# Diascopic Approach as a Way to Connect Science with Humanity in General Education

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# Content

1. What is science NOT about?
2. In Dialogue with Nature (UGFN1000)
   - Diascopic-science Approach
3. Common misunderstanding

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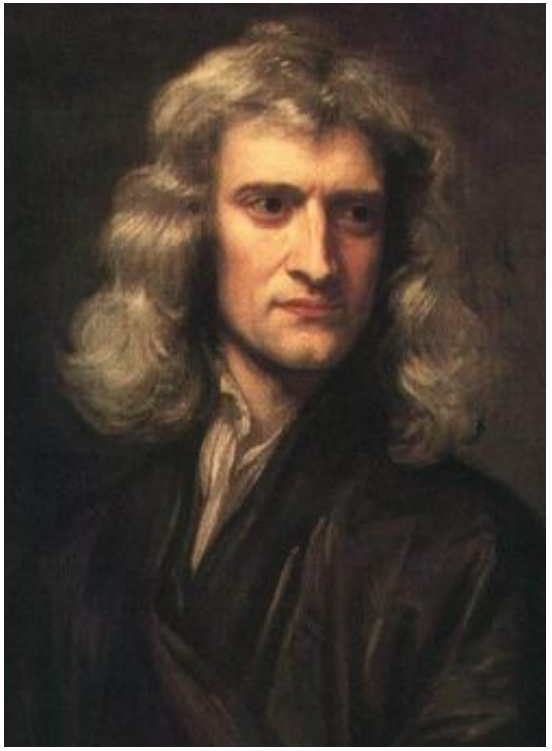
# What is science NOT about?

Is it about good or bad?

# Isaac Newton

- Three laws of motion.
- Laid the foundation of modern physics.



Newton in 46 (Wikimedia commons)

# A mechanical universe

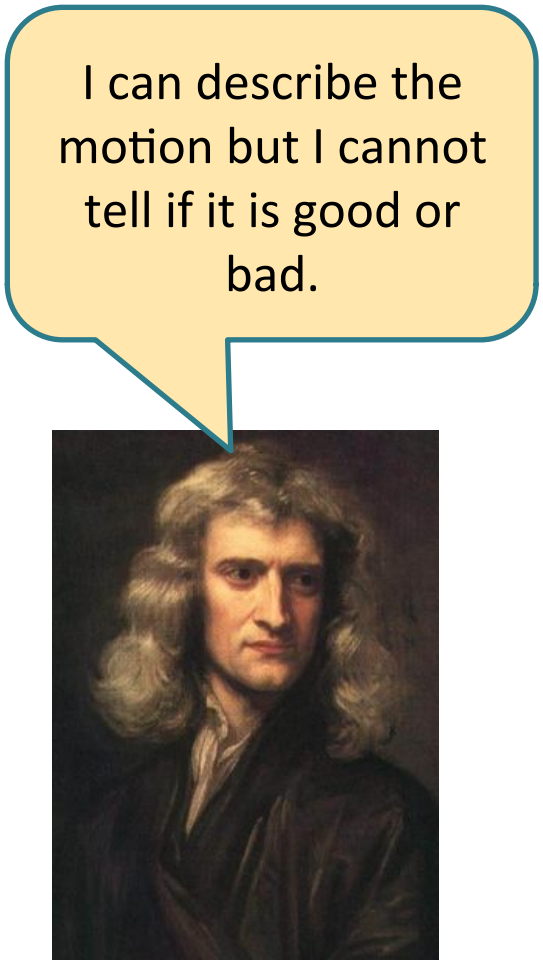
- Everything follows physical laws.
- The purpose is unknown.
  - Physics cannot tell whether a motion is good or bad.

$$-\frac{\hbar^2}{2m}\nabla^2\psi + V\psi = i\hbar\frac{\partial\psi}{\partial t}$$

$$\nabla\times\vec{E} = -\frac{1}{c}\frac{\partial\vec{B}}{\partial t}$$

# Basketball …


It is good!

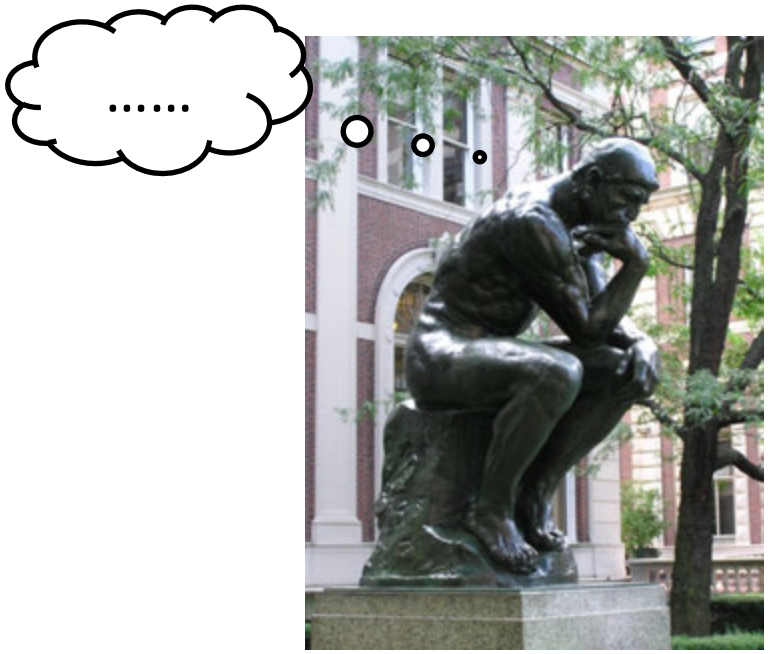

I can describe the motion but I cannot tell if it is good or bad.

# What is science about?

- A precise description of the universe.
- The purpose is unknown.
  - Not about good or bad.
- Science is NOT about human values.

# Humanity

- Awareness of human values.
  - Meaning: What does an action mean?
  - Judgement: Is it good or bad?




A statue at Columbia University

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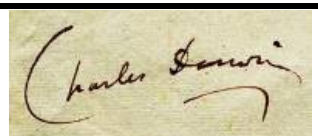
# UGFN1000
# In Dialogue with Nature

DIANA

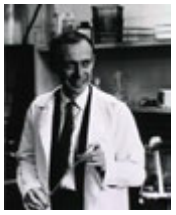

# I. Exploration of the **Physical Universe**

| Readings |
| --- |
| Plato, *Republic* Book VII: The allegory of the cave **and** David C. Lindberg, *The Beginnings of Western Science* (Chapter 2) |
| David C. Lindberg, *The Beginnings of Western Science* (Chapters 3, 12) |
| I. Bernard Cohen, *The Birth of a New Physics* (Chapter 7) **and** Isaac Newton, *Principia* (Definitions and Axioms). |

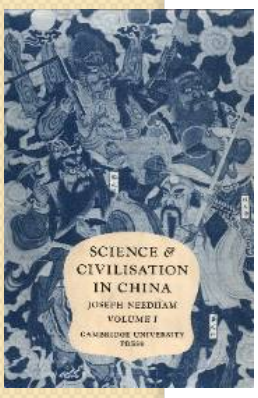
# II. Exploration of the **World of Life**



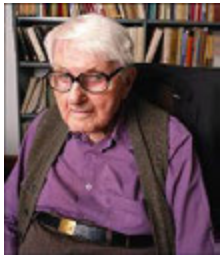
| Readings |
| --- |
| Charles Darwin, *On the Origin of Species* (Chapter 4) |
| James D. Watson, *DNA: The Secret of Life* (Chapters 1 and 2) |
| Rachel Carson, *Silent Spring* (Chapter 6) |

# III. Understanding of **Human Understanding**




| Readings |
| --- |
| Henri Poincaré, *Science and Method* (Chapters 1, 3) |
| Eric R. Kandel, *In Search of Memory: The Emergence of a New Science of Mind* (Chapters 4, 28) |
| Joseph Needham, *The Shorter Science and Civilisation in China* (Chapter 10) |
| Nathan Sivin, 'Why the Scientific Revolution Did Not Take Place in China – or Didn't it?' and<br>Shen Kua, *Brush Talks from Dream Brook* (沈括：《夢溪筆談》) |
| William Dunham, *The Mathematical Universe* (Chapter G) and<br>Euclid, *Elements* (selected propositions) |



# Learning activities

- 1-hour lecture (introduction to the text)
- 2-hour discussion
- Reflective journal, online discussion, quiz, term paper, class discussion.

# Diascopic-science (透觀科學) Approach

Science

Enduring questions

# Diascopic

- *dia-*
  - From Greek, means “through” (e.g. diameter)
- *scopic*
  - From Greek, means “look at”
- Diascopic science: by looking through science …

# What is our understanding of the universe?

# Newton's *Principia*

DEFINITIONS.

**Definition 1**

***Quantity of matter is a measure of matter that arises from its density and volume jointly.***

If the density of air is doubled in a space that is also doubled, there is four times as much air, and there is six times as much if the space is tripled. The case is the same for snow and powders condensed by compression or liquefaction, and also for all bodies that are condensed in various ways by any causes whatsoever. For the present, I am not taking into account any medium, if there should be any, freely pervading the interstices between the parts of bodies. Furthermore, I mean this quantity whenever I use the term "body" or "mass" in the following pages. It can always be known from a body's weight, for—by making very accurate experiments with pendulums—I have found it to be proportional to the weight, as will be shown below.

# Newton's *Principia*

(The last paragraph before Axioms)

The quantity of centripetal force is of three kinds: absolute, accelerative, and motive.

[. . .]

Further, it is in this same sense that I call attractions and impulses accelerative and motive. Moreover, I use interchangeably and indiscriminately words signifying attraction, impulse, or any sort of propensity toward a center, considering these forces not from a physical but only from a mathematical point of view. Therefore, let the reader beware of thinking that by words of this kind I am anywhere defining a species or mode of action or a physical cause or reason, or that I am attributing forces in a true and physical sense to centers (which are mathematical points) if I happen to say that centers attract or that centers have forces.

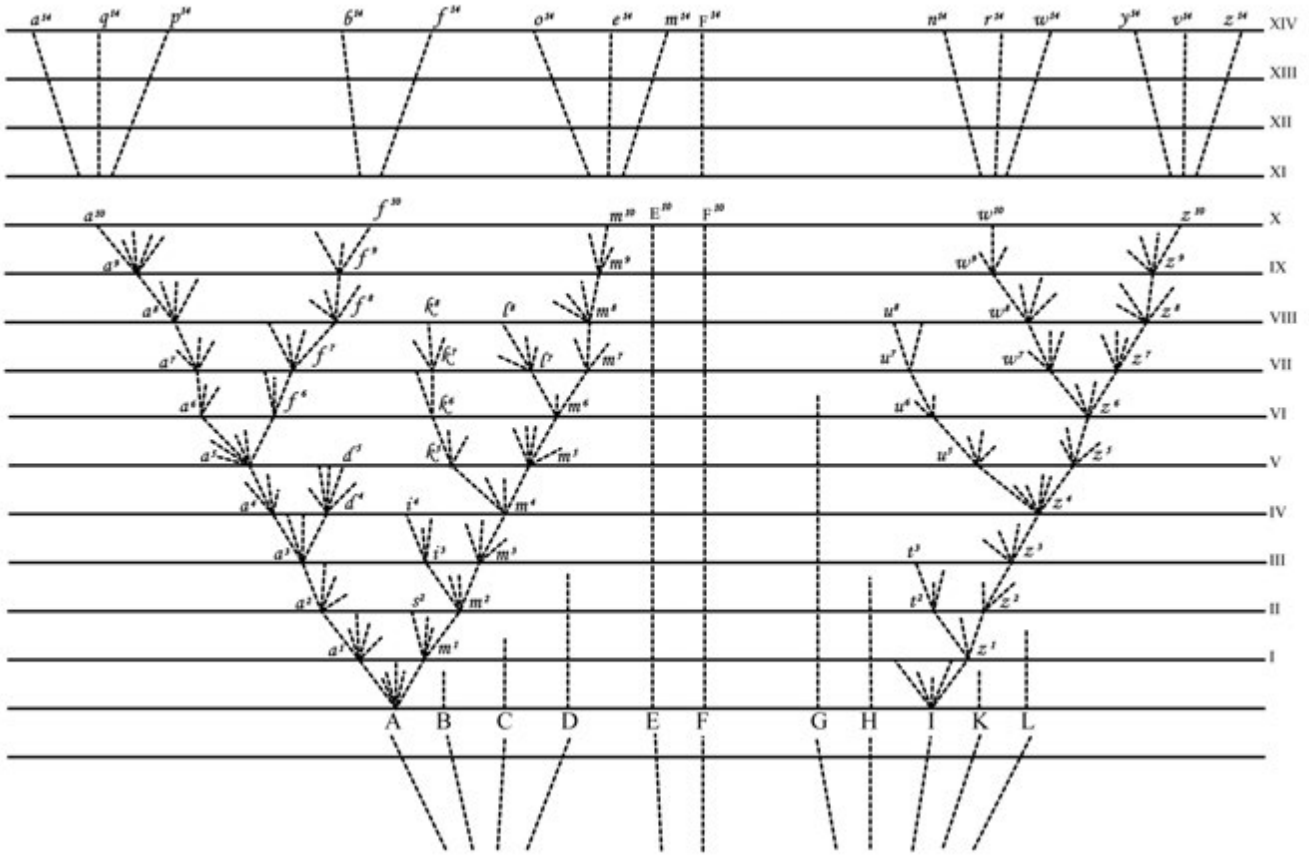
- What do we know about the universe?
- Mathematical understanding.

# Mathematical understanding

- Limitation
- Respectful to other points of view

# In science, is there belief?

# Darwin's dream




- What do scientists assume? Universality.

# Newton ⇔ Darwin

- What similarities can you find between how Darwin explained the world of life and how Newton explained the physical universe?
  - Universality (natural laws are general)
  - Reductionism (if each bit is understood, so is the whole)
  - Both are beliefs.

# Creationism vs. Evolution

- A hot debate topic in the dialogue between science and religion.
- Is science completely different from religion?
  - Can a scientist be superstitious?

# What beauty does Nature have?

# Rachel Carson

- The use of DDT and herbicides.

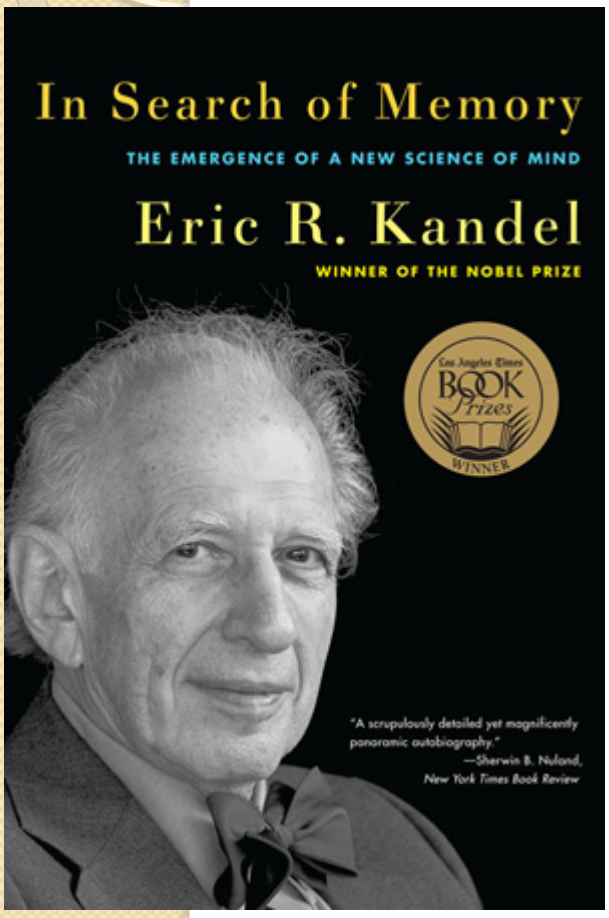

Carson's Fish & Wildlife Service employee photo, from *Wikipedia*

# *Silent Spring*

- Nature is beautiful.
- What beauty is it?
- Harmony between species.
- Really harmonious? Is extinction beautiful?
- Beauty in your major?

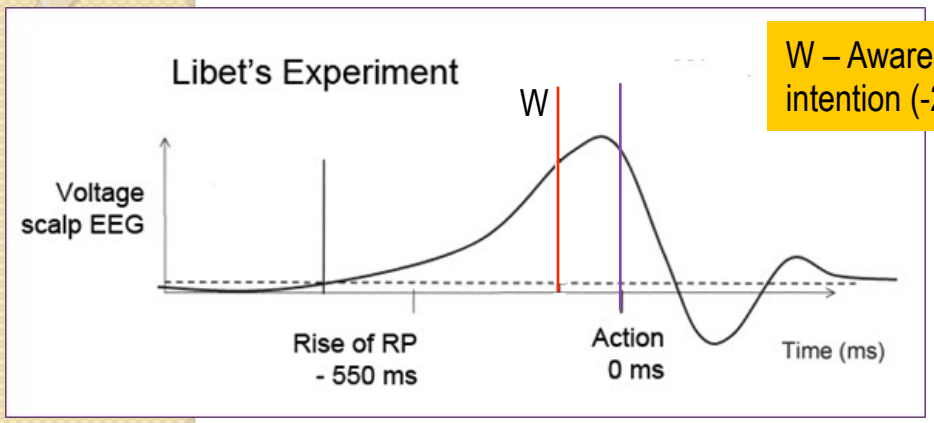
# Do we have free will?

# *In Search of Memory*




- Eric Kandel
- Nobel Laureate in Physiology or Medicine in 2000 for his contribution to the study of memory storage in the brain.

# Libet's experiment

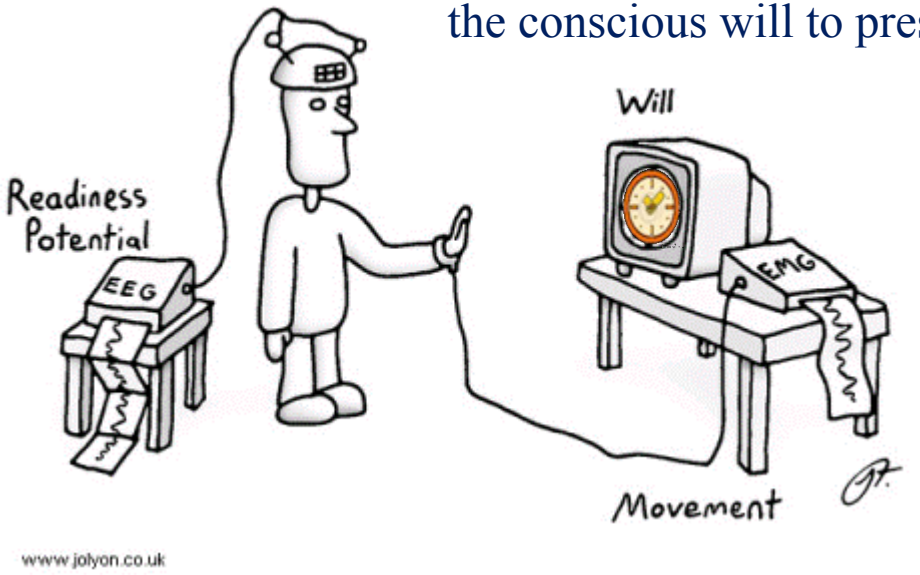



W – Awareness of intention (-200 ms)

His brain appears to prepare for movement long before he consciously decides to move.
Does he have free will?

The brain signal of his movement (pressing a button)

He recorded the time at which he first felt the conscious will to press the button



# Free Will

- Do you have free will?
- Do you want to have free will?

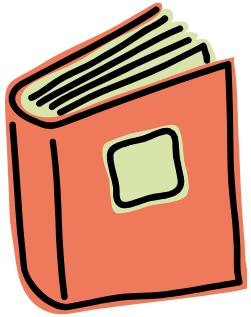
# Enduring questions

- Is science going towards the truth?
- What do I mean when I say “I understand”?
- Do you accept that “life is just a matter of physics and chemistry”?
- Do I have a soul?
- …

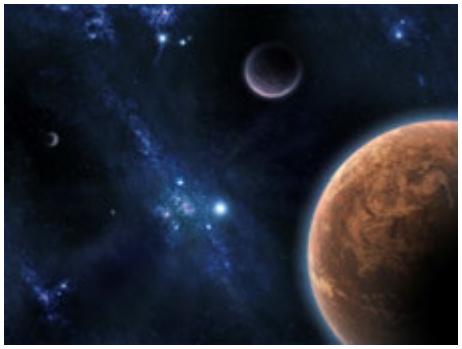
# Learning Outcomes

1. Ability

read and discuss science texts with confidence



2. 3. 4. 5. Intellectual



identify the essential characteristics of various methods of scientific inquiry that have significant impacts on how human beings view life and universe.

world (世界)

formulate informed personal views on the societal implications of scientific explorations.

society (社會)

relate the development in natural sciences highlighted in the course to contemporary human conditions.

individuals (個體)


evaluate highlighted scientific methods using multiple perspectives

science (科學)

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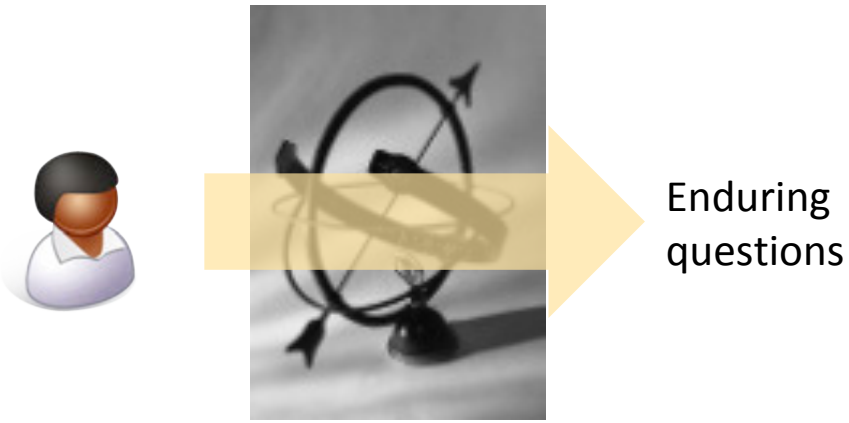
# Common misunderstanding …

- GE science = popular science
- GE science = science with no mathematics
- GE science = 1000-level major science

# Diascopic science and others

| | Popular science | Diascopic science | Technical science |
|---|---|---|---|
| Scientific concepts | Explained | Explained | Explained |
| Technical details | Avoided | Avoided | Important |
| Methodology | Described | Described and reflected on | Assumed |
| Discussion of relations between science and other fields | To arouse the reader's interest in science | To acquire an understanding of what science implies | Rare |
| Target | Common readers | All people | Researchers/ major students |

Diascopic science: welcomed by **both** science majors and non-majors.




Science

- End-