



OPERATORS COMBATING

LEGIONNAIRES DISEASE

OTCO-B13221-OM

What is Legionella?



- A naturally occurring bacterium
- Found in most water systems
- Often present in water mains
- Easily colonises most domestic water systems – hot and cold

Legionnaires' disease (also called legionellosis) is an uncommon infection caused by a germ (bacterium) called legionella. There are two types of illness which can develop after being infected with this bacterium:

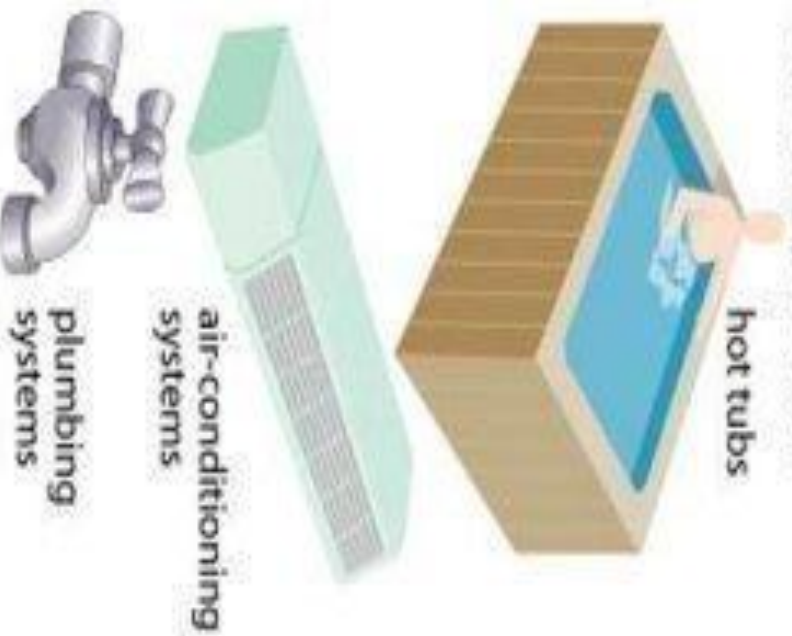
- **Legionnaires' disease.** This causes a lung infection (pneumonia). It is usually a severe illness which is sometimes fatal.

- **Pontiac fever.** This occurs when the bacteria cause a flu-like illness. It is not usually serious.

Legionnaires' disease

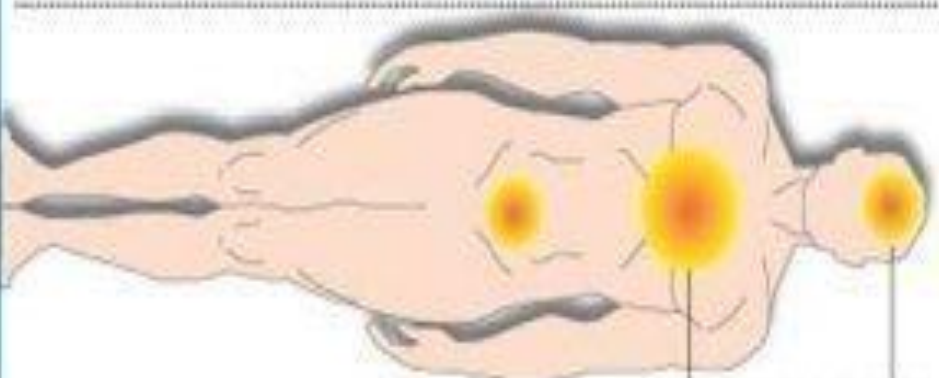
Infection

Caused by bacteria which thrives in warm water and damp places like:



source : WHO, UK NHS

Symptoms



Similar to a severe flu and can include fever, chills, loss of appetite, headache, lethargy

Potentially fatal form of pneumonia



Legionella bacteria

Can not be transmitted from person to person

Treatment

Antibiotics



No vaccine is currently available

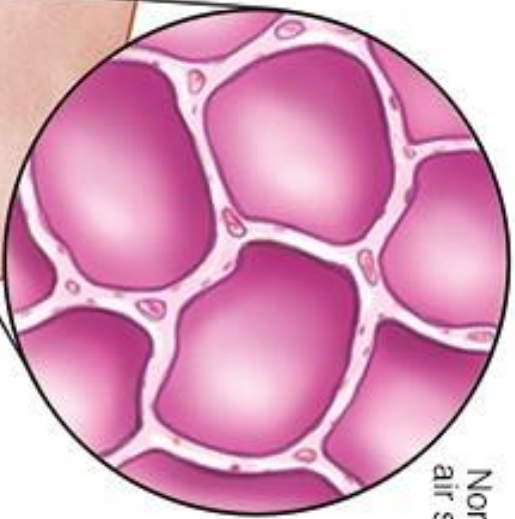
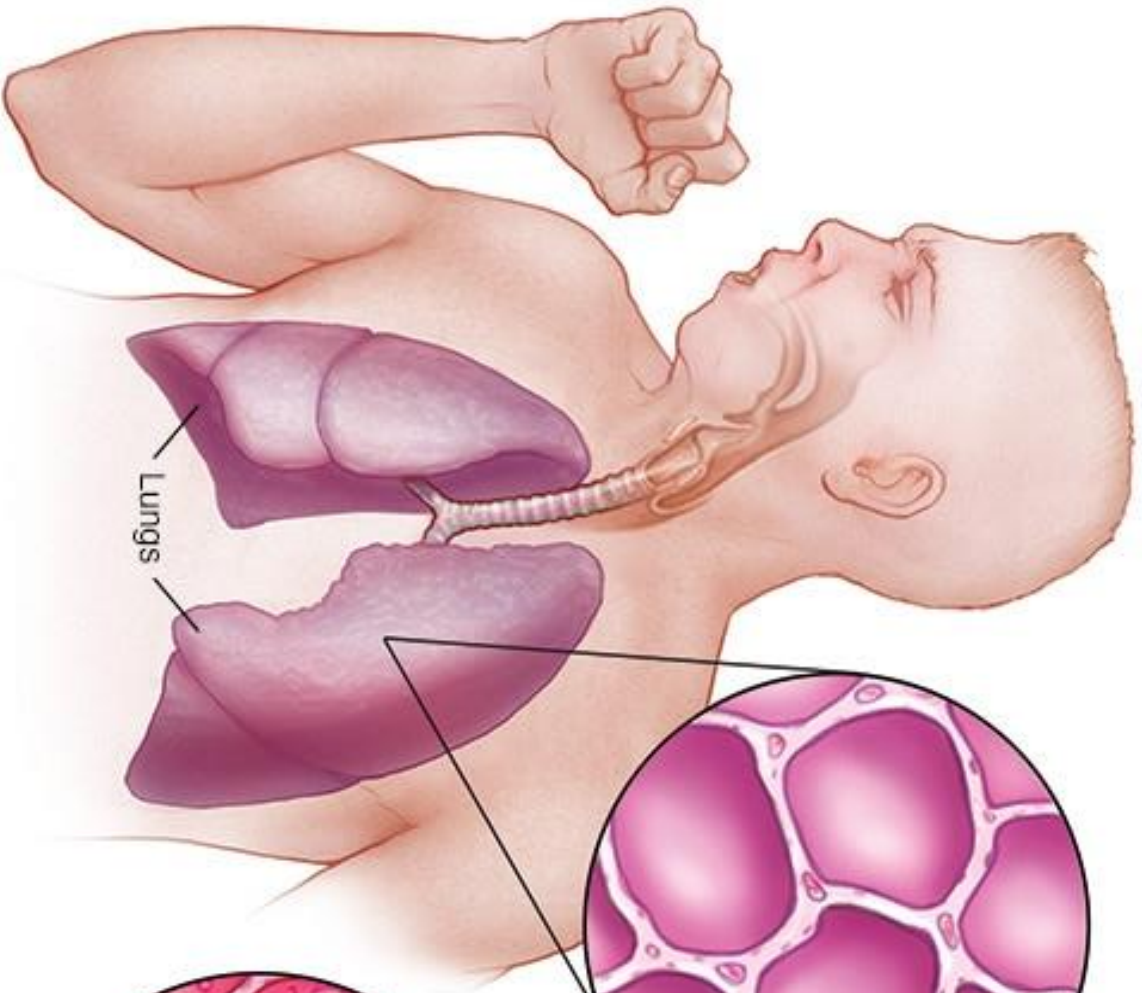


Prevention



Water supply systems should be cooled below 20C or heated above 60C

<68°F & > 140°F



Normal air sacs

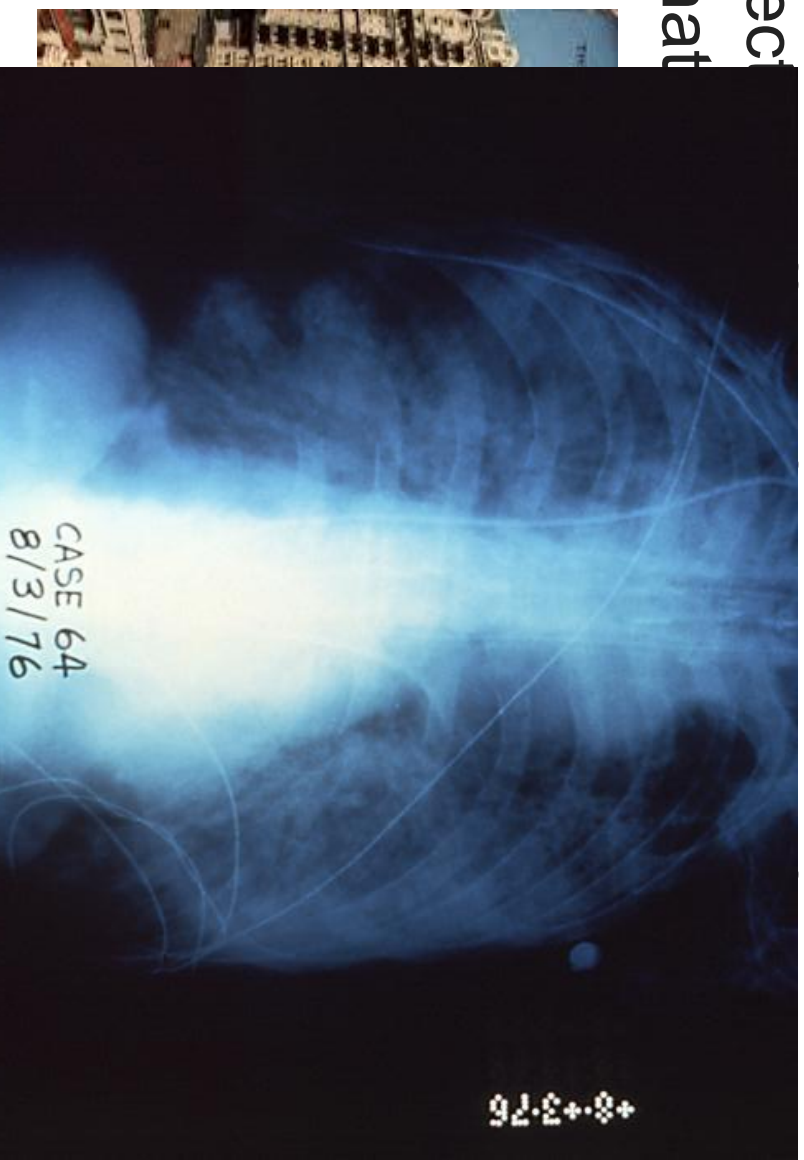


Inflamed air sacs filled with fluid (pneumonia)



Legionella was discovered after an outbreak in **1976** among people who went to a **Philadelphia** convention of the **American Legion**. Those who were affected had **pneumonia** (lung infection) that was called **Legionnaires' disease**.

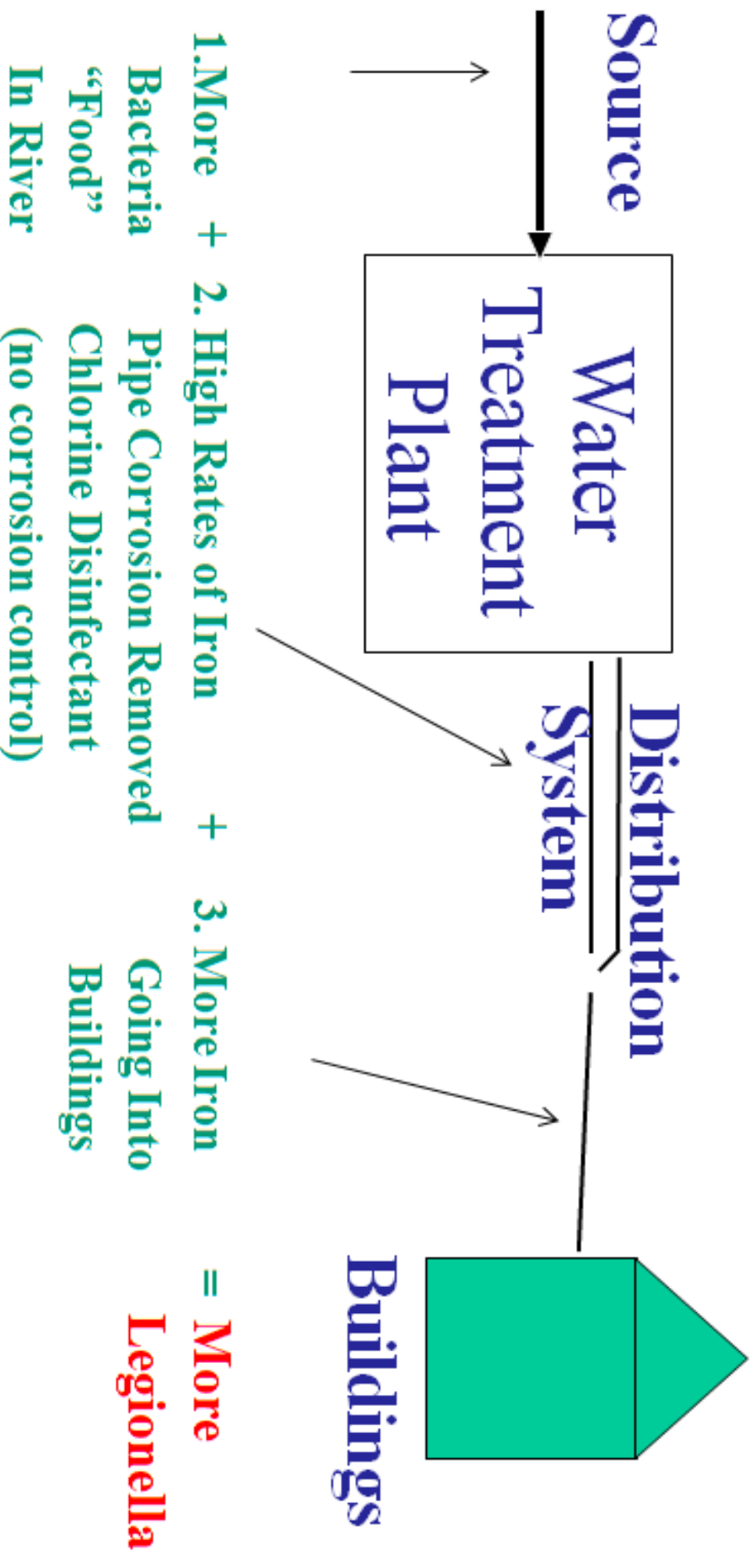
29 Legionnaires died from cooling tower feeding an air conditioning unit.





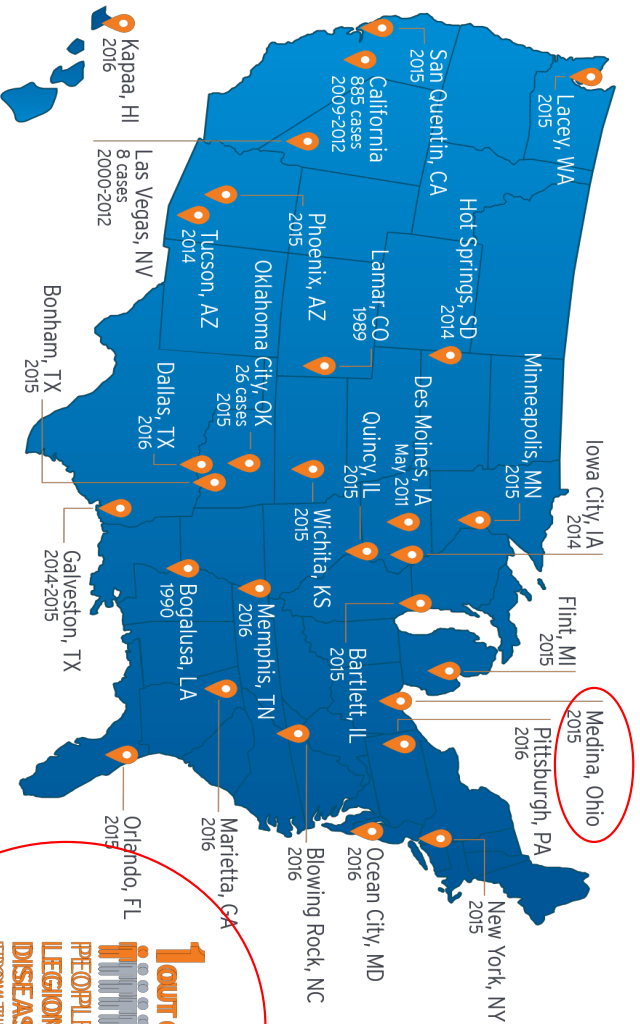
From 2014 to 2017, thousands of people in Flint, Michigan, were exposed to dangerously high levels of lead after city officials began drawing water from a nearby river. But the dangers didn't stop there: Residents also suffered the third largest outbreak of Legionnaires' disease in U.S. history, with at least 87 people infected and 12 dead. **Now, a new study adds support to the idea that a drop in chlorine levels in the water supply may have sparked the epidemic.**

3 Reasons Why Flint River Without Corrosion Control May Have Caused More Legionnaires Disease



LEGIONELLA OUTBREAKS:

**ON THE RISE:
REPORTING, OUTBREAKS & PUBLIC AWARENESS**



Medina, Ohio
2015

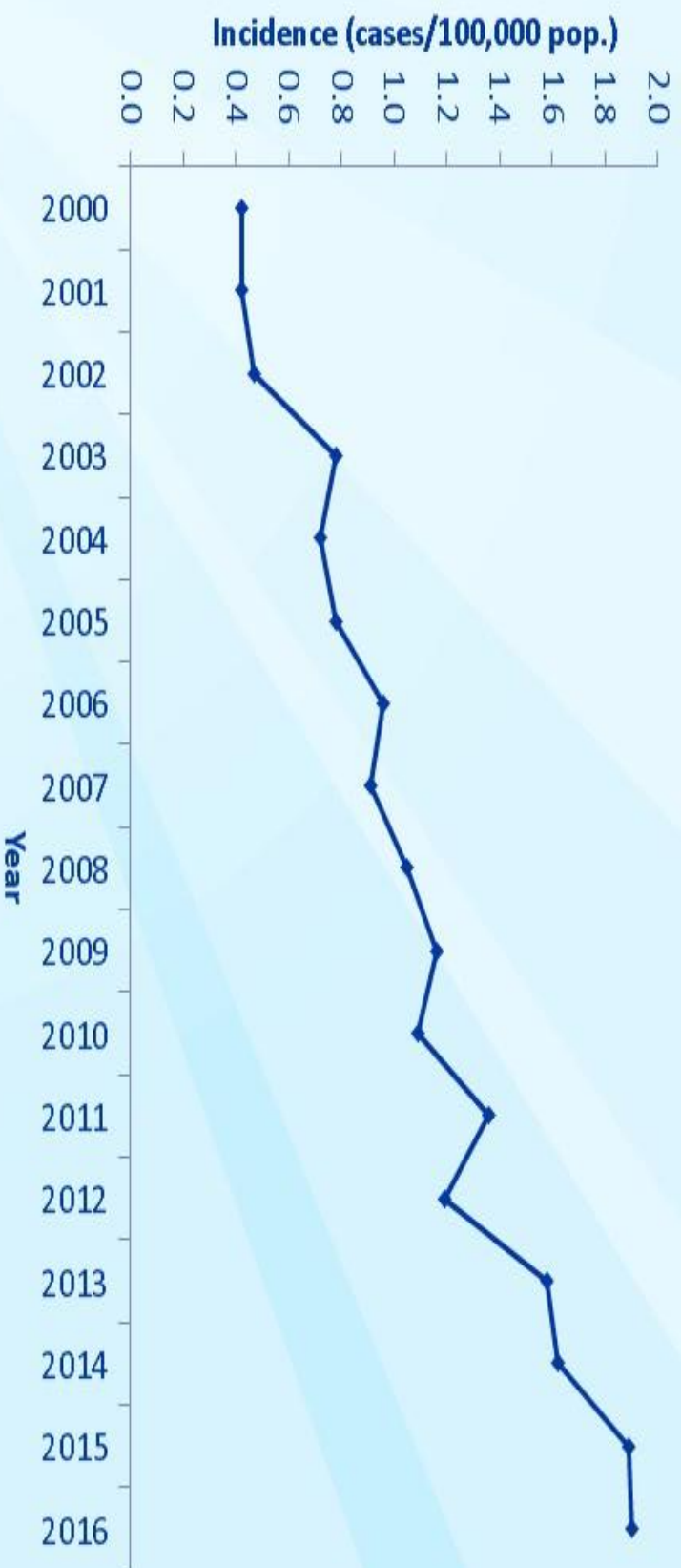
1 out of 10
PEOPLE WHO GET
LEGIONNAIRES'
DISEASE WILL DIE
FROM THE INFECTION!

Source: <https://www.cdc.gov/legionella/factsheet.html>

RESULTS:
INCREASING
ATTENTION &
REGULATIONS
from Government and
Professional Organizations

- ASHRAE Standard 188
- Guidance from the Centers for Disease Control
- VHA Directive 1061
- NYC (under Local Law 7)
- New York (under Emergency Regulations)
- New Jersey Proposed Regulations

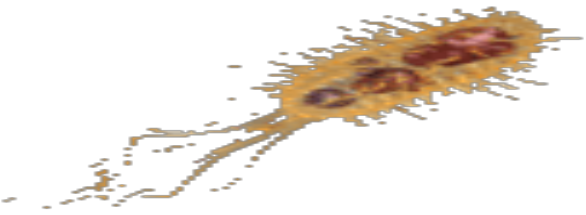
Legionnaires' Disease Is On The Rise 2000—2016*



*National Notifiable Diseases Surveillance System

MOST RECENTLY

An outbreak of Legionnaires' disease in Union County N.J. has sickened 22 people between March 8 through May 13, 2019 and five people have died.



COULD IT HAPPEN HERE???



Ohio hospital reports patient death amid Legionnaires' outbreak

A patient has died amid an outbreak of Legionnaires' disease in a recently opened hospital, authorities said.

Author: Associated Press

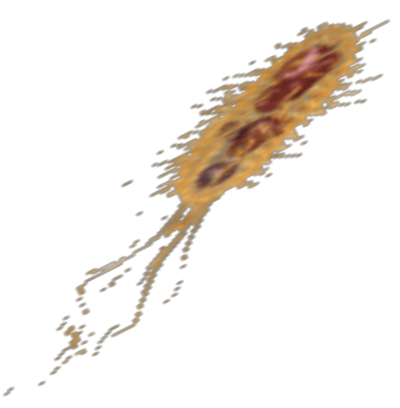
Published: 10:34 AM EDT June 3, 2019

Updated: 10:34 AM EDT June 3, 2019

[Mount Carmel confirms 1 death following Legionnaires ...](#)

www.10tv.com/article/mount-carmel-confirms-1...

21 hours ago · One person has died after they were diagnosed with Legionnaires' disease following recent treatment at Mount Carmel Grove City, the hospital confirmed to 10TV Sunday



Legionnaires' Disease News

information

Mount Carmel Grove City



The hospital is in suburban Columbus.

Month-old Ohio hospital reports 7 ill in outbreak

- **Strongsville Sept. 23, 2019**
- **Parma Sept. 24, 2019**

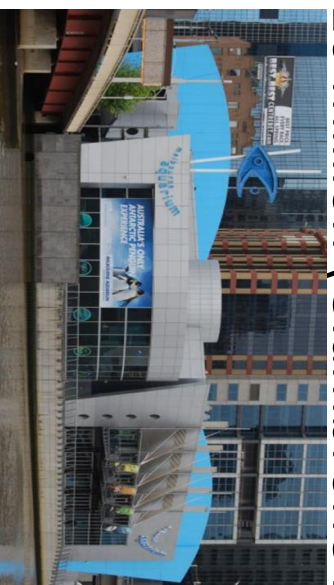
.....

- Flush all hot and cold water lines and fixtures throughout the entire seven-floor, 200-bed facility
- Implement immediate remediation practices to disinfect hot and cold water lines and fixtures
- Test and clean all [ice machines](#)
- Ensure the two on-site cooling towers are cleaned and serviced
- Provide any and all test results to the Ohio Department of Health
- Provide **water management plan** to the Ohio Department

- True incidence of Legionellosis could be 20 times greater than the currently reported incidence.



- In the US *Legionella* is the leading cause of all drinking water outbreaks (Centers for Disease Control and Prevention 2013).
- The annual cost of hospitalizations due to Legionellosis in the United States is estimated to exceed US\$716 million (Giambrone 2013)



The Centers for Disease Control and Prevention (CDC) has acknowledged that *opportunistic premise plumbing pathogens (OPPPs)* are the primary cause of waterborne disease in the United States.¹ Legionella pneumophila, one type of OPPP, can develop in water supply systems and result in Legionnaires' disease, a severe form of pneumonia. About 5,000 cases of Legionnaires' disease are reported each year in the U.S., according to the CDC.²

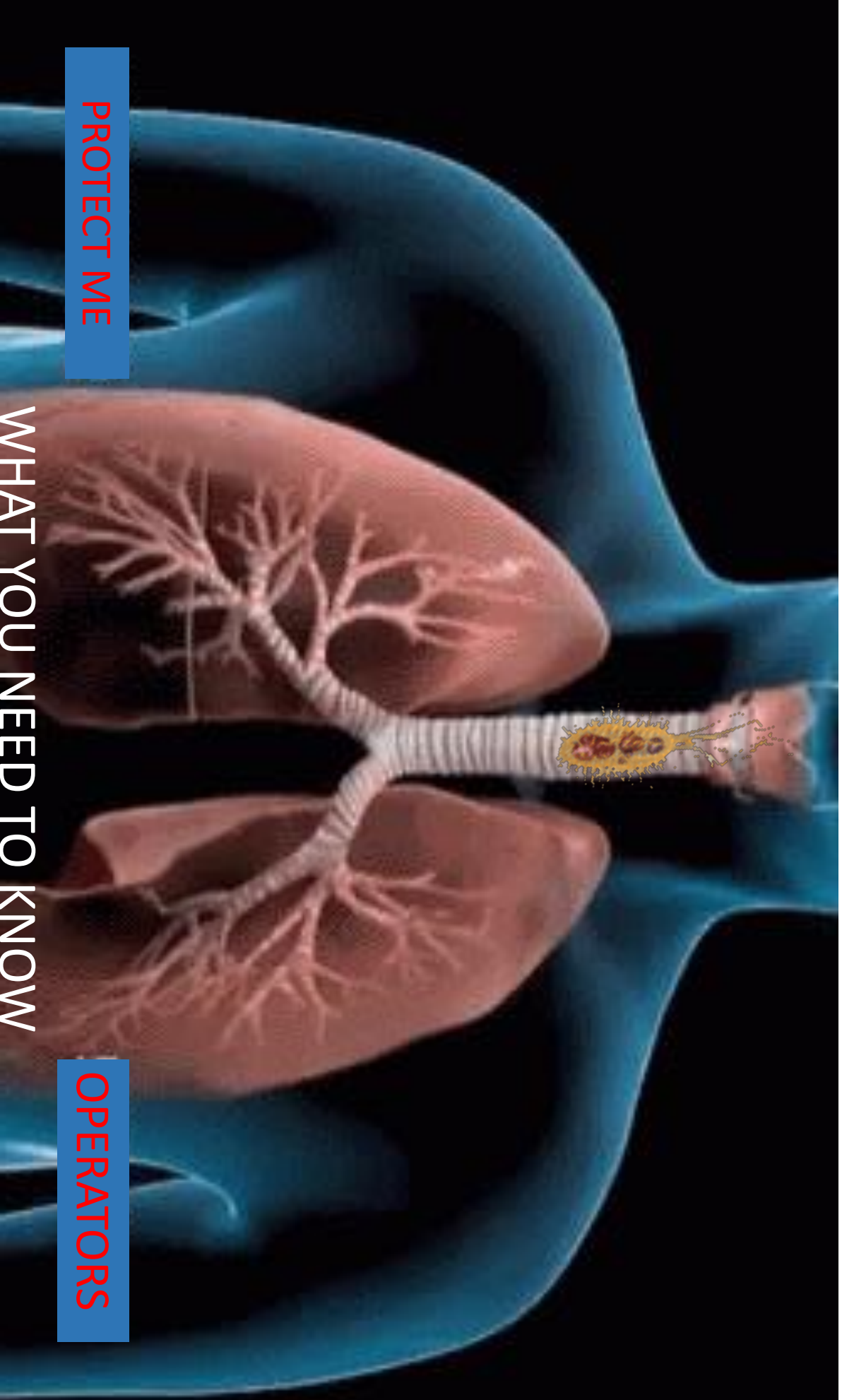
LEARN THIS ACRONYM

That's 500
people/year will die

Should there be concern about the aging U.S. underground water infrastructure and Legionella?

Older water infrastructure can be more vulnerable to contamination through leaks and breaks. When a leak or break occurs, it increases the possibility of OPPPs like Legionella entering the infrastructure, forming in biofilms, and then being released into the water supply.²⁶

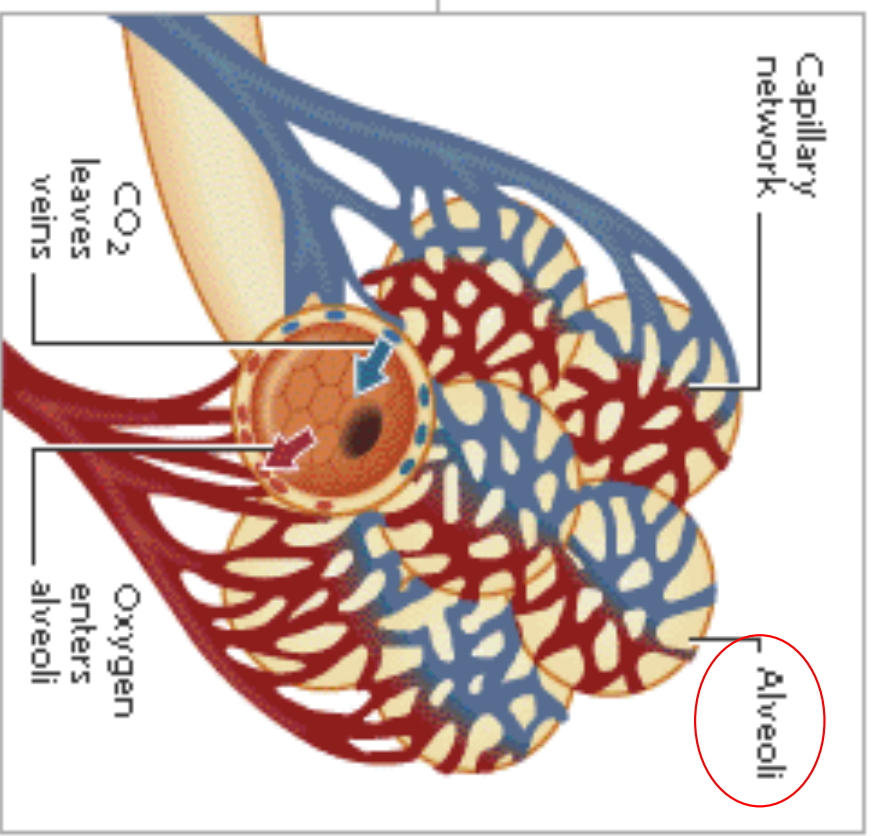
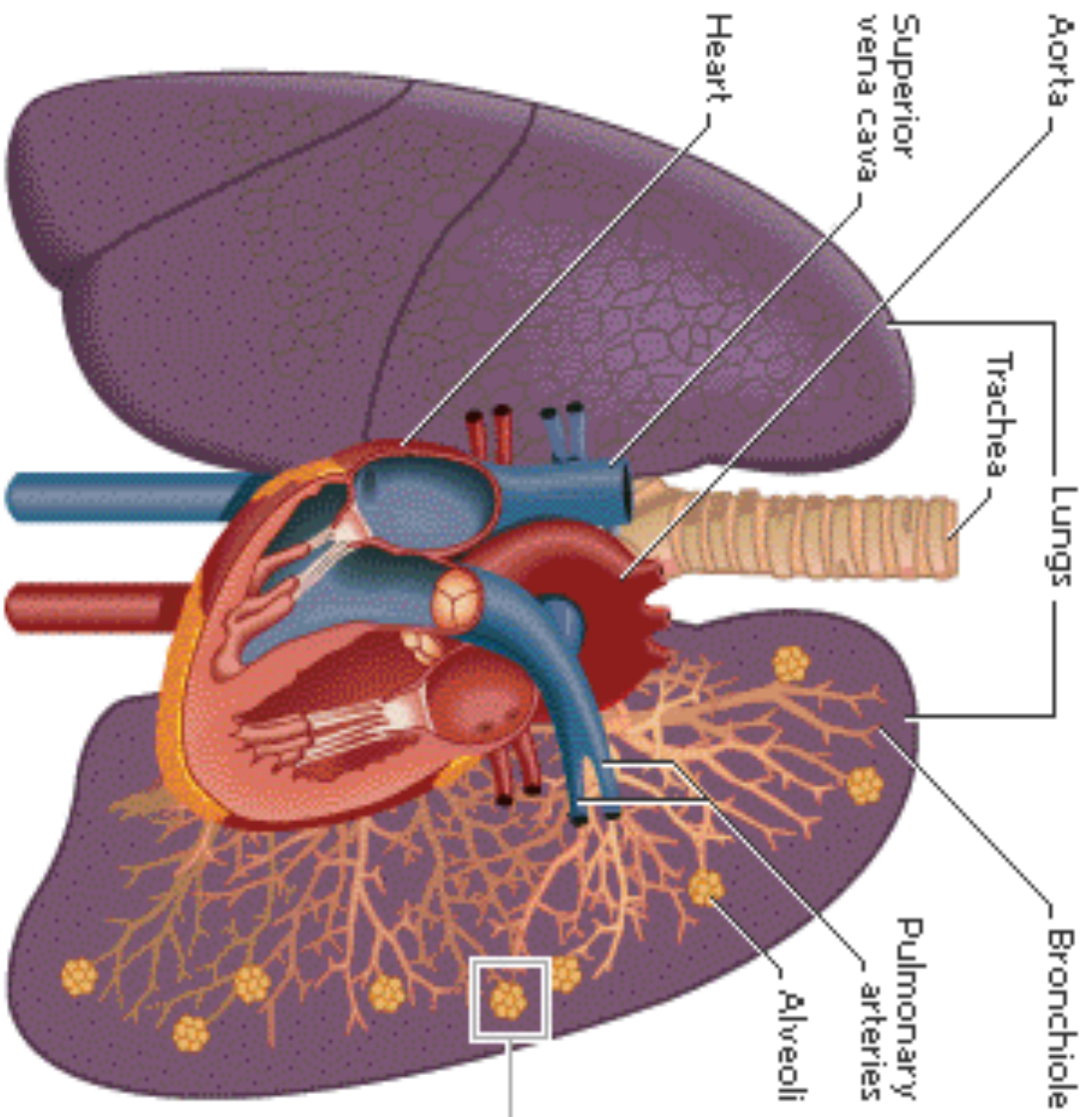
Approximately 240,000 water main breaks occur annually in the U.S., wasting more than 2 trillion gallons of treated drinking water, according to the 2017 Infrastructure Report Card by the American Society of Civil Engineers. In addition, the report card noted that many of the 1 million miles of pipes delivering drinking water across the country have either (40 times around the world) reached – or are fast approaching – *the end of their lifespans.*²⁷ In addition, maintenance, repair and replacement of water mains has been associated with multiple large outbreaks of Legionella.¹⁴



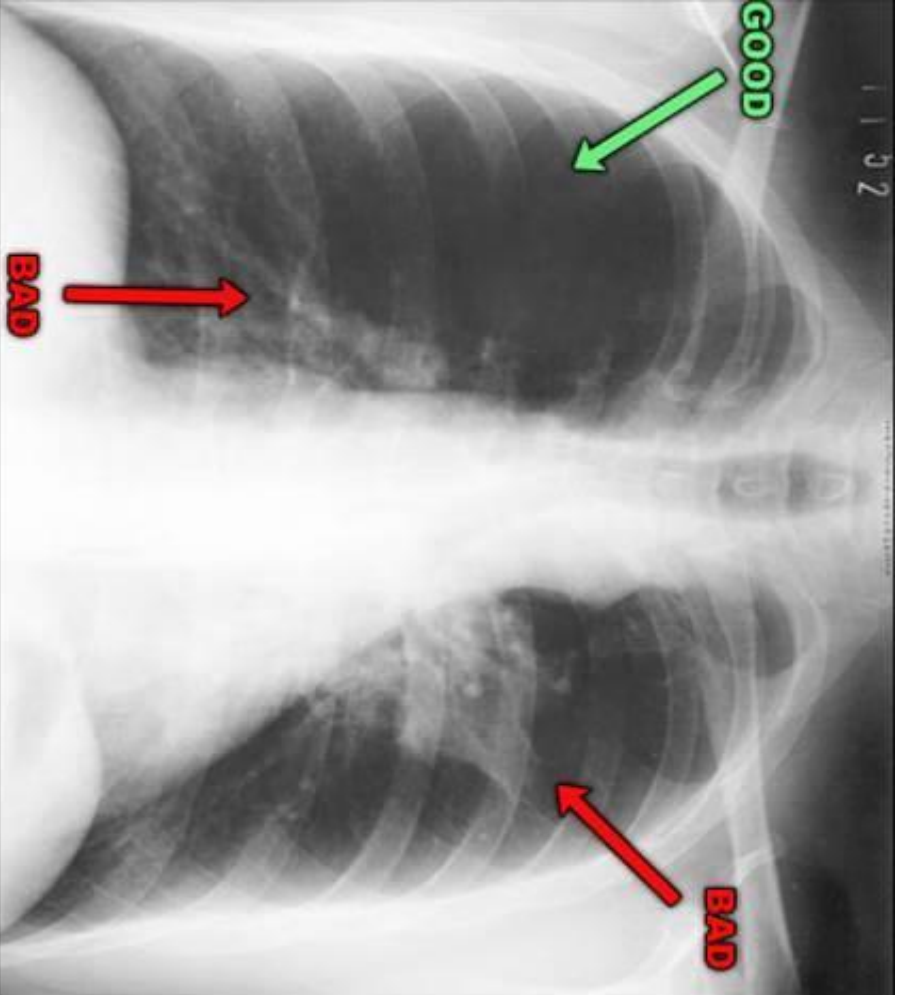
PROTECT ME

WHAT YOU NEED TO KNOW

OPERATORS



LUNGS FILLING WITH FLUID



Chest X-Ray with Pleural Effusion on the Left

There are several key elements that can promote the growth of Legionella bacteria in a water supply system, including:

- **Excessive water age.** The longer water sits in a system or piping in a system, the greater likelihood the water disinfectant will dissipate over time, leading to pathogen growth.⁸
- **Biofilm.** When biofilm, a sticky substance created by bacteria, forms on the inside wall of water supply piping, it protects Legionella from heat and disinfectant.⁹
- **Lukewarm water.** Legionella growth is enabled by lukewarm water temperatures, usually in the range of 77 degrees Fahrenheit to 108 degrees Fahrenheit.⁹
- **Dead legs.** A “dead leg” is caused by no flow or rare flow of water in pipes.⁹
- **Insufficient disinfectant.** Effective water disinfectant strategies are necessary to control Legionella in a water system. For example, chlorination is one method used by water districts to disinfect drinking water that provides a lasting residual disinfectant.¹⁰
- **Inadequate corrosion control.** Corrosion can occur in system pipes, depending on several water quality variables, including disinfectants used, water temperature and pH levels. Improper corrosion control can create the ideal environment for Legionella growth.¹¹
- **Cross connections.** Cross connections between potable and non-potable water can introduce Legionella into the potable water supply system.¹²

Sources of *L. pneumophila*



Cooling towers



Hydrotherapy pools



Humidifiers



Birthing pool



Fountains



Respirator



Ice machines



showers



Dental units



Feeding tubes

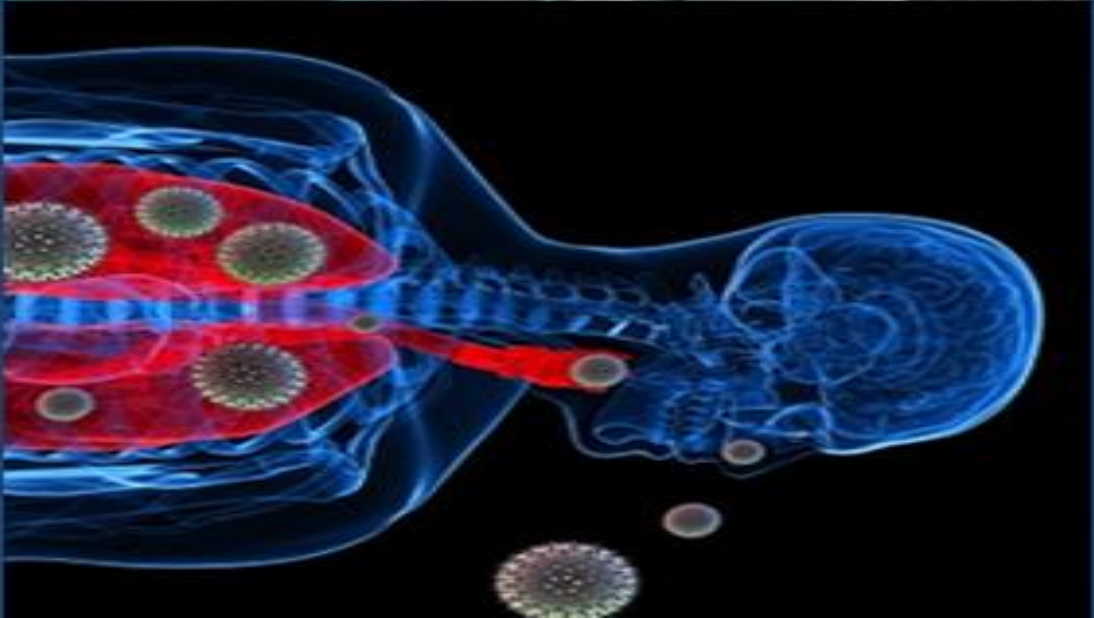
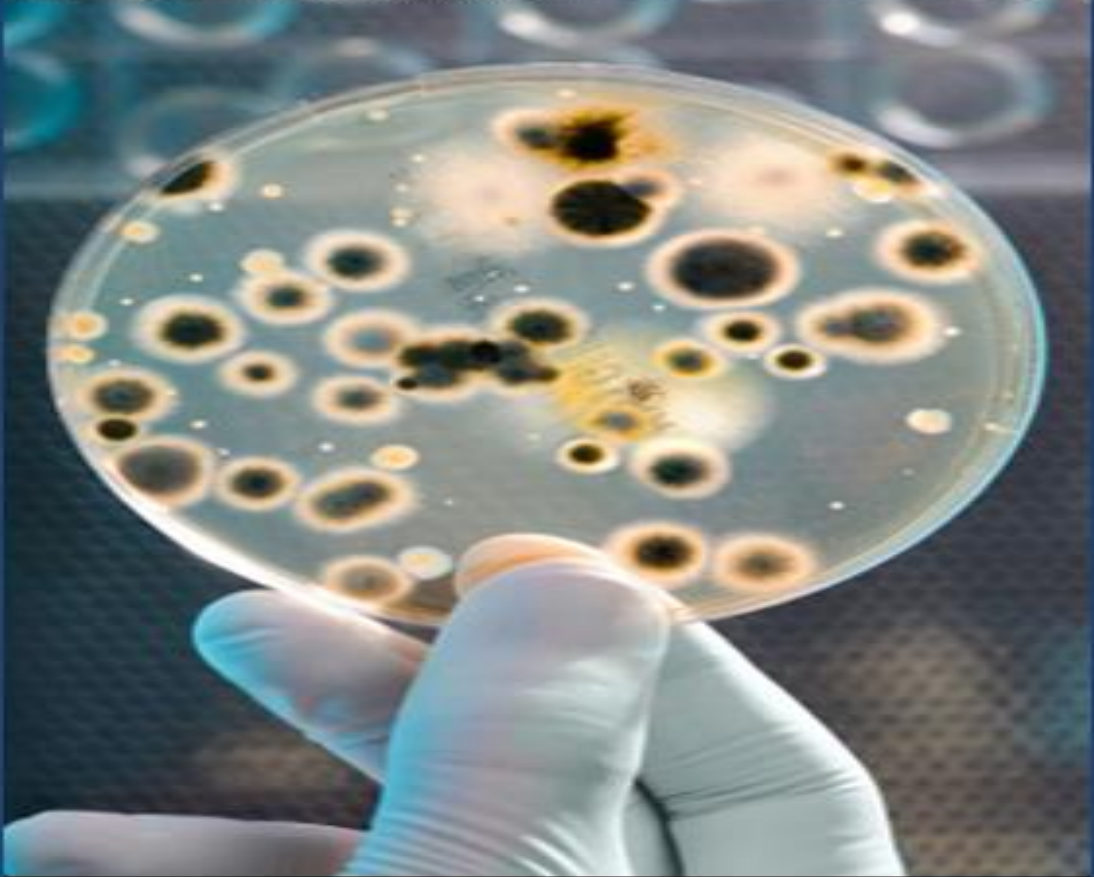


Spas

Sources of Aerosolized Legionella

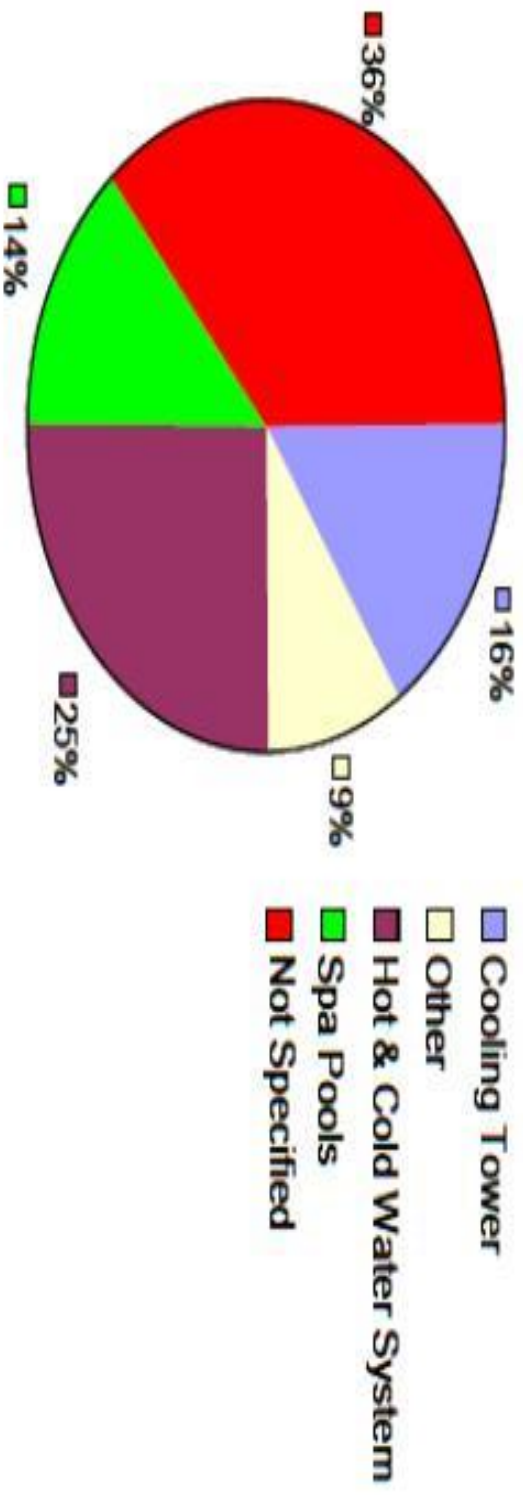
- Cooling towers
- Evaporative coolers (swamp coolers)
- Misters (produce, recreational)
- Decorative fountains
- Spa pools, thermal pools, springs
- Humidifiers
- Respiratory therapy equipment
- Domestic plumbing (hot and cold water)





OUTBREAKS

Outbreaks by System Type



“The rate of reported cases of legionellosis has increased 286% in the US during 2000–2014.”

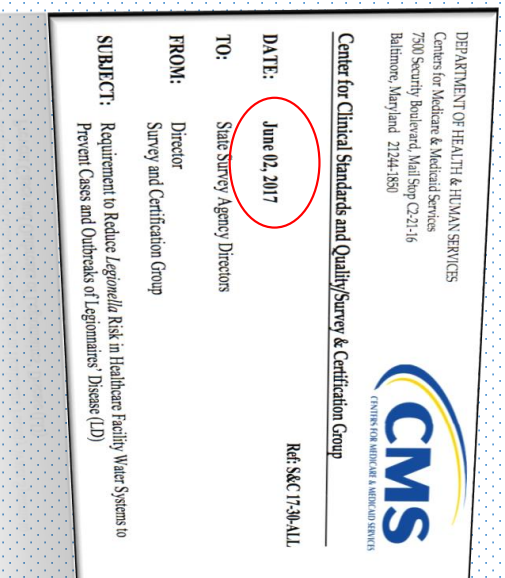
“Approximately 9% of reported legionellosis cases are fatal.”

“19% of outbreaks were associated with long-term care facilities and 15% with hospitals”

CENTERS FOR Medicare and Medicaid Services

CMS REQUIREMENT S&C 17-30

Requires healthcare facilities to develop policies/procedures to inhibit microbial growth in water systems



A facility must.....

- ✓ Conduct a facility risk assessment
- ✓ Implement a water management program per ASHRAE 188 & CDC Toolkit
- ✓ Define and specify testing protocols/ranges for control measures & document

CMS REQUIREMENT S&C 17-30

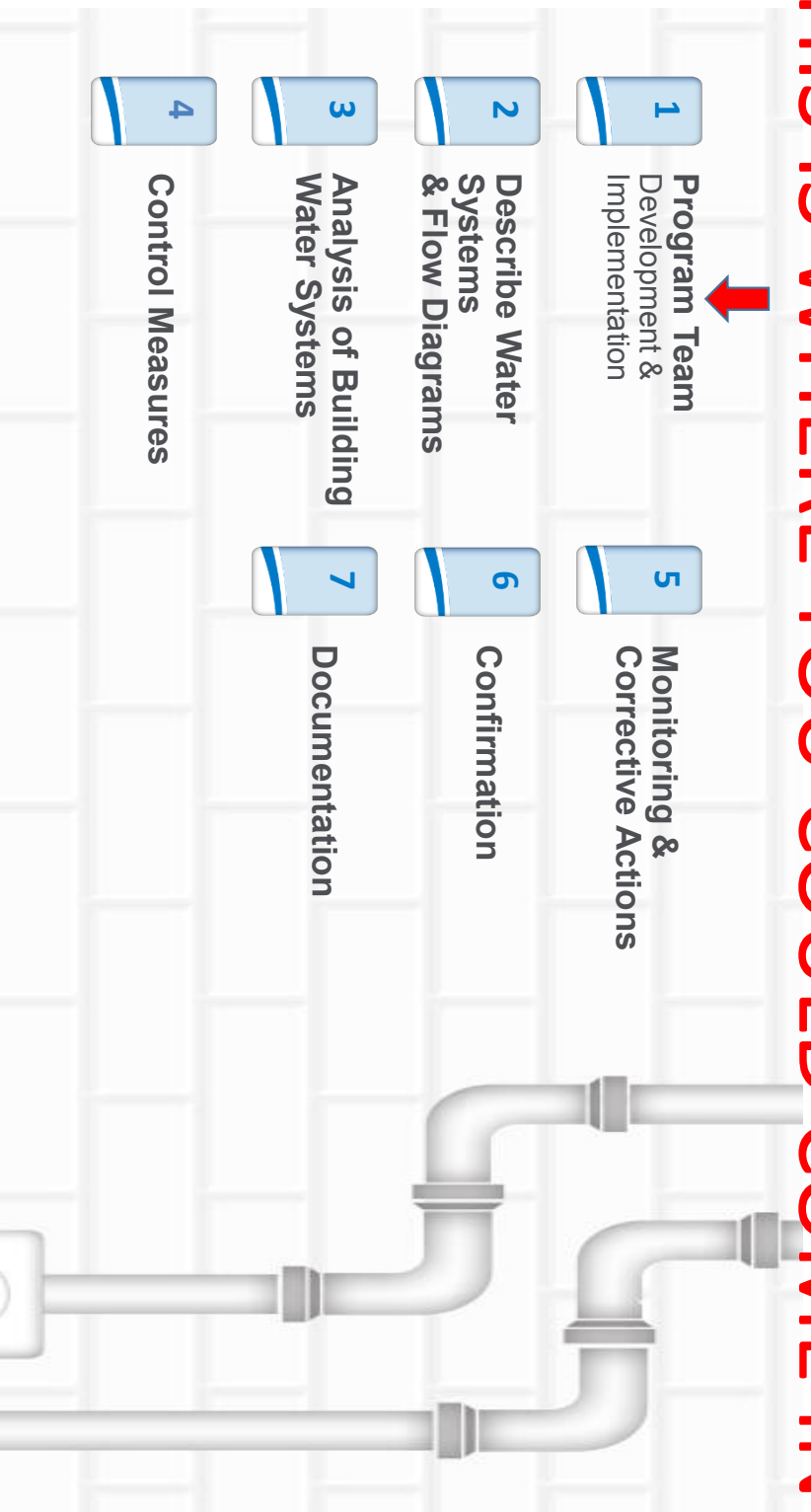
- Surveyors will review policies, procedures, and reports documenting water management implementation results to verify that facilities:
 - Conduct a risk assessment – identify where Legionella and other opportunistic waterborne pathogens could grow and spread in the facility water system.
 - Implement a water management program – includes control measures such as physical controls, temperature management, disinfectant level control, visual inspections, and environmental testing for pathogens.
 - Specify testing protocols and acceptable ranges for control measures and document the results of testing and corrective actions taken when control limits are not maintained.
- The Joint Commission, **DNV**, **ACHA** will check for compliance and will cite non-conformances; risk of citation for non-compliance.

DNV – Det Norske Veritas (Det norske " means "The Norwegian", while "veritas" is Latin meaning "verity" or "truth".)

ACHA – American College of Hospital Administrators

Elements of a Water Management Program

THIS IS WHERE YOU COULD COME IN!



SHOWERS

Operate at ideal temps

Poor hygiene

Infrequently used

Prone to scaling

Create aerosol



DEAD LEGS

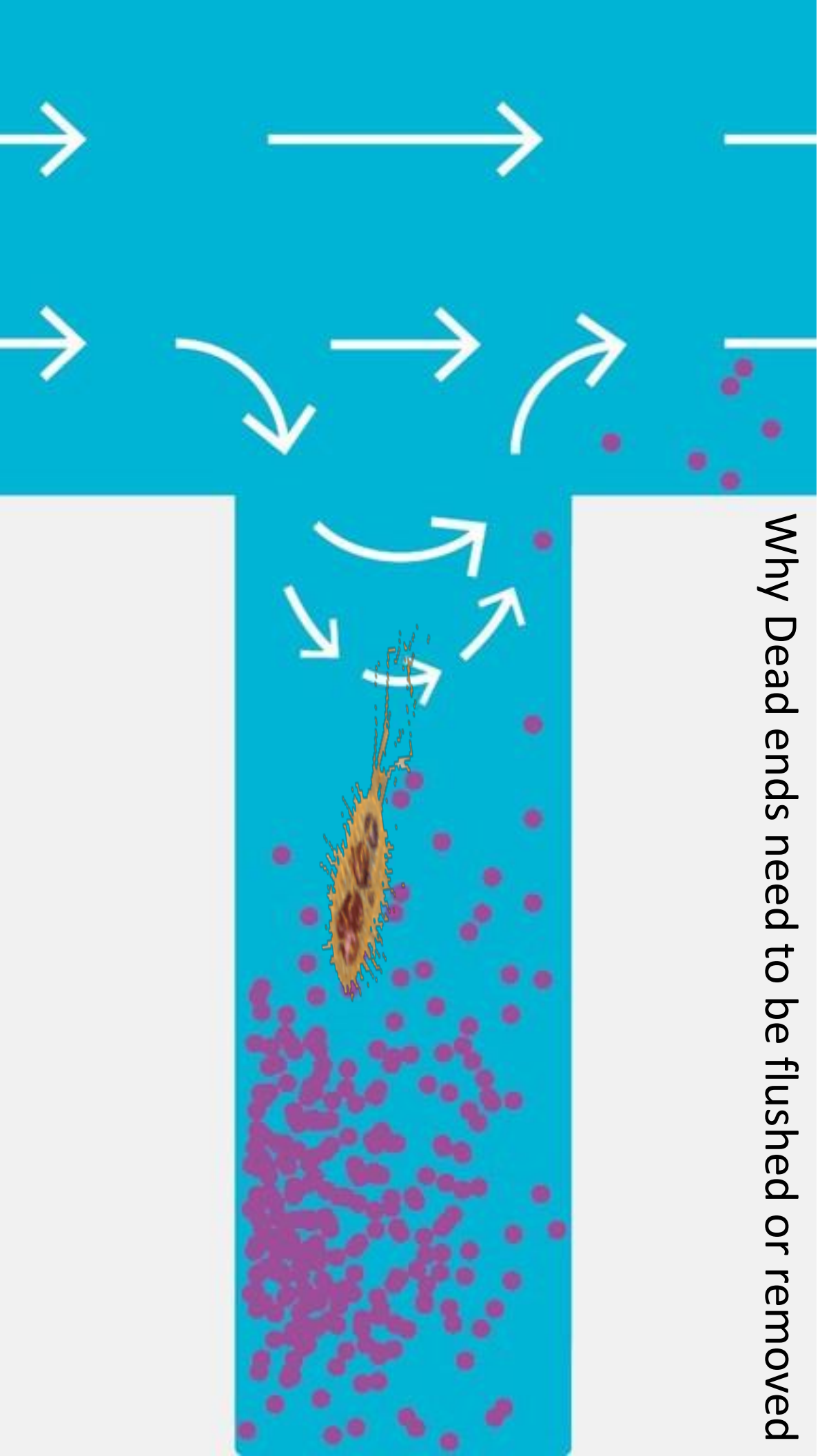
Stagnant water

Ambient temps

Breeding ground



Why Dead ends need to be flushed or removed







Flushing Dead Ends

CROSS

CONNECTION!



STORAGE TANKS

Over capacity

Stagnation

Out of sight

Poor flow

Ambient temps



COOLING TOWERS

Run at ideal temps

Open to elements

Contamination via
water supply

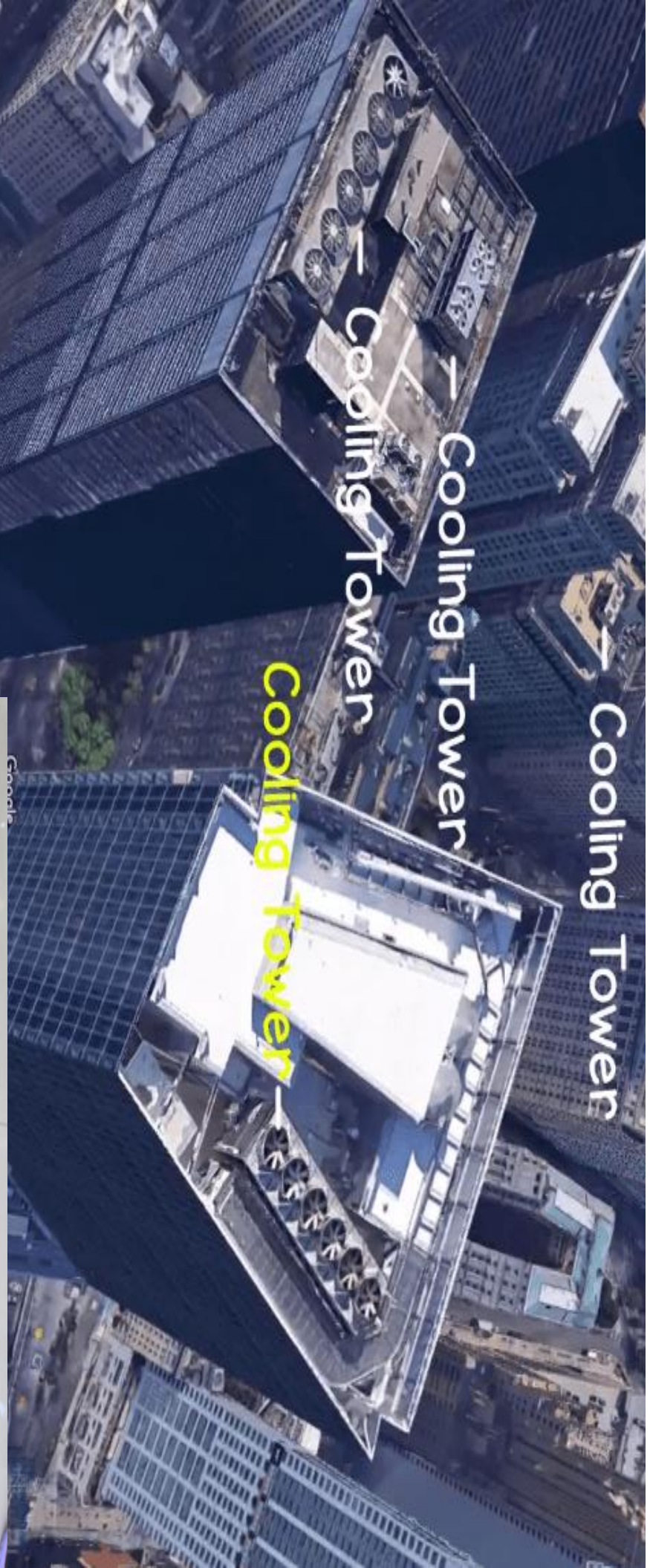
Intermittent use

Drift affects wide
area





A Cooling Tower Basin Is A Great Breeding Ground For Legionella



Cooling Tower

Cooling Tower

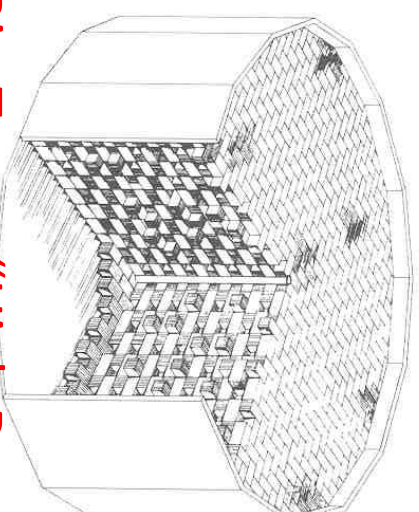
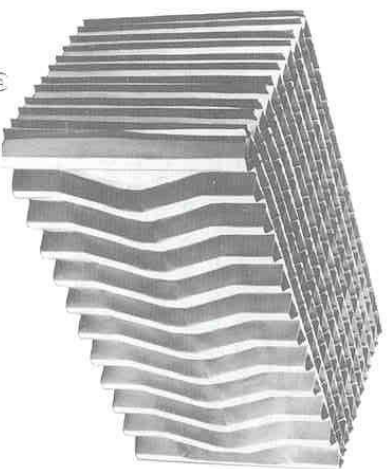
Cooling tower

Cooling tower

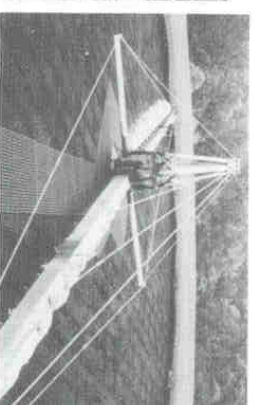
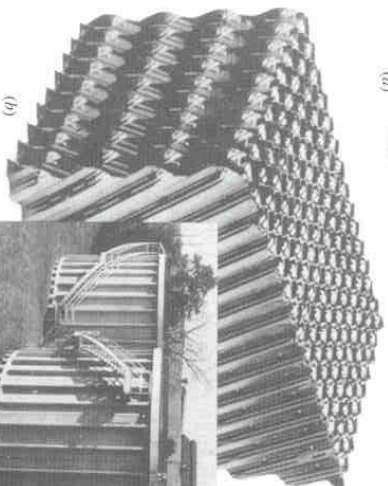


Drift Eliminator

Bio-towers media or Drift Eliminators



Bio-Tower “High Rate Trickling Filter”



Must monitor disinfection residuals

LEGIONELLA WHAT THEY LIKE !

- Temperature range 20 - 50°C (68 – 122 F)
- Proliferates at 37 °C – 98 F
- Requires nutrients
- Slow moving / stagnant water
- Poorly managed water system
= perfect environment

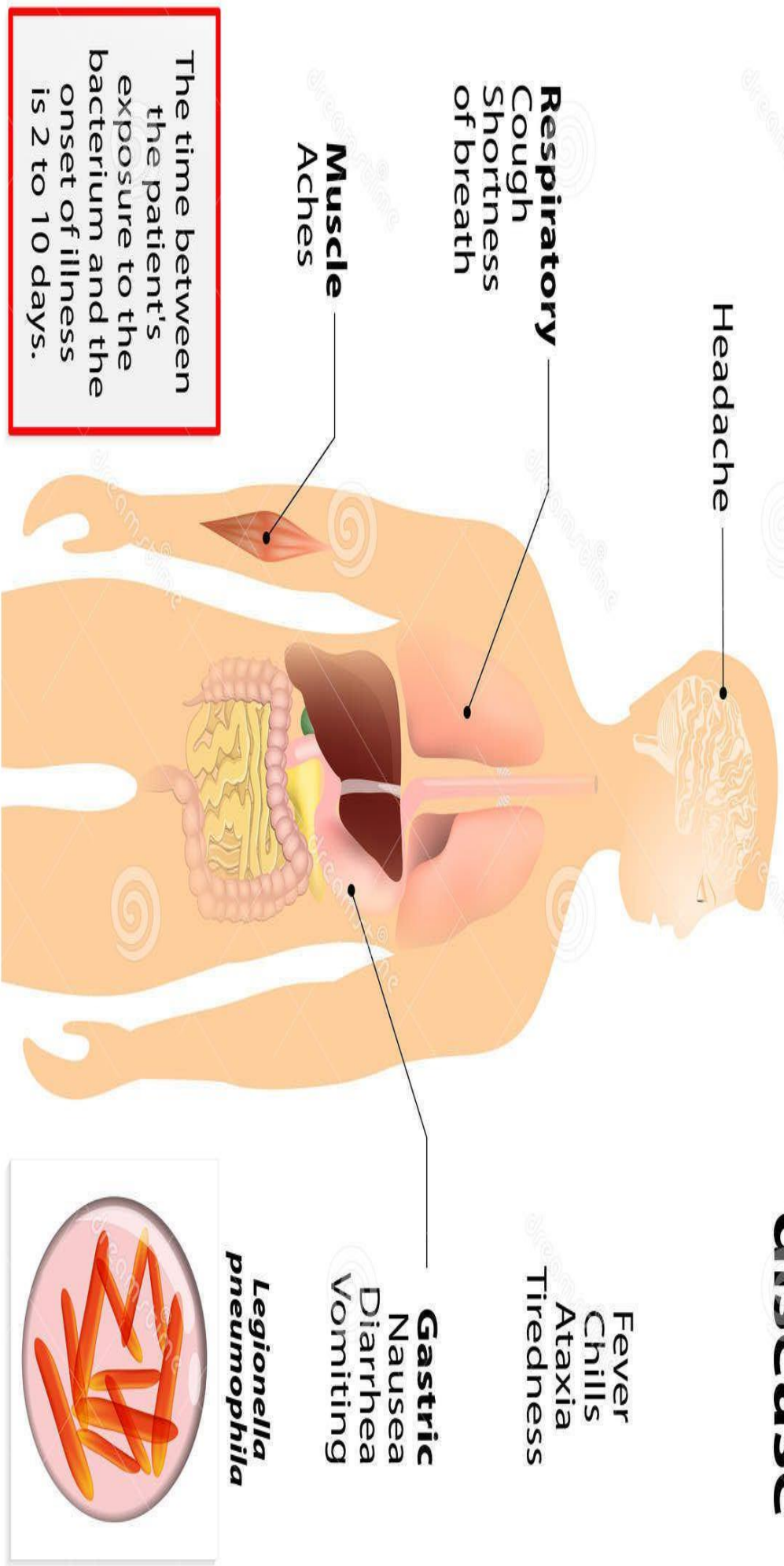


Requirements for Growth?



- Optimum temperature range of 20 - 45 °C (68 – 113 F)
- Food source (other bacteria & sediments)
- Prefers stagnant conditions

Legionnaires' disease



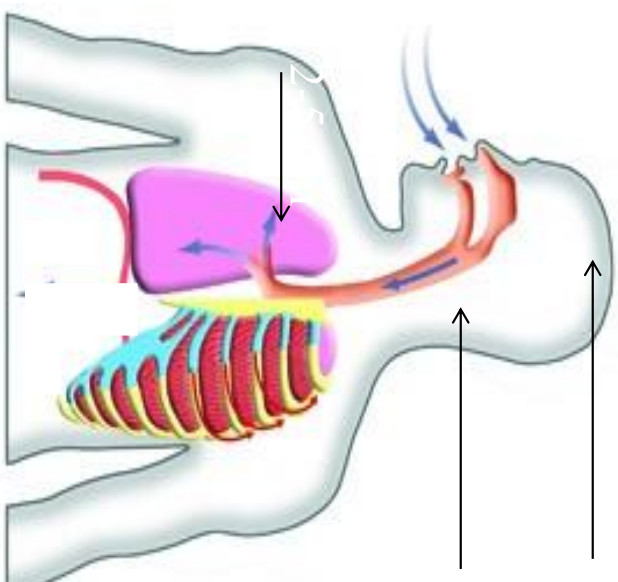
For an aerosol 'size is important!'



>10 μm nose
and throat

5-10 μm upper
and lower
respiratory tract

2-5 μm lungs
and conducting
airways



“Don't Breathe the Water”

Fig. 90% shower aerosols 1-5 μm

Route of Infection?

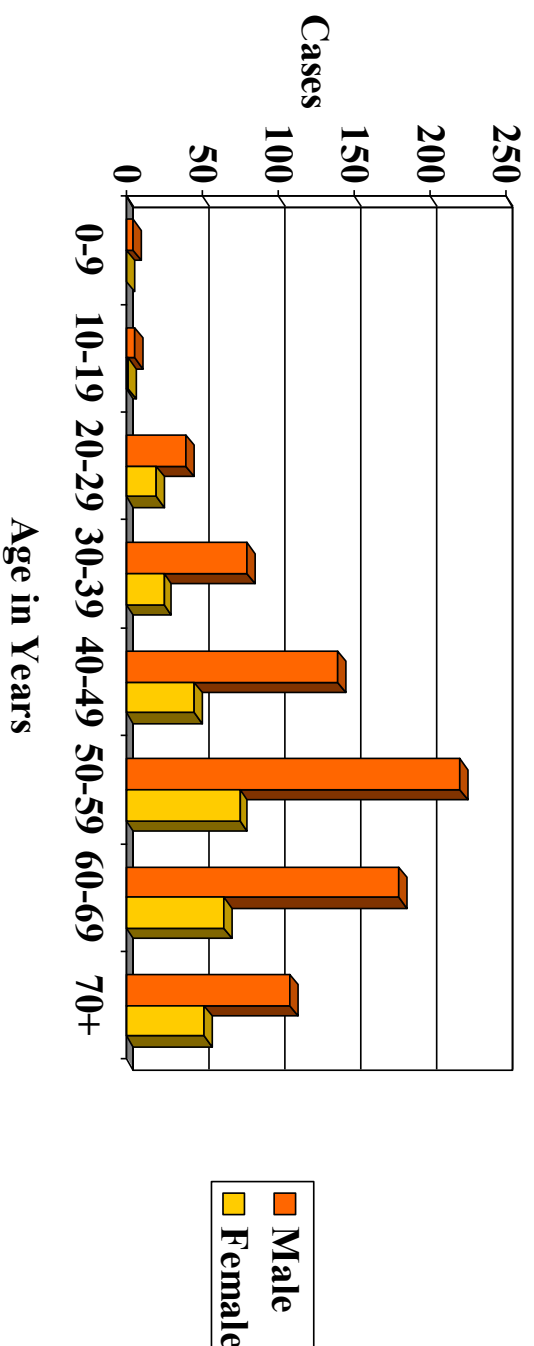
- Primarily through inhalation of aerosols, fine droplets & mists
- Can be contracted by choking on contaminated water
- Statistically most susceptible
 - 50 to 70 year olds
 - Males
 - Smokers



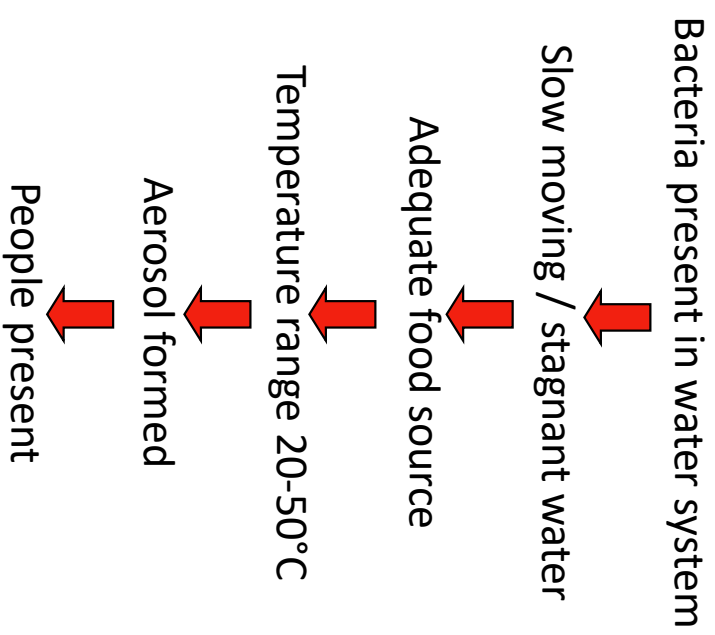
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'AT RISK' GROUPS

England & Wales Cases

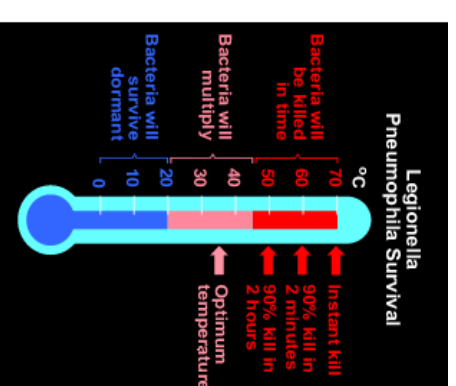


CHAIN OF EVENTS



Legionella Ecology

- *Legionella* bacteria live in water (primarily) and soil, can live inside protozoa
- Favorable conditions:
 - Stagnant water (dead legs in plumbing)
 - Warmer water (prefers: 77°F-108°F)
 - Presence of organic matter
 - Absence of residual disinfectant





AMOEBA



AMOEBA

L. pneumophila survival:
Biofilm



Biofilm growth on hot water

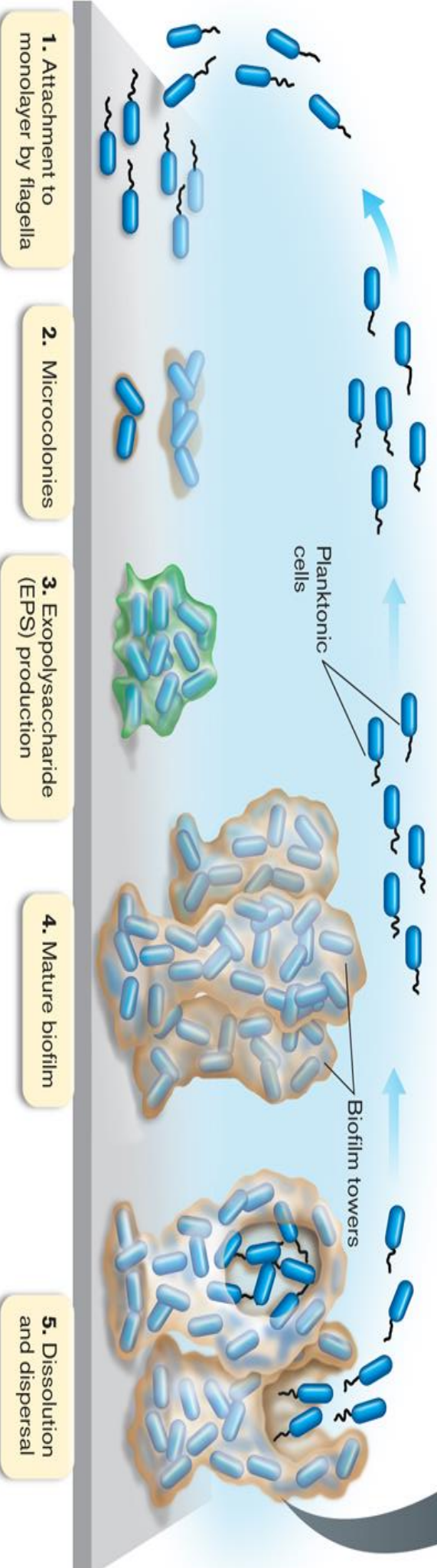
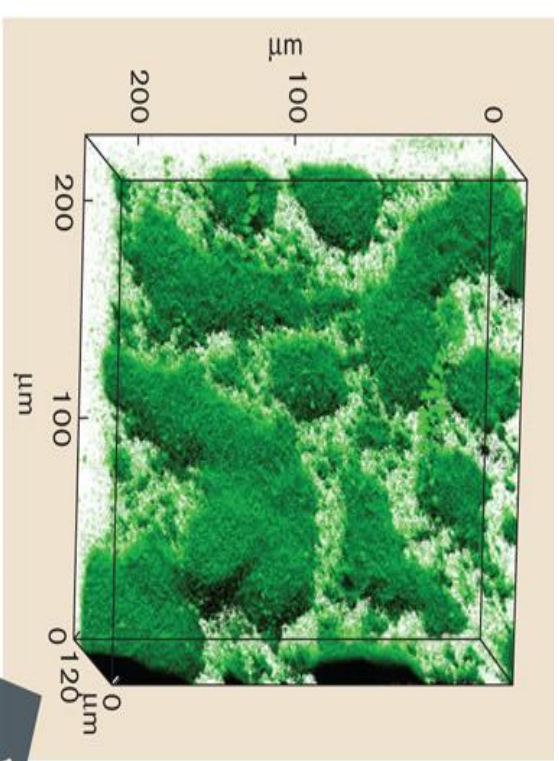
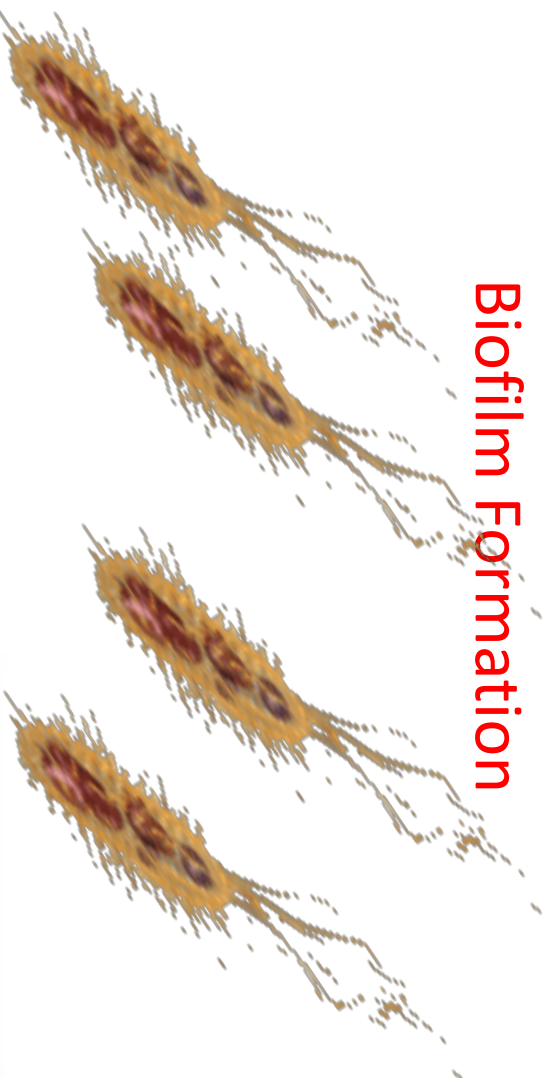


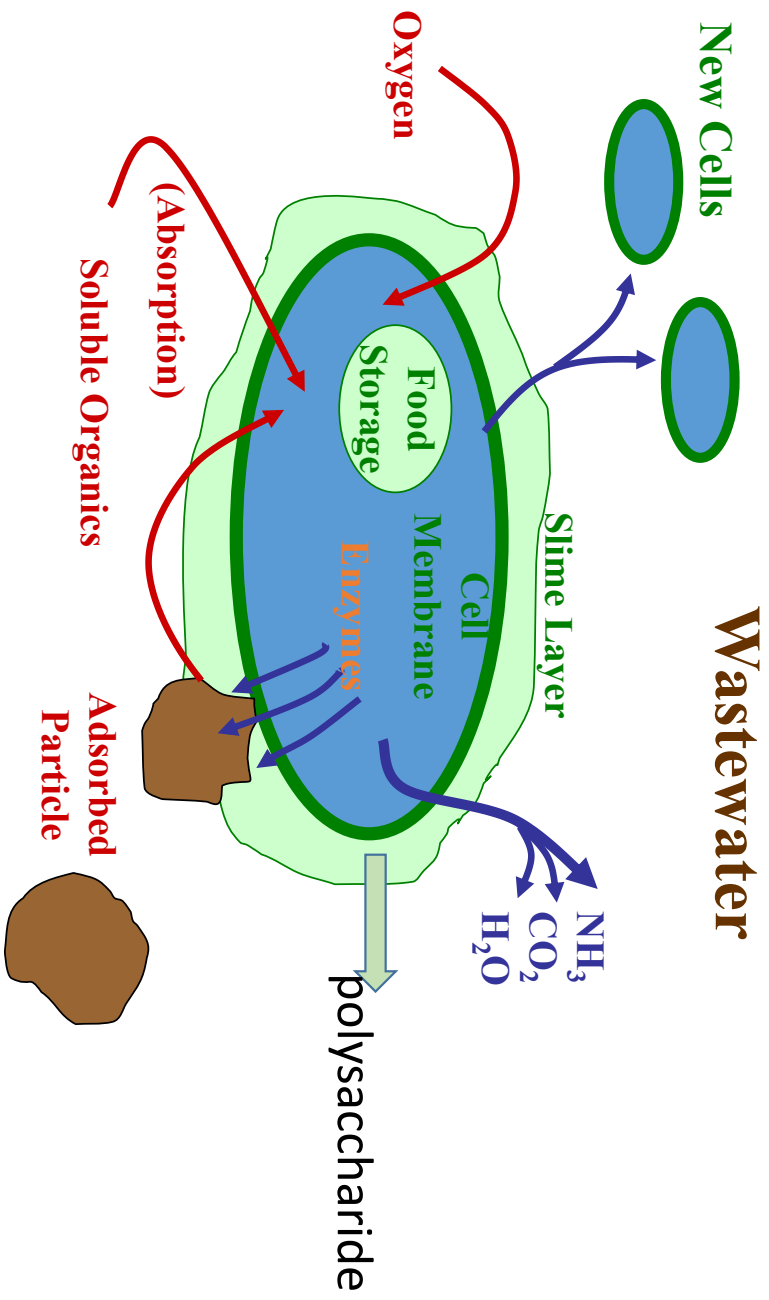
Biofilm growth on plastic tubing



Biofilm growth on cooling
tower

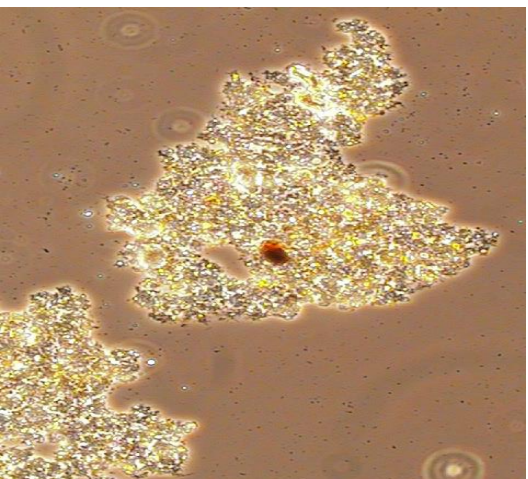
Biofilm Formation





Need Food to create Polysaccharide so they can stick together

Biomass 400X



7200X

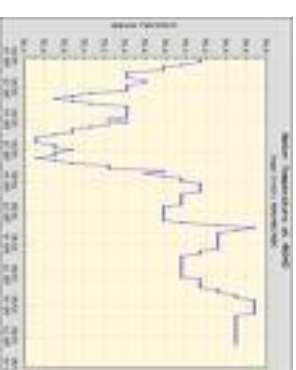




COMBATING
LEGIONELLA

Controlling Legionella bacteria

- Temperature monitoring
- Controlled release of water spray
- Avoid temp. conditions 68 - 113° F
- Avoid water stagnation - empty & clean regularly
- Avoid materials which harbor bacteria
- Maintain cleanliness of spray outlets
- Water treatment where necessary
- Ensure correct & safe operation of system
- Flushing regime for rarely-used outlets



RISK ASSESSMENT

- 'Suitable & Sufficient' - all water systems
- Reviewed regularly (bi-annually) and where:
 - change to plant / water system or its use
 - change to the use of the building
 - new information about risks / control measures
 - tests indicate control measure are ineffective
- Carried out by competent person

SCHEME FOR CONTROL

- Weekly flushing - infrequent use services
- Monthly temperature monitoring
- Quarterly shower head disinfection / de-scaling

REMEMBER

TO

DOCUMENT

- Annual review of scheme and risk level
- Bi-annual review of the risk assessment
- Cleaning and disinfection as required

Contingencies to Regain Control
in Building Water Systems

SHORT TERM REMEDIATION STRATEGIES



Hot & Cold
Hyperchlorination



Super
Heat & Flush

L8 states you must maintain your temperatures as follows:

**ACOP L8 2013 - Legionnaires' disease
The control of Legionella bacteria in
water systems**

The ACOP and Guidance are now
separate documents

The ACOP focuses on
requirements of Risk Assessment,
Responsibility and Management



"The Science of Compliance"



Cold Water Outlets

These must be below 68°F within 2 minutes of running the outlet.

Hot Water Outlets

These must be above 122°F within 1 minute of running the outlet.

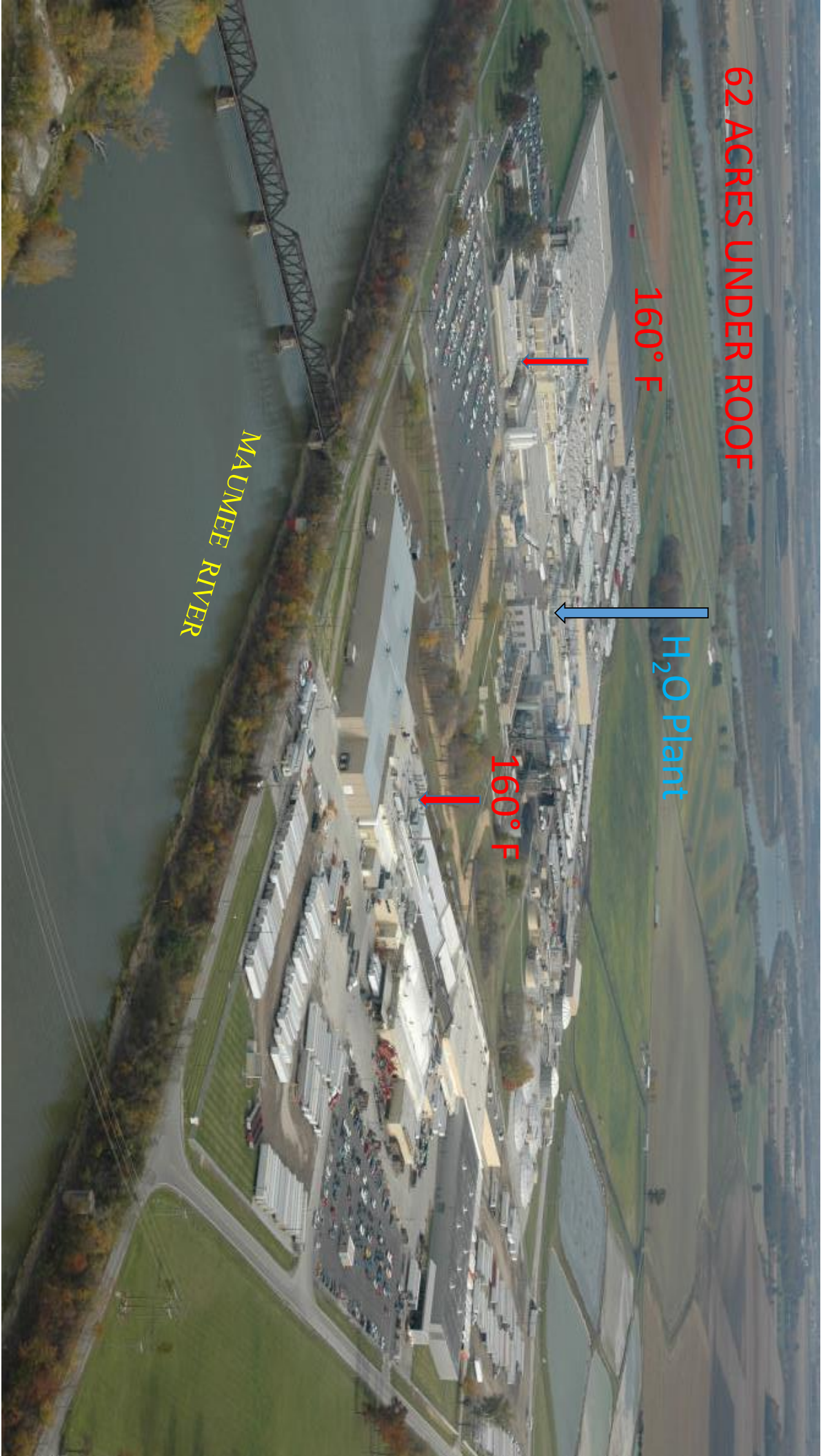
62 ACRES UNDER ROOF

160° F

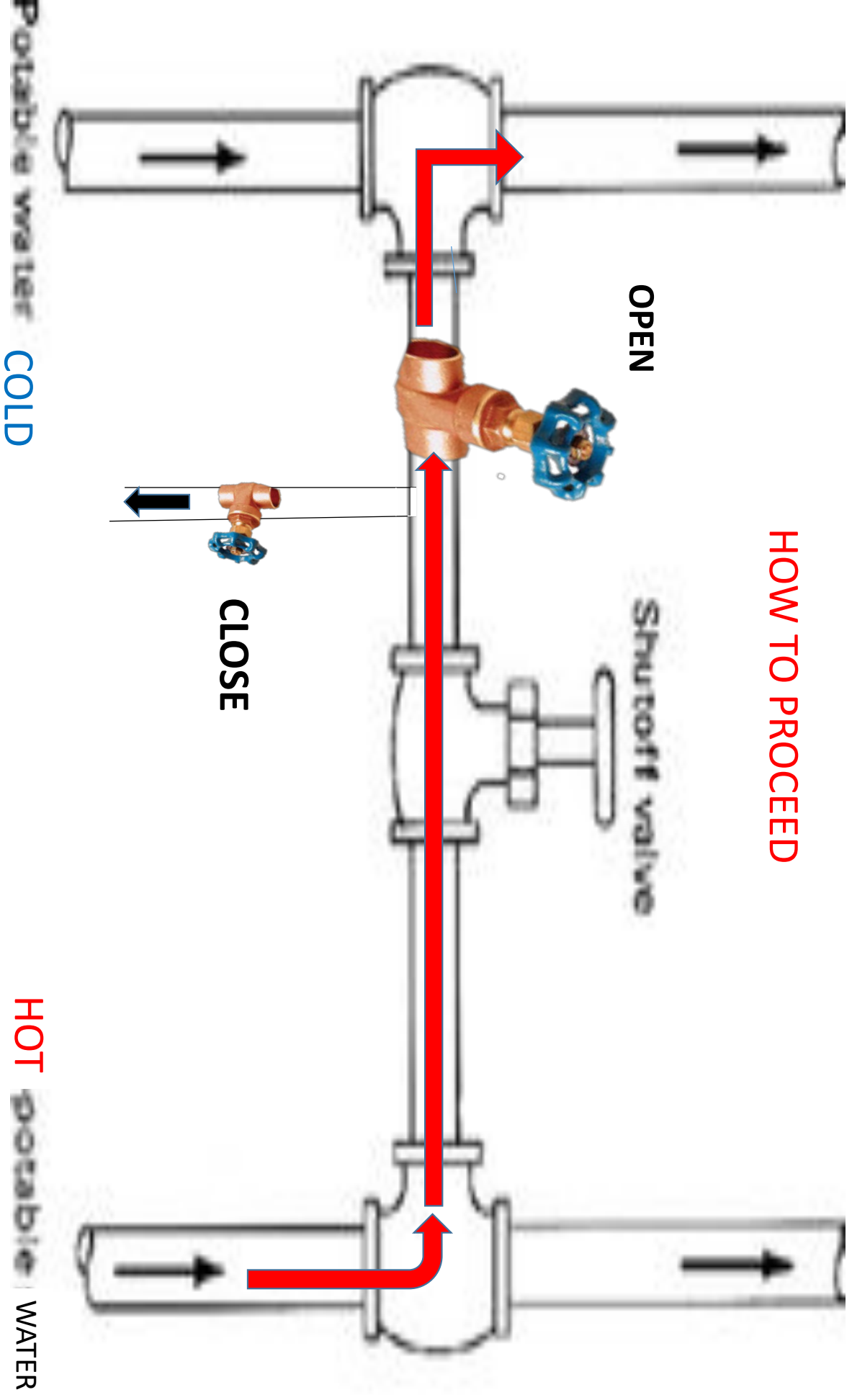
H₂O Plant

160° F

MAUMEE RIVER



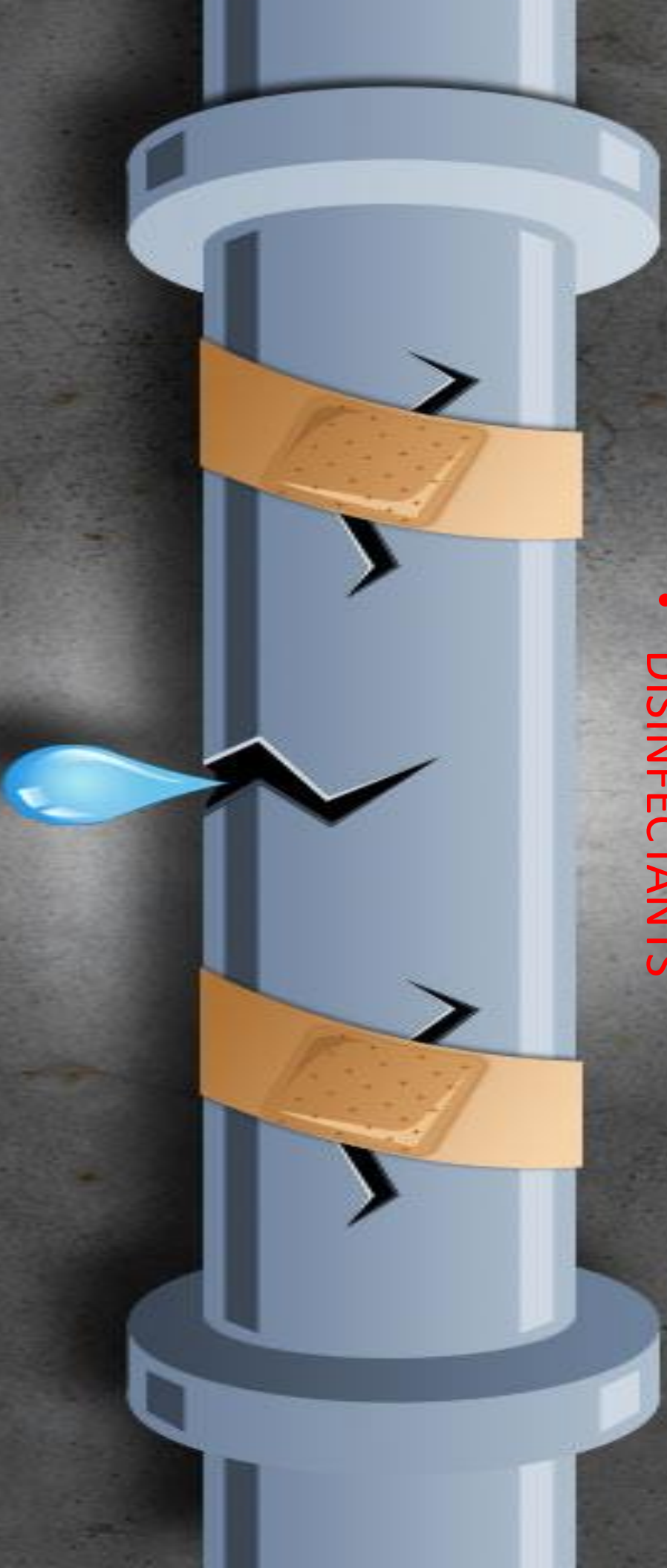
HOW TO PROCEED



Plastic Pipe Material	Operating Temperature			
	With Pressure		Without Pressure	
	(°F)	(°C)	(°F)	(°C)
<u>ABS</u> - Acrylonitrilebutadiene Styrene	100	38	180	82
PE - Polyethylene	100	38	180	82
PVC - Polyvinylchloride	100	38	140	60
CPVC - Chlorinated Polyvinyl Chloride	180	82	180	82
PB - Polybutylene	180	82	200	93
PP - Polypropylene	100	38	180	82

CHECK FOR INCOMPATIBILITY WITH PIPELINES

- HOT WATER
- DISINFECTANTS

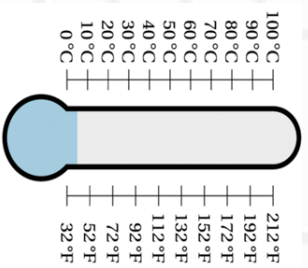


Oxidant and Temperature Mapping

➔ DISINFECTANT RESIDUAL



➔ TEMPERATURE



How Residual is Impacted

1 ppm

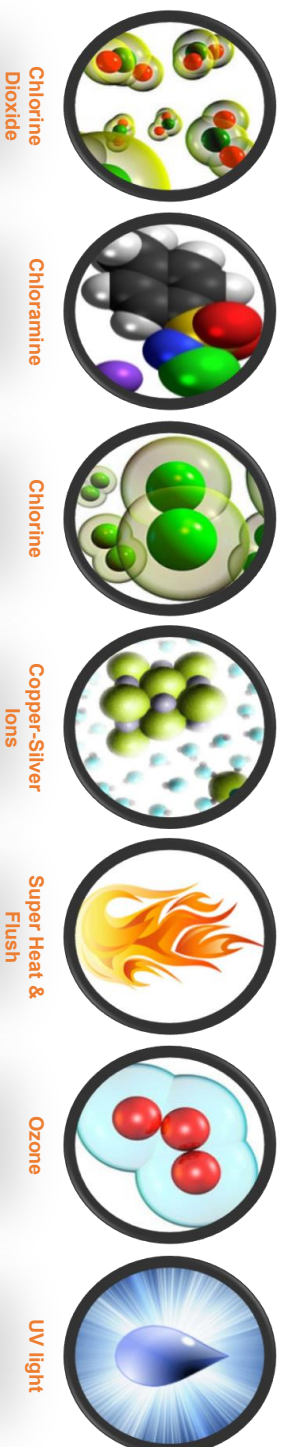


0.4 ppm

1 ppm



0.06 ppm



DISINFECTION

Domestic Water – Short Term and Long Term

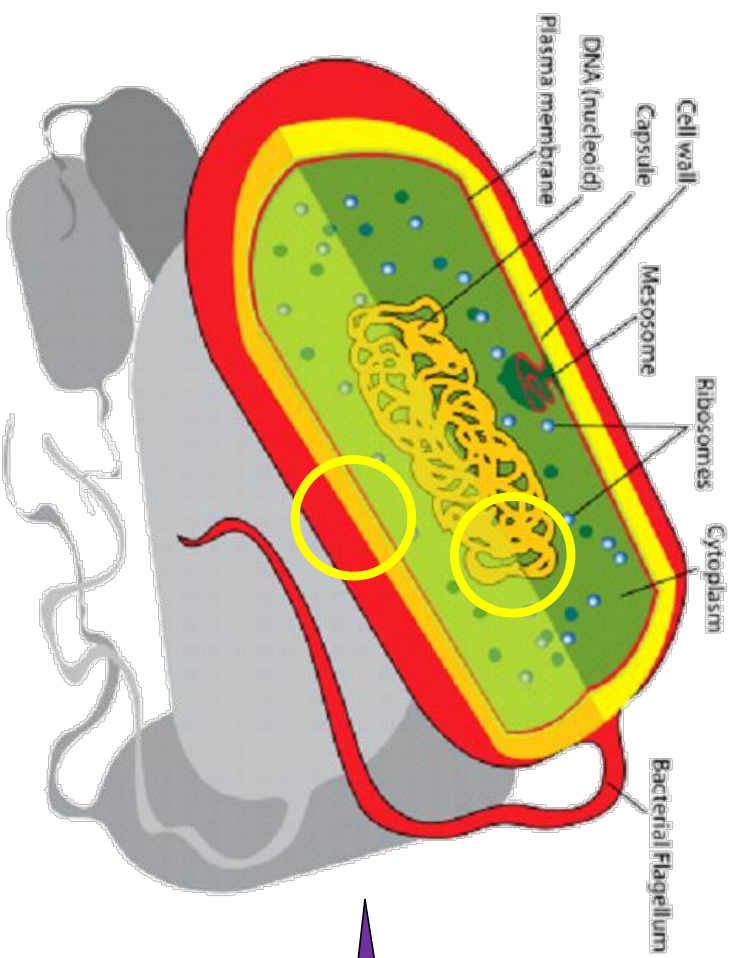
Why is chlorine dioxide so effective at controlling legionella?

First, chlorine dioxides potency is very impressive. It means only a small amount of the chemical is required to have the desired disinfecting effect. Chlorine dioxide can kill off more than just bacteria, too. Fungi will also be eradicated when the chemical is added to water, along with biofilm. Second, its versatility means it is suitable for use as a disinfectant in both water and on hard surfaces depending on the situation.

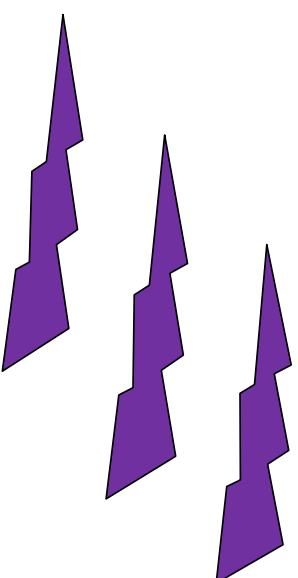
Disinfection from the microbial perspective

Using a bacterial cell as an example here, inactivation of microorganisms during disinfection may be due to:

- Disruption of cell wall \Rightarrow structural deterioration of cell
- Diffusion of oxidant into cell \Rightarrow disruption of vital functions



Oxidant



Oxidant

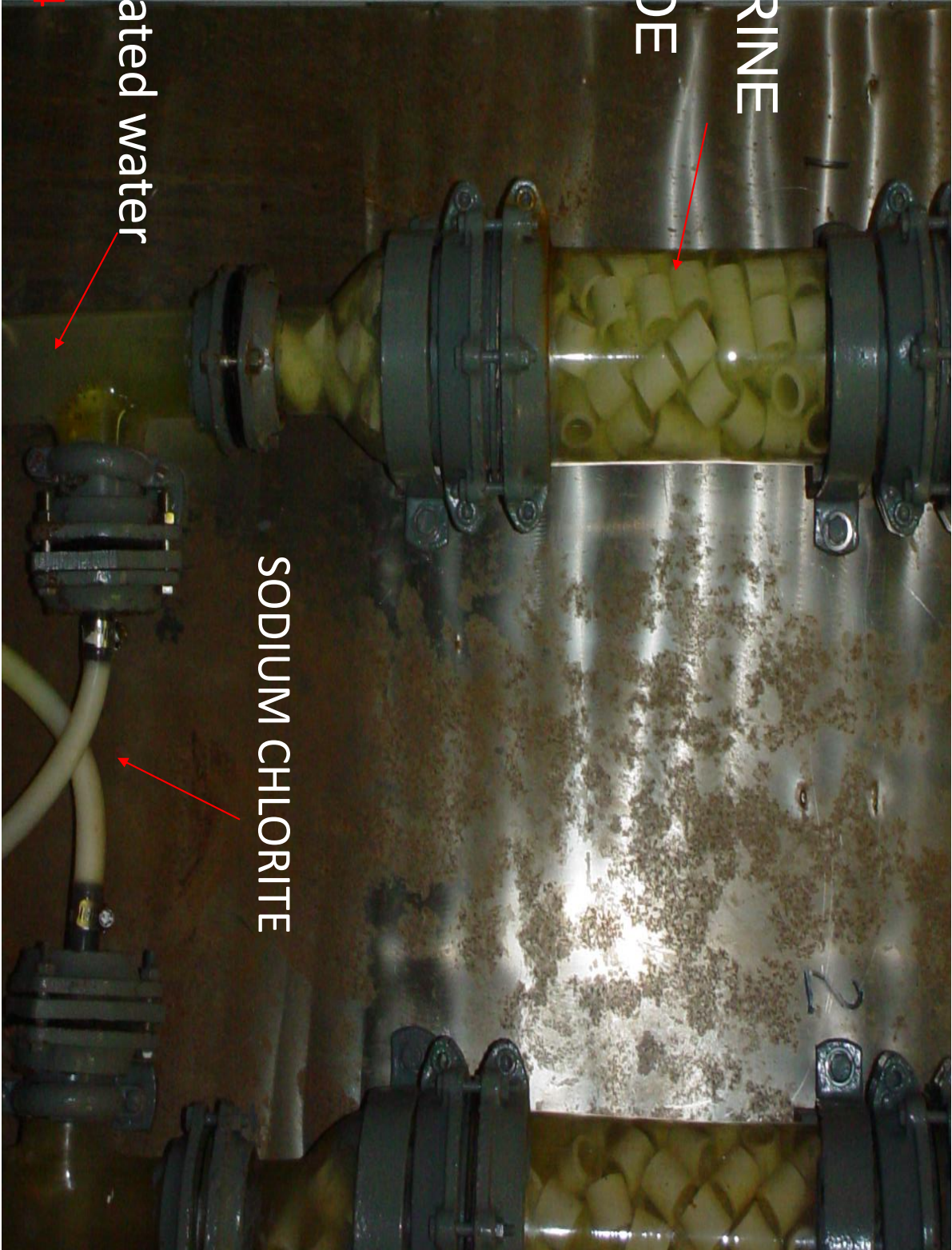
CHLORINE
DIOXIDE



Highly chlorinated water

pH < 4

SODIUM CHLORITE



Growth Risk Potential

HOT WATER	LOW	MODERATE	HIGH
Temperature	≥124°F	123 to 118°F	<118°F
Free-Chlorine	>0.3	0.1 to 0.3 mg/L	<0.1 mg/L
Total-Chlorine	>0.5	0.3 to 0.5 mg/L	<0.3 mg/L

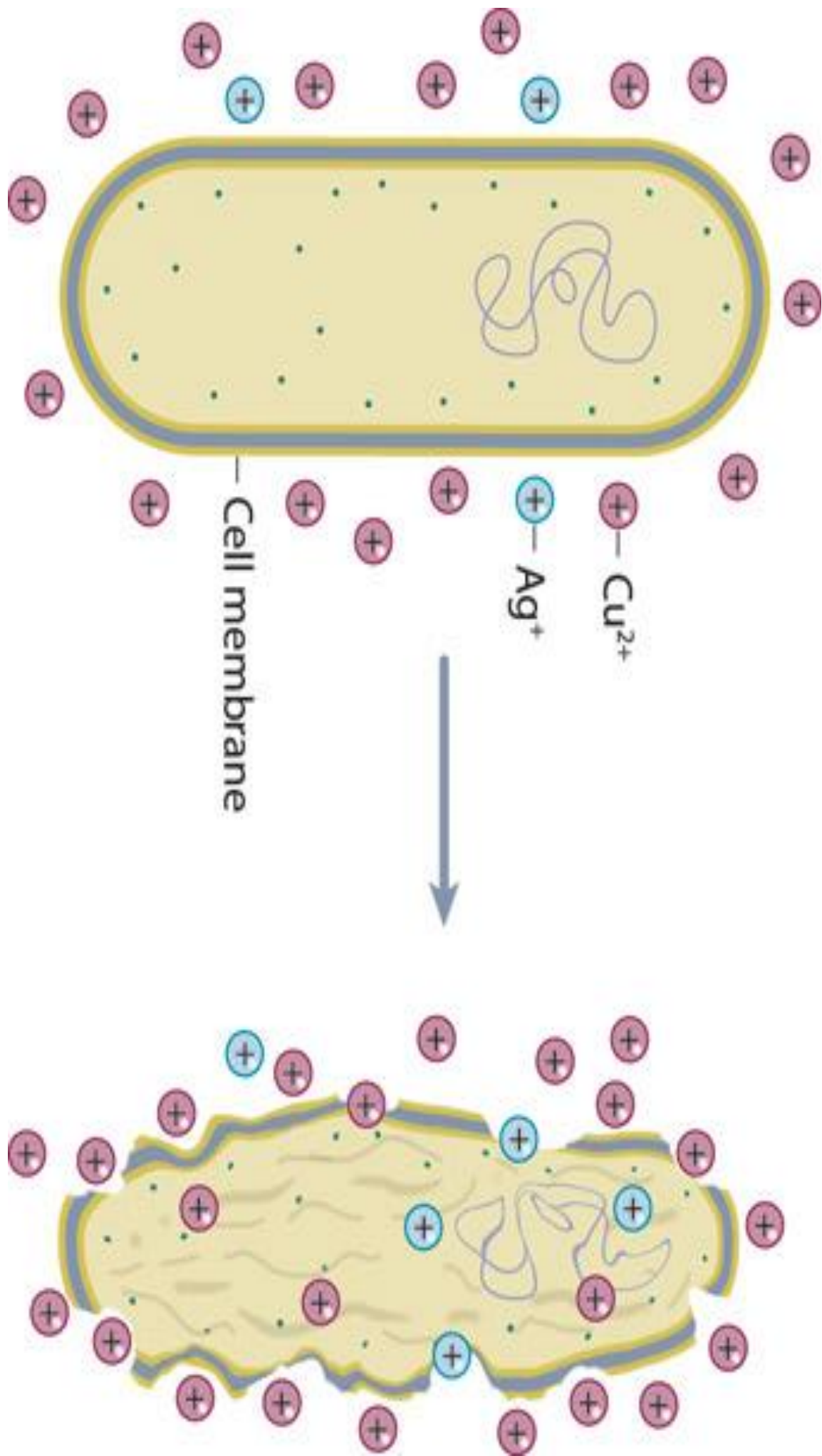
COLD WATER	LOW	MODERATE	HIGH
Temperature	≤68°F	69 to 77°F	>77°F
Free-Chlorine	>0.5	0.2 to 0.5 mg/L	<0.2 mg/L
Total-Chlorine	>1.0	0.5 to 1.0 mg/L	<0.5 mg/L

A scanning electron micrograph (SEM) showing numerous rod-shaped Legionella bacteria. The bacteria are oriented in various directions, some appearing in cross-section which reveals internal structures like the cell wall and internal organelles. The image is rendered in a monochromatic purple and pink color scheme.

CONTROL LEGIONELLA WITH COPPER SILVER IONIZATION

What is Copper Silver Ionization?

- Process that introduces (+) charged copper and silver ions into a water system
- Ions bond with (-) sites on bacterial cell walls and denature proteins
- Long term, ionization disperses and destroys biofilms and slimes that harbor Legionella





LEGIONELLA MONITORING

- Program for continual risk assessment
- Early identification of problem areas
- Demonstrate effective control
- Visual inspection – cleanliness / operation
- Compliance with current guidance



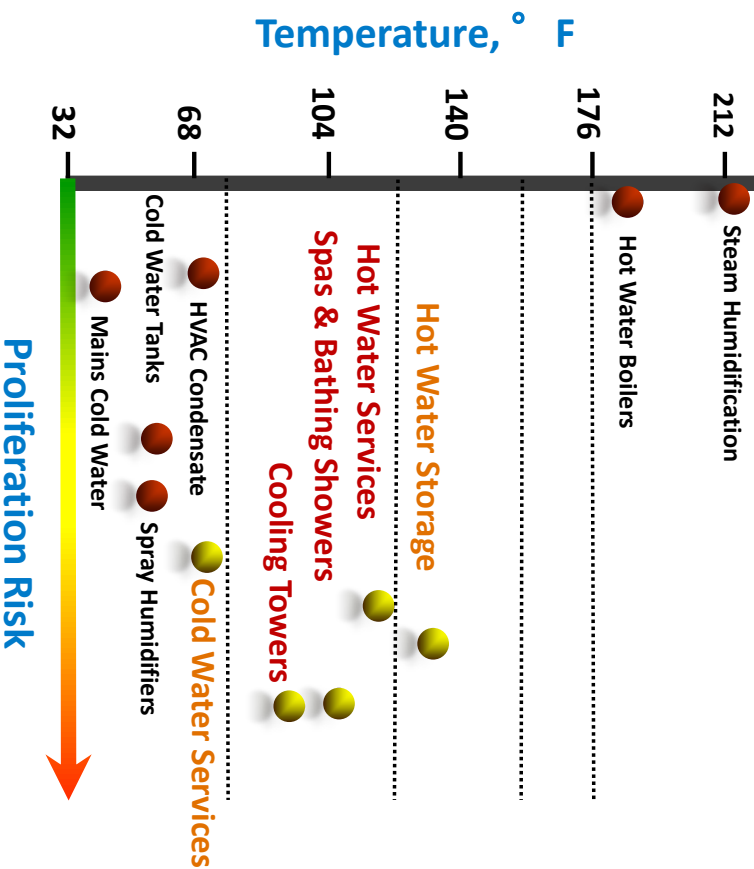
Treatment / remedial options

- Monitor temperatures; 20-45°C = risk range
- Every 2 weeks - heat water to 60°C (**140 F**) for 5 mins
- Add disinfectants / Chlorox as advised
- Empty out the water system, thoroughly clean & refill with fresh water every month
- Clean & disinfect spray heads every month
- Flush rarely-used outlets weekly
- Arrange with Estates for removal of “dead-legs”
- Arrange with Estates for samples to be taken if risk exists (sampling is NOT a control measure – it takes 10 days for results to be sent through – it monitors whether your controls work)



Utility & Domestic Services

Temperature vs. Proliferation Risk



Disinfection Range

158 - 176°F

Slowly Die

122-158°F

- 131°F ; die within 5-6 hrs
- 140°F ; die within 32 min.
- 151°F ; die within 2 min.

Growth Range

77 - 122°F

95 - 115°F optimum

Do Not Grow Well

68-77°F

Below 68°F Dormant

Drinking water coolers

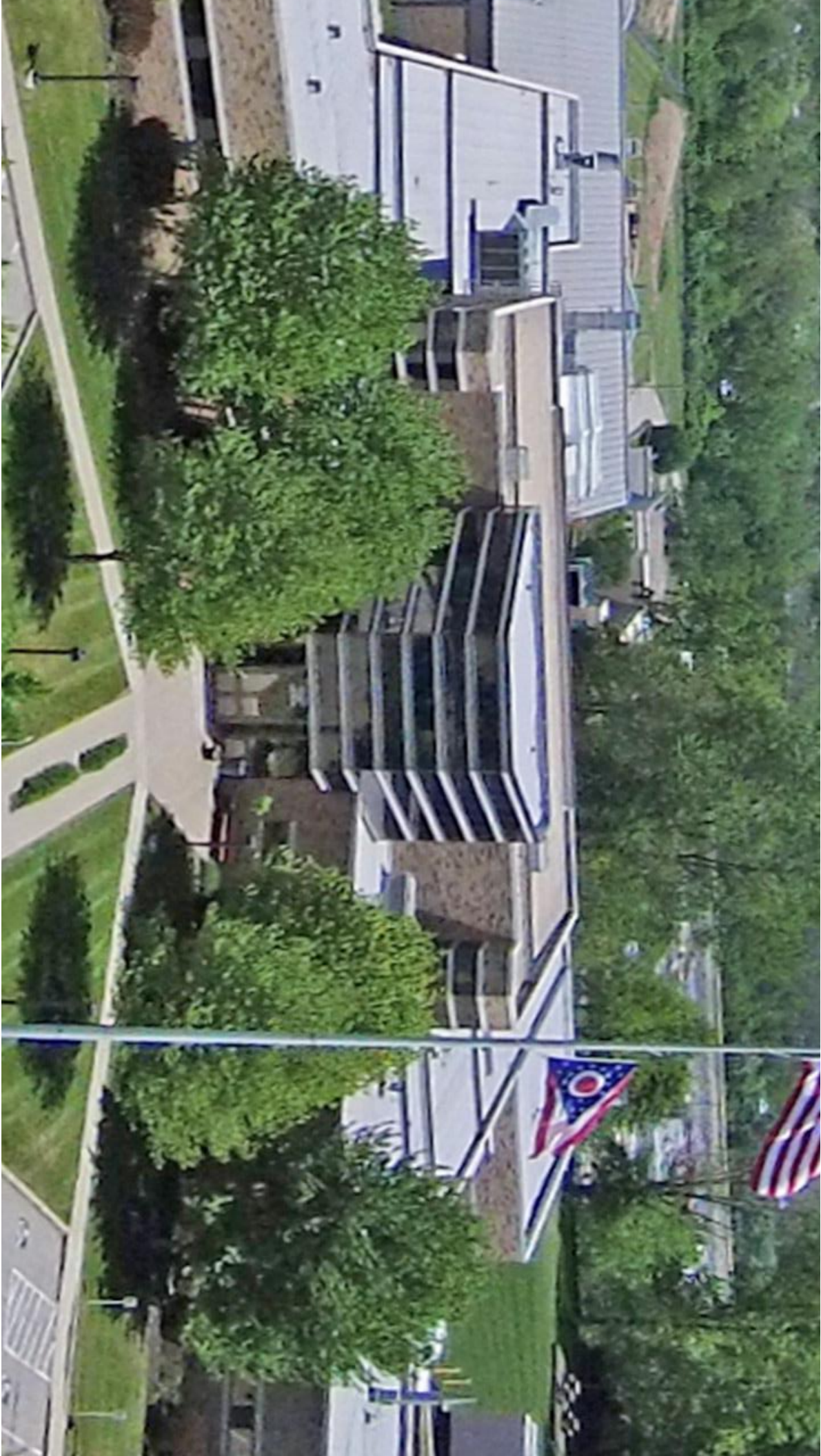


- 2 types generally available:
 - Using large bottles of mineral water
 - Plumbed-in units
- Legionella is not reported to be a problem with water bottle coolers, usually work outside “critical temperature range”,
- 1 reported instance of Legionella bacteria being isolated from Activated Carbon filters in a plumbed-in unit in New Zealand – replace as recommended by manufacturer.

Legionella Testing

Testing Information:

Testing water for the presence of *Legionella* bacteria is reliably accomplished by culture in an accredited microbiology laboratory using well-characterized and validated methods. The most pathogenic (disease-causing) strain of *Legionella* bacteria is *Legionella pneumophila* group.





Contact at NEORSD for Legionnaires' Testing

Sheela Agrawal, Ph.D.

QA/QC Specialist

NEORSD Analytical Services

4747 E. 49th St

Cuyahoga Heights, OH 44118

agravals@neorsd.org

216 641 6000, ext. 2451



Legionella Action Levels (Best Practice) Potable Water

Colony Forming Units

Level	CFU/mL	Recommended Action
1	Non-Detect	» Acceptable control. No remedial action required
2	10 or less	» Immediately implement corrective action by flushing affected outlets or systems; or take other precautions. » Immediately review treatment program and risk assessment to develop remedial risk management plan.
3	More than 10 and up to 100	» Immediately implement corrective action by flushing affected outlets or systems; cleaning; biocide treatment; or take other precautions
4	More than 100	» Take prompt action to prevent employee exposure. » Immediately review treatment program and risk assessment to develop remedial risk management plan. Amend risk assessment accordingly and consider additional monitoring. » Immediately implement corrective action by cleaning & disinfecting; superheating; shock dose chlorination; or take other precautions.

Legionella Action Levels (Best Practice)

Cooling Water

Level	CFU/mL	Recommended Action
1	Non-Detect	✓ Acceptable control. No remedial action required.
2	100 or less	✓ Shock dose system with biocide.
3	More than 100 and up to 1,000	✓ Immediately review treatment program and risk assessment to develop remedial risk management plan. ✓ On-line disinfection with biocide plus dispersant.
4	More than 1,000	✓ Take prompt action to prevent employee exposure. Immediately review treatment program and risk assessment to develop remedial risk management plan. Amend risk assessment accordingly and consider additional monitoring. ✓ Off-line cleaning & disinfection with biocide plus dispersant.

Preventing the first case

A *Legionella* water management program routinely consists of:

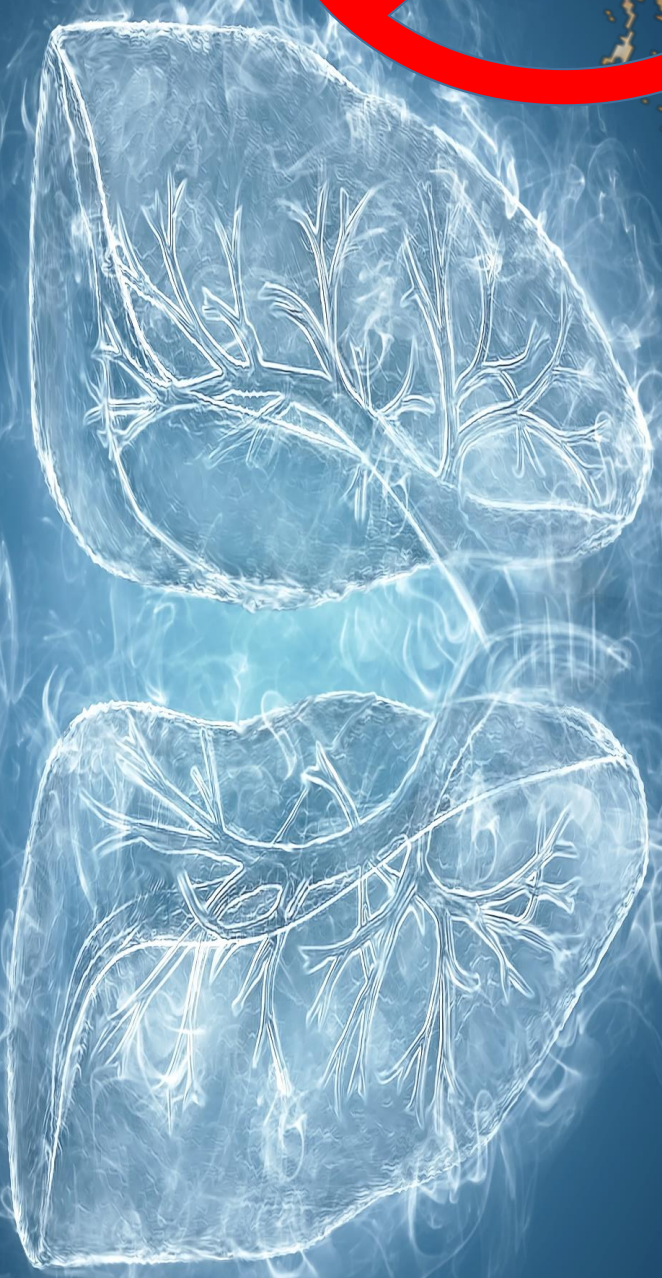
- 1 Establishing a water management program team.
- 2 Describing the building water systems using words and diagrams.
- 3 Identifying areas where *Legionella* could grow and spread.
- 4 Deciding where control measures should be applied and how to monitor them.
- 5 Establishing ways to intervene when control limits are not met.
- 6 Making sure the program is running as designed and is effective.
- 7 Documenting and communicating all the activities.

www.cdc.gov/Legionella/WMPtoolkit

IN SUMMARY



THANK YOU



JEFFERSON /ASHTABULA COUNTY OPERATORS



TO ANSWER PAT



Average person emits 75cc CH₄/Fart
or 0.0025486 Ft³

127Ft³ geg = 49,831 Farts=1 gal. of gas
0.0025486

Google says we average 10 to 20 farts/D
49,831/15 = 3322 days or 9.1 years



Um, uh...hm.

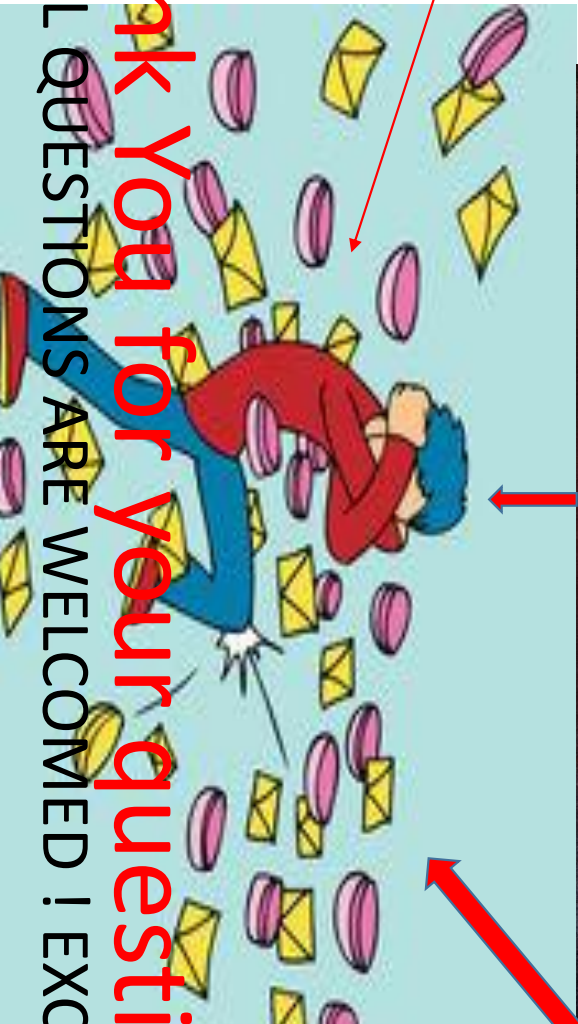


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BACKFLOW PREVENTER



**To Be Accurate Pat !!!!!
You May Have More Octane?**

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Thank You for your question PAT
ALL QUESTIONS ARE WELCOMED ! EXCEPT Pat's