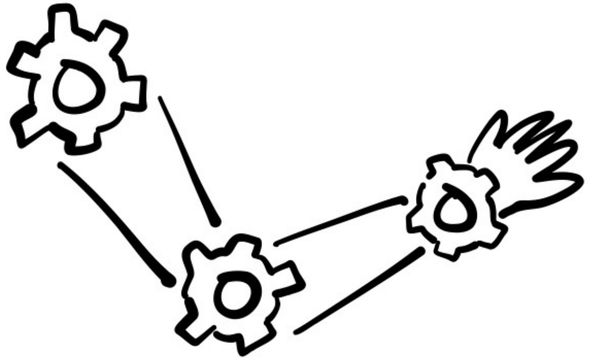
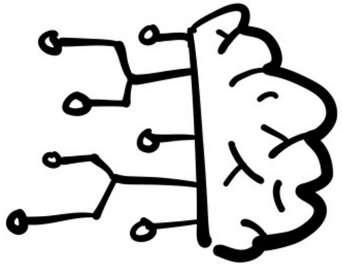
SKETCH IT OUT



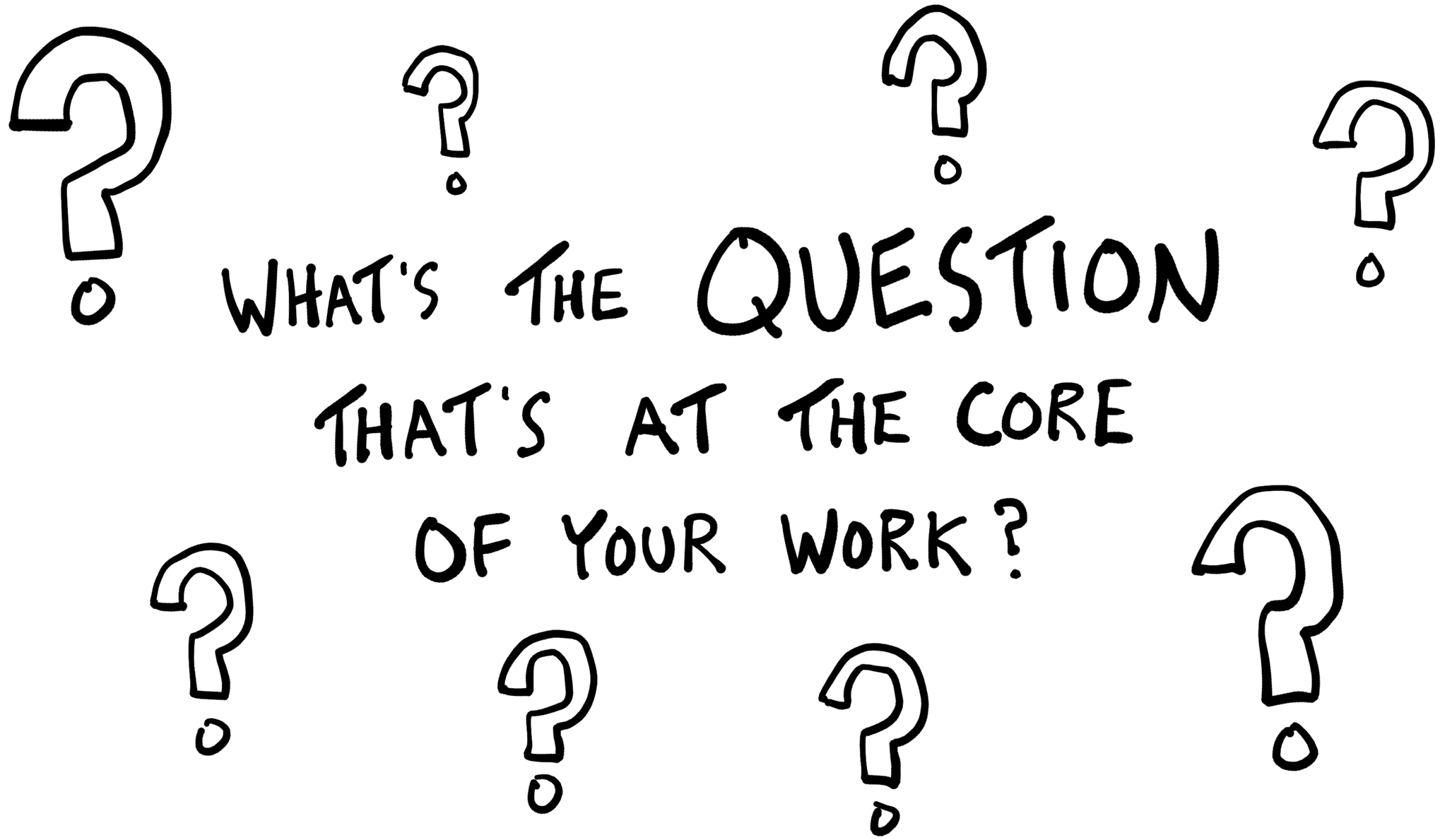


BUILD THE SKILL OF VISUAL THINKING TO SUPPORT
YOUR RESEARCH, GRANT PROPOSALS, & PUBLIC COMMUNICATION

19TH MARCH, 26TH MARCH, 2ND APRIL
14:00-15:30

Bionics+

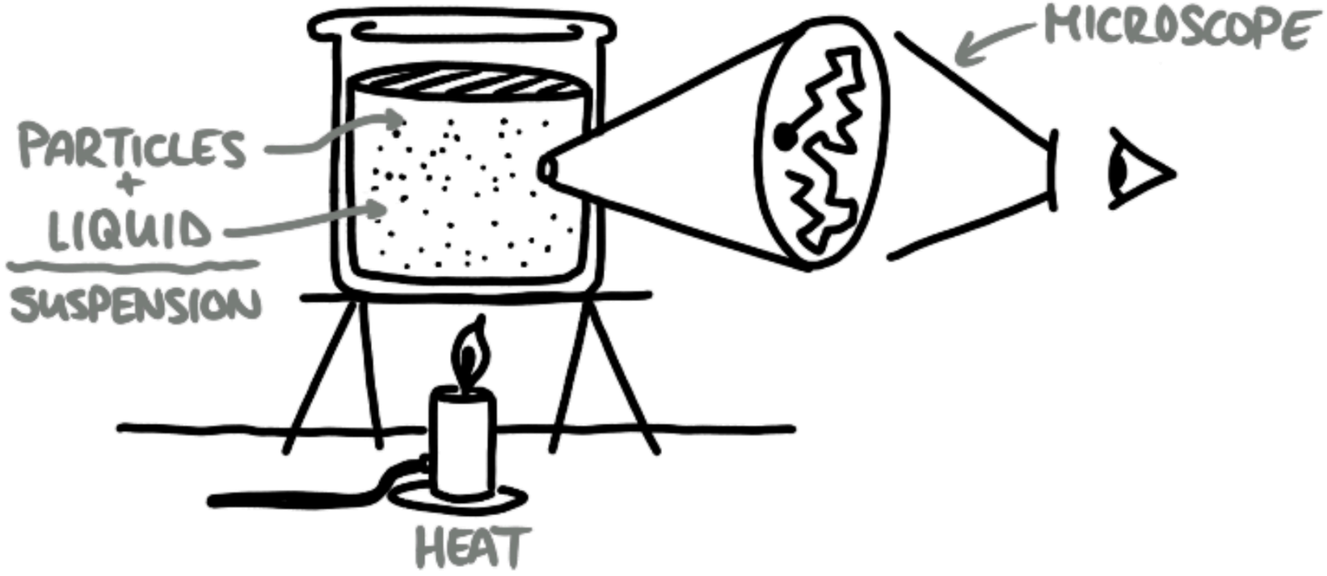
VERBAL TO VISUAL


WHAT'S THE QUESTION
THAT'S AT THE CORE
OF YOUR WORK?

ROB DIMEO

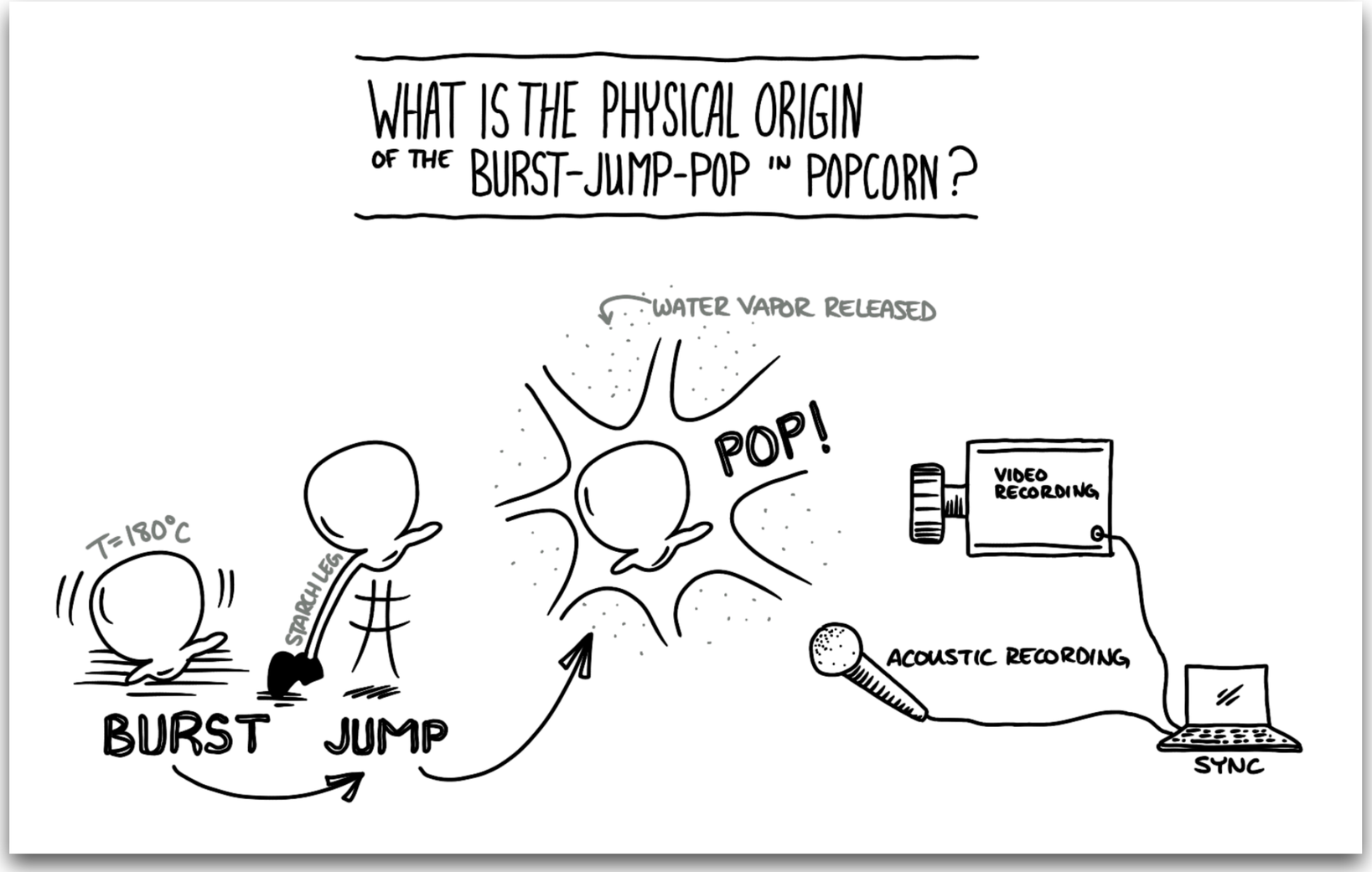
NIST

MOTION OF SUSPENDED PARTICLES SHOULD BE OBSERVABLE WITH MICROSCOPE IF THE MOLECULAR-KINETIC THEORY OF HEAT IS CORRECT



ROB DIMEO

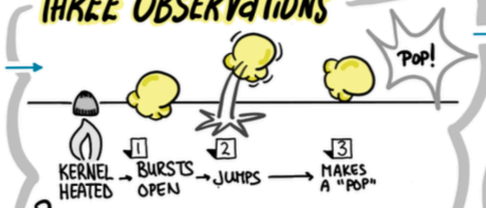
NIST

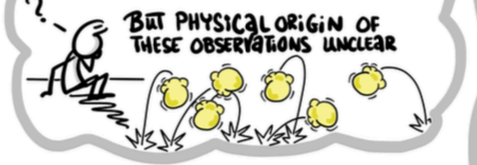


POPCORN SCIENCE

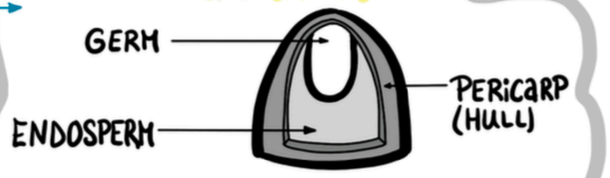
VIROT E, PONOMARENKO A. 2015 POPCORN: CRITICAL TEMPERATURE, JUMP AND SOUND. J. R. SOC. INTERFACE 12 20141247.

THREE OBSERVATIONS





POPCORN KERNEL ANATOMY



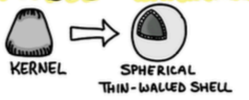
EACH KERNEL CONTAINS **20 mg** OF H_2O

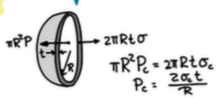
WHEN THE KERNEL IS HEATED HIGH ENOUGH THE WATER BOILS → PRESSURE BUILDS

$P > P_c$ → HULL BREAKS

P_c ← CRITICAL PRESSURE

MODEL & CRITICAL TEMPERATURE





$\pi R^2 P_c = 2\pi R t \sigma_c$

$P_c = \frac{2\sigma_c t}{R}$

$P_c = \frac{2 t \sigma_c}{R_K}$ → CRITICAL PRESSURE

$\sigma_c = 10 \times 10^6$ Pa
$t = 160 \times 10^{-6}$ m
$R_K = 3.1 \times 10^{-3}$ m

P_c = PRESSURE WHEN HULL RUPTURES
t = MEAN HULL THICKNESS (160 ± 40 μm)
σ_c = ULTIMATE STRENGTH OF HULL (~10 MPa)
R_K = MEAN KERNEL RADIUS (3.1 ± 0.1 mm)

P_c = 10.22 bar

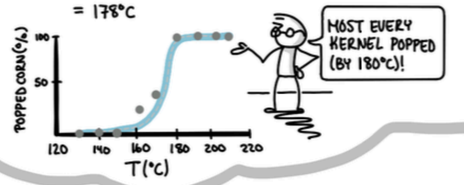
WATER VAPOR AS IDEAL GAS

$$T_c = \frac{T_0}{1 - \left(\frac{RT_0}{ML_v}\right) \ln\left(\frac{P_c}{P_0}\right)}$$

$R = 8.3$ J/mol·K $M = 18.9$ g/mol $P_0 = 1$ bar
$L_v = 2.3 \times 10^6$ J/kg $T_0 = 100$°C

$$T_c = \frac{100 + 273}{1 - \left(\frac{8.3 \times (100+273)}{18 \times 10^{-3} \times 2.3 \times 10^6}\right) \ln(10.22)} - 273$$

$= 178$°C



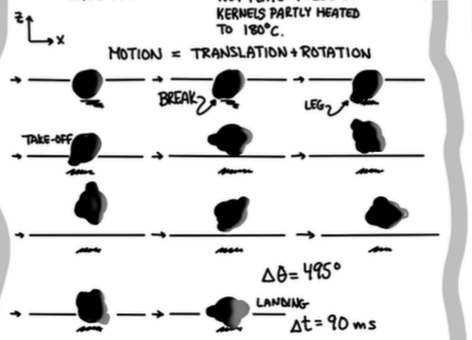
MOST EVERY KERNEL POPPED (BY 180°C)!

JUMPING POPCORN

HIGH SPEED VIDEO CAPTURE 2900 FPS

$T_{AIR} = 20$°C

HOT PLATE T=350°C
KERNELS PARTLY HEATED TO 180°C.



$E_0 = \frac{1}{2} m (v_{x0}^2 + v_{z0}^2) + \frac{1}{2} I \omega_0^2$

$E_0 \approx 20$ μJ JUMP ENERGY

$\alpha = \frac{\text{INITIAL VERTICAL KE}}{\text{TOTAL KE}}$

$\frac{1}{2} I \dot{\theta}^2 = (1-\alpha) E_0 \Rightarrow \theta(\alpha) = 2\sqrt{10}\sqrt{\alpha(1-\alpha)}\,\frac{E_0}{mgR_K}$

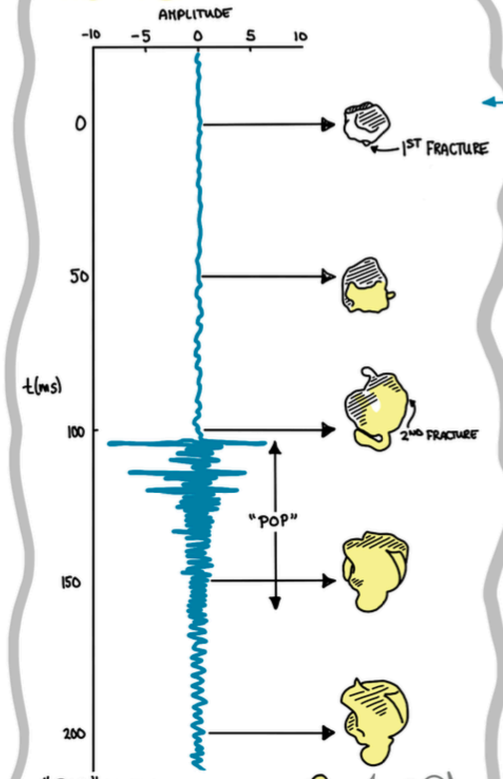
$\left.\frac{\partial \theta}{\partial \alpha}\right|_{\alpha_m} = 0 \Rightarrow \alpha_m = 1/2$ & $\theta(\alpha_m) = \theta_m = 700°$

MORE REALISTIC $\alpha = 0.7 \Rightarrow \theta_m = 500°$ $(= \Delta\theta)$

USING SIMILAR ANALYSIS FOR A GYMNAST DOING A SOMERSAULT, $\theta_m = 360°$

THE "POP"

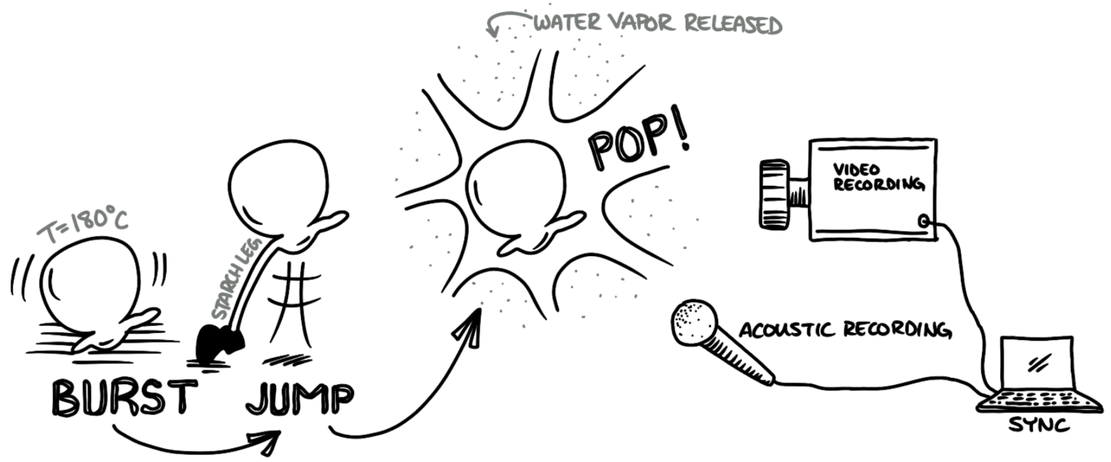
WHERE DOES THE SOUND COME FROM?



"POP" LIKELY COMES FROM RELEASE OF POCKETS OF WATER VAPOR

SKETCHNOTE: [illegible] 08.09.2016

WHAT IS THE PHYSICAL ORIGIN OF THE BURST-JUMP-POP IN POPCORN?



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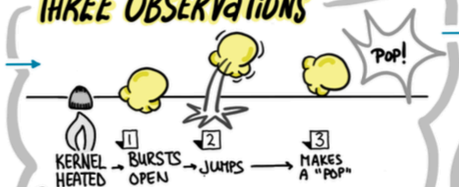
THE "POP"

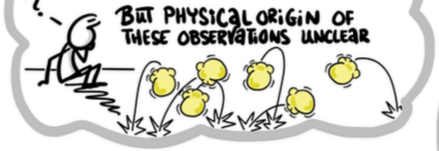
WHERE DOES THE SOUND COME FROM?

FRACTURE

FRACTURE

THREE OBSERVATIONS





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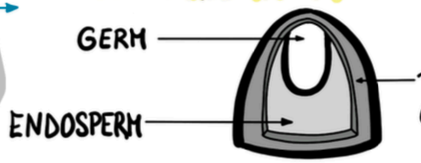

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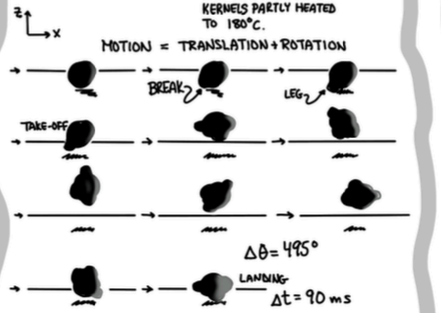

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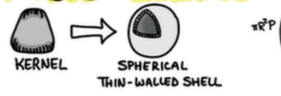

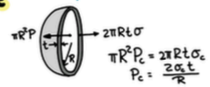

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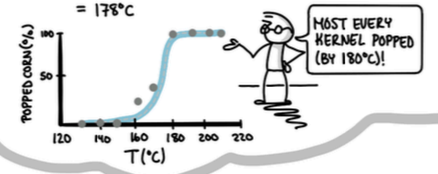


SKETCHNOTE: [illegible] 08.09.2016

ROB DIMEO

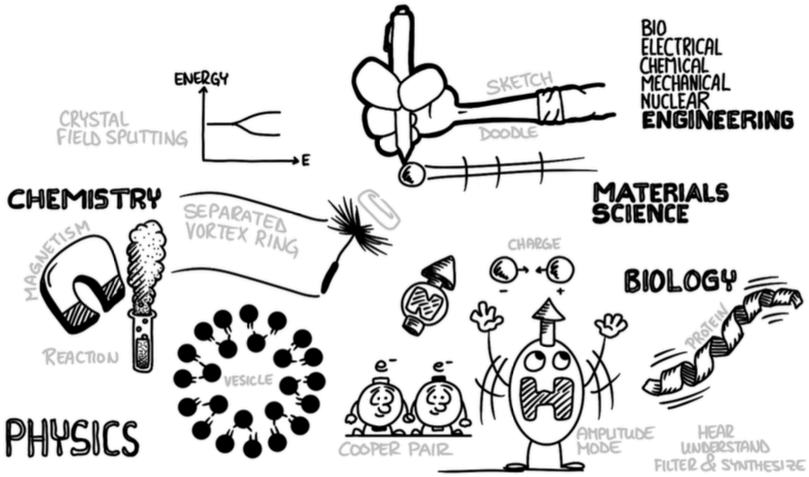
NIST

NIST Special Publication 1265

Sketchnoting Science

How to Make Sketchnotes from Technical Content

Rob Dimeo



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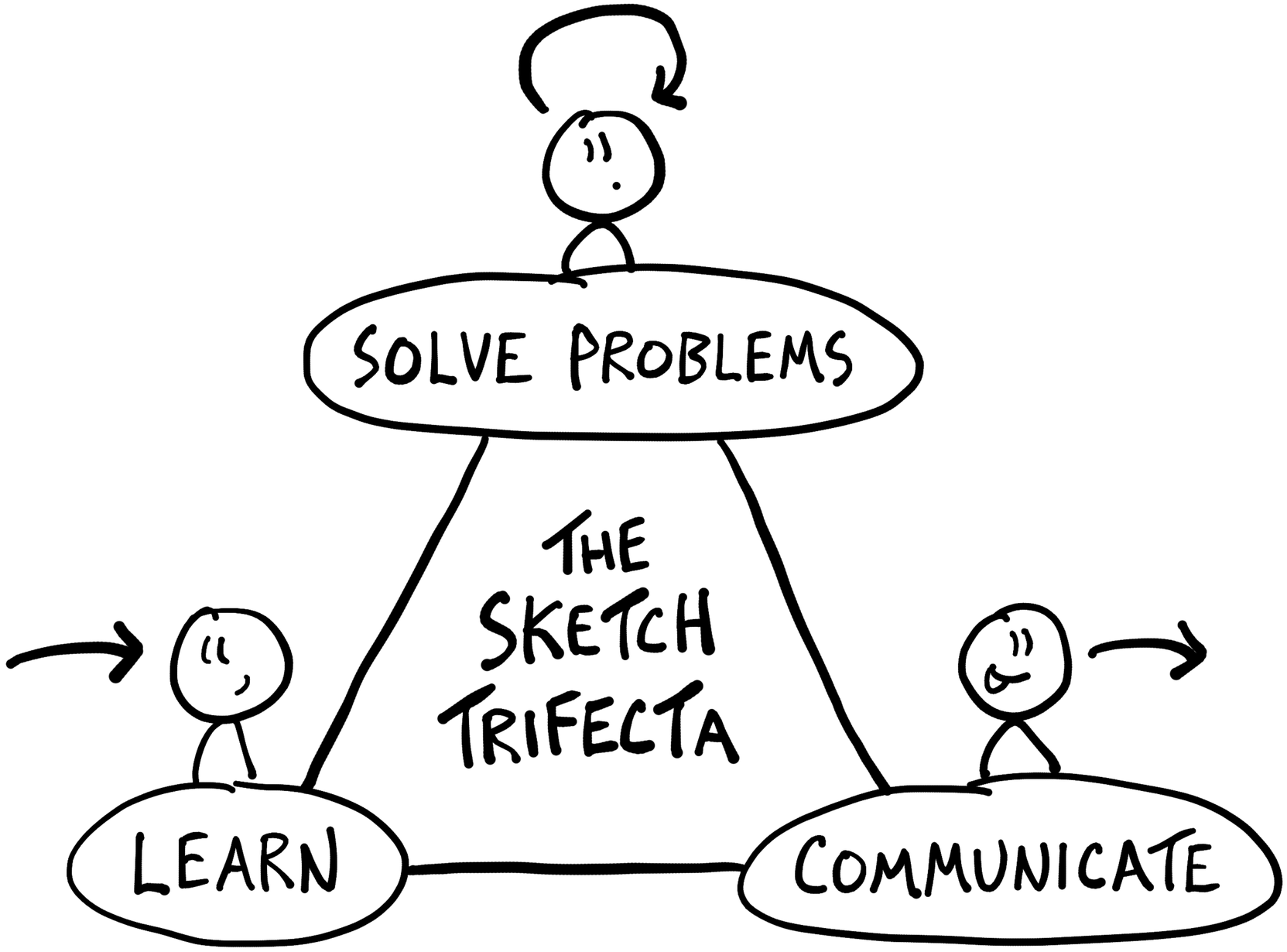
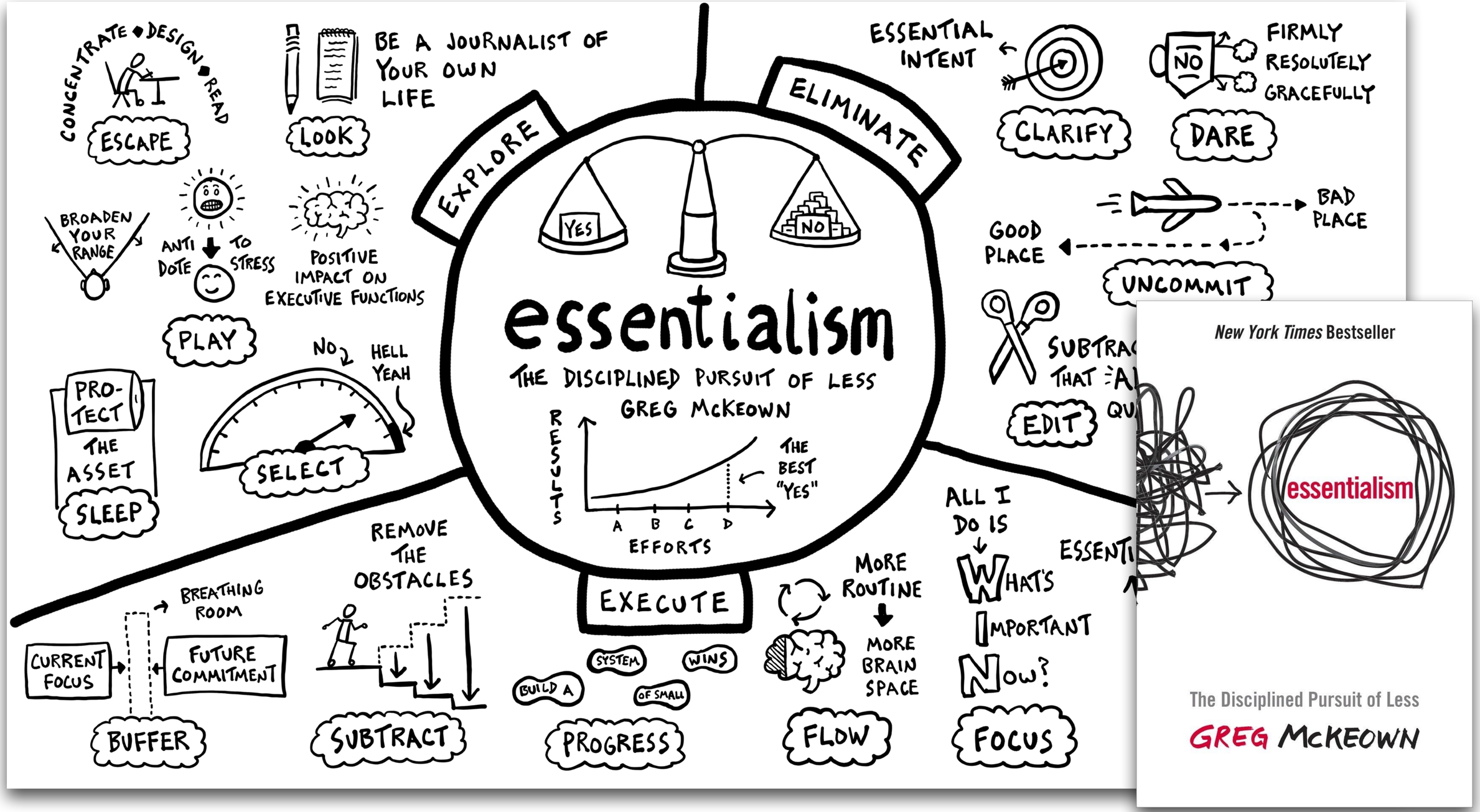
NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

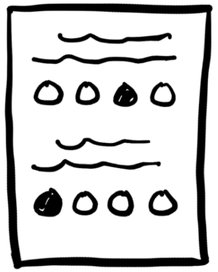

SOLVE PROBLEMS
THE SKETCH TRIFECTA
LEARN
COMMUNICATE


essentialism
THE DISCIPLINED PURSUIT OF LESS
GREG McKEOWN
EXPLORE
ELIMINATE
EXECUTE
YES
NO
RESULTS
EFFORTS
A B C D
THE BEST "YES"
CONCENTRATE • DESIGN • READ
ESCAPE
BE A JOURNALIST OF YOUR OWN LIFE
LOOK
BROADEN YOUR RANGE
ANTI DOTE TO STRESS
POSITIVE IMPACT ON EXECUTIVE FUNCTIONS
PLAY
PRO-TECT THE ASSET
SLEEP
NO HELL YEAH
SELECT
ESSENTIAL INTENT
CLARIFY
NO
FIRMLY RESOLUTELY GRACEFULLY
DARE
GOOD PLACE
BAD PLACE
UNCOMMIT
SUBTRAC
THAT A
QU
EDIT
ALL I DO IS
WHAT'S IMPORTANT NOW?
FOCUS
MORE ROUTINE
MORE BRAIN SPACE
FLOW
REMOVE THE OBSTACLES
SUBTRACT
BUILD A
SYSTEM
WINS
OF SMALL
PROGRESS
BREATHING ROOM
CURRENT FOCUS
FUTURE COMMITMENT
BUFFER
New York Times Bestseller
essentialism
The Disciplined Pursuit of Less
GREG McKEOWN

MAKE IT STICK

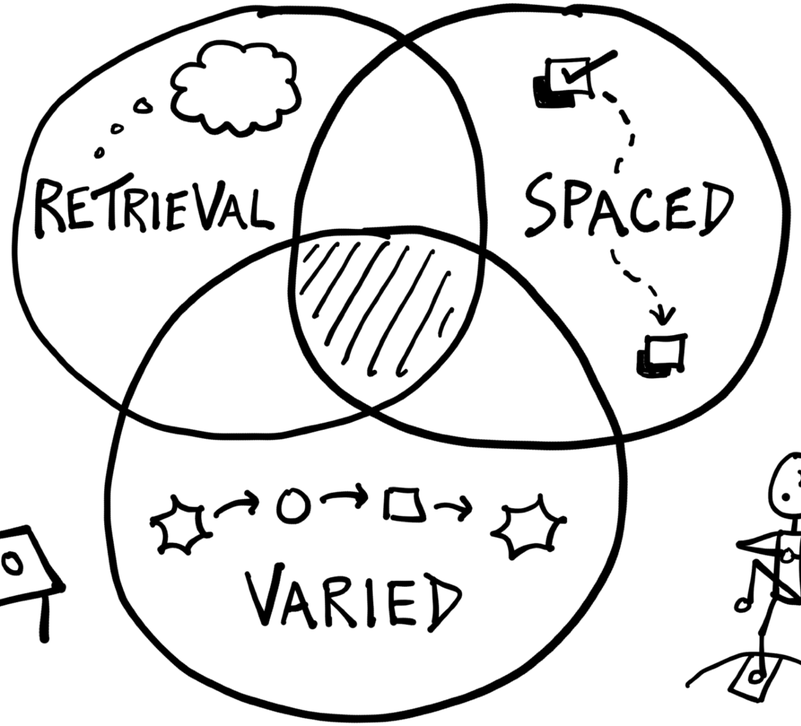
BY BROWN, ROEDIGER III, & MCDANIEL

THE TESTING EFFECT

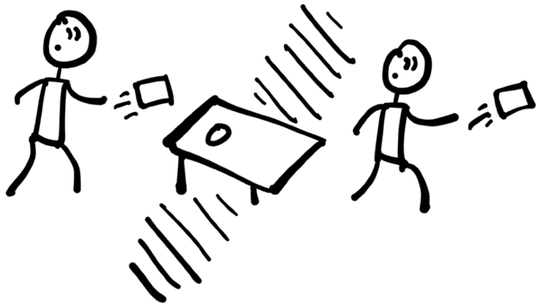


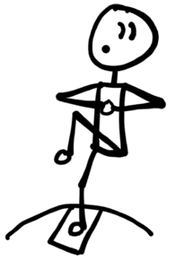
FLASHCARDS

REFLECTION & ELABORATION



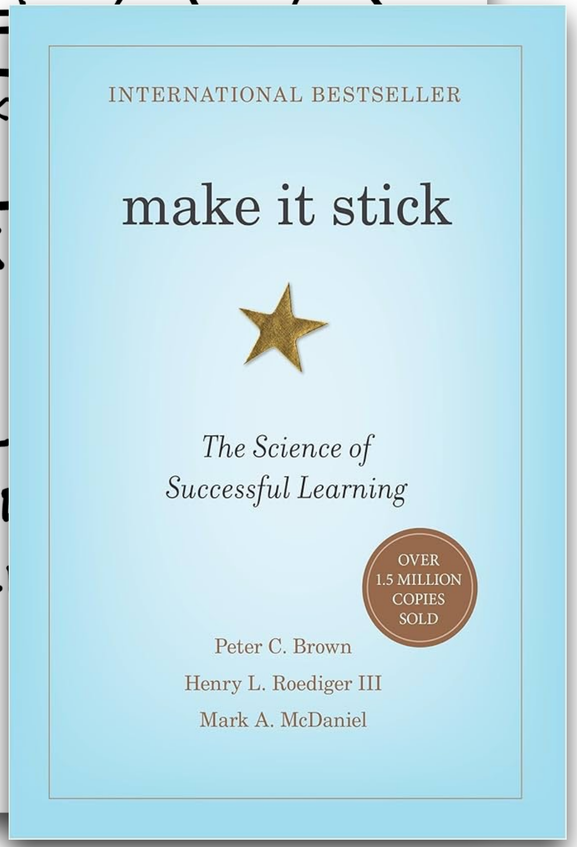
THE LIETNER SYSTEM

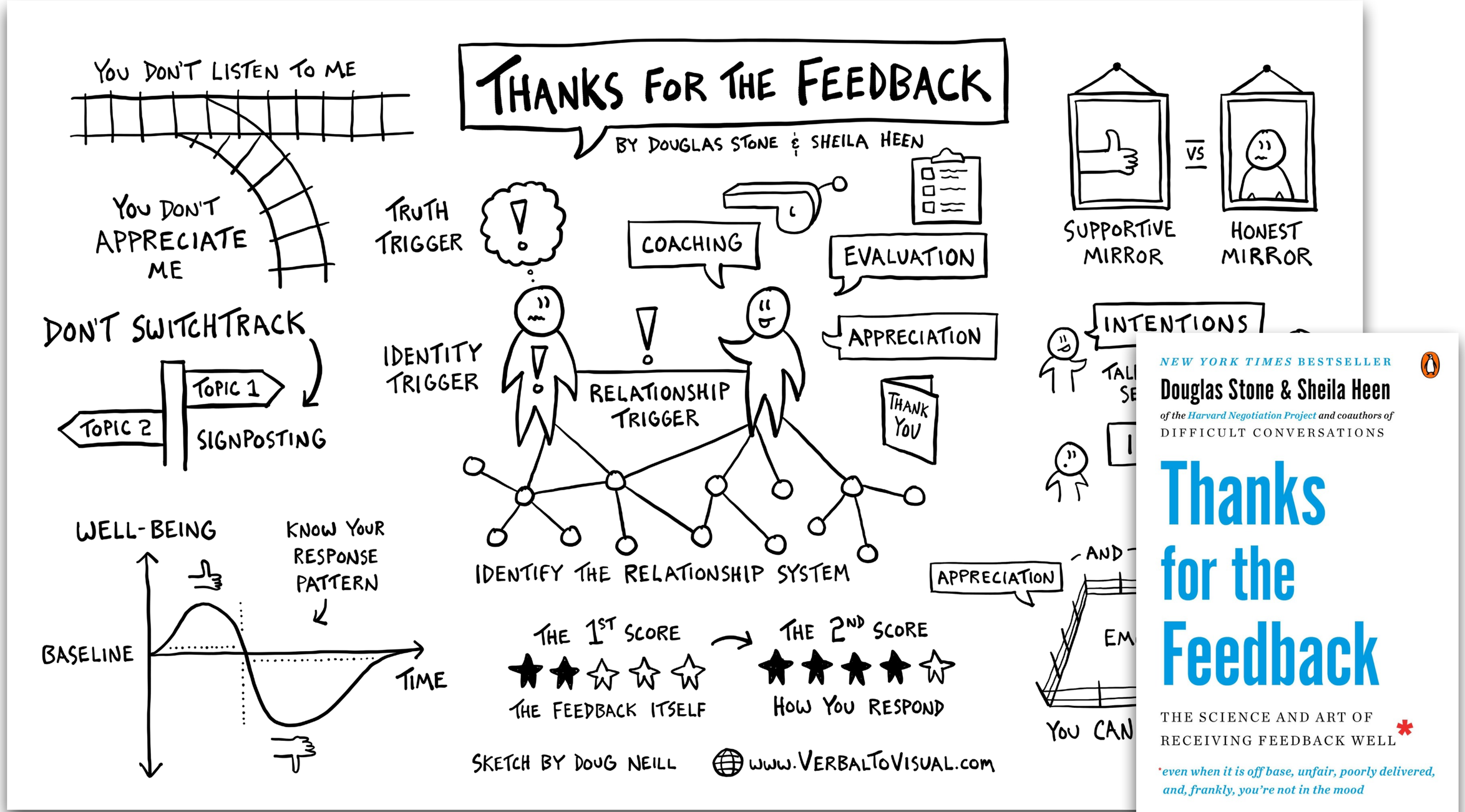




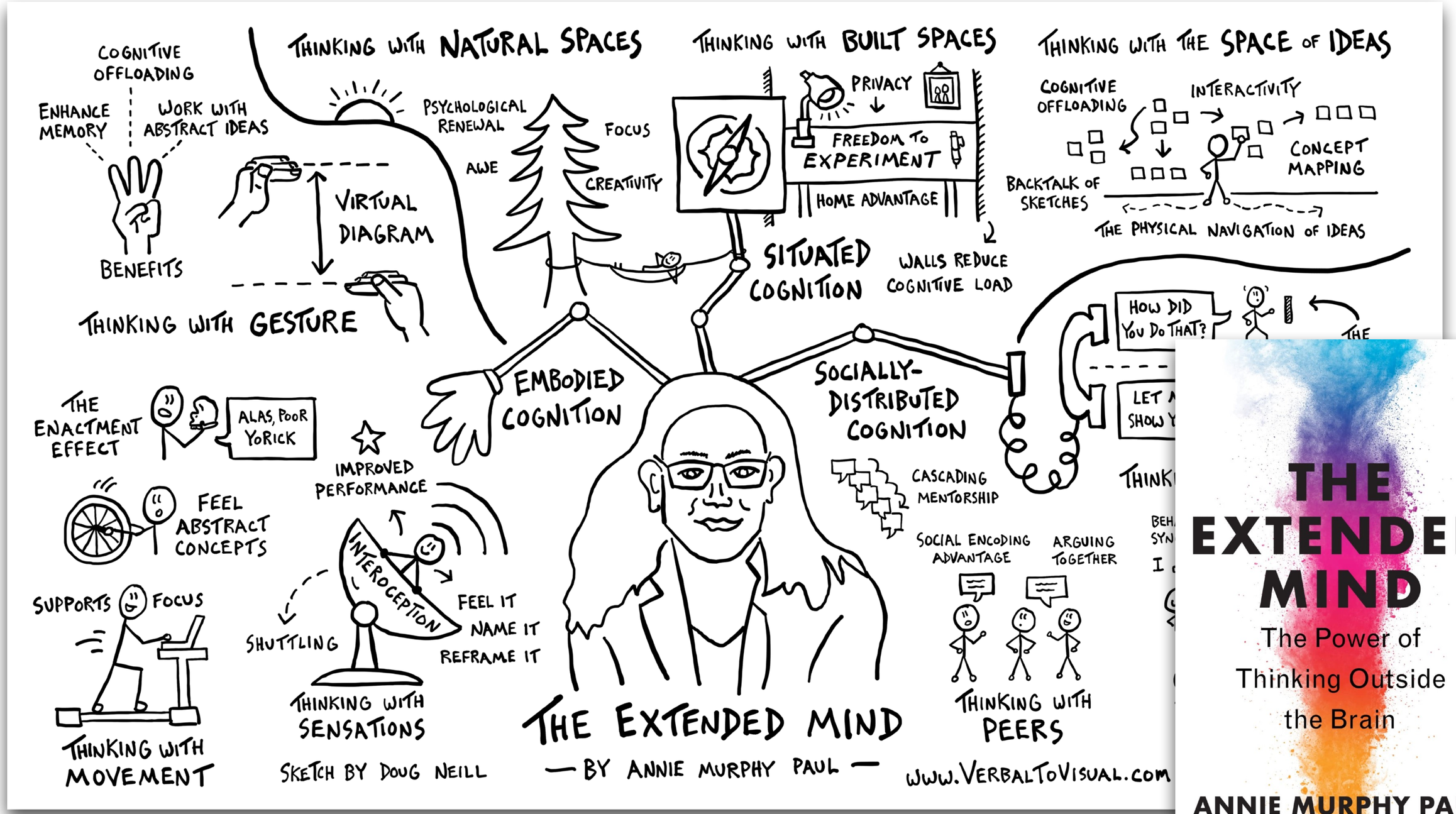
CURVEBAL
FAST
KNUCKL

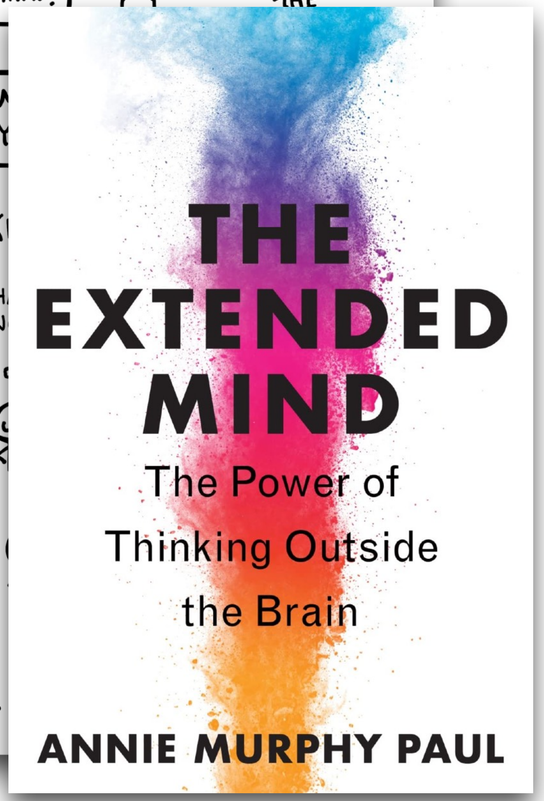
SKETCH BY DOUG NEILL ◆ WWW.VERBALTOVISUAL.COM




YOU DON'T LISTEN TO ME
YOU DON'T APPRECIATE ME
THANKS FOR THE FEEDBACK
BY DOUGLAS STONE & SHEILA HEEN
SUPPORTIVE MIRROR
VS
HONEST MIRROR
DON'T SWITCHTRACK
TOPIC 1
TOPIC 2
SIGNPOSTING
TRUTH TRIGGER
COACHING
EVALUATION
IDENTITY TRIGGER
RELATIONSHIP TRIGGER
APPRECIATION
THANK YOU
INTENTIONS
WELL-BEING
KNOW YOUR RESPONSE PATTERN
BASELINE
TIME
IDENTIFY THE RELATIONSHIP SYSTEM
THE 1ST SCORE
THE FEEDBACK ITSELF
THE 2ND SCORE
HOW YOU RESPOND
APPRECIATION
AND
YOU CAN
SKETCH BY DOUG NEILL
www.VERBALTOVISUAL.com

NEW YORK TIMES BESTSELLER
Douglas Stone & Sheila Heen
of the Harvard Negotiation Project and coauthors of
DIFFICULT CONVERSATIONS
Thanks for the Feedback
THE SCIENCE AND ART OF RECEIVING FEEDBACK WELL*
*even when it is off base, unfair, poorly delivered, and, frankly, you're not in the mood


THINKING WITH NATURAL SPACES
COGNITIVE OFFLOADING
ENHANCE MEMORY
WORK WITH ABSTRACT IDEAS
BENEFITS
PSYCHOLOGICAL RENEWAL
AWE
FOCUS
CREATIVITY
VIRTUAL DIAGRAM
THINKING WITH GESTURE
THINKING WITH BUILT SPACES
PRIVACY
FREEDOM TO EXPERIMENT
HOME ADVANTAGE
WALLS REDUCE COGNITIVE LOAD
SITUATED COGNITION
THINKING WITH THE SPACE OF IDEAS
COGNITIVE OFFLOADING
INTERACTIVITY
CONCEPT MAPPING
BACKTALK OF SKETCHES
THE PHYSICAL NAVIGATION OF IDEAS
EMBODIED COGNITION
THE ENACTMENT EFFECT
ALAS, POOR YORICK
FEEL ABSTRACT CONCEPTS
SUPPORTS FOCUS
THINKING WITH MOVEMENT
IMPROVED PERFORMANCE
INTEROCEPTION
FEEL IT
NAME IT
REFRAME IT
SHUTTLING
THINKING WITH SENSATIONS
SOCIALLY-DISTRIBUTED COGNITION
CASCADING MENTORSHIP
SOCIAL ENCODING ADVANTAGE
ARGUING TOGETHER
THINKING WITH PEERS
HOW DID YOU DO THAT?
THE
LET
SHOW
THINK
BEH
SYN
I
THE EXTENDED MIND
— BY ANNIE MURPHY PAUL —
SKETCH BY DOUG NEILL
WWW.VERBALTOVISUAL.COM


THE EXTENDED MIND
The Power of Thinking Outside the Brain
ANNIE MURPHY PAUL

THINKING IN BETS

BY ANNIE DUKE

LEARNING POD

TRUTH SEEKING

EVERY DECISION IS A BET

COMMUNISM

UNIVERSALISM

DISINTERESTEDNESS

ORGANIZED SKEPTICISM

POTENTIAL OUTCOMES

10% DEFENSIVE PENALTY

10% OFFENSIVE PENALTY

40% INCOMPLETE

5% SACK

32% TOUCHDOWN

3% INTERCEPTION

DECISION

BACK-CASTING

PRE-MORTEM

PAST

RESULTING

BAD OUTCOME = BAD DECISION

HINDSIGHT BIAS

"THAT OUTCOME WAS INEVITABLE."

PROBABILISTIC THINKER

"NAH, I'LL PASS."

PETE CARROLL

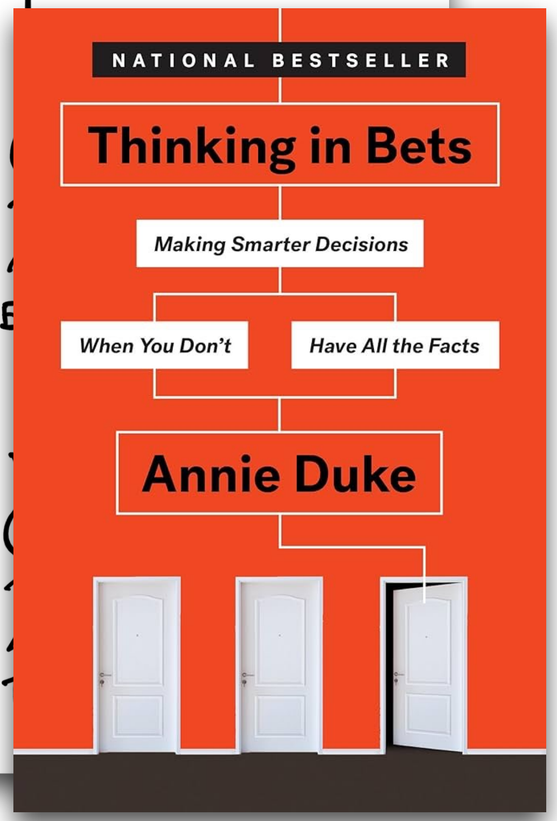
MENTAL TIME TRAVEL

DON'T FORGET ABOUT ME!

FUTURE SELF

PRESE

PAS



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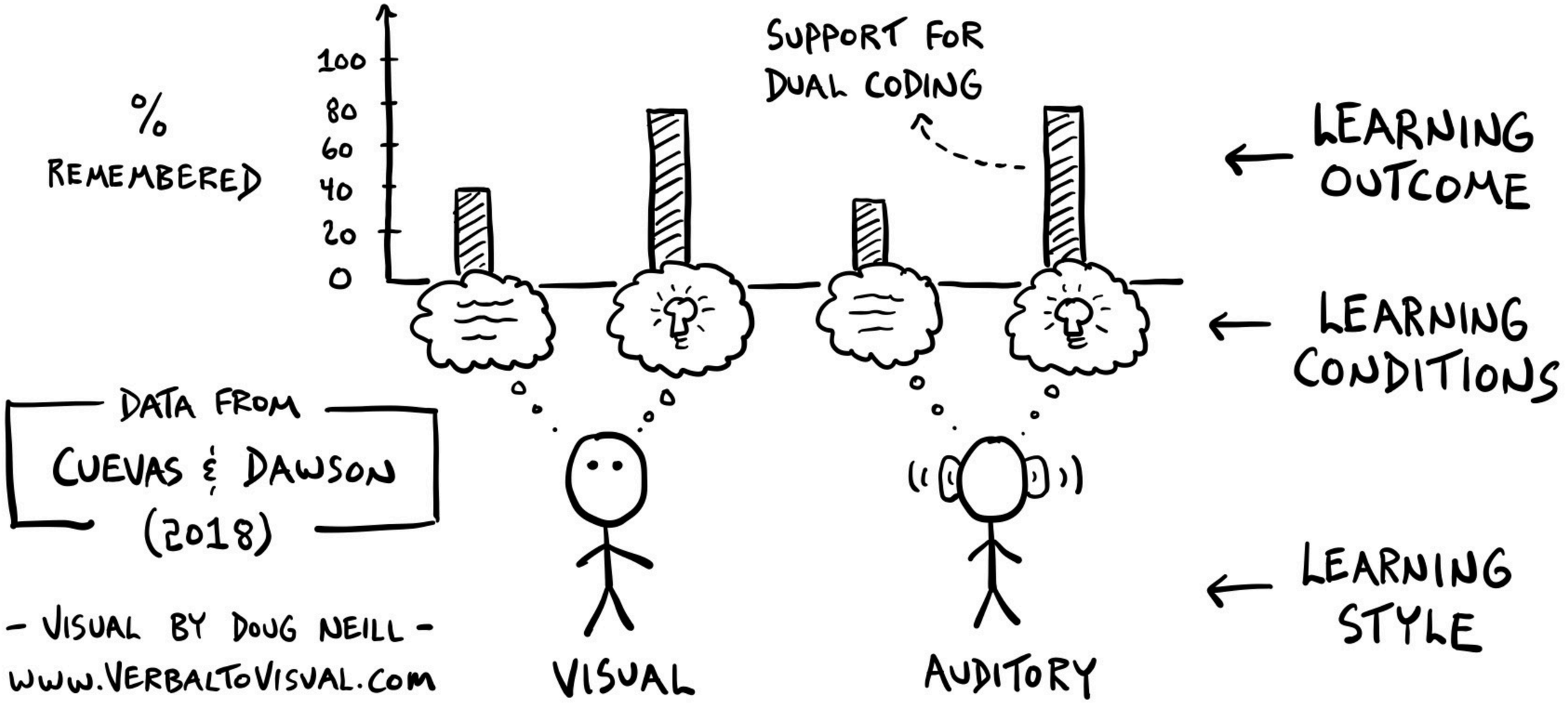
LEARNING STYLES VS DUAL CODING



DATA FROM CUEVAS & DAWSON (2018)

- VISUAL BY DOUG NEILL -
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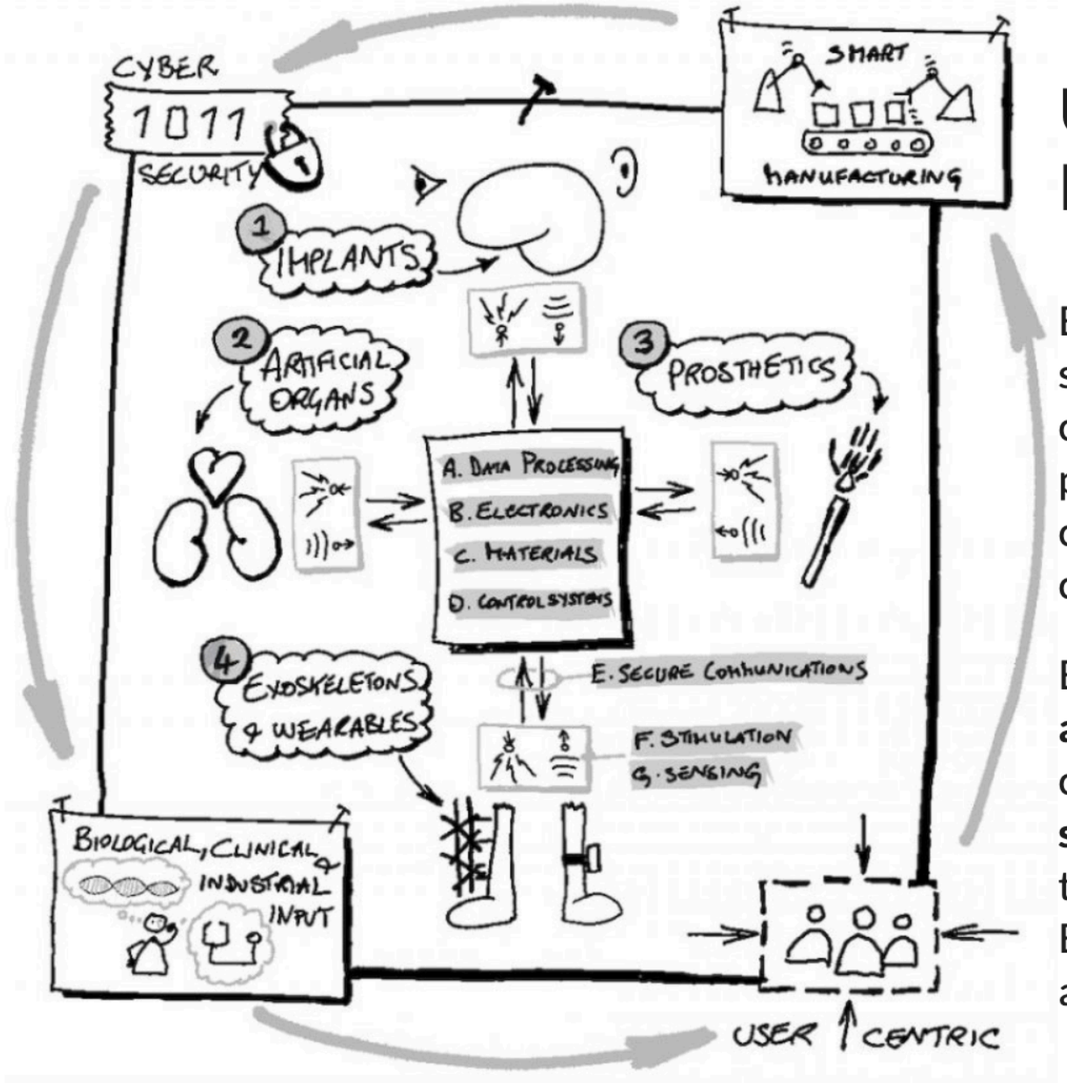


User-Centred Design and Usability of Bionic Devices

Bionics+ is an EPSRC funded research network plus and will stimulate and support a cohesive activity towards next-generation bionic technologies to co-create user-centred systems, methods and care models that are fit for purpose. Bionics+ takes place with four central tenets in mind: **A)** a user-centric approach; **B)** security in our data (cybersecurity); **C)** inclusive of clinical and industry inputs; **D)** promoting smart manufacturing processes.

Bionics+ deals with four major application areas: **implants**, **prostheses**, **artificial organs** and **exoskeletons/ wearables**, and seven cross-cutting capabilities: **data processing and AI**, **bioelectronics**, **materials**, **control systems**, **secure communications**, **sensing** and **stimulation**. Taken together these will allow for cross-fertilisation of ideas across the network such that Bionics+ will focus on ambitious, collaborative and transformative research and the formulation of longer-term strategy.

WE GOT THE GRANT! AND THEY SPECIFICALLY MENTIONED THE VISUAL WE INCLUDED...

THE PUBLIC IS RESPONDING TO MY RESEARCH DIFFERENT NOW...

ONE OF MY STUDENTS CAME UP TO THANK ME AFTER CLASS...

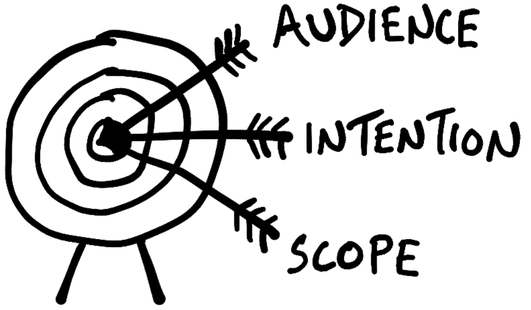
I KNOW WHERE I'M TAKING MY RESEARCH NEXT..

SUCCESS INDICATORS

THE

SKETCH IT OUT

FRAMEWORK



DEFINE YOUR
PURPOSE

IMPACT

INQUIRY

SOLVE THE
PUZZLE

COLLECT THE
PIECES

INTEGRATION

MAKE A
MODEL

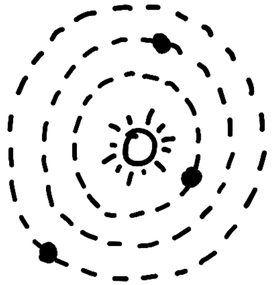
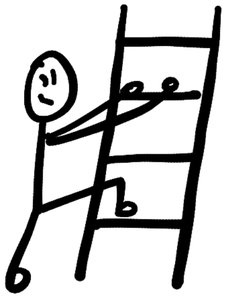


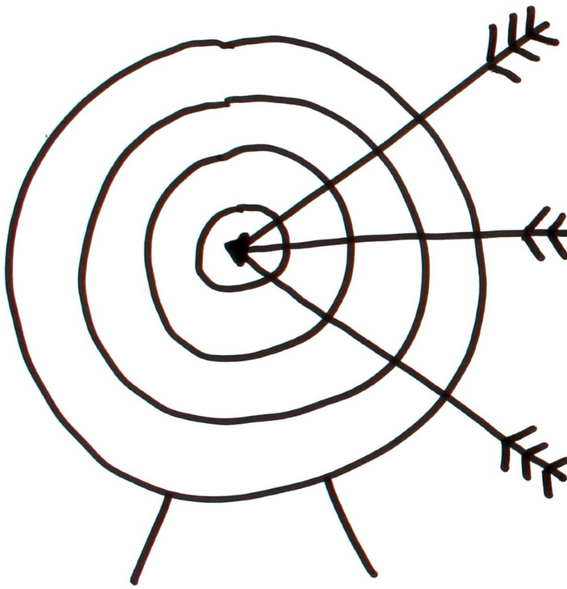
DIAGRAM ⟷ DRAWING



VISUAL
LANGUAGE
LADDER

DEFINE YOUR PURPOSE

DRAWING = COMBINING BASIC SHAPES

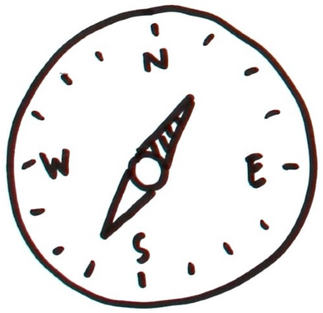


AUDIENCE: STROKE, POTENTIAL TRIAL PARTICIPANTS

INTENTION: TO SKETCH OUT A BRIEF DESCRIPTION OF TRIAL SO THAT PATIENTS CAN DECIDE.

SCOPE:

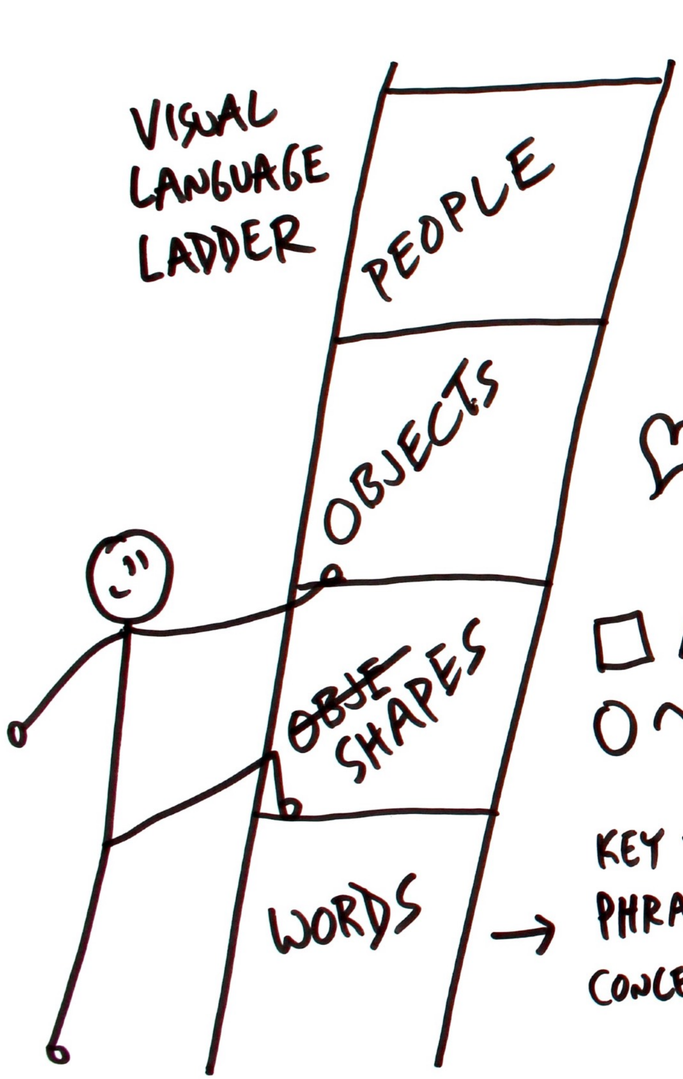
I WILL INCLUDE ELIGIBILITY BRIEF SUMMARY, VISITS, TRAVEL COSTS.

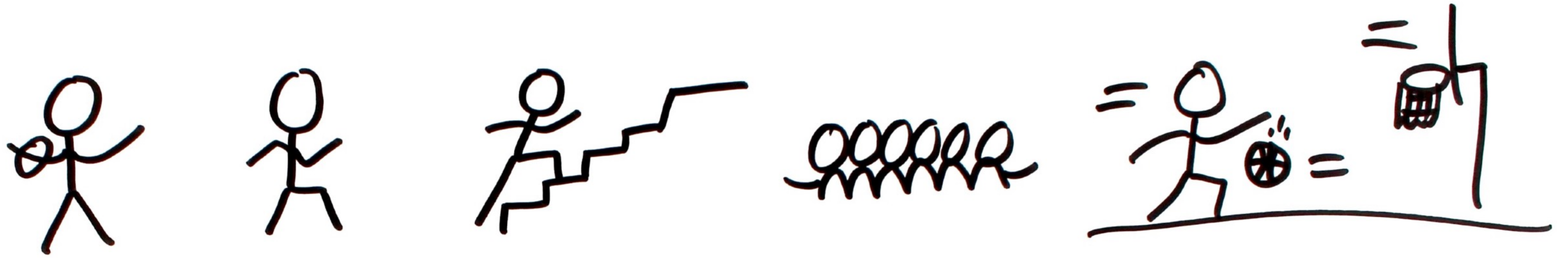


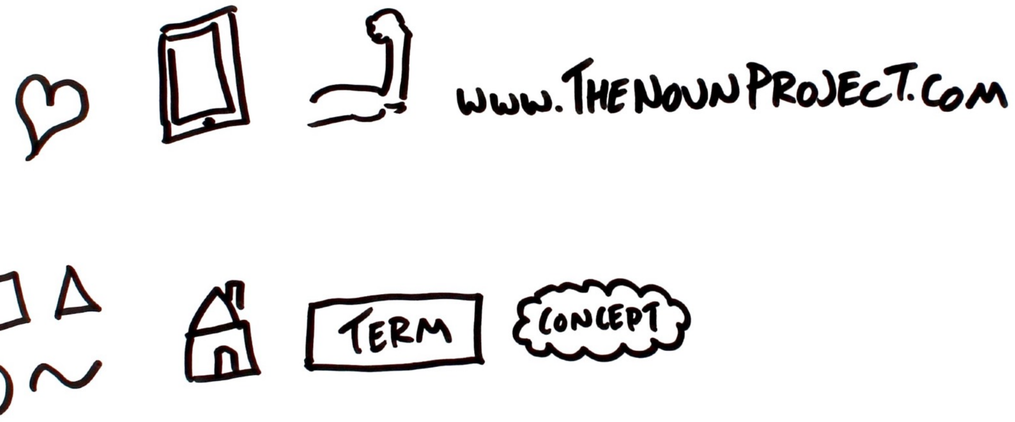
I WON'T INCLUDE DEVICE DETAILS, OUTCOME MEASURES.

COLLECT THE PIECES

★ BULLET POINT LIST ★ STICKY NOTES / INDEX CARDS







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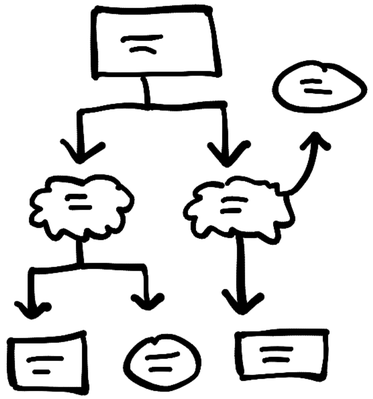
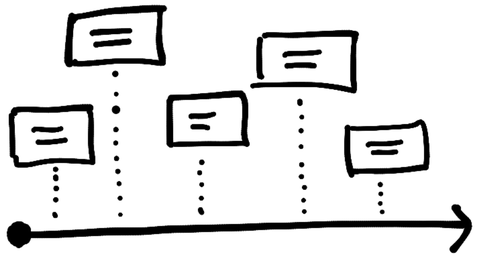
KEY TERMS
PHRASES
CONCEPTS



FLOWCHART

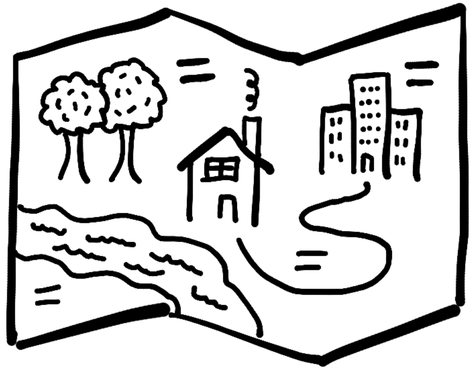


TIMELINE

MAKE MODELS

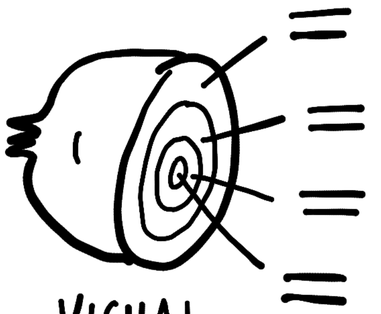
DIAGRAMS

DRAWINGS

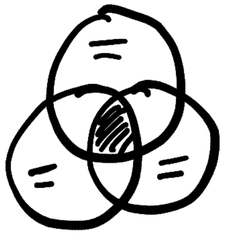


MAP

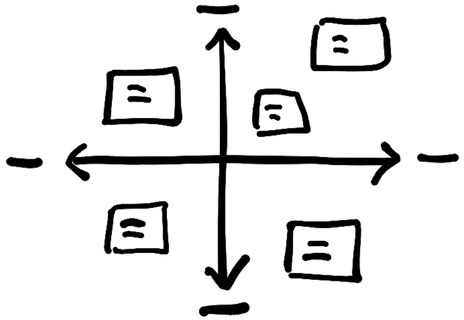
PORTRAIT



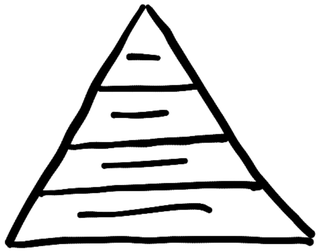
VISUAL METAPHOR



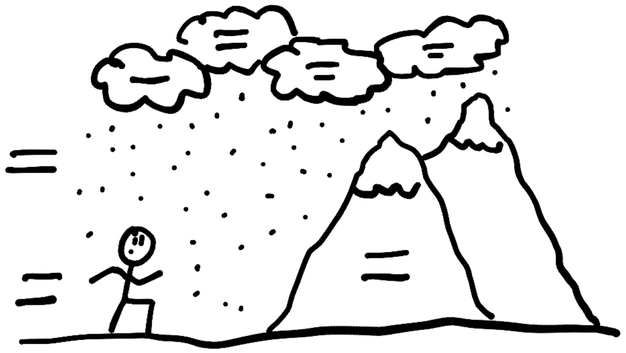
VENN



COORDINATE SYSTEM

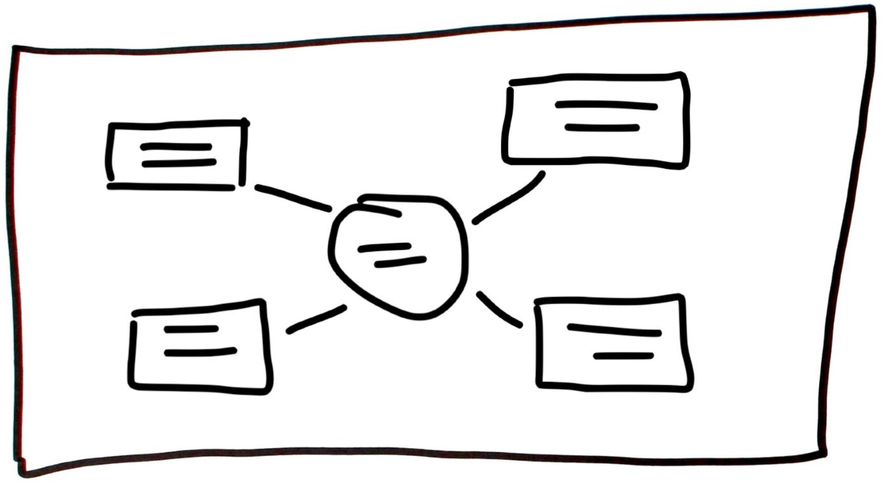


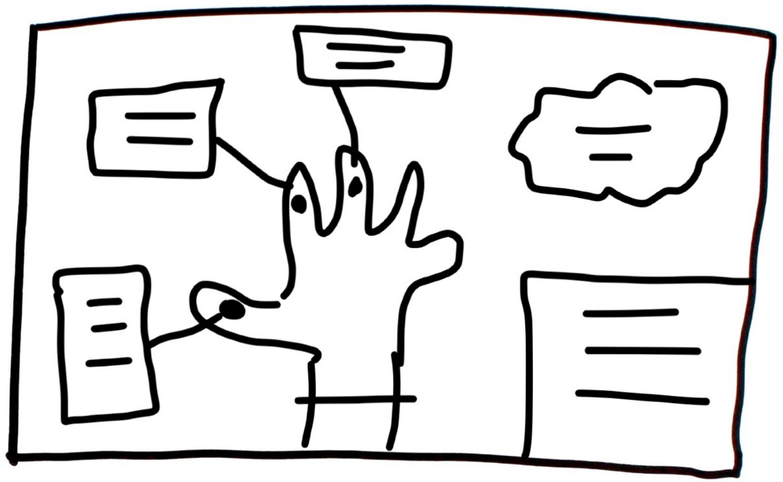
PYRAMID

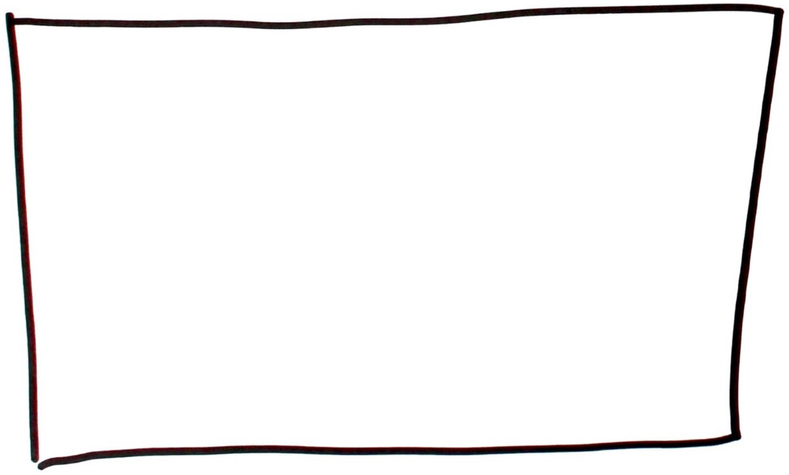


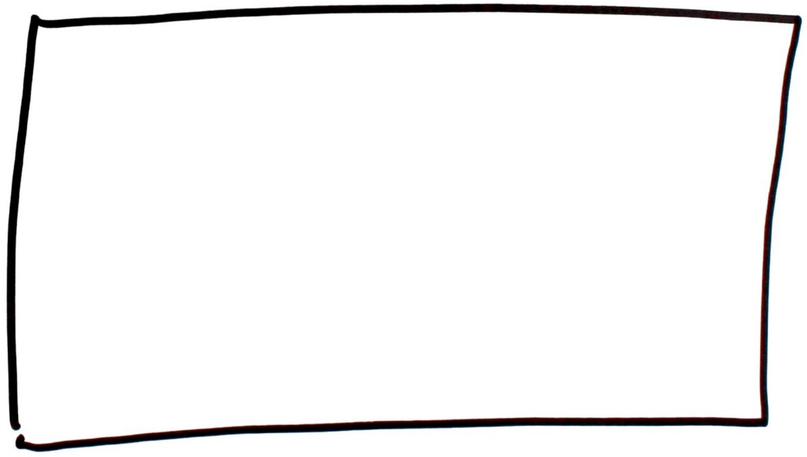
SCENE

SOLVE THE PUZZLE: THUMBNAIL BRAINSTORMING • VISUALFRAMEWORKS





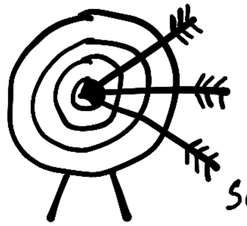




THE SKETCH IT OUT FRAMEWORK

1

AUDIENCE:



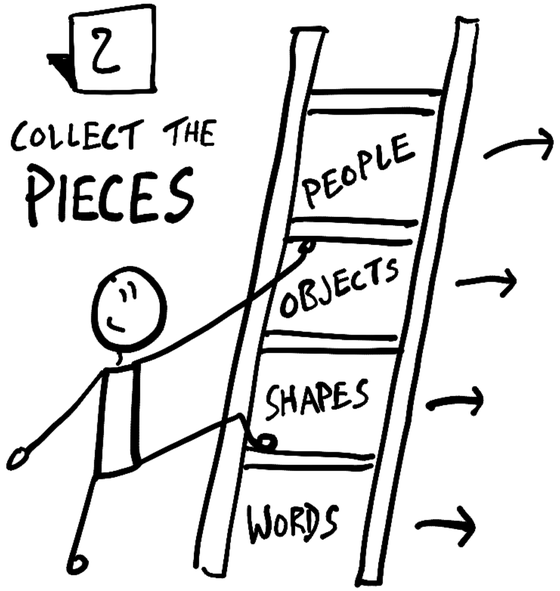
INTENTION:

SCOPE:

DEFINE YOUR
PURPOSE

2

COLLECT THE
PIECES



3

SOLVE THE
PUZZLE

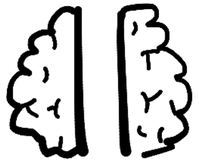
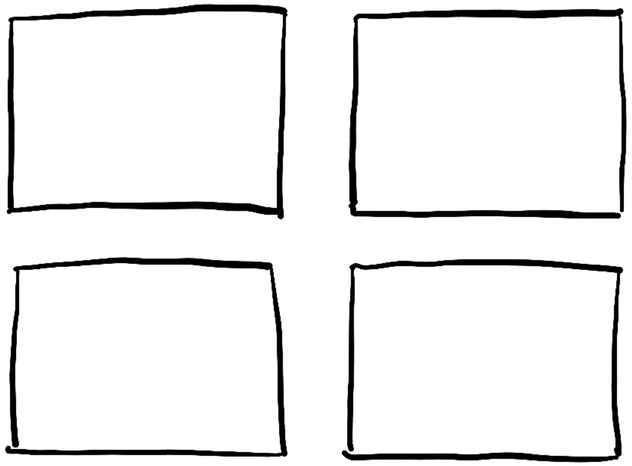


DIAGRAM DRAWING



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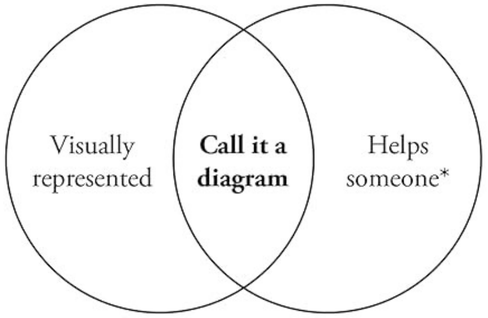
STUCK?

Diagrams Help.



** you are someone*

Abby Covert

Author of How to Make Sense of Any Mess

HAPPY 10TH BIRTHDAY 2012 2022

the Sketchnote HANDBOOK

→ THE ILLUSTRATED guide ← to VISUAL NOTE-TAKING

by MIKE ROHDE

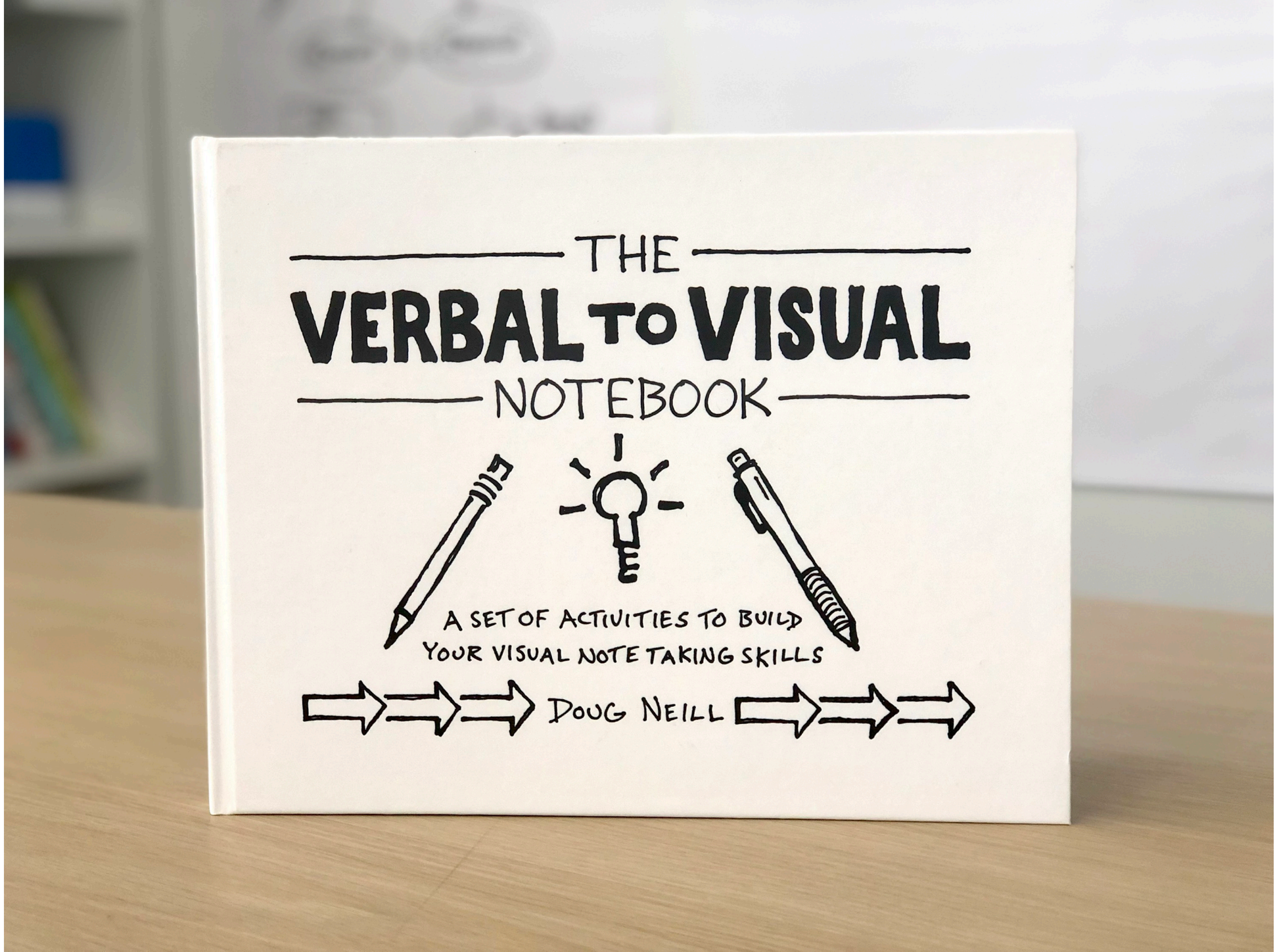
the illustrator of REWORK

SHOW & TELL

HOW EVERYBODY CAN MAKE EXTRAORDINARY PRESENTATIONS

DAN ROAM

AUTHOR OF THE INTERNATIONAL BESTSELLER THE BACK OF THE NAPKIN


THE
VERBAL TO VISUAL
NOTEBOOK
A SET OF ACTIVITIES TO BUILD
YOUR VISUAL NOTE TAKING SKILLS
DOUG NEILL

— The Verbal To Visual Notebook —

The Categories

The activities that follow share the common thread of focusing on one or more of the skills required to effectively take visual notes. But they differ in their at... so that you have a sense...

Train t... and

These are good activities to ... new to sketching. Don't wor... if it gets tedious.

Playful Practice

Lo... Lig...

Another activity good for...

— The Verbal To Visual Notebook —

Purposeful Practice

More focused

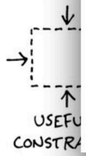
Build a ... or tw...

These activities are a bit more serious. Skill-build... but the topics addressed are more practical and...

Sketch → Then → Do

These activities encourage you to act on your ideas, often in fun ways, but sometimes with a more serious bent.

Get your bearings



Useful constra...

...e to a visual note taking session. You get ...dcast, video, etc.) and test out the set of ...hat you like. By all means, keep using it!

— The Verbal To Visual Notebook —

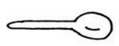
Fill this page with squiggles, lines, triangles, circles, rectangles, and anyother shapes you can imagine. (No representations of actual objects, please).

4

— The Verbal To Visual Notebook —

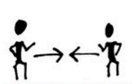
Before cooking a meal, sketch out the recipe. Then cook and eat, and sketch out a review of the meal

Sketch → Then → Do



12

— The Verbal To Visual Notebook —



Connect

Communicate

Collaborate

Get out of your own head

Though we often sketch out ideas for our own purposes, these activities give you an opportunity to use your sketches as a way to connect with others.

Personal

Attention turned inward

Personal development (no running required)

Self-knowledge

Moving in the opposite direction, these activities will turn your attention inward, giving you the opportunity to get to know yourself a bit better while also developing the skill of sketching out ideas.

Adventure

Get out into the world

Potentially challenging

Rewarding

These activities encourage you to get out into the world, interact with it in a variety of ways, and sketch out your experience. Take these on at your own risk ☺.

viii

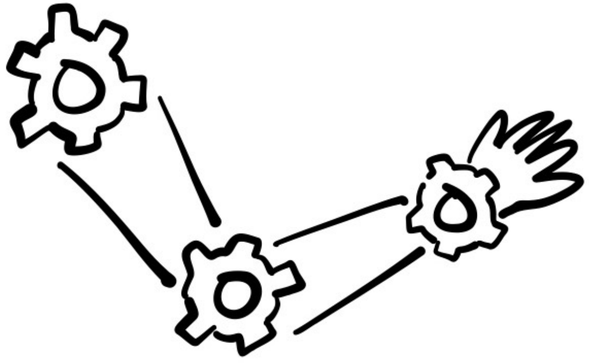
...l To Visual Notebook —

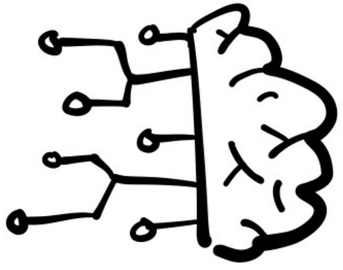
...h laws you wished existed but don't. ...de an icon within each sign.

...layful ...ractice

31

SKETCH IT OUT





BUILD THE SKILL OF VISUAL THINKING TO SUPPORT
YOUR RESEARCH, GRANT PROPOSALS, & PUBLIC COMMUNICATION

19TH MARCH, 26TH MARCH, 2ND APRIL
14:00-15:30

Bionics+

VERBAL TO VISUAL