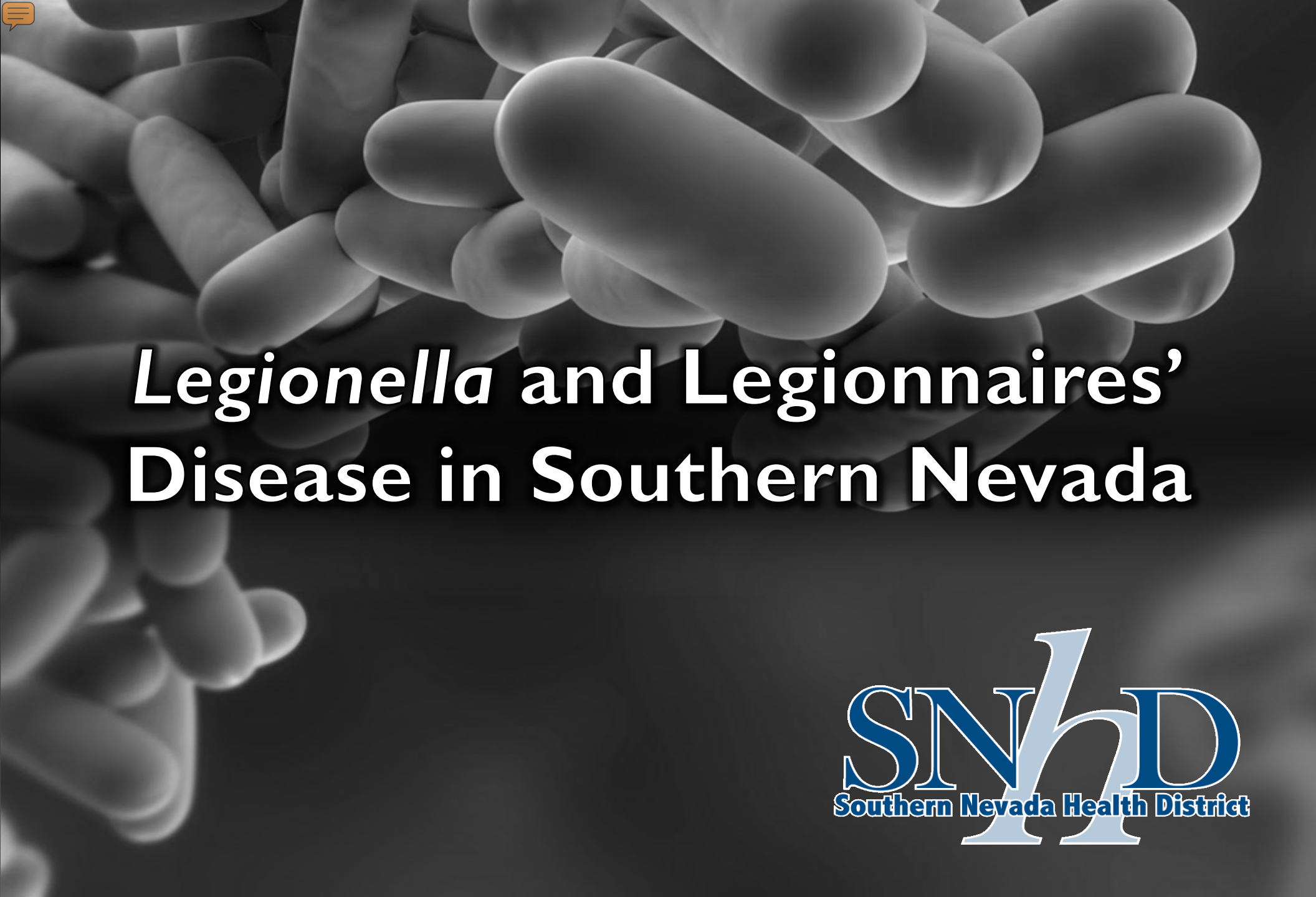


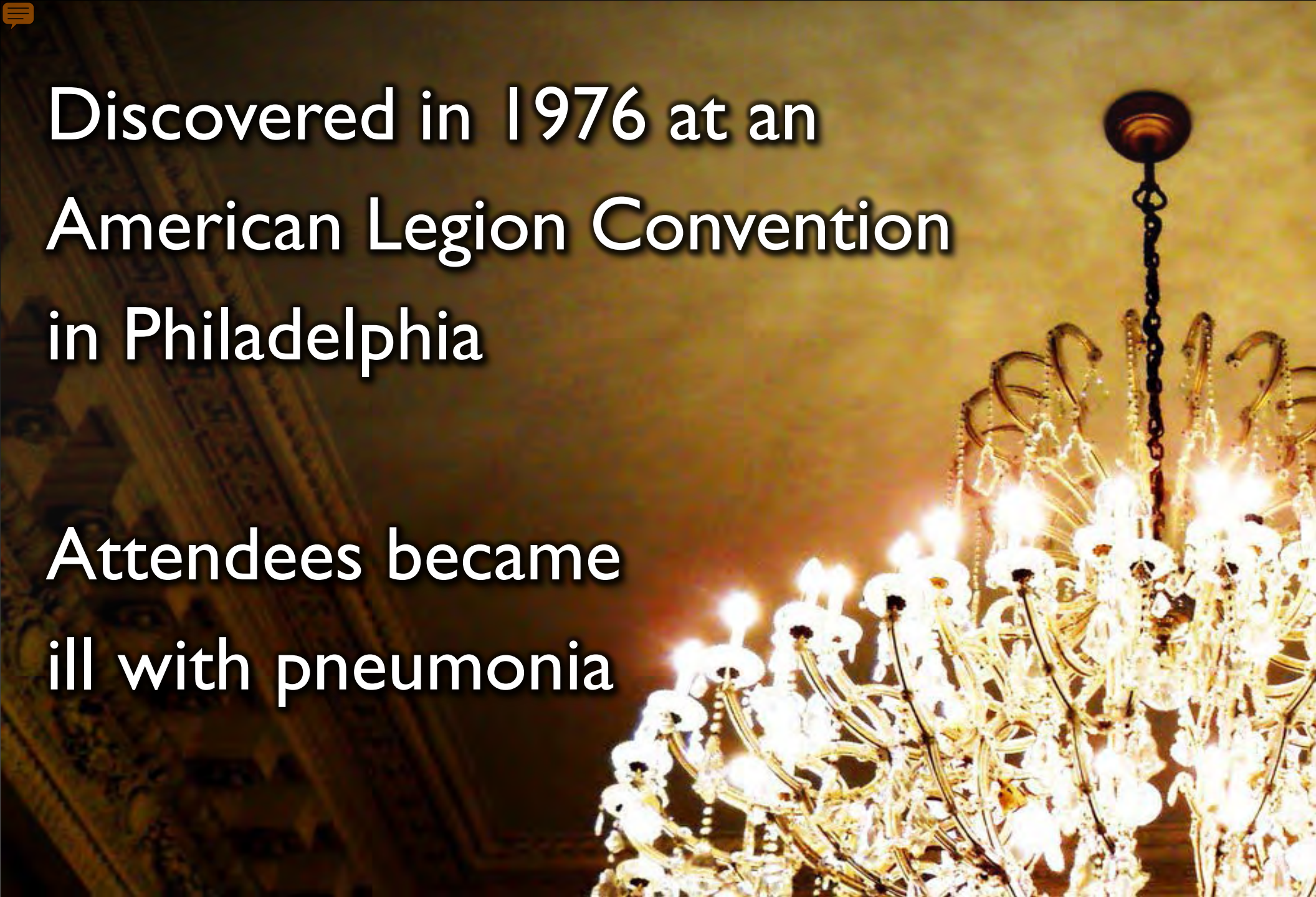
Legionella and Legionnaires' Disease in Southern Nevada

Southern Nevada Health District

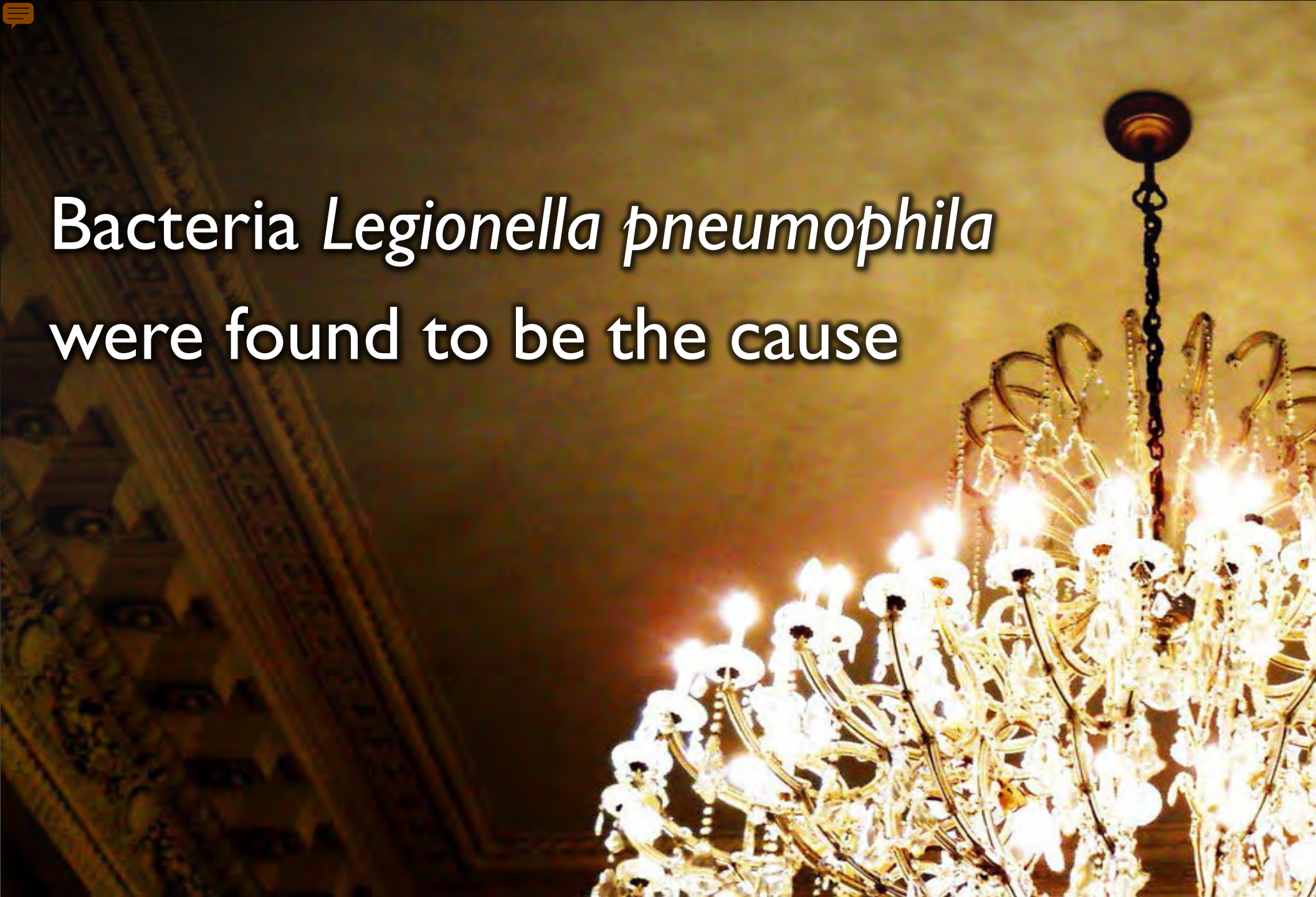
- What is *Legionella*?
- Where does it come from?
- How it causes infections
- Finding, investigating, reporting
- Preventive steps
- Case Study

Discovered in 1976 at an American Legion Convention in Philadelphia

Attendees became ill with pneumonia




221
Total Cases
2/3
Hospitalized
34
Deaths


Bacteria *Legionella pneumophila*
were found to be the cause

What is *Legionella*,
and where does it come from?

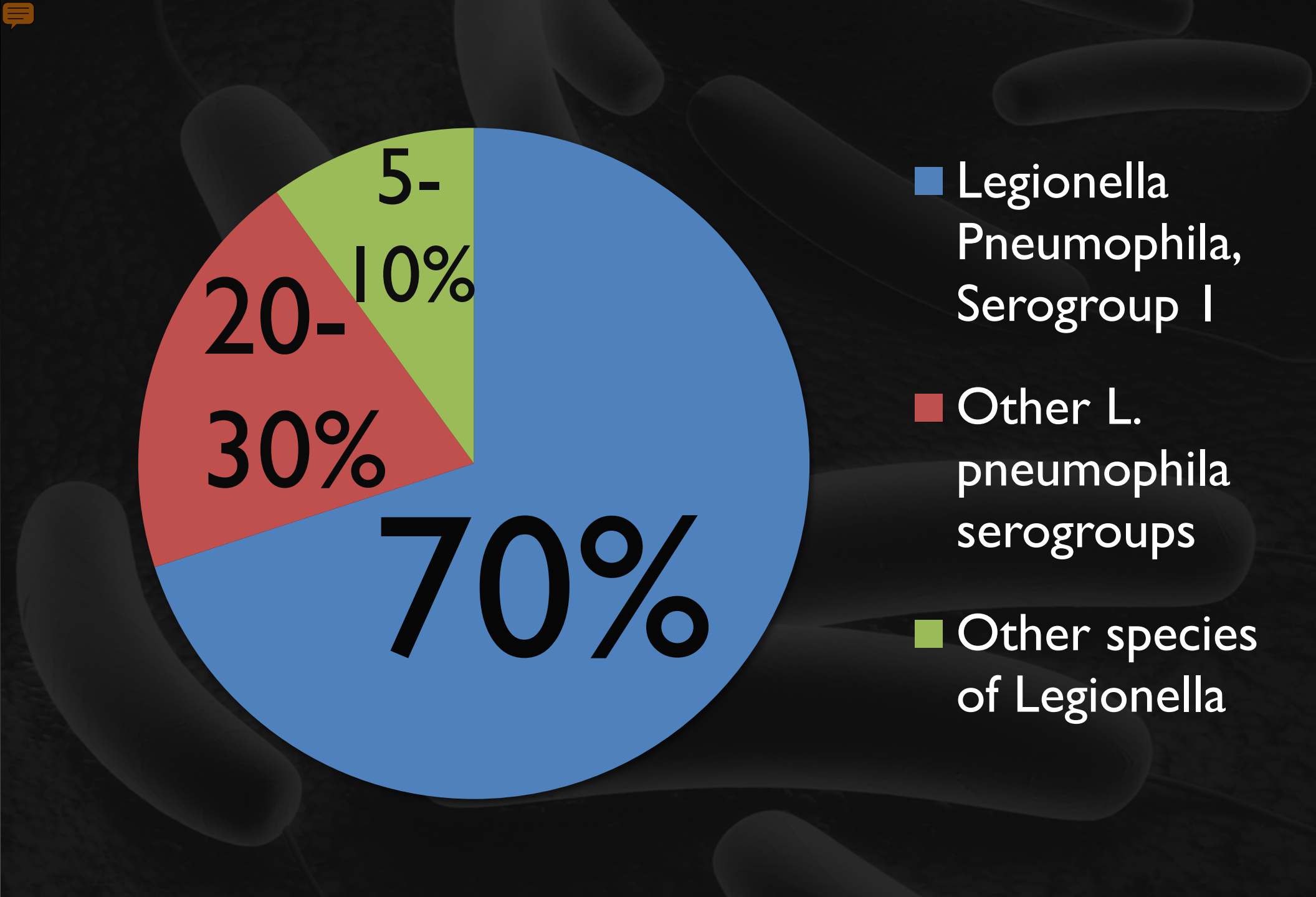
Organism Characterization

Kingdom Bacteria, Genus *Legionella*

43 or more identified species of *Legionella*

Multiple **Serogroups**, with over 60 serogroups presently identified for the genus

Many of the species serogroups are further differentiated into numbers of **subtypes**


5-10%
20-30%
70%
Legionella Pneumophila, Serogroup 1
Other L. pneumophila serogroups
Other species of Legionella

Ecology of *Legionella*

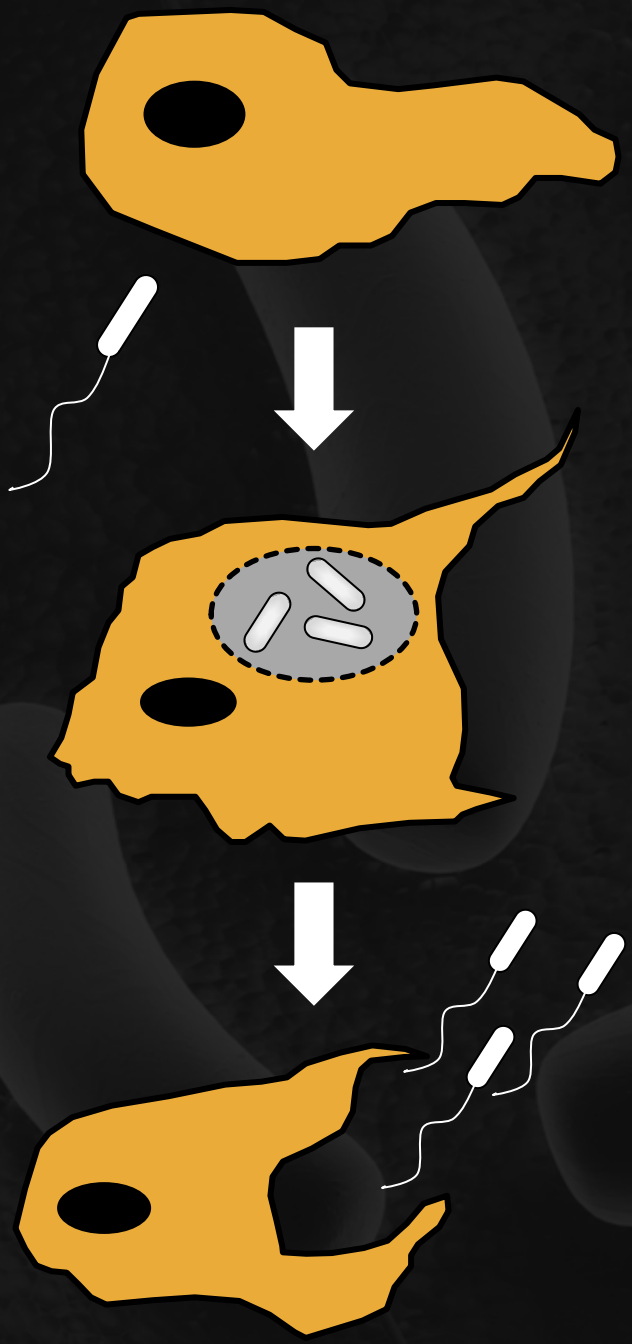
Grow best at 68 to 115° Fahrenheit

(Water supply systems often kept at 77 to 108°F)

Can be found in natural surface waters and in buildings

Infect/replicate in both protozoa and human white blood cells

The protozoa/blood cells infected with *Legionella* burst and release the bacteria into the water



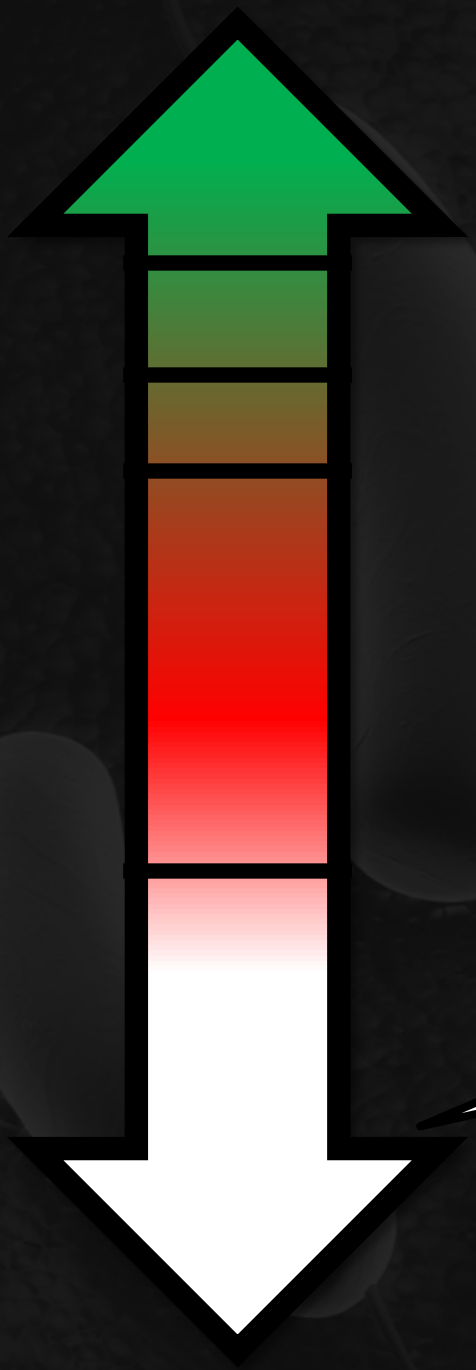
Legionella enters the amoeba or white blood cell macrophage

Legionella fuses with the cell's endoplasmic reticulum-inside a membrane-bound vacuole and replicates

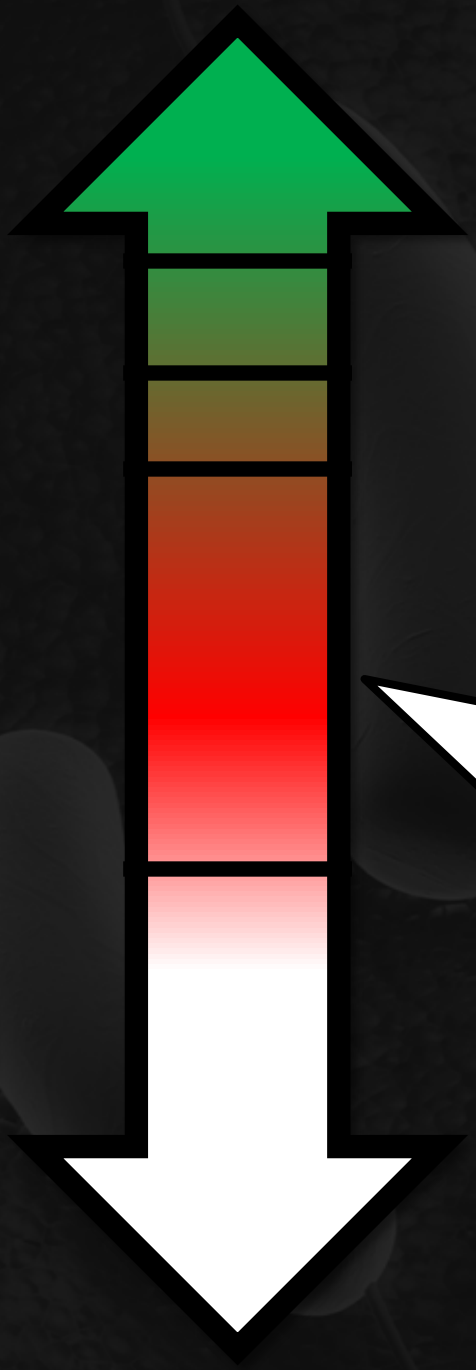
Legionella releases from amoeba/white blood cell, exiting as the cell dies by forming a pore and exploding

Growth curve

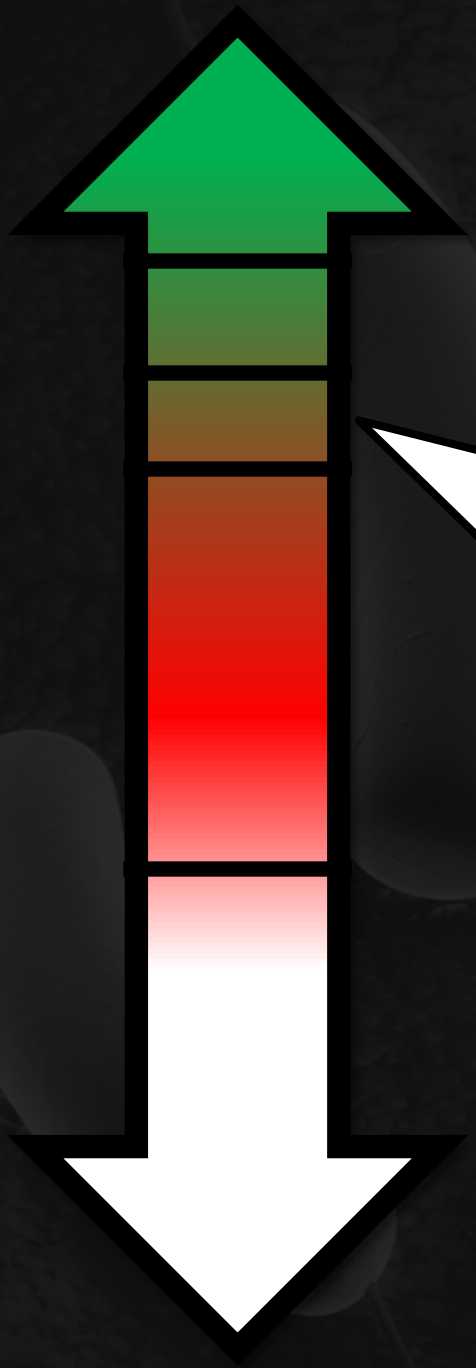
Like other bacteria, *Legionella sp.* have optimum growth temperatures



<20˚C (68˚F)
Predominantly dormant,
but still viable

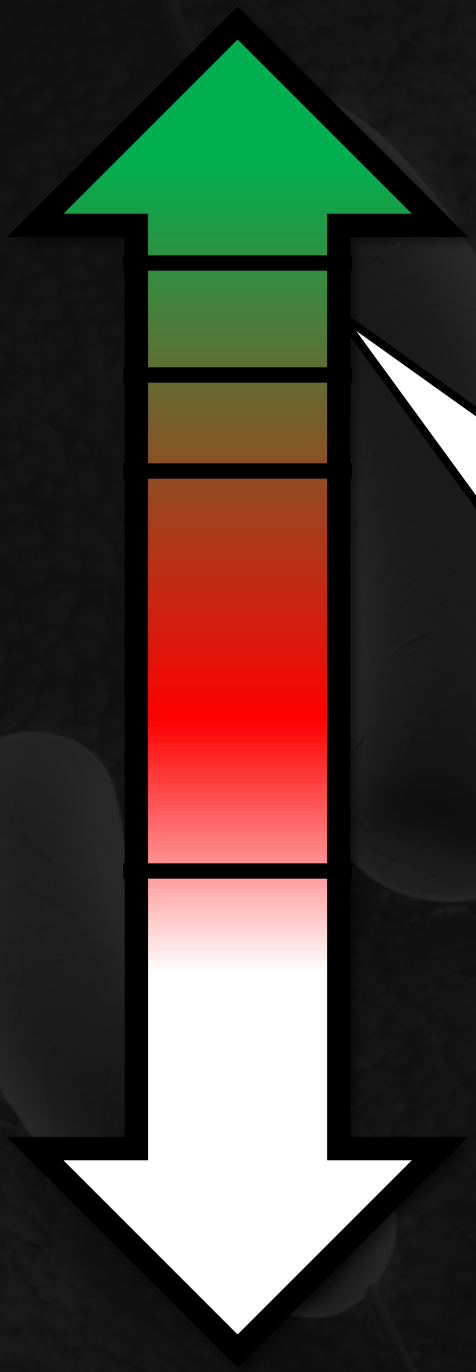


35-46˚C (95-115˚F)
Legionella's optimal
growth temperature



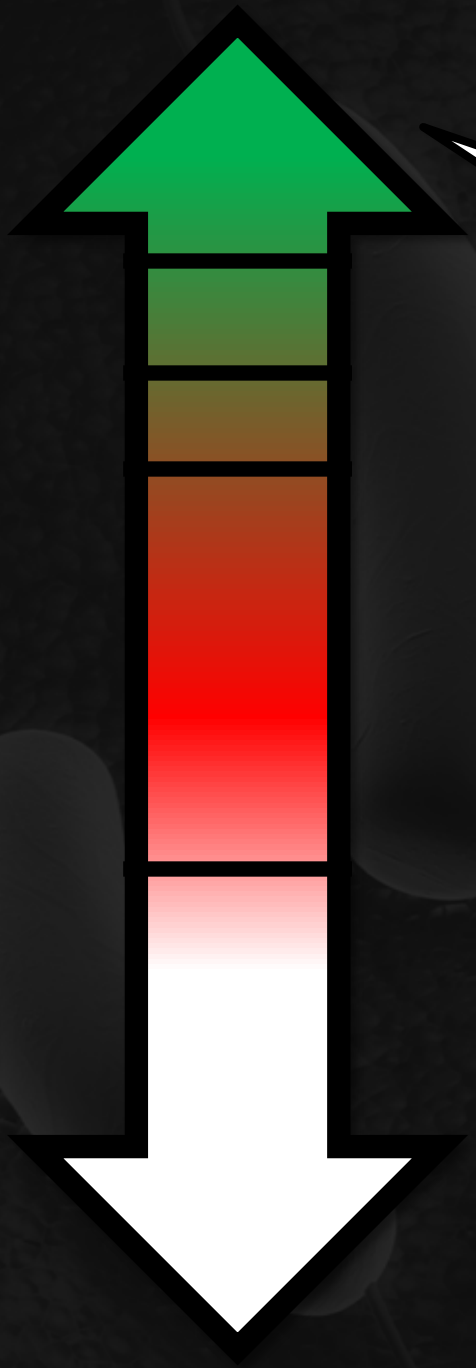
50˚C (122˚F)

90% Kill in 2 Hours



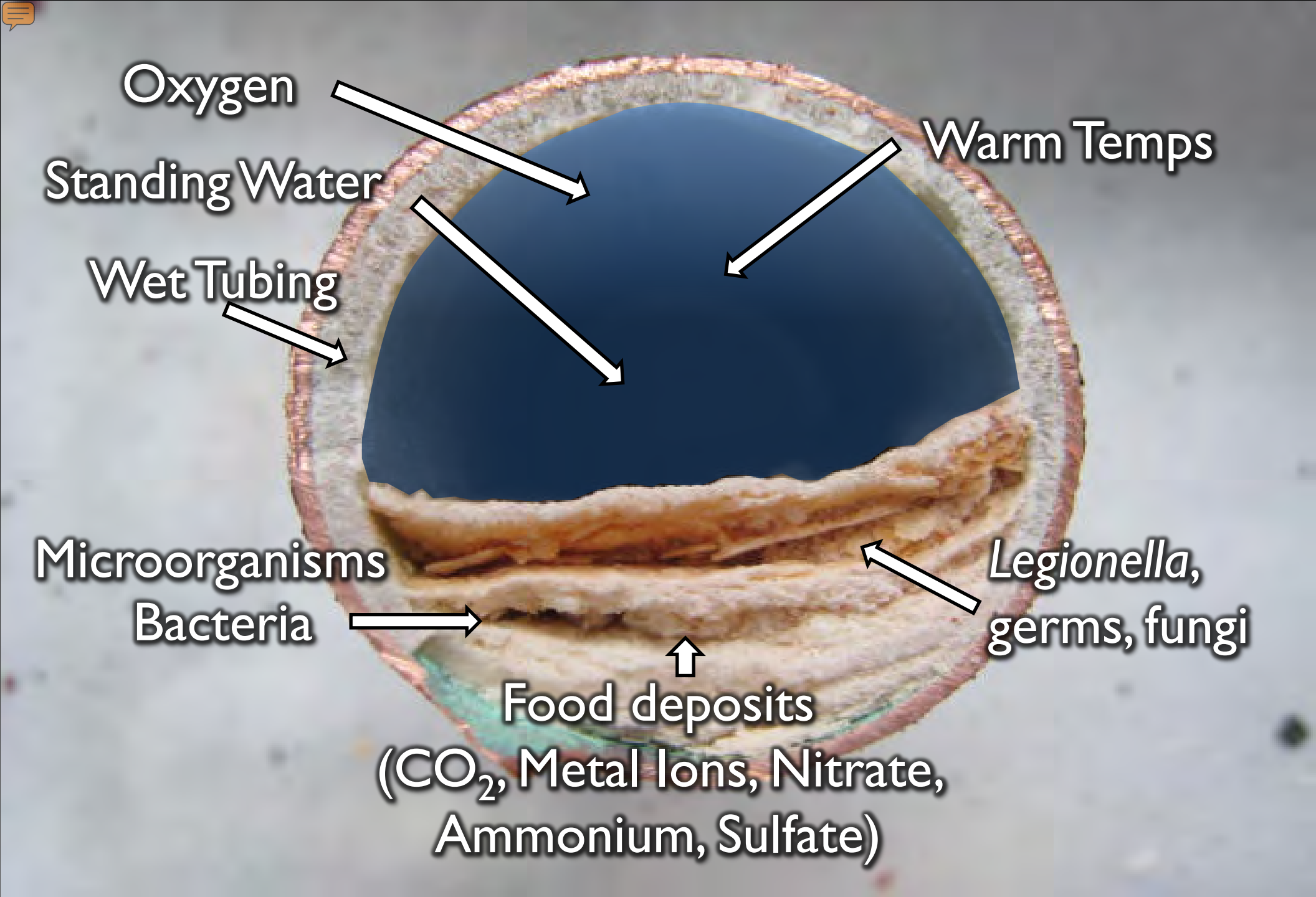
60˚C (140˚F)

90% Kill in 2 Minutes

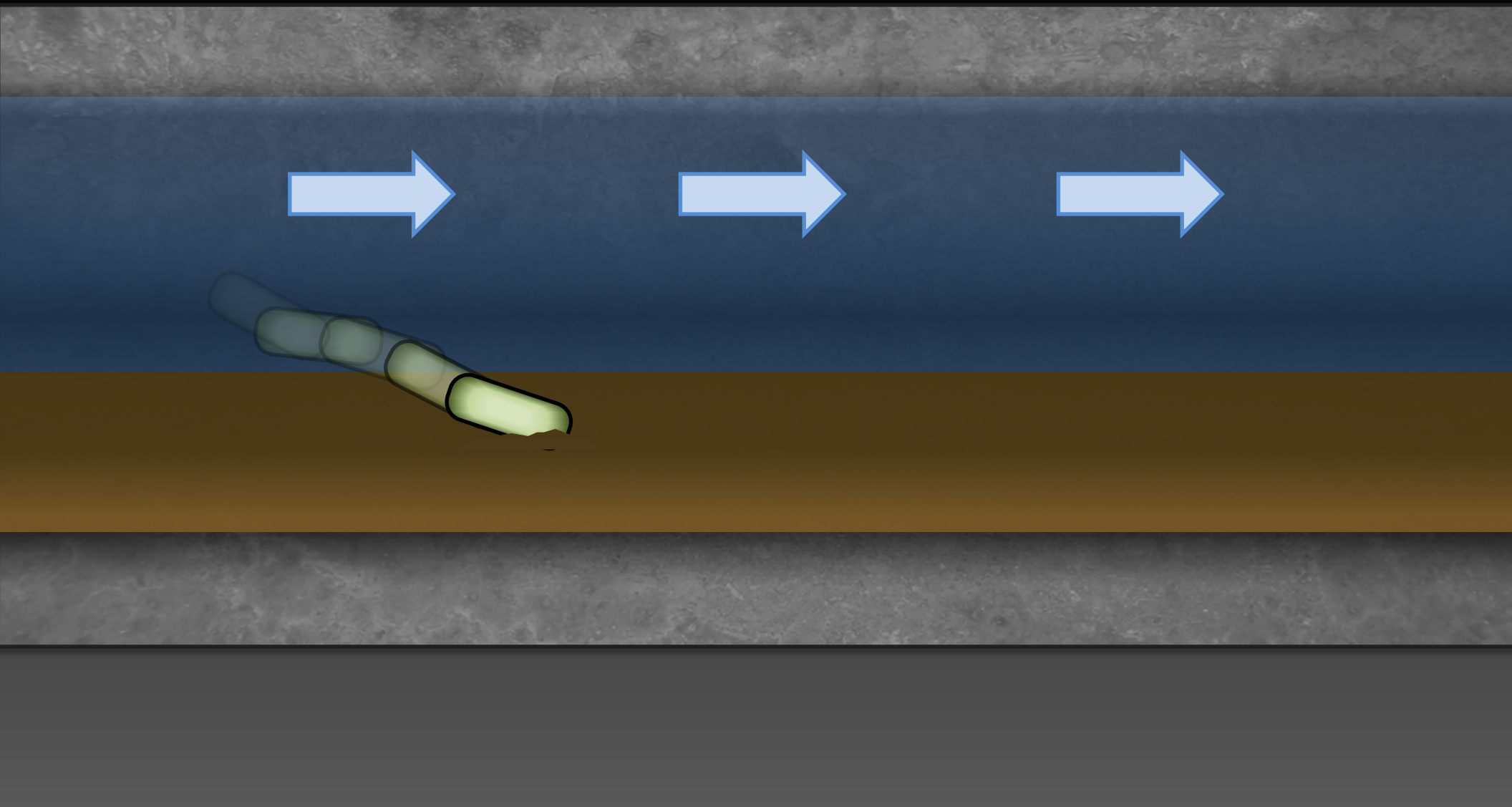


>70˚C (158˚F)

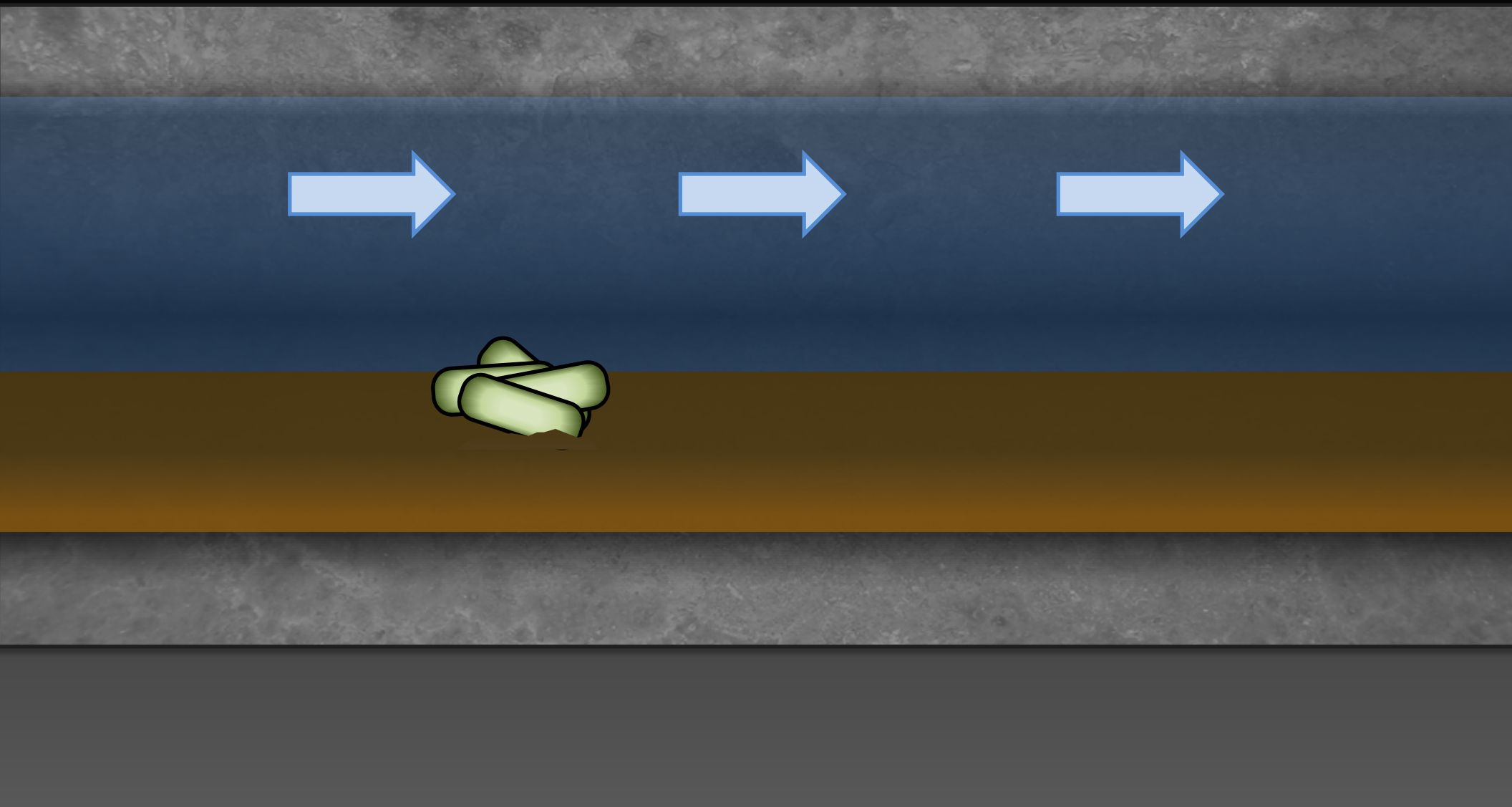
100% Rapid Kill


Oxygen
Standing Water
Wet Tubing
Warm Temps
Microorganisms
Bacteria
Legionella,
germs, fungi
Food deposits
(CO_2, Metal Ions, Nitrate,
Ammonium, Sulfate)

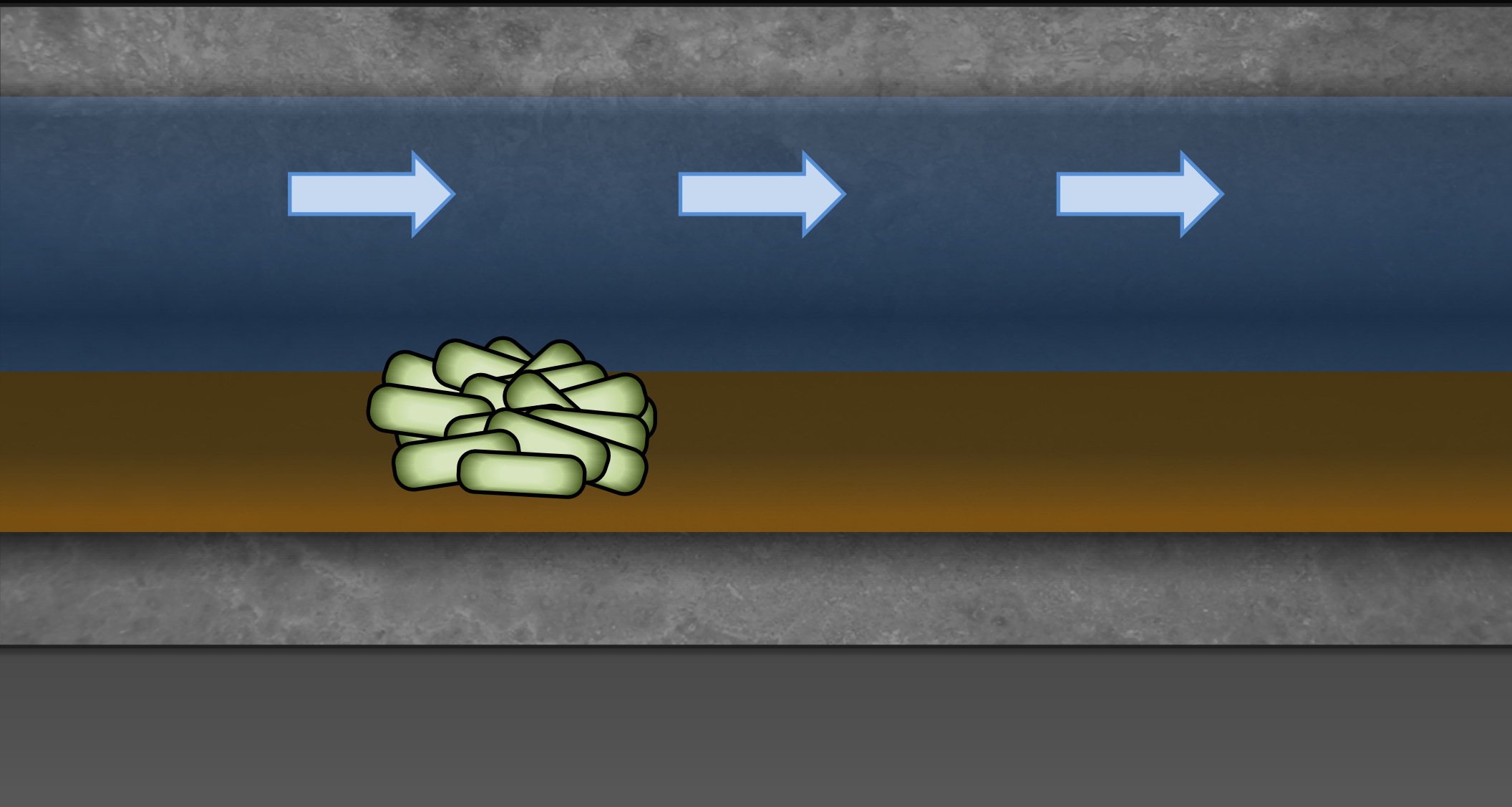
Legionella attaches to biofilm



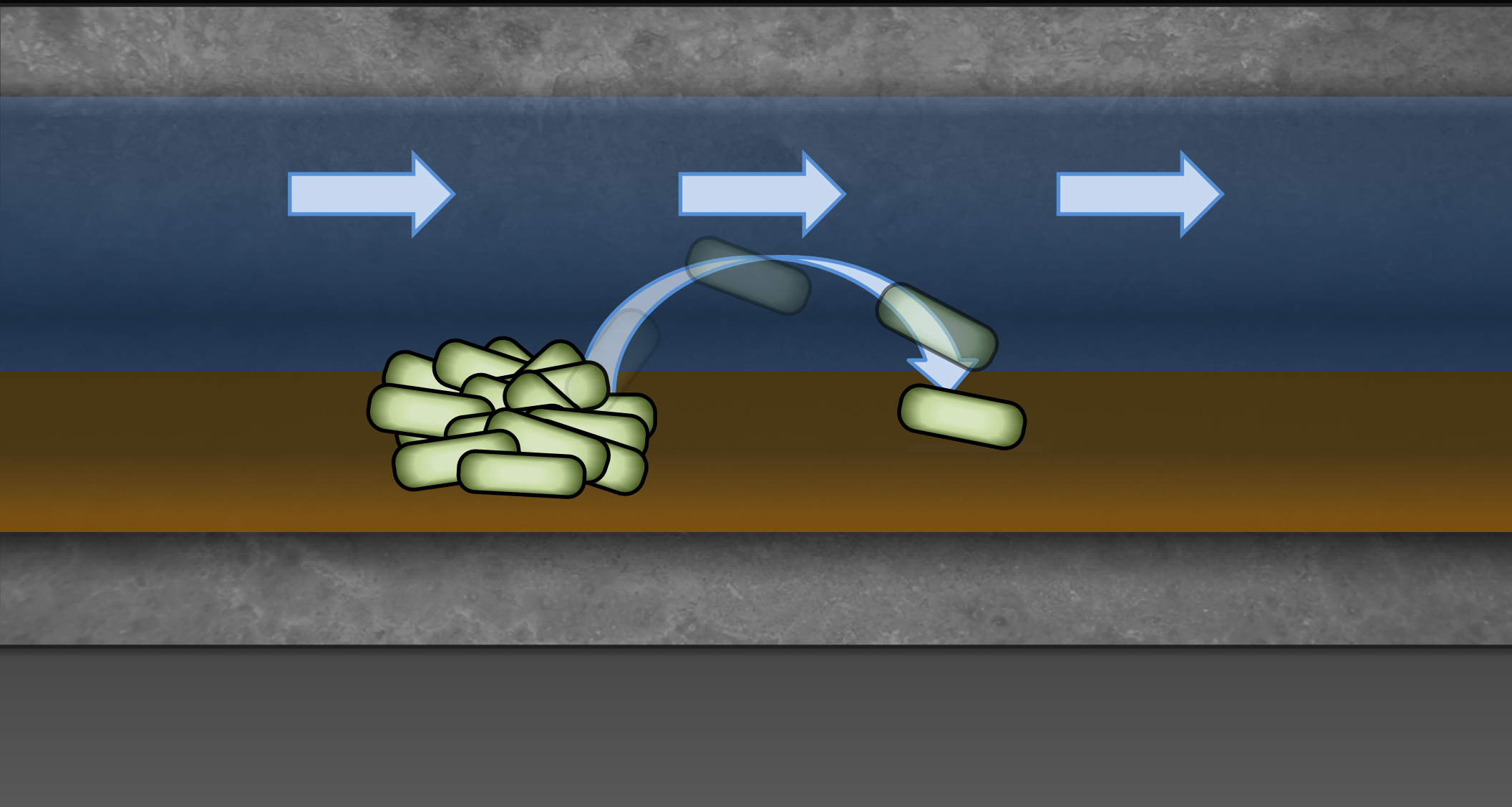
Replication forms a microcolony



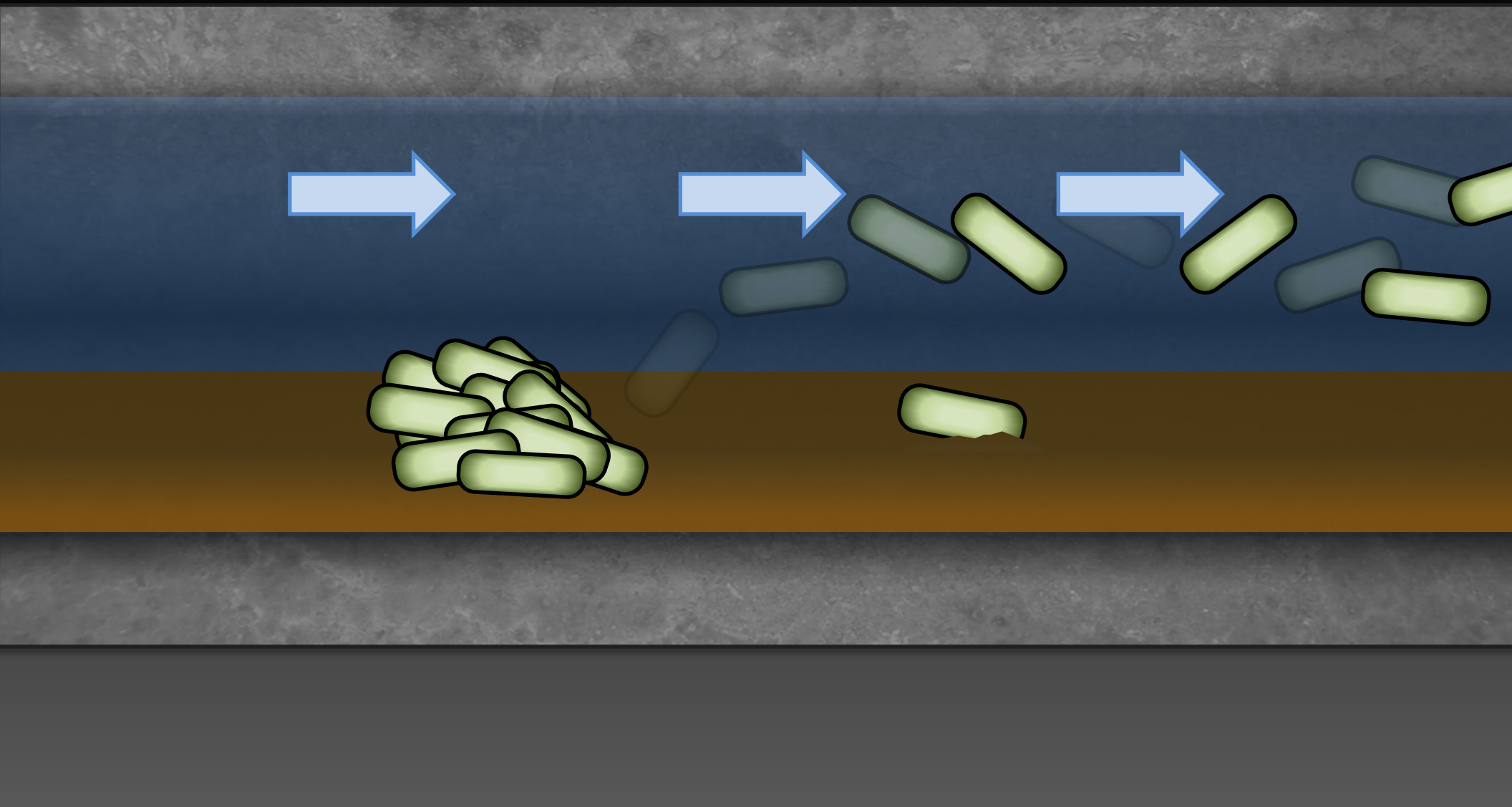
Colony reaches maturation



Some *Legionella* form new colonies



Others continue to end fixture



Legionella are found in the biofilms that accumulate in the built environment:

How *Legionella* causes human infections

The bacteria travel downstream to locations where it is aerosolized, such as:

Susceptible Individuals:

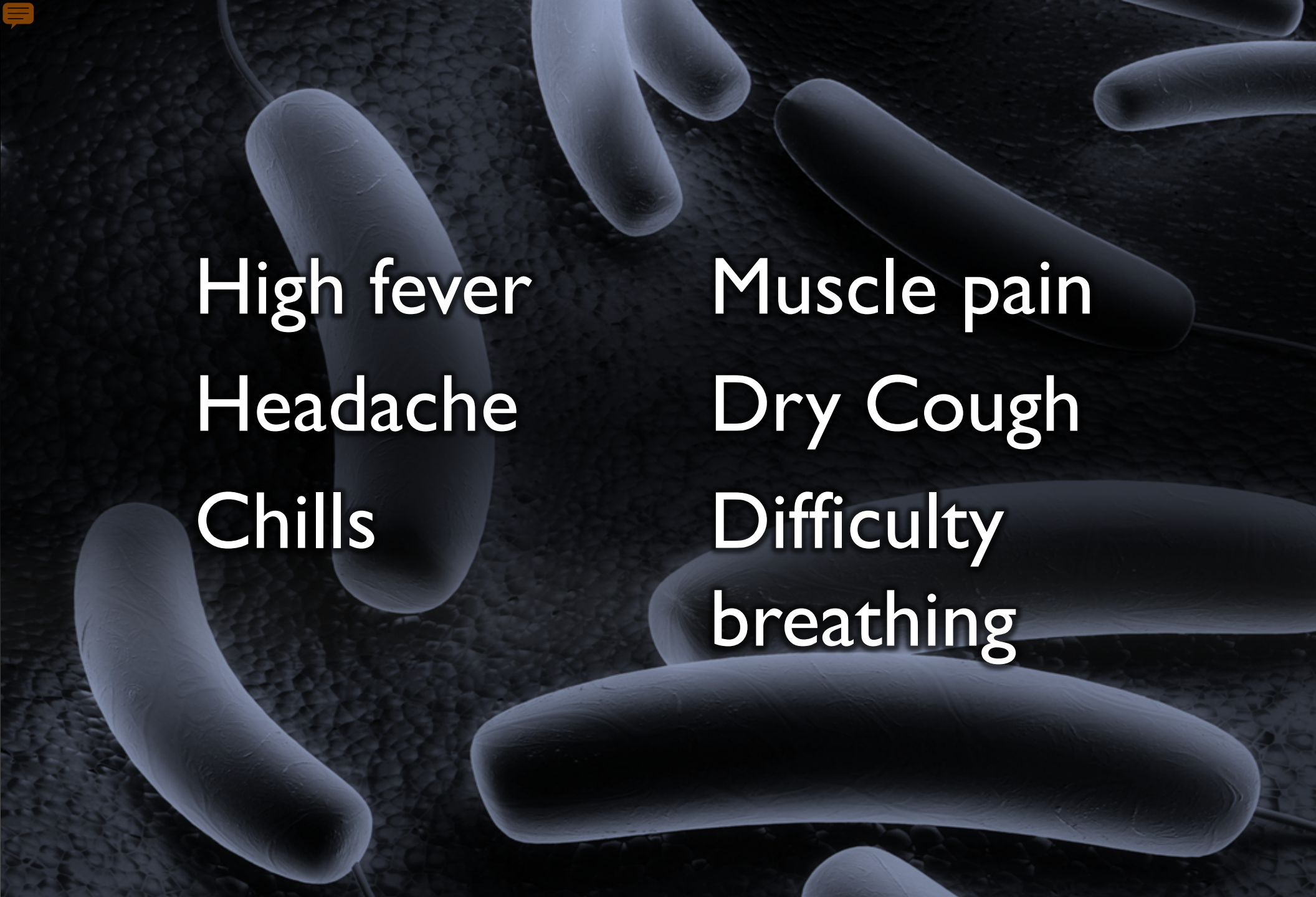

50+
Years
of Age

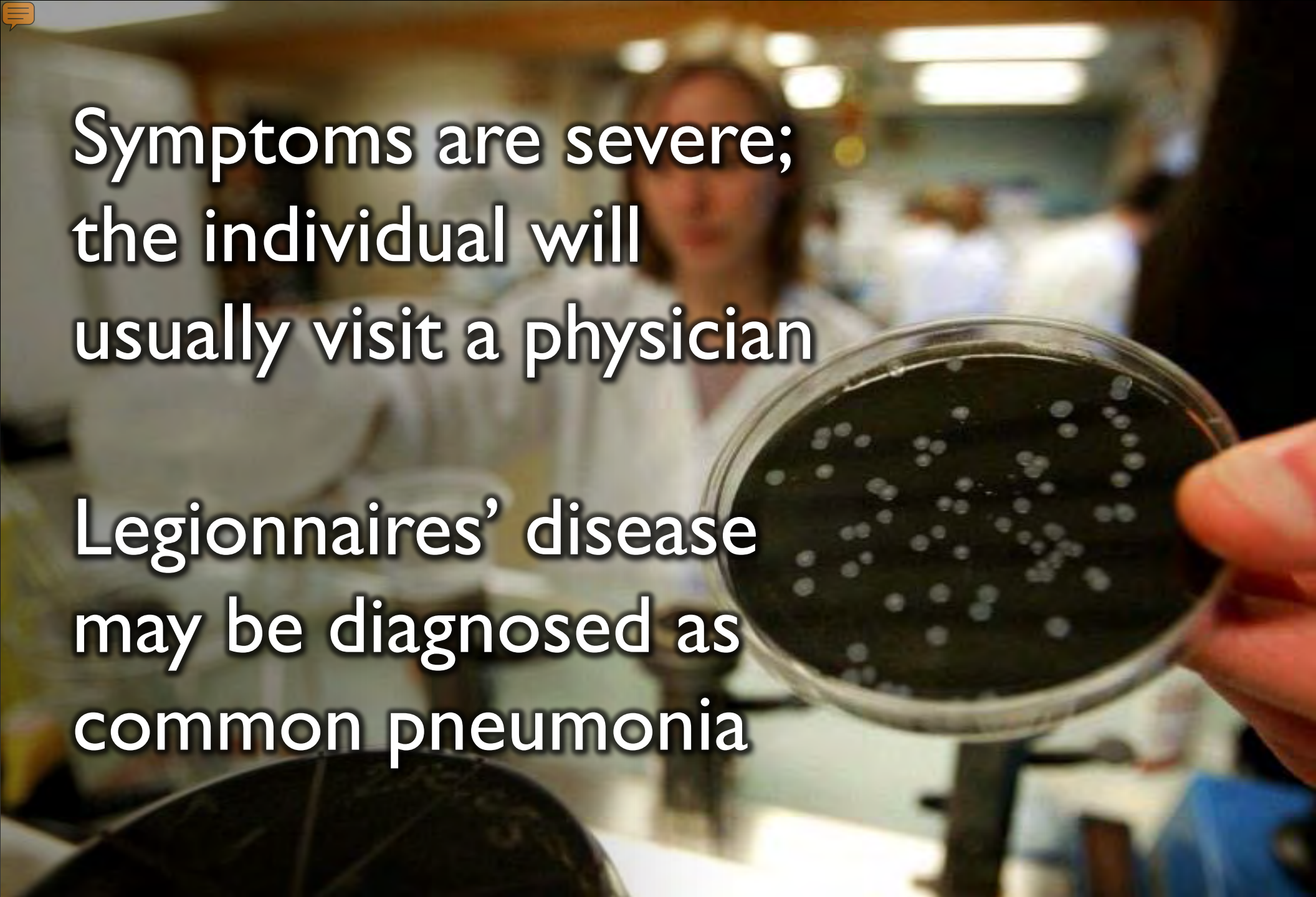

Has Chronic
Lung Disease

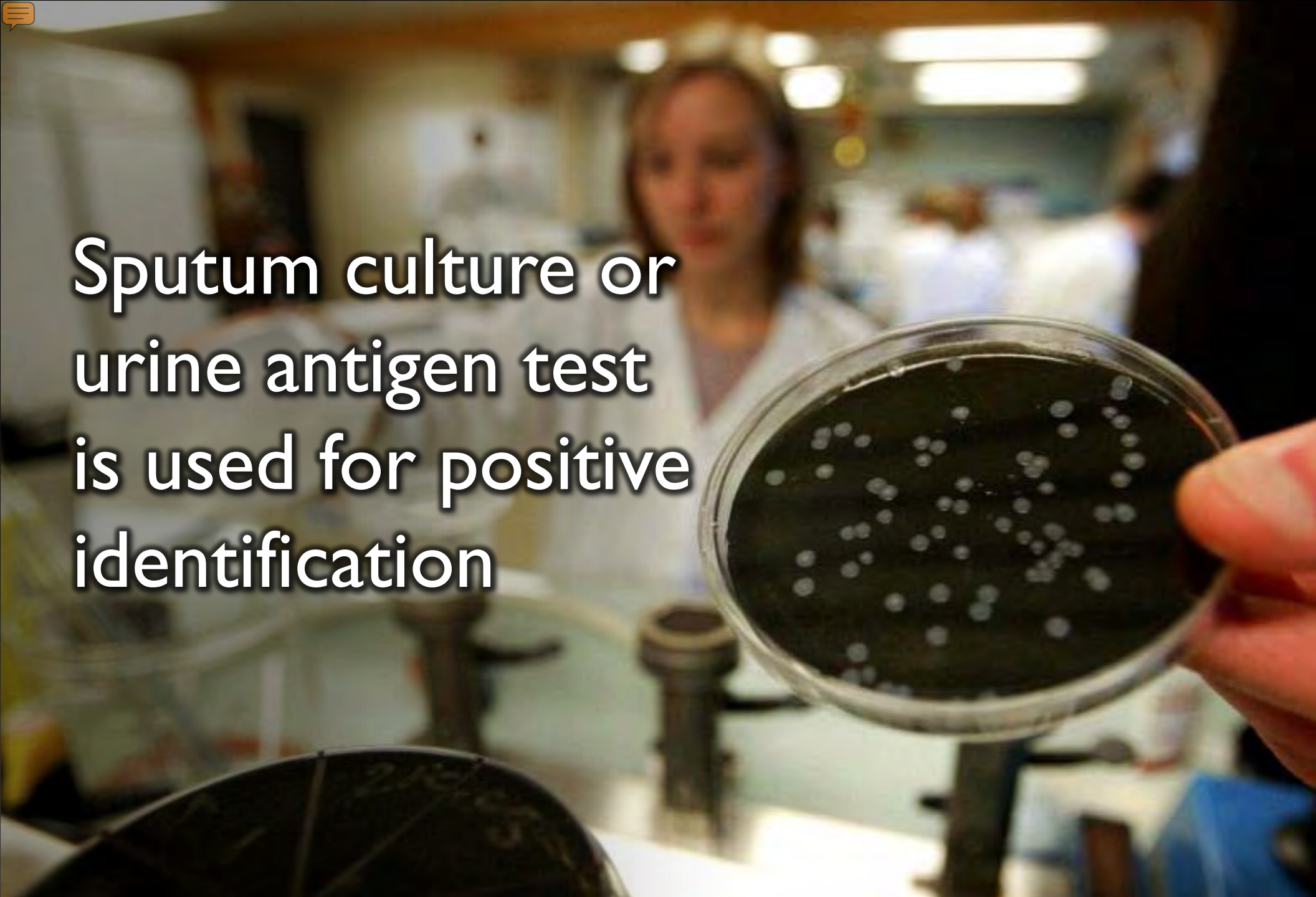

Has Weakened
Immune System


Is a current or
former smoker


2 day -14 day
Incubation Period


High fever
Headache
Chills
Muscle pain
Dry Cough
Difficulty breathing


Symptoms are severe;
the individual will
usually visit a physician
Legionnaires' disease
may be diagnosed as
common pneumonia


Sputum culture or
urine antigen test
is used for positive
identification

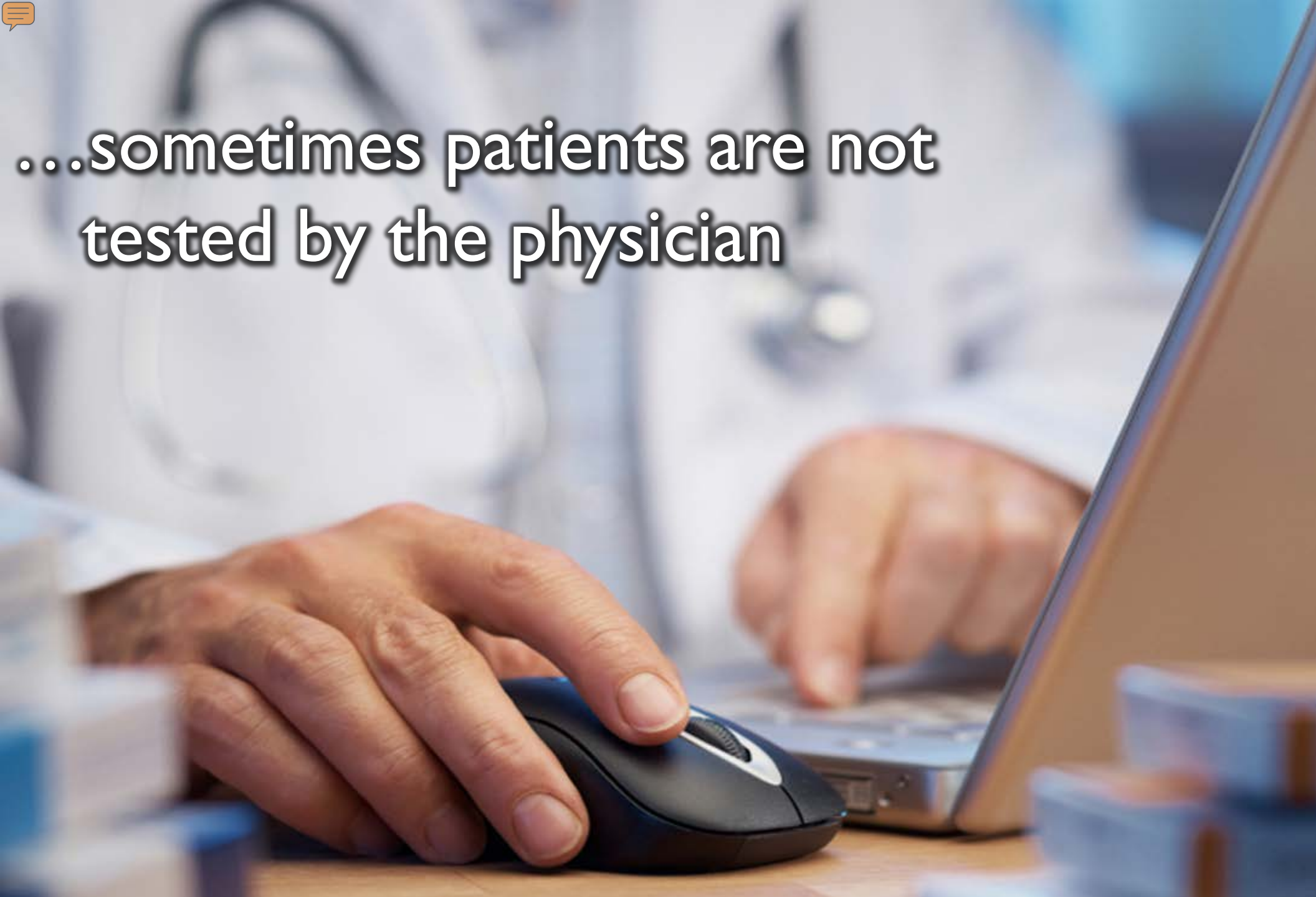

8,000
to
18,000
Hospitalizations
Annually


4,000
Deaths Annually

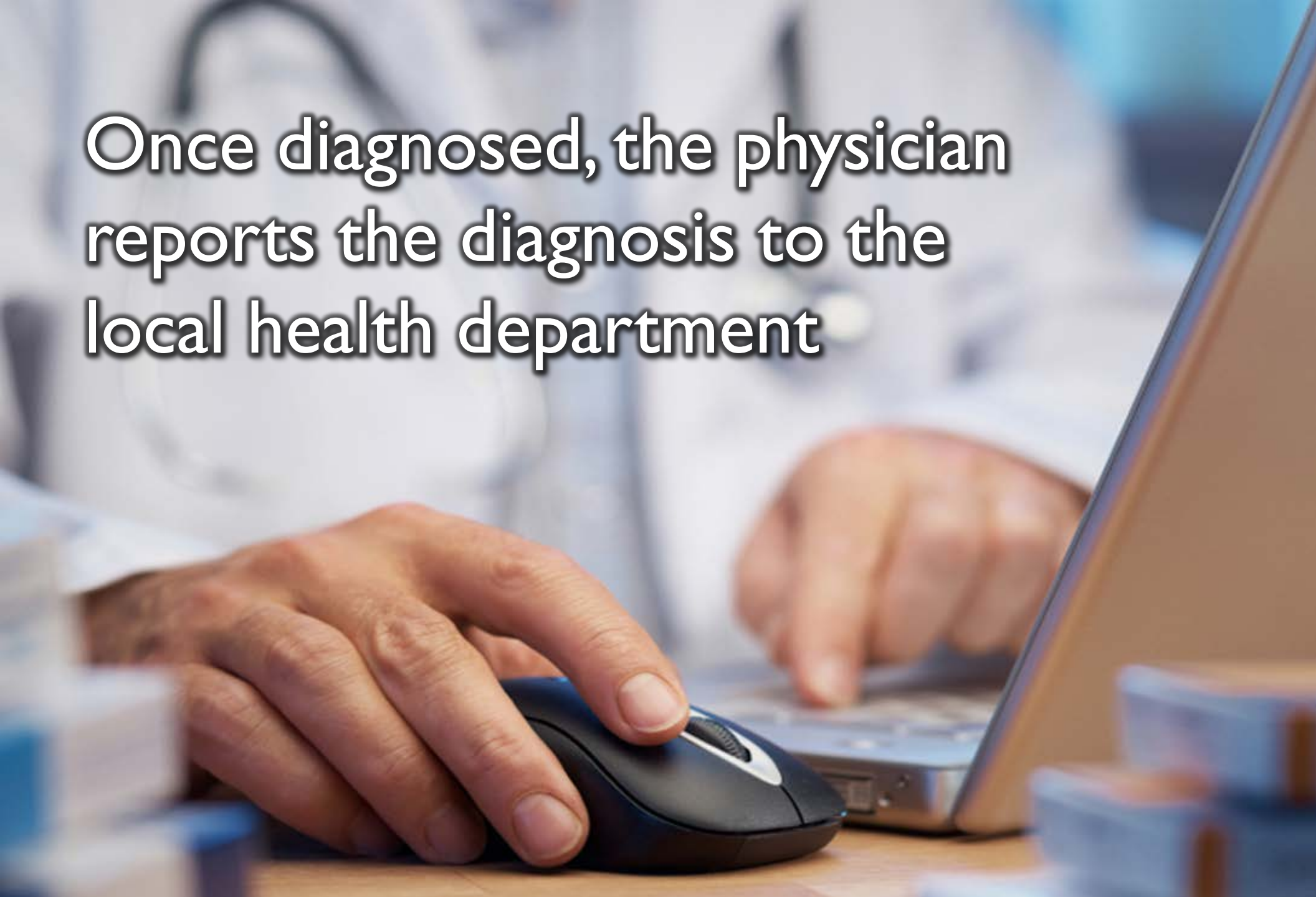

5–30%
Mortality Rate


Legionnaires' disease is under reported


…sometimes patients recover
without medical assistance


…sometimes patients are not
tested by the physician

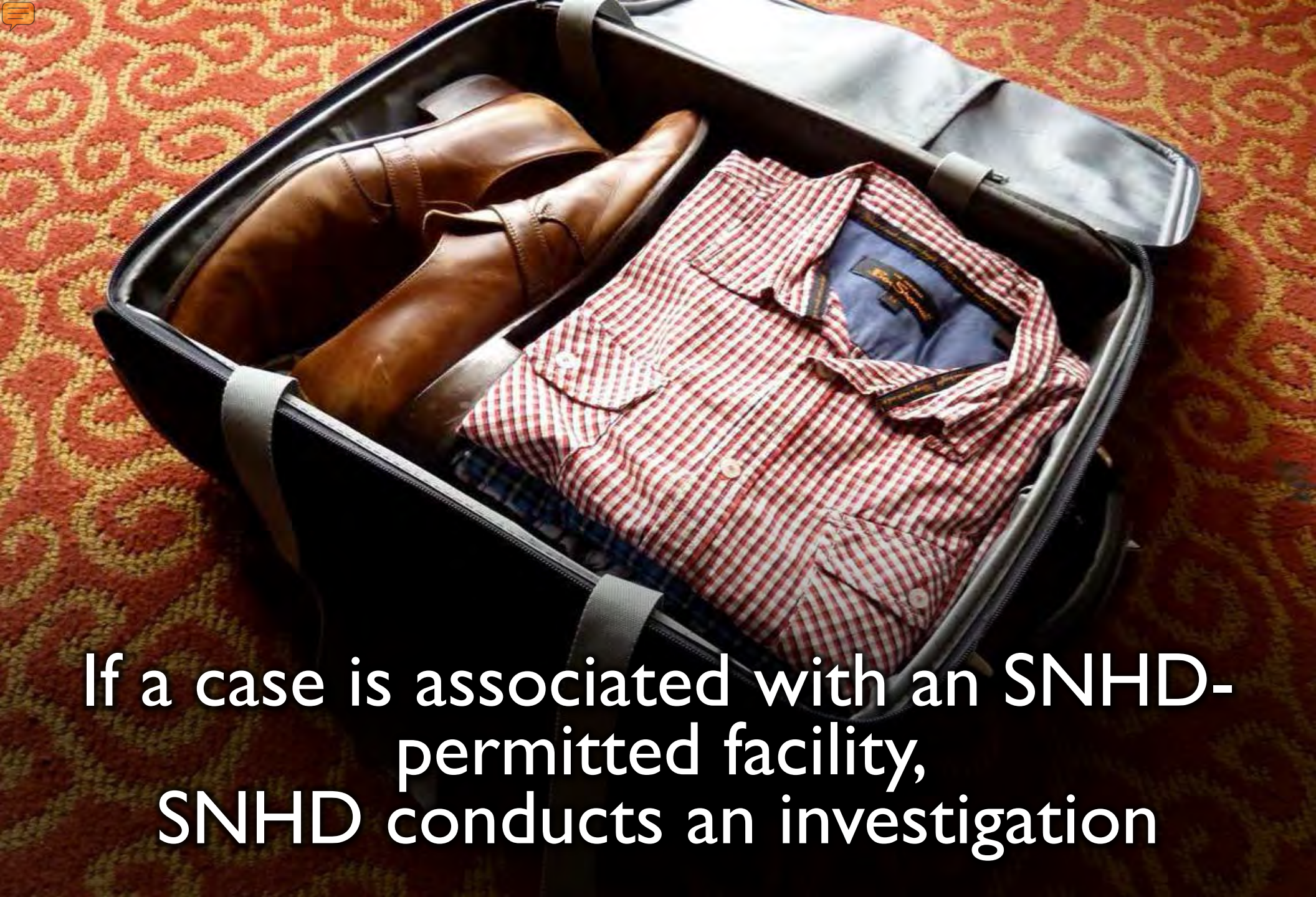

…and sometimes patients receive
a misdiagnosis


Once diagnosed, the physician reports the diagnosis to the local health department


Local Health Department
State Health Department
Centers for Disease Control

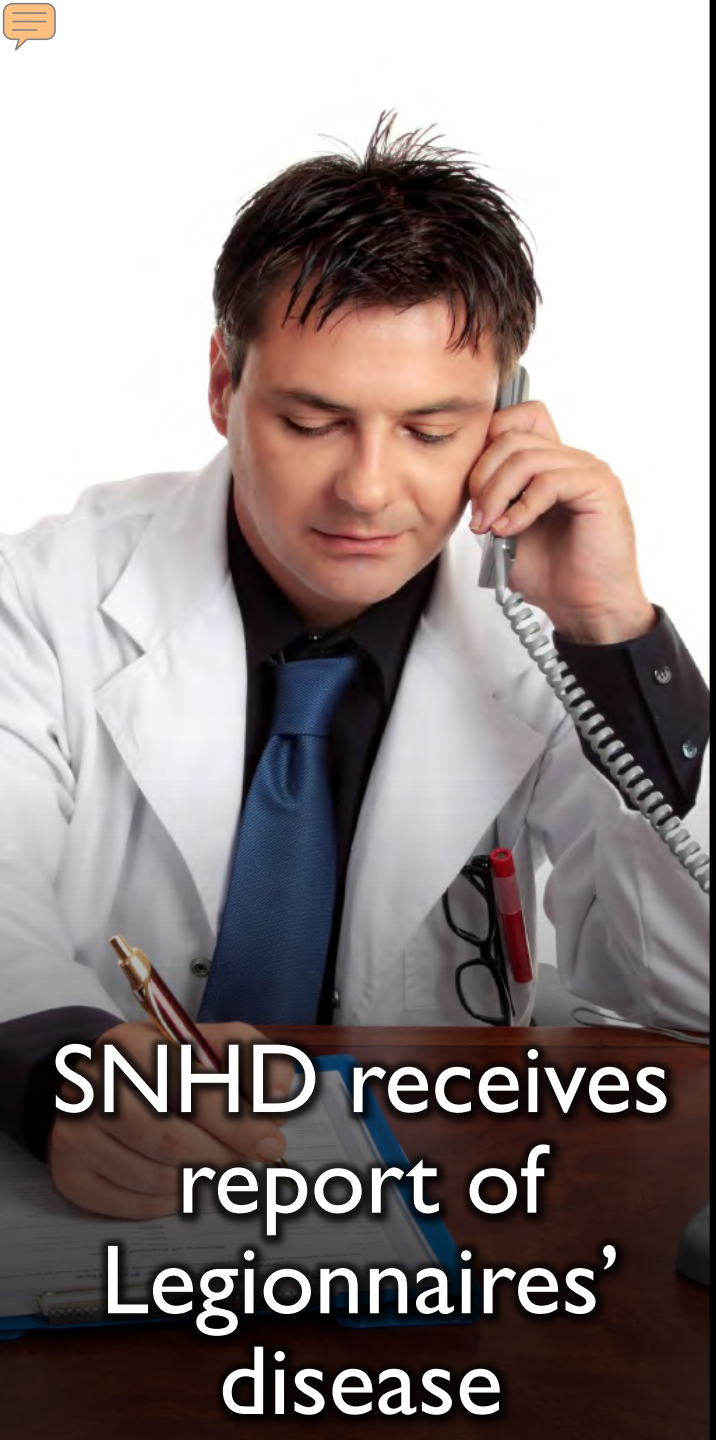
More than 20% of cases are associated with travel

CDC reports the case to the visited state or community

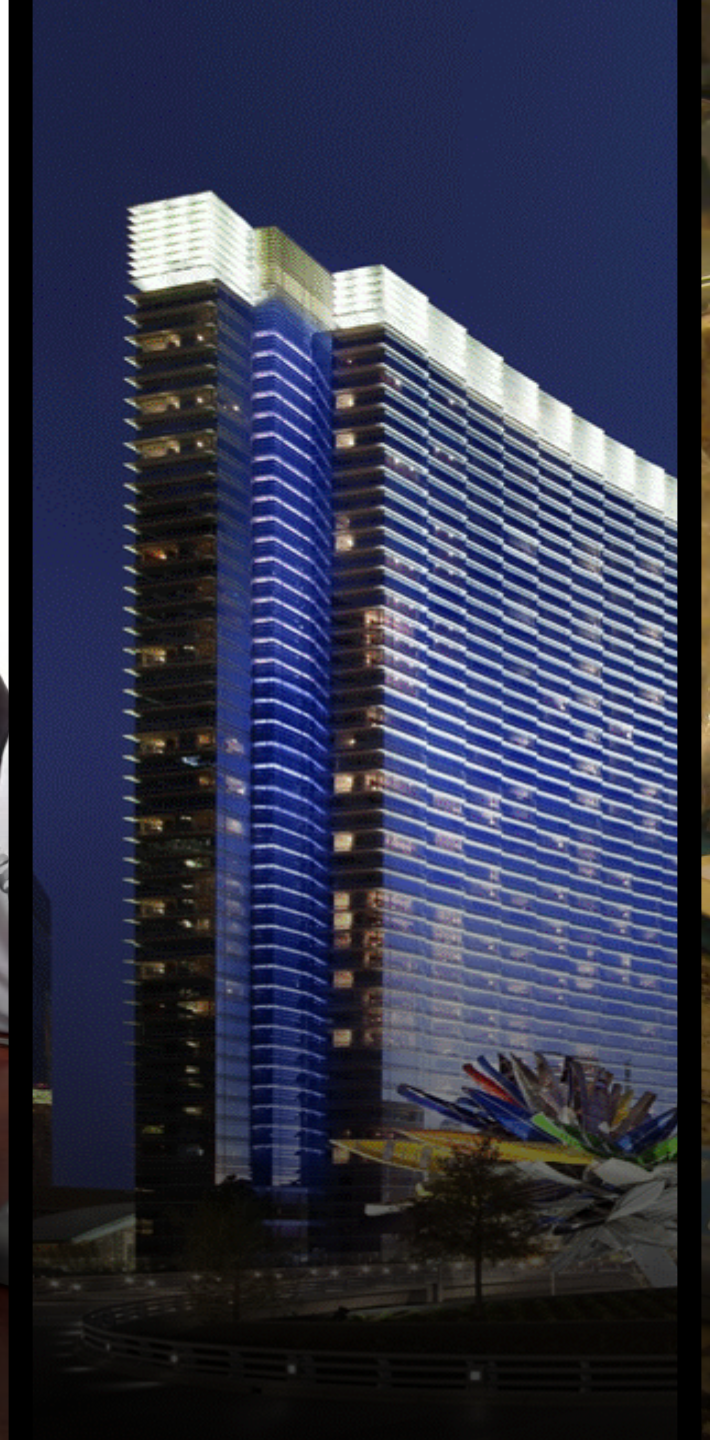


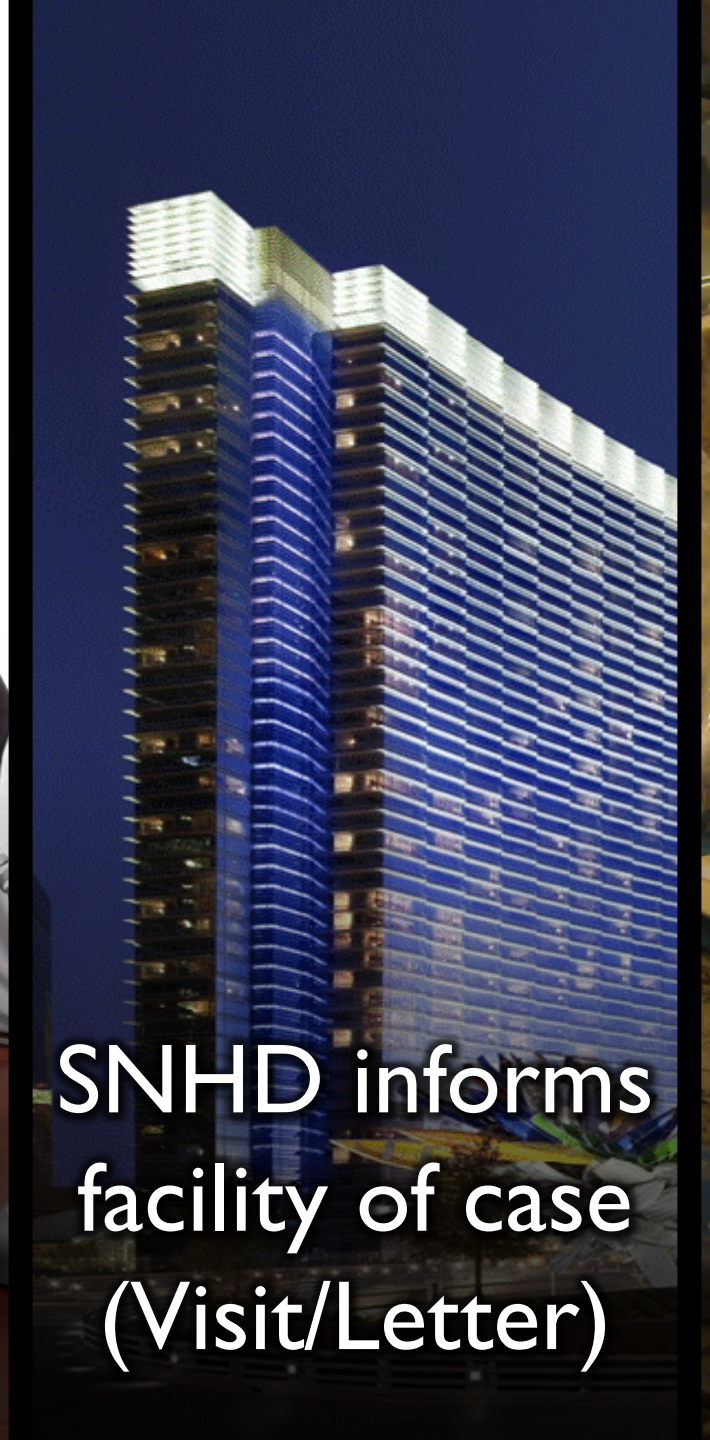
If a case is associated with an SNHD-permitted facility,
SNHD conducts an investigation

Environmental Investigation

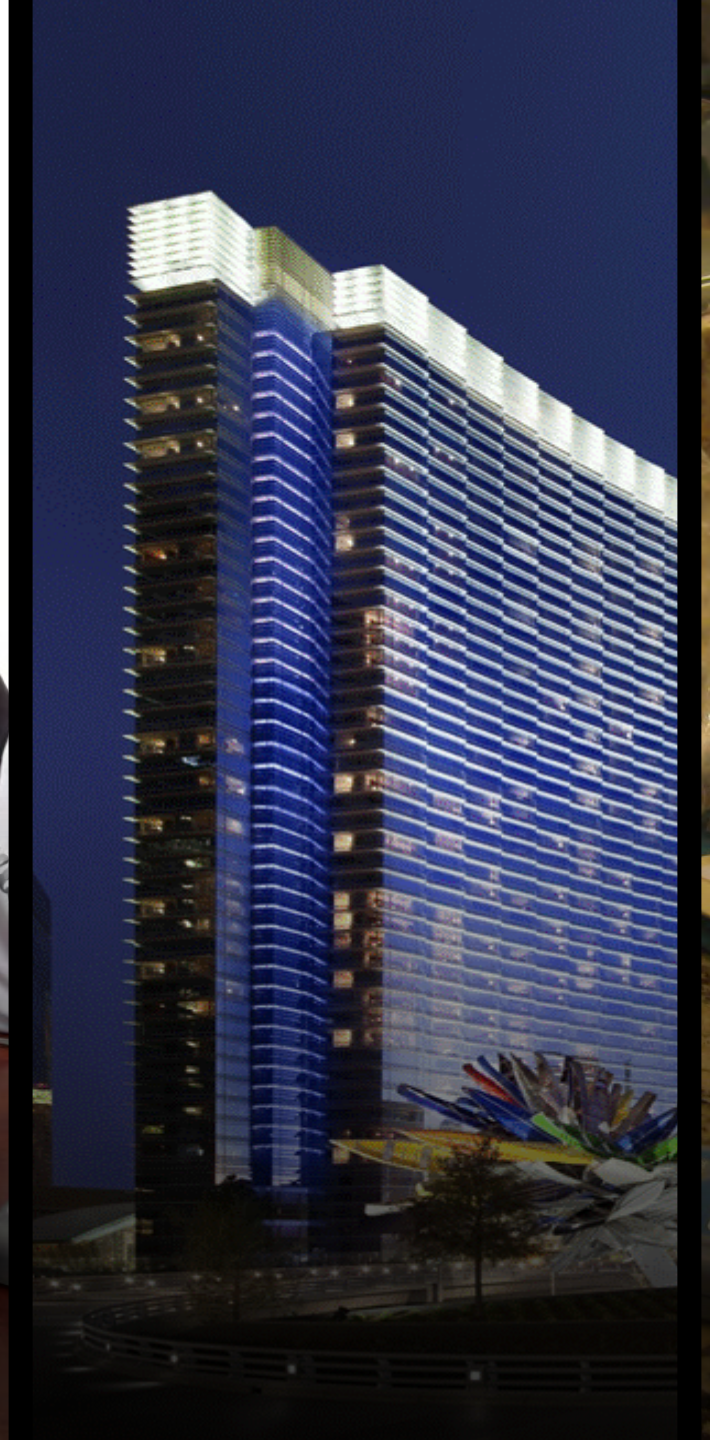


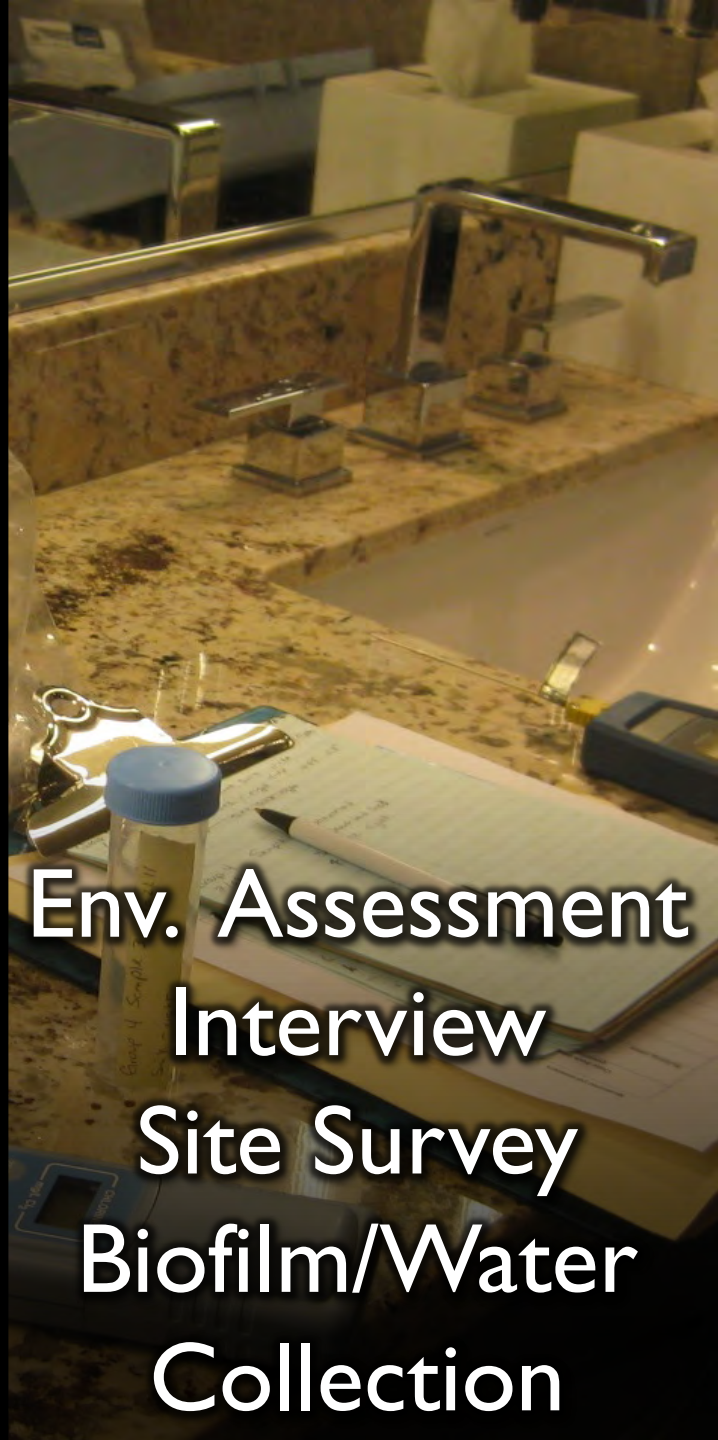
SNHD receives report of Legionnaires' disease





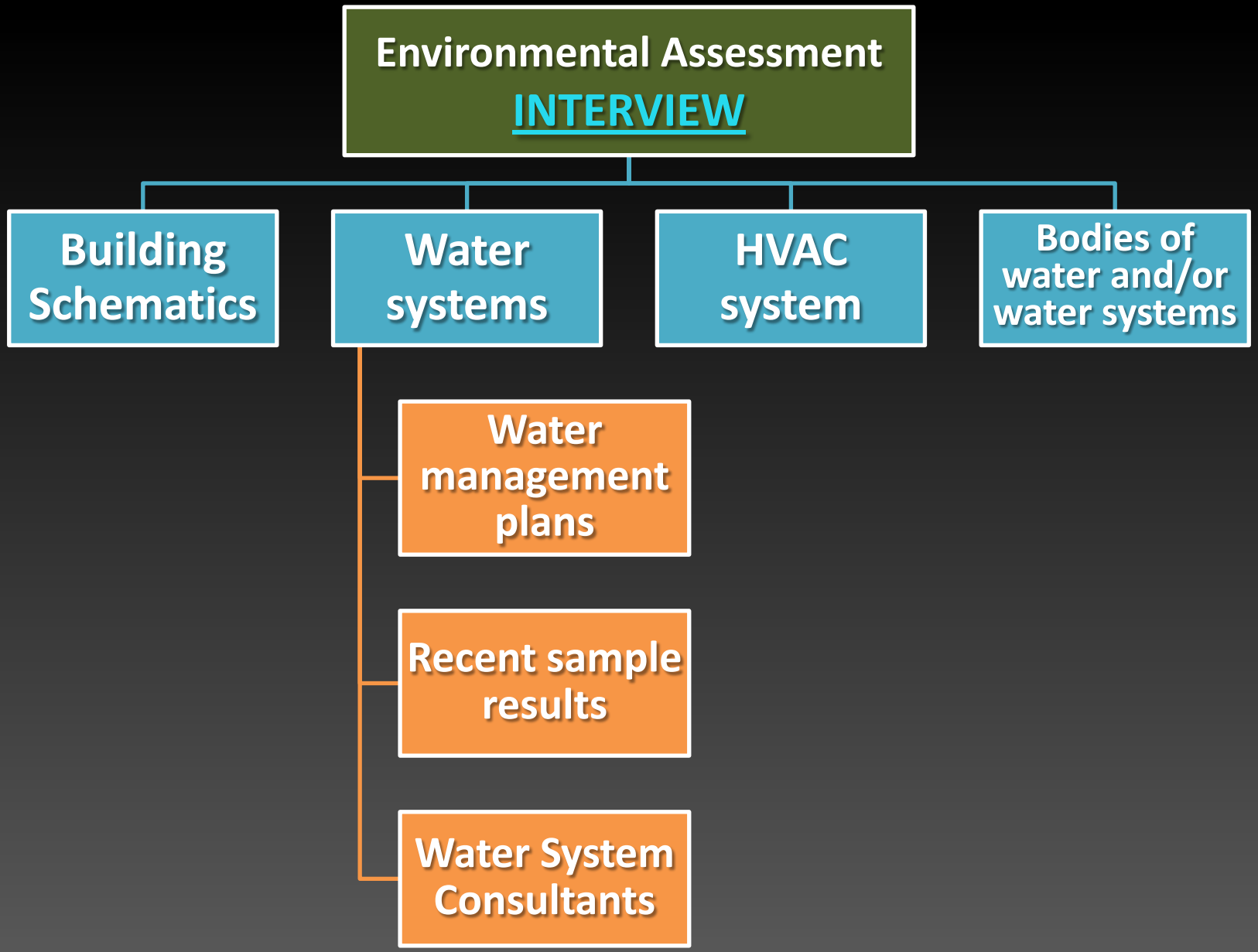
SNHD informs facility of case (Visit/Letter)



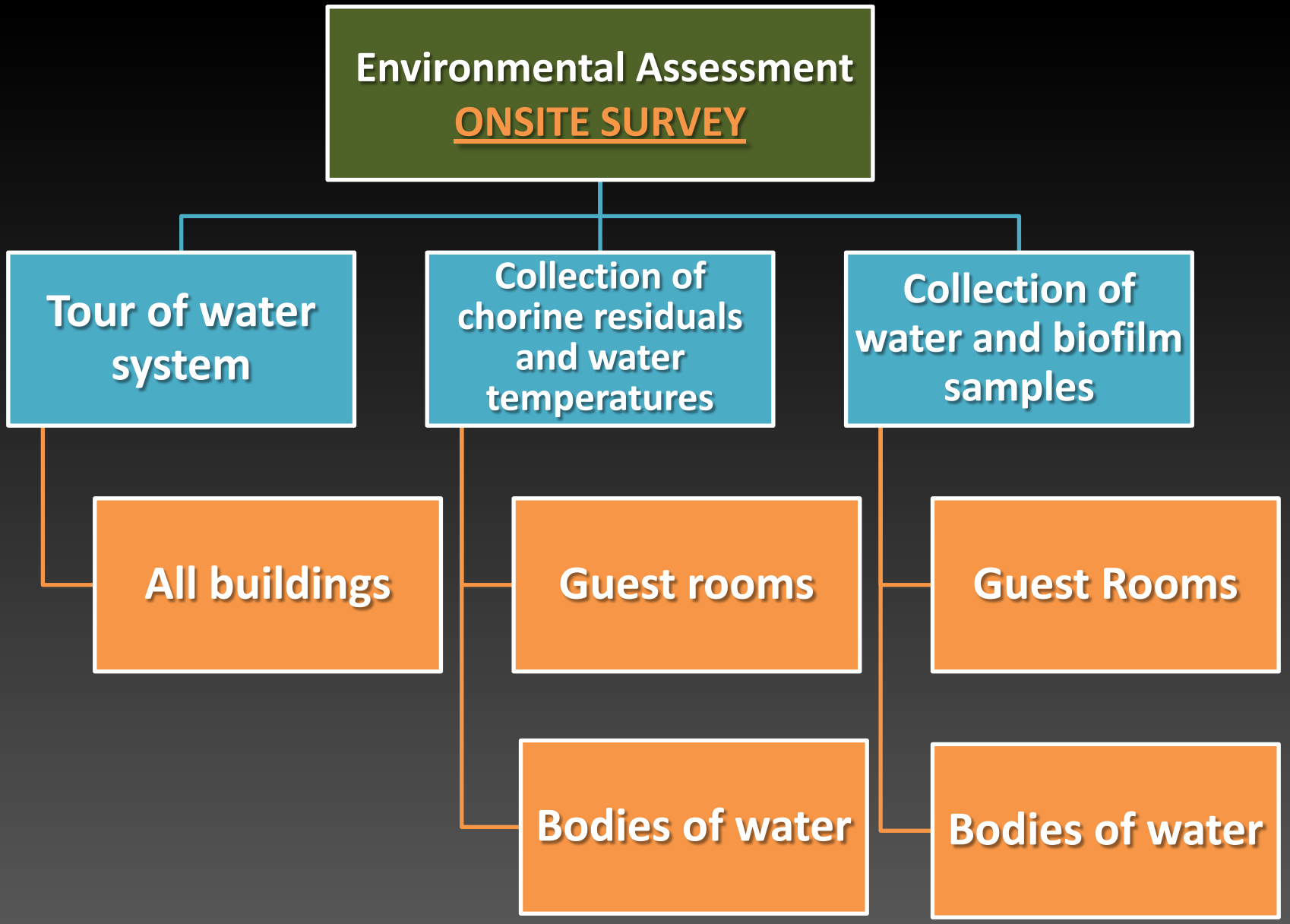


Env. Assessment
Interview
Site Survey
Biofilm/Water
Collection

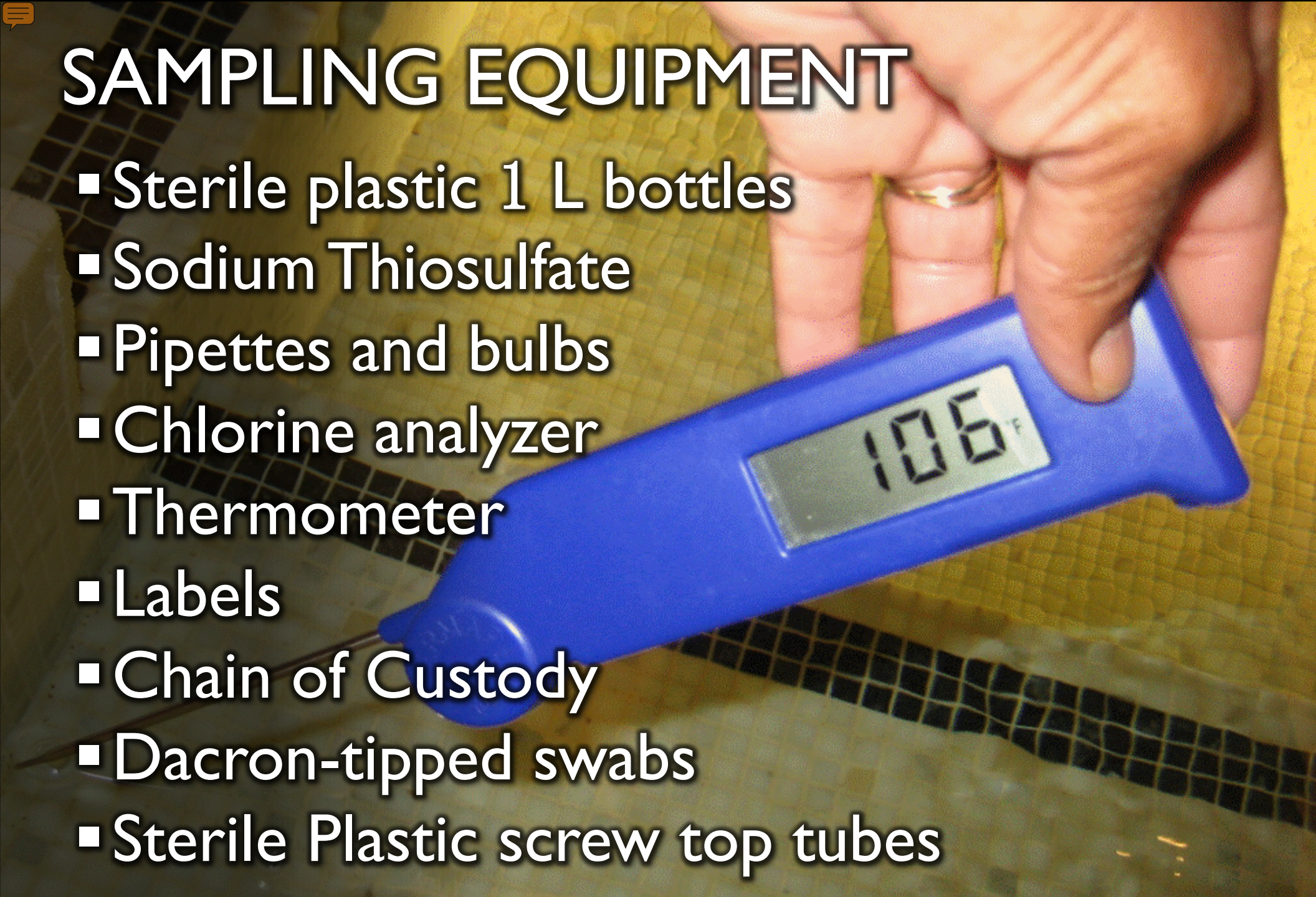
Investigation



Investigation



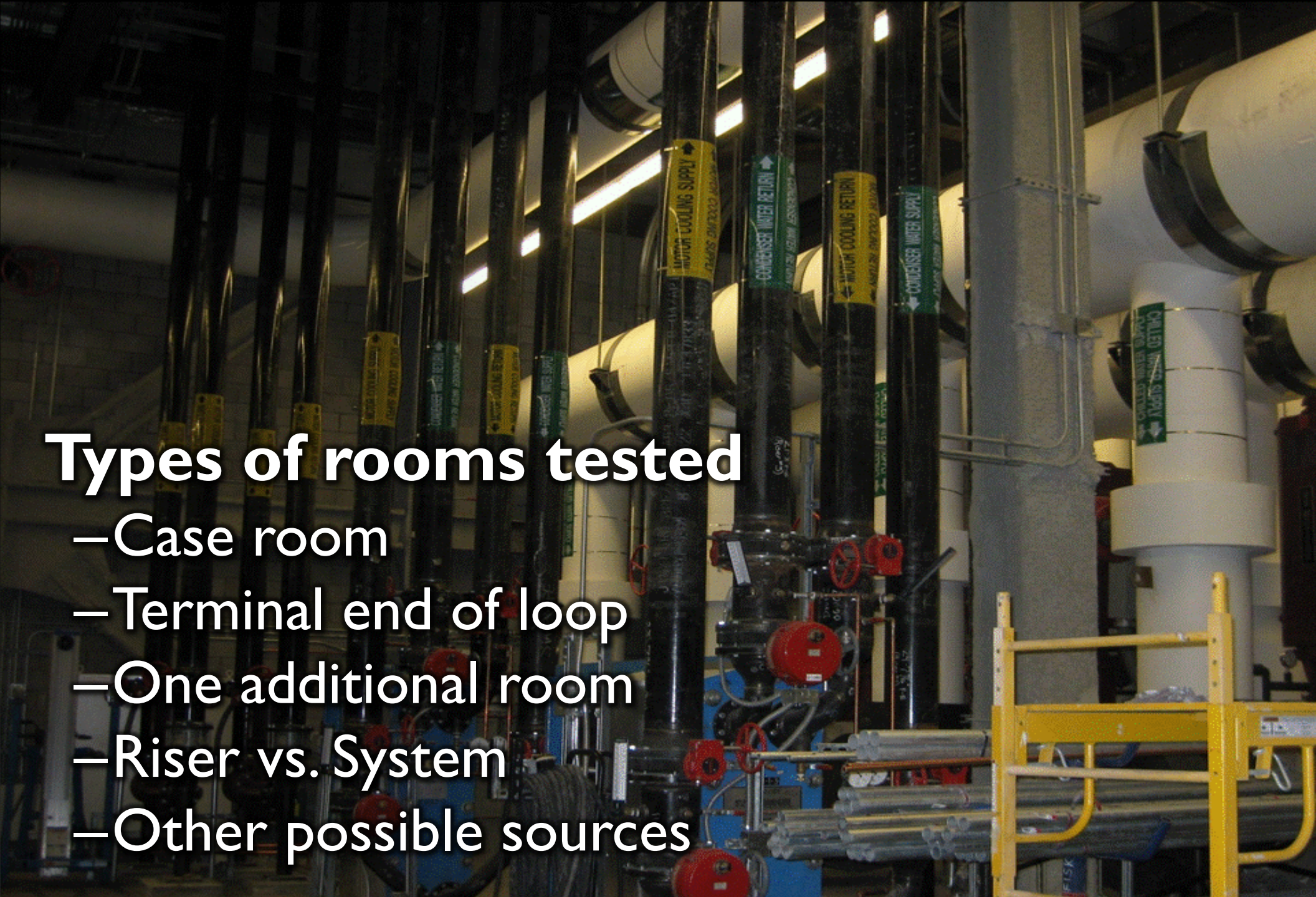
SAMPLING EQUIPMENT



- Sterile plastic 1 L bottles
- Sodium Thiosulfate
- Pipettes and bulbs
- Chlorine analyzer
- Thermometer
- Labels
- Chain of Custody
- Dacron-tipped swabs
- Sterile Plastic screw top tubes

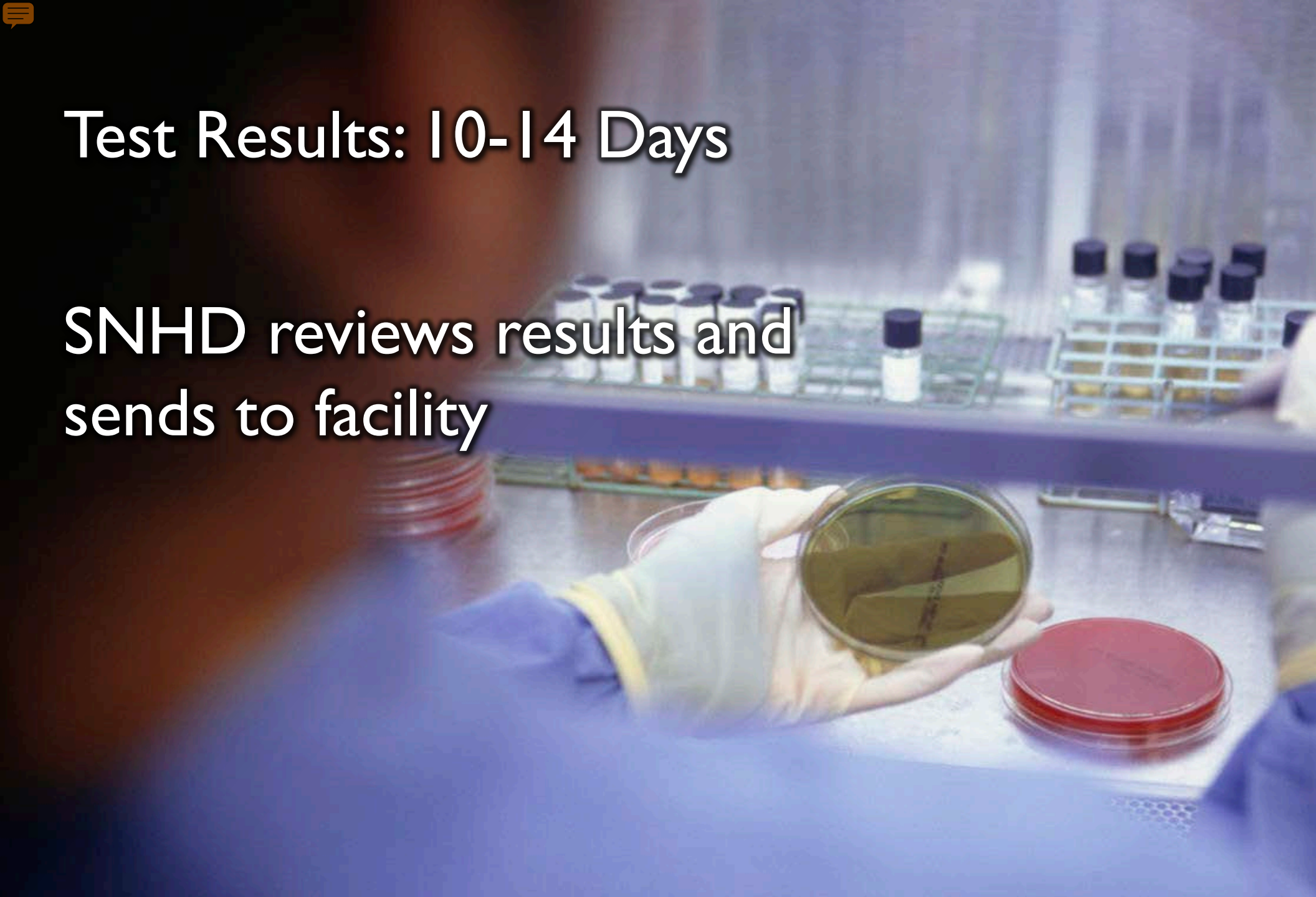
SAMPLING-PROCEDURE

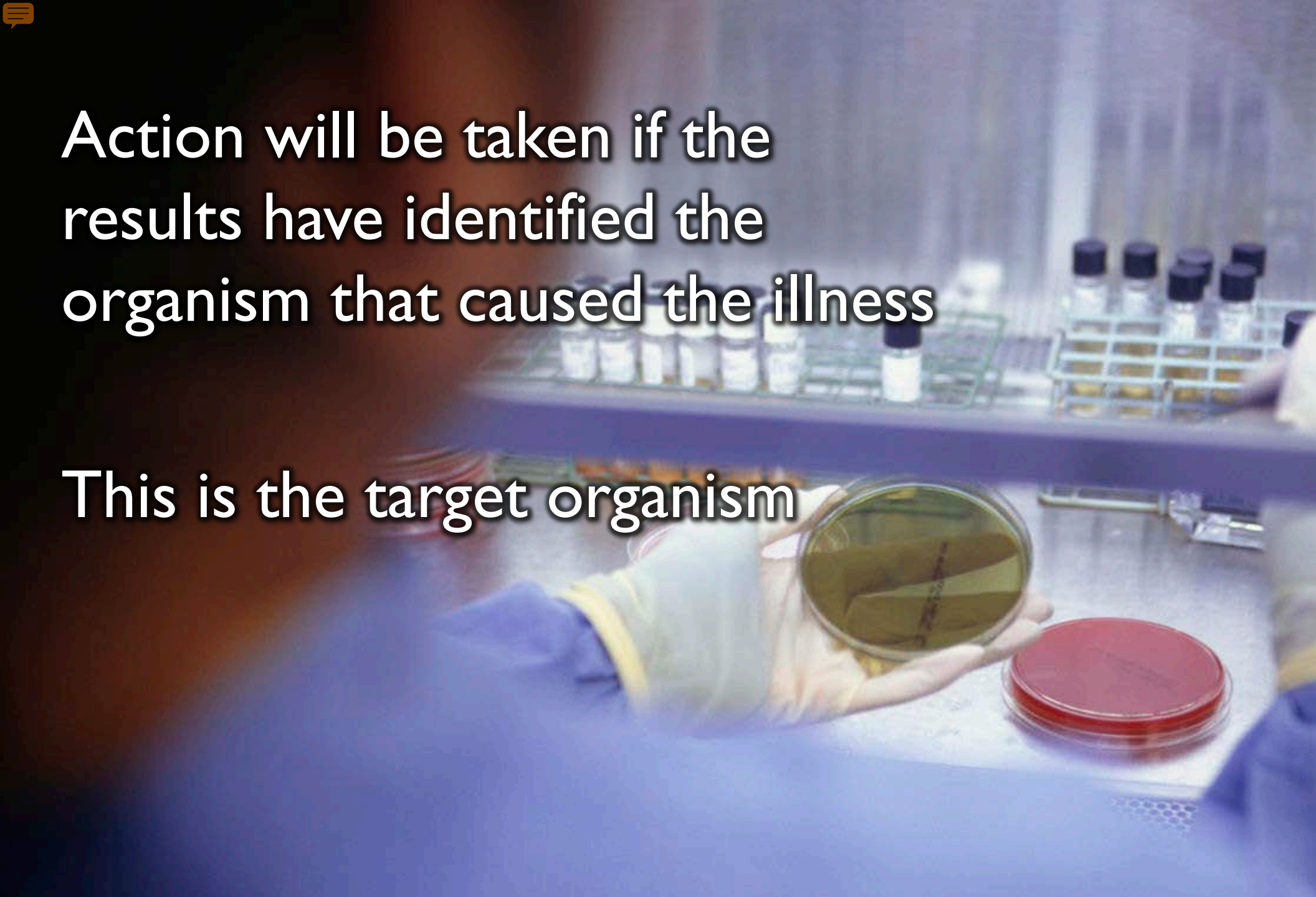
- Pre-Flush sampling the Hot and Cold water
- Post-1 minute flush sampling the Hot and Cold water
- Swab samples of faucets / emitters

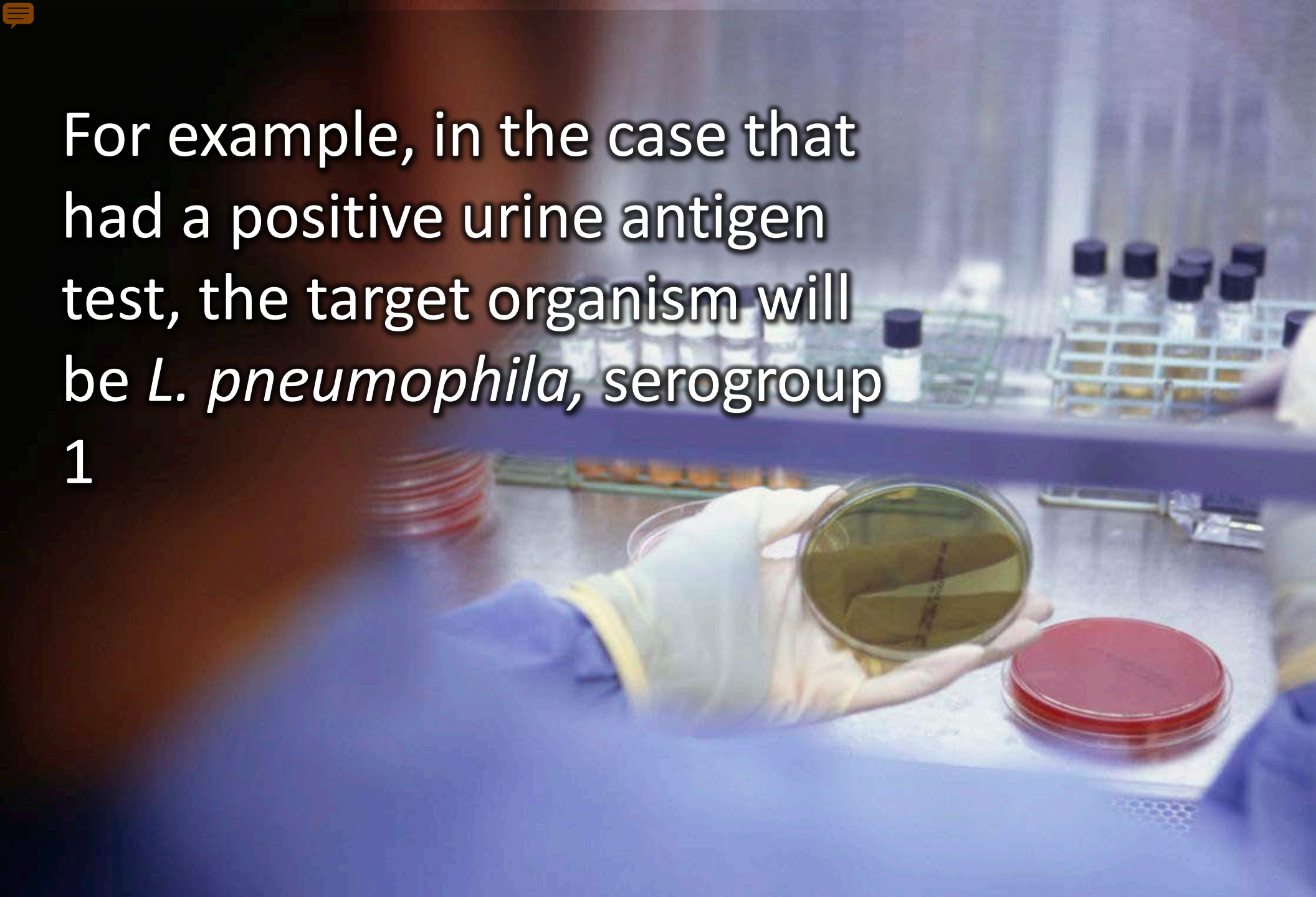


Types of rooms tested

- Case room
- Terminal end of loop
- One additional room
- Riser vs. System
- Other possible sources


Test Results: 10-14 Days
SNHD reviews results and sends to facility


Action will be taken if the results have identified the organism that caused the illness
This is the target organism



For example, in the case that had a positive urine antigen test, the target organism will be *L. pneumophila,* serogroup 1

Results

If the target organism is identified in the results of room fixtures or hot water system, SNHD will require that the water system supplying the room water system be remediated based on the following results:

- Target organism in bulk water greater than 10 cfu/ml
- Environmental swabs from two different fixtures greater than 10 cfu/ml
- Water or environmental swabs from two different fixtures less than 10 cfu/ml

Results

If a single water sample or environmental swab returns with results less than 10 cfu/ml, but is the target organism, then the SNHD shall determine what type of remediation is required

Results

If the results find other *Legionella* in the samples, SNHD will make a recommendation based on results

Results

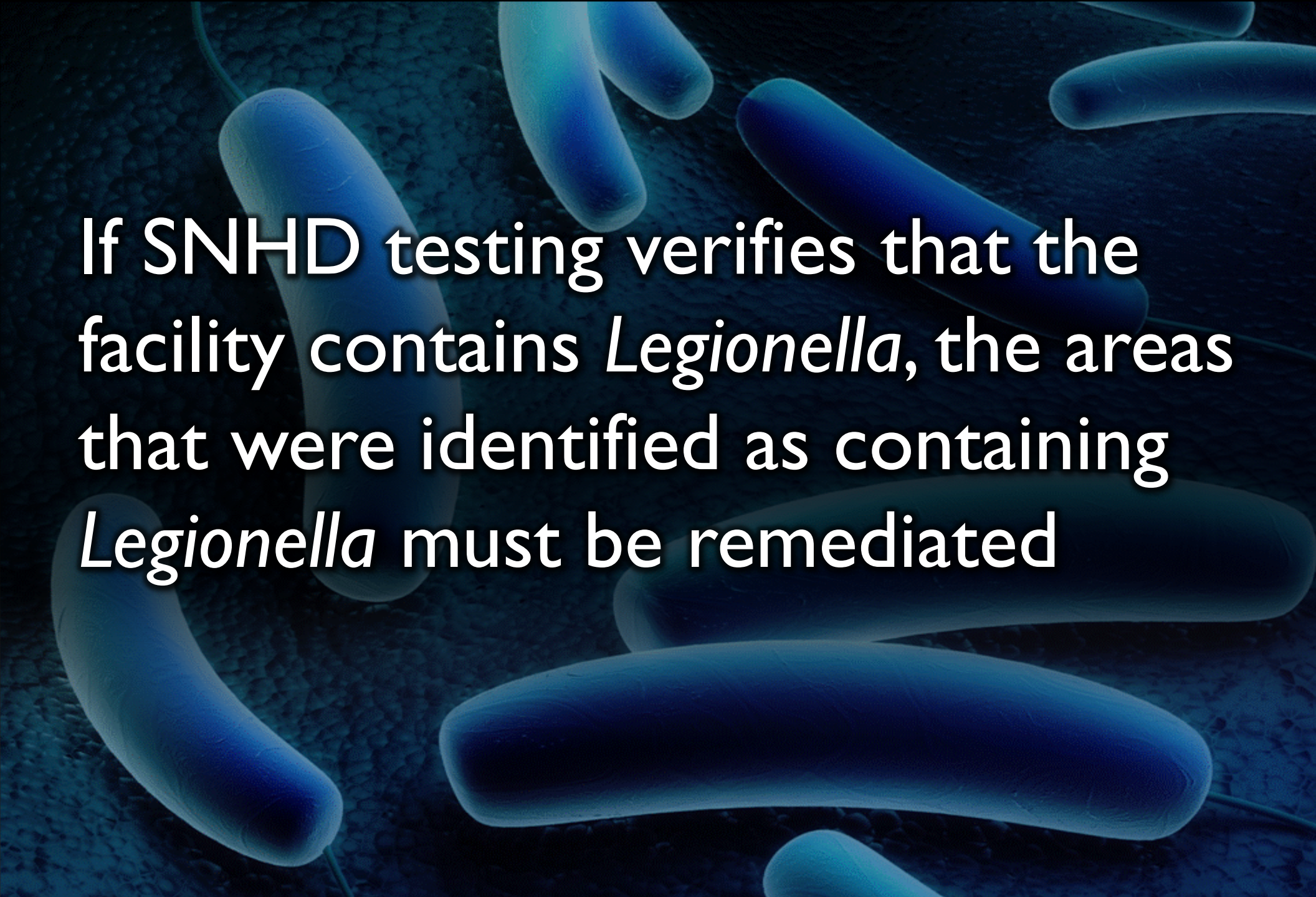
Environmental samples collected from areas that are not guest room fixtures must meet the OSHA standards

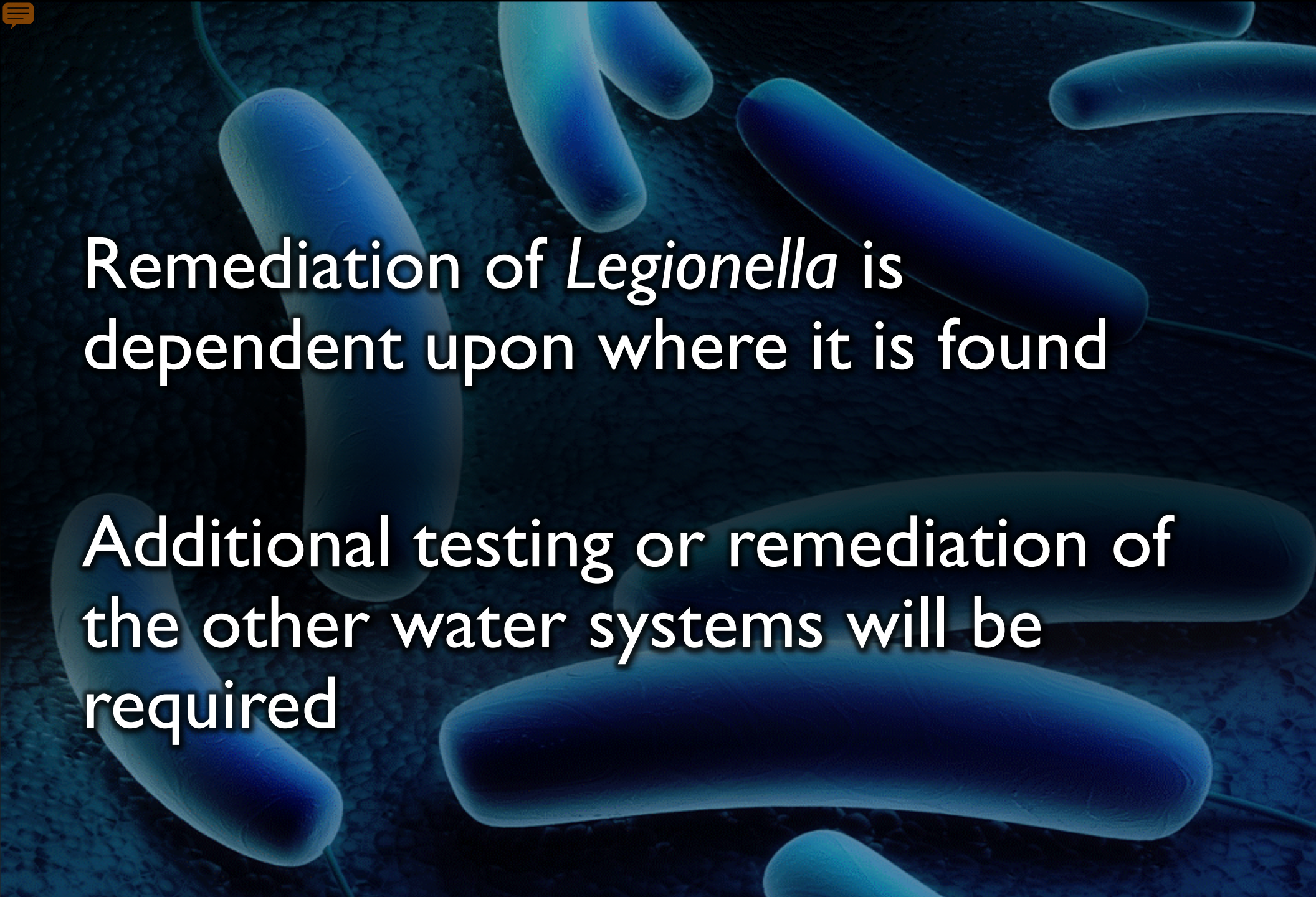
If the samples do not meet OSHA standards, then remediation of the system will be required


Marley
971-1000
QUALITY
AIR CONDITIONING
100 CFU


10 CFU


1 CFU

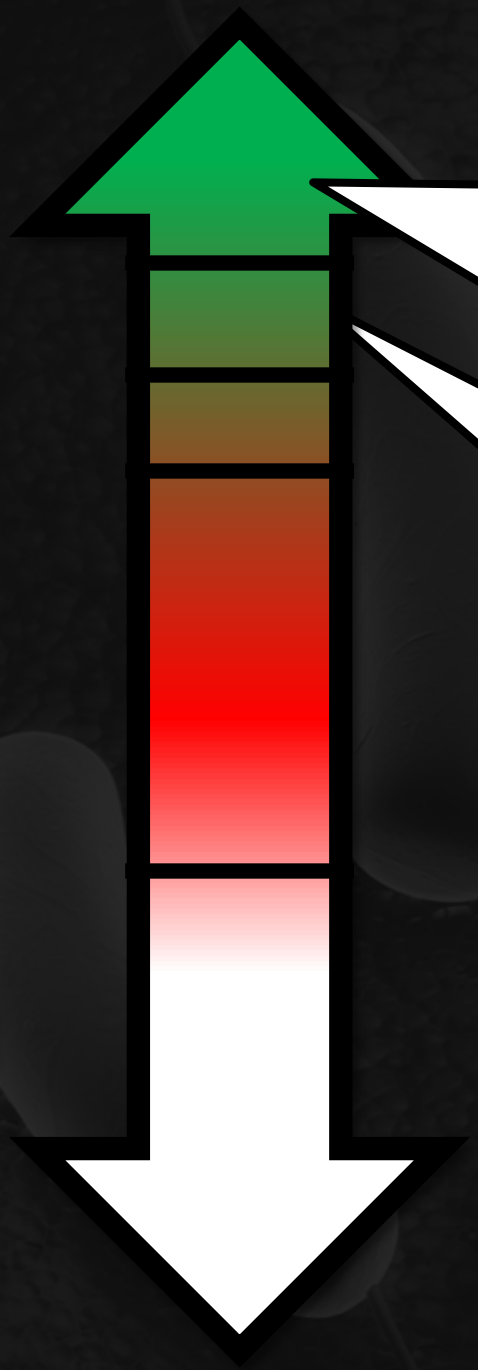

If SNHD testing verifies that the facility contains *Legionella*, the areas that were identified as containing *Legionella* must be remediated


Remediation of *Legionella* is dependent upon where it is found
Additional testing or remediation of the other water systems will be required

Remediation

ASHRAE recommends two methods to remove *Legionella:*

1: Hot Water Flush (160 - 170˚F)



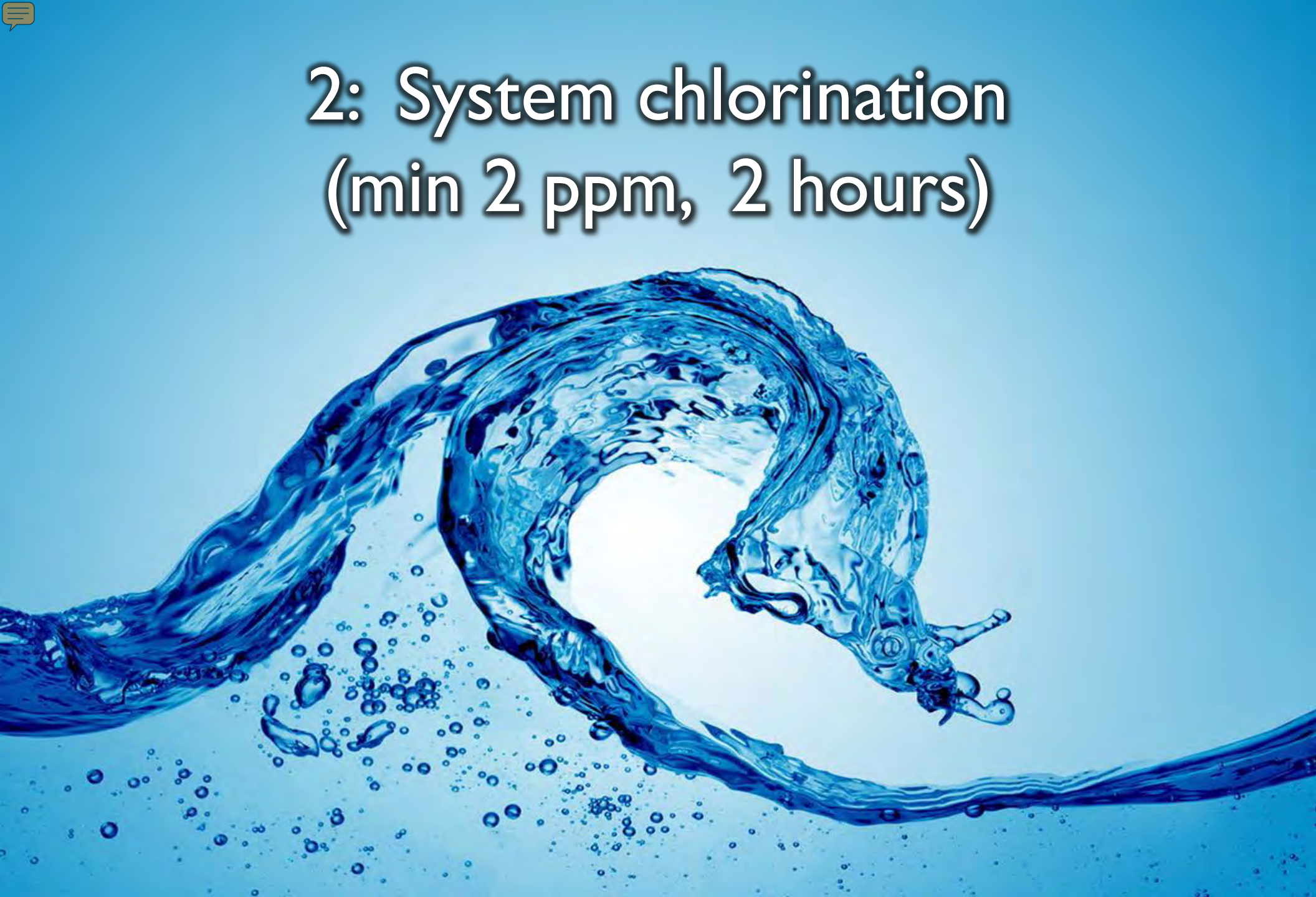
>70˚C (158˚F)

100% Rapid Kill

60˚C (140˚F)

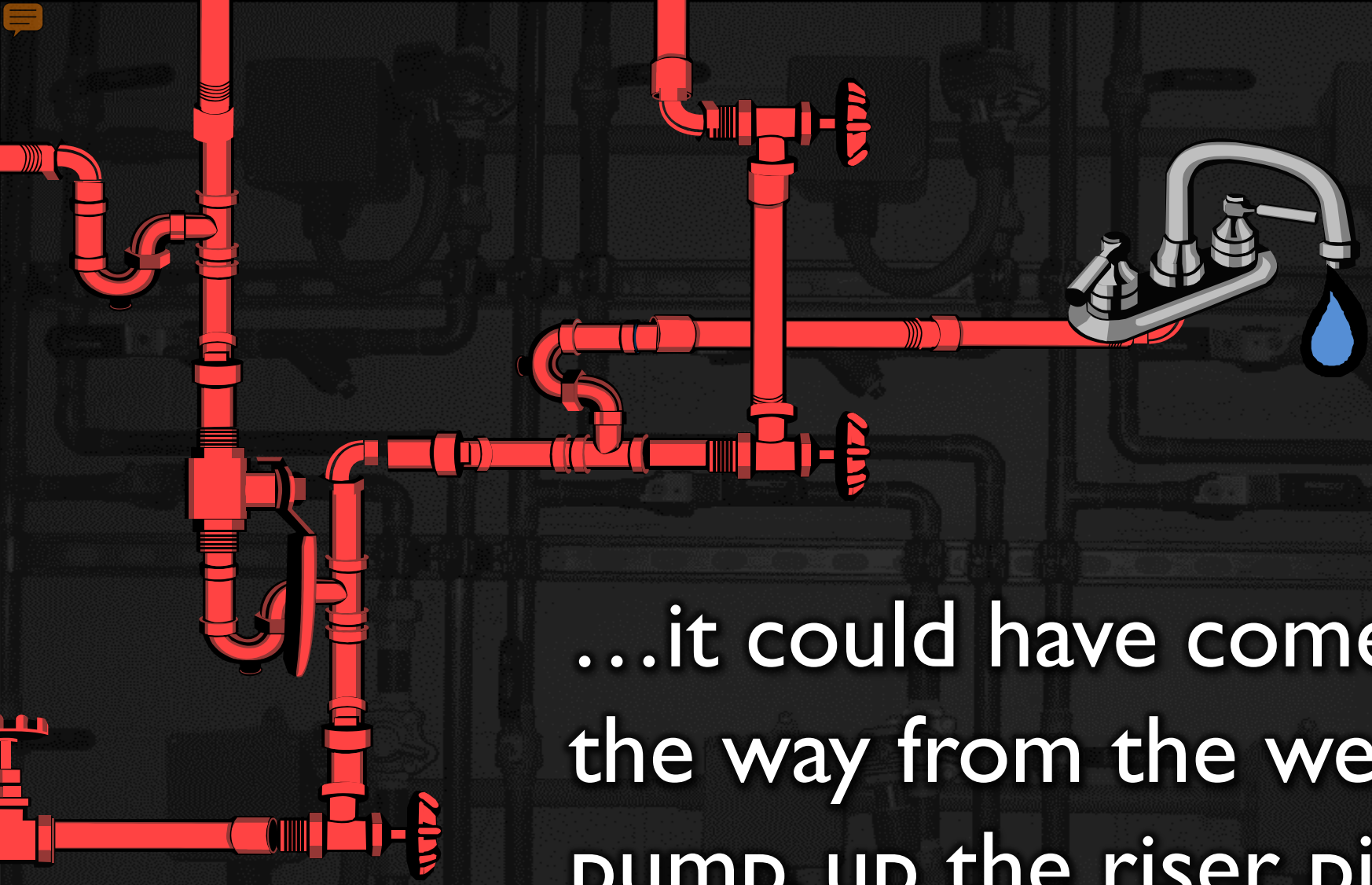
90% Kill in 2 Minutes

2: System chlorination (min 2 ppm, 2 hours)

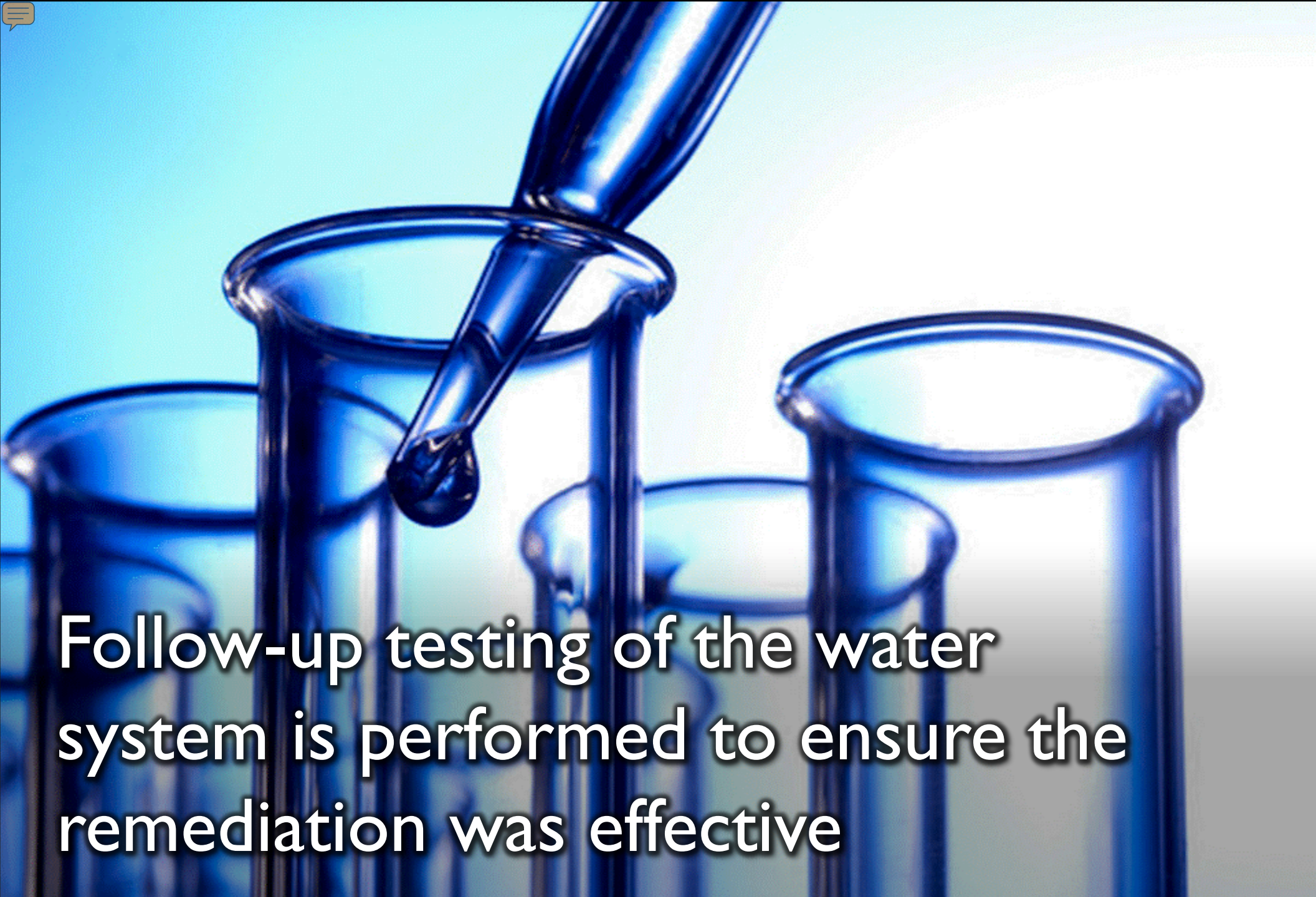


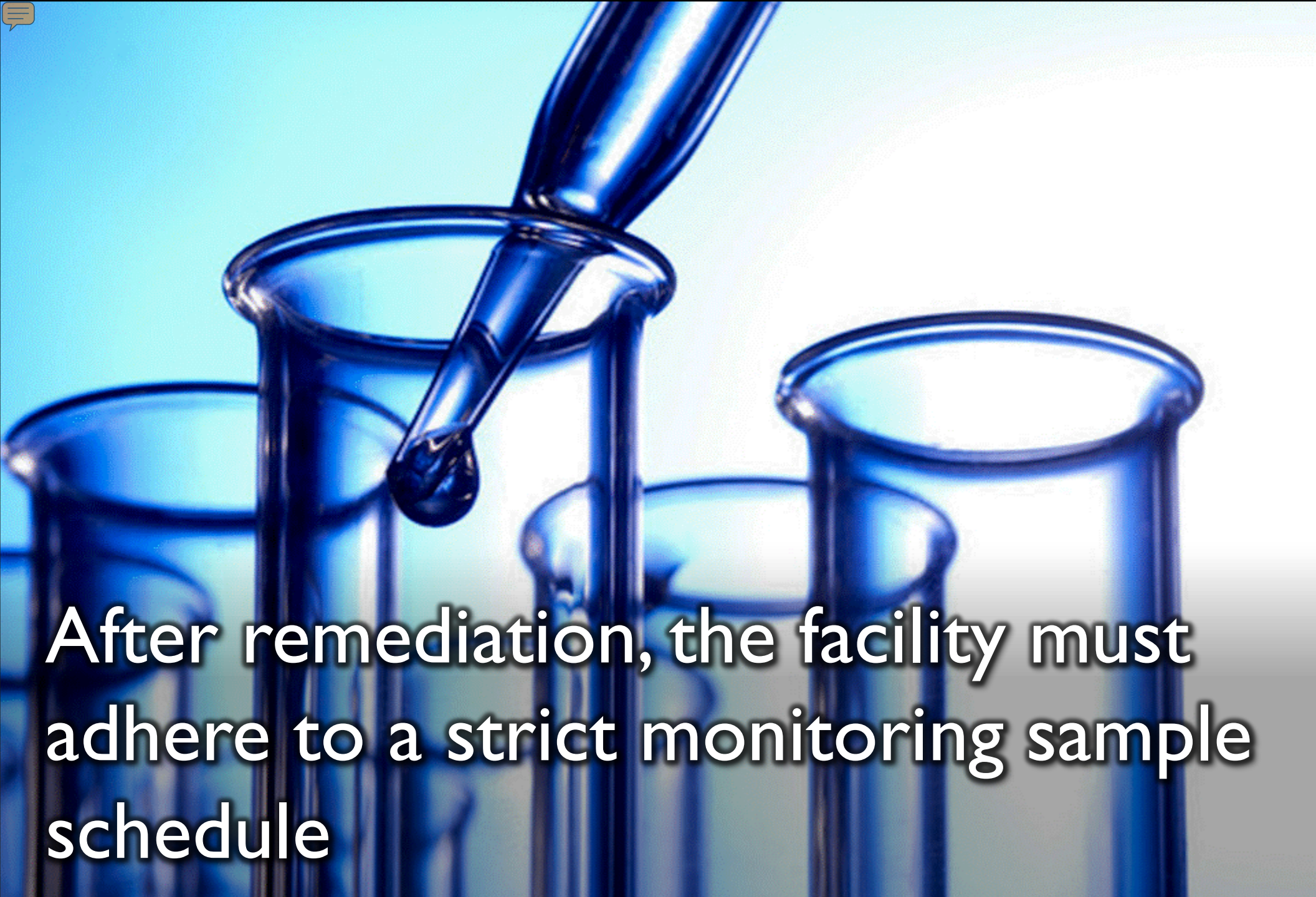

Legionella can come from
any source upstream…


…So, if this site tests
positive for *Legionella*,…



…it could have come all the way from the well pump, up the riser pipes, and into the faucet


Follow-up testing of the water system is performed to ensure the remediation was effective


After remediation, the facility must adhere to a strict monitoring sample schedule


3
Biweekly
Monthly
Quarterly

Communication with Public during an Outbreak Investigation

During an outbreak investigation, SNHD will issue reports updating the public on the ongoing investigation and what has been found

Timing of the reports will be dependent upon the activities of Environmental Health and the Office of Epidemiology


Ongoing control is necessary to ensure
that the facility does not pose an
increased risk to occupants

ASHRAE Standard

- Proposed New Standard 188, Prevention of Legionellosis Associated with Building Water Systems
- The goal of the document is to specify a Standard Practice for use by facility managers/owners to prevent legionellosis associated with building water systems
- Requires a Hazard Analysis Critical Control Point (HACCP) plan


Active Control Measures
currently in use


Control can include raising the
temperature of the water or adding
secondary disinfection


If secondary disinfection is used as a control, the facility may need to obtain public water system (PWS) permit

Ongoing secondary control options that…

…<u>may not</u> require a PWS permit

- Heat-and-Flush (Heat Shock)
- Ultraviolet (UV) Radiation
- Ozonation

Ongoing secondary control options that…

…<u>may</u> require a PWS permit

- Chlorination
- Copper-Silver Ionization
- Chlorine Dioxide
- Monochloramine

Public Water System Requirements

Application to Nevada Department of Environmental Protection, Bureau of Safe Drinking Water

PWS Classification

- Community
- Non-Transient Non-Community
- Transient Non-Community

Tri-annual sanitary survey

Public Water System Requirements

Water Quality Monitoring

– Chlorine Residuals

– Disinfection By- Products

– Total Coliforms

– Lead and Copper

Water Operator Certification

– Distribution operator

– Treatment operator

Public Notice Requirements/ Consumer Confidence Reports

Case Study

CDC

- Multiple cases different time periods
- Urine Antigen Positive
- Provided information on the facilities and rooms where the cases stayed

SNHD

- Informed Facility
- Performed Environmental Assessment
- Collected water and biofilm samples

Facility

- Assisted SNHD with all requests


The positive urine antigen tests indicated that the cases' Legionellosis were caused by ***Legionella pneumophila*** **serogroup 1**
Facility
Environmental sample results indicated the presence **of *Legionella pneumophila*** **serogroup 1** in the riser tested.

SNHD required remediation of the hot water system in addition to additional testing of the remaining hot water risers

The facility decided to remediate all of the risers beginning with the riser where the most recent case stayed

The most recent case had a sputum isolate of *Legionella pneumophila* serogroup 1, the CDC requested cultures from the case and environmental isolates be sent to them for DNA sequencing

The DNA sequencing found that all of the environmental isolates either matched the case isolate or varied by a single nucleotide mutation on one gene

Follow-up post remediation testing did not detect *Legionella* in the hot water system

The facility was then placed on the additional testing protocol discussed earlier

To date, *Legionella pneumophila* serogroup 1 has not been identified in the facility

Reports on the recent investigations can be found at

- www.snhd.info
- Click 'Health Topics'
- Then click 'Statistics, Surveillance and Reports'

Summary

Ultimate Goal is for us to work together in a proactive way

- Not working together in a proactive manner will result in:
  - Rolling the dice for the second case

- Two cases with no response will result in an OUTBREAK response from SNHD, including:
  - Need for SNHD to notify the public
  - SNHD requesting guest lists
  - Notification of new guests regarding the outbreak while investigation is ongoing
  - Potential/likely posting of outbreak locations by CDC on their website
  - MEDIA WILL BE VERY INVOLVED/INTERESTED


VERSUS

- Being proactive by looking at one reported case as a canary in a mine:
  - Facility has a proactive Water Management Plan
  - If SNHD gets report of a case, SNHD will work with you to review the Water Management Plan and take samples to identify potential sources
  - Implement disinfection and take corrective action before sample results are received

- By SNHD responding and investigating and the facility using the best practices/taking the appropriate corrective action:
  - Any second case reported prior to the disinfection requires no further action
- If the SNHD investigation does not identify the target organism, then the investigation is closed and potential outbreak can be ruled out
- If a case subsequently occurs, and the SNHD does not identify a source, there will be no outbreak identified
- Minimizes the need for public notification/media attention

Discussion

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