

YOU AND YOUR BEER SUCK!

LEARN WATER CHEMISTRY AND STOP SUCKING, LOSER

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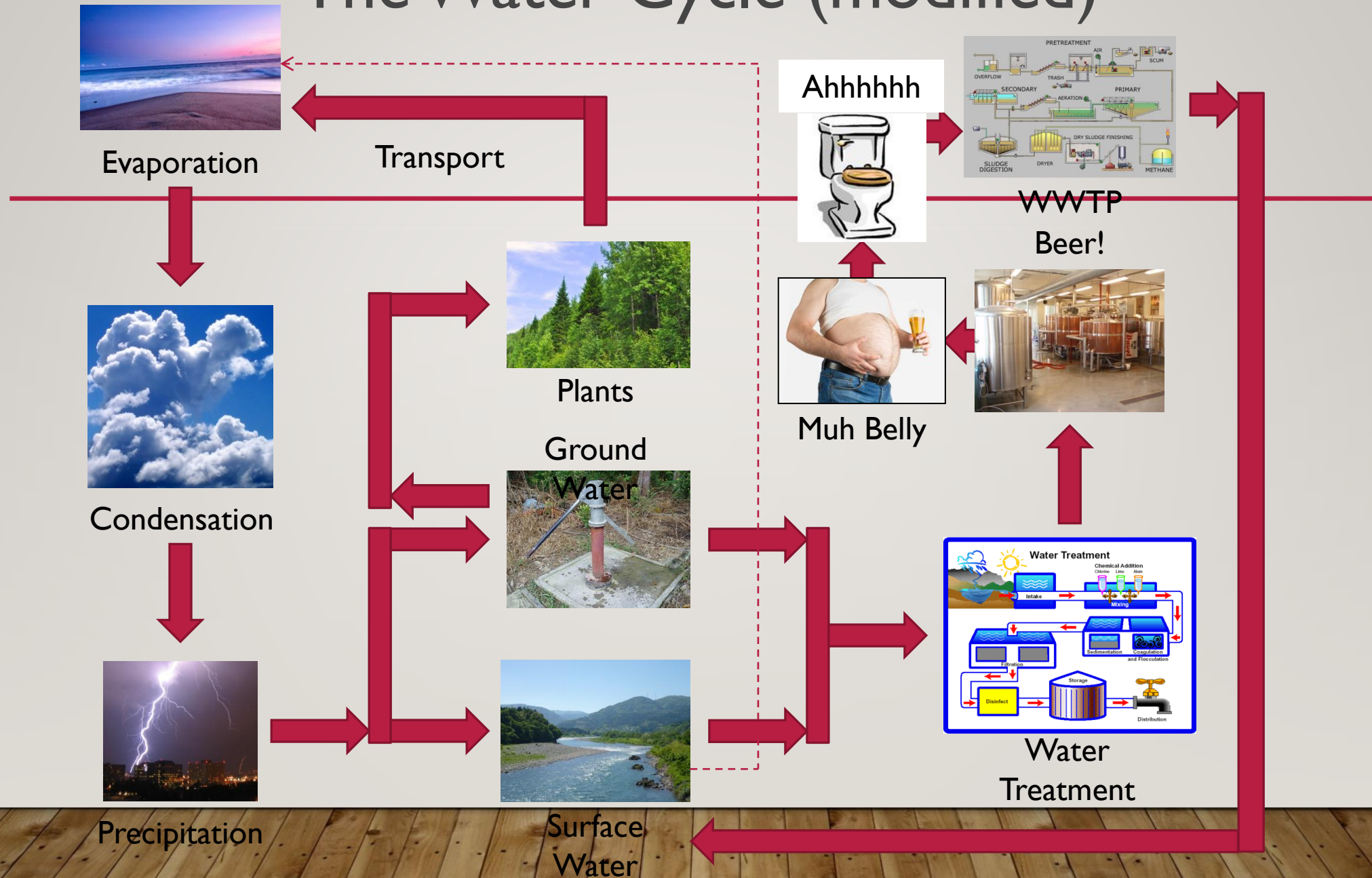
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SOURCES OF WATER

- The water that comes from your faucet comes from two primary sources: ground and/or surface.
- The primary source in Cincinnati is the Ohio River. The majority of drinking water in the US comes from ground water sources.
- Rural sources are often private wells, springs, and cisterns. This accounts for about 14% of the US population.
- Ground water tends to be more clean, but also higher in mineral content, aka higher water hardness

The Water Cycle (modified)



WATER HARDNESS

- The concentration (mg/L) of Calcium Carbonate (CaCO_3) in water determines how hard the water is.
- Soft water: 0-60 mg/L
- Moderately hard water: 61-120 mg/L
- Hard water: 121-180 mg/L
- Very hard water: 181+ mg/L
- CaCO_3 raises the pH of water

MUNICIPAL WATER REPORT

- By law, your municipality is required by law to provide you with a report on water quality. However, the required reporting is only for health-related issues like agricultural byproducts and radiation. Up-to-date information on mineral content may be difficult to obtain unless you get private testing done or do it at home. Sources can vary depending on time of year and other factors.



The image shows the components of the LaMotte BrewLab Plus Water Test Kit. It includes a blue carrying case with the LaMotte logo, a digital pH meter, several bottles of reagents, a box of test strips, and a box of test kits. The kit is designed for home brewers to test water quality.

LAMOTTE - BREWLAB PLUS WATER TEST KIT 7188-01

MODEL: MB_MT201

\$189.99
+ FREE Shipping

The BrewLab Plus® test kit, model 7188-01, for home brewers quantifies 6 important water test factors. Includes everything in BrewLab Basic kit plus a high quality digital pH meter for monitoring batches from start to finish. Experts agree water conditions affect your final product, so take the mystery out of making great beer. Trust LaMotte, the water analysis experts since 1919, to help you control your most important ingredient—water. See the Documents Tab above for additional information.

WHICH IONS/SALTS DO WE CARE ABOUT?

- There are 6: Bicarbonate, Calcium, Sulfate, Chloride, Magnesium, and Sodium
- Bicarbonate (HCO_3^-) is the primary driver of alkalinity and is commonly added to the brewing process as chalk or baking soda.
- Calcium (Ca^{2+}) is required for reactions in mash and fermentation and decreases mash pH. Is commonly added to brew process via chalk, gypsum (calcium sulfate), or calcium chloride.
- Sulfate (SO_4^{2-}) is used to increase hop character in beer and is added to the brewing process via Epsom salt (magnesium sulfate) or gypsum.

WHICH IONS/SALTS DO WE CARE ABOUT?

- Chloride (Cl^-) will increase the perceived maltiness of beer and is typically added by calcium chloride or magnesium chloride
- Magnesium (Mg^{2+}) is required in small amounts for mashing but is usually present in the malt itself. Magnesium decreases the mash pH and is typically added via Epsom salt (magnesium sulfate) or magnesium chloride.
- Sodium (Na^+) often plays a role in some styles like Gose but can give a salty flavor if used too excessively. Can be added via sodium chloride or baking soda.
- Sulfate, chloride, and sodium ions are considered “flavor” ions.

ADDITIONS TO WATER

- Calcium carbonate (Chalk) CaCO_3 – 1 gram per gallon of water will add 105 mg/l of Ca^{2+} and 161 mg/l HCO_3^-
- Calcium sulfate (Gypsum) CaSO_4 – 1 gram per gallon of water will add 62 mg/l of Ca^{2+} and 147 mg/l SO_4^{2-}
- Calcium chloride CaCl_2 – 1 gram per gallon of water will add 72 mg/l Ca^{2+} and 127 mg/l Cl^-
- Magnesium sulfate (Epsom salt) MgSO_4 – 1 gram per gallon of water will add 26 mg/l Mg^{2+} and 103 mg/l SO_4^{2-}
- Sodium bicarbonate (Baking soda) NaHCO_3 – 1 gram per gallon of water will add 75 mg/l Na^+ and 191 mg/l HCO_3^-

CHEMISTRY VS STYLE

- The important measurement for your beer is “residual alkalinity” represented by the following equation: $RA = 0.83 (\text{HCO}_3^-) - 0.71 (\text{Ca}^{2+}) - 0.59 (\text{Mg}^{2+})$
- The darker the malt, the more acidic. So, water with higher residual alkalinity is better for darker beers. Targets for RA in brew water should be based on the malt you are using as follows:
 - 20 for pale, 20 for gold, 60 for amber, 100 for brown, and 150+ for black
- This rule of thumb will keep you in a targeted mash pH range

ADJUSTING THE WATER FOR STYLE

- Calculate RA of your source water – add alkalinity (chalk/baking soda) if too low, add salts (calcium or magnesium salts) if too high. Also consider diluting your source water with RO or distilled water.
- Make sure flavor ions (sodium, sulfate, and chloride) are not too high.
- Confirm that enough calcium is present
- Add sulfate and chloride salts for flavor if needed
- Brewing software such as Brewer's Friend and BeerSmith can aid with your calculations

LEVEL TARGETS

- Keep sodium no higher than 50 mg/l
- Sulfate less than 50 mg/l in a malty beer and chloride less than 50 mg/l in a very hoppy beer
- Calcium at least 50 mg/l in mash and 100 mg/l in the boil
- 100-200 mg/l sulfate in moderately hoppy and 200-300 mg/l in very hoppy beers
- 50-100 mg/l chloride in moderately malty and 100-150 mg/l in highly malt-forward beers
- Sulfate and chloride can be added in the kettle rather than the mash (to avoid pH changes)

EXTRACT VS ALL GRAIN

- Extract beers do not require the same efforts as all grain, since you aren't dealing with a mash
- However, malt extracts contain whatever minerals were present in the mash used to make the extract
- Best to use distilled or RO water with malt extract, and then adjust with flavor ions
- Having a known water profile or building one from scratch prior to mashing is the best way to avoid causing issues with your beer style

QUESTIONS?



SOURCES

- <https://sensorex.com/blog/2021/05/31/groundwater-vs-surface-water/>
- <http://www.homebrewing.com/articles/water-chemistry/>
- <https://drive.google.com/file/d/1Sxtrcrsipj89WUrd2Na24EjKQtDPuW4I/view>
- <https://www.freedrinkingwater.com/water-education/water-info-safe-drinking-source.htm#:~:text=There%20are%20two%20main%20sources,transmit%20groundwater%20are%20called%20a%20quifers.>
- <https://www.grecoandhaines.com/groundwater-vs-surface-water/#:~:text=While%20groundwater%20typically%20contains%20fewer,the%20dissolving%20action%20of%20water.&text=Moderately%20Hard%20Water%20%E2%80%93%2061%20to,180%20or%20more%20mg%20FL>
- http://www.homebrewing.com/equipment/MB_lamotte-brewlab-water-test-kit-718801-MT201/