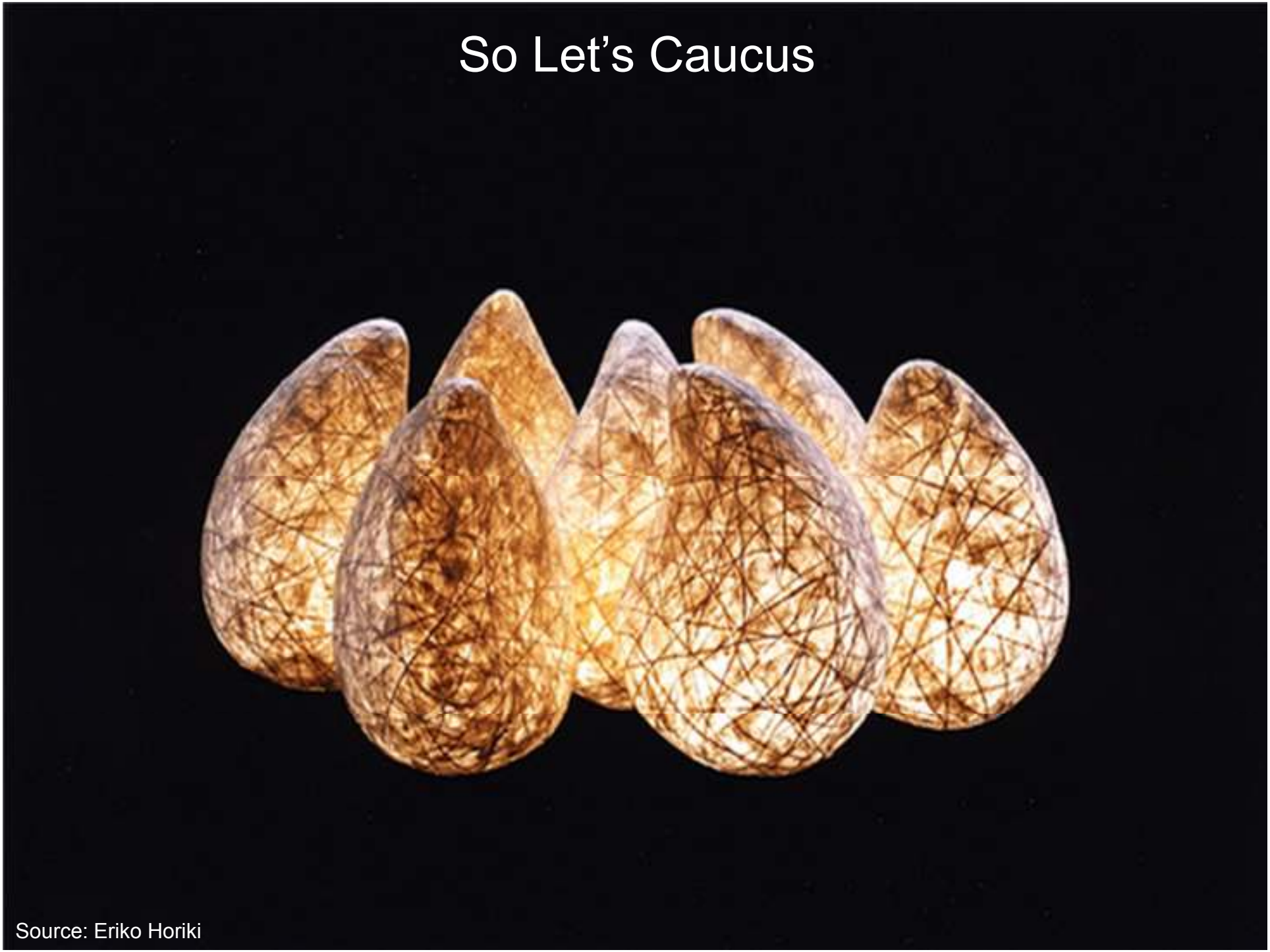
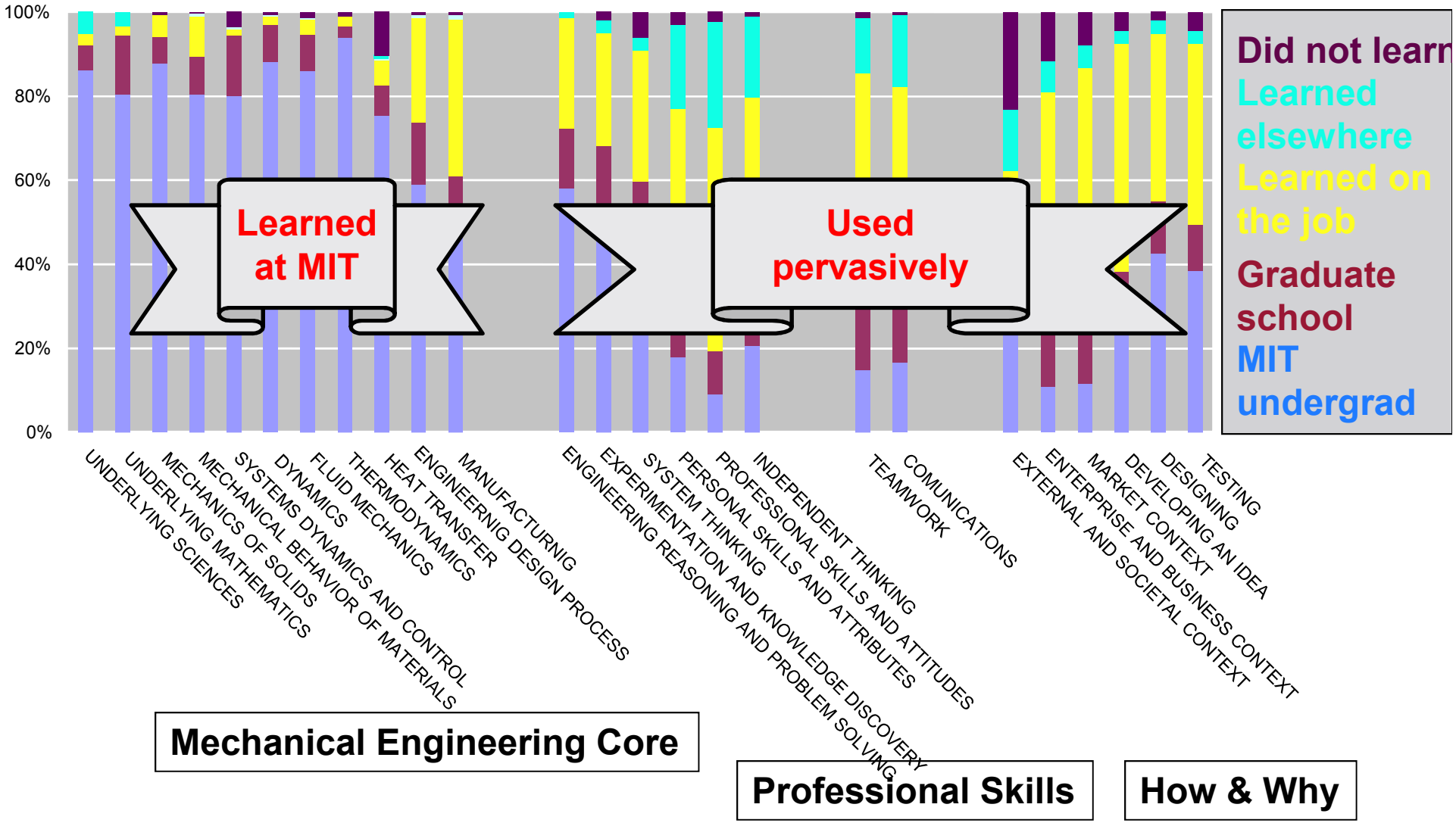
# So Let's Caucus



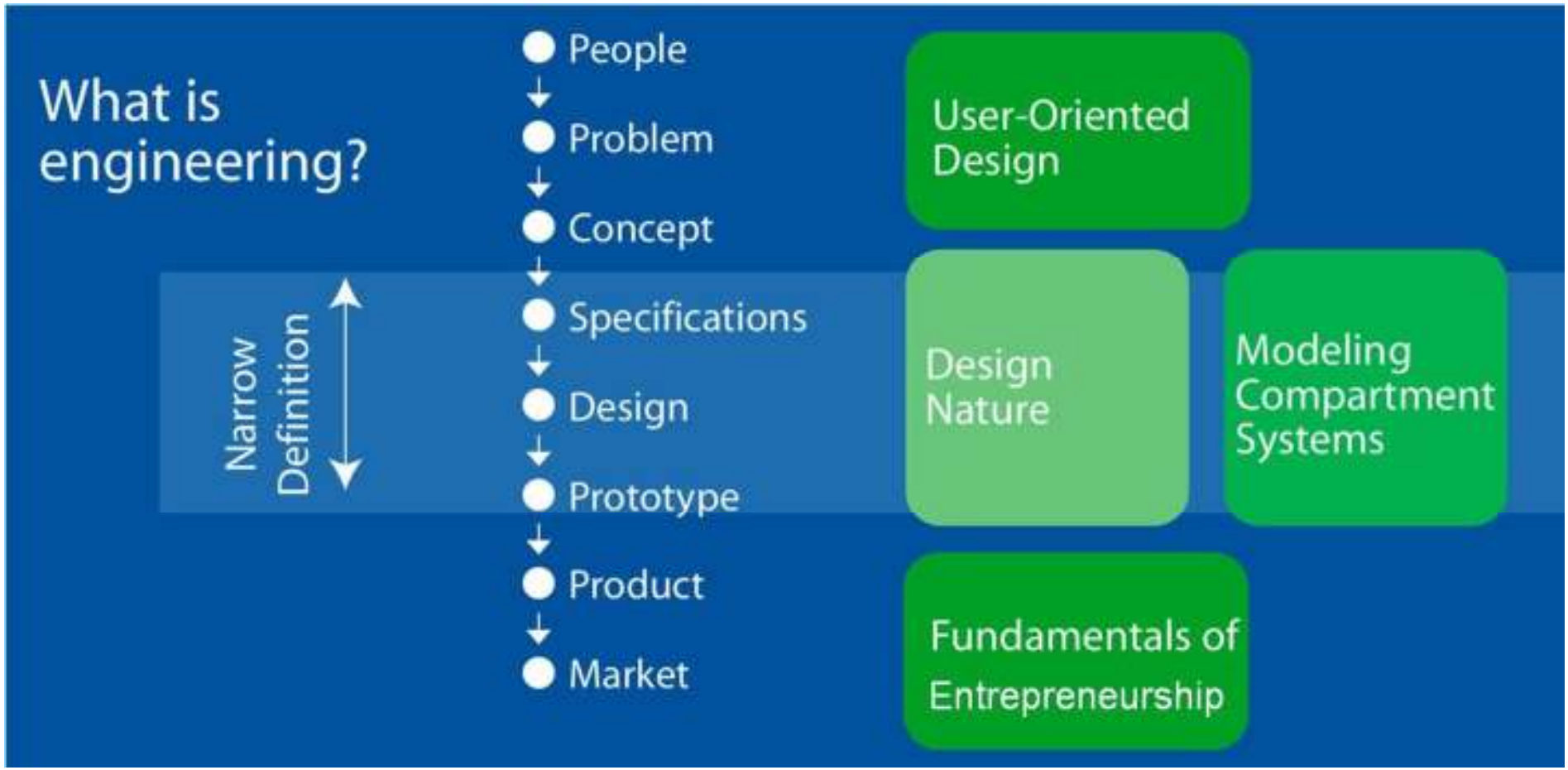
Source: Eriko Horiki

# Mechanical Engineering




Source: Kristen Wolfe June,2004 S.B. Thesis & Professor Warren Seering. Courtesy Professor Woodie Flowers

# Expanding the Mindset



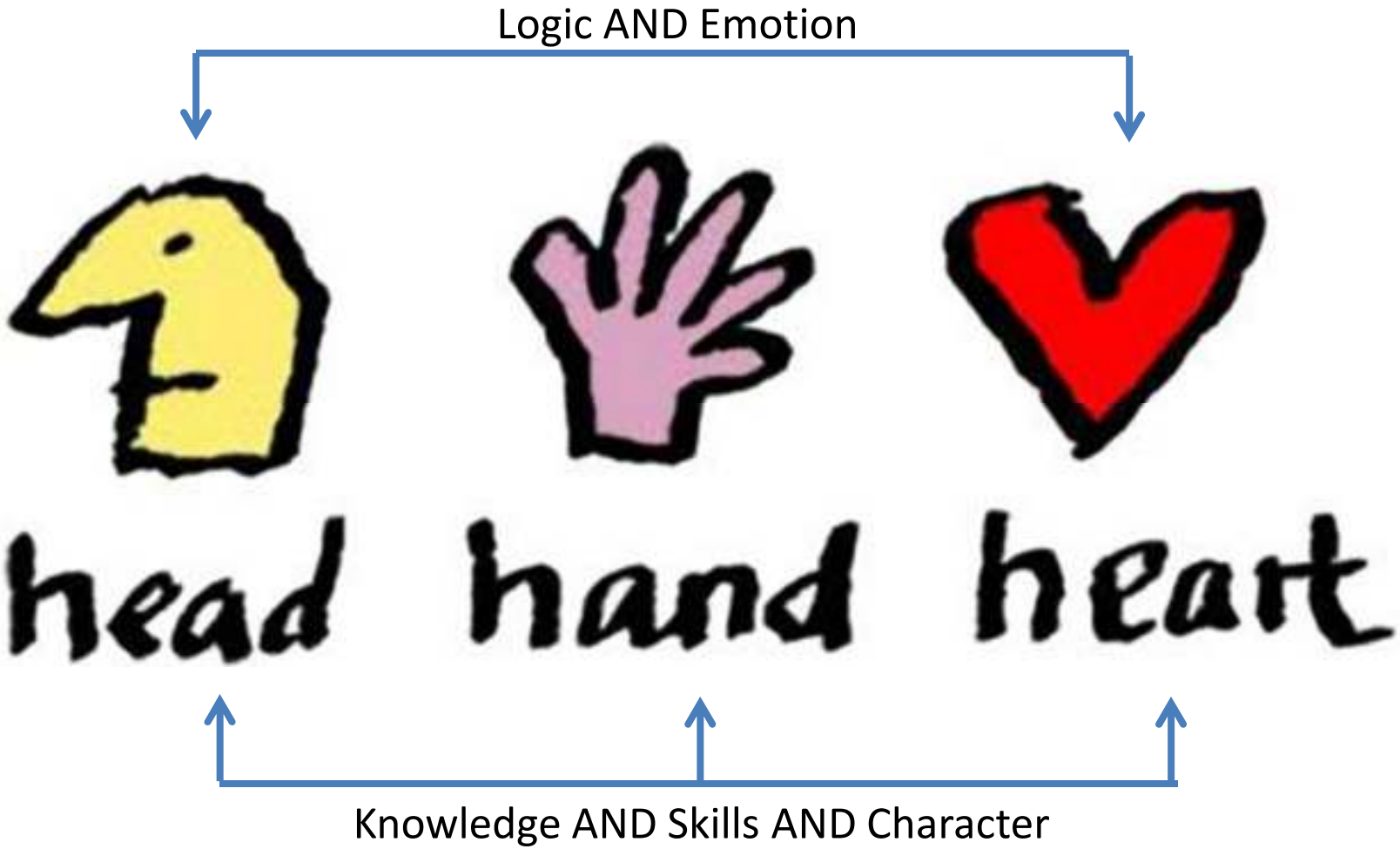

Franklin W. Olin College of Engineering

Courtesy of Olin President Richard Miller

**Monday January 16**

- 8:00 – 10:00 am:  aggregate, breakfast, review questions (amend as needed), discuss how to proceed (all) based on Charles's proposed template (co-design template and fill it)
- During Lunch: feedback on the CCR timeline and strategy
- All day:  small group work and presentations sharing insights (all)
  - Synthesizing the views
  - Answering the questions
  - Asking the next questions and defining the next steps
- End time:  4:00 pm to allow for plane-catching.

# CCR Mindset




Inspired by an inscription used by Charles Voysey, Britain 1896

# Leadership lessons from the dancing guy

# Key questions to explore

1. What are the consequences of a VUCA world?

2. Are we factoring in technology's growth sufficiently? Can we reasonably predict significant inflection points in ICT, Biotech, and Energy – and their impact?

3. What are the demands created by 1) and 2) on education systems?

4. Can they adapt fast enough? (if not, what is the hedge ? can we harness/blend informal systems?)

→What should be the key tenets of a 21st century curriculum?

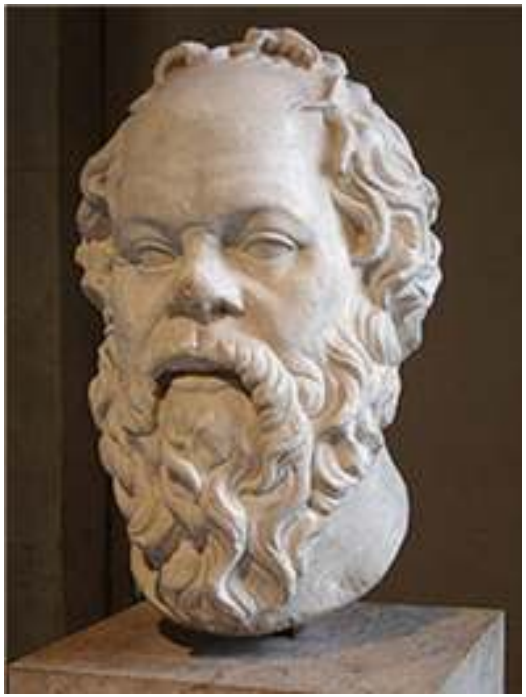
# Ancient Wisdom

Confucius (~551-479 BC):

"I hear and I forget, I see and I remember, *I do and I understand*"

Socrates (~469– 399 BC):

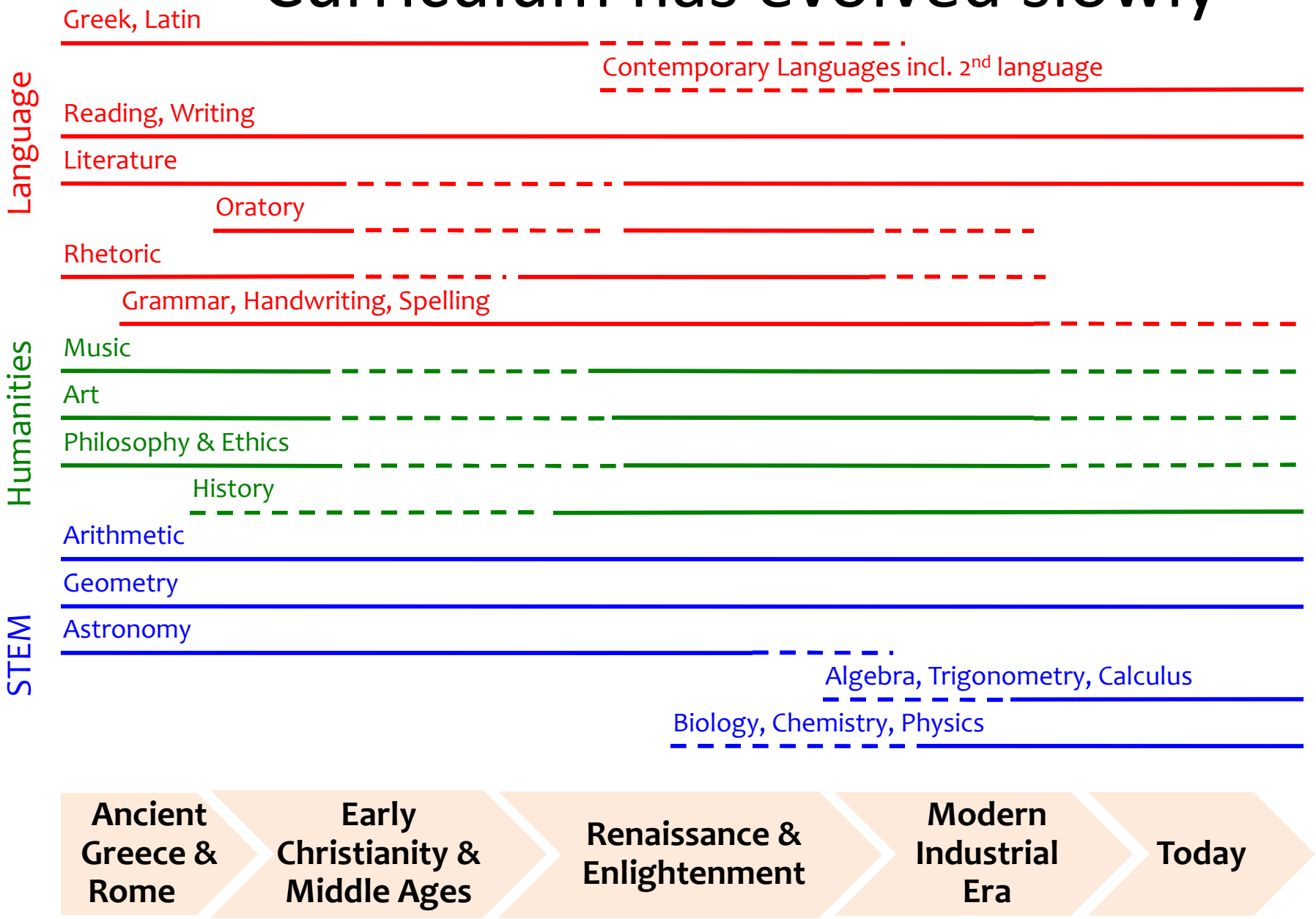
"Education is the kindling of a flame, not the filling of a vessel"



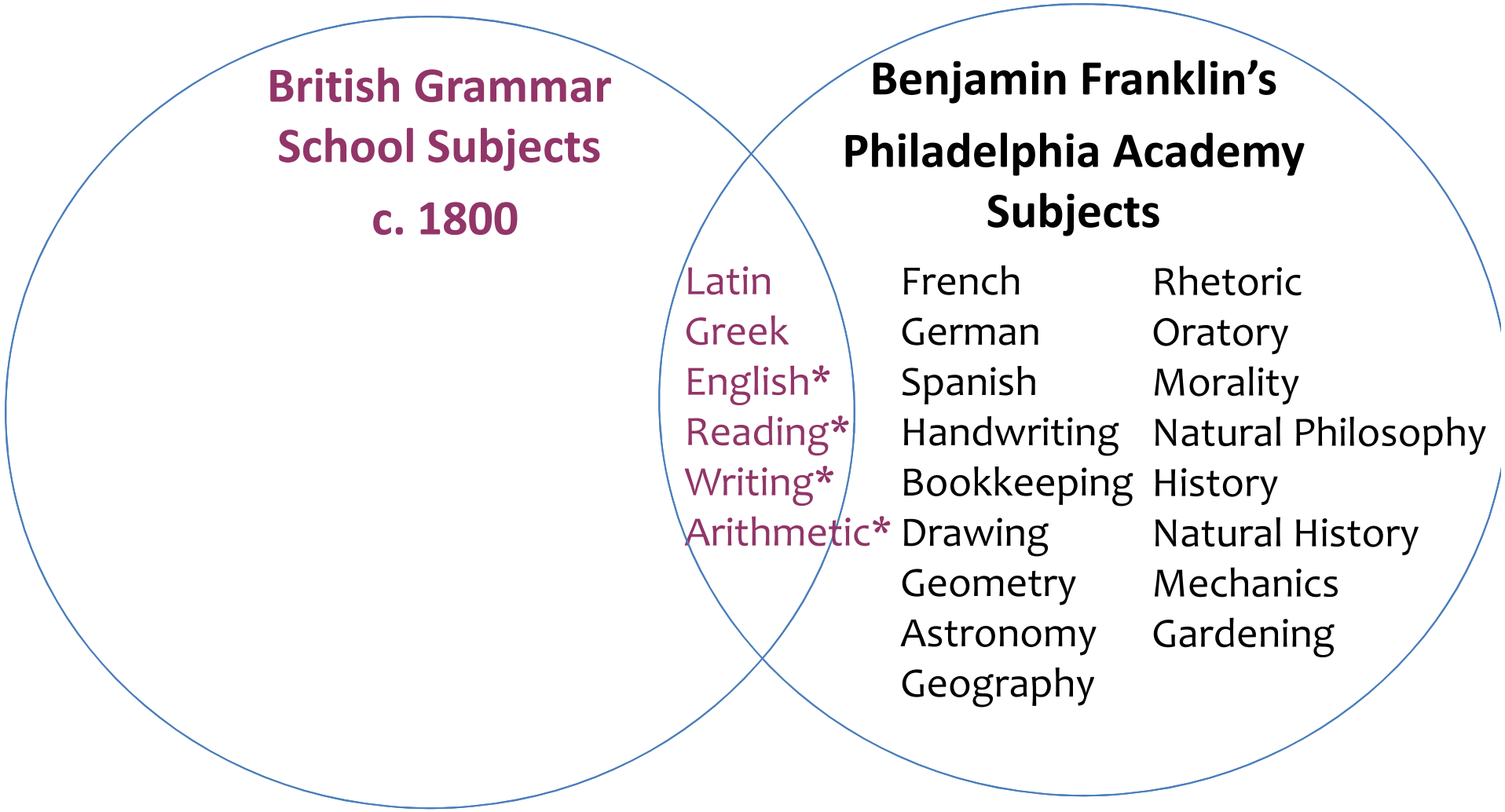
Michel de Montaigne (1533-1592 AD):

"rather a mind shaped than a head full"

# Curriculum has evolved slowly



# This is not a new debate




* usually optional

# More recently

Spencer (1911, UK): The (Seven) Cardinal Principles:

- Health
- Fundamental processes
- Worthy home membership
- Vocational efficiency
- Civic participation
- Worthy use of leisure time
- Ethical behavior

Victorian

# More recently (2)

Dewey:

- Experiential education
- Self-directed learning
- Group & social learning
- Inquiry
- Growth & adaptability
- Citizens in society

Pedagogical

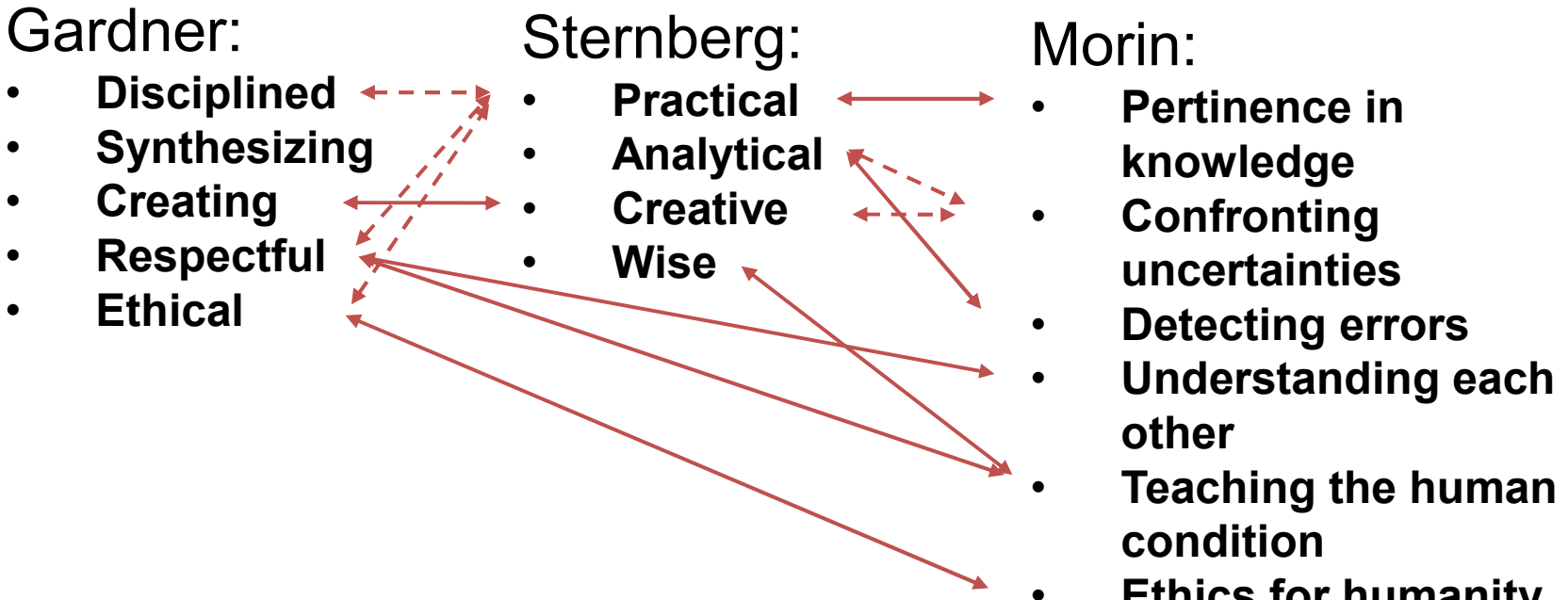
Toffler (1970's):

- Learn how to Choose
- Learn how to Relate
- Learn how to Learn

Meta

# Even more recently

## Commonality of Concepts




Psychological

# Yet more

Schank: An educated mind can: (paraphrased)

- Generalize reasonably
- Determine connections
- Spot analogies
- Predict outcomes
- Deal with abstraction
- Be self-aware
- Learn from failure
- Recover from failure
- Handle exceptions
- Absorb newness
- Seek explanations

Task

# Yet more (2)

Homer-Dixon: Four Conceptual shifts for Prospective Mind

- Systems: From mechanical to complex
- Self: From consumer to problem solver
- Knowledge: From specialized to integrated
- Values: From utilitarian to moral and existential

Systems dynamics

# The OECD's View

1. The great collaborators and orchestrators
2. The great synthesizers
3. The great explainers
4. The great versatilists
5. The great personalizers
6. The great localizers


Source: Andreas Schleicher

Skills

7. *To which I add:* The great innovators

# 21st Century Skills Framework

## Core Subjects

- Native Language/Reading
- World Language(s) incl. English
- Arts
- Geography
- History
- Mathematics
- Science
- Government/Civics

## 21st Century Themes

- Global Awareness
- Financial, Economic, Business and Entrepreneurial literacy
- Civic Literacy
- Health Literacy
- Environmental Literacy

Policy

# 21st Century Skills Framework

Learning & Innovation Skills

- Critical Thinking & Problem Solving
- Creativity & Innovation
- Communication & Collaboration

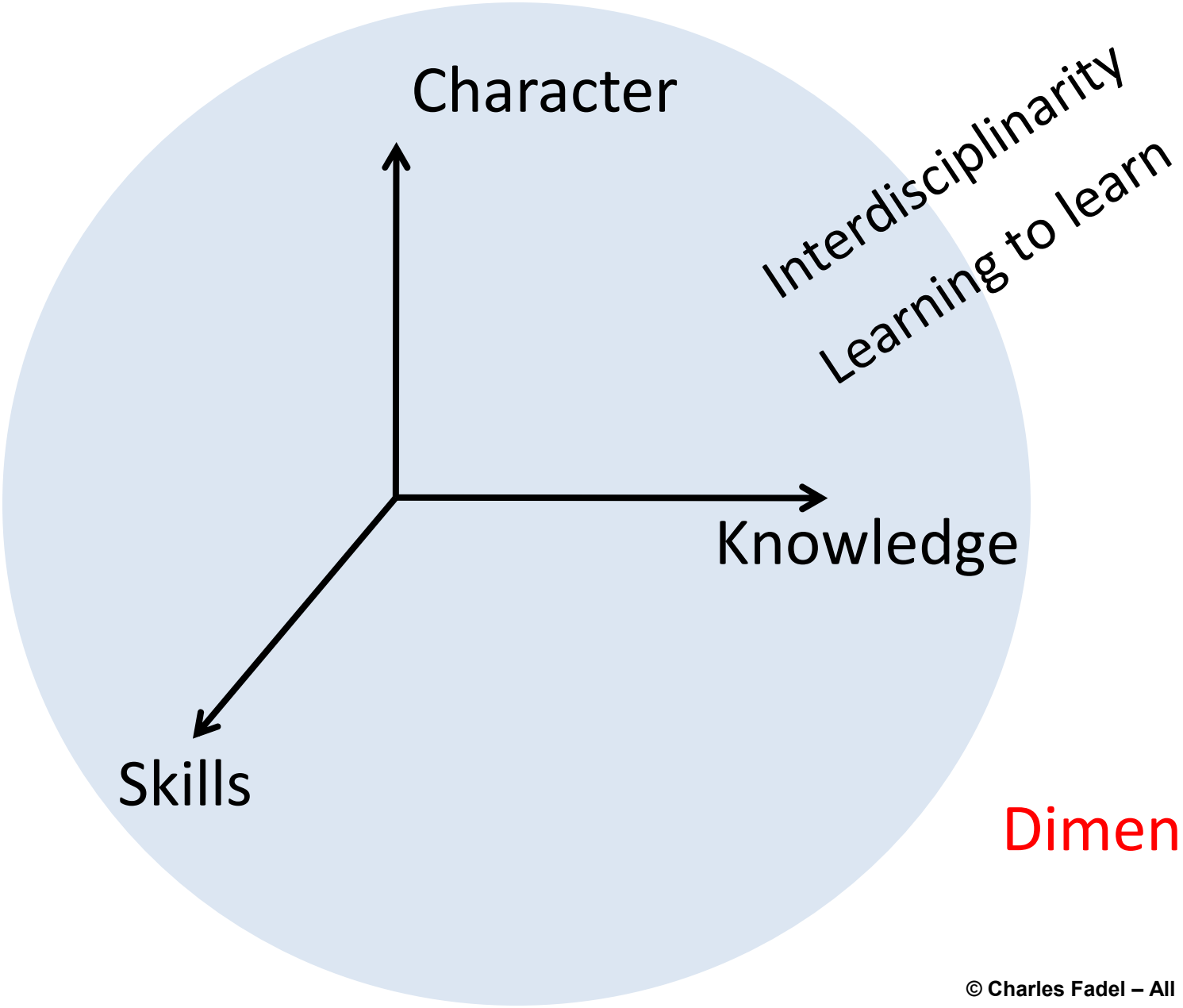
Information, Media & Technology Skills

- Information Literacy
- Media Literacy
- ICT (Information, Communications & Technology) Literacy

Life & Career Skills

- Flexibility & Adaptability
- Initiative & Self-Direction
- Social & Cross-Cultural Skills
- Productivity & Accountability
- Leadership & Responsibility

# CCR Framework



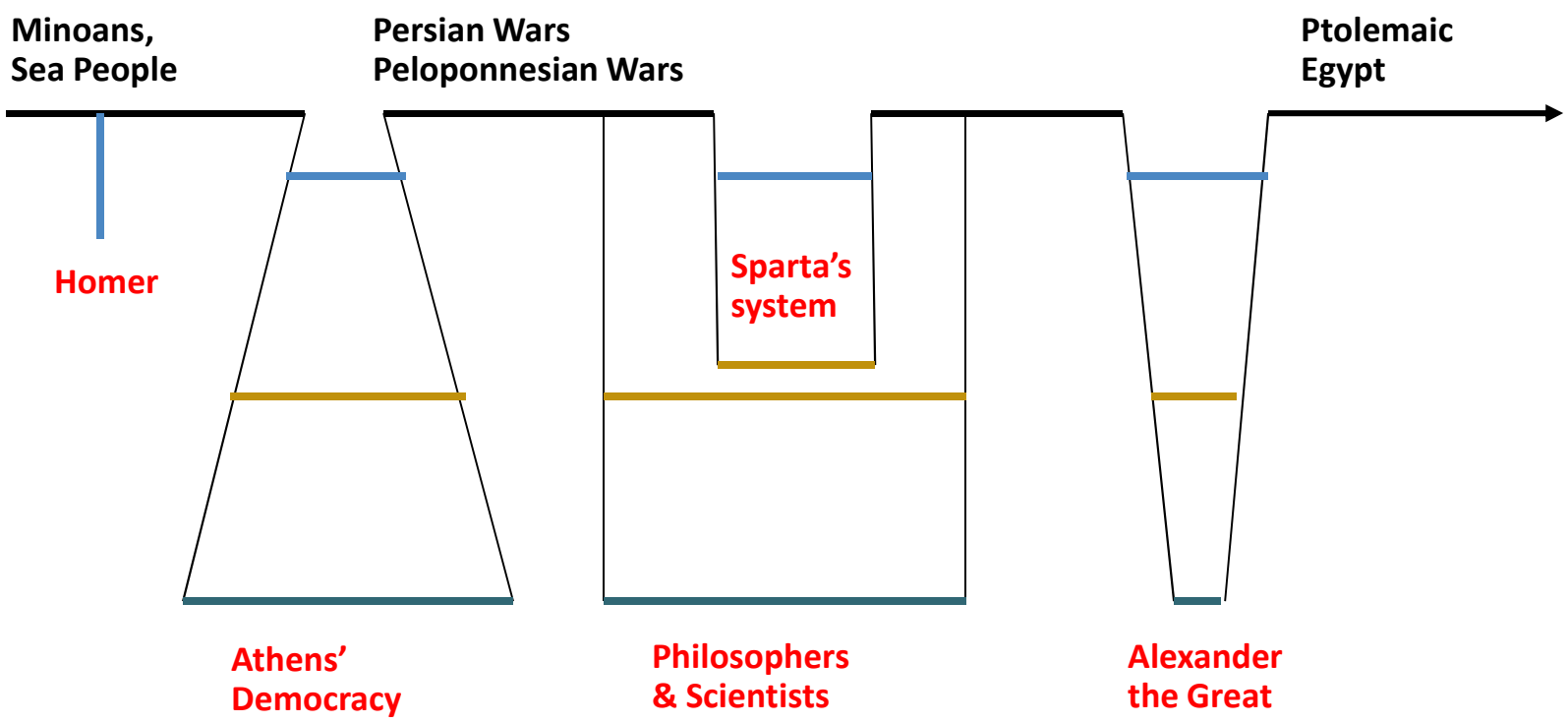

Dimensional

# Relevance is a choice

| Discipline (below) | Algebra | Applied Maths | Calculus | Discrete Mathematics | Foundations | Geometry | Numbers & Operations | Statistics & Probability | Topology & Recreational |
|---|---|---|---|---|---|---|---|---|---|
| X represents significant usage in | Matrices, Operations, Vectors etc | Complex systems, Control, Game theory, etc | Analysis, Transforms, Polynomials, etc | Automata, Graphs, Computational maths etc | Sets, Logic etc | Curves, Dimensions, Trans-formations, Trigonometry, etc | Arithmetic operations, Fractions, Sequences, etc | Distributions, Analysis, Estimation, etc | Knots, Figures, Folding, Spaces, etc |
| Anthropology | | | | | | | X | X | |
| Architecture | | X | | | | X | X | X | X |
| Art/Design | | | | | | X | X | | X |
| Biology (genetics, zoology, etc) | X | X | X | X | | X | X | X | X |
| Business | X | X | X | X | | | X | X | |
| Civil engineering | X | X | X | X | | X | X | X | X |
| Computer science | X | X | X | X | X | X | X | X | X |
| Economics | X | X | X | X | | X | X | X | X |
| Electrical engineering | X | X | X | X | | X | X | X | |
| Geology/Geography | X | | X | | | | X | X | |
| History | | | | | | | X | X | |
| Law | | | | | | | X | X | |
| Linguistics | | X | | | | | X | X | |
| Mechanical engineering | X | X | X | X | | X | X | X | X |
| Medicine/Pharmacy | | X | | | | | X | X | |
| Music | | | X | | | | X | | |
| Neuroscience | X | X | X | X | | X | X | X | |
| Philosophy | | | | | X | | X | X | |
| Physics | X | X | X | X | X | X | X | X | X |
| Psychology | X | X | X | X | | | X | X | |
| Sociology | | | | | | | X | X | |

*"Numbers and probability provide the basis for statistics, which, together with Logic, constitute the foundation of the Scientific Method"* John Allen Paulos

# Impact vs Context



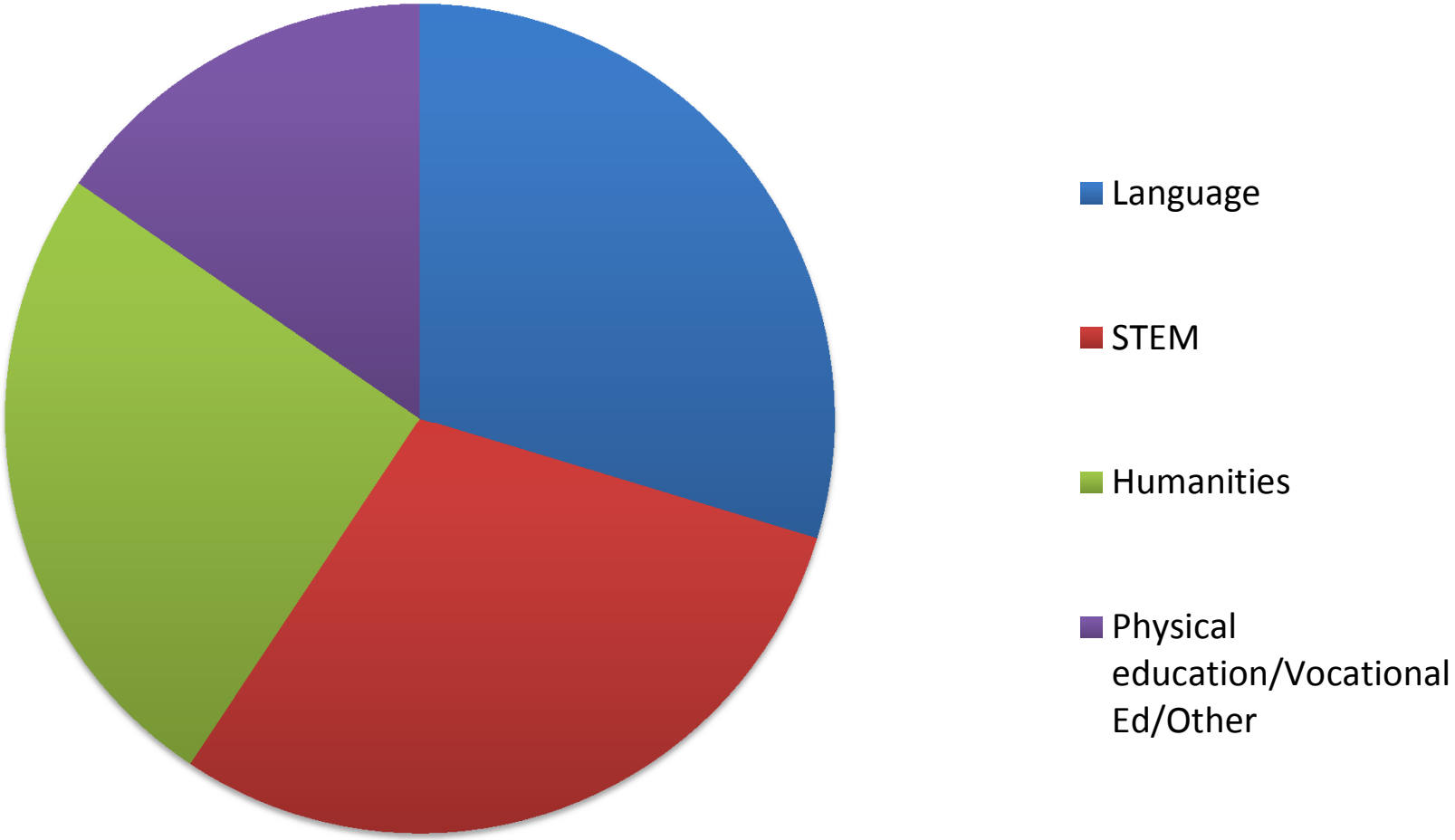

4 grade

8 grade

12 grade

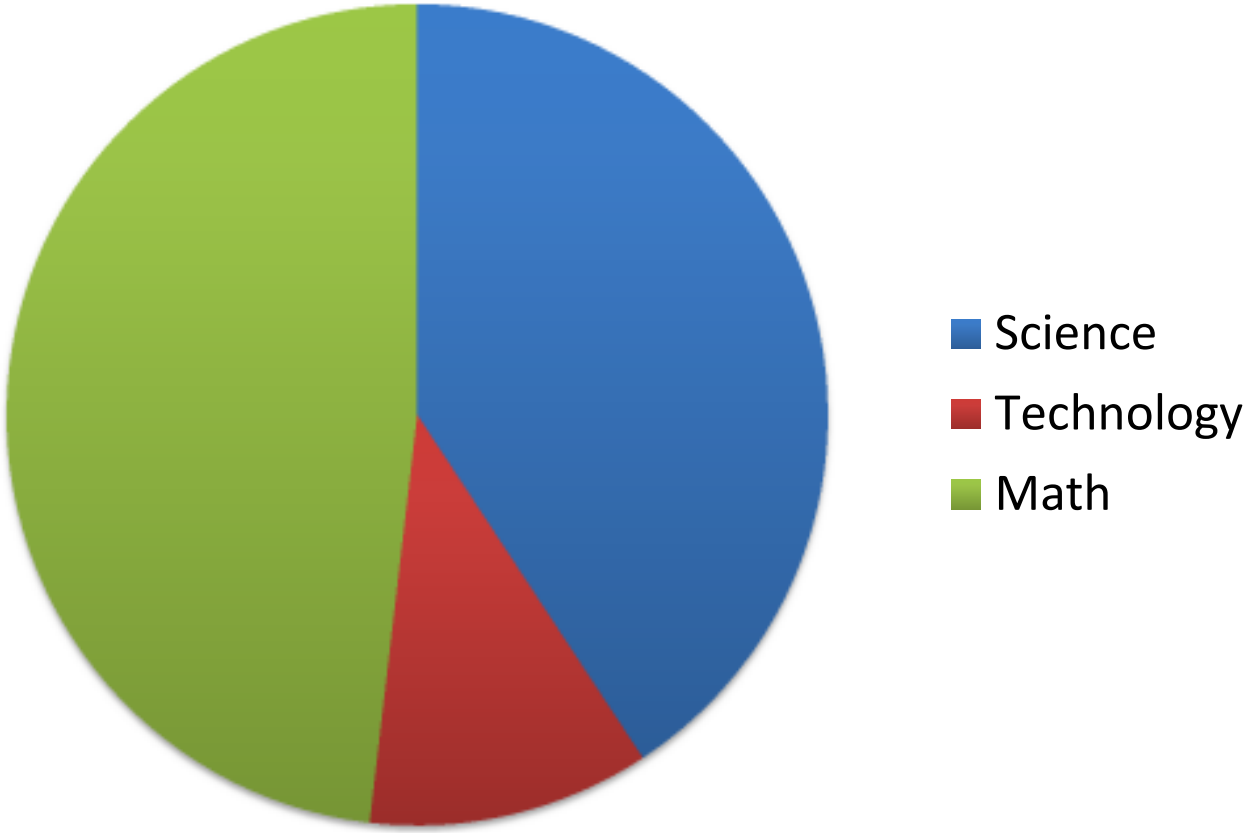
Example: Ancient Greece

# Ratio of Subjects – OECD Average




What should be the ratios ?

# STEM Education – OECD average




Why so little Technology ? (and so much about volcanoes?)
Why is Engineering only a College discipline?

# If we need more:

Statistics & Probabilities

For multiple fields (i.e. business, social sciences)

Art

For creativity, expression, multimodality

Music

For memory, brain agility, creativity

***What do we remove ?***

# What else is needed ?

Psychology/Sociology/Anthropology ?
Personal Finance/Economics ?
Entrepreneurship ?
Engineering ? Robotics ? Programming ?
Recreational Maths in lower grades ?
Linguistics ?
Mythology ? Philosophy ?
Woodworking ? Gardening ?
Career management ?
Resourcefulness ?
Project management ?

Etc.

# Invariance vs inertia

Today's task:

1. Document the concerns of the end-users (to be defined) and Pareto them; identify root causes; identify possible mechanisms to address
2. What should be the key tenets of a 21st century curriculum?
3. Devise a documented, global model (completion, ontologic and taxonomic robuststness to be iterated upon later)