Surface Water Use

Essential Standard 2.4

Evaluate how humans use water.

Learning Objective 2.4.1

Evaluate human influences on freshwater availability

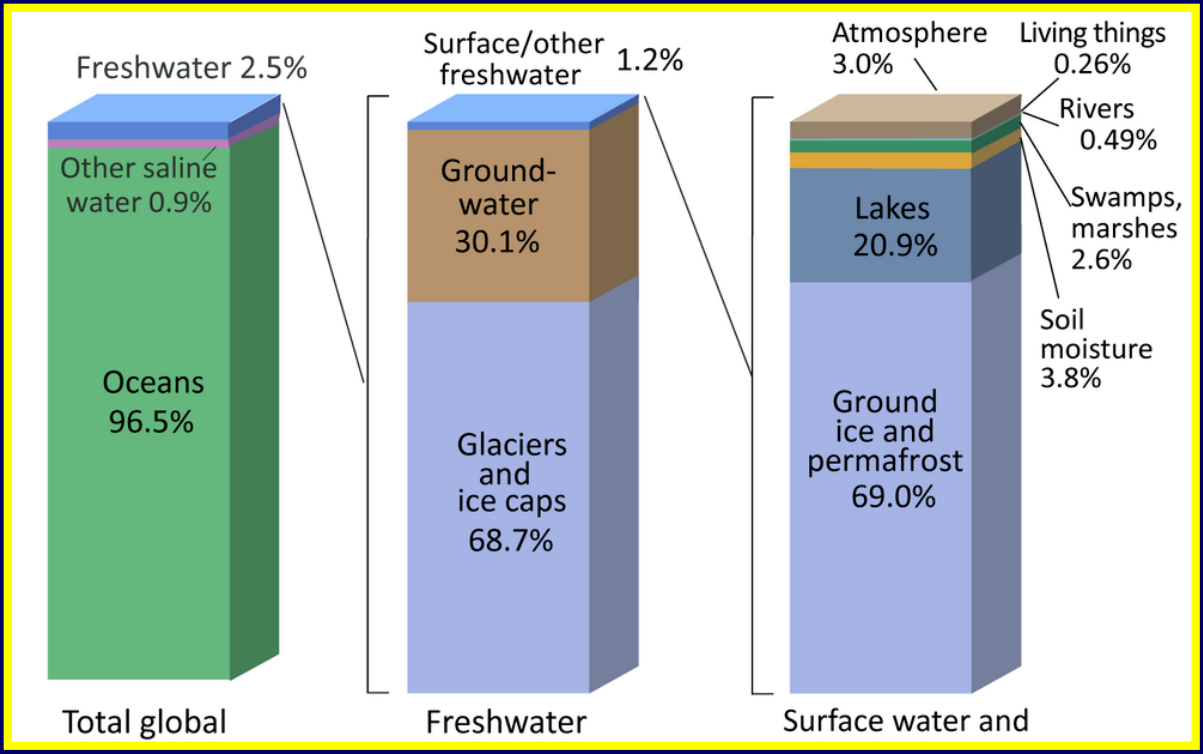
I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can describe how surface water is used for human activities.
- I can explain how surface water is collected and treated before being sent to homes and businesses.
- I can explain how waste water is treated before being released back into streams or lakes.

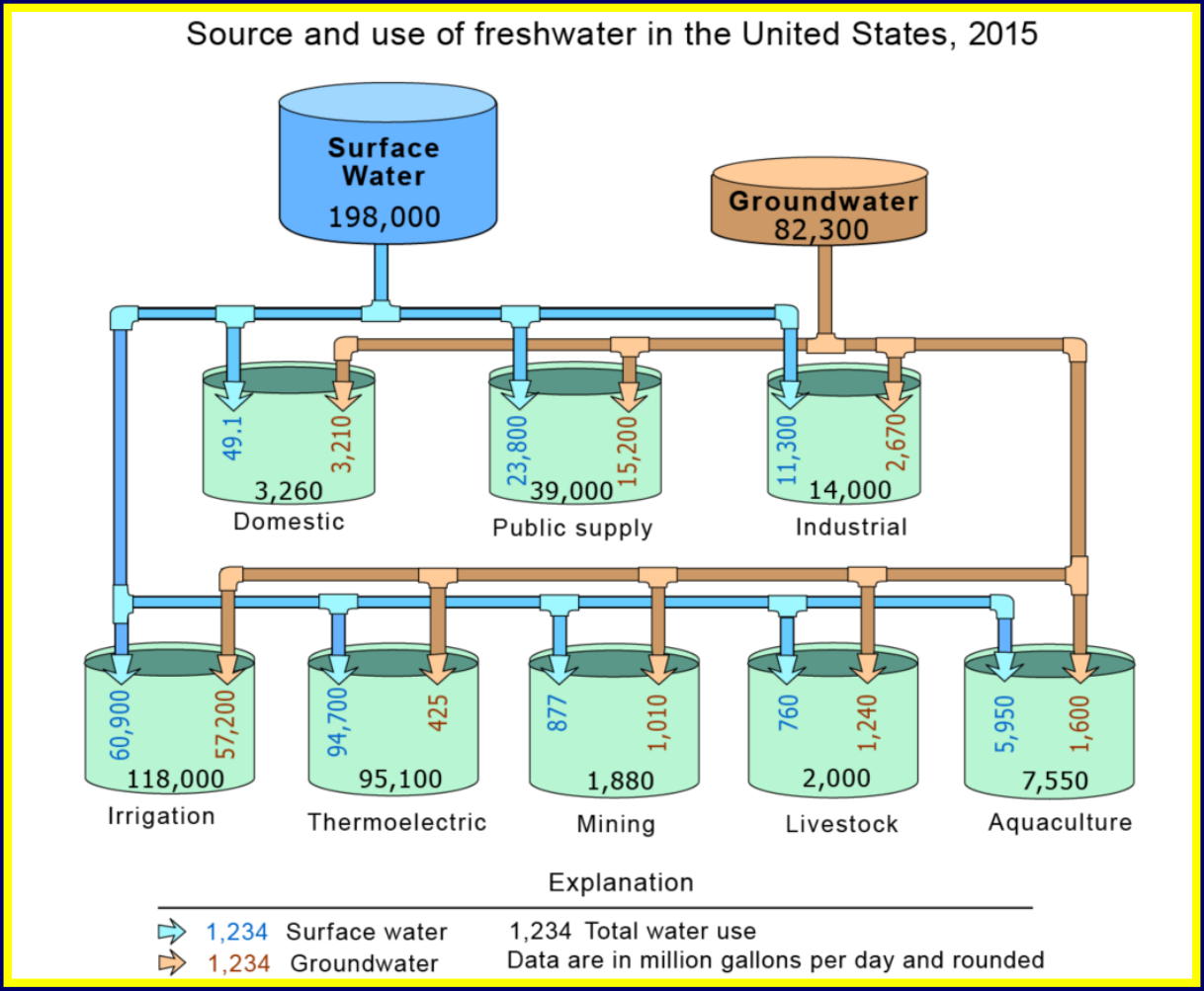
Distribution of Earth's Water

Only 2.5% of Earth's water is freshwater and of that amount, less than 1.2% is surface water. Of that 1.2%, only 21.4% is available for human use.



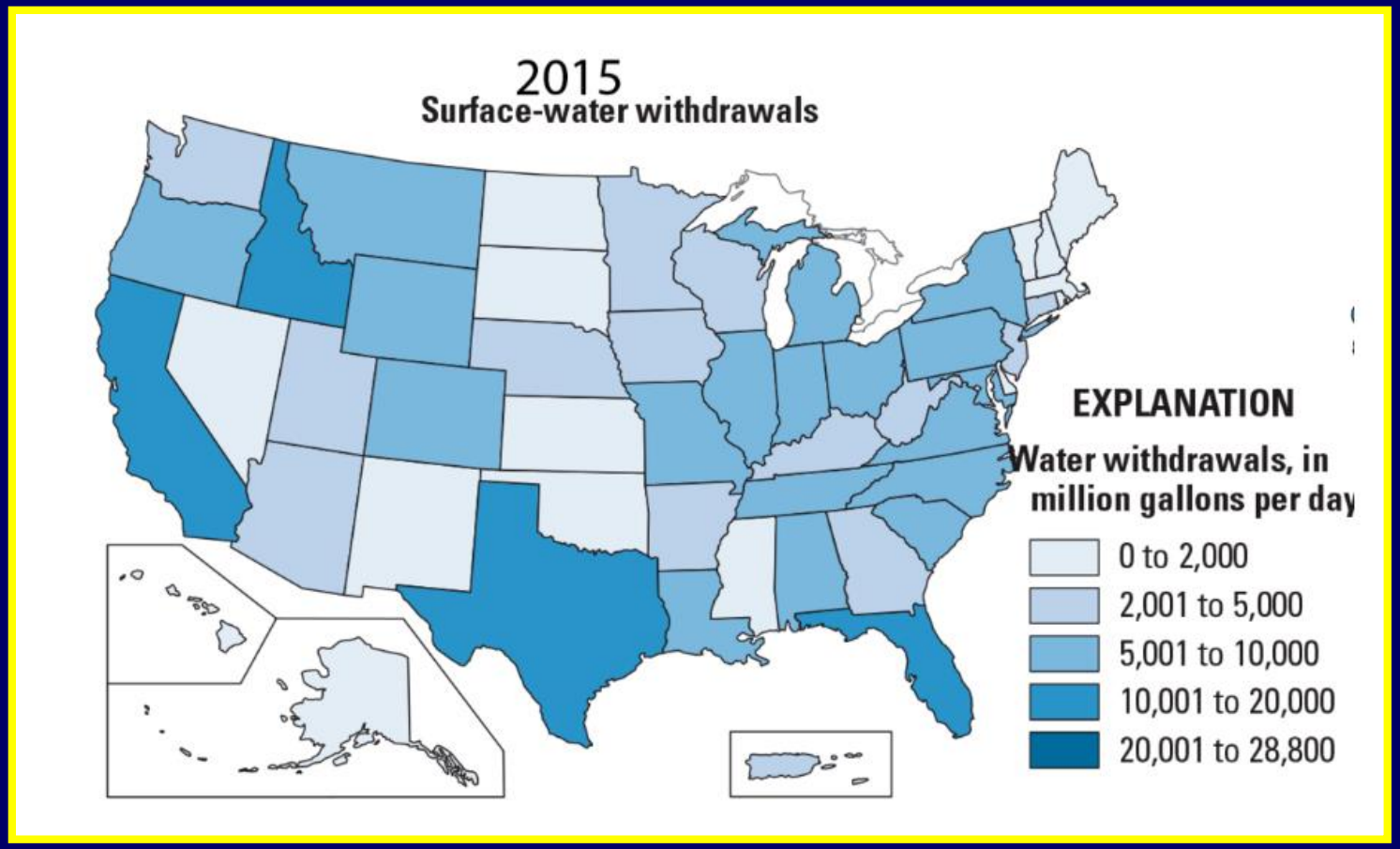
Surface Water Use

About 74% of all the freshwater used in the USA comes from surface Water.



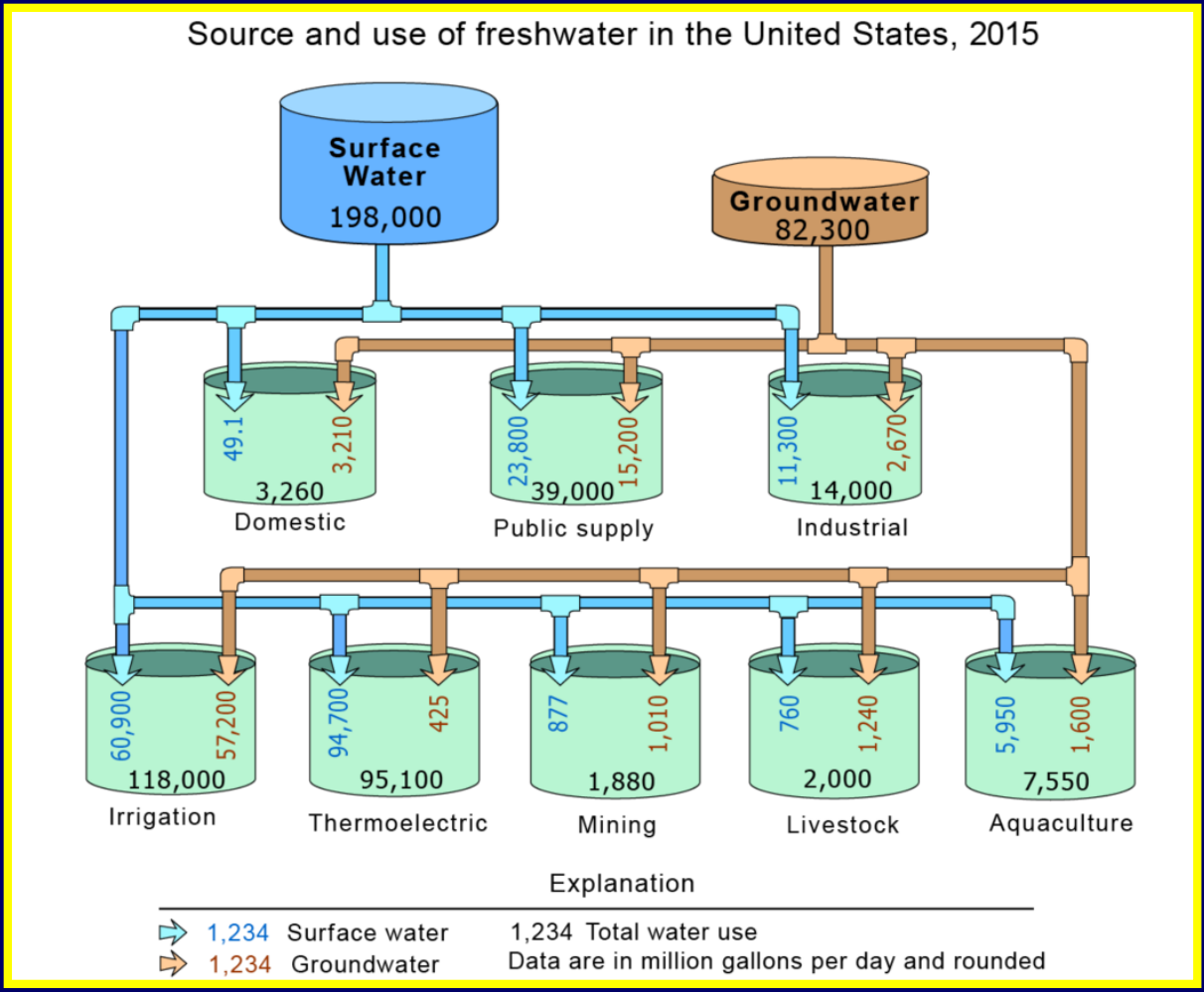
Surface Water Use

California uses the most surface water, followed by Texas, Idaho, and Florida.



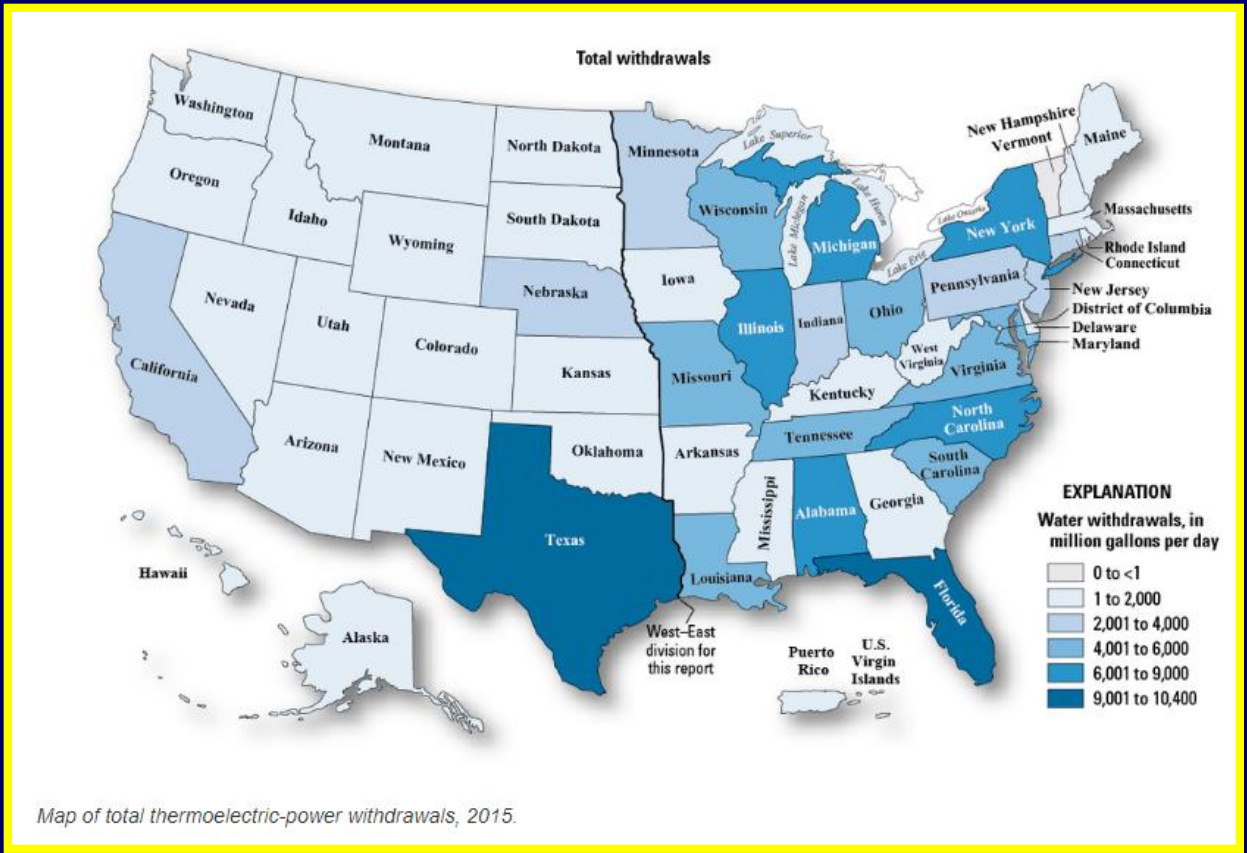
Thermoelectric Power

The most common use of surface water is for thermoelectric power, followed by irrigation.



Thermoelectric Power

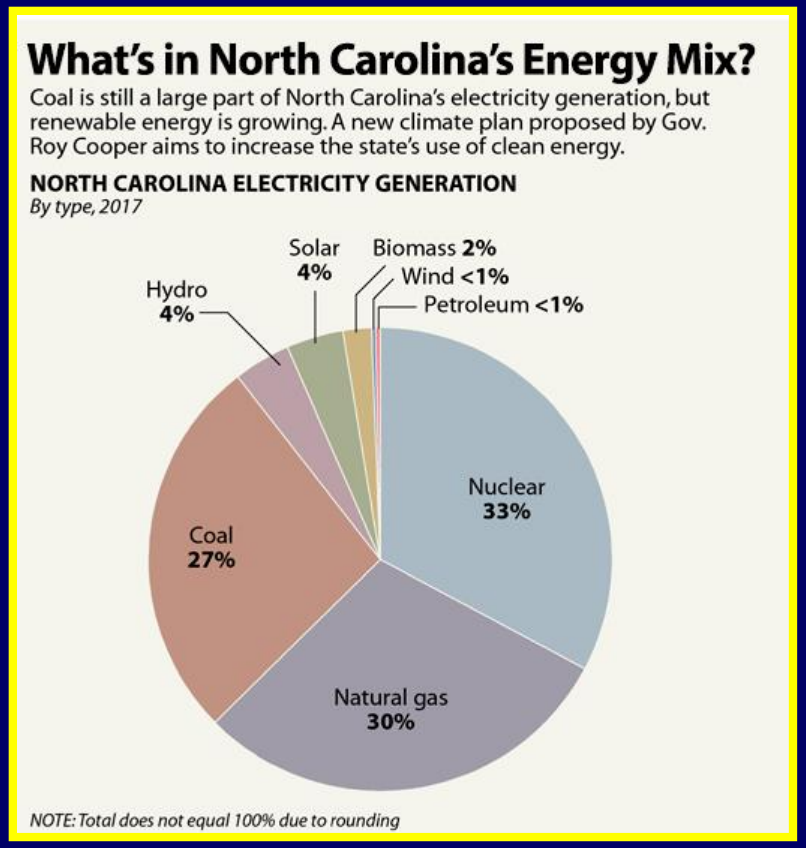
States that use the most water for thermoelectric power are Texas and Florida, but North Carolina is in the top 7 states.



Map of total thermoelectric-power withdrawals, 2015.

North Carolina's Energy Source

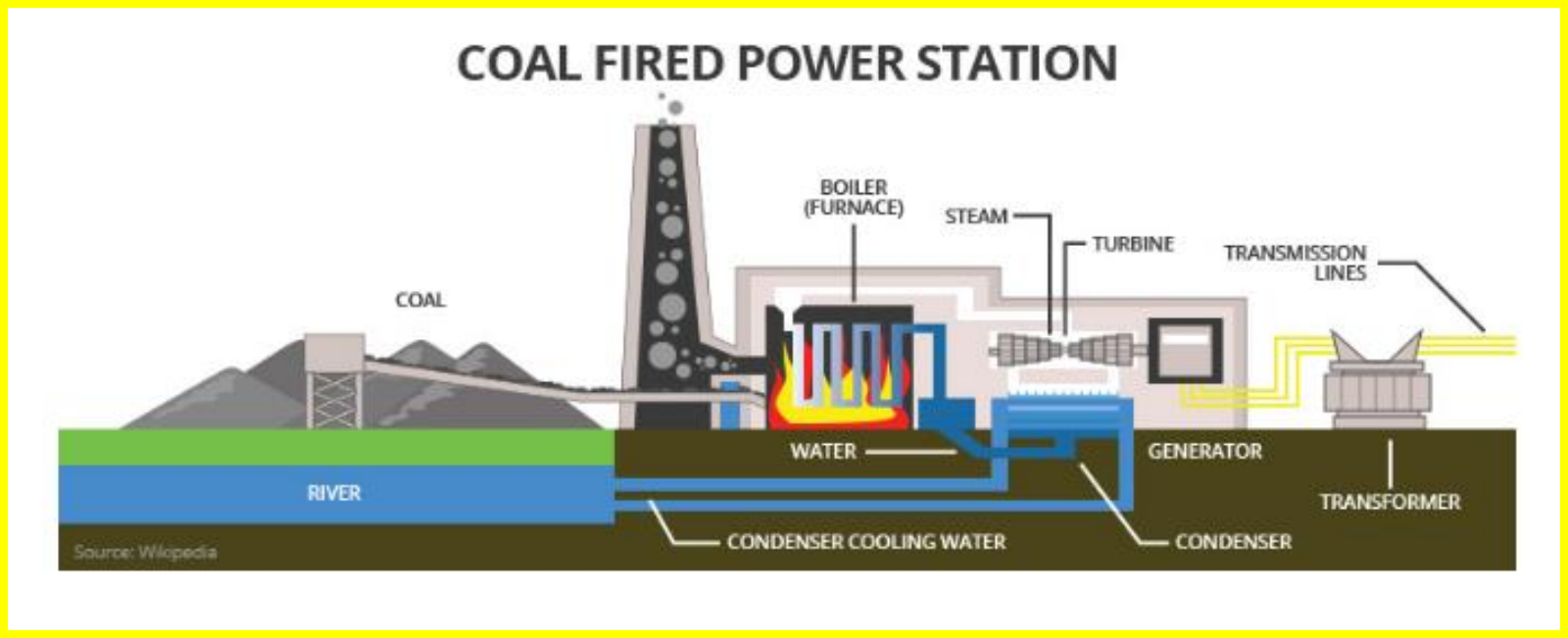
Most of North Carolina's electricity is generated at nuclear power plants, followed by natural gas power plants, and coal burning plants.



These percentages have changed a lot just in the past few years, with North Carolina reducing their dependency upon coal and switching over to more natural gas use.

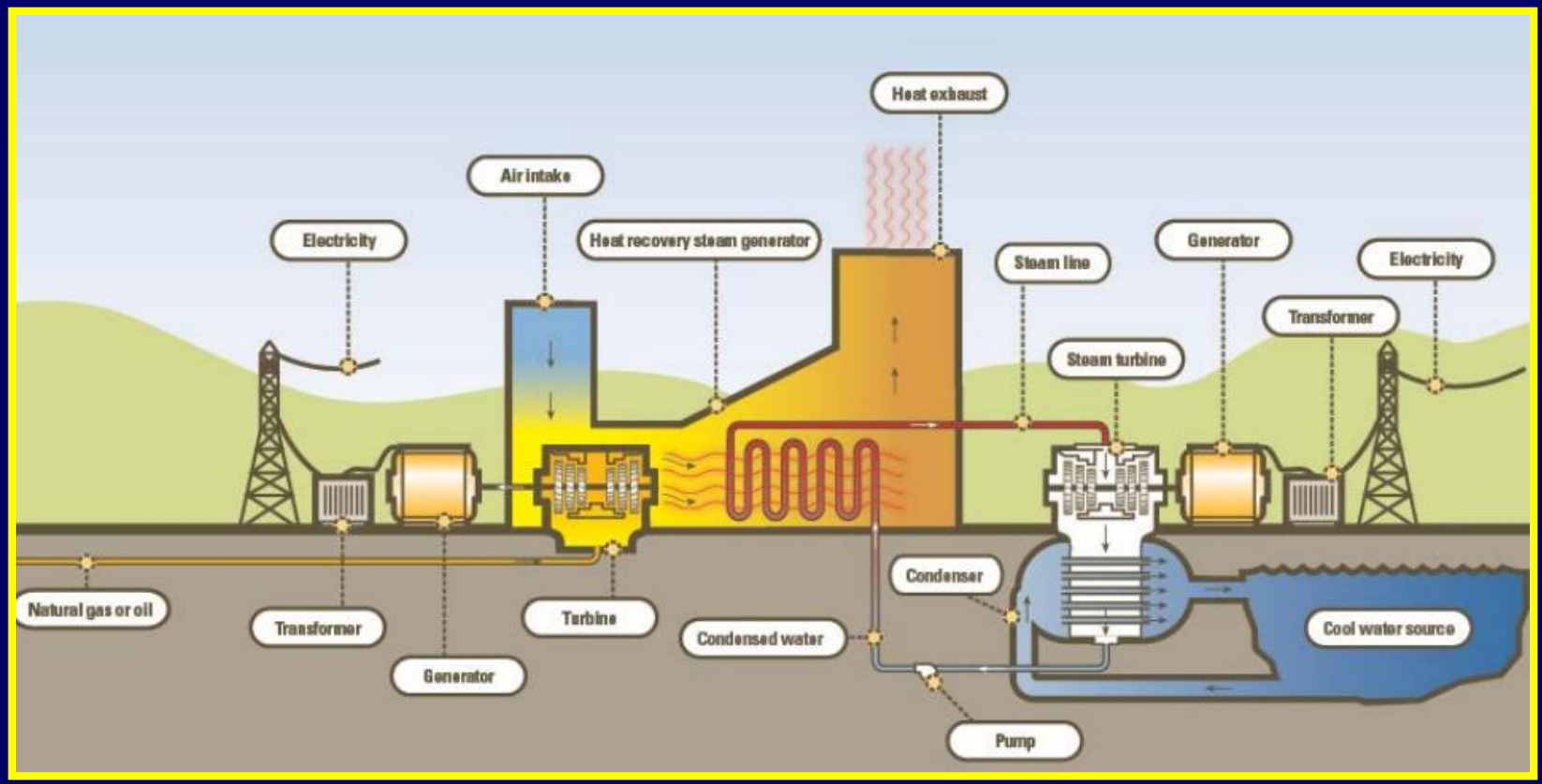
Coal Burning Power Plant

At coal burning electric plants, the coal is burned to turn water into steam. That steam then turns a turbine connected to a large magnet inside a wire coil to generate electricity.



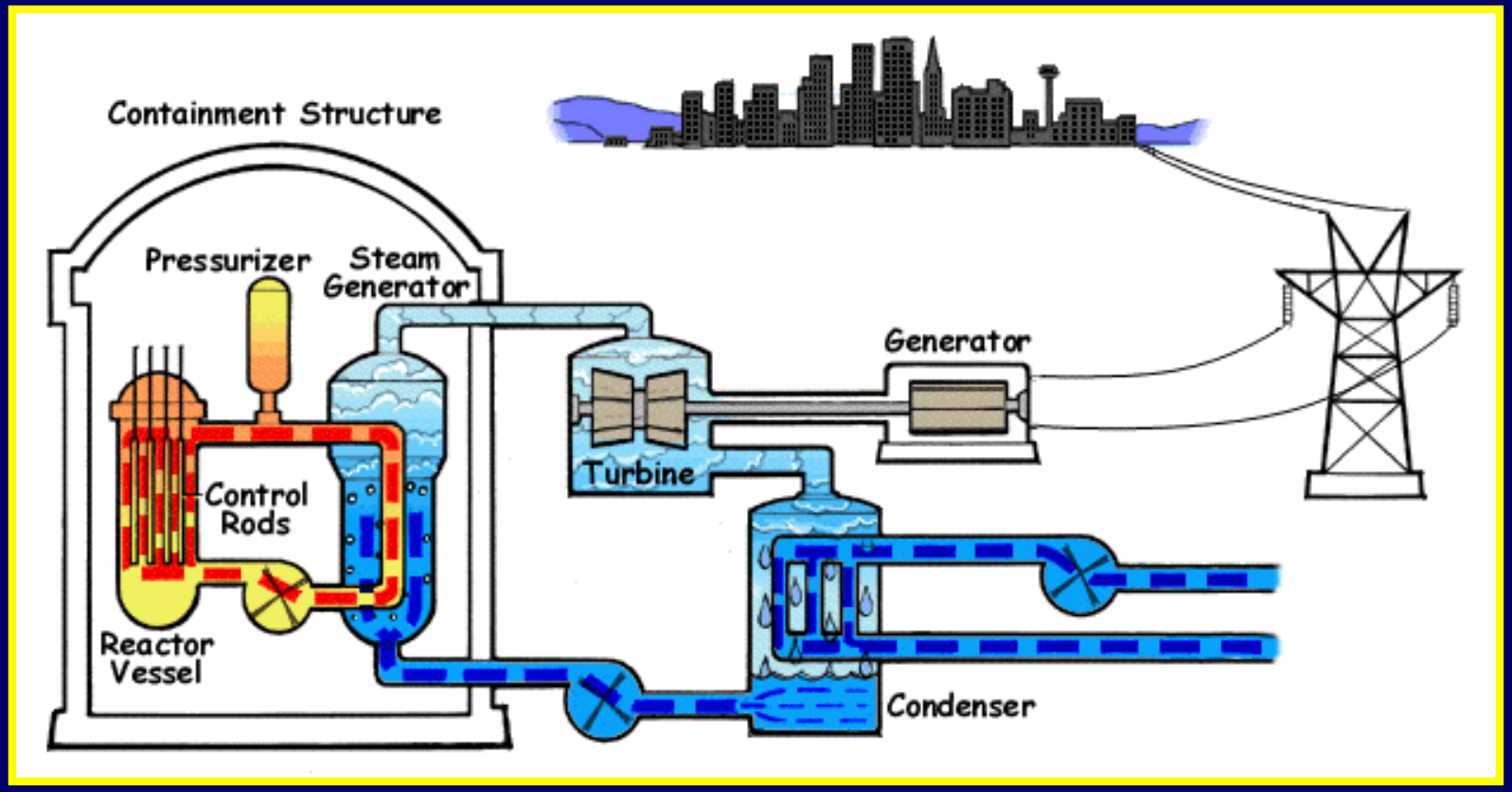
Natural Gas Power Plant

Natural gas power plants are similar to coal burning power plants, except that they burn natural gas to heat the water into steam.



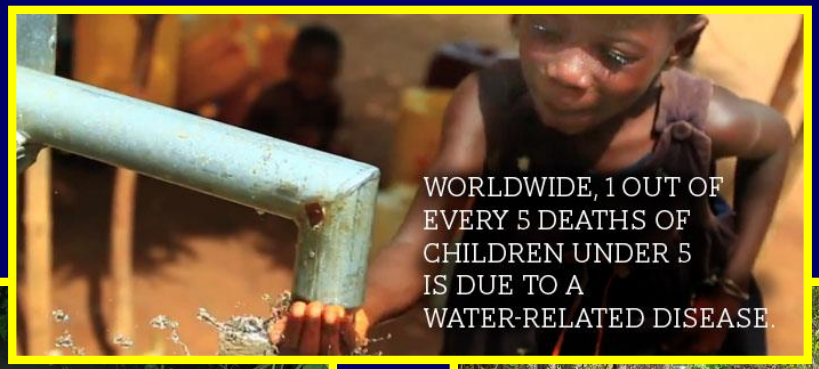
Nuclear Power Plant

At nuclear power plants, the heat released from radioactive materials is used to turn water into steam.



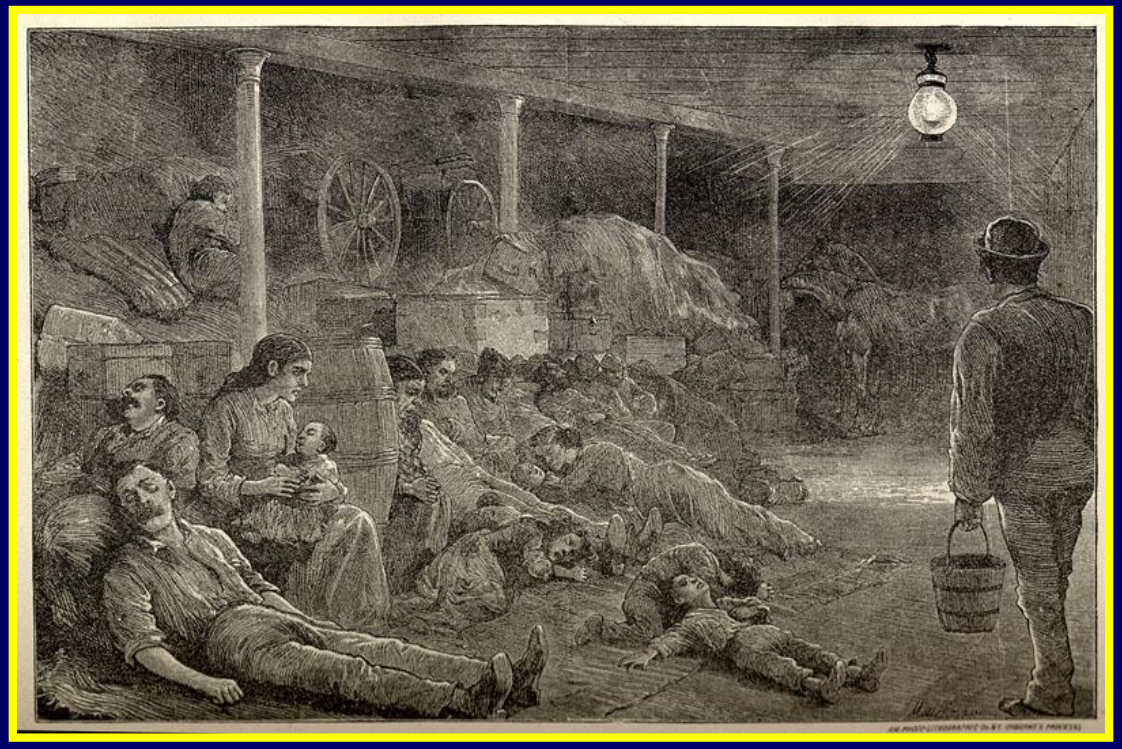
Obtaining Surface Water

Millions of people in developing nations still gather water straight from a stream and use it for drinking water or to cook food in. However, this is not the healthiest choice.



Cholera

In the mid-1800's, cholera epidemics broke out around the world, killing millions of people.

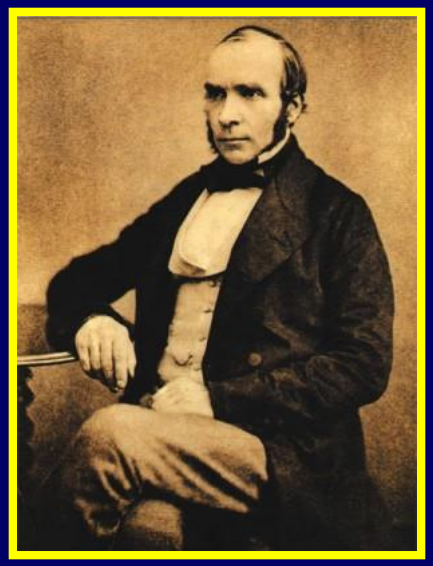


One outbreak in London, England, killed over 10,000 people within a few months.

At the time, cholera was believed to be caused by "bad air".

Dr. John Snow

John Snow, an English surgeon, believed cholera was caused by drinking sewage-contaminated water.



Snow was able to trace all cases of Cholera, within one region of London, to a well, located on Broad street.

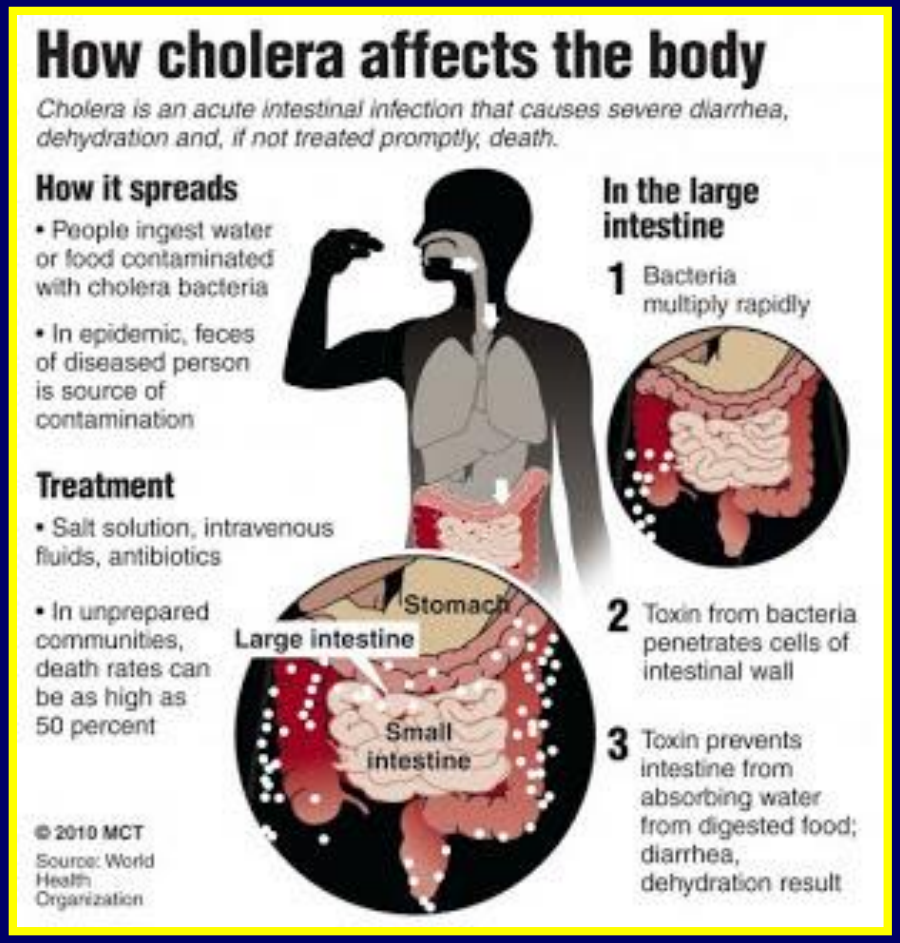
Broad Street Well Pump

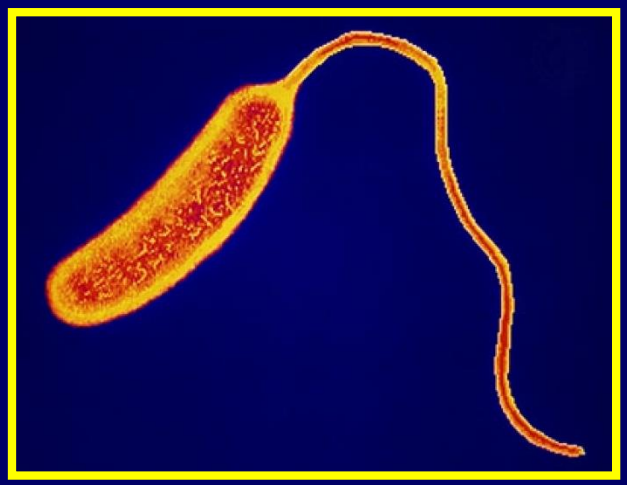
Snow had the handle to the well pump removed and the cases of cholera, near Broad street, decreased dramatically, beginning a new understanding of water-borne diseases.

Although inactive, the pump remains in the same place today in tribute to Dr. John Snow.

Cholera – Water Borne Disease

It is now known that cholera is caused by ingesting food or water containing a bacteria called *Vibrio cholerae*.

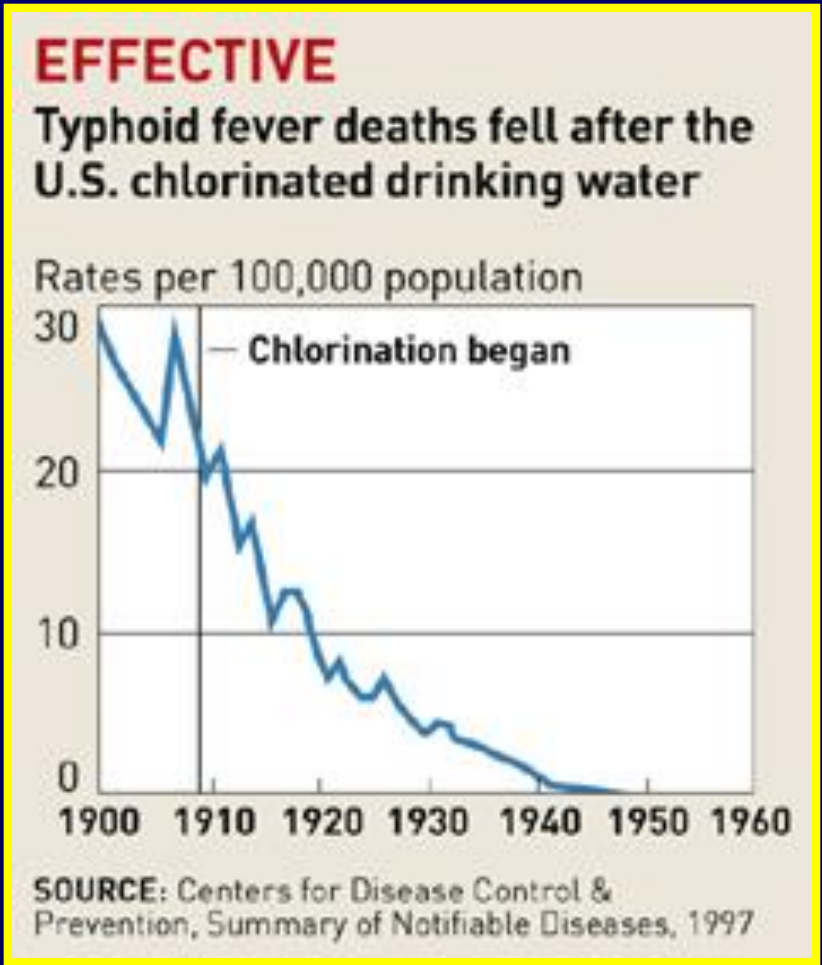




Other lethal water-borne diseases include: typhoid fever, dysentery, and hepatitis A.

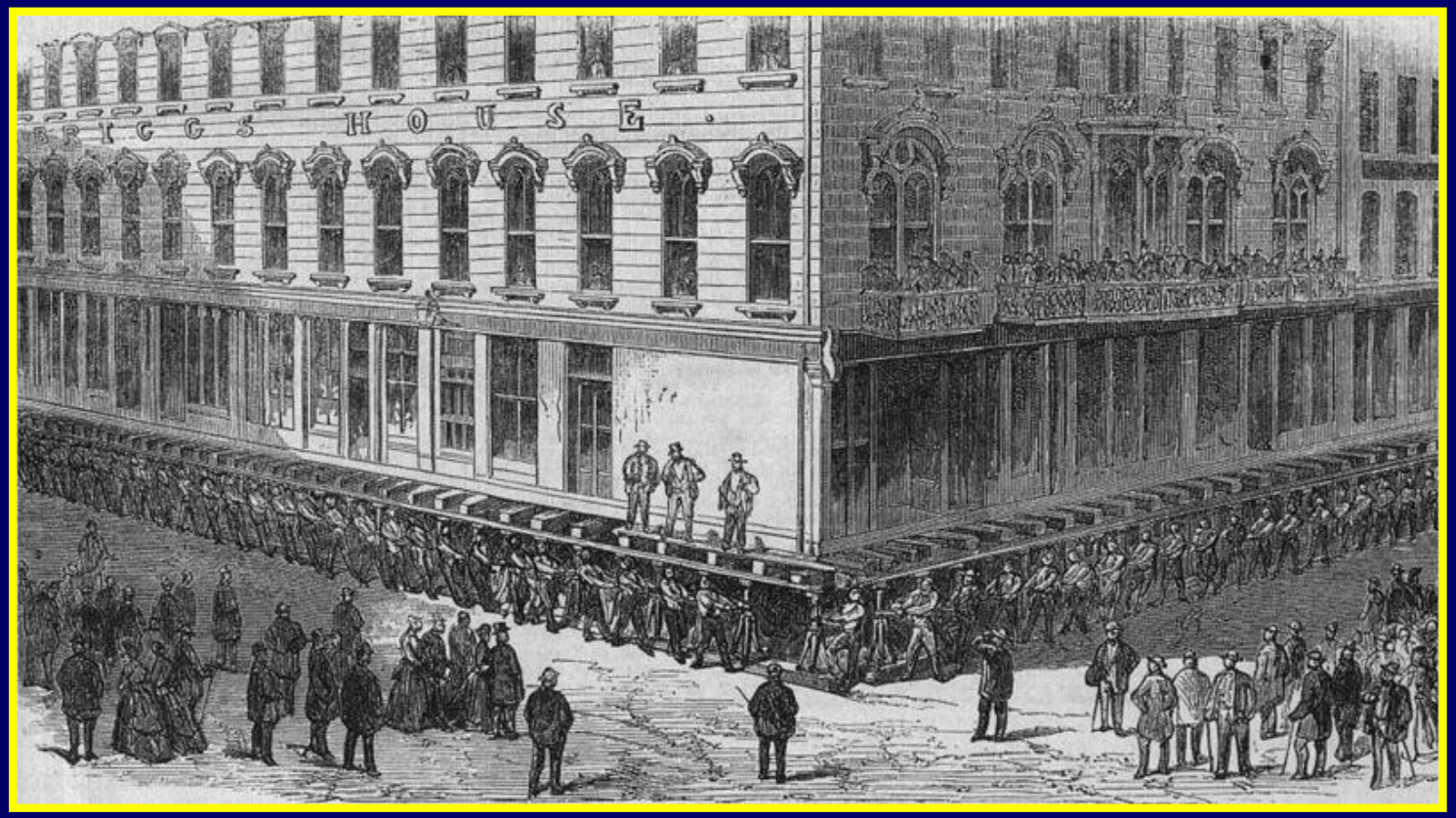
Chlorination

All of these water-borne diseases can be prevented by chlorinating drinking water.



First US Water Treatment

Beginning with Chicago and Jersey City, in 1908, cities began treating public drinking water with chlorine.

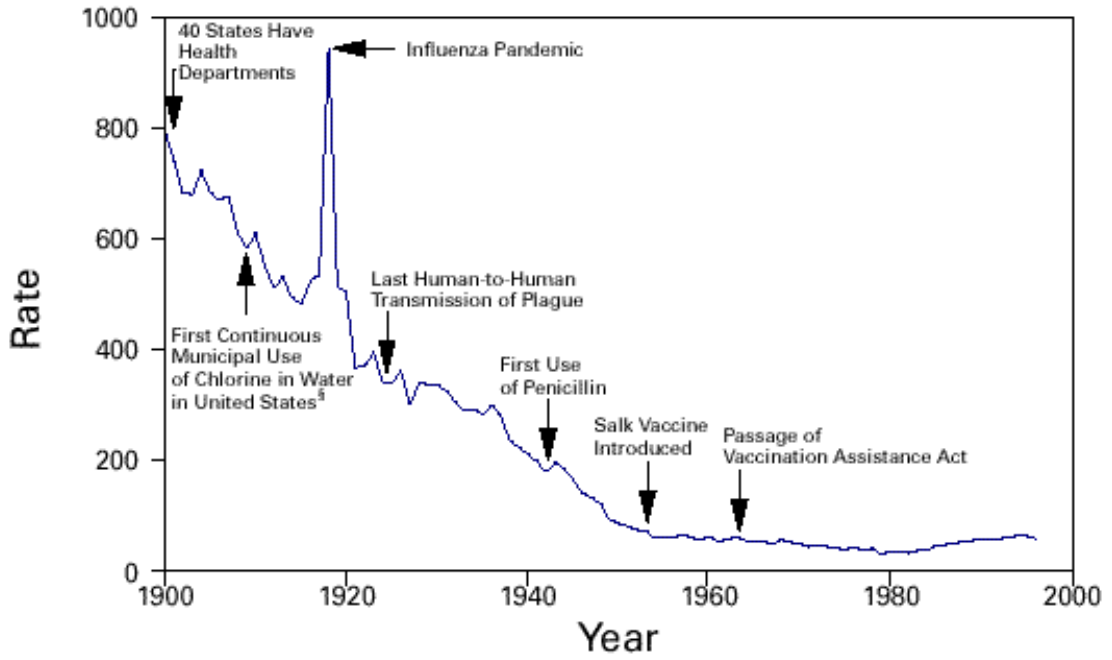


Chicago had to lift up all their buildings, in order to install water pipes. To so, they used hundreds of jacks.

Decrease in Death Rate

The use of treated water helped lead to dramatic decrease in deaths related to infectious diseases in the United States during the 20th century.

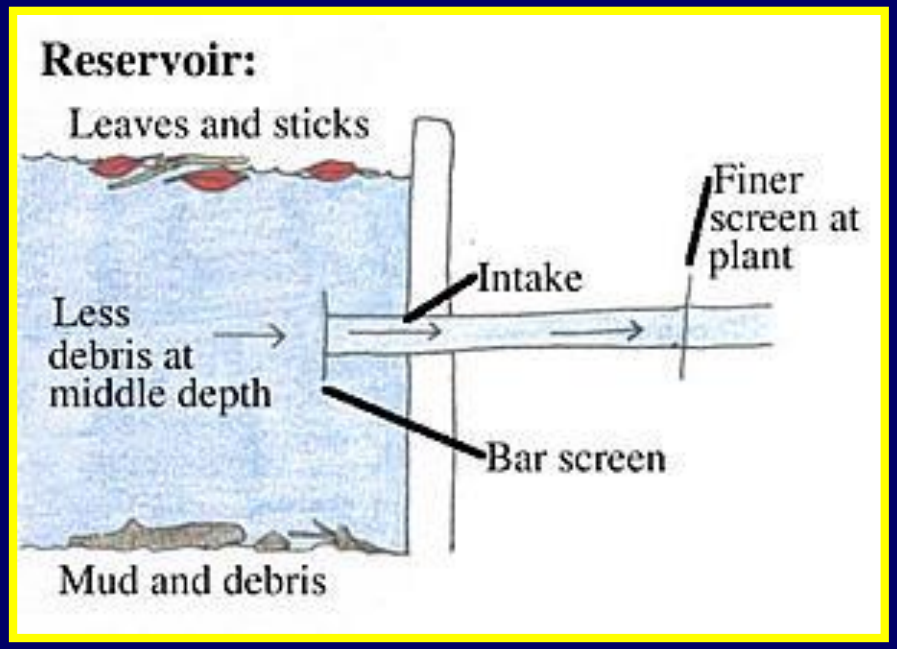
FIGURE 1. Crude death rate* for infectious diseases — United States, 1900–1996†



*Per 100,000 population per year.
†Adapted from Armstrong GL, Conn LA, Pinner RW. Trends in infectious disease mortality in the United States during the 20th century. JAMA 1999:281;61–6.
§American Water Works Association. Water chlorination principles and practices: AWWA manual M20. Denver, Colorado: American Water Works Association, 1973.

Water Treatment Plants

The school's water supply comes from Randleman Lake.



Upon initial collection, the water runs through a series of screens that prevent debris from entering the water treatment plant.

Water Treatment Plants

After screening, the next step is called the coagulation process.

During coagulation, alum is added to the water to make the sediments “floc” or stick together.

As sediments floc together, they form large clumps.

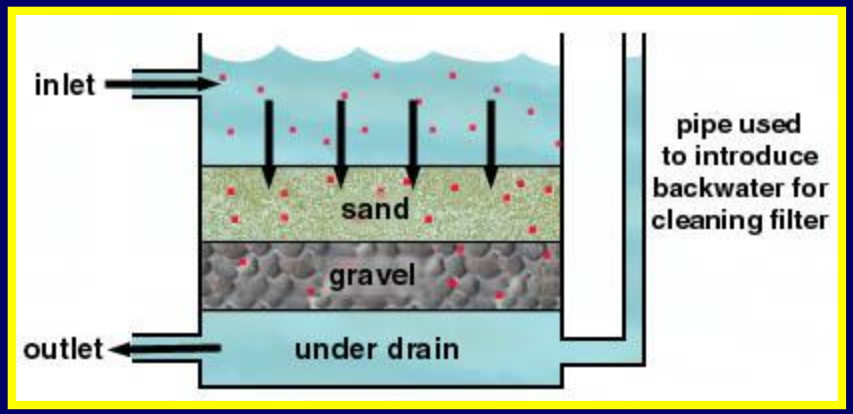
Sedimentation Tanks

The water is then sent to a sedimentation tank where the heavy clumps of sediment drop to the bottom.

The sediments are then collected, removed, dried, and often re-purposed as topsoil.

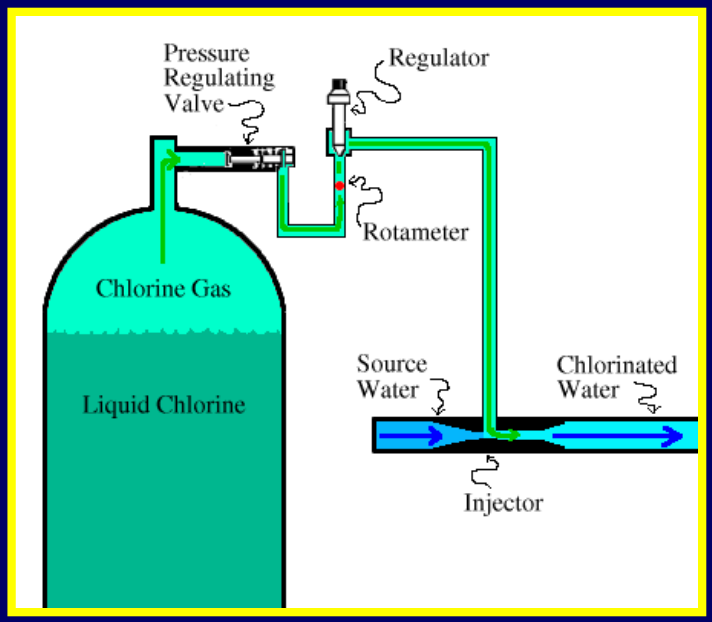
Filtration

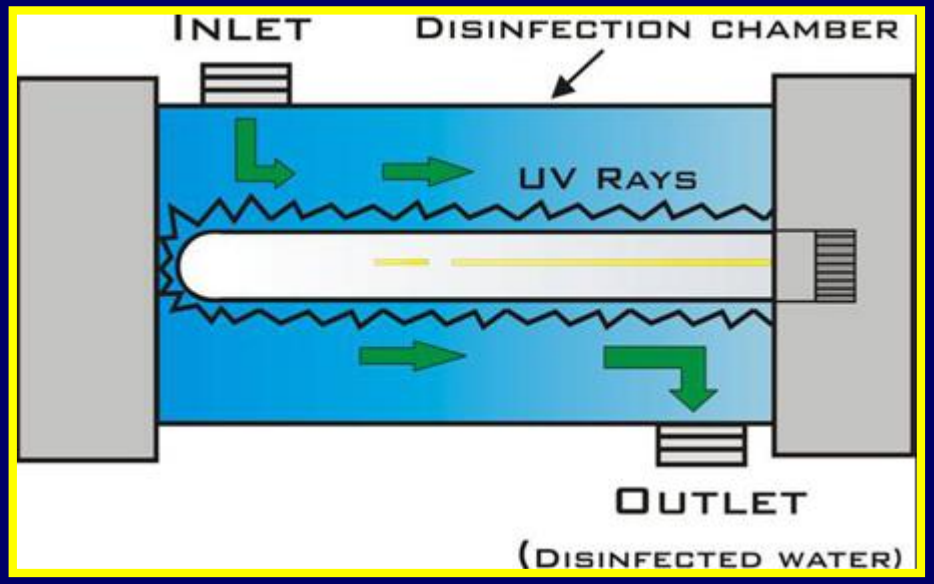
The water is then through filters consisting of activated carbon, sand, and gravel.



Disinfection

To remove any microbial organisms, chlorine is added to the water.

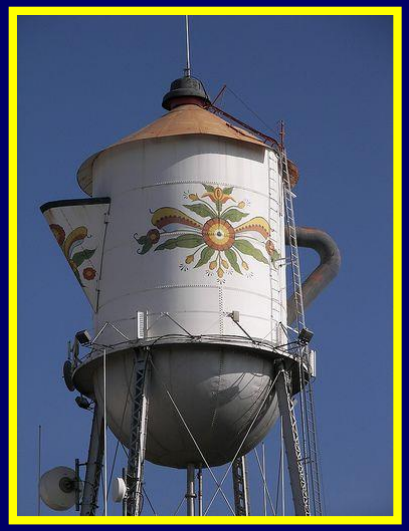




Some plants use UV light in place of chlorine.

Storage

Water is then stored in water tanks until it is pumped through pipes to homes and businesses.



Waste Treatment Plant

Waste water from the school is sent to the Eastside Waste Water Treatment Plant.

Waste Water

Everything that goes down any of the drains, at homes not on septic tanks, end up at the waste treatment plant.

Waste Water From Septic Tanks

Even some of the waste from septic tanks make it to the waste treatment plant.

Septic Truck in front of holding tank at East Point Waste Water Treatment Plant

Screening

When the waste water arrives at the plant, it goes through a series of screens that separate out plastics and other non-biodegradable material.

Next, the waste water is sent through a grit collector which removes gravel, sand and other inorganic grit.

Primary Clarifier

The fluid, now called effluent, is then sent to a large tank called a primary clarifier

Here, large organic material sinks to the bottom, while floating organic matter is skimmed off the top.

Sludge Removal

The solid organic material collected in the primary clarifier is called sludge.

Some of the sludge is packaged and sold for fertilizer or used as fill material, while the rest of the sludge is burned in the incinerator.

Anaerobic Bacteria

Next, the effluent waste water is ready for removal of the biodegradable material with the help of anaerobic bacteria.

Because anaerobic organisms require an environment without oxygen, this step of the process takes place underground in a 30 foot deep tank.

Aerobic Bacteria

Next, the waste water is sent to the aeration tanks where air is pumped back into the water.

Aerobic bacteria that require oxygen now begin removing the organic matter.

Second Clarifier Tank

Next, the effluent is sent to another large tank called a secondary clarifier. Once again, any solid organic matter drops to the bottom of the tank, while floating organic matter is skimmed off the top.

Ultraviolet Light

During the last step in the treatment process, ultra-violet (U.V.) light is used to prevent any remaining micro-organisms from reproducing.

The treated water is then pumped into Randleman Lake, the same place we get our drinking water.

The End