NC STATE UNIVERSITY

Drinking Water Treatment Seminar
Leesville Middle School

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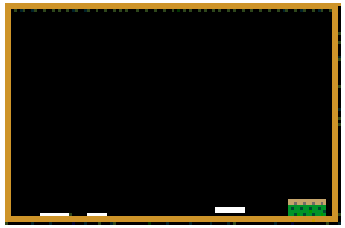
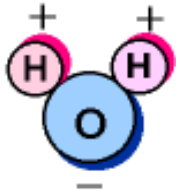
Importance of water





- *Looking at water, you might think that it's the most simple thing around.*
- *Pure water is colorless, odorless, and tasteless.*
- *But it's not at all simple and plain and it is vital for all life on Earth.*
- *Where there is water there is life, and where water is scarce, life has to struggle or just "throw in the towel."*

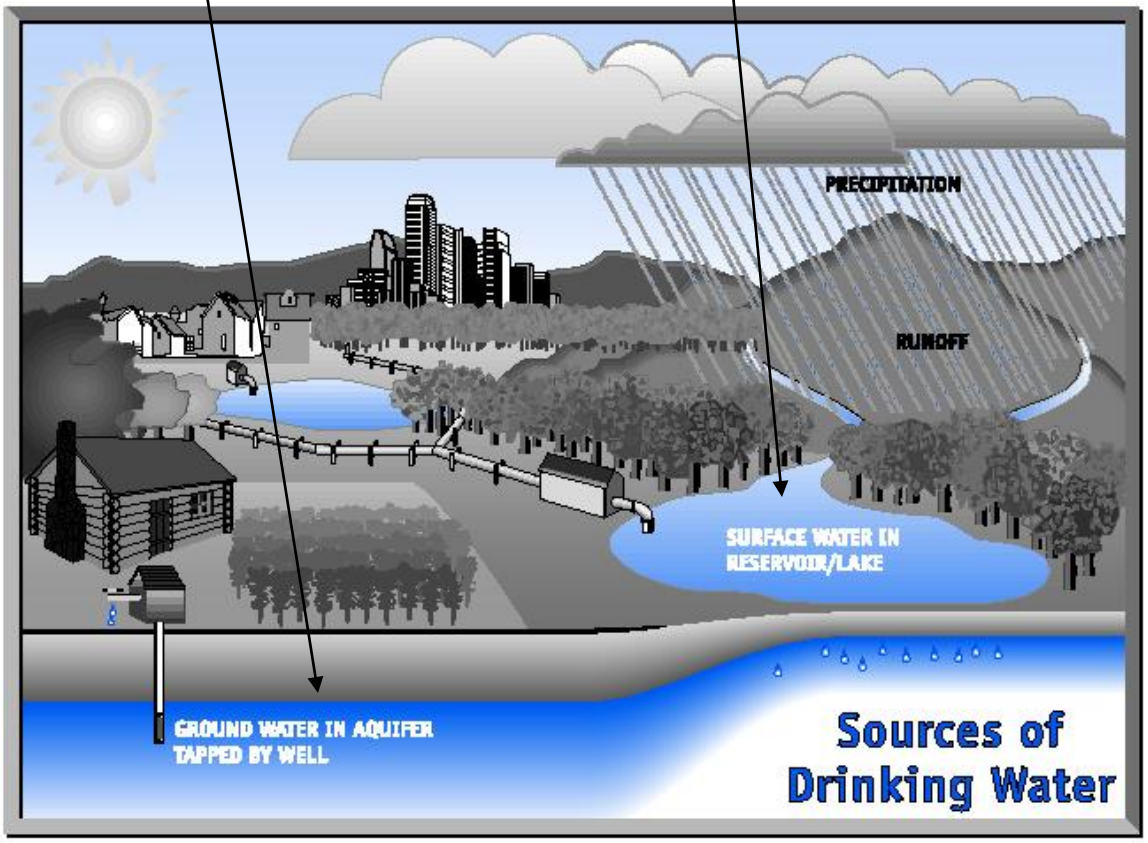
"Water is life"

SO WHAT IS IT ABOUT WATER THAT MAKES IT SO IMPORTANT TO US?

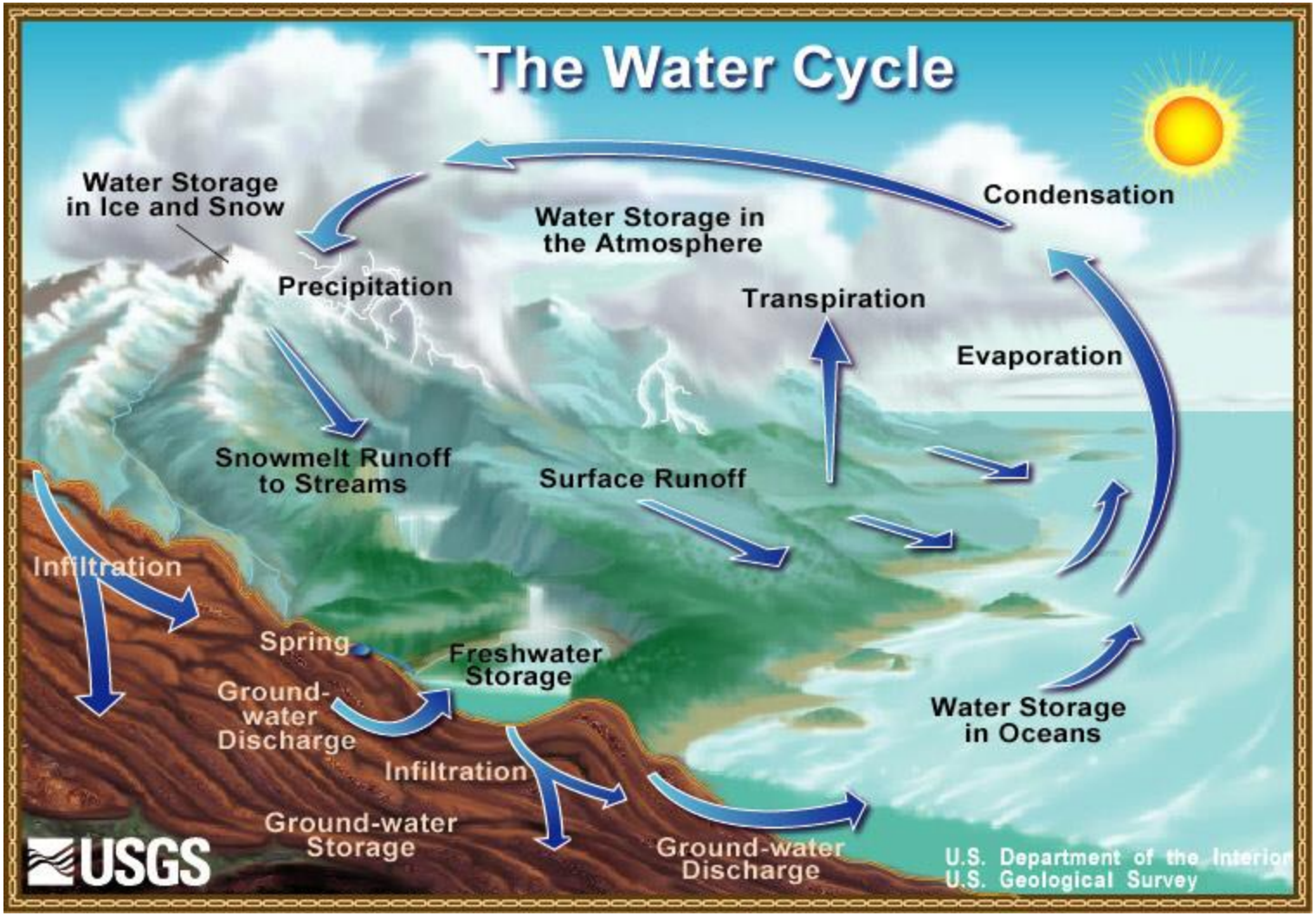
- *Water is of major importance to all living things.*
- *Up to 60 percent of the human body is Water.*
- *Therefore the quality of Water we drink is very important.*
- *The Drinking Water should be totally clean, pure and free of any disease causing MICROBES, and that's why it should be properly Treated and DISINFECTED before using it for drinking purpose.*

Where does the water come from?

- surface waters (lakes, rivers, and reservoirs)
- groundwater (wells).



The Water Cycle

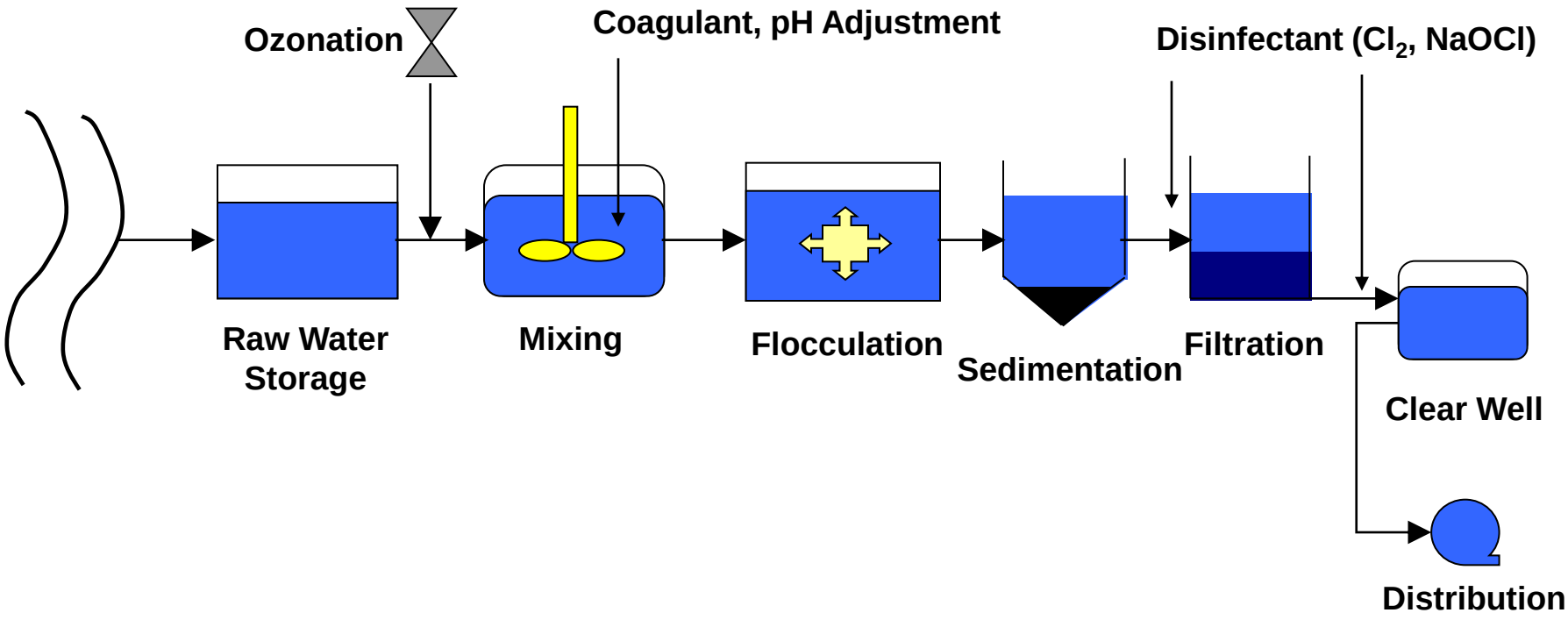


Drinking water in U.S.

- The United States has one of the safest water supplies in the world.

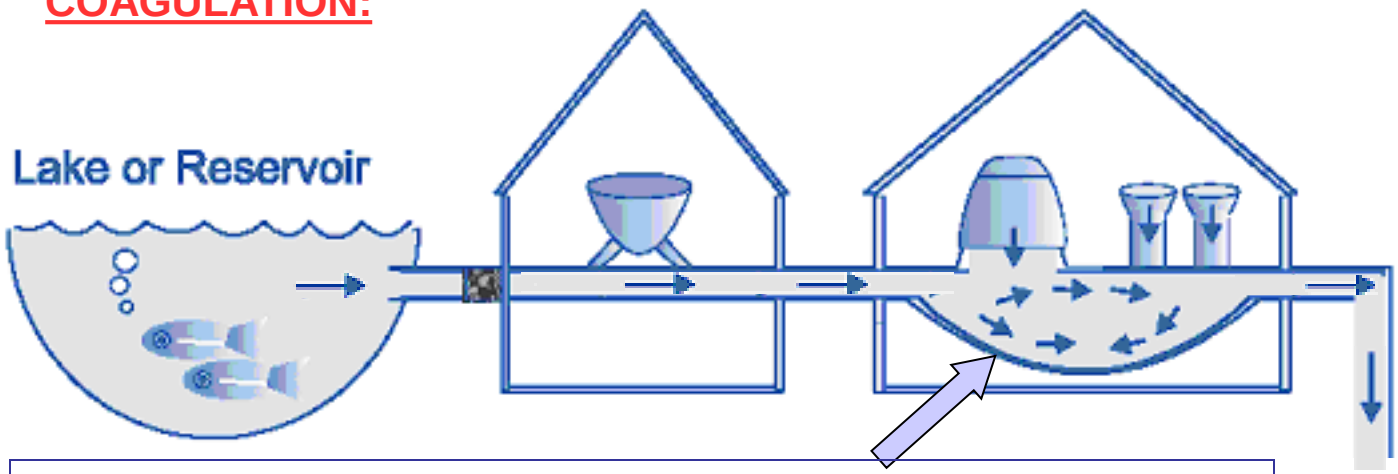
- In recent years, microbial contamination of the water supply has led to highly publicized outbreaks of disease, causing illness and even death.
- How safe is our water?
  - Where do these infectious microbes come from?
  - How is water treated now and what's being done to make it even safer?

Surface Water Treatment Plant



Water Treatment

- ***Water treatment transforms raw surface and groundwater into safe drinking water.***
- ***Water treatment involves two major processes: physical removal of solids and chemical disinfection.***
- **COAGULATION:**



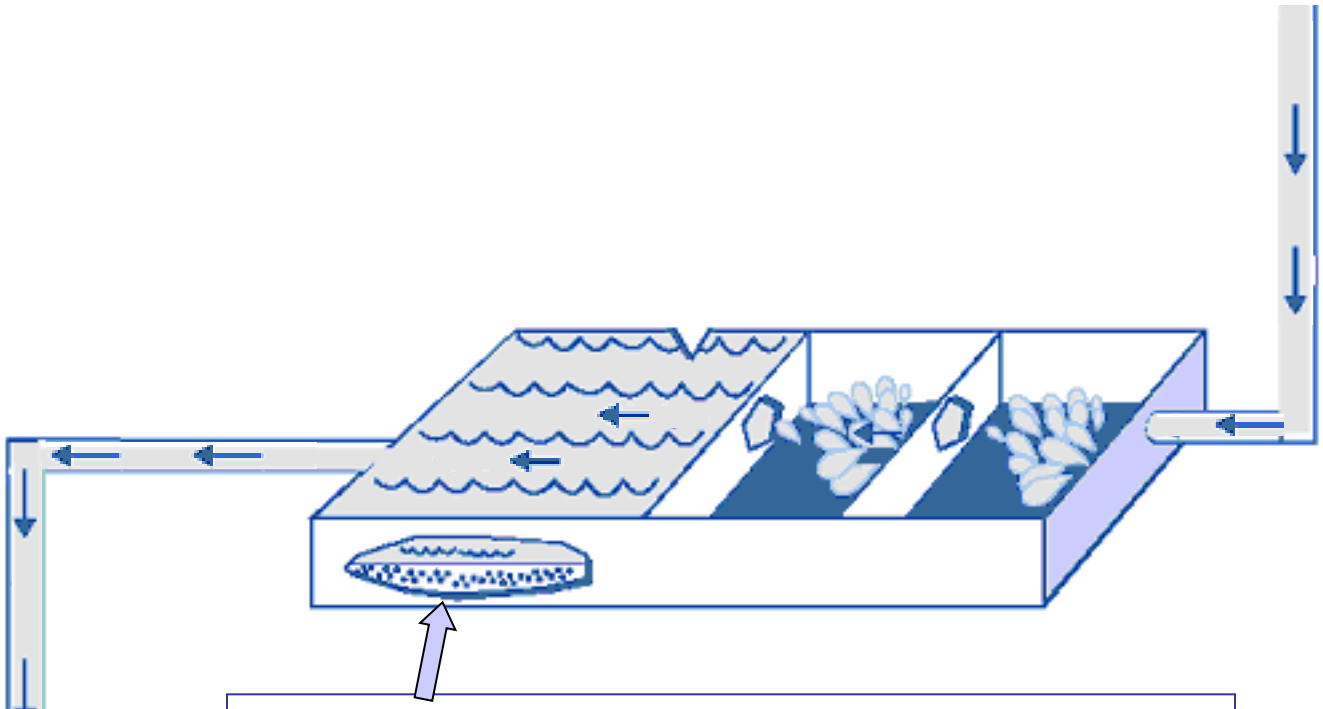
Coagulation removes dirt and other particles suspended in water. alum and other chemicals are added to water to form tiny sticky particles called "floc" which attract the dirt particles. The combined weight of the dirt and the alums (floc) becomes heavy enough to sink to the bottom during sedimentation.

WATER TOWARDS SEDIMENTATION


NO
SMOKING

Water Treatment

- **SEDIMENTATION:**



Coagulated particles fall, by gravity, through water in a settling tank and accumulate at the bottom of the tank, clearing the water of much of the solid debris and clear water moves to filtration.

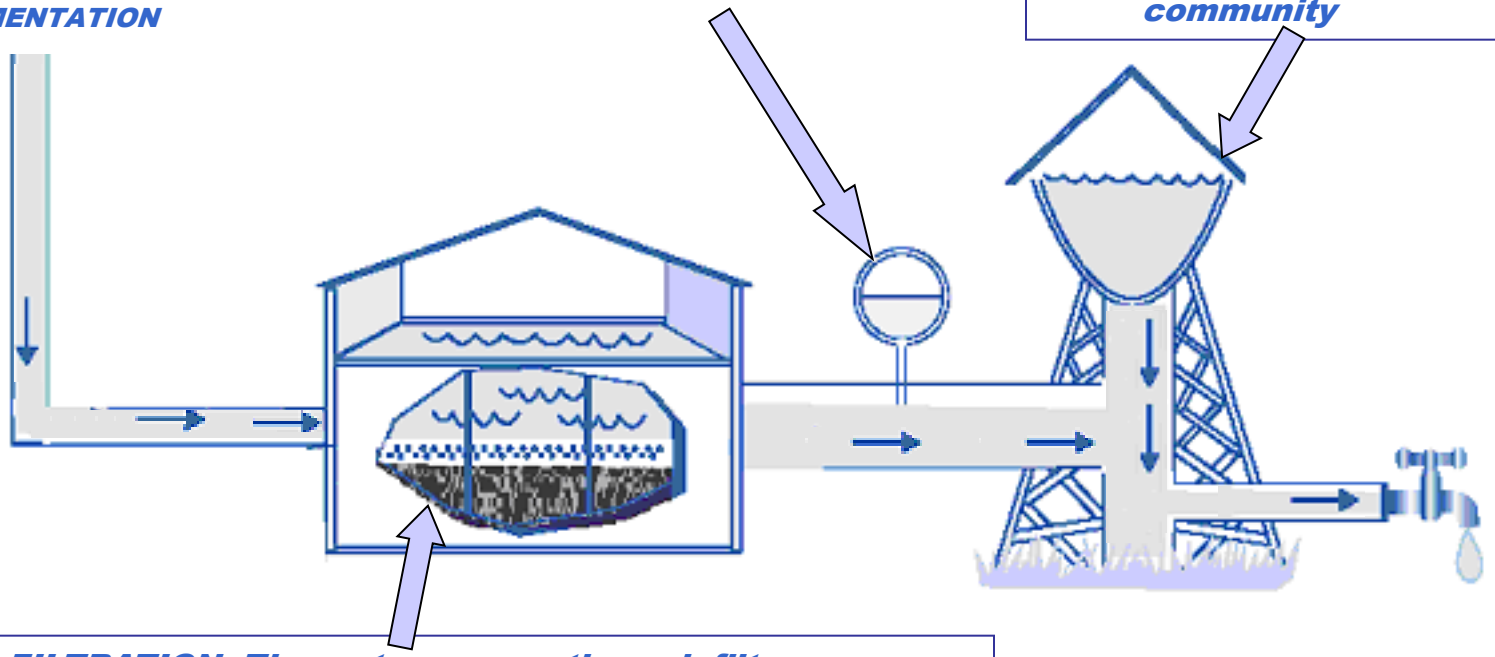
Water Treatment

FILTRATION, DISINFECTION & STORAGE:

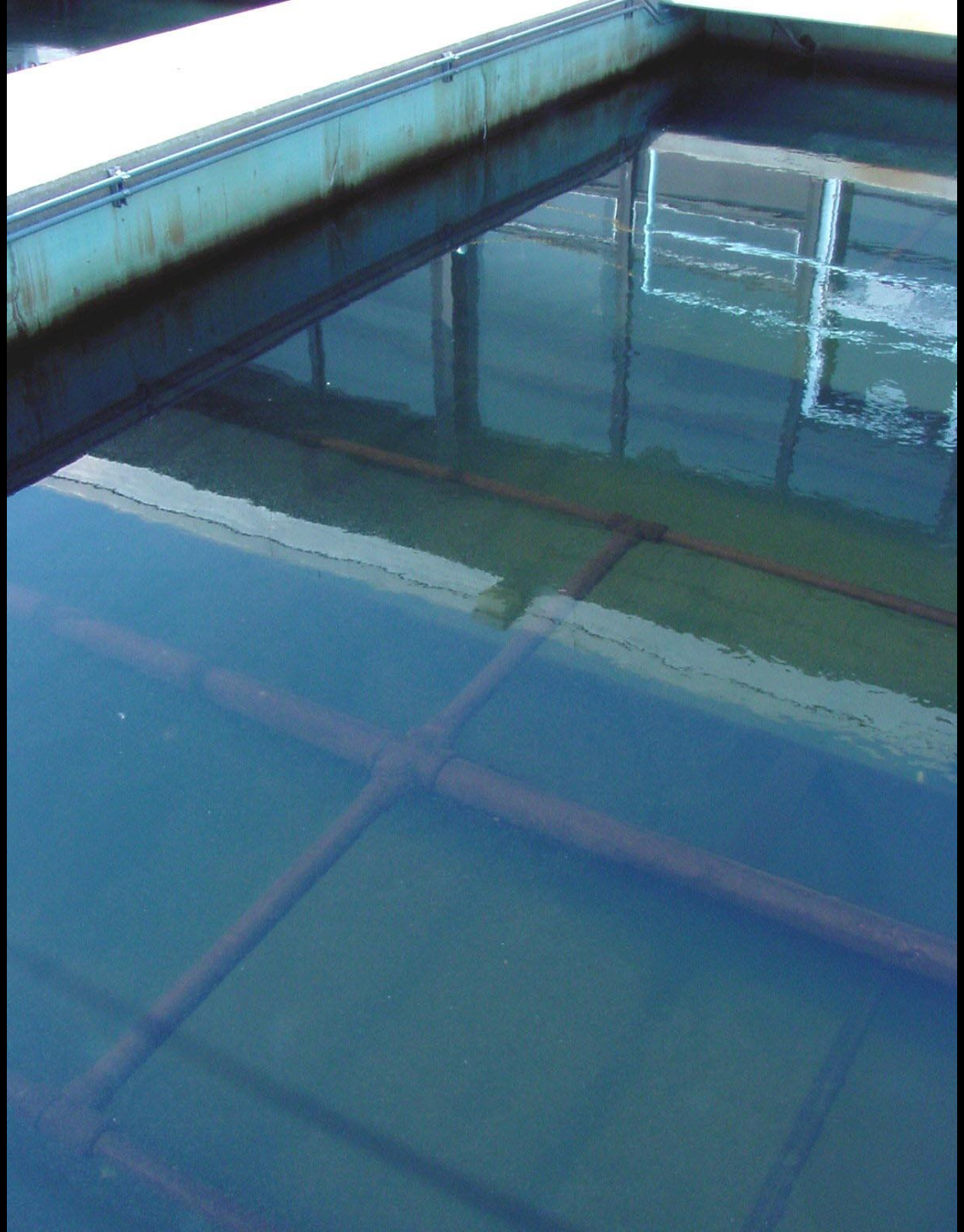
STORAGE: Water is placed in a closed tank or reservoir for disinfection to take pace. The water then flows through pipes to home and business in the community

DISINFECTION: A small amount of chlorine is added or some other disinfection method is used to kill microorganisms that may be in the water.

WATER FROM SEDIMENTATION



FILTRATION: The water passes through filters, some made of layers of sand, and charcoal that help remove smaller particles.



Water Disinfection

- ***Purpose of disinfection:***
  - ***To make Drinking water free of any disease causing bacteria and microbes.***

- **Methods of disinfection:**
  - ***There are 3 mainly used disinfection methods at large scale.***
    - ***CHLORINATION***
    - ***OZONATION***
    - ***ULTRAVIOLET RADIATION***

CHLORINATION

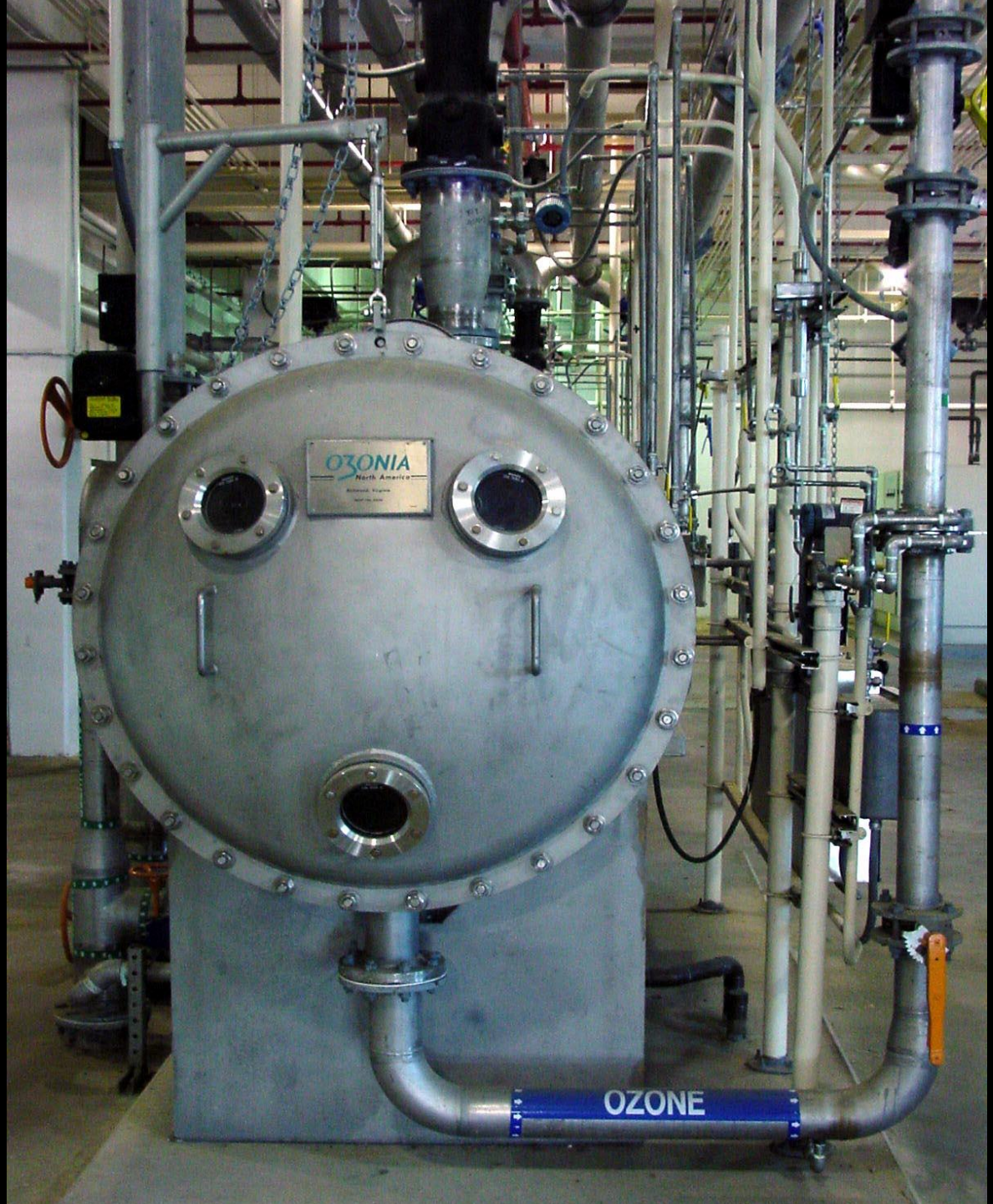
- ***Chlorine is the most common cost-effective means of disinfecting water in the U.S.***
- ***The addition of a small amount of chlorine is highly effective against most bacteria, viruses, and protozoa.***
- ***But cysts (durable seed-like stages) formed by parasitic protozoa such as Cryptosporidium and Giardia can survive chlorine.***
- ***Chlorine is applied to water in one of three forms: elemental chlorine (chlorine gas), hypochlorite solution (bleach), or dry calcium hypochlorite. All three forms produce free chlorine in water***


PUMP 4

OZONATION

- ***OZONE is Strongest oxidant/disinfectant available.***
- ***More effective against microbes than chlorination.***
- ***But, costly and difficult to monitor and control under different condition.***

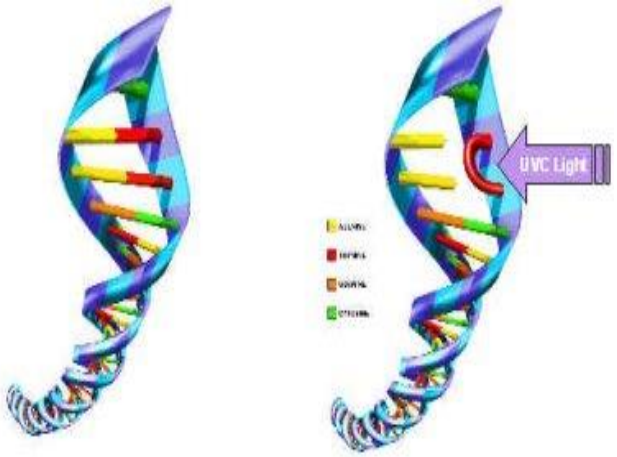
- **Ozonation process:**
  - ***Ozone (o3) is generated on-site at water treatment facilities by passing dry oxygen or air through a system of high voltage electrodes.***


OZONIA
North America
OZONE

ULTRAVIOLET RADIATION

- When UV radiation penetrates the cell wall of an organism, it damages genetic material, and prevents the cell from reproducing

- Now a days emerging technology made UV radiation to find a place in both household and large scale drinking water disinfection.

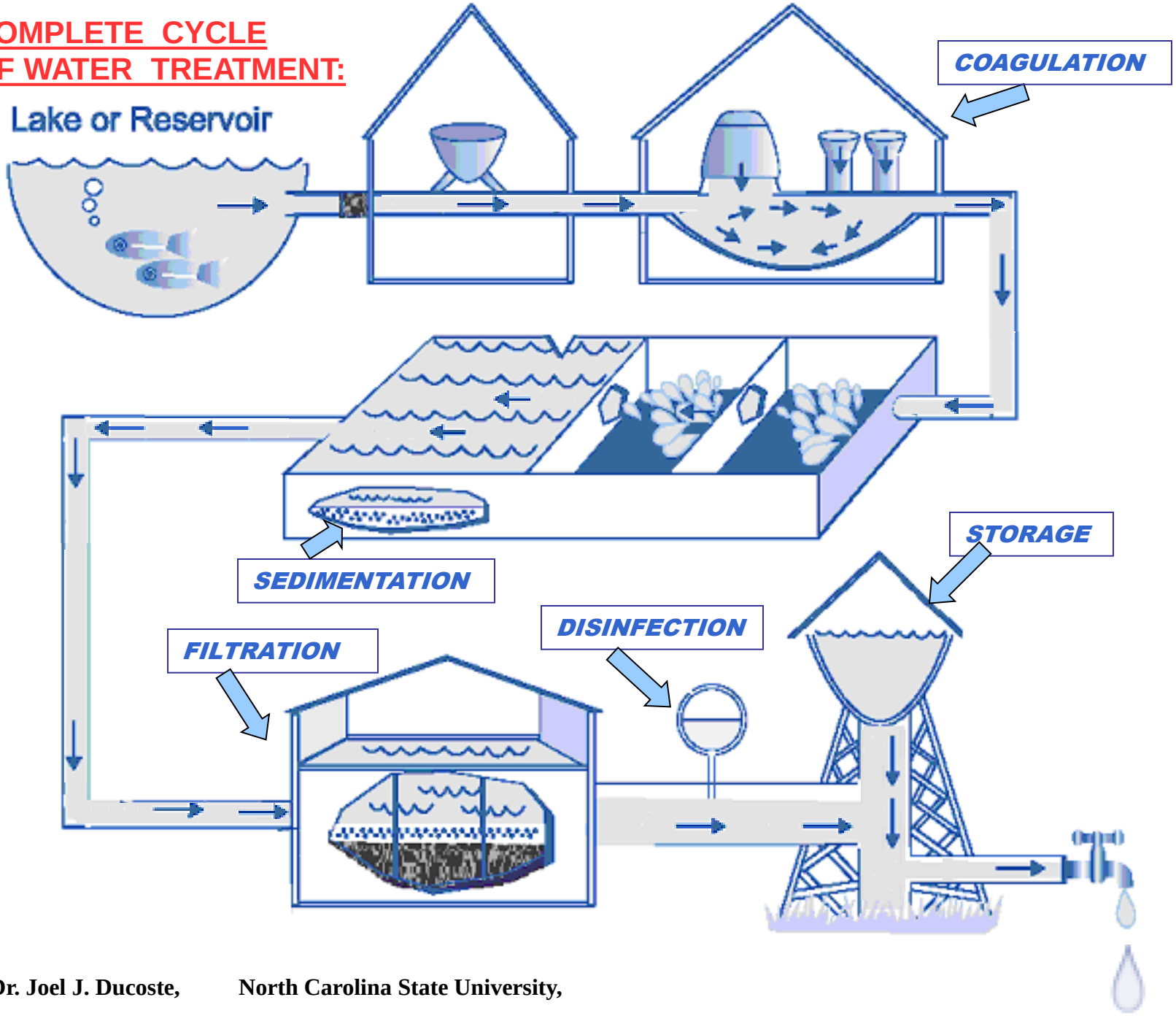


- How is UV light generated?

- Ultraviolet light is most typically generated from a low pressure or a medium pressure lamp generating UV light.

ULTRAVIOLET RADIATION

COMPLETE CYCLE OF WATER TREATMENT:



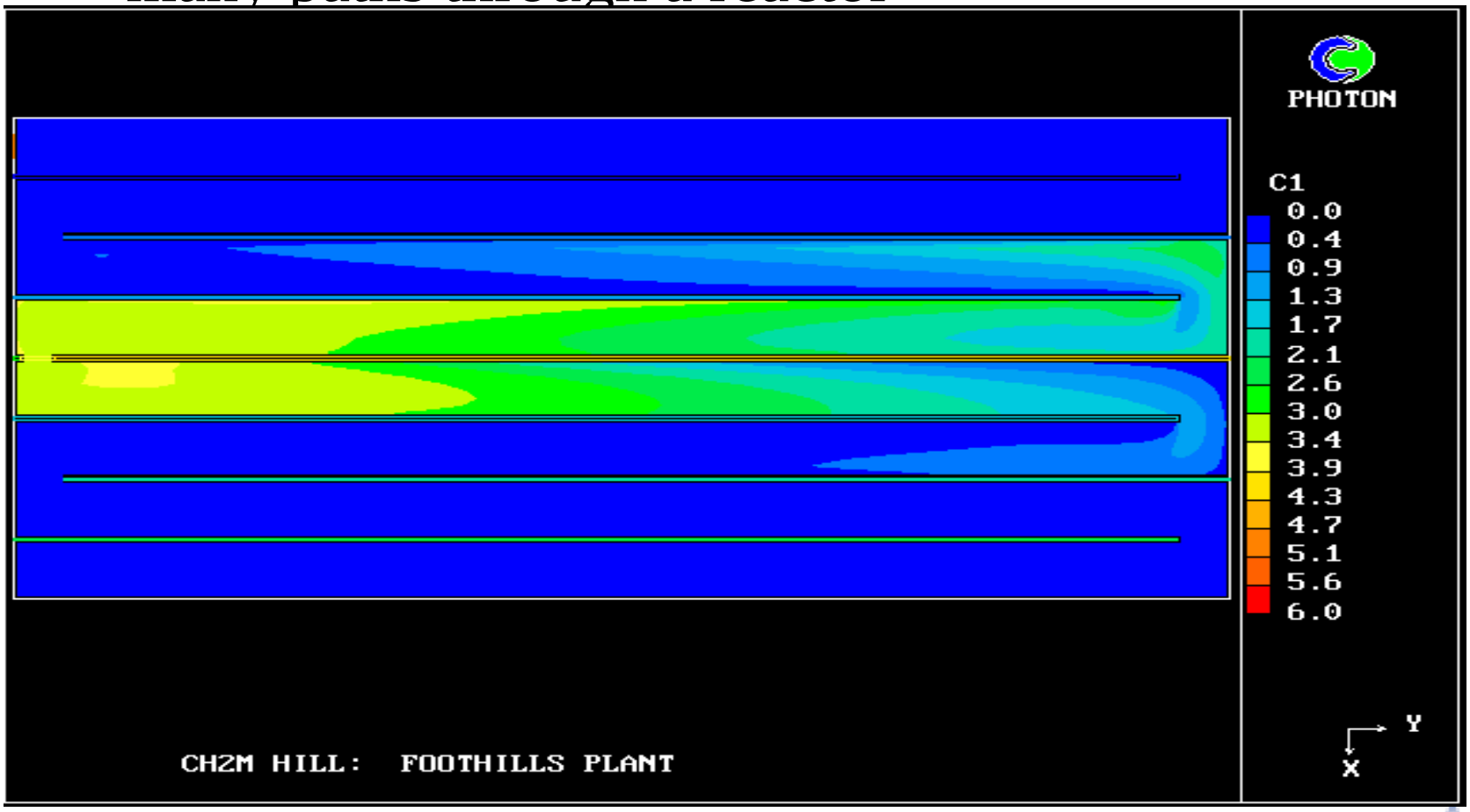
Dr. Joel J. Ducoste, North Carolina State University,

Design of a Chlorination Process

- Based on exposing a microorganism for an amount of time with a minimum amount of disinfectant
- Rough calculation of the amount of time spent in a reactor is based on the reactor volume and the flow rate:
- Time = volume/flow rate

Design of a Chlorination Process

- This is only an average time since water can take many paths through a reactor

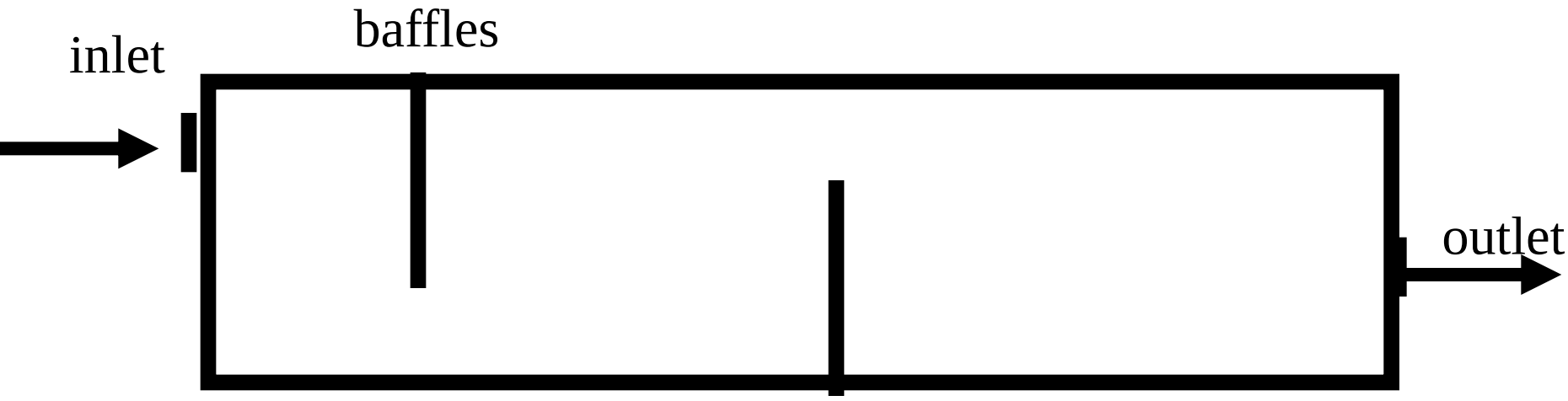


Your job!

- Design a chlorine contactor
  - Shape: must be rectangular
  - Size: must be less than 120 m^2: Cost is \$300/m^2
  - May include baffles: cost of baffles are \$50/m
    - Baffles are 0.3 m wide, length is up to the design team
  - Must have 1 inlet and 1 outlet placed anywhere on the reactor border
    - Inlet and outlet width is 0.25 m
    - Depth is set at 1 m
  - Speed of water = 0.25 to 0.75 m/s
    - Total flow (MGD) = speed of water * inlet width*depth*22.8
    - You need to supply at least 2 MGD
  - Next time you will evaluate:
    - Outlet microorganism concentration
    - Cost of design

Your job!

- Example sketch of design



- Make sure to specify all dimensions and location of baffles, inlet, and outlet from bottom left corner