

What you will find in SCIENTIFICALLY THINKING by Stanley A. Rice

Introduction: We Need Science, and We Need It Now

We have an incredible amount of information available to us. What we need is an organized and unbiased way of thinking about that information and making decisions. That way exists, and it is science!

SECTION I: THE ADVENTURE OF SCIENCE

Chapter 1. Science and How to Recognize It

Science is an adventure of discovery, not a heap of facts. Unlike other human modes of thought, science uses “hypotheses,” which are statements that can be proven to be right or wrong. This is how you recognize science, and how it differs from pseudo-science that is so abundant today.

Chapter 2. Science and Fiction: Organized Common Sense and Organized Creativity

Science tells stories, then tests these stories against the data of reality. Science studies the real world the same way that fiction studies imaginary worlds.

Chapter 3. Experimenting with a Mountain

Scientists try to turn their hypotheses into experiments by controlling all the factors that they can. Sometimes this is not possible. But don't underestimate the creativity of scientists, who come up with absurdly creative ways of designing experiments, some of them as large as a mountain.

Chapter 4. Wright and Rong

In science, there are two ways of being wrong: false positives and false negatives. Scientists can never be 100% sure; they usually settle for 95%.

SECTION II: LEGACY OF AN APE'S BRAIN

Our brains are the playthings of bias and illusion, which served our evolutionary ancestors very well, but which can lead us today to draw the wrong conclusions.

Chapter 5. A World of Illusion

You cannot trust your senses to provide true measurements of reality, because your senses are illusory and biased. For example, there is no such thing as color! And from there it gets strange.

Chapter 6. Just Measure It!?

When you are testing a hypothesis, what do you measure, and how accurately do you measure it? There are lots of ways to do this wrong, which scientists carefully avoid.

Chapter 7. We See Lines While Nature Throws Us Curves

One of our greatest human biases is to see everything in a linear fashion, while in the natural world few processes are linear. Populations explode, and processes have threshold effects. Note: there is an out-take chapter, available for free on this website, which explores the non-linear effects of size and shape, and why King Kong could never exist.

Chapter 8. It's Not All Black and White

Humans like to categorize things, often into two categories. But in the natural world you see everything blending together, from the molecular level to the whole Earth.

Chapter 9. Cause and Effect

Science is often the study of cause and effect. But frequently an effect can have more than one cause, and sometimes the effect can be a cause, leading to a vicious cycle.

Chapter 10. Is Bartholo-meow Intelligent?

A pervasive human bias is to think we see intelligence in animals, plants, or planets. Actions in nature that look intelligent to us might have a much simpler underlying cause.

Chapter 11. Measuring What You Think You're Measuring

The thing you are measuring may not actually answer the question you are asking. This is a problem of validity, and it takes an astonishing variety of forms.

Chapter 12. Oops, I Hadn't Thought of That

Nobody can think of all the factors that might be at work. When you use the process of elimination, be aware that the right answer might be something none of us anticipated.

Chapter 13. Everybody's Biased But Me

Bias is natural. We are all biased all the time. Scientists design experiments, for example double-blind experiments, to try to avoid having bias determine the results.

Chapter 14. Trust Us, We're Scientists

Scientists are the most trustworthy people in the world. Most of the time. Here are some stories of scientists who did not deserve our trust.

Chapter 15. Trapped

Pseudo-science can get people trapped into a corner from which they have to rationalize their way out.

Chapter 16. What Exactly Do You Mean: Why Scientists (Should) Carefully Define their Terms

SECTION III: BIG IDEAS

Chapter 17. Natural Selection: The Biggest Idea Ever

Darwin's theory of natural selection is the biggest idea ever. It explains the way the world works, not only the world of wild species but why some ideas spread and others die away. You find natural selection literally everywhere. Maybe even universes evolve. Note: this website has two out-take chapters about other big ideas from science: the common ancestry of all species, and the interconnectedness of all things.

Chapter 18. The Rediscovery of Human Nature

Science has allowed us to understand human nature: what it is (both good and bad at the same time), and why.

SECTION IV: THE ROLE OF SCIENCE IN THE WORLD

Chapter 19. The Scientist in a Political World

In many cases, the results of scientific study pitch the scientists against people who have political, economic, or religious power.

Chapter 20. Who Is Your Favorite Scientist and Why?

Why, George Washington Carver, of course, mainly because of his dedication to using his scientific discoveries to help his neighbors be healthy and prosperous.

Chapter 21. Amateurs and Specialists

Everybody can think like a scientist. But with the rise of “citizen science,” everybody can contribute to scientific research!

Chapter 22. Science Is an Adventure

Science is a way of exploring the world, of looking in a new way at something you have seen a thousand times.

Epilogue: A Beautiful World

The more you know about the world, the more interesting it becomes, and science is essential to this understanding. Once you study science, you will see the world in a new way and never be able to un-see it.