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Acknowledgement

We respectfully acknowledge the Elders and custodians of the Whadjuk Nyungar nation, past and present, their descendants and kin. The Curtin University Bentley Campus enjoys the privilege of being located in Whadjuk / Nyungar Boodjar (country) on the site where the Derbal Yerrigan (Swan River) and the Djarlgarra (Canning River) meet. The area is of great cultural significance and sustains the life and well being of the traditional custodians past and present.

As representatives of Curtin University, we are proud to honour the Nyungar people and value this place of shared learning. We recognise the impacts of colonisation on Indigenous Australians and as active participants in reconciliation, we are committed to moving forward together in a spirit of mutual honour and respect.

Always was and always will be Aboriginal land.

! Aboriginal and Torres Strait Islander users of this material are advised there may be images, viewings, stories, photos and written materials of people which could be disturbing and/or of persons who are deceased.

Image credit: https://www.indigenous.gov.au/news-and-media/event/indigenous-science-conversations

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Indigenous Science and Western Scientific Thinking

Dr Reva Ramiah

Outline

- Definitions of science
- Evolution of science
- What is Western science?
- What is Indigenous science?
- Building bridges

What is Science?

DEFINITIONS OF SCIENCE

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SCIENCE

Originates from the Latin word “scientia” meaning knowledge.

Definitions of Science

Science is the **pursuit and application of knowledge** and understanding of the natural and social world following a systematic methodology based on evidence.
(Science Council UK)

Science is the study of the nature and behaviour of natural things and the **knowledge** that we obtain about them. ... A **science** is a particular branch of **science** such as physics, chemistry, or biology. Physics is the **best** example of a **science** which has developed strong, abstract theories.
~ Unknown

“**Knowledge or a system of knowledge** covering general truths or the operation of general laws especially as obtained and tested through scientific method”

Knowledge

Epistemology:

how knowledge is made or acquired

knowledge making framework

Knowledge: the state of knowing. **Knowledge** as distinguished from ignorance or misunderstanding. Merriam Webster

Epistemology (knowledge production) is culture specific

Image credits: https://www.tes.com/lessons/XlxLVm03Glnxwg/cultural-competence-principles

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Evolution of Science - Timelines

A LOOK BACK IN TIME

image credit: https://www.pinterest.com.au/pin/355...6013380/

Ancient Times through to Middle Ages

- Aboriginal Science
- Babylonian Science
- Egyptian Science
- Indian Science
- Chinese Science
- Greek Science
- Mesoamerican Science

Birth of the 'Scientific Method' (15th-16th century)

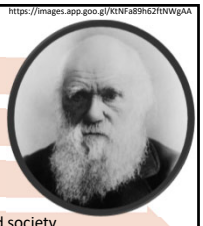
- Nicolaus Copernicus
- Tycho Brahe
- Johannes Kepler
- Francis Bacon
- Galileo Galilei
- Rene Descartes
- Issac Newton

Evidence of Indigenous & Neo-Indigenous Science

40,000 Years Old	Traditional Aboriginal fish traps at Brewarrina fish traps demonstrate a strong scientific knowledge and understanding of tidal patterns
11,000 Years Old	Wurdi Youang – world's first observatory (pre-dating Stonehenge and even the Great Pyramids of Giza)
c. 551 to c. 479 BCE	Chinese astronomers successfully calculated the occurrence of eclipses
3rd century BCE	Indian mathematicians discovered numbers and the decimal notation that the world uses today already appear in the Rock Edicts of the Mauryan emperor Ashoka
780- 850 BCE	"Father" of algebra - Persian mathematician, who wrote on the systematic solution of linear and quadratic equations. His book, *On the Calculation with Hindu Numerals*, was translated into Latin in the twelfth century as *Algoritmi de numero Indorum*.

Evidence of Western Science

https://images.app.goo.gl/KtNFa89h62ftNWgAA



1451	• Christopher Columbus
1454	• Amerigo Vespucci
1514	• The initial appearance of the heliocentric theory of Nicholas Copernicus (1473-1543)
1518	• The London College of Physicians is granted a royal charter and functions both as a traditional professional guild as well as a learned society.
1522	• Ferdinand Magellan famously completes the first circumnavigation of the globe.
1545	• In mathematics, Girolamo Cardano's (1501-1576) The Great Art contained many algebraic innovations and new methods for treating equations of the third degree.
1576	• Construction began on the observatory made famous by Tycho Brahe's (1541-1601), Uraniborg, the 'Fortress of the Heavens, on the Danish island of Hven (now a possession of Sweden). Here Tycho made observations and collected astronomical data aided, over a period of nearly twenty years, by some 48 assistants.
1585	• In mathematics, Simon Stevin (1548-1620) proposes the use of decimals.
1620	• The English attorney and advocate of the 'New Science', Francis Bacon (1561-1626) published his justly famous Novum organum, which sought to establish a method based on observation and experiment in opposition to Aristotle (who wrote the 'original' Organon).
1633	• Galileo is called before the Inquisition in Rome; he is vehemently suspected of heresy for supporting and teaching the Copernicanism hypothesis. After he abjured, Galileo was placed under house arrest for the remainder of his life, his visitors, his mail, and his daily actions were monitored.
1644	• René Descartes' Principles of Philosophy supplies arguments for the Mechanical Philosophy, most notably that the Universe is filled with uniform matter and united across space and time by uniform principles of motion and hence mechanical forms (contact, impact, pressure) of causation.
1669	• Isaac Newton (1642-1727) builds his first reflecting telescope; the design, which includes an eyepiece and a concave mirror, is known today as 'Newtonian'.

Adapted From http://users.clas.ufl.edu/ufhatch/pages/13-NDFE/newton/05-sr-Inq-timeline.htm

Fundamental difference – Conception of Nature

INDIGENOUS, NEO-INDIGENOUS SCIENCES & ANCIENT GREEK SCIENCE

WESTERN SCIENTIFIC METHOD
1600s

Nature is a manifestation of super-nature:

The supernatural and unobservable

Nature now is only what is observable in the world

(Betz, 2011)

Western Science

LEAPING FORWARD

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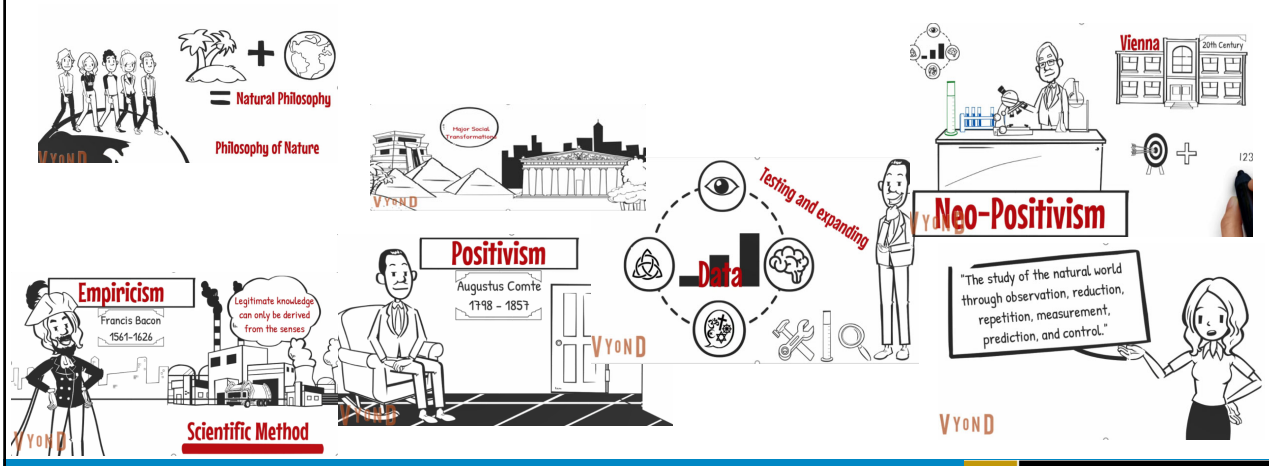
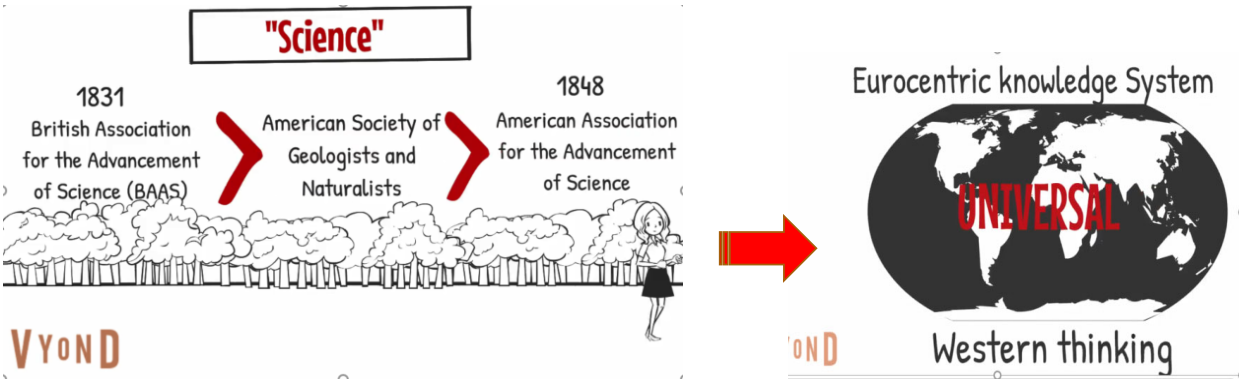
The Origins of Modern Science



The Origins of Modern Science



Characteristics of Western Science

1. The earth, solar system, and all life forms are products of two separate and basically unrelated events caused by the accidental coming together of cosmic materials and chemical reactions.
2. No spiritual entities exist, creative or otherwise.
3. Current life on earth is the latest stage in the process of evolution as first defined by Charles Darwin.
4. Each form of life evolved separately. Even though humankind shares a common origin with all life, it does not have an intimate relationship with other life forms.
5. Humankind is the *ultimate expression* of the evolutionary process and as such, is superior to other life forms.
6. The ultimate purpose of humankind – and of Western science – is to advance the progress of humankind.

(Pavlik, 2007)

Characteristics of Western Science (Pavlik, 2007

7. All other life forms exist for the pleasure, use and advancement of humankind.
8. While most environmental problems are acknowledged to be the mistakes of humans, the need to solve them is directly tied to the desire to enhance the quality of *human* life.
9. There are no limits placed on the quest for knowledge.
10. Only the knowledge that can be proven using the scientific method is considered legitimate and accepted as fact.
11. Those things which are abstract in the natural world are dismissed as being of no relevance or importance.
12. In the end, science will ultimately provide the answer to all environmental problems.

(Pavlik, 2007)

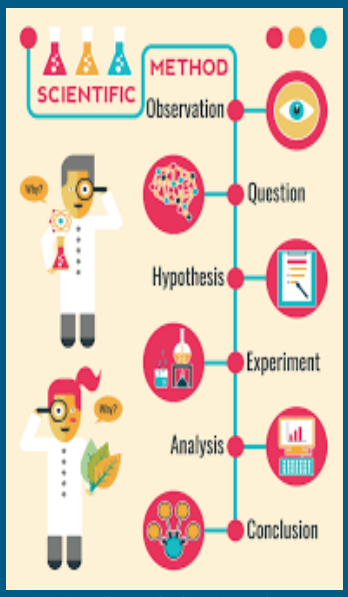


Image credit :https://newmr.org/blog/what-is-the-scientific-method-and-how-does-it-relate-to-insights-and-market-research/

Summary of characteristics of western science/scientific method

- Replicability
- Testability
- Generalisable
- Empirical (grounded in observation)
- Parsimony
- **Objectivity**

Thomas Kuhn and Paradigms

Image credit: https://cosmosmagazine.com/physics/this-week-in-science-history-the-paradigm-shifter-dies

Kuhn's proposed that in science the notion of objectivity is about "…consensus making within a community of practitioners determines scientific truth – it does not achieve objectivity but instead reduces the subjectivities of individual scientists… (Aikenhead and Ogawa, 2007)

Issues of privilege that come with 'science'

"In science, like many other professions, better-off individuals and those educated at elite institutions such as Eton College, UK, are often over-represented."

Nature Vol 537 23 September 2016

The practice of 'science' in all senses continues to perpetuate inequality in terms of:

- Race
- Gender
- Ethnicity
- Social Class

What is Indigenous Science?

FOUNDATIONS OF INDIGENOUS SCIENCE

Indigenous Science

Other more common references:

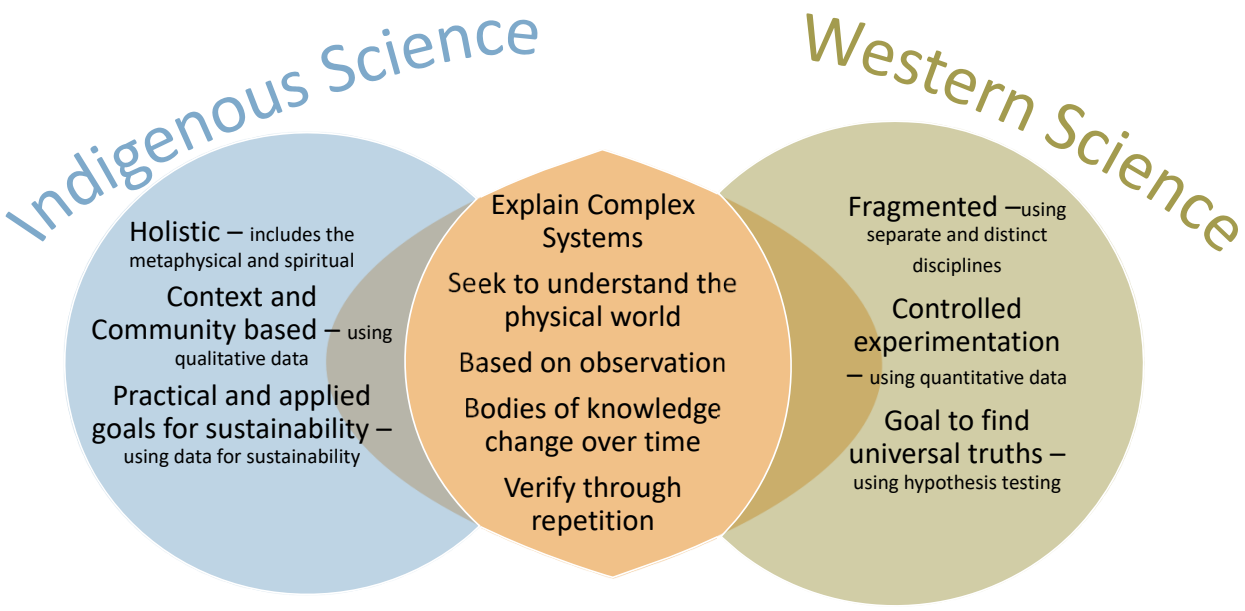
- Indigenous knowledge
- Traditional Ecological knowledge
- Traditional Ecological Knowledge and Wisdom

Indigenous Science

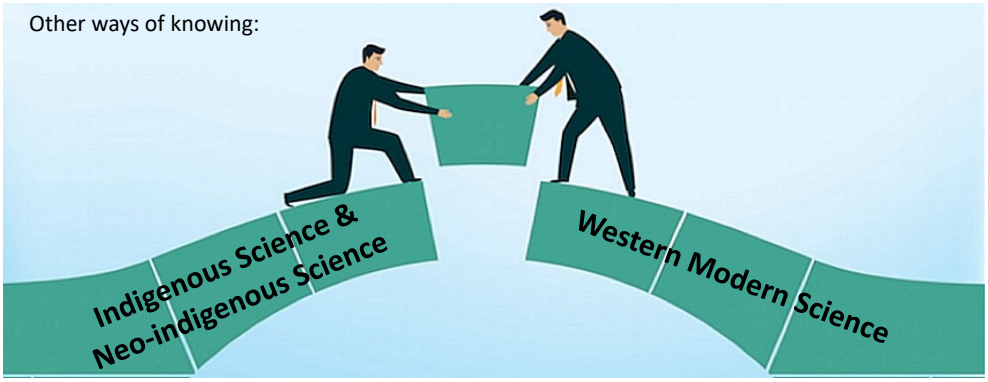
Underpinned by traditional wisdom:

- *an understanding that spiritual essence infuses and defines all forms,*
- *and that all life forms must be respected as conscious, intrinsically invaluable, and interdependent.*
- *extends the caring relationships associated with "family" life to communities and even to the environment.*
- *we are all related, it is wrong to exploit other life forms or take more than one's share.*
- *all creatures can be our teachers and while humans may readily affect other life forms, we need not see ourselves as superior.* (p. 29).

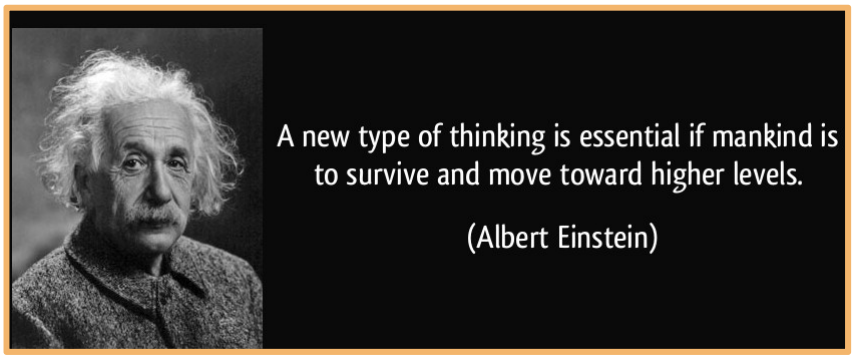
Corsiglia and Snively, 1997



Building Bridges



"… build bridges between…Eurocentric knowledge systems and other ways of knowing, thereby spanning the colonial false dichotomy between science and Indigenous ways of knowing nature."
(Aikenhead and Ogawa, 2007, p.540)



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Justin Martin, Susan Milne and Greg Stonehouse, *NGOOK – Beehive*, stainless steel and LED lights, 386 x 140 x 140cm, Curtin University Art Collecting commissioned 2017

'Ngook (honey) was a prized commodity and used by the Nyungar people of Western Australia for many different purposes… Honey was one of the sweetest delights for Nyungar people. It was mixed with ground local saps, flowers and plant species and used for medicinal purposes for Nyungar people. It is a natural remedy for sores, cuts and bruises. One of the more common activities honey was used for is to create sweet drinks, which many people still practice today.' (taken from the Justin Martin, Susan Milne and Greg Stonehouse proposal, 2017).

Curtin University Art Collection.

See Our Artist Tab in Blackboard