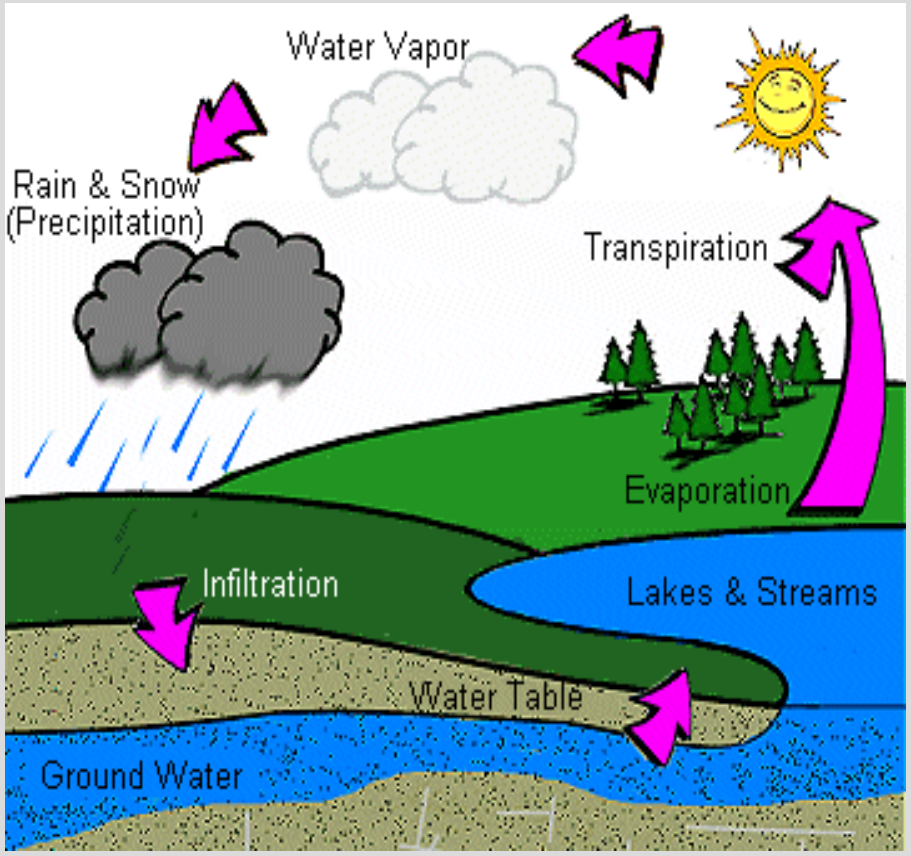
Impacts on Earth's Resources

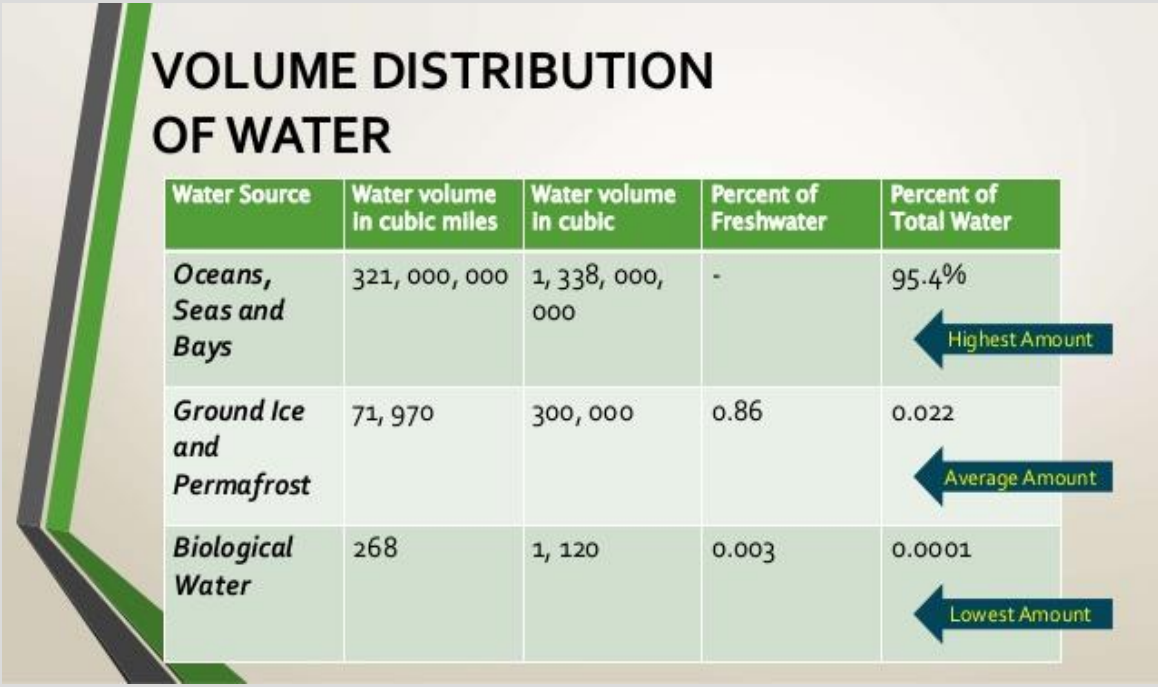
Water Cycle

- Evaporation: Solar energy hits surface water and causes water molecules to move to gas state.
- Transpiration: Plants lose moisture to atmosphere.
- Condensation: Water vapor rises, cools and condenses into tiny water droplets (clouds)
- Precipitation: clouds cool, condense and release moisture.
- Groundwater: Water filters into ground.
- Surface Water: any standing water on the surface of Earth. Oceans, lakes, rivers, etc.



Water Distribution

- Covers nearly ¾ of Earth's surface
- <1% is available for human use
- Oceans and ice caps hold most water
- Oceans contain 97% of all the water on Earth



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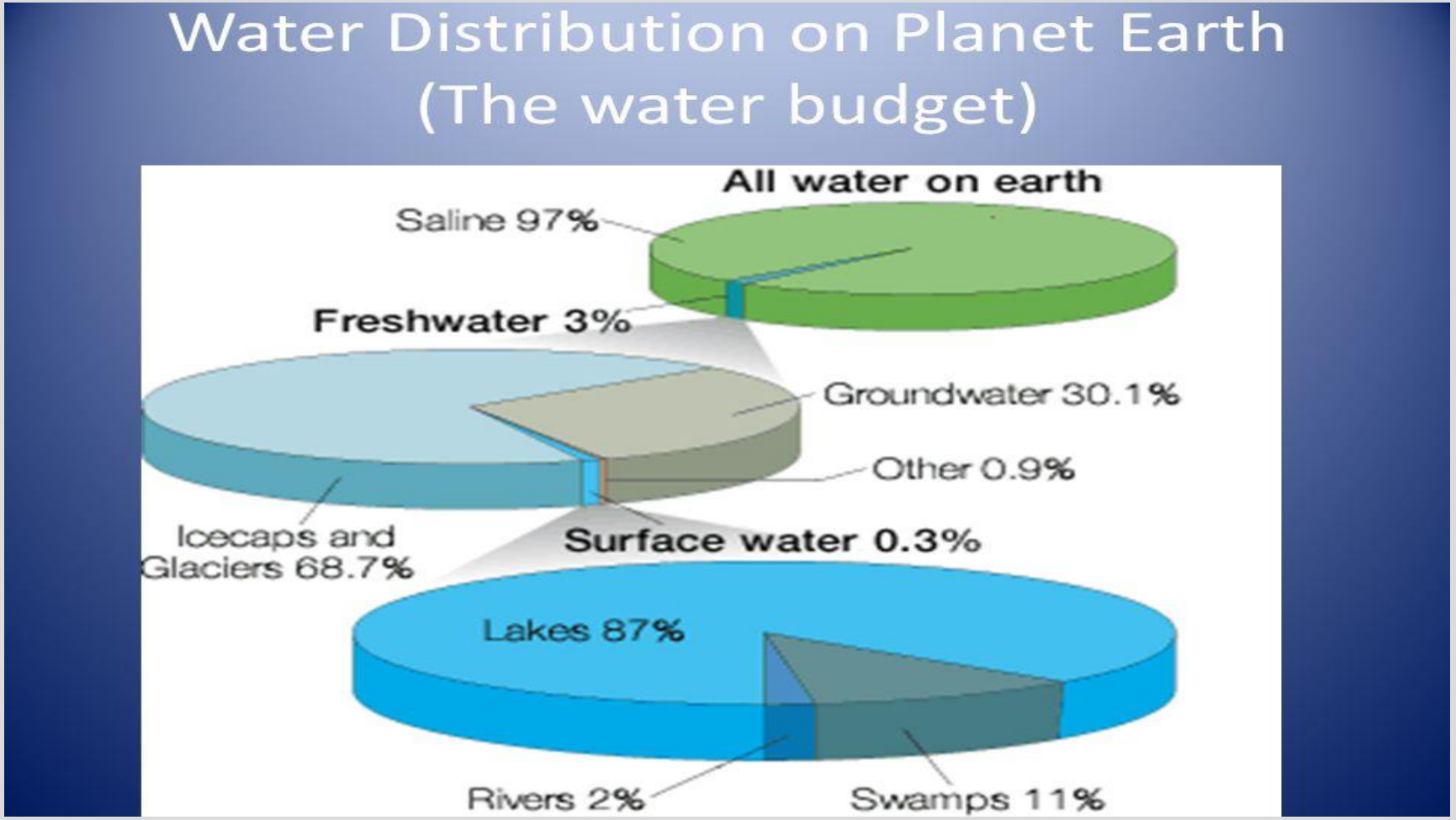
Water Distribution



Water Uses

1. Agriculture (69%)
   - Irrigation
   - Aquaculture

2. Industrial (15%)
   - Power Plants
   - Oil refineries
   - Manufacturing

3.Environmental(<1%)
   - Building lakes
   - Fish ladders

4. Household (15%)
   - Cooking
   - Bathing
   - Gardening
   - Drinking
   - Cleaning

5. Recreational (<1%)
   - Swimming
   - Fishing
   - Boating

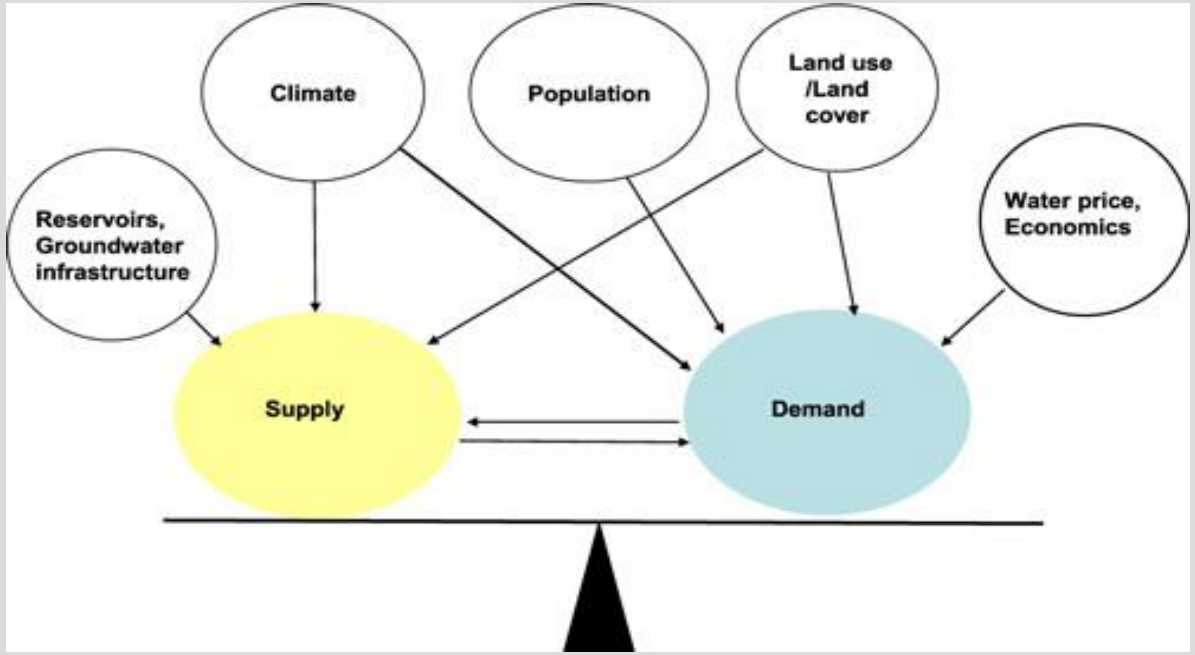
Water Conservation

- Ultra low flush toilets
- Low flow faucets
- Short cycles on dishwashers/washing machines
- Less grass – more native plants
- Car washes
- Dry cooling towers at electric power plants. Circulate water in pipes rather than evaporating in open air.
- Irrigation ditches: lined with cement, plastic or closed pipes. Unlined ditches can lose 40-50% of water.
- Drip irrigation instead of sprinklers
- Water recycling – reusing or reclamation. Treated wastewater either mixed with surface water or used for drinking purposes.
- Desalinization

https://s-media-cache-ak0.pinimg.com/originals/95/d4/59/95d459caa5653dcc26ae55540eb80ffe.jpg

Factors Affecting Water Supply

1. Human Influences
2. Climate
3. River systems
4. Geology



https://www.researchgate.net/publication/227657267/figure/fig4/AS:281293230231564@1444076940847/Figure-1-Factors-Affecting-Water-Supply-and-Demand-and-Their-Relations.png

Climate

- Regions near the equator receive high levels of annual precipitation.
- Monsoon areas of Asia have a very wet season
- Changing climate patterns
- More droughts
- Global warming can cause slight seasonal changes, which decrease rainfall in certain areas

River Systems

- River flow increases downstream as more tributaries flow into the river.
- World's major rivers store large quantities of water.
- Construction and use of hydrological dams
- Rainfall amounts – precipitation runoff from watersheds
- Sedimentation of lakes and wetlands
- Formation or dissipation of glaciers, permafrost and snowfields.

Geology

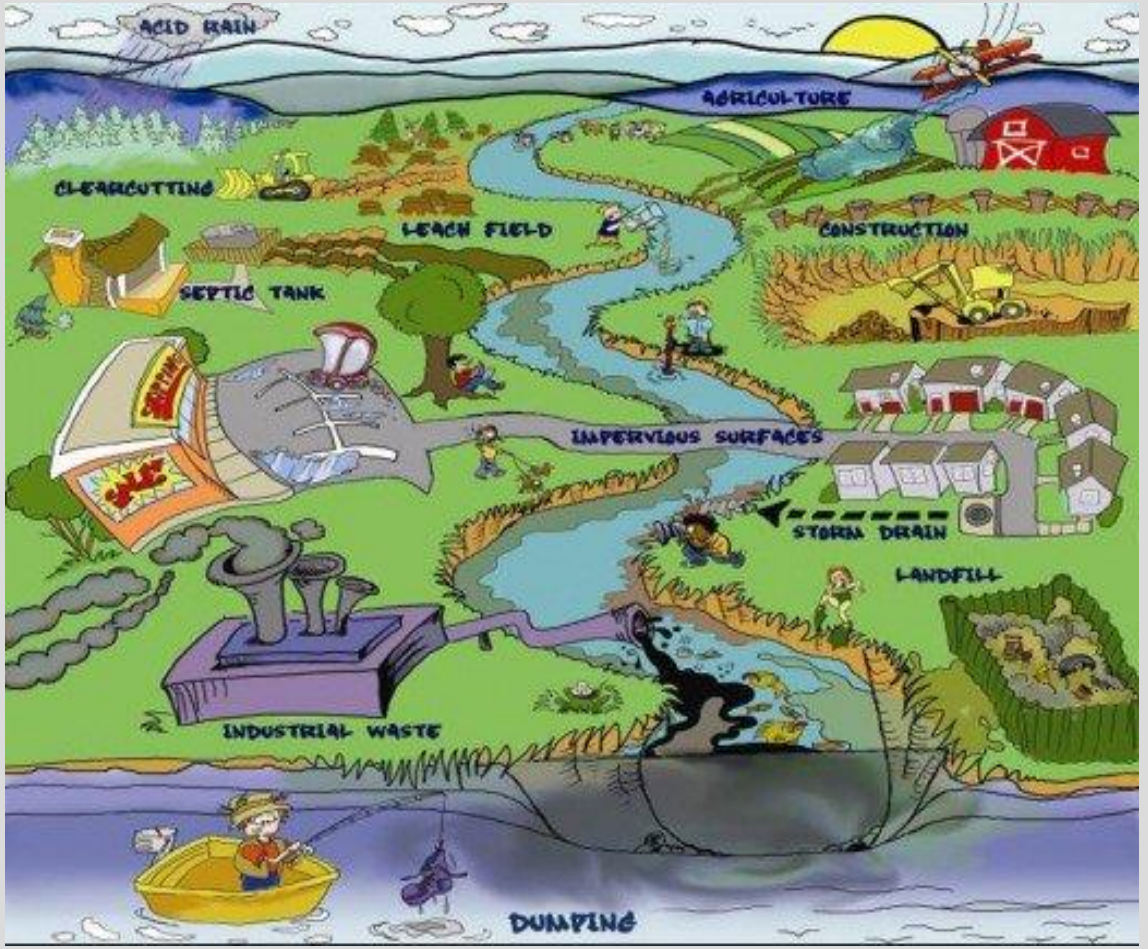
- Aquifers can store huge amounts of water underground
- Where rocks underlying a river basin are impermeable, water will remain on surface creating a high drainage density.
- Groundwater near coastal regions is becoming saltier due to the natural replacement of groundwater by seawater.
- Decreasing groundwater levels due to lack of rainwater to replace groundwater. Instead much of the rainwater is flowing into seas and oceans. The lower the groundwater gets, the harder is for people to access it.

Human Influences

- Increased population
- Demand for resources
- Irrigation and increased agricultural activities
- Undeveloped piping and other water distribution infrastructures
- Urbanization and industrialization
- Deforestation
- Increases in water pollution

Water Pollutants/Contaminants

- Disease causing agents
- Inorganic chemicals
- Synthetic organic compounds
- Fertilizers
- Sediments
- Oxygen using wastes
- Radioactive materials
- Thermal pollution



https://usercontent1.hubstatic.com/8789340_f520.jpg

Regulating Drinking Water

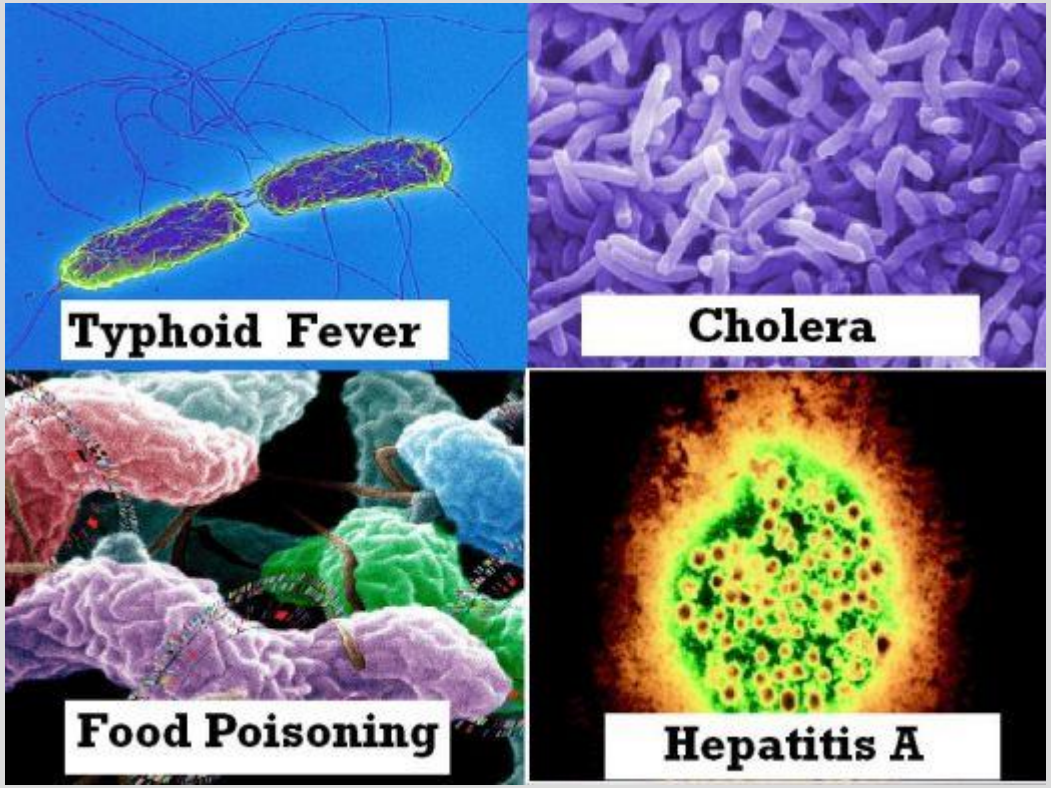
- **The Safe Drinking Water Act** was the first federal law mandating drinking-water standards for all public water systems, and it remains a cornerstone of the nation's drinking water standards. Under the act, the EPA is charged with setting water quality standards for particular contaminants (such as arsenic or mercury) in public water systems.
- Currently, 87 chemicals, disinfectants and disinfection byproducts, radioactive chemicals, and microorganisms are monitored for compliance with EPA standards.
- The Safe Drinking Water Act authorizes states and tribes to assume the primary responsibility for oversight and enforcement of regulations for public water systems.
- The cost of delivering water to the tap reflects the water's extraction, treatment, and distribution; however, water prices often do not reflect the full cost of these activities.

Privatization

- Private companies formed the early water utilities in the United States. As cities expanded ever more rapidly, more of them developed publicly owned water systems.
- Many public water utilities are again considering some form of privatization, which can encompass a wide variety of water utility operations, management, and ownership arrangements.
- Public or private have their own constraints
- Privately owned and operated water utilities may be less tied to local politics and could have more flexibility.
- Public systems may be more responsive to public input and more amenable to conservation and long-term resource management objectives.

Disease Causing Agents

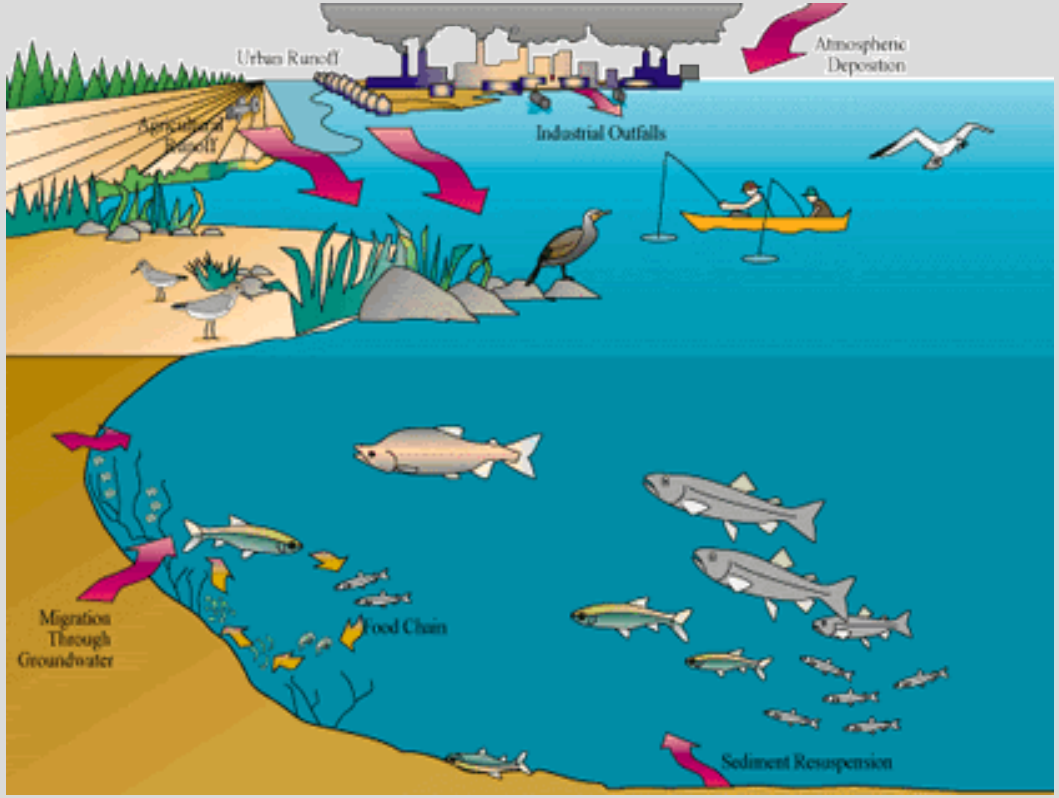
- Bacteria, parasites and viruses
- Many found in water contaminated with human/animal feces
- Water Treatment Plants – Chlorine
- Cannot get rid of viruses



http://waterbornediseases.in/wp-content/uploads/2017/02/Water_Quality.jpg

Inorganic Chemicals

- Salts, acids, and toxic metals
- Heavy metals: lead, mercury, copper, arsenic, chromium
- Can lead to biomagnification
- An increase up the food chain of a pollutant



https://1.bp.blogspot.com/-Vfwg6U0TFwI/UE3o-orHH8I/AAAAAAAADA0/n5FUeaCBwDU/s1600/Bioaccumulation.gif

Synthetic Organic Compounds

- Detergents – lead to Artificial Eutrophication
- Oils: cars, offshore drilling, pipeline leaks
- Industrial wastes
- Pesticides – Cause biomagnification
- Solvents

https://images.csmonitor.com/csmarchives/2011/01/0106-ASPILLREPORT-Gulf-Oil-Spill.jpg?alias=standard_600x400

Fertilizers

- Applied to farms and lawns and washed away by rain and end up in stream, rivers, lakes or ponds.
- Contain nitrate/phosphate ions which encourage the growth of bacteria and algae.

http://agriculturewire.com/wp-content/uploads/2014/09/fertilizer409.jpg

Artificial Eutrophication

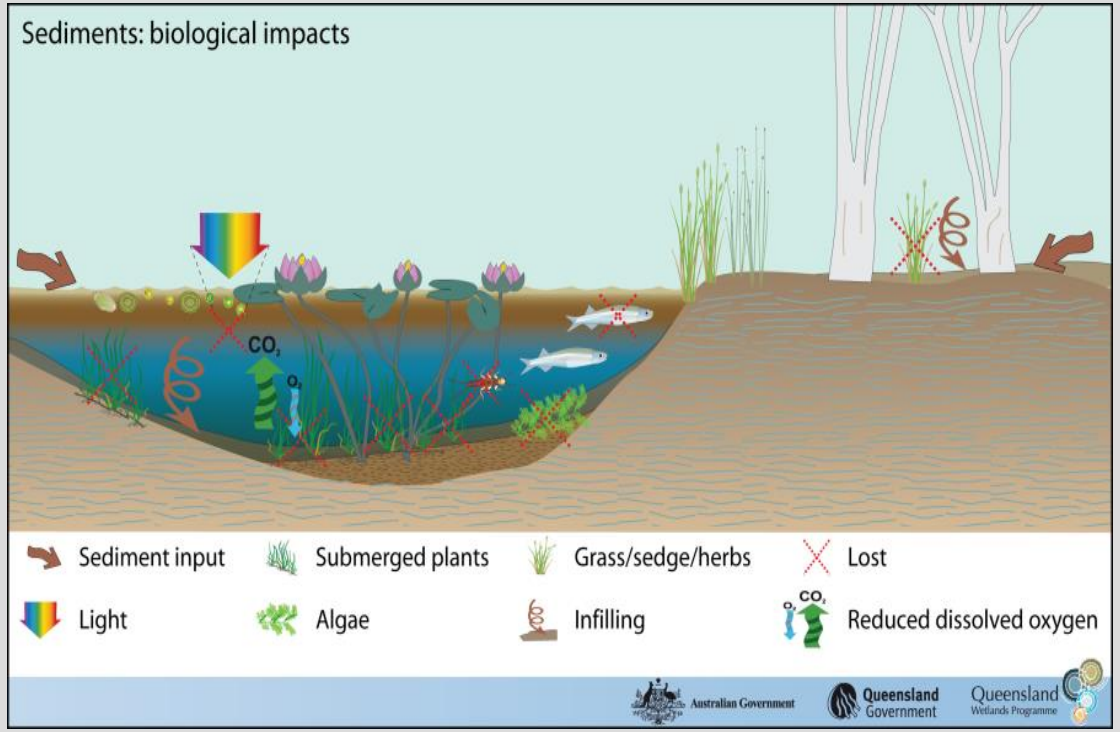
- An increase in the amount of nutrients.

1. Excess nitrates released in water.
2. Algal bloom
3. Algae die and fall to bottom.
4. Bacteria feed on dead algae
5. Bacteria use up available oxygen in water.
6. Fish and aquatic wildlife die.

https://upload.wikimedia.org/wikipedia/commons/thumb/0/01/Powai_Lake_Summer.JPG/1200px-Powai_Lake_Summer.JPG

Sediments

- Soil, silt and clay
- Affects aquatic wildlife
- Dissolved oxygen is reduced



https://wetlandinfo.ehp.qld.gov.au/resources/static/images/assessment/threats/strssor-conceptual-models/sediment/biological-impact-sediments.jpg

Oxygen Demanding Wastes

- Sewage
- Manure
- Industrial wastes
- Artificial eutrophication
- Decaying vegetation
- Food processing plants
- Paper mills
- Oil refineries

https://www.crestawards.org/site-content/uploads/2016/10/Monitoring-water-pollution-1-1024x675.jpg

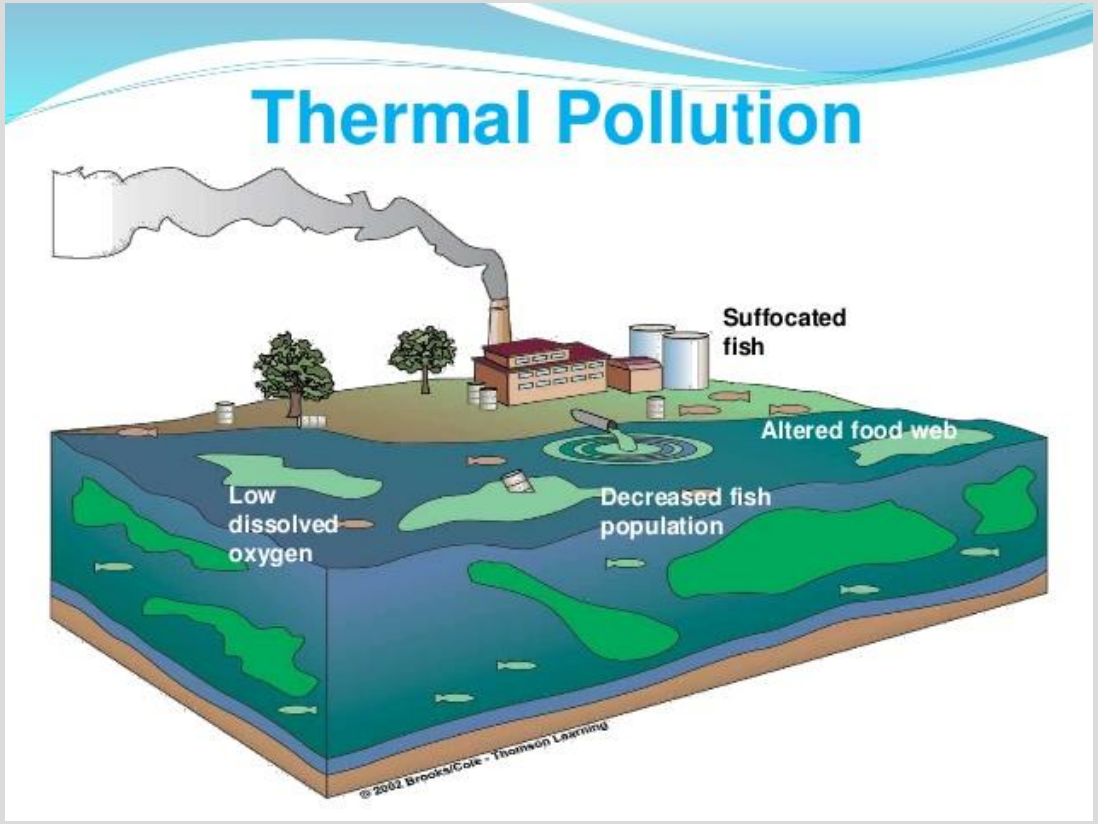
Radioactive Wastes

- Erosion of naturally occurring rocks
- Mining and processing of radioactive materials
- Nuclear power plants
- Nuclear weapons testing

https://www.greenoptimistic.com/wp-content/uploads/2009/11/nuclear_power_plant.jpg

Thermal Pollution

- Heat from industrial and electric power plants
- Excess heat from steam used to move turbines is released
- Dissolved oxygen decreases
- Cold water fish cannot survive



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Surface Water Treatment

- Surface water includes water obtained from dams, streams and rivers. These sources may be more easily contaminated by animal and human wastes, and chemicals from runoff. Surface water may also be at risk of algal blooms. *Due to the potential for contamination, surface water is not recommended as a source of drinking water unless filtered and disinfected.*
- Unless drinking water quality can be assured through disinfection and routine testing, surface water should only be utilised for purposes other than drinking such as toilet flushing, garden watering and irrigation. Treatment may still be necessary for such non-drinking uses.

http://www.health.nsw.gov.au/environment/water/Documents/Surfacewater-Treatment-Guide.pdf

Surface Water Treatment

- Surface water should be tested for E. coli and chemicals of health concern on a regular basis. Depending upon the level of treatment involved, surface water systems would generally require regular sampling to assure drinking water quality (e.g. monthly). If there is any suspicion or evidence of algal blooms, an analysis should also be undertaken for any potential algal toxins.
- By far the greatest risk to health comes from the contamination of water with disease causing microorganisms, which come from human or animal waste. Drinking water sourced from surface water needs to be free of disease causing microorganisms (bacteria, viruses and protozoa) and harmful levels of chemicals.
- The activities in the water catchment area and the associated run-off will determine the types and level of contamination in surface water. Disease causing microorganisms can enter surface water from human waste (sewage and septic tank seepage), animal waste (animal and bird droppings), and intensive farming practices (dairying, feedlots). Surface water may also contain agricultural chemicals such as pesticides and industrial wastes. Some surface water supplies may be susceptible to blooms of potentially toxic cyanobacteria (blue green algae).

http://www.health.nsw.gov.au/environment/water/Documents/Surfacewater-Treatment-Guide.pdf

Surface Water Treatment Systems

- Filtration to remove particulate matter and some dissolved material from water
- UV disinfection by ultraviolet light irradiation (UV) is effective against most bacteria, viruses and protozoa.
- Chlorine disinfection is a common form of disinfection that is effective against harmful bacteria, viruses and Giardia, but has limited effect against Cryptosporidium

http://www.health.nsw.gov.au/environment/water/Documents/Surfacewater-Treatment-Guide.pdf

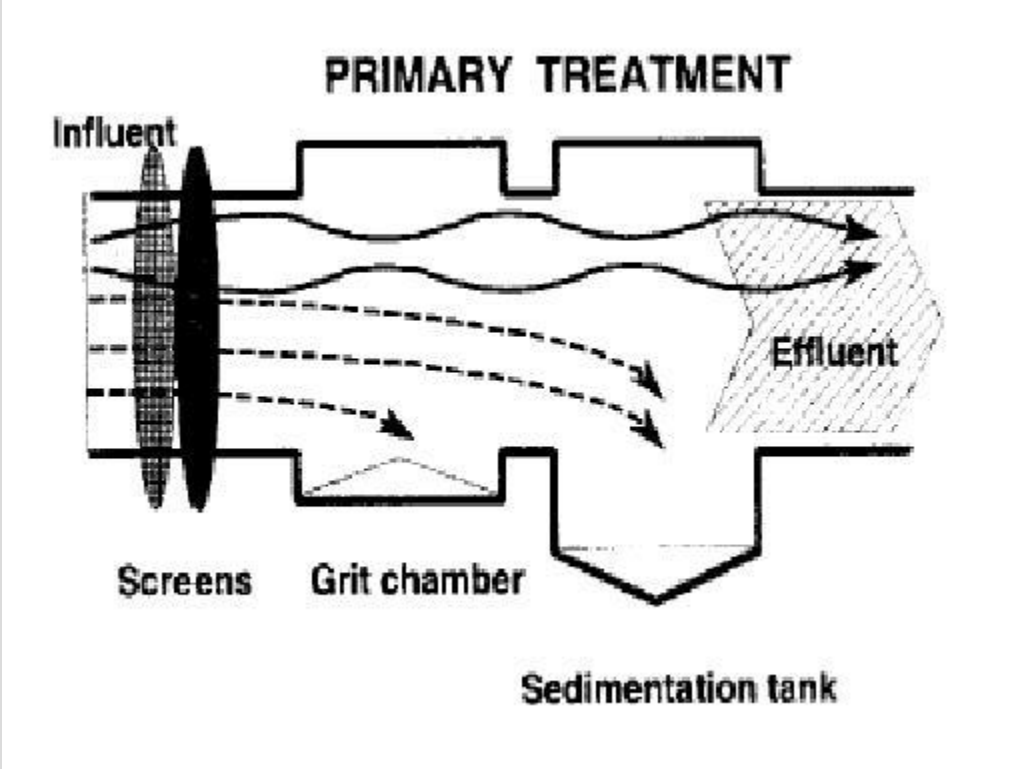
Wastewater Treatment

- Primary
- Secondary
- Tertiary

http://earthtechling.com/wp-content/uploads/2012/08/wastewater-treatment-shutterstock-e1344889530999.jpg

Primary Treatment

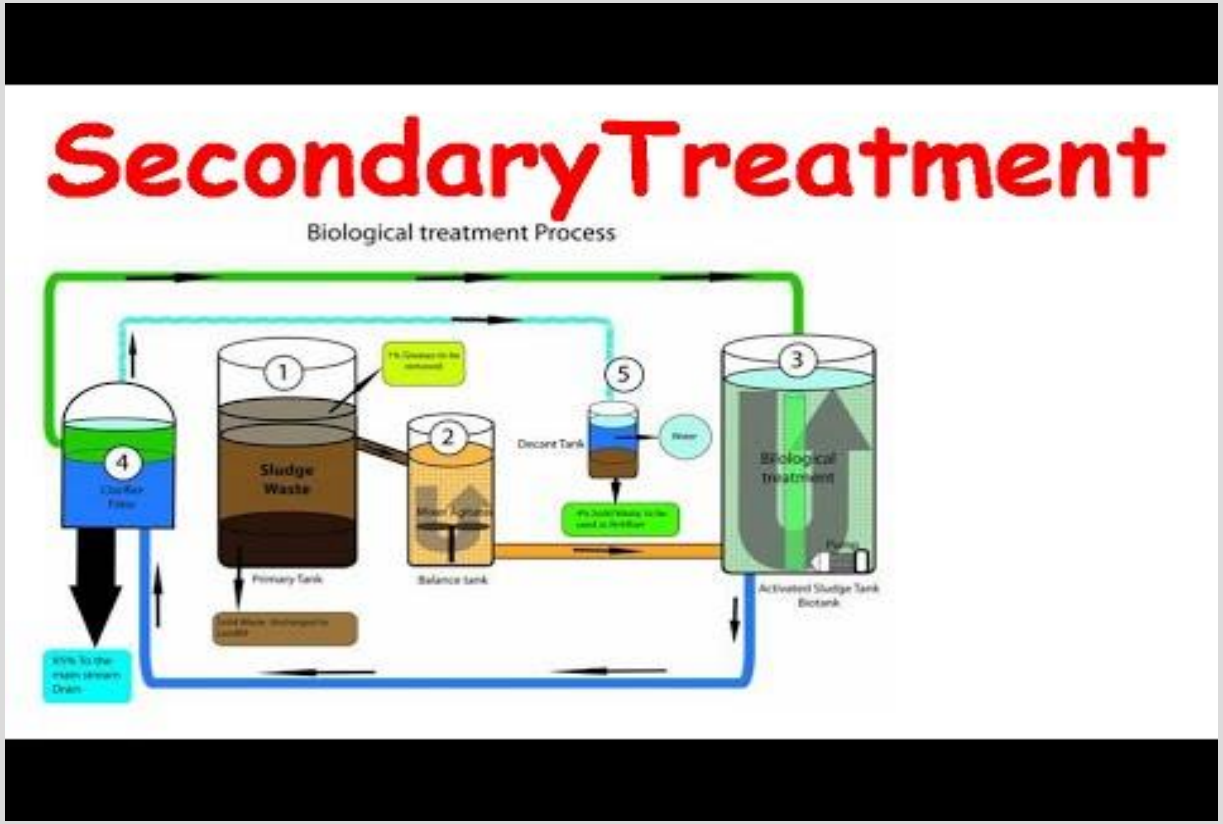
- Removes large objects
- Particles settle
- Raw sludge removed



http://www.appropedia.org/images/9/9a/Primary_Picture.jpg

Secondary Treatment

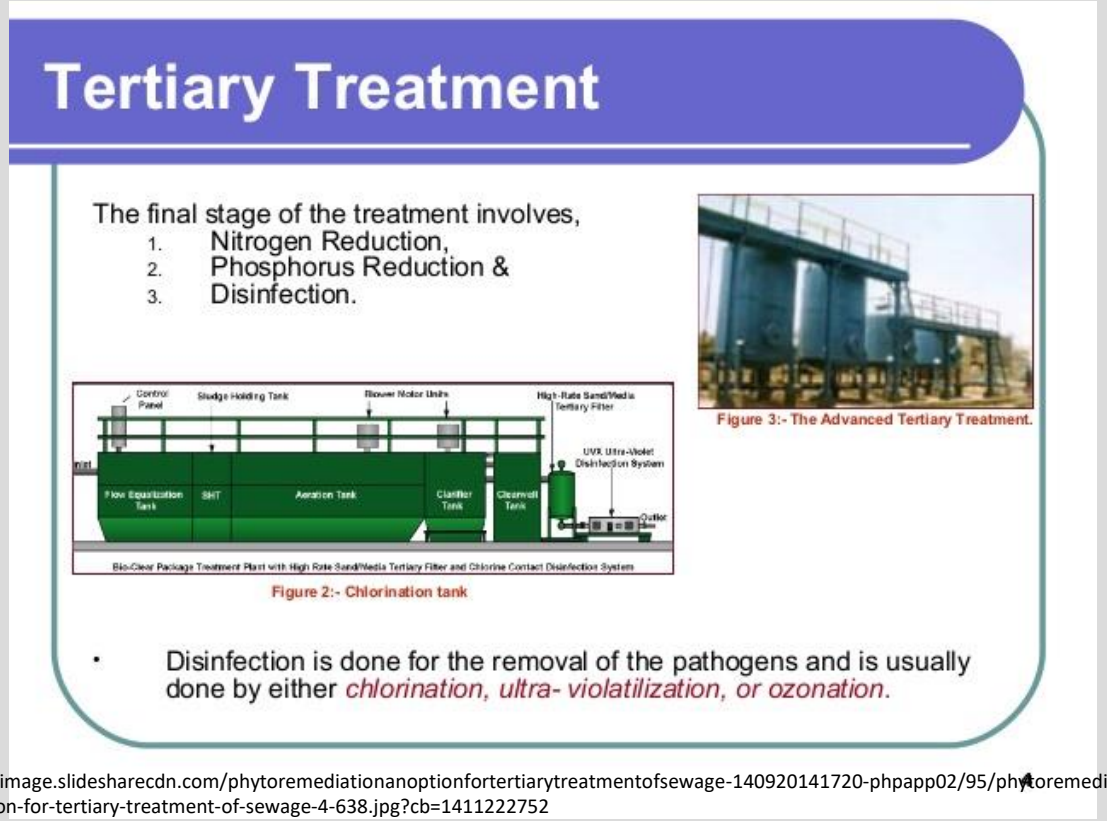
- Removes dissolved and suspended matter
- Kills microorganisms
- Aeration tanks
- Treated with chlorine
- **Trickling filter**: stones sprayed with bacteria/microorganisms break down sewage in smaller components



https://i.ytimg.com/vi/orm1MIgBGjM/hqdefault.jpg

Tertiary Treatment

- Oxidation
- Absorption
- Reverse osmosis
- Removes pesticides, salts nitrates, phosphates



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Polymers and Plastics

- Large organic compounds made of many smaller bonded units.

Example: polyethylene

- Original molecule is a monomer.
- Elasticity is determined by structure
- Long thin chains
- Cross link chains

http://cdn.sailingscuttlebutt.com/wp-content/uploads/2014/01/WP.jpg

Water Bottles

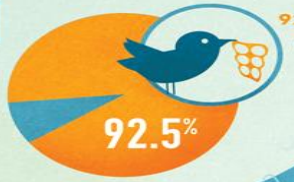
- Only 1 in 5 plastic bottles are recycled
- Americans consume over 8.6 billion gallons of bottled water
- Most tap water is more heavily tested and regulated than bottled water
- Plastic water bottles can take between 400 and 1,000 years to decompose
- It requires 3 times the amount of water to produce a plastic bottle than it does to fill it
- Bottled water costs over 1,000+ times more than tap water
- Last year, the average American used 167 water bottles, but only recycled 38
- In many taste tests, tap water was preferred over bottled water
- It takes 17 million barrels of oil to produce plastic bottles yearly. This could fuel 1 million cars for a year

- 10 STARTLING FACTS ABOUT BOTTLED WATER
- **Published On** October 25, 2012 | By Hannah Ellsbury | ***Articles***

PLASTICS BREAKDOWN

WE USE TONS OF PLASTIC. IT'S IN **EVERYTHING** FROM PACKAGING TO TOYS, TO THE DASHBOARD IN YOUR CAR. MASSIVE AMOUNTS OF IT END UP IN THE OCEAN. IT CONTAINS TOXINS, AND ABSORBS MORE TOXINS. IT ENTANGLES AND KILLS SEA LIFE. IT CERTAINLY DOESN'T BIODEGRADE. BUT THERE ARE WAYS WE CAN HELP.

BAD FOR THE OCEAN, BAD FOR US



92.5% OF DEAD SEABIRDS [NORTHERN FULMARS] IN A STUDY HAD INGESTED PLASTIC IN AMOUNTS EQUAL TO **5%** OF THEIR BODY WEIGHT.

54% OF THE **120** MARINE MAMMAL SPECIES ON THE THREATENED LIST HAVE BEEN OBSERVED **ENTANGLED** IN OR **INGESTING** PLASTIC.

AMERICANS USE ROUGHLY **100 BILLION** PLASTIC BAGS PER YEAR. **PLASTIC BAGS CAN TAKE 400 TO 1,000 YEARS TO DECOMPOSE,** BUT THEIR CHEMICAL RESIDUES REMAIN FOR YEARS AFTER.

HOW BIG IS THE PROBLEM?

73.9 MILLION POUNDS OF PLASTIC ARE SPREAD THROUGHOUT THE WORLD'S GYRES.

IT'S EXPENSIVE TOO...
AS OF 2009, SOUTHERN CALIFORNIA CITIES HAD SPENT OVER **$1.7 BILLION** TO KEEP WATER-WAYS FROM BEING OVER LEGAL TRASH LIMITS.

CHEMICALS USED IN PLASTICS LIKE PHTHALATES AND FLAME RETARDANTS HAVE BEEN FOUND IN FISH, MOLLUSKS, SEA MAMMALS, AND OTHER SEA LIFE

HOW MUCH PLASTIC ENDS UP IN THE OCEAN?

CIRCULAR CURRENTS **(GYRES)** THOUSANDS OF MILES ACROSS COLLECT IMMENSE AMOUNTS OF PLASTIC IN ALL OF THE WORLD'S OCEANS.
MICROPLASTIC CONCENTRATIONS IN THE NORTH PACIFIC GYRE **INCREASED 100X IN THE PAST 40 YEARS.**

CURRENTS CARRY THE PLASTIC EVERYWHERE.
RUBBER DUCKS LOST FROM A SHIPPING CONTAINER IN THE **NORTH PACIFIC** WERE FOUND NEAR **SCOTLAND,** IN THE NORTH ATLANTIC. TSUNAMI DEBRIS FROM JAPAN ARRIVED IN **NORTH AMERICA,** AFTER CROSSING THE LARGEST OCEAN ON EARTH **IN JUST 10 MONTHS.**

PLASTIC IS MADE OF TOXINS

331 MILLION BARRELS OF PETROLEUM & NATURAL GAS LIQUIDS
WERE USED TO MAKE U.S. PLASTIC PRODUCTS, EQUAL TO ABOUT **5%** OF THE NATIONAL PETROLEUM CONSUMPTION.

PLASTICS CONTAIN **TOXIC** CHEMICALS

FACT:

MORE TOXINS ADHERE AS PLASTIC BREAKS DOWN

IN PLASTIC FROM **THE NORTH PACIFIC GYRE:**

40% CONTAINED PESTICIDES LIKE DDT. **50%** CONTAINED PCBs (**BANNED** BY U.S. CONGRESS IN 1979, FOR HAVING VARIOUS **NEUROTOXIC** EFFECTS). **80%** CONTAINED PAHs (MAY BE **HIGHLY CARCINOGENIC**).

FLOATING TOXIC MICROPLASTICS ARE OFTEN INGESTED BY MARINE LIFE, WHICH IN TURN IS CONSUMED BY US.

RESEARCH PROVIDED BY THE OCEAN 5 CONSERVANCY, 5 GYRES, AND OTHERS

INFOGRAPHIC BY WWW.ABRAHAMTHINKIN.COM | 2012

WHAT CAN WE DO TO HELP?

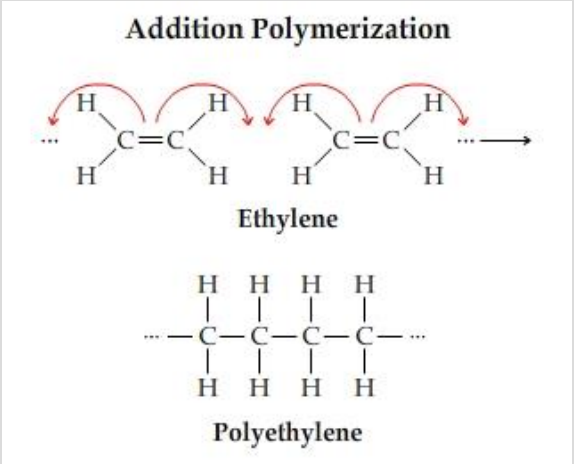
USE LESS PLASTIC

8 OF THE TOP 10 ITEMS FOUND ON BEACHES DURING LAST YEAR'S INTERNATIONAL COASTAL CLEAN-UP DAY WERE PLASTICS RELATED TO EATING & DRINKING.

PLASTIC BAGS > REUSABLE BAGS, NO BAG **STRAWS >** NO NEED **UTENSILS >** USE NON-PLASTIC
TO GO CUPS > REUSABLE MUGS & CUPS **ELECTRONICS >** REPAIR OR UPGRADE. RECYCLE THE OLD ITEM WHEN YOU NEED SOMETHING NEW.
BOTTLED WATER > REUSABLE WATER BOTTLE **PACKAGING >** BUY ITEMS WITH MINIMAL PACKAGING
CLOTHING > BUY NATURAL MATERIALS. SYNTHETIC FIBERS END UP IN THE OCEAN

Polymerization

- **Polymerization** is the process of connecting monomers together and creating large macromolecules of different sizes and shapes**.**
- There are 2 main types: **Addition** and **Condensation** polymerization.
- Some common commercial addition polymers are:
- Polyethylene - films, packaging, bottles
- Polypropylene - kitchenware, fibers, appliances
- Polyvinyl chloride - pipe fittings, clear film for meat packaging



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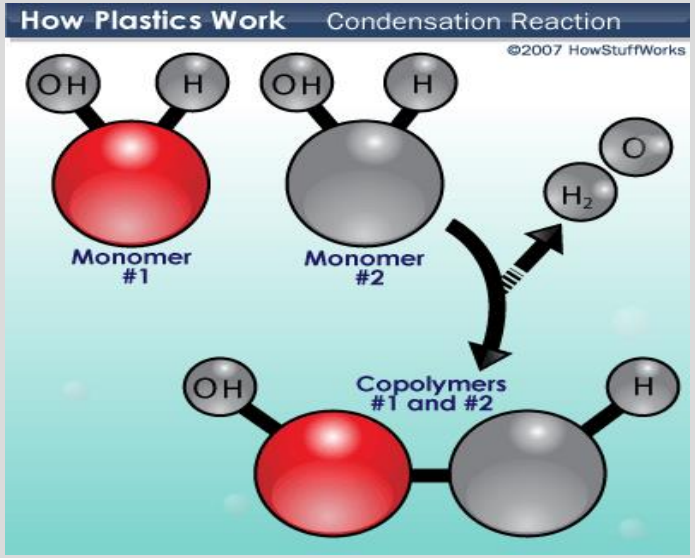


Fossil Fuels and Plastics

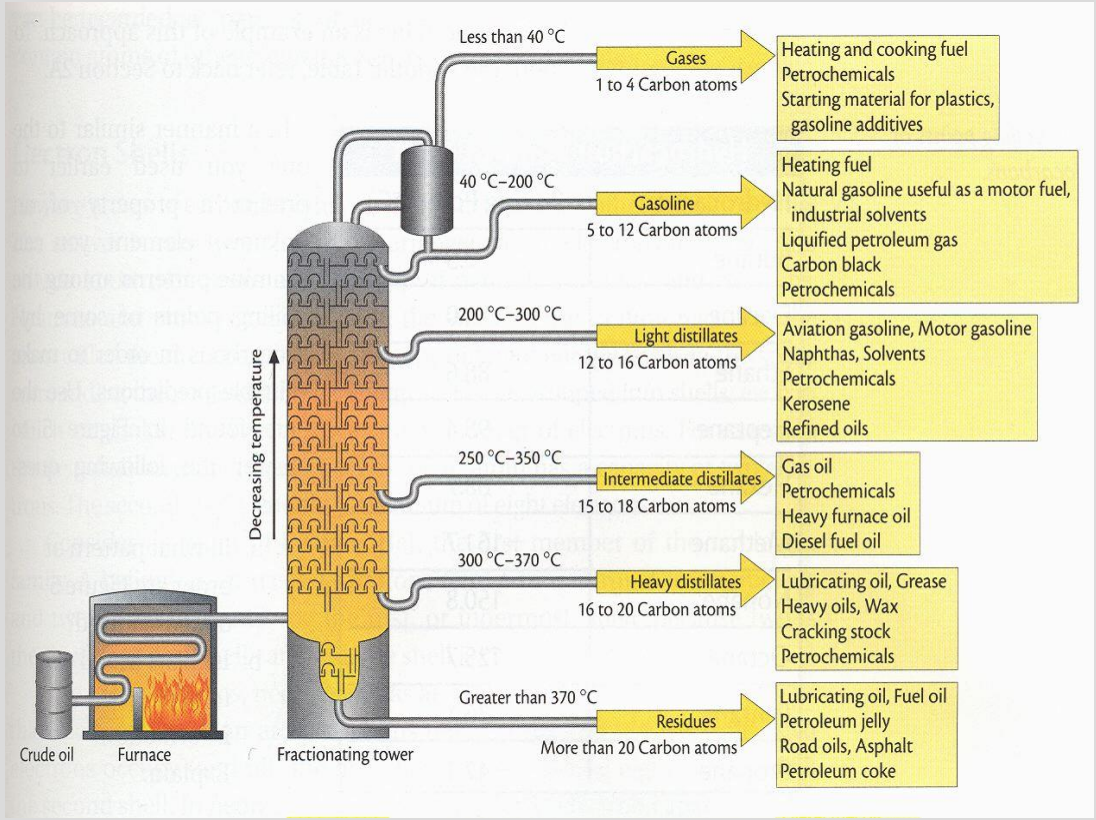
"Fossil fuels and plastics are not only made from the same materials, they are made by the same companies," says Steven Feit, Staff Attorney at CIEL. "Exxon is both the gas in your car and the plastic in your water bottle." If trends in oil consumption and plastics production continue as expected, plastics will account for 20% of total oil consumption by 2050. plasticpollutioncoalition.org

two images

- Coal
- Petroleum
- Natural Gas
- Plastics are produced from natural gas, feedstocks derived from natural gas processing, and feedstocks derived from crude oil refining.

Fossil Fuels and Plastics

- **Naptha** is the crucial by - product of petroleum used to make plastics.
- **Ethane** is a natural gas liquid that gets turned into ethylene in one of the first steps of making plastics.
- These hydrocarbon-bearing formations matured at different rates, even within the same formation, depending on temperature, time, and pressure. Within a formation, one area may produce oil, another area 'wet' natural gas (natural gas mixed with natural gas liquids), and yet another area only 'dry' gas (almost pure methane).



http://moodle.oakland.k12.mi.us/clarenceville/mod/resource/view.php?id=33782&redirect=1

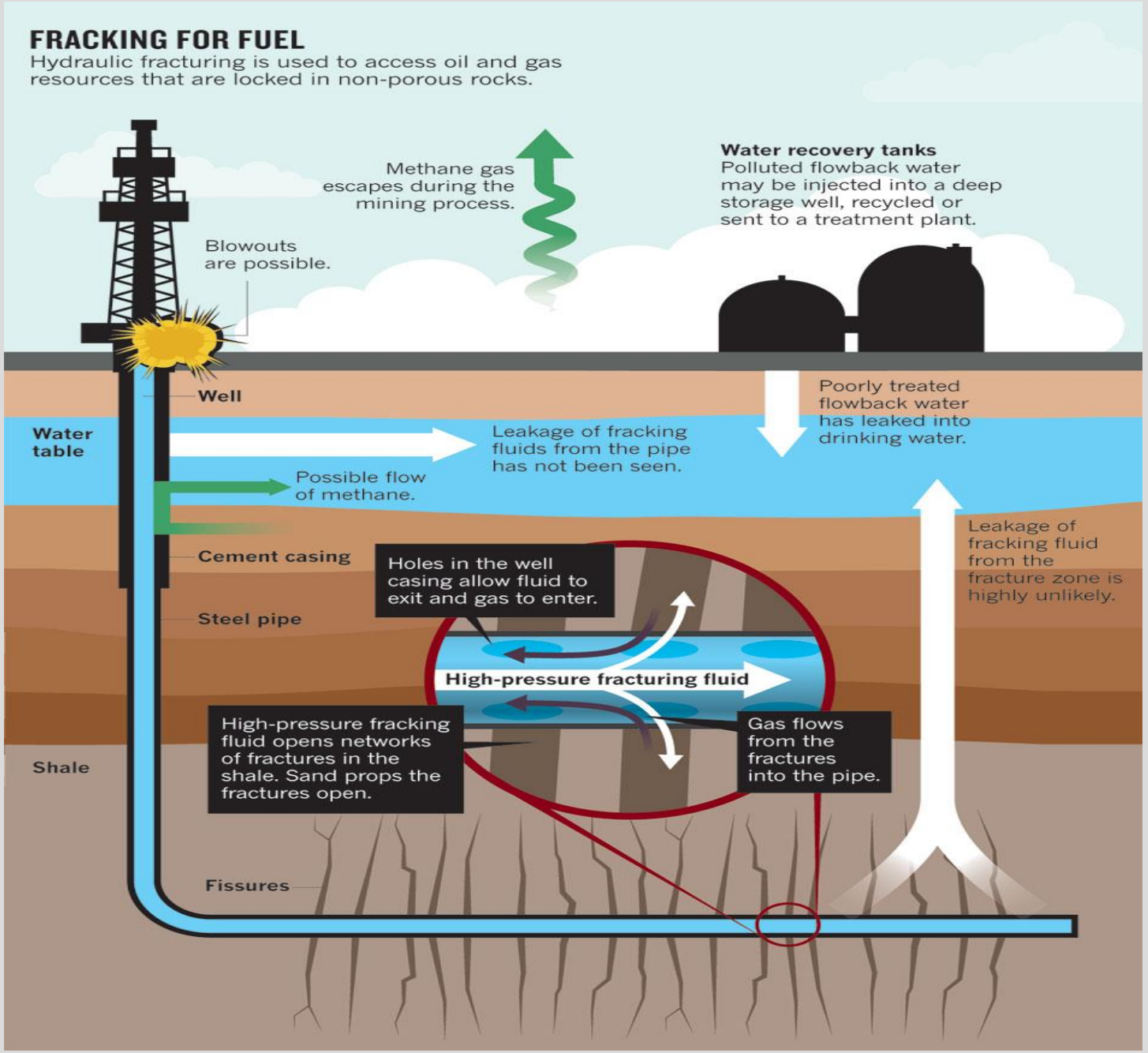
Fossil Fuels and the Environment

Petroleum

- Oil spills
- Air pollution
- Nonrenewable

Natural Gas

- **Hydraulic fracturing**, or fracking, is a drilling process that injects millions of gallons of water, sand and undisclosed chemicals at high pressure into horizontal wells to crack open shale rock and release natural gas.
- Contaminates groundwater and surface water


FRACKING FOR FUEL
Hydraulic fracturing is used to access oil and gas resources that are locked in non-porous rocks.
Methane gas escapes during the mining process.
Blowouts are possible.
Water recovery tanks
Polluted flowback water may be injected into a deep storage well, recycled or sent to a treatment plant.
Well
Water table
Leakage of fracking fluids from the pipe has not been seen.
Poorly treated flowback water has leaked into drinking water.
Possible flow of methane.
Cement casing
Holes in the well casing allow fluid to exit and gas to enter.
Steel pipe
Leakage of fracking fluid from the fracture zone is highly unlikely.
High-pressure fracturing fluid
High-pressure fracking fluid opens networks of fractures in the shale. Sand props the fractures open.
Gas flows from the fractures into the pipe.
Shale
Fissures

Great Pacific Garbage Patch

- A collection of marine debris in the North Pacific Ocean. Marine debris is litter that ends up in oceans, seas, and other large bodies of water
- Also known as the Pacific trash vortex, spans waters from the West Coast of North America to Japan.
- The amount of debris in the Great Pacific Garbage Patch accumulates because much of it is not biodegradable. Many plastics, for instance, do not wear down; they simply break into tinier and tinier pieces.

https://www.nationalgeographic.org/encyclopedia/great-pacific-garbage-patch

Great Pacific Garbage Patch.

https://upload.wikimedia.org/wikipedia/commons/thumb/1/1f/North_Pacific_Subtropical_Convergence_Zone.jpg/300px-North_Pacific_Subtropical_Convergence_Zone.jpg

http://www.thecivilengineer.org/media/k2/items/cache/01d8b43f4f3fa760f12ff89aa5d9028b_XL.jpg

Henderson Island

- Henderson Island lies in the South Pacific, halfway between New Zealand and Chile. No one lives there. It is about as far away from anywhere and anyone on Earth.
- Articles from Russia, the United States, Europe, South America, Japan, and China. All of it is trash, most of it plastic.
- All swept into the South Pacific Gyre

https://news.nationalgeographic.com/2017/05/henderson-island-pitcairn-trash-plastic-pollution/

Henderson Island

TedEd video

Ooho video

https://static.independent.co.uk/s3fs-public/styles/article_small/public/thumbnails/image/2017/05/16/01/henderson-island.jpg

Interactive Drought Map
World Population Map
US Drought Map
interactive map of where bottled water is sourced
https://www.youtube.com/watch?v=taJOV-YCieI

Drought – Causes and Effects

- A prolonged period during which rainfall is below average.
- Crops grow without irrigation can produce low yields or fail.
- Can cause famine in places where most food is grown locally.
- No seed to plant crops the following year.
- The effects of a drought can last for years.
- After years the soil may be less able to support the production of food crops.

https://media1.britannica.com/eb-media/27/188727-004-8FED71D9.jpg