



01

[1] In school, there's one curriculum, one right way to study science, and one right formula that spits out the correct answer on a standardized test.

[2] Textbooks with grand titles like The Principles of Physics magically reveal "the principles" in three hundred pages.

[3] An authority figure then steps up to the lectern to feed us "the truth."

[4] As theoretical physicist David Gross explained in his Nobel lecture, textbooks often ignore the many alternate paths that people wandered down, the many false clues they followed, the many misconceptions they had.

[5] We learn about Newton's "laws" — as if they arrived by a grand divine visitation or a stroke of genius — but not the years he spent exploring, revising, and changing them.

[6] The laws that Newton failed to establish — most notably his experiments in alchemy, which attempted, and spectacularly failed, to turn lead into gold — don't make the cut as part of the one-dimensional story told in physics classrooms.

[7] Instead, our education system turns the life stories of these scientists from lead to gold.



02

[1] Over 4.5 billion years ago, the Earth's primordial atmosphere was probably largely water vapour, carbon dioxide, sulfur dioxide and nitrogen.

[2] The appearance and subsequent evolution of exceedingly primitive living organisms (bacteria-like microbes and simple single-celled plants) began to change the atmosphere, liberating oxygen and breaking down carbon dioxide and sulfur dioxide.

[3] This made it possible for higher organisms to develop.

[4] When the earliest known plant cells with nuclei evolved about 2 billion years ago, the atmosphere seems to have had only about 1 percent of its present content of oxygen.

[5] With the emergence of the first land plants, about 500 million years ago, oxygen reached about one-third of its present concentration.

[6] It had risen to almost its present level by about 370 million years ago, when animals first spread on to land.

[7] Today's atmosphere is thus not just a requirement to sustain life as we know it — it is also a consequence of life.



03

- [1] In the modern world, we look for certainty in uncertain places.
- [2] We search for order in chaos, the right answer in ambiguity, and conviction in complexity.
- [3] "We spend far more time and effort on trying to control the world," best-selling writer Yuval Noah Harari says, "than on trying to understand it."
- [4] We look for the easy-to-follow formula.
- [5] Over time, we lose our ability to interact with the unknown.
- [6] Our approach reminds me of the classic story of the drunk man searching for his keys under a street lamp at night.
- [7] He knows he lost his keys somewhere on the dark side of the street but looks for them underneath the lamp, because that's where the light is.
- [8] Our yearning for certainty leads us to pursue seemingly safe solutions – by looking for our keys under street lamps.
- [9] Instead of taking the risky walk into the dark, we stay within our current state, however inferior it may be.



04

[1] In the late twentieth century, researchers sought to measure how fast and how far news, rumours or innovations moved.

[2] More recent research has shown that ideas — even emotional states and conditions — can be transmitted through a social network.

[3] The evidence of this kind of contagion is clear: 'Students with studious roommates become more studious. Diners sitting next to heavy eaters eat more food.'

[4] However, according to Christakis and Fowler, we cannot transmit ideas and behaviours much beyond our friends' friends' friends (in other words, across just three degrees of separation).

[5] This is because the transmission and reception of an idea or behaviour requires a stronger connection than the relaying of a letter or the communication that a certain employment opportunity exists.

[6] Merely knowing people is not the same as being able to influence them to study more or over-eat.

[7] Imitation is indeed the sincerest form of flattery, even when it is unconscious.



05

[1] In 2011, Micah Edelson and his colleagues conducted an interesting experiment about external factors of memory manipulation.

[2] In their experiment, participants were shown a two minute documentary film and then asked a series of questions about the video.

[3] Directly after viewing the videos, participants made few errors in their responses and were correctly able to recall the details.

[4] Four days later, they could still remember the details and didn't allow their memories to be swayed when they were presented with any false information about the film.

[5] This changed, however, when participants were shown fake responses about the film made by other participants.

[6] Upon seeing the incorrect answers of others, participants were also drawn toward the wrong answers themselves.

[7] Even after they found out that the other answers had been fabricated and didn't have anything to do with the documentary, it was too late.

[8] The participants were no longer able to distinguish between truth and fiction.

[9] They had already modified their memories to fit the group.



06

[1] One of the keys to insects' successful survival in the open air lies in their outer covering — a hard waxy layer that helps prevent their tiny bodies from dehydrating.

[2] To take oxygen from the air, they use narrow breathing holes in the body—segments, which take in air passively and can be opened and closed as needed.

[3] Instead of blood contained in vessels, they have free—flowing hemolymph, which helps keep their bodies rigid, aids movement, and assists the transportation of nutrients and waste materials to the appropriate parts of the body.

[4] The nervous system is modular — in a sense, each of the body segments has its own individual and autonomous brain — and some other body systems show a similar modularization.

[5] These are just a few of the many ways in which insect bodies are structured and function completely differently from our own.