

Atlantic Canada Association of Science Educators (ACASE),  
Second Annual Conference and Workshops  
“Weaving Together the Many Threads of Science Education”  
St. Francis Xavier University, Antigonish, NS, 7-9 July 2005

# Diverse Conceptualizations of Nature’s Patterns: Science for the 21<sup>st</sup> Century

*For Conference Session Theme:*

***Where are science and science education headed?***

**Cheryl Bartlett, PhD**

**Canada Research Chair in Integrative Science**



## **Abstract: Diverse Conceptualizations of Nature's Patterns: Science for the 21<sup>st</sup> Century**

Nature's patterns are the fundamental focus of science; indeed, mathematics is often referred to as the "language of patterns" for mainstream science. Other cultures, however, may express their conceptualizations of nature's patterns in somewhat different ways. Is it possible for mainstream science, as well as science educators at various levels, to acknowledge this? This presentation will explore some of the considerations that a "yes" answer entails. It will draw upon the author's understandings as gleaned through participation in three science-based initiatives that involve a "learning journey of inclusion" of Aboriginal knowledge alongside Western science. The initiatives are in Cape Breton, Nova Scotia, and separate yet related; each is a collaborative effort involving Mi'kmaq First Nations and the mainstream (e.g. university researchers, non-native community, and/or government). The first, "Integrative Science" ([www.integrativescience.ca](http://www.integrativescience.ca)), is a unique undergraduate science program at Cape Breton University; its overall objective is to include Aboriginal knowledges in new university science curricula. The second, "Integrative Health and Healing", is an Aboriginal community-based, participatory action, health research project funded by CIHR-IAPH (Canadian Institutes of Health Research - Institute of Aboriginal Peoples' Health); its overall objective is to co-learn ways to help Mi'kmaq youth re-establish aspects of tribal consciousness wherein connectedness with the land contributes to an expanding sense of wholeness (and improved mental health). The third, "CEPI" (collaborative environmental planning initiative), is an effort by Mi'kmaq First Nations in conjunction with non-native others to create a management plan for the Bras d'Or Lakes ecosystem which is greatly valued by all peoples in Cape Breton. The presentation will also point to the "new commitment for science for the 21<sup>st</sup> Century" envisioned by the UNESCO and the 1999 World Conference on Science, and with this the need for mainstream science to become more aware of the world views of diverse others.

*Conference Session Theme:*

# Where are Science and Science Education Headed?

## Presentation Outline

- 3 different contexts for this question
- 1 particular context: Integrative Science
- 2 insights: pattern awareness & co-seeing
- how much "conceptual space shifting"?

*Conference Session Theme:*

# Where are Science and Science Education Headed?

3 different contexts

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- 1) cultures: different perspectives
- 2) 21<sup>st</sup> Century: new global commitment
- 3) creativity: innovation for prosperity

**The central dilemma of  
science education today  
is the teaching of science from  
only one cultural perspective ...**

(Gregory Cajete, PhD, Univ. of New Mexico)

1) cultures: different perspectives



1) cultures: different perspectives

We (scientists) can dialogue with other cultures re our knowledges about nature.

**The main challenge for science in the 21<sup>st</sup> Century is to enact a new commitment to society ... in which science is harnessed more effectively for the promotion of human well-being and sustainable development.**

(1999 UNESCO World Conference on Science)

**2) 21<sup>st</sup> Century: new global commitment**



2) 21<sup>st</sup> Century: new global commitment



We (scientists) can find more effective ways of communicating with society, re both educating and listening.



2) 21<sup>st</sup> Century: new global commitment

**A profound realization is that  
Canada's most significant natural  
resource is human creativity.**

**(Peter Hackett, CEO and President of Alberta Ingenuity)**

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**As a scientist, I want my imagination  
rekindled. I want to be shown how to  
look at things in new ways; I believe my  
capacity for innovation and creativity in  
my own discipline will grow as a result.**

**(Arthur J. Carty, National Science Advisor to PM)**

**(2000 Conference on Creativity in the Arts and Sciences)**

**3) creativity: innovation for prosperity**



We (scientists) can learn transformational consciousness towards thinking in new ways.

3) creativity: innovation for prosperity

“conceptual space shifting”  
... 3 very different generative contexts

**cultures:**  
different perspectives

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**21<sup>st</sup> Century:**  
new global commitment

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**creativity:**  
innovation for prosperity

**cultures:**  
*different perspectives*

**The central dilemma of  
science education today  
is the teaching of science from  
only one cultural perspective ...**

(Gregory Cajete, PhD, Univ. of New Mexico)

cultures:  
different perspectives

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# Integrative Science



Artist Basma Kavanagh

# Integrative Science

CAPE BRETON  
UNIVERSITY

Aboriginal

Western

“bringing knowledges together”



# How? Integrative Science



1



Mi'kmaq community Elders, resource people & organizations, TK events in community

2



TK literature

3



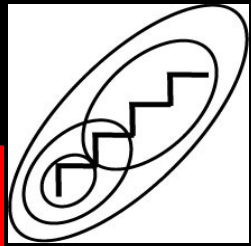
students out-of-doors

4

Aboriginal concepts & pedagogy

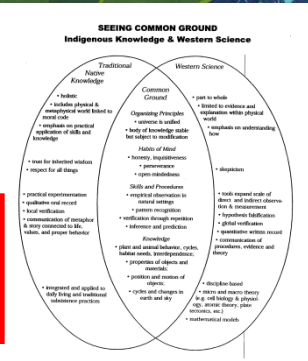


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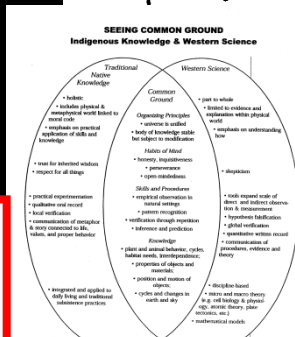
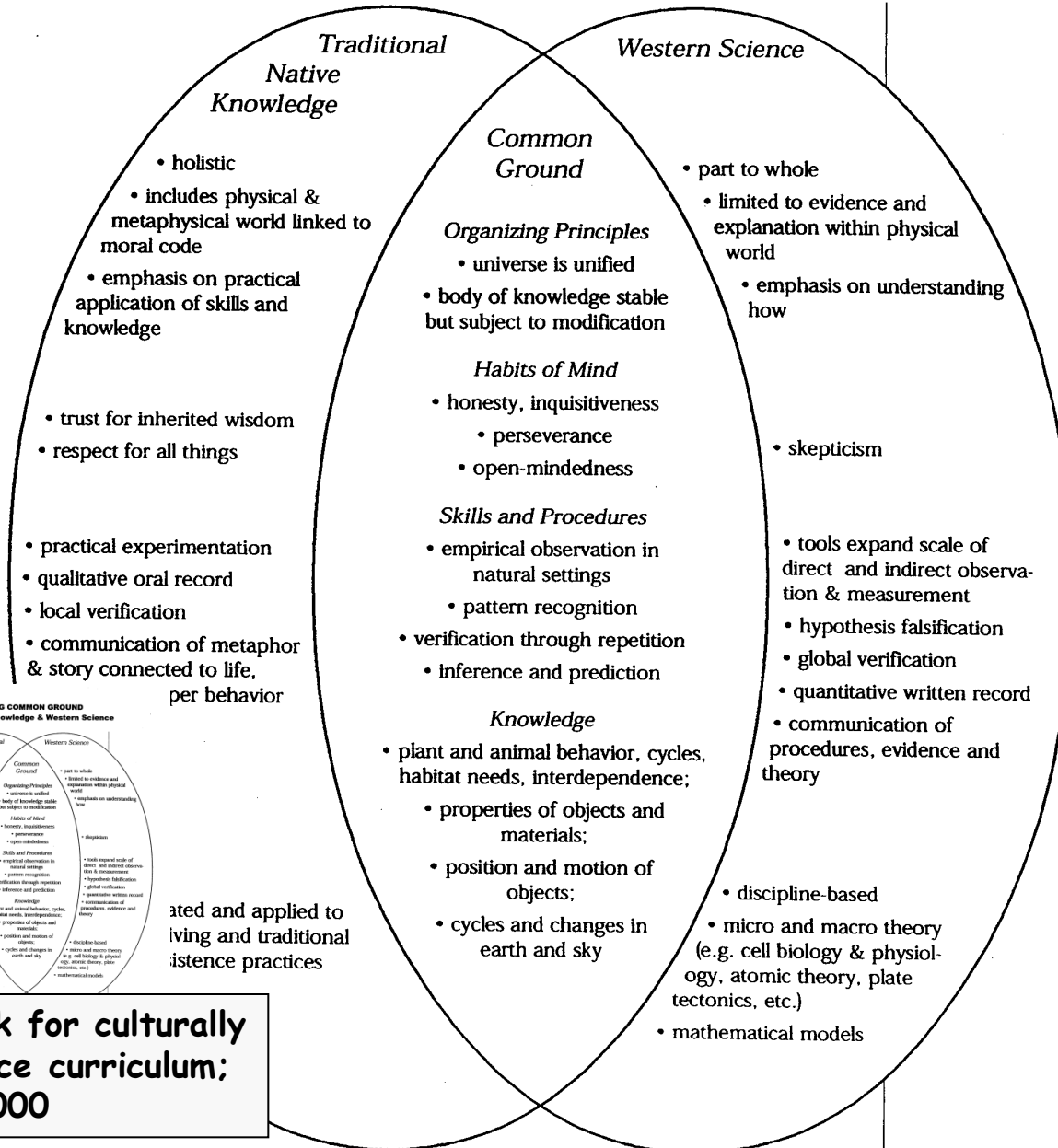
Western science: cosmology-physics-chemistry-geology-biology-consciousness

6



# SEEING COMMON GROUND

## Indigenous Knowledge & Western Science

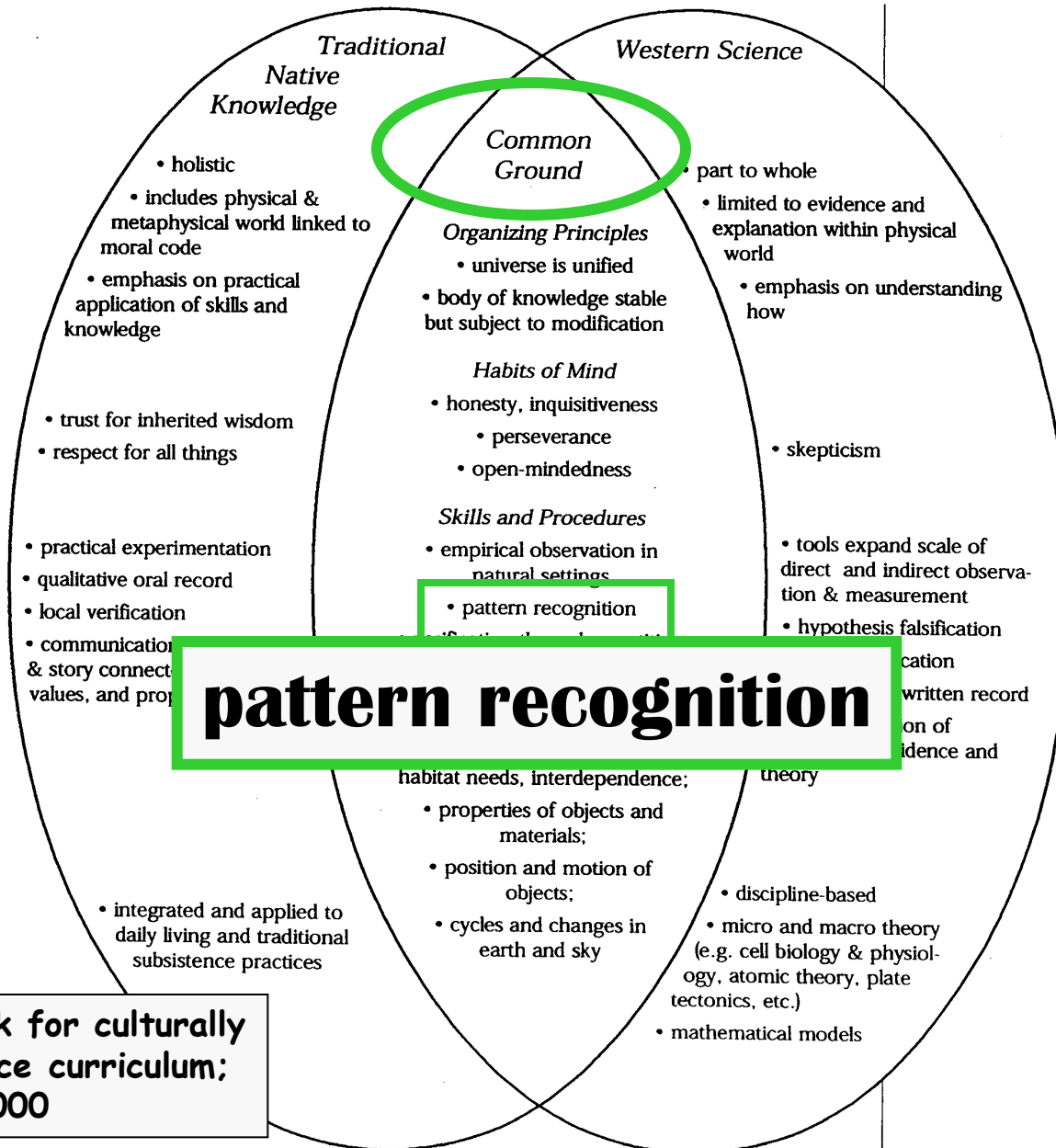


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from: Handbook for culturally responsive science curriculum;  
S. Stephens, 2000

# SEEING COMMON GROUND

## Indigenous Knowledge & Western Science



from: Handbook for culturally responsive science curriculum;  
S. Stephens, 2000

# We must make a shift in our conceptual space ...

(Peter Hackett, CEO and President of Alberta Ingenuity)

pattern recognition & pattern breaking

metaphoric thinking, empathetic thinking,  
imaging, abstracting, analogizing,  
body thinking, dimensional thinking,  
modeling, playing, transforming

**PATTERN**

# We must make a shift in our conceptual space ...

(Peter Hackett, CEO and President of Alberta Ingenuity)

## pattern smarts

metaphoric thinking, empathetic thinking,  
imaging, abstracting, analogizing,  
body thinking, dimensional thinking,  
modeling, playing, transforming

**PATTERN**

# CONCEPTUAL FRAMEWORK

natural

ideal

abstract

outer

inner

outer



recognize pattern

express pattern

# CONCEPTUAL FRAMEWORK

natural

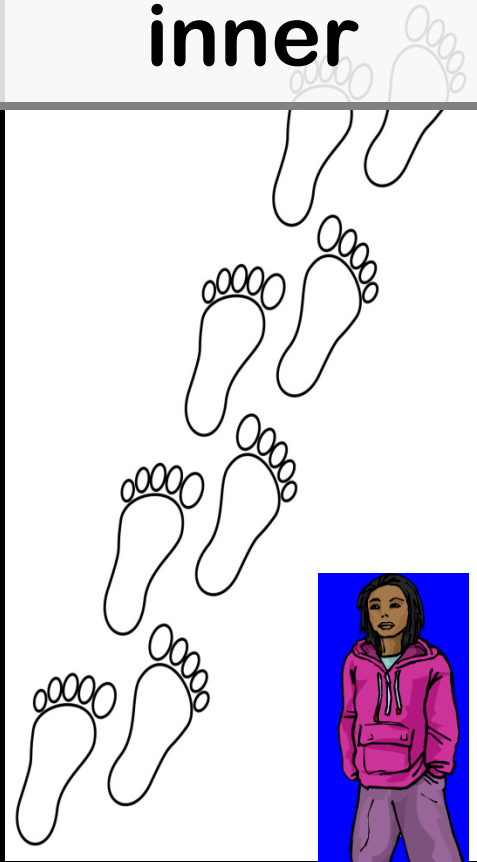
ideal

abstract

outer

inner

outer



observe

interpret

via expression

share

# pattern expression smarts

multiple intelligences theory

(H. Gardner, Harvard Univ.)

use ... tied to  
cultural value

- ◇ numbers (logical-mathematical)
- ◇ language (linguistic)
- ◇ music (musical)
- ◇ body (body-kinesthetic)
- ◇ spatial (spatial)
- ◇ other people (interpersonal)
- ◇ self (intrapersonal)
- ◇ naturalist (naturalist)

- 
- spiritual / existential



# pattern expression smarts

multiple intelligences theory

(H. Gardner, Harvard Univ.)

use ... tied to  
cultural value

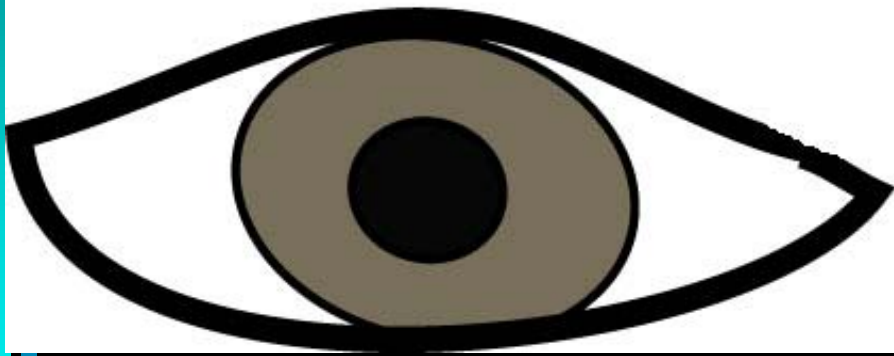
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"Western"

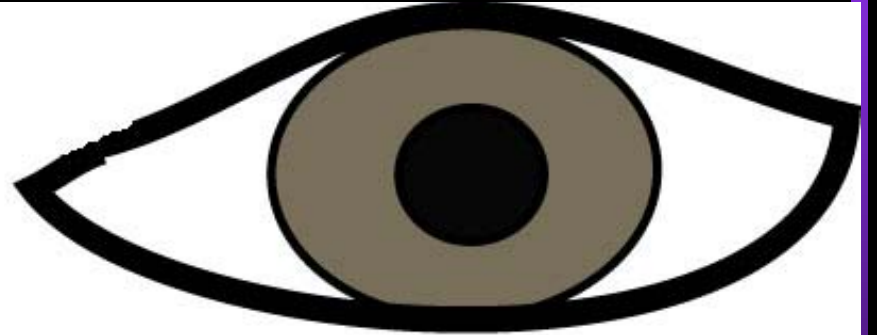
"Aboriginal"

- 
- spiritual / existential

“co-seeing”

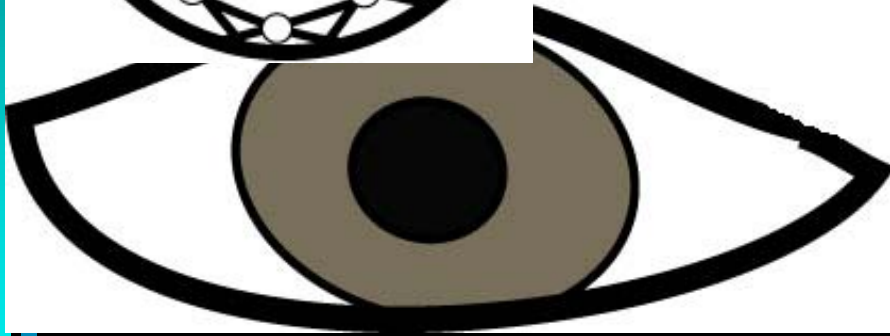
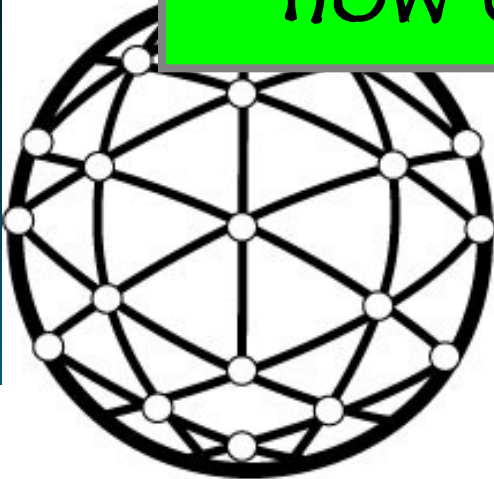


**TK**



**Science**

**“co-seeing”**  
how the world hangs together



**TK**

interconnected

**Science**

parts & wholes

“co-seeing”  
language & methodology

“vigour” & “rigour”



**TK**



**Science**

**WEAVING**

**UN-WEAVING**

# “co-seeing” overall knowledge objective



towards resonance  
of understanding



towards construction  
of understanding

**WEAVING**

**UN-WEAVING**



## WEAVING

- relationship
- respect
- reverence
- reciprocity
- ritual
- repetition
- responsibility

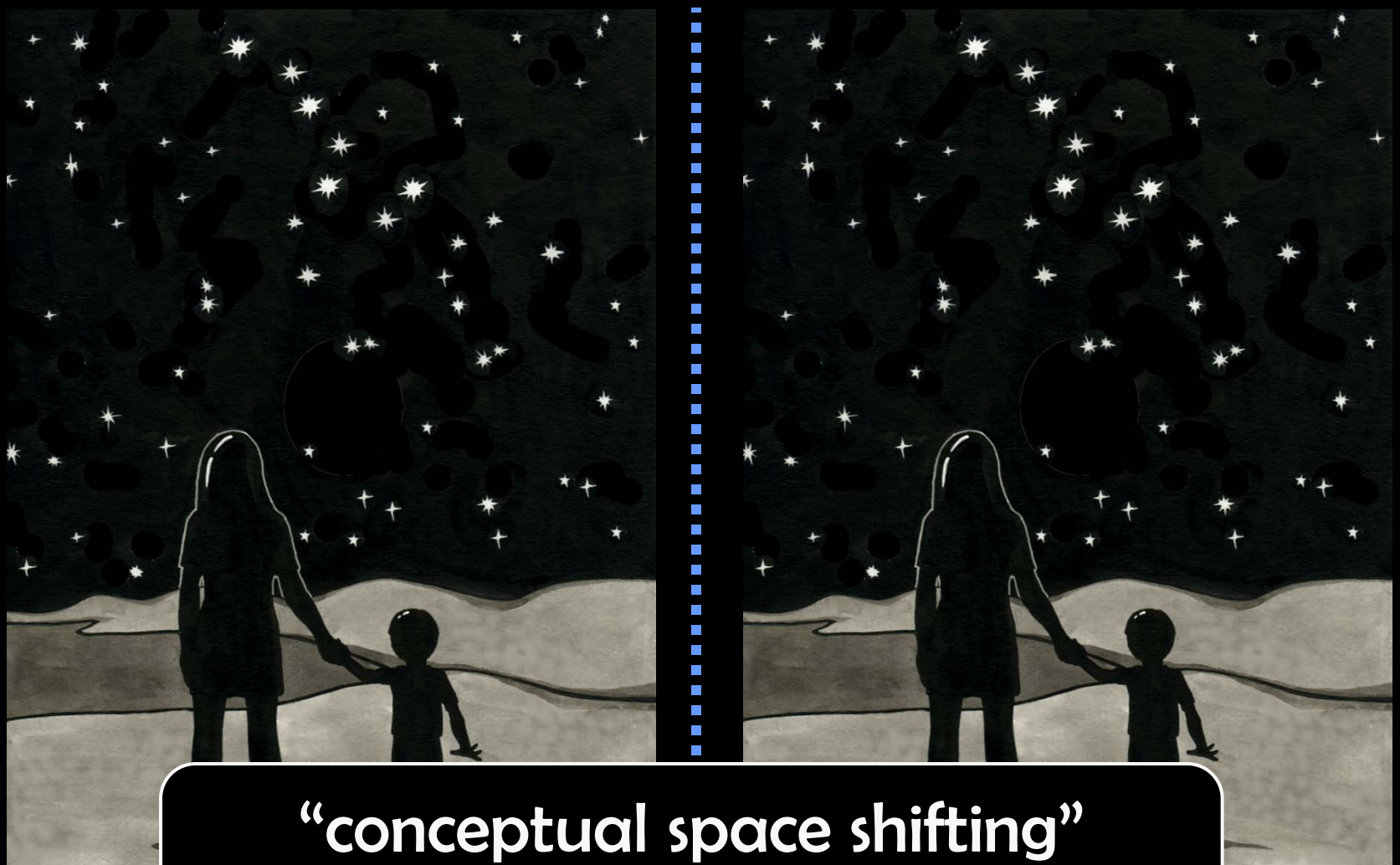


## UN-WEAVING

- data collection
- data analysis
- hypothesis  
(induction, deduction)
- testing
- theory

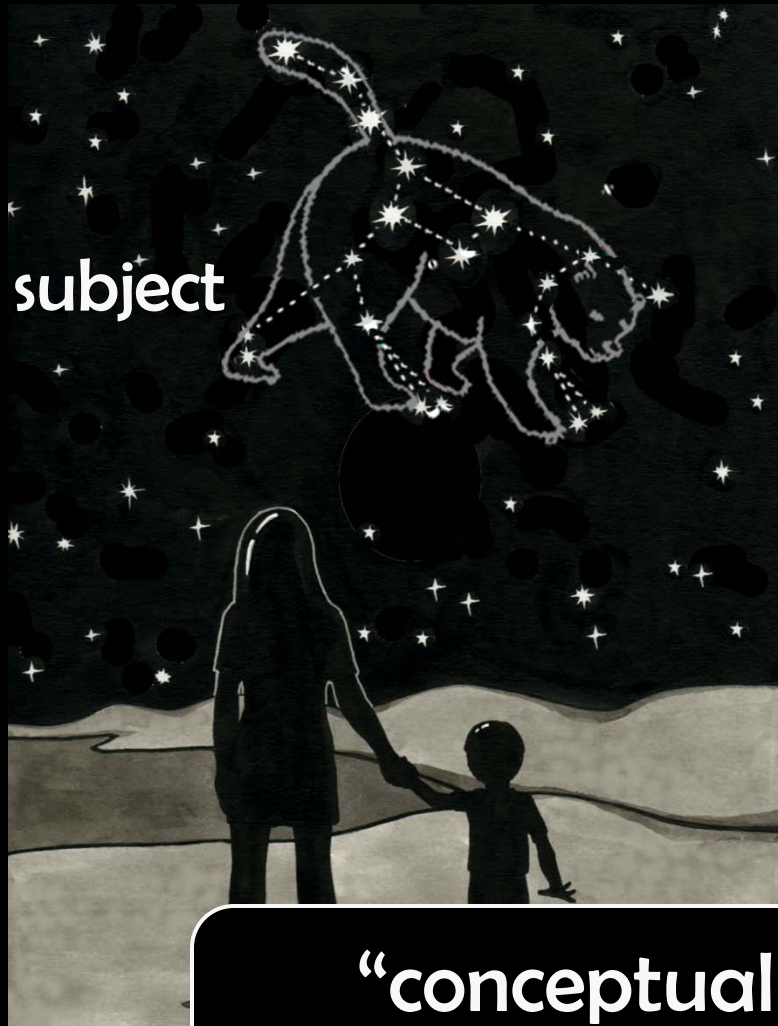
**“vigour language” & “rigour language”**

Artist Basma Kavanagh



“conceptual space shifting”  
transformational consciousness

Artist Basma Kavanagh



“conceptual space shifting”  
transformational consciousness



relationships: cosmos



image from:  
Mi'kmaq Family  
& Children's  
Services

relationships: human



image from:  
The Society of  
Obstetricians and  
Gynaecologists of  
Canada

**“conceptual space shifting”  
transformational consciousness**

pattern expression smarts

multiple intelligences ... tied to ... value

# SCIENCE ?

- ◇ numbers (logical-mathematical)
- ◇ language (linguistic)

metaphoric thinking, empathetic thinking,  
imaging, abstracting, analogizing,  
body thinking, dimensional thinking,  
modeling, playing, transforming

- ◇ self (intrapersonal)
- ◇ naturalist (naturalist)

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- ◇ spiritual / existential

FEAR

unknown



known



must become  
PATTERN-able

must learn co-seeing  
“conceptual space shifting”

Thank you

