

*Sherlock Holmes, Alice in
Wonderland, and Other
Metaphors for Modern Science*

-or-

*Is There a User's Manual for This
Thing?*

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How does science work?

~~How does science work?~~

*Science is what happens when
a scientist is working.*

→ *How does a scientist work?*

What characteristics
does a scientist have?

Are they inborn?

Can they be taught?

Let's think about 4
things --

The image features three light blue thought bubbles with black outlines, arranged in a vertical stack. The top bubble contains the word 'Curiositu', the middle bubble contains 'Imaginación', and the bottom bubble contains 'Visión'. The background is a vibrant, multi-colored pattern of small dots in shades of blue, green, and purple.

Curiositu

Imaginación

Visión



“Alice in Wonderland”

Illustrations by John Tenniel

Curiosity is part of human nature!





Marlene Russell



Courtesy Steve Barnes (Burlington, ON)

The Visionary

Curiosity

Sense of wonder

Open-minded

New ideas

New connections

Insight

Inquiry wherever it leads



"If we *knew* what we were doing, it wouldn't be research."

[apocryphal]

By definition, research is new exploration into new territory



Mistakes and messes
are OK! (If they
help lead somewhere)



Taniyama was the epitome of the absentminded genius ... [and] sloppy to the point of laziness. Surprisingly this was a trait that Shimura admired. "He was gifted with the special capability of making many mistakes, mostly in the right direction. I envied him for this and tried in vain to imitate him, but found it difficult to make good mistakes."

[Simon Singh, "Fermat's Enigma"]

"Even a scientist who falls on his face is going in the right direction forward."

[Fred MacMurray in *The Absent Minded Professor*]

"If we *knew* what we were doing, it wouldn't be research."

[apocryphal]

How do you make good mistakes?

- (1) Read everything you can about the subject.
Work with it.
- (2) Think about it all the time.
- (3) Wait for inspiration to strike.

But what do you do next if you have no idea
what the right direction is?

Let Nature answer the question for you!
Try *everything* and see what works.



Skepticism

The Skeptic

Test, test, test

Find flaws

Get more evidence

Compare alternate routes

Question authority

Rigor, solidity



Rick Showalter

*Scientific ideas are only valid insofar
as they match the real world*

"Another beautiful theory killed by an
ugly fact" [apocryphal]

The professional duty of a scientist confronted
with a new and exciting theory is to try to prove
it wrong. That is the way science stays honest.
[Freeman Dyson]



Technique

The Craftsman

Tools & techniques

Expertise

Modelling

Labs

Computation

Experience!



Bryan Baeumler



Persistence

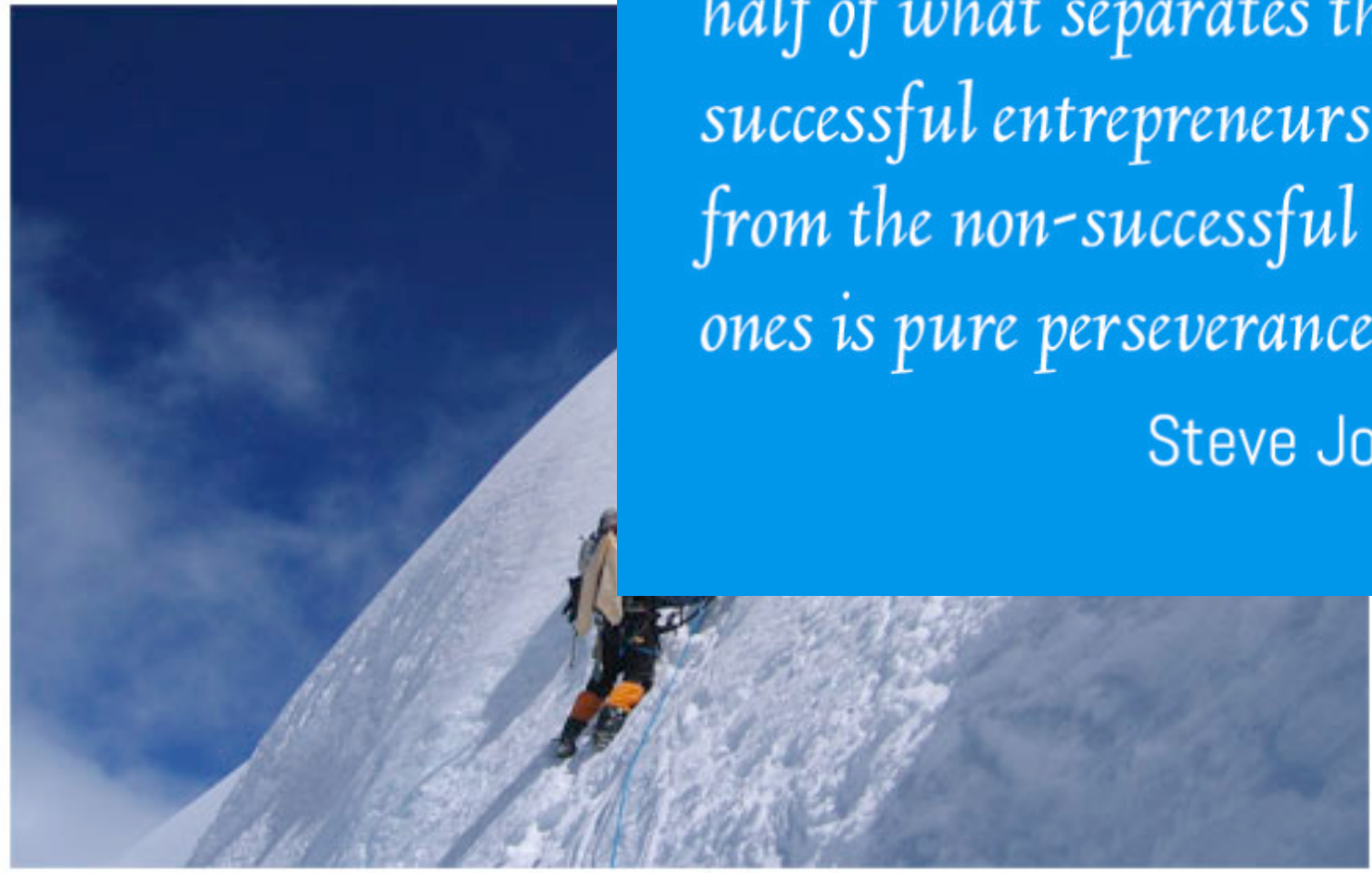
Long term goals

Not put off by setbacks

Don't give up!



Persistence



“I’m convinced that about half of what separates the successful entrepreneurs from the non-successful ones is pure perseverance.”

Steve Jobs

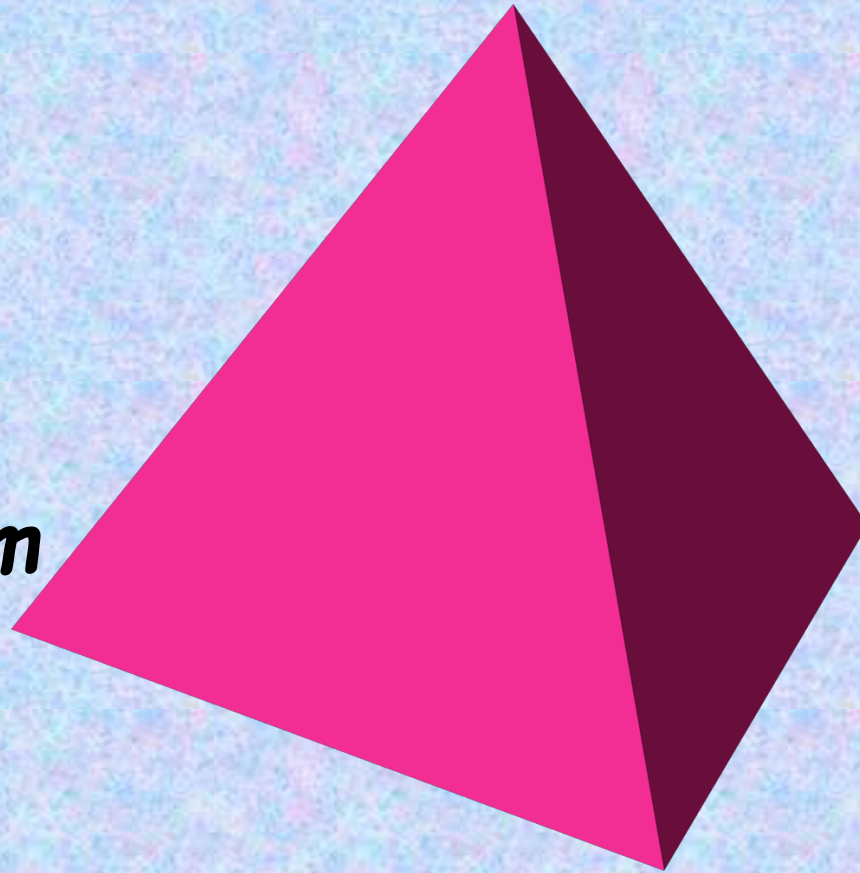
Vision: the Ideas

Skepticism

Persistence

Technique

What happens if things get out of balance?





*Naïve, even gullible
Undisciplined
"Butterfly"*





Nothing is good enough
Obsession with flaws
Cynicism
No direction
No spark





Obsession with method
Loss of purpose
Valuable team member
Direction set by others





LUNATIC LYNX



Reaching The Truth is an asymptotic ideal.
We never quite get there.

And new questions keep coming up that
usually complicate the issue

*How does this reality of the scientific
process match up with public perception of
what goes on?*

How do you *prove* the Big Bang happened?

How do we know the same physical laws apply out there?

Cosmology sounds like just assumptions and theories. And all these “facts” just come down to ‘narratives’. Is this even science?

In the media, science just sounds like “duelling experts”. It’s all just opinion.

Right ●

We can't "prove" things in natural science. We are never entirely sure that a law, model, or theory is absolutely right.

Wrong ●

If science can't prove anything, then what good is it? If you're not sure about something, then you don't know anything.

Right ●

Wrong ●

The “Truth line”



Right ●



The Earth is round
Matter is made of atoms
Newton's laws of motion
Bacteria and viruses cause disease
Continental drift
DNA is the basis of the genetic code

Wrong ●

Right ●


Wrong ●

Flat Earth
Phlogiston theory of heat
“Humours” cause disease
The Sun goes around the Earth



Right ●

Wrong ●



To make its way up to the top, an idea has to survive lots of experimental tests and revisions, till everyone generally accepts that it's OK

Right ●

The middle ground is where research is happening.



(We're working on it)

Dark energy
Auto-assembly of RNA
String theory

Wrong ●

Right

Textbook stuff. Not newsworthy (no arguments going on)



Media stories are about these: debate, controversy

(Thus: science is just opinion and argument ?!)

Wrong

Also not newsworthy. Historical interest only

Right

Your life

Your car

How much would you *bet* that a given idea is actually true?

A bottle of whiskey

A loonie

(Take someone else's bet)



Wrong

Right

*Science is
Directed
Curiosity!*

Wrong



Jesse Springer (springercreative.com)

