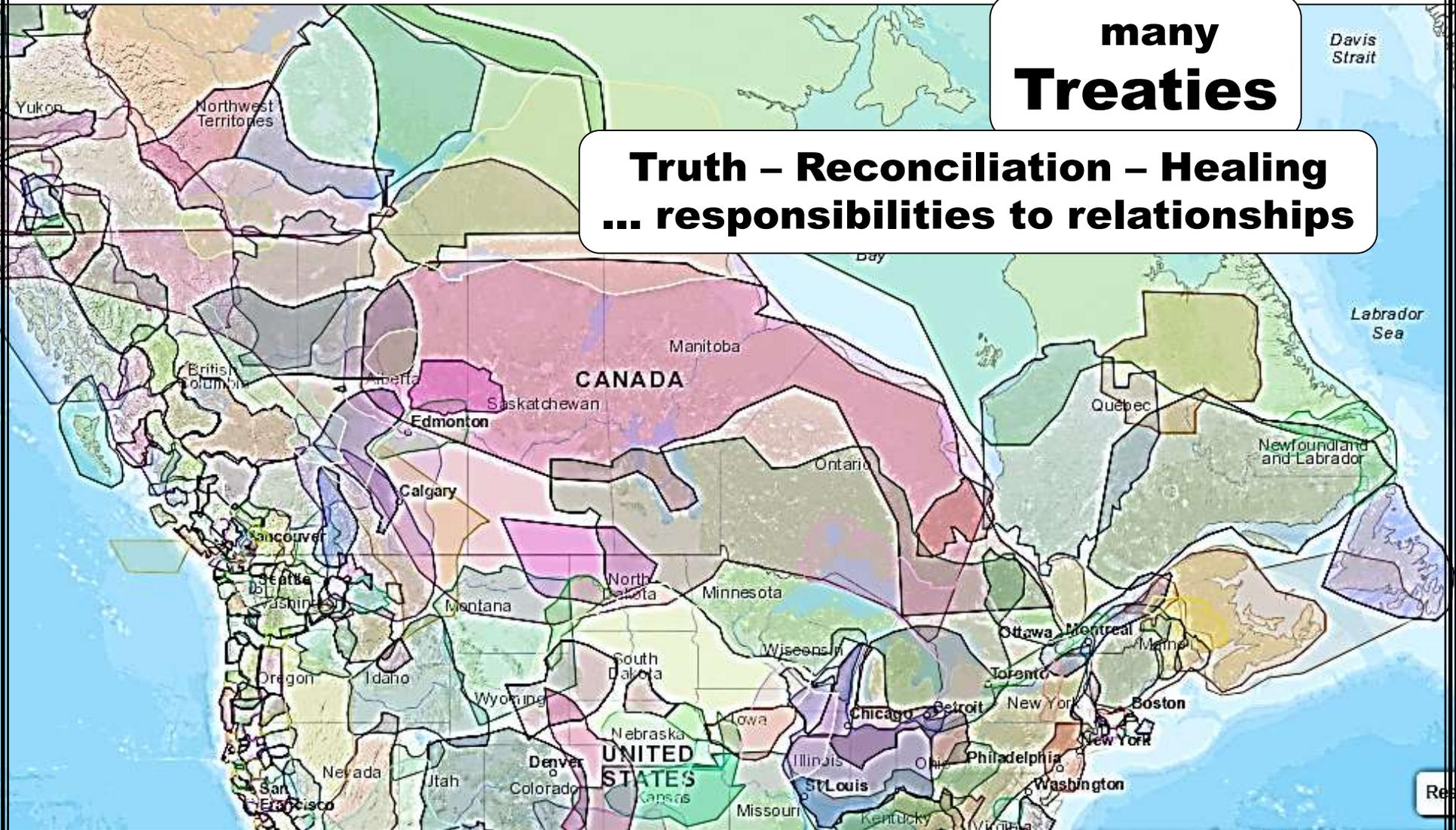


Indigenous Traditional Territories - Canada

many
Treaties

**Truth – Reconciliation – Healing
... responsibilities to relationships**



WE, TOGETHER

Integrative Science and Two-Eyed Seeing E.A. Robinson Science Education Lecture

University of Toronto – Mississauga; 5 June 2017

Cheryl Bartlett, CM, PhD

Professor Emerita

- retired Professor of Biology
- former Tier 1 Canada Research
Chair in Integrative Science

Cape Breton University

Sydney, NS

Traditional Territory of Mi'kma'ki



WE, TOGETHER

**... the story of a journey with
three core (early & ongoing) participants**

Cheryl Bartlett, CM, PhD
settler / newcomer lineage
grew up in Blackfoot Territory

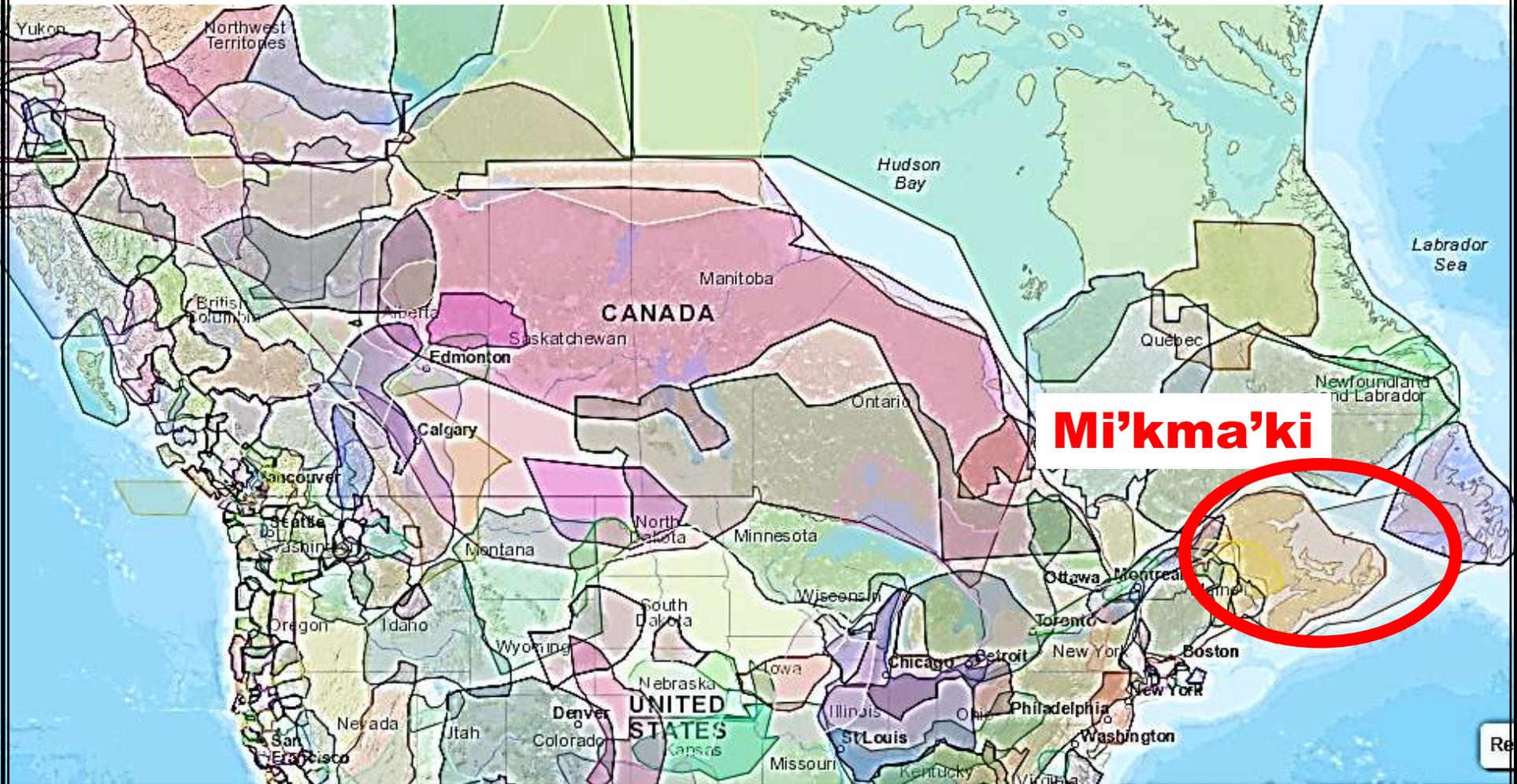
Albert Marshall, Elder, LLD
Mi'kmaq Nation

Murdena Marshall, Elder, LLD
Mi'kmaq Nation

www.integrativescience.ca

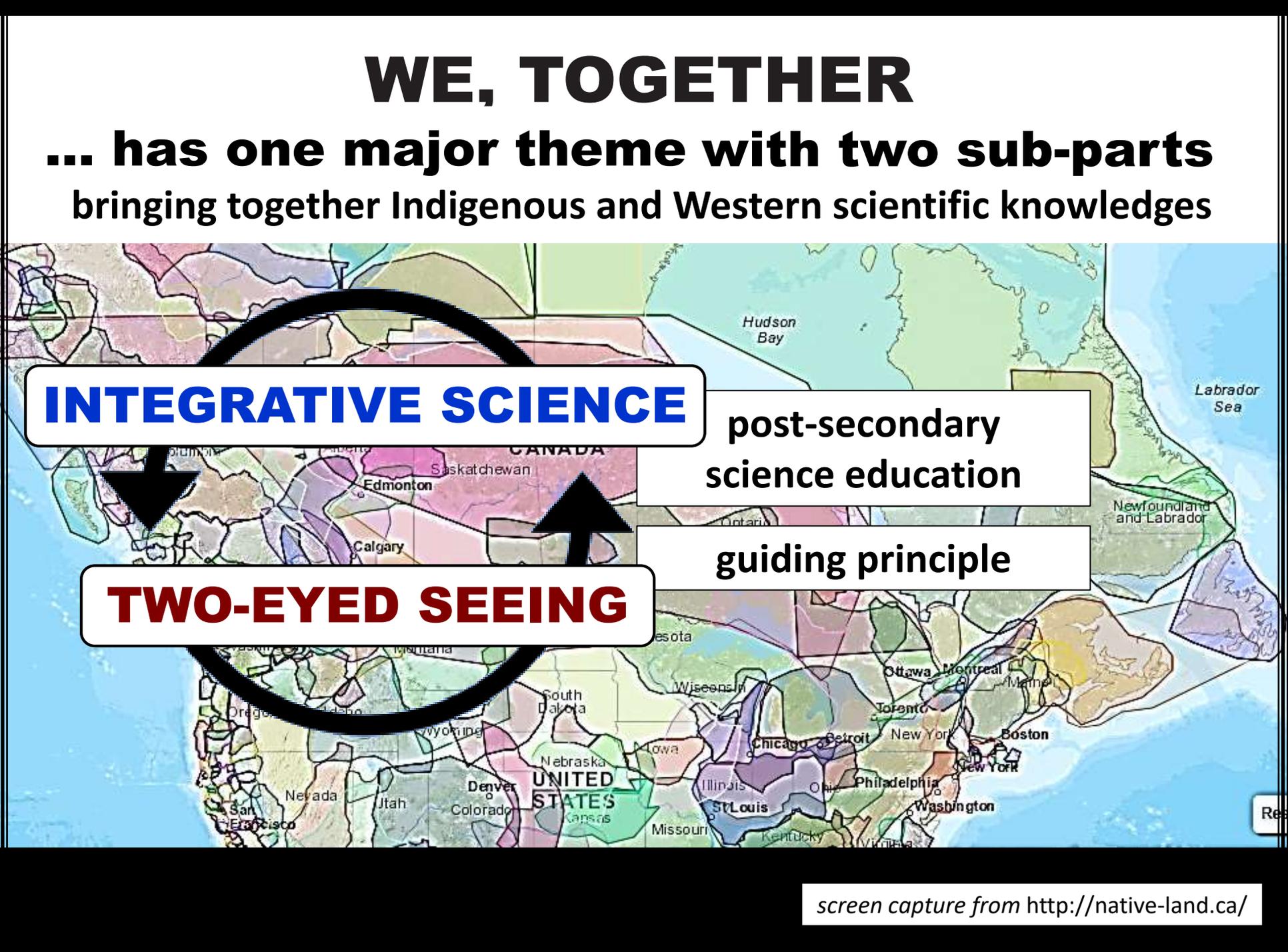


WE, TOGETHER ... starts in Mi'kma'ki



WE, TOGETHER

... has one major theme with two sub-parts
bringing together Indigenous and Western scientific knowledges

A map of North America showing the borders of Canada and the United States. Two large black curved arrows are drawn over the map, one pointing from the top towards the center and another from the bottom towards the center. Two white callout boxes with black borders are overlaid on the map. The top box contains the text 'INTEGRATIVE SCIENCE' in blue. The bottom box contains the text 'TWO-EYED SEEING' in red. To the right of the top box is another white callout box with black text 'post-secondary science education'. Below that is another white callout box with black text 'guiding principle'. The map shows various cities and states/provinces, including Edmonton, Calgary, Chicago, Detroit, New York, Boston, Philadelphia, and Washington.

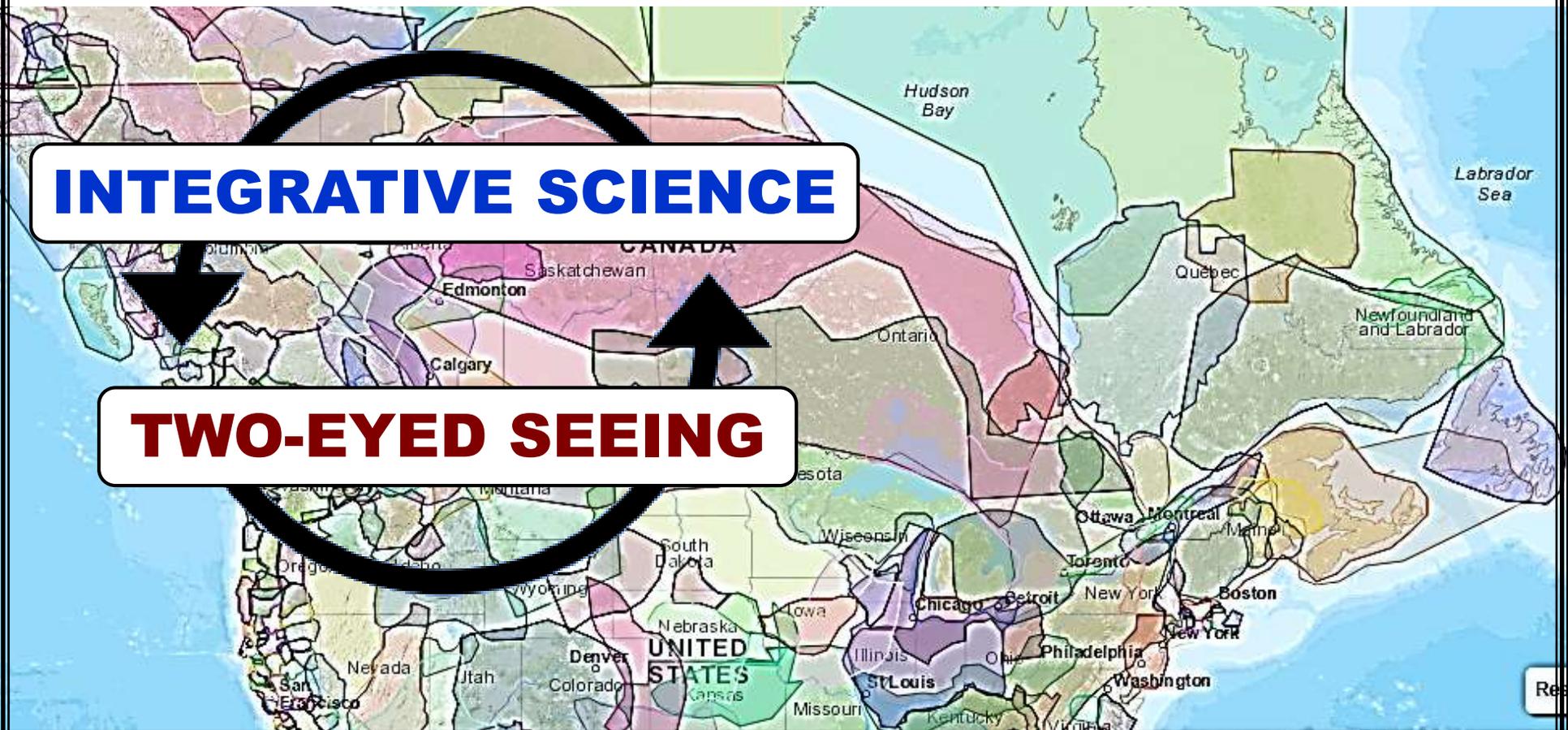
INTEGRATIVE SCIENCE

post-secondary
science education

TWO-EYED SEEING

guiding principle

WE, TOGETHER
... is a good story, ongoing,
involving many valued participants



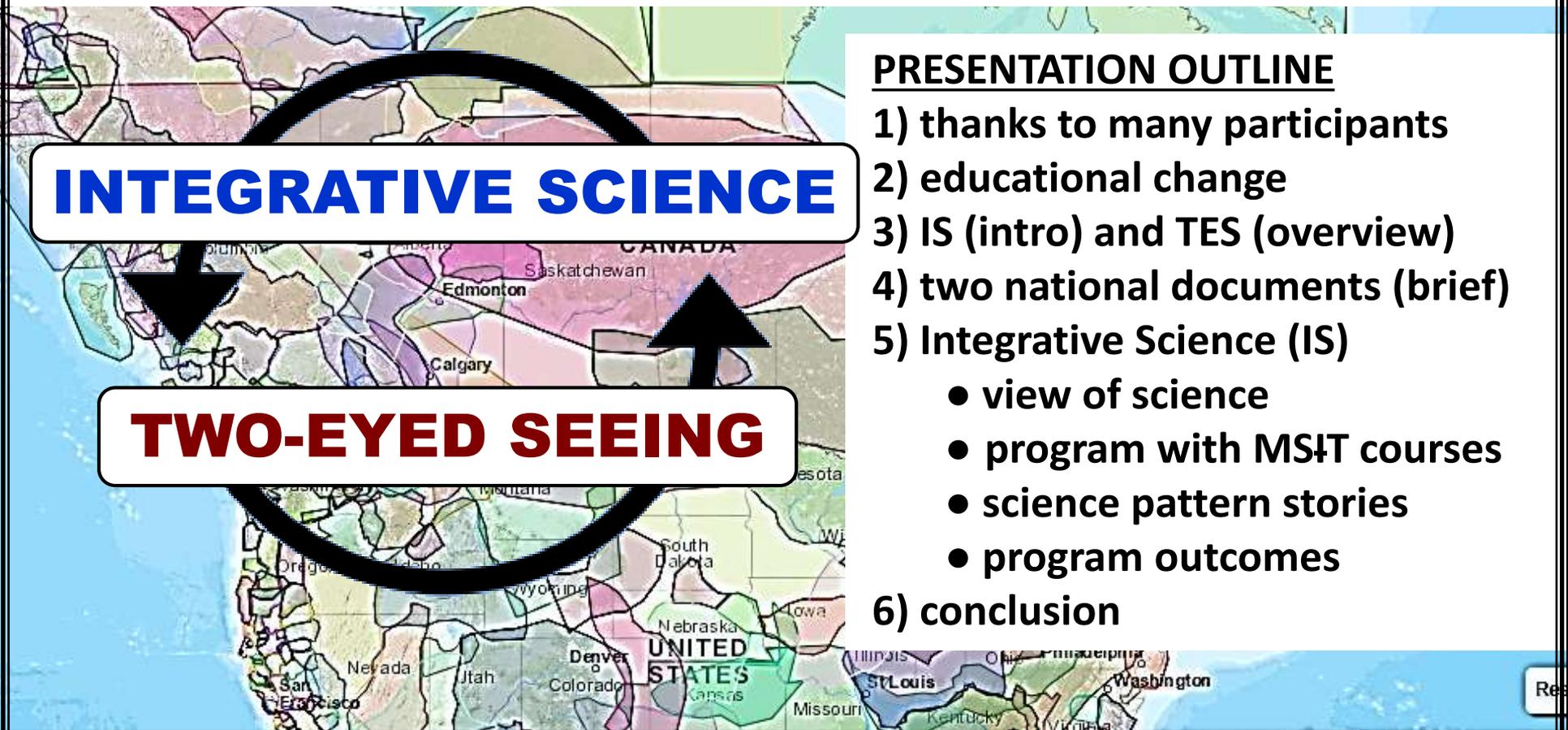
INTEGRATIVE SCIENCE

The image features a map of North America, showing the borders of Canada and the United States. Overlaid on the map are two large, thick black curved arrows forming a circle. The top arrow points from the United States towards Canada, and the bottom arrow points from Canada towards the United States. Two white rectangular boxes with black borders are positioned over the map. The top box contains the text 'INTEGRATIVE SCIENCE' in blue capital letters. The bottom box contains the text 'TWO-EYED SEEING' in red capital letters. Two black arrows point from the top box down towards the bottom box, one on the left and one on the right, indicating a relationship or flow between the two concepts.

TWO-EYED SEEING

WE, TOGETHER

**... is a good story, ongoing,
involving many valued participants**



INTEGRATIVE SCIENCE

TWO-EYED SEEING

PRESENTATION OUTLINE

- 1) thanks to many participants
- 2) educational change
- 3) IS (intro) and TES (overview)
- 4) two national documents (brief)
- 5) Integrative Science (IS)
 - view of science
 - program with MS&T courses
 - science pattern stories
 - program outcomes
- 6) conclusion

WE, TOGETHER

Chi Migweech / Wela'lin / Thank you



Canada Research
Chairs

Chaires de recherche
du Canada

Canada 



Social Sciences and Humanities
Research Council of Canada

Conseil de recherches en
sciences humaines du Canada

Canada 

Elders, Colleagues,
CRC Team, Friends,
Students, Youth

CAPE BRETON
UNIVERSITY



Mi'kmaq College Institute
Mi'kmaq Espi Kina'matno'kuom



Canada Foundation
for Innovation

Fondation canadienne
pour l'innovation



Membertou
Elementary



CIHR IRSC

Canadian Institutes of
Health Research

Instituts de recherche
en santé du Canada



NSERC
CRSNG



Mi'kmaq
Debort
CULTURAL CENTRE



Mermaid Theatre
of Nova Scotia



IWK Health Centre
Foundation



Eskasoni First Nation Detachment

Royal Canadian
Mounted Police

Gendarmerie royale
du Canada

Mi'kmaq Elders and CRC team



Mi'kmaq Elders and Organizations in *Unama'ki* – Cape Breton, NS



photo by Clifford Paul

Mawisikamukawey ... the nurturing wholeness

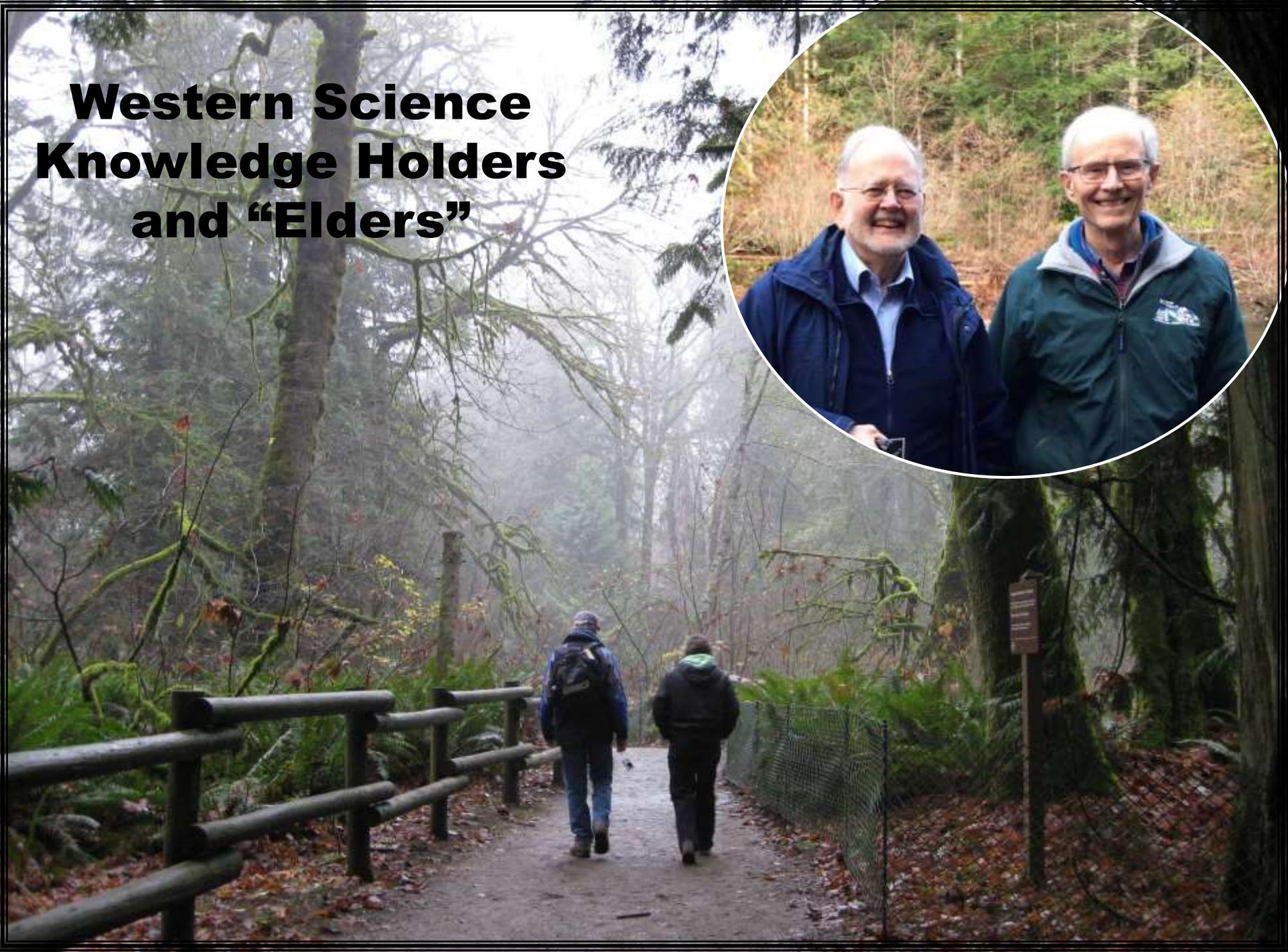
Unama'ki ... “Land of the Fog”

our natural world

Indigenous Knowledge Holders and Elders across Canada



Western Science Knowledge Holders and “Elders”



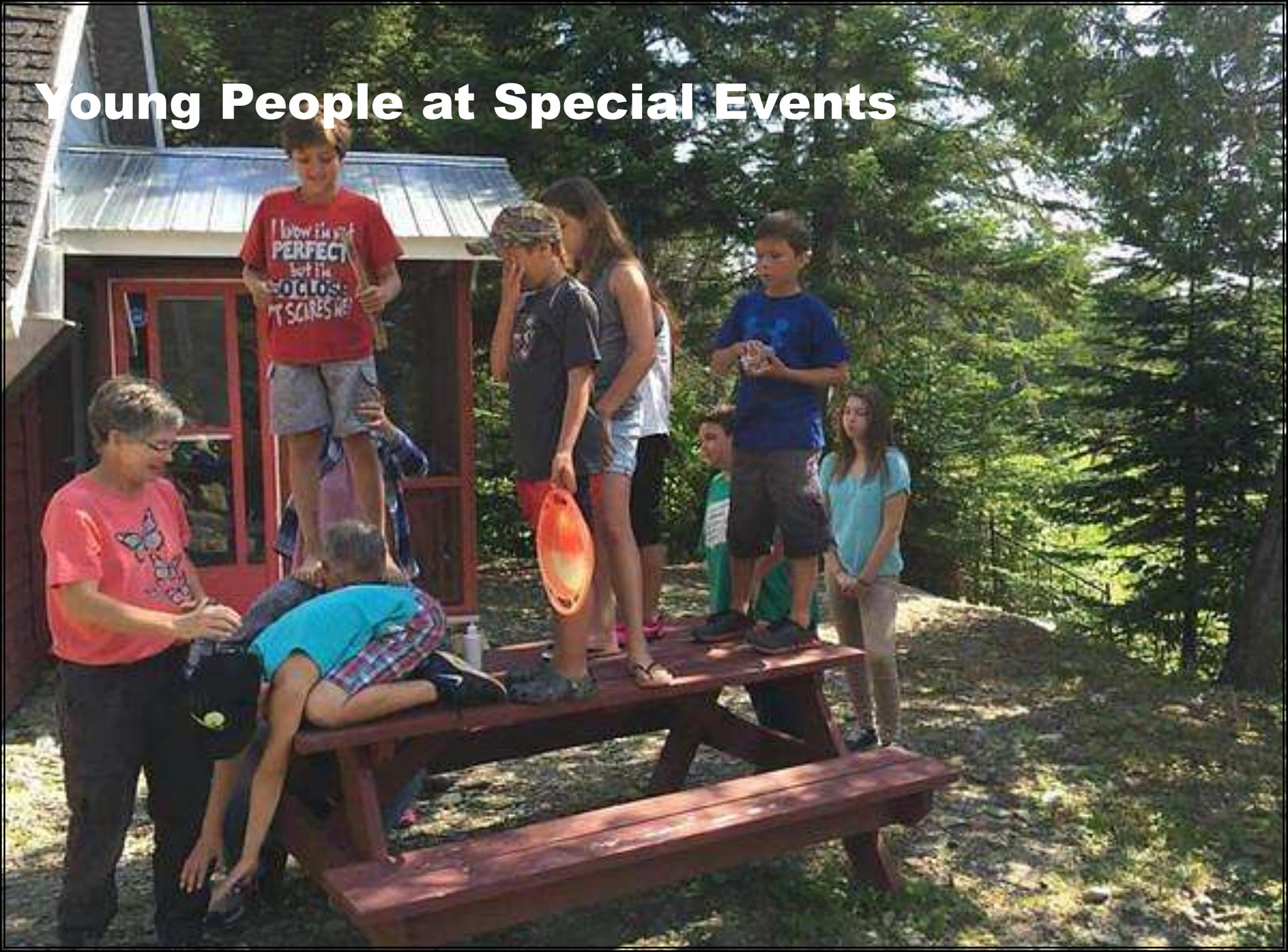
Integrative Science Students at CBU



Young People in Unama'ki – Cape Breton, NS



Young People at Special Events



Artists & Poets



**Colleagues
across
Canada**



Colleagues across Canada



Colleagues across Canada



**Colleagues
across
Canada**



Colleagues across Canada



WE, TOGETHER

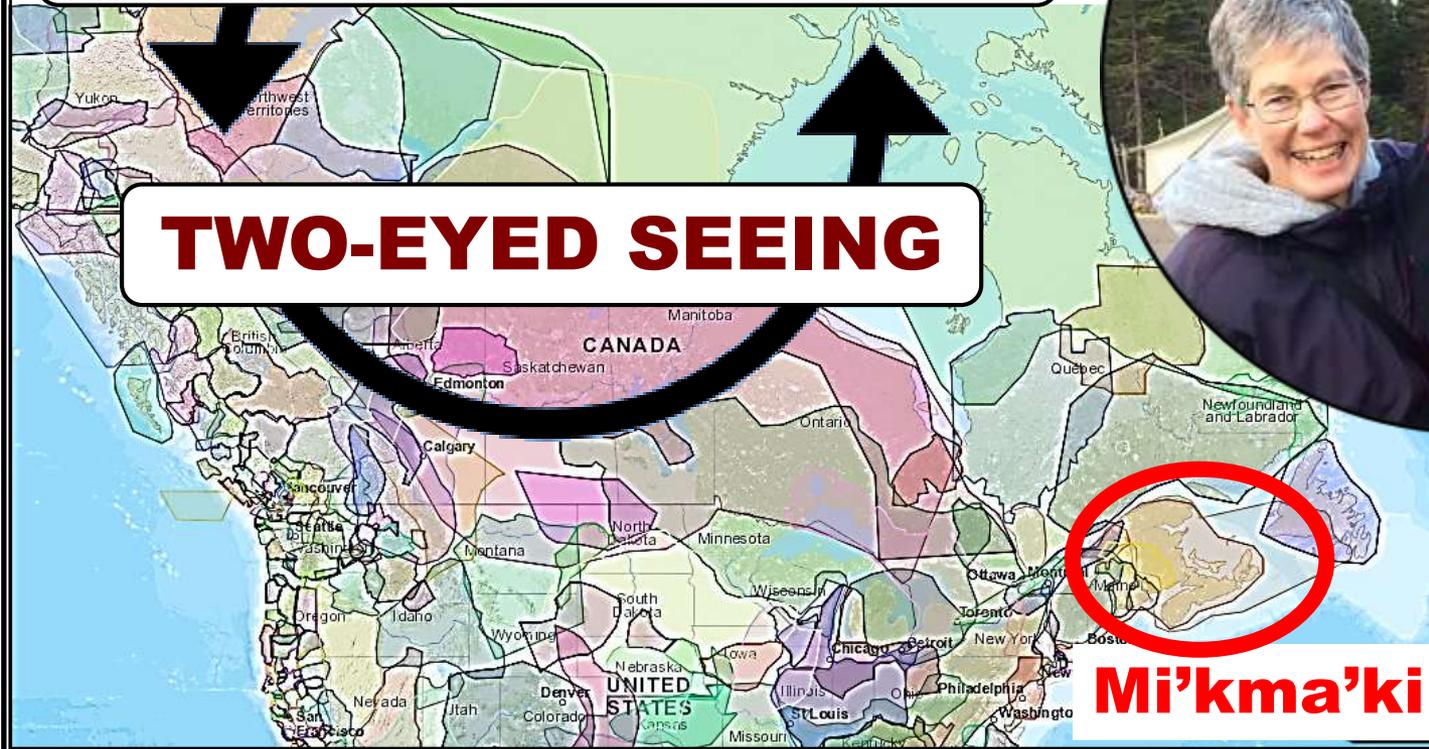
back to Mi'kma'ki ... 25 years ago

INTEGRATIVE SCIENCE

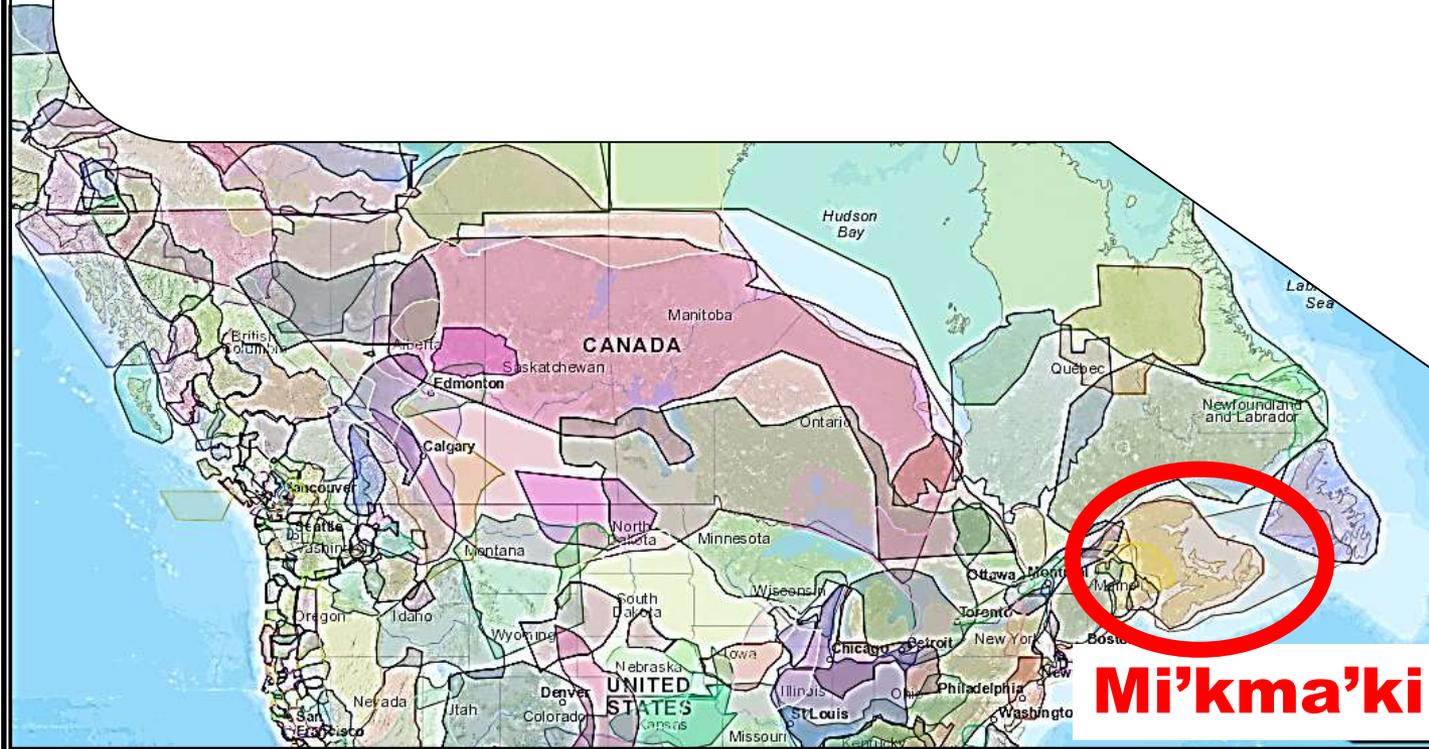
TWO-EYED SEEING



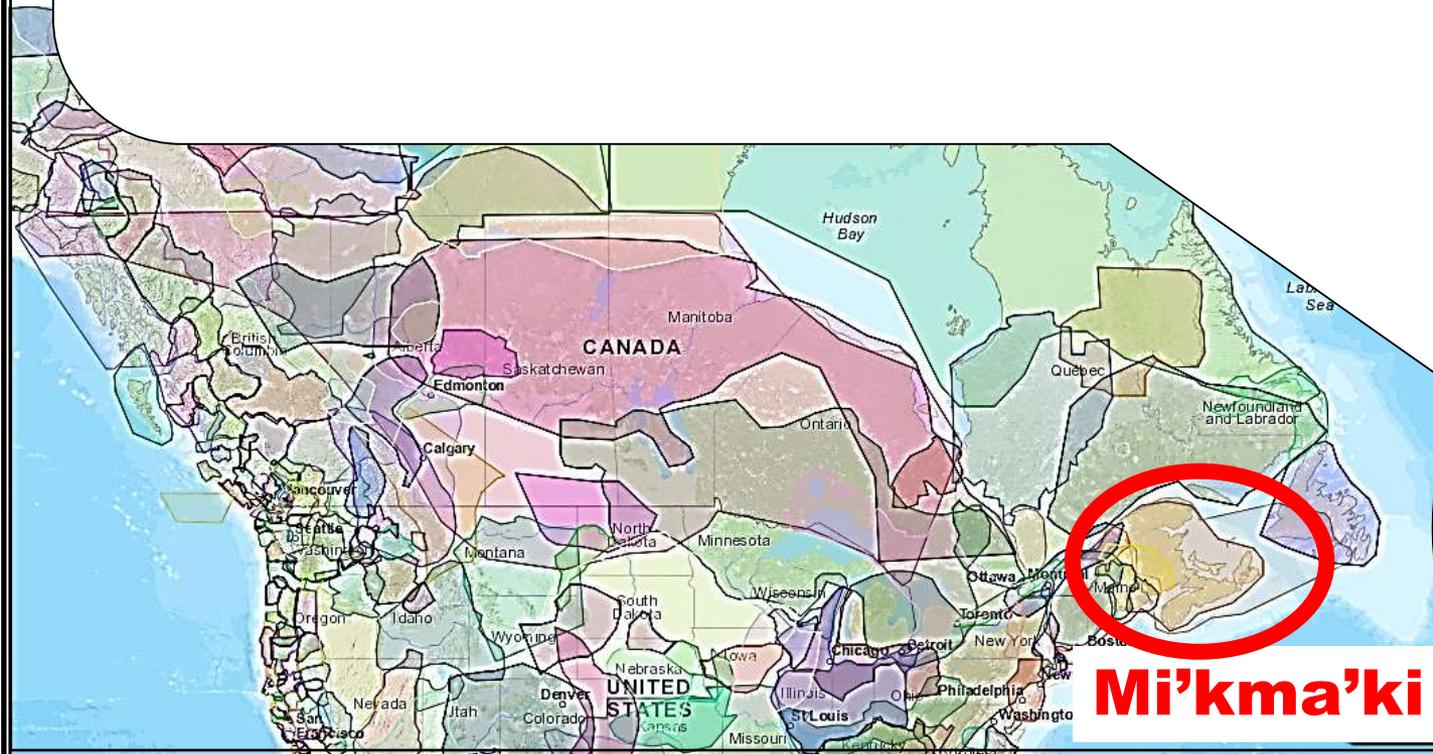
Mi'kma'ki



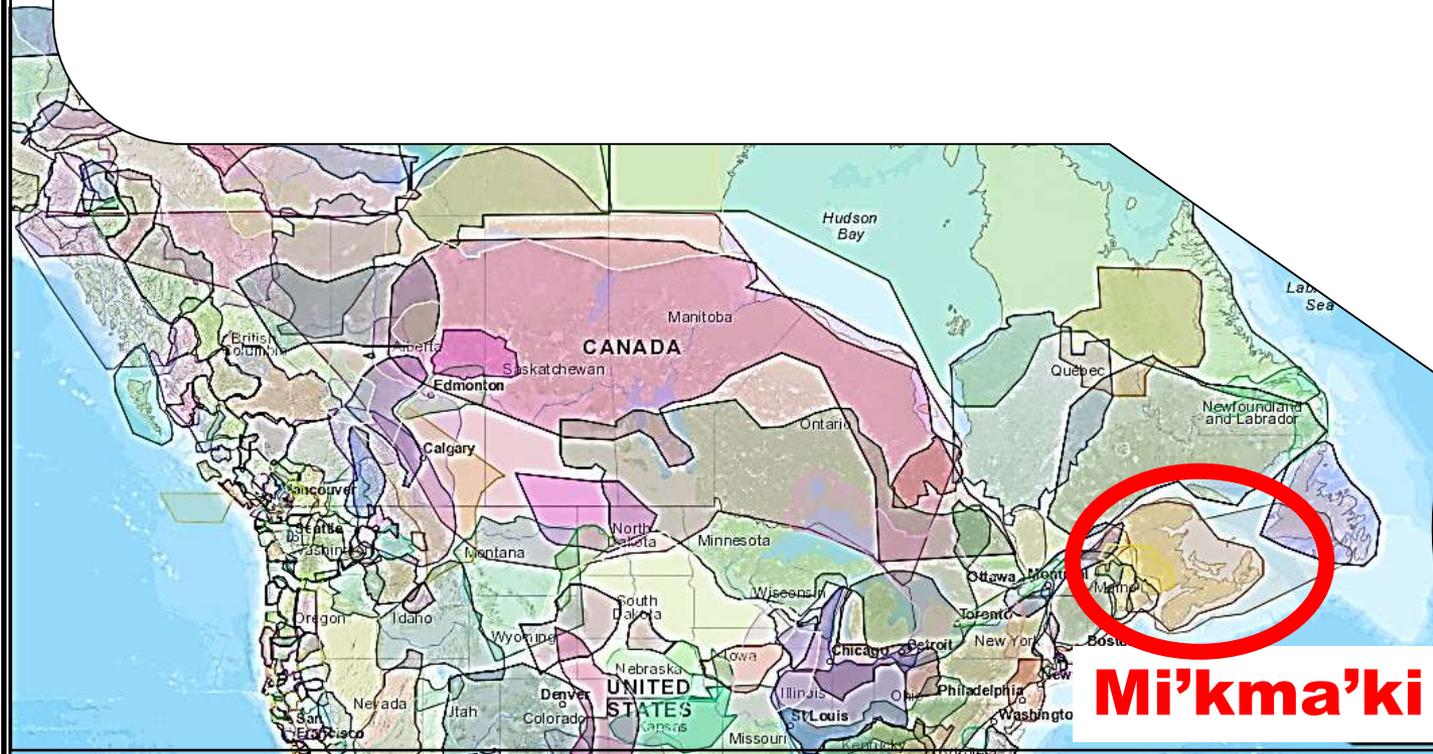
early 1990's: Kwe! Cheryl! Look!



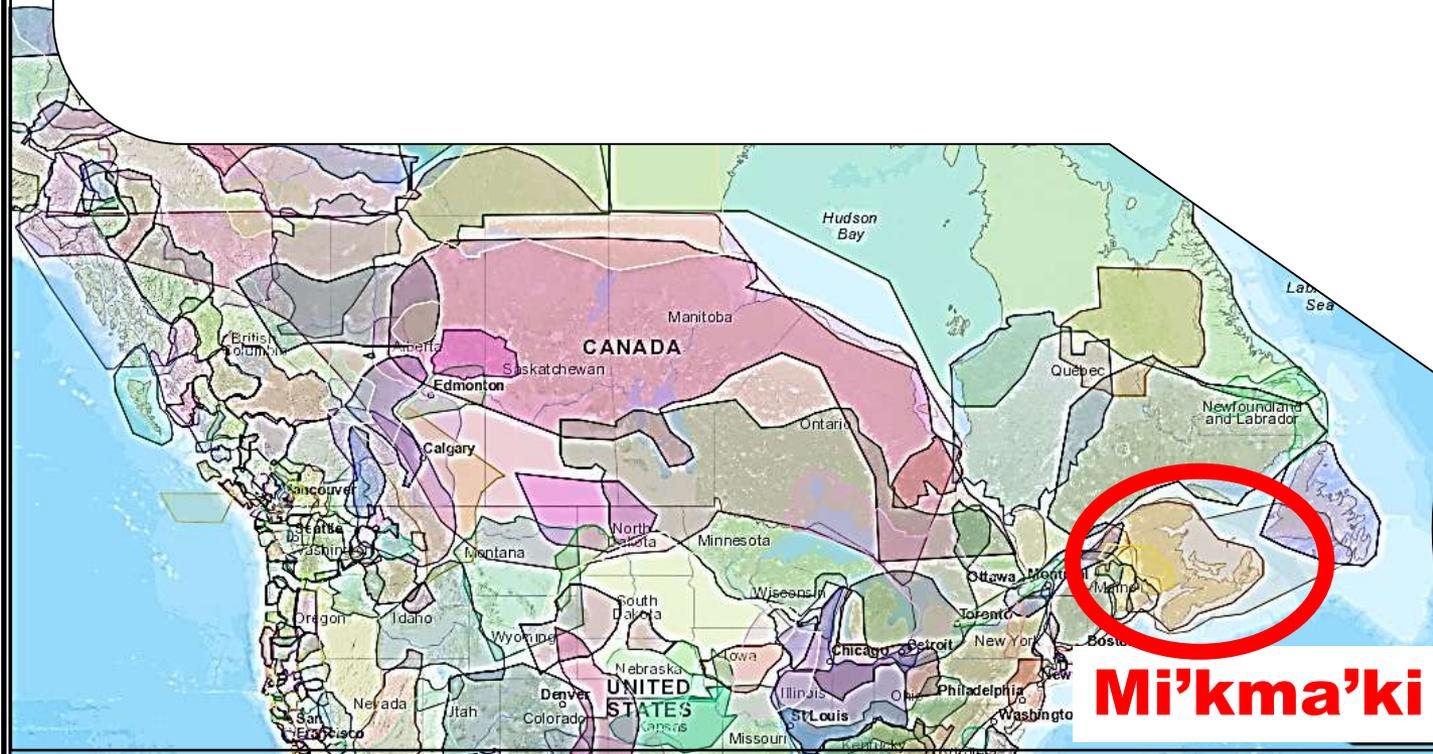
early
1990's: Kwe! Cheryl! Look! We Mi'kmaq People
have lived in Mi'kma'ki, our traditional territory, for
thousands of years



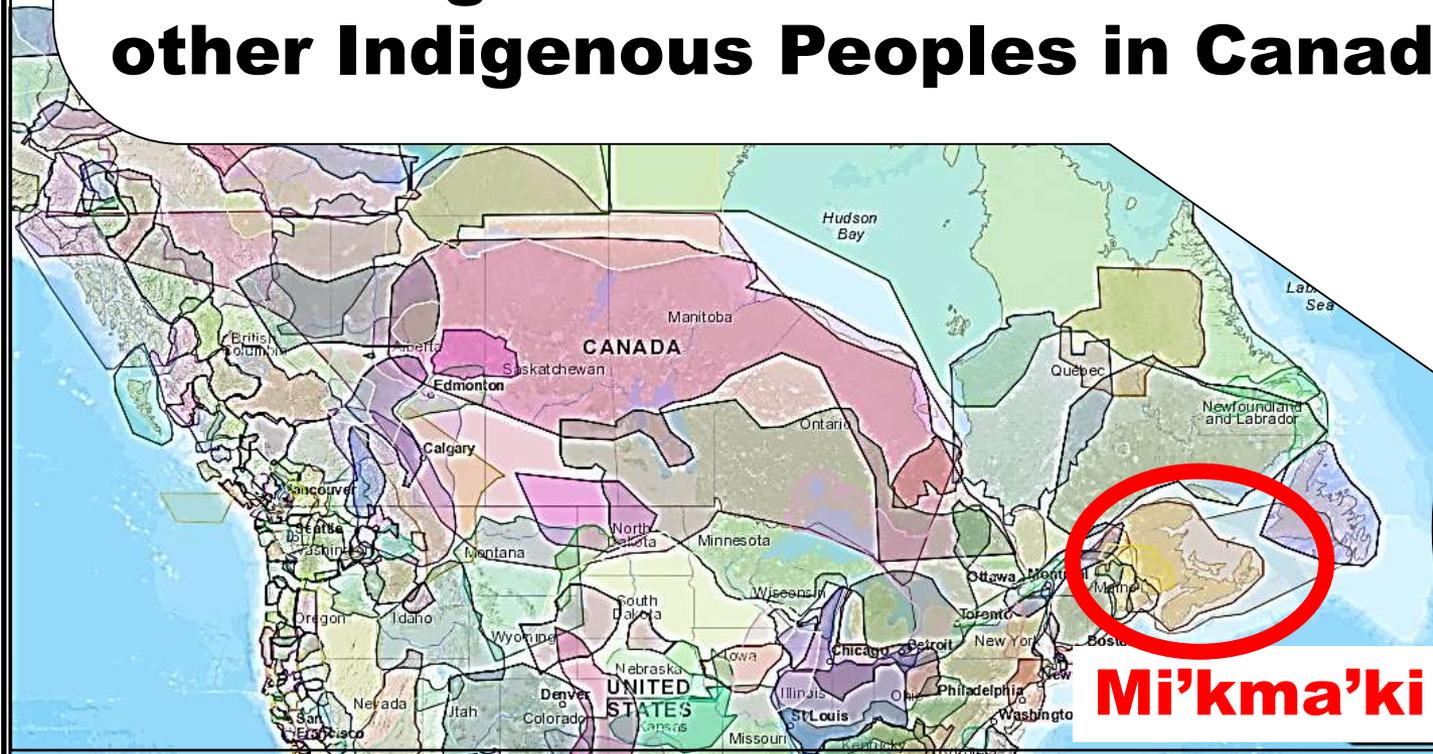
early 1990's: Kwe! Cheryl! Look! **We Mi'kmaq People have lived in Mi'kma'ki, our traditional territory, for thousands of years ...** and we have rich knowledge about the land, plants, fishes, birds, other animals, medicines, the waters and skies.



early 1990's: Kwe! Cheryl! Look! **We Mi'kmaq People have lived in Mi'kma'ki, our traditional territory, for thousands of years ...** and we have rich knowledge about the land, plants, fishes, birds, other animals, medicines, the waters and skies. Aren't those what you teach about in biology, in science?



early 1990's: Kwe! Cheryl! Look! **We Mi'kmaq People have lived in Mi'kma'ki, our traditional territory, for thousands of years ...** and we have rich knowledge about the land, plants, fishes, birds, other animals, medicines, the waters and skies. Aren't those what you teach about in biology, in science? **So, why isn't our Mi'kmaq Knowledge included in science? Or that of other Indigenous Peoples in Canada?**



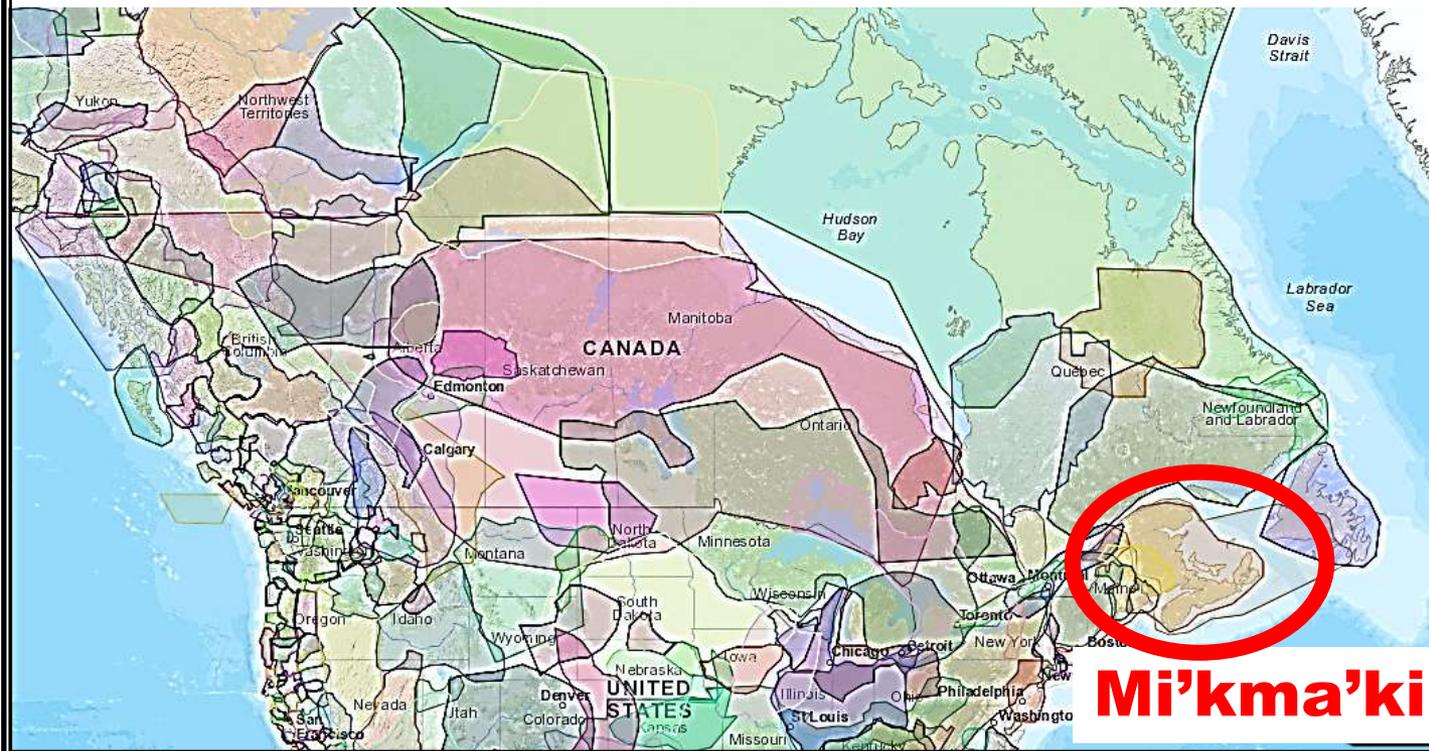
early
1990's: Kwe! Cheryl! Look!

And ... if our Indigenous knowledges were included within PSE science, then science would likely be much more attractive for Indigenous students and they would choose to study it, rather than avoid it as they all too often tend to do.



2017: But what about the higher grades and also the post-secondary educational (PSE) levels: could they become more inclusive as to how science is viewed and taught?

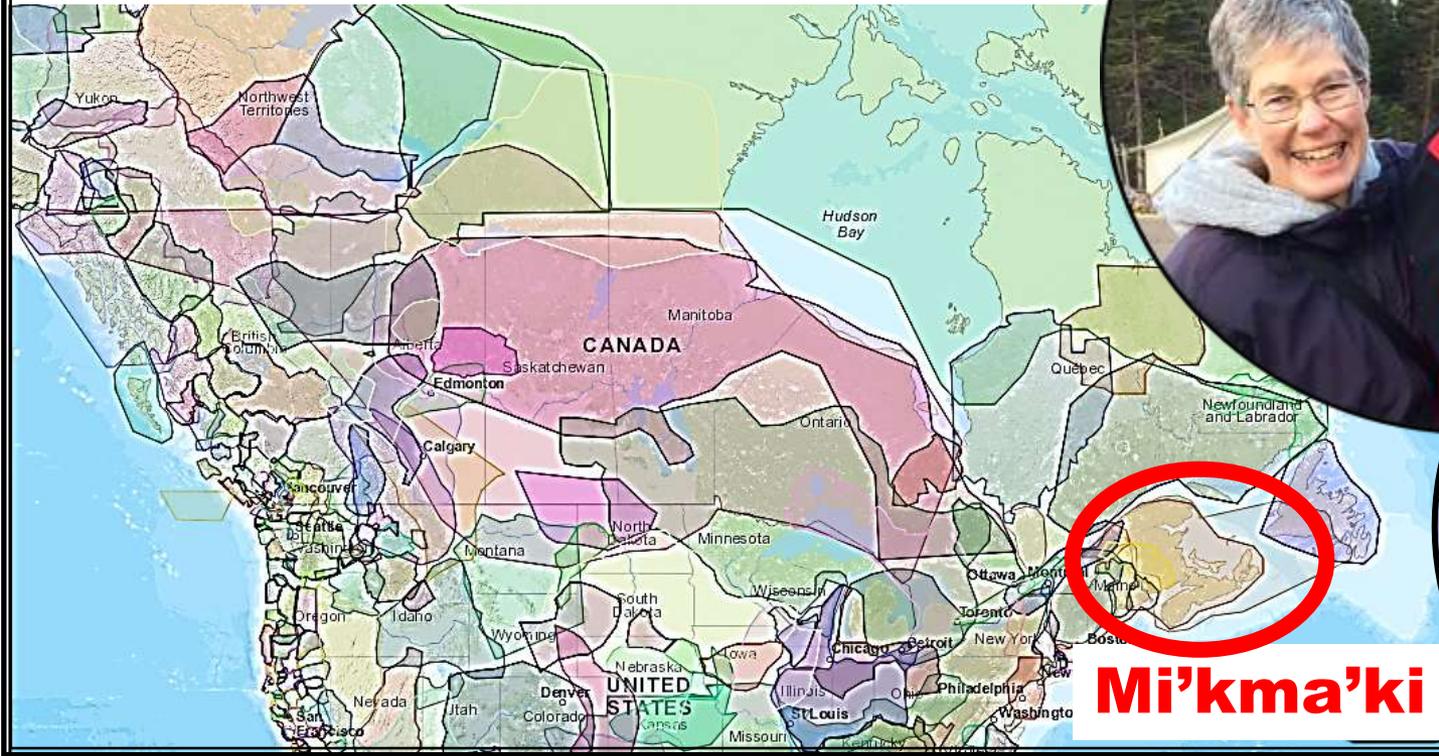
For Murdena, this was a long-held dream ...



2017: But what about the higher grades and also the post-secondary educational (PSE) levels: could they become more inclusive as to how science is viewed and taught?

**One PSE level “yes” answer:
Integrative Science**

**1999-
2010**



Mi'kma'ki

2017: But what about the higher grades and also the post-secondary educational (PSE) levels: could they become more inclusive as to how **science** is viewed and taught?

One PSE level “yes” answer:
Integrative Science

1999-2010

OTHER PSE LEVEL “yes”:
Dr. Michelle Hogue
Co-ordinator, FNs’ Transition Program
Univ. of Lethbridge



**Blackfoot
Territory**

Mi'kma'ki



2017: But what about the higher grades and also the post-secondary educational (PSE) levels: could they become more inclusive as to how **science** is viewed and taught?

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Univ. of Lethbridge



Anishinaabe Territory

**Dr. Dan Longboat, Director,
Indigenous Environ Studies & Sci
Trent Univ.**

**Blackfoot
Territory**

Mi’kma’ki



Integrative Science

Toqwa'tu'kl Kjijitaqnn

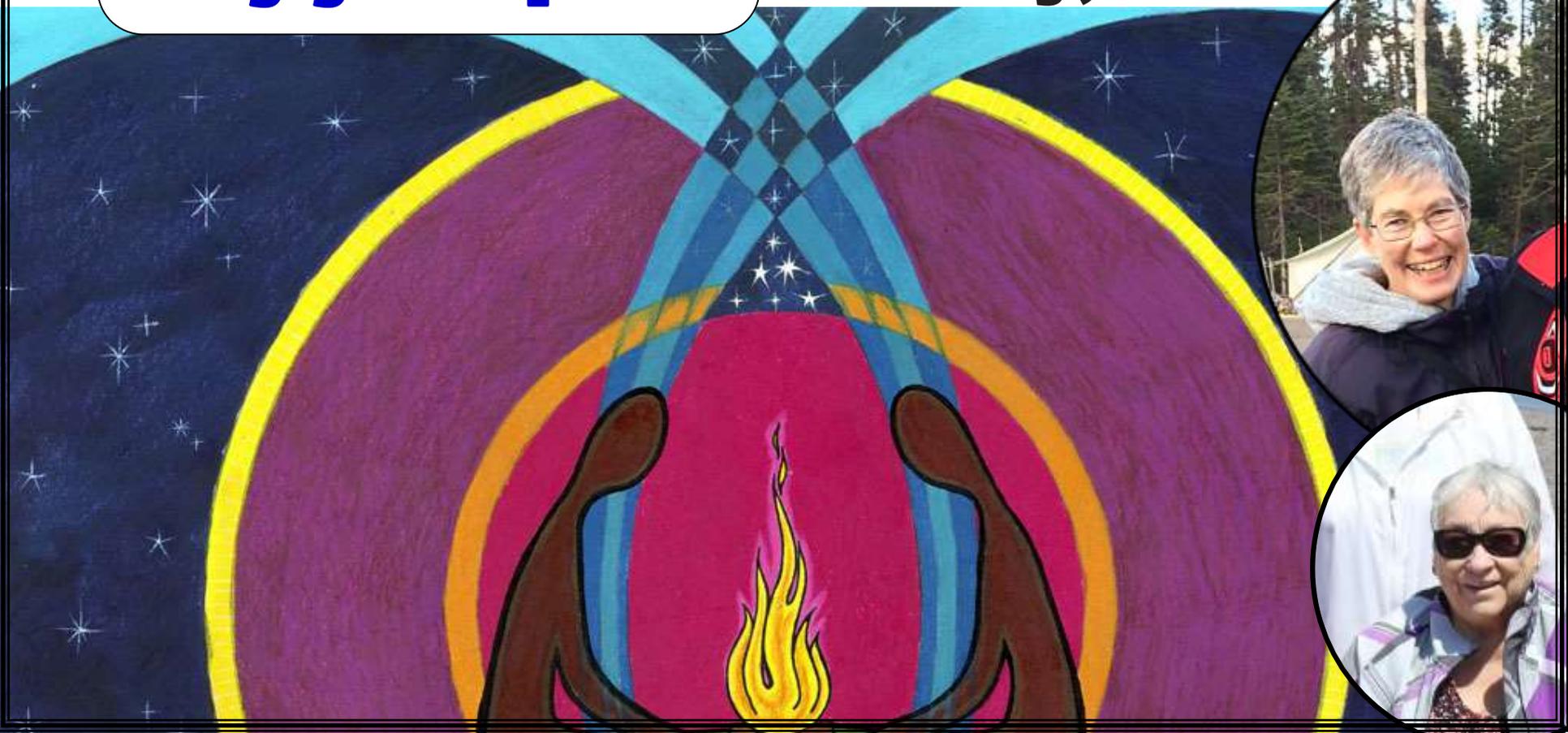
... the short story

- **WHAT:** new science program created for an existing 4 year degree BScCS at Cape Breton University (NS)
- **WHY:** make science education more attractive for Mi'kmaq First Nations students by *bringing together* Indigenous and Western (mainstream) scientific knowledges and ways of knowing
- **WHEN:** 1999-2010
- **RESULT:** more Mi'kmaq students in science

Integrative Science

**Toqwa'tu'kl
Kjijitaqnn**

**... the long
story, later**



Two-Eyed Seeing

What?

- **guiding principle for Integrative Science ... and similar inter-cultural collaborations wherein the overall effort is to have Indigenous and mainstream knowledges and ways of knowing work together**
- **brought forward by Mi'kmaq Elder Albert Marshall**
- **in Mi'kmaq = *Etuaptmumk***



Two-Eyed Seeing

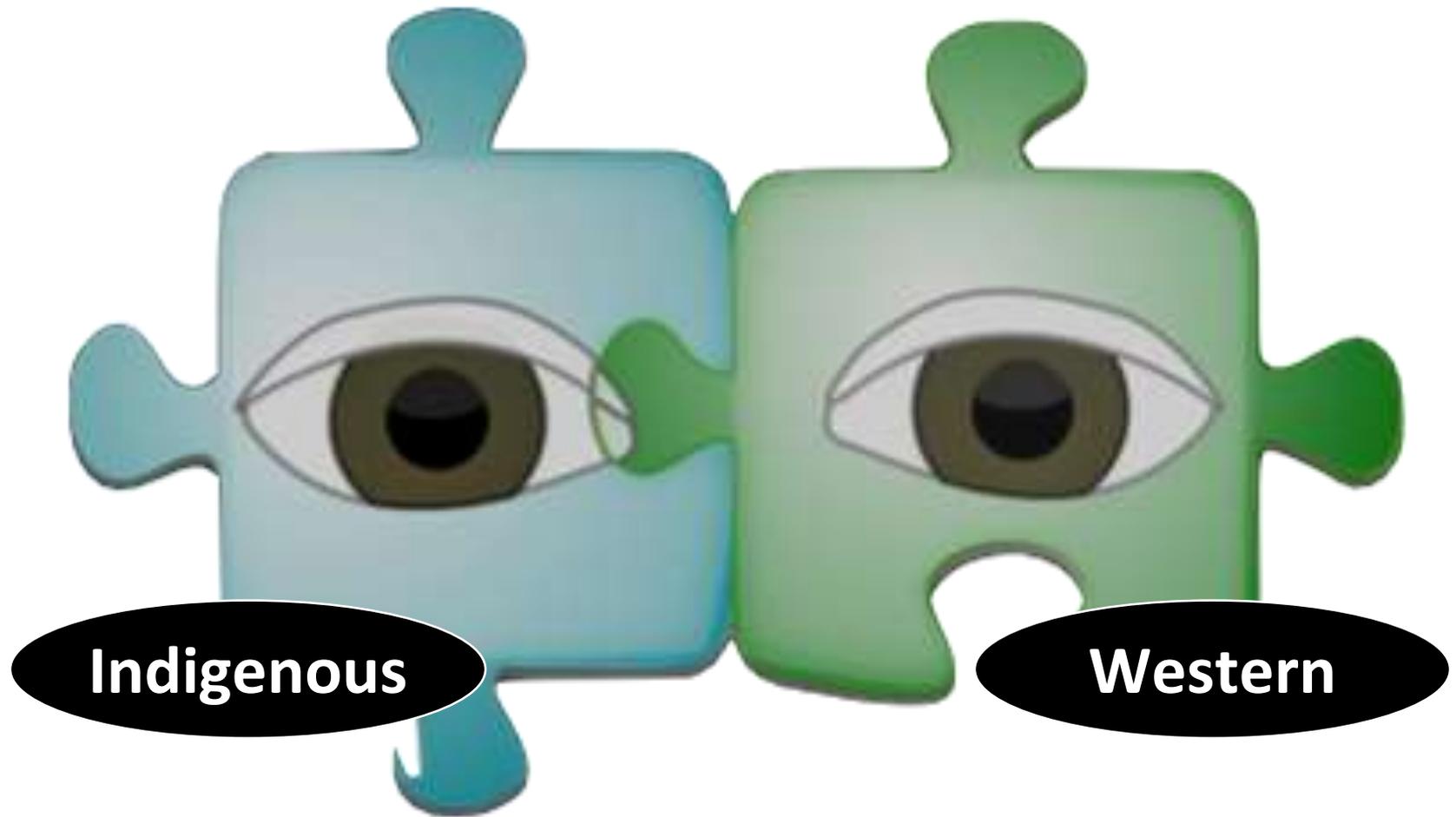
Elder Albert's words:

**LEARN ... to see from one eye
with the best in Indigenous
ways of knowing, and from
the other eye with the best in
Western (or mainstream)
ways of knowing**

**... and LEARN to use
both these eyes together
for the benefit of all.**



Two-Eyed Seeing

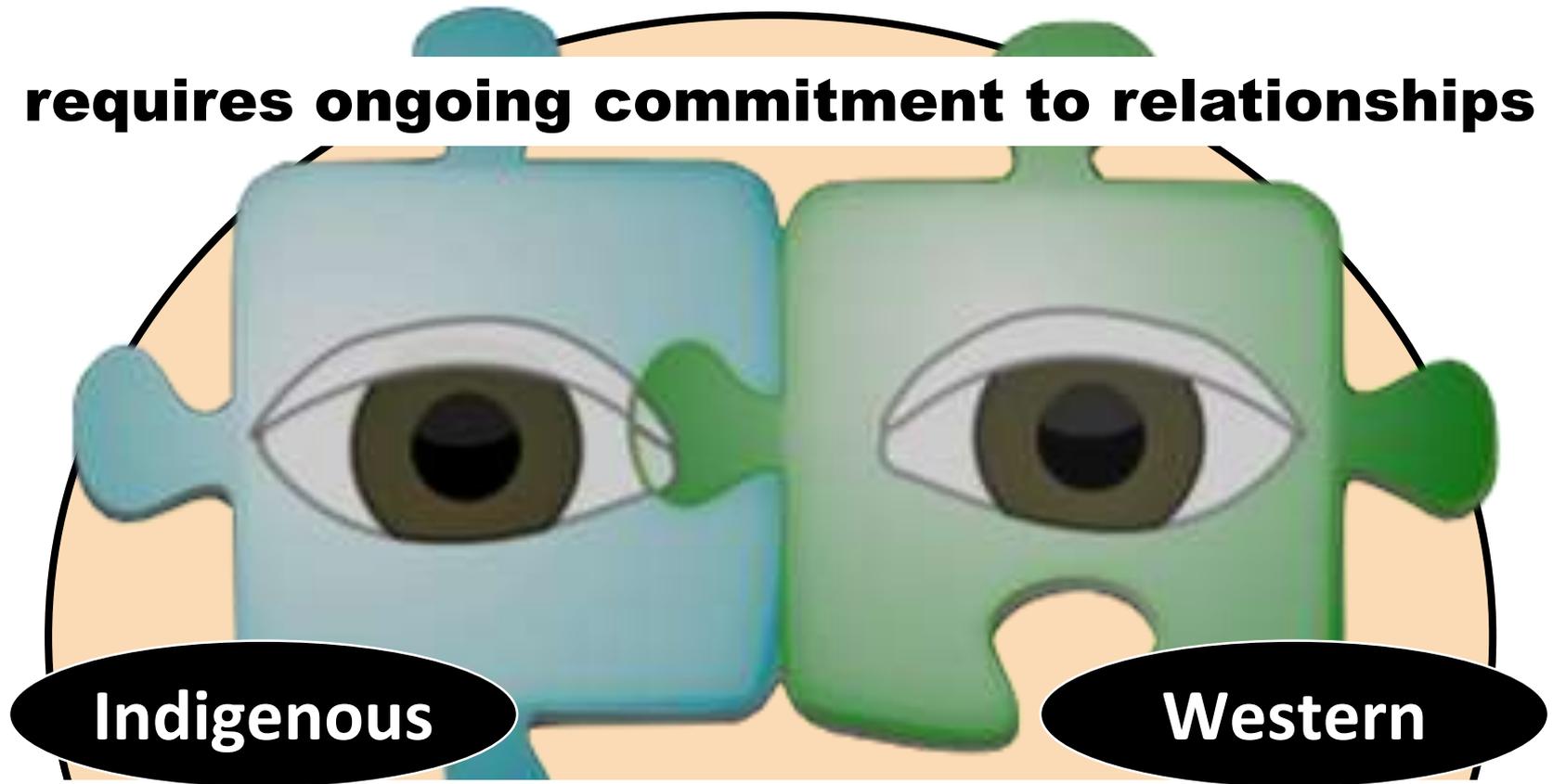


icon encouraged by Elder Albert Marshall

a **GUIDING PRINCIPLE**

for our minds, souls, spirits ... not a “mechanism”

requires ongoing commitment to relationships



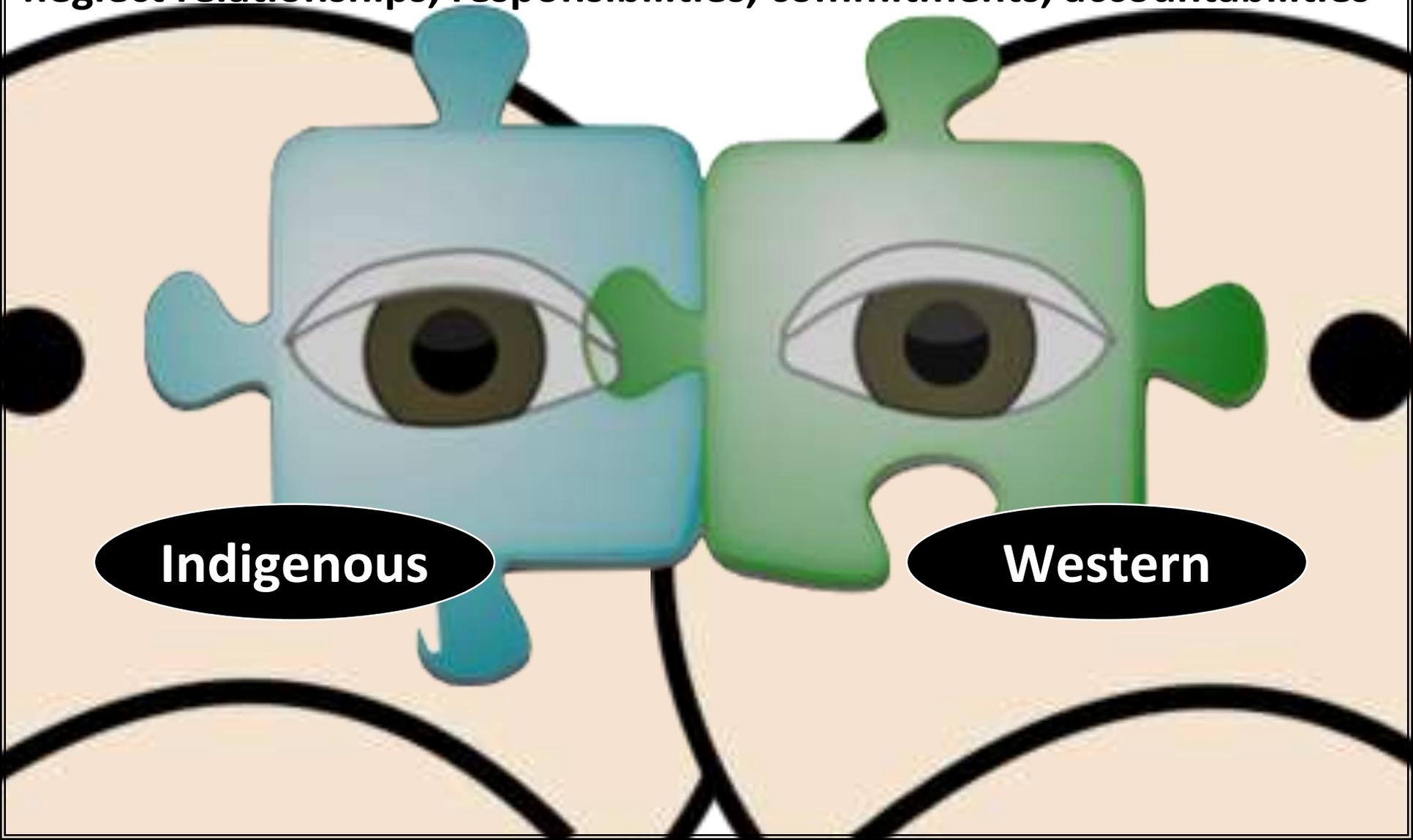
Indigenous

Western

requires personal understanding of positionality and acting upon responsibilities to reciprocities and accountabilities

Two-Eyed Seeing

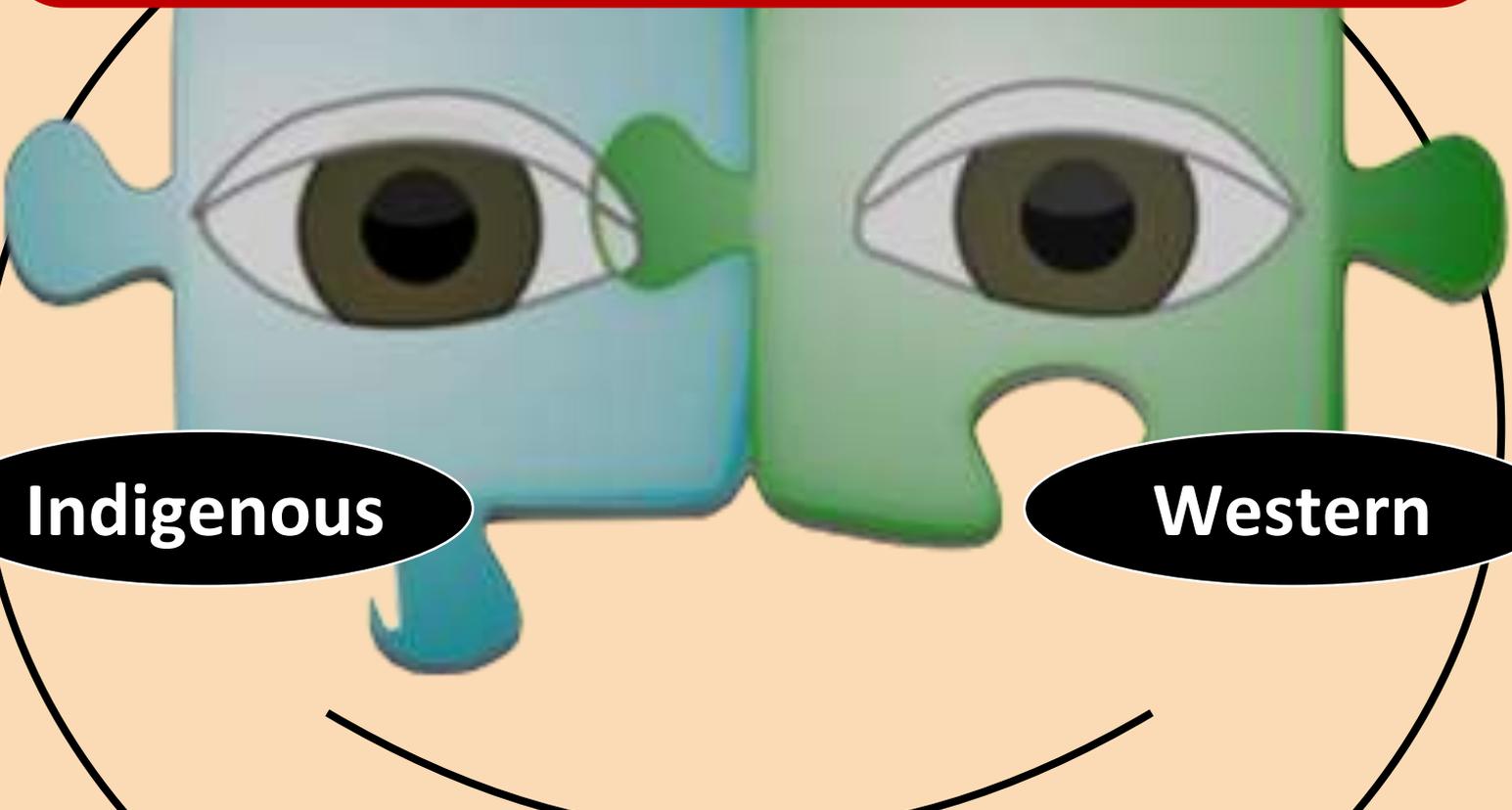
THE DOWNSIDE: some individuals merely co-opt TES and neglect relationships, responsibilities, commitments, accountabilities



Two-Eyed Seeing

... to preclude "The Downside" ...

INCLUDE four key essentials ...
each brings
profoundly challenging questions



Indigenous

Western

Two-Eyed Seeing

**INCLUDE four key essentials ...
each brings
profoundly challenging questions**

1. Co-Learning learning together

2. Knowledge

Scrutinization ... to see “the best”

3. Knowledge

Validation by peers

4. Knowledge

Gardening walking our talk

1. Co-Learning

- **How do we move to working collectively, rather than as individuals?**
- **How do we get our spirits to start collaborating?**
- **How do we invoke the Spirit of Co-Learning at universities?**

**WE MUST ALSO CONSIDER:
colonialism, racism,
unequal power dynamics**



Why?

**new hope for
nurturing better
relationships
congruent with**

TRC

94 calls to action
plus

**UN Declaration
on the
Rights of
Indigenous
Peoples**

adopted by Canada

4. Knowledge Gardening

Why?



We need to grow our understandings so our different knowledges can be respected as we learn how to have them “work as one”.

*We need to “Walk our Talk”
... abiding by and with interests and needs
of local communities and protocols*

• How can we create opportunities to grow, together ... and help each other?

**EDUCATION and RESEARCH
= EXCELLENT ARENAS**

4. Knowledge Gardening: ^{retrospective} example

Integrative Science

emerged in

EDUCATIONAL ARENA

CBU Faculty, Educator, Elder, Spiritual Leader, Fluent Speaker of Mi'kmaq, Grand-daughter of Grand Chief

grown in above plus

RESEARCH ARENA

CBU Faculty, Educator, Biologist, Tier 1 Canada Research Chair in Integrative Science



INTEGRATIVE SCIENCE

TWO-EYED SEEING

**2017 ... with 25 years of work (and ongoing):
growing, explaining, promoting across Canada
... in two key national documents and
TES also in many local and national projects**



2010, Blackfoot Crossing

2017 report to Government of Canada



CANADA'S FUNDAMENTAL SCIENCE REVIEW

Final Report



INVESTING IN **CANADA'S FUTURE**

Strengthening the Foundations of Canadian Research



**1st key
document
released
April 2017**

<http://www.sciencereview.ca/eic/site/059.nsf/eng/home>

2017 report to Government of Canada



Dr. David Naylor (Chair),
former president of the
University of Toronto



This report sets out a multi-year agenda that, if implemented, could transform Canadian research capacity and have enormous long-term impacts across the nation.

- C. David Naylor, Professor of Medicine, University of Toronto (Chair)

<http://www.sciencereview.ca/eic/site/059.nsf/eng/home>

2017 report to Government of Canada

The Panel was encouraged to learn about some relevant changes in the research landscape. We were apprised that attitudes, processes, and beliefs

page
99

INTEGRATIVE SCIENCE

they are moving towards a respectful partnership culture based on research *by* and *with* Indigenous researchers and communities. As relationships and

TWO-EYED SEEING

These communities have also asserted better access to and appropriate control over how information is gathered, used, and disseminated so that they can benefit from outcomes.

We note that highly credible colleagues have drawn on traditional Indigenous knowledge to improve their understanding of the workings of complex social and environmental systems. They argue that through methods for acquiring knowledge based on systematized observation and the formation and testing of hypotheses, Indigenous ways of knowing are not unlike the paradigms used within academe. Oral traditions represent reproducible, organized bodies of knowledge that are beneficial to answering specific questions within specific contexts, geographies, and timescales. Canadian researchers in this regard are now affirming what Indigenous people have known for centuries about geological events and human migrations.

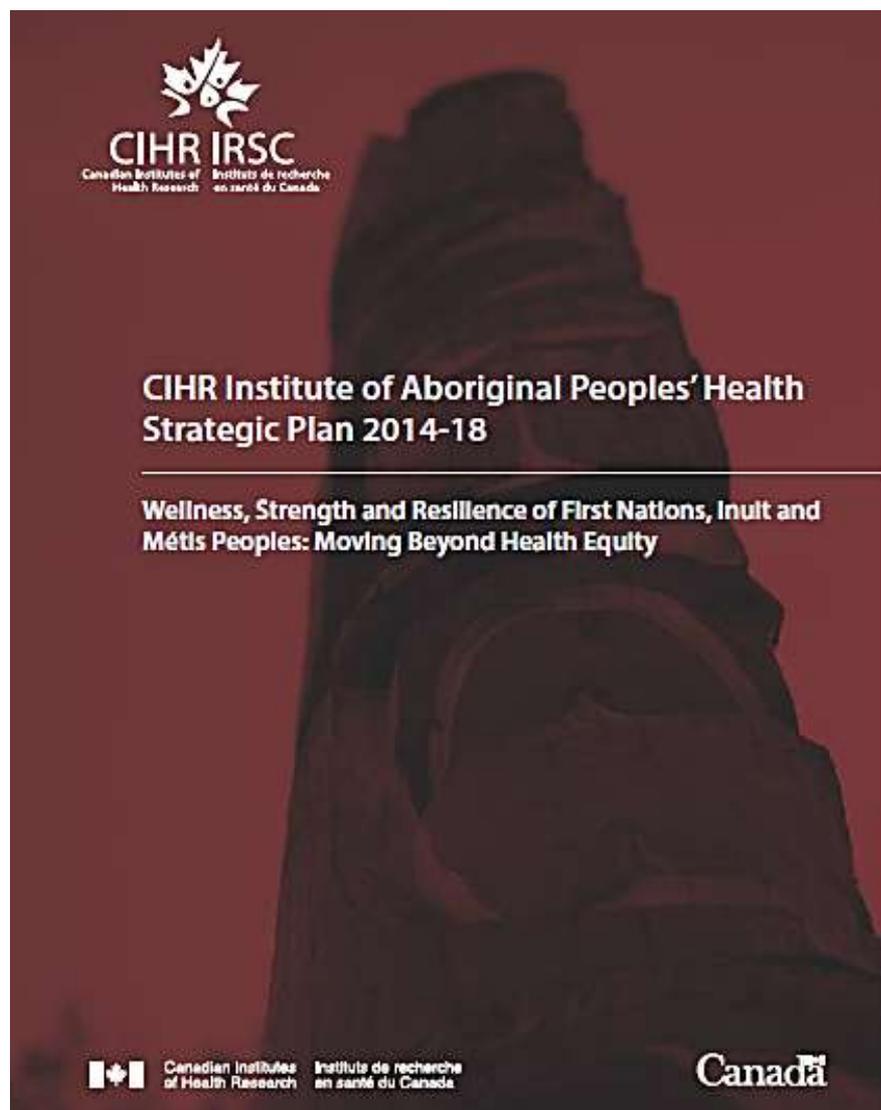
Indigenous Approaches to Research and Discovery

Integrative Science is an initiative designed to bring together Indigenous and Western scientific knowledges and ways of knowing. It takes a much broader view of science that emphasizes the natural world and our human participation in it, cultural inclusivity, and the role of the agent in the knowledge system.

Two-Eyed Seeing is the guiding principle for integrative science. It refers to the achievements that can be gained by learning from the best of Indigenous ways of knowing, inherently tied to the natural world, and the best in Western (or mainstream) ways of knowing. In effect, it involves learning to use each eye to see the world through the lens of one tradition, and then using both eyes together for the benefit of all.

– From: www.integrativescience.ca

CIHR Institute of Aboriginal Peoples' Health: Strategic Plan 2014-2018



**2nd key
document**
released
Feb 2016



<http://www.cihr-irsc.gc.ca/e/49589.html>

CIHR Institute of Aboriginal Peoples' Health: Strategic Plan 2014-2018



under the leadership, 2009-2016, of
Malcolm King, PhD, FCCP
Scientific Director, IAPH-CIHR

- Member, Mississaugas of the New Credit First Nation

**The 2014-2018 CIHR-IAPH strategic plan
embeds Two-Eyed Seeing.**



CIHR IRSC

Canadian Institutes of
Health Research

Instituts de recherche
en santé du Canada

Strategic Direction 2:

TWO-EYED SEEING

Transforming First Nations, Inuit and Métis Health through Indigenous Ways of Knowing and Two-Eyed Seeing

The concepts informing IAPH's Indigenous Ways of Knowing and Two-Eyed Seeing opportunities are guiding principles of IAPH's vision and mandate, and several funded studies have incorporated and qualified the benefits of these approaches. IAPH continues to advance Indigenous Ways of Knowing in health research, including community-specific and common Indigenous health research. This is reflected in the March 2013 National Colloquium on Indigenous Health Research.

Two-Eyed Seeing⁶ in research
research that engages
analysis, data
Seeing

page
26

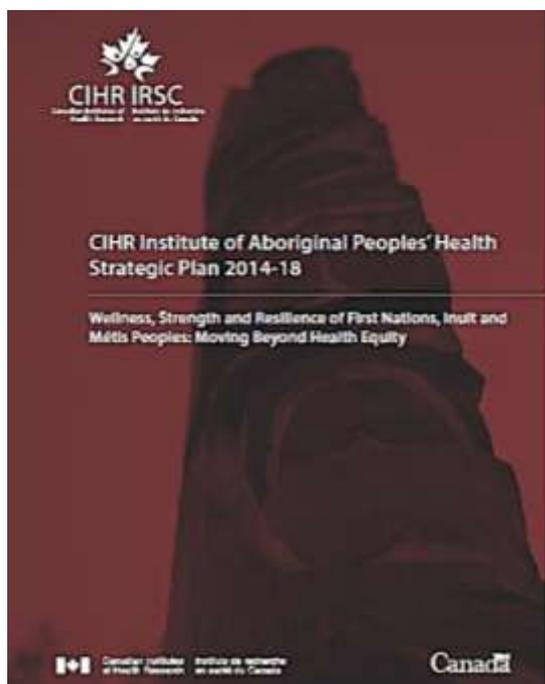
The 2014-2018 CIHR-IAPH strategic plan embeds Two-Eyed Seeing. Page 26 indicates it has been qualified by research and incorporates it as a strategic direction.

WE, TOGETHER

promising ways forward ... in two key, national documents

TWO-EYED SEEING

INTEGRATIVE SCIENCE



CANADA'S FUNDAMENTAL SCIENCE REVIEW

Final Report

INVESTING IN
 **CANADA'S FUTURE**

Strengthening the Foundations of Canadian Research



Integrative Science

CAPE BRETON
UNIVERSITY

late 1980s – late 1990s
both on faculty

**Murdena, why no Mi'kmaq
students in science?**

**Cheryl, enrich how you teach
science!! Then, more
Mi'kmaq students might
choose to study science.**



Integrative Science

the longer story

view of science

PREMISE:

- **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.**



Integrative Science

the longer story

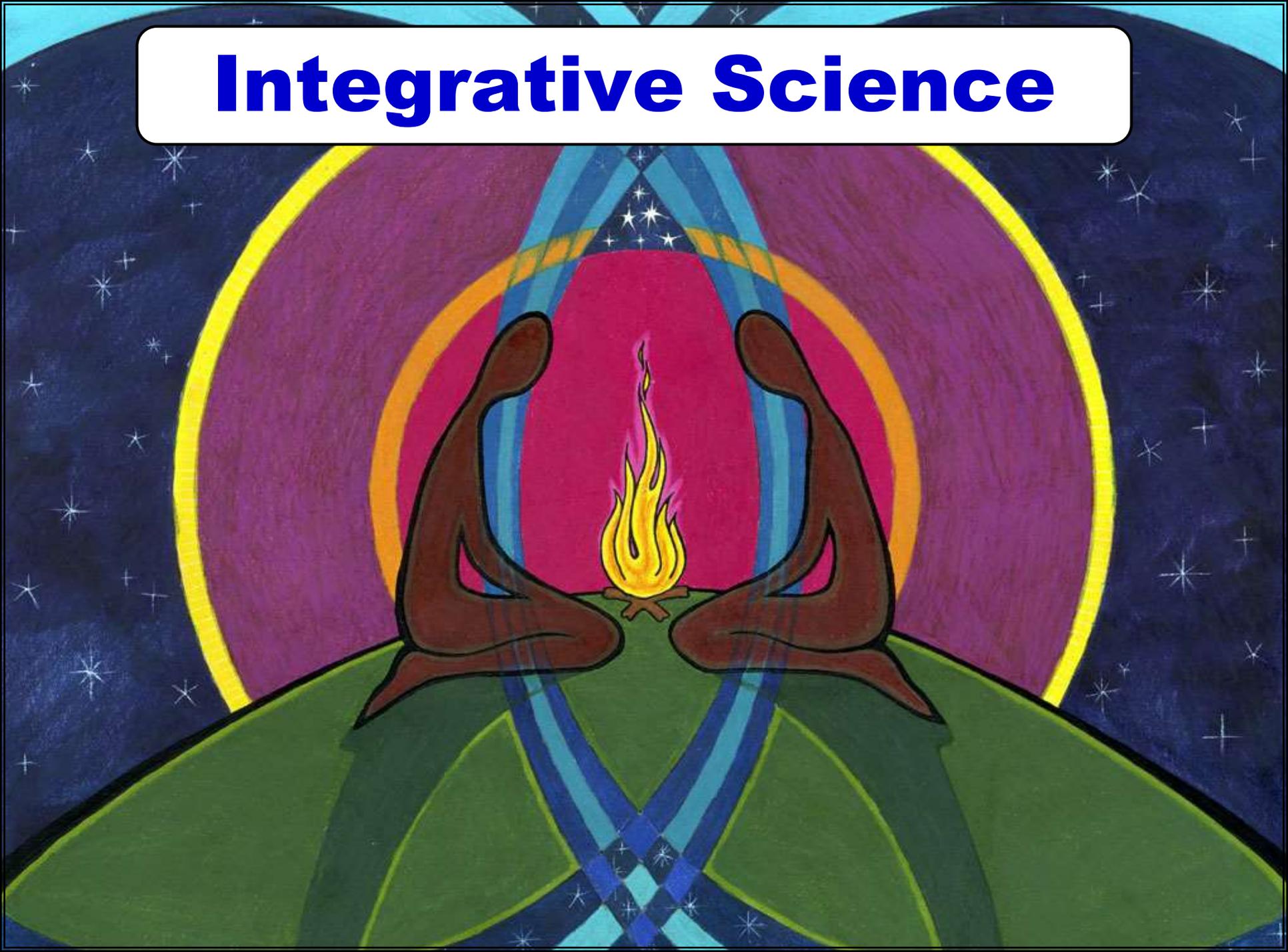
view of science

INTEGRATIVE SCIENCE emphasizes:

- **the natural world and our human participation within it,**
- **cultural inclusivity, and**
- **our roles, including responsibilities, as agents ... indeed, as storytellers ... in our knowledge systems**



Integrative Science



Integrative Science



Indigenous

Western

“bringing our knowledges together”

Integrative Science

The “ive” in integrative indicates our work is forever active and ongoing.

not merged, rather:
COMMON GROUND recognized
DIFFERENCES respected

Indigenous

Western

“bringing our knowledges together”

April 2001: celebrating MPHEC approval of Integrative Science program within BScCS ... after four years of internal and external inquisition



BScCS: a 4 yr SCIENCE degree

Bachelor of Science Community Studies

Degree Profile for:
Toqwa'tu'kl Kijijitaqnn /
Integrative Science

Bringing Knowledges Together
... from Western scientific and Aboriginal world views



core

- 1) PubH 100: Analysis and Decision Making (6 credits)
- 2) PubH 100: Applied Research (6 credits)
- 3) PubH 300: Community Intervention (6 credits)
- 4) science and technology perspectives (6 credits): Phil 222, or equivalent
- 5) world views and values (3 credits): Phil 251, Phil 253, or equivalent
- 6) Aboriginal perspectives (3 credits): Mikm at 100 or 200 level, or 361, or equivalent
- 7) business perspectives (3 credits): Buss 111, Buss 231, or equivalent
- 8) public communication (3 credits): Comm 103, Comm 105, or equivalent
- 9) environmental perspectives (6 credits): East 100, East 205 + Engl 207, or equivalent
- 10) psychology perspectives (6 credits): Psych 102 or 111, Buss 181, or equivalent
- 11) social perspectives (6 credits): Buss 182, Psych 201, or equivalent

concentration

- 1) 3 credits: MSIT 101
- 2) 3 credits: MSIT 103
- 3) 3 credits: MSIT 201
- 4) 3 credits: MSIT 202
- 1 + 2) 6 credits: Chem 121 + 122
- 3 + 4) 6 credits: Math 131 + 132, or
Phys 100, or Phys 111 + 112
- 5 + 6) 6 credits (at least 3 credits must be at 300 level):
 - Geol 111
 - any PubH at 200 level or higher
 - any Envi at 200 level or higher

electives

Student's Electives (30 credits)
1) 3 credits: _____
2) 3 credits: _____

work placements

Work Placements (paid or voluntary, each at least 120 hours)
1) _____
2) _____

An overall average of 60% (in courses) over your four years is required for graduation.

four parts
in degree
profile

program structure



BScCS: a 4 yr SCIENCE degree

Bachelor of Science Community Studies

Indigenous & Western sciences together in

MSIT courses

4 full year courses

4 of degree's 20

concentration

Integrative Science

regular science courses:

Chemistry

Math or Physics

Environmental or Public Health

Work Placements (paid or voluntary, each at least 120 hours)

- 1) _____
- 2) _____

An overall average of 60% (in courses over your four years) is required for graduation.

program structure

Integrative Science – MSIT courses

**I'm happy to share how we tried
to shape and evolve curricula.**

(several people were involved)

**MSIT
curricula**
(1st year courses)



Integrative Science – MSIT courses

WE HAD: early input via Talking Circles plus (many and ongoing) coffee and tea conversations

... with community
Elders, educators, and
leaders of organizations,
plus experts from away
and interested friends

Also: literature, although not
nearly as voluminous as now



Integrative Science – MSIT courses

KEY advice:
learn
with and from
Mawisikmukawey

KEY request:
Mi'kmaq Language



Integrative Science – MSIT courses

KEY advice:

**Be courageous,
get going, teach
yourselves how.**

**Re-awaken student's
sense of creativity.**

(it will be your greatest challenge)

Dr. Gregory Cajete
Director of Native Studies
artist and scientist
Univ. of New Mexico
(personal communication)

... focusing on the
similarities between the
two systems of knowledge
rather than their differences

... could be a more
useful place to start ...

Dr. Marie Battiste
Dept of Educational Foundations
Univ. of Saskatchewan

Indigenous Knowledge and Pedagogy
in First Nations Education;
a 2002 literature review with recommendations
*from p. 11 in paper prepared for
National Working Group on Education and
the Minister of Indian Affairs*

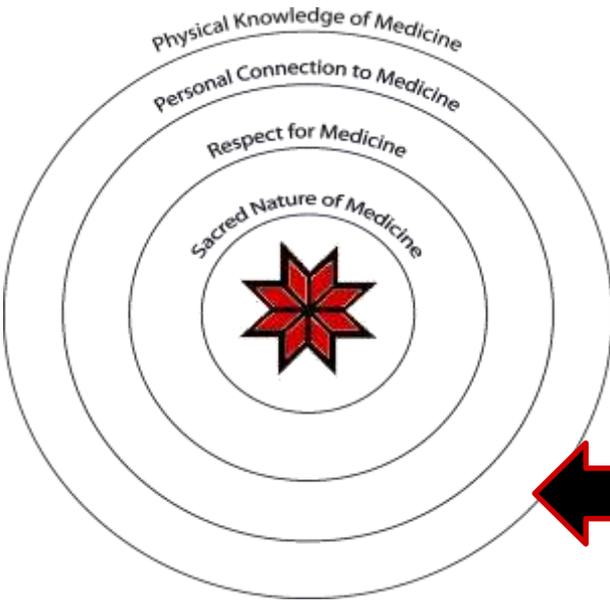
http://www.afn.ca/uploads/files/education/24_2002_oct_marie_battiste_indigenousknowledgeandpedagogy_lit_review_for_min_working_group.pdf

Integrative Science – MSIT courses

shared with Western Science

**KEY theme:
Visual Thinking**

**Elder
Murdena's
Mi'kmaq
Knowledge
Model**



Physical Knowledge of Medicine

Personal Connection to Medicine

Respect for Medicine

Sacred Nature of Medicine

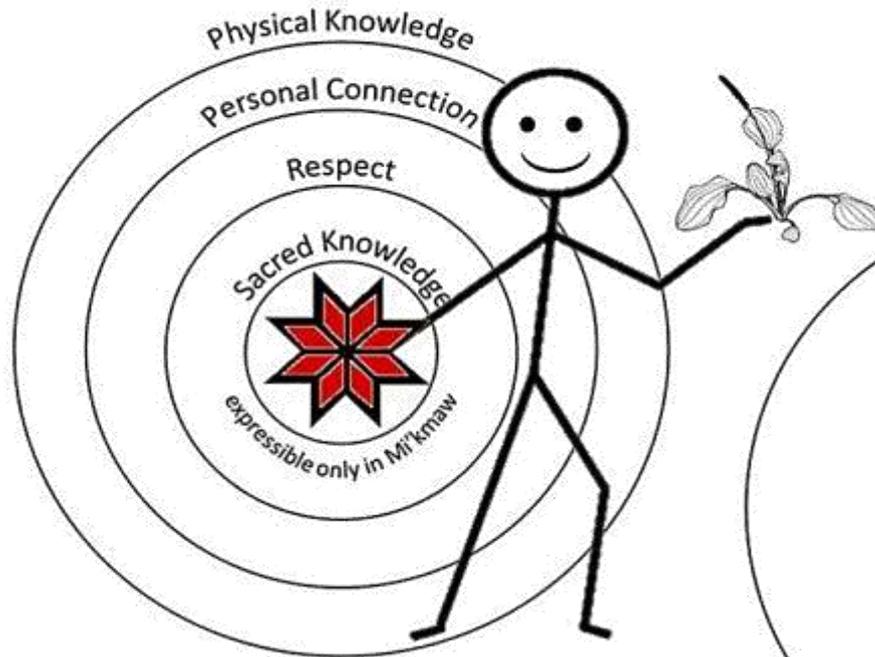
4 concentric circles



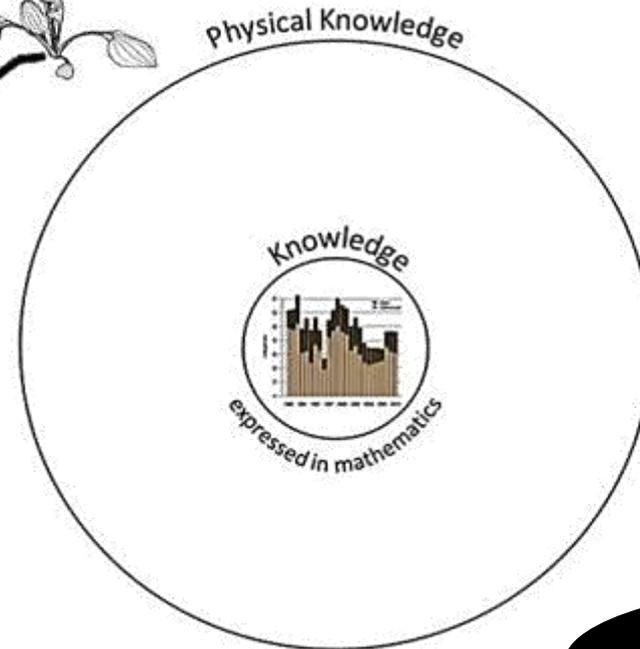
Integrative Science – MSIT courses

Knowledge System Models

**KEY theme:
Visual Thinking.**



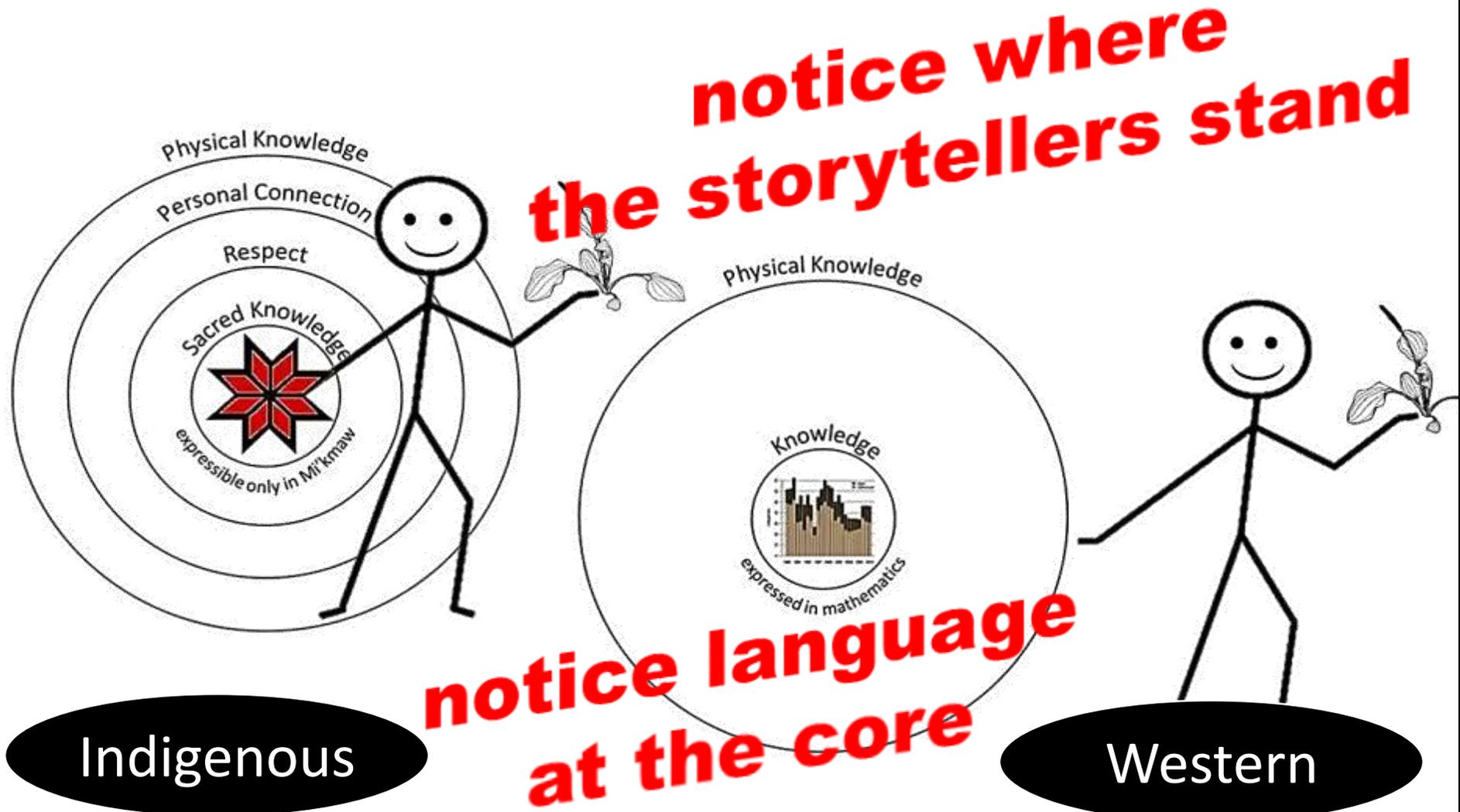
Indigenous



Western

adapted from Elder Murdena Marshall

Integrative Science – MSIT courses



Integrative Science – MSIT courses

**KEY
theme:**

**We Humans are
Storytellers**



**Elder Albert Marshall
Mi'kmaq Nation**



**The foundational basis
for any relationship is
an exchange of stories.**

Integrative Science – MSIT courses

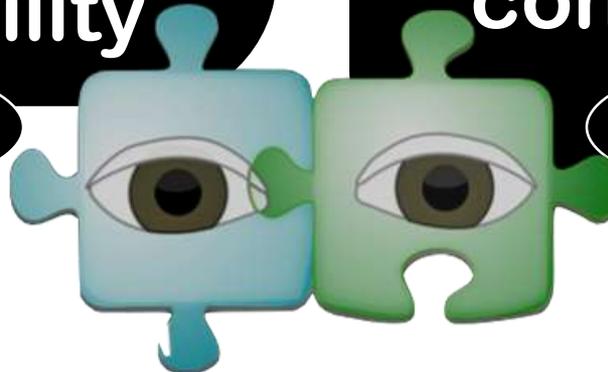
**as storytellers, as knowledge agents ...
we have responsibilities**

- respect
- relationship
- reverence
- reciprocity
- ritual (ceremony)
- repetition
- responsibility

Indigenous

- question asking
- hypotheses
(making & testing)
- data collection
- data analysis
- model & theory
construction

Western



Integrative Science – MSIT courses

**as storytellers, as knowledge agents ...
we have responsibilities**

CO-LEARNING for Two-Eyed Seeing
learning our strengths and learning together

CONCEPTS and ACTIONS (epistemologies)

<ul style="list-style-type: none"> - respect - relationship - reverence - reciprocity - ritual (ceremony) - repetition - responsibility 	<ul style="list-style-type: none"> - the question - hypothesis (making & testing) - data collection - data analysis - model & theory construction
--	--

epistemology

CO-LEARNING for Two-Eyed Seeing
learning our strengths and learning together

NATURAL WORLD (ontologies)

<p>All my Relations</p> <p>beings ... interconnective and animate: spirit + energy + matter</p> <p>with CONSTANT CHANGE with the sacred and the profane</p>	<p>parts & wholes</p> <p>objects ... comprised of parts and wholes characterized by systems and emergences: energy + matter</p> <p>with EVOLUTION</p>
---	---

ontology

CO-LEARNING for Two-Eyed Seeing
learning our strengths and learning together

METHODOLOGIES

<p>weaving of patterns within nature's patterns via creative relationships and reciprocities among <i>love, land, and life (vigour)</i> that are constantly reinforced and nourished by Aboriginal languages</p>	<p>un-weaving of nature's patterns (especially via analytic logic and the use of instruments) to cognitively reconstruct them, especially using mathematical language (rigour) and computer models</p>
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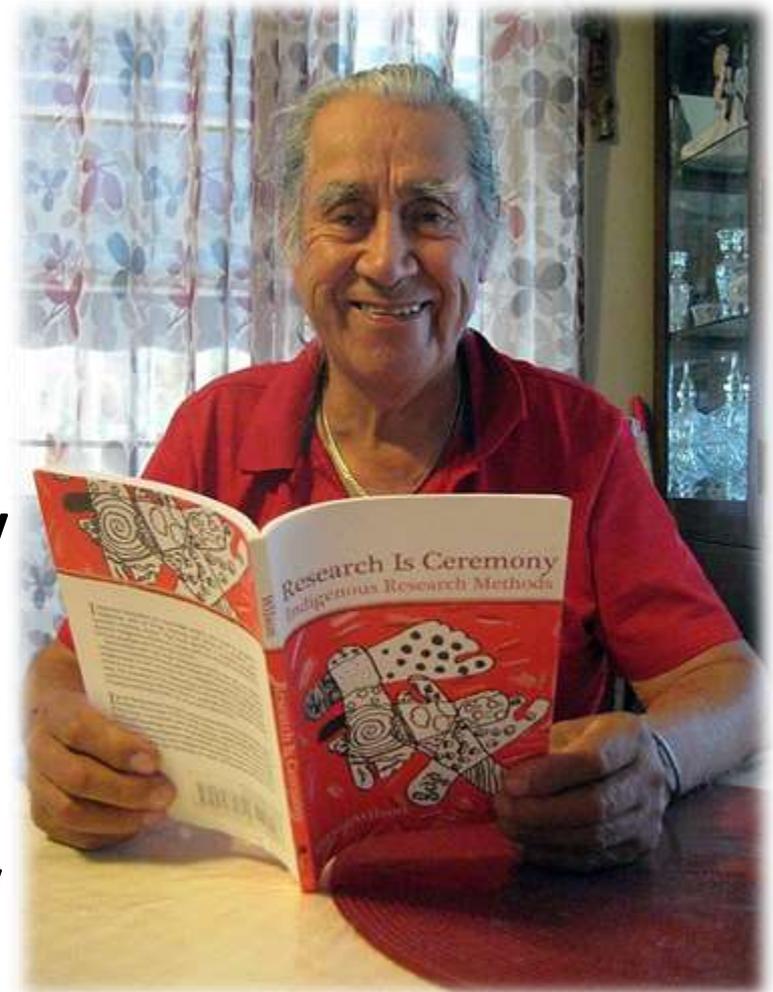
methodology

CO-LEARNING for Two-Eyed Seeing
learning our strengths and learning together

KNOWLEDGE OBJECTIVES

<p>collective, living knowledge to enable nourishment of one's journey within expanding sense of "place, emergence and participation" for collective consciousness and interconnectiveness</p> <p>enables re-orientation of understanding within ourselves</p>	<p>dynamic, testable, published knowledge independent of personal experience that can enable prediction and control (and "progress")</p> <p>enables construction of understanding of environments</p>
--	---

axiology

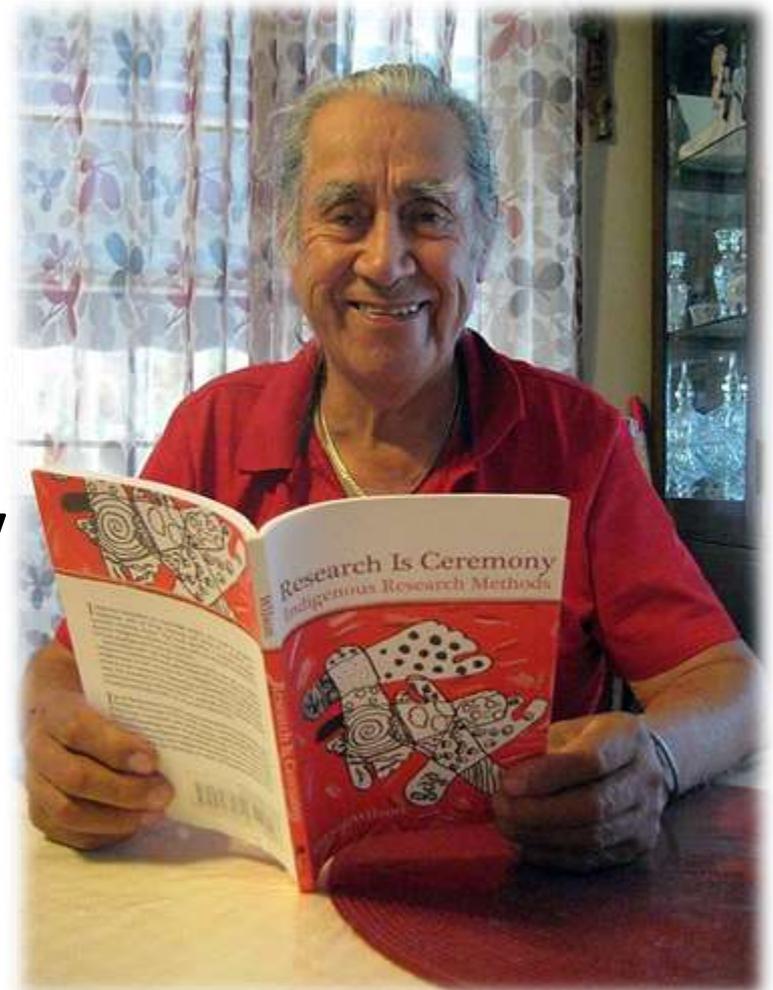


Integrative Science – MSIT courses

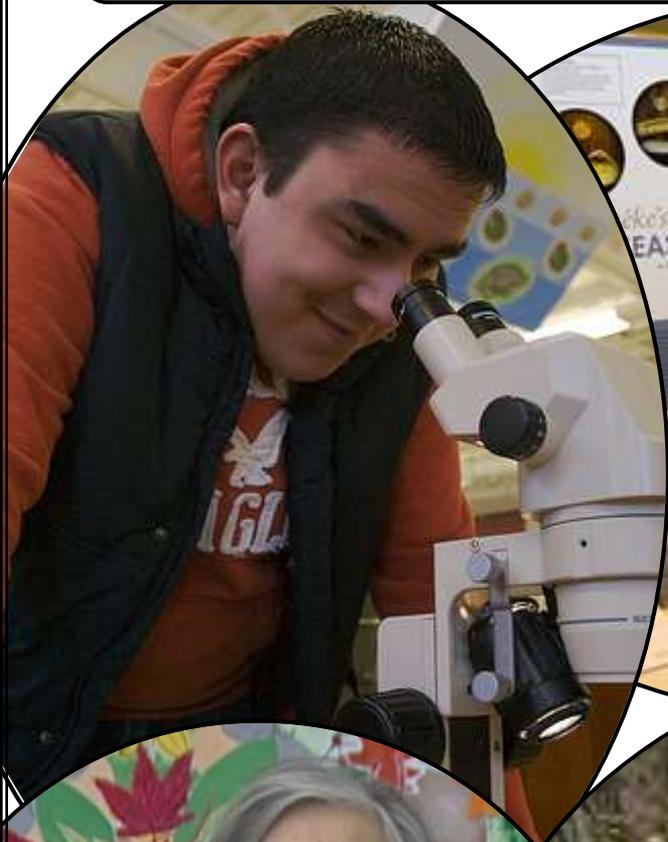
**as storytellers, as knowledge agents ...
we have responsibilities**

- *nature of thinking or thought:*
wsitqamu'kewe'l ankitasuaqnn
(worldly thoughts or knowledge gained throughout your life) ≈ epistemology
- *worth of reality; real world; real life:*
wsitqamu'kewe'l penawsinn ≈ ontology
- *how knowledge is gained: ta'n tel mnsnmen kjiji'taqn ≈ methodology*
- *worth of knowledge that will be used:*
kjijitaqn ta'n tel wie'wasitew ≈ axiology

italicized text = Albert's thoughts



Integrative Science – MSIT courses



**Mi'kmaq
Language**

Integrative Science – MSIT courses

CORE approach:
science ...
pattern stories



work of Dr. Cheryl Bartlett
Tier 1 Canada Research Chair
and team with Elders & Educators



Integrative Science – MSIT courses

CORE approach:

**science ...
pattern stories
view**

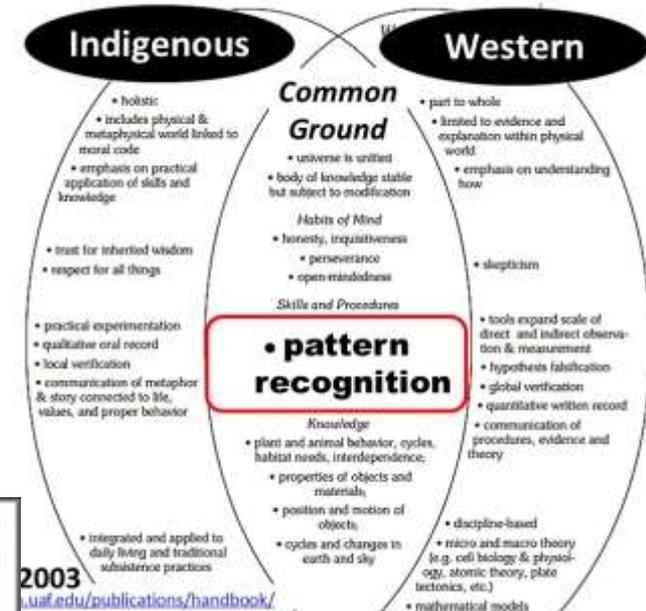
**science inclusively
by recognizing:**

Common Ground

**science = dynamic, pattern-based knowledge
shared through stories
about our interactions with and within nature**



our knowledge systems feature **pattern recognition**

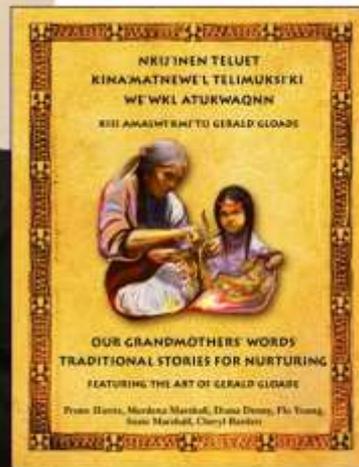


Common Ground

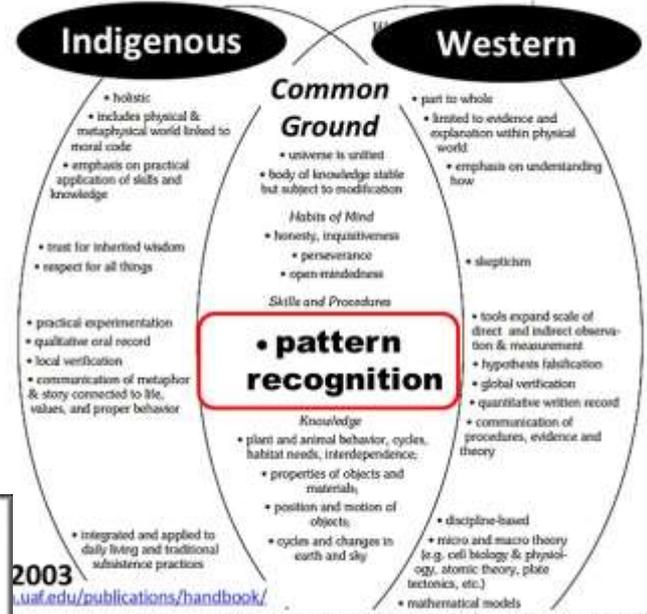
**Gerald Gloade, Millbrook First Nation,
Cultural Officer (MDCC) and Artist**

**“... pattern recognition is a basic skill
within Mi’kmaq Traditional Knowledge”**

- artwork for 2013 Integrative Science book of Elders’ stories
- designed the beaver for the 2017 Canadian nickel



our knowledge systems feature pattern recognition



Gerald Gloade, Millbrook First Nation, Cultural Officer (MDCC) and Artist

“... pattern recognition is a basic skill within Mi’kmaq Traditional Knowledge”

- artwork for 2013 Integrative Science book of Elders’ stories
- designed the beaver for the 2017 Canadian nickel

Math: the language of pattern recognition in Western Science

Integrative Science – MSIT courses

How to teach
pattern stories
... as science?

And, what
“ways of knowing”
... to learn patterns?

PATTERNS

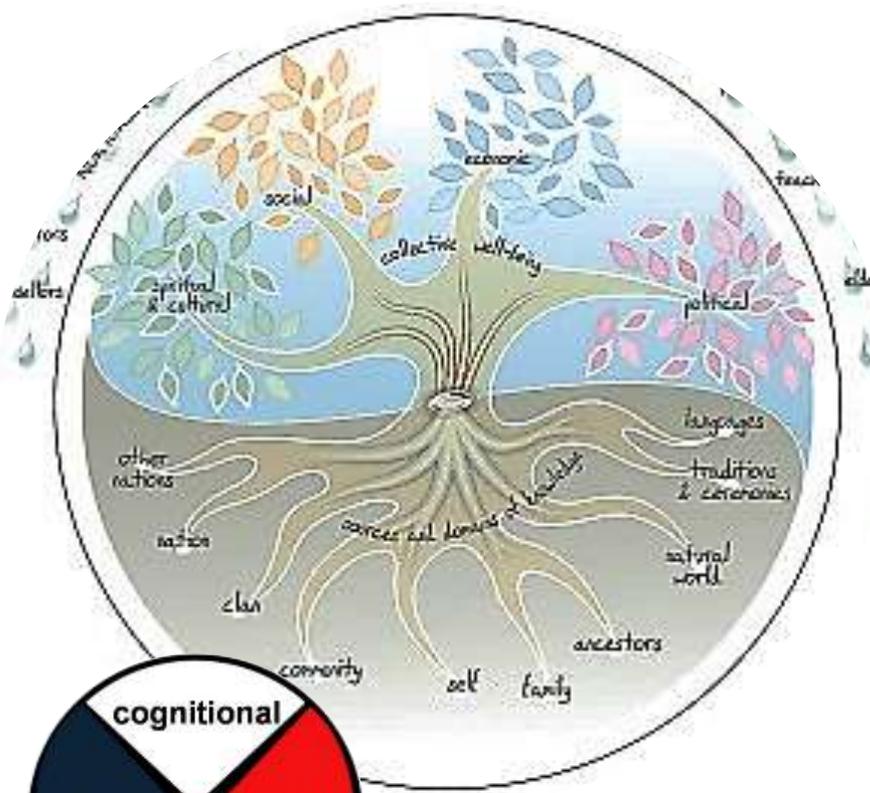
**sensitivity, recognition,
transformation,
communication**



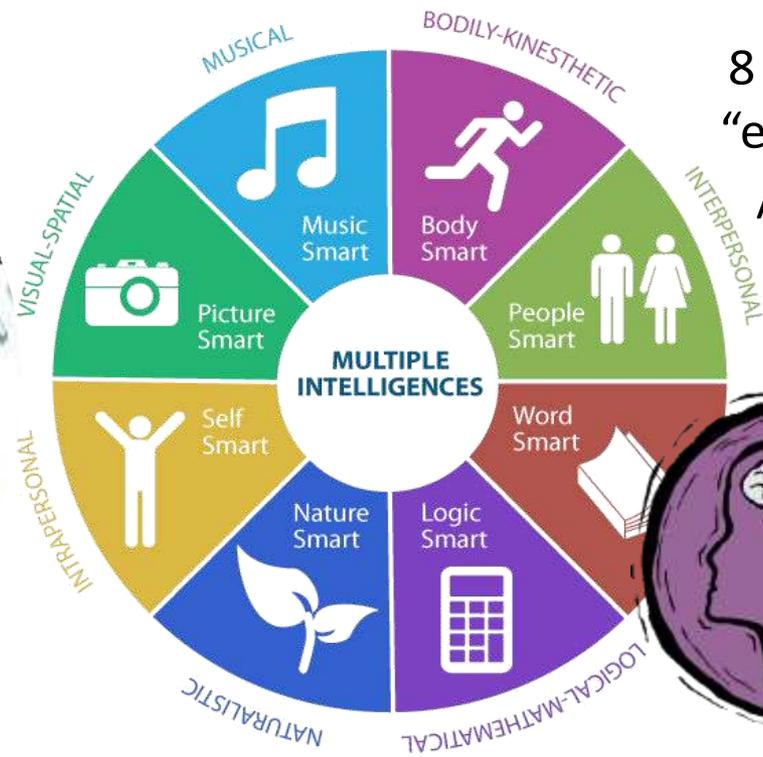
**Re-awaken student's
sense of creativity.**

Science stories are pattern knowledge!

Humans have lots of "pattern smarts". We can sanction many or few ...



**First Nations
Holistic Lifelong
Learning Model**



8 + maybe
"existential
/ spirit"

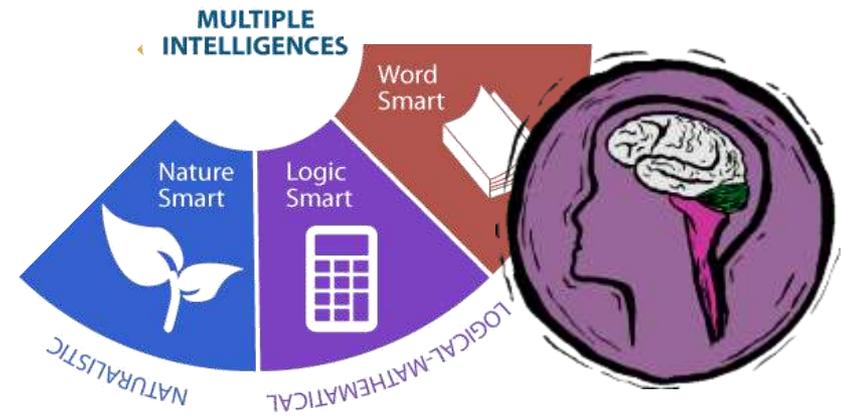
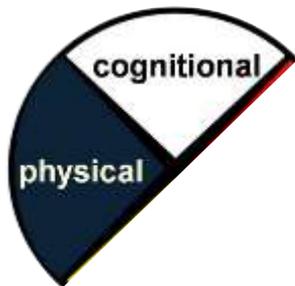


**Howard Gardner's
Multiple Intelligences
Theory**

Humans have lots of “pattern smarts”. **We sanction few in Western science.**

“[Western] Science is distinguished from other pursuits by the precise and limited intellectual means that it employs and the integrity with which it uses its limited means.”

quoting: Jane Jacobs, 2004; Dark Age Ahead; p. 65. Vintage Canada



Thus my
^ Science stories are

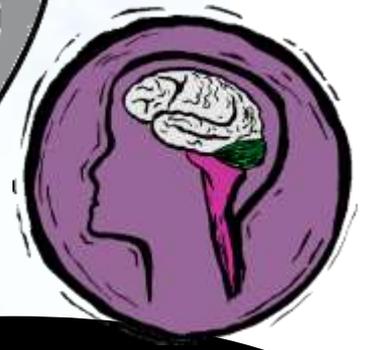
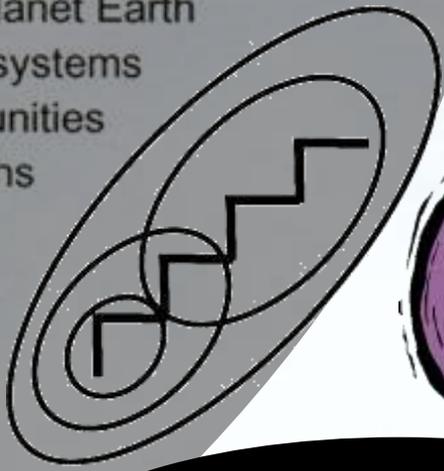
stories
of

parts & wholes

... stories of:
MATTER & ENERGY



- ┌ Universe
- ┌ super clusters (Local)
- ┌ clusters (Local Group)
- ┌ galaxies (Milky Way)
- ┌ star systems (Sun)
- ┌ planet Earth
- ┌ ecosystems
- ┌ communities
- ┌ populations
- ┌ organisms
- ┌ organ systems
- ┌ organs
- ┌ tissues
- ┌ cells
- ┌ organelles
- ┌ molecules & minerals
- ┌ atoms (natural elements #1-92; artificial)
- ┌ baryons (neutrons & protons)
- ┌ fundamental particles (quarks & leptons)



**Western
science**

Thus my
^ Science stories are

stories
of

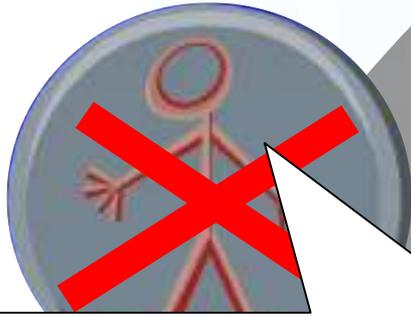
parts & wholes

... stories of:
MATTER & ENERGY

**Spirit does not exist.
Consciousness is
“problematic”.**

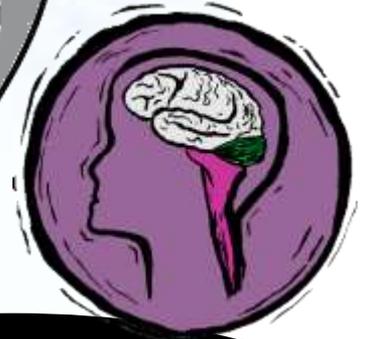
My world is
many “its”
(objects).

... and energy
fields!



I am not in the story

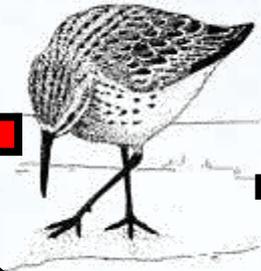
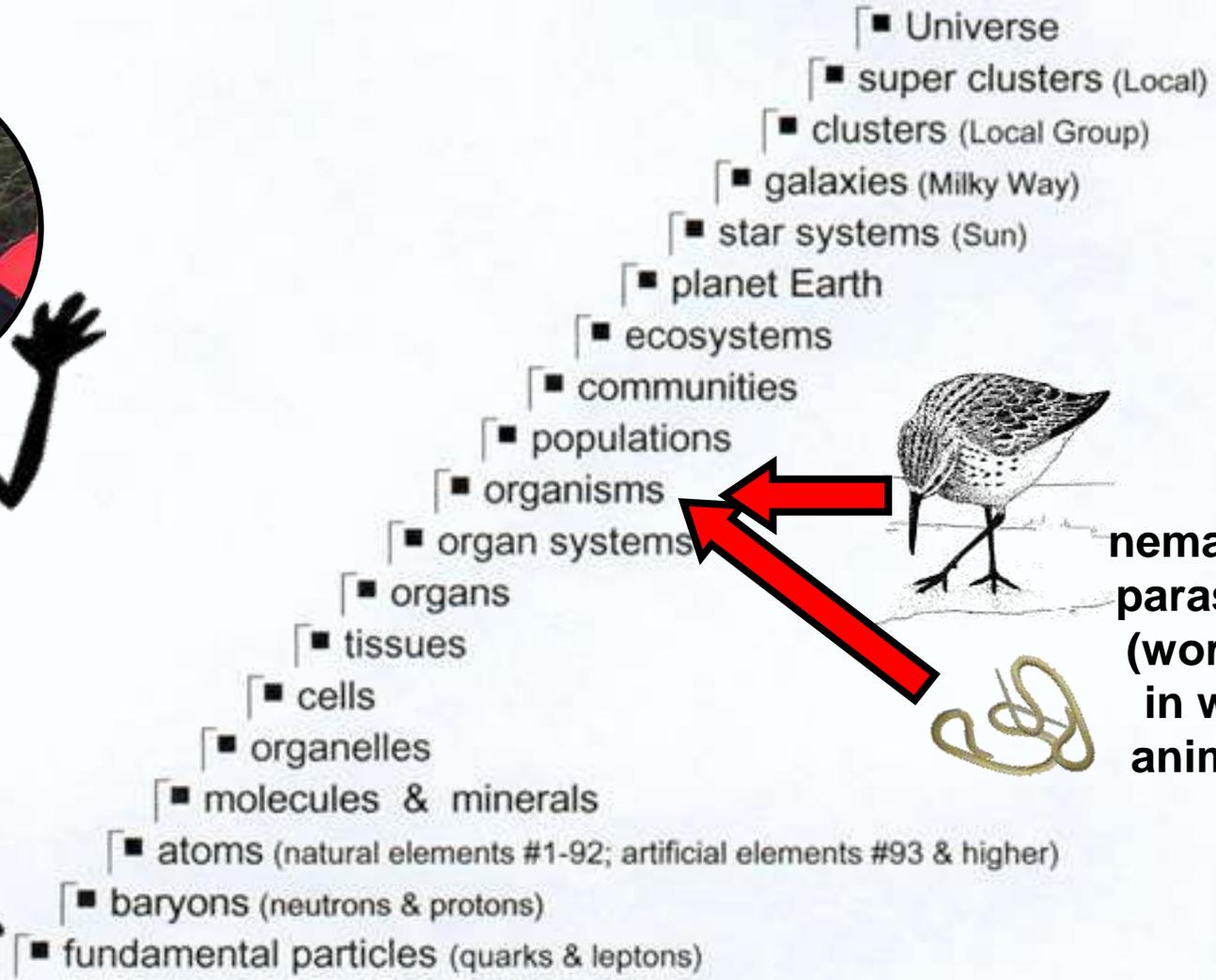
but I am for
quantum
physics!



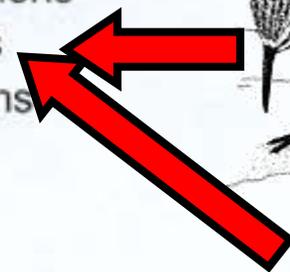
**Western
science**

- Un
- super
- clusters
- galaxies (M
- star systems
- planet Earth
- ecosystems
- communities
- populations
- organisms
- organ systems
- organs
- tissues
- organelles
- molecules & minerals
- atoms (natural elements #1-92; artificial)
- baryons (neutrons & protons)
- fundamental particles (quarks & leptons)

my own research in the staircase pattern



nematode
parasites
(worms)
in wild
animals



my own research in the staircase pattern

lots of technical words!

EPIDEMIOLOGY
at the level of populations

DISEASE
response at the level of
(multi-cellular) organism

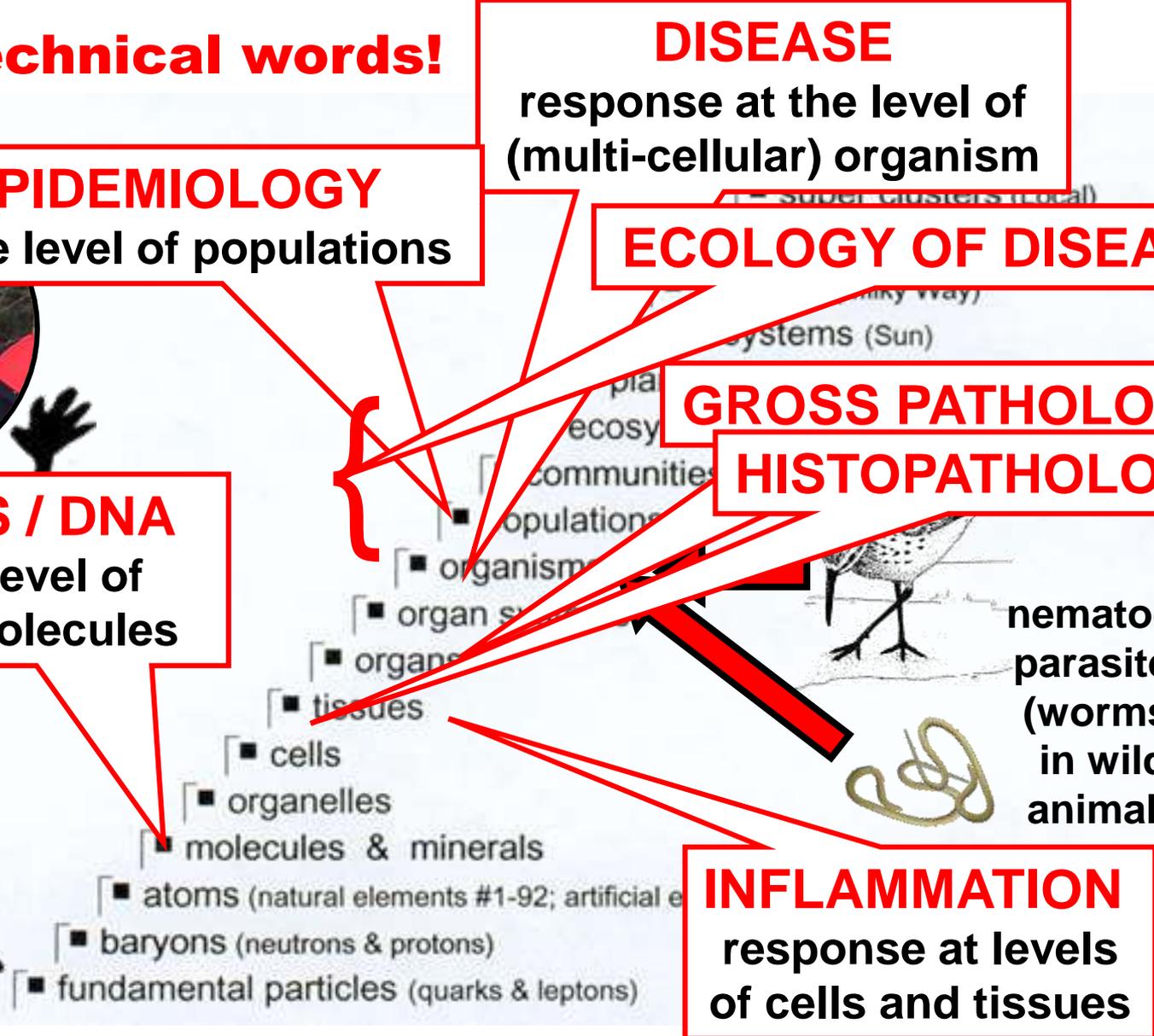
ECOLOGY OF DISEASE

GROSS PATHOLOGY
HISTOPATHOLOGY

GENES / DNA
at the level of
macromolecules

INFLAMMATION
response at levels
of cells and tissues

nematode
parasites
(worms)
in wild
animals

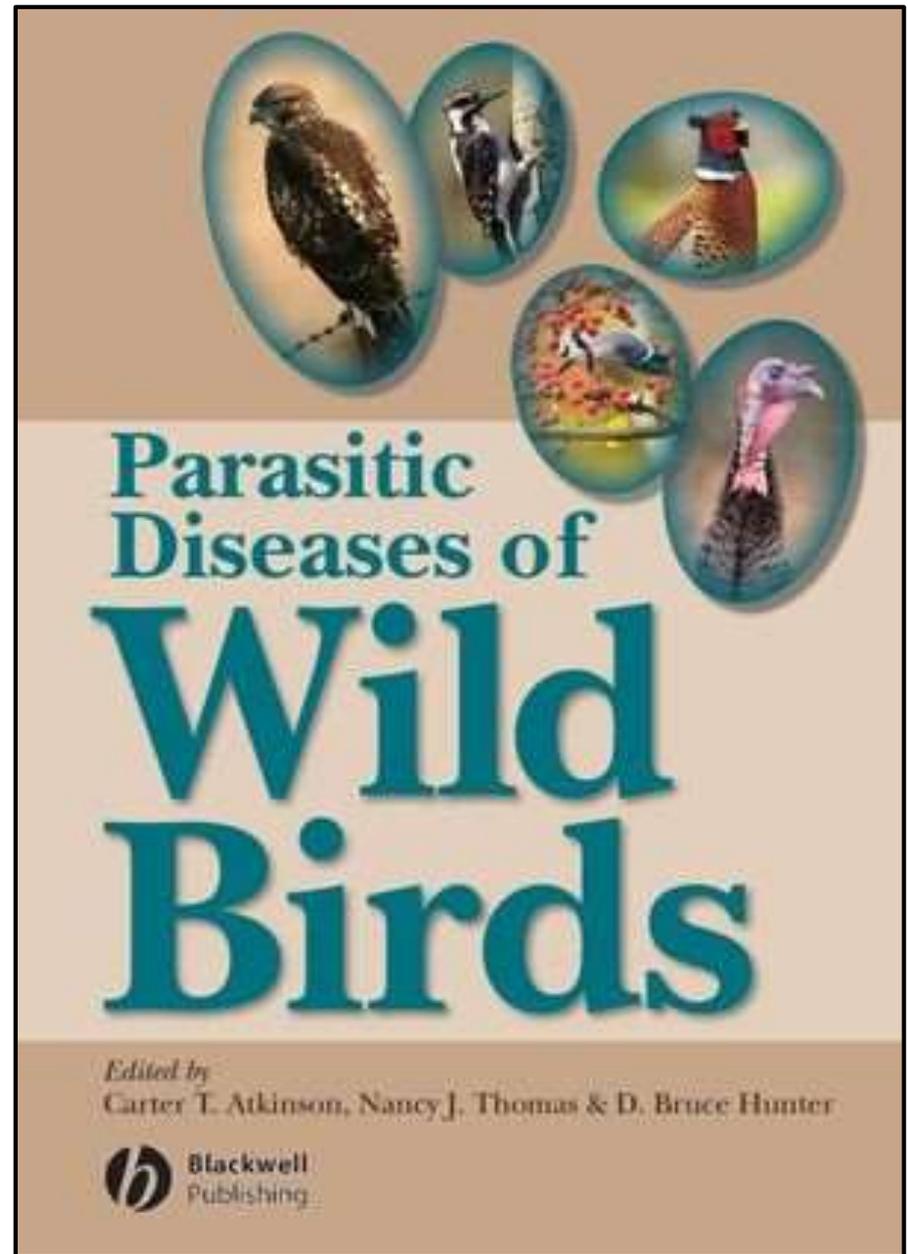


my own research Western science stories



... and I
am not in
this story

patterns taken apart
to gain understanding
... re-assembled
within explanatory
professional
publications



Then my

^ **Science stories are**

Our stories are alive.

stories of

interconnectiveness

**Place
Emergence
Participation**

**... and I am
in the story**

Vision ~~is~~

Volition

Mental

Physical

**Spirit
everywhere**



**My world, our world, is
"All My Relations" (kin / subjects).**

Indigenous

**The land is alive
with our stories.**

**Place
Emergence
Participation**

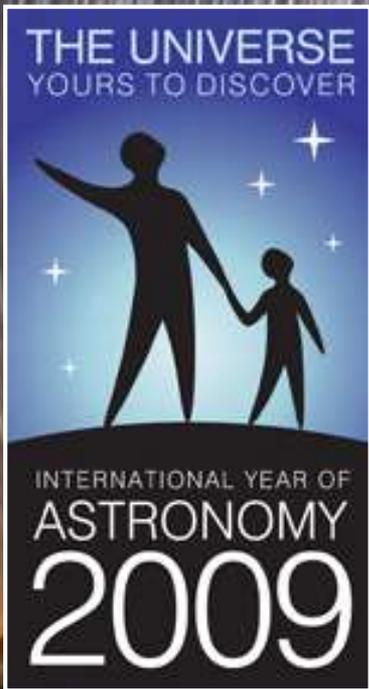
**Moose Harvest
Mi'kmaq
Youth Camp**

photos by Clifford Paul, Membertou FN



The sky is alive
with our stories.

Place
Emergence
Participation



TATAPN (North Star)

Mi'kmaq science stories: patterns woven within patterns

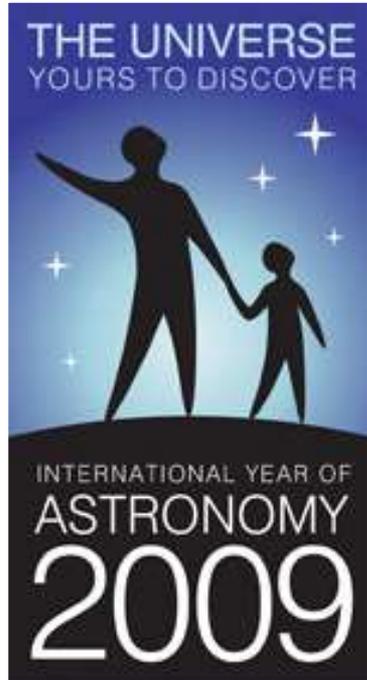
CRC Team: Sana Kavanagh, Kristy Read, Nadine Lefort, Prune Harris



**Elder Murdena Marshall
Eskasoni FN**

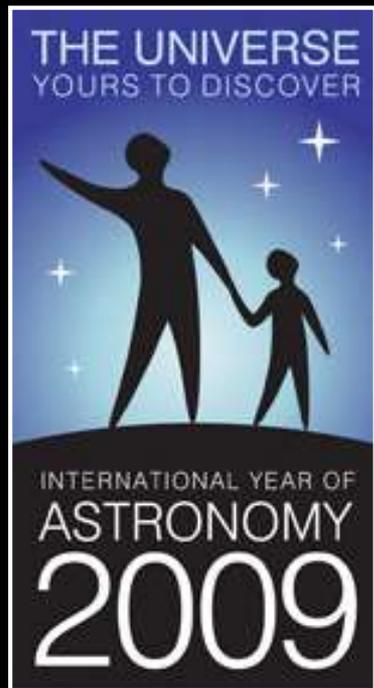


**Elder
Lillian Marshall
Potlotek FN**



**Mi'kmaq Traditional Night Sky Story:
Muin and the Seven Bird Hunters
("oral calendar")**

Patterns in Stars



Patterns on Earth



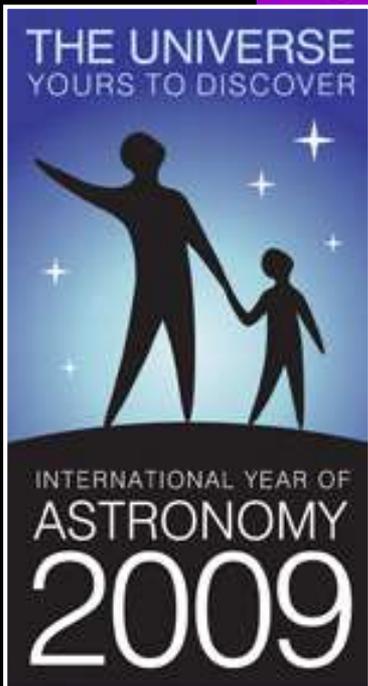
Patterns in Stars

“Reflections”

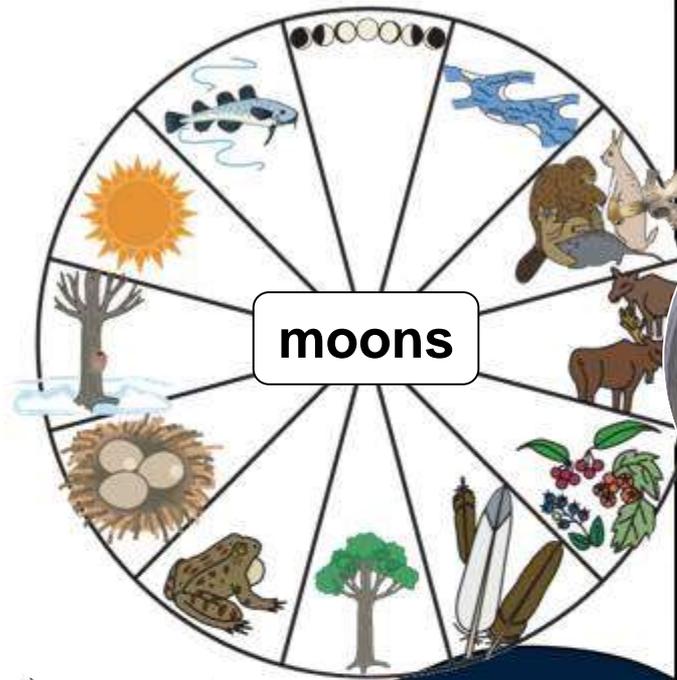
artist Gerald Gloade
Millbrook First Nation



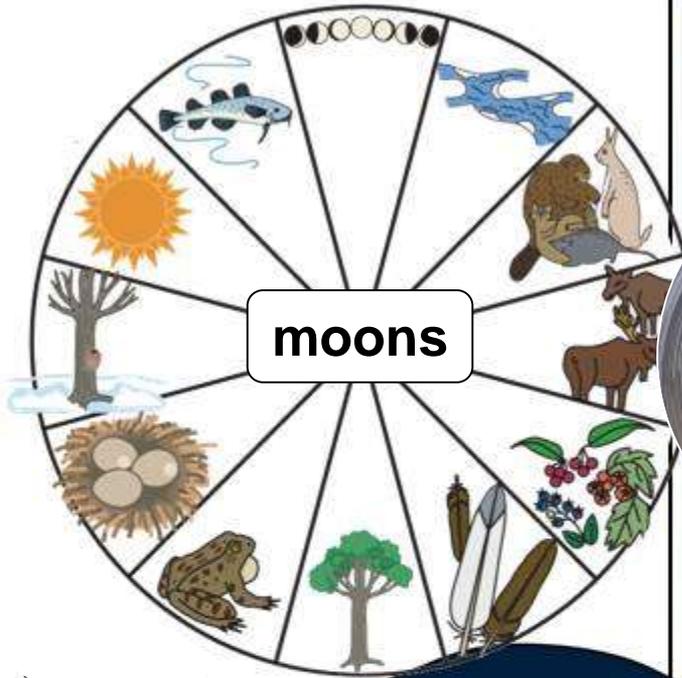
Patterns on Earth



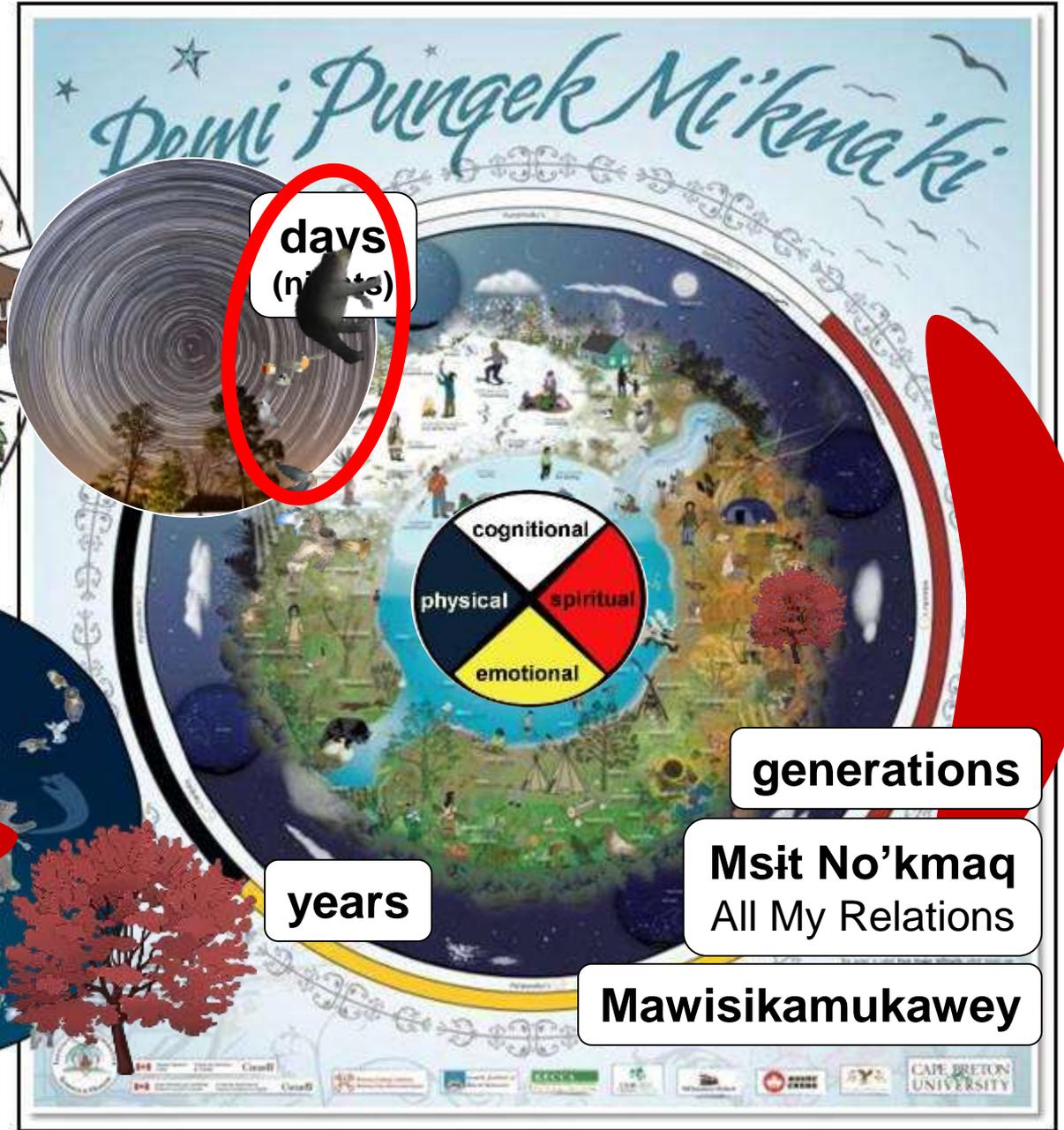
Mi'kmaq science stories: patterns woven within patterns



Mi'kmaq science stories: patterns woven within patterns



moons



days
(nights)

generations

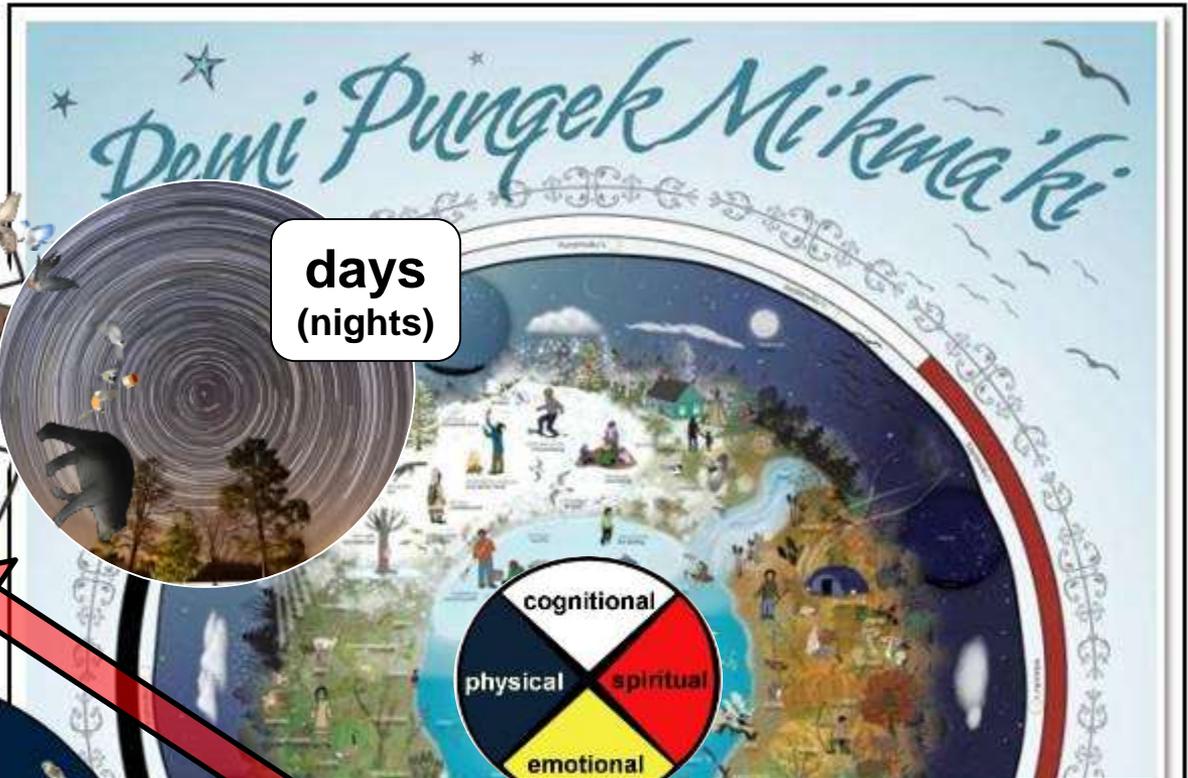
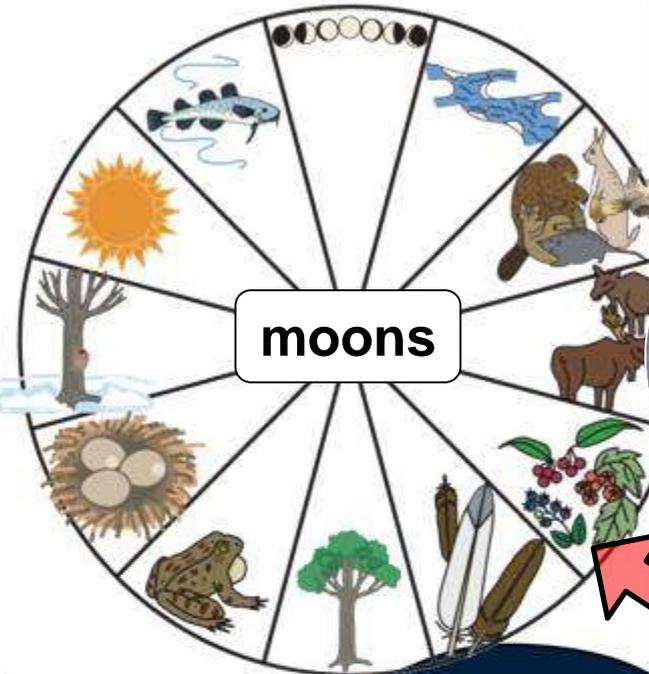
Msit No'kmaq
All My Relations

Mawisikamukawey

seasons

years

Mi'kmaq science stories: patterns woven within patterns



The Elders and the creative team knew this.

The natural pattern of the moons and the human-rendered pattern in this picture as 12 moons / yr ... **DO NOT MATCH 100%.**

This Mi'kmaq night sky story “works” in Mi'kma'ki.

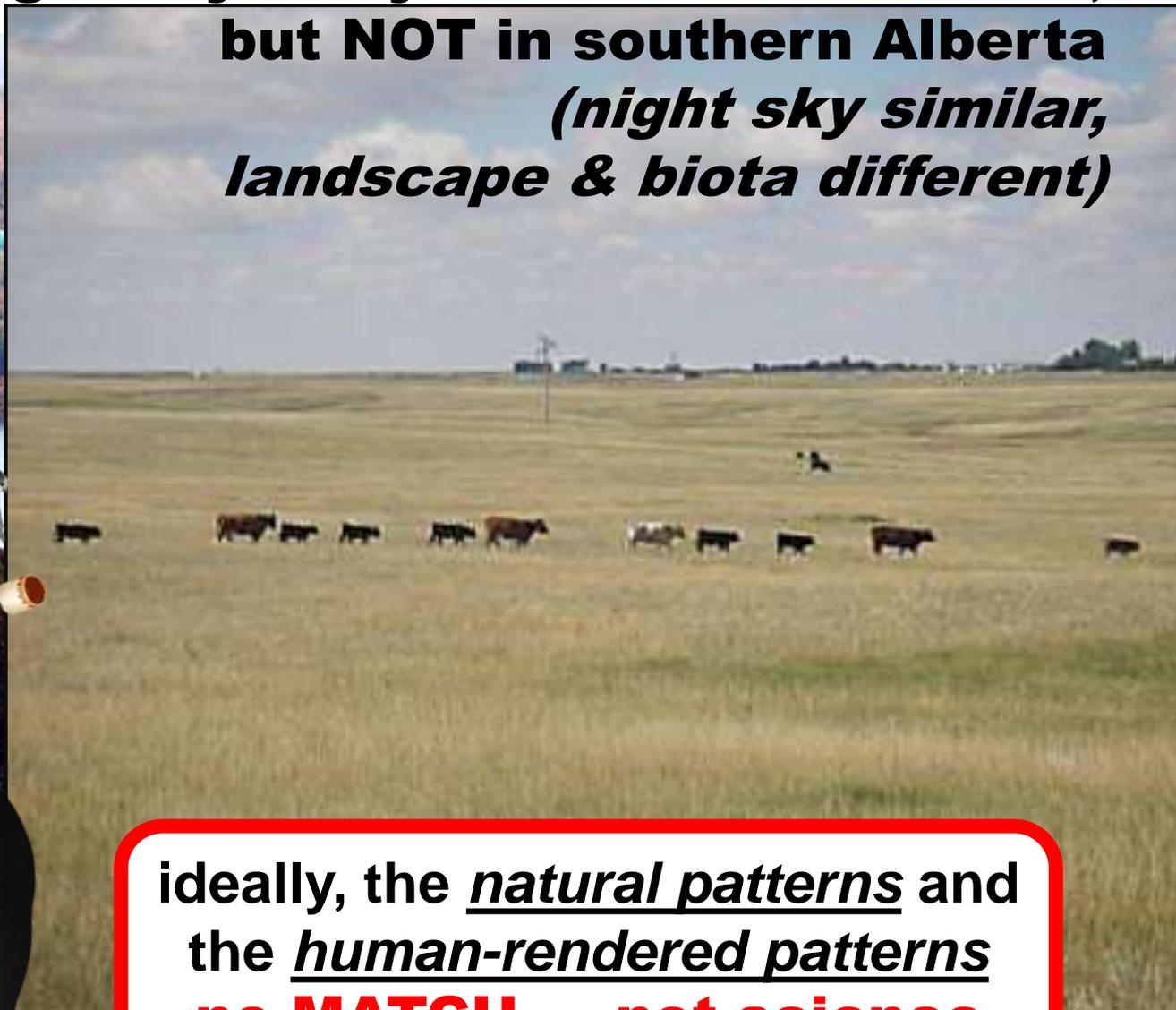
REMEMBER: Elder Murdena's “Sense of Place, Emergence, and Participation”



ideally, the natural patterns and
the human-rendered patterns
MATCH ... towards science

This Mi'kmaq night sky story “works” in Mi'kma'ki,

but NOT in southern Alberta
*(night sky similar,
landscape & biota different)*



ideally, the natural patterns and
the human-rendered patterns
no MATCH ... not science

Integrative Science academic program within 4 year degree Bachelor of Science Community Studies

outcomes



**Mi'kmaq
Language**

Integrative Science academic program

within 4 year degree Bachelor of Science Community Studies

What happened?

PROGRAM

1999-2005: program running well (though problems apparent)

11 students with NSERC-USRA awards



2006-2010: program collapsing → defunct

STUDENT INTAKE

1999-2008: 100-120

GRADUATES

2003-2010: 13 BScCS - Integrative Science

14 other science degree (took 1st year Int Sci or worked as RA)

15-20 arts degree graduates (took 1st year Int Sci)



**Most of these graduates are now working
in key positions in their communities.**

**Integrative Science academic program
within 4 year degree Bachelor of Science Community Studies**

Educational pathway?

**At different times, it probably was each
below and/or some combination.**

- a 4 year science program ... as per original vision
- a facilitated first year of university science
- a science bridge program for those lacking adequate high school science
- a couple of first year courses for BA students

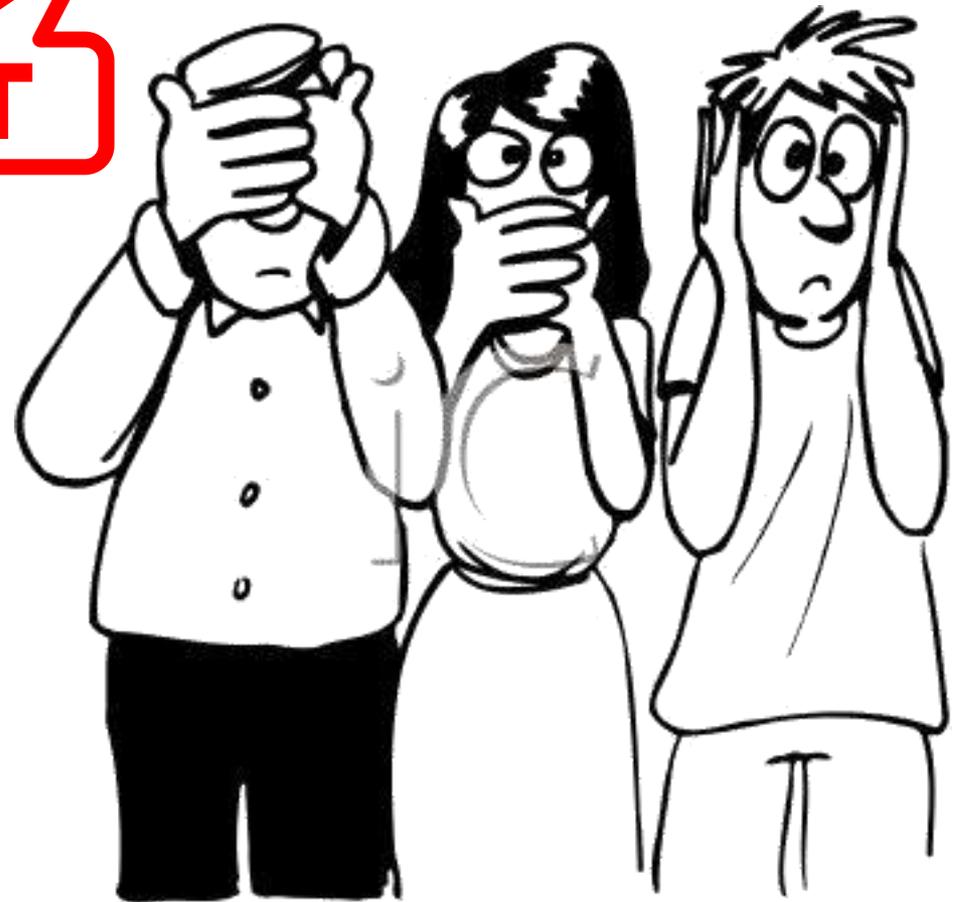
Integrative Science academic program

within 4 year degree Bachelor of Science Community Studies

**Questions not asked ...
something was working ... what?**

NOT

**THE
UNIVERSITY
SHOWED LITTLE
INTEREST
IN KNOWING.**



**Integrative Science academic program
within 4 year degree Bachelor of Science Community Studies**

(no) SURPRISE!!

By 2010, the program is dead.



Integrative Science academic program within 4 year degree Bachelor of Science Community Studies

**Why did this innovative
and apparently successful
program fall apart?**



Integrative Science academic program

within 4 year degree Bachelor of Science Community Studies

**THOUGH THE UNIVERSITY NEVER ASKED,
IT WAS BRAVE TO GO DOWN THIS EDUCATIONAL PATH
... and LOTS OF “LESSONS LEARNED” EMERGED**



** In my opinion:*

**“... the program met diverse challenges from the outset including inconsistencies and insufficiencies at the administrative, faculty, budgetary and recruitment levels”
... which, unaddressed, eventually became overwhelming.**

** from: “In my opinion” by C. Bartlett:
The gift of multiple perspectives in scholarship
(March 2012 issue of *University Affairs*)*

Integrative Science academic program within 4 year degree Bachelor of Science Community Studies

**e.g., HOW DID THE SKUNK GET INTO
THE GARDEN IN THE FIRST PLACE?**

... with the active support of an exceedingly insightful
and community-minded President, namely,
Dr. Jacquelyn Scott, OC.

The garden environment changed
dramatically after she resigned
as President in 2002.



**REMEMBER:
Integrative Science was
a grassroots initiative.**

This work is not easy; it requires ongoing commitment to Co-Learning, to relationships, and to reciprocities. “We need to find ways for our spirits to collaborate.”



**INTEGRATIVE
SCIENCE**
or its kin

TWO-EYED SEEING

WE, TOGETHER

This work is not easy; it requires ongoing commitment to Co-Learning, to relationships, and to reciprocities. “We need to find ways for our spirits to collaborate.”

requested artwork for words of Elder Albert Marshall



WE, TOGETHER

**Our hope is that with lots of seeds being planted ... Co-Learning will continue to grow with many people and in many places.
“We need to find ways for our spirits to collaborate.”**

requested artwork for words of Elder Albert Marshall



WE, TOGETHER

**we need
INCLUSIVE SCIENCE EDUCATION**

Elder Albert:

We need to re-learn our responsibilities to sustain the nurturing wholeness of *Mawisikamukaway* ... her ecological integrity. And we need to enact these responsibilities. We humans (*kinu*, all of us) have responsibilities. The other species, our eco-kin, have rights.



WE, TOGETHER

**we need
INCLUSIVE SCIENCE EDUCATION**

Elder Murdena:

We need science researchers, teachers, nurses, doctors, dentists, natural resource managers, science policy makers, etc. in and from our Indigenous communities ... our young people in these careers helping all of us (*kinu*) ... while knowing who they are and where they come from.



WE, TOGETHER

**we need
INCLUSIVE SCIENCE EDUCATION**

Professor Cheryl:

We could, I wish ... all of us (*kinu*) ... have science educational opportunities where we emphasize the natural world and our human responsibilities ... and we include diverse cultural understandings of this ... and we learn to take responsibility for our roles as storytellers in our knowledge systems.



WE, TOGETHER

Chi Migweech / Wela'lin / Thank you



Canada Research
Chairs

Chaires de recherche
du Canada



Social Sciences and Humanities
Research Council of Canada

Conseil de recherches en
sciences humaines du Canada



Elders, Colleagues,
CRC Team, Friends,
Students, Youth

CAPE BRETON
UNIVERSITY



Mi'kmaq College Institute
Mi'kmaq Espi Kina'matno'kuom



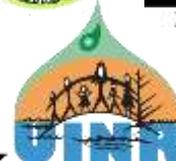
Canada Foundation
for Innovation
Fondation canadienne
pour l'innovation



Membertou
Elementary



NSERC
CRSNG



Mi'kmaq
Debert
CULTURAL CENTRE



Mermaid Theatre
of Nova Scotia



IWK Health Centre
Foundation

CIHR IRSC

Canadian Institutes of
Health Research
Instituts de recherche
en santé du Canada



Eskasoni First Nation Detachment
Royal Canadian
Mounted Police
Gendarmerie royale
du Canada

WE, TOGETHER

ABSTRACT: Change is occurring to the historical picture of science education in Canada wherein curricula and pedagogy have ignored the traditional knowledges and ways of knowing of the many and diverse indigenous peoples of Canada, the First Peoples, whose traditional territories collectively cover the country's vast landscape. Most of this change (even though often slow) is occurring at the K-6 levels, fueled by the determined efforts of indigenous educators and scholars and allies. But what about the higher grades and also the post-secondary educational (PSE) levels: could they, too, become more inclusive as to how science is viewed and taught? As one "yes" answer to this (often highly contentious) question, Dr. Bartlett's presentation will provide an overview of "Integrative Science", an initiative that originated in the 1990s as a globally unique, 4-year degree program at Cape Breton University in Sydney, NS, in the traditional territory of the Mi'kmaq Nation. Integrative Science functioned successfully for several years during which time it saw several Mi'kmaq students earn NSERC-USRA awards and also many Mi'kmaq students graduate, benefitted from the research program of a Tier 1 Canada Research Chair in Integrative Science (with SSHRC, CIHR, NSERC, and CFI funding), and received a national award of recognition from the Canadian Council on Learning. However, by 2010 Integrative Science had collapsed. Dr. Bartlett's presentation will address the questions of "why was/is an inclusive approach to science education, such as that represented by Integrative Science, of interest for PSE in Canada?" and "what challenges manifest in implementing and sustaining such?". She will additionally talk about "Two-Eyed Seeing" which was the guiding principle for Integrative Science, brought forward in the early years by Mi'kmaq Elder Albert Marshall. While Integrative Science was functioning but also subsequent to its demise and ongoing to this day, Two-Eyed Seeing was/has been grown and extensively promoted across Canada within co-learning work conducted by Elder Marshall, his wife Elder Murdena, and Dr. Bartlett. An overall result is that Two-Eyed Seeing has gained traction in many different places and projects, as well as at the national level. For example, it was formally adopted by CIHR-IAPH (Canadian Institute of Health Research – Institute of Aboriginal Peoples' Health) in 2011 for various competitive research funding programs and then embedded in IAPH's strategic plan for 2014-2018. Significantly and most recently, Two-Eyed Seeing and Integrative Science were highlighted (p. 99) in the report "Investing in Canada's Future - Strengthening the Foundations of Canadian Research" submitted to the Government of Canada by the expert panel that undertook "Canada's Fundamental Science Review 2017" (released publicly on 10 April 2017).