed knowledge* eliminates or rules out *gaining knowledge* by way of those activities that characterize "genuine" science
  - ☺ belief in divine revelation may be a way of knowing (right or wrong), but it is not the same as the scientific way of knowing

Once again ...

✔ genuine science is characterized by its "way of knowing" which includes:

→ asking questions ... about what Nature is and how it works, including humans

→ generating potential answers ... i.e. explanation or ideas about Nature
  → thinking creatively
  → recognizing pattern
  → thinking critically

→ testing of those ideas against reality

→ changing or discarding ideas if they are a poor match with reality

→ open communication of ideas

❒ Read: New Age medicine meets Western science (insert, from *University Affairs*)

SOURCES

☞ under construction

ARTICLES

☞ to be handed out in class to those who *purchased* ThoughtTraps ∞ and ThoughtTraps ∞∞.