



**Approaches to Scientific Thinking:  
The Traditional, the Feminist and the  
Aboriginal**

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MECH 410E class, UBC

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# Topics of Discussion

- ❖ The Western or Traditional view of Science
- ❖ Feminist science
- ❖ Aboriginal science
- ❖ The Medicine Wheel
- ❖ Using the Medicine Wheel to analyze science



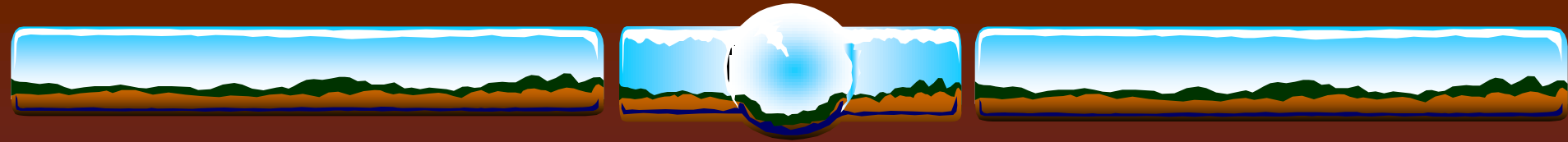
# The Sacred Dogma of Western Science

1. The scientific method is infallible and always leads us to the “Truth”.
2. The scientist is objective or neutral.  
He (she) sees things without any bias.



# Subjectivity is inherent in the Scientific Method

- ❖ Formulation of the Conclusion of the experiments involves inductive reasoning.
- ❖ It involves interpretation of data as they apply to the real world – i.e., it is a subjective process.
- ❖ This subjectively reasoned conclusion leads to a new or modified hypothesis – i.e., the conclusion feeds back into step 1 of the scientific method.



1. Hypothesis generation



6. Generalize to a conclusion

2. Design experiment



5. Judge the hypothesis

3. Perform experiments



4. Analyze data





# What This Means

- ❖ Western Science is supposed to be all about COLD, HARD Facts – the TRUTH.
- ❖ But facts do not exist in a vacuum.
- ❖ “Numbers don’t lie” – but we do interpret what they mean.
- ❖ Science is not infallible – our tools are not perfect.
- ❖ Scientists are subject to cultural or other biases.



# Facts can be interpreted differently and lead to different conclusions

- ❖ Eg. From Star Trek: Voyager –  
Episode: the Saurans (dinosaur-like species)
- ❖ Fact: Humans and Saurans share many DNA codes.
- ❖ Conclusions:
  1. Confirms the hypothesis that the Saurans originated on Earth.
  2. it's heresy to think that – the shared DNA is simply 'accidental'.



# Real Examples of bias in scientific thinking

- ❖ The ‘thrifty gene’ in First Nations and diabetes
- ❖ Vaccination and autism
- ❖ Leakage of CO<sub>2</sub> from deep geological storage sites





# “How the diabetes-linked ‘thrifty gene’ triumphed with prejudice over proof”

From the Globe & Mail, Feb 24, 2011:

- ❖ Dr. James Neel, U Michigan, proposed in 1962 that the high rates of type 2 diabetes in Aboriginals was due to a faulty genetic ability to store extra calories in case of famine.
- ❖ This was widely accepted until recently.
- ❖ Lifestyle and environmental factors are now thought to be more important than genes.



# A recent example of different interpretations of the same data

❖ A Jan 2011 news release:

“Weyburn CO2 claims unfounded: researchers”

❖ Leakage from the Carbon Capture & Storage site onto a farm nearby:

1. was from the storage site (Petro-Find Geo-Chem)
2. was not from the storage site

(Petroleum Technology Research Centre)



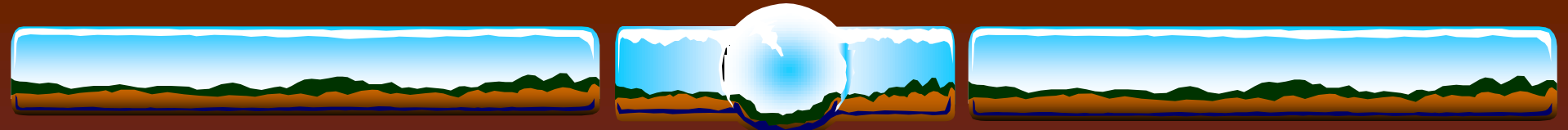
# Why are we sometimes wrong?

- ❖ Bias in our hypothesis
- ❖ Bias in our interpretation of results
- ❖ Imperfect measurements or tools



# What is Feminist Science?

- ❖ Science that doesn't pretend to be unbiased.
- ❖ Science that exposed the male-bias in research.
- ❖ Science that exposed the patriarchal nature of western science ('male' values of domination & exploitation), (male expert = PI)
- ❖ Science that is non-hierarchical.
- ❖ Science by, with and for a community (women).
- ❖ Collaborative, community-based science.

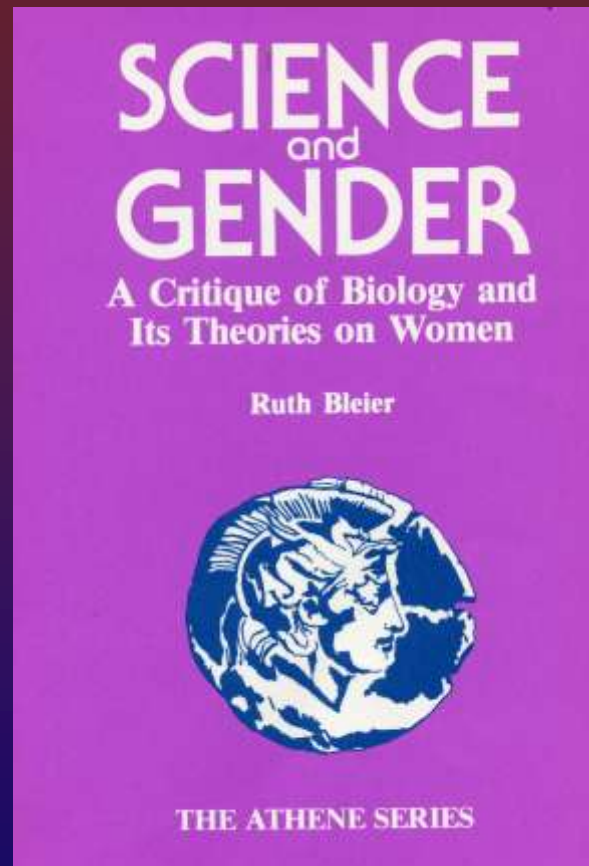


A Canadian pioneer in Feminist science  
Margaret Benston (1937-1991)  
Chemist, SFU





Ruth Bleier, neuroanatomist: 1984  
Gender does matter in science!

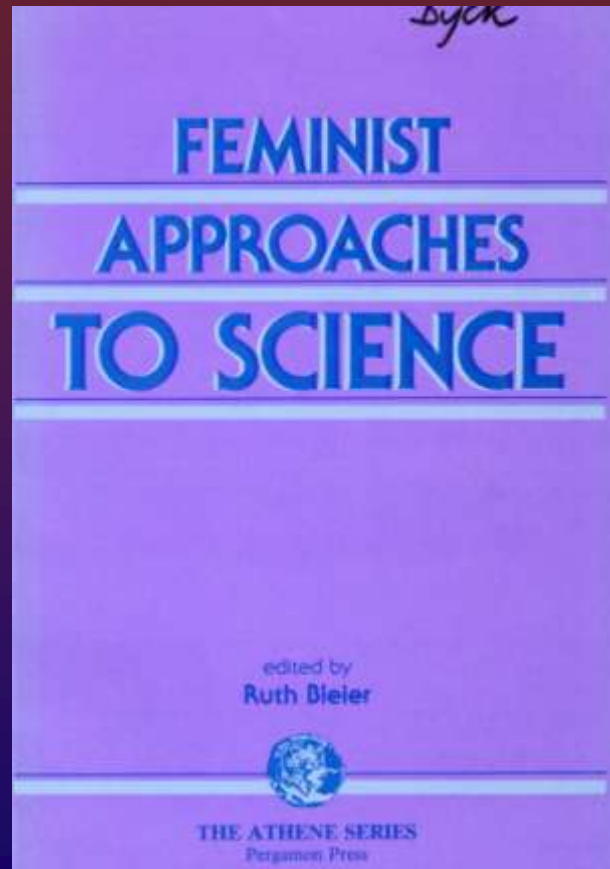


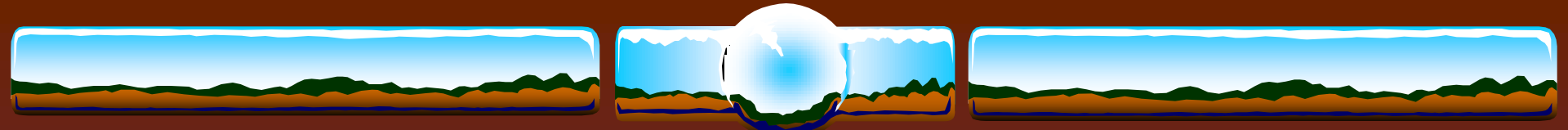
**A welcome affirmation!**



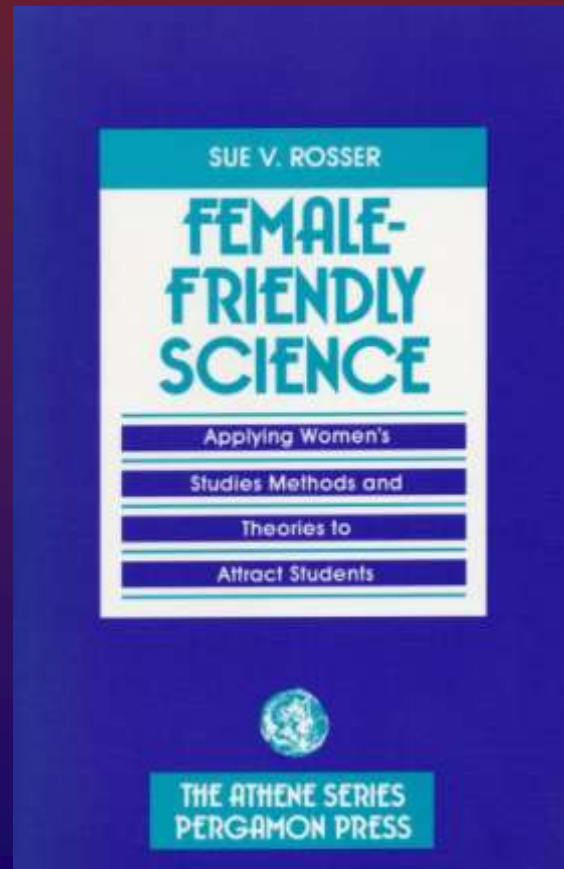
Ruth Bleier: 1988

Gender does matter in how we do science!





Sue Rosser: 1990  
Gender and the teaching of science







# Dr. Ursula Franklin



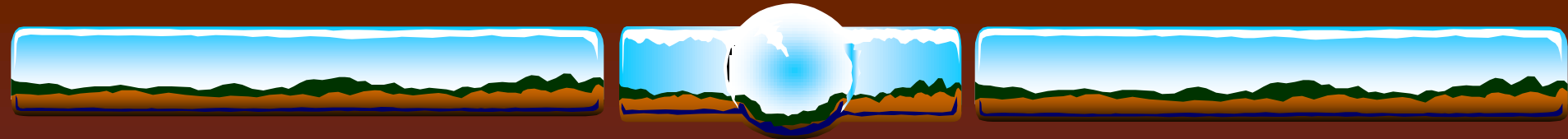
- ❖ 1948, PhD in experimental physics
- ❖ 1<sup>st</sup> female Prof of metallurgy and materials science, UofT, 1967; full prof 1973
- ❖ 1<sup>st</sup> female UofT University Professor, 1984
- ❖ Retired, 1989
- ❖ Part of a class action lawsuit which resulted in UofT offering a pay equity settlement, 2002
- ❖ UofT acknowledged barriers and pay discrimination against women profs



# Letter to a Graduate Student

## 1993, Ursula Franklin

- ❖ “You may well be the only female doctoral student in a particular group, but what about the secretaries, the cleaning staff, the librarians or the technicians? ... As you watch over the well being of others, your own will take care of itself and the chilly climate will warm up a bit.”

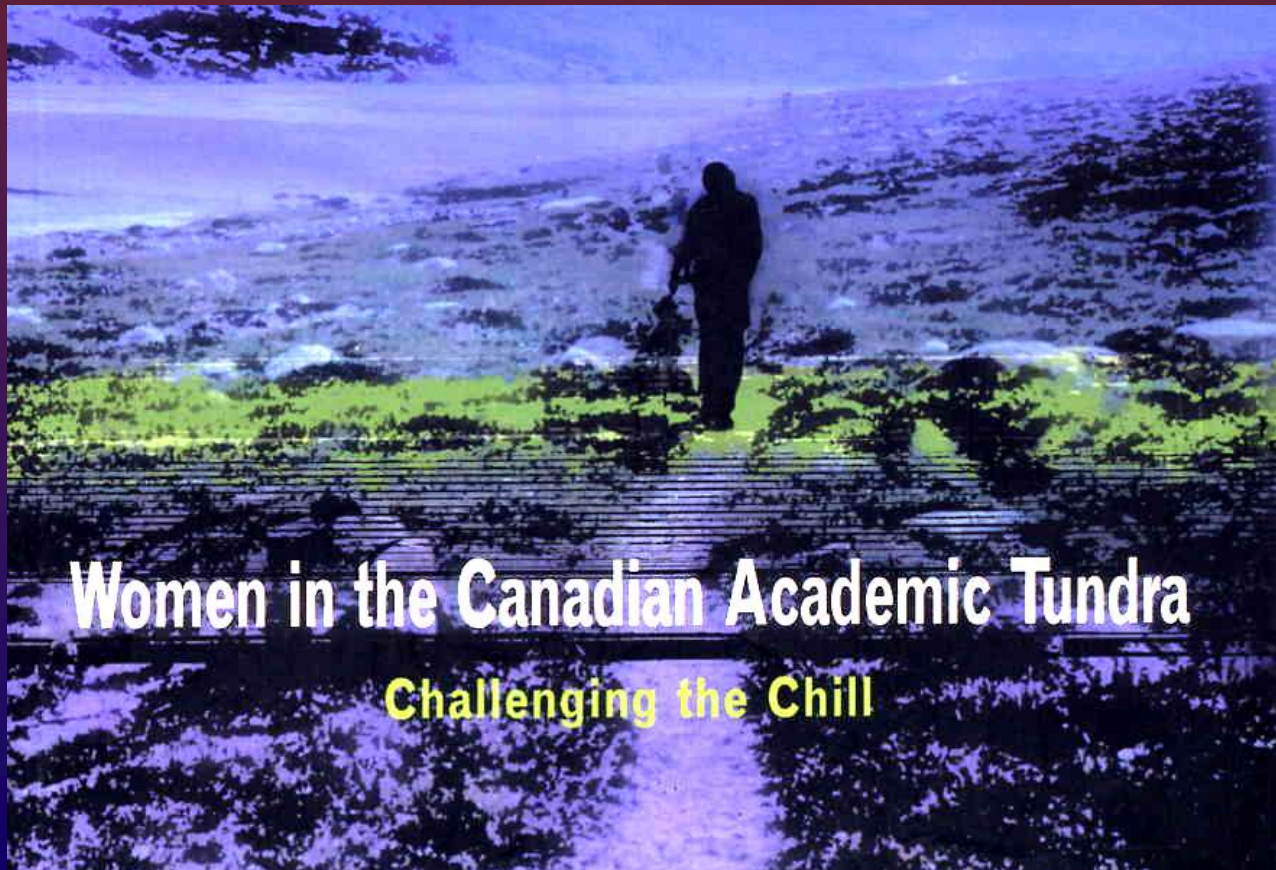


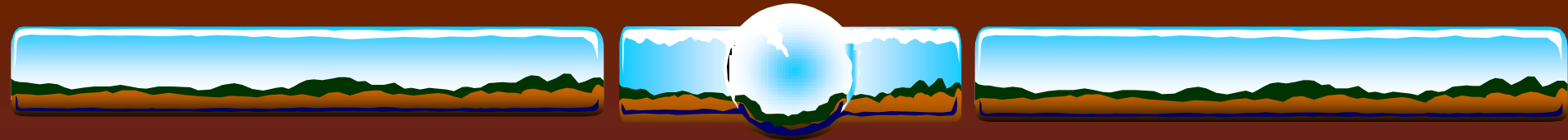
- ❖ “And finally, when the going gets tough and you feel yourself surrounded by jerks, take an anthropological approach. .... Regard yourself as an explorer, having come upon a strange tribe. Observe and describe the tribe’s customs and attitudes with keen detachment and consider publishing your field observations.”



# A Chilly Climate for Women

Dare to Brave: Stand up to the Bullies, L.E. Dyck, 2002





# Key messages from Feminist scientists

- ❖ Women ‘subjects’ have been ‘discriminated’ against in scientific research (eg., heart disease)
- ❖ Women have been discriminated against or excluded from scientific careers or their work ignored, because of societal (patriarchal) bias.
- ❖ Women ask different research Q’s and thus expand the research landscape!



# Feminist science

- ❖ Changed the way we conduct research – collaborative, team research is now the norm.
- ❖ Community-based research is now acceptable.
- ❖ Changed the way we teach science.
- ❖ Has been so successful in attracting women into science that we are the majority in many specialties. The concern now is on the absence of men in universities and in some sciences (eg., Biol, VetMed).





# Dr. Monique Frize

P.Eng., OC, FCAE, FEC, D.U., D.Sc., D.Eng., D.Hum.



- ❖ 1<sup>st</sup> female Elec Eng grad, Uof O
- ❖ 1<sup>st</sup> NSERC Chair WISE, 1989
- ❖ Internationally well known advocate for Women in Engineering



# WEEKEND EXTRA

arPhoenix Saturday, February 10, 2007

Weekend Extra Editor Ted Hainworth

Phone 657-6229 Fax: 657-6437

E1



## Girl Power on Campus

February 10, 2007, Star Phoenix





# What is Aboriginal Science?

- ❖ A1. Traditional or Ancestral Knowledge of astronomy, agriculture, medicine – past knowledge
- ❖ A2. Traditional or Ancestral ways of Knowing
  - ❖ The process of gaining knowledge
  - ❖ Observational skills
  - ❖ Oral tradition
  - ❖ Elders
  - ❖ Holistic world view



# ‘Experts’ on Aboriginal Science

❖ Greg Cajete

❖ David Pete

❖ Leroy Littlebear

❖ Elders, Shamans



# The Medicine Wheel

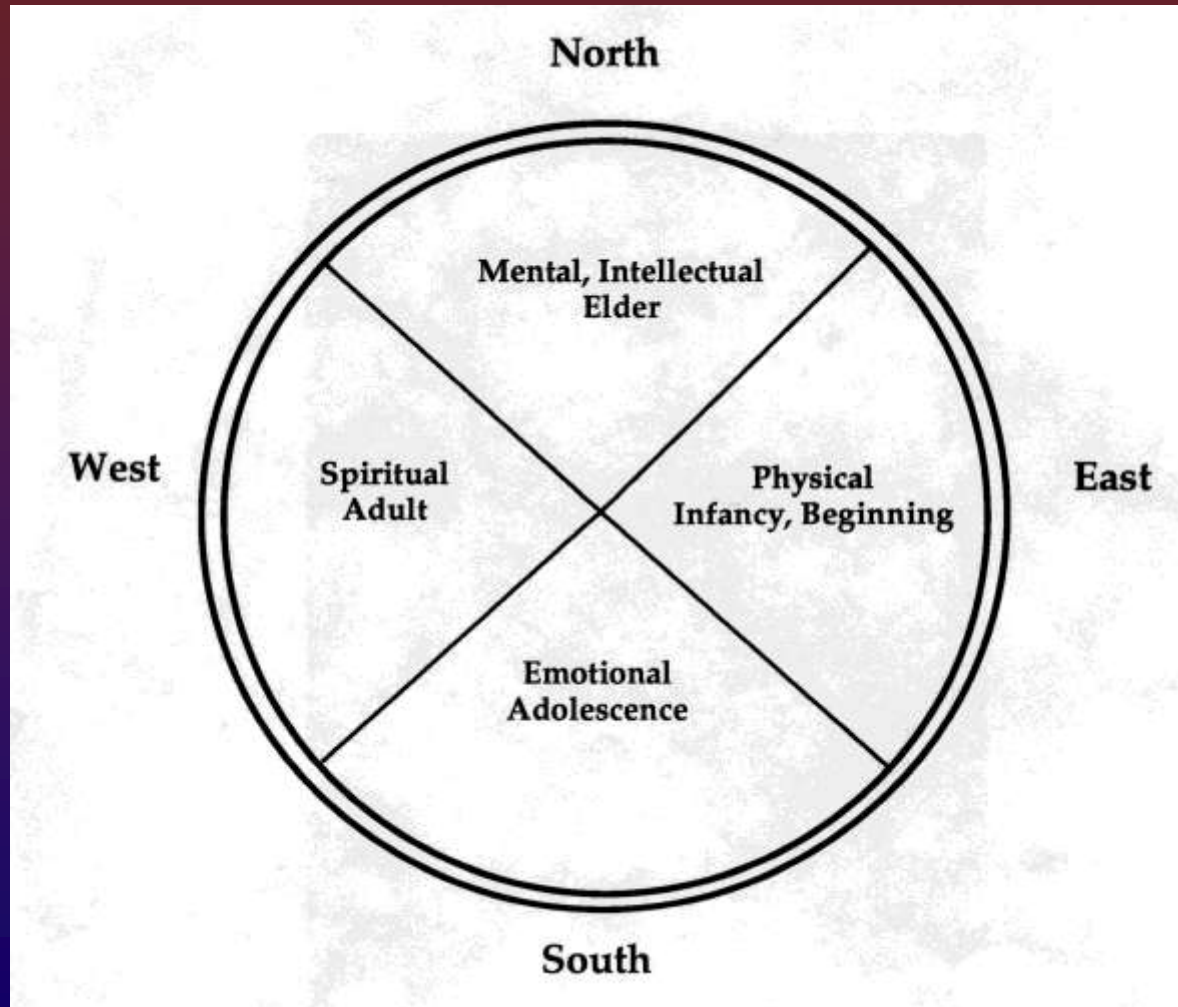
An ancient Indian symbol used to understand ideas, to show how all things are connected.

The foundation of human development.

Describes the four aspects of all things.

Underlies the concept of Balance.

From: **Dyck LE , Native Studies Review 11: 89-102 (1996)**





# East Door – Physical Aspect

## The Initial Training Phase of Science

Learning the language of science

the methods

the Tools, Hands-on science

Observation



# South Door - Emotional

## ❖ The Emotionally “Appealing” aspect of Science

Living and loving science

Science as fun

Defending your findings

Becoming hooked on science



# West door - Spiritual

The Intuitive or Creative Aspect of Science  
is **not** thought to be part of Western science but is  
part of Feminist and Aboriginal science

Using “Inner” wisdom

Gut hunches, intuition

Night-time dreams

Spiritual insight

Consideration of ethical & moral issues



# North door - Mental

## The Wisdom Aspect of Science

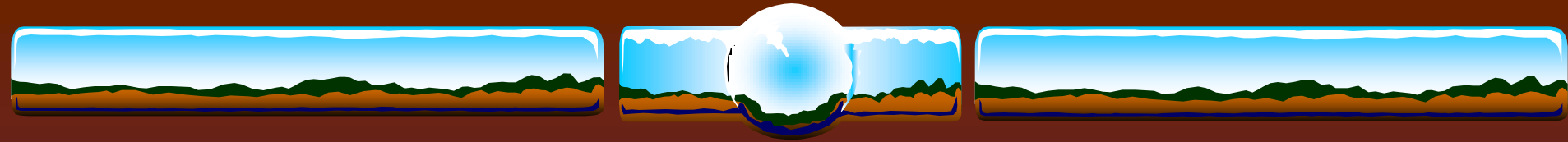
Learning the current state of knowledge.

Developing wisdom via experience.

Until the 90's, most funding for science was for that done by independent PI's.

Doing collaborative science (the norm for Feminist, Aboriginal and other alternative sciences).





- ❖ OOPS! I reversed the E and W doors of the Medicine wheel!
- ❖ The E door should be spiritual,
- ❖ and the W door should be physical.



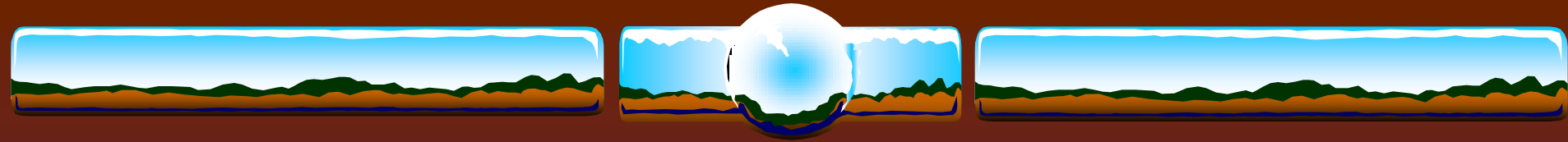
OOPS!

We've actually entered the MW backwards –  
using the W door instead of the E door!

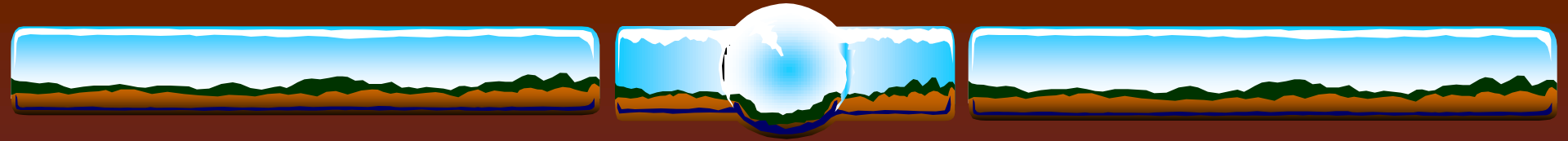
So ... the way we begin to teach or learn  
science is like a breech birth into science!

Because we enter through the West (physical)  
door instead of the East (spiritual) door.

We do not even acknowledge the East  
(spiritual) door in Western science!



❖ The Medicine Wheel analysis shows what is missing in Western science.



The Eastern door, the spiritual aspect of science is missing.

To address this oversight we can:

Build on those things that inspire our target audience (students, etc).

Build on the inner spark, the inner drive or motivation of our target group.

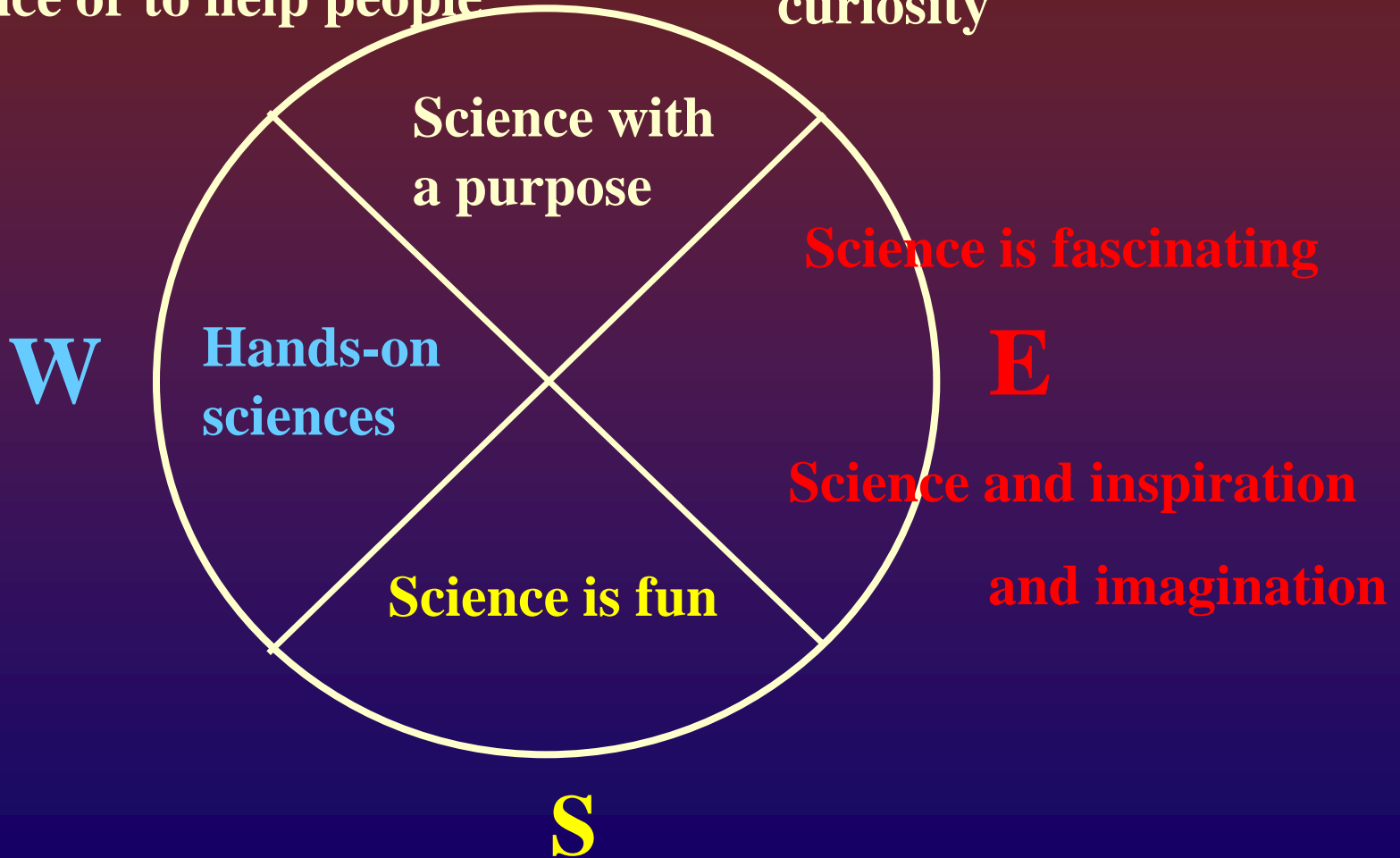


# Using the Medicine Wheel to attract students into Science

Doing science to make a difference or to help people

**N**

Encourage natural curiosity



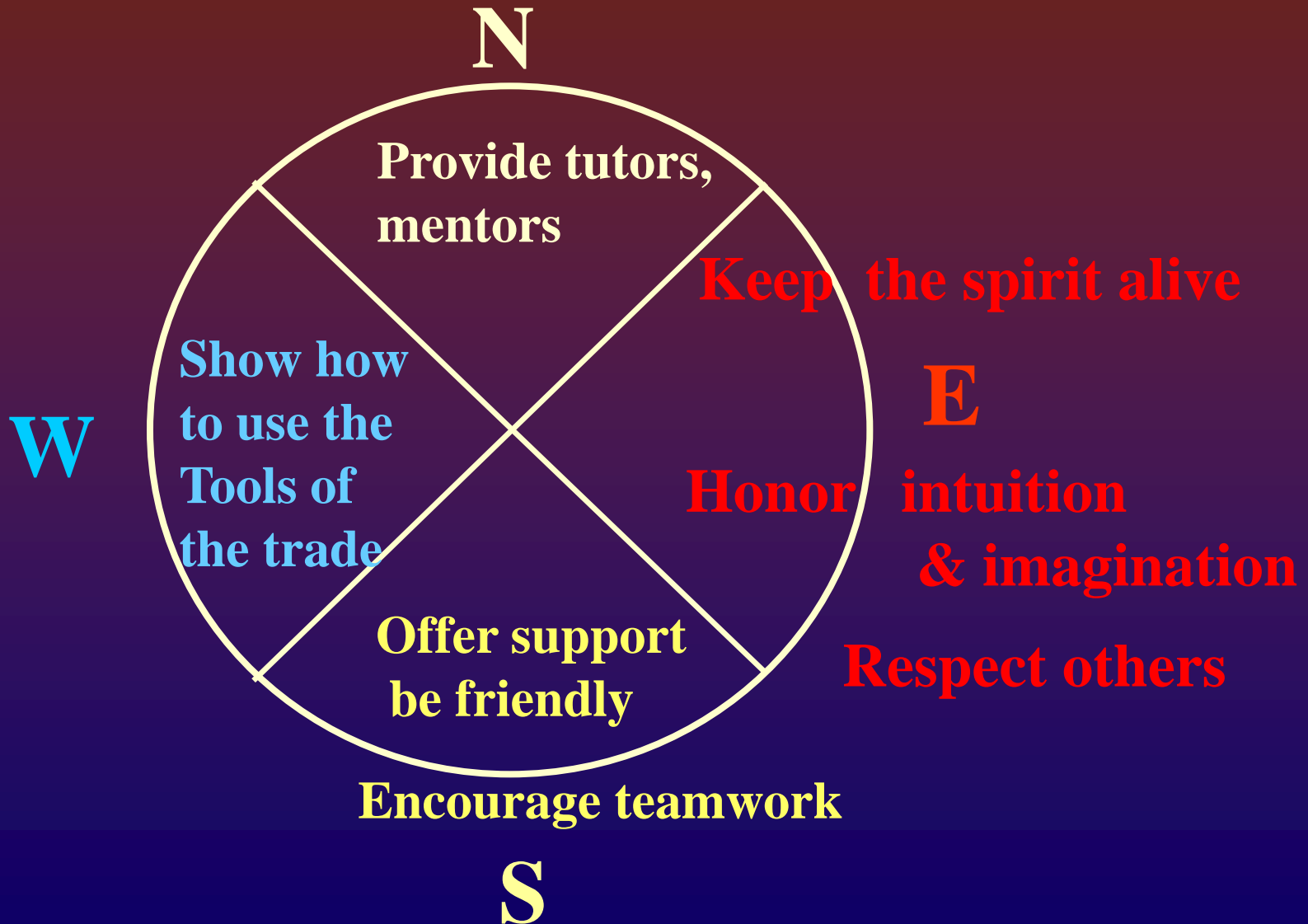


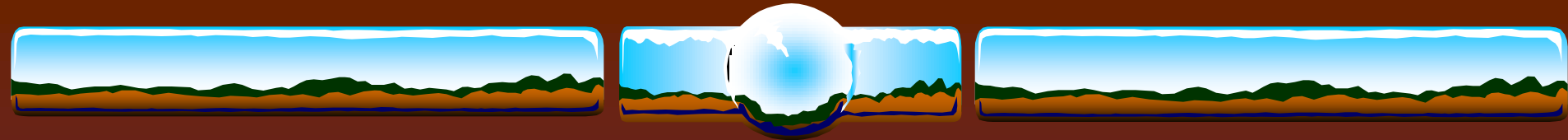
# The Medicine Wheel can identify Obstacles in Science





# The Medicine Wheel & Finding Solutions to Obstacles





- ❖ These models are fluid – some topics may not be in the ‘right’ place in the MW for you.
- ❖ For eg., where should “intuition” go?  
the East or West door?

You will likely think of different topics arising from your own experiences.





# Summary

The Medicine Wheel can be used as an analytical tool.

Doing so, shows that Western Science is unbalanced; there is no Eastern door or Spiritual aspect in science.

Including the Spiritual aspect in the way we teach science and in the way we recruit students may improve recruitment of women and Aboriginals and may increase their retention.



# Creative Science: the ultimate goal

Perhaps to be creative, innovative scientists

We need to honor the unconventional -  
the ideas or hunches - that are hard to explain logically and  
could be called intuitive, spiritual knowledge.