Wits scientists debunk climate change myths, impact remains severe

News flash 26\textsuperscript{th} February 2014
Iphakade and the Art of Climate Cycle Maintenance

see: ‘Zen and the Art of Motorcycle Maintenance’ – An Inquiry into Values is a 1974 philosophical novel, the first of Robert M. Pirsig’s texts in which he explores his Metaphysics of Quality. The book sold 5 million copies worldwide; and was a cult book when I was at University.

Teaching and inculcating Iphakade - Earth Stewardship Science using concepts of adaption and mitigation with 2020 vision
Earth Stewardship Science

Borrowed from Xhosa Culture

Iphakade

‘observe the present and consider the past to ponder the future’
*Earth Stewardship* — ethical, democratic management of the physical and living systems of our planet:
Earth as in ‘Commons’

*Science* is used here in the broadest sense of the word, covering all fields of scientific enquiry: a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions across the natural, social, health and engineering sciences; a body of knowledge of the type that can be rationally explained and reliably applied.

*Earth Stewardship Science* is a new, broad intellectual field in tune with contemporary global perspectives of the world and its complexities. Its consilience approach seeks a deeper understanding of people and planet issues of both local and global significance; and has the potential to make a major impact on the way Africa manages its resources — and how it responds to the many pressures on diversity, environment, and society; and how it relates to poverty and well-being.
The Earth-is a gigantic recycling machine
An Evolving planet of coevolving systems
First evidence of water on the planet.
Energy budget of Sun and Earth

Sun’s size and radiation 23% increase

EXOSPHERE
(atmosphere, hydrosphere, cryosphere, biosphere)

Earth’s internal radioactive heat production 80% decrease

millions of years (10^6 years)
Earth is 4560 million years old
Africa is 120 million years old
Primates: 65 million years ago
Humans: 0.2 million ago

Oldest Homo *Sapiens* fossils & symbolic artefacts
Cape Caves: ‘Cradle of Culture’

Africa emerges as a continent

Earth is 4560 million years old
Africa is 120 million years old
Primates: 65 million years ago
Humans: 0.2 million ago

Oldest fossils of World in Mpumalanga
Makonjwa Mountians: ‘Cradle of Life’

Sustainable Life on Earth emerges

Anthropocene
Humans emerge
Sustainable?
Expanded continental shelf with sea level ca 120 m lower than today;
Southern Coastal Plain expanded by ca twice the area of the Kruger National Park

Adapted from Compton (2011)
Solid Earth
A Dialogue of Scientists

What's inside......

.....how does it work?
..................how did it start?
..............................................how can we can fix it?
origins

“self-organization”
Everywhere, everything is on the move
Living in the Anthropocene & Facing the Anthropocide

Destruction.
Dialogue between the HUMAN and NATURAL SCIENCES on a SUSTAINABLE FUTURE

Maarten de Wit, Chair: Earth Stewardship Science
Nelson Mandela Metropolitan University
55 years ago, CP Snow argued that the failure of science and the humanities to converse was disastrous for society:
‘It is the perceived need for intense specialization of any kind in history or physics, in languages or biology that needs to be tackled’.

CP Snow also foresaw applied science and engineering as holding the key to a humane future, in terms of a rational understanding of nature but also as the only force that could tackle the problems of well-being in developed and developing countries.
55 years on

• *In almost all countries, a gulf of understanding has opened up by the time students enter university*”  
  (CP Snow, 1959)

• “The real enemy of understanding is not just the ‘two cultures’ but specialization in all disciplines”  
  (M Kemp, 2009)

**Why are we still debating this?**
Colonization of Nature

Since the beginning of the 19th Century, by its own growing activities, Mankind opened a new geological era: the Anthropocene.

We are clearly affecting climate and can deliberately do so.
An estimated 863 million people reside in slums in the developing world.
and dehumanised
What’s gone wrong?

Housing development in Mexico City—yes, it’s real.
This is not the work of ignorant people...

It is, rather, largely the result of the "most highly educated" workforce in the history of humankind, people with:

- BAs.....
- BSs.......
- MEs.......
- Ph.Ds......
- LLBs......
- MBAs, etc.
Cartesian science and its emphasis on *parts* instead of *wholes* replaced a spiritual view of a ‘whole’ universe with that of a fragmented and mechanized one.

A collection of objects...
Physical Laws of the Universe......

Don't apply here...

Only apply here...
“Earth Stewardship Science”
& new discourse for sustainable living, green activism
and citizen science in the Anthropocene”
Accelerated progress and bolder action are needed in many areas

Environmental sustainability is under severe threat, demanding a new level of global cooperation.

The growth in global emissions of carbon dioxide (CO2) is accelerating, and emissions today are more than 46 per cent higher than their 1990 level.

Forests continue to be lost at an alarming rate.

Overexploitation of marine fish stocks is resulting in diminished yields.

More of the earth’s land and marine areas are under protection, but birds, mammals and other species are heading for extinction at an ever faster rate, with declines in both populations and distribution.

The Millennium Development Goals Report, July 04, 2013
What have we done?

Mortgaged the future?

• Explosion of debt
• Next generation less well off?
• Intergenerational debt
• Unaffordable university education and health
• Borne bankrupt
• What will we do for the next ½ century?
• What should we do before 2020?
Technical, social and environmental challenges you and your kids will face for the next 50 years:

• Demand for their new skills will vastly outpace your capacity to teach them.
• Half-lives of your/their skills are shrinking.
• Mass unemployment is endemic.
• Private employers will not take on their labour as an act of charity.
• Their collective purposes will contain competing objectives.
• Your/Their development is linked to an exponential knowledge-curve based on creativity-technology.
• Their communication systems, language and art-forms metamorphose faster than yours.
• Our environments are metastable
Next generation standards

• Virtually all Africa’s (the world’s) most urgent problems require collective, integrative action – be it environmental protection, energy needs, infrastructure, water/food security, financial system overhaul, run-away inequality, well-being or basic research.

• Why then do universities continue to separate their students and their research and place them in silos?

• Is continuation along this path the best way to train them to address increasingly complex problems?
Living in the Anthropocene

We now live in the Anthropocene Era. We are still only beginning to comprehend how much radical re-thinking we will need to understand the forces with which we are shaping and transforming the planet and how to best to manage them. The scale of forces this time is planetary – the time scale a century or more, the stakes are what we might call civilization – and it is all taking place at the headlong speed of self-accelerating human need, greed, technology and environmental turbulence. And it is not the earth, not life, but humans who are in trouble, because whilst we might know what things cost, we mostly have no idea what they are worth.

We need a new holistic approach to stimulate inquisitiveness, self-motivation, creativity, knowledge retention and responsibility of the learner in the school, university and beyond.................. HOW?

Fundamental Requirement:
understanding the evolving dynamics and complexity of systems
STEWARDSHIP of SYSTEMS

- How nature works
- How earth works
- How societies work
- How interactive systems work
- How systems collapse
• How do things emerge?
• How does collaboration emerge?
• How does inequality emerge?
• How do things fall apart — *dissipate*?
• How does complexity emerge and collapse?
• What are the risks?

There is no system without evolution
Self organized system
how do group skills emerge?
Population... issues are not so simple anymore
The aim of *Earth Stewardship Science* is to search for something fundamental about the interactive dynamics of complex natural and social systems, about how such complex systems emerge and dissipate, and how systems sometimes bounce back, yet at other times take unexpected turns when confronted with internal and external forces?

*Earth Stewardship Science* will explore this in a transdisciplinary way, using examples taken from our planet, its ecosystems, its organic life, and human cultures, to learn more about interactive processes with their myriads of feedbacks.
New learning and teaching tools

Networks, communications
Risks Interconnection Map 2011 illustrating systemic interdependencies in the hyper-connected world we are living in.

doi:10.1038/nature12047
KEEPING TRACK of our evolving environment

Globalization
- 12% biodiversity decline globally
- 60% women parliamentarians increase
- 21 megacities
- +0.4°C global mean temperature rise
- +75% GDP
- Ocean Acidity from 8.11 to 8.06 pH
- 36% increase in CO₂ emissions

Efficiency
- +130% plastics production
- Ozone depleting substances down 93%
- 13% renewable energy sources
- Global warming
- Sustainable living
- Energy technology
- Drinking water coverage up 13%
- Slum dwellers up 171 million

Population +26%

From Rio to Rio+20 (1992-2012)
Where will our energy come from?
How will this all work out?

- Oil price
- Climate change events
- CCS development
- UCG development
- Renewables cost reduction
- Carbon pricing
- New breakthrough technologies
- Water availability
- Energy efficiency success
- Public acceptance of nuclear
- Shale gas developments
- Off-Shore gas
Globally networked risks and how to respond

Today’s strongly connected, global networks have produced highly interdependent systems that we do not understand and cannot control well. These systems are vulnerable to failure at all scales, posing serious threats to society, even when external shocks are absent. As the complexity and interaction strengths in our networked world increase, wo/man-made systems can become unstable, creating uncontrollable situations even when decision-makers are well-skilled, have all data and technology at their disposal, and do their best. To make these systems manageable, a fundamental redesign is needed.

A ‘Global Systems Science’ or ‘Earth Stewardship Science’, might create the required knowledge and paradigm shift in thinking, collaboration and evolving dialogue.
„How to manage a habitable planet“

Living systems and the changing Earth
The Inevitable

Executive Summary:

Crutzen Somewhat Simplified
Seitz Somewhat Simplified

Microbubbles Injected into Hydrosphere
(Sky Stays Blue)

Aerosols Injected into Stratosphere
(Sea Stays Dark)

Sky Gets Lighter

Water Gets Brighter
Plan B

Geo-Engineer Climate Change
Inject sulfate aerosols into the atmosphere

more geo-mimicry

Paul Crutzen
Annual Average Surface Temperature

2xCO2 - Control

A giant airconditioner

Geo-SO4/2xCO2 - Control
Making clouds underwater

WATER SUPERSATURATED WITH COMPRESSED AIR

BEING RELEASED THROUGH A VORTEX NOZZLE

Start                               Stop                   2 minutes later

Start                                Stop                      2 minutes later
Local can add up to global: GCM runs based on hydrosol physics show a 5% ocean albedo rise more than offsets warming from doubled CO2.

CAM 3.1 model: temperature change in Kelvins from global ocean albedo increase of .05 with 780 ppm CO2 doubling
Risk, systemic risk and hyper-risk

Globalization and technological revolutions are changing our planet. Today we have a worldwide exchange of people, goods, money, information, and ideas, which has produced many new opportunities, services and benefits for humanity. At the same time, however, the underlying networks have created pathways along which dangerous and damaging events can spread rapidly and globally. This has increased systemic risks.

The related societal costs are huge.
"Empty World" Model of the Economy

Based on a simplistic view of capital and narrow definition of GDP

Perfect Substitutability Between Factors

Manufactured capital
Labor
Land

Property rights

Private
Public

Economic Process

Goods and Services

GNP

Individual Utility/welfare

Cultural Norms and Policy

Consumption
(based on fixed preferences)

Investment
(decisions about, taxes, government spending, education, science and technology policy, etc., based on existing property rights regimes)

Basic premises:

More is always better
The economy can grow forever
Private property is always best

This has been tried and should now be discarded
OF COURSE IRAQ IS FREE!
DIDN'T COST US A DIME.
THE PUBLIC PAID FOR
THE WHOLE OPERATION!
Ecological Economics and the War on Externalities

Inculcating the value of nature into our economy and commerce:

EARTH IS A GOODS AND SERVICES PROVIDER, BUT NOT A BOTTOMLESS PIT OF FREEBEES

Materially closed earth system
Environmental - Economic Interface System

concepts and definitions ...
Can we learn to mimic nature?
Earth Stewardship Science

with everyone a stakeholder
Marikana platinum mine in Rustenburg, South Africa

The stark facts

Not everyone is a stakeholder
• Stewardship: living in the anthropocene
• Systems: how they emerge, work and dissipate
• Learning about the past to plan for the future
• Interdisciplinary thinking and implementation
• Resources and Values
• Stewardship and Culture in Africa
The True Size of Africa

A small contribution in the fight against rampant illiteracy, by Kai Krause

Graphic layout for visualization only. Some countries are cut and rotated. But the conclusions are very accurate: refer to table below for exact data.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>AREA x 1,000 km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>9.597</td>
</tr>
<tr>
<td>USA</td>
<td>9.629</td>
</tr>
<tr>
<td>India</td>
<td>3.287</td>
</tr>
<tr>
<td>Mexico</td>
<td>1.964</td>
</tr>
<tr>
<td>Peru</td>
<td>1.285</td>
</tr>
<tr>
<td>France</td>
<td>633</td>
</tr>
<tr>
<td>Spain</td>
<td>506</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>462</td>
</tr>
<tr>
<td>Sweden</td>
<td>441</td>
</tr>
<tr>
<td>Japan</td>
<td>378</td>
</tr>
<tr>
<td>Germany</td>
<td>357</td>
</tr>
<tr>
<td>Norway</td>
<td>324</td>
</tr>
<tr>
<td>Italy</td>
<td>301</td>
</tr>
<tr>
<td>New Zealand</td>
<td>270</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>243</td>
</tr>
<tr>
<td>Nepal</td>
<td>147</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>144</td>
</tr>
<tr>
<td>Greece</td>
<td>132</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30.102</td>
</tr>
<tr>
<td>AFRICA</td>
<td>30.221</td>
</tr>
</tbody>
</table>

In addition to the well known social issues of illiteracy and innumeracy, there should also be such a concept as “immappancy”, meaning insufficient geographical knowledge.

A survey with random American schoolkids let them guess the population and land area of their country. Not entirely unexpected, but still rather unsettling, the majority chose “2-3 billion” and “largest in the world”, respectively.

Even with Asian and European college students, geographical estimates were often off by factors of 2-3. This is partly due to the highly distorted nature of the predominantly used mapping projections (such as Mercator).

A particularly extreme example is the worldwide misjudgement of the true size of Africa. This single image tries to embody the massive scale, which is larger than the USA, China, India, Japan, and all of Europe......combined!
Fig. 4. World of R&D in 2010. Size of circle reflects the relative amount of annual R&D spending by the country noted. [Reproduced by permission of R&D Magazine (28)]
Human development index and electricity consumption

In the year 1500 European territories were some of the wealthiest on earth, when measured by the Gross Domestic Product (GDP) per person.

The regions with the largest total GDPS were Eastern Asia and Southern Asia. These were also the most populous regions at that time.

The regions with the lowest GDP in 1500 were Central Africa and Southeastern Africa. These regions also had the lowest GDP per person. In 2002 these regions enjoyed an even smaller proportion of the world total GDP expressed in purchasing power parity dollars than they did in 1500.

Territory size shows the proportion of worldwide Gross Domestic Product equalised in US$ in purchasing power parity that was produced there in 1500.

“Slaves captured in raids and war grew in importance as a commodity ... Kola nuts ... were also important, as were the dyestuff of northern Nigeria. All these goods were highly prized in and around the Mediterranean basin.” Richard Effland, 2003
Wealth Year 1900

By the 1900s Western Europe had experienced an industrial revolution. Workers who may previously have performed all stages of a production process in their own homes were now in mechanised factories with a greater division of labour. This increased efficiency and therefore output.

In the period between 1500 to 1900 the world average of Gross Domestic Product per person had doubled. The world population had also risen over this period, thus the rise in total Gross Domestic Product was even greater than the per person increases. In 1900 the world total was US$2 trillion when expressed in 1990 purchasing power parity.

Territory size shows the proportion of worldwide Gross Domestic Product measured in US$ equalised for purchasing power parity that was produced there in 1900.

“The industrial revolution ... enormously increased the capacity of some groups, mostly Europeans at first, to produce goods and services. It greatly altered the distribution of wealth and poverty around the world ...”  National Centre for History, 2006
In 1960 most of the world’s wealth was recorded as being produced in North America and Western Europe. Wealth distribution maintained a similar pattern to that in 1900, except that the proportion of world wealth found in Asian territories generally decreased, whilst it tended to increase in South American territories.

The highest levels of Gross Domestic Product per person in 1960 were in the small Middle Eastern territories of Qatar, Kuwait and the United Arab Emirates. The territories with the lowest Gross Domestic Product per person were mainly in Northern Africa and Southeastern Africa.

“...The first Asian economic miracle was Japan’s after World War II, rooted in the changes of the Meiji restoration... The Asian Tigers... began to emerge from 1960 onward...”

Luis Alberto Moreno, 2006

www.worldmapper.org © Copyright 2006 SASI Group (University of Sheffield) and Mark Newman (University of Michigan)
In 1990 the region with the lowest wealth or Gross Domestic Product (GDP) was Central Africa. The GDP of Central Africa was 0.8% of the GDP of the richest region, North America. If just 1% of the North America’s GDP had been redistributed to Central Africa the region’s GDP would have more than doubled.

Wealth per person had doubled since 1960, and the world GDP rose from PPP US$8 trillion to US$27 trillion over these thirty years. This vast increase in wealth was distributed in a broadly similar pattern to 30 years before. One change is the growth of Japan, China, the Republic of Korea and Taiwan.

 Territory size shows the proportion of worldwide Gross Domestic Product measured in US$ equalised for purchasing power parity that was produced there in 1990.

“As of 1990 ... the Korean stock market was equal in size to all the emerging markets of East Asia combined.”

Andrew Horvat, 2005
Wealth Year 2015

The projected wealth of China in 2015 could mean it producing 27% of all the wealth in the world, if the economic trends established between 1975 and 2002 continue for another 13 years. In year 1 of the current era China produced 26% of the wealth in the world, but very slowly declined to generating only 5% of the world total in 1960.

Whilst China is predicted to recover its former position within the world economy, this time instead of the Americas having a very small percentage of world wealth, as in year 1, now it is African territories that are predicted to remain small on the international financial stage. Eastern European territories are also predicted to have decreasing proportions of world wealth.

Territory size shows the proportion of worldwide Gross Domestic Product measured in US$ equalised for purchasing power parity to be produced there in 2015.

“Asia’s rise is the economic event of our age. Should it proceed as it has over the last few decades, it will bring the two centuries of global domination by Europe and, subsequently, its giant North American offshoot to an end.”

Martin Wolf, 2003

www.worldmapper.org © Copyright 2006 SASI Group (University of Sheffield) and Mark Newman (University of Michigan)
A Growth Ethic...

“There are no great limits to growth because there are no limits of human intelligence, imagination, and wonder.”

(Ronald Reagan 40th president of US)

“Growth for the sake of growth is the ideology of the cancer cell.”

Edward Abbey
Exponential Growth...

The failure to understand the concept of exponential growth by those “in charge” may be the single biggest problem we face...

Doubling Time = \( \frac{70}{n} \) years

<table>
<thead>
<tr>
<th>Growth rate</th>
<th>D time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>24 yrs</td>
</tr>
<tr>
<td>5%</td>
<td>14 yrs</td>
</tr>
<tr>
<td>7%</td>
<td>10 yrs</td>
</tr>
<tr>
<td>10%</td>
<td>7 yrs</td>
</tr>
</tbody>
</table>

CO2 emissions rising 10 per cent from 1990 to 2000 and 33 per cent from 2000 to 2010.
Global Population... Migration and urbanization

Brain drain, globalization, coastal and city crowding, xenophobia and discrimination, dying rural towns...

The number of people uprooted by conflict or persecution is at its highest level in 18 years

Developing regions carry the heaviest burden in hosting uprooted populations. By the end of 2012, developing countries hosted 8.5 million refugees, accounting for 81 per cent of the refugee population falling under the aegis of the UNHCR. In 2012, least developed countries provided asylum to 2.5 million of those refugees.
Earth Stewardship Science must be challenging

• Why are you at university; what do you want & why do you want it?
• Does your communication and conversation at university need recasting?
• Can you learn to live an ethical life without reference to post-mortem rewards or punishment?
• What do social democracy/eco-socialism and the local/global Commons mean to you?
• If something is profoundly wrong with the way you live – What is to be done?
The return of people to the streets, on this epic scale, is a powerful step forward.

The green movement: YOU can do it too

Egypt today: a revolutionary pursuit of social justice and an end to state violence against citizens.
Increased heritage and scientific proof of genomics
Enlivened arts and social traditions
Enhanced flow of knowledge, health, science and ideas
Fostered science and scientists across Africa
Sustained academic networks
New product innovation and derivation

Earth Stewardship Science

‘observe the present and consider the past to ponder the future’
If ALL Africans are stakeholders - Something sustainable will emerge
Aim  
critical thinking and teaching outside the box  
to induce and catalyse the emergence of a new  
trans-disciplinary science – called Earth  
Stewardship Science – that will integrate research  
on, and teaching in, our understanding of the  
dynamic resilience of our Earth-Life-Social System  
and help us to better define our life support  
systems within which we will mitigate, adapt, and  
manage the global commons in the Anthropocene  
under the isiXhosa motto ‘Iphakade’:  

“Observe the present and consider the past to ponder the future”.
Africa Alive Corridors

Autobiography of the continent told along 20 corridors
12. Saharan Paradise Lost Corridor (Niger to Chad)

22,000 BP – present
‘The rock-art gallery traces desertification’

• Rock art & fossils: from forest to desert
  • The Sahara in global context (climate change)
• Sahelanthropus, the earliest known hominid
A warning from other species

First Cultural evidence for severe climate change:

7000 years ago the Sahara was a lush place to live, then changed very rapidly

Oldest evidence of Human activity: 7 million years old hominin fossils (Chad)

Corridor 12

‘Saharan Paradise Lost’ (Niger, Algeria, Libya, Chad): 20,000 BP to present; one of the greatest rock art galleries on Earth traces the desertification of the Sahara from a savannah paradise to the most extensive desert—a clear tale of global warming.
Revive the art of story telling through
ArtScience

“A people are as healthy and confident as the stories they tell themselves. Sick storytellers can make nations sick. Without stories we would go mad. Life would lose it’s moorings or orientation... Stories can conquer fear, you know. They can make the heart larger.”

Ben Okri – *The Famished Road*
The Entire IPCC Report in 19 Illustrated Haiku

A work of art that doubles as powerful talking points and a visual guide

Reports released by the Intergovernmental Panel on Climate Change (IPCC) can be daunting, even for science and policy insiders. The full Physical Science Assessment, the first instalment of the Fifth Assessment Report (pdf), released in manuscript form earlier this year, is over 2,000 pages long.

And even the Summary for Policymakers, rather optimistically referred to as a “brochure,” is a dense 27 pages.

What if we could communicate the essence of this important information in plain language and pictures? Well, that’s just what one Northwest oceanographer Greg Johnson has done. He’s distilled the entire report into 19 illustrated haiku.

The result is stunning, sobering, and brilliant. It’s poetry. It’s a work of art. But it doubles as clear, concise, powerful talking points and a compelling visual guide.
CLIMATE CHANGE SCIENCE 2013: HAIKU

Gregory C. Johnson
Big, fast carbon surge:
Ice melts, oceans heat and rise.
Air warms by decades.
Carbon increases:
Air warms through century past.
More heavy rains fall.
Abyss warms, coasts flood.
Air moistens – salt patterns shift.
Carbon sours oceans.
Seas rise as they warm.
Rates quicken last century.
Melting ice joins in.

WATER MEETS EARTH
CO2, methane
warm despite sun-spots, dust, soot, clouds, and volcanoes.
We burn more carbon air warms for decades – but seas . . . for millennia.
Models of climate improve with time and details . . . capture big patterns.
Recent air warming slowed by volcanoes and sun?
Seas sequester heat.
Forty years from now children will live in a world shaped by our choices.
we must ensure that these kids become “stakeholders of Africa”
The Berlin Wall 2.0
Earth Stewardship needs Disruptive Innovation

6 habits of mind that characterize disruptive innovators:

• Associating
• Questioning
• Observing
• Networking
• Experimenting
• Multi-tasking
Innovation — Can it be learned?

Innovators excel at connecting seemingly unconnected things
Creative associations come from broadening your experiences

The best innovators are T-Shaped: they need to have depth in one area and breadth in lots

The taste for questions is linked to a talent for observation
Why aren’t things done differently?

Language and SMS
Physics for Poets/DNA for the Arts
The complexity of sound/music
The economics of nature
The business of waste
The ethics of living
Ill-being and environmental decay
The communication revolution & mobile learning
The networking society
Experiments and self-assembly
Some questions

- How do societies fail or survive?
- Where do we come from; how did everything begin?
- How resilient is Earth to impacts of human activities?
- What are the boundaries of a safe operating space for humanity?
- Does social stability depend on natural resources?
- What can we learn from the past?
- Is intergenerational equity attainable/desirable?
- How might democracy evolve in a system that also votes for other species?
- Can technology provide sustainable solutions for an ailing planet?
- How can we distil reliable scientific information out of social noise?
- Is something profoundly wrong with the way we live today?
- How do we know where the end begins?
What counts for the new university student?

• Engagement through an enabling and efficient support system
• **Ethics and values; are there limits?**
• Knowledge about truth-value of statements, what counts as knowledge and how it can be validated (epistemic cognition)
• Understand accuracy, precision and uncertainty in observations, measurements, projections, models, risks
• Not what you cover, but what you uncover and discover
• **Questions never thought to ask or respond to before**
• Knowing about knowing (metacognition)
• Emergence of infectious curiosity and discovery
• Engaging sense of wonder and responsibility
• Transcending cultural and intellectual boundaries: ArtScience
• **Discovering alternatives to the way people live globally**
• A rich language for thinking and cultivating disposition of inquiry
• Learning about learning (deep transformational approach to learning)
• Sharing the joy of learning and the language of learning
• **Grasping the essence of Consilience** - the unity of knowledge
Listen to the voices of experience

• **You** must draw on a much broader range of knowledge and stakeholders
• Simply generating and communicating scientific knowledge is not sufficient to combat biodiversity loss
• If people are seen as major contributors to climate evolution and loss of biodiversity then people behaviour and attitude must be a major part of the solutions — **in the language of the social sciences.**