STEAM TO STEAM
as well as
STEM to STEAM

Roger Malina

Director, ARTSCILAB, University of Texas at Dallas

Director of Research and Design Prof Cassini Nazir

Prof Kathryn Evans, Music

Dr Eun Ah Lee, Science Education

**Jason, Brogden, Lynx High School, Dallas**

My narrative today

- **A few words about the Artscilab we started 3 years ago at UTDallas**

- The US context on STEM to STEAM

- My provocation:

- STEAM to STEM as well as STEM to STEAM

- How the arts, design and humanities can work with STEM to
  redesign science itself
  - The scientific method needs redesigning for the problems we are
    working on today
  - Scientific culture needs redesigning to couple better to the needed
    social re-design (design 4.0) for a sustainable global civilization
  - Some STEAM collaboration tools: ARTECA, Cloud Curriculum Project

ArtScilab @ ATEC University of Texas at Dallas

- Opened 2013
- Research that requires collaboration between artists, designers, scientists, engineers, humanities researchers
- Experimental Publishing
- STEM to STEAM and now STEAM to STEM
- Cultural Timeliness (why now ?)
- Society Urgency (justify cost of collaboration)

Is Science in Trouble ?

- 1945 « **Science the Endless Frontier** » report, Vannevar Bush

- *"New frontiers of the mind are before us,*

- *and if they are pioneered with the same vision, boldness, and drive with which we have waged this war*

- *we can create a fuller and more fruitful employment and a fuller and more fruitful life."--*

    FRANKLIN D. ROOSEVELT
    November 17, 1944.

- **This vision of science: science for the winning of "wars"**

- **War on Cancer**

- **War on Drugs… rather than co-design !!!**
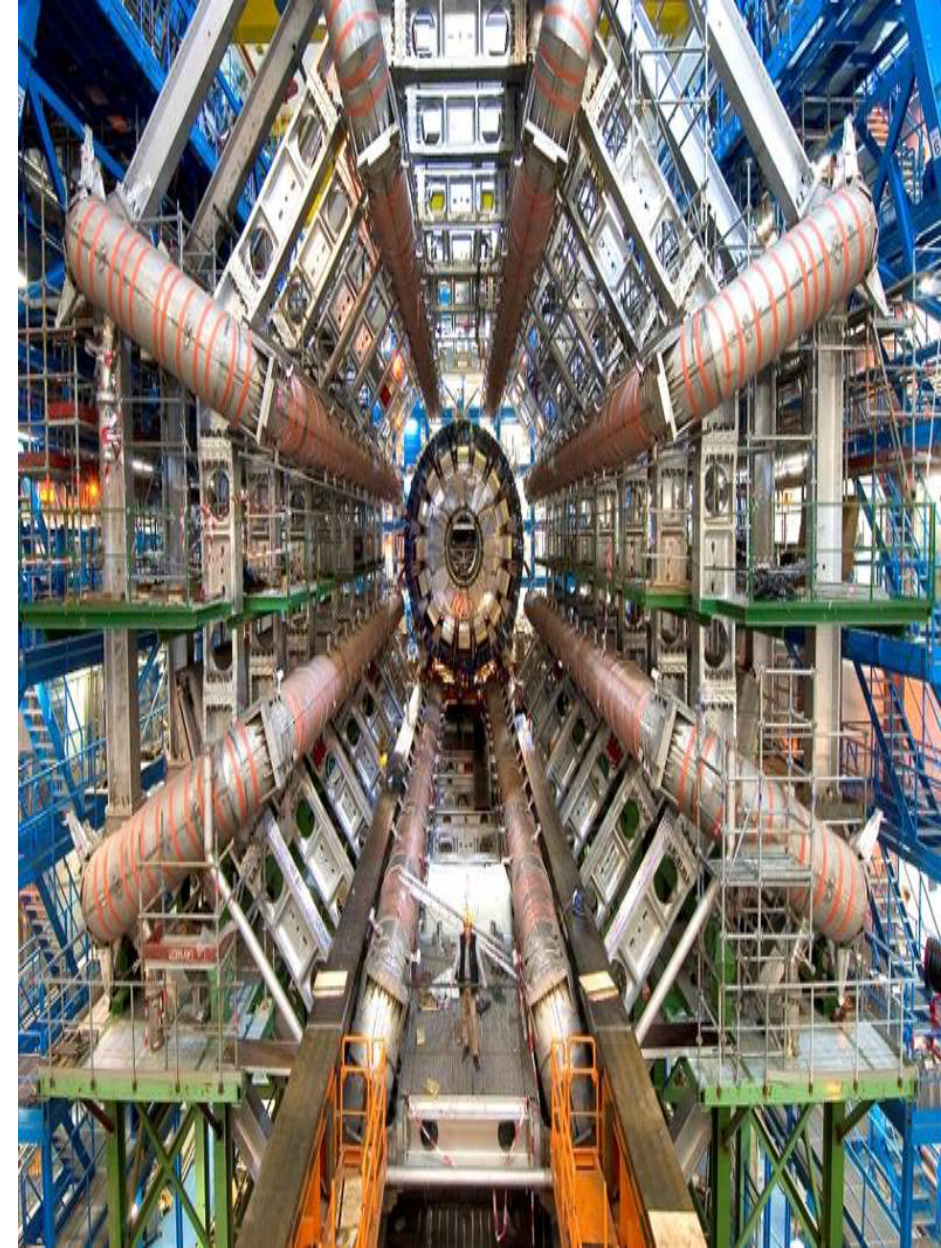
The US context..some events..

- **20 years ago the US National Academies issue the "Beyond Productivity" report addressing the new areas of research that coupled to the 'arts' (creative industries in Europe)**

- **10 years ago the US national science foundation, the US national endowment for the Arts and national endowment for the humanities convened work shops**
  - **Recognising the growing community of practices that bridges the "arts", sciences and engineering, and its impact**
  - **Inability of agencies to fund transdisciplinary/trans agency initiatives**

- **The workshops triggered a number of things in US**
  - **John Maeda coined STEM to STEAM,led to the "STEAM caucus in congress"**
  - **NSF funded SEAD report (Malina et al.) identified key enabling areas**
  - **Triggered formation of the Innovation Collaborative – that bridges professional societies in art education, science education and other related professional societies**

Under Way

- US National Academies Study on Integrating the Arts and Humanities into STEM in higher education (Chair D. Skorton, Secretary of US Smithsonian)

- Report Due end of this year.

- Final KAFKI conference/Keck Foundation: 1millon$ seed money

- US National Academies/Sackler Conference: March 2017 at NAS, DC.

- Creativity & Collaboration: Revisiting Cybernetic Serendipity" 50th

- "Ben Shneiderman, R Malina, D Cox…Organising committee

- What are the benefits of STEAM to research in science and engineering

- Speakers from academia, industry- Sara Diamond, Jasia Reichardt

- Provocation from Shneiderman: Do we need to create a US National Academy of Art/Design ? Elect artists to Academies of Science and Engineering ?

In Europe

- **EC STARTS initiative**
  - **Leonardo/OLATS is part of the FEAT (artists in companies) – see you at Ars Electronica...**

- *More Recently: Creation of UKRI: UK Research and Innovation*

- http://www.ukri.org/our-organisations/

-
  "A primary role of UK Research and Innovation is to fund research into science, technology, humanities, social science and innovation.

- We will maximise impact from the research we fund, with three key strategic strands:

   We will push the frontiers of human knowledge
      We will deliver economic impact and create better jobs
         We will create social impact by supporting our society to become stronger, healthier and more resilient."

- ???????????????????? !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! at least humanities !

RE-Designing the scientific Method: " re inventing Scientific Illustration"

- In/before the renaissance 'illustration' was a key way to discover new knowledge both in the arts and sciences.

- Before the invention of photography artists were usually part of scientific teams (eg Humboldt)

- Mathematics has always used illustration as a discovery methodology- 1990s saw emergence of visual mathematics using digital media

- Embodied cognition research re-inforces the argument for the importance of 'illustration"
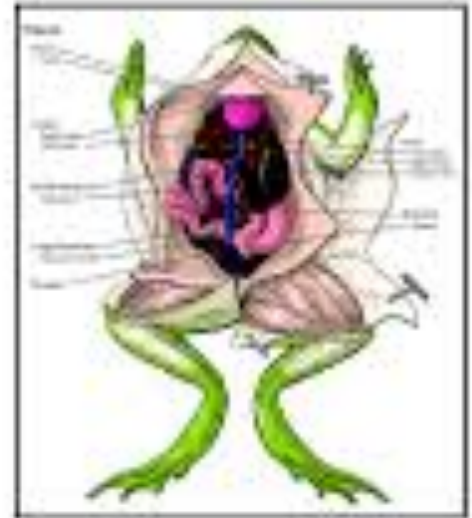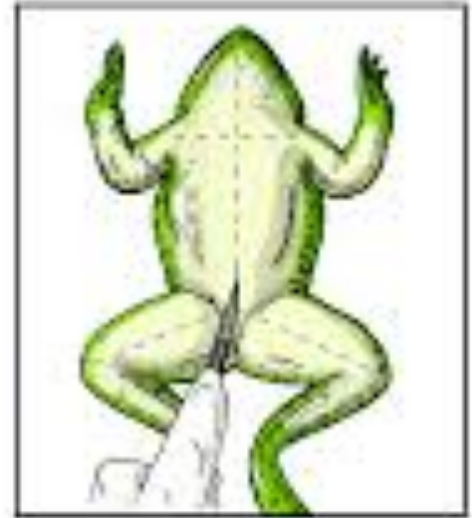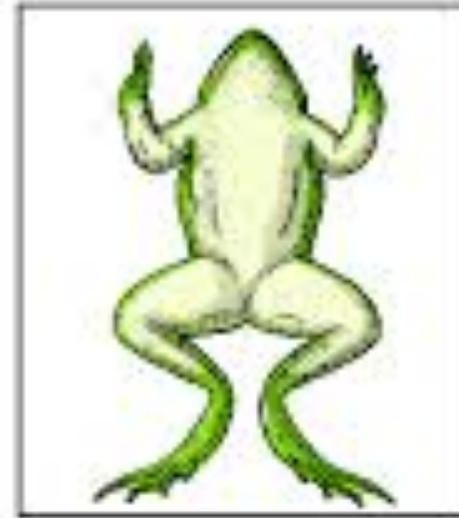
We don't have a clue how to represent big data:
Re thinking scientific illustration through embodied
cognition ? Visual, sound, haptic, performative...
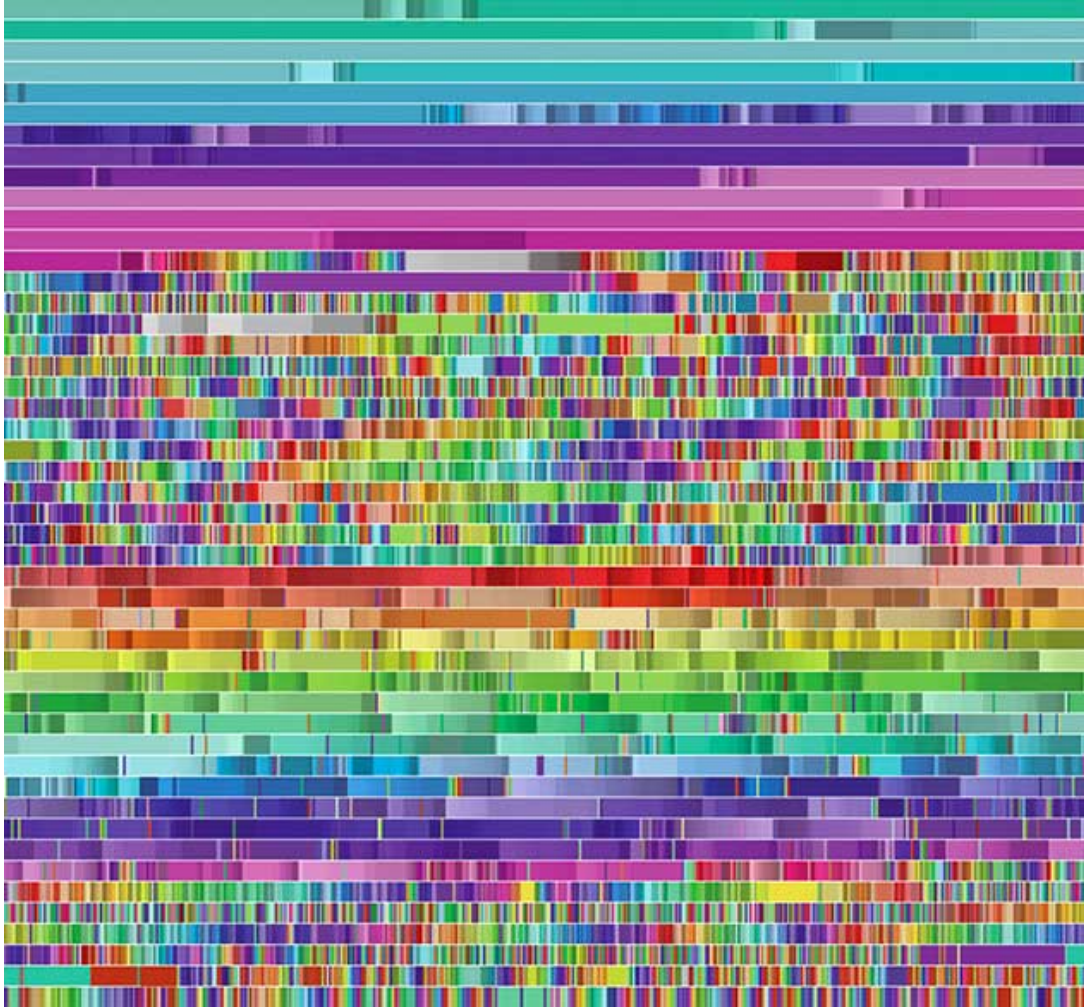
# Redesigning Science: Improving the "the scientific 'method"

- Has evolved steadily over the centuries

- Evolving concepts of causality and how to demonstrate causal connections

- "Alchemy" A+B > C

- Newton   A "causes' B linear causation- 'reductive' method

- 19th C. Statistical Mechanics: collective phenomena rather than individual objects

- Quantum Mechanics-

- Complexity science/emergence/chaos theory

- Simulations as Explanations –you cant write an equation for climate change

- Artists, game designers, designers as experts
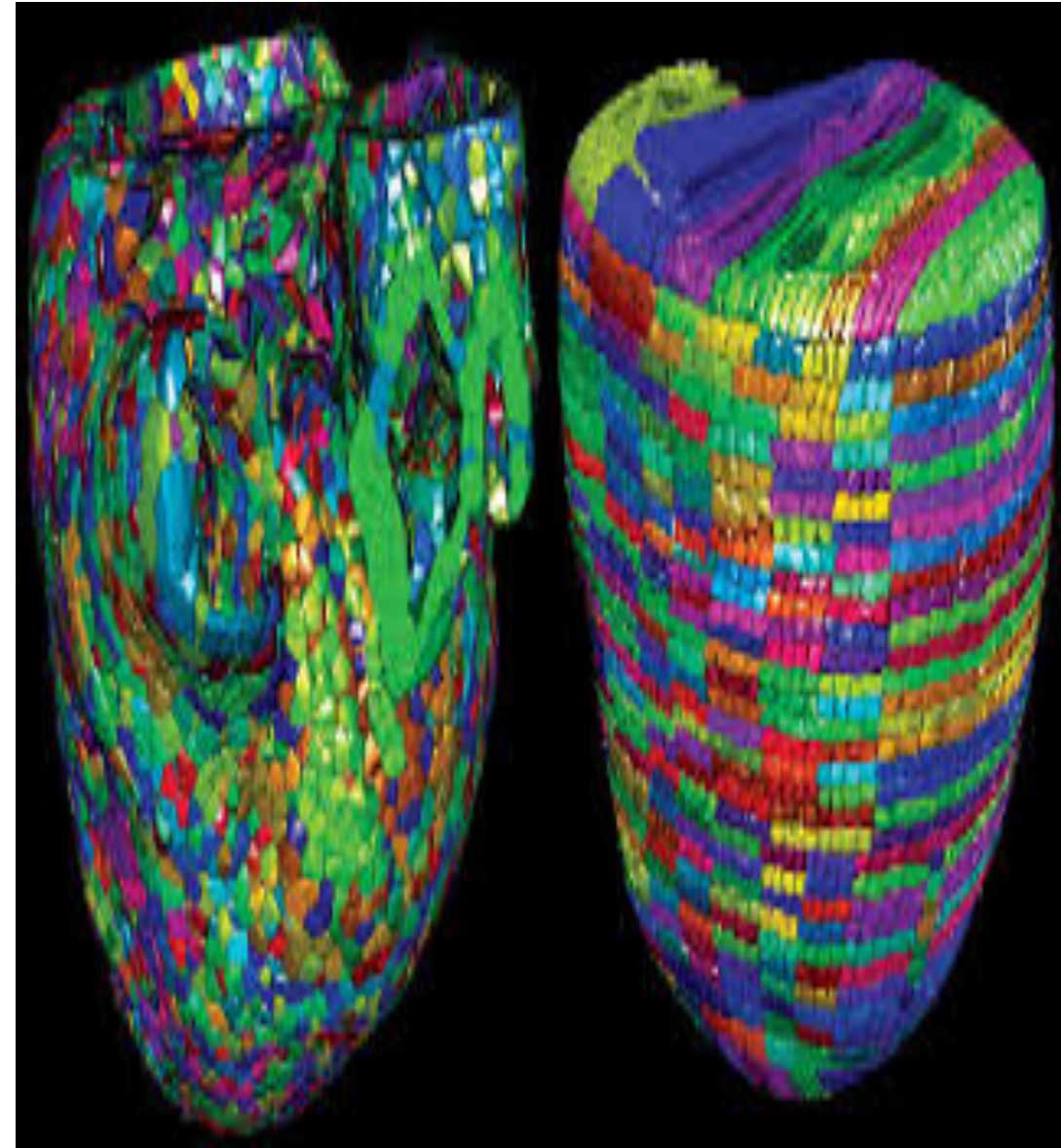
Changing role of Mathematics: the end of theory ?

- Boorstin: "Epistemological Inversion"- we have gone from being data poor and meaning rich, to data rich/ meaning poor

- **End of Theory**

- Kathryn Hayles: retrodiction vs prediction

- Eg climate change theories verified on past data, economics,ecological systems

- Emergence of pattern recognition, AI, Deep Learning methods

- **Cyberscientists are now 'making' discoveries that cannot be explained by humans- no predictive theories**
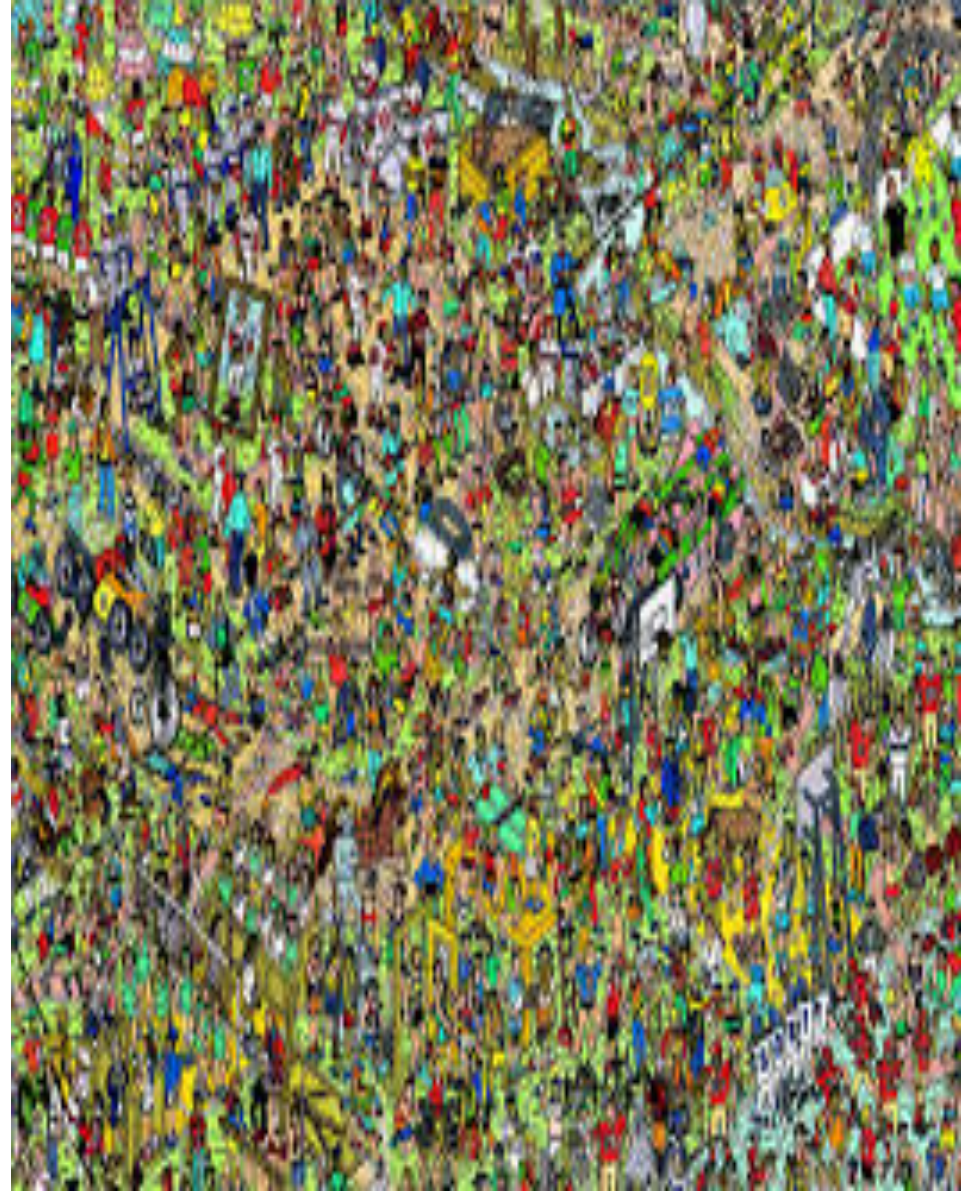
Redesigning the social embedding of science

- Helga Nowotny, fm President European Research Council call for "socially robust science"

- SETI at home opened up age of 'Citizen Science" movement

- Hacking, Making, Co-Design Space as loci of discovery, innovation and invention

- Open Data, Open Science

- Re invention/ re design of the 'amateur' (Levy Leblon, Stiegler) 'amatorat"

- Trans-disciplinary and Trans-social collaboration ....

- Ben Shneirderman call for new 'laws of robotics"….data mining as cognitive extraction

Rethinking the way science is taught

- Transdisciplinary as well as disciplinary curricula
- Embodied learning
- Science of Learning
- Training of team creativity
  - Teams as exhibiting genis
- Training the Imagination
- Science Fiction Prototyping
- ………

Introducing ARTECA

The latest research, reference and professional tools in the arts, science, and technology community

Over 200 titles.
Over 160 journal issues.
And counting.

MASS EFFECT
ART AND THE INTERNET IN THE TWENTY-FIRST CENTURY

Lev Manovich
The Language of New Media

MOVING IMAGE

ARTECA.MIT.EDU multi-media literature aggregator & transdisciplinary research collaboration platform

A gated 'commons, Hybrid "open access"

Free access to anyone who contributes to

Content (authors)

Quality (peer reviewers)

Pertinence (editorial advisors)

300 Mitpress books, Leonardo journal archives, computer music journal..

Collection available for search engine, data visualisation research, collaboration tools etc

Announcing the Leonardo ARTECA 'Cloud Curriculum'

- **Initiated by Paul Thomas as part of Leonardo Education and Art Forum, LEAF workshops..Project director Prof Kathryn Evans, UTD**

- **First phase: http://www.utdallas.edu/atec/cdash/**

- **CDASH "Curriculum Development' in Arts, Sciences and Humanities.**

- **150 curricula, initial listing of programs..currently being relaunched**

- **Curriculum sharing in a gated commons**

- **Anyone who contributes a curriculum can access the other contributed curricula. Trust exchange re Intellectual Property. Curriculum development collaboration tools.**

- **Report to be submitted to the US National Academies Study Integrating arts and humanities in science,engineering "STEM to STEAM"**

Provocation : STEAM TO STEM

- How the arts, design and humanities can work with STEM to redesign science itself
- Redesigning the scientific method
- Redesigning the social embedding of science

Thank you: rmalina@alum.mit.edu