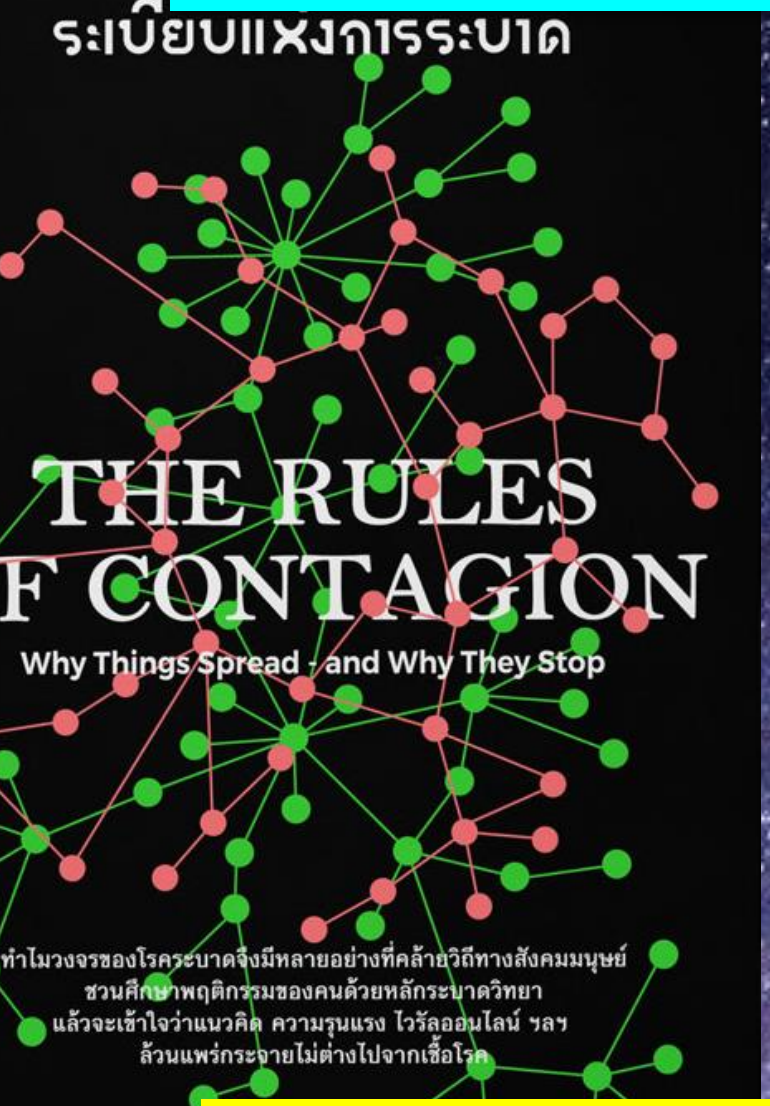
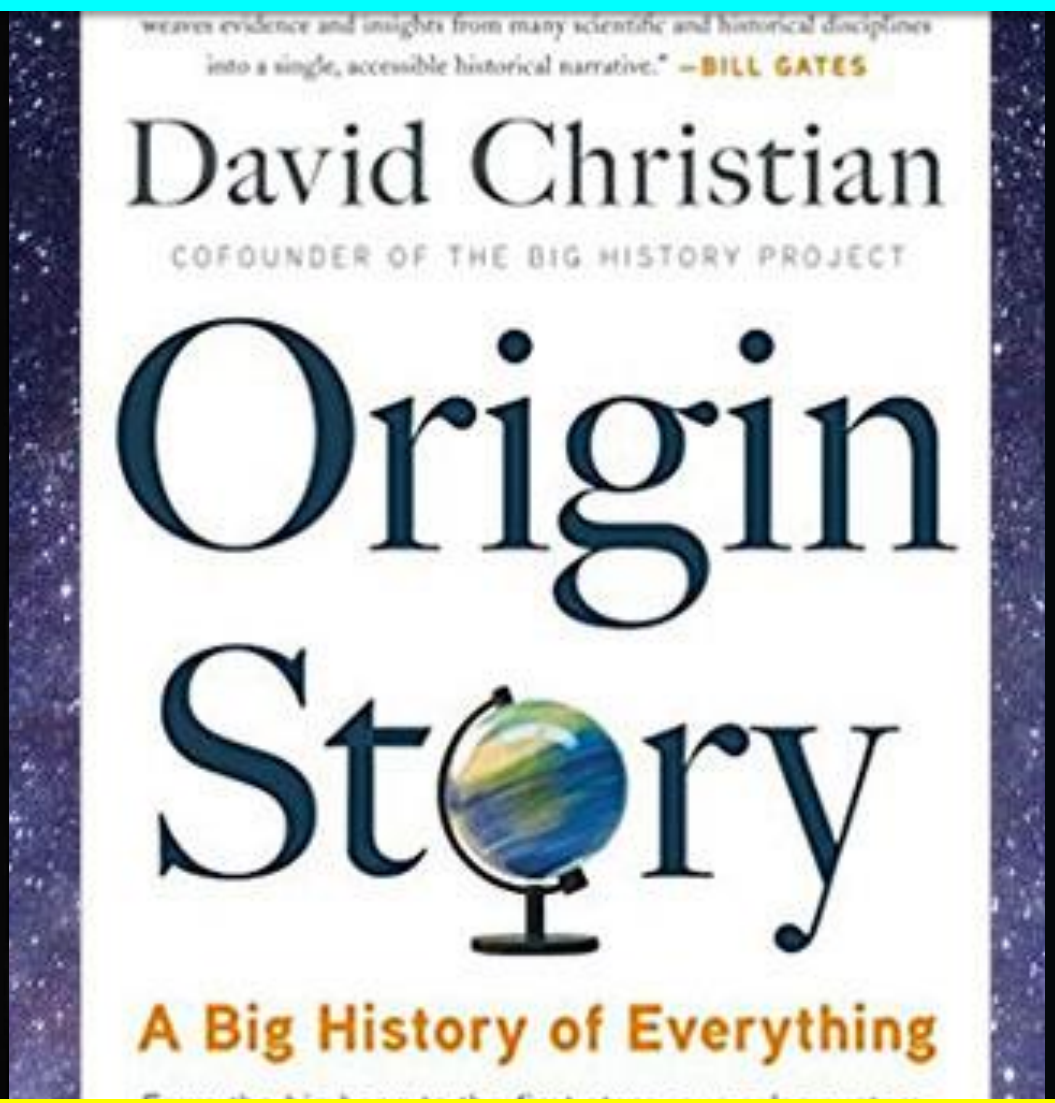
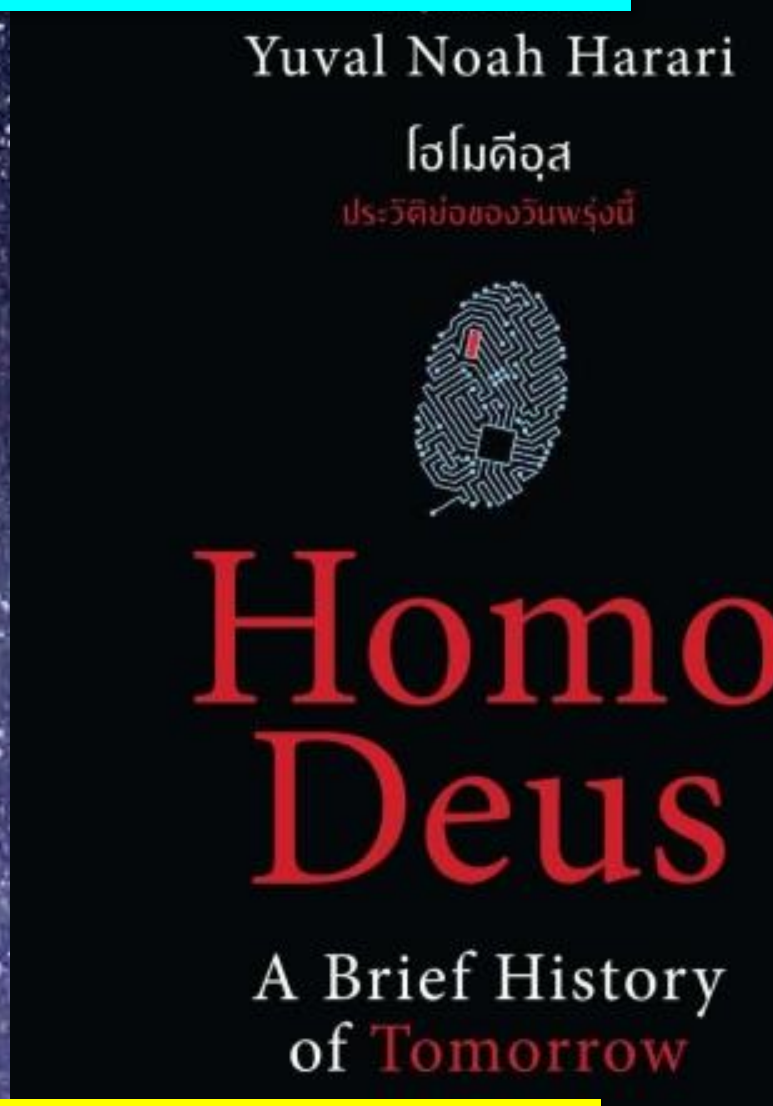
Science and Technology Trends







ดร.นำชัย ชีววิวรรธน์, ฝ่ายสร้างสรรค์สื่อและผลิตภัณฑ์, สวทช.

Classical Science

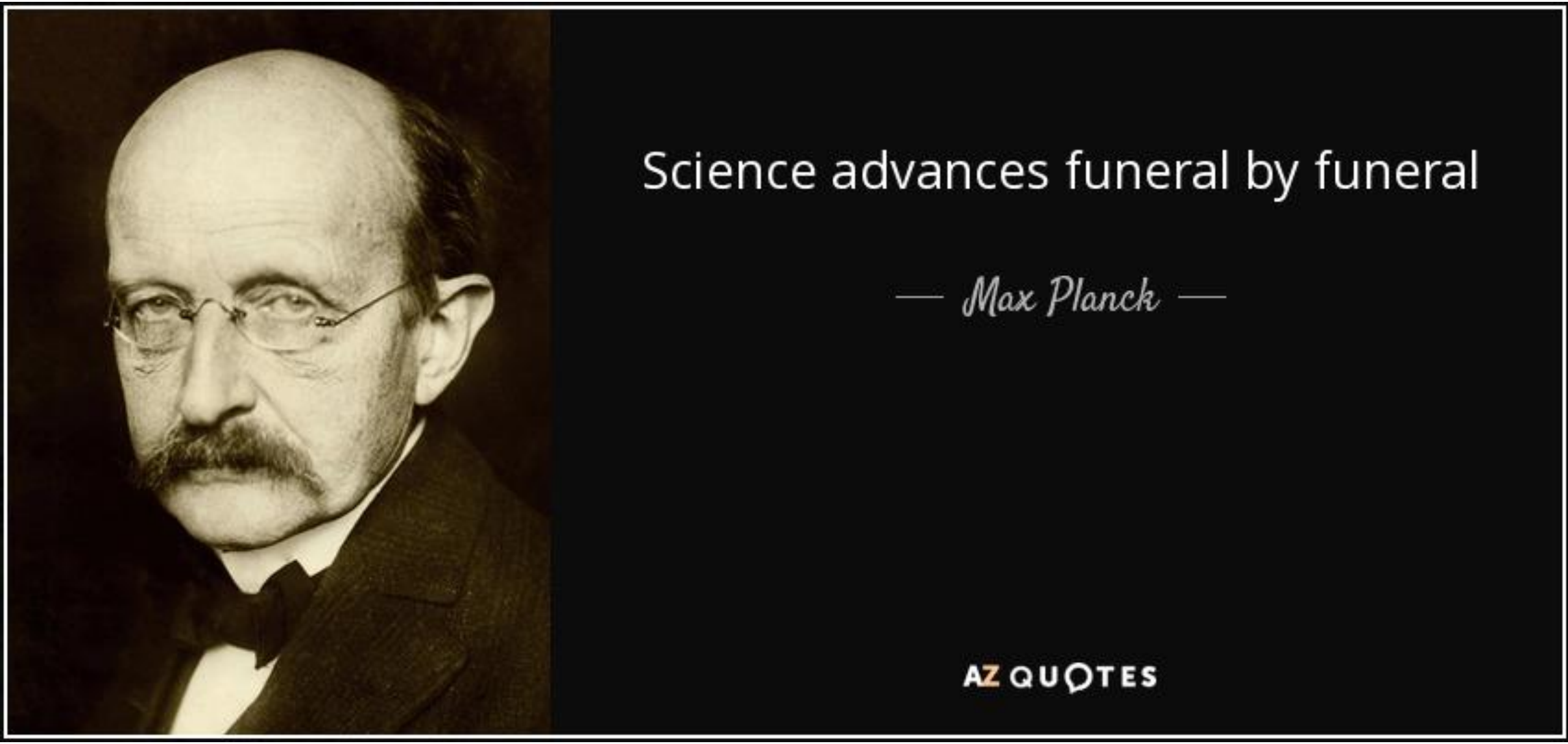
- Scientific Method
  - Observation (Observatory)
  - Assumption (Speculation, Hypothesis)
  - Experiment (Models, Graphs)
  - Conclusion (Laws, Theories, Equations)
  - Publication
- Logic (Cause–Result)
- Mathematics & Statistics
- Reproducibility
- Self-improvement processes (Retraction & Subtraction)

Weak Points

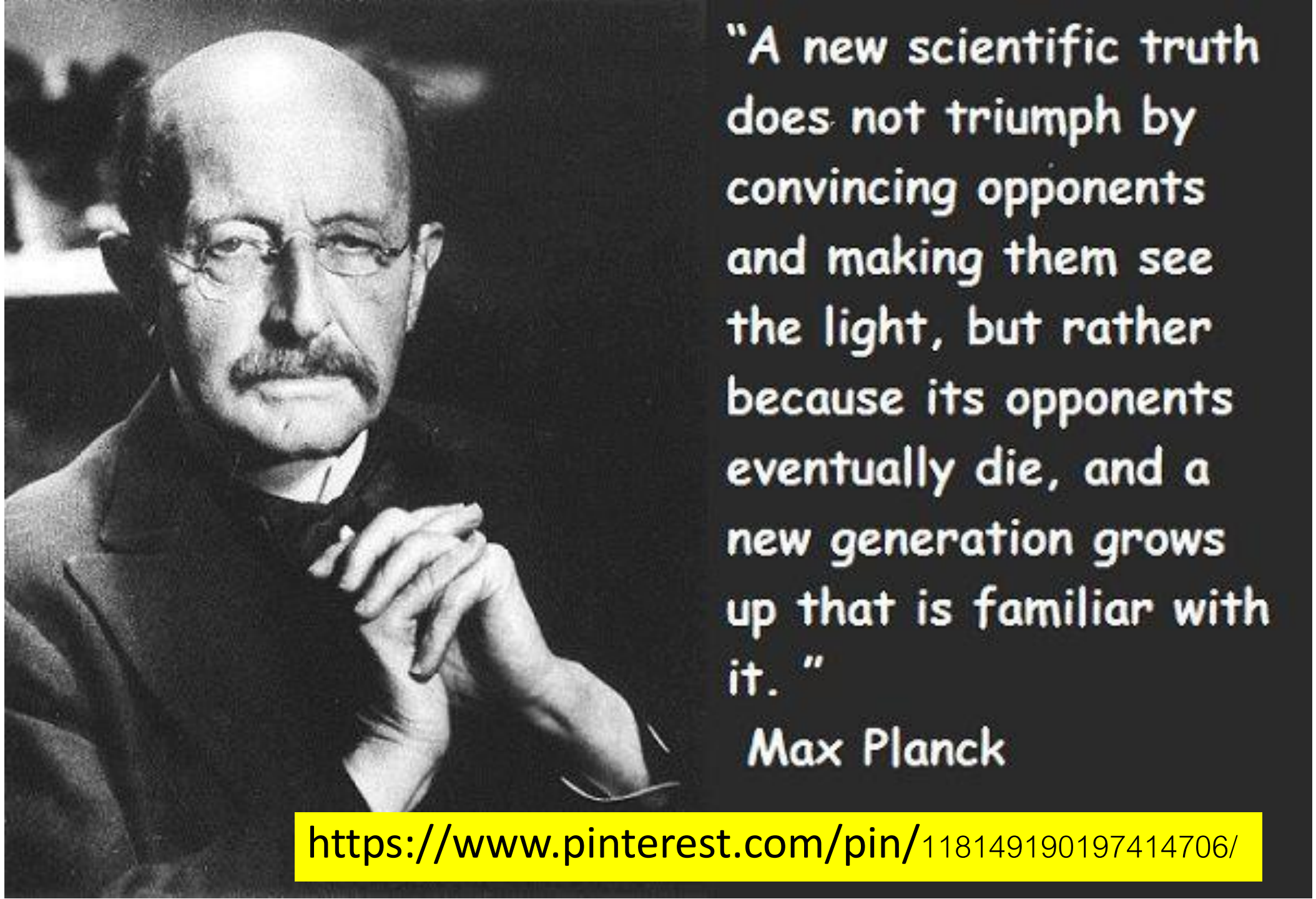
- Study in separate topics:
  - Physics, Chemistry, Biology: Simplicity
  - Trends: More & more integration;
    - Biophysics, Biochemistry, Bioengineering, etc.
- (Over)simplified Method
  - Trends: More Complex Study Methods
- Technical terms (Jargons):
  - ‘Space’ in common language (ที่ว่าง), physics (อวกาศ), mathematics (ปริภูมิ)
  - Definition (Context)

Weak Points

- Limits of technology or mindset
  - Technology
    - Light Microscope, Elecltronmicroscope (TEM, SEM, Cryo-EM), Atomic Force Microscope, etc.
    - EEG, MRI, fMRI, PET, etc.
  - Mindset
    - Heliocentric
    - Aether
    - Light speed (absolute vs relative)
    - Etc.



https://www.azquotes.com/quote/1056769



https://www.pinterest.com/pin/118149190197414706/

New Science(s)

- ❑ Big Pictures (More Integration)
  - ○ Big Science, Big Story, Big History
  - ○ Multi-disciplinary
- ❑ Wider Projection & Impact
- ❑ Crossed Application
- ❑ More Complexity
  - ○ Supercomputer, Big Data, AI
  - ○ Epigenetics

More Integration
Big Picture

"I have long been a fan of David Christian. In *Origin Story*, he elegantly weaves evidence and insights from many scientific and historical disciplines into a single, accessible historical narrative." —BILL GATES

David Christian

COFOUNDER OF THE BIG HISTORY PROJECT

Origin Story

A Big History of Everything

From the big bang to the first stars, our solar system, life on Earth, dinosaurs, *Homo sapiens*, agriculture, an ice age, empires, fossil fuels, a moon landing, and mass globalization. **And what happens next.**

More complex things appeared at key transition points, and I will refer to the most important of these as *thresholds*. The thresholds give shape to the complicated narrative of the modern origin story. They highlight major turning points, when already existing things were rearranged or otherwise altered to create something with new, "emergent" properties, qualities that had never existed before. The early universe had no stars, no planets, and no living organisms. Then, step by step, entirely new things began to appear. Stars were forged from atoms of

the new properties, just as arranging tiles in a different way can generate a new pattern in a mosaic. Take an example from chemistry. We normally think of hydrogen and oxygen as colorless gases. But join two hydrogen atoms to a single oxygen atom in a particular configuration, and you get a molecule of water. Put lots of those molecules together, and you get the utterly new quality that we think of as "wateriness." When we see a new form or structure with new qualities, we are really seeing new arrangements of what already existed. Innovation is emergence. If we think of emergence as a character in our story, it's probably slinky, mysterious, and unpredictable, likely to pop up from the darkness unexpectedly and take the plot in new and surprising directions.

The first structures and patterns in the universe emerged in just this way, as things and forces that popped out of the big bang were arranged in new configurations.

At the earliest moment for which we have some evidence, a

Big History examines our past, explains our present, and imagines our future

Journey through nearly 14 billion years of history in this self-guided, six-hour version of Big History. You'll find every chapter full of great activities to keep you entertained and test your learning.

GET STARTED

SIGN IN

GO TO SCHOOL SITE

https://www.bighistoryproject.com/home

WHAT IS BIG HISTORY?

Big History examines our past, explains our present, and imag
contained fields of study to grasp history as a whole. This grov
answers to the big questions about the history of our Universe

The Big History Project is a joint effort between teachers, scho
learners around the world.

PART I: COSMOS

Chapter 1: In the Beginning: Threshold 1

Chapter 2: Stars and Galaxies: Thresholds 2 and 3

THE UNIVERSE

Matters & Anti-matters

The Universe started simply with a burst of energy. As it developed over billions of years, stars were born, new complexities emerge, setting the stage for radical change.

THRESHOLD 1: **THE BIG BANG**
Beginning at the beginning. As far as we know.

THRESHOLD 2: **STARS LIGHT UP**
How stars are born.

THRESHOLD 3: **NEW CHEMICAL ELEMENTS**
How stars forge matter in the Universe.

OUR SOLAR SYSTEM & EARTH

The birth and death of stars leave an aftermath of matter, gas, and clouds of dust. Through gravity, accretion, and random collisions, new complex forms of matter grow to become galaxies, the Earth, and even living organisms.

THRESHOLD 4: **EARTH & THE SOLAR SYSTEM**

How tasty morsels of gas and rock created our home.

Chapter 3: Molecules and Moons: Threshold 4

LIFE

Entropy Waste

What makes life on Earth so special? How do you explain its diversity? And what exactly is it? How life emerged remains a mystery, but we've learned that life is fragile in the face of gradual and sudden change. Just ask the dinosaurs.

THRESHOLD 5: **LIFE ON EARTH**

How life evolves, adapts, and thrives.

PART II: BIOSPHERE

HUMANS

Powerful brains. Precise language. Humans have a knack for gathering, preserving, and sharing information. We use these skills to create entirely new forms of complexity, making us the most powerful force of change on the planet.

THRESHOLD 6: **COLLECTIVE LEARNING**
How humans are different.

THRESHOLD 7: **AGRICULTURE**
How farming sows the seeds of civilization.

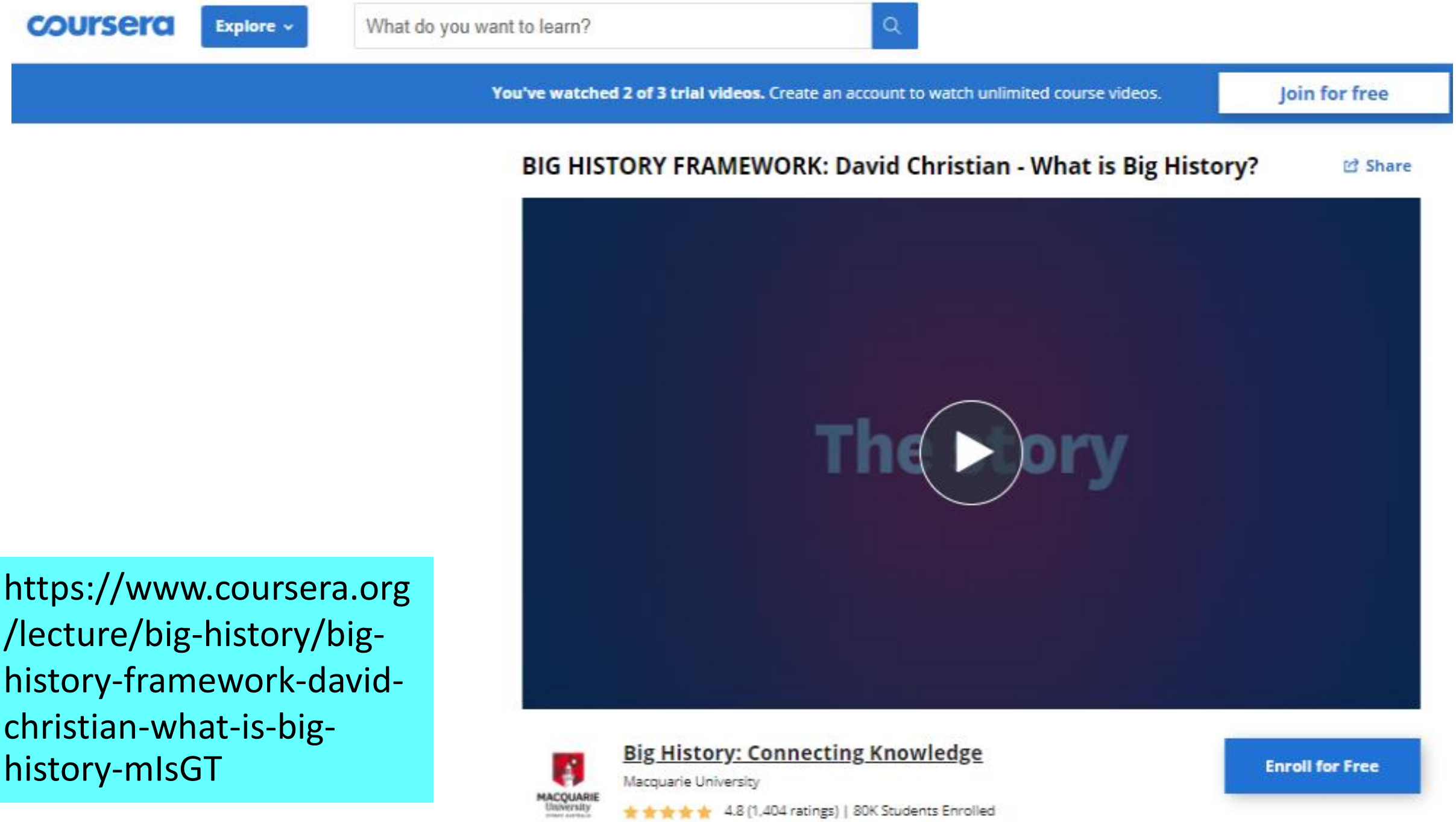
PART III: US

THE FUTURE

What does 13.8 billion years of history tell us? How does knowing so m
about the past influence how we think about the future? These may be t
important questions Big History asks.

THRESHOLD 8: **THE MODERN REVOLUTION**

Why change accelerates faster and faster.



https://www.coursera.org/lecture/big-history/big-history-framework-david-christian-what-is-big-history-mIsGT

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- ❑ Crossed Application
- ❑ More Complexity
  - ○ Supercomputer, Big Data, AI
  - ○ Epigenetics

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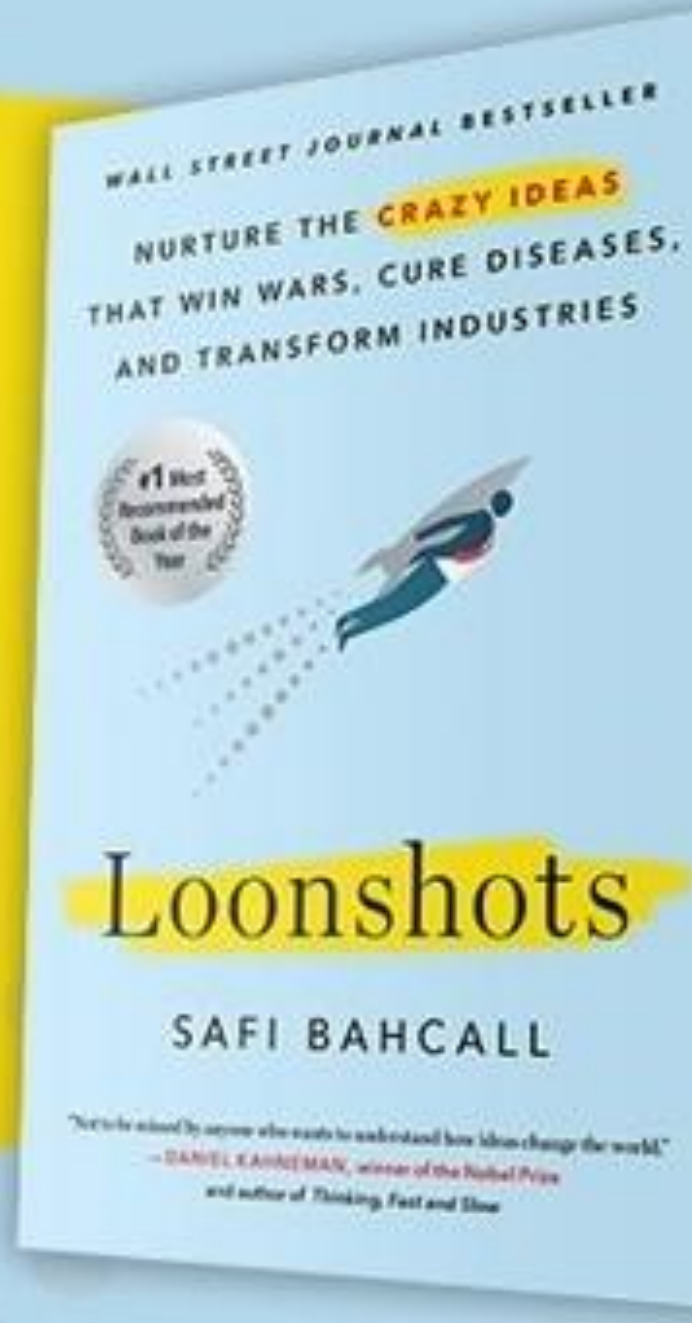
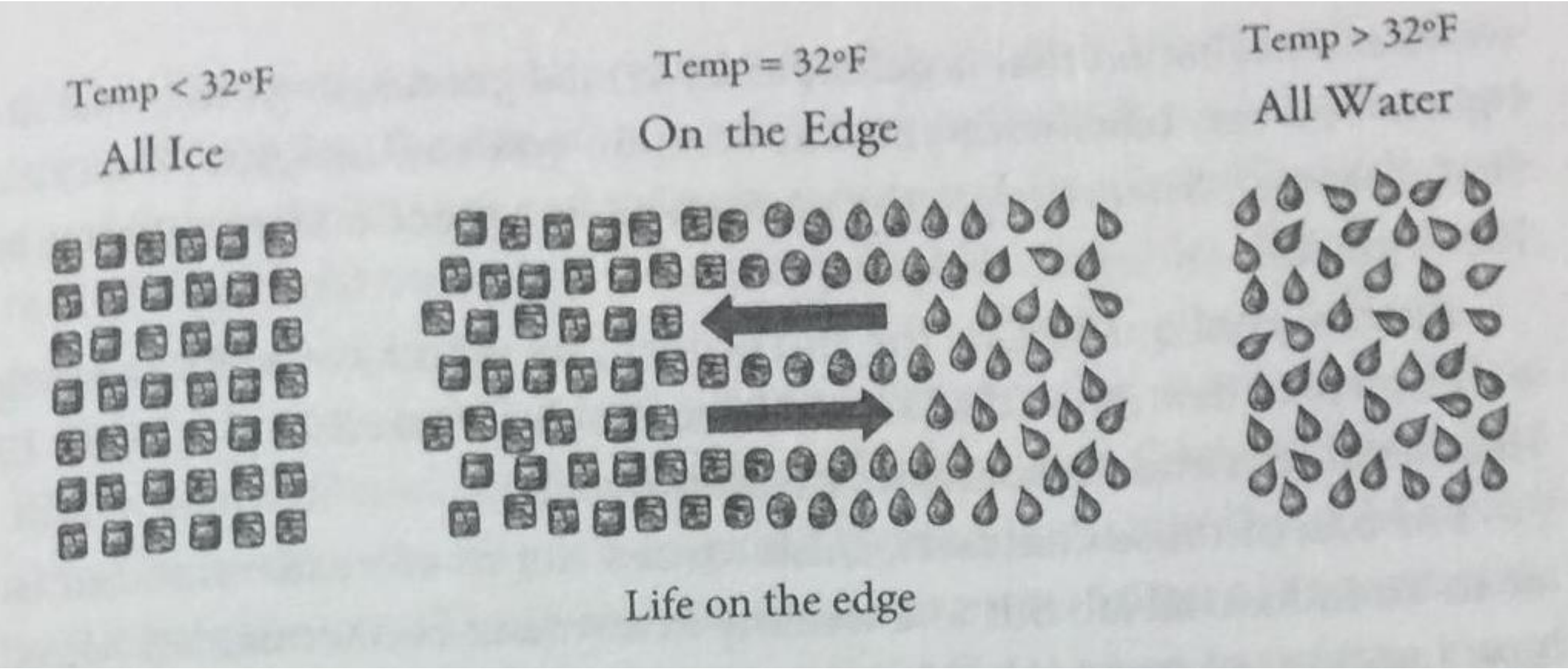
- A Best Business Book of the Year: *Bloomberg*, *Financial Times*, *Washington Post*, and more
- Recommended by Bill Gates, Daniel Kahneman, Malcolm Gladwell, Tim Ferriss, and more



Scientists vs Artists



Not Culture Issue,
But Nature Itself

Dynamic Equilibrium
(continuous exchange)

Strong	Chaos	Bush–Vail Balance
Weak	Stagnation	Moses Trap
	Weak	Strong

Phase separation
(two groups)

Phase Transition

Sudden transformation in system behavior, as one or more control Parameters cross a critical threshold

Water	From liquid to solid, as temperature decreases
Cars on Highways	From smooth flow to jammed flow, as car density increases
Fires in forests	From contained to uncontrolled, as wind speed increases
Individuals in companies	From a focus on *loonshots* to a focus on careers, as size of company increases

Loonshot		Franchise
	Widely dismissed or ridiculed idea	
1922	A 12-year-old patient with diabetes is treated with ground-up pancreas extract	Insulin
1935	An 80-pound payload is accelerated to 500 miles per hour through rocket propulsion	Long-range ballistic missiles
1961	A 32-year-old former milk-truck driver plays a metrosexual British spy who saves the world	James Bond
1976	A script titled *The Adventures of Luke Starkiller* is green-lit	Star Wars

Model

- ❑ *In vitro*
- ❑ *In vivo*
- ❑ *In silico*

- ❑ Organoid

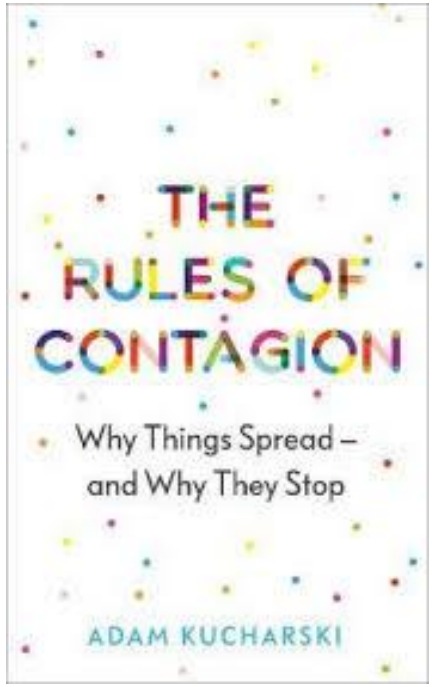
- ❑ **Epigenetics**
  - Genetics + Environment

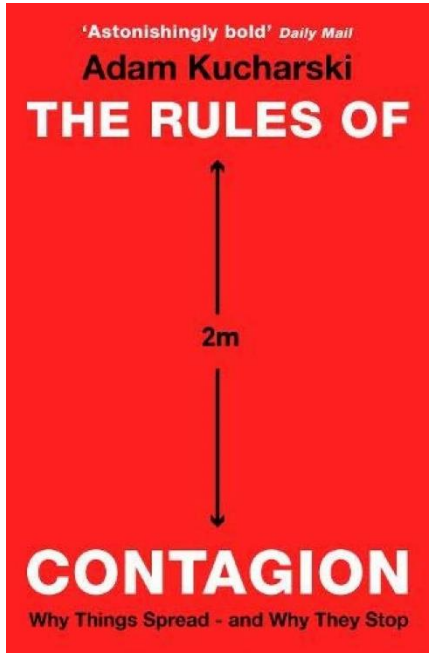
Genetic Worlds

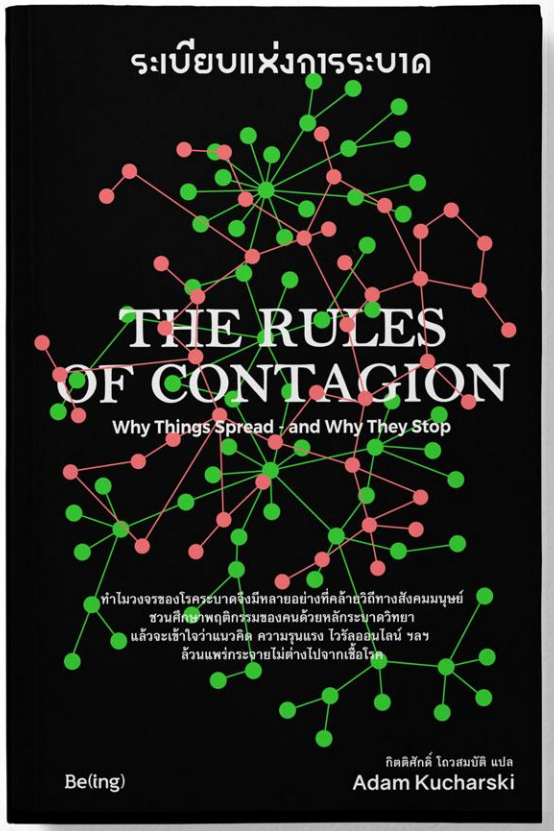
- ❑ Chromosome
- ❑ DNA, Gene
- ❑ Genome

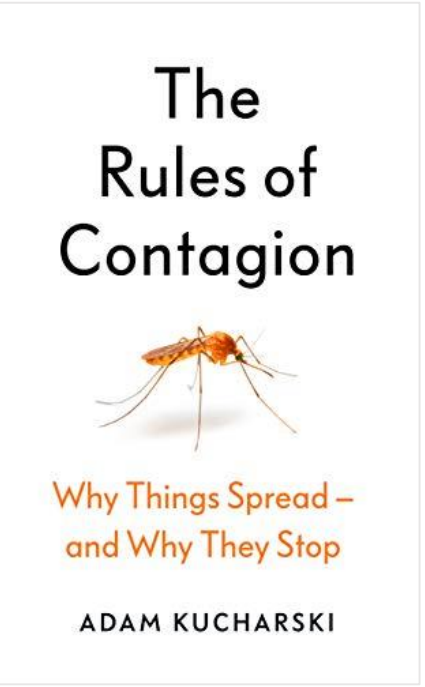
Omic Studies

- ❑ Genomics
- ❑ Proteomics
- ❑ Trasnscriptomics
- ❑ Metabolomics


THE
RULES OF
CONTAGION
Why Things Spread –
and Why They Stop
ADAM KUCHARSKI


'Astonishingly bold' Daily Mail
Adam Kucharski
THE RULES OF
2m
CONTAGION
Why Things Spread - and Why They Stop


ระเบียบแห่งการระบาด
THE RULES
OF CONTAGION
Why Things Spread - and Why They Stop
ทำไมวงจรของโรคระบาดจึงมีหลายอย่างที่คล้ายวิถีทางสังคมมนุษย์
ชวนศึกษาพฤติกรรมของคนด้วยหลักระบาดวิทยา
แล้วจะเข้าใจว่าแนวคิด ความรุนแรง ไวรัลออนไลน์ ฯลฯ
ล้วนแพร่กระจายไม่ต่างไปจากเชื้อโรค
Be(ing)
กิตติศักดิ์ โถวสมบัติ แปล
Adam Kucharski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Why Things Spread –
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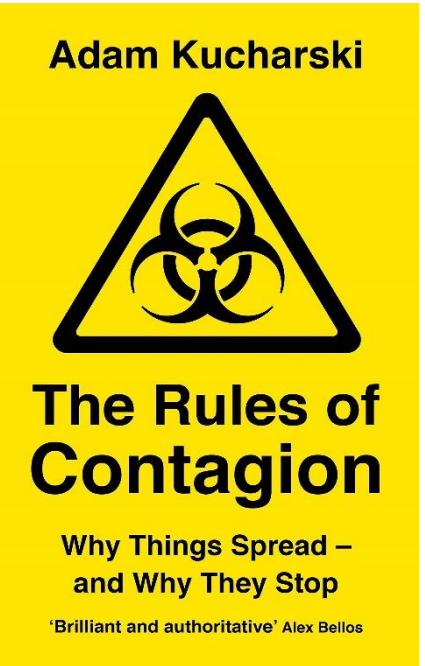
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The Rules of
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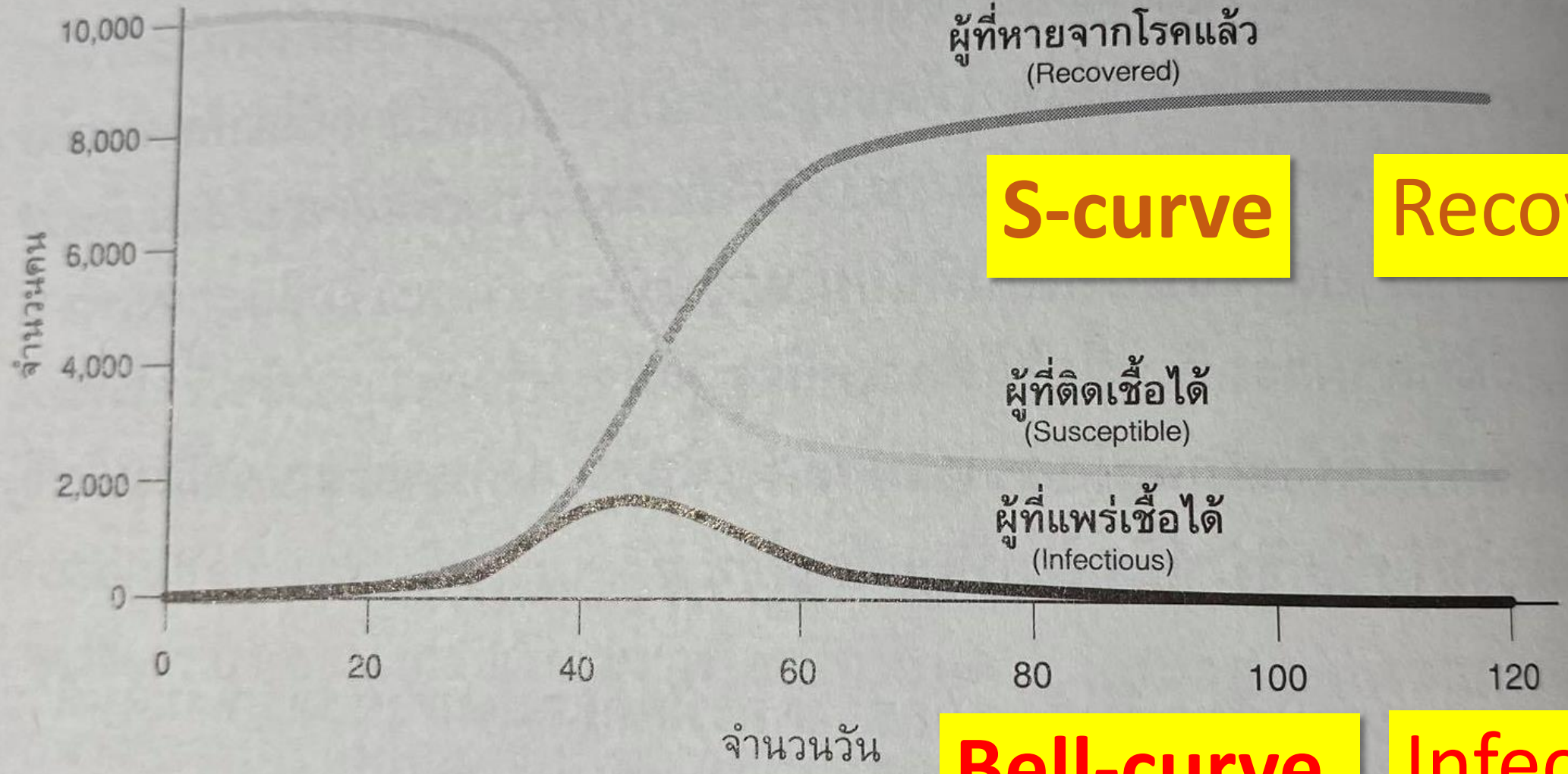
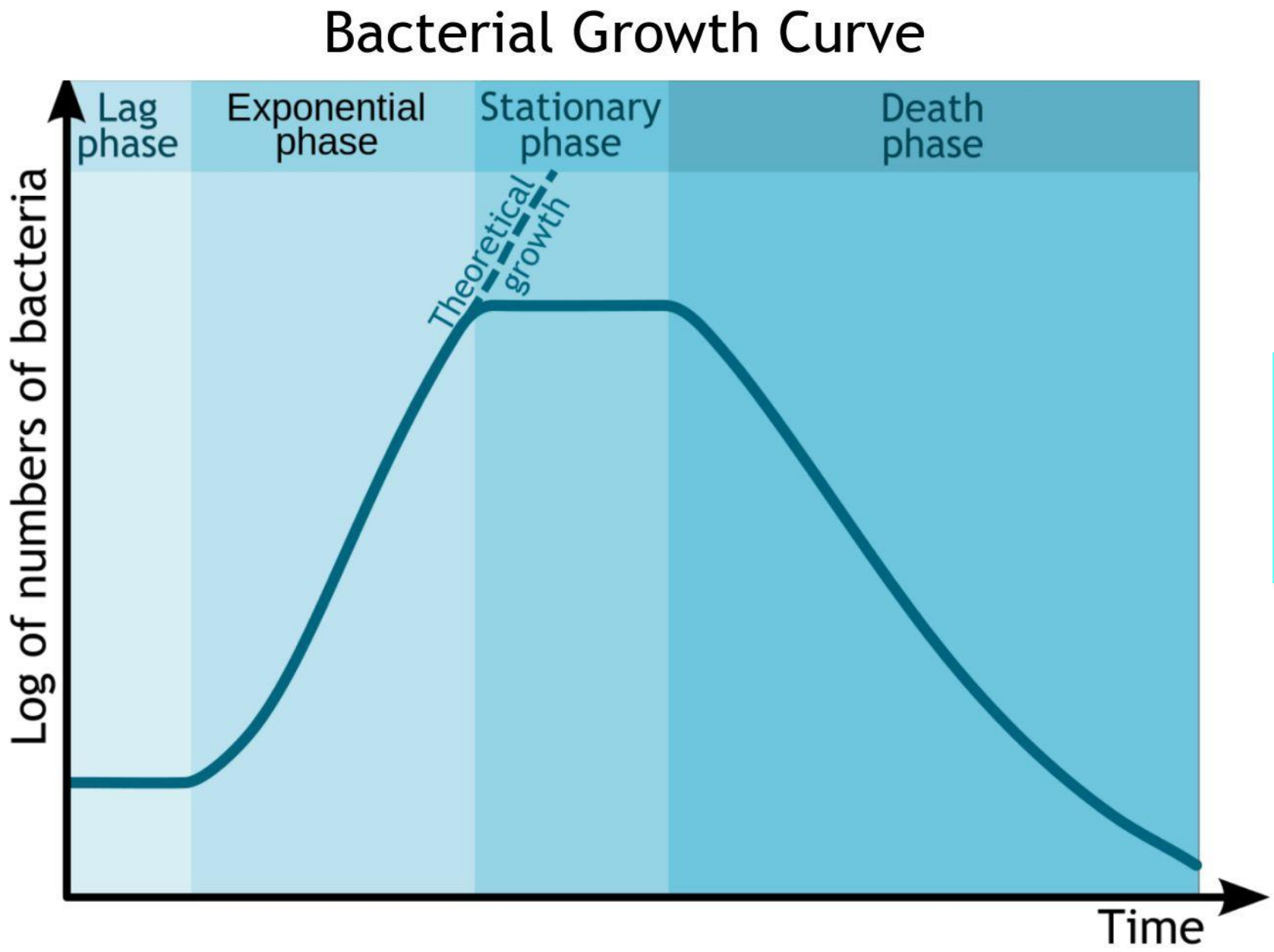
and Why They Stop
'Brilliant and authoritative' Alex Bellos



การจำลองการระบาดของไข้หวัดใหญ่ โดยใช้แบบจำลอง SIR

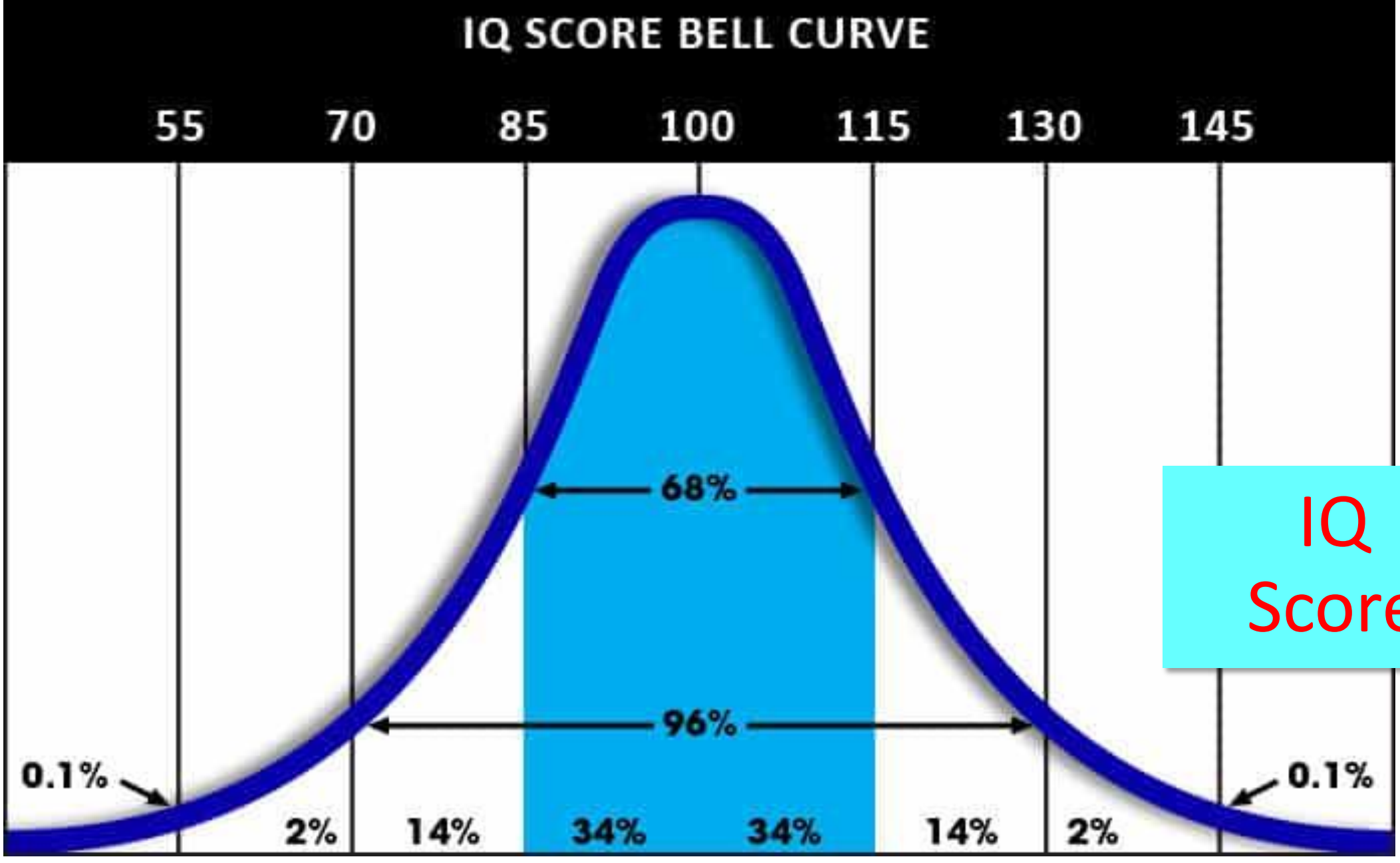
S-curve Recovered

Bell-curve Infectious



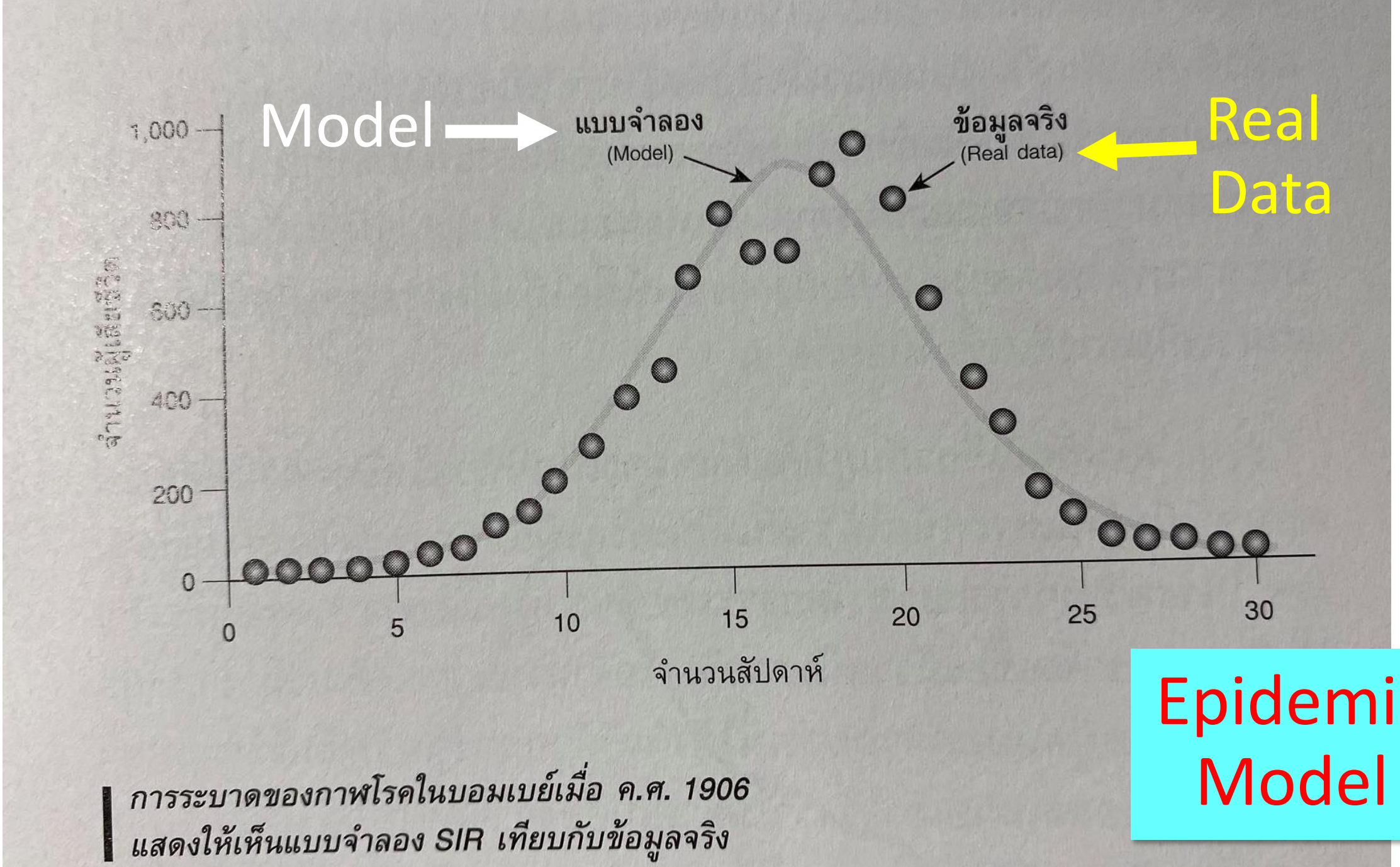
Bacterial Growth

https://www.thoughtco.com/bacterial-growth-curve-phases-4172692



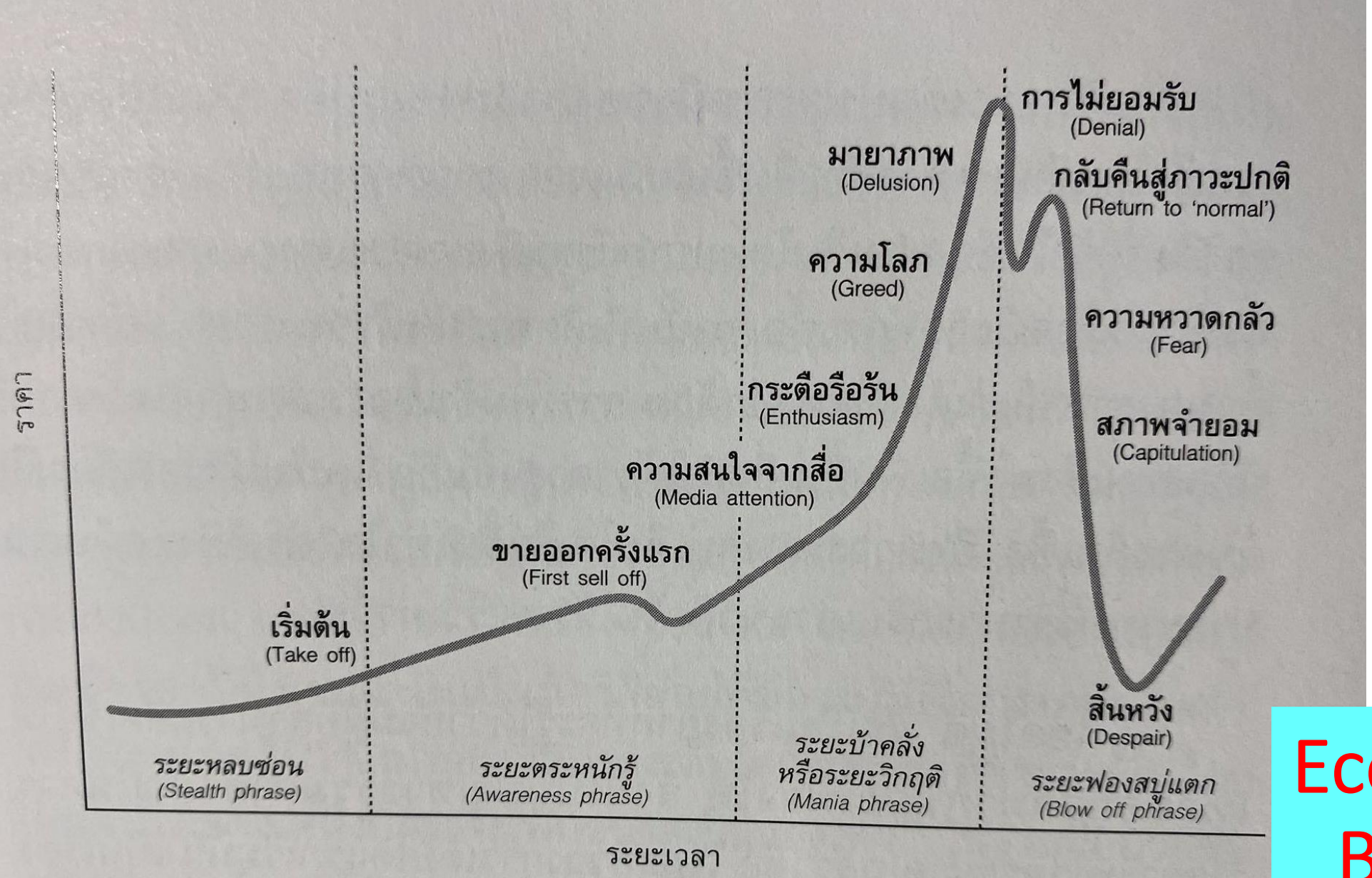
IQ Score

https://iqtestprep.com/iq-bell-curve/



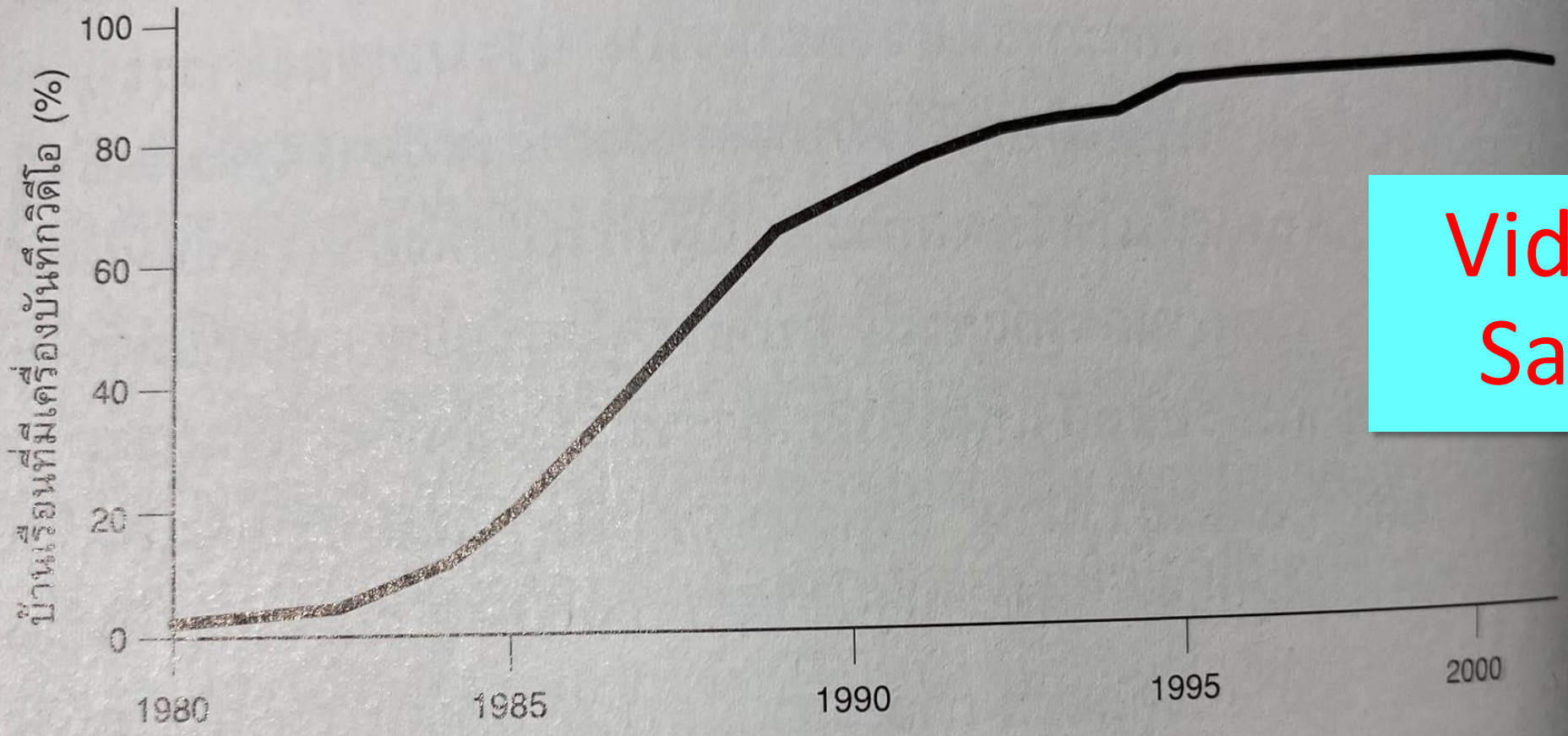
การระบาดของกาฬโรคในบอมเบย์เมื่อ ค.ศ. 1906 แสดงให้เห็นแบบจำลอง SIR เทียบกับข้อมูลจริง

Epidemic Model



ระยะทั้งสี่ของภาวะฟองสบู่
ปรับปรุงจากภาพกราฟิกดั้งเดิมของฌอง-ปอล โรดริก

Economic Bubble



จำนวนผู้มีเครื่องบันทึกวิดีโอในช่วงเวลาต่างๆ ในประเทศสหรัฐอเมริกา
ข้อมูลจากสมาคมเครื่องใช้ไฟฟ้าเพื่อการอุปโภค

- การแพร่กระจายของสินค้า
  - เครื่องเล่นวิดีโอ
  - วิทยุ
  - ตู้เย็น
  - โทรทัศน์
  - เตาไมโครเวฟ
  - โทรศัพท์มือถือ
  - ฯลฯ
- การแพร่กระจายของความคิด (นามธรรม) และพฤติกรรม
  - Feynman’s Diagram
  - โรคอ้วน
  - การหาว
  - การสูบบุหรี่
  - ความสุข
  - ฯลฯ

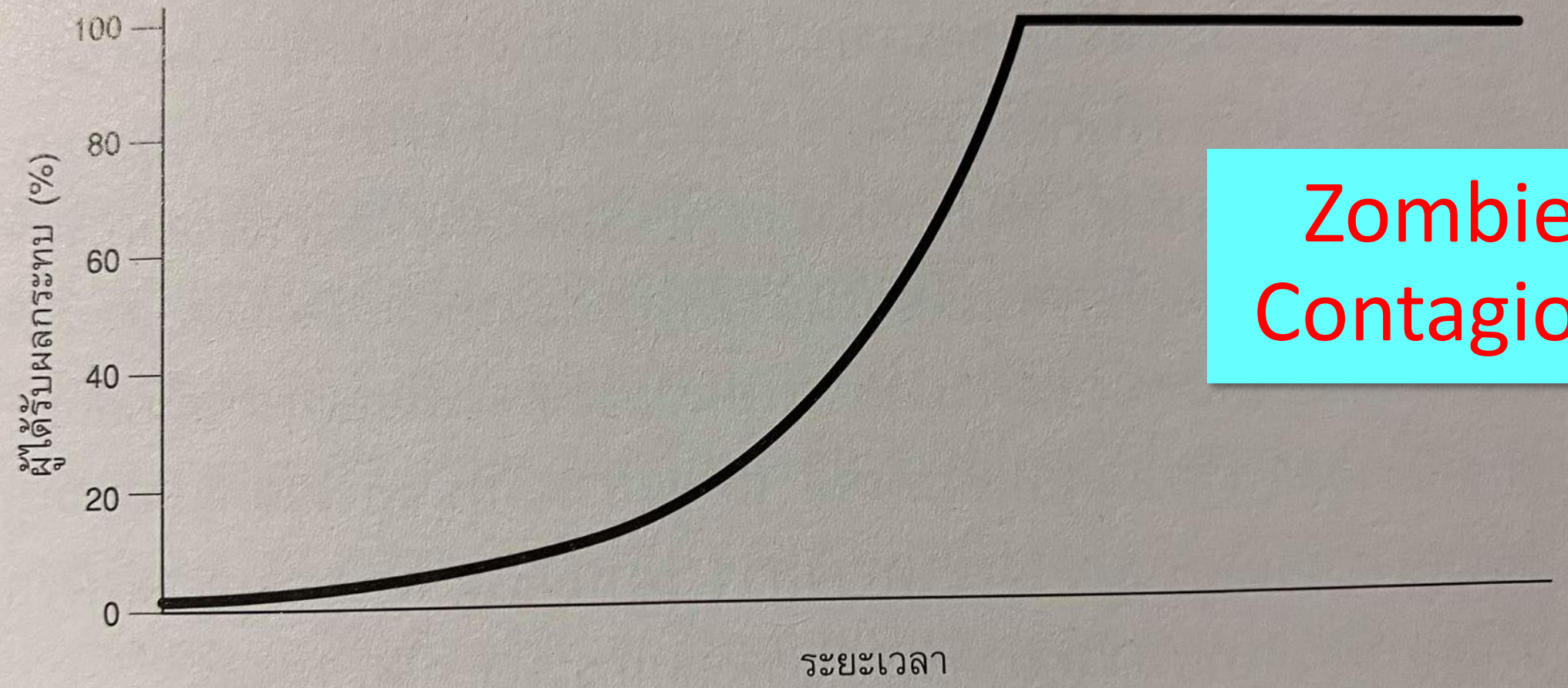
Universal Patterns ?

❑ มีอะไรที่ระบาดได้บ้าง ? มีรูปแบบการระบาดที่คล้ายกัน ?

- ภาพการจัดกลุ่มการฆาตกรรมบนแผนที่ในเมืองต่าง ๆ ในสหรัฐ เหมือนกับภาพแผนที่การระบาดของอหิวาตกโรคในบังคลาเทศ
- กราฟการฆ่าล้างเผ่าพันธุ์ในรวันดา เหมือนกับกราฟการระบาดของอหิวาตกโรคในโซมาเลีย
- ในผู้ถูกยิง **100** ราย จะระบาดทำให้เกิดเหตุยิงกันตามมาอีก **63** ครั้ง

Power of Prediction

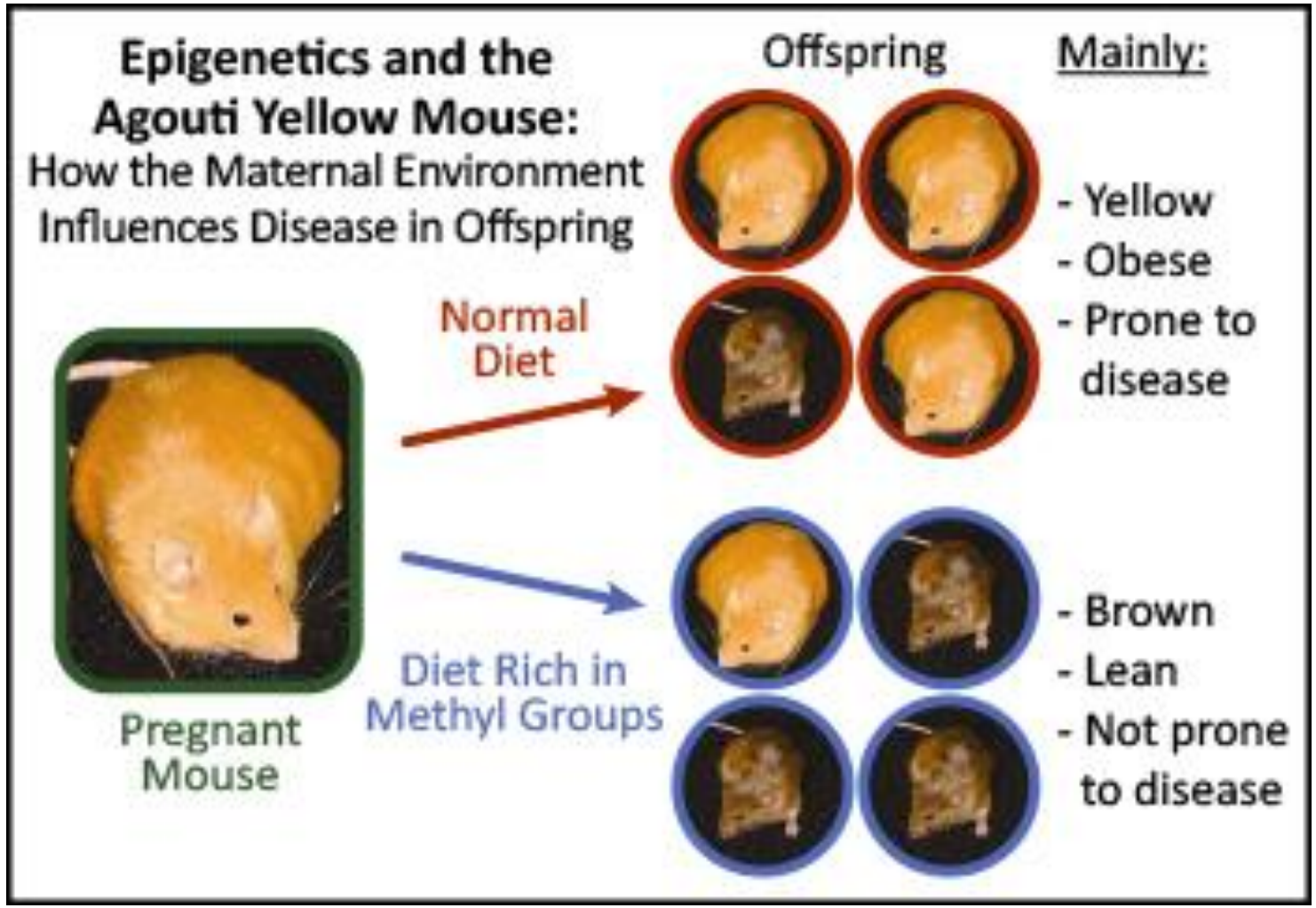
กราฟที่ไม่มีจริง: ซอมบี้ฆ่าคนจนหมดโลก



Zombie Contagion

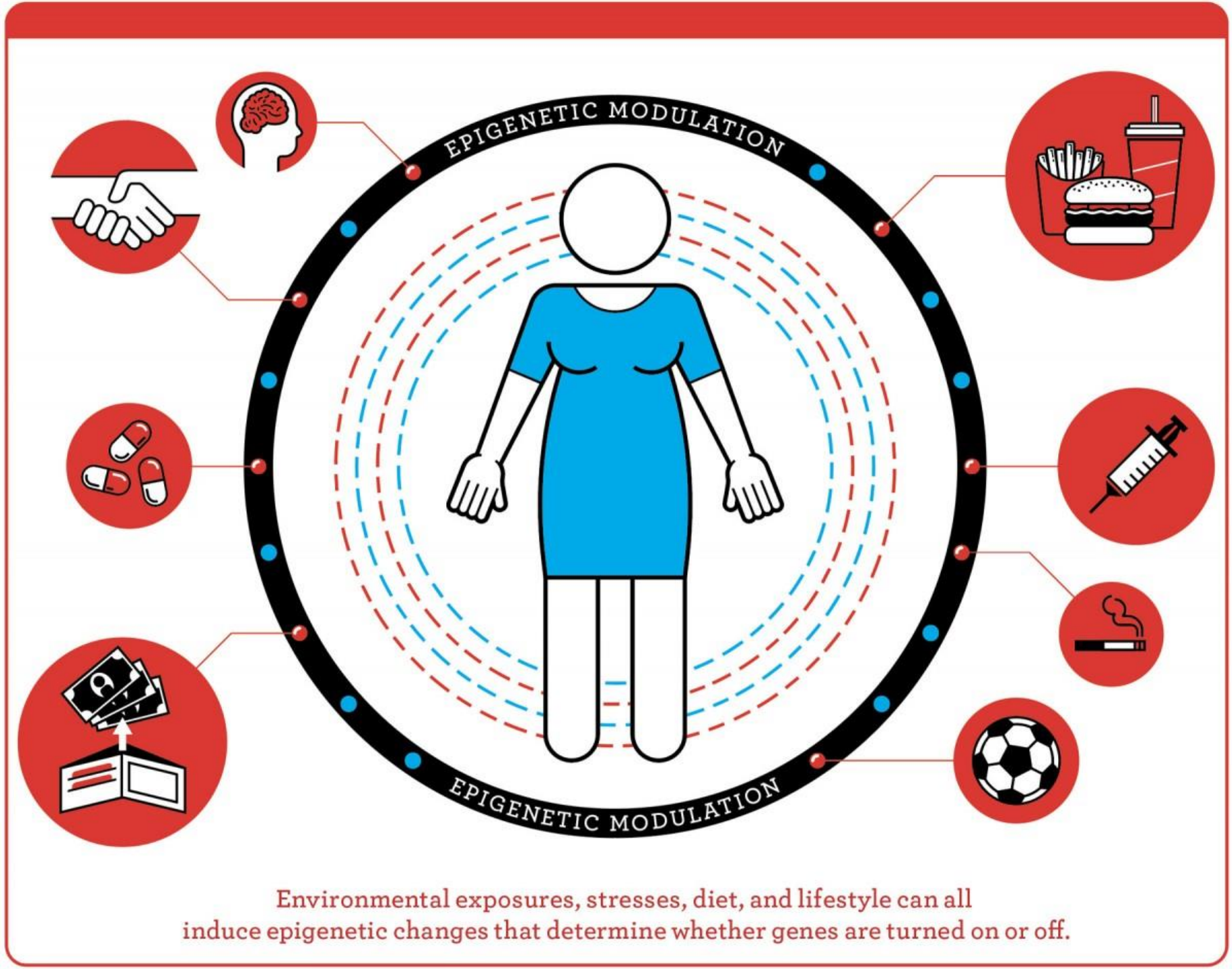
แผนภาพแสดงกราฟการระบาดที่เพิ่มจำนวนแบบทวีคูณจนกระทั่งทุกคนติดเชื้อหมด

Not only Genetics, but Epigenetics

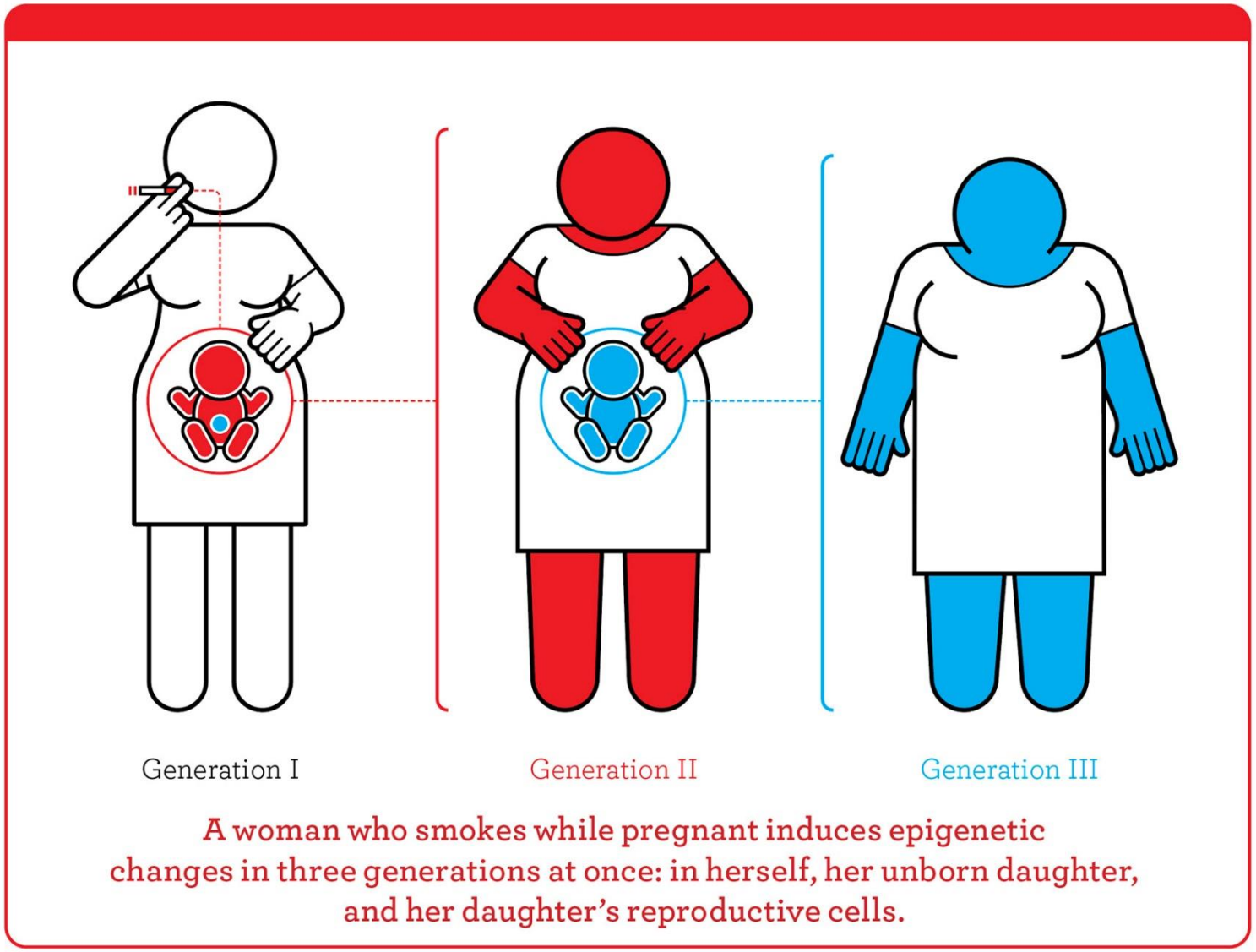


The mouse has an altered version of the ***agouti* gene**, which causes them to be **yellow, obese, and highly susceptible to developing diseases**, such as cancer and diabetes.

https://www.niehs.nih.gov/health/topics/science/epigenetics/index.cfm



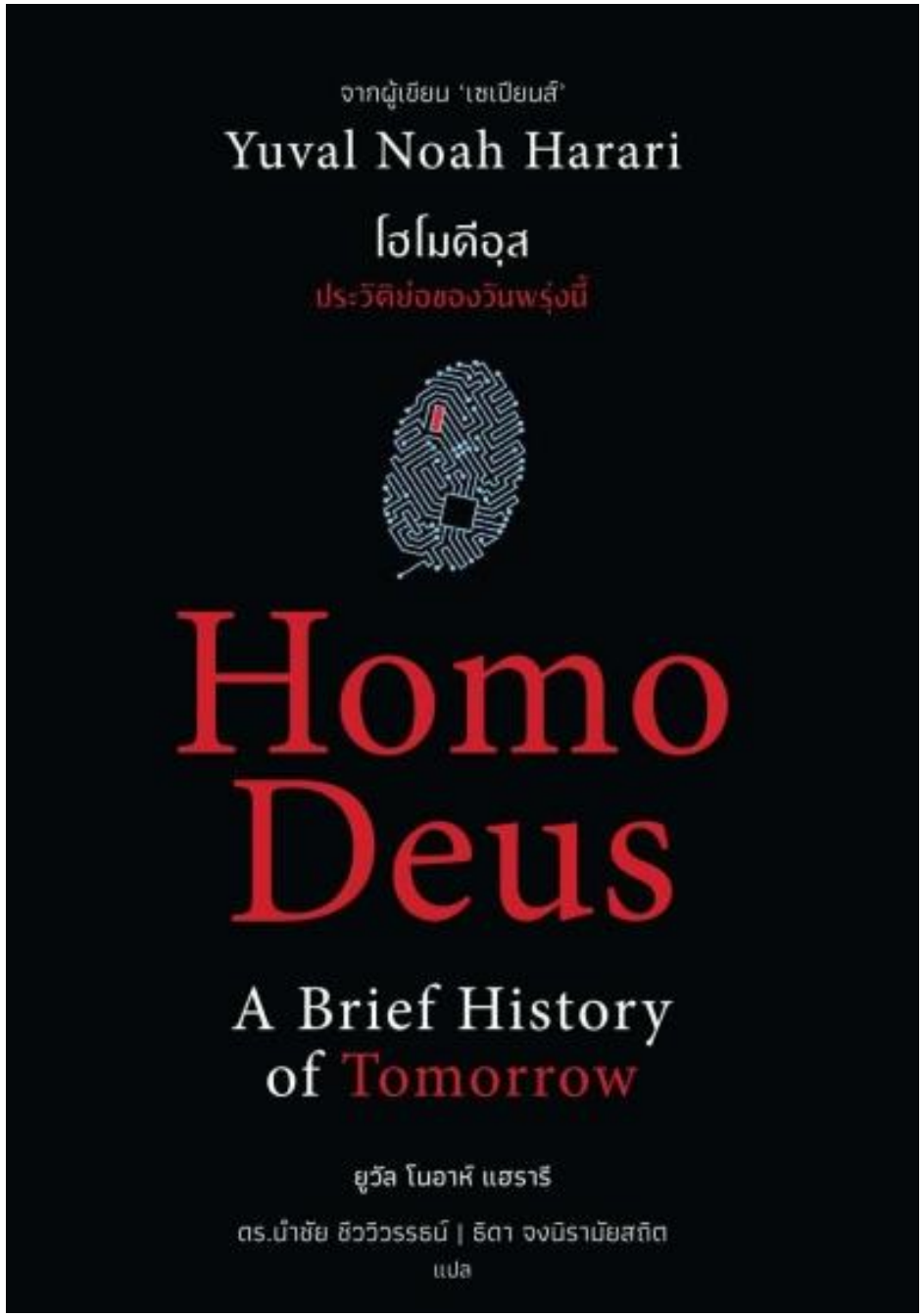
Environmental exposures, stresses, diet, and lifestyle can all induce epigenetic changes that determine whether genes are turned on or off.



A woman who smokes while pregnant induces epigenetic changes in three generations at once: in herself, her unborn daughter, and her daughter's reproductive cells.

A grandmother who smokes, thus altering her own epigenome, could in theory pass on the harmful epigenetic configuration caused by her habit.

Research has shown that smoking can cause abnormal increases in hormones that signal hunger, and if this is heritable, that could lead to obesity in her granddaughter.



❖ อายุยืนมากกว่า **200** ปี
อาจจะเกือบเป็นอมตะ

❖ อัปโหลดความจำ **&** ตัวตน

❖ เข้าอินเทอร์เน็ตผ่านความคิดล้วน ๆ

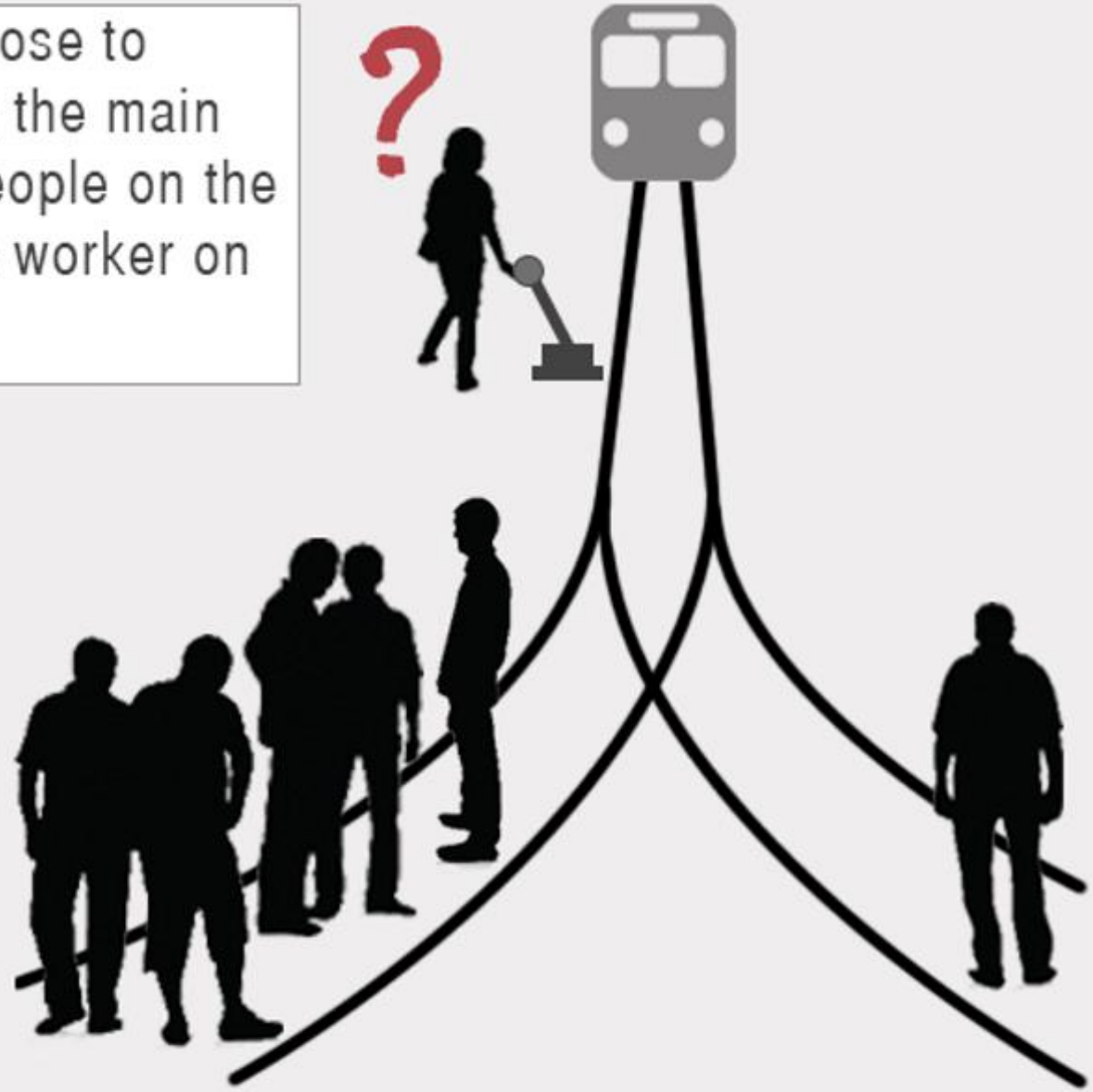
❖ ไม่ต้องทำงาน หุ่นยนต์ทำงานทุกอย่าง
แล้วเราจะทำอะไรกัน?

ฯลฯ

ครั้งแรกที่วิชา “ปรัชญา”
นำมาใช้งานได้จริง

The trolley problem

The person can choose to divert the tram from the main track, saving five people on the track, but killing the worker on the other track.



Safety Software

http://www.thaiauto.or.th/2012/th/news/news-detail.asp?news_id=4679

https://www.nstda.or.th/th/e-book/12990-nstda-diary-2020

10 เทคโนโลยีที่น่าจับตามอง

เป้าหมายหลักข้อหนึ่งคือ เป็นการให้ข้อมูลเพื่อการลงทุนกับผู้ประกอบการ ซึ่งช่วยกระตุ้น

การลงทุนให้แก่เทคโนโลยีใหม่ๆ ที่มีอนาคตสดใสอีกทางหนึ่งด้วย

Biological & Medical Technologies

New Lab Models

- ❑ Cell-lines for Drug Testing
- ❑ Organoids: Brain, Uterus, etc.
- ❑ Organ-on-a-chip
- ❑ Etc.

More Precision & Personal

- ❑ Personalized Genomics
- ❑ Pharmacogenetics
- ❑ Nanoparticle-Based Diagnosis
- ❑ Customized Stem Cells (iPSC)
- ❑ Etc.

New Prevention & Treatments

- ❑ Mobile Diagnostic Tools
- ❑ Edible Vaccines
- ❑ Personalized Cancer Vaccine
- ❑ Nano Drug Delivery
- ❑ Nano Theranostics (Therapy + Diagnosis)
- ❑ Nano Valve
- ❑ RNAi-based Therapeutic
- ❑ CRISPR-Cas9
- ❑ DNA Robot
- ❑ Etc.

Lifelong Health Quality

- Artificial Organs
  - Tissue Engineering
  - 3D Bio-printing
- Exoskeletons
- Nano Needle
- Etc.

New & Renewable Energy

New Materials, Methods & Sources

- Solar Cells
  - Flexible Solar Cells
  - High Efficiency Solar Cells (Hetero-Junction)
  - Perovskite Solar Cell
- Energy from Algae, etc.

Battery & Storage

- Printed Paper Battery
- Super-Battery & Micro-Supercapacitor
- Next Generation Li-Ion Battery
- Etc.

ICT & Electronics

New Electronics

- ❑ Printed Electronics
- ❑ 3D Display, 3D Gesture Recognition
- ❑ OLED
- ❑ Next Generation LED, etc.

Internet—Related

- ❑ IoT (Internet of Things)
- ❑ M2M (Machine-to-Machine) Communication
- ❑ V2X (Vehicle-to-Anything) Communication
- ❑ Semantic Web, etc.
- ❑ Haptic Tech, etc.

Computer—Related

- ❑ Social-, Cognitive-Computing
- ❑ Augmented Reality (AR)
- ❑ Deep Learning & AI
- ❑ Big Data Analytic Platform,
- ❑ Image & VDO Content Analytic, etc.
- ❑ Quantum Computing
- ❑ Etc.

New & Smart Materials

Brand-New or Modified Materials

- ❑ Graphene, Graphene Composite
- ❑ Intelligence Materials
- ❑ Self-Healing Materials
- ❑ Smart Polymers (respond to stimulants)
- ❑ Smart Textiles (change color, temp. or release drugs, etc.)
- ❑ Programmable Materials (self-assembly)
- ❑ Second Skin
- ❑ Etc.

Green & Circular Products

New Food & Packaging

- ❑ Cellular Agriculture
- ❑ Food Structure Design
- ❑ Personalized Food
- ❑ Edible Packaging, etc.

Just Examples!

Green & Circular Products

- ❑ Bio-based Plastics
- ❑ Biorefinery
- ❑ Cellulose Biofuel
- ❑ Bio-based Plastics, Bio-composite Plastics
- ❑ From-Air-to-Chemicals Bacteria, etc.

CONCLUSION

Trends :

Science is more wonderful & deeper,

Technology support more & go beyond limits,

Innovation is all around and unimaginative.

Life is more comfortable, convenient & lasting, possibly.


Thank You