Did You Just Eat That?
Busting Food Myths

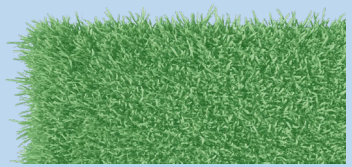
CLEMSON CREATIVE INQUIRY

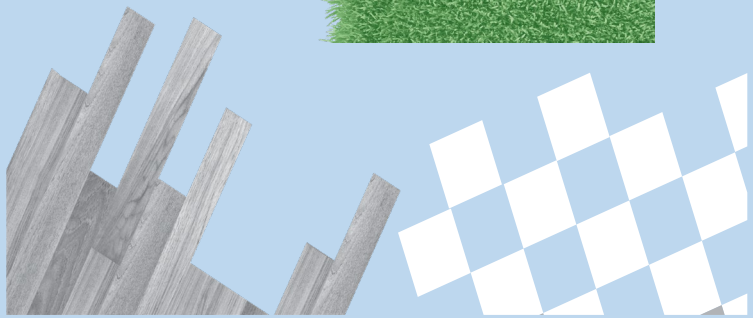
Paul Dawson

2.

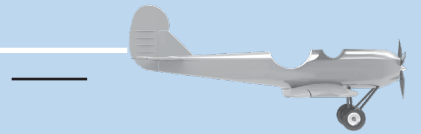
Air & Water

Surfaces





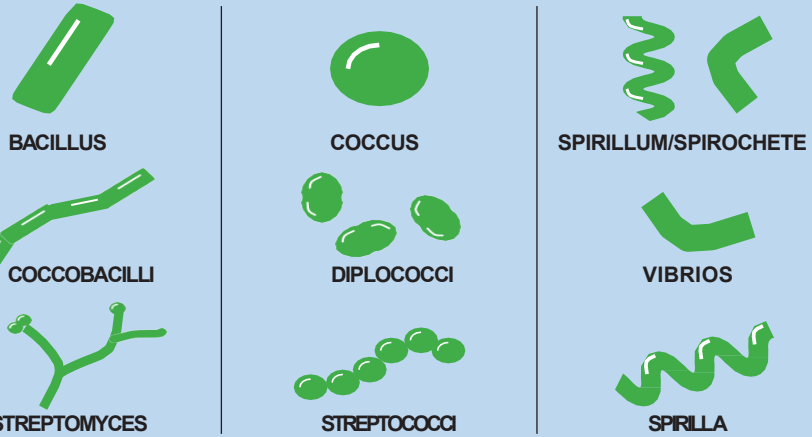
Bacterial



Transport

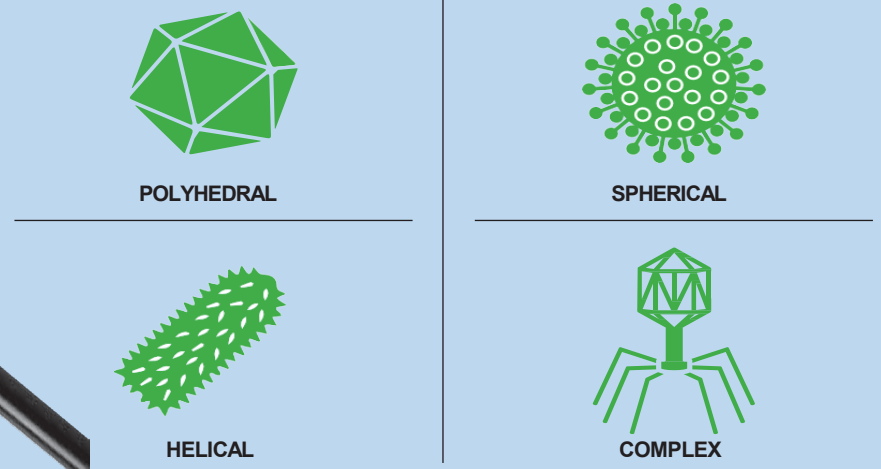
Mechanisms

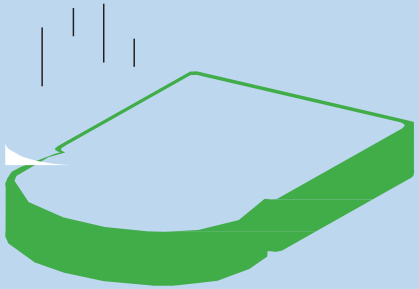
EXAMPLES OF BACTERIAL SHAPES AND ARRANGEMENTS



A DIVE INTO THE MYSTERIOUS MICROBIAL WORLD

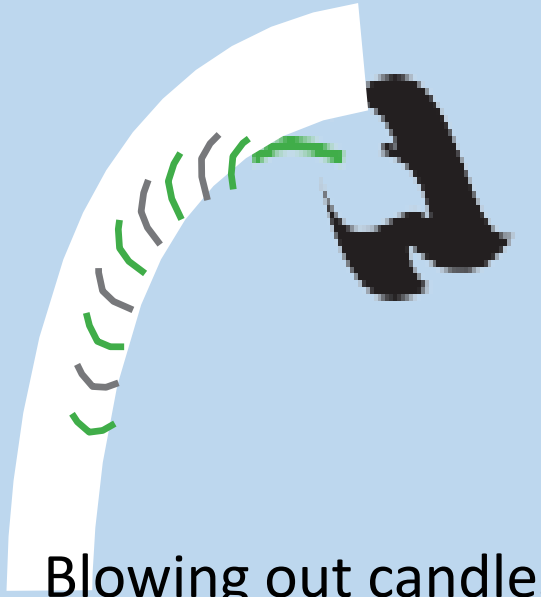
VIRUS VARIETIES





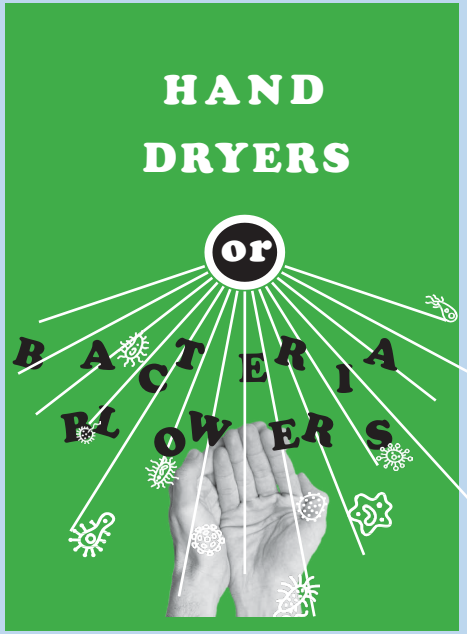
5-second rule

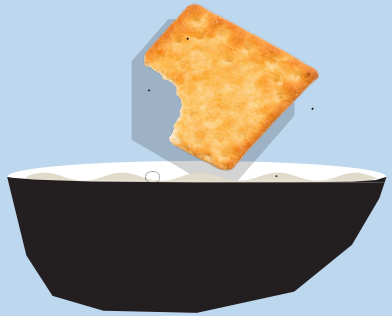
Restaurant menus



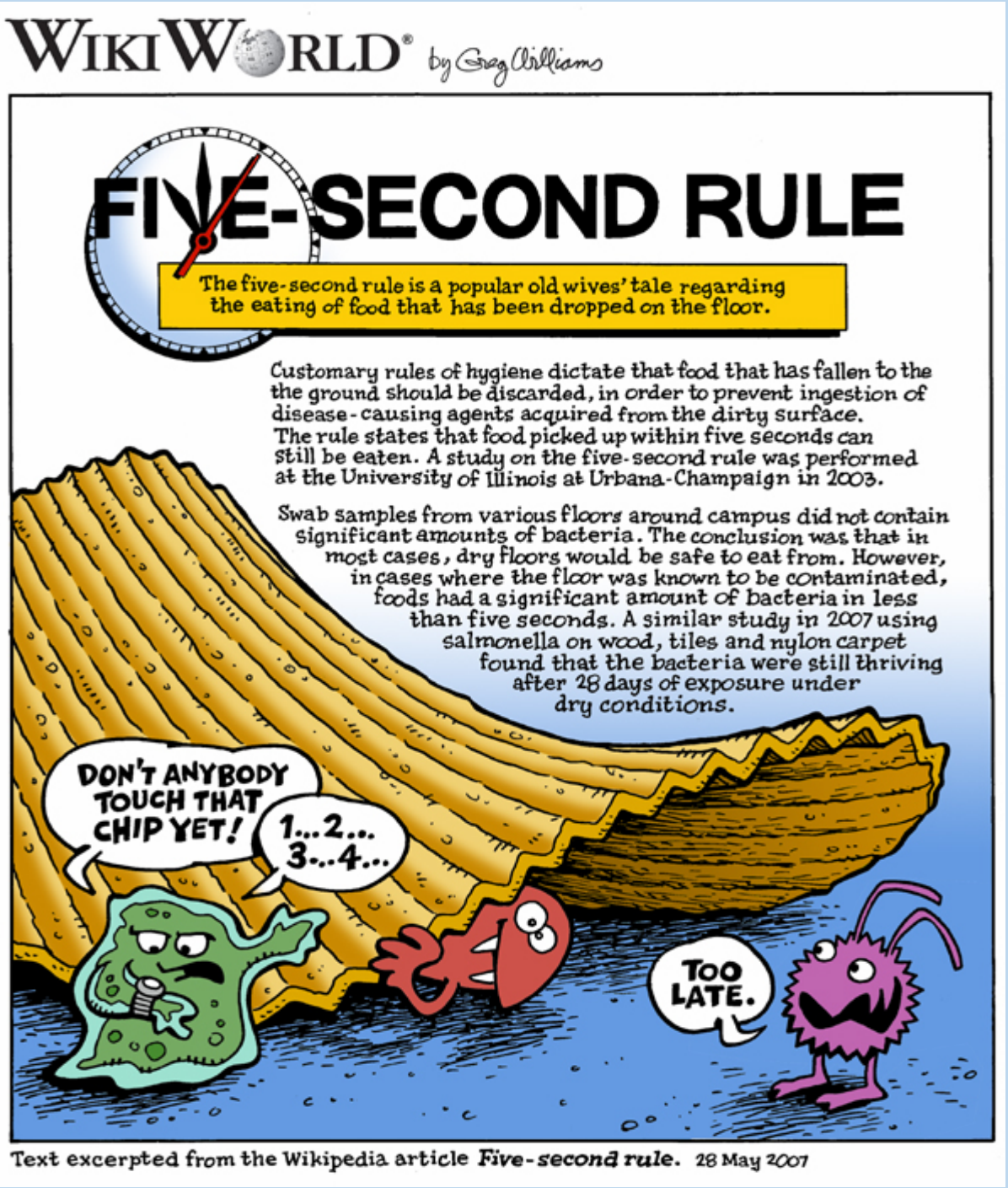
Blowing out candles

Beer pong





Double-dipping



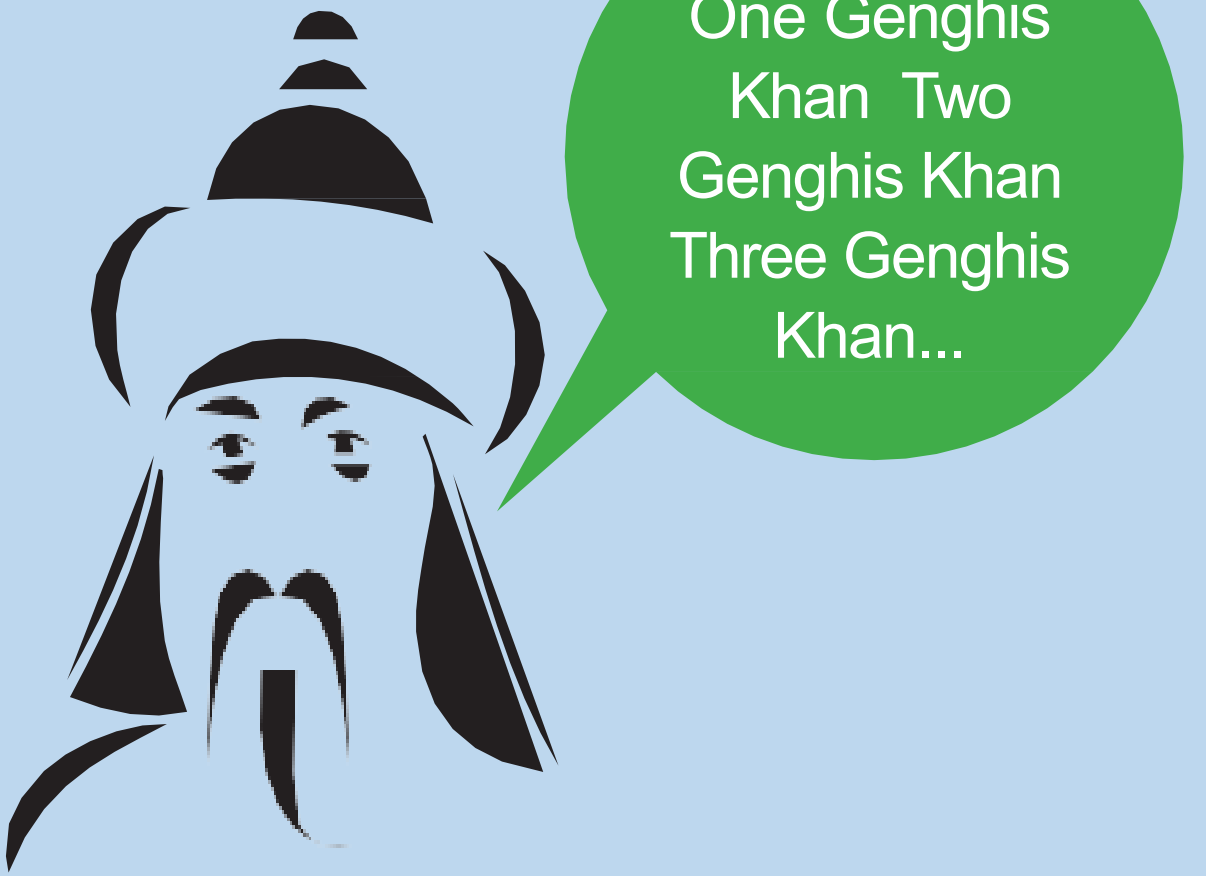
How many of you have eaten food that had been dropped?

1,061 public places in Tucson, Chicago, San Fran, Tampa

-21% of movie theaters 51 % of restaurants had highly contaminated surfaces

- 1 in 5 had a biochem marker (blood, urine, sweat, mucus)

Origin of the 5-second rule?



Salmonella

- If not disinfected, Salmonella can survive on a surface for up to 28 days!

Studies on the 5-second rule

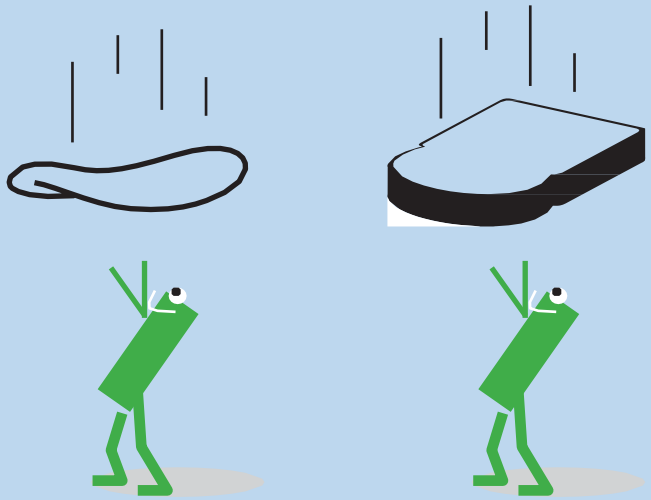
- 2003, U. of IL. Gummy bears and fudge cookies placed on floor tiles inoculated with E. coli. Reported transfer but no publication or numbers.
- 2005, Mythbusters Jamie Hyneman and Adam Savage dropped pastrami and crackers on contaminated surfaces for 2 and 6 seconds. No replications were done so no statistical analysis.
- **2006, We published our study from Clemson University testing three surfaces tile, carpet and wood) and 2 types of food (bread and bologna) left in contact for 5, 30 or 60 seconds, published in the Journal of Applied Microbiology**.
- 2007, Connecticut College seniors dropped food on surfaces around the university and stated skittles were safe after 30 sec and apple slices after 60 seconds. No publication.
- 2014, Aston University in the UK had a press release supporting the findings of the Clemson study but no publication.
- 2016, the Science Channel show “The Quick and the Curious” had a NASA engineer dropping cookies in a park and asking people if they would eat the cookie.
- 2016, the only other refereed publication out of Rutgers University tested stainless steel, carpet and wood with various foods finding similar results as our study.

Can food be dropped and picked up in 5 seconds without bacteria getting on the food?

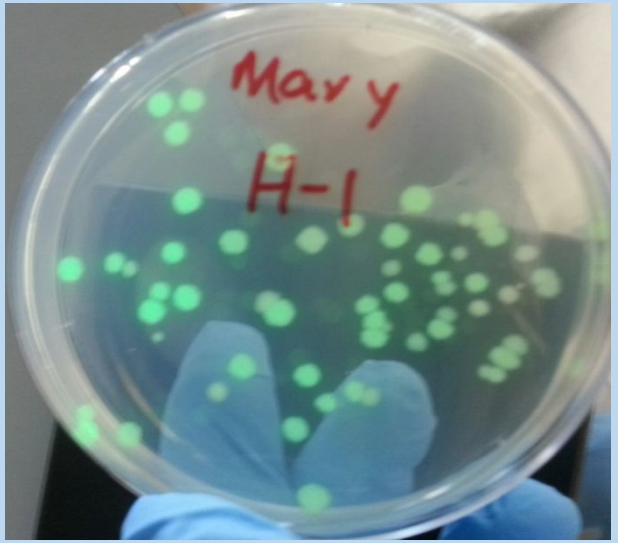
Variables: the food, the surface, time

Dawson, P., I. Han, B. Cox, C. Black and L. Simmons. 2006. Residence time and food contact time effects on transfer of *Salmonella* Typhimurium from tile, wood and carpet: Testing the five-second rule. Journal of Applied Microbiology 102, (4): 945-953.

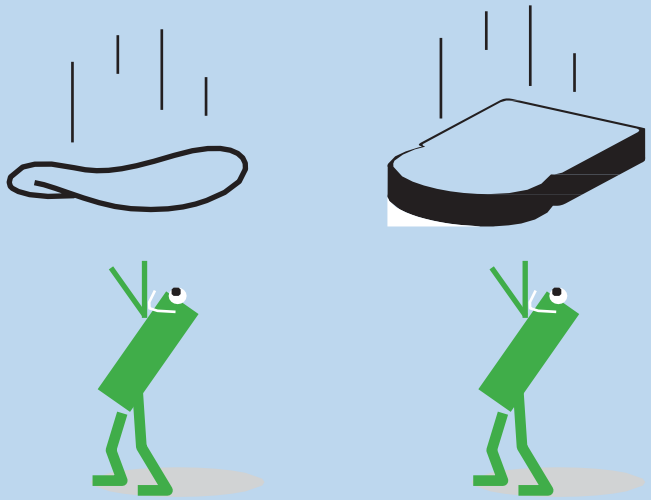
Methods



1. Inoculate tile, carpet, or wood with Salmonella
2. Let the bacteria remain 5 min or 24 hours
3. Drop bologna on tile, carpet, or wood
4. Leave for 5, 30 or 60 seconds
5. Count the Salmonella on bologna
6. Repeat with bread on tile

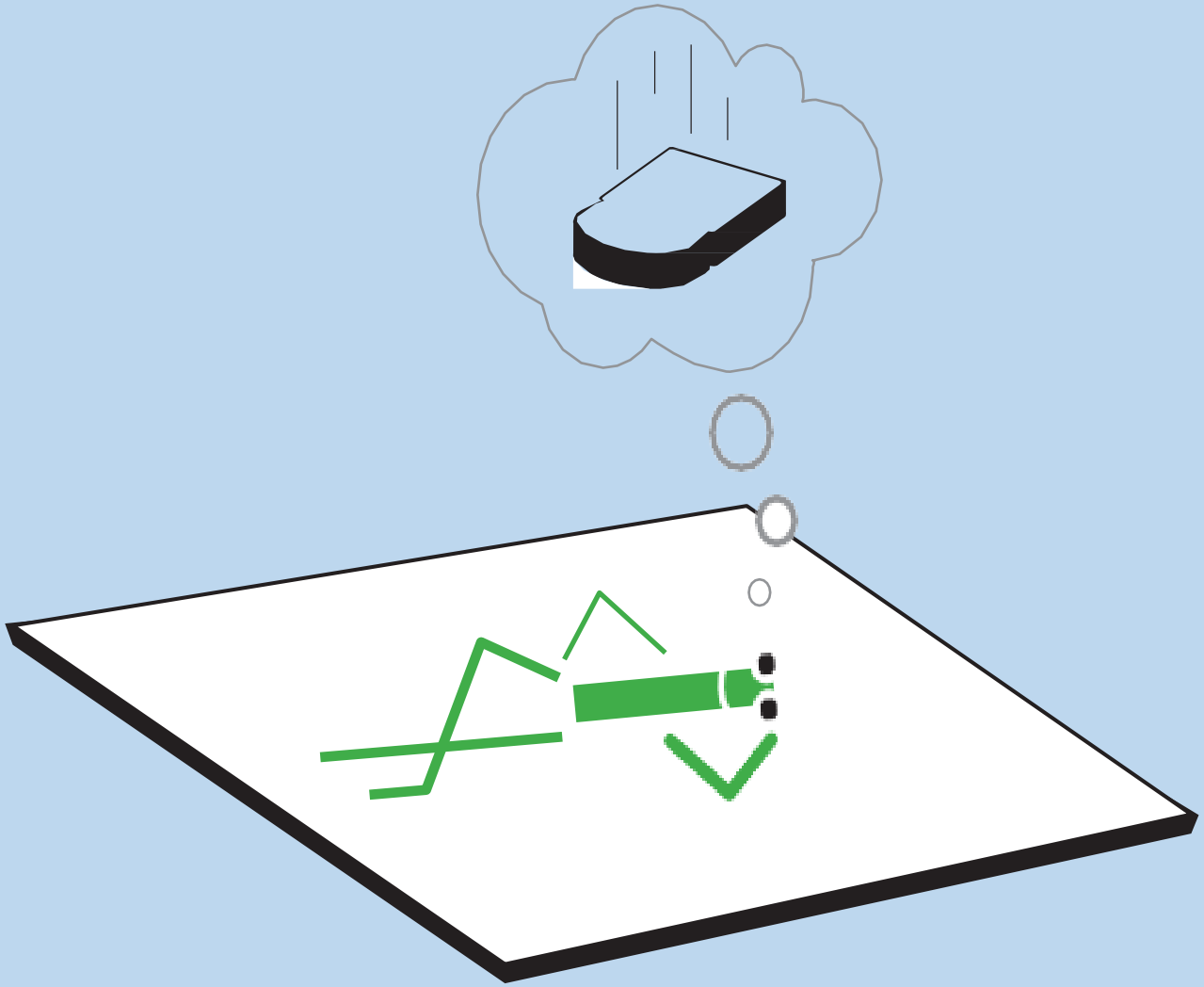


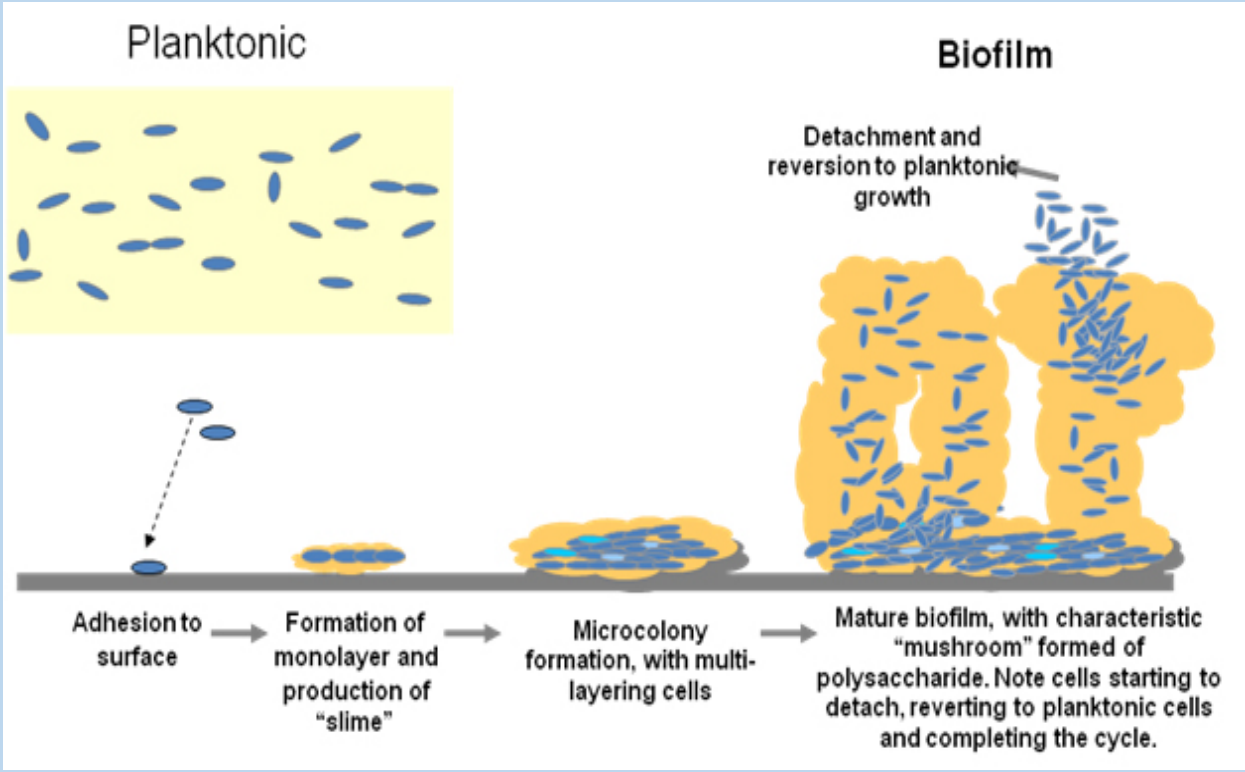
Results



1. Salmonella transferred in 5 seconds
2. Less from carpet than tile or wood
3. Salmonella survived better on carpet
4. White bread picked up Salmonella too

Finally, Salmonella survived 4 weeks on tile?





Can you get sick from eating out?

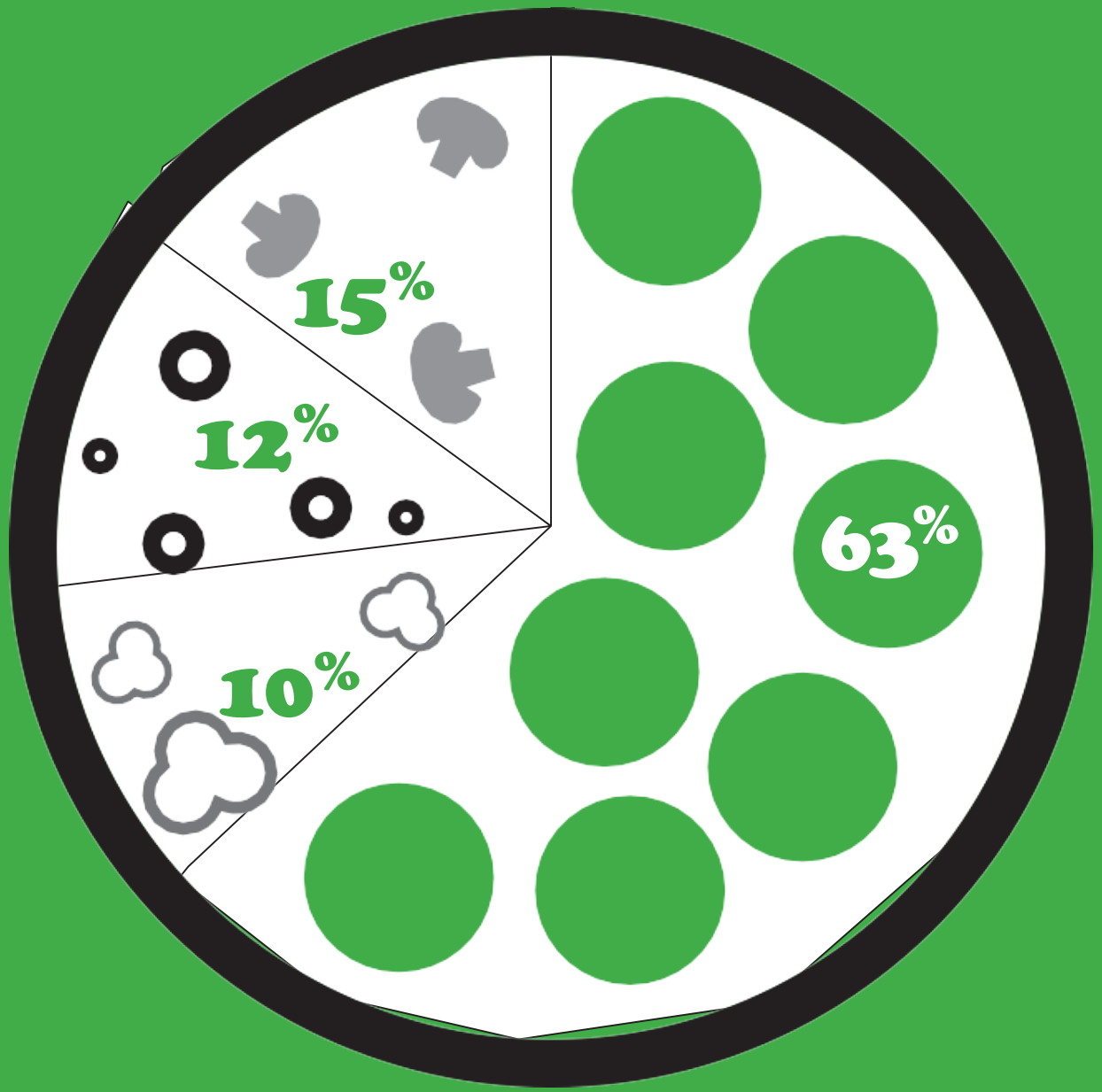
CDC – between 1998 and 2015
19,119 reported foodborne outbreaks

72% of reported food-related outbreaks were linked to a single prep location

Good News
Public Health makes inspections

L.A. County spends $10 million/year

Where? by single location

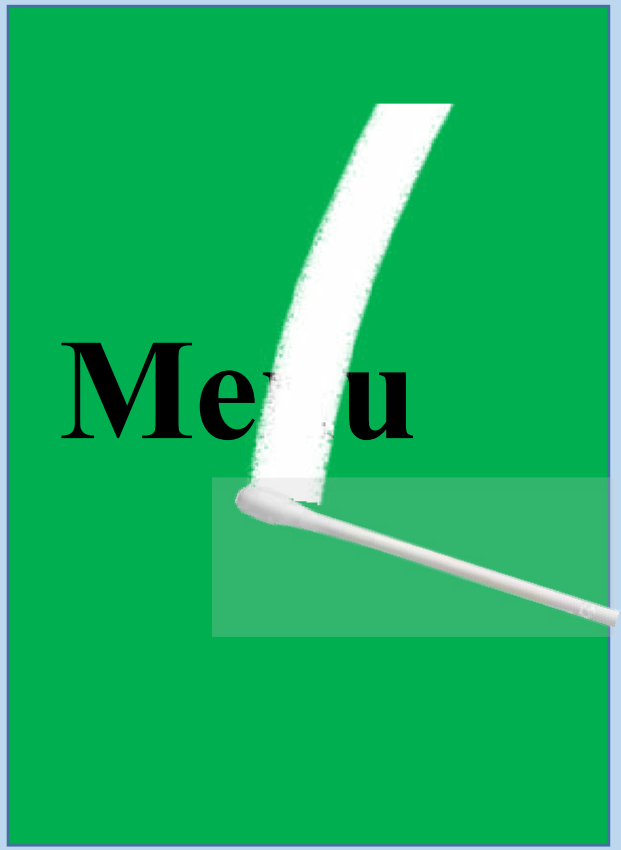


Restaurant or Deli

Catering

Private Home

Other

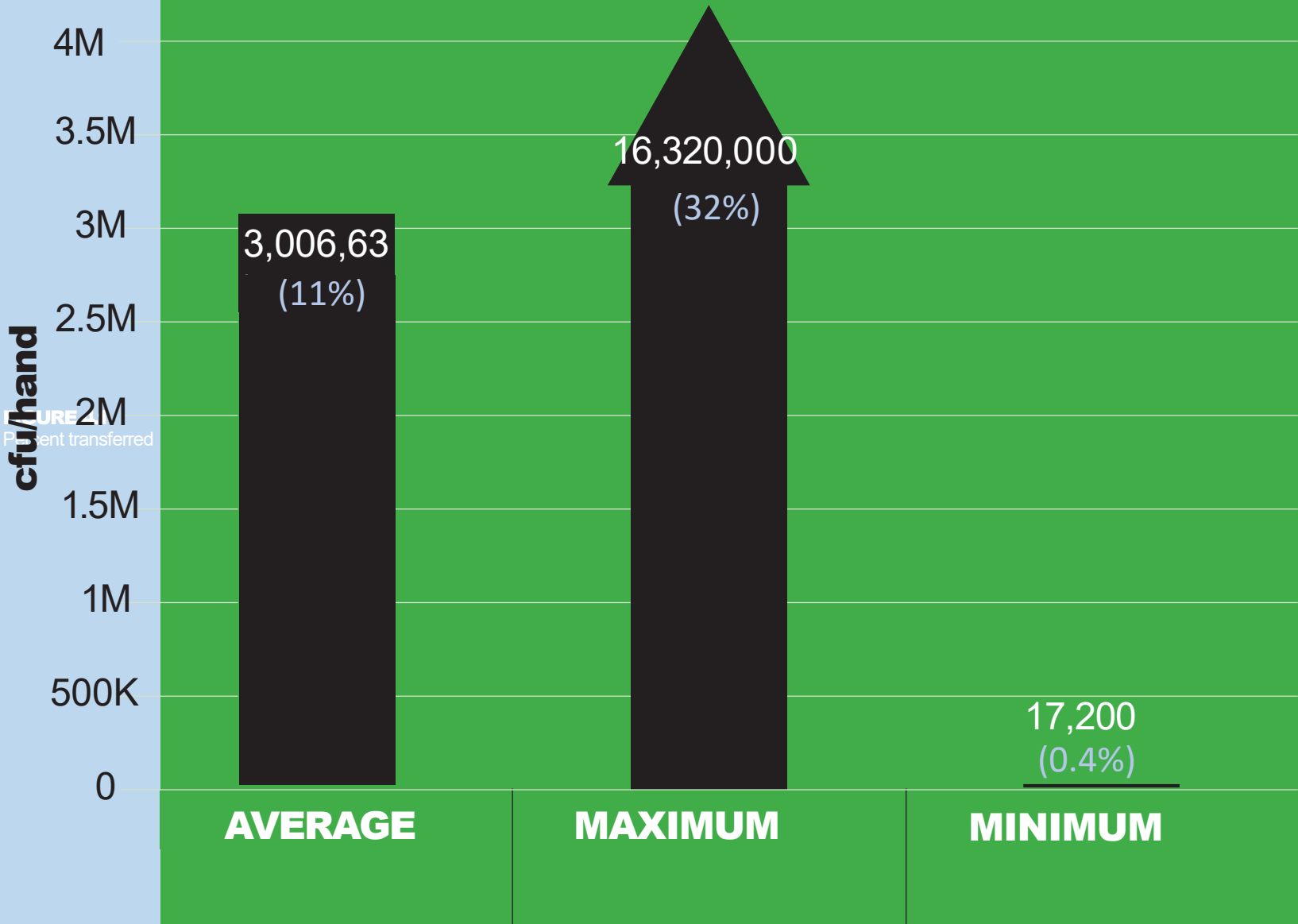


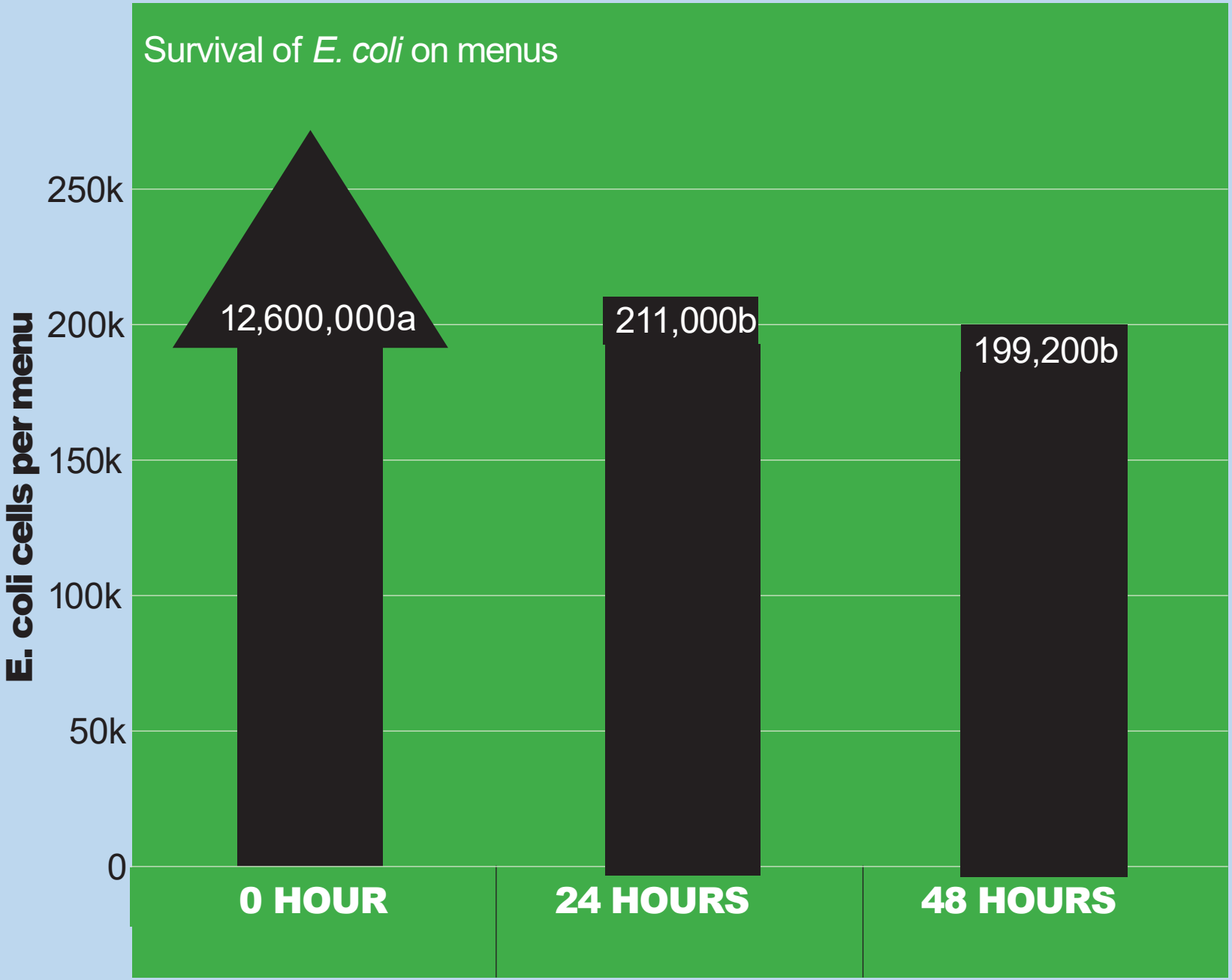
A 6 square inch area was sampled
Menus much more surface area

- Over 3,000 bacteria recovered from dirtiest menus on the 6 square inch area was sampled.
- Menus 40 to 80 times the area sampled.
- Over 1,200 Staph recovered from the dirtiest menus.

1. Inoculate menus
2. Handle menus
3. Count bacteria on hands

E. coli transferred from inoculated menus to hands. The inoculation levels ranged from 60-100 million cells per menu.

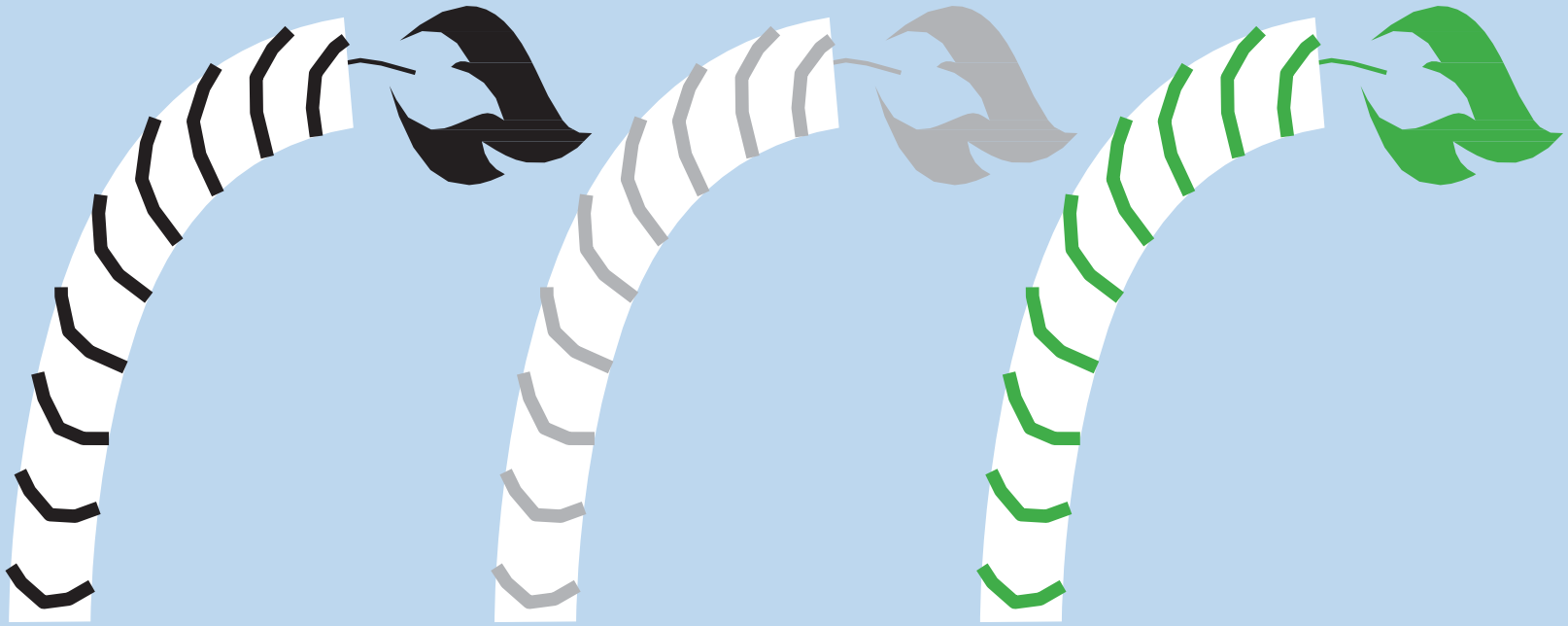




[a,b]means with different letters are significantly different (p≤0.05).

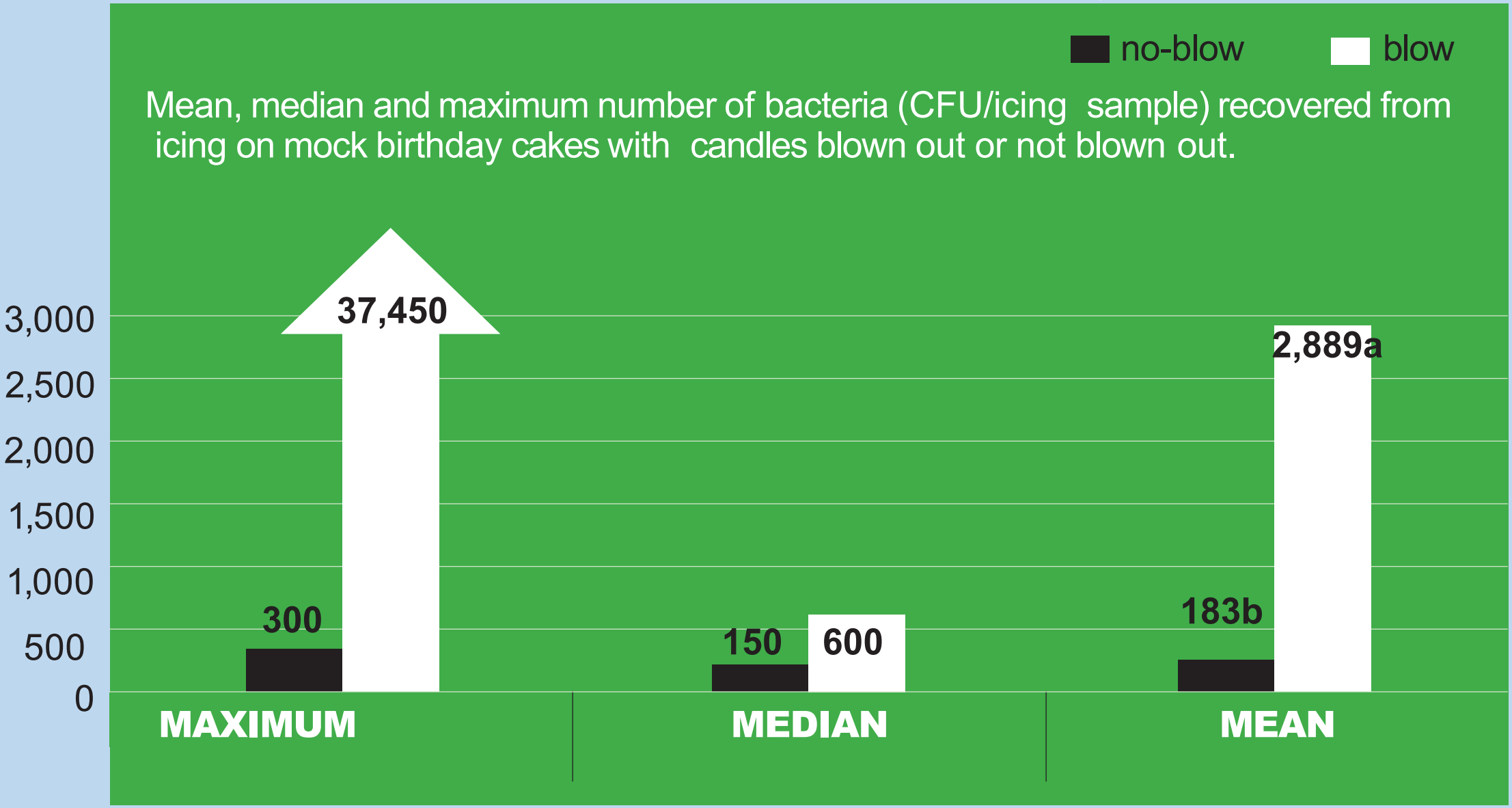
Staph can survive on plastic, some up to 90 days

Blowing Out Birthday Candles



Mock test cake consisting of a layer and candle Styrofoam™ base, foil and icing holders and candles.

FIG2



No-Blow=cake icing not exposed to blowing out candles. Blow=cake icing exposed to blowing out candles.
CFU/sample = colony forming units per cake icing sample.
a,b Means within a statistical category with different letters ($p \leq 0.0001$). n=33 observations per treatment.

Bioaerosols

Average bioaerosols particle size:
13.5 um – coughing
16.0 um – speaking

Bacteria length = 0.5 to 5.0 um
Viruses length = 0.02 to 0.3um

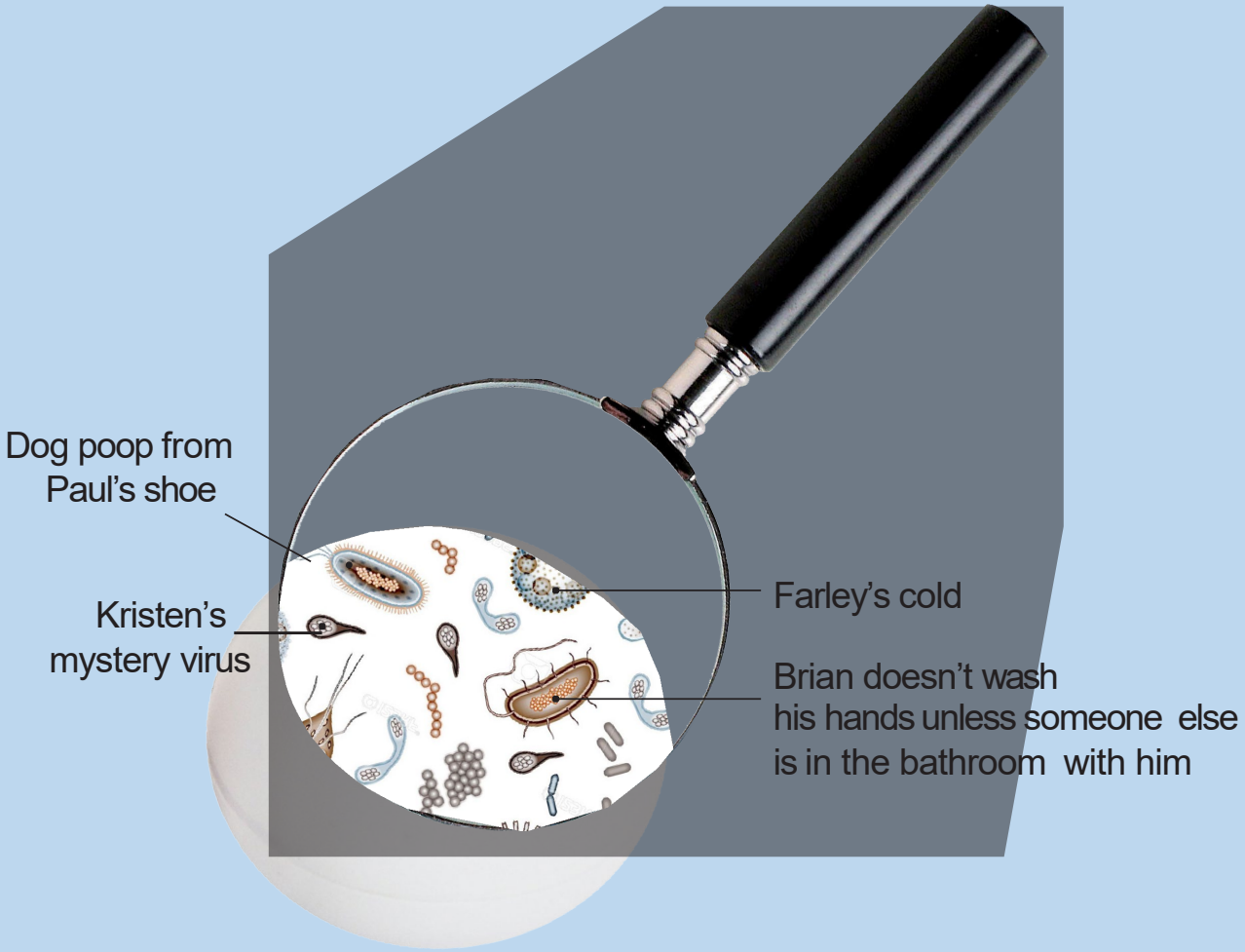
693 to 6,293 bacteria/cubic meter

5 infectious diseases from saliva droplets: TB, pneumonia, flu, SARS, Legionaires

Beer pong: Don't Blame the Game!

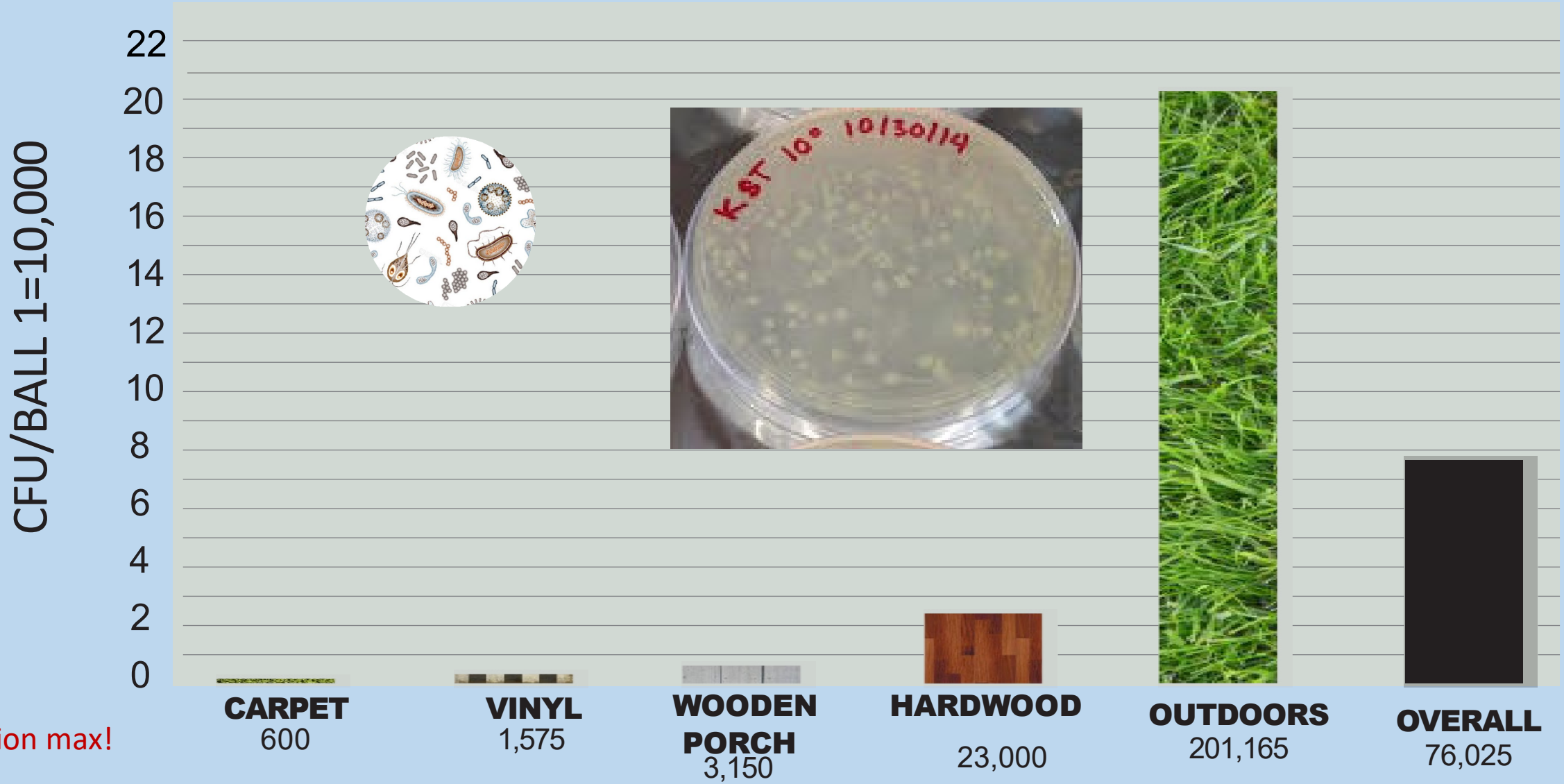
The best way to catch a knuckleball is to wait for it to stop rolling and pick it up

Collection and analysis of bacteria found on ping pong balls used in homecoming Beer Pong games



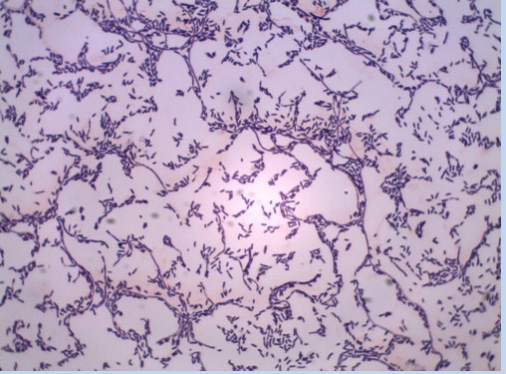
Possible pathogen carrier

Bacterial populations recovered from ping pong balls used in Beer Pong games played during a homecoming football game weekend.

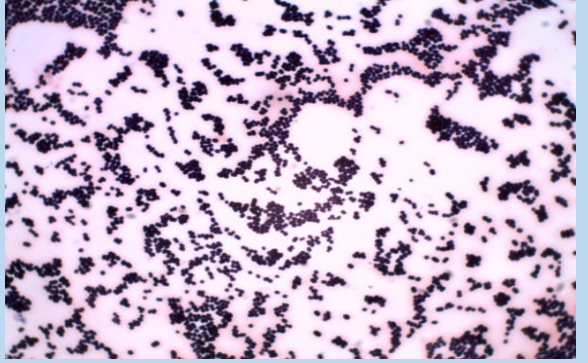


CFU/ball = colony forming units (bacteria) per ping pong ball.

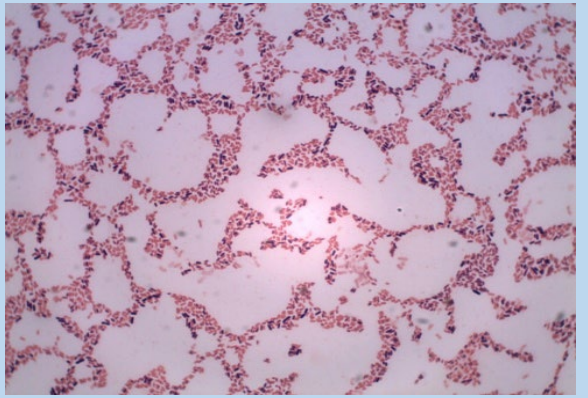
N = number of ping pong balls tested per surface: carpet (6), hardwood (4), vinyl (17), outdoors (24), wood porch (12), overall (63).



Bacteria belong to Group III of Bergey's Manual. Possible Genus includes *Lactobacillus*, *Listeria*, and *Kurthia*.



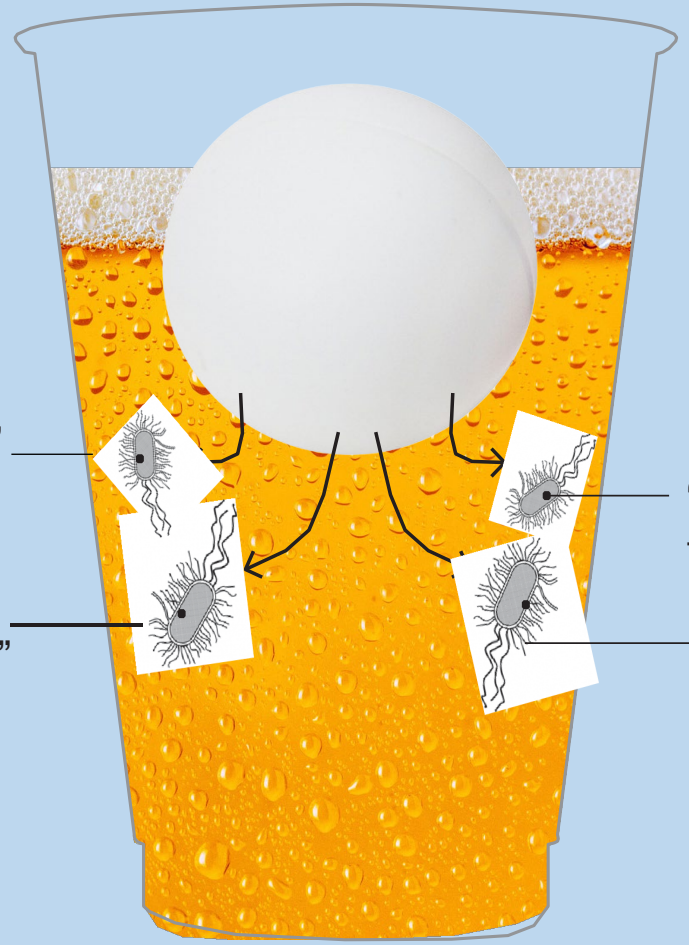
Bacteria belong to group VI of Bergey's Manual. Possible genus include *Micrococcus*, *Planococcus*, and *Staphylococcus*.



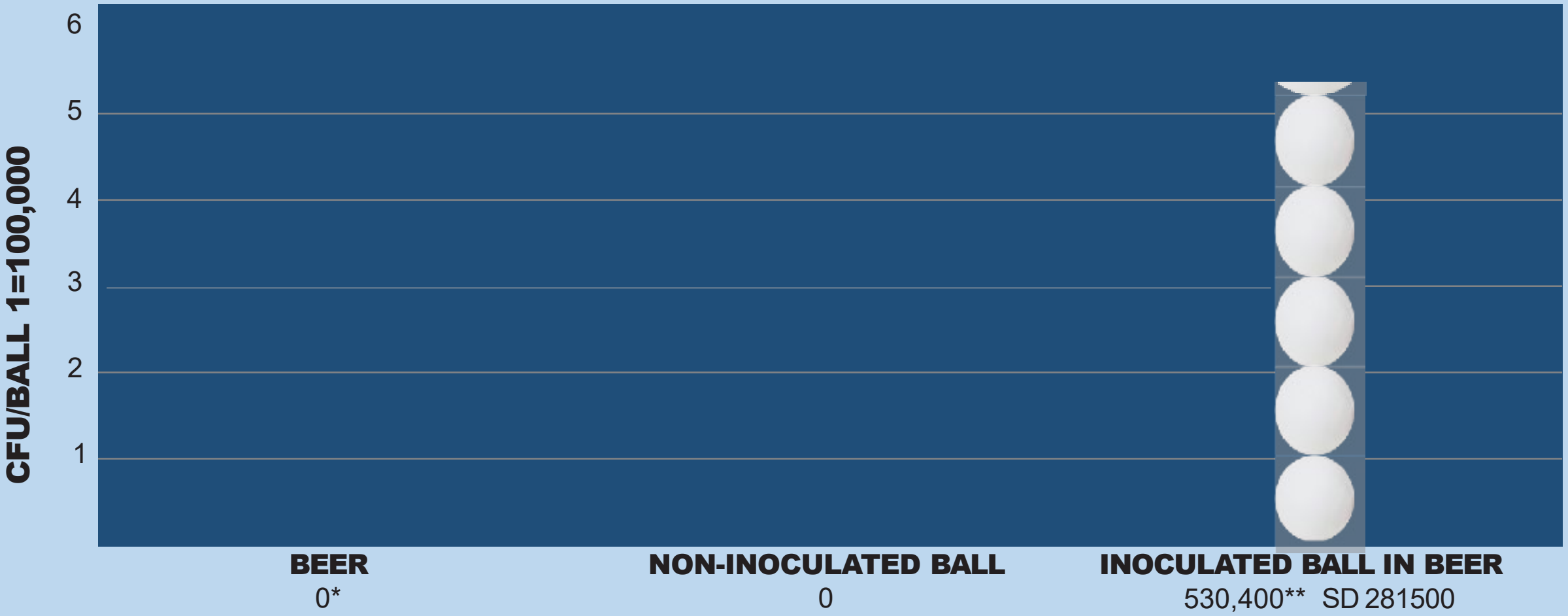
Bacteria belong to Group IX of Bergey's Manual. Possible genus include *Escherichia*, *Enterobacter, Citrobacter, Erwinia, Proteus, Providencia, Morganella*, and *Salmonella*.

Population of bacteria transferred from inoculated ping pong balls to beer.

1. Inoculate ping pong balls
2. Throw one into a cup of beer
3. Measure bacteria in the beer



Population of *E. coli* cells recovered from beer exposed to inoculated or non-inoculated ping pong balls.

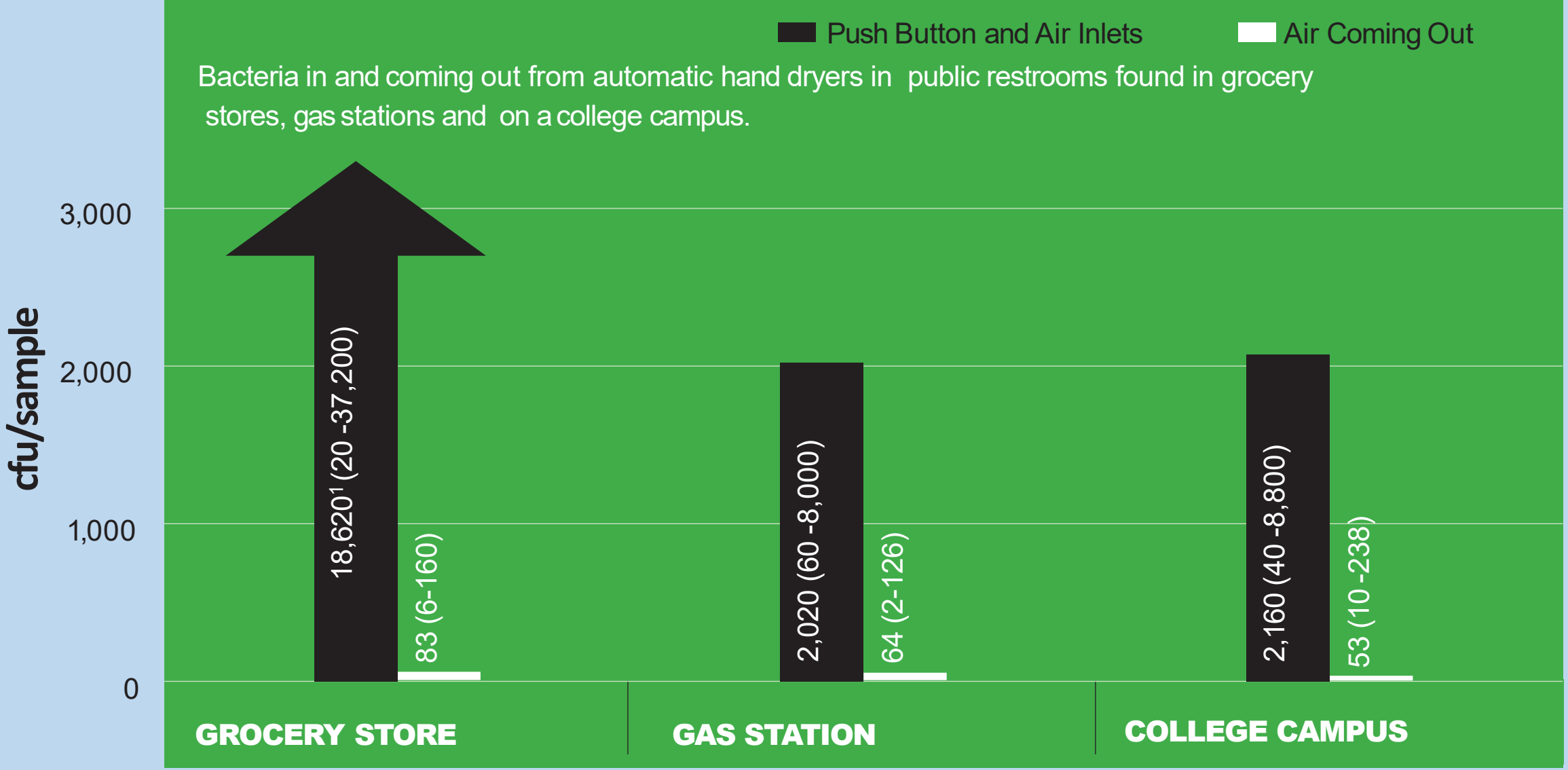


*no cells were recovered at the detection limit of <10 cells. n=12. ** mean with standard deviation (SD) below.
CFU/ball = colony forming units (bacteria) per ping pong ball.

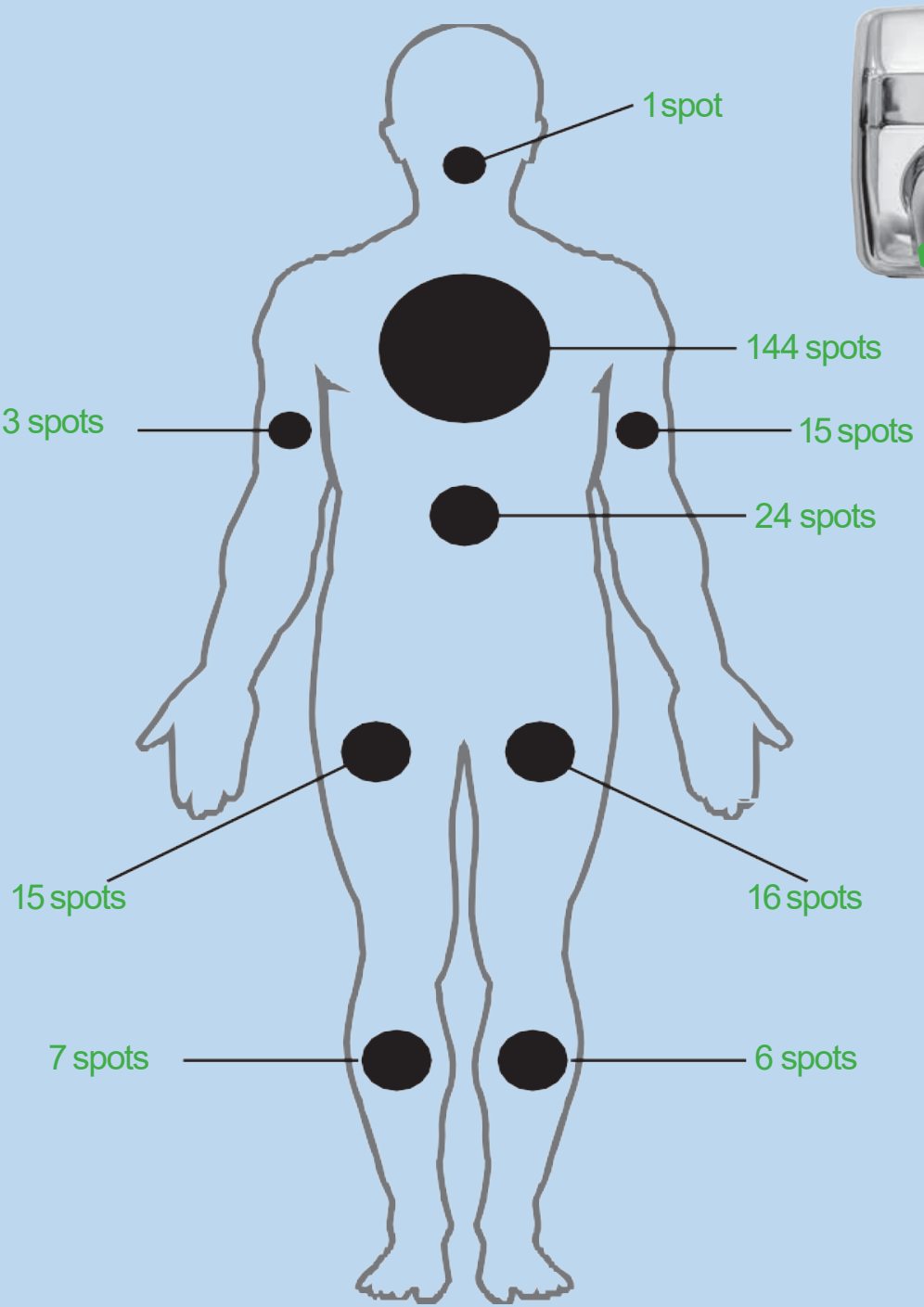
HAND DRYERS

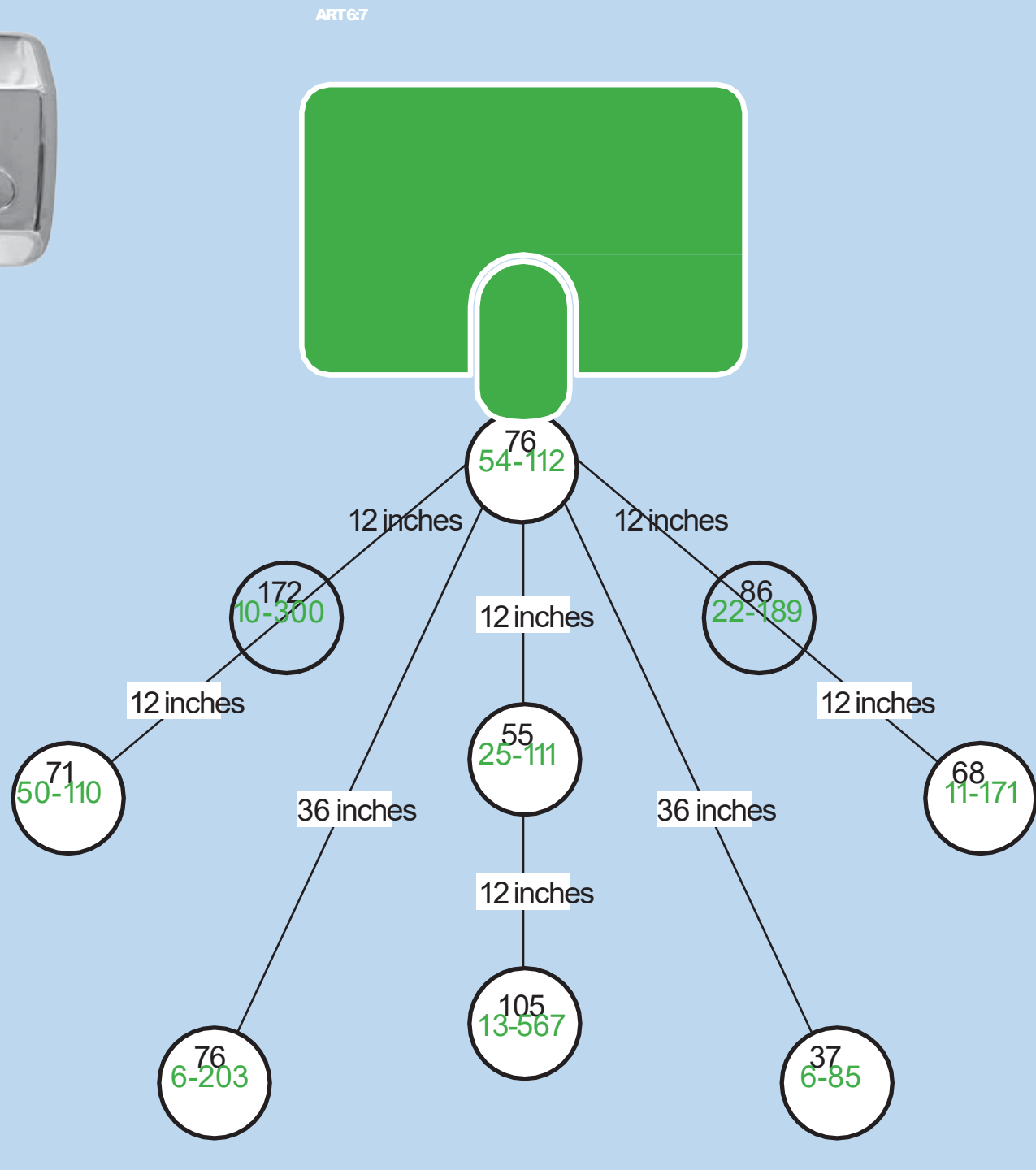
or

BACTERIA BLOWERS

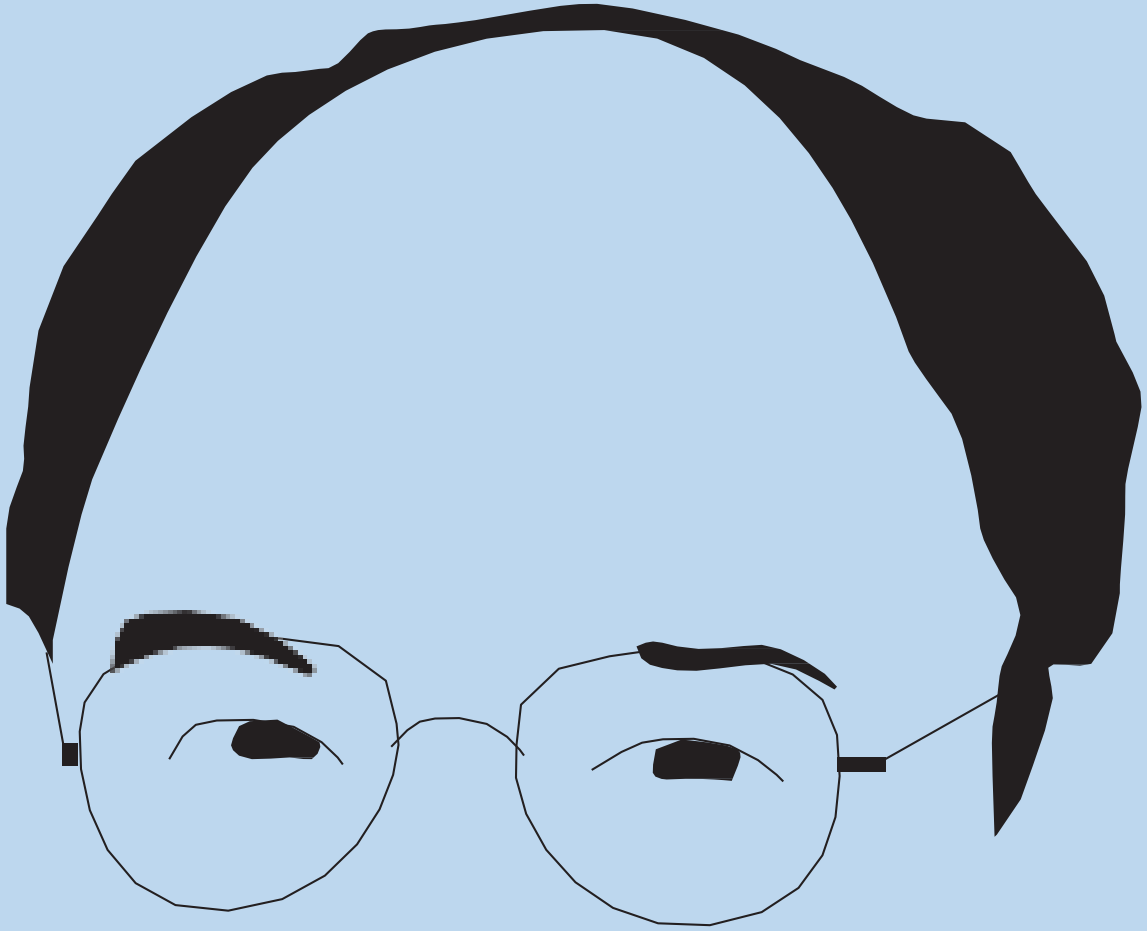


[1]Mean followed by the range of bacteria found in the samples. (n=50 for college campus, 28 for gas stations and 42 for grocery stores). Average air velocity and temperature was 18.7 m/sec (ranging from 6.8 – 40 m/sec) and 108.2°C (ranging from 88 - 130°C), respectively.


1 spot
144 spots
3 spots
15 spots
24 spots
15 spots
16 spots
7 spots
6 spots


76
54-112
12 inches
12 inches
172
10-300
12 inches
86
22-189
12 inches
12 inches
71
50-110
55
25-111
68
11-171
36 inches
36 inches
12 inches
105
13-567
76
6-203
37
6-85

Sorry, *Timmy.* But I don't dip that way



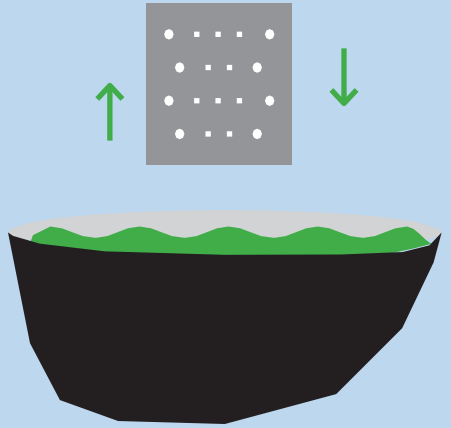
Alton Brown: "a dip is defined by its ability to "maintain contact with its transport mechanism over three feet of white carpet."

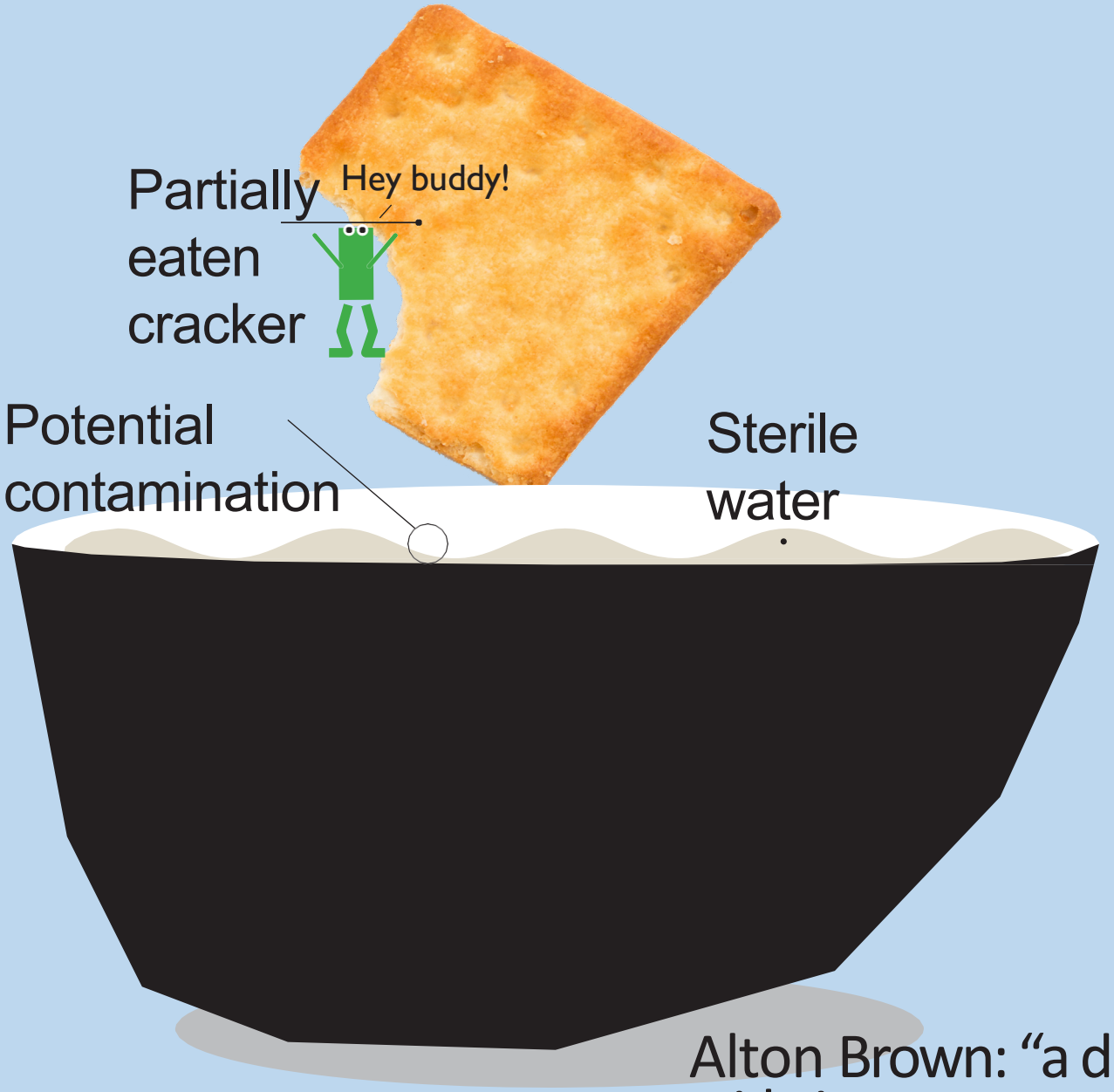
The Experiments

Crackers dipped in sterile water

Crackers dipped in sterile water at three pH levels (4, 5, 6)

Crackers dipped in three dips





EXP 1 Treatments

1.Dipped crackers 3 times no bite

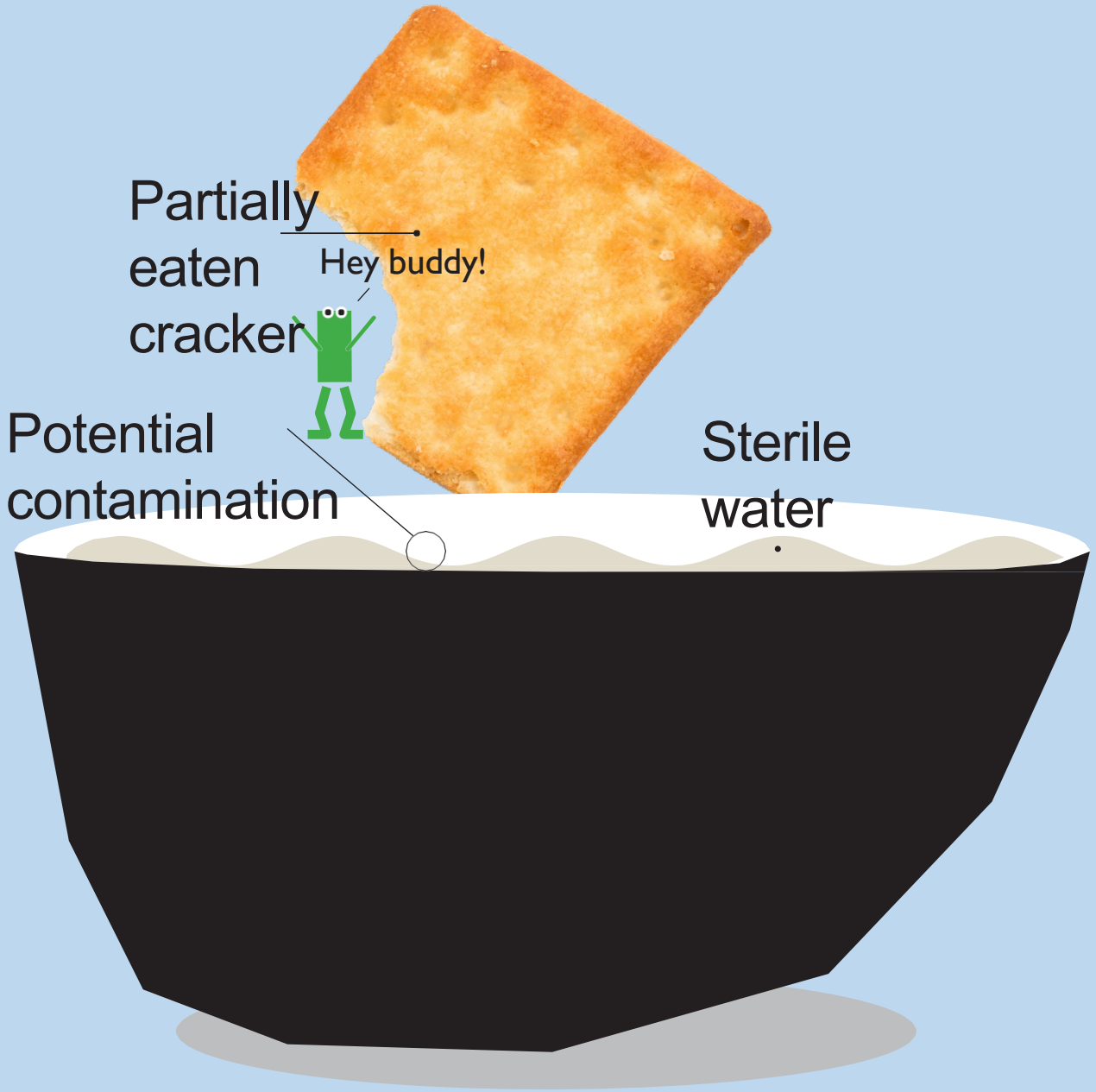
2.Dipped crackers 6 times no bite

3.Dipped 3 crackers biting each once before dipping

4.Dipped 6 crackers biting each once before dipping

Measured bacteria left in the water

Alton Brown: “a dip is defined by its ability to “maintain contact with its transport mechanism over three feet of white carpet.”



Experiment 1

1.Dipped crackers 3 times no bite

2.Dipped crackers 6 times no bite

3.Dipped 3 crackers biting each once before dipping

4.Dipped 6 crackers biting each once before dipping

5. Measured bacteria left in the water

3000
2500
2000
1500
1000
500
0

cfu/ml of water

5b
10b
1852a
2622a

3 no bite dips
6 no bite dips
3 bite-dips
6 bite-dips

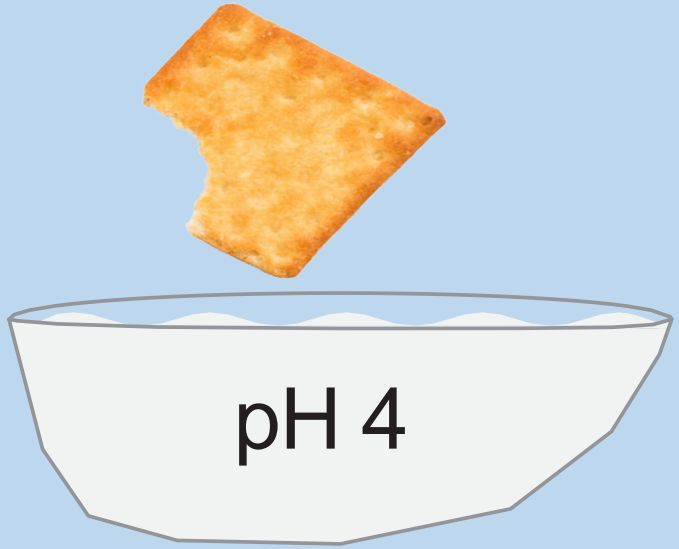
Treatments

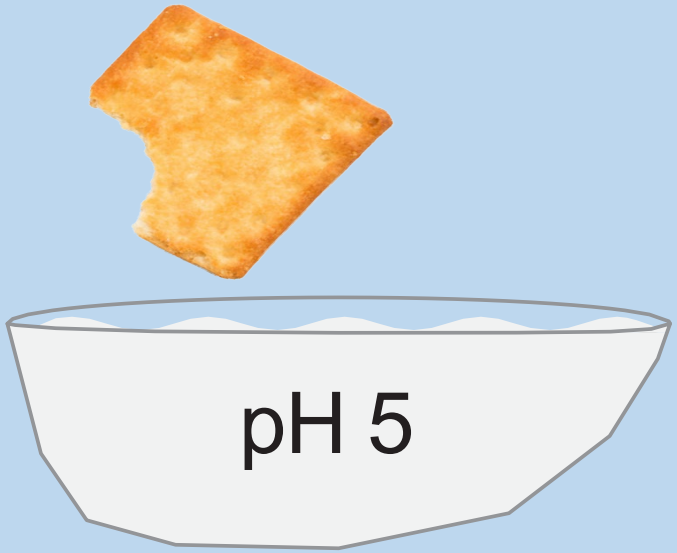
Experiment 2

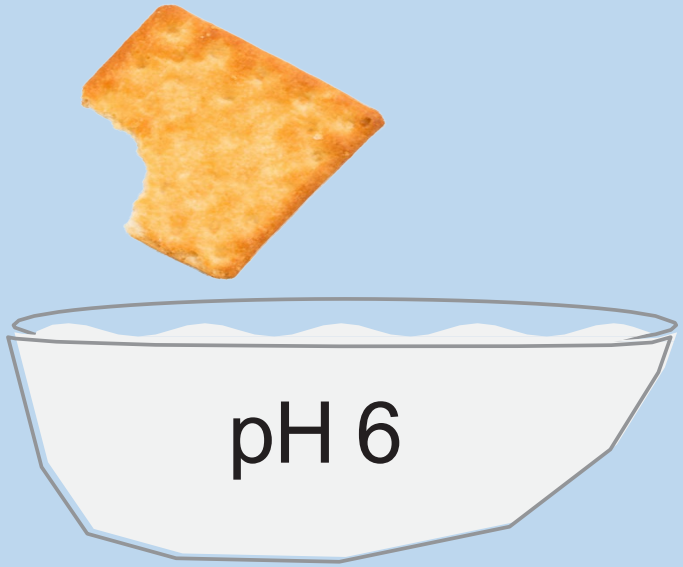
1.Dip 3 crackers no bite

2.Dipped 3 crackers biting each once before dipping

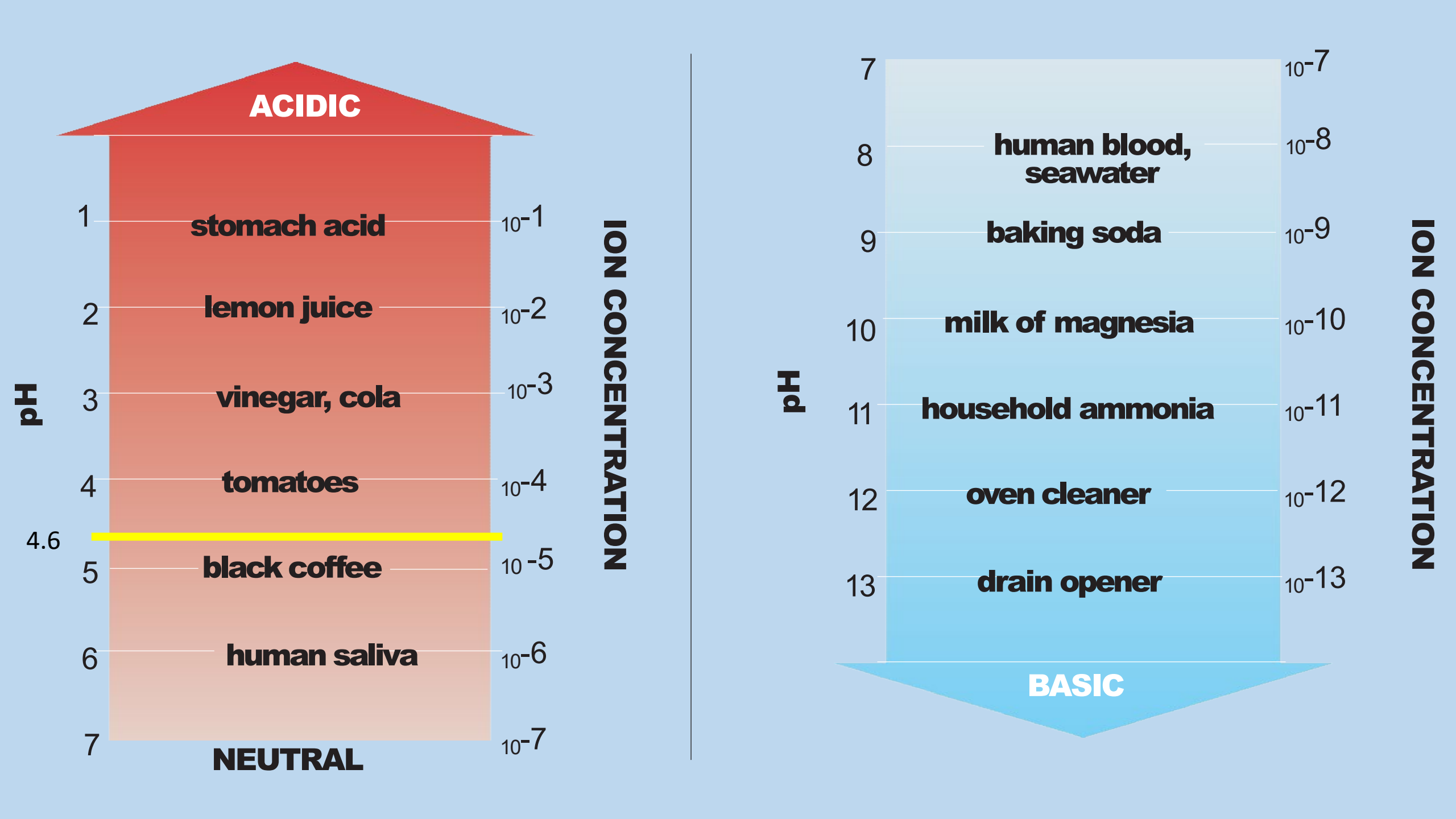
3. Measure bacteria left in the water

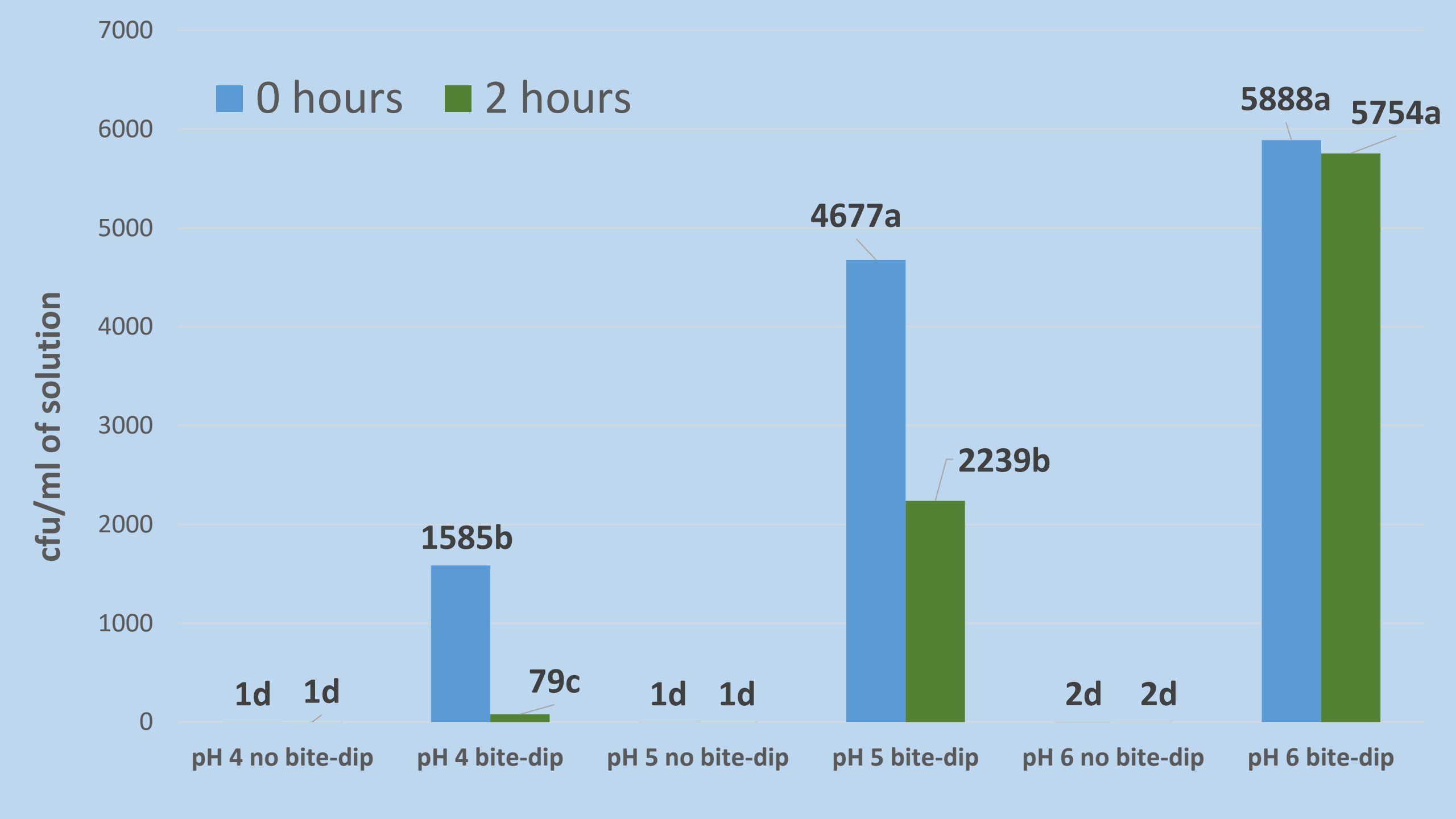




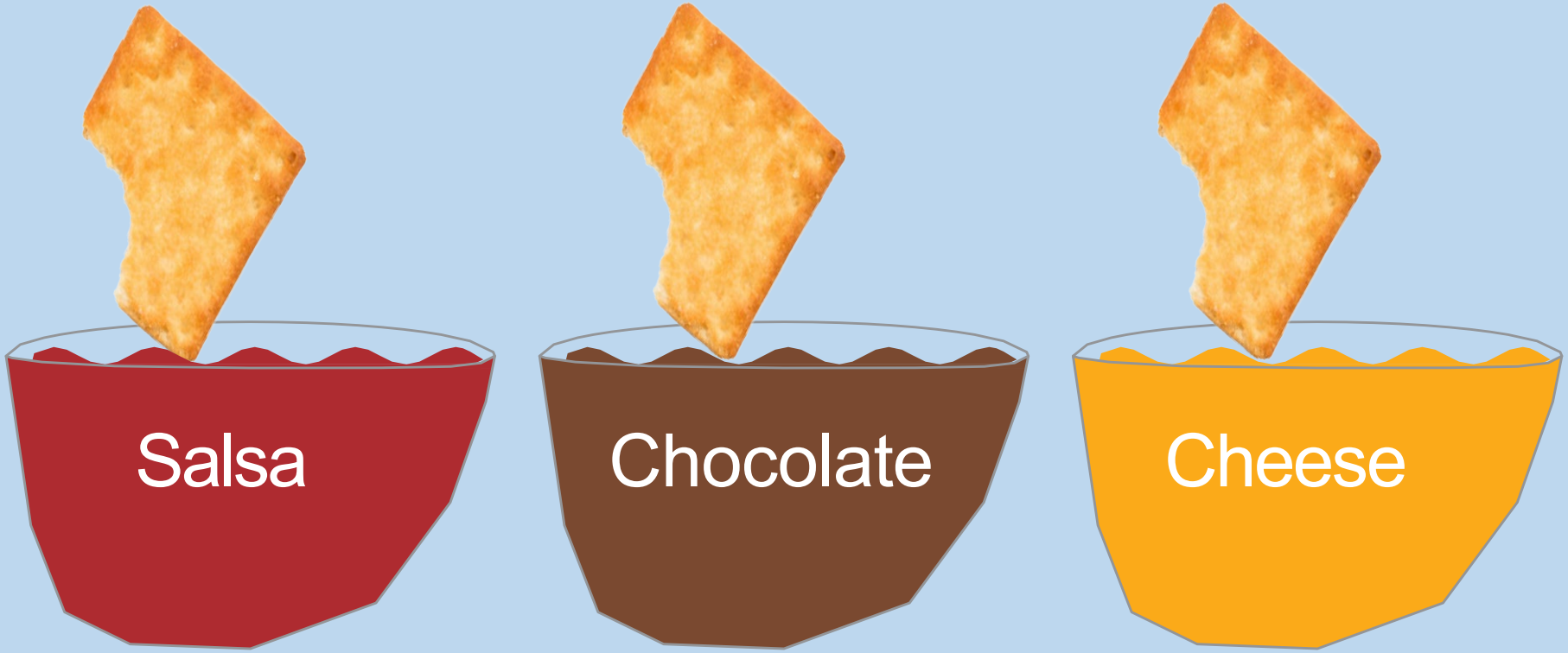


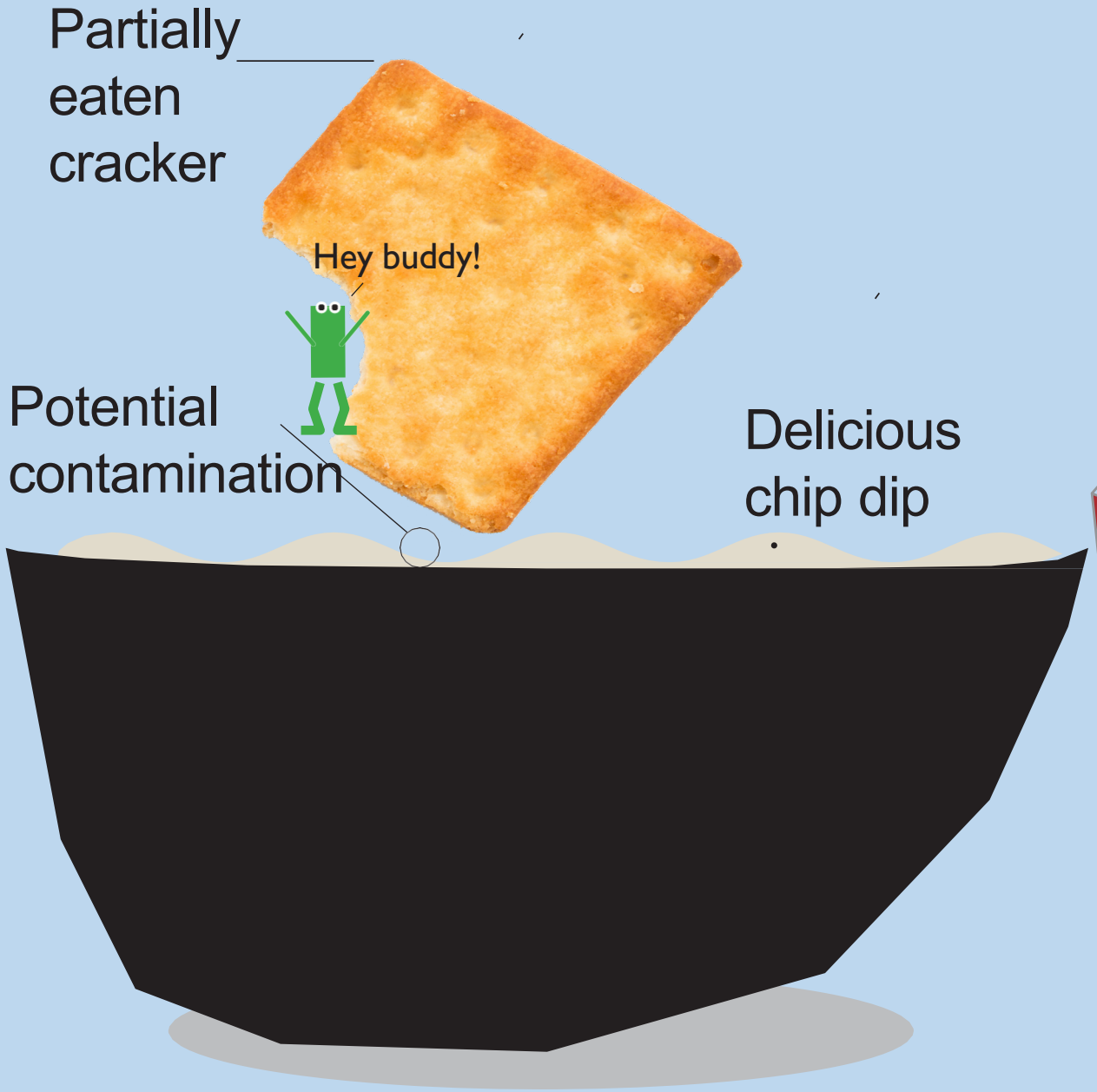
Acid in water


ACIDIC
pH
1
stomach acid
10^{-1}
2
lemon juice
10^{-2}
3
vinegar, cola
10^{-3}
4
tomatoes
10^{-4}
4.6
5
black coffee
10^{-5}
6
human saliva
10^{-6}
7
NEUTRAL
10^{-7}
ION CONCENTRATION
pH
7
10^{-7}
8
human blood, seawater
10^{-8}
9
baking soda
10^{-9}
10
milk of magnesia
10^{-10}
11
household ammonia
10^{-11}
12
oven cleaner
10^{-12}
13
drain opener
10^{-13}
BASIC
ION CONCENTRATION


7000
6000
5000
4000
3000
2000
1000
0
cfu/ml of solution
0 hours
2 hours
1d
1d
1585b
79c
1d
1d
4677a
2239b
2d
2d
5888a
5754a
pH 4 no bite-dip
pH 4 bite-dip
pH 5 no bite-dip
pH 5 bite-dip
pH 6 no bite-dip
pH 6 bite-dip

The Real Deal



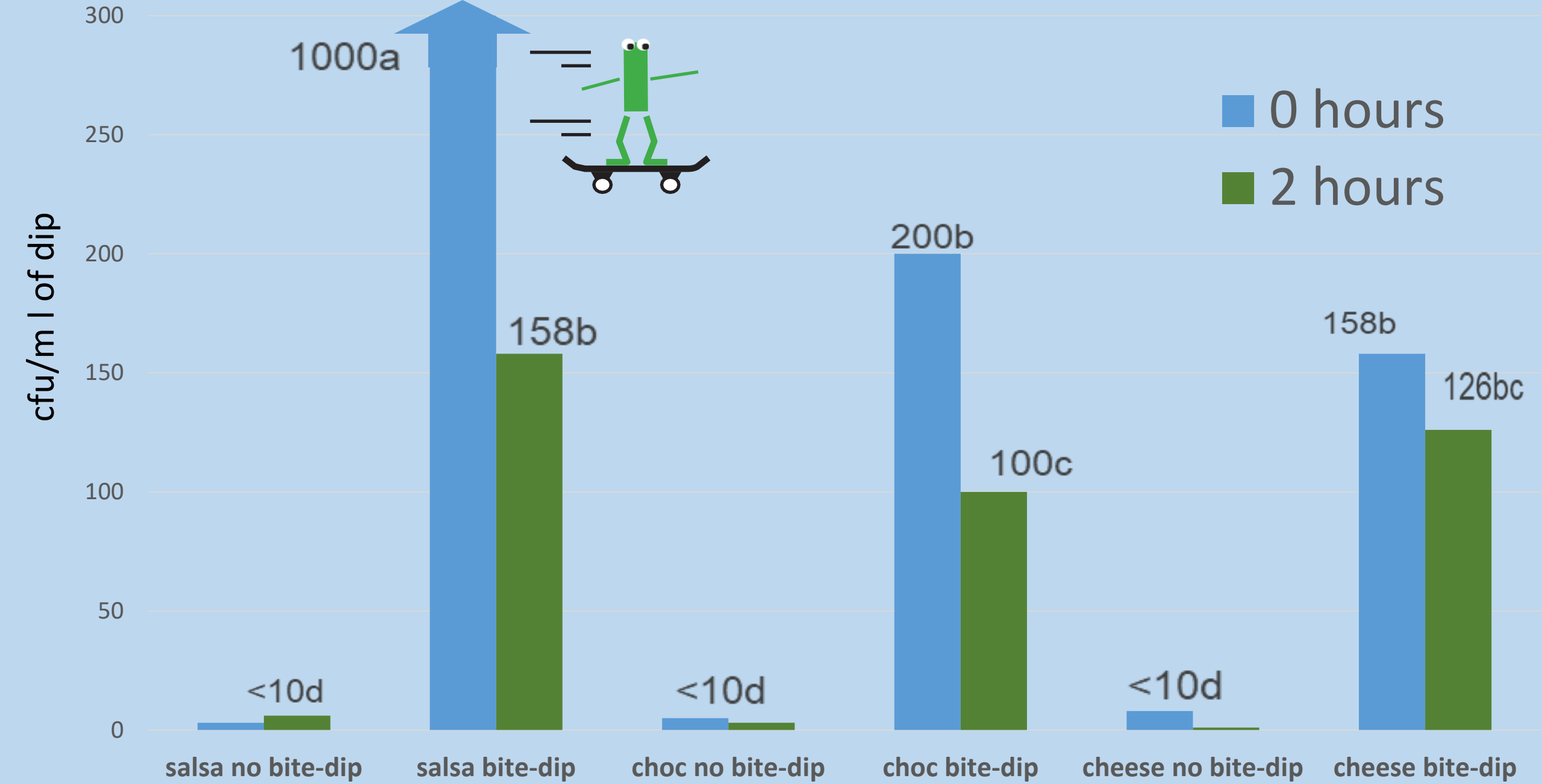


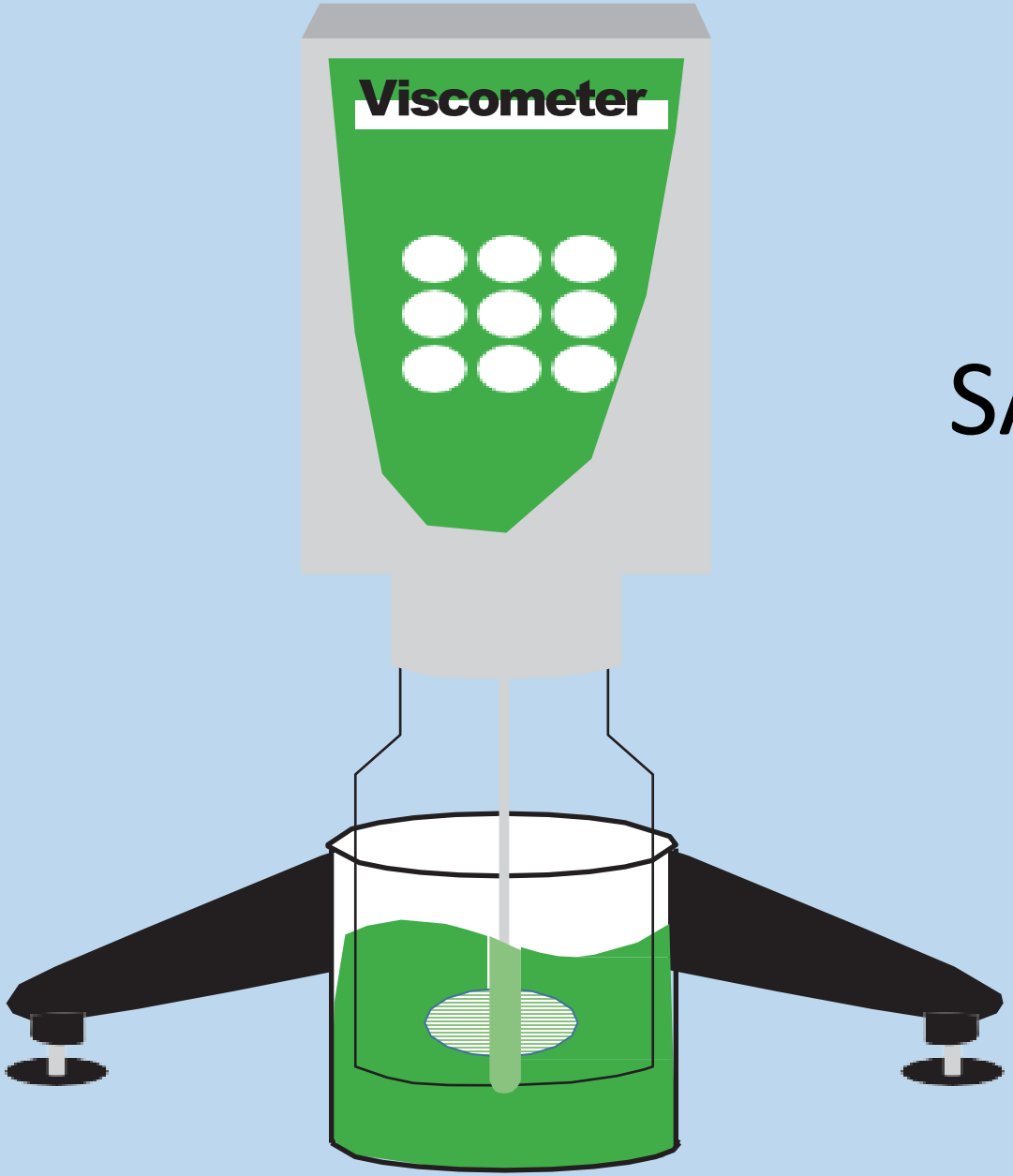
EXP 3 Treatments

1.Dipped crackers 3 times no bite

2.Dipped 3 crackers biting each once before dipping

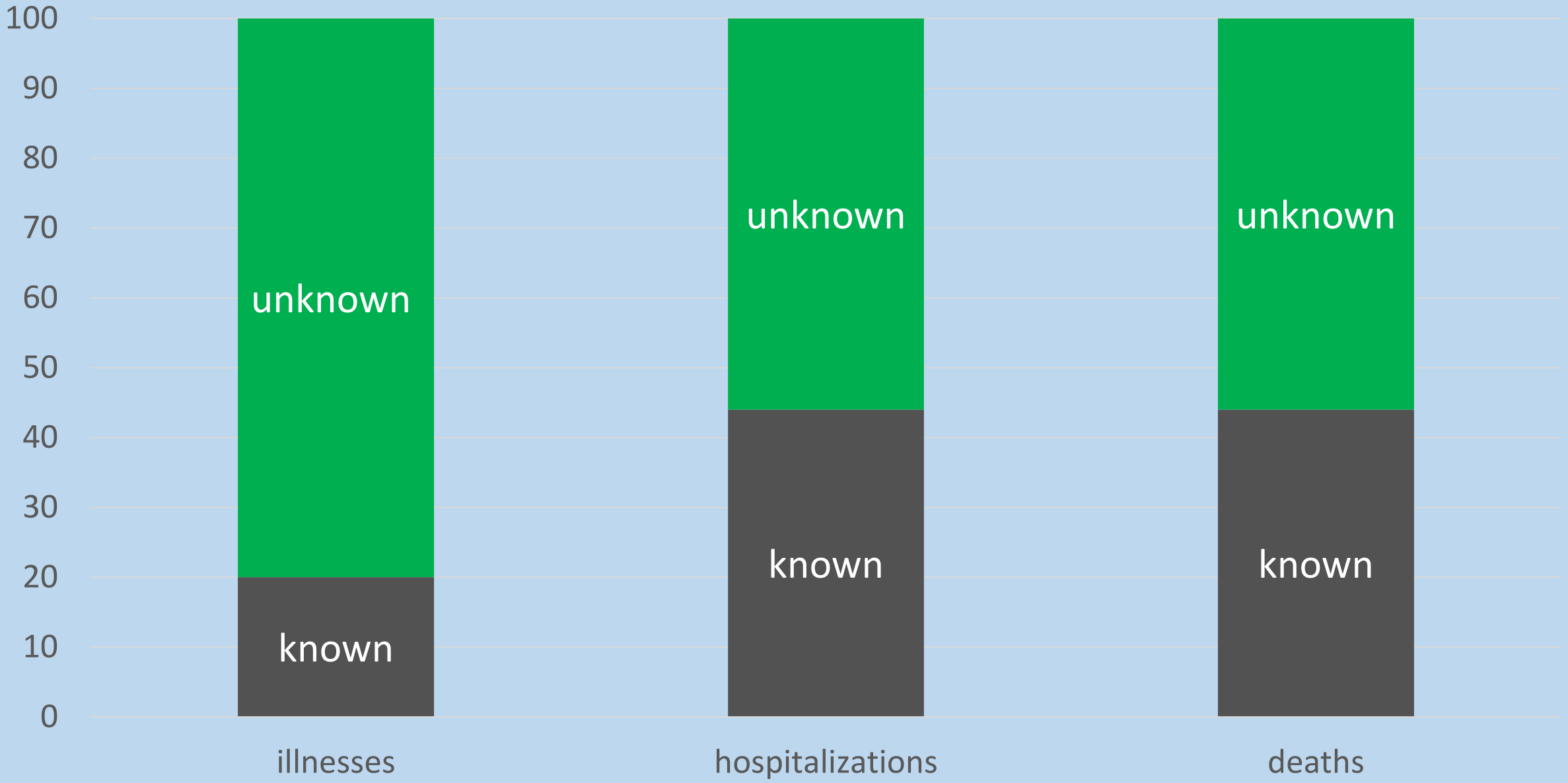
Measured bacteria in the dips immediately and after 2 hours


cfu/m l of dip
300
250
200
150
100
50
0
0 hours
2 hours
1000a
158b
200b
100c
158b
126bc
<10d
<10d
<10d
salsa no bite-dip
salsa bite-dip
choc no bite-dip
choc bite-dip
cheese no bite-dip
cheese bite-dip



THE THICKER THE SAUCE THE LESS SALIVA FALLS BACK IN THE BOWL

WHAT?



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3204615/

Food Safety Facts (CDC)

- 1 in 6 (17%) of Americans will have a foodborne illness each year.
- ~3,000 Americans die each year from foodborne agents.
- The cost of foodborne illness in the US is about $80 billion.

Top five foodborne pathogens causing illness as ranked by the CDC

58%	11%	10%	9%	3%
Noroviruses	Salmonella	Clostridium Perfringens	Campylobacter	Staphylococcus

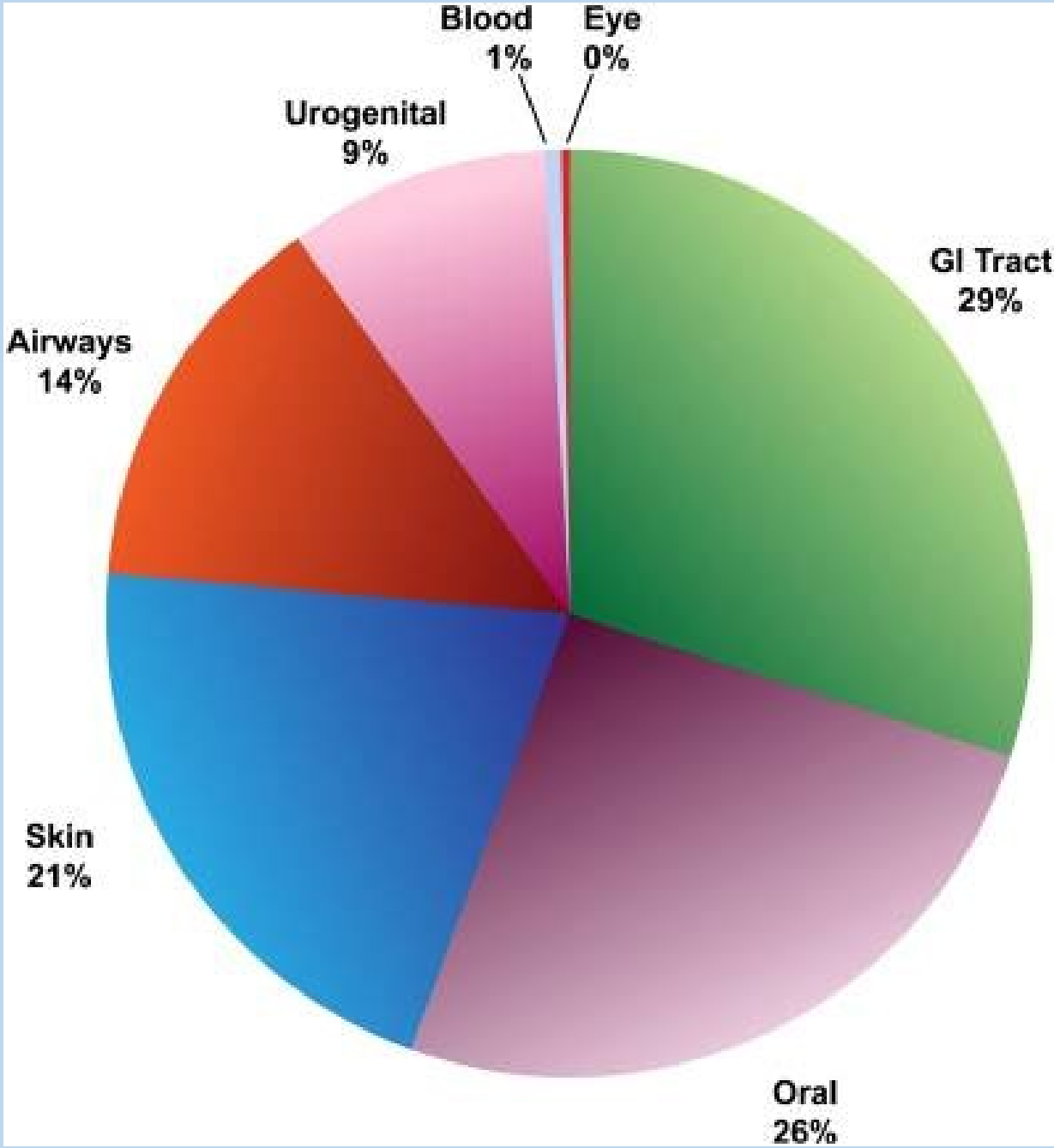
Which foods?

Hey guys, that quiche might've made me sick

NIH Microbiome Project

- Characterize the human microbiome

- 90% of disease related to microbiome
- 10-100 trillion microbiome bacteria
- Human microbiome includes bacteria, fungi, viruses and archaea.
- Implicated in diabetes, cancer, allergies, asthma, MS, autism,etc.



Genome Res. 2009 Dec;19(12):2317-23. doi: 10.1101/gr.096651.109. Epub 2009 Oct 9.

Immunity vs Illness

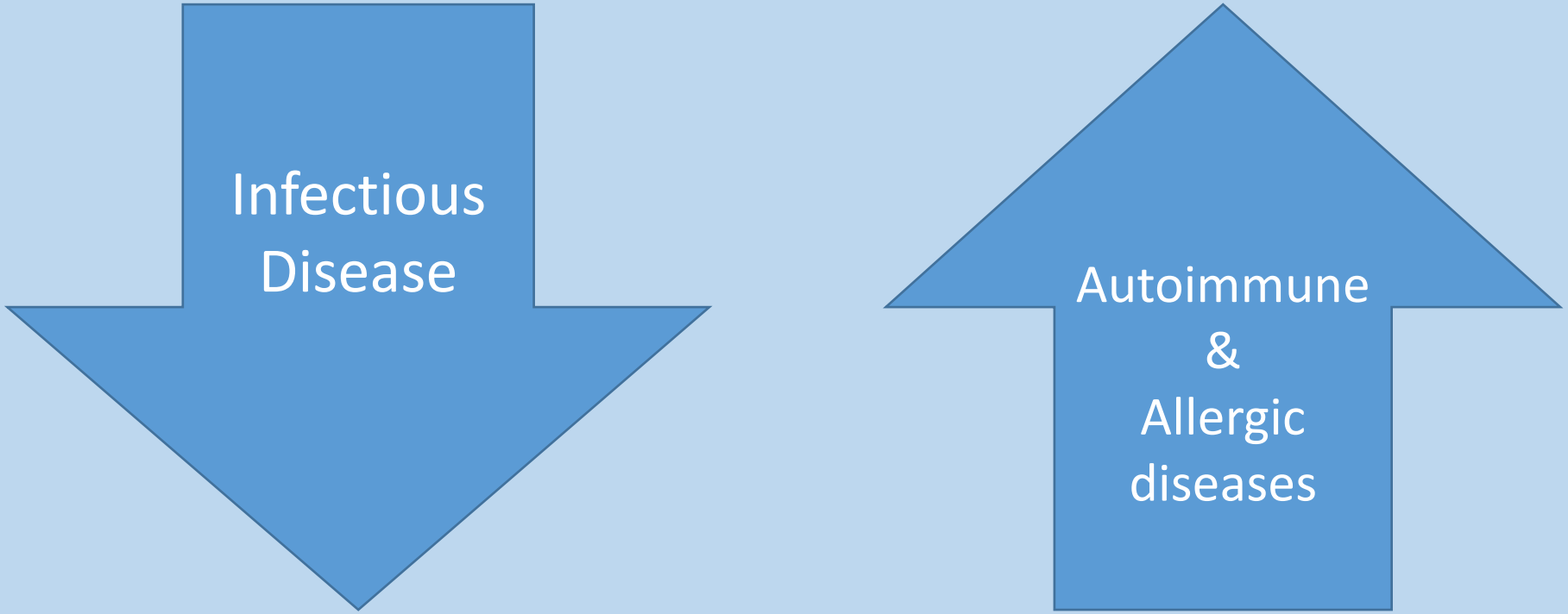
- The Hygiene Hypothesis for asthma- Exposure to germs as a child “teaches” the body to differentiate harmless substances from the harmful substances that trigger asthma
- Not that simple –
  - a number of microbes — such as respiratory syncytial virus (RSV) — may cause asthma rather than prevent it.
  - In addition, infections that might help prevent asthma can cause a number of other health problems.

- There is compelling evidence that some exposure to “germs” builds a strong immune system but some believe that exposure to non-pathogens is as good or better than challenging the children’s immune system with pathogens.

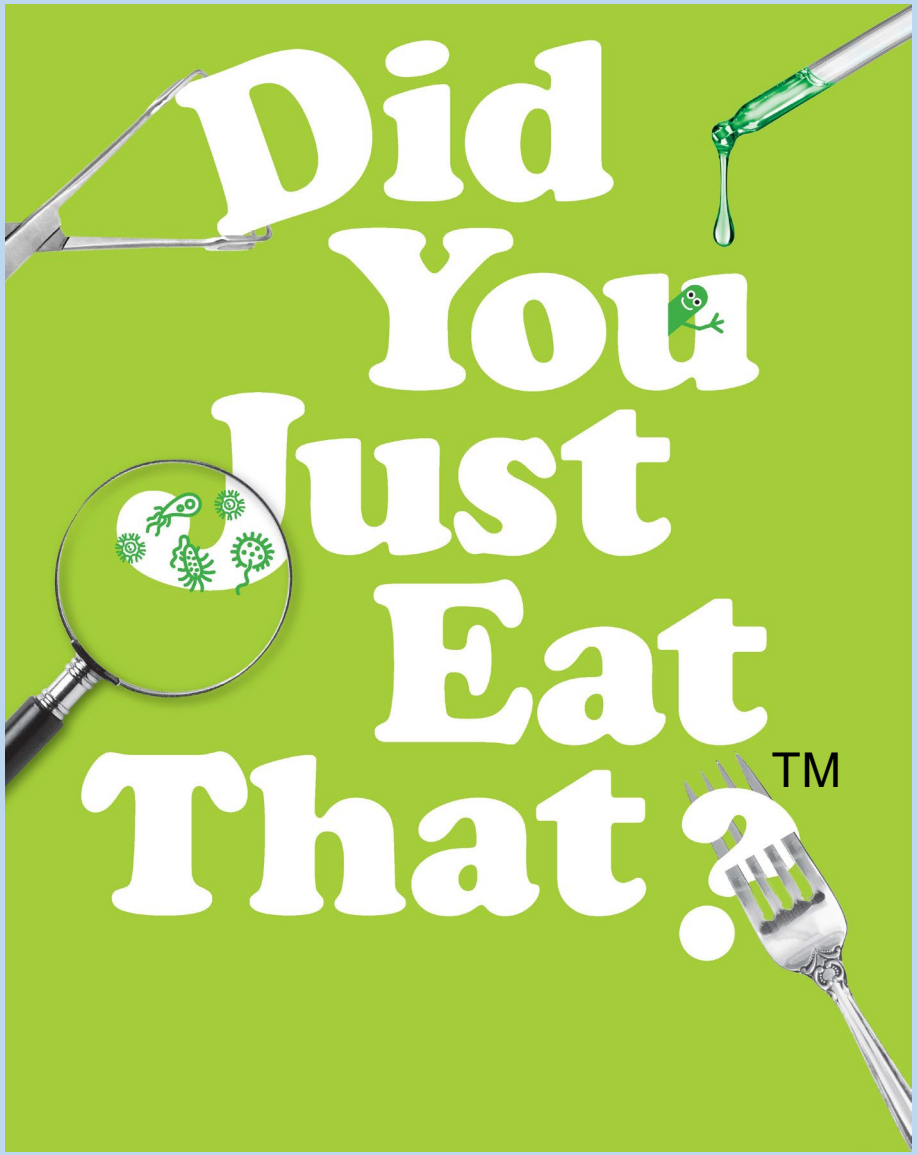
Louis Pasteur vs. Antione Bechamp
Germ Theory vs. Host Theory

- Germ Theory – germs enter a healthy host and cause disease
- Host Theory –germs exist in everyone and are opportunistic

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2841828/



Clin Exp Immunol. 2010 Apr; 160(1): 1–9. doi: 10.1111/j.1365-2249.2010.04139.x



Thank You!

AFDOSS