



Tami Tolpa, MFA

# The Three S's in Visual Science Communication

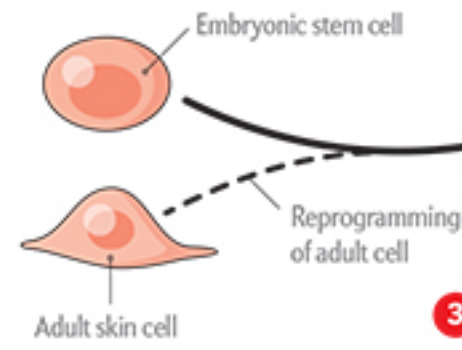




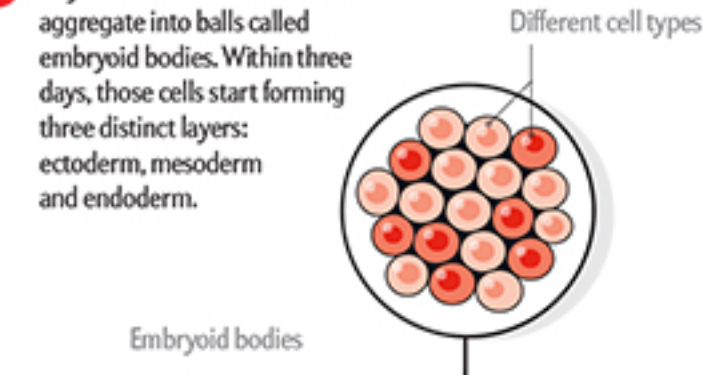
# Grow Your Own

The technology that coaxes stem cells to develop into different types of biological tissue has now been used to grow a part of the brain that contains the cortex and other structures and is responsible for such higher mental functions as processing information from the outside world, forming memories and making decisions. To create such a mini brain, researchers give a tiny ball of cells nutrients and a bed on which to grow; then the cells recapitulate much of the developmental process that occurs in the early embryo.

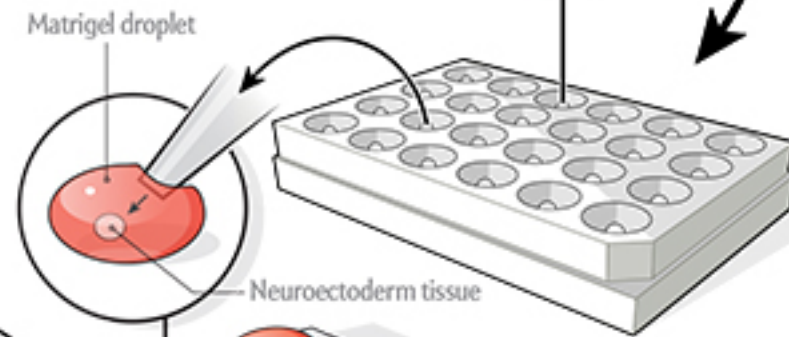
**1** The procedure begins with embryonic stem cells or induced pluripotent stem cells capable of turning into any cell type in the body. The latter cells can be derived from adult skin or blood cells that have been genetically altered.



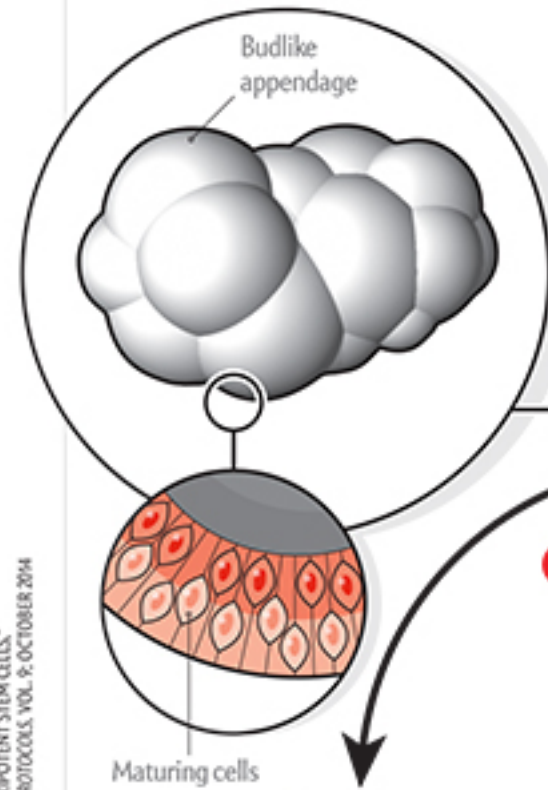
**2** Days 0-5: The cells divide and aggregate into balls called embryoid bodies. Within three days, those cells start forming three distinct layers: ectoderm, mesoderm and endoderm.



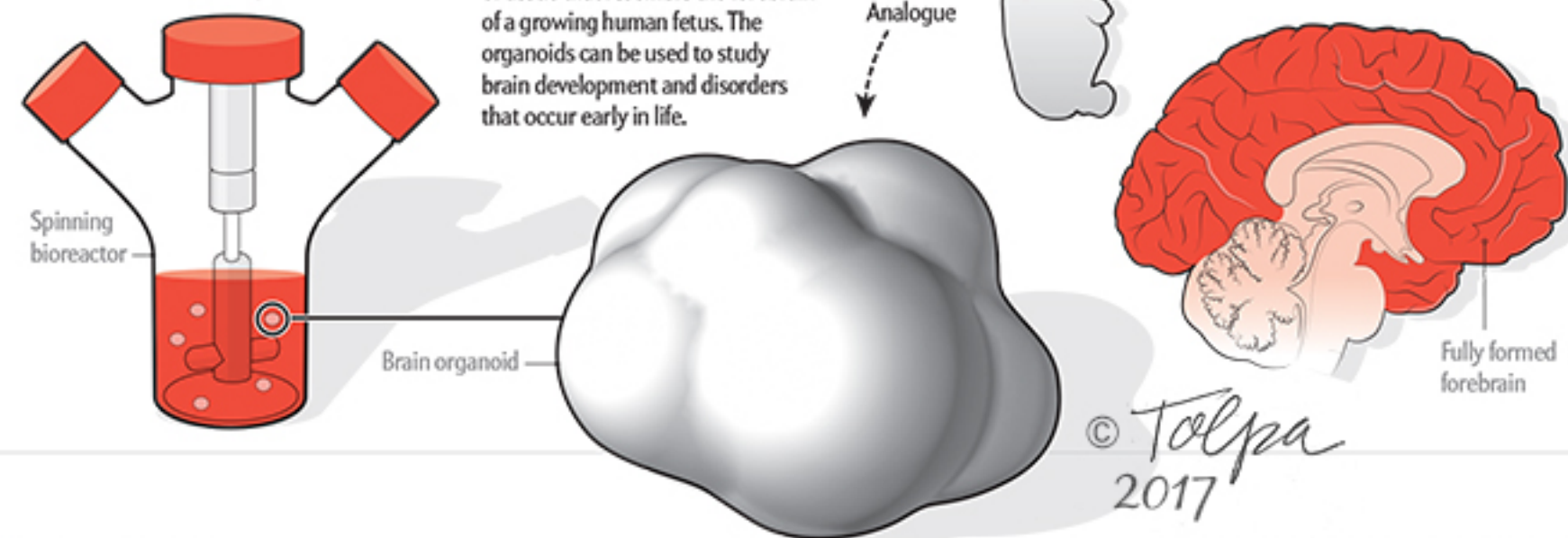
**3** Days 6-10: Embryoid bodies, after being placed in a liquid containing the nutrients for the part of the fetus that forms the nervous system (the neuroectoderm), begin to cluster into layers that form the embryonic tissues that give rise to the human brain.



**4** Days 11-15: Tiny balls of neuroectoderm are embedded in Matrigel—a medium rich in chemicals that stimulate cells to divide, prevent them from dying and provide an environment that supports growth of budlike appendages, a prelude to development of fully formed brain structures.



**5** Days 15-30: Matrigel droplets are transferred to a spinning bioreactor or a device known as an orbital shaker. In the gel, the embryoid bodies grow into brain organoids—three-dimensional, white balls of tissue that resemble the forebrain of a growing human fetus. The organoids can be used to study brain development and disorders that occur early in life.



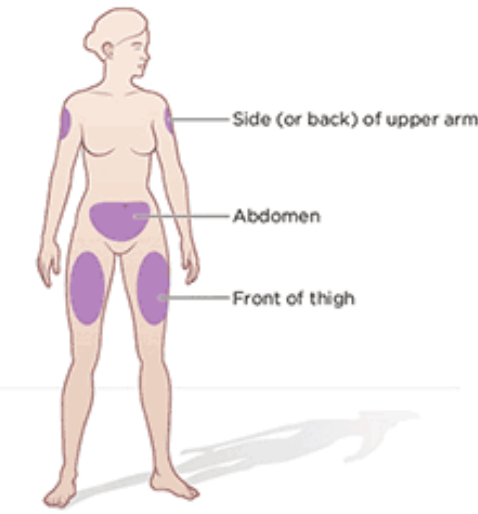
Outcome: After a month of nurturing the stem cell concoction, the cultures are strikingly similar to the forebrain of a 10-week-old embryo. This brain region includes the cortex (the large, folded outer structure) and the choroid plexus (the region that generates cerebrospinal fluid).

SOURCE: "GENERATION OF CEREBRAL ORGANIDS FROM HUMAN PLURIPOTENT STEM CELLS" BY MADLINE A. LANCASTER AND JURGEN A. KNOBLOCH, IN NATURE PROTOCOLS VOL. 9, OCTOBER 2014

Illustration by Tami Tolpa

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## Preparing for a Subcutaneous Injection



The most common injection sites are:

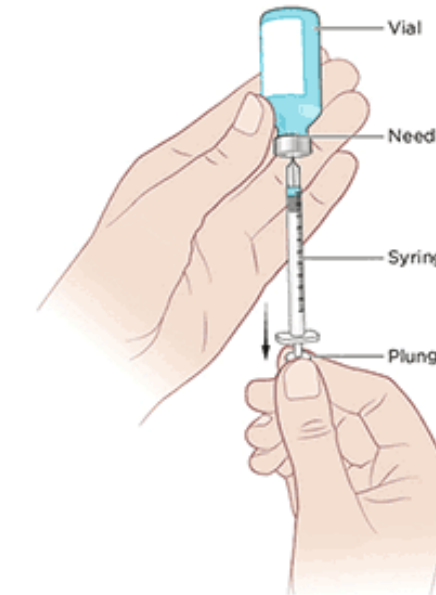
- Abdomen: at or under the level of the belly button, about two inches away from the navel
- Arm: back or side of the upper arm
- Thigh: front of the thigh

## Insert air into the vial



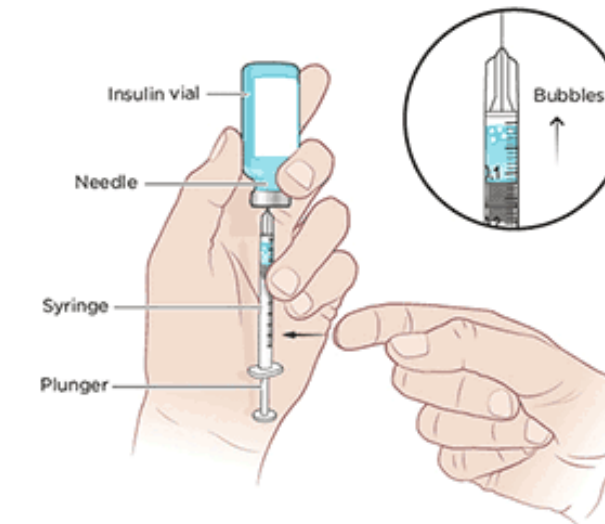
Remove the cap from the needle and push the needle through the rubber stopper at the top of the vial.  
Inject all the air into the vial.  
Be careful to not touch the needle to keep it clean.

## Withdraw the medication



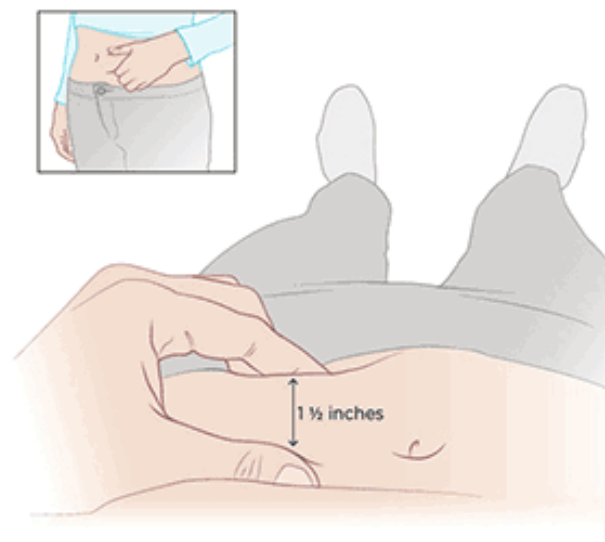
Turn the vial and syringe upside down so the needle points upward.  
Then pull back on the plunger to withdraw the correct amount of medication.

## Remove any air bubbles



Tap the syringe to push any bubbles to the top and gently depress the plunger to push the air bubbles out.

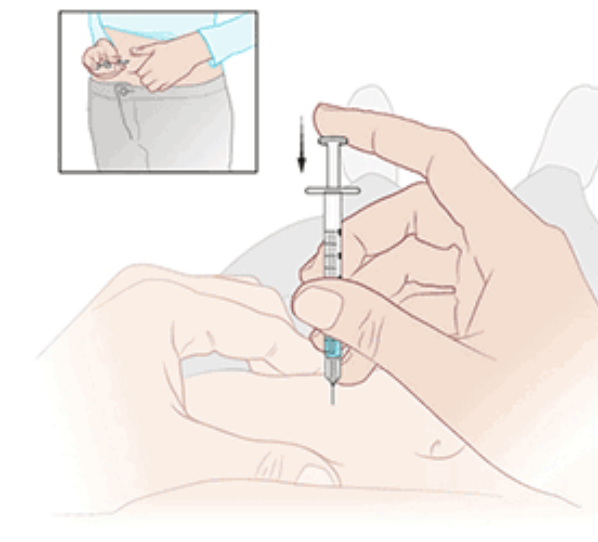
## Pinch your skin



Take a big pinch of skin between your thumb and index finger and hold it. Your thumb and forefinger should be about an inch and a half apart.

This pulls the fatty tissue away from the muscle and makes the injection easier.

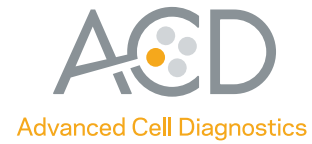
## Insert the medication



Slowly push the plunger to inject the medication.  
You should inject the entire amount of medication.

# RNASCOPE® IN SITU HYBRIDIZATION

Designed for highly sensitive and specific detection of any gene

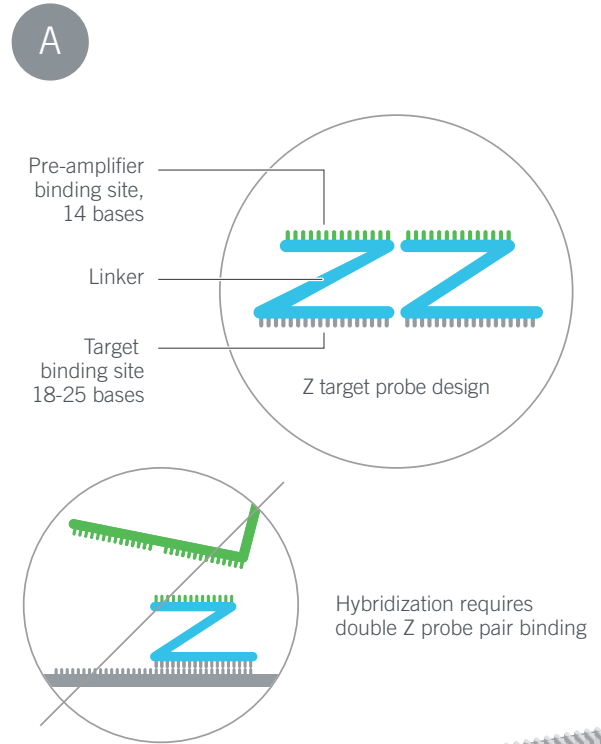


## A RNAscope probe design

A standard target probe consists of a pool of 20 double Z probes targeting a region of 1000 bases. Each Z target probe contains three elements: The lower region is complementary to the target RNA and is selected for target specific hybridization and uniform hybridization properties. A spacer sequence links the lower region to an upper region. The two adjacent upper regions from a double Z target probe forms a 28 base binding site for the pre-amplifier.

Two independent Z probes, designed as probe pairs, need to hybridize to the target sequence in tandem in order to enable binding of the pre-amplifier.

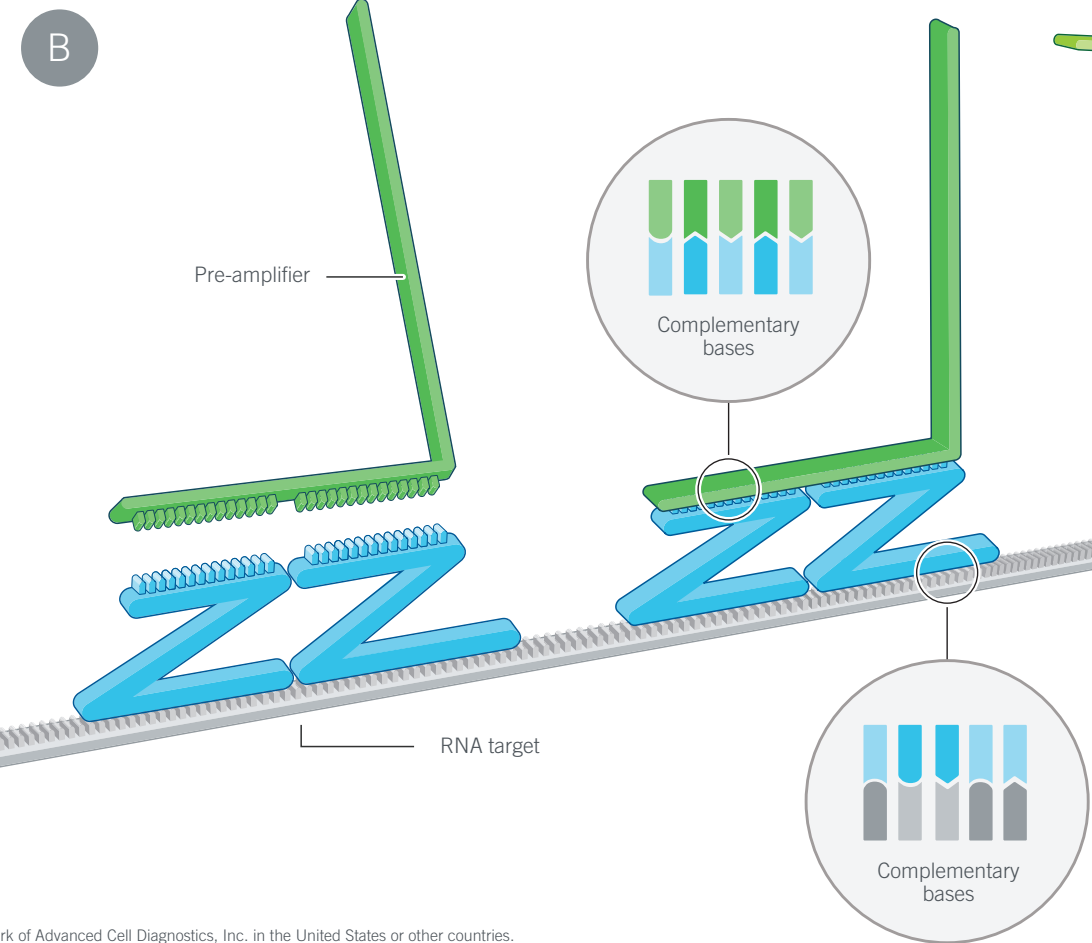
A single Z probe hybridization onto a non-specific RNA target can happen, but the resulting hybridization of the pre-amplifier onto the upper region of a single Z will be unstable and therefore will be removed during the wash steps. This design ensures a low background noise level.



## B RNAscope probe hybridization and amplification occurs as a cascade of events:

- Step 1:** Z Probe pairs bind to the RNA target
- Step 2:** Hybridization of the pre-amplifier to the upper regions of the Z probe pairs
- Step 3:** Hybridization of multiple amplifiers per pre-amplifier
- Step 4:** Hybridization of multiple labeled probes per amplifier

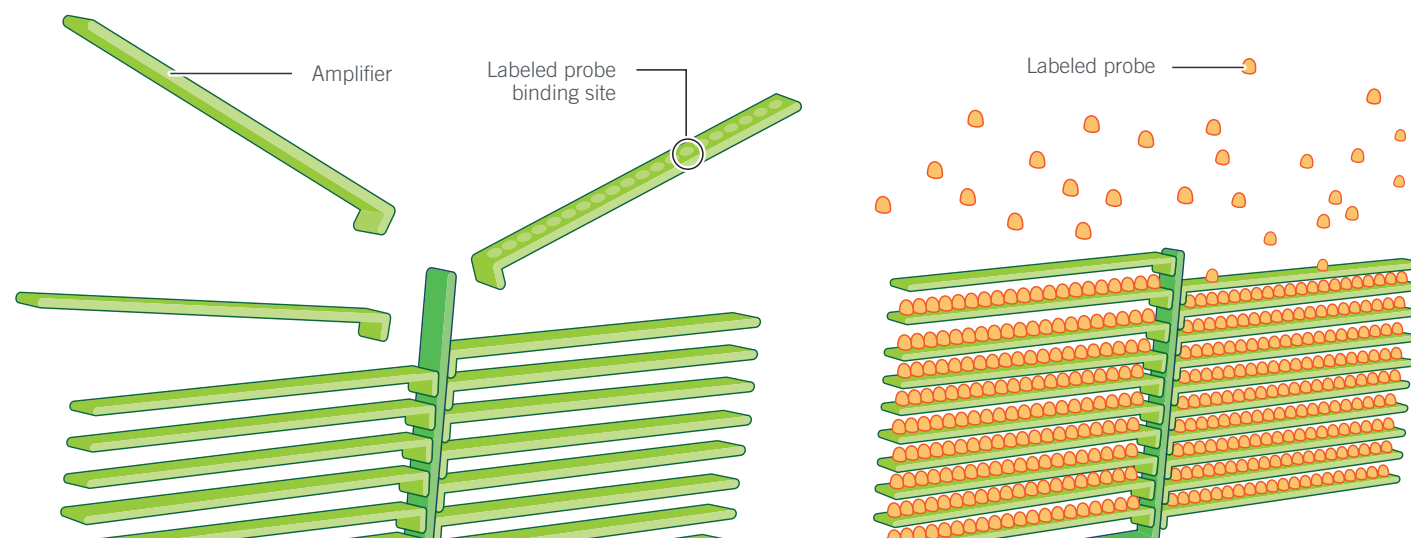
This serial hybridization events—20 Z probe pairs, multiple amplifiers, multiple labeled probes—result in hybridization of thousands of labeled probes per RNA target.



## C RNAscope signal detection

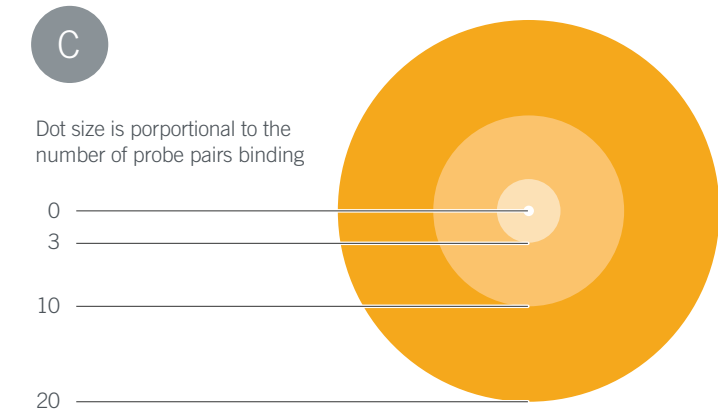
Labeled probes contain chromogenic enzyme or fluorescent signal generating one punctuate dot per RNA target. The size of the dot is directly proportional to the number of Z probe pairs hybridized onto the RNA target.

Hybridization of only three Z probe pairs is sufficient to obtain a detectable signal by brightfield or fluorescent microscope.

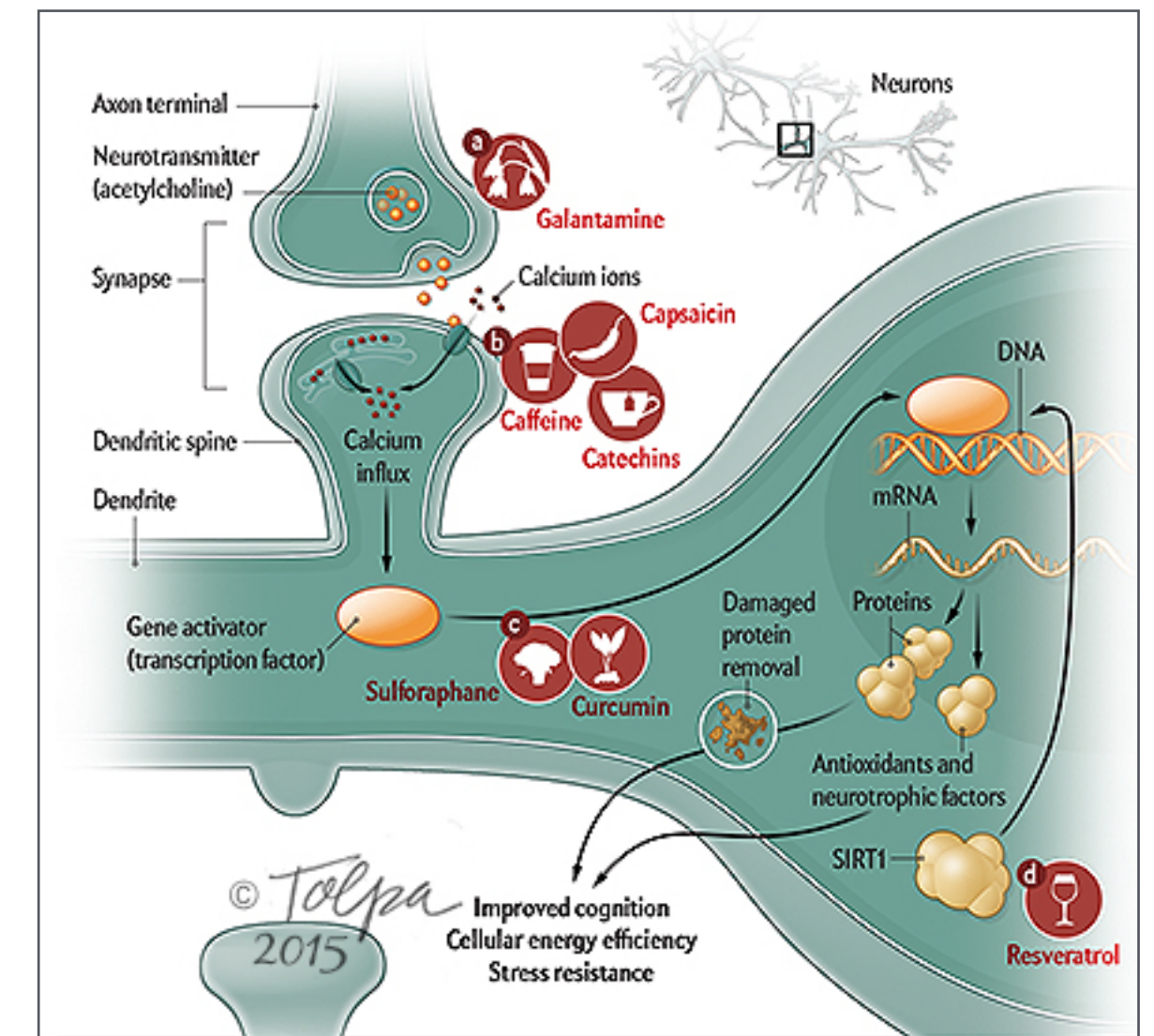


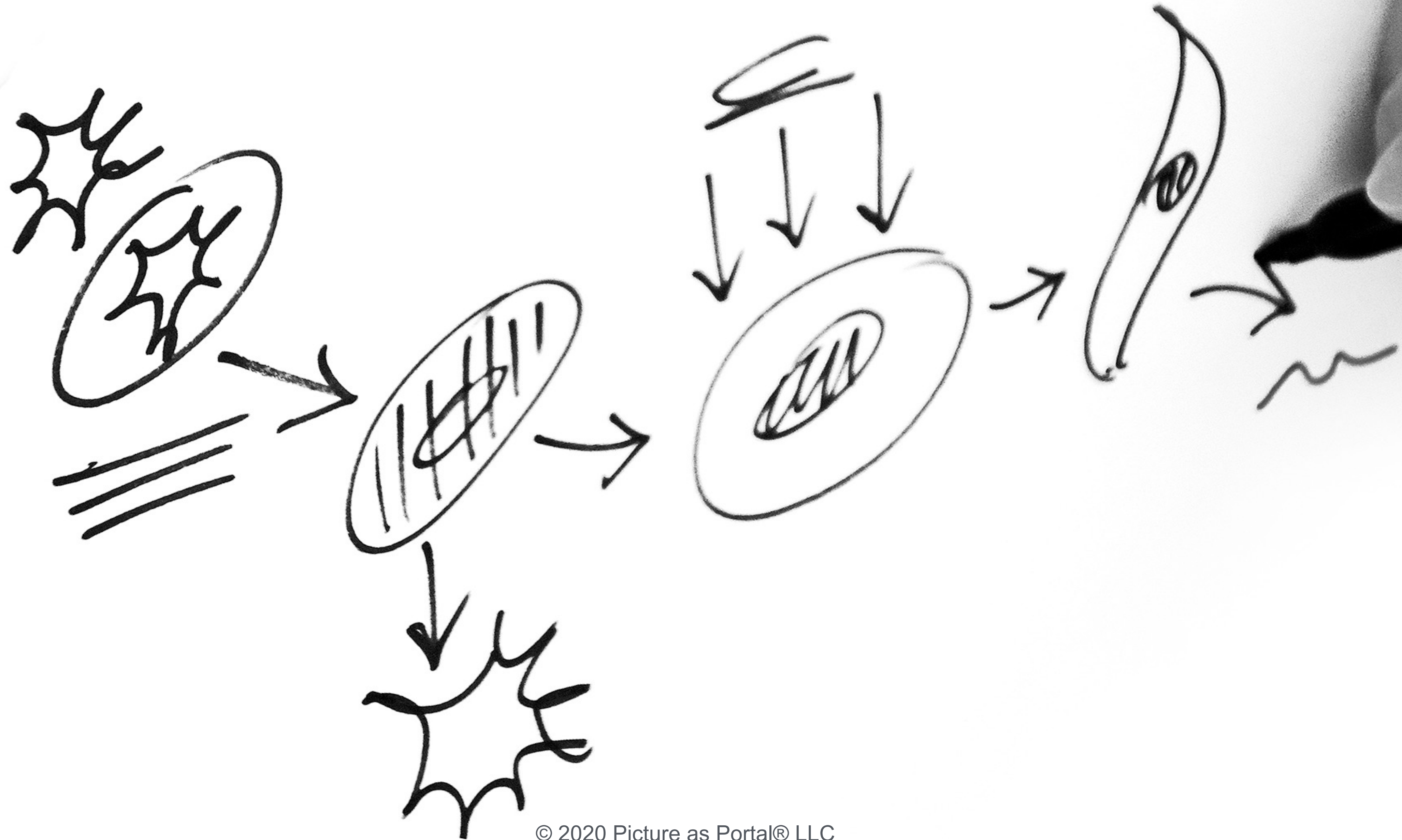
## Summary of benefits

- **High sensitivity:** The serial signal amplification design increases sensitivity such that a single RNA molecule can be detected.
- **High specificity:** Proprietary probe design ensures target-specific binding while the double Z probe design prevents signal amplification of non-specific hybridization.
- **Morphological context:** Expression analysis within the cellular or tissue context
- **Per-cell quantitation:** High sensitivity combined with morphological context results in single-molecule detection at single-cell resolution
- **Universal:** Works for virtually ANY gene from ANY species in ANY tissue.




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We're born  
visual  
thinkers



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$$+ \frac{2}{16} (RrYy) = \frac{3}{16} \text{ro}$$

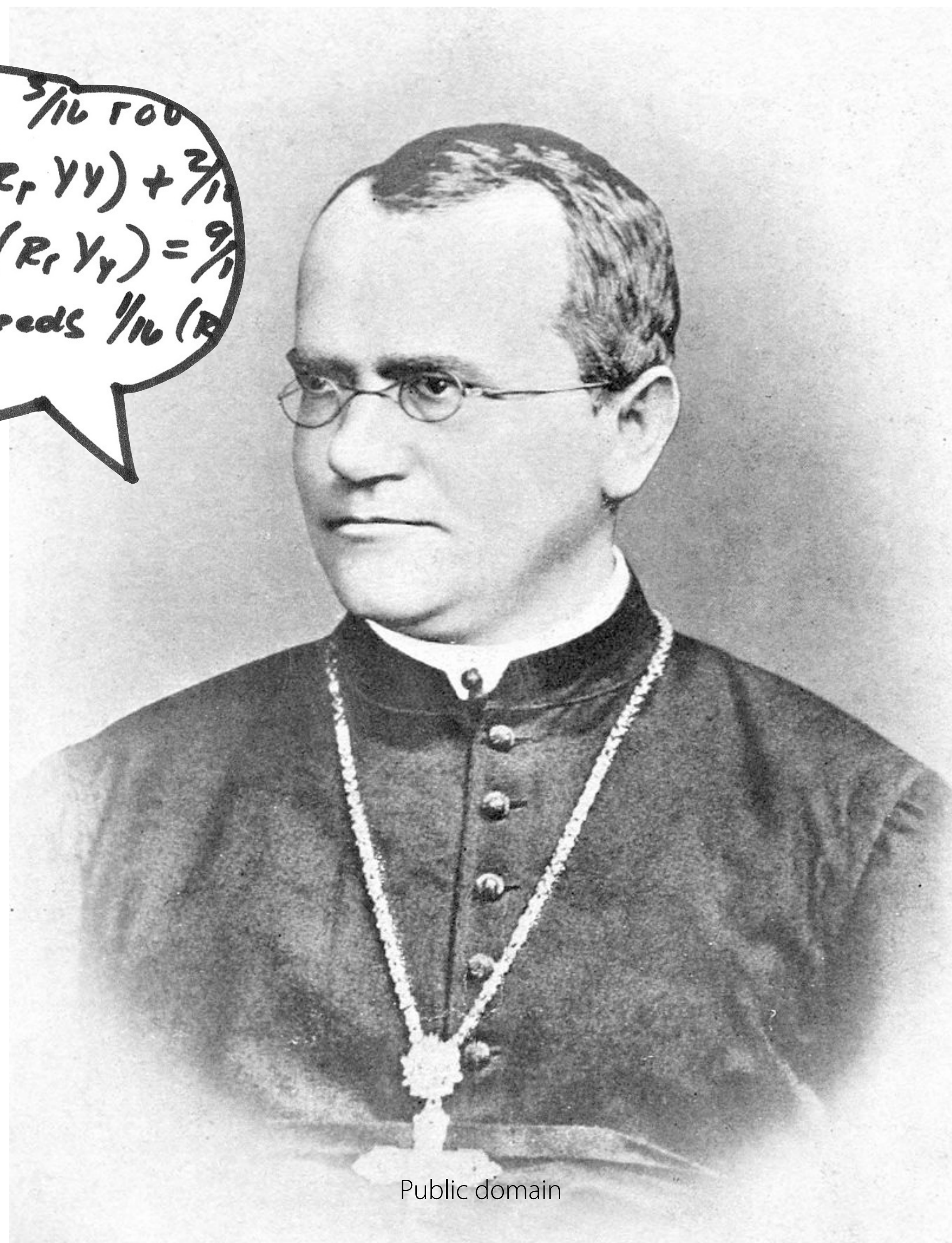
$$\frac{1}{16} (RRYY) + \frac{2}{16} (RrYY) +$$

$$\frac{2}{16} (RRYy) + \frac{4}{16} (RrYy)$$

$\frac{9}{16}$  round-yellow seeds  $\frac{1}{16}$

$$\frac{1}{16} (RRyy) + \frac{2}{16}$$

$y) + \frac{2}{16} (RrYy) = \frac{3}{16} rOo$   
 $+ \frac{1}{16} (RRYy) + \frac{2}{16} (RrYy) + \frac{2}{16}$   
 $+ \frac{2}{16} (RRYy) + \frac{4}{16} (RrYy) = \frac{9}{16}$   
 $= \frac{9}{16}$  round-yellow seeds  $\frac{1}{16} (R$   
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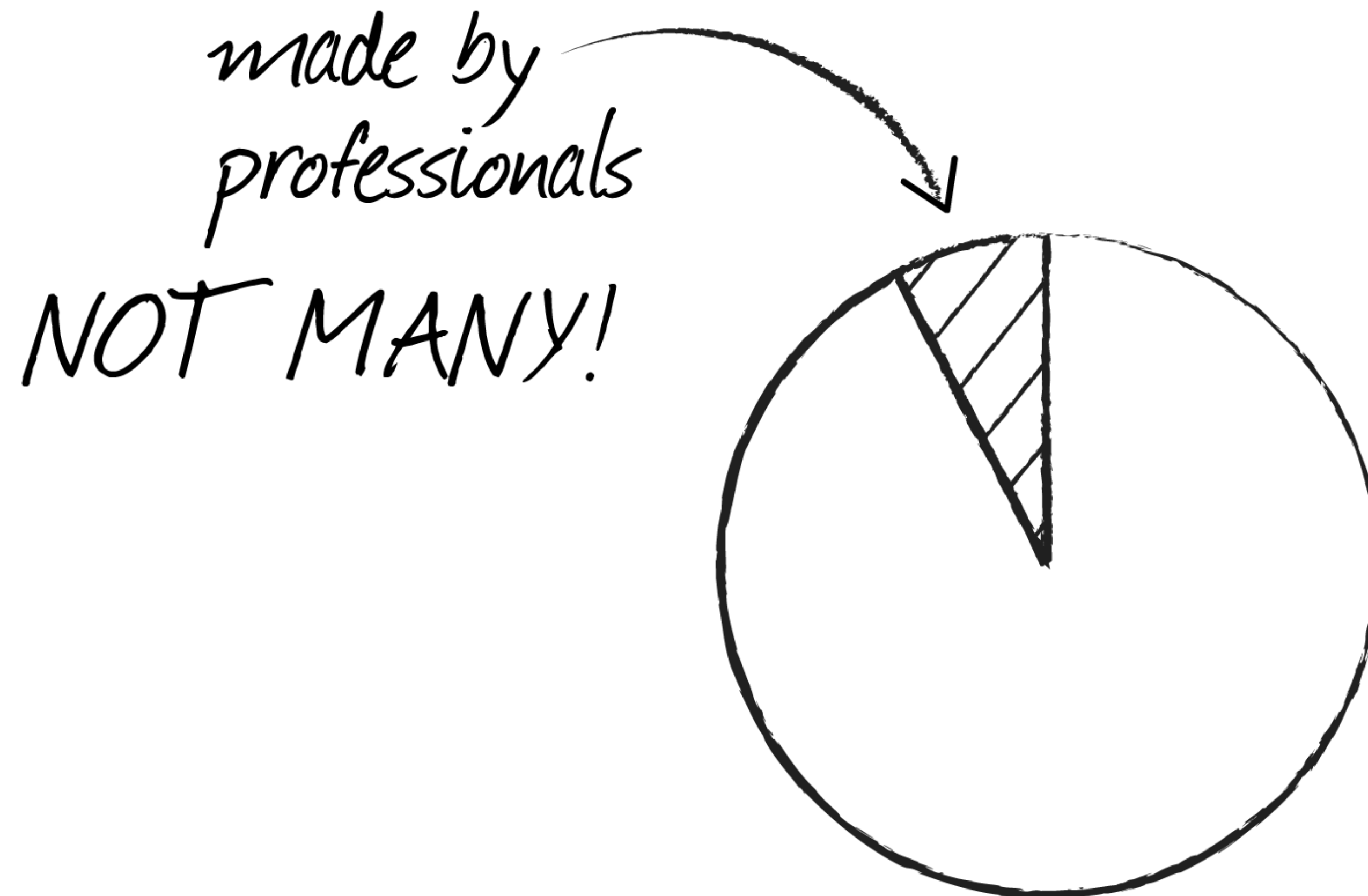


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MENDEL PRESENTED HIS THEORY IN 1865 TO THE BRÜNN  
NATURAL SCIENCE SOCIETY... IT PUT THEM TO SLEEP.



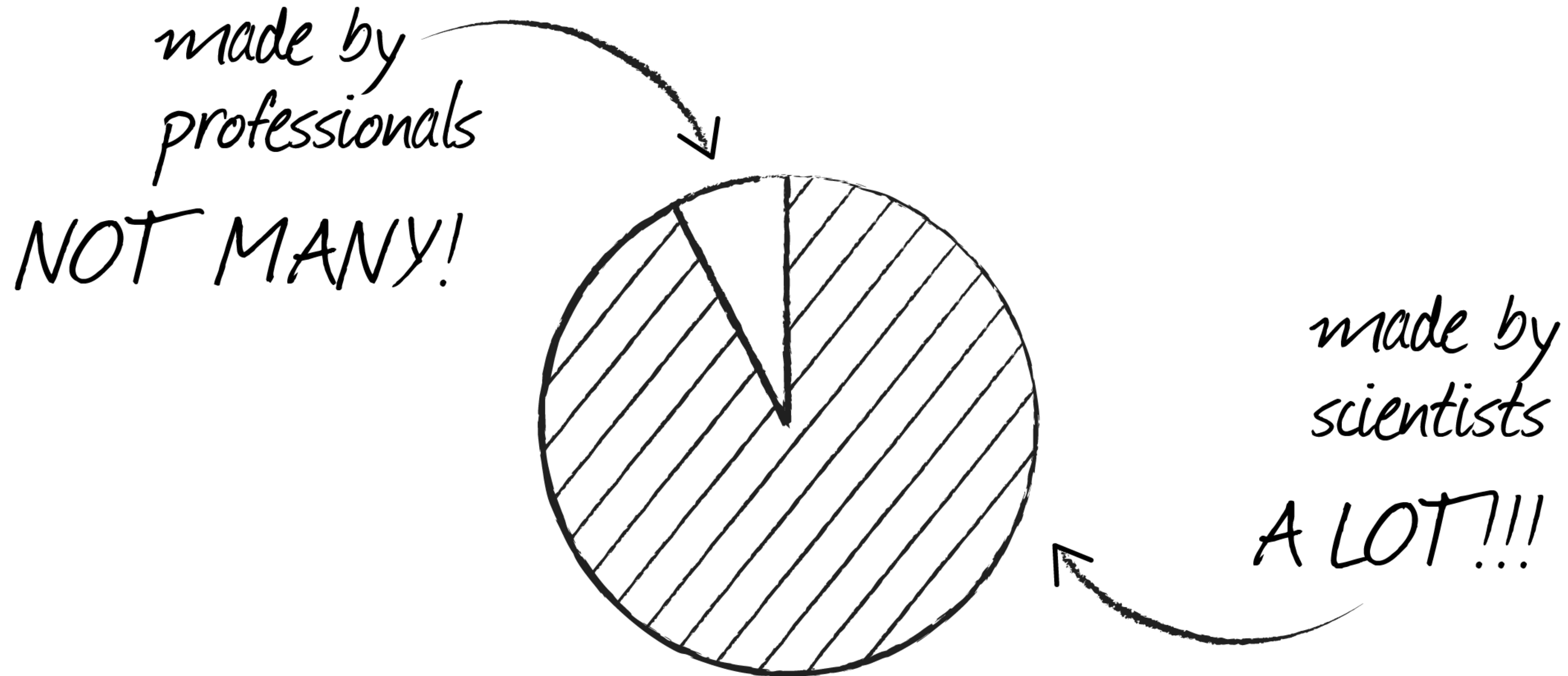
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**S-P-A-R-K**

5 strategies for the visual  
communication of science

# SPARK checklist

## S Serve a Sandwich

- Is the content served in a context sandwich: context | content | context?

## P Plan a Path

- Is the narrative path clear?  Is the pattern easy to recognize?

## A Access your Audience

**Let go of literalism**

**Customize for your audience**

- Does the complexity of the picture match your audience sweet spot?
- Is the picture selective?  Is it schematic?  Is it symbolic?
- Is the picture selective about visual language?
- Does it show visual context?  Is it humanized?  Does it show location or scale?
- Is content served in bite-sized chunks?
- Does the picture invite participation by engaging the senses or using interactivity?

## R Refine Relationships

**Perform visual triage**

- Is there a content hierarchy?  Is optional content eliminated?

**Use elements of visual language**

Are these elements used effectively?

- Points  Size  Shape  Texture  Lines  Direction  Value  Color

**Apply principles of perception**

Are these principles used effectively?

- Proximity  Similarity  Enclosure

**Make use of bonus tips**

Are these tips used effectively?

- White space  Alignment  Visual repetition

## K Keep it clear

**Follow best practices for color**

Is color used only for a good reason?

Does color choice consider these?

- Is the Goldilocks rule followed: avoid extremes except for a good reason?

- Emphasis  Differentiation  Coding
- Nearby colors  Grayscale value  Deficiency in color perception
- Limited to only the minimum needed

**Follow best practices for text**

Is text legible from the audience viewpoint?

- Size  Font  Background  Contrast  Chunking  Alignment
- Are leader lines designed to avoid distraction?

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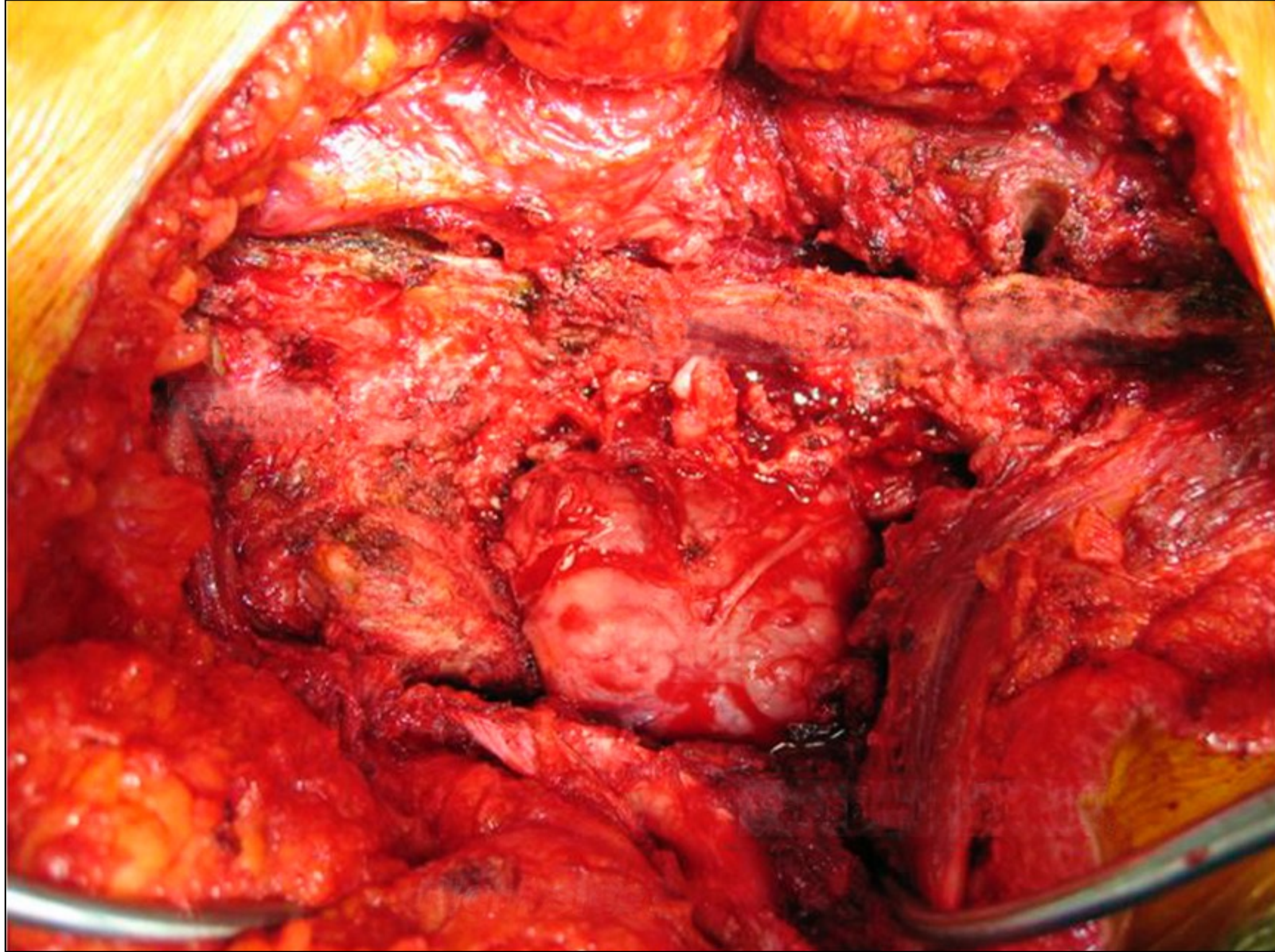
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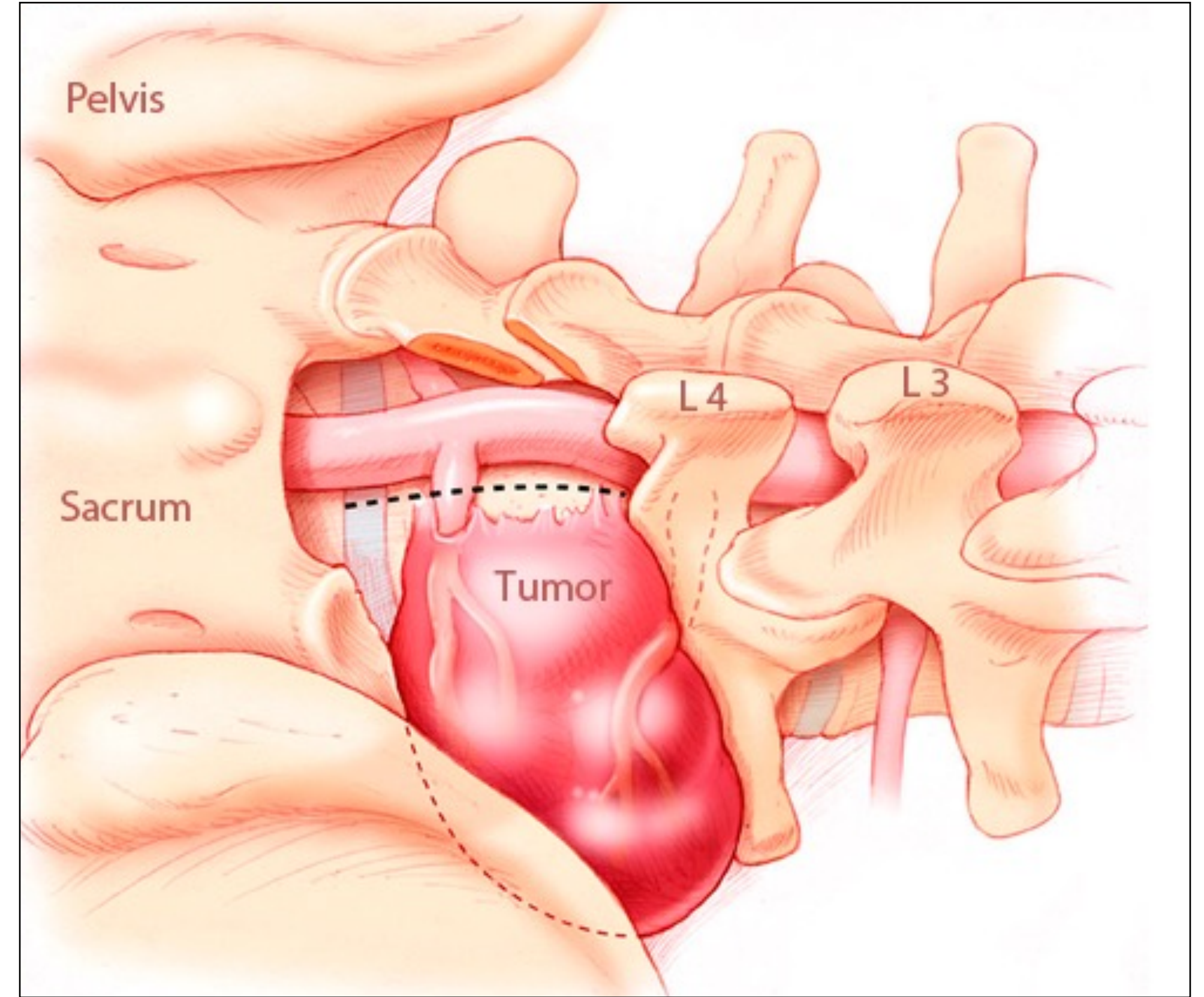
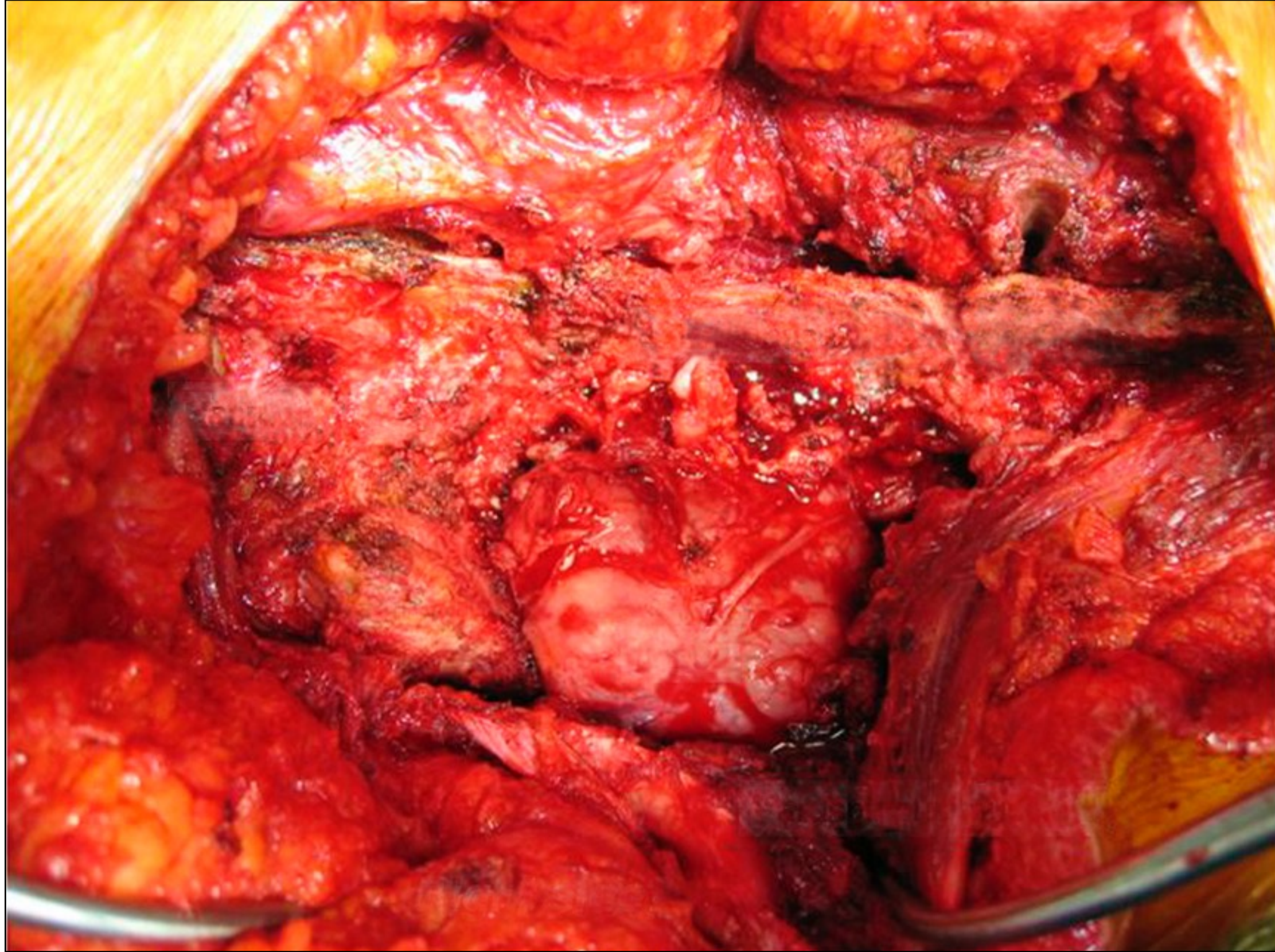
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# Let go of literalism: Use the 3 S's

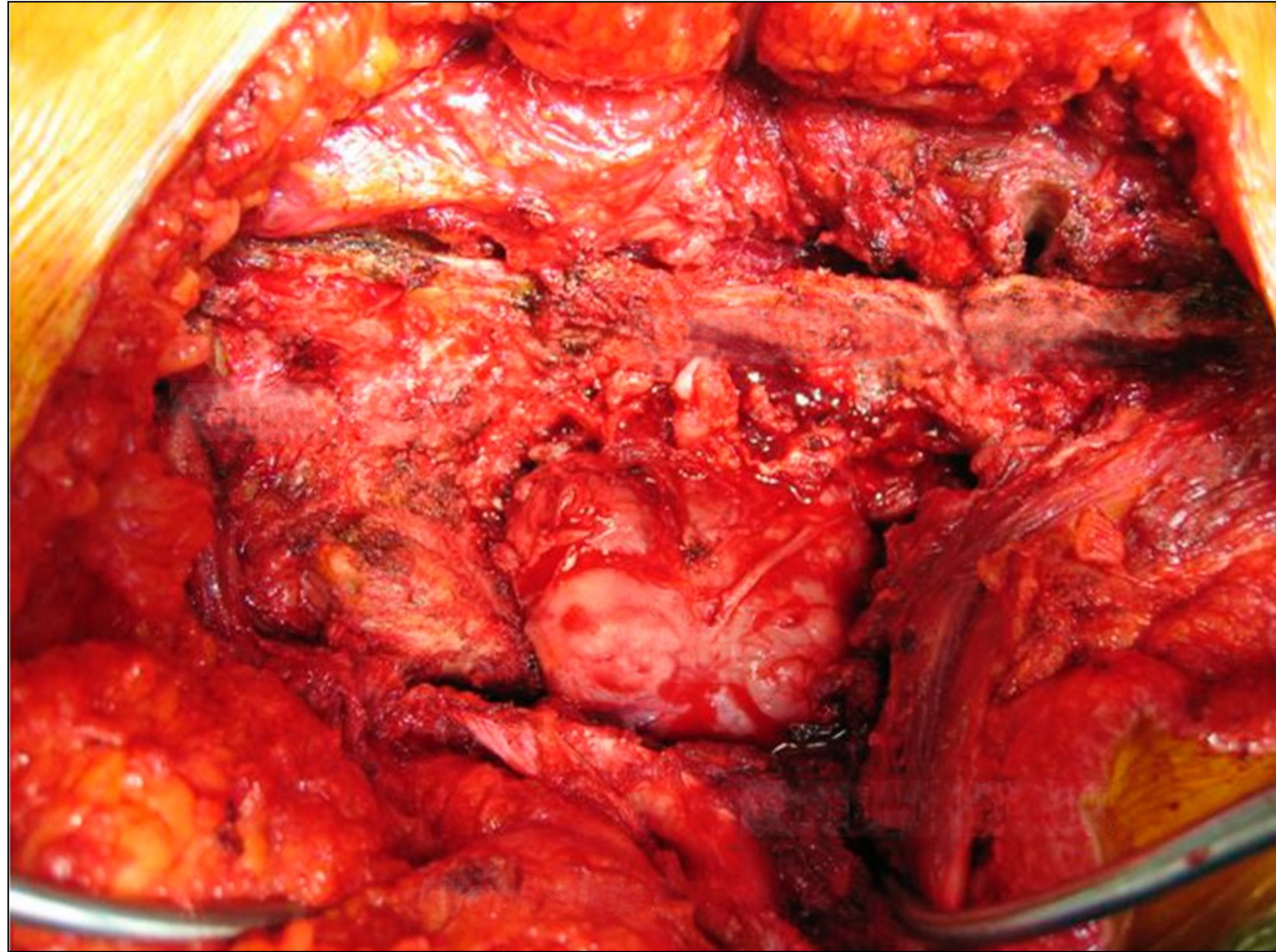
# Literal



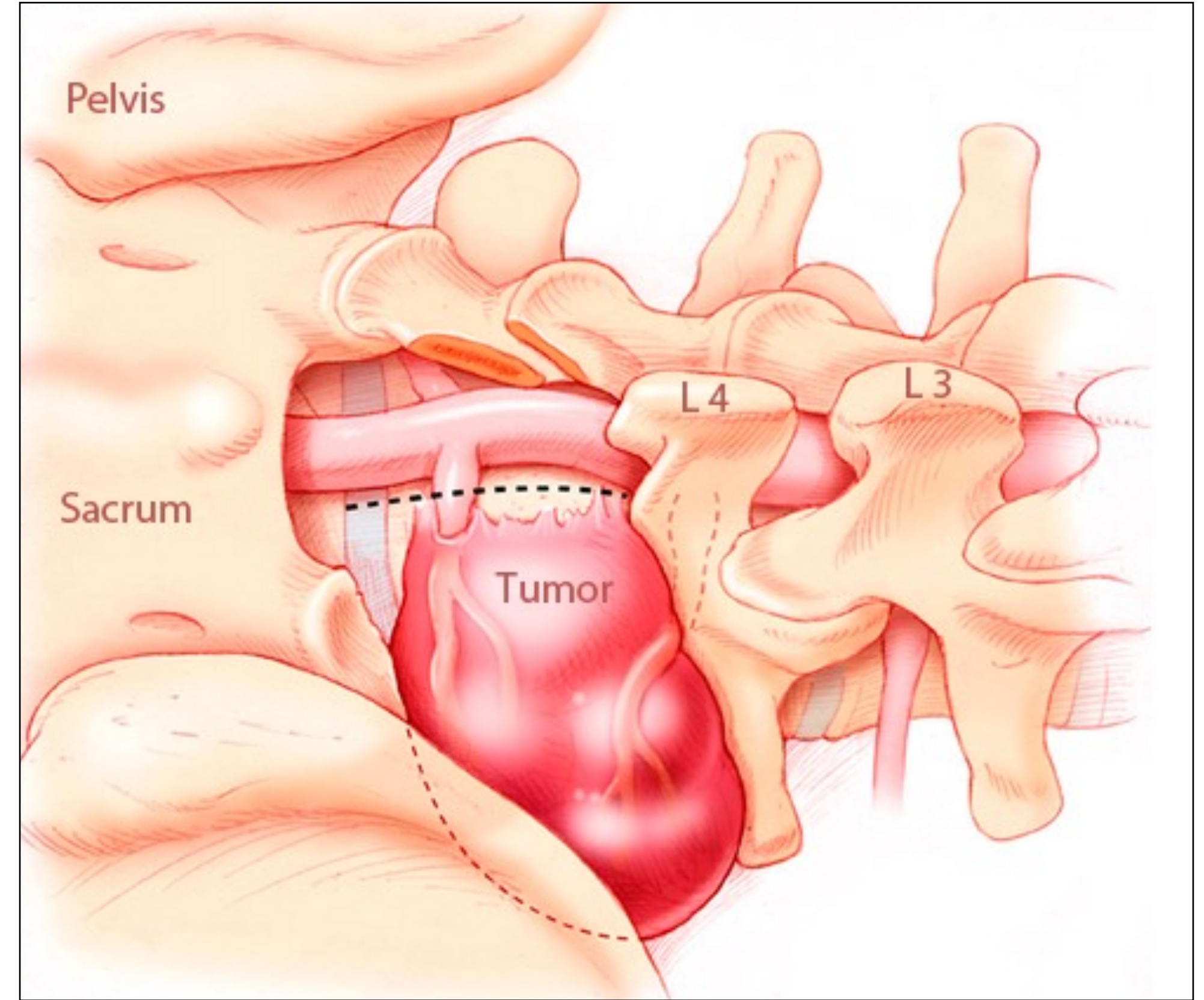
# Literal



# Literal



# Selective

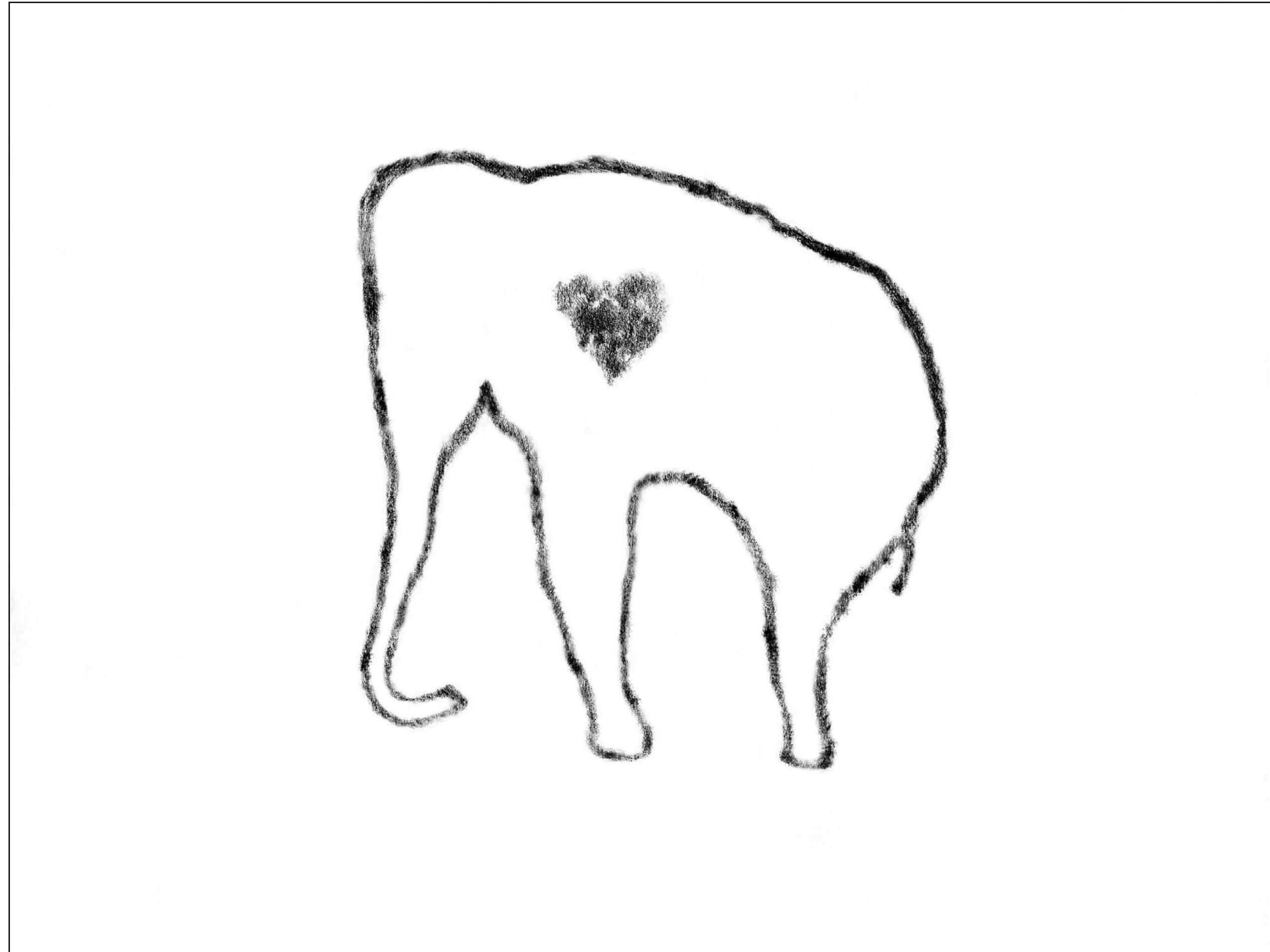


# Be Selective



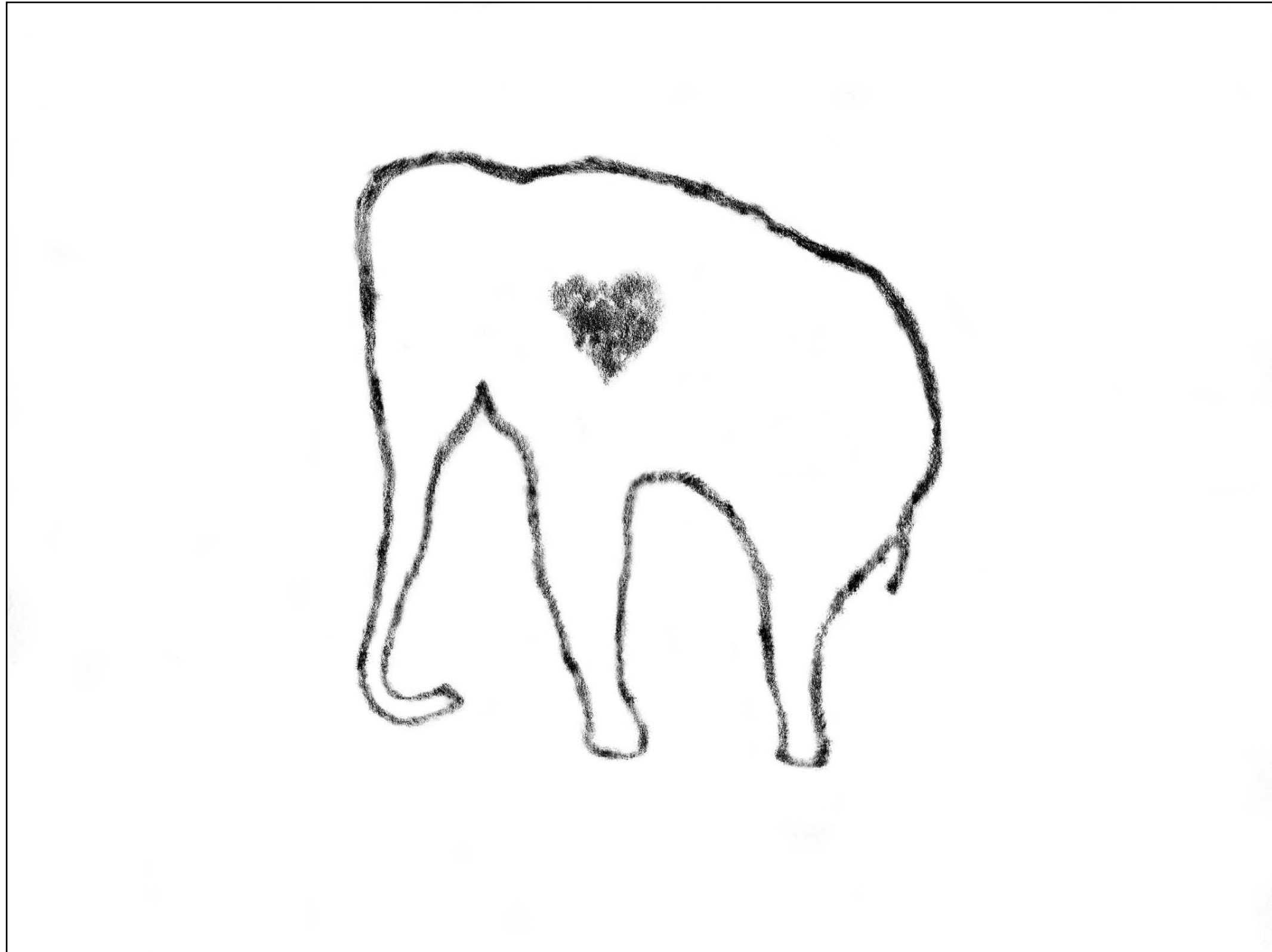
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# Be Selective

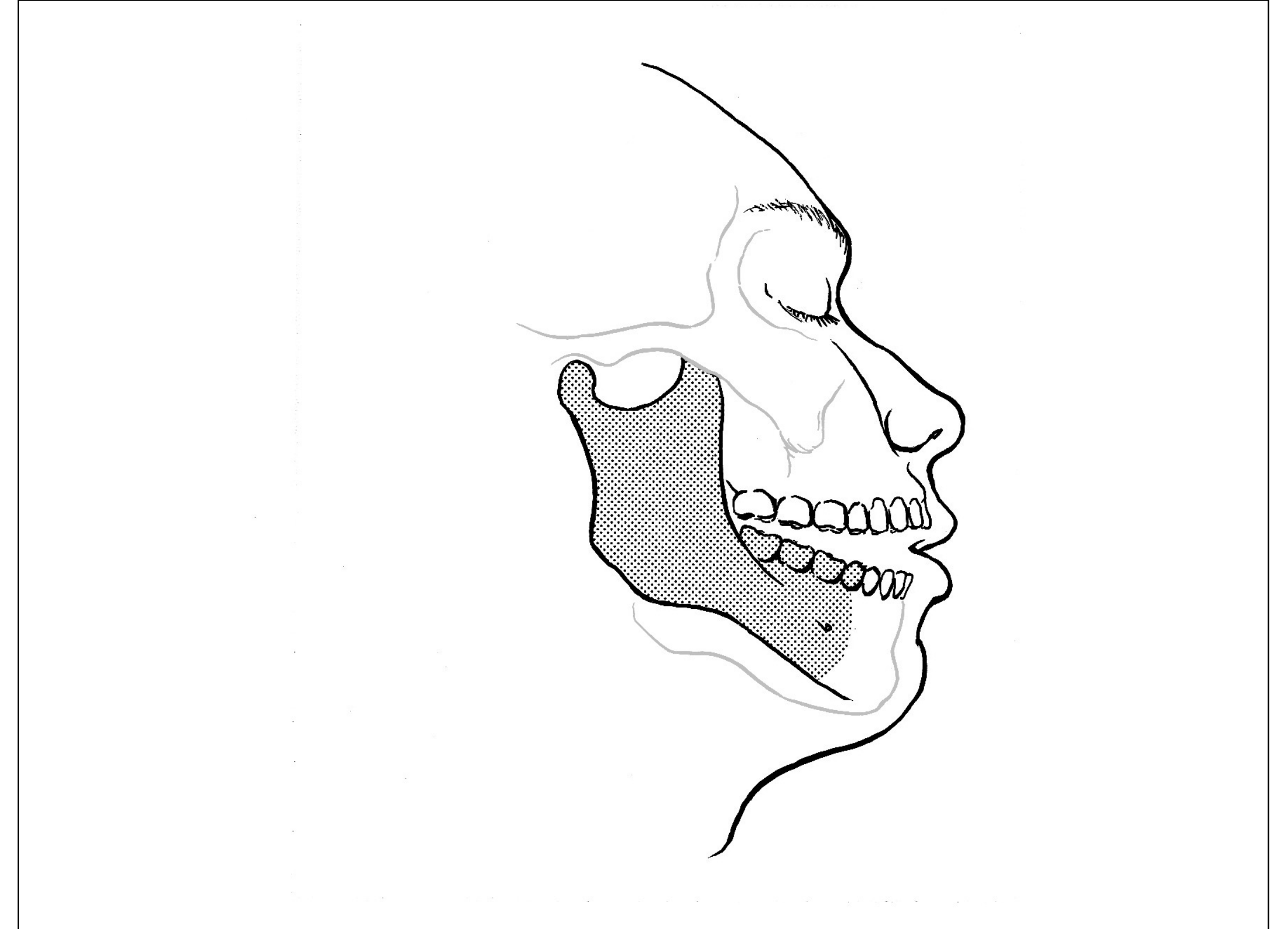


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# Be Selective



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When you have a lot of content,  
**be selective.**



# Be Selective

## The Jobless Rate for People Like You

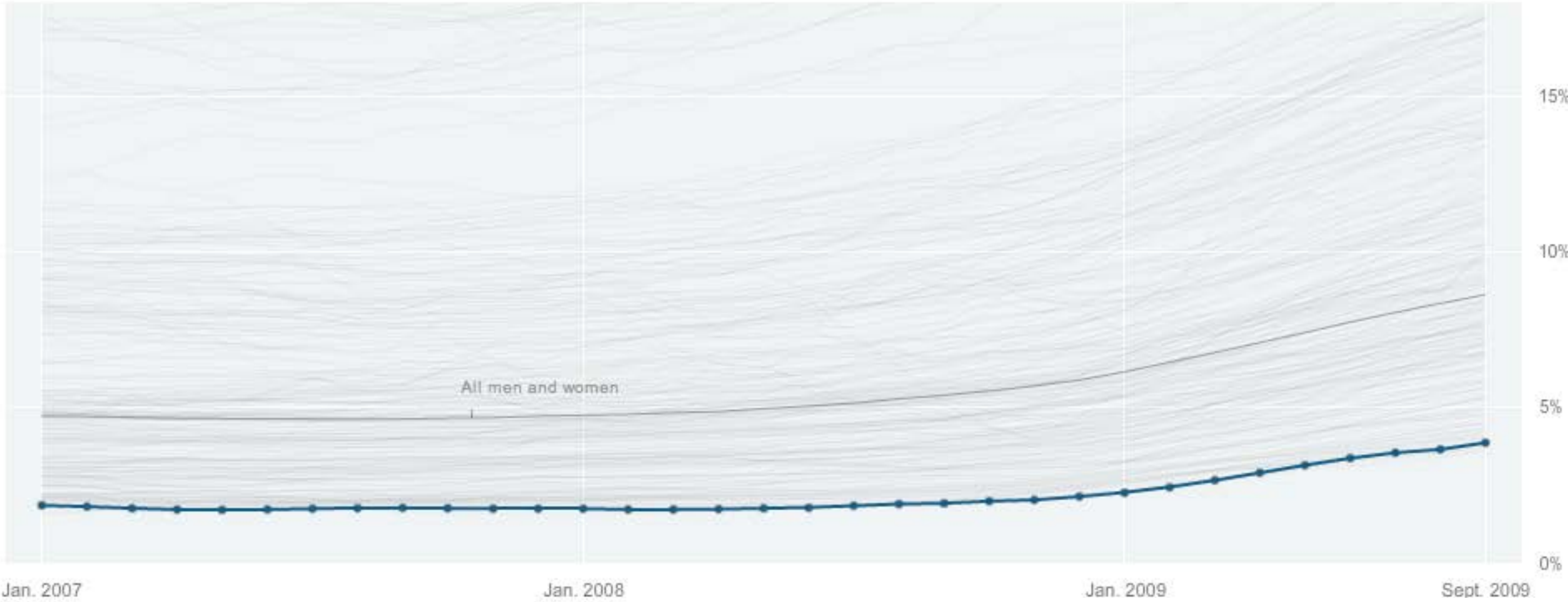
Not all groups have felt the recession equally.

All races	Men and Women	All ages	All education levels
<b>White</b>	<b>Men</b>	Ages 15 to 24	Not a high school graduate
Black	Women	<b>Ages 25 to 44</b>	High school graduate
Hispanic		Age 45 and older	<b>College graduate</b>
All other races			

UNEMPLOYMENT RATE,  
12 MONTH AVG. ENDING SEPT. '09

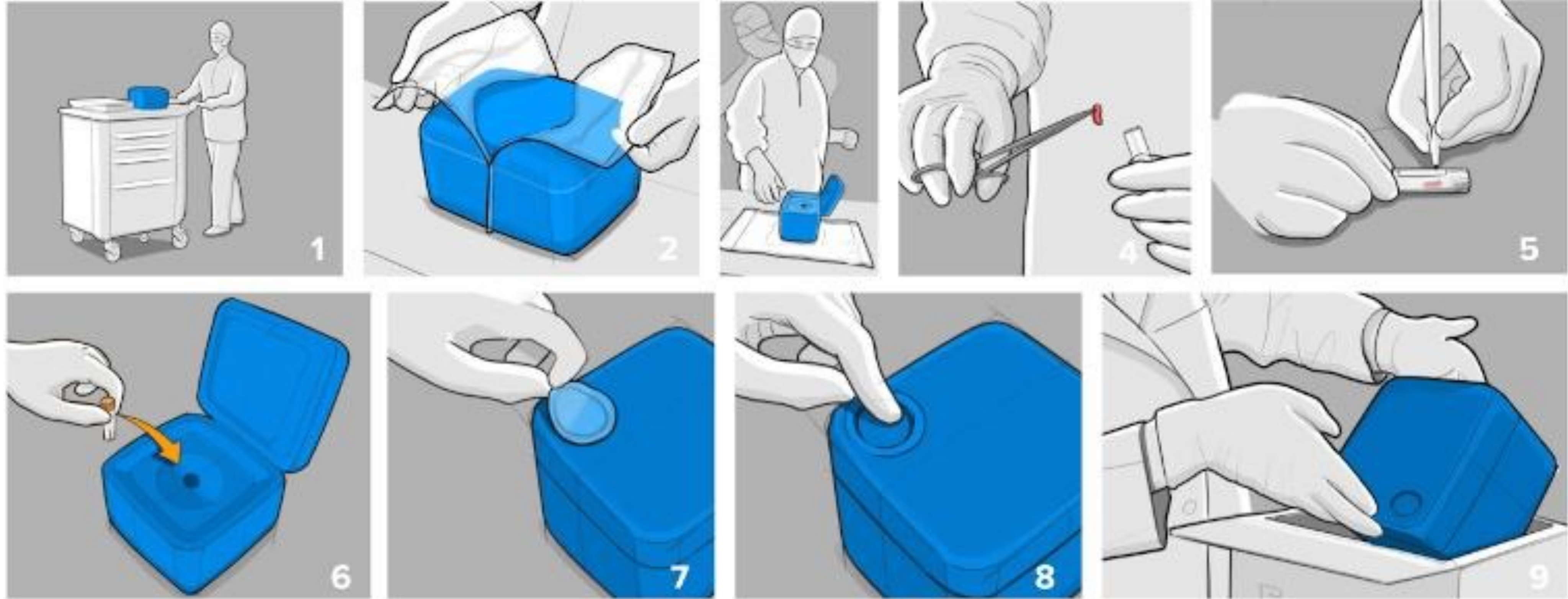
### 3.9%

For white men ages 25 to 44 with a college degree

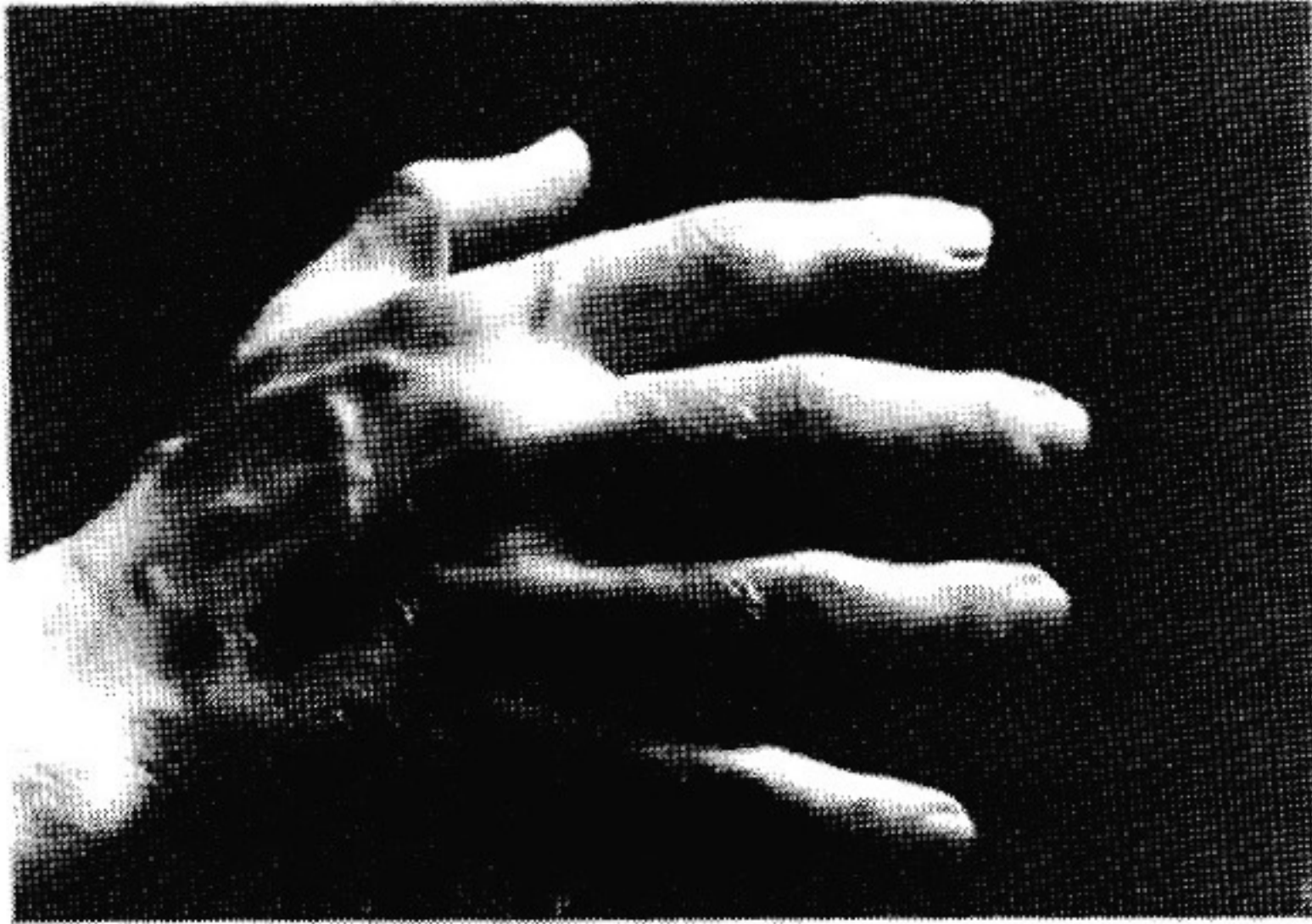


Note: 12-month rates are shown because monthly estimates for small groups are not reliable.

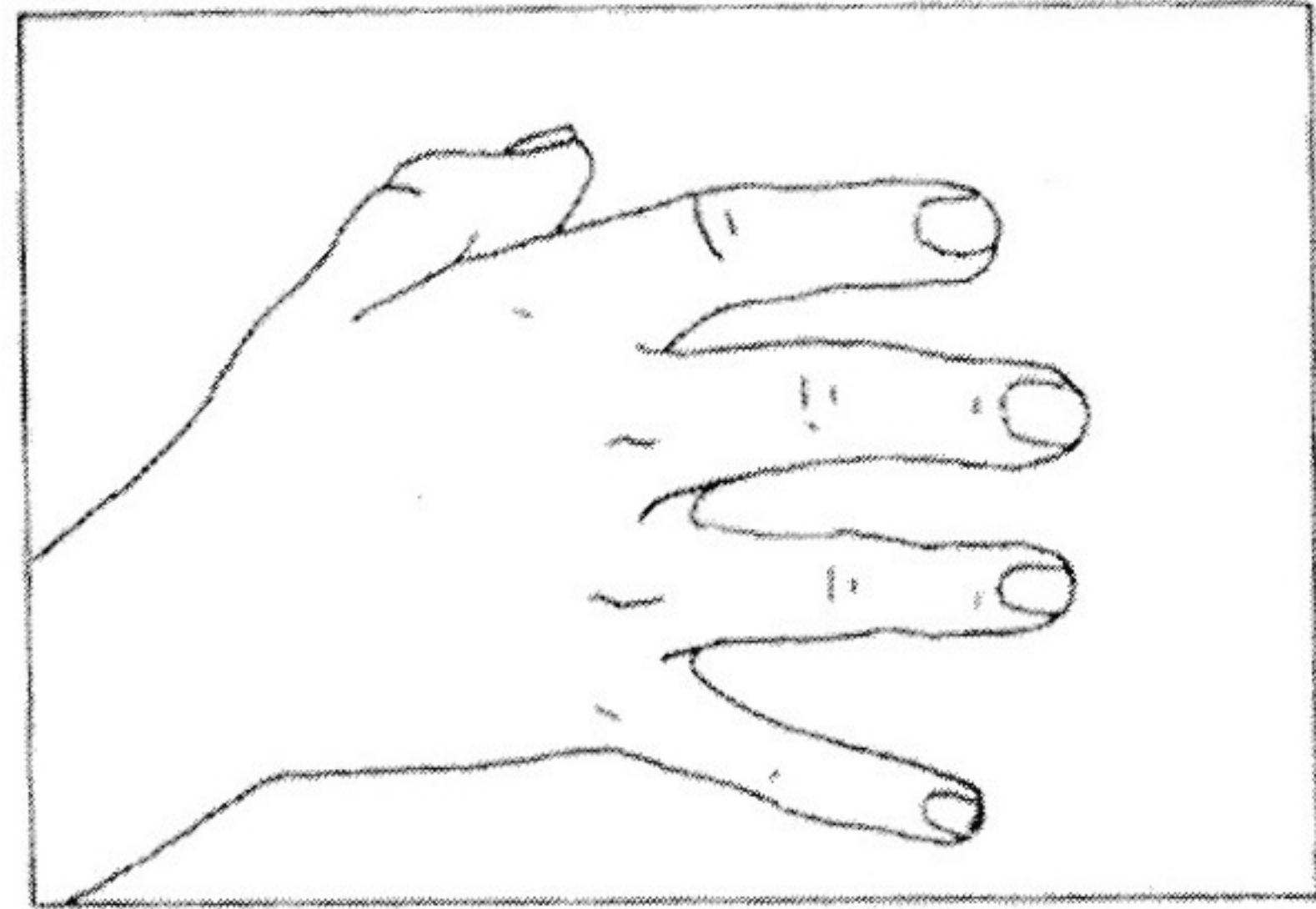
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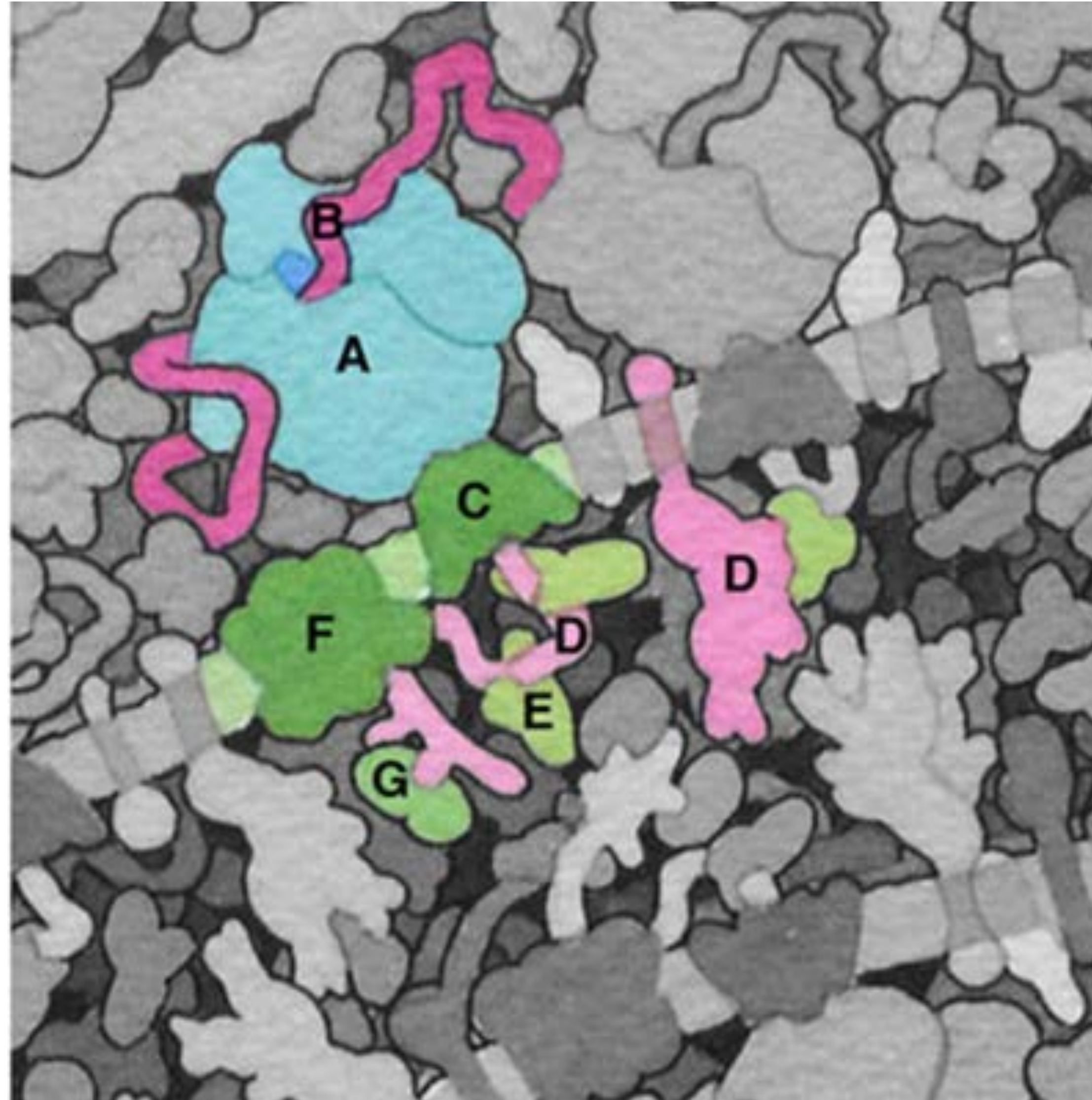
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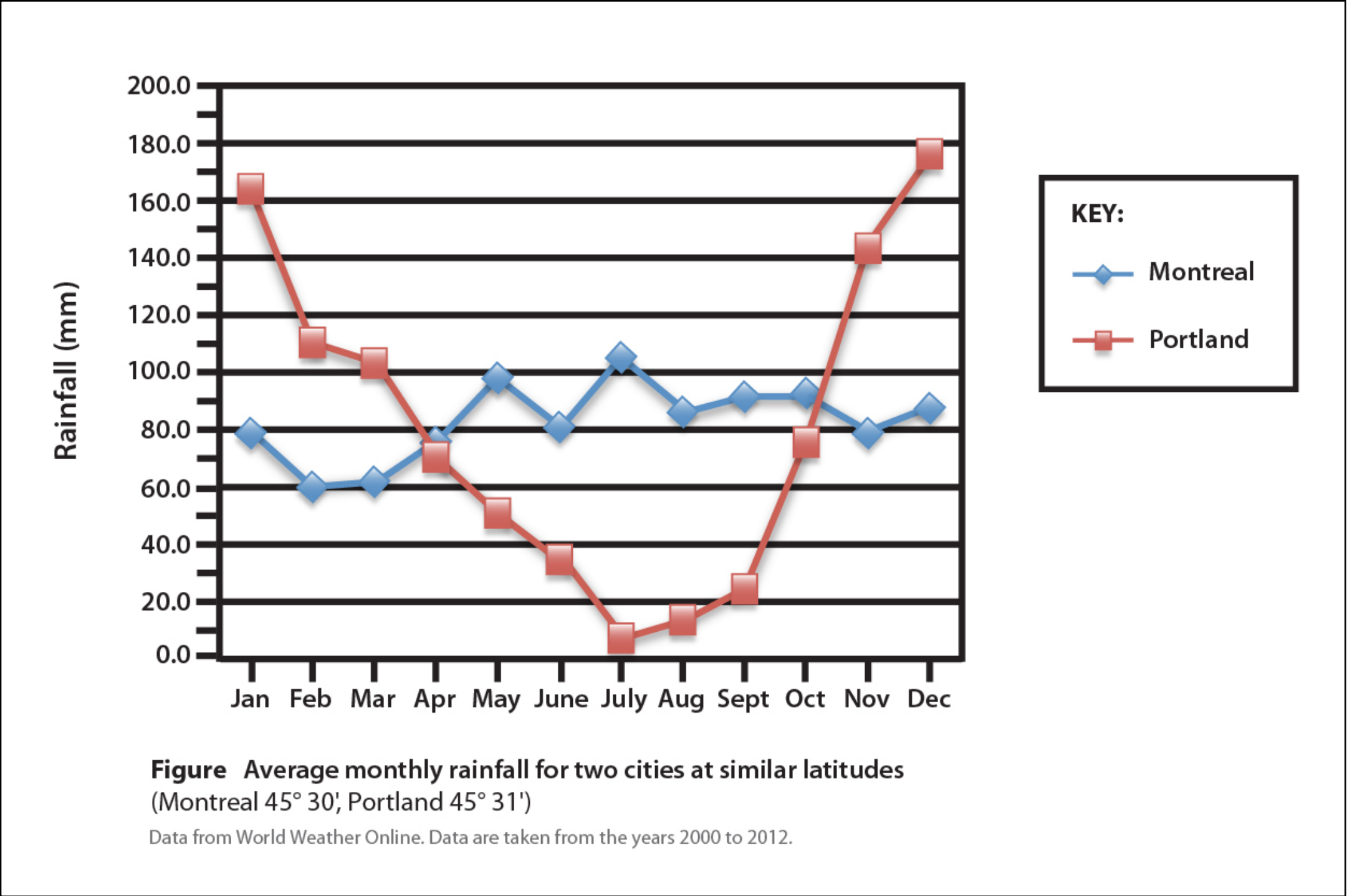
© Colin Ware



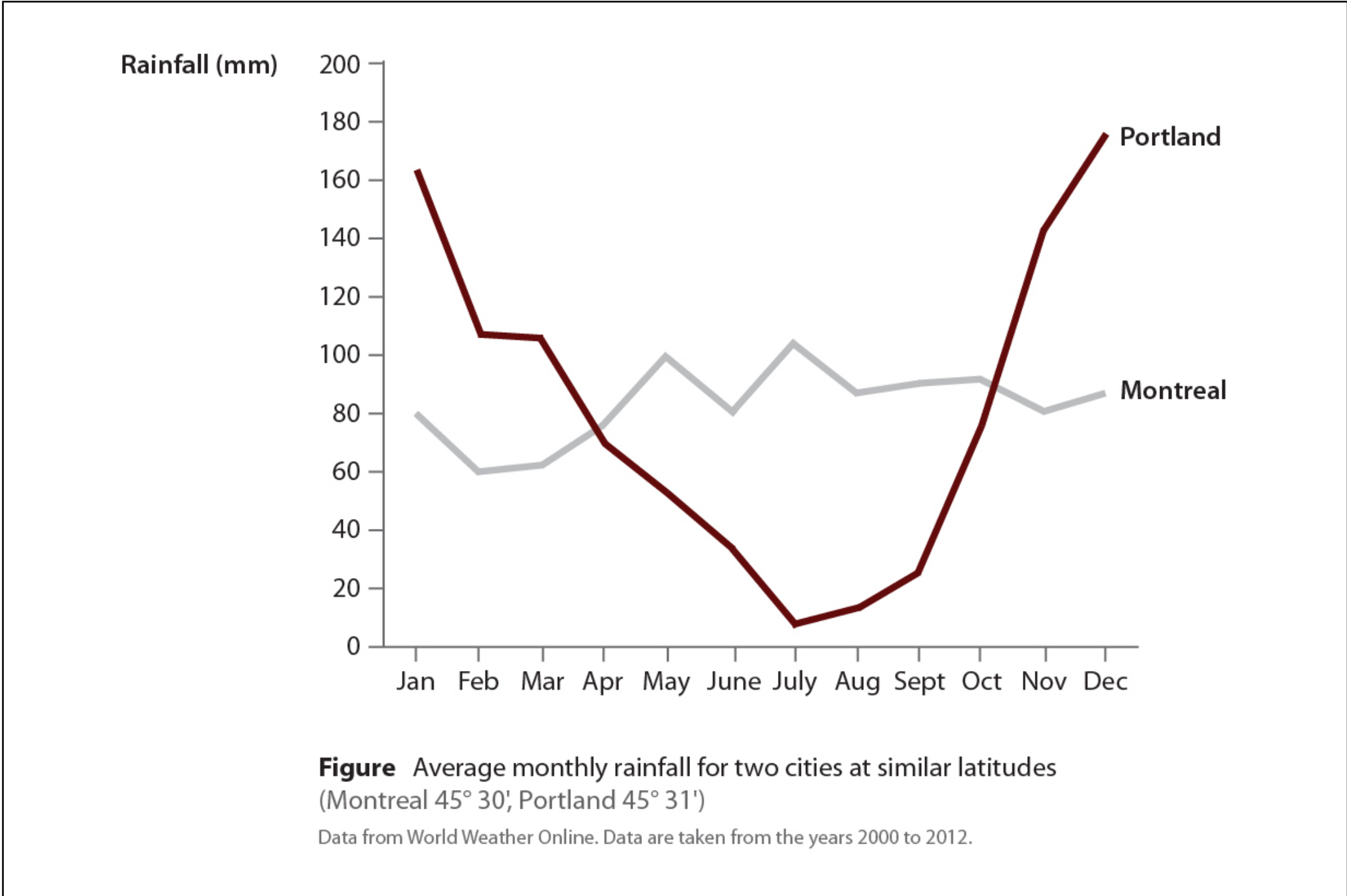
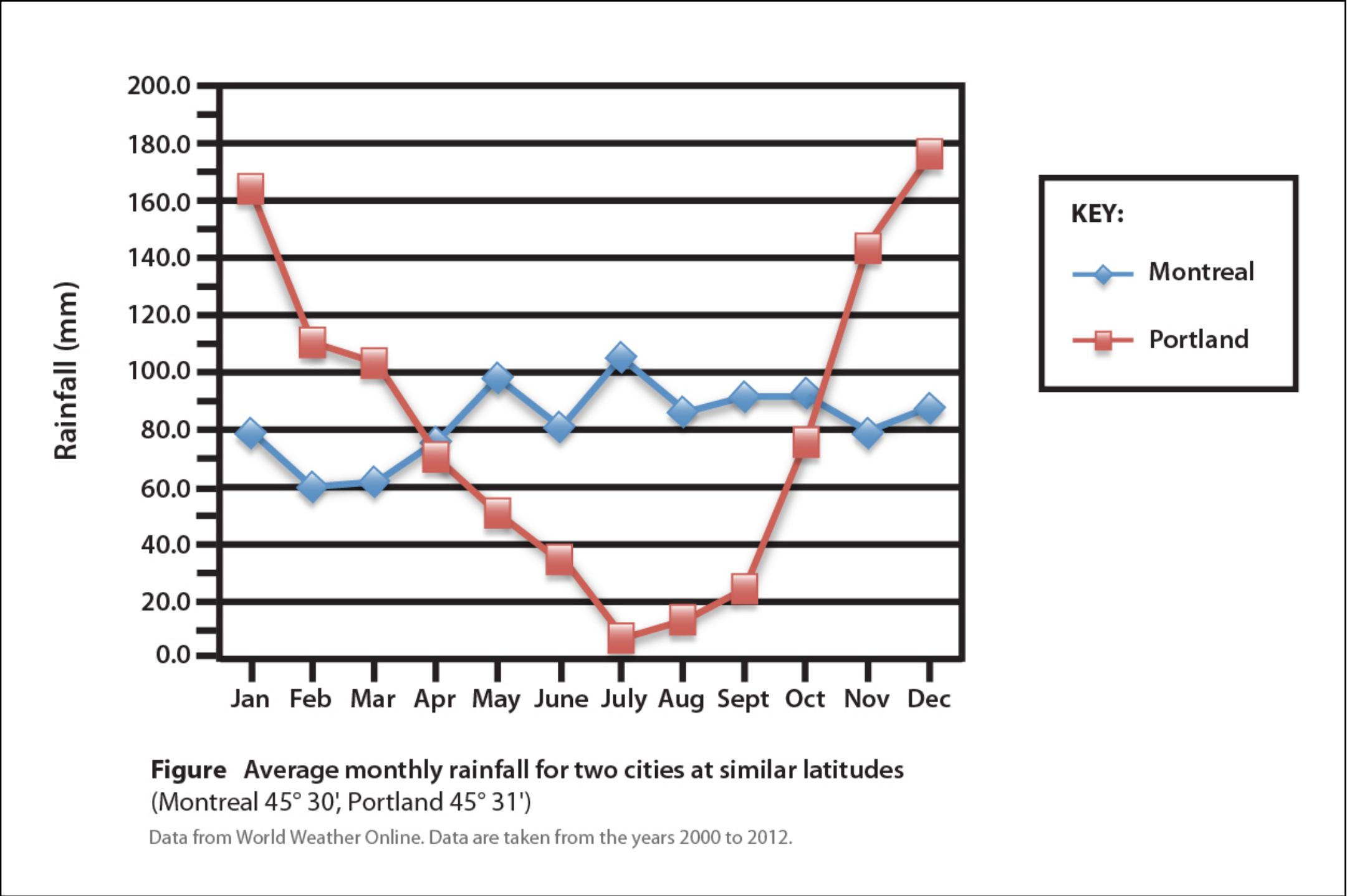
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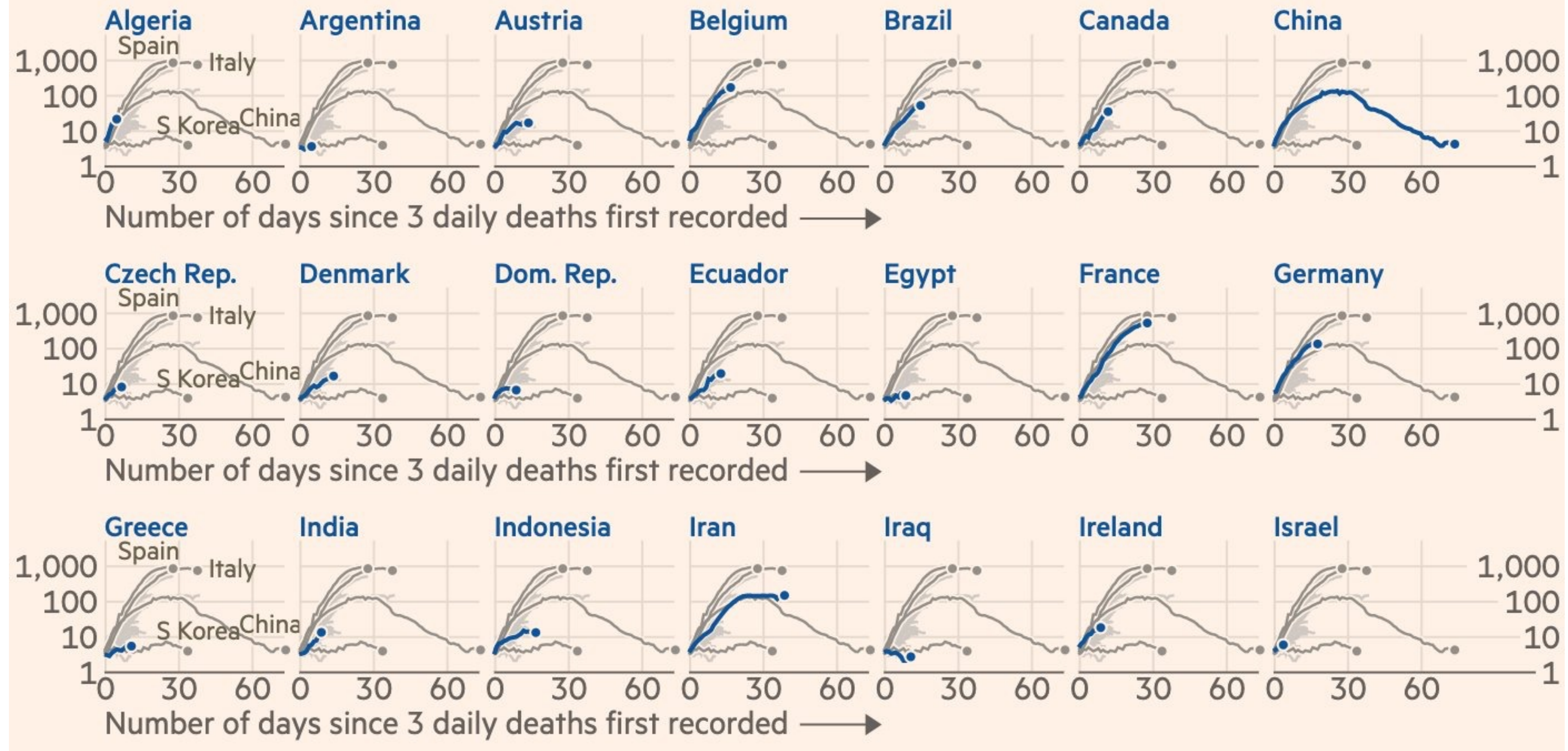


Mary Beth Hasselquist

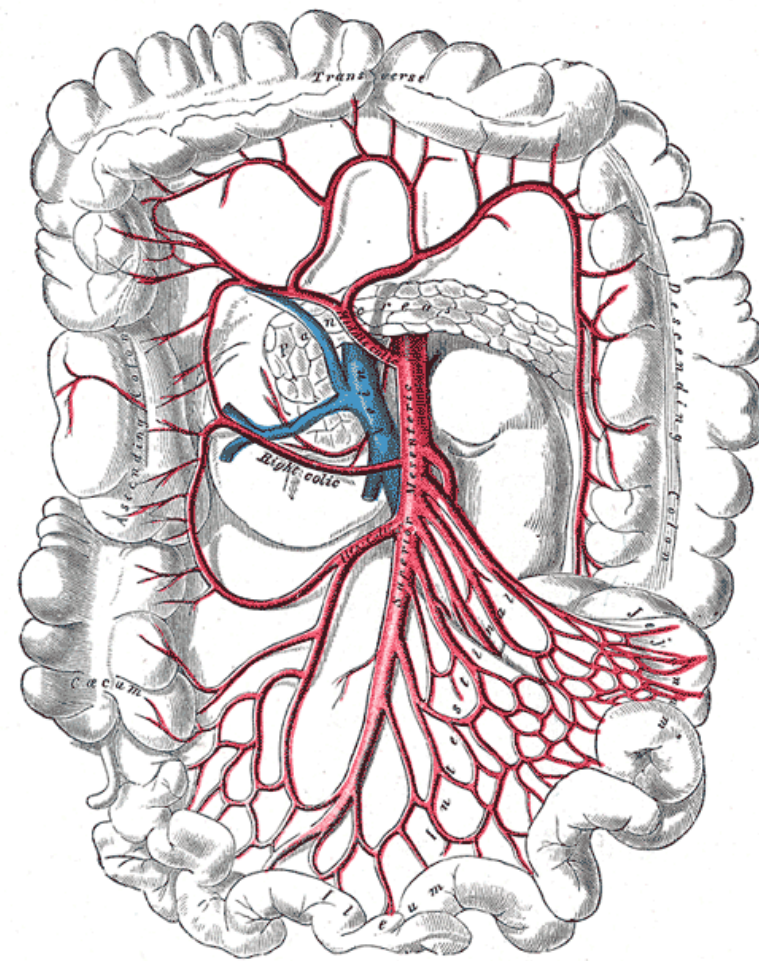
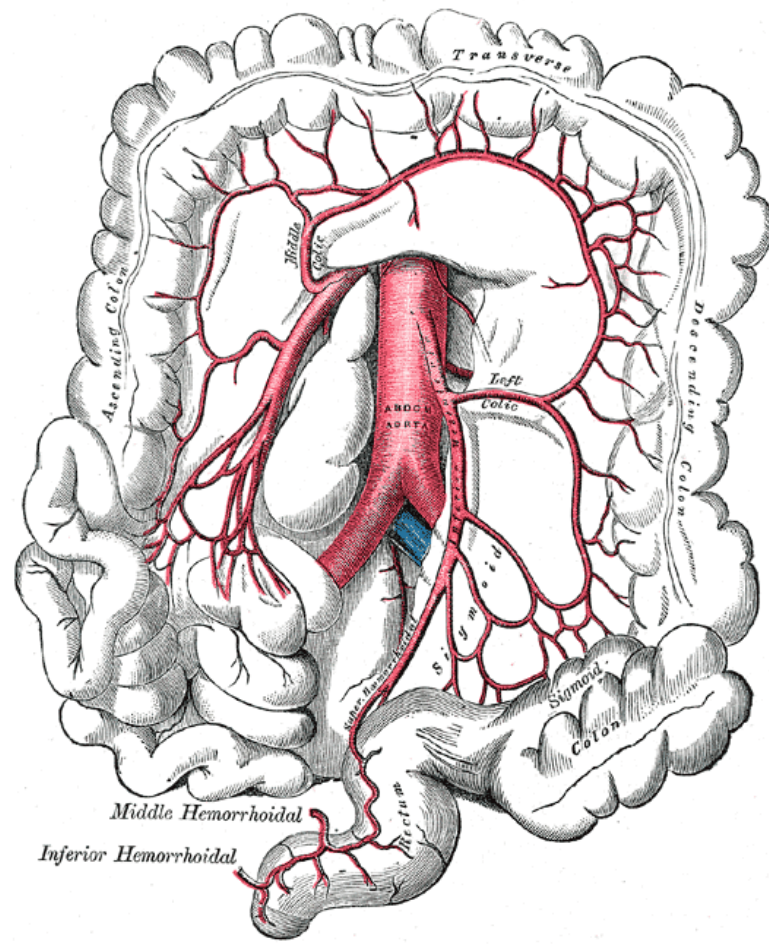
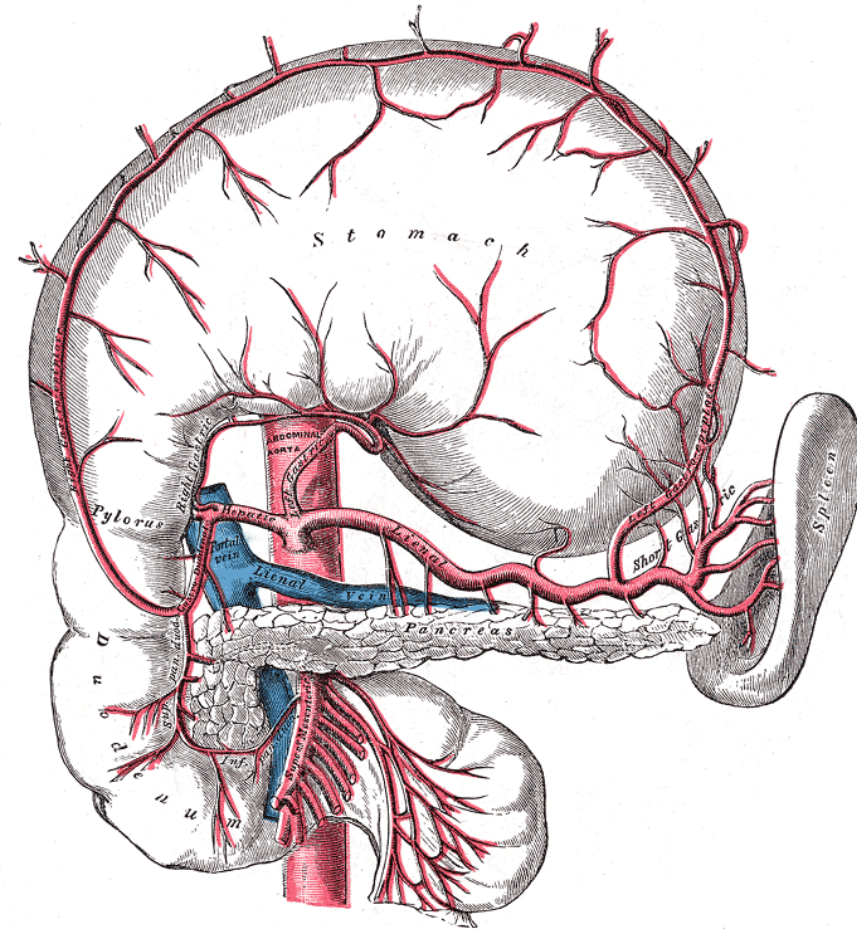
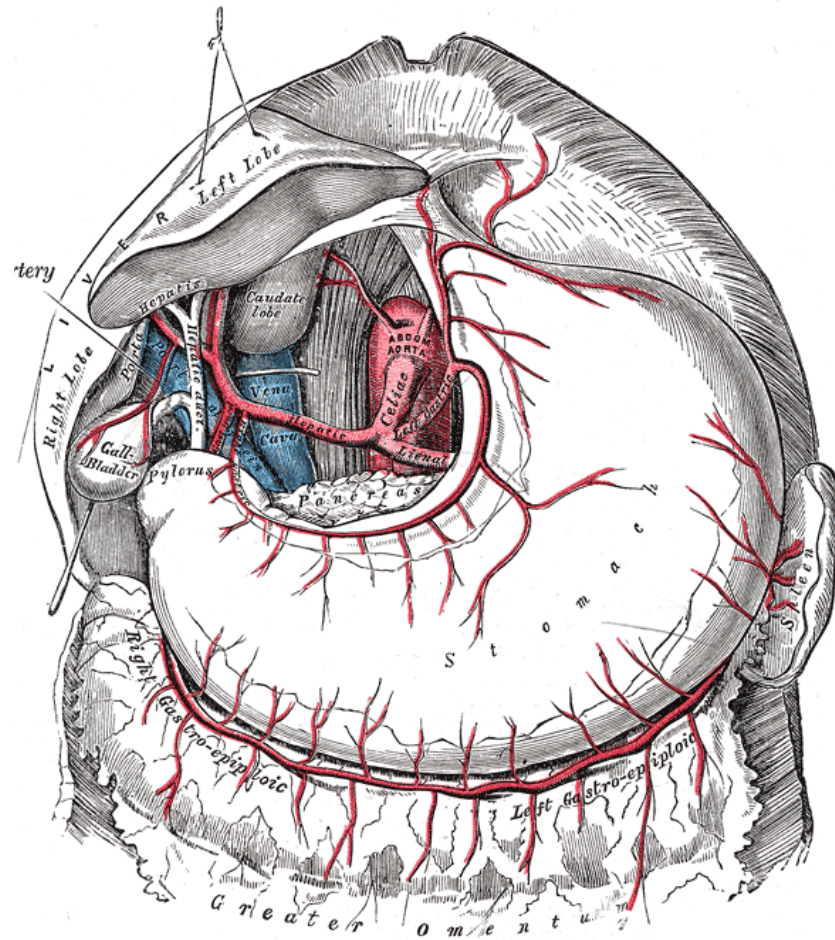
# Be Selective

## Daily death tolls are still accelerating in most countries

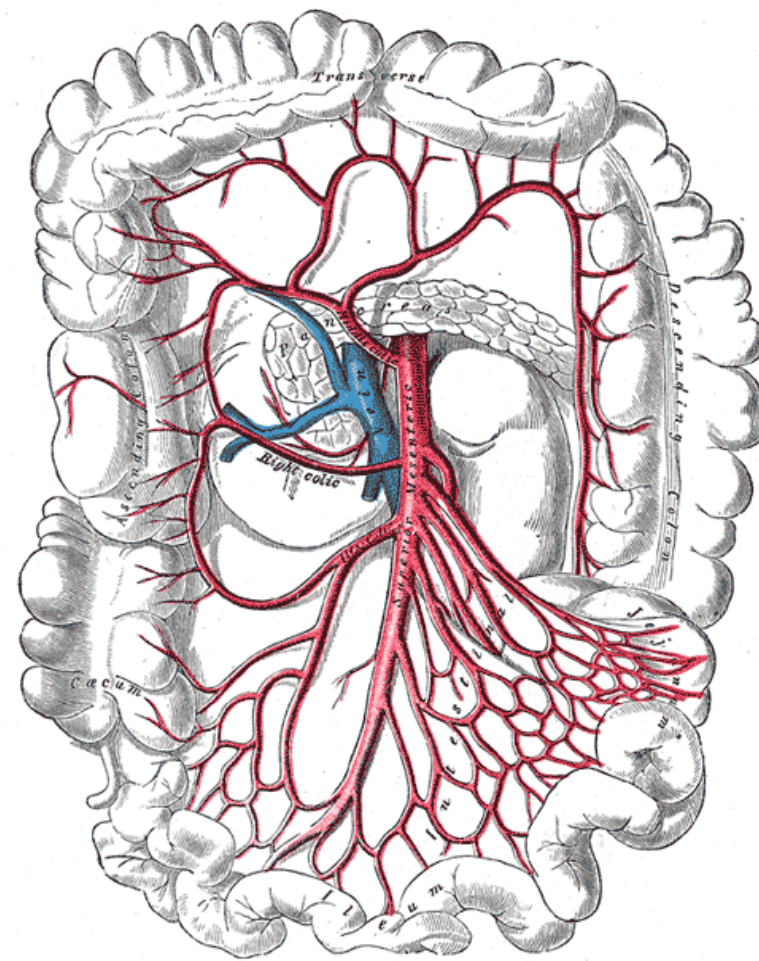
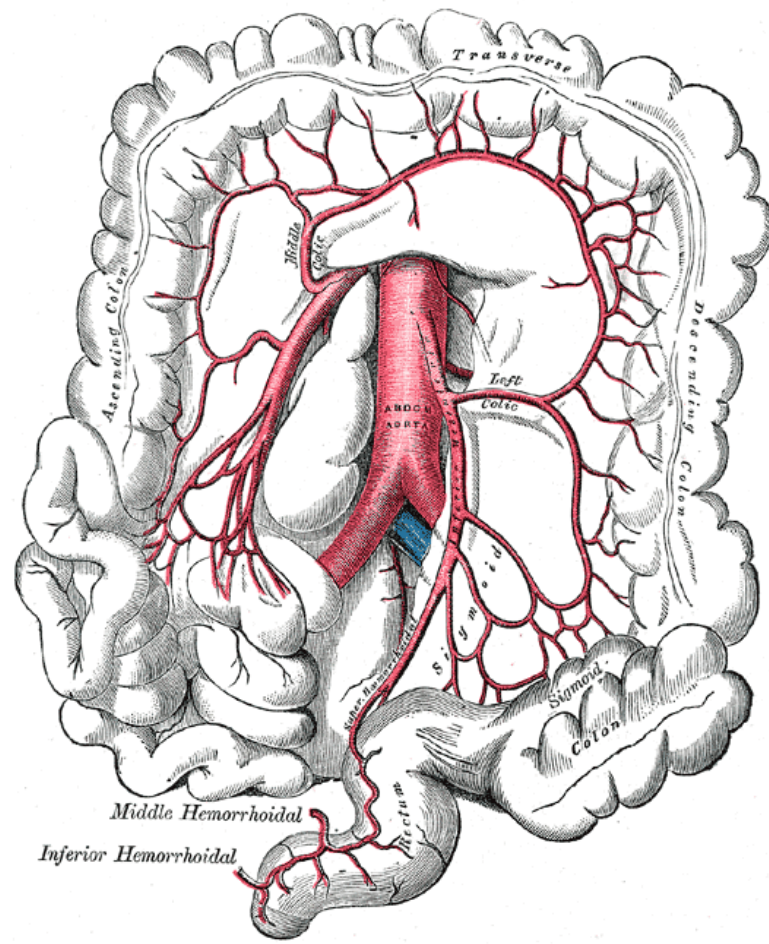
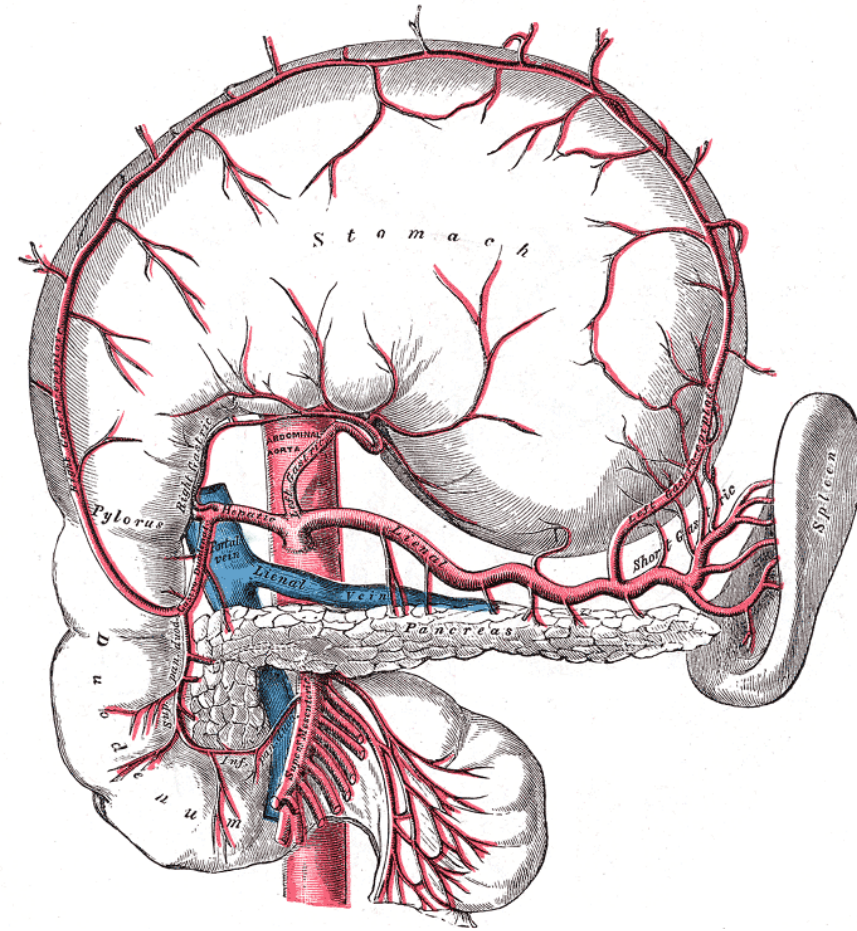
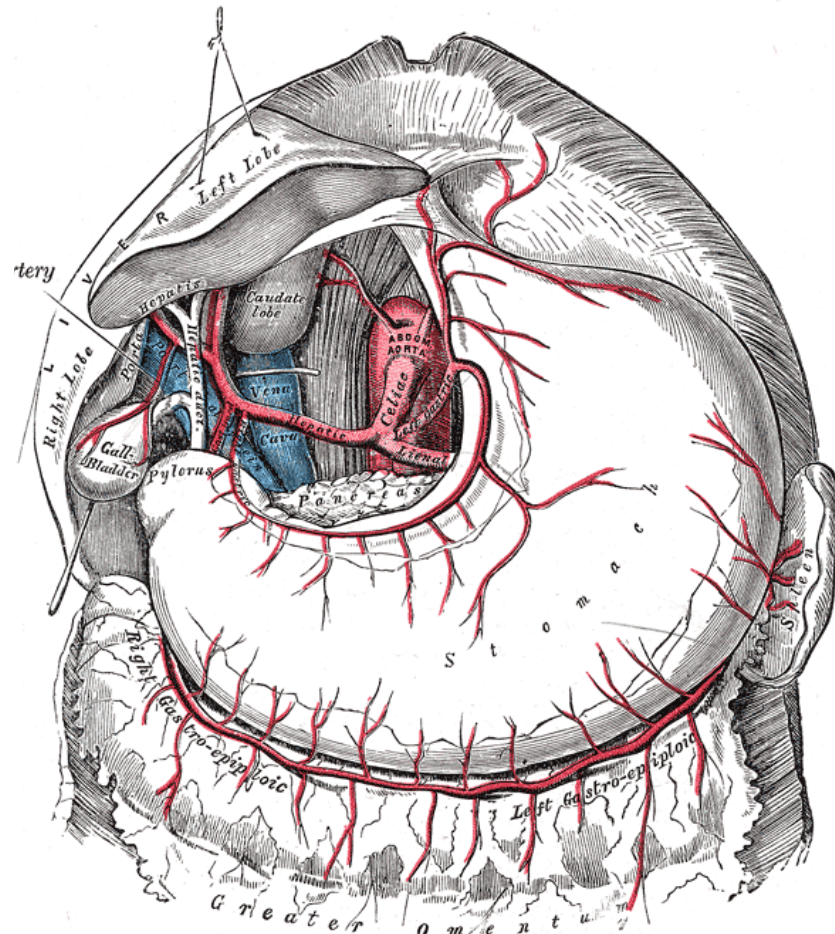
Daily coronavirus deaths (7-day rolling avg.), by number of days since 3 daily deaths first recorded



# Literal

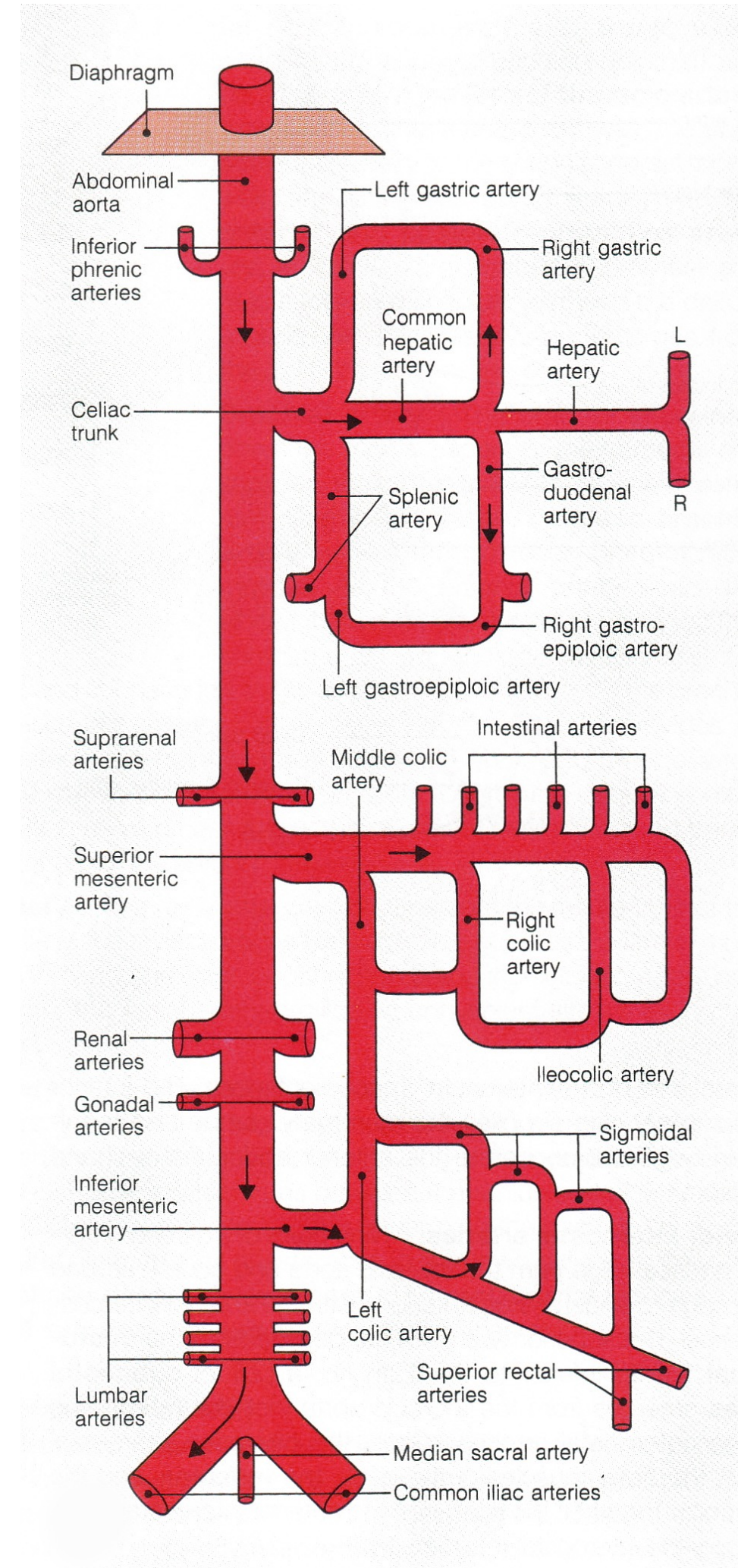


# Literal



Gray's Anatomy, Public domain

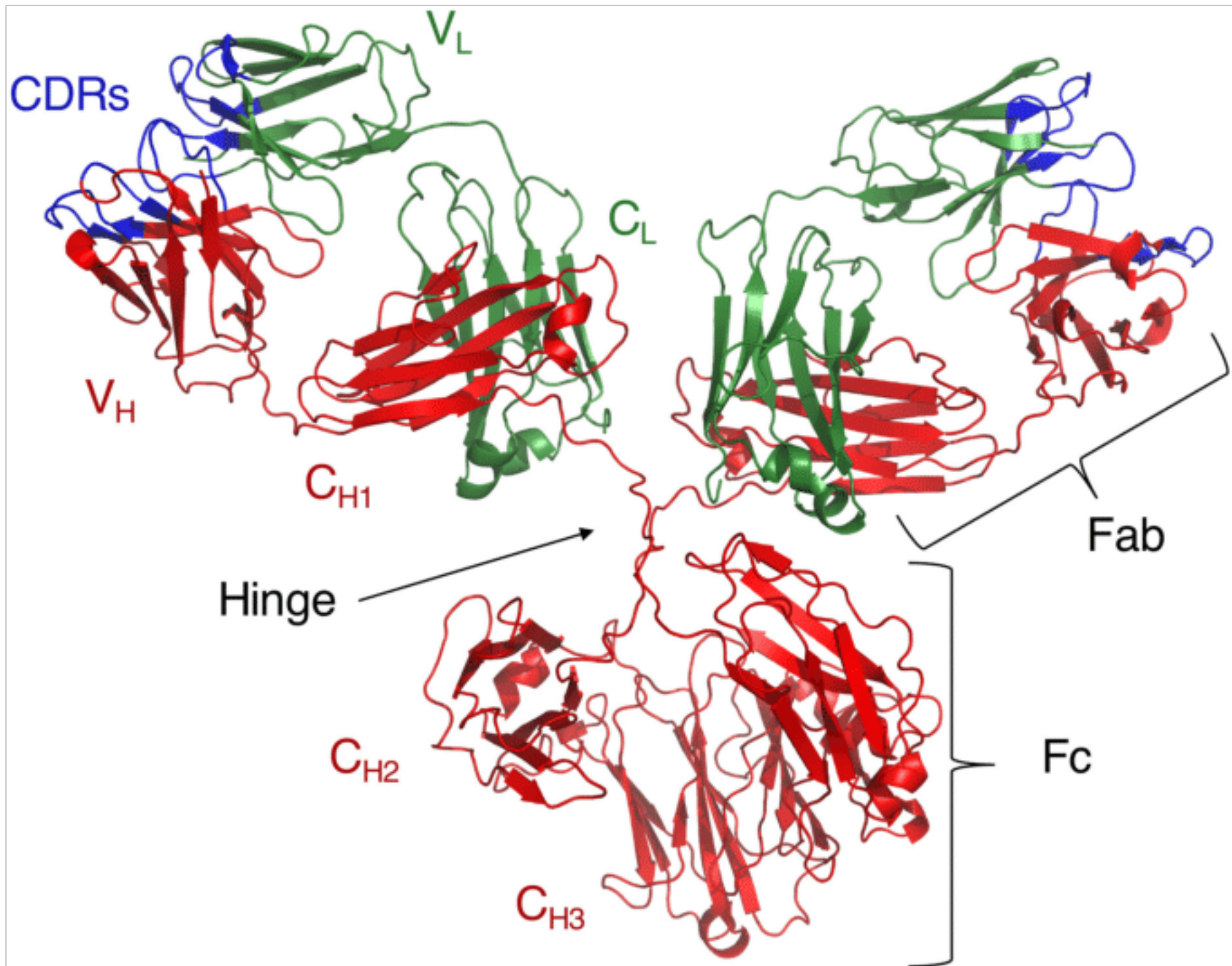
# Schematic



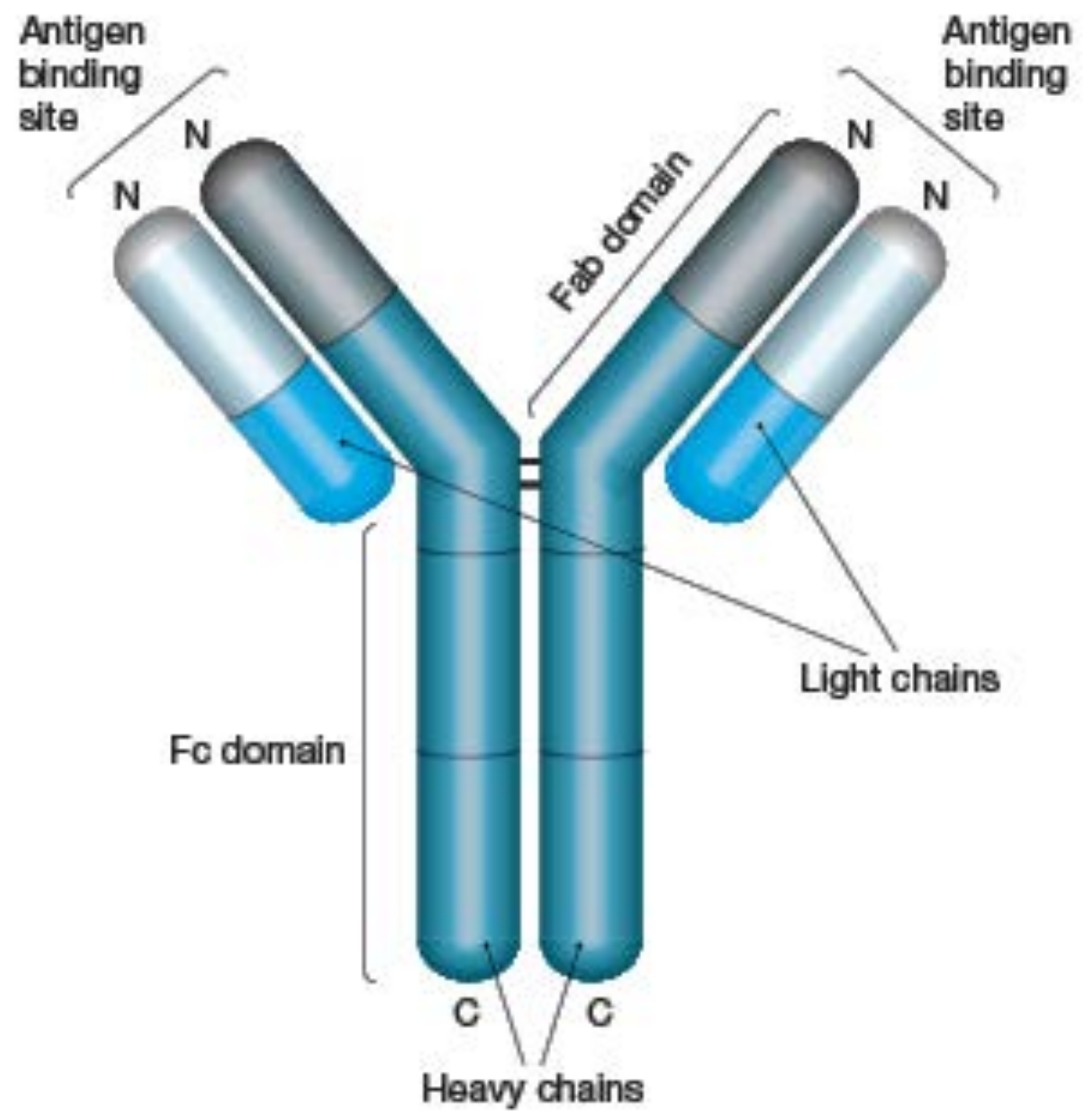
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When your content is very complex,  
**be schematic.**

# Be Schematic

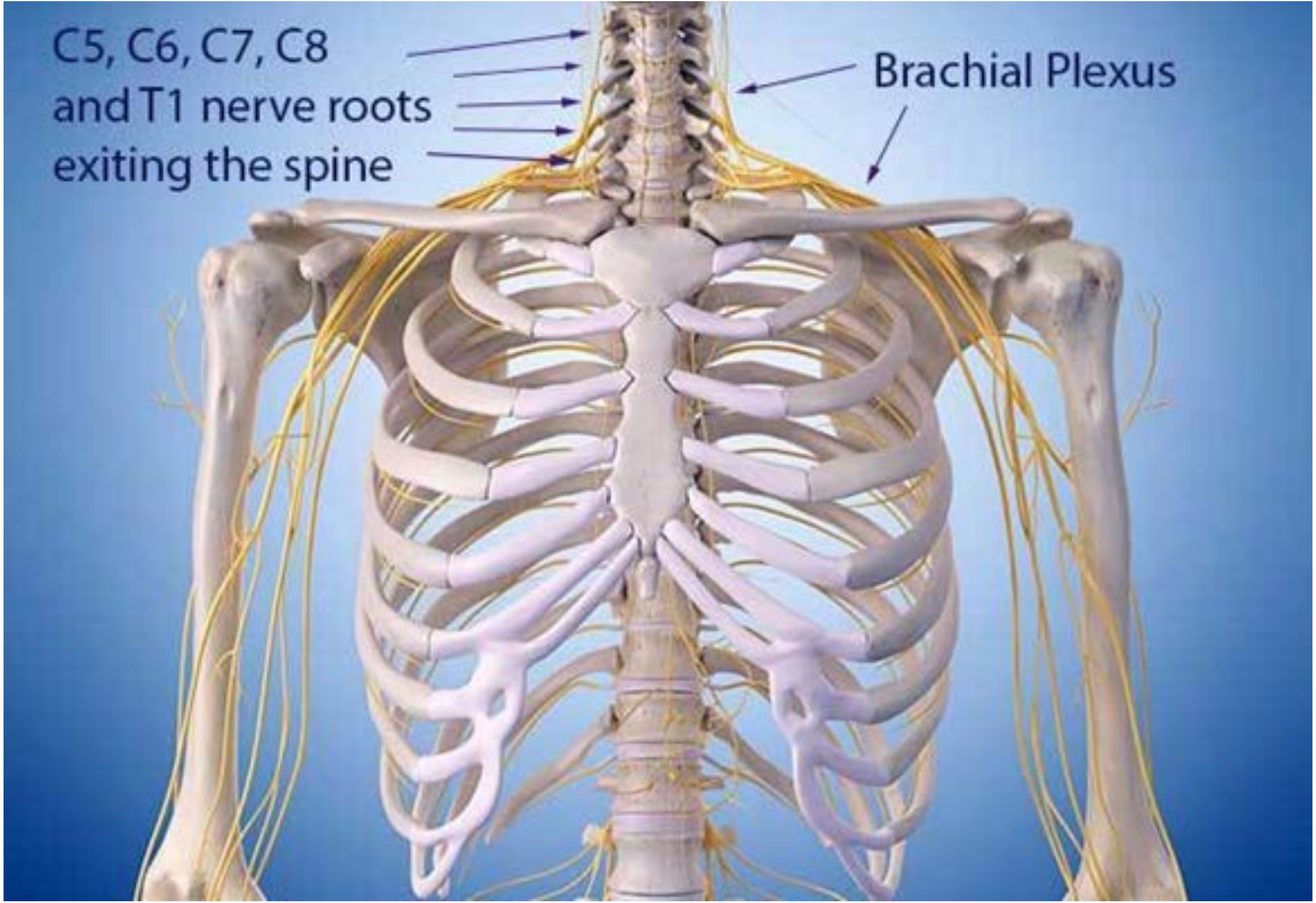


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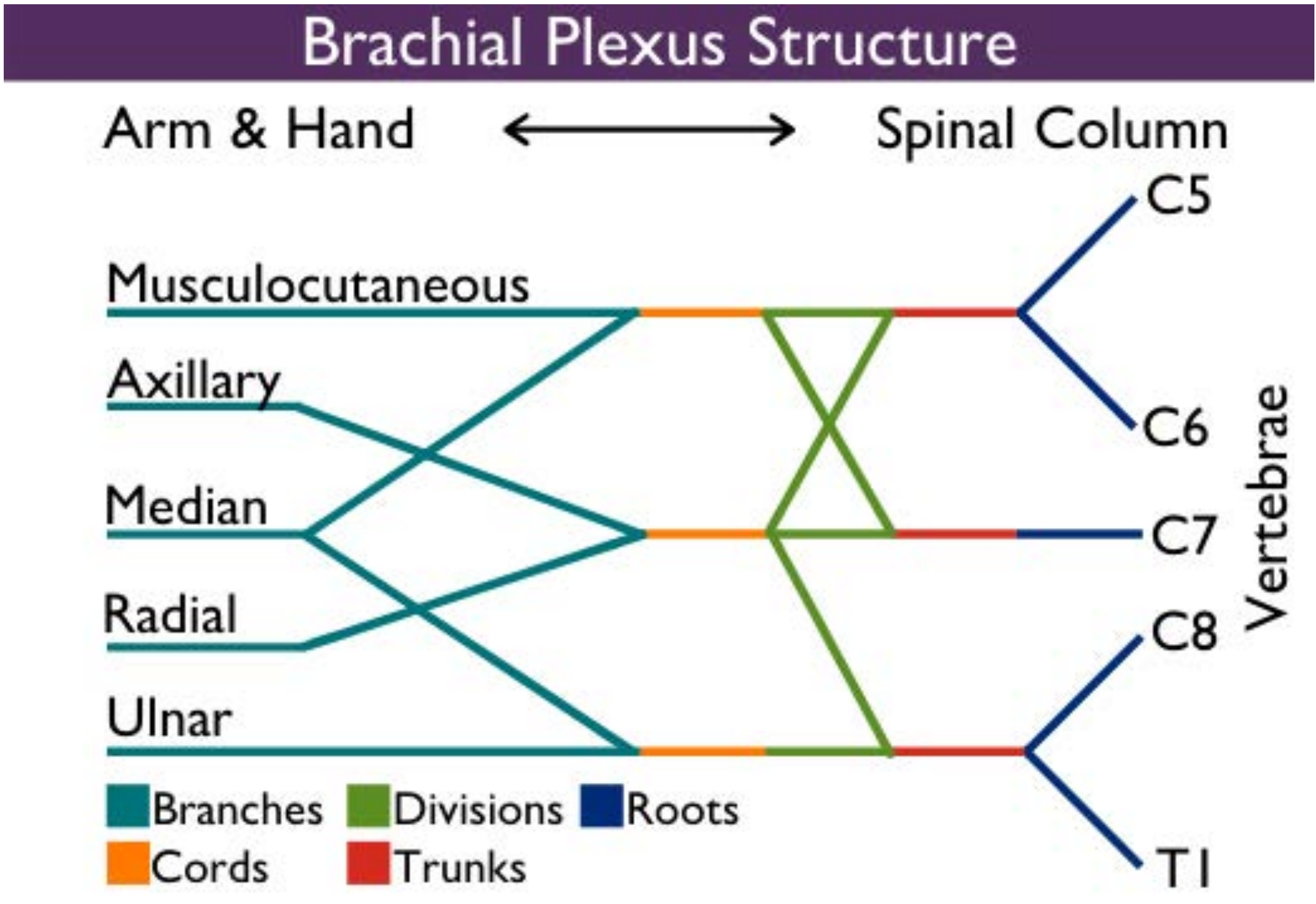


© BioRad

# Be Schematic

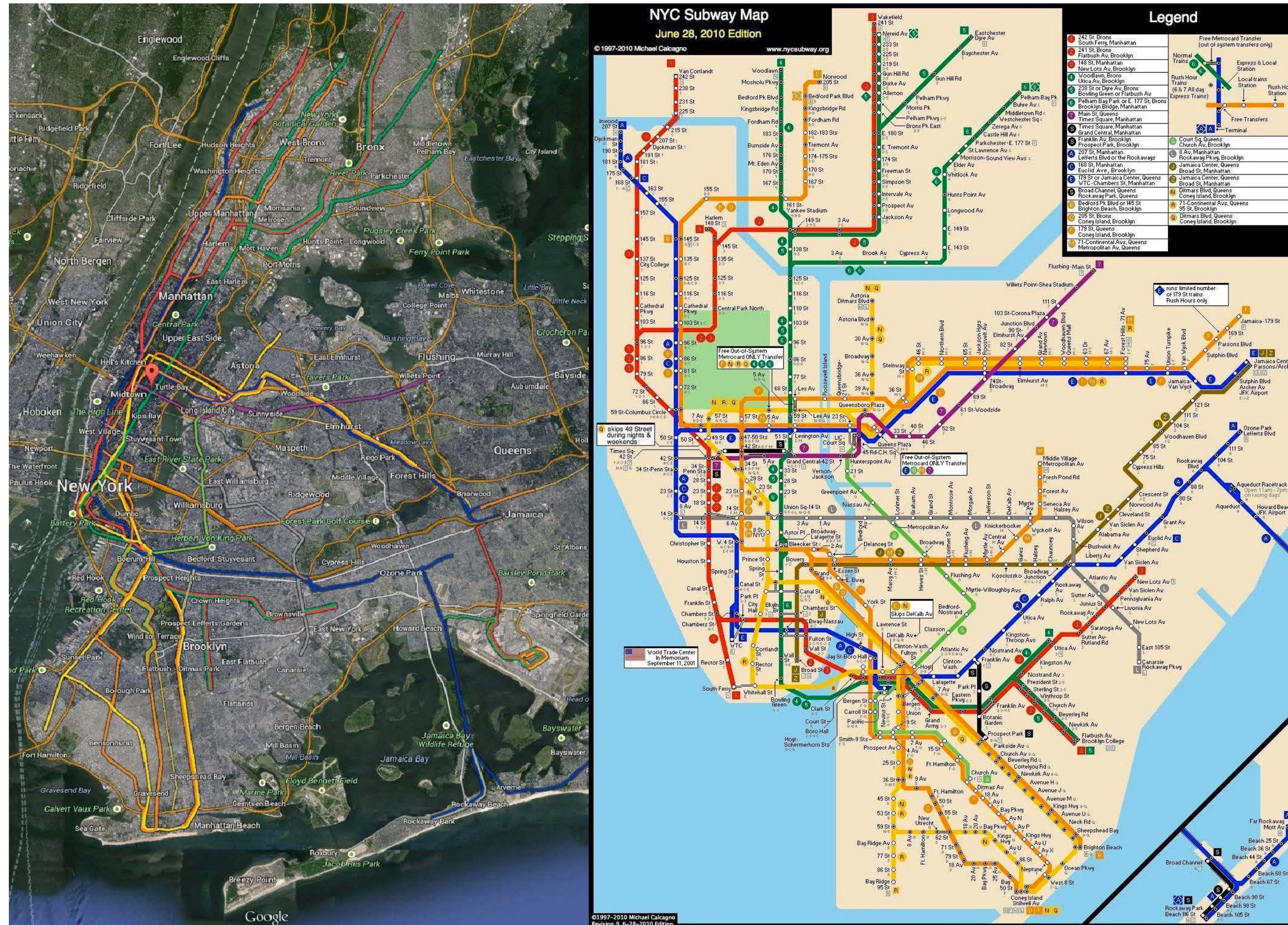


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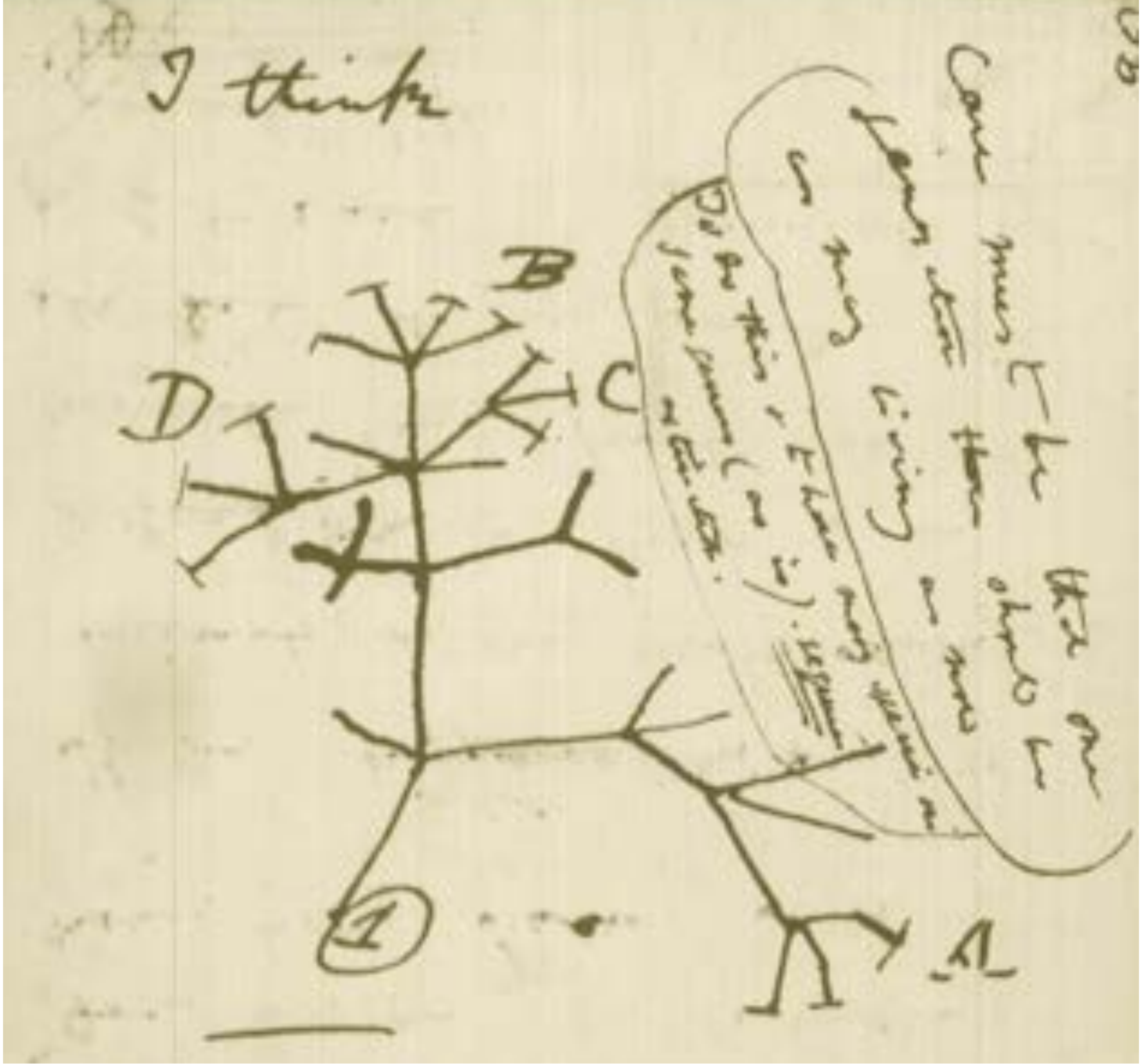
© The Johns Hopkins University

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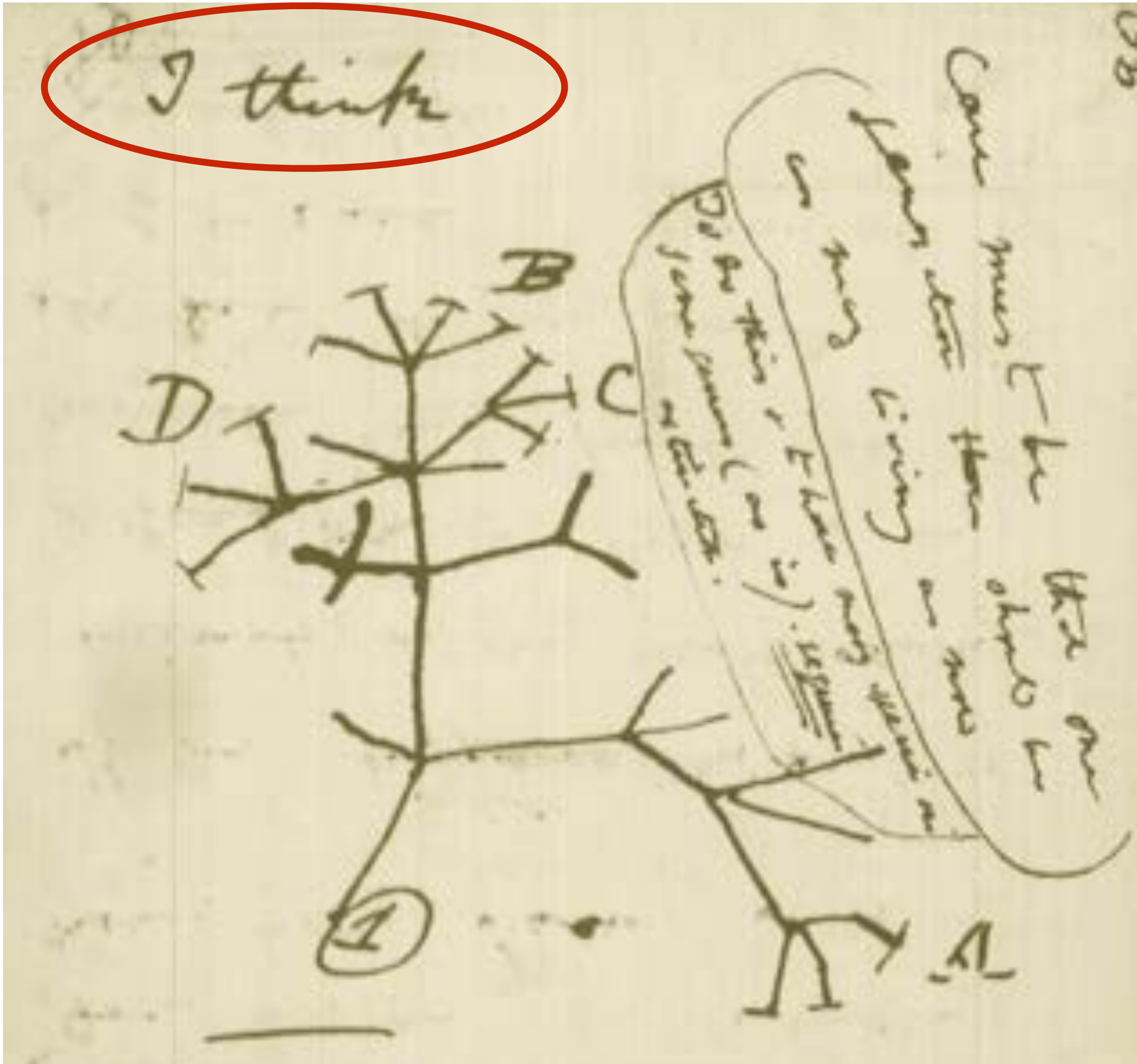
Source Unknown

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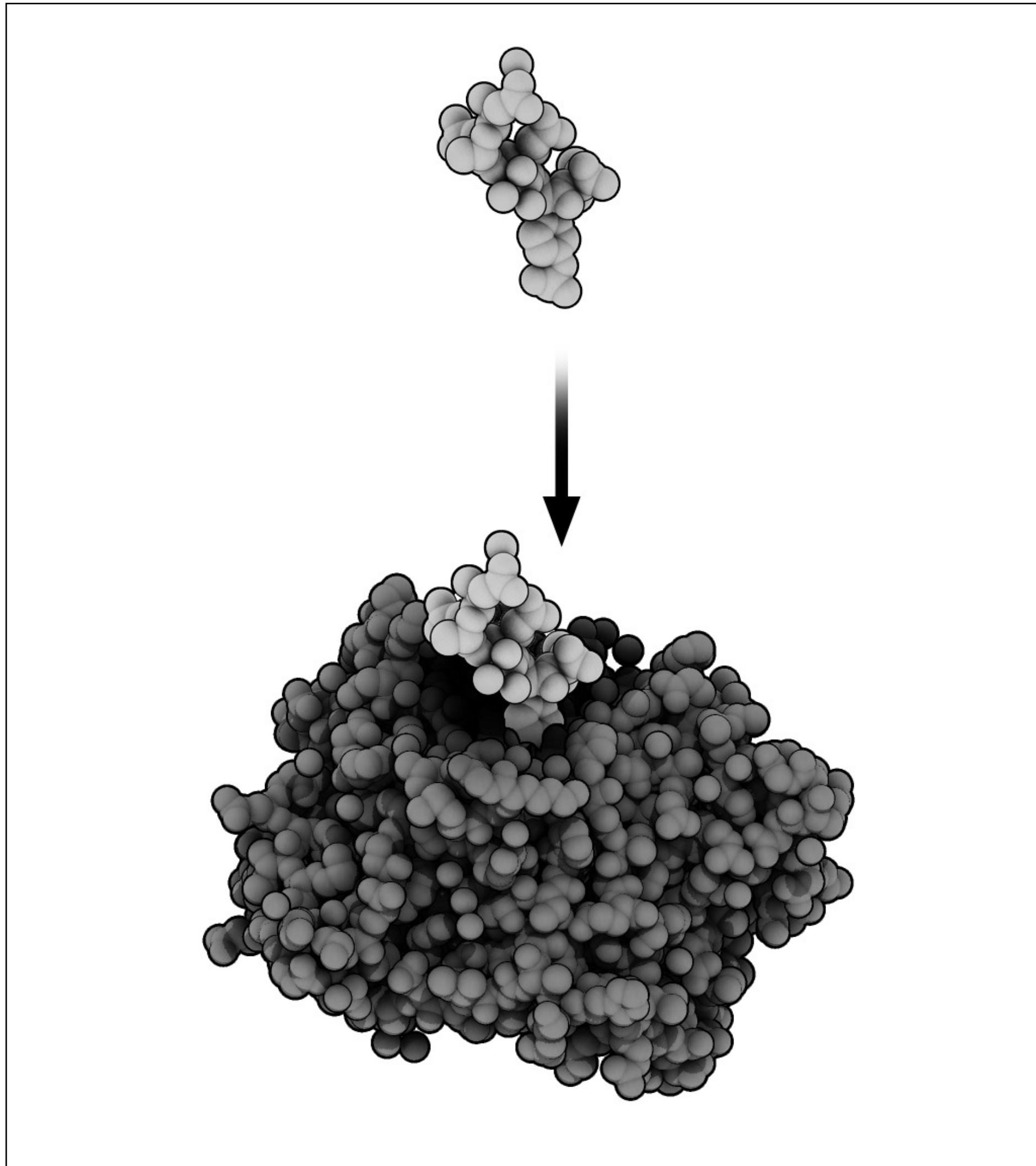
Charles Darwin, public domain

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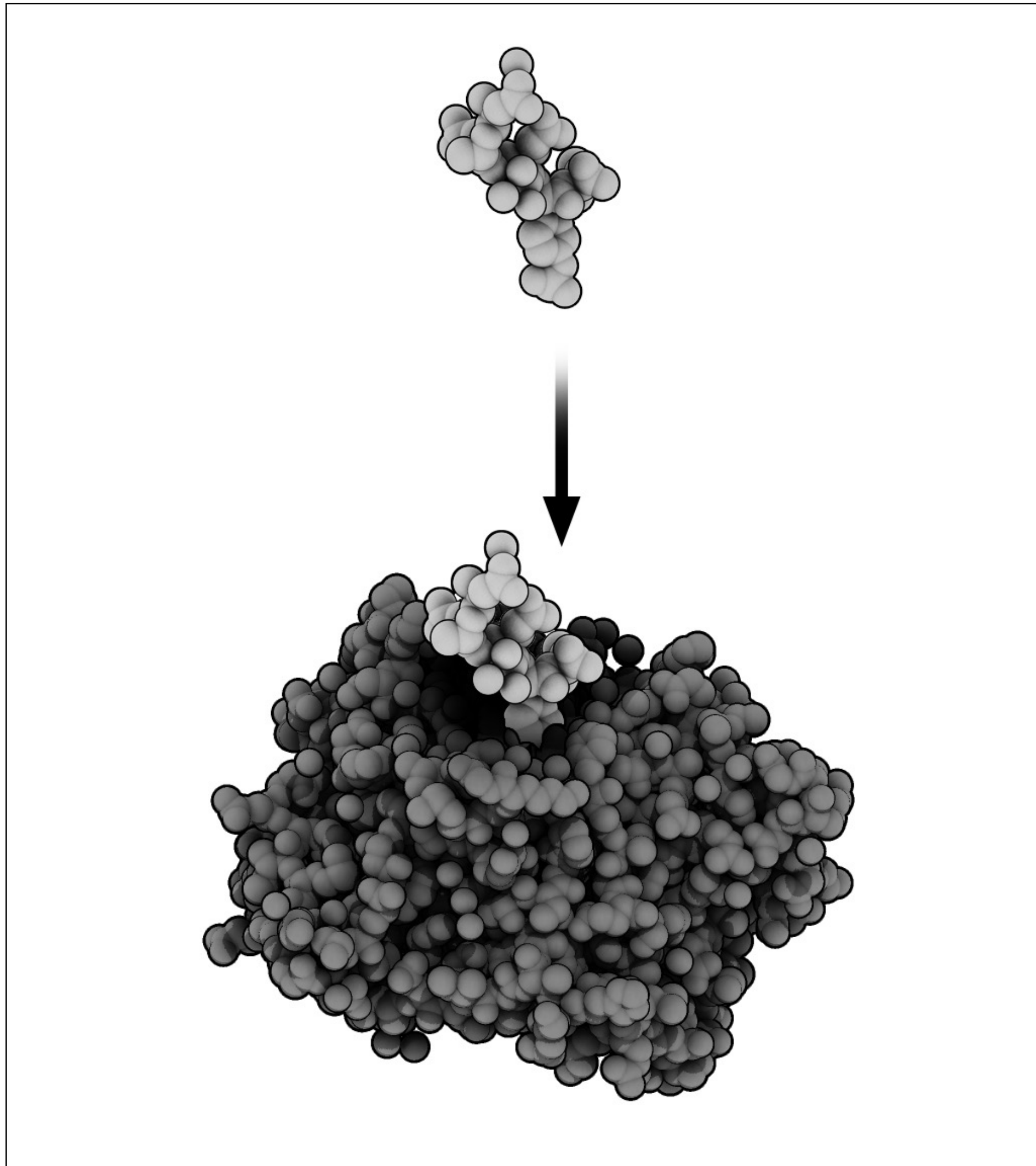


Charles Darwin, public domain

# Literal

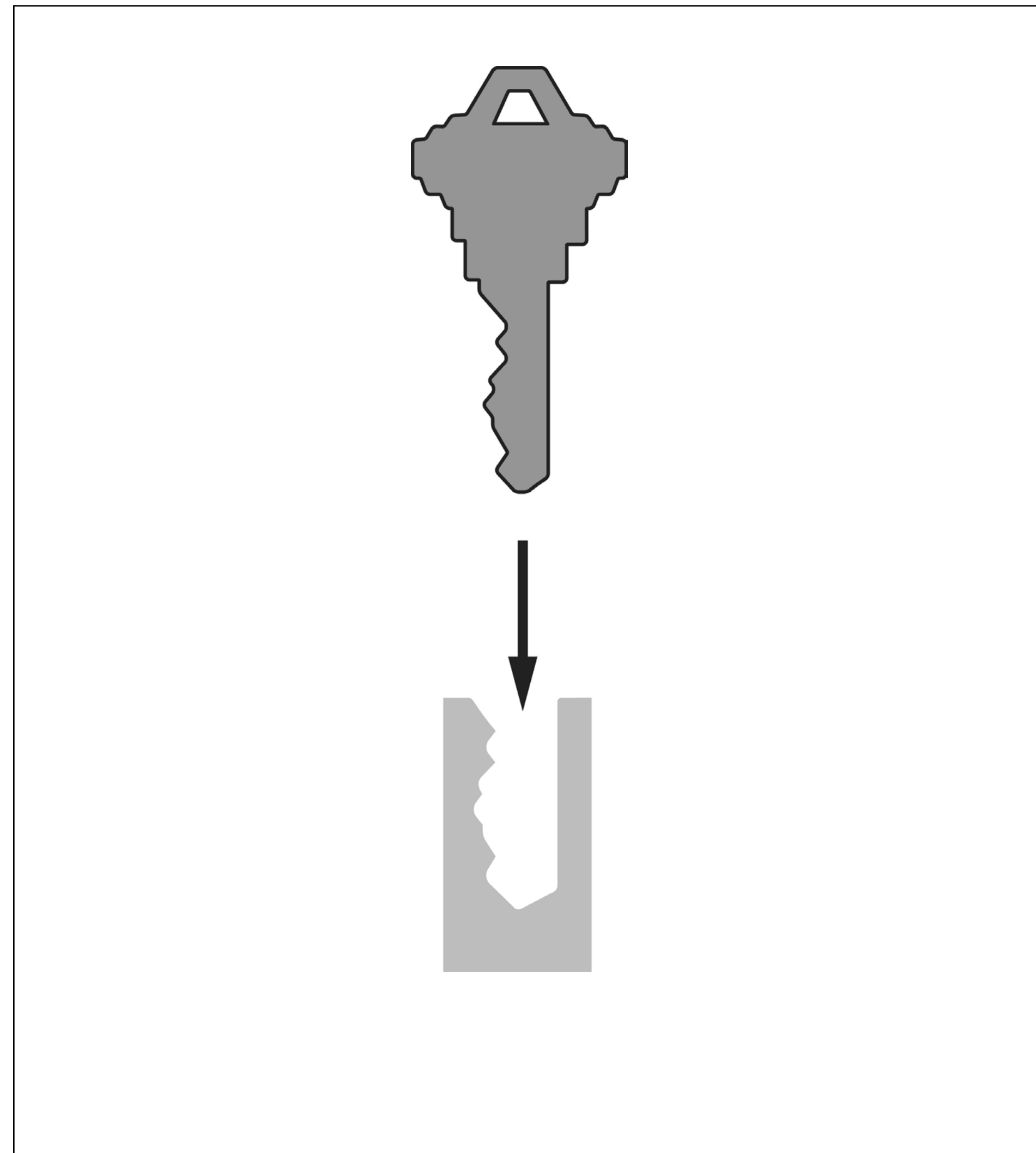


# Literal



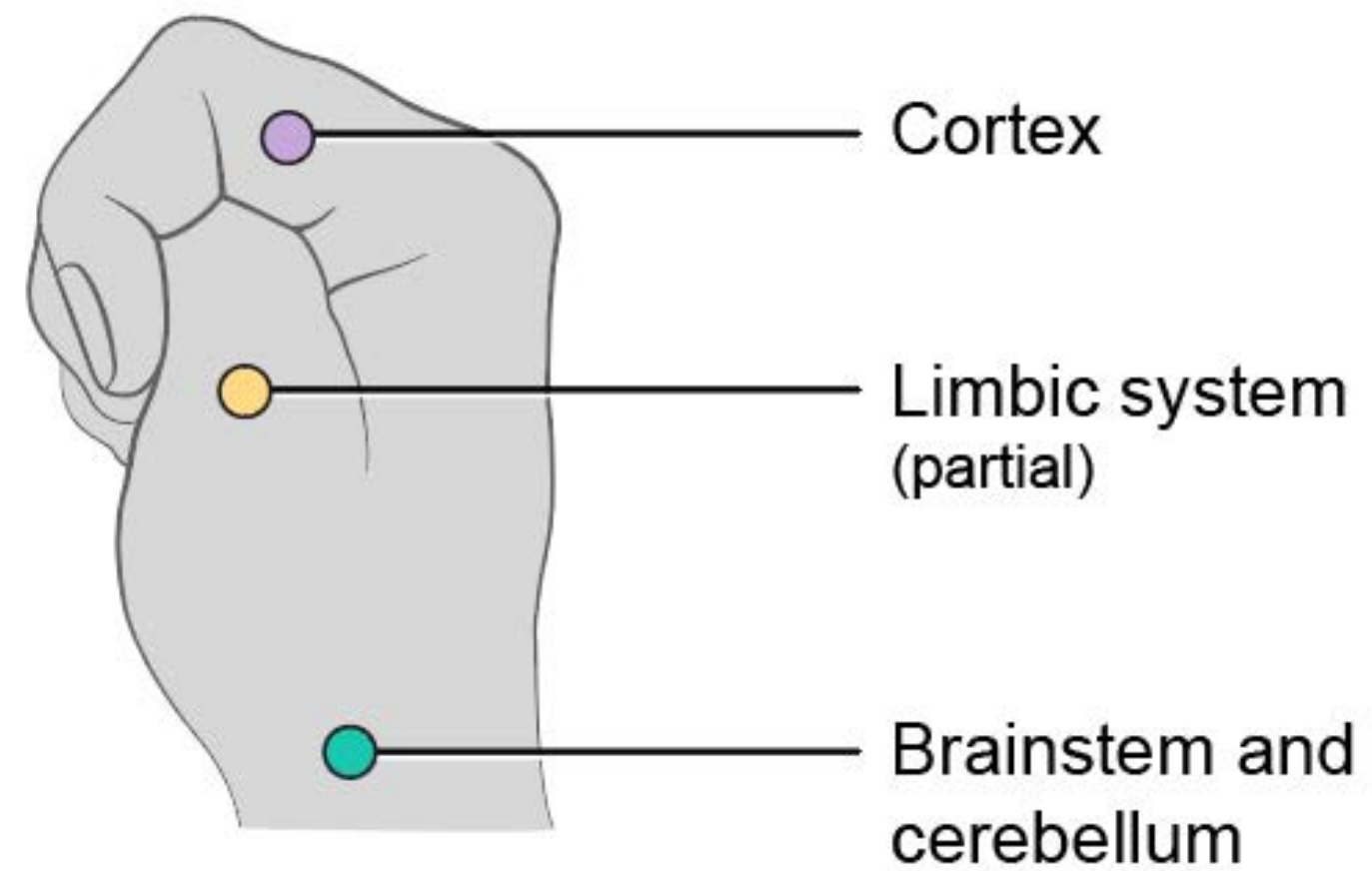
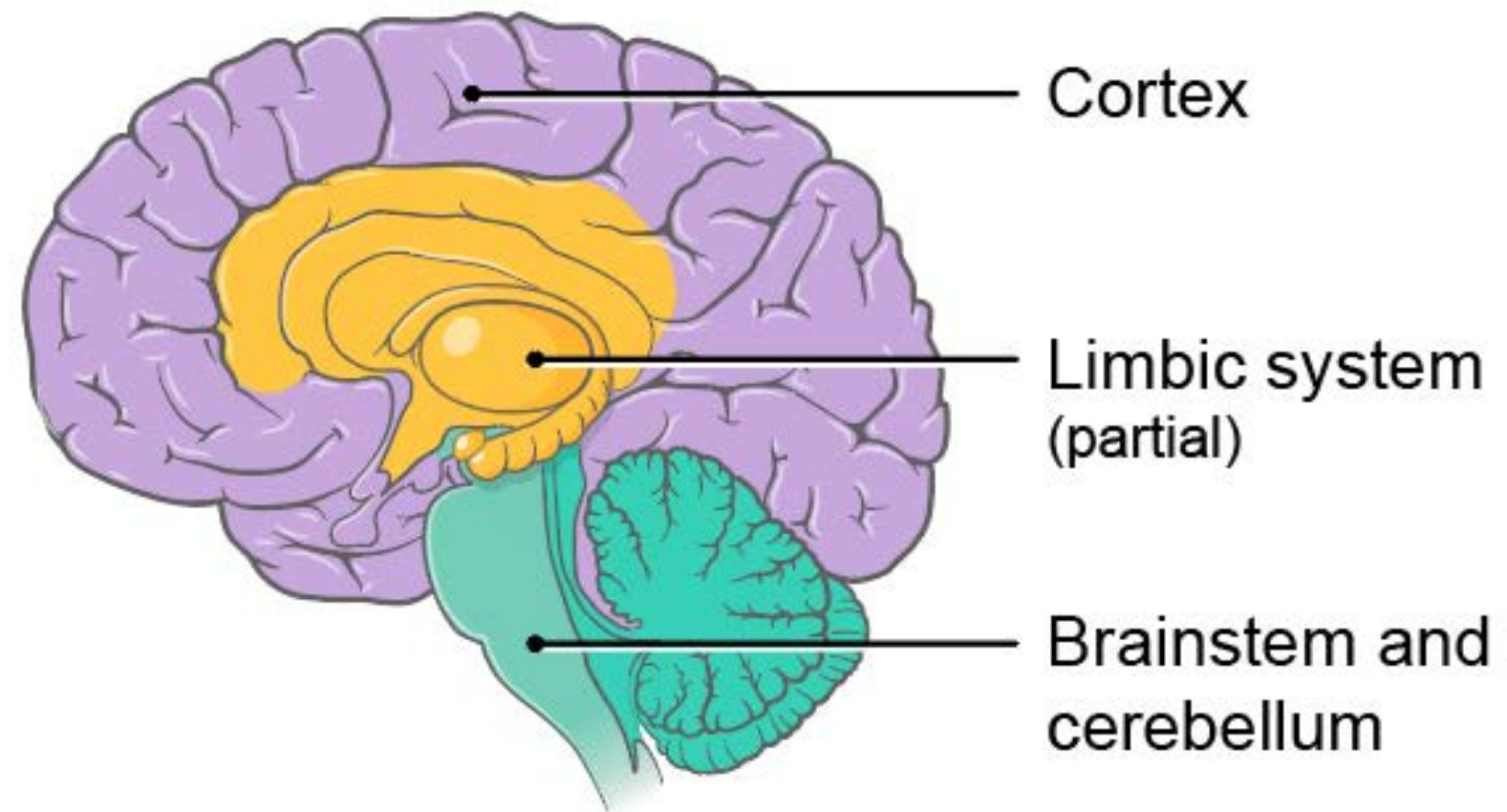
© Picture as Portal, LLC

# Symbolic



© Picture as Portal, LLC

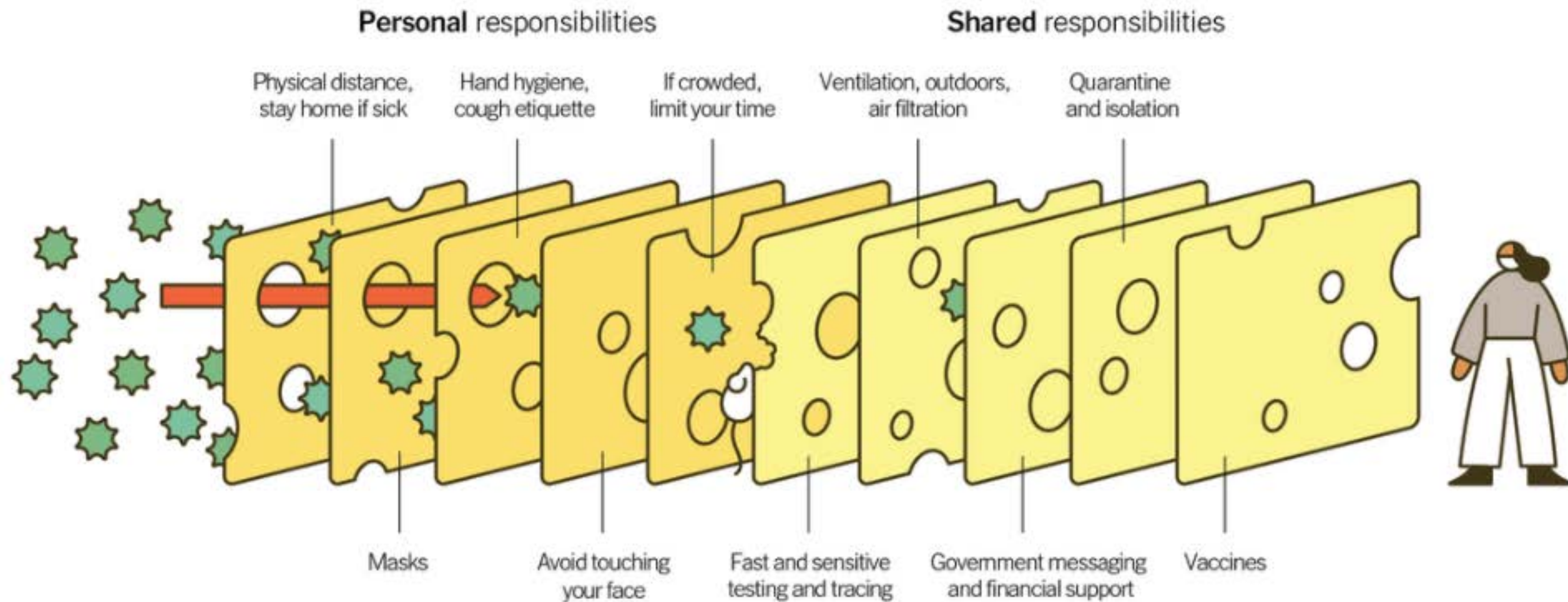
# Be Symbolic



# Be Symbolic

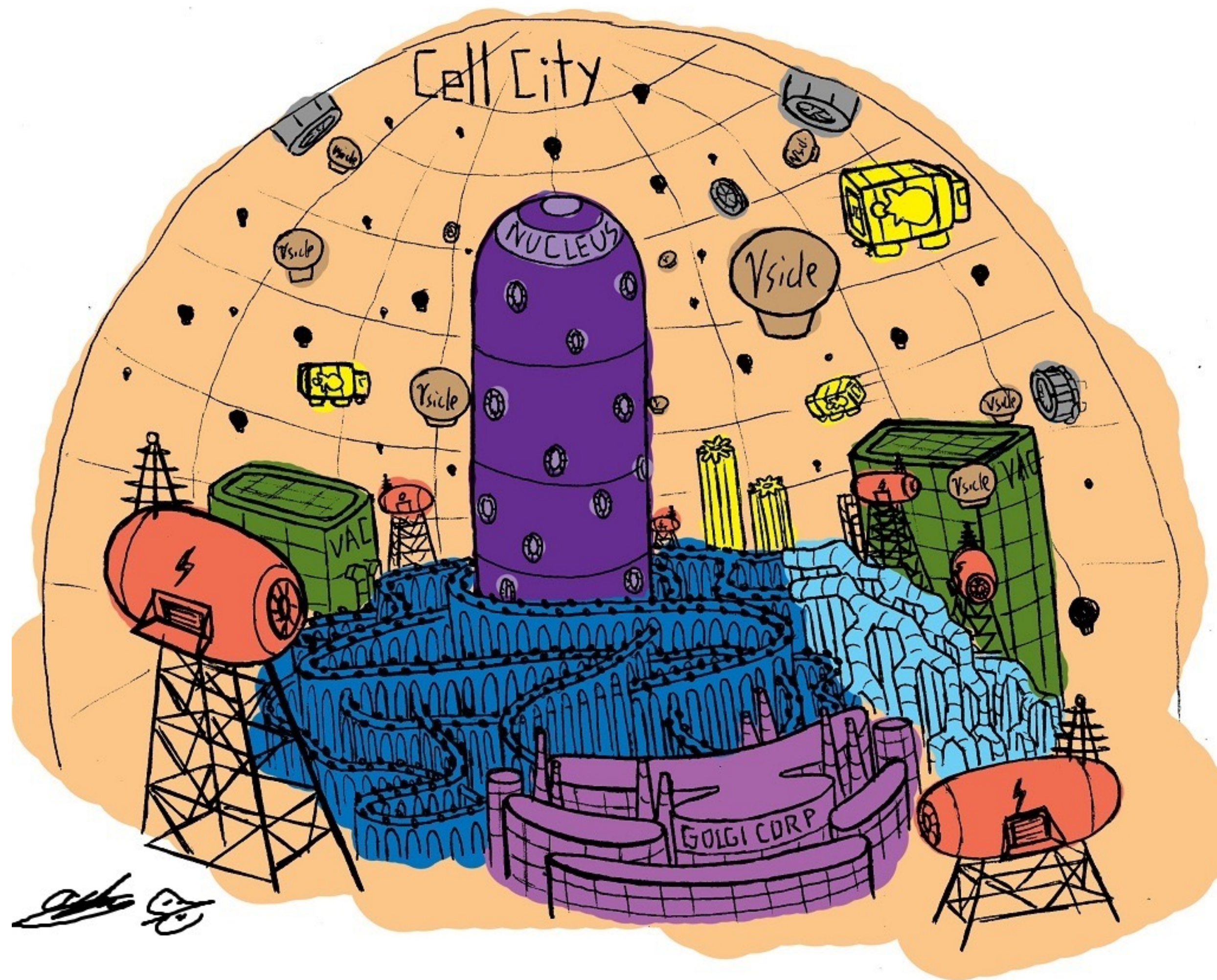
## Multiple Layers Improve Success

The Swiss Cheese Respiratory Pandemic Defense recognizes that no single intervention is perfect at preventing the spread of the coronavirus. Each intervention (layer) has holes.



Source: Adapted from Ian M. Mackay ([virologydownunder.com](http://virologydownunder.com)) and James T. Reason. Illustration by Rose Wong

# Be Symbolic

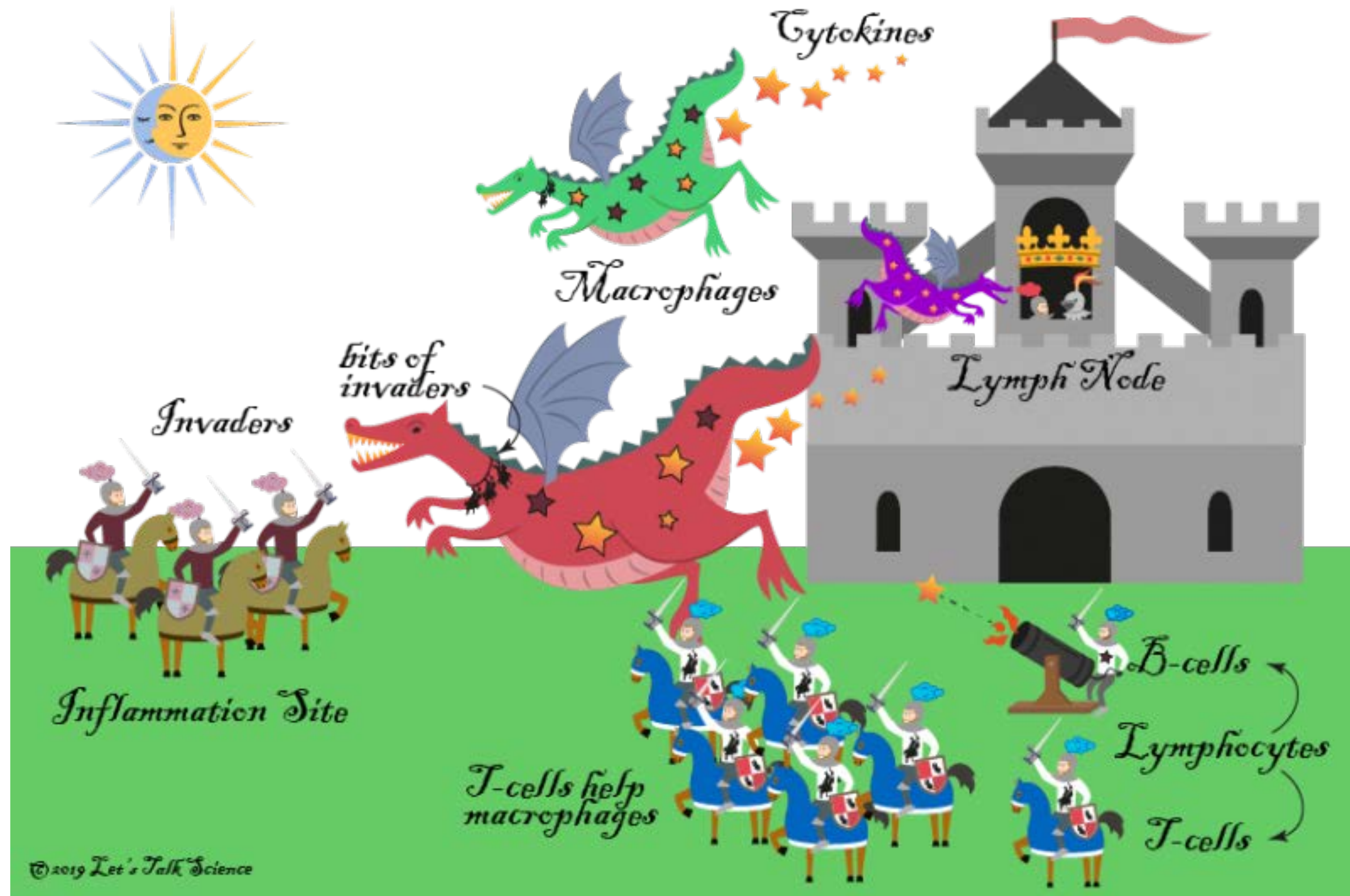


© Somerandomguy1 on deviantart.com



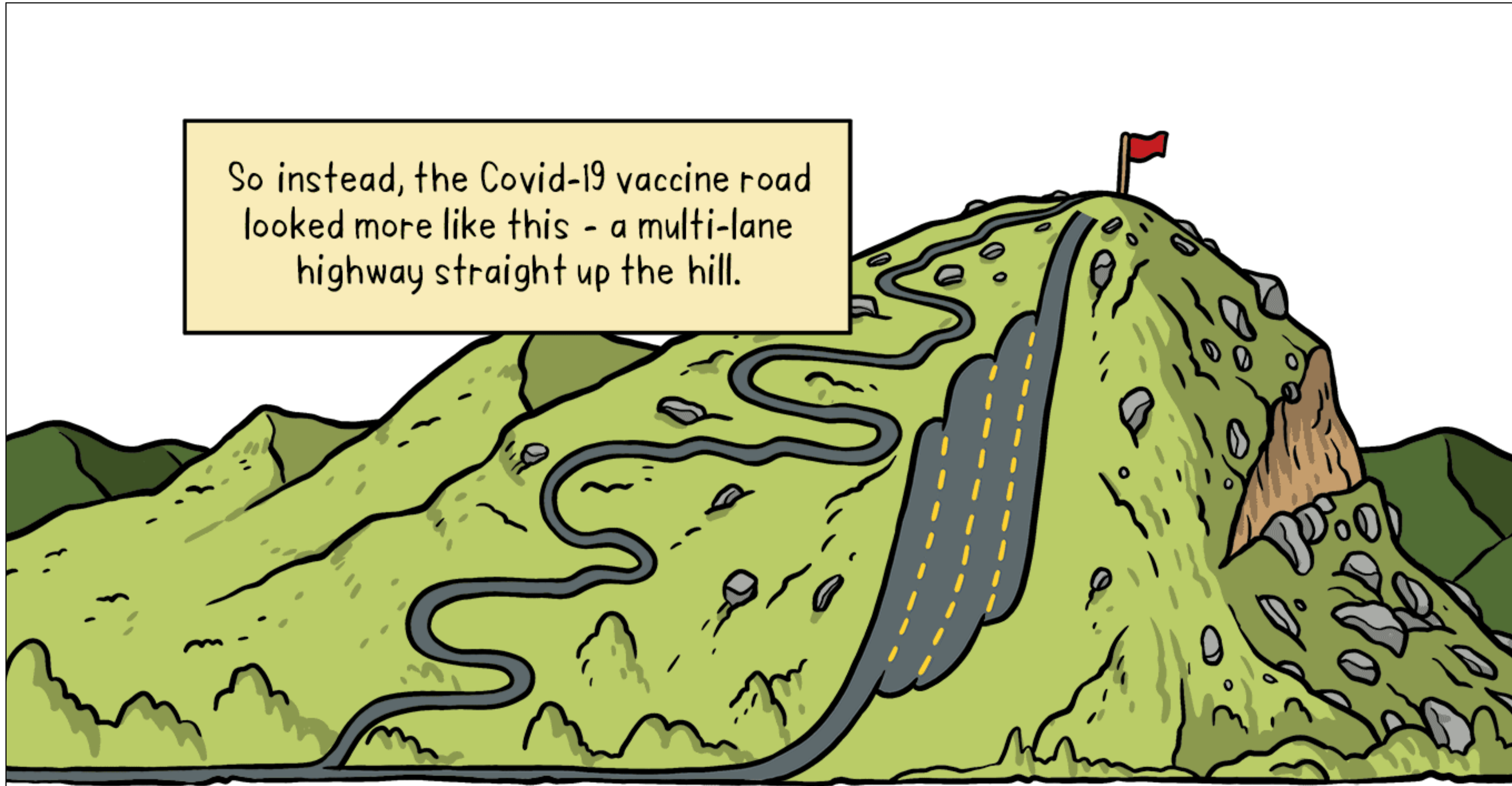
Unknown

# Be Symbolic



# Be Symbolic

So instead, the Covid-19 vaccine road looked more like this - a multi-lane highway straight up the hill.

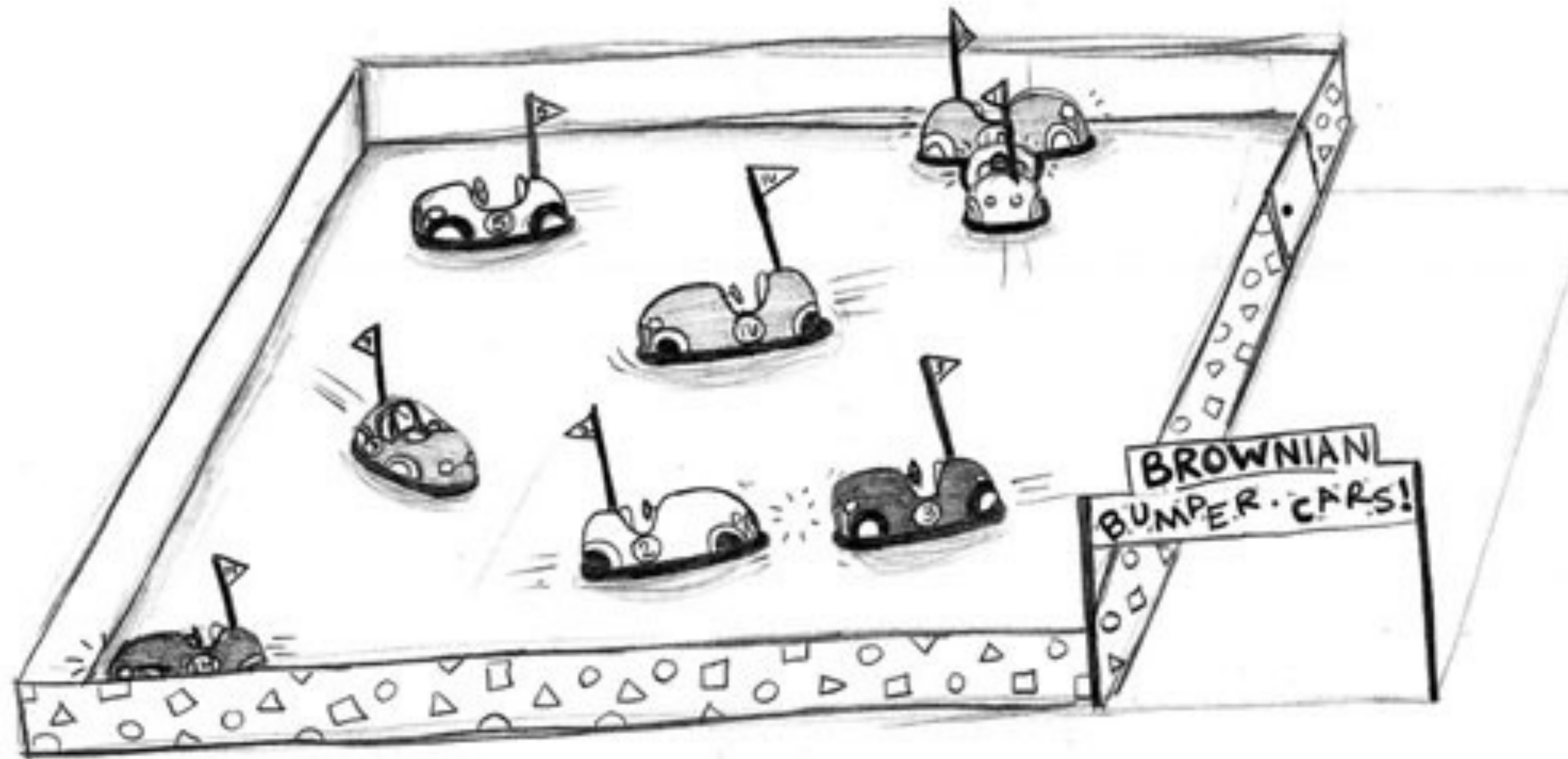


# Be Symbolic



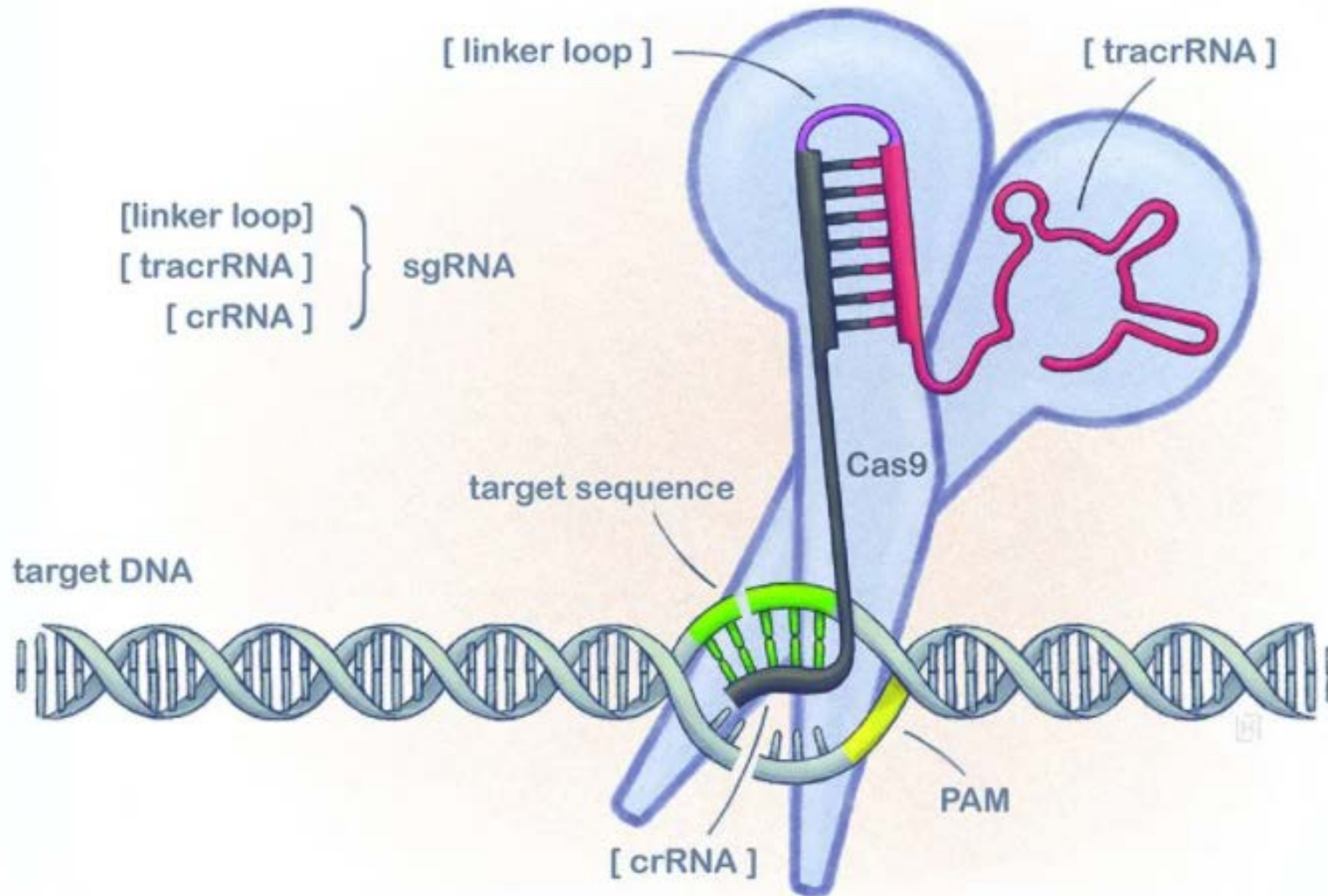
When your content  
is unfamiliar or abstract,  
**be symbolic.**

# Be Symbolic



\* more energy/speed [caused by higher temperature]  
causes more collisions + more intense chaos!

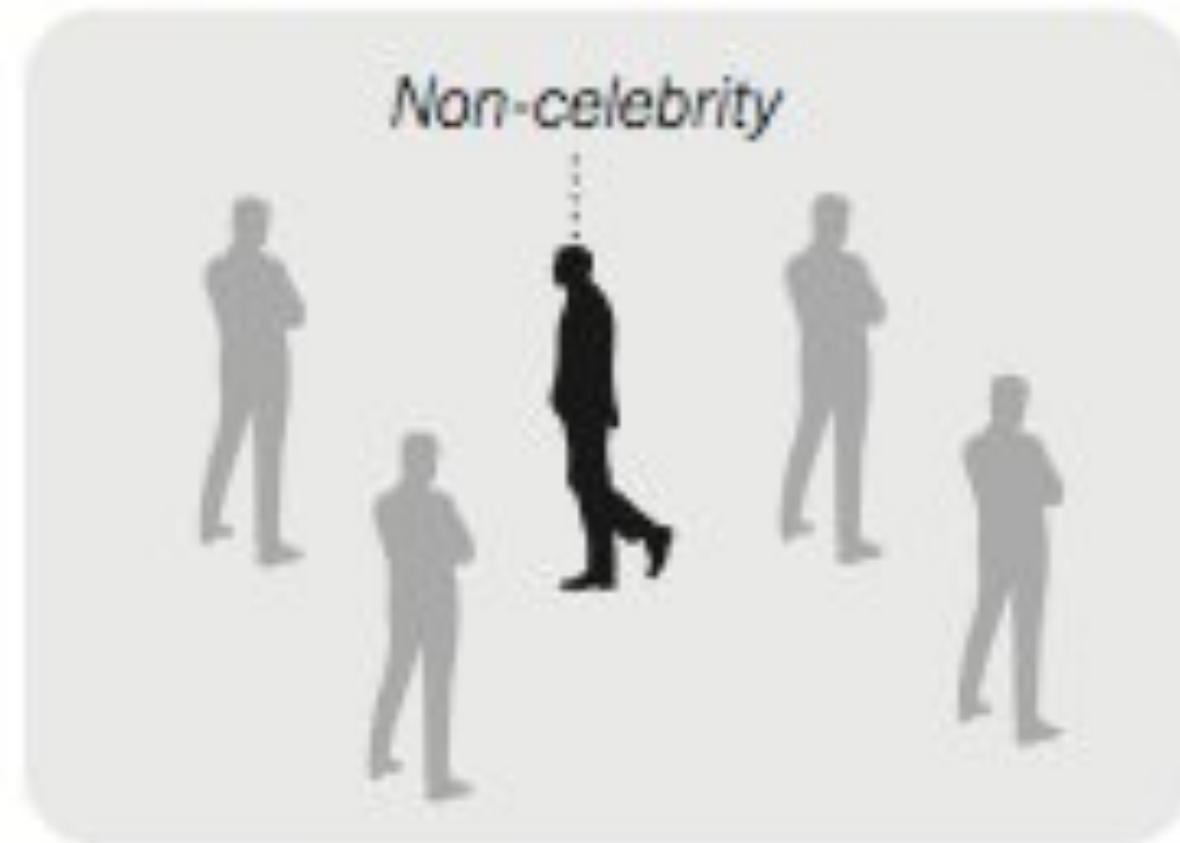
# Be Symbolic



# Be Symbolic

## Hints of the Higgs Particle?

Scientists hope they are getting closer to the discovery of the Higgs boson, an elusive subatomic particle that is thought to make up the Higgs mechanism, a pervasive field that gives mass to elementary particles.

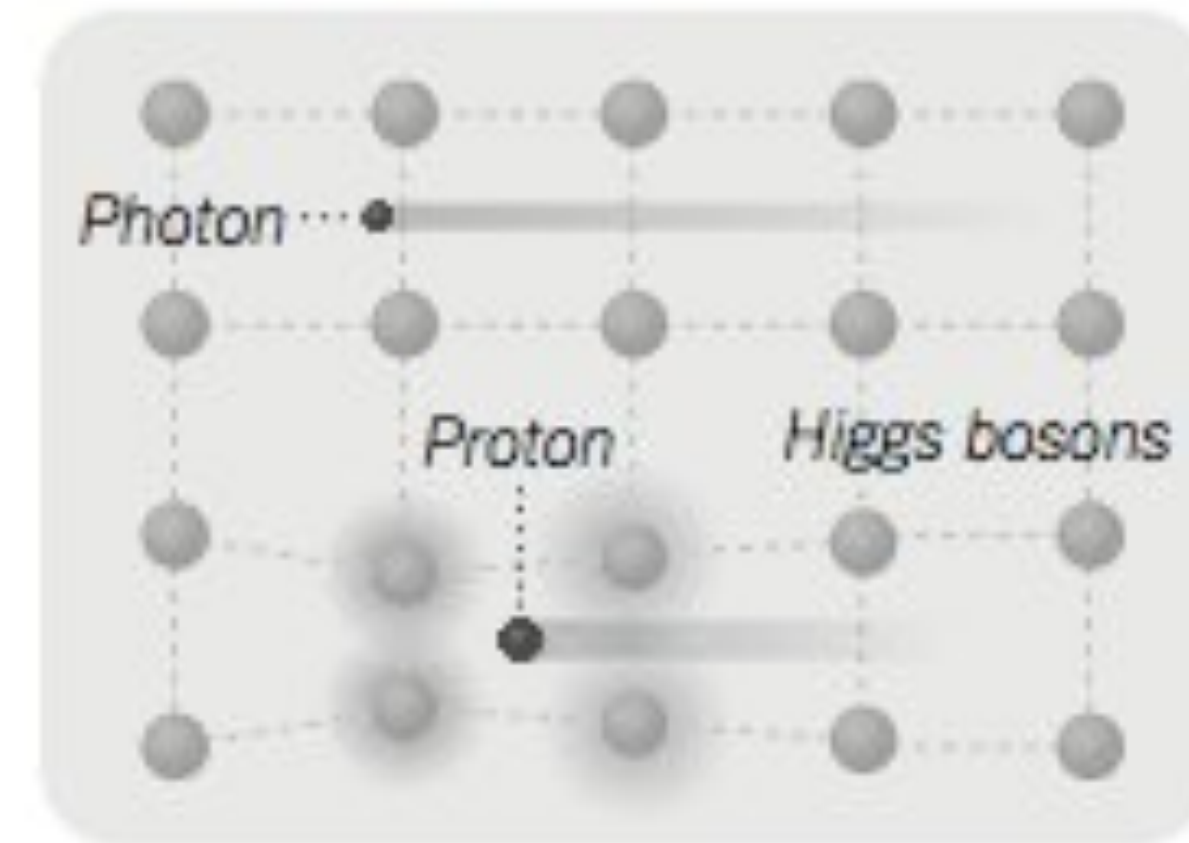


**AN ANALOGY** The Higgs field is difficult to visualize but has been likened to a group of paparazzi. A normal person is able to accelerate through the paparazzi without any interaction, and without being slowed down at all.

Source: "The Fabric of the Cosmos," by Brian Greene

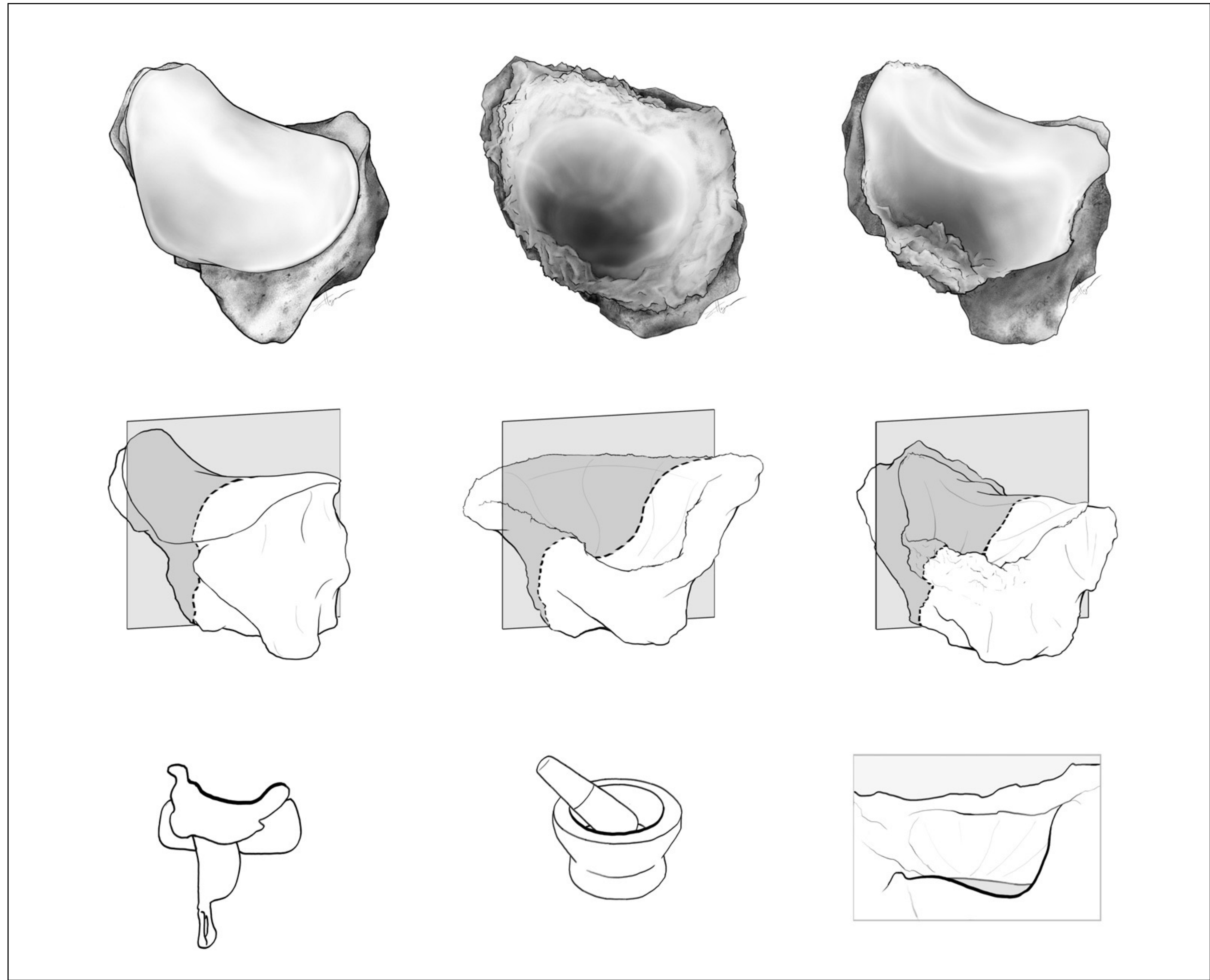


**THE INERTIA OF FAME** A minor celebrity would have a few interactions with the paparazzi, which would slow her down slightly. But a major celebrity would cause a frenzy of interaction, and would have a hard time moving through the field.



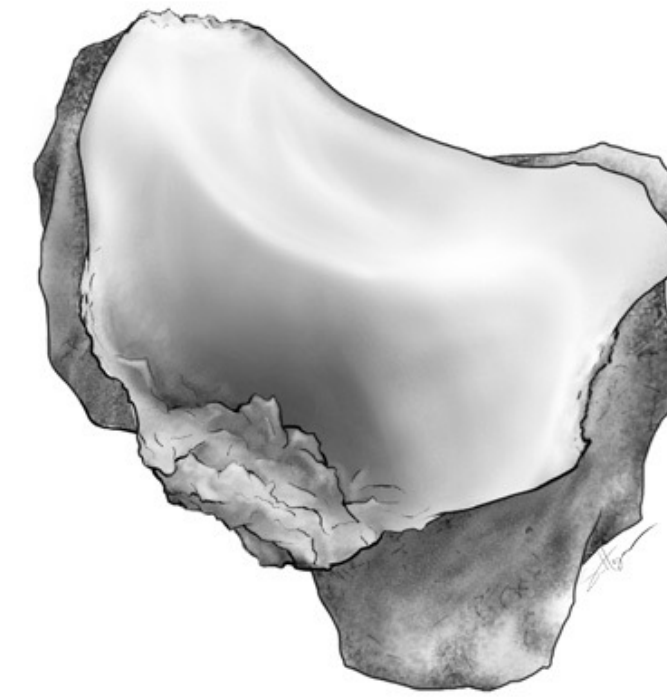
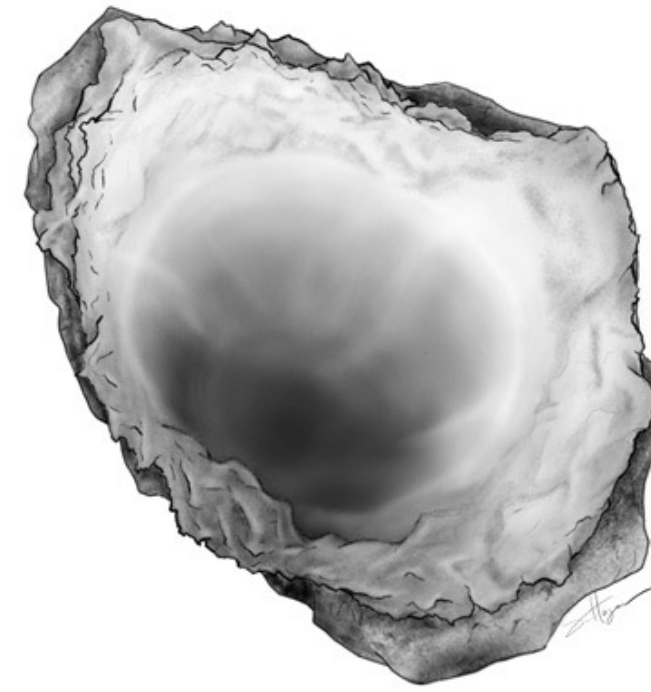
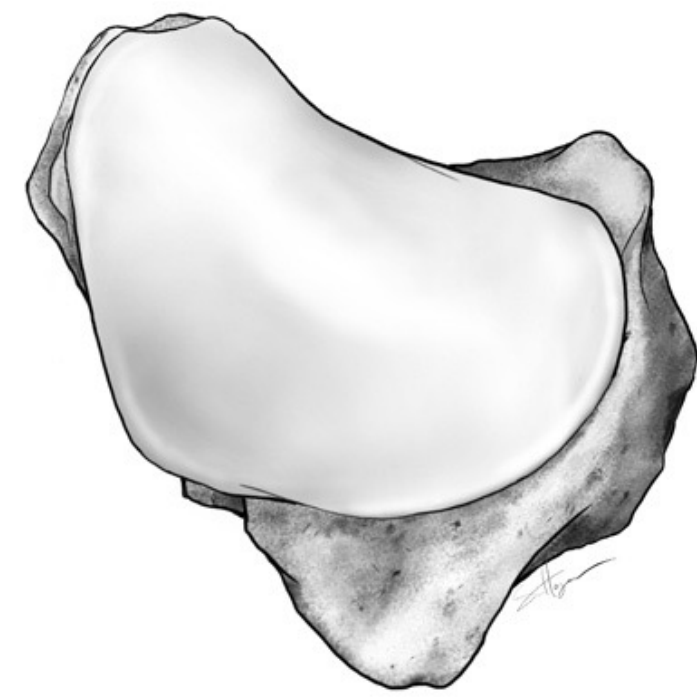
**MASS, NOT FAME** Similarly, the Higgs field is thought to interact differently with different particles. Photons pass untouched, and have no mass, while other particles interact to different extents, which gives them different masses.

THE NEW YORK TIMES



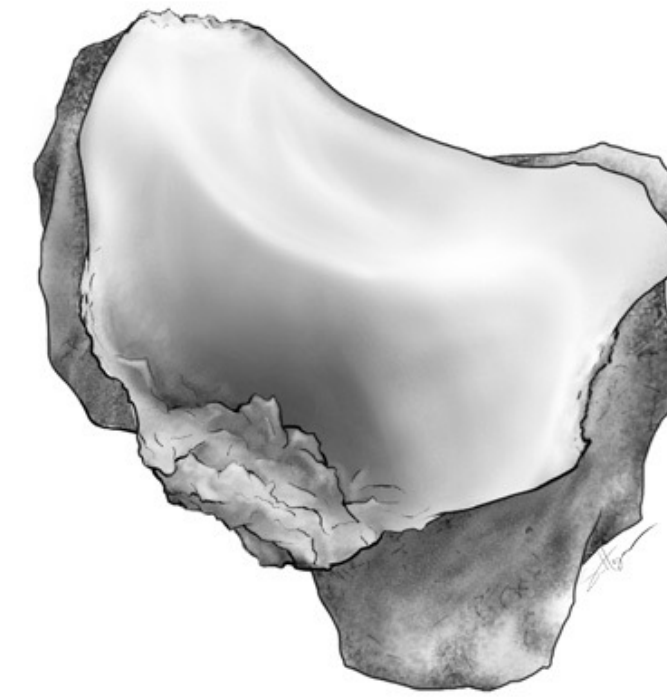
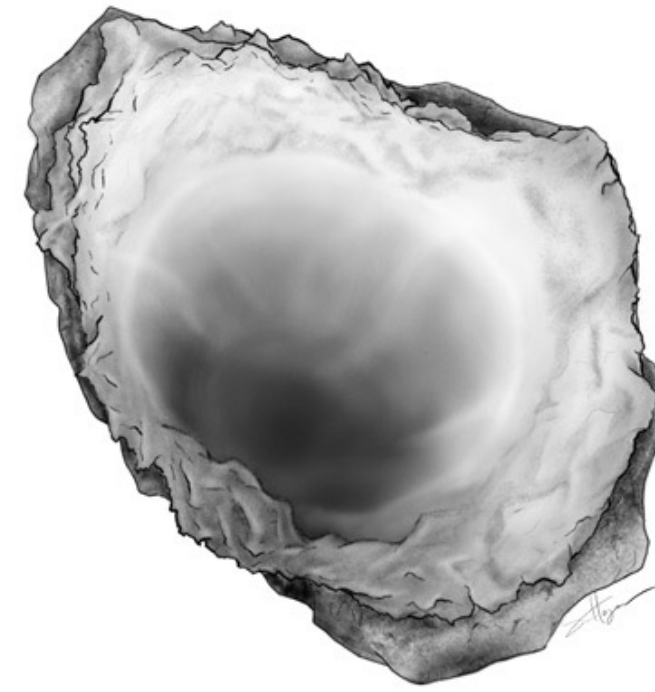
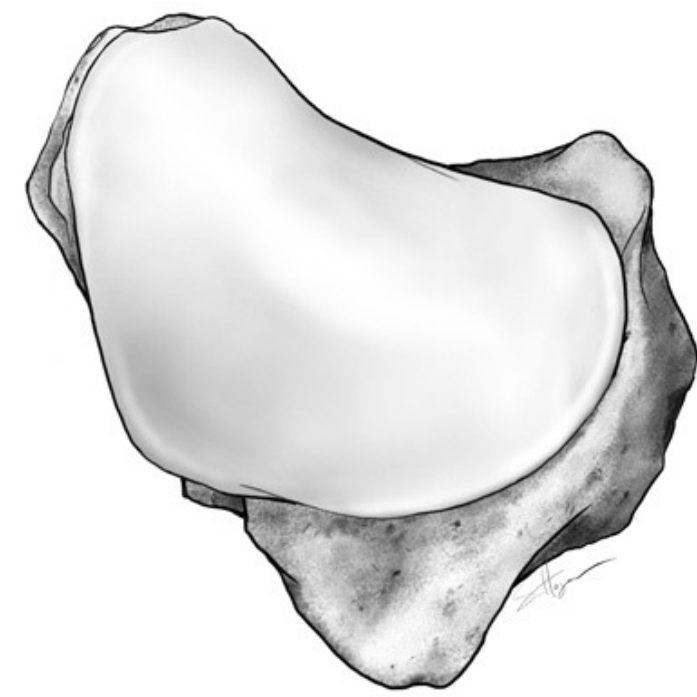
With permission © Sarah Hegmann

Literal

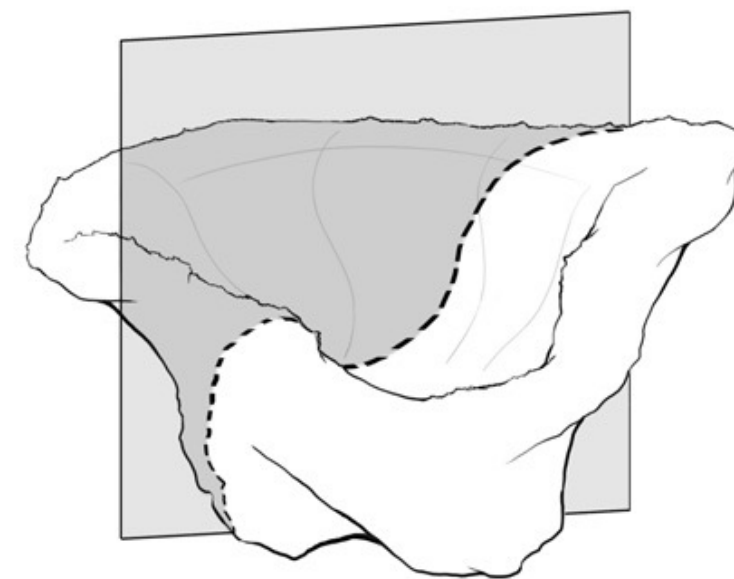
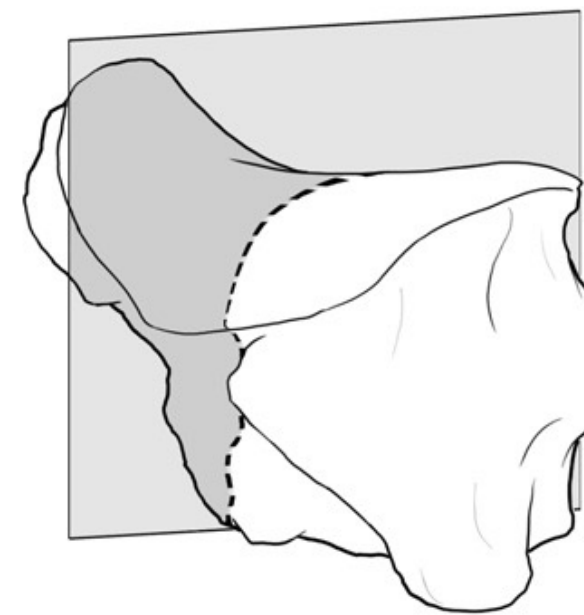


With permission © Sarah Hegmann

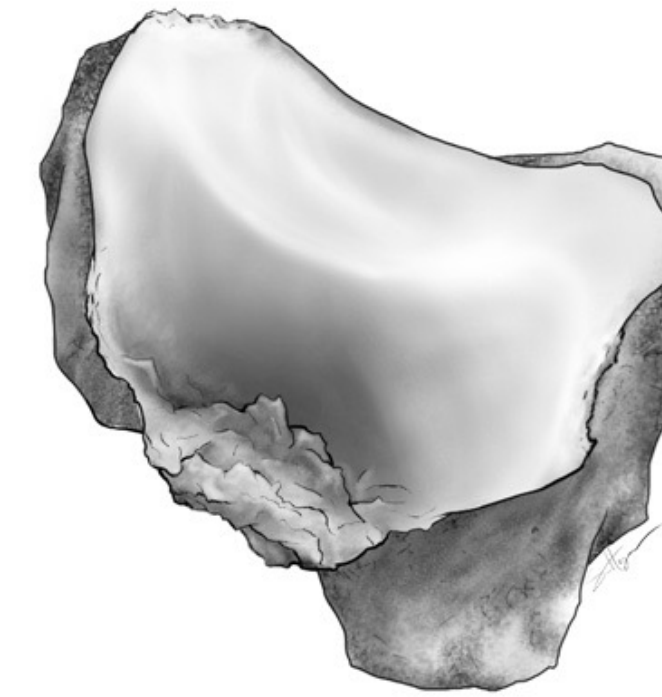
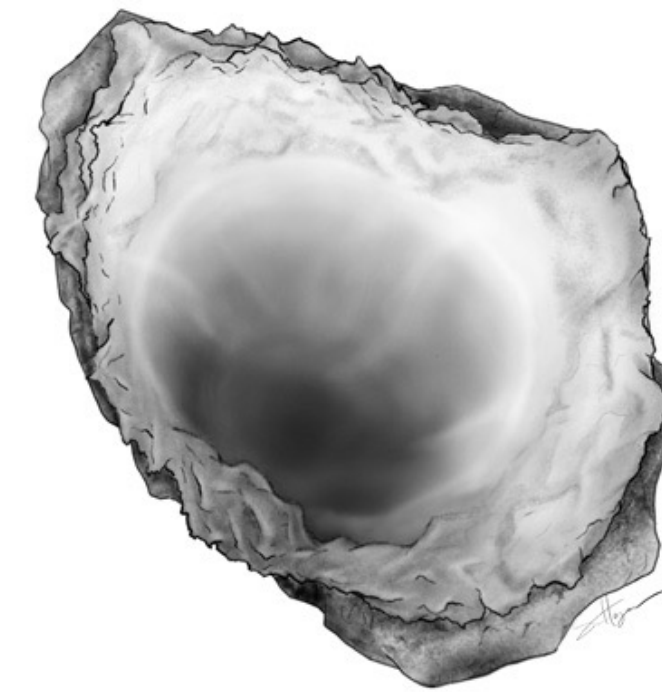
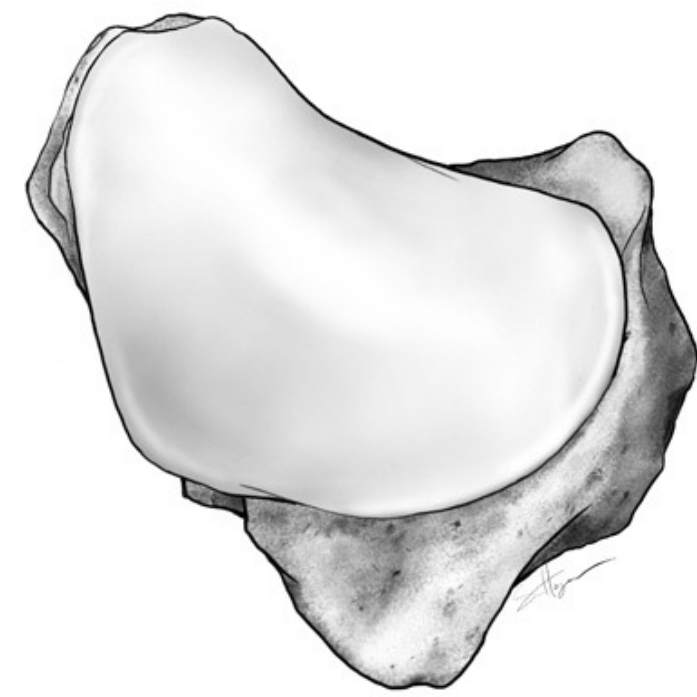
Literal



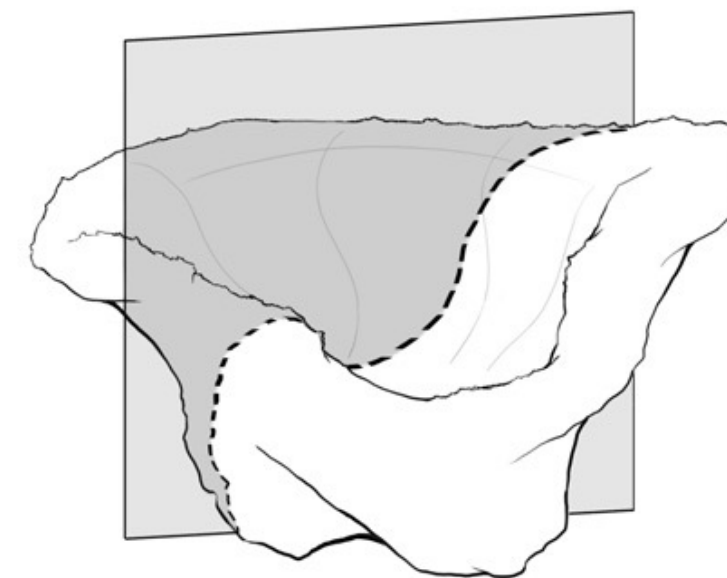
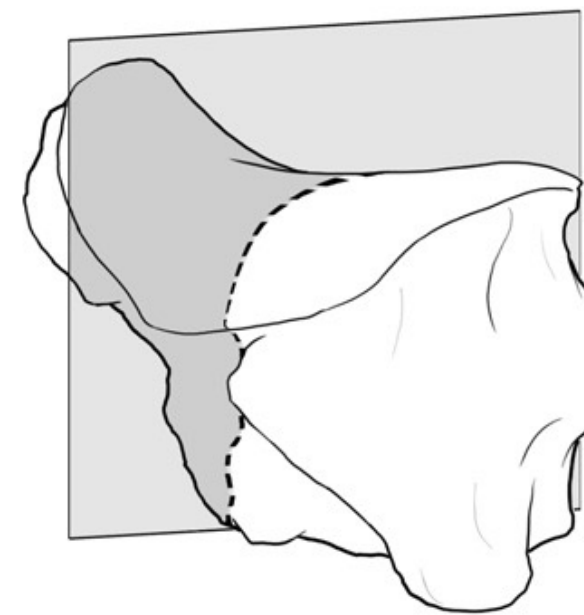
Schematic



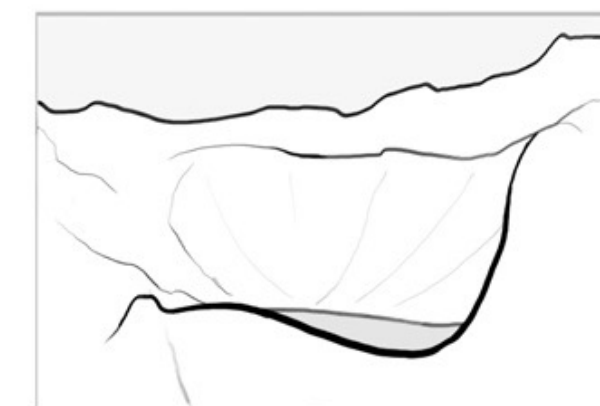
Literal



Schematic



Symbolic



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A picture is always a representation,  
**so let go of literalism.**

# **The Three *S*'s in Visual Science Communication**

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When you have a lot of content,  
**be selective.**

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# Thank you!

[tami@tolpa.com](mailto:tami@tolpa.com)

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