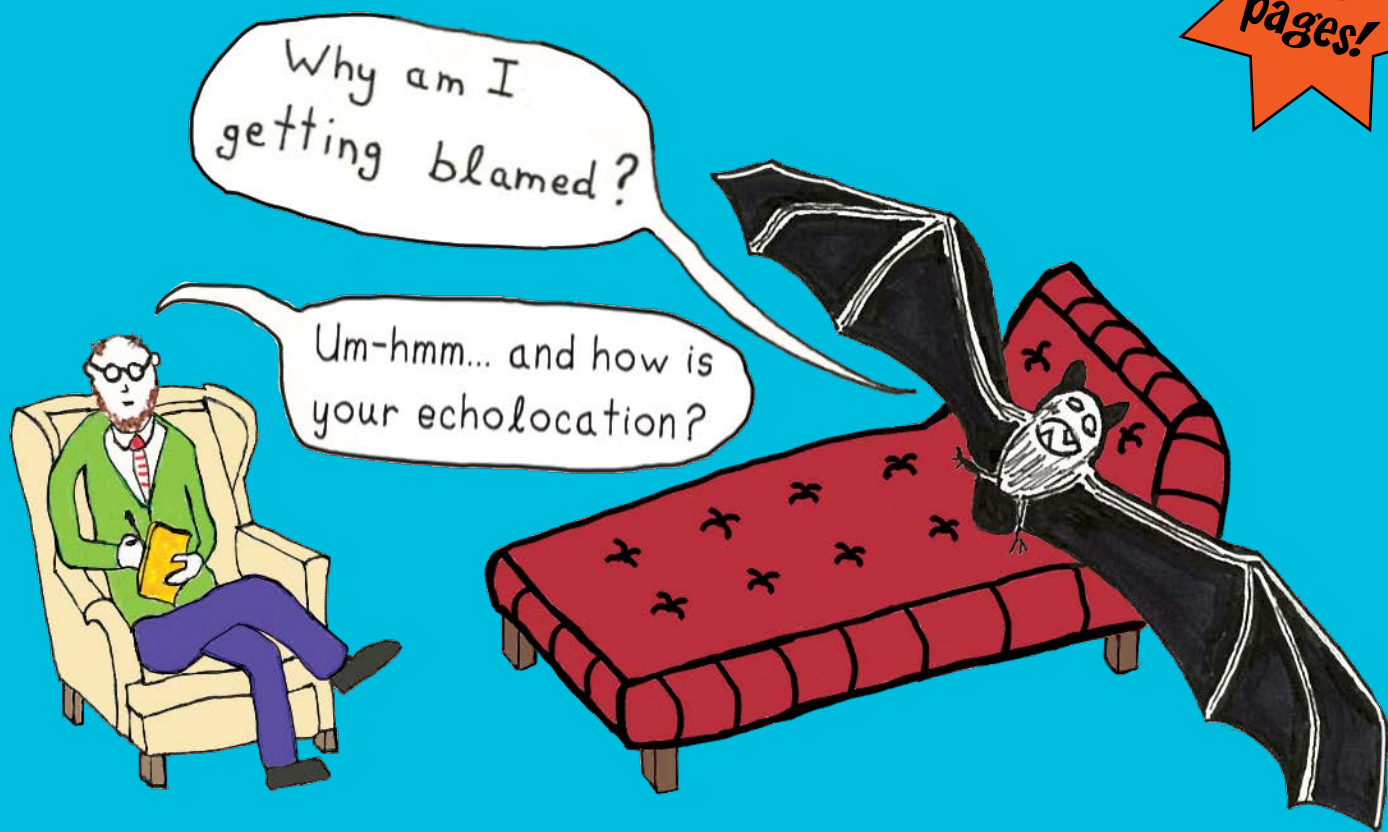


THE HIDDEN ZOO INSIDE YOU

An illustrated guide to
pesky organisms and pandemics

224
pages!



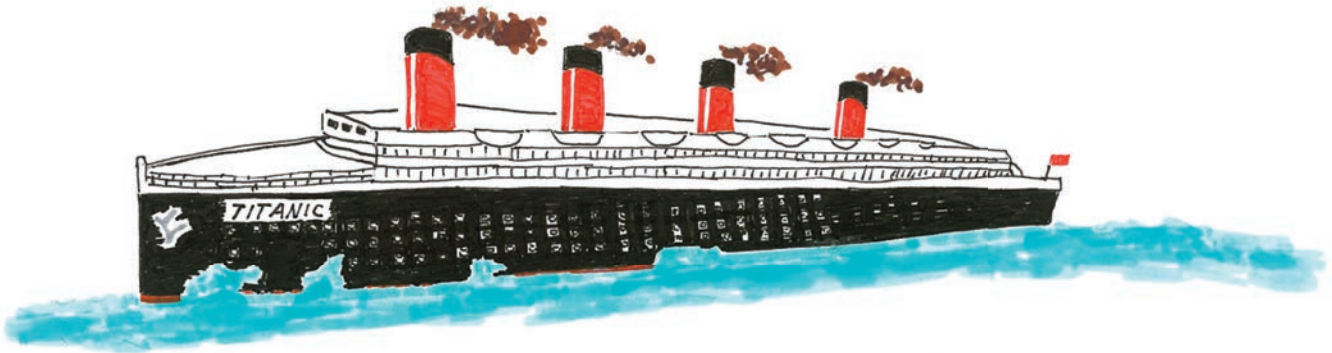
Hand-written and drawn by
DR. ALLEN JONES, M.D.

THE HIDDEN ZOO INSIDE YOU

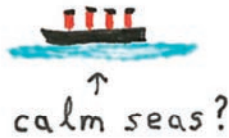
**An illustrated guide to
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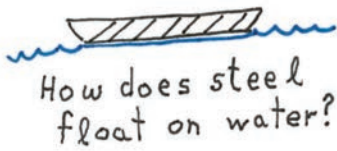
☹️ - I am SOMPOO. I am your guide. You will learn a ton of stuff. Oh, and I like hyphens.



☹️ - If you were asked, "Why did the Titanic sink?", what background information would you need?



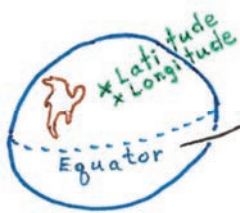
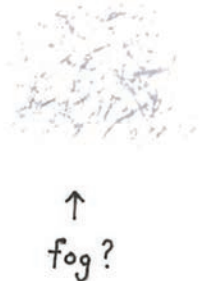
or



or



or



Morse code →

dash dot
 ↓ ↓
 C Q D
 Come Quickly Danger

"This is Titanic. CQD. Engine room flooded."

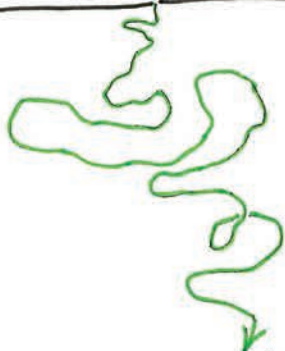
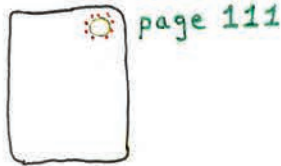
S O S
 Save Our Souls

← (Only became popular after Titanic sank)

☹️ - A good investigator considers all possibilities

(Suggested) Options for reading this guide

Cut to the chase and head straight to the **Coronavirus**



Completely random

Sort of random

Old School

Page 1 → Page 189
START END

Just Keep on turning the pages

Dracula p.109

Cat-lover's page  72

Volcanoes page 265-267

Lots o' bats  page 114-118

Bronx Zoo lions p.133



Megalodon p. 16

Virus ATTACK! p.93

Check out my cool skeleton 
Bat skeleton p.114

pangolin p.126

Is a virus considered **Life**?  page 57

BUBONIC PLAGUE + BLACK DEATH page 9-14

Wuhan + Wuhan Institute of Virology page 3-6

SMALLPOX page 21

Anthrax p.58


Zombies  page, um, let me think... I forget

R.I.P. - What Kills humans? p.38



N95 mask → page 155


Ebola. Eeek! p. 18-20

TORCH infections during Pregnancy page 84 

1918 (Spanish) Influenza and the Amazing Alaska Roadtrip pages 22-29

GANGRENE p. 61

Typhoid Mary p.59

Camels p.125, p.138  I have 1 hump

FLESH-EATING DISEASE p.66

old Yeller p.100

River Blindness 77 78 79 

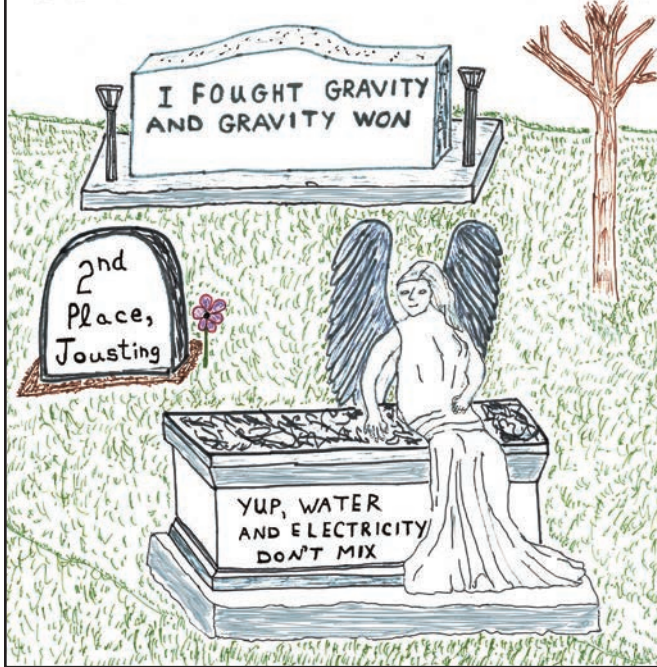
raindrops (p.165) 

Tapeworms page 80  slurp, slurp

METRIC SYSTEM FOR NEWBIES p. 53

CHAPTER 1

THE COLD, HARD FACTS OF DEATH AND DISEASE



- 34. 1424 Pathogens that Don't Like Us
- 35. **Epidemiology Triangle**
- 36. Civilization is Terrible 4U
- 37. **Karaoke Virus**. For real?
- 38. Cemetery of Humanity
- 39. Tombstones That Glitter

Big Picture

- 40. Passport Control
- 41. Death Certificate
- 42. **Homicide, Suicide**
- 43. Death by Python
- 44. **Strangling, Carbon Monoxide Poisoning, and Cyanide**: Generally Speaking, a Bad Day
- 45. How **Coronavirus** Got its Name
- 46. A Complicated Coronavirus Death
- 47. Death by Old Age is not Allowed

Think,
A → B → C
↓
Death

- Page 2 - Death by Definition
Pan-demic vs. **Epi**-demic vs. **En**-demic
- 3. Paranoid Tourist Map of Wuhan
 - 4. Wuhan Institute of Virology (WIV)
 - 5. Wuhan bridges
 - 6. China Lockdown

Welcome to Wuhan

- 48. Nuns with Shotguns
- 49. **Risk Factors**: Doctors are Crazy About Them
- 50. **Zombie Day at the CDC**

Epidemiology tidbits

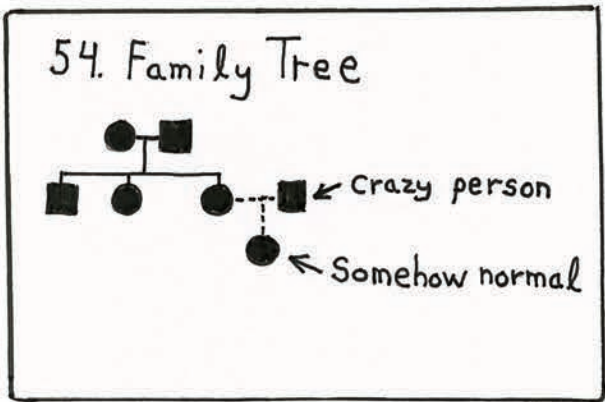
Can I eat your intestines?

- 7. Plague Yearbook
- 8. **Typhus**: class of 430 B.C.
- 9. Plague definitions
- 10-14. **Bubonic Plague** a.k.a. **Black Death**
- 15. **Yellow Fever** ... you turn yellow?
- 16. **Megalodon**, somehow
- 17. Yearbook Pause ▶ ||
- 18-20. **Ebola**
- 21. **Smallpox** - it's no fun
- 22-29. **1918 (Spanish) Influenza**
- 25-27 Alaska roadtrip and the reconstruction of the virus by the **CDC**.
- 30-32. **Cholera**: Death by Diarrhea
- 33. Yearbook Recap

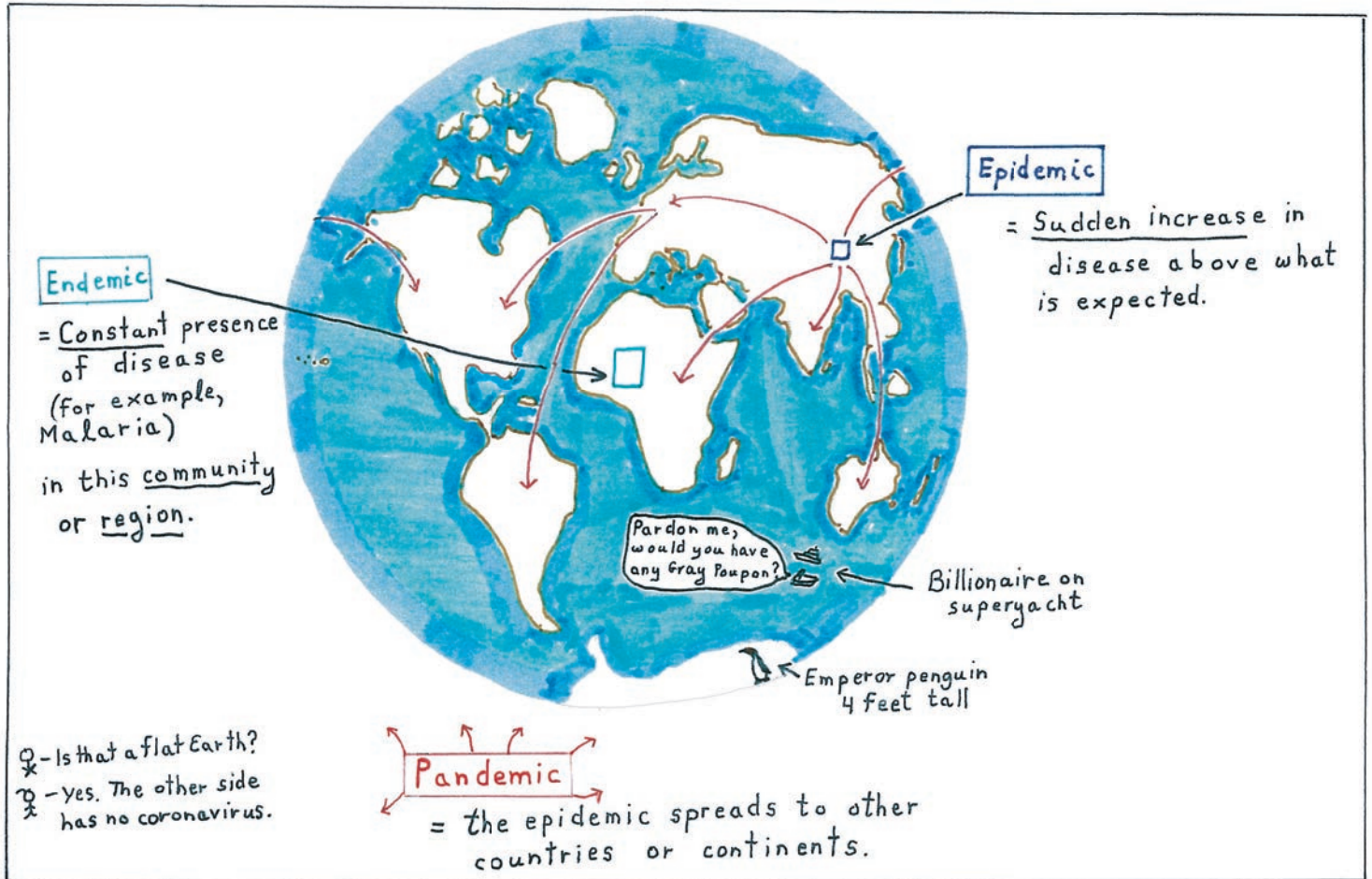
A smattering of nasty

- 51⁵¹ **Scale**, as in, the relative size of things
- 52. Chop Up Those Credit Cards
- 53. Learn the **Metric System** in 1 page, if you dare

♀ - How small is it?
♀ - It's so small that even mosquitoes have to squint



☹️ - If we agree on definitions, life is a bit easier



Q - Is that a flat Earth?
A - Yes. The other side has no coronavirus.

☹️ - Epidemiology is the study of patterns of disease.

- This is what the folks at the CDC (Centers for Disease Control and Prevention) do all day, every day.



This is good This is better

"Epid ee me all aw jee"

☹️
SOMPPOO SAYS

Hollywood Outbreak

OUTBREAK (2005, Warner Brothers)

"We got 19 dead, 100 more infected. It's spreading like a bush fire."

Dustin Hoffman (trying to prevent outbreak from turning into a pandemic)

Outbreak: Motaba River village

☹️ - An 'outbreak' is an Epidemic in a limited geographic area.

Real Outbreak: ☹️ Coronavirus

Origin: Seafood market, Wuhan, Hubei, China

city province country

"A novel coronavirus from patients with pneumonia in China"
New England Journal of Medicine
24 January 2020
Authors: Zhu et al
'and others' (Latin)

<p>Patient #1: 49 year-old ♀ (Female)</p> <ul style="list-style-type: none"> ⊙ Retailer in seafood market ⊙ 23 December 2019: cough, chest pain ⊙ 4 days later: worse ⊙ CT chest: Pneumonia ⊙ Discharged (sent home) 	<p>Patient #2: 61 year-old ♂ (male)</p> <ul style="list-style-type: none"> ⊙ Frequent visitor to seafood market ⊙ 20 December 2019: cough, fever ⊙ Respiratory Distress ⊙ Ventilator ⊙ 9 January 2020: Died
--	---

☹ - Plagues and pandemics are the constant companion of human kind.



Typhus
Class of 430 B.C.
Enjoys terrifying strangers



Bubonic Plague
Voted most likely to Kill multiple times



Smallpox
Voted most likely to wipe out civilizations



Influenza
Has always wanted to visit Spain

PLAGUE YEARBOOK



Cholera
Voted most likely to Kill by diarrhea



Yellow Fever
Crazy about mosquitoes



Ebola
A self-admitted loner who scares even the principal

☹ - Everyone on the Left page is a bacteria.
☹ - Everyone on the Right page is a virus.
Let's explore them to create some context for what coronavirus is up to.

WHO LIVES ON EARTH?

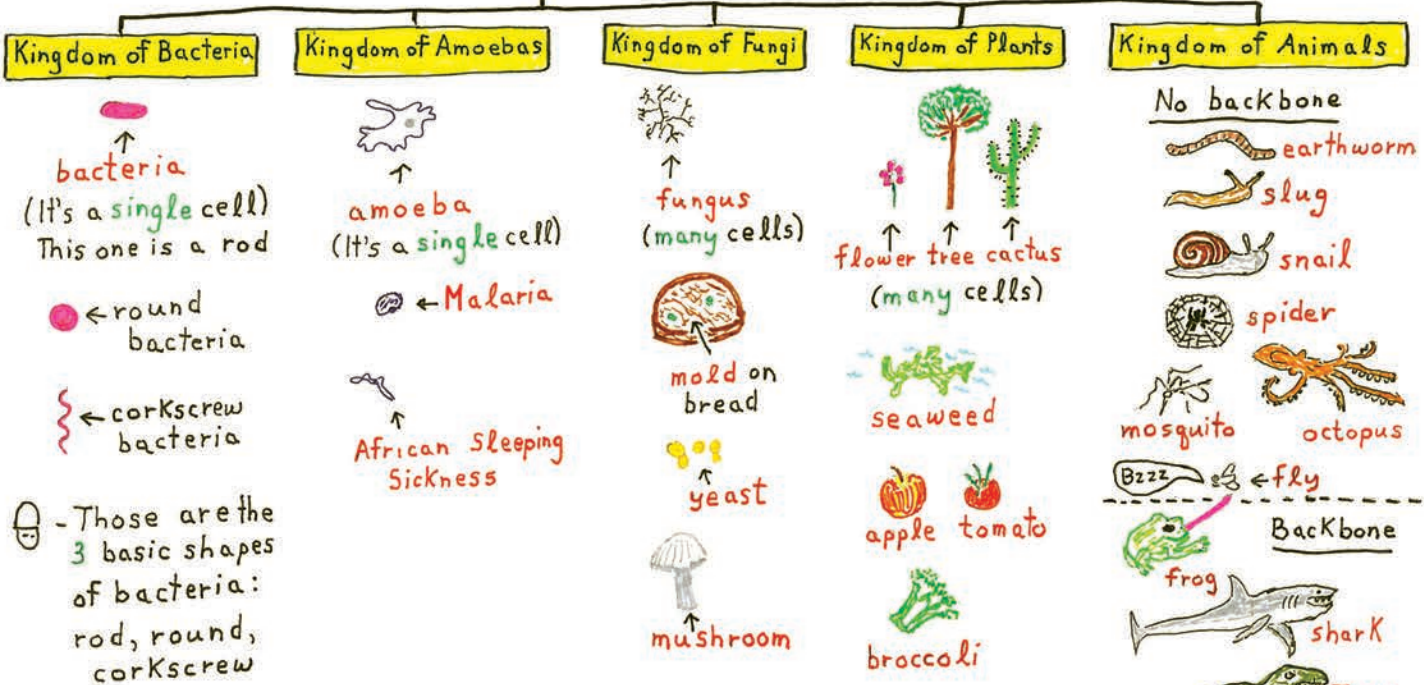


← Earth from 30,000 miles
(Google Earth maximum altitude)



☹️ - All life can be divided into 5 Kingdoms.

Life



☹️ - Those are the 3 basic shapes of bacteria: rod, round, corkscrew

↑

Robert Harding Whittaker
 ◉ 1920 - 1980
 ◉ Plant ecologist (study of plant communities)
 ◉ He came up with the 5 Kingdoms

↑

That was his signature.
Hard to forge?





- Here's a description of Plague:

"For it began in England in Dorsetshire in the year of our Lord 1348, and immediately advancing from place to place it attacked men without warning and for the most part those who were healthy. Very many of those who were attacked in the morning it carried out of human affairs before noon. And no one whom it willed to die did it permit to live longer than three or four days."

o - so 1348 would be a year to avoid in a time machine
 o - I concur

Plague Recipe

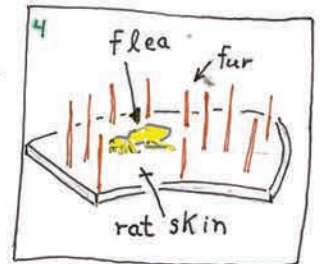
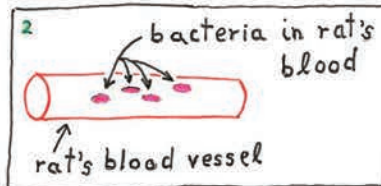
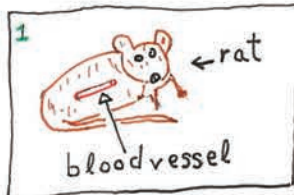
Ingredients:



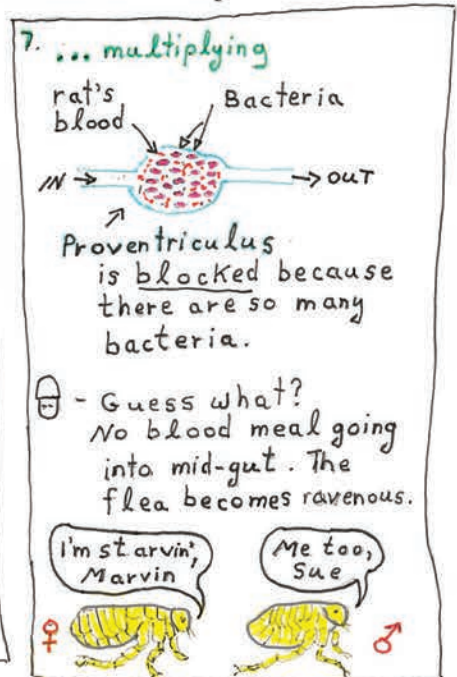
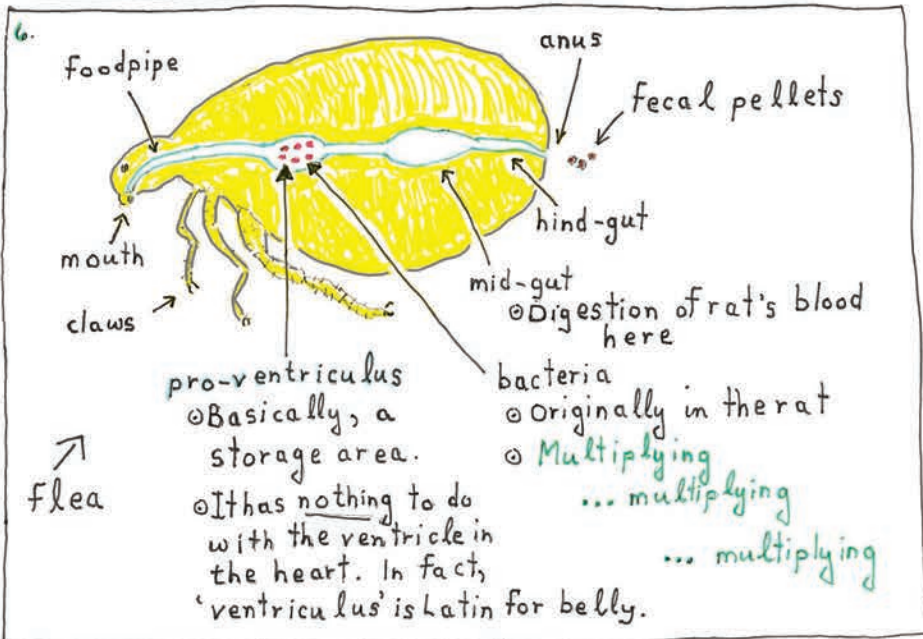
(black rat preferred but brown acceptable)

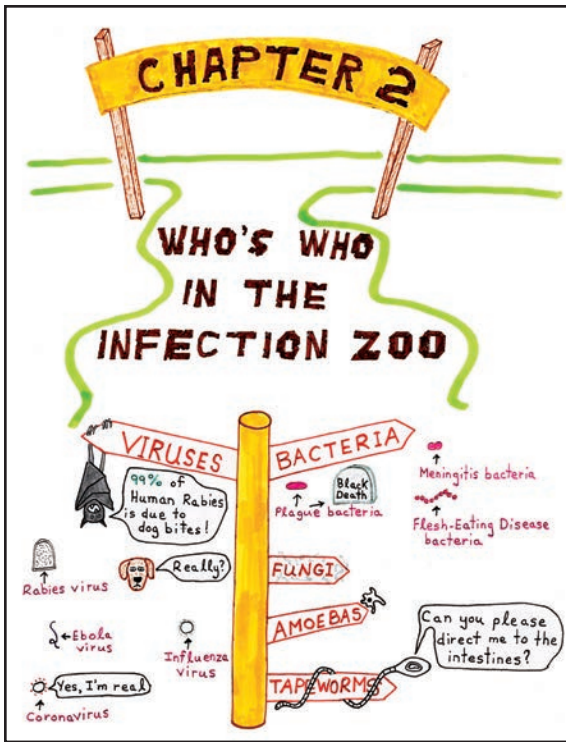


Plague Instructions (think, sequence of events)



o - Now things take an unexpected turn, which requires an understanding of flea digestive anatomy (which you probably had no idea you were going to learn today).





73. Stinky Fungus is a Great Way to Learn about SKIN

74-75. **Aspergillus**: A Fungus that can Kill you on a bad day **Fungi Can Be Mean**

76. **Poison Ivy, Pollen Allergies, and Rose Handler's Disease**

Do Plants Infect Us? Please think carefully before submitting your answer

77-79. **River Blindness**: Oh my, this is rather fascinating

80. Is a **10-foot tapeworm** inside your intestines causing a **Vitamin B-12 Deficiency**? If you are a hypochondriac, start screaming.

81. Lifestyles of the Fish and Famous

Parasitic Worms are so Fascinating that You Forget to be Scared.

56. The 5 Kingdoms of **Life** **Bacteria, to freshen up**

57. What is **Life**?

58. **Infection Zoo** - Please Don't Pet the **Anthrax** and **Salmonella**

59. **Typhoid Mary**: You Should Probably check Her Resume

60. **TB (Tuberculosis)** - Avoid if possible

61-64. **The Nasty Cousins**
 Gangrene Botulism Tetanus C.diff diarrhea

65. Staph vs. Strep

66. **Flesh-Eating Disease**. Cooler than you thought it was

67. Amazing **Zoology Story** and **Membranes** You've Never Heard Of

68. **Meningitis** and **Lyme Disease**


82. Transmission I } How the bugs
 83. Transmission II } get into us

84. **V T** **Post-Zoo Debrief**
 er
 a
 n
 s
 i
 c
 a
 mission
 during
 & Pregnancy

69. Impressive, most impressive, **Malaria**.

70. **Hydroxy-chloro-quine**: not where you expected it?

71. A lowly Amoeba Kills **Alexander the Great** **Amoebas Can Be Mean**

72. **Cat Lovers Page**  **Amoebas Can Be Mean**

85. **Predators** and **micro-Predators**

86-87. **TAXONOMY** - a non-negotiable pit stop for **Obsessive People**

88. **Zoonosis** - a strange word you are not obligated to memorize. But you may as well.

INFECTION ZOO



Roit ya!
The foive Kingdoms are at war with each utha, and even witheen themselves. This two-ah is about attecks on humans

Billy! Get back here. Don't touch that goat

Bubonic Plague

Black Death

Yersinia pestis

flea

rat

Typhus Plague of Athens

430 B.C.

Rickettsia prowazekii

louse

Anthrax!

Bacillus anthracis

Lives for decades in soil in dormant state.

Goat gets infected.

Your hand →

goat minus hide

goat hide

goat hide drum

Inhale bacteria

Anthrax in lungs a.k.a. Pulmonary Anthrax. Can be fatal. RIP

less often

more often

black, dead skin

Cutaneous Anthrax - Skin infection

"Bass ill us"

SOMPPO SAYS - "an thra sis"

- "g tane ee us" Rhymes with cane

Can treat with the anti-biotic called Cipro.

Salmonella

Salmonella enterica

Okay, put your thinking cap on!

Salmonella has a nice form and a nasty form.

Nice = Food Poisoning (that's nice!!)

hen (♀) cluck, cluck

1 Hen infected with Salmonella.

2 Salmonella gets inside egg before shell forms.

3 Egg contains Salmonella.

zoom

4 Salmonella growing in egg sandwich after hours in the sun at family picnic

6 Hours to 6 Days

5 Food Poisoning

vomiting

diarrhea (might be bloody)

fever

Sorry about that gramma.

Yummy

☹️ - In the 1918 Influenza Pandemic, guess which bacteria caused the super-infection in the lungs?

- Staph aureus
- Strep pneumoniae
- Group A Strep



Group A Strep (GAS)

← The chain does not have to be straight



Strep Throat

☹️ - However, you might be an asymptomatic carrier.

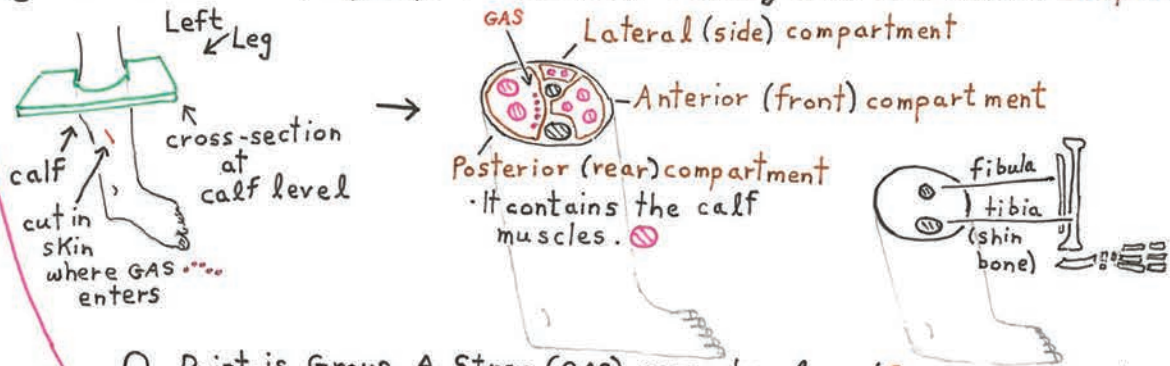
○ GAS causes Strep Throat, usually in children 4-7y old.
○ Usually there is no cough.

FLESH-EATING DISEASE a.k.a. **Necrotizing Fasciitis**

☹️ - The key to understanding this is knowing what fascia is.

muscle ← fascia } It's like biological Saran wrap that wraps individual muscles. } This is thought to ↓ friction to allow muscles to slide past each other.

☹️ - Fascia also wraps groups of muscles, creating what are called compartments.



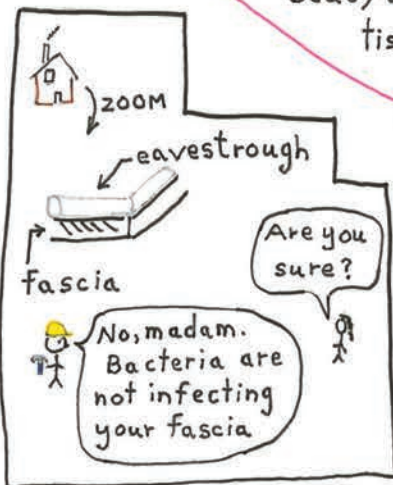
☹️ - Point is Group A Strep (GAS) spreads along 'fascial planes'. It destroys the fascia.

Necrotizing Fasciitis
Dead/dying tissue Inflamed fascia

2/3 of cases involve the leg.

☹️ - In a totally different scenario, severe burns can cause swelling within a compartment. That's called a **Compartment Syndrome**

→ A surgeon will slice the fascia to relieve the swelling.

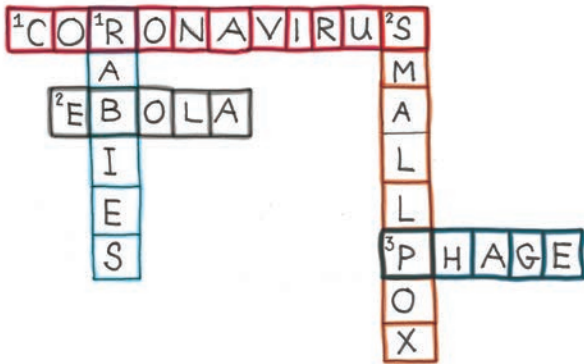


☹️ - "fah shah"
- "Neck row tie zing"
SOMPPOO - "fash ee eye tiss"
SAYS

☹️ - If I have Strep Throat, will I get Flesh-Eating Disease?

☹️ - This happens once per million cases. It affects fascia in the throat.
That's less likely than being struck by lightning (1/700,000).

Chapter 3 Meet the Viruses



90. Pause for Station Identification

91. Virus versus Cell

92. Viral Geometry



93. Bacteriophages infect bacteria

± ♥ this word

94. Matryoshka virus: From Russia with Love

95. Rembrandt Tulip-Breaking Virus
Say again?

96. Orsay virus: From France with Love

97. Special Guest Appearance

98. 20 (twenty) viruses of humans.

♀ - Um, since there are 219 viruses that infect humans, isn't that a Short List?

♀ - Affirmative

Hello, viruses

99. Polio virus

100. Rabies virus

101-110 BATS ON TRIAL

↳ Rabies Inquest

101. State Your Full Name

102. JAWS

103. Vampire bat

104. What are fangs?



105. Bram Stoker's Dracula

106. } 99 dogs: 1 bat

107. }

108. The Most Important Book

109. HOLLYWOOD

110. Reduction to absurdity

VIRUS ATTACK

☹ Viruses infect all 5 Kingdoms of **Life**

Viruses infect **Bacteria**

A day that started like any other...
 La, la, la. What a great day to divide
 ↑ rod bacteria

Hi, thought I'd stop by and kill you
 Nooooooo!



← bacterio-phage
 bacteria eat

- It's a virus that infects bacteria.
- Has a unique appearance.
- No harm to human cells.

CLOSE-UP

- ♀ - Does it actually eat bacteria?
- ♂ - No. But it kills them

Please stop flinching. I'm trying to inject my DNA into you.
 Gaaagh!

Later that day
 ← new viruses
 dead bacteria

- ♀ - Are those legs?
- ♂ - No. Viruses don't walk. They are called tail fibers to bind to the bacteria.

☹ "back tee ree oh fage"
 SOMPOO SAYS
 Rhymes with page

♀ - And viruses infect and kill even something as small as a bacteria?
 ♂ - Yup

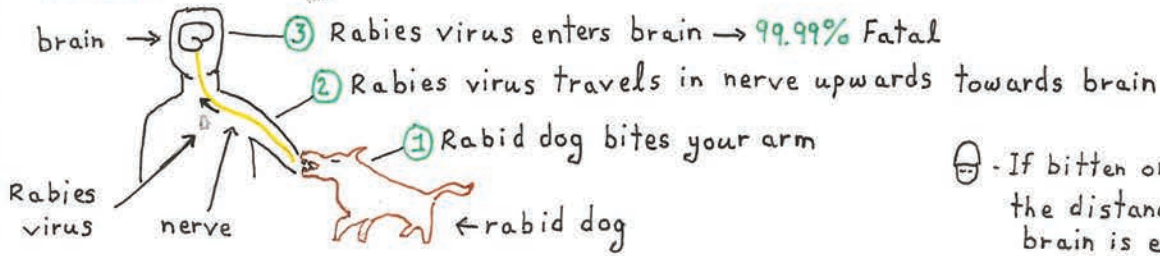
☹ - This is more accurate in terms of relative size

We bacteriophages outnumber everything on Earth

bacteria splits apart, releasing 100 to 150 new viruses

☹ - Do you remember **E. coli** the bacteria in our intestines? That's 1 ^{dead} E. coli.

Rabies virus →



⊖ - If bitten on the face, the distance to the brain is even shorter.

Multiple Choice Question

If you are bitten by a rabid dog you should:

- Refuse to round up 99.99% to 100% and insist you'll be the exception.
- Photograph the dog and post to Instagram #isthisyourrabiddog
- Seek medical attention for Rabies vaccine and Rabies Immune Globulin.

⊖

Rabies

↑
Rabies virus



Worldwide
• 59,000 Human Rabies deaths per year.
• 99% due to dog bites (the rabies virus is in the dog saliva).



Bats are a 'natural reservoir' for rabies. It has to bite you to transmit the virus.

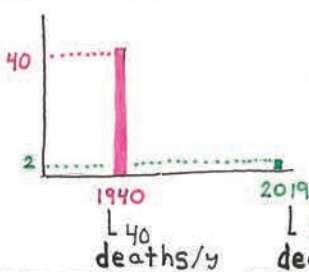
Plot Spoiler: Travis

Somebody in this story gets rabies.

Old Yeller



Human Rabies deaths per year in USA.



⊖ - Why the dramatic decline?

1. Vaccination of dogs!!

rabies vaccine →



2. Rabies anti-bodies Y

• You get this if you're bitten by a rabid animal.

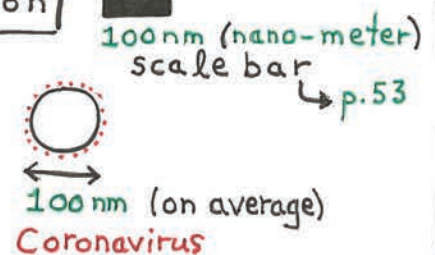
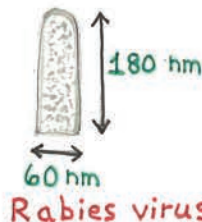
deaths/y (in a country of 328 million people)



← Rabies virus

- ⊙ Bullet shape
- ⊙ The earliest written record of rabies was 2300 B.C. in Babylon.

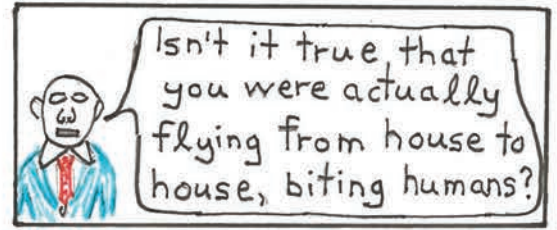
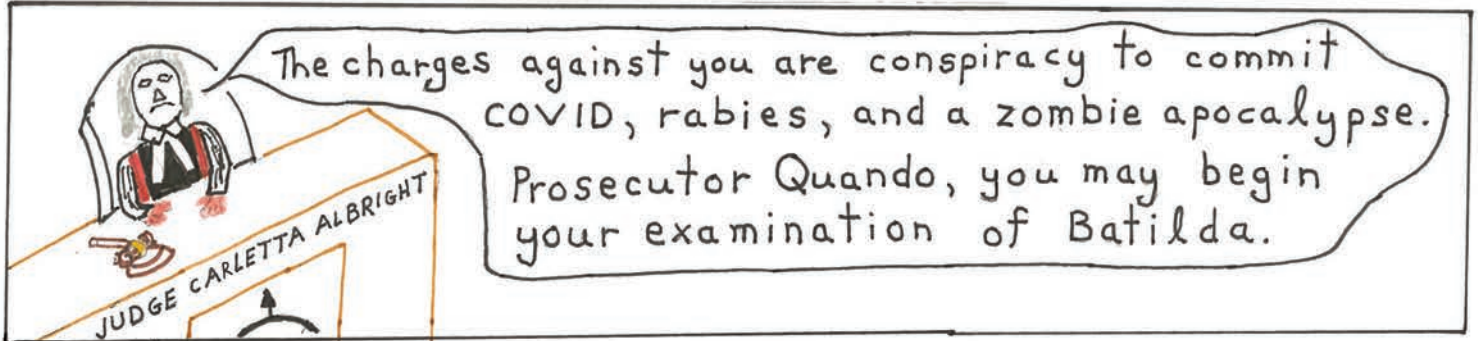
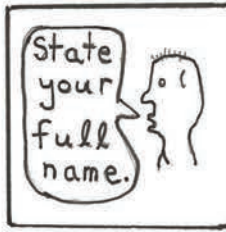
Size comparison

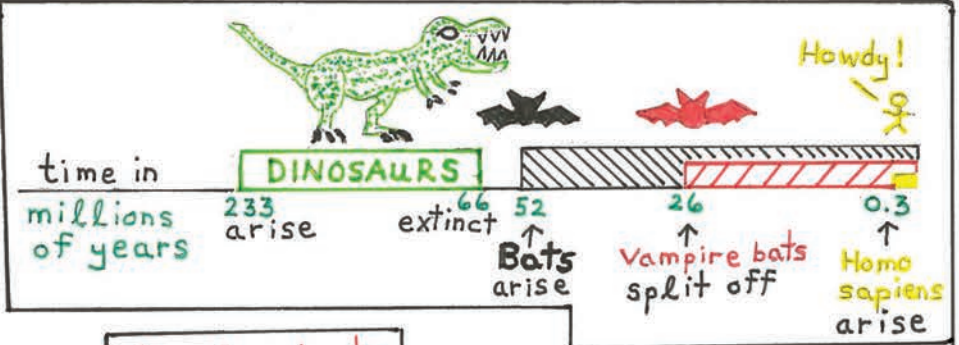
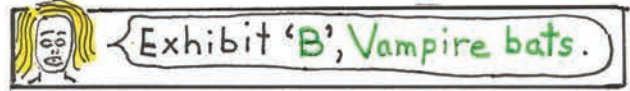
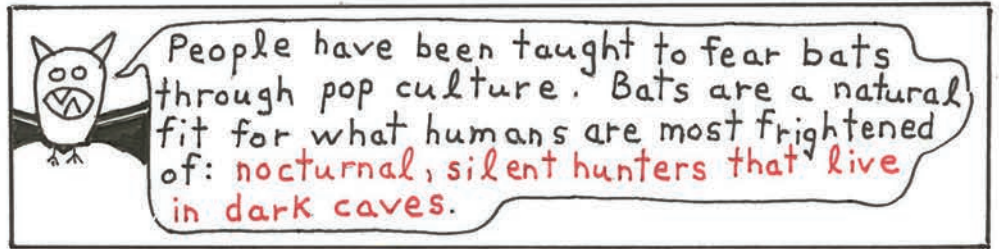


♀ - Do you think any of the animals on Noah's ark had rabies?

♀ - Hmm, they seemed to march up the ramp politely, so I vote No.

BATS ON TRIAL

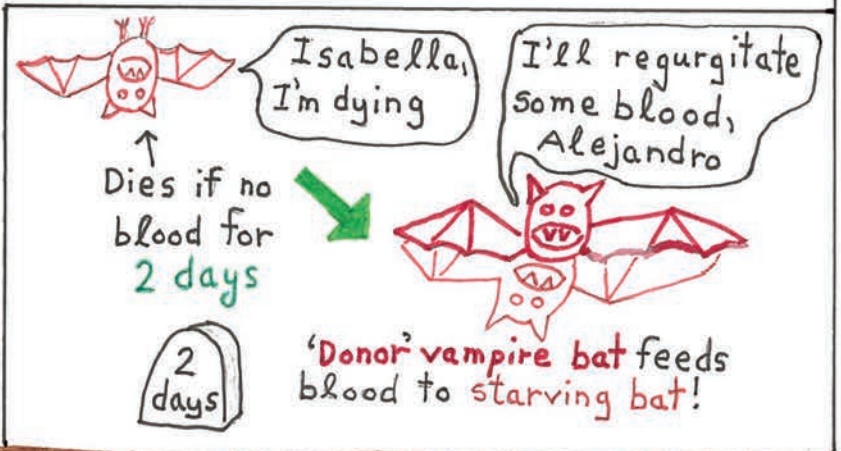




Vampire bats

- ◆ They are mammals (warm blooded, live birth).
- ◆ They are the only mammals that feed exclusively on **blood**.
- ◆ There are **3** species of vampire bat.

Common vampire bat	Hairy-legged vampire bat	White-winged vampire bat
Feeds on blood of mammals	Feed on the blood of birds	
	sleeping chicken	



Chapter 4

Coronavirus - it has more personality than you thought



Could I interest you in a glass of wine? Perhaps some Pneumonia?

The list goes on

- 129. More birds
- 130. Alpaca, Cow calf
- 131. Giraffe, yak, deer, water buffalo
- 132. Hyena, ferret, raccoon dog, mink
- 133. The Tiger Sisters at the Bronx Zoo



♀ - I had no idea giraffes got diarrhea

♂ - stand clear


- 112. Who does Coronavirus infect?
- 113. Sock drawers
- 114. Bent-wing bat
- 115. Soprano pipistrelle Japanese house bat
- 116. Chinese rufous horseshoe bat
- 117. Intermediate horseshoe bat Egyptian fruit bat a.k.a. flying fox
- 118. Lesser bamboo bat Vampire bat



Bats

- 119. Chinese bulbul
- 120. Gallus gallus a.k.a. The Chicken that Coronavirus beat the crap out of

Birds

- 121. "Things went downhill after
- 122. the diarrhea started," said my cat.
- 123. 
- 124. Cheetah, civet, dog
- 125. European hedgehog 1-hump camel
- 126. Pangolin
- 127. Pig, mouse
- Experimental animal for Multiple Sclerosis (MS)
- 128. Beluga whale, dolphin, seal

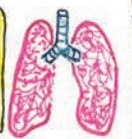
A potpourri of animals that Coronavirus infects

- 134. human Coronavirus 229E
- 135. human Coronavirus NL63
- 136. human Coronavirus HKU1 human Coronavirus OC43
- 137. SARS Coronavirus
- 138. MERS Coronavirus
- 139. COVID-19 Coronavirus 

human Coronaviruses

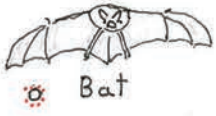
- 140. What's special about COVID?
- 141. Let's collect our thoughts
- 142. Anatomy, Anatomy, Anatomy
- 142. What does 'Respiratory Tract' mean?
- 143. SOMPOO's Soliloquy
- 144. Goblet cells make gob
- 145. How Coronavirus enters nose cells
- 146. Let's slice the Lungs open
- 147. An air sac is a hollow ping pong ball
- 148. What if the virus lands on your eye?
- 149. Cry me a river
- 150. Can you swallow coronavirus?
- 151. Excretion versus Secretion - yes, it's on the exam
- 152. Saringas and Cystic Fibrosis (CF)

Anatomy to cement the concepts together. Don't you dare skip this!



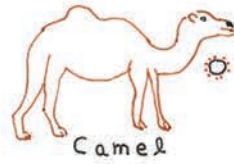
WHO DOES CORONAVIRUS INFECT?

☉ - Lots of different animals



Bat

Miniopterus bat coronavirus
 Pipistrellus bat coronavirus
 Rhinolophus bat coronavirus
 Rousettus bat coronavirus
 Tylonycteris bat coronavirus



Camel

Camel coronavirus

• This jumped from camel ^{to} human in 2012, causing the MERS Coronavirus Pandemic



Bulbul

Bulbul coronavirus

• A bulbul is a bird



Pangolin

Pangolin coronavirus

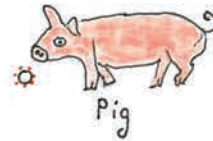
• This jumped from pangolin ^{to} human in 2019. Maybe.



Chicken

Avian coronavirus

• A chicken is a bird



Pig

Porcine coronavirus

Porcine epidemic diarrhea virus

• It's a coronavirus
Transmissible gastro-enteritis coronavirus



Cat

Feline coronavirus



Mouse

Murine coronavirus



Cheetah

Feline coronavirus



Civet

Civet coronavirus

• This jumped from civet ^{to} human in 2003, causing the SARS Coronavirus Pandemic



Beluga whale

Beluga whale coronavirus



Dog

Canine coronavirus



Harbor seal

Harbor seal coronavirus



Hedgehog

Hedgehog coronavirus



Bottlenose dolphin

Bottlenose dolphin coronavirus



Human

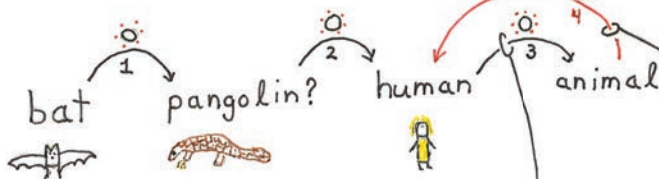
Full name	Short name	Transmission	Disease
Human CoronaVirus 229E	HCoV-229E		
Human CoronaVirus NL63	HCoV-NL63		
Human CoronaVirus HKU1	HCoV-HKU1		
Human CoronaVirus OC43	HCoV-OC43		
Severe Acute Respiratory Syndrome CoronaVirus	SARS-CoV-1 [⊗]	bat → civet → human	SARS
Middle East Respiratory Syndrome CoronaVirus	MERS-CoV	bat → camel → human	MERS
Severe Acute Respiratory Syndrome CoronaVirus-2	SARS-CoV-2	bat → pangolin? → human	COVID-19

CoronaVirus Disease 2019

☉[⊗] To ↓ risk of confusion, let's refer to it as SARS-CoV-1.

3 - Has a human transmitted coronavirus to an animal in the current pandemic?

4 And did that animal transmit it back to humans?

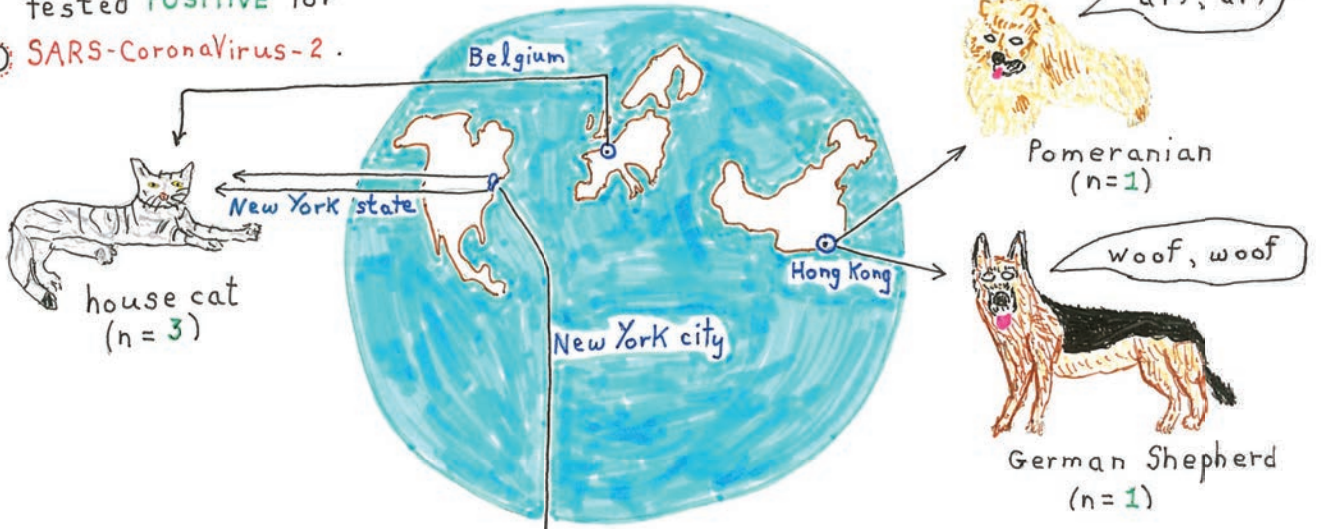


This has happened

This has not happened as far as anyone knows

The following 13 animals have tested POSITIVE for

SARS-CoronaVirus-2.



BRONX ZOO = 8 big cats
 { 7 symptomatic
 { 1 asymptomatic



African lion (n=3)

- Adamma
 - Nala
 - Shani
- } triplet sisters



Malayan tiger (n=3)

- Nadia
 - Azul
 - Bumi
- } sisters



Siberian tiger (n=2)

- Bashuta
- Julian

INVESTIGATION 2 April 2020

- Nadia (4 years old) has a cough and ↓ appetite → swabs taken from
 { nose
 { mouth
 { trachea (windpipe)
- The other 7 big cats → fecal (poop) samples

RESULTS All 8 big cats are SARS-CoronaVirus-2 POSITIVE. They all recover.

CONCLUSION An asymptomatic zookeeper (identity unknown) probably infected them.

ACTION As punishment, a random zookeeper is chosen by drawing straws and fed to the lions.
 Just Kidding.

#7



Severe Acute Respiratory Syndrome CoronaVirus-2

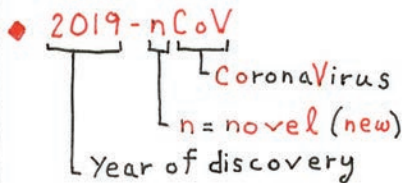


Is Best Buy open during COVID-19?

- In case you arrived late, this coronavirus is the one currently wreaking havoc on our lives.

Same, same

- You may encounter different names for the virus. They all mean the same thing.



- This was the original name assigned to the virus in the **New England Journal of Medicine** (one of the top journals in medicine) on **24 January 2020** in an article titled:

A novel coronavirus from patients with pneumonia in China

Wuhan Human 1 Coronavirus

. This name was assigned in the journal **Nature** (a top-tier science journal) on **3 February 2020** in an article titled:

A pneumonia outbreak associated with a new coronavirus of probable bat origin

WHCV

Severe Acute Respiratory Syndrome CoronaVirus-2

- . This is the official name as of **11 February 2020**.
- . It was assigned by the **Coronavirus Study Group** of the **International Committee on Taxonomy of Viruses (ICTV)**.
- . The **CDC** and **WHO** use this name.



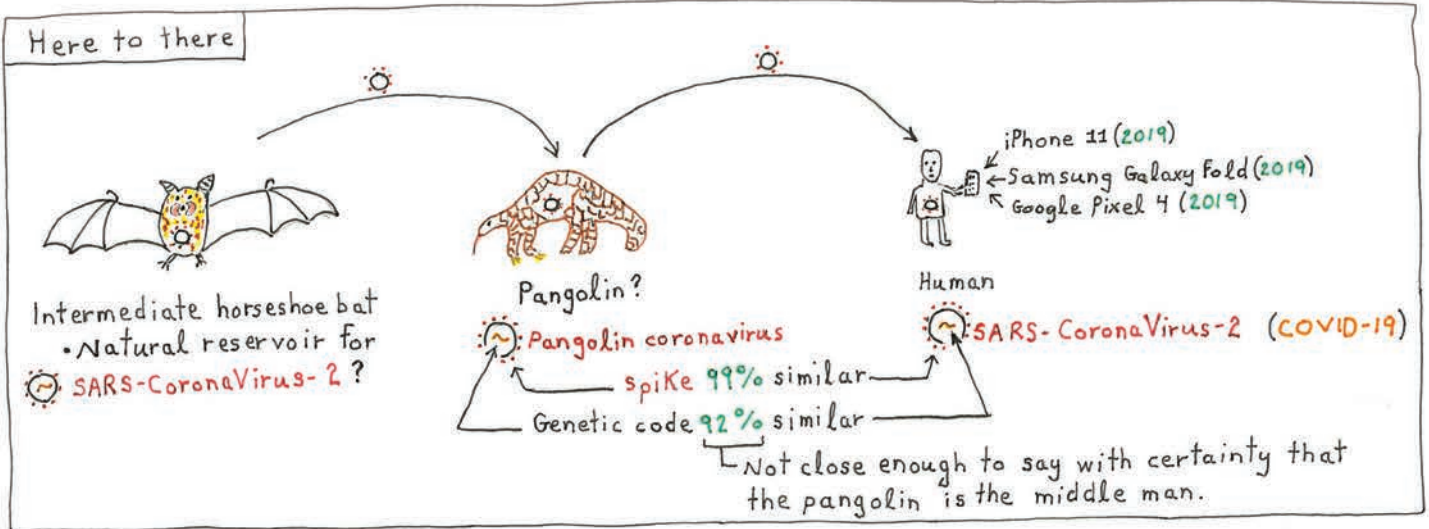
We met them before. They have assigned an official name to **6590** viruses.

SARS-CoV-2

CoV-2 - "Kow vee 2"
SOMPoo SAYS rhymes with low

- COVID-19 virus
- COVID Coronavirus
- Coronavirus

. If you hear this, **99.999%** chance it means this particular coronavirus.



☹ - Let's compare Case Fatality Rates

SARS (2003) $\frac{774 \text{ deaths (RIP)}}{8098 \text{ cases}} = 10\% \text{ Case Fatality Rate (CFR)}$

☉ SARS-CoronaVirus-1

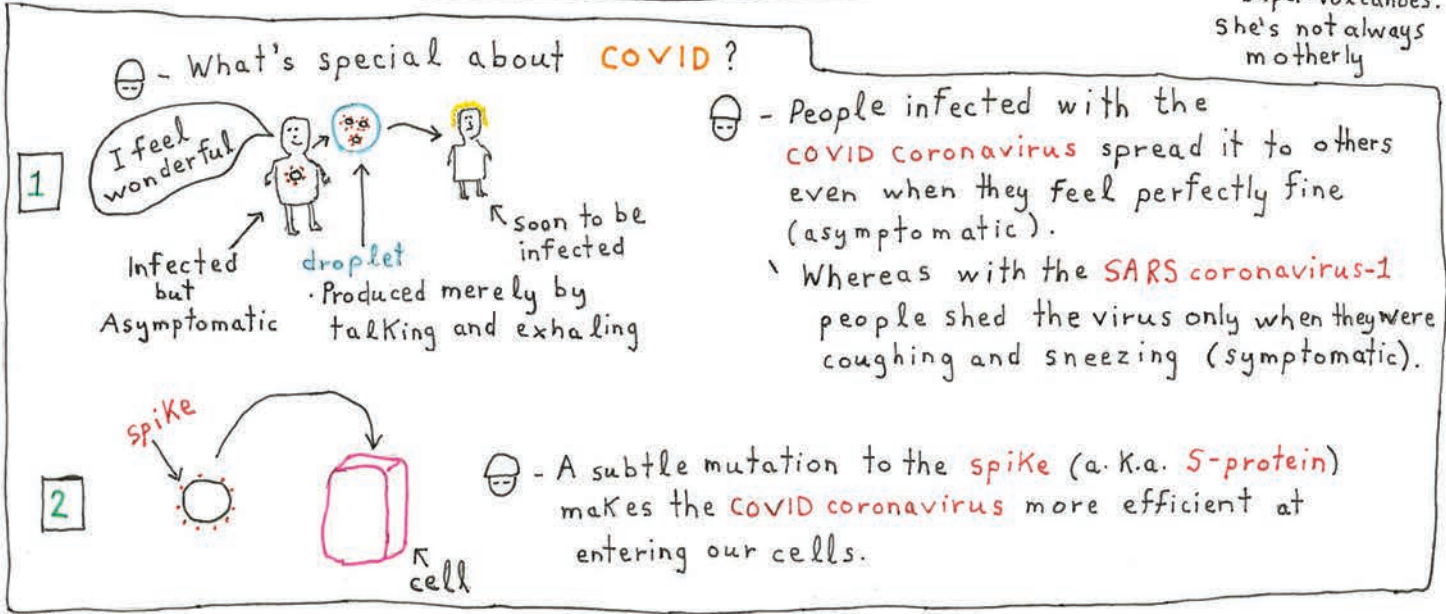
MERS (2012) $\frac{858 \text{ deaths (RIP)}}{2494 \text{ cases}} = 34\% \text{ Case Fatality Rate (CFR)}$

☉ MERS-CoronaVirus

COVID (2019) $\frac{6,881,995 \text{ deaths (RIP)}}{676,169,955 \text{ cases}} = 1\% \text{ Case Fatality Rate (CFR)}$ $\nearrow 10 \text{ March } 2023$

☉ SARS-CoronaVirus-2
I'm silent but deadly, like a nasty fart from Mother Nature

♀ - That's no way to talk about Mother Nature.
♀ - She also releases super-volcanoes. She's not always motherly



CHAPTER 5

THE HORRENDOUSLY CONFUSING



OF



aerosols,

PARTICLES,



MASKS,

AND SOCIAL

DISTANCING.



154-155. 5 Types of Respirators

- ⊙ Gas mask
- ⊙ Escape Respirator. Yikes!
- ⊙ Self-Contained Breathing Apparatus (SCBA)
- ⊙ Powered Air-Purifying Respirator (PAPR)
- ⊙ N95 mask

Masks
+
Droplets

156-157. N95 Technical Details

158-159. Guinea Pigs Who Died for Your Sins

160. What is a Negative Pressure Room?

161. The 5 micron dividing line you've never heard of

Droplet transmission Airborne transmission

162. Blast Zone: a bit of melodrama

163. Location, Location, Location

164. How Long Does It Take For An Anvil To Fall 1 mile?

165. More Scale: Getting to Know Your Droplets

166. Atmosphere Layers and Bio-aerosols

167. Volcanic ash, PM_{2.5}, and colloids. What?

168. A Dead Horse named Equus



UNCLE WALTER'S SUPREMO MASK is made of spider silk, my scrap underwear, and graham crackers. It is ga-ron-teeed to stop Ebola, croonervirus, and comet-hitching bacterions from outermost space.



\$9.99 for 1
\$99.99 for 5

☹ - Before this conversation goes off the rails, the whole concept of social distancing and masks (whether N95 or otherwise) is based on droplets.

✓ Coughing/sneezing/talking/breathing generate droplets of liquid - some are big and fall to the ground, and some are small and float in the air.

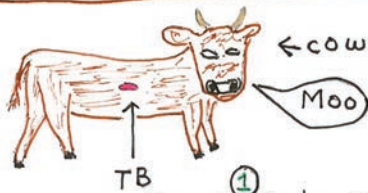
✓ Let's look at some seminal scientific experiments on droplets because they highly influenced the understanding of disease transmission.

♀ - Seminal?
♂ - An adjective for groundbreaking experiments that change how we think about a topic.

EXPERIMENT #1 - 1954

🔴 ← Myco-bacterium tuberculosis (TB, for short)

☹ - Remember this guy? It's the rod-shaped bacteria that causes the lung infection called TB.

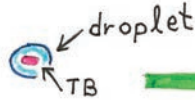


← cow Cows can suffer from TB. It's called **Bovine TB**.

① Isolate this bacteria (well, millions of them) from cows

vial
• Contains TB and water

② "Atomize" the water to create airborne droplets containing the bacteria



← guinea pig (inhales droplets)
③ Expose guinea pig to airborne droplets

④ Guinea pig develops TB

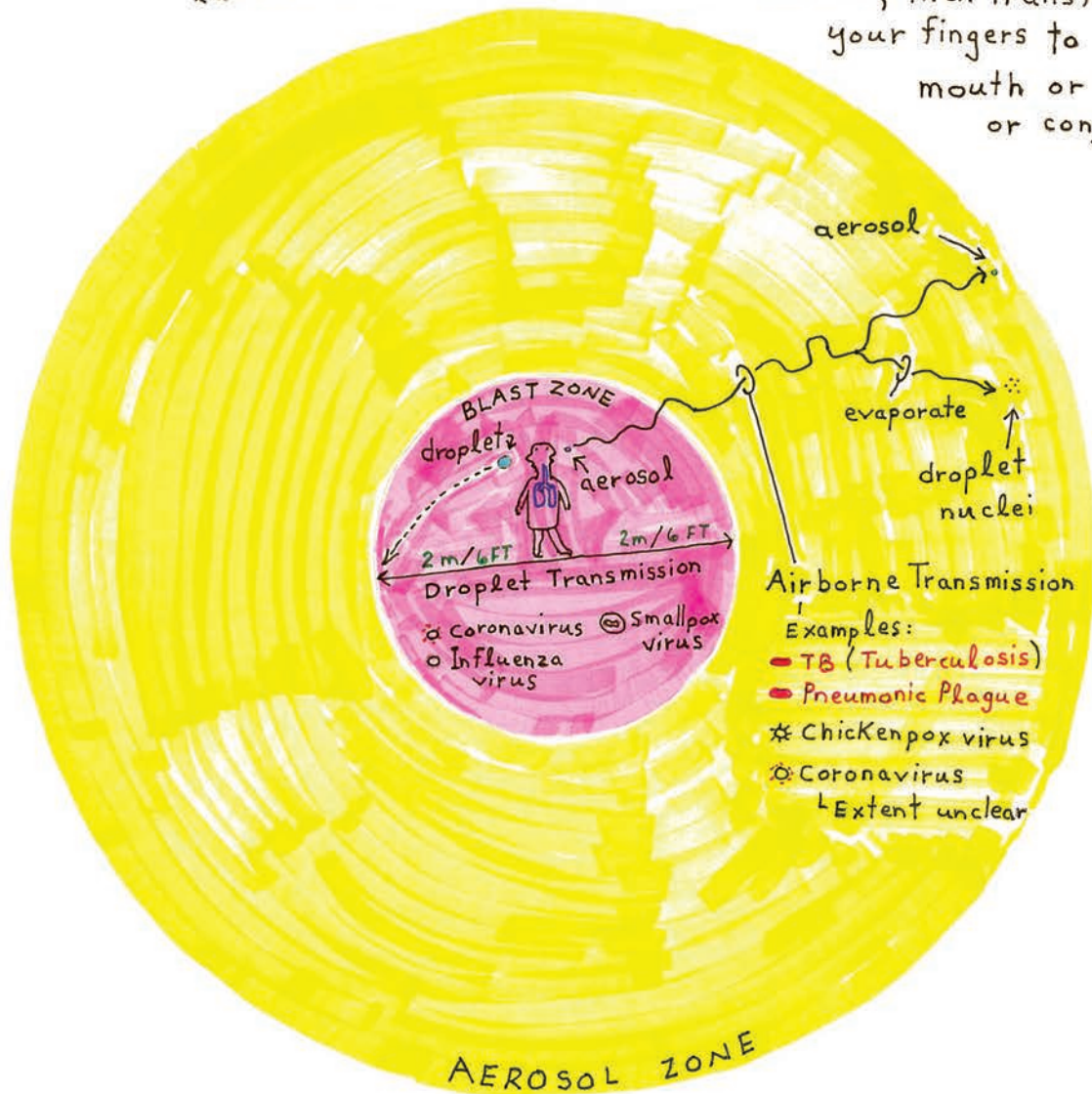
☹ - This experiment was performed by an "eccentric genius" named **William Firth Wells**.

- Guess what? The guinea pigs were in hospital rooms (without patients) at the VA Hospital in Baltimore, Maryland.
- And airborne droplets were released into the ventilation system.

- ⊖ Let's pretend a person infected with a bacteria or virus in their **nasal cavity**, **oral cavity** or **lungs** is like a bomb that explodes every time they sneeze or cough, sending 'shrapnel' everywhere.
- Anyone inside a blast radius of **2 meters (6 feet)** from the infected guy in the center will get blasted in the face by a droplet (larger than **5 μm** wide).

⊙ We'll call it the **BLAST ZONE**

⊙ This is **Droplet Transmission** (by the way, the droplet could land on a surface and then be touched, then transferred by your fingers to your mouth or nose or conjunctiva).



- Anyone in the **Aerosol Zone** (I made that term up) can inhale the aerosol (a droplet < **5 μm** wide) or droplet nuclei.

- This is **Airborne Transmission**

⊙ The classic example is **TB (Tuberculosis)**, which was the point of those experiments with guinea pigs.

⊙ This also includes **Aspergillus fungal spores** released into the air.

⊙ Some pathogens simply die in the air. They don't cause Airborne Transmission.

☹ - Time again for a sense of scale, looking specifically at liquid droplets and solid particles.
 Remember, micron shorthand is μm .

hair on scalp is $100 \mu\text{m}$ wide (diameter)
 AAACHOO!
 $100 \mu\text{m}$ is a large droplet
 pollen

$0.1 \mu\text{m}$ Coronavirus, atmospheric dust, radioactive fallout
 scale bar: 200 nm , $0.1 \mu\text{m}$

$0.2 \mu\text{m}$ Cloud Condensation Nuclei (CCN)
 This is the minute dust that water condenses on to form clouds.

$0.3 \mu\text{m}$ N95 mask filters 95% of 300 nm ($0.3 \mu\text{m}$) particles or droplets

$1 \mu\text{m}$ Small droplet ("aerosol") produced by cough/sneeze
 tobacco smoke
 Staph aureus
 single coccus in cluster is $1 \mu\text{m}$ in diameter

$2 \mu\text{m}$ Fungal spore
 Aspergillus ← air-borne spore is $2 \mu\text{m}$ wide

$2.5 \mu\text{m}$ PM_{2.5} = Particulate Matter small enough to be inhaled deep into the lungs (into the air sacs).
 = Environmental Protection Agency (EPA) sets PM_{2.5} as a hazardous size.

Volcanic ash that is smaller than $4 \mu\text{m}$ wide

"aerosol"
 $5 \mu\text{m}$ dividing line
 "droplet"

$4 \mu\text{m}$ capillary diameter is $4 \mu\text{m}$
 Red Blood Cell (RBC)

$5 \mu\text{m}$ broncho-dilator particle size
 eg, Ventolin
 We want these particles to land in the bronchi (airway) where they cause the muscle to relax → ↑ diameter → ↑ air flow

Fuel injection gasoline droplet

$7 \mu\text{m}$ Red Blood Cell (RBC) squished flat on a glass microscope slide is $7 \mu\text{m}$ wide

$9 \mu\text{m}$ Type II Pneumo-cyte that Coronavirus infects (okay, it's not a particle; it's a cell)

☹ - Basically, everything on this page fits inside a period with ease.





$20 \mu\text{m}$ cloud droplet
 This is the water that condenses on the Cloud Condensation Nuclei (CCN)
 1,000,000 of these $20 \mu\text{m}$ droplets make a raindrop.

The quick brown fox jumps over the lazy dog. ← $300 \mu\text{m}$
 The period is so big it cannot fit on this page

A raindrop is $2000 \mu\text{m}$ (2 mm) ($\frac{3}{16}$ " wide. Relatively huge.
 On the scale of this page, a raindrop is 4 m (12 feet) wide - probably about the size of the room you are in.

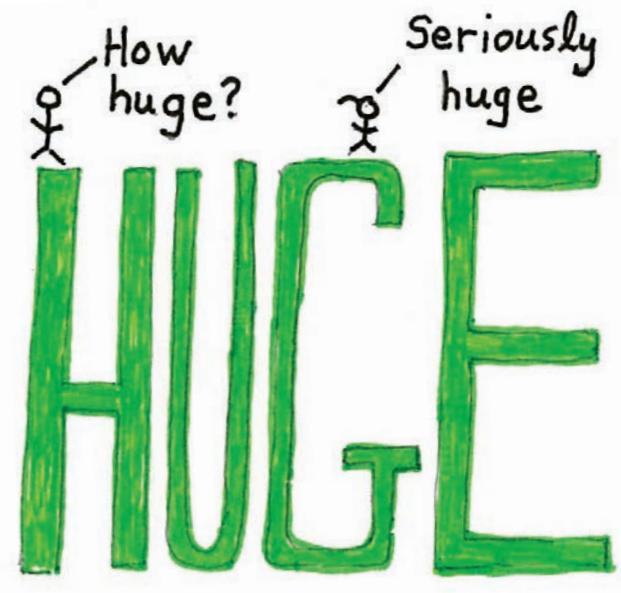
CHAPTER 6

OMG WHAT A DISASTER

WHAT CAN THE TITANIC, 
 A NUCLEAR ACCIDENT, 
 A PLANE CRASH, 
 AND COW INTESTINES 
 TEACH US ABOUT MANAGING
 A PANDEMIC?

- 170-172. Titanic
- 173-174. Three Mile Island nuclear accident
- 175. Worst Plane Crash ever
- 176-178. Please Don't Drink the Cow Manure
- 179. Information Failures
- 180. Acronyms Who Want to Help You
- 181-183. The Unicorn of Prevention
- 184. Can a Pandemic actually be Prevented?
- 185. Continuum of Badness
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- 188. How you find it
- 189. The Mucous Escalator
- 190-191. Acknowledgements
- 192-219. Index
- 220-222. Pesky organisms at your fingertips
- 223-224. Author Bio



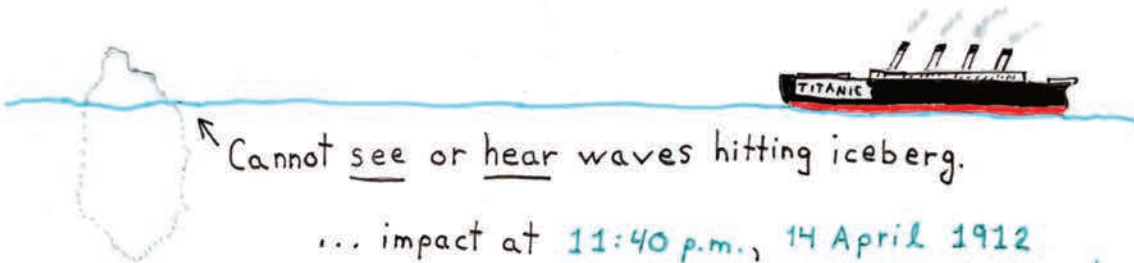
Want more information? There is a huge **bibliography** on allenjonesmd.com where the key points of every source used in this guide are summarized in bulleted points.

You may not know this, but you can memorize vast amounts of information using the simple tools described on **page 189**.

☹️ - Oh, silly me, I almost forgot that we first met at the Titanic.
There are 4 reasons why she sank.

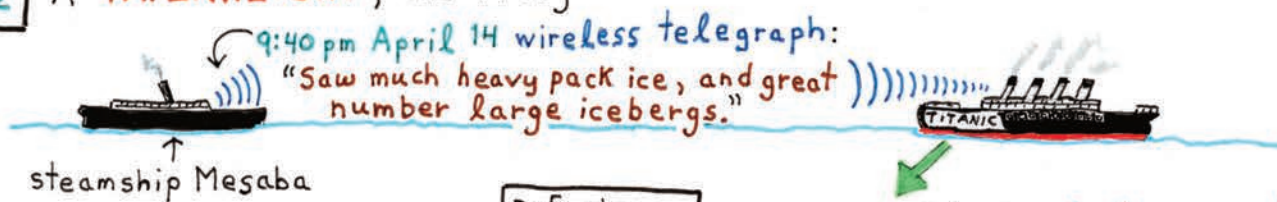
#1 CALM WEATHER, ironically.

☆ ☆ ← Moonless night
Iceberg not visible by reflected moonlight.

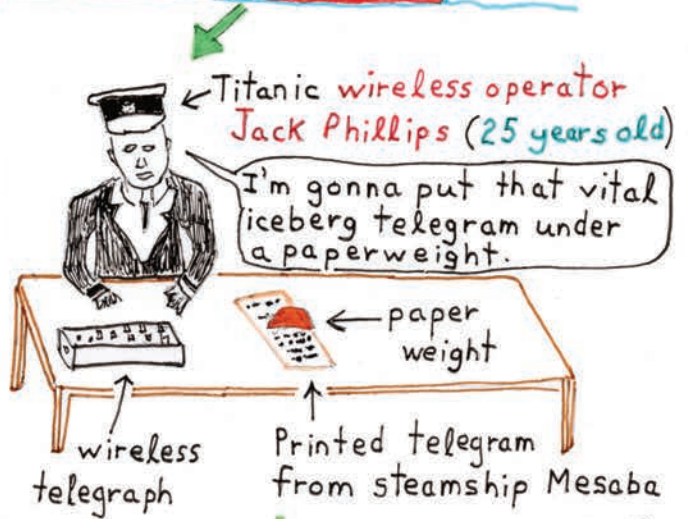


... impact at 11:40 p.m., 14 April 1912
... 20 Knots (1 Knot = 1.15 miles per hour)
↳ 23 miles per hour
... sinks (as in, disappears) 2:20 a.m., 15 April

#2 A PAPERWEIGHT, bizarrely.



Definitions		
<p>16 feet or higher Above Sea Level (ASL) 5382 square feet iceberg</p>	<p>3-16 feet ASL 1076-3299 sq. ft. 'bergy bit'</p>	<p>0-3 feet ASL 215 sq. ft. 'growler' (size of a grand piano)</p>

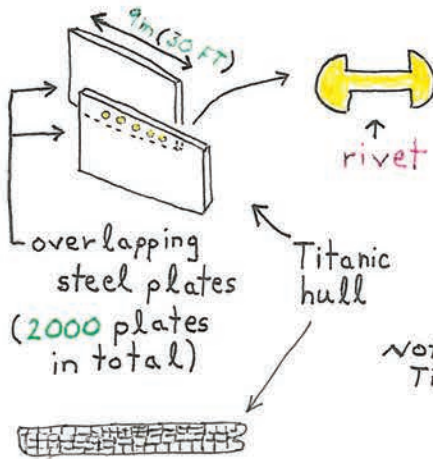


Fatal delay as Phillips continues to send passenger messages to Cape Race, Newfoundland



Money Talks
1896 - Guglielmo Marconi invents wireless telegraph.
1903 - Marconi wireless telegraphs installed on ships.
↳ Ship-to-ship message \$
↳ Passenger-to-land message \$\$\$
10-word 'Marconigram' is \$82 (if 2023).

#4 RIVETS, RIVETS, RIVETS



- ⊙ 600 rivets per steel plate.
- ⊙ 3,000,000 rivets in total.
- ⊙ Manually pounded into holes with a rivet hammer.
- ⊙ Made of steel.
 - ⊙ Iron + 1% Carbon = Steel
 - ⊙ steel is stronger than iron alone.
- Not the Titanic [
 - ⊙ Chromium is added to make Stainless Steel (Like a Japanese Knife to chop credit cards).
 - ⊙ Sulfur is added to increase the 'machinability' of steel (which is how easy it is to cut).

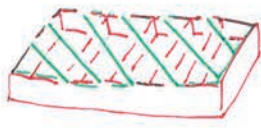
* The steel rivets of the Titanic had a high sulfur content, causing them to be brittle in cold water, which when combined with the high impact forces with the iceberg, caused the steel plates of the hull to separate, allowing water to enter the ship. *

- ☹ - What was the point of that Titanic trivia?
- The Titanic was a state-of-the-art ship in 1912.
 - It had more rivets than the Eiffel Tower.
 - It had motors to lower the bulkhead between compartments.



After the Titanic sank, there were changes to ship design.

① ↓ sulfur in rivets

②  ← The 5-sided compartments (think, ice cube tray) of new ships became 6-sided. Basically a lid was added ∴ ∅ H₂O spill-over if a single compartment floods. Alternatively, a taller bulkhead.

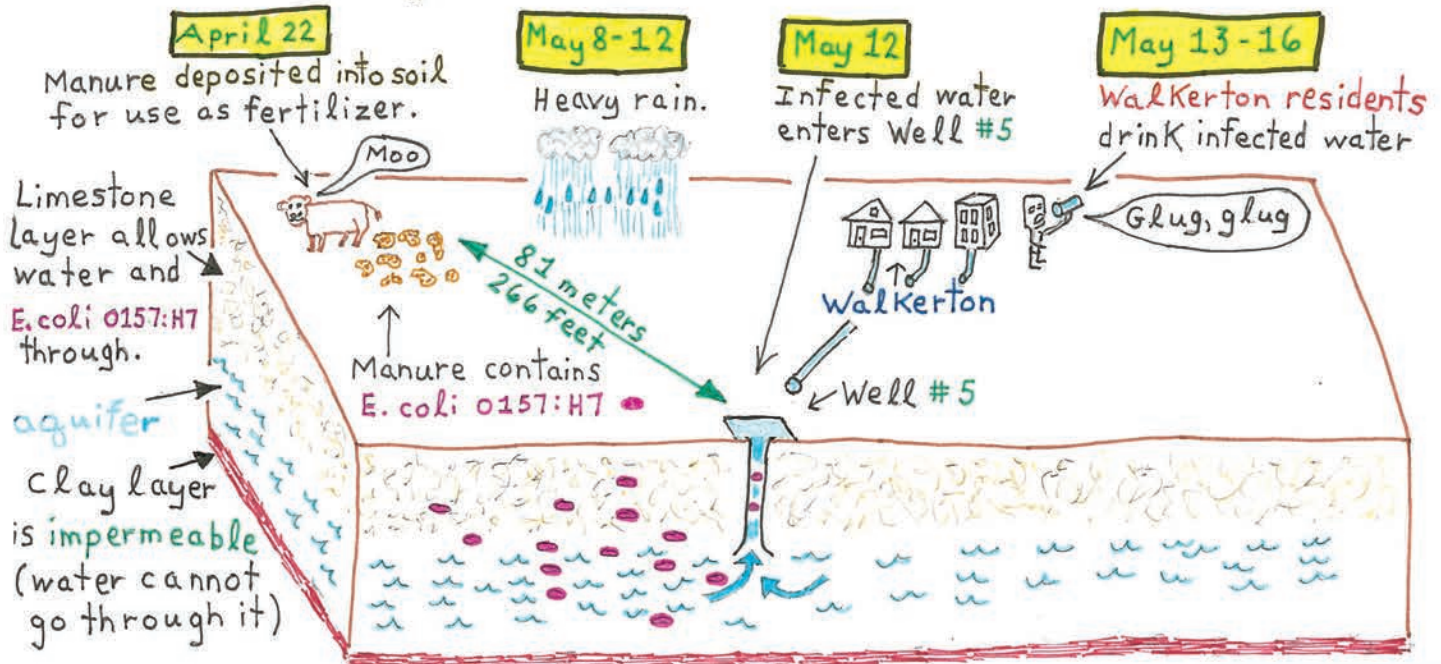
- ☹ - Disasters reveal the flaws in 'state-of-the-art' technology and prompt change and innovation. State-of-the-art during the 1918 Influenza Pandemic was basically subpar cloth masks. No vaccine existed. And no one had ever even seen a virus (the electron microscope was invented in 1931).
- Let's explore some disasters to gain context on how to manage a pandemic.

☹ - Welcome to Walkerton. The year is 2000.



Walkerton, population 5000.

◊ The drinking water is supplied by an aquifer (water trapped by rock layers).



☹ - This was a tightly-coupled system. The heavy rains were like a transit strike revealing flaws in the system.

① The Walkerton **Public Utilities Commission (PUC)** employees knew very little about water safety, nevertheless the **government** certified them as qualified. That's double complacency.

→ Chlorine is added to water to kill **E. coli 0157:H7**.

0.5 mg Chlorine per 1 ml of water was the standard.

0.27 mg/ml was what the **PUC** maintained.

→ **Water samples** were carelessly taken.



Report goes to (clueless) **PUC** who have no obligation to contact **MOH** whose job is to safeguard the public.

What happened?

Shiga Toxin → 2000 cases of Gastro-Enteritis (diarrhea or bloody diarrhea).

→ 6 deaths in children from

Hemo-lytic Uremic Syndrome where Red Blood Cells fragment and there is sudden **Kidney Failure**.

☹️ - Can a PANDEMIC actually be prevented?

In a world of planes, automobiles, ships, and vectors



Singapore, here we come!
Road Trip!
S.S. CROWDED
AAACHOO!
All aboard!
droplets, aerosols,
>5µm <5µm


and vectors



Really? I'm a vector?
I have 1,000,000 followers in my cave. #dontblameme
I transmit the Black Death. And I jump like a champ.
flea (Class Insecta: 6 legs)

... that's a challenge.

☹️ - The World Health Organization (WHO) divides up the world into 6 regions, each with a Regional Director (usually a Medical Doctor).



Americas
Africa
Europe (includes Russia)
Western Pacific (China, Australia)
South East Asia (India, Thailand)
Eastern Mediterranean (Egypt, Saudi Arabia)

♀️ - Is there a regional director in Antarctica?
♂️ - Nope. But maybe they should send a vet down there because the nasty fungus *Aspergillus* can infect penguins.

Aspergillus




penguin → call the vet on my sat phone



☹️ - Within each WHO region, every country has a Medical Officer of Health (MOH) to implement pandemic guidelines. But the MOH does not work for the WHO, necessarily.

I'm me - What are the biggest obstacles to cooperation?

You're you - sovereign states do not have to comply with the WHO.
Lack of 'metrics' that measure how many people are infected.
Inability to cope with a surge in cases.
War, famine.



mucociliary
escalator

I just got here!
I don't want
to leave

See you in
Volume 2

As you can see, I'm avoiding
the mucous.

In Volume 2 we'll explore **DNA/RNA**, **blood**,
the **immune system**, **vaccines**, the difference
between **anti-biotics** (eg., penicillin for bacteria)
and **anti-viral drugs** (for viruses), **ventilators**,
Shock, and the **Intensive Care Unit (ICU)**.
Plus other random goodies.

You probably spent **12 hours** reading this guide.
It's nice to remember what you read. So if you
now head back to the **Table of Contents**
and rapidly scan it, you'll see what you've learned.
That helps to cement it in your brain.

If you spend **60 minutes** in a class (or making notes by yourself),
take **2 minutes** at the very end to summarize the lesson in
1 to 2 sentences (as in, write it/type it). Then **24 hours later**
do a quick **2 minute** review of the notes plus your summary.
This is a powerful tool for converting Short Term Memory (STM)
to Long Term Memory (LTM). **4 minutes** on top of **60 minutes**.
The **4 minutes** creates cement.

Well, blah blah blah

Ciao
for now,
SomPoo

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Color coding

- Disease, Infection, or Medical Condition
- People

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Allen Sohrab Jones was born in Nairobi, Kenya and is a dual citizen of the United States and Canada. Educated in Canada, he received a B.Sc. in zoology from Brandon University, Manitoba and an M.Sc. in neuroscience from the University of Manitoba, then an M.D. from the University of British Columbia, Vancouver. He completed his internship as a primary care physician at McMaster University in Hamilton. This was followed by ten months of emergency medicine training, including electives in toxicology at Bellevue Hospital in Manhattan, trauma at the R Adams Cowley Shock Trauma Center in Baltimore, and aerospace medicine at the Kennedy Space Center in Cape Canaveral. Subsequently, he became certified in addiction medicine, his current area of practice. Concurrently, he is a surgical assistant for procedures in orthopedic surgery, plastic surgery, and general surgery.

Dr. Jones started writing and drawing *The Hidden Zoo Inside You* during the pandemic after realizing the extent of misinformation regarding the coronavirus, and was further motivated by his passion for explaining and demystifying the language of medicine to his patients. When not working on his book or with his patients, he enjoys rock climbing and traveling. He currently lives in Vancouver.

The Hidden Zoo Inside You is Allen Jones's fascinating, funny illustrated guide to microscopic organisms and the problems they can create. ... Stuffed with an incredible amount of information. ... Warmth, humor, and enthusiasm permeate the hand-drawn and lettered book. ... *The Hidden Zoo Inside You* is a thorough, understandable graphic history of microbes and disease, presenting facts with a unique and appealing visual style.

— Foreword Reviews

Jones' artwork features hand-drawn sketches, accompanied by an array of in-the-margins notes that recall Randall Munroe's popular webcomic *xkcd*. ... there is a definite sense of thoroughness to the work that makes it unnecessary to be an expert in the subject matter to follow its many explanations. Any complicated or confusing jargon is helpfully broken down into accessible definitions, with explications of each of their root words and their origins. Readers will find that there is a real sense of movement in the book's cluttered scribbles, which bring to life such complex processes as how air moves through the respiratory system, or how viruses and bacteria invade ecosystems and the bodies that exist within them. Like any good work of comic art, the subject dictates the reader's pace, and this is certainly a resource that one should take time to pore over and not rush through. ... An expansive and informative epidemiological look at viruses.

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Professor Emeritus of Infectious Disease
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