

**SCIENCE: dynamic, pattern-based,  
knowledge stories ...**  
*pondering the nature of our sciences of nature*

## **OISE – University of Toronto**

7 November 2007; Research Seminar

**Cheryl Bartlett, PhD**

Canada Research Chair  
in Integrative Science

Professor of Biology



**CAPE BRETON  
UNIVERSITY**



Science

stories of our interactions with and within nature

Science

Science is  
dynamic,  
pattern-based  
knowledge.

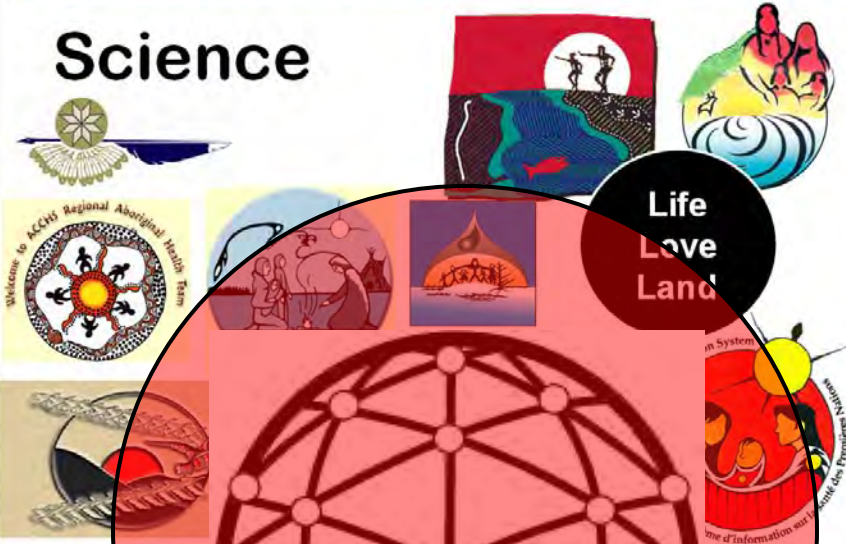
= PATTERN-BASED  
STORIES



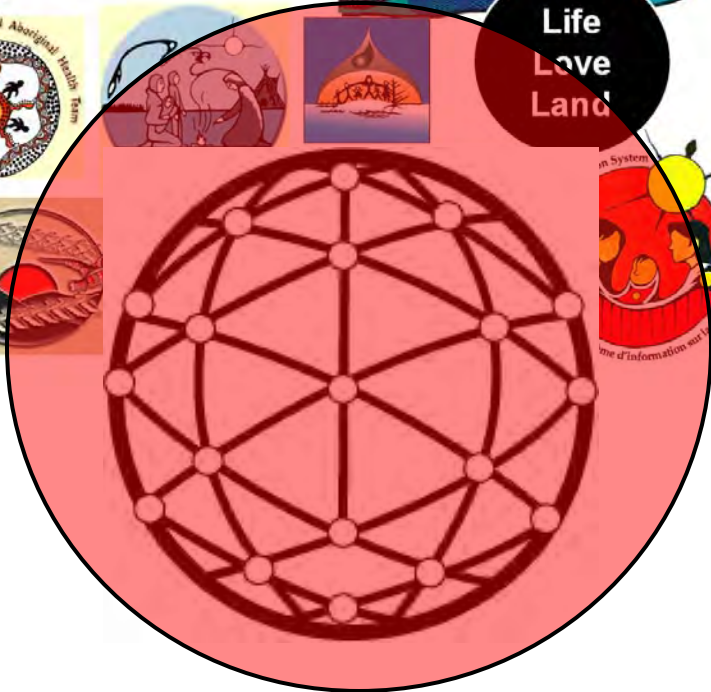


stories of our interactions with and within nature

# Science

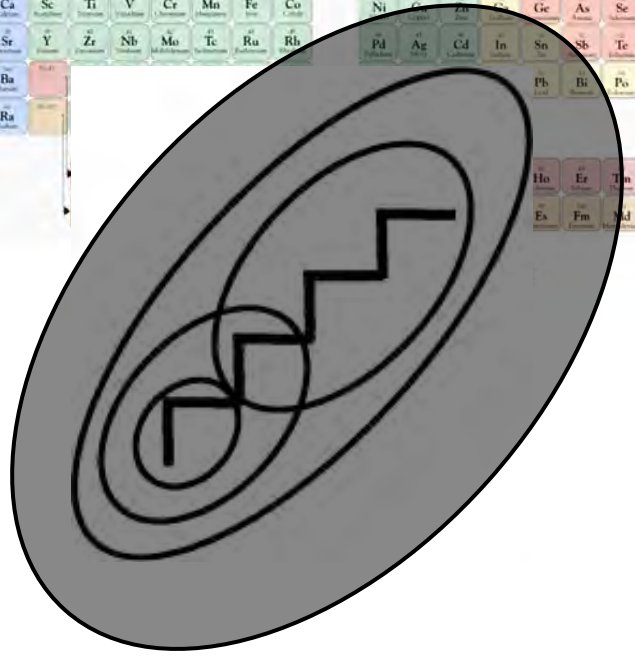


Life  
Love  
Land



stories of our interactions with and within nature

# Science

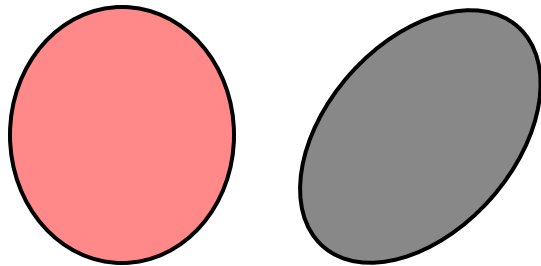




# stories of our interactions with and within nature

## Science

**Science is  
dynamic,  
pattern-based  
knowledge.**



### **PATTERNS ...**

- spirits within ecosystem-wide minds
- ideas in brain-based minds



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 Foundation for Innovation / Fondation canadienne pour l'innovation

CAPE BRETON UNIVERSITY



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

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



IWK Health Centre Foundation

IAPH

ATLANTIC ABORIGINAL Health Research Program

Mi'kmaq Elders

NOVA SCOTIA Health Research FOUNDATION

SABLE OFFSHORE ENERGY INCORPORATED

UNAMA'KI INSTITUTE OF NATURAL RESOURCES

KECCA Knowledge: Education and Cultural Consultant Associates

NSERC CRSNG

Mi'kmawey Debert

Eskasoni Detachment Royal Canadian Mounted Police / Gendarmerie royale du Canada



# Co-Learning Journey

together

This visual is based on the Medicine Wheel (or Circle of Learning) which is a commonly used Aboriginal teaching tool. The visual shows that within the discussion, all have a role to play. Each person has an opportunity to speak, to share, to teach, and to learn.

6

Each participant gains some new understandings of Mother Earth and her lessons for humans about health, healing and wholeness based on sharing, listening, and discussing.



**10+ years: where our Co-Learning Journey has been and still is ...**

## **Integrative Science**

**bringing together Indigenous and Western scientific knowledges and ways of knowing**

**Indigenous**

**Western**



# Why?

**The central dilemma of science education today is the teaching of science from only one cultural perspective, and in an incomplete and non-connected manner.**

Gregory Cajete, PhD, scientist & educator, Univ. of New Mexico

Indigenous

Western



**... to Co-Learn, we  
must “WALK” our  
“know, do, value”**

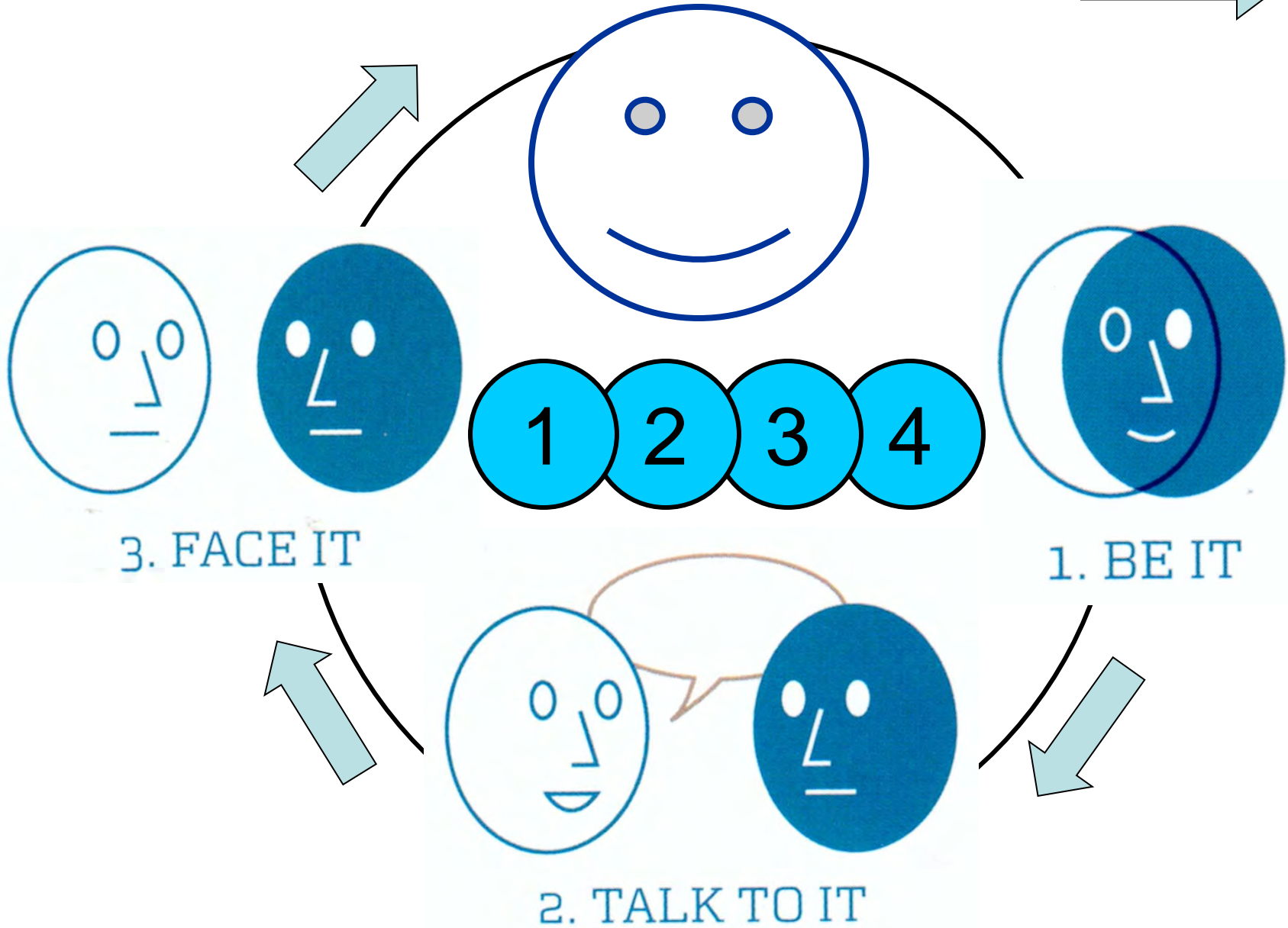
**= an insight ...  
coming via  
extension  
of understandings  
from discussions  
about healing  
language**

We must become able to put the “**know, do, value**” aspects of our worldviews in front of us ... like an object ... and then we must develop the abilities to walk around them ... to acknowledge them, take ownership of them, understand them, and put them beside those of another worldview ... to see our mutual strengths and to begin working together in a reciprocally respectful manner.





4. "KNOW, VALUE, and DO" IT ... SHARE IT ... and GROW IT



# “Two-Eyed Seeing”

learning to see with the strengths of each & together



Indigenous



Western



Mr. Albert Marshall, Mi'kmaq Elder  
Eskasoni First Nation

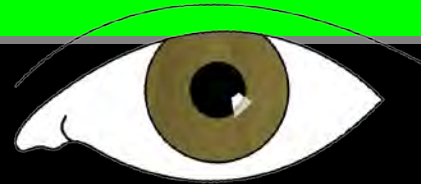
1

# Two-Eyed Seeing

our key concepts & actions



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



- hypothesis  
(making & testing)
- data collection
- data analysis
- model & theory  
construction



2

# Two-Eyed Seeing our language & methodology



vigour

**WEAVING**



rigour

**UN-WEAVING**

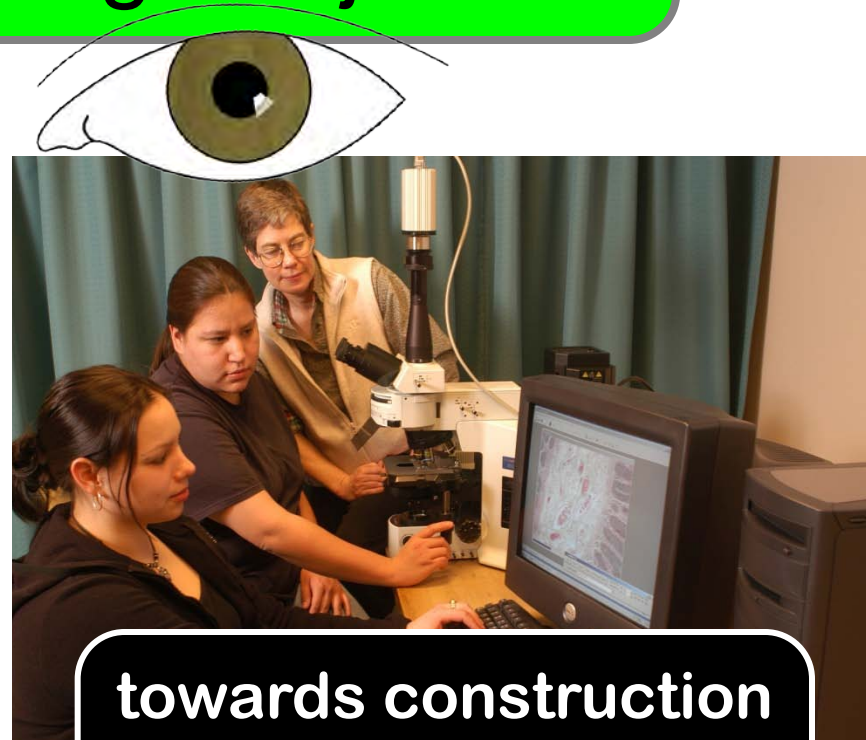
3

# Two-Eyed Seeing

our overall knowledge objective



towards resonance  
of understanding  
within environment

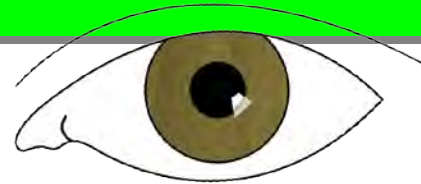
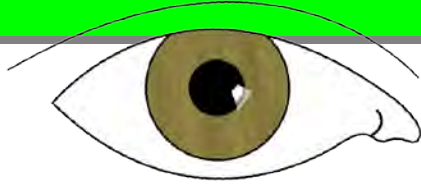


towards construction  
of understanding  
of environment

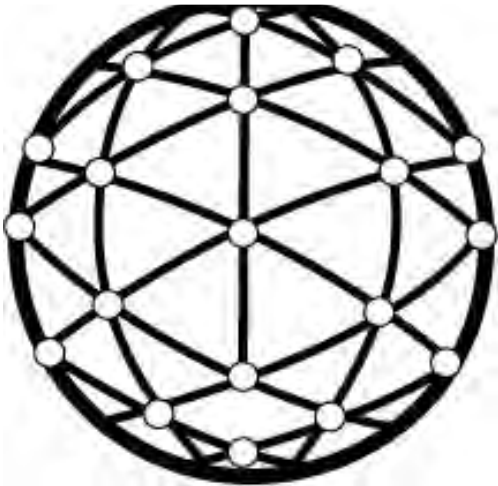
4

# Two-Eyed Seeing

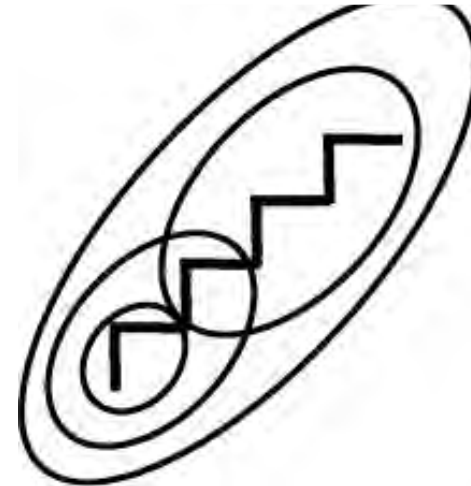
how our world is



**interconnective**



**parts & wholes**





# Integrative Science



Artist Basma Kavanagh

# Integrative Science

## SCIENCE

education, research, applications,  
youth and community outreach

Indigenous

our sciences  
our stories

Western

“bringing our knowledges together”

our worldviews



# 4 yr Science Degree Program

## Bachelor of Science Community Studies

Degree Profile for:  
**Toqwa'tu'kl Kijjitaqnn /**  
**Integrative Science**



1) core

18

CREDITS: 48

Science: PCS (3 core)

Topics: perspectives\*  
& skills\*

2) concentration

42

CREDITS: 42

Science: university &  
applied (tech)

3) electives

30

CREDITS: 30

Science: all, some, none

4) work placements

max. 105

CREDITS: 0

min. 60  
(18+42)

Science: experience

### Degree Core (48 credits)

- 1) \_\_\_\_\_ PCS 100: Analysis and Decision Making (6 credits)
- 2) \_\_\_\_\_ PCS 200: Applied Research (6 credits)
- 3) \_\_\_\_\_ PCS 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

### Science Area of Concentration (42 credits)

- a) University (8 courses)
  - 1) 3 credits: MSIT 101
  - 2) 3 credits: MSIT 103
  - 3) 3 credits: MSIT 201
- b) Technology (6 courses)
  - 1 + 2) 6 credits: Chem 121 + 122
  - 3 + 4) 6 credits: Math 131 + 132, or Phys 100, or Phys 111 + 112
  - 5) 6 credits (at least 3 credits must be at 300 level):
    - Geol 111
    - Biol at 200 level or higher
    - any ENR

### Student's Electives (30 credits)

- 1) 3 credits: \_\_\_\_\_
- 6) 3 credits: \_\_\_\_\_

### 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.



# 4 yr Science Degree Program

## Bachelor of Science Community Studies

Degree Profile for:  
**Toqwa'tu'kl Kjjitaqnn /  
Integrative Science**

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



### Degree Core (48 credits)

- 1) \_\_\_\_\_ PCS 100: Analysis and Decision Making (6 credits)
- 2) \_\_\_\_\_ PCS 200: Applied Research (6 credits)
- 3) \_\_\_\_\_ PCS 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 equivalent  
\_\_\_\_\_ or equivalent  
\_\_\_\_\_ 05, or equivalent  
\_\_\_\_\_ 207, or equivalent  
\_\_\_\_\_ L1, Buss 181, or equivalent  
\_\_\_\_\_ psych 201, or equivalent

2) concentration

### Science Area of Concentration (12 credits)

- a) **University** (8 courses)
  - 1) 3 credits: MSIT 101
  - 2) 3 credits: MSIT 103
  - 3) 3 credits: MSIT 201
  - 4) 3 credits: MSIT 203
  - 5) 3 credits: MSIT 301
  - 6) 3 credits: MSIT 303
  - 7) 3 credits: MSIT 401
  - 8) 3 credits: MSIT 401
- b) **Technology** (6 courses)
  - 1 + 2) 6 credits: Chem 121 + 122
  - 3 + 4) 6 credits: Math 101 + 102, 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

### Student's Electives (10 credits)

- |                     |                      |
|---------------------|----------------------|
| 1) 3 credits: _____ | 6) 3 credits: _____  |
| 2) 3 credits: _____ | 7) 3 credits: _____  |
| 3) 3 credits: _____ | 8) 3 credits: _____  |
| 4) 3 credits: _____ | 9) 3 credits: _____  |
| 5) 3 credits: _____ | 10) 3 credits: _____ |

### 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.**



**CREDITS: 24**  
**Science**

**MSIT**  
**courses**  
(core)  
**24 credits**

# Bachelor of Science Community Studies

## Degree Profile for: Toqwa'tu'kl Kijjitaqnn / Integrative Science

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



### Degree Core (48 credits)

- 1) \_\_\_\_\_ PCS 100: Analysis and Decision Making (6 credits)
- 2) \_\_\_\_\_ PCS 200: Applied Research (6 credits)
- 3) \_\_\_\_\_ PCS 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) \_\_\_\_\_ effective writing (6 credits): Engl 100, Engl 205 + Engl 207, or equivalent
- 10) \_\_\_\_\_ computer literacy (3 credits): Phil 115, Comp 102 or 111, Buss 181, or equivalent
- 11) \_\_\_\_\_ statistics (3 credits): Math 135, Math 335, Buss 182, Psych 201, or equivalent

### Science Area of Concentration (42 credits)

- |   |   |
|---|---|
| <p>a) <u>University</u> (8 courses)</p> <ol style="list-style-type: none"><li>1) 3 credits: MSIT 101</li><li>2) 3 credits: MSIT 103</li><li>3) 3 credits: MSIT 201</li><li>4) 3 credits: MSIT 203</li><li>5) 3 credits: MSIT 301</li><li>6) 3 credits: MSIT 303</li><li>7) 3 credits: MSIT 401</li><li>8) 3 credits: MSIT 401</li></ol> | <p>b) <u>Technology</u> (6 courses)</p> <p>1 + 2) 6 credits: Chem 121 + 122</p> <p>3 + 4) 6 credits: Math 131 + 132, or<br/>Phys 100, or Phys 111 + 112</p> <p>5 + 6) 6 credits (at least 3 credits must be at 300 level):<br/>- Geol 111<br/>- any PubH at 200 level or higher<br/>- any Envi at 200 level or higher</p> |
|---|---|

### Student's Electives (30 credits)

- |                     |                      |
|---------------------|----------------------|
| 1) 3 credits: _____ | 6) 3 credits: _____  |
| 2) 3 credits: _____ | 7) 3 credits: _____  |
| 3) 3 credits: _____ | 8) 3 credits: _____  |
| 4) 3 credits: _____ | 9) 3 credits: _____  |
| 5) 3 credits: _____ | 10) 3 credits: _____ |

### 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.**



# Science

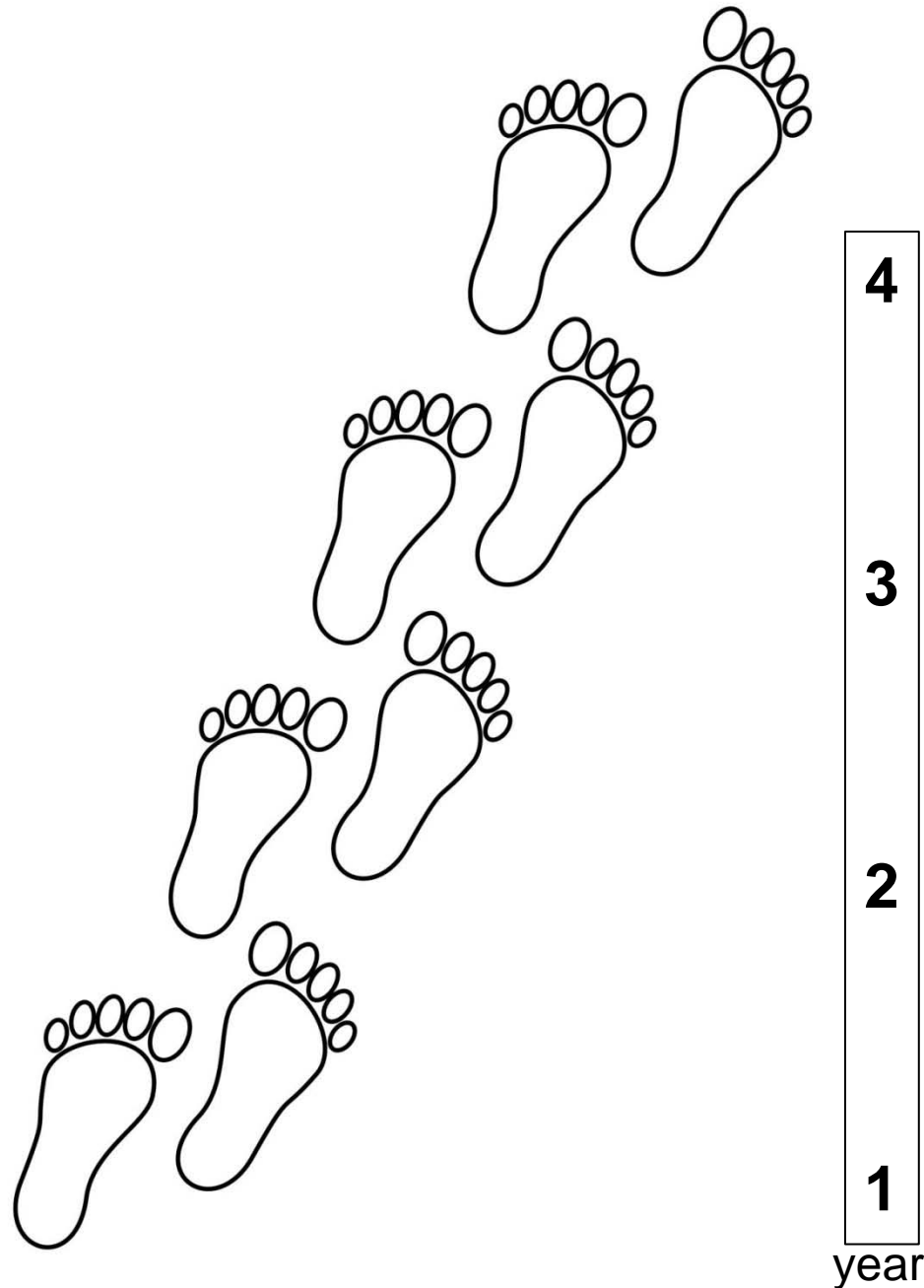
## PATTERN

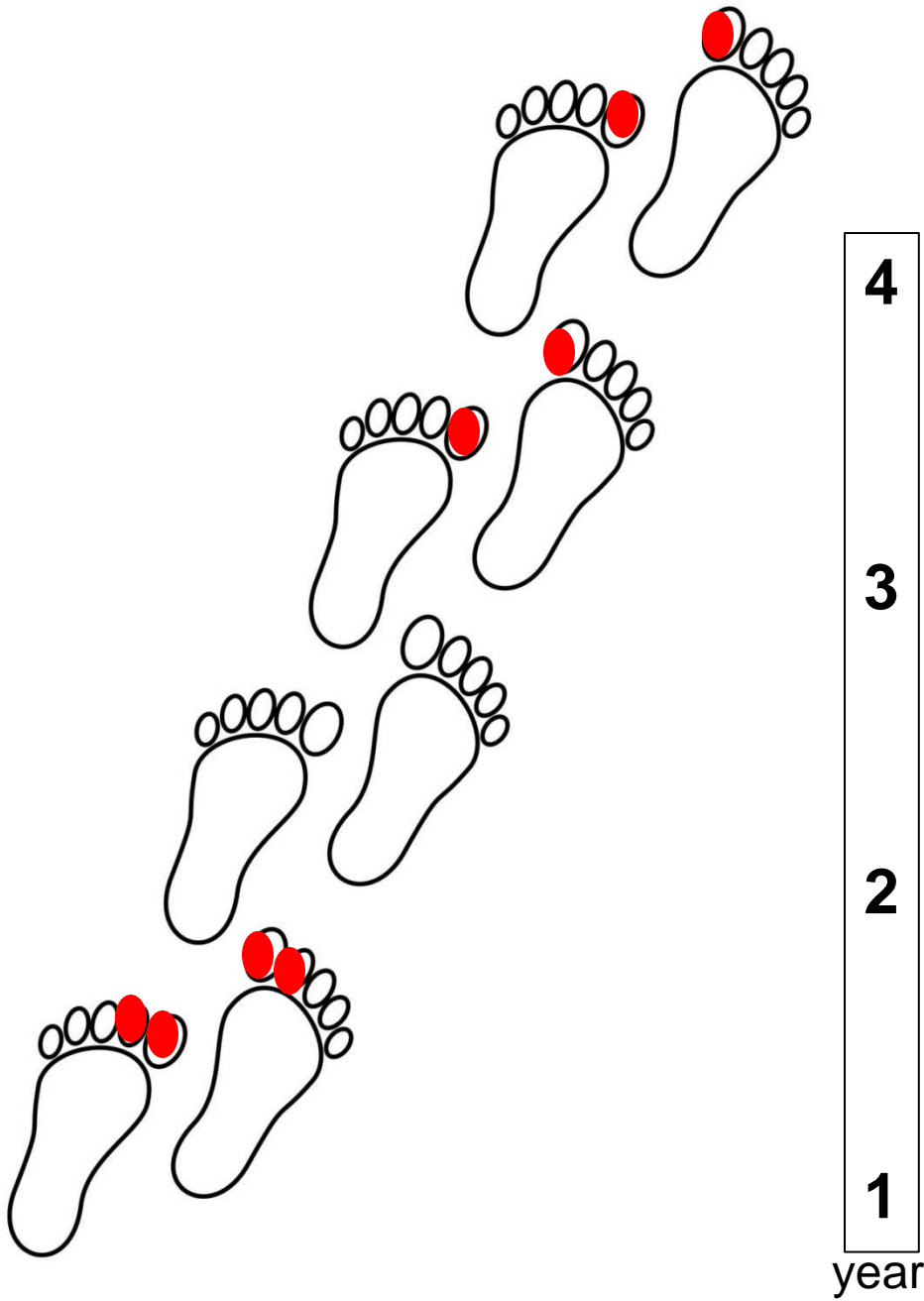
## conceptual space shifting

# Science

**PATTERN**

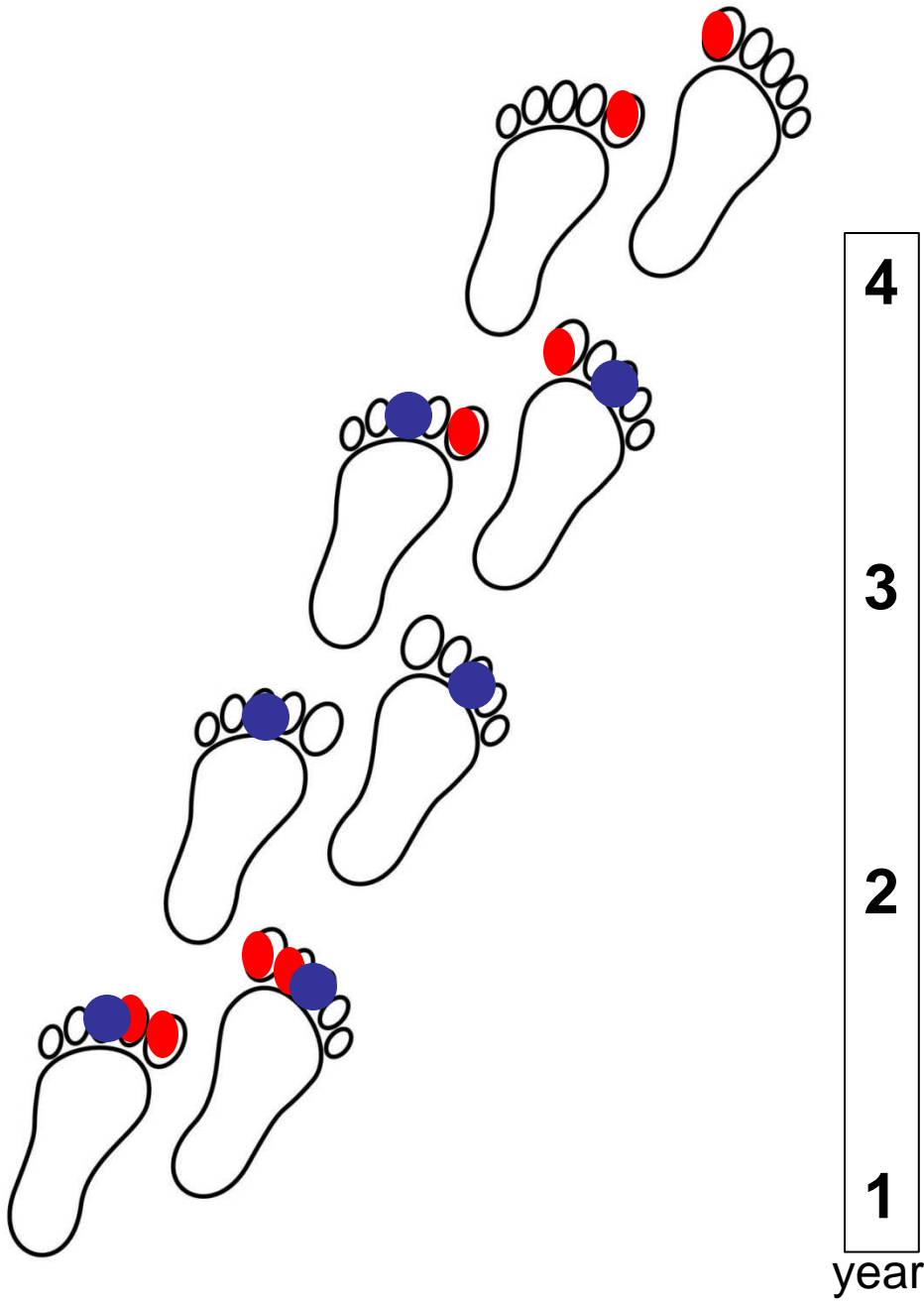
**conceptual  
space  
shifting**





**MST**  
**science**  
**courses**





**MST+T  
science  
courses**

**PCS  
courses**

How: **MSIT?**

education

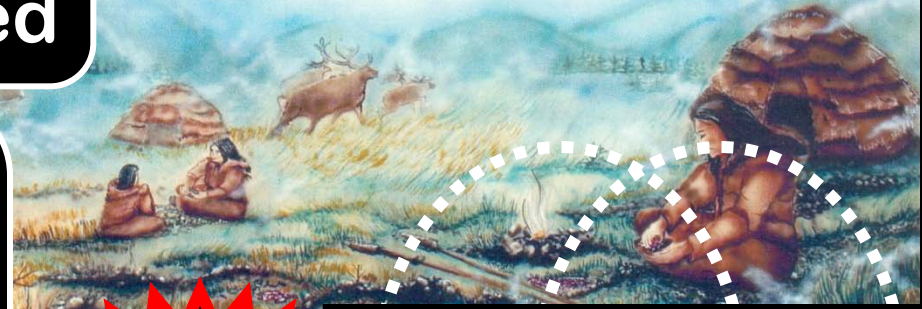
lived | book-based

emphasis

change  
wholeness | parts  
balance

spirituality

central | absent



**challenges!**

today's students  
exceedingly familiar with  
entertainment technology,  
but not with nature



Blondie



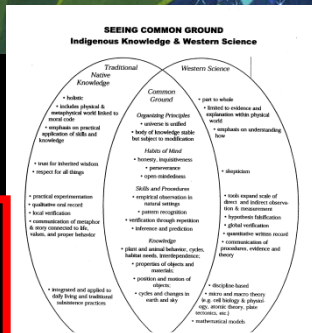
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www.blondie.com



# How?

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1



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



2

TK literature



3

students out-of-doors

Aboriginal concepts & pedagogy

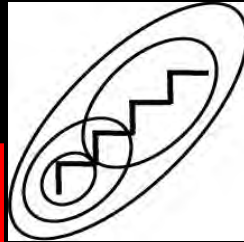
4



6

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

5





# common ground

Both Indigenous and Western scientific knowledges are based on observations of the natural world.



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# PATTERN RECOGNITION

common ground

Both Indigenous and Western scientific knowledges result from the same intellectual process of creating order out of disorder.

order

= **PATTERN-BASED STORIES**



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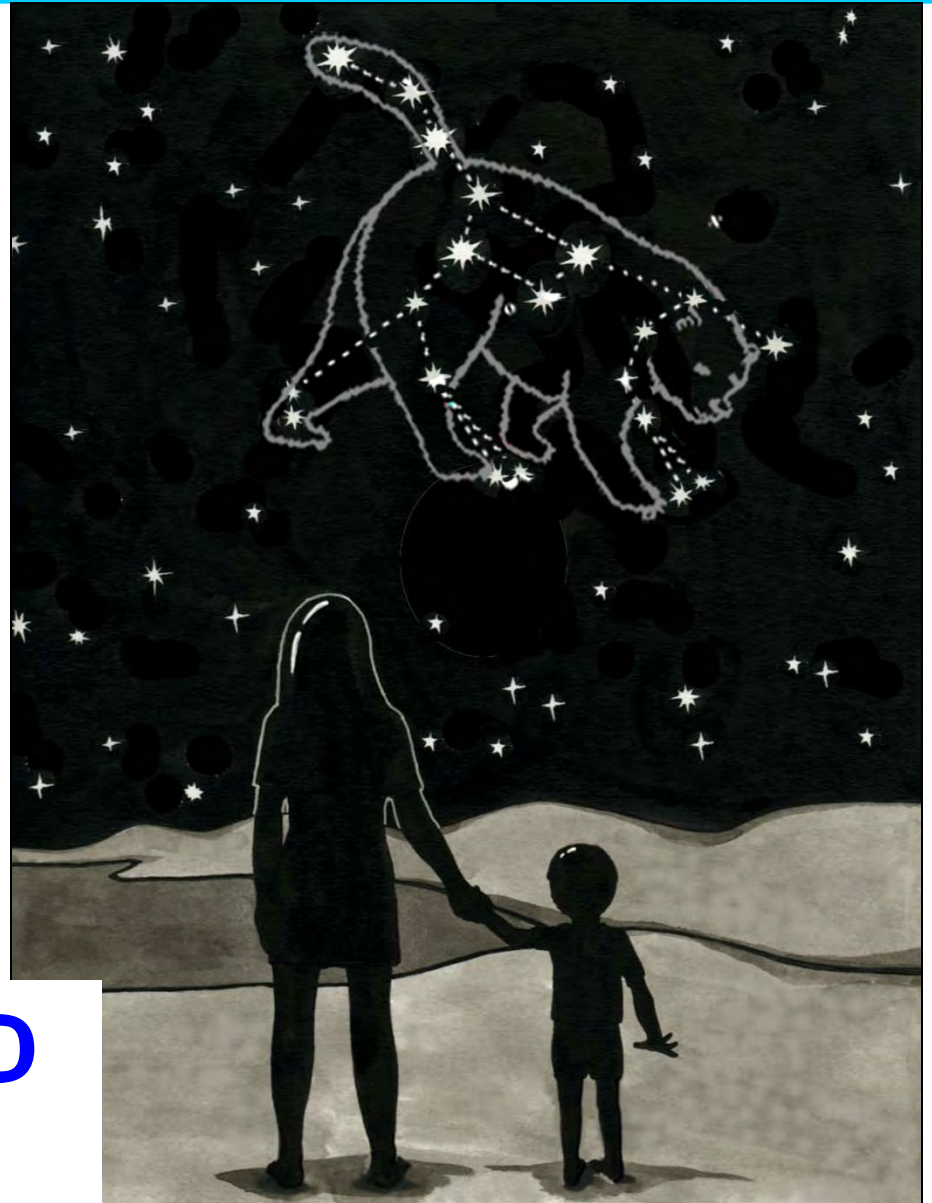


# stories of our interactions with and within nature

## Science

**Science is  
dynamic,  
pattern-based  
knowledge.**

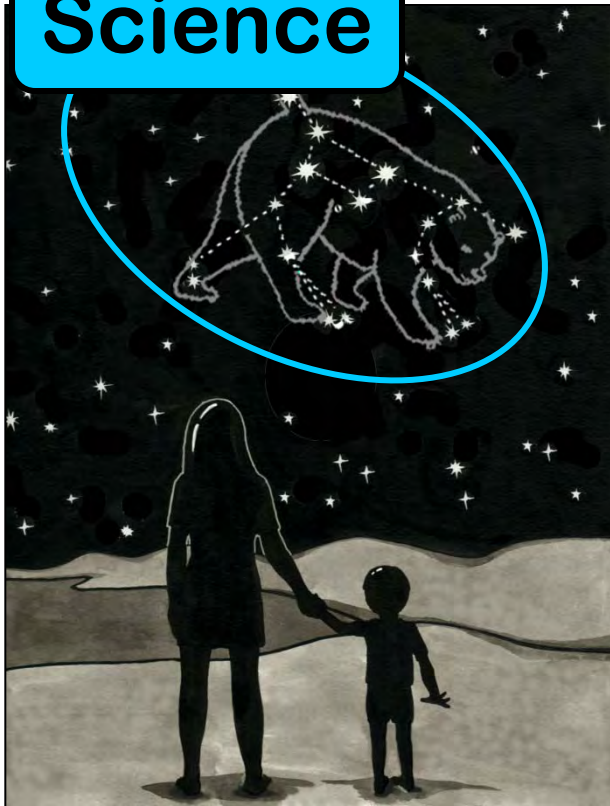
**= PATTERN-BASED  
STORIES**



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# stories of our interactions with and within nature

## Science



## PATTERN

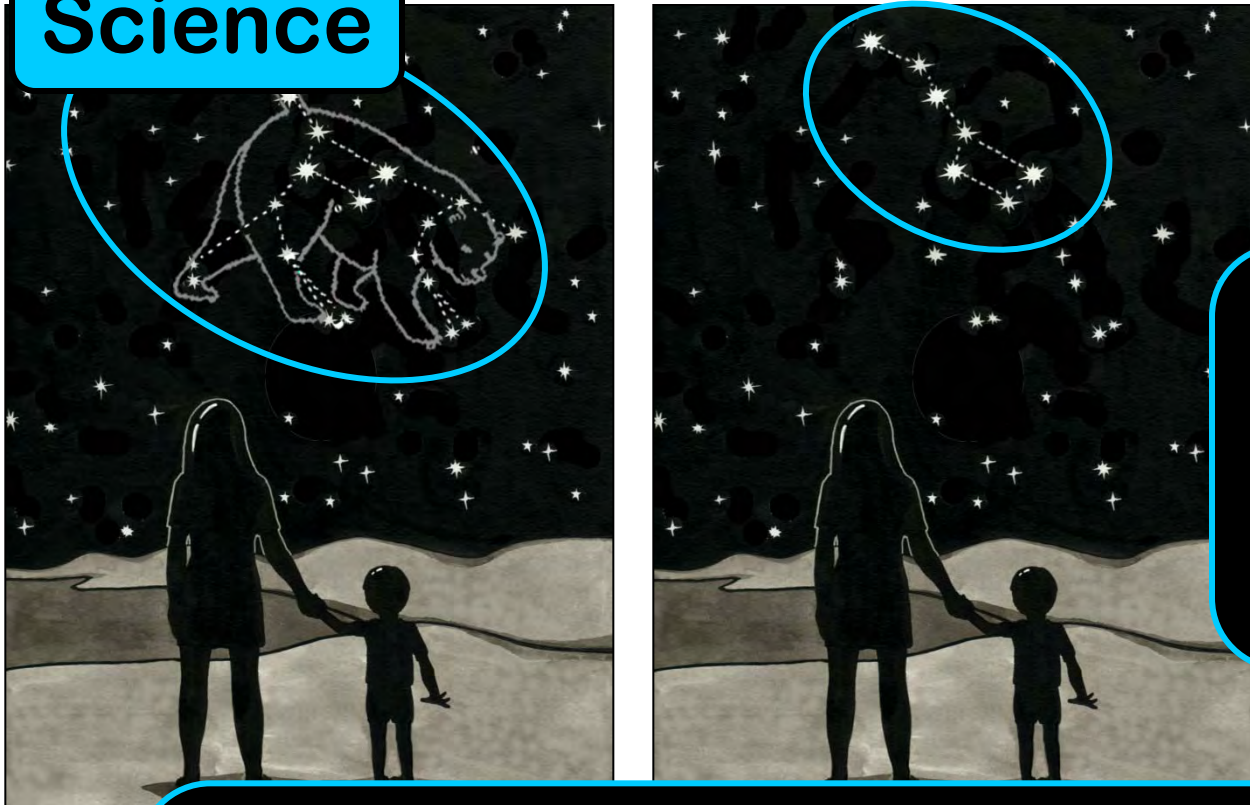
- recognition
- transformation
- expression

- various **pattern smarts**
- various ways to connect the dots
  - variety in our stories



# stories of our interactions with and within nature

## Science



the patterns  
that we see  
within nature  
reflect our ...

**SANCTIONED  
PERSPECTIVES & INTELLIGENCES:**  
who we are; where we are; where we were;  
what we know, do and value

# “pattern smarts”

multiple intelligences theory

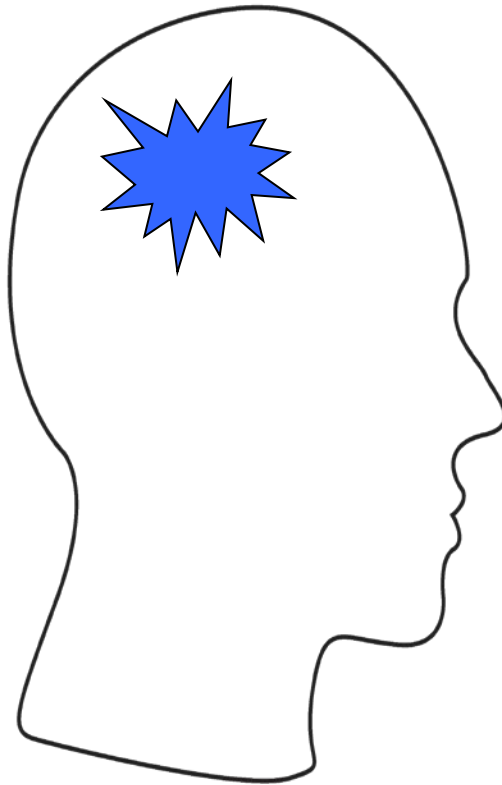
(H. Gardner, Harvard Univ.)

sanctioned  
world view or methodology

KNOW

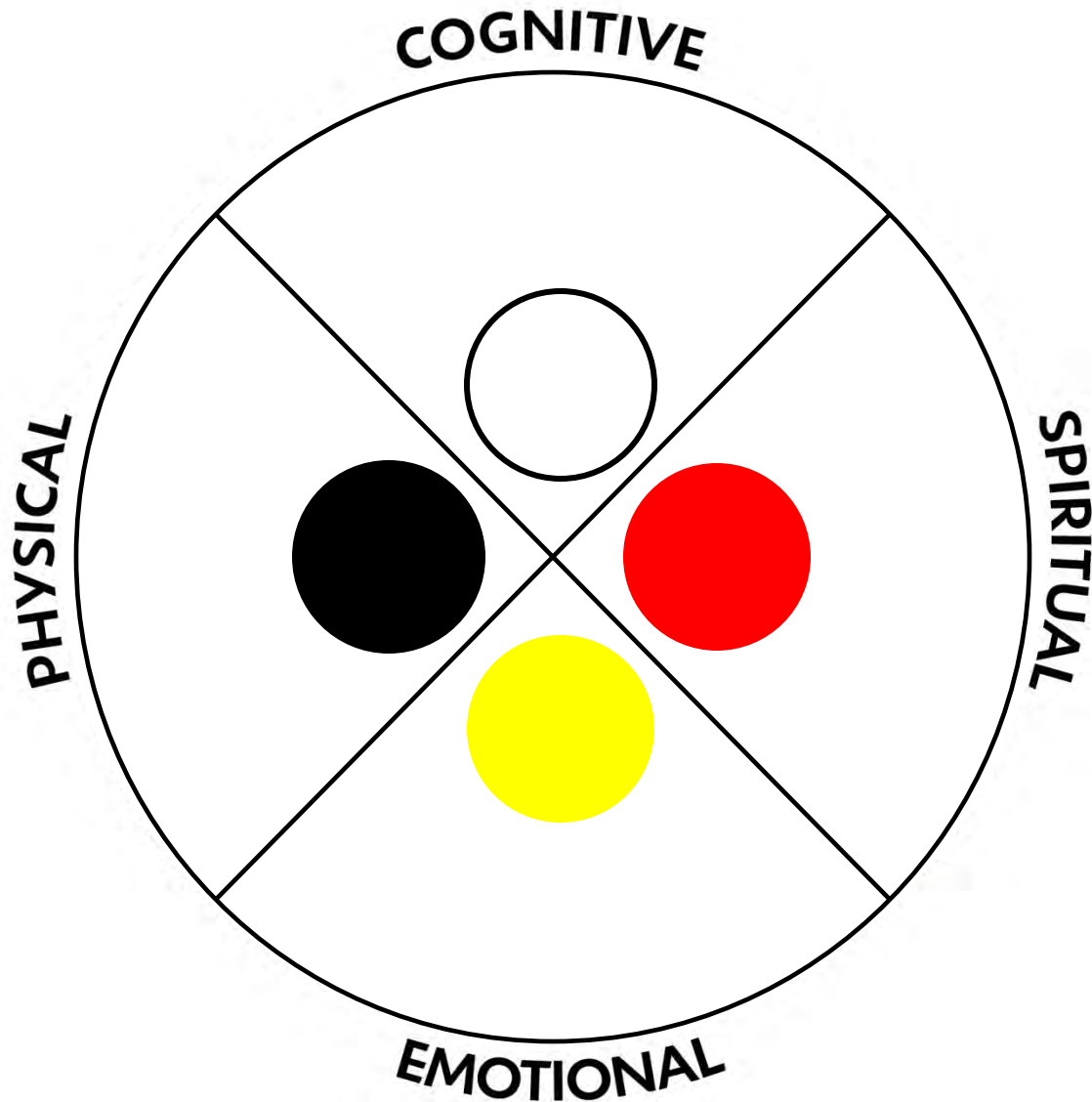
VALUE

DO



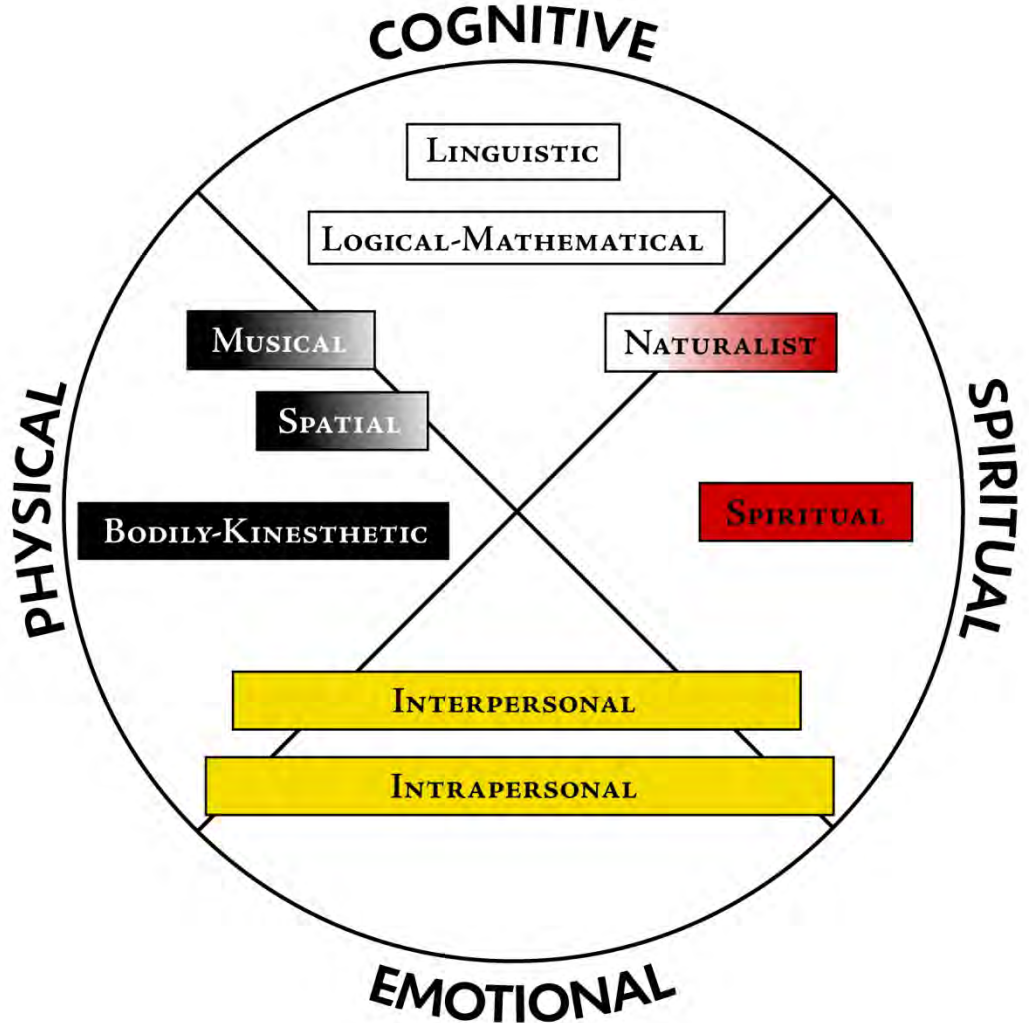
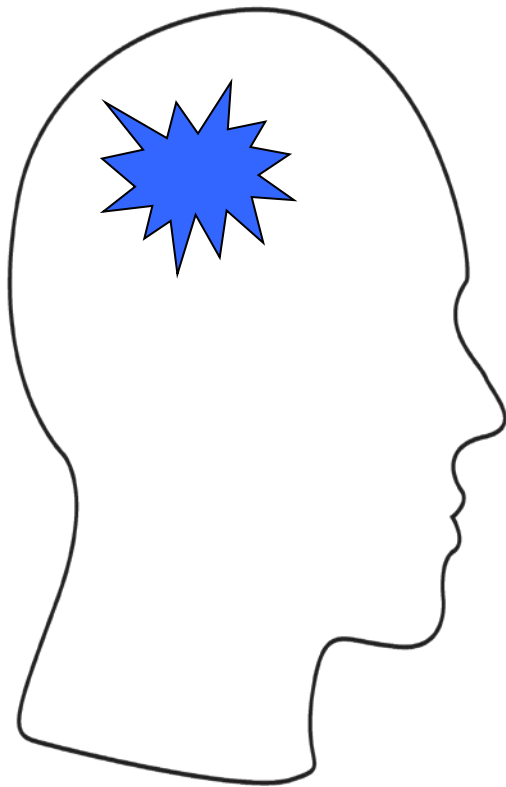
- ◇ numbers (logical-mathematical)
- ◇ language (linguistic)
- ◇ music (musical)
- ◇ body (body-kinesthetic)
- ◇ spatial (spatial)
- ◇ other people (interpersonal)
- ◇ self (intrapersonal)
- ◇ naturalist (naturalist)
- ◇ spiritual / existential \*

# Circle Teachings: lived relationships



# “pattern smarts”

## Circle Teachings: lived relationships

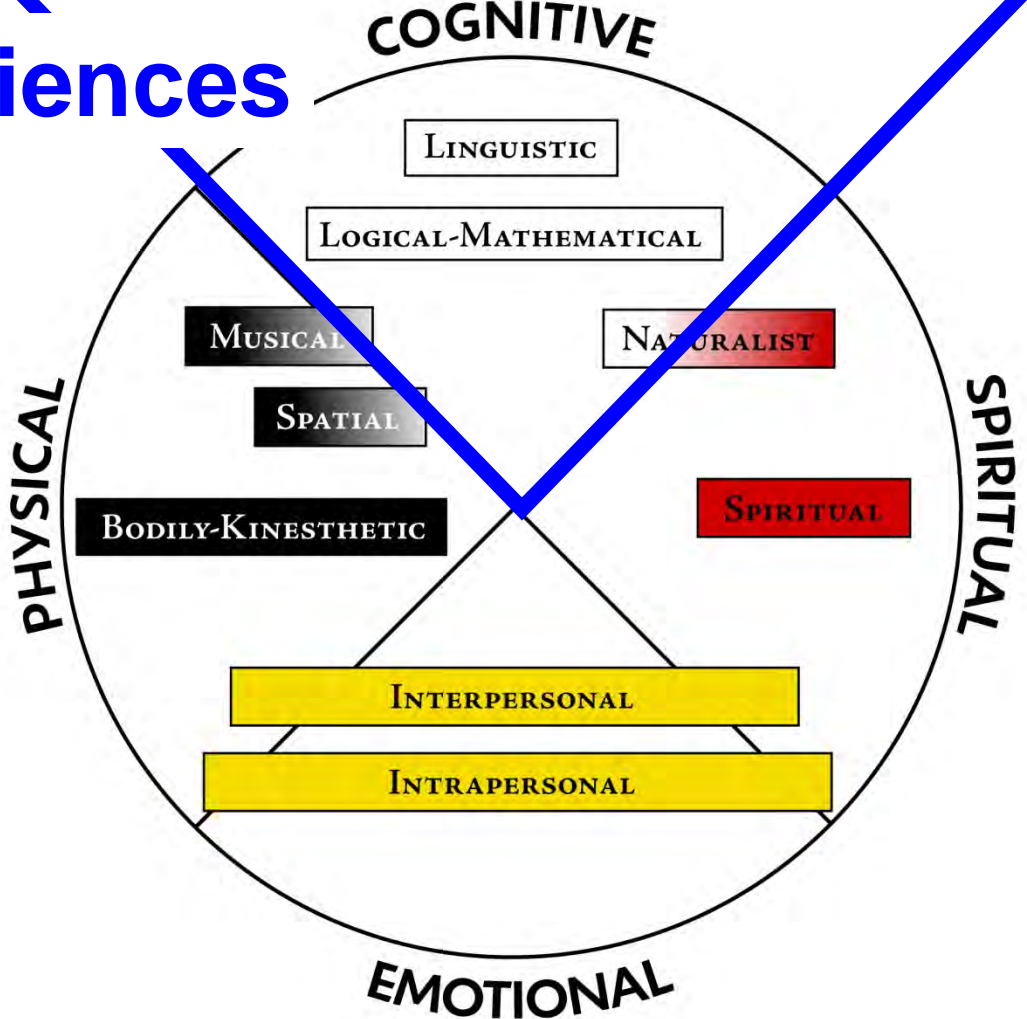
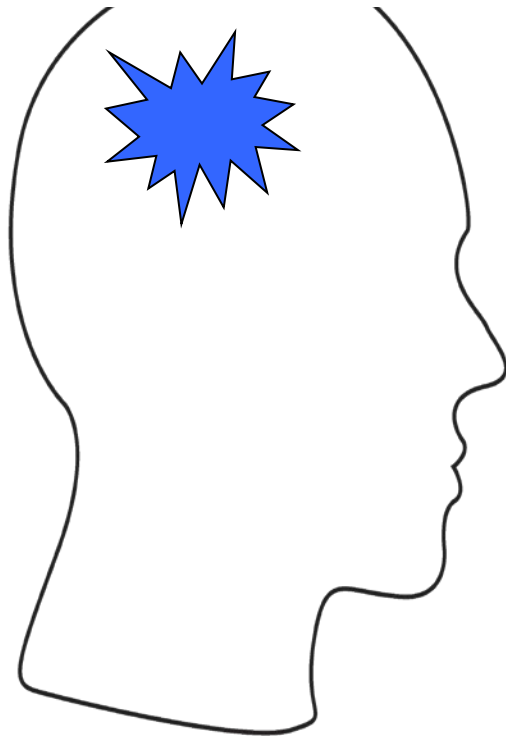




**“pattern smarts”**

**Circle Teachings: lived relationships**

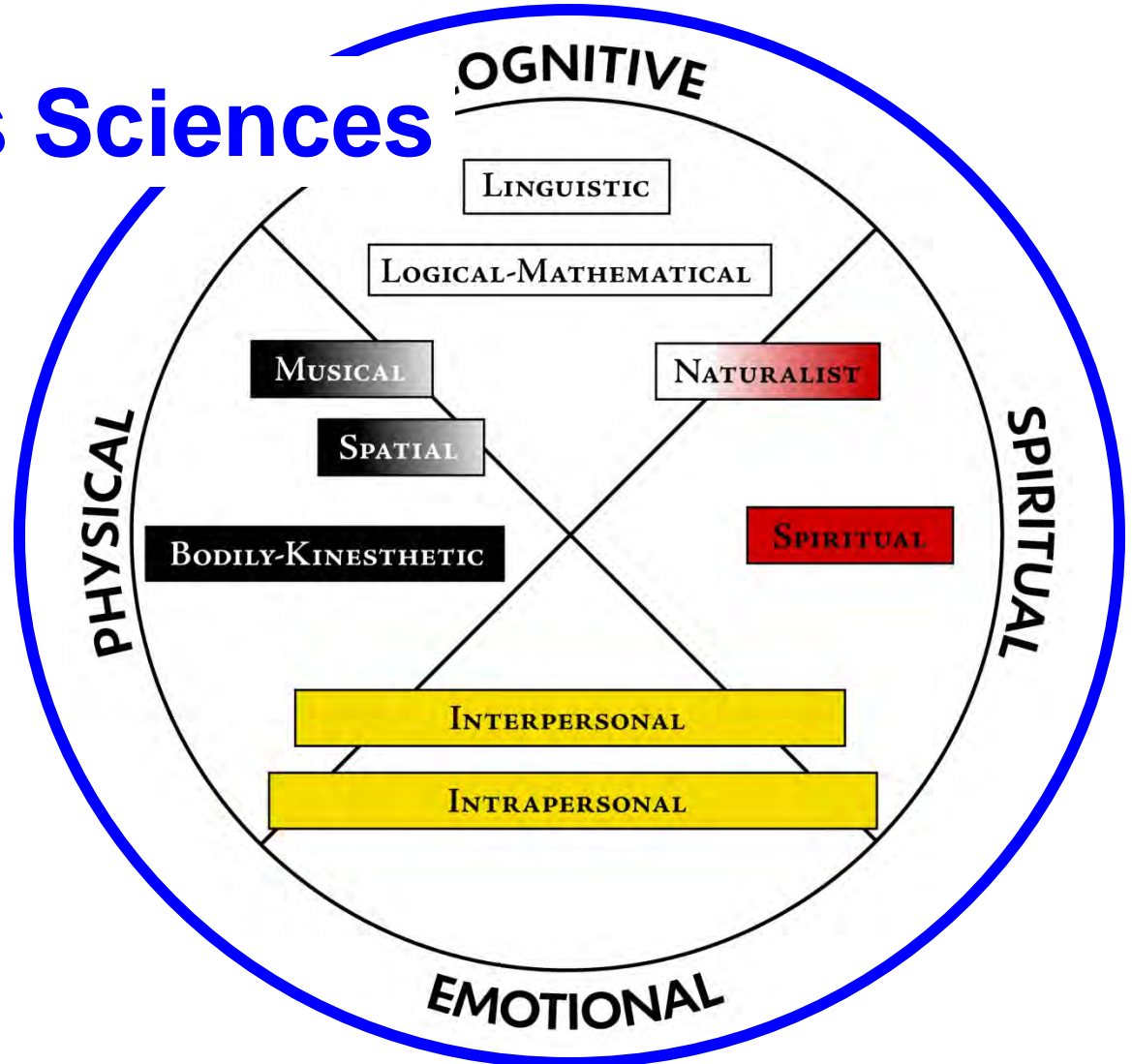
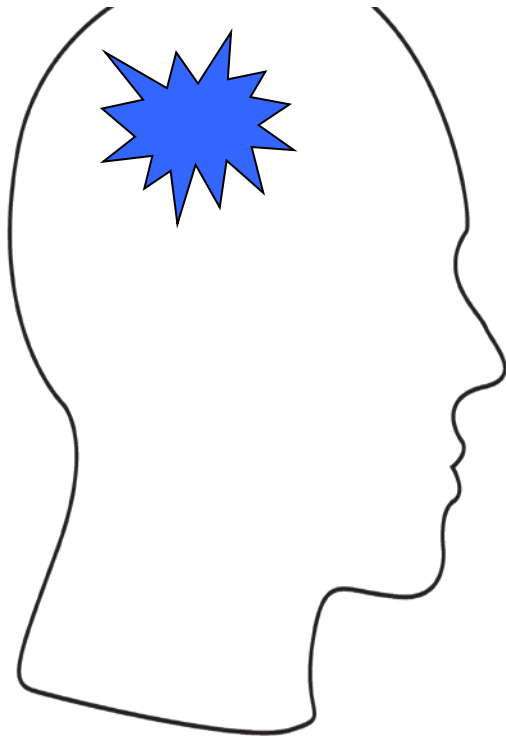
**Western Sciences**



“pattern smarts”

Circle Teachings: lived relationships

# Indigenous Sciences



FEAR

domain of the  
unknown

Land of Eagle



ONE WHO SEES BIG PATTERNS

domain of the  
known



“must become  
**PATTERN-able**”

(Douglas J. Cardinal)  
architect

# PATTERN-BASED KNOWLEDGE

## Sherman's Lagoon

OKAY, WE'RE HERE AT THE MALL. WHERE'S THIS WATCH YOU WANT TO BUY?

PATIENCE.  
PATIENCE.

ONE DOESN'T JUST RUSH INTO THE MALL FOR A QUICK ITEM AND LEAVE. IT'S NOT A CONVENIENCE STORE.

ONE MUST TAKE IT ALL IN. MEASURE THE VIBE. SOAK UP THE AMBIENCE. FIND PATTERNS AND IDENTIFY THE DISTURBANCES.

TRANSLATION?

YOU'RE HERE ALL DAY, PAL.

<http://www.shermanslagoon.com>

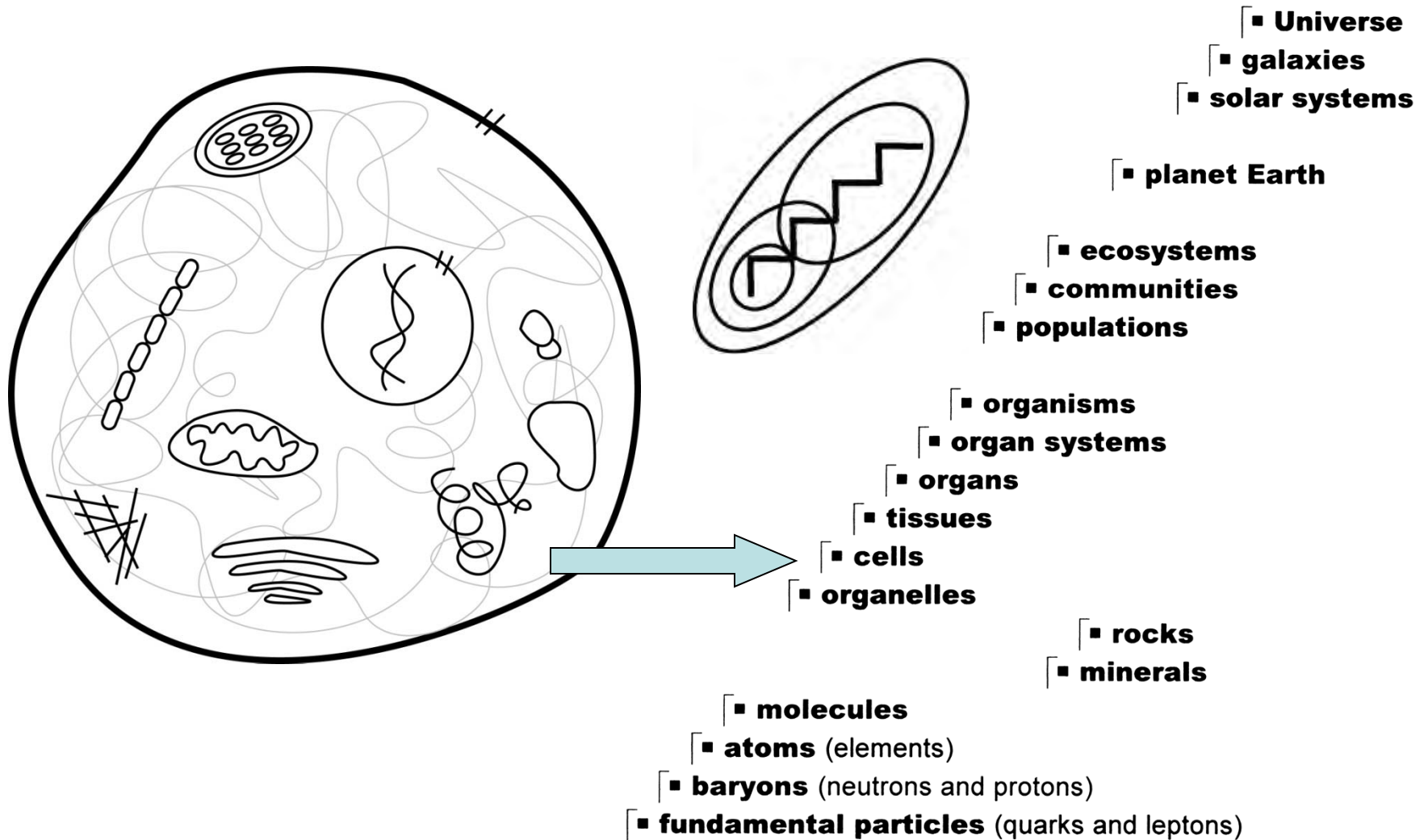
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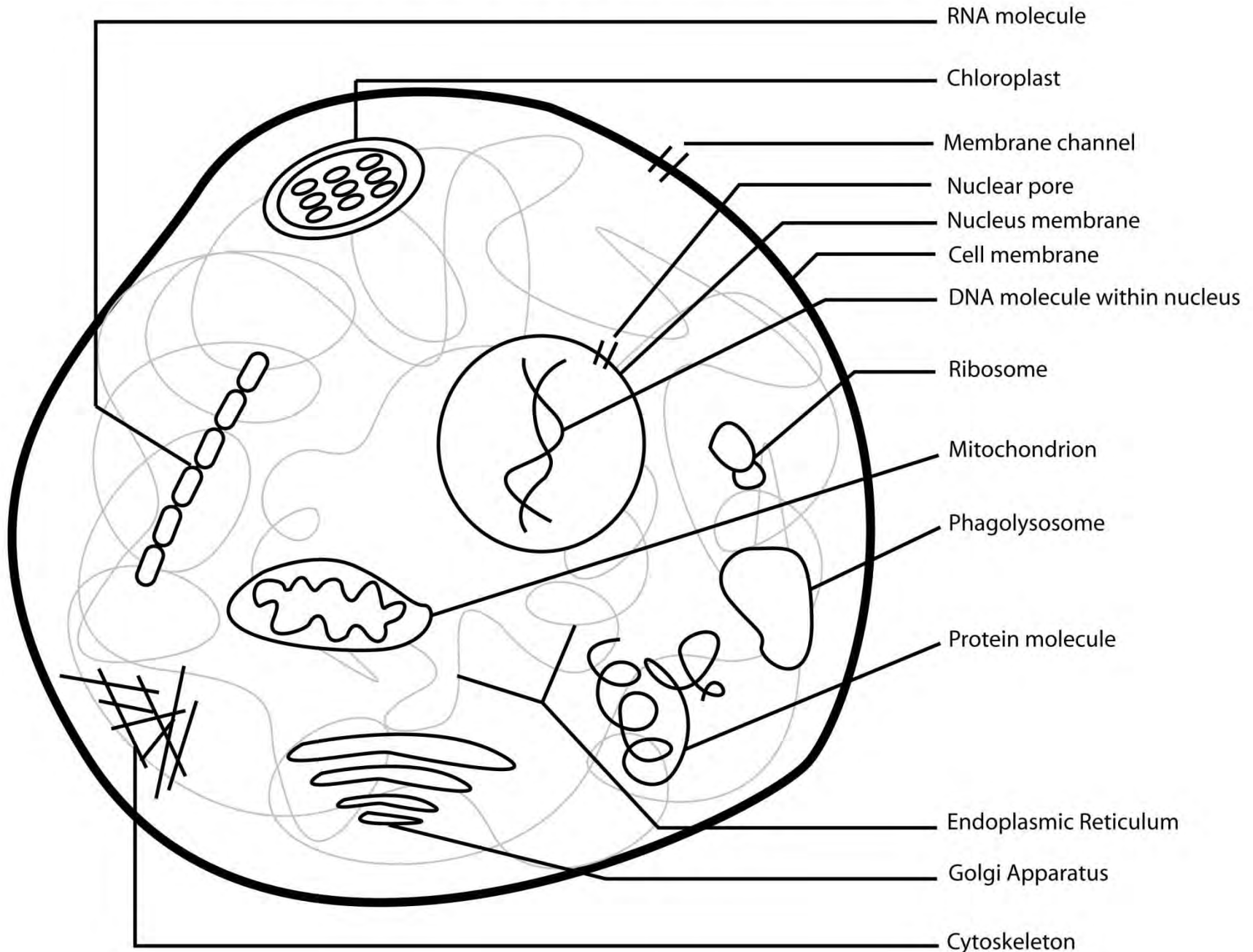
# HOLARCHY

## - VISIBLE MATTER IN THE UNIVERSE -

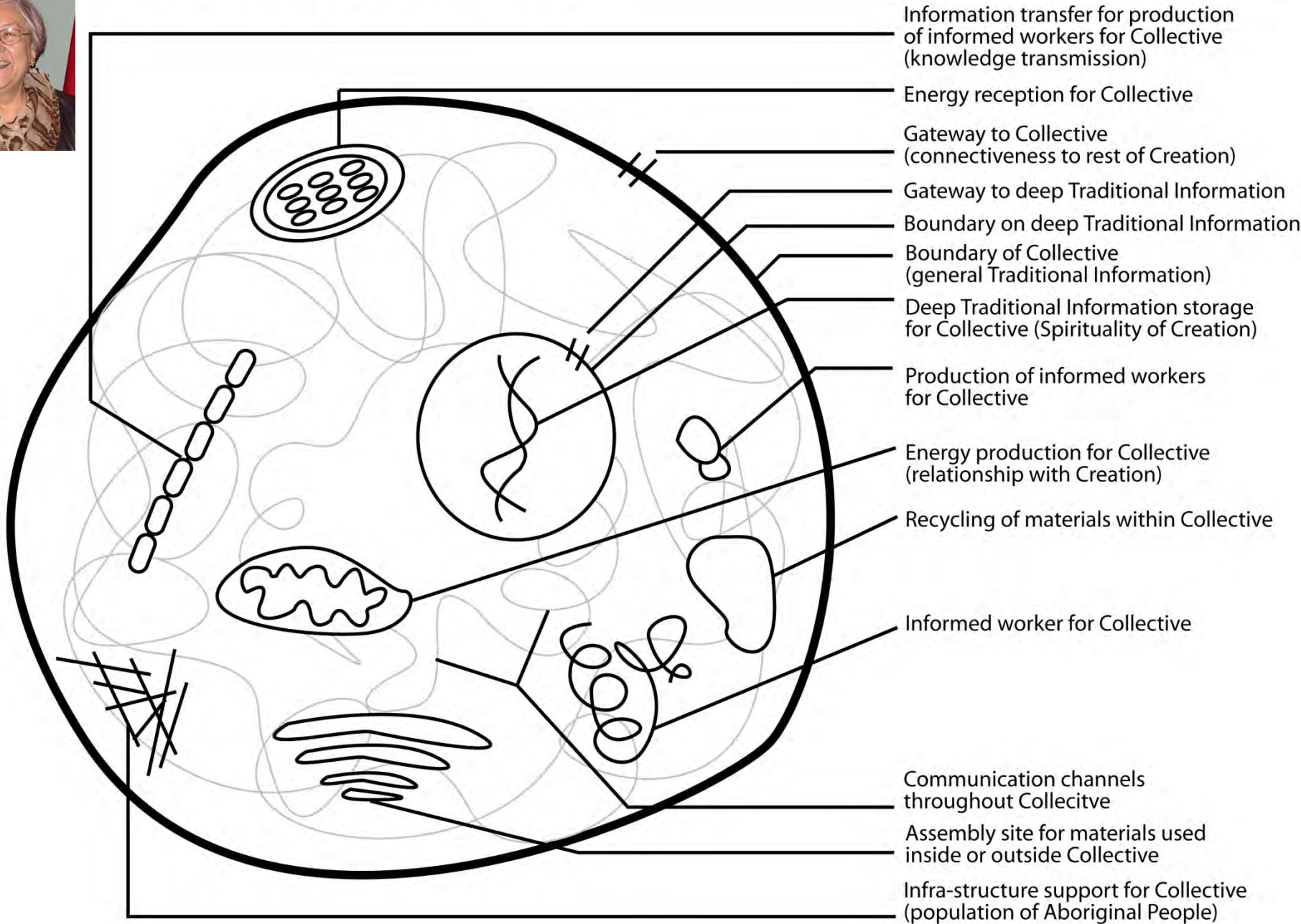
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# The Collective: Its Parts (example = the living cell)



# The Collective: Its Functions (by Elder Murdena Marshall BA, MEd)





## Fibre-optical features of a glass sponge

Some superior technological secrets have come to light from a deep-sea organism.

### Fibre-optical features of a glass sponge; some superior technological secrets have come to light from a deep sea organism



*Euplectella aspergillum*  
from the Invertebrate  
Collection of the  
National Museum of  
Natural Sciences,  
Madrid, Spain.

the spicule and air (Fig. 1d, right). Biological fibres therefore resemble telecommunication fibres, they are made of the same material comparable dimensions, as well as refractive indices for the high-index core and low-index cladding. They also function as efficient single-mode, few-mode waveguides, depending on launch conditions.

Principal weakness of commercial fibres is that they fracture as a result of stress, whereas the spicules' lamellar structure, connected by organic ligands at the inner exterior, provide an effective crack-arresting mechanism and enhance fracture toughness<sup>23,24</sup>. Another superior feature of the spicules is their formation under ambient conditions, a process that is regulated by organic molecules<sup>25,26</sup>. This ambient-temperature process, unlike the high-temperature manufacture of man-made fibres, allows the structure to be doped with specialized impurities that improve the refractive index and therefore the wave-guiding properties. Our preliminary elemental analysis

We anticipated that the spicules' rich substructure should be reflected in their optical properties as well. Indeed, interferometric refractive-index profiling revealed three regions that correspond to the three regions of structural composition (Fig. 1c): a core with high refractive index that is comparable to (or higher than) that of vitreous silica; a cylinder of lower refractive index that surrounds the core; and an oscillating pattern with progressively increasing refractive index at the outer part of the spicule.

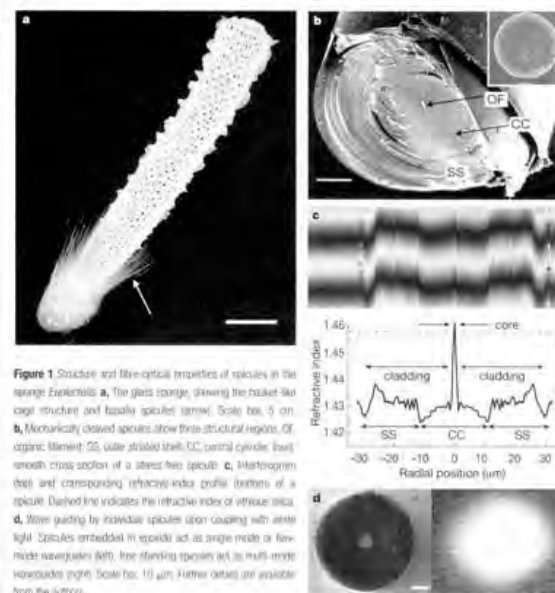
To determine whether this typical 'core-cladding' refractive-index profile endows the spicules with wave-guiding properties, we investigated their transmission characteristics. We found that embedded spicules act as single- or few-mode waveguides — that is, light waves are effectively confined to the core, where refractive index is highest (Fig. 1d, left). When light was coupled into free-standing spicules, they functioned as multi-mode fibres, with most of the light filling the entire cladding, because of the enhanced refractive-index contrast

shows, for example, that sodium ions are present throughout the spicules, particularly in the core. Although sodium ions (and many other additives) are desirable fibre-optic dopants, they present a manufacturing challenge, for example by causing devitrification at high temperatures.

Our results suggest the intriguing possibility that the spicules of *Euplectella*, beyond structural anchorage support, could also provide a highly effective fibre-optical network, which may be useful in distributing light in its deep-sea environment. This illuminating sponge should also shed light on low-temperature, biologically inspired processes that could give rise to better fibre-optical materials and networks.

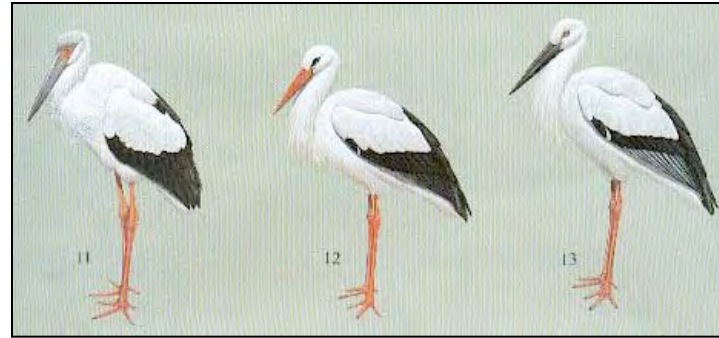
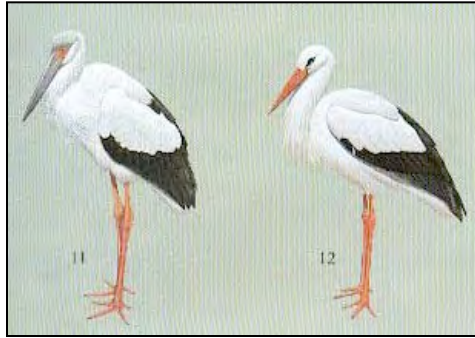
Vikram C. Sundar\*, Andrew D. Yablon<sup>†</sup>, John L. Grazul<sup>‡</sup>, Micha Ilani<sup>§</sup>, Joanna Aizenberg\*

\*Bell Laboratories/Lucent Technologies, Murray Hill, New Jersey 07974, USA  
†e-mail: aizenberg@lucent.com  
‡ODS, Murray Hill, New Jersey 07974, USA  
§Department of Zoology, Tel Aviv University, Tel Aviv 69978, Israel



**Figure 1** Structure and fibre-optical properties of spicules in the sponge *Euplectella*. **a**, The glass sponge, showing the basket-like cage structure and basal spicules (arrow). Scale bar, 5 cm. **b**, Mechanically cleaved spicules show three structural regions: OF, organic filament; SS, wide striated shell; CC, central cylinder. **c**, Interferometric refractive-index profile of a spicule. Dashed line indicates the refractive index of vitreous silica. **d**, Wave guiding by individual spicules upon coating with silver light. Spicules embedded in spicules act as single-mode or few-mode waveguides (left). Free-standing spicules act as multi-mode waveguides (right). Scale bar, 10  $\mu$ m. Further details are available from the authors.





**difference**

**PATTERN**

**human  
consciousness**

**variation**



# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer



# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer



**SANCTIONED**

**PERSPECTIVES & INTELLIGENCES:**

**who we are; where we are; where we were;  
what we know, do and value**



# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer



Big  
Dipper



**SANCTIONED**

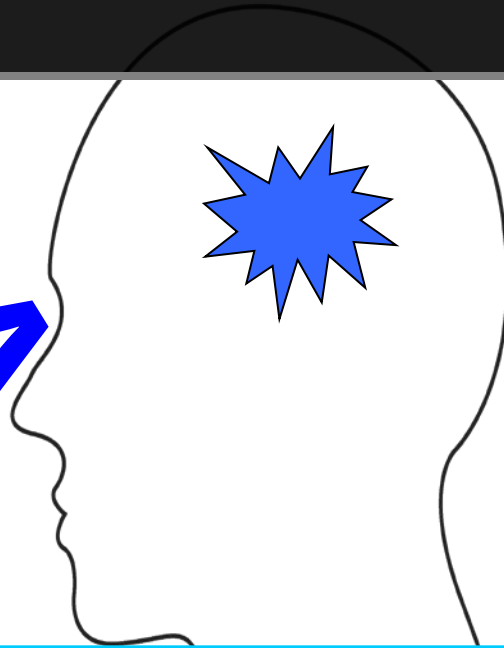
**PERSPECTIVES & INTELLIGENCES:**

who we are; where we are; where we were;  
what we know, do and value



# PATTERN CONCEPTUAL FRAMEWORK

outer

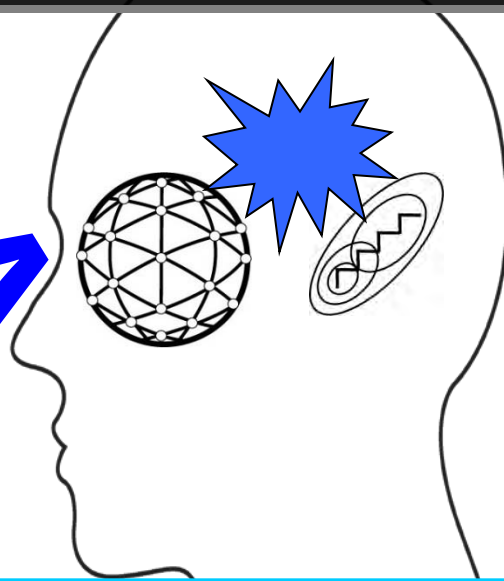


**SANCTIONED  
PERSPECTIVES & INTELLIGENCES:**  
who we are; where we are; where we were;  
what we know, do and value

# PATTERN CONCEPTUAL FRAMEWORK

outer

inner



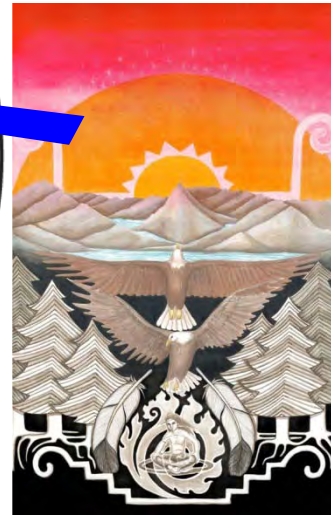
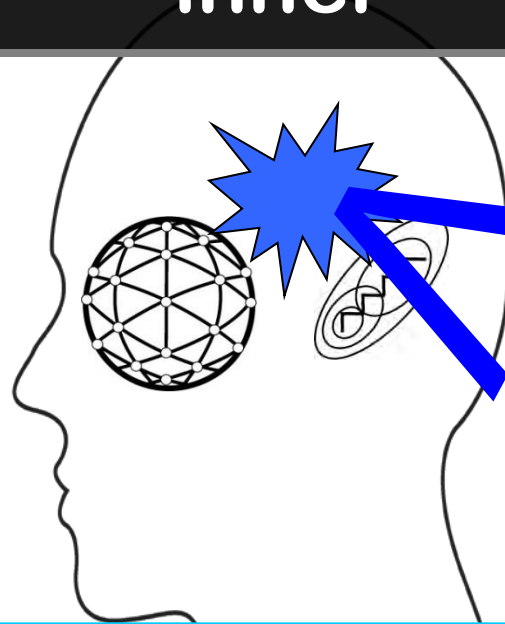
**SANCTIONED  
PERSPECTIVES & INTELLIGENCES:**  
who we are; where we are; where we were;  
what we know, do and value

# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer



Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun											
01	01/01/2000	01/02/2000	01/03/2000	01/04/2000	01/05/2000	01/06/2000	01/07/2000	01/08/2000	01/09/2000	01/10/2000	01/11/2000	01/12/2000	01/13/2000	01/14/2000	01/15/2000	01/16/2000	01/17/2000	01/18/2000	01/19/2000	01/20/2000	01/21/2000	01/22/2000	01/23/2000	01/24/2000	01/25/2000	01/26/2000	01/27/2000	01/28/2000	01/29/2000	01/30/2000	01/31/2000	02/01/2000	02/02/2000	02/03/2000	02/04/2000	02/05/2000	02/06/2000	02/07/2000	02/08/2000	02/09/2000	02/10/2000	02/11/2000	02/12/2000	02/13/2000	02/14/2000	02/15/2000	02/16/2000	02/17/2000	02/18/2000	02/19/2000	02/20/2000	02/21/2000	02/22/2000	02/23/2000	02/24/2000	02/25/2000	02/26/2000	02/27/2000	02/28/2000	02/29/2000

**SANCTIONED PERSPECTIVES & INTELLIGENCES:**  
who we are; where we are; where we were;  
what we know, do and value

**participatory &  
creative choice**



Artist Basma Kavanagh

**Wjipenuk Etek  
Lnuimlkikno'ti  
- Spirit of the East -**

**East (sunrise)**

**... a place of  
beginnings and  
enlightenment**

**... where new  
knowledge can be  
created or received  
to bring about  
harmony or right  
relations.**



# Physical Direction

# detached & instrumental

East (sunrise)

... measurement of the time of sunrise

... for each new day over the course of one full year.

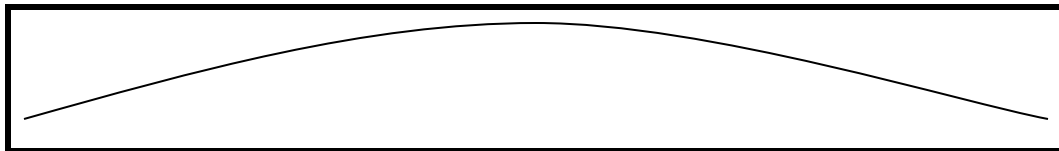
SYDNEY, NS  
Rise and Set for the Sun for 2004

Location: W060 11, N46 09      Zone: 4h West of Greenwich

Astronomical Applications Dept.  
U. S. Naval Observatory  
Washington, DC 20392-5420

Day	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
01	0743	1625	0724	1705	0639	1748	0540	1830	0447	1910	0413	1945	0413	1956	0443	1930	0522	1839	0600	1740	0642	1646	0723	1617
02	0743	1626	0723	1706	0637	1749	0538	1831	0445	1911	0412	1946	0414	1955	0444	1929	0523	1837	0601	1738	0644	1644	0724	1616
03	0743	1627	0722	1708	0635	1750	0536	1833	0444	1912	0412	1947	0415	1955	0446	1927	0524	1835	0602	1736	0645	1643	0725	1616
04	0743	1628	0720	1709	0634	1752	0534	1834	0442	1913	0411	1947	0415	1955	0447	1926	0525	1833	0604	1734	0646	1642	0727	1616
05	0743	1629	0719	1711	0632	1753	0532	1835	0441	1915	0411	1948	0416	1954	0448	1925	0527	1831	0605	1732	0648	1640	0728	1615
06	0743	1630	0718	1712	0630	1755	0530	1837	0439	1916	0410	1949	0417	1954	0449	1923	0528	1829	0606	1730	0649	1639	0729	1615
07	0743	1631	0716	1714	0628	1756	0528	1838	0438	1917	0410	1950	0418	1953	0450	1922	0529	1827	0607	1729	0651	1638	0730	1615
08	0743	1632	0715	1715	0626	1757	0527	1839	0437	1919	0410	1950	0418	1953	0452	1920	0530	1825	0609	1727	0652	1636	0731	1615
09	0742	1633	0714	1717	0624	1759	0525	1841	0435	1920	0409	1951	0419	1952	0453	1919	0532	1823	0610	1725	0654	1635	0732	1615
10	0742	1635	0712	1718	0622	1800	0523	1842	0434	1921	0409	1952	0420	1952	0454	1917	0533	1821	0611	1723	0655	1634	0733	1615
11	0742	1636	0711	1720	0620	1802	0521	1843	0433	1922	0409	1952	0421	1951	0455	1915	0534	1819	0613	1721	0657	1633	0734	1615
12	0741	1637	0709	1721	0619	1803	0519	1845	0431	1924	0409	1953	0422	1951	0457	1914	0535	1817	0614	1719	0658	1631	0734	1615
13	0741	1638	0708	1723	0617	1804	0517	1846	0430	1925	0409	1953	0423	1950	0458	1912	0537	1815	0616	1717	0659	1630	0735	1615
14	0740	1640	0706	1724	0615	1806	0515	1847	0429	1926	0409	1954	0424	1949	0459	1911	0538	1813	0617	1716	0701	1629	0736	1615
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18	0738	1645	0700	1730	0607	1811	0508	1852	0424	1931	0409	1955	0427	1946	0504	1904	0543	1805	0622	1708	0706	1625	0739	1616
19	0737	1646	0658	1732	0605	1812	0507	1854	0423	1932	0409	1955	0428	1945	0505	1902	0544	1803	0624	1707	0708	1624	0739	1617
20	0736	1648	0657	1733	0603	1814	0505	1855	0422	1933	0409	1956	0430	1944	0507	1900	0546	1802	0625	1705	0709	1623	0740	1617
21	0735	1649	0655	1735	0601	1815	0503	1856	0421	1934	0409	1956	0431	1943	0508	1859	0547	1800	0627	1703	0710	1623	0741	1618
22	0735	1650	0653	1736	0559	1817	0501	1858	0420	1935	0410	1956	0432	1941	0509	1857	0548	1758	0628	1702	0712	1622	0741	1618
23	0734	1652	0651	1738	0557	1818	0500	1859	0419	1936	0410	1956	0433	1941	0510	1855	0549	1756	0629	1700	0713	1621	0741	1619
24	0733	1653	0650	1739	0555	1819	0458	1900	0418	1937	0410	1956	0434	1940	0512	1853	0551	1754	0631	1658	0714	1620	0742	1619
25	0732	1655	0648	1740	0553	1821	0456	1902	0418	1938	0411	1956	0435	1939	0513	1852	0552	1752	0632	1657	0716	1620	0742	1620
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27	0730	1658	0644	1743	0550	1823	0453	1904	0416	1940	0411	1956	0437	1936	0515	1848	0554	1748	0635	1653	0718	1618	0743	1622
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29	0728	1700	0641	1746	0546	1826	0450	1907	0415	1942	0412	1956	0440	1934	0518	1844	0557	1744	0638	1650	0721	1617	0743	1623
30	0727	1702			0544	1827	0448	1908	0414	1943	0413	1956	0441	1933	0519	1842	0558	1742	0639	1649	0722	1617	0743	1624
31	0725	1703			0542	1829			0413	1944			0442	1931	0520	1840			0641	1647			0743	1625

X



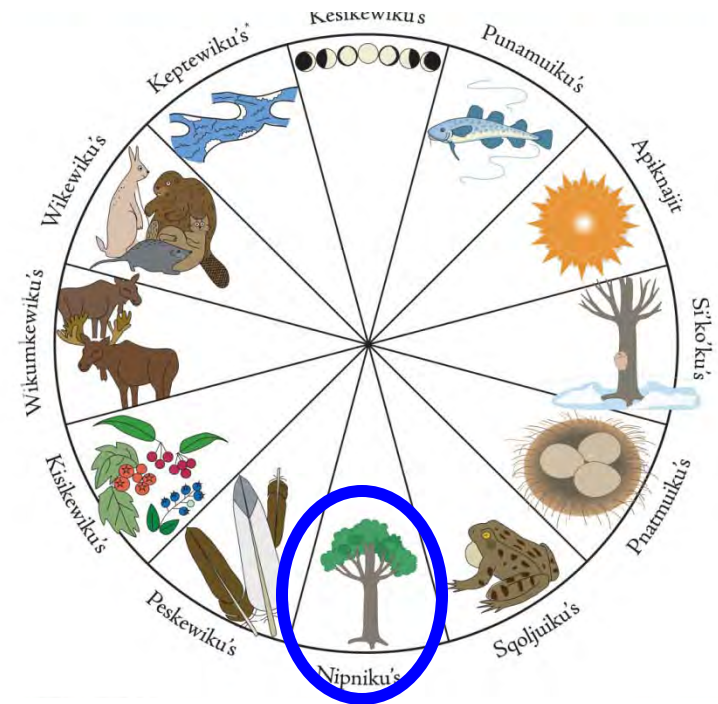
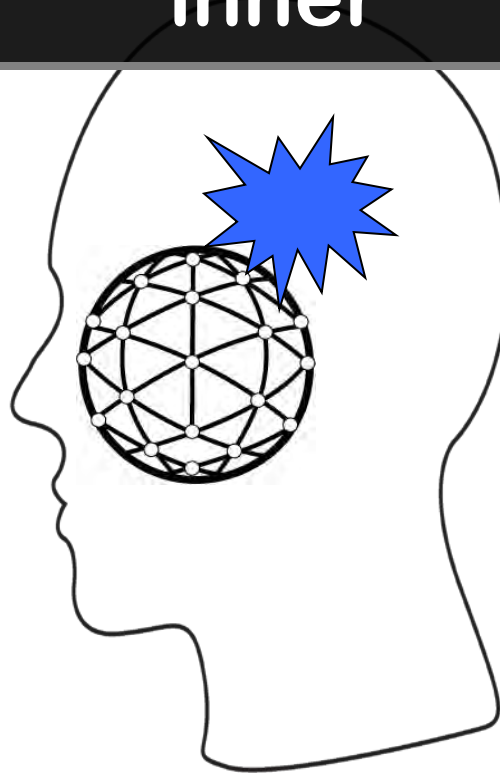
y

# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer



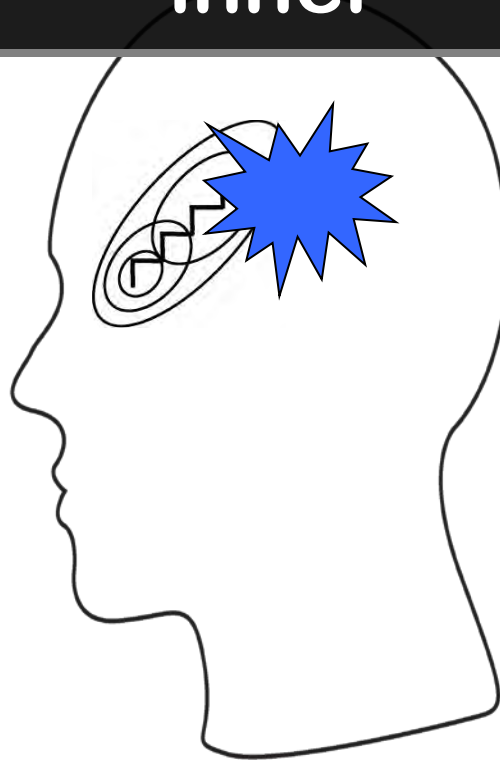
# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer

**X**



**June**

... in honour of  
"Juno", the  
Roman Queen  
of the Gods

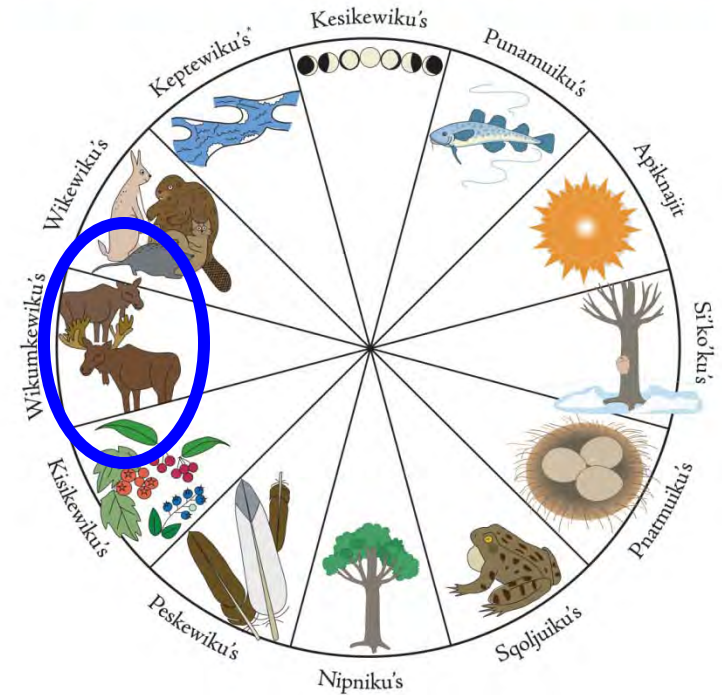
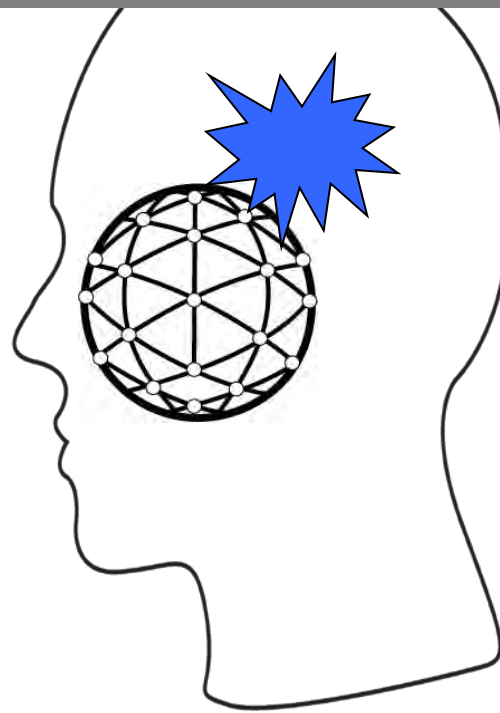


# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer





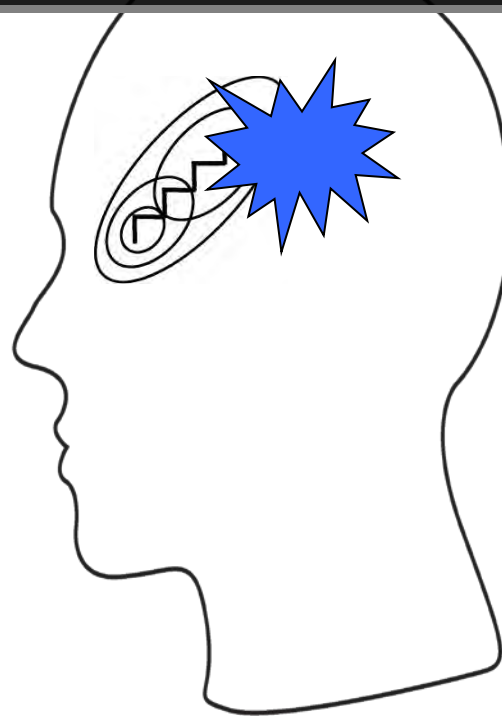
# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer

**X**



**September**

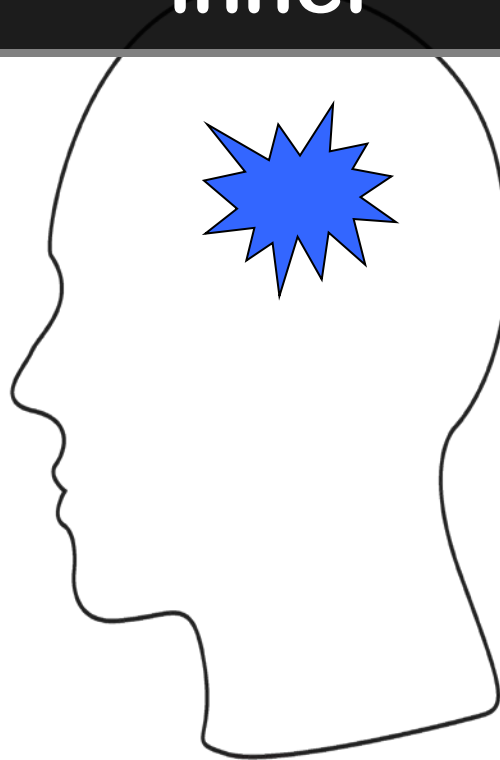
*“sept” = 7 in Latin  
... was 7<sup>th</sup> month in  
a 10 month year  
... now is 9<sup>th</sup> month in  
a 12 month year*

# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer



Attu'tuejualu



*millefolium*

1000



Yarrow

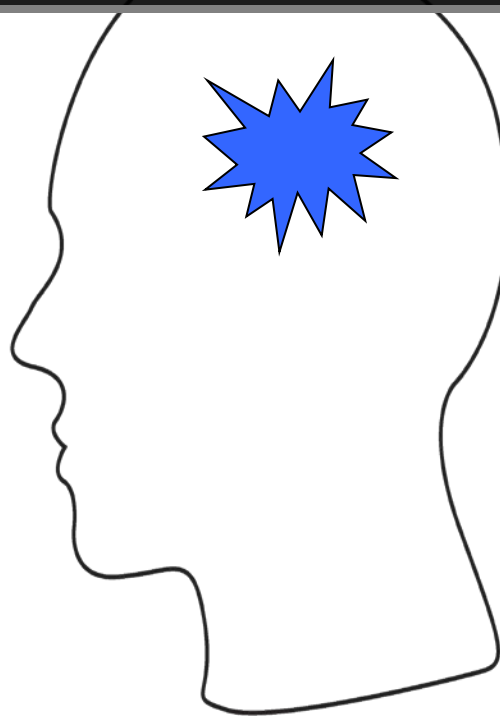


# PATTERN CONCEPTUAL FRAMEWORK

outer

inner

outer



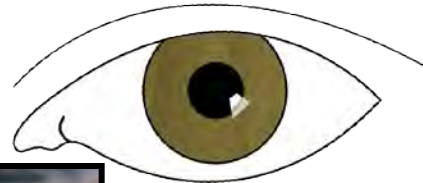
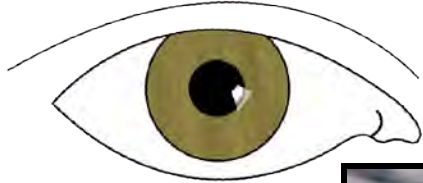
Mtèskmwaqsil



Fiddlehead  
fern

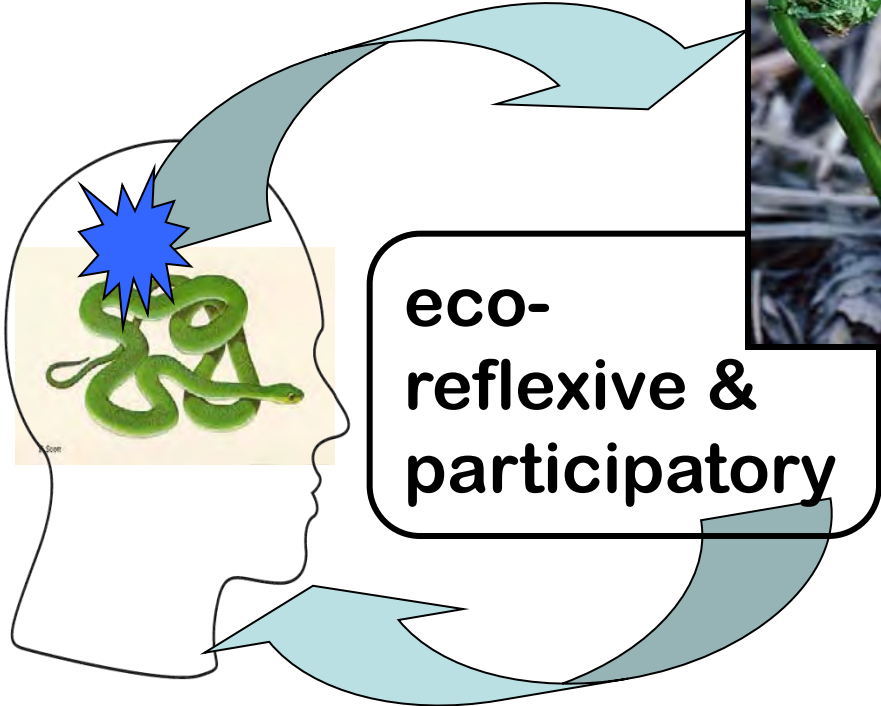


# what our "pattern seeing" (re)generates

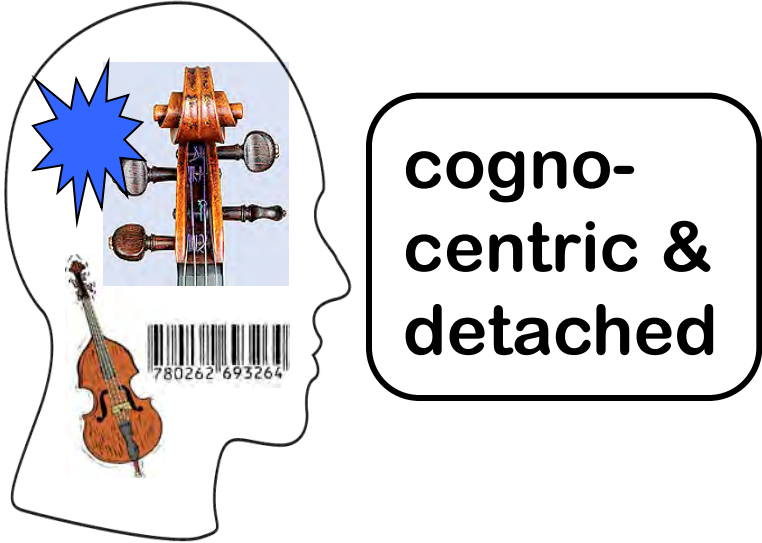


**subject-subject**

**subject - object**



**eco-reflexive & participatory**



**cogno-centric & detached**

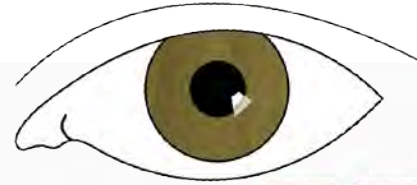
connectedness

disconnectedness



# stories of our interactions with and within nature

# Science



1 H Hydrogen																	2 He Helium					
3 Li Lithium	4 Be Beryllium															10 Ne Neon						
11 Na Sodium	12 Mg Magnesium															18 Ar Argon						
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt							36 Kr Krypton							
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium							54 Xe Xenon							
55 Cs Cesium	56 Ba Barium	57-71 Lanthanides	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium							86 Rn Radon							
87 Fr Francium	88 Ra Radium	89-103 Actinides	104 Unq Unnilquadium	105 Unp Unnilpentium	106 Unh Unnilhexium	107 Uns Unnilseptium	108 Uno Unniloctium	109 Une Unnilennium														
		57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium							63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
		89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium							95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

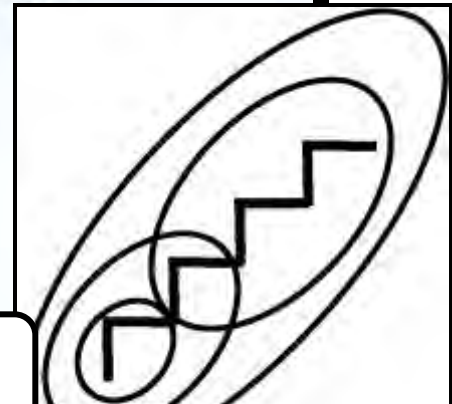
5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon			
13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon			
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

Periodic Table of the Elements

# Universe: Visible Matter (levels of organization - biology)

Setford, Steve. 1996. Science Facts. Firefly Books Ltd., Willowdale, ON. (pp. 36-37)

- 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 elements #93 & higher)
    - baryons (neutrons & protons)
    - fundamental particles (quarks & leptons)



stories of:

**parts & wholes**



**towards construction  
of understanding  
of environment**

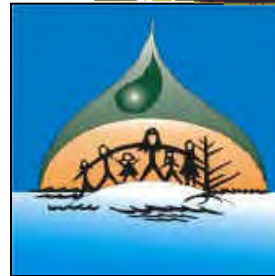


stories of our interactions with and within nature

# Science



Life  
Love  
Land

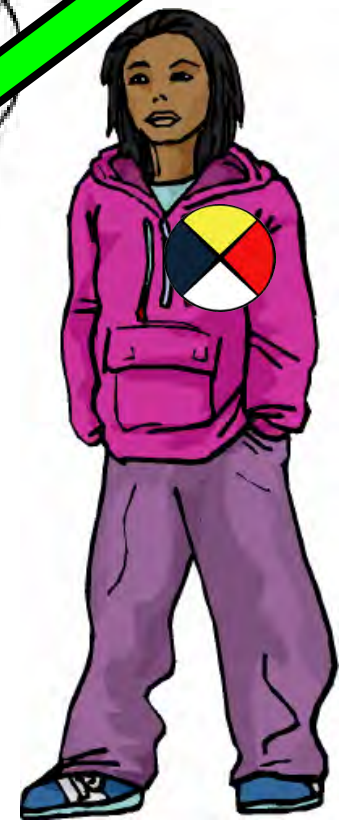
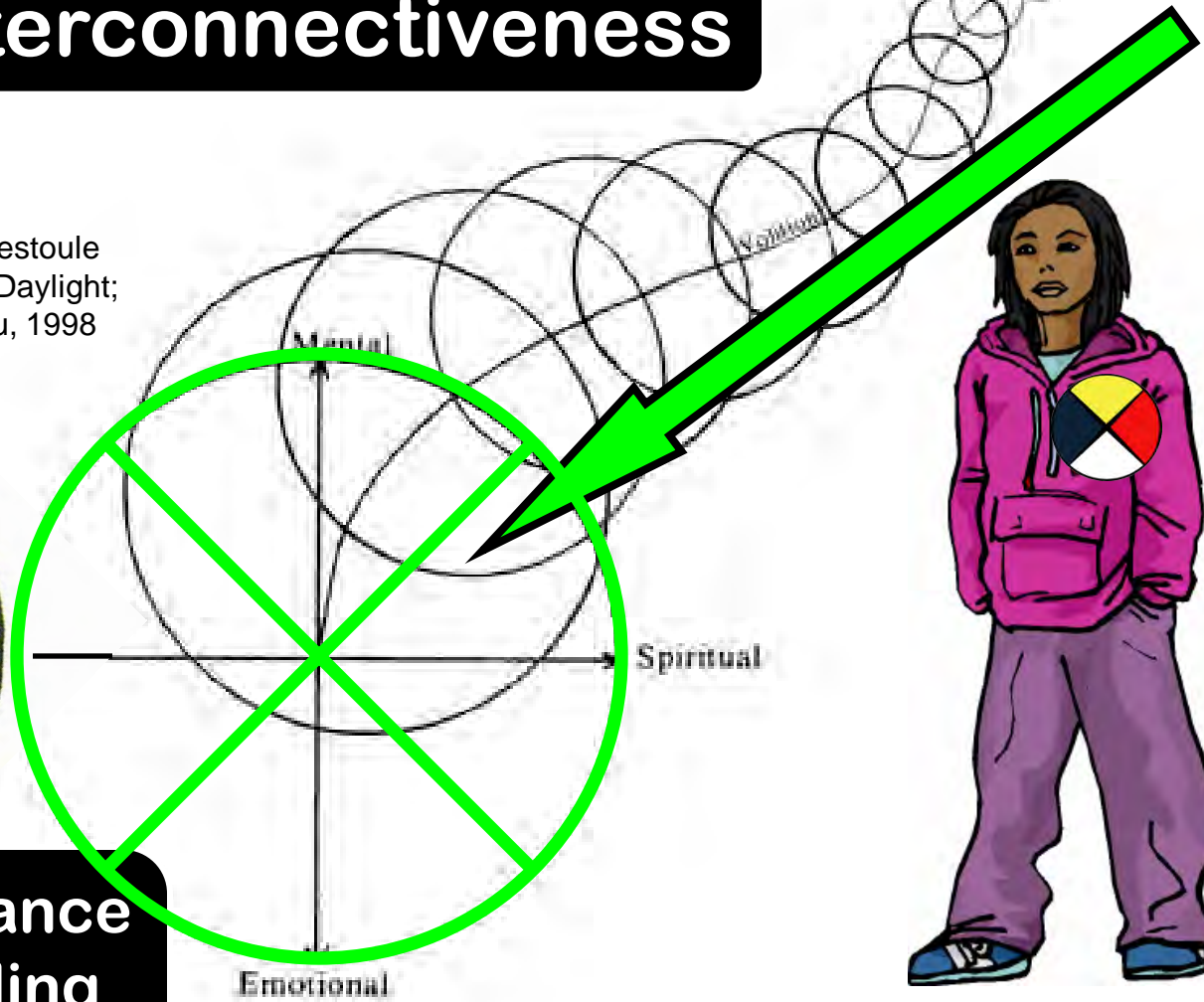


stories of:

**interconnectiveness**

Vision 

Artist: Rod Restoule  
from: Into the Daylight;  
C. Morrisseau, 1998



**towards resonance  
of understanding  
within environment**

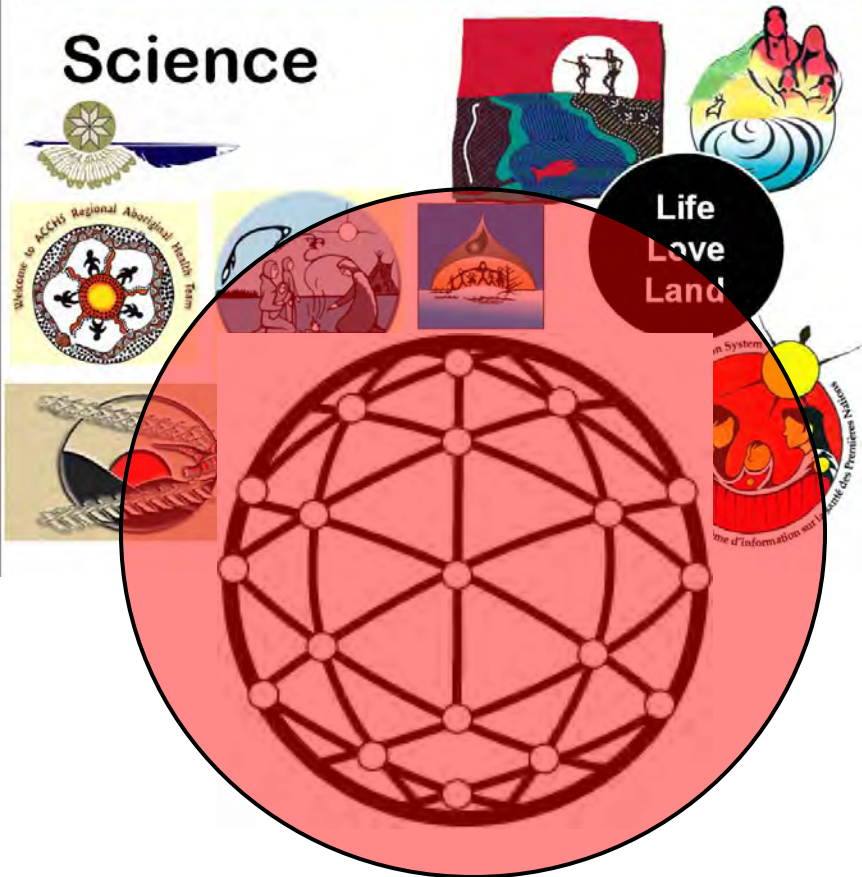
**"all my relations"**





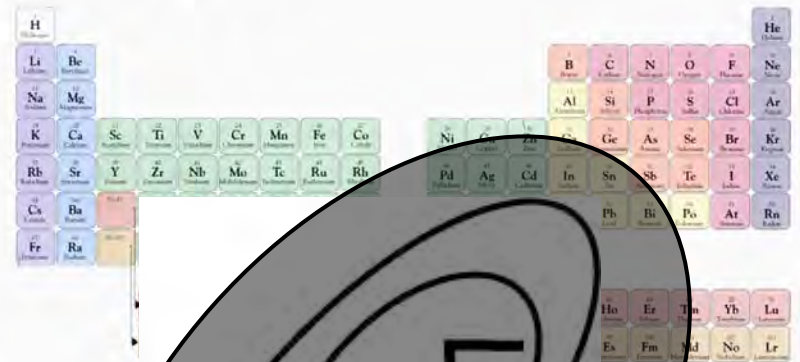
stories of our interactions with and within nature

# Science



stories of our interactions with and within nature

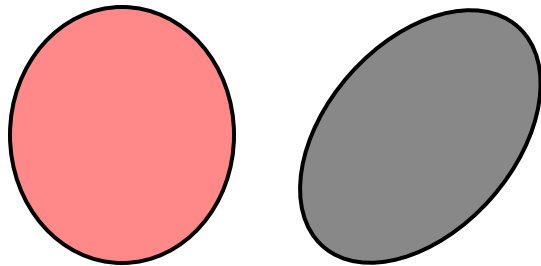
# Science



# stories of our interactions with and within nature

## Science

**Science is  
dynamic,  
pattern-based  
knowledge.**



### **PATTERNS ...**

- spirits within ecosystem-wide minds
- ideas in brain-based minds





# Integrative Science



Indigenous

Western

“bringing our sciences together”

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



Wela'ioq / Thank you



Mi'kmaq Elders

