my green lab certification.

Building a global culture of sustainability in science

Water

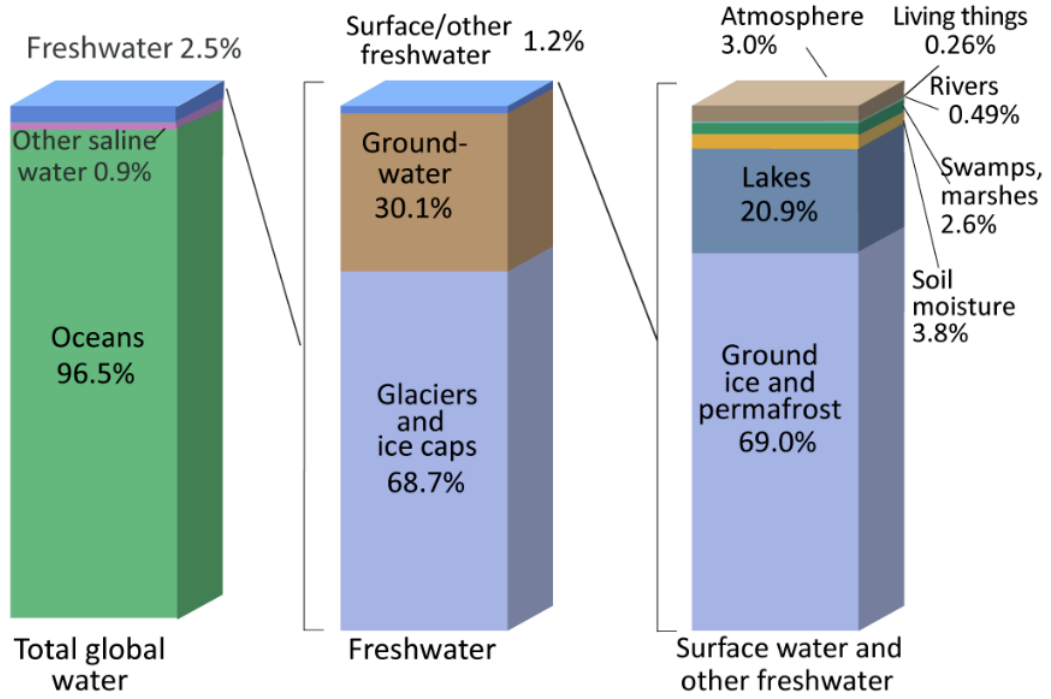
Water, Water, Everywhere…but Nowhere

Fresh Water is SCARCE!

- Only 2.5% of water on Earth is fresh water
- Most is locked up in glaciers and permafrost

Access is Limited

- **72% of all water withdrawals** are used by **agriculture**, 16% by municipalities for households and services, and **12% by industries**
- About **4 billion people**, representing nearly two-thirds of the global population, **experience severe water scarcity during at least one month of the year**

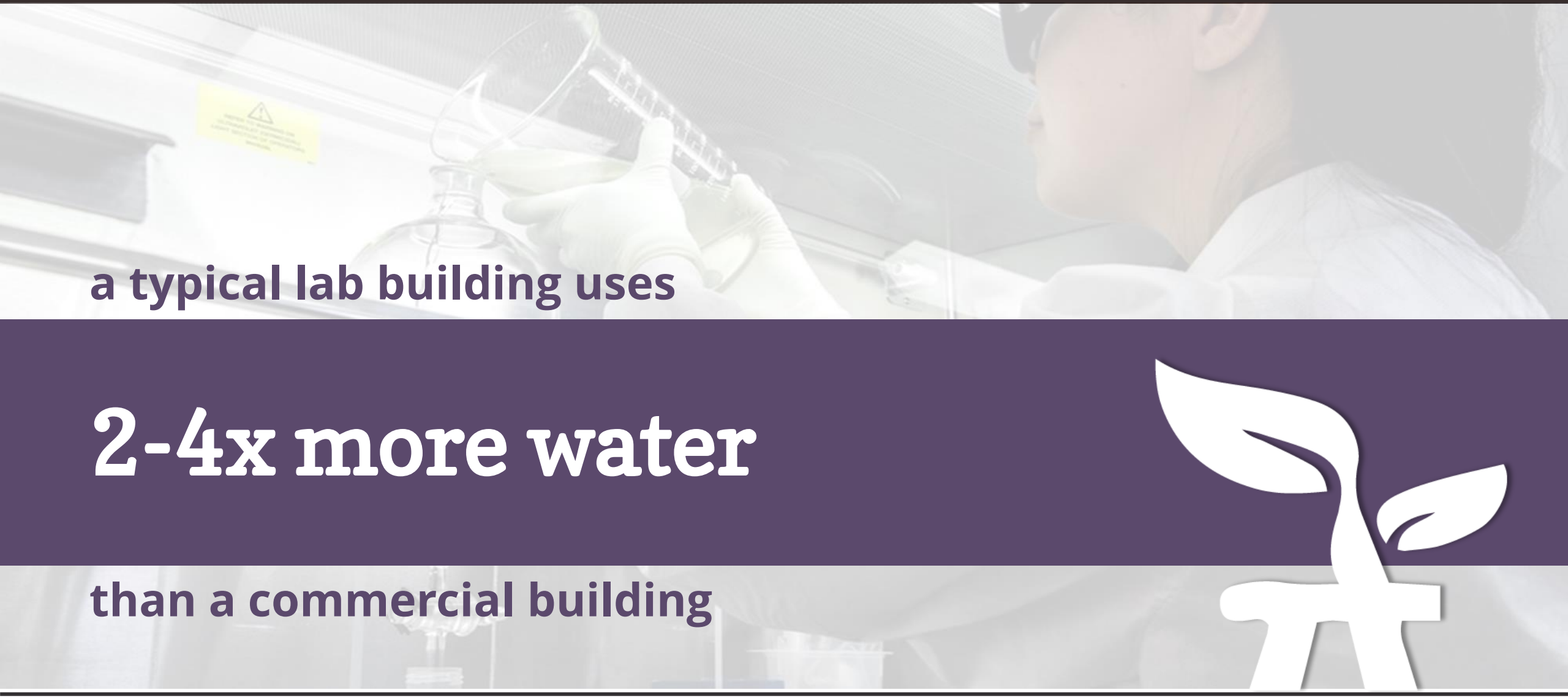


Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources. (Numbers are rounded).

https://www.unwater.org/water-facts/scarcity/#:~:text=Water%20scarcity%20can%20mean%20scarcity,scarcity%20already%20affects%20every%20continent.

my green lab.

Water Consumption in Labs

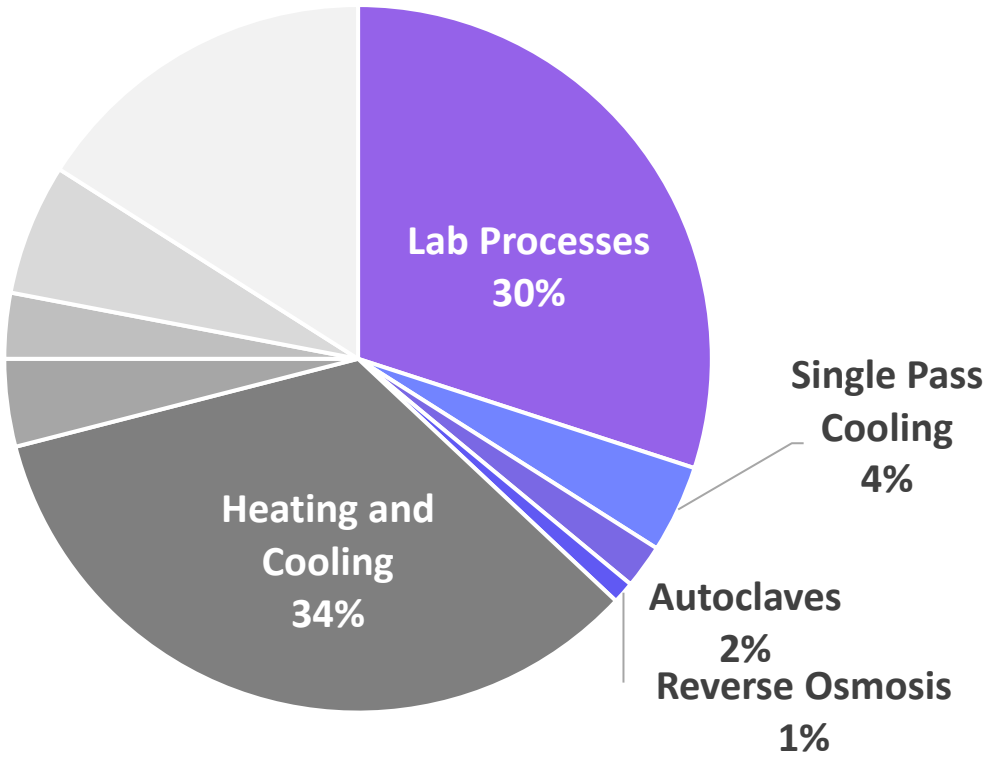


a typical lab building uses

2-4x more water

than a commercial building

A Closer Look at Water



Graph adapted from US EPA WaterSense 2009

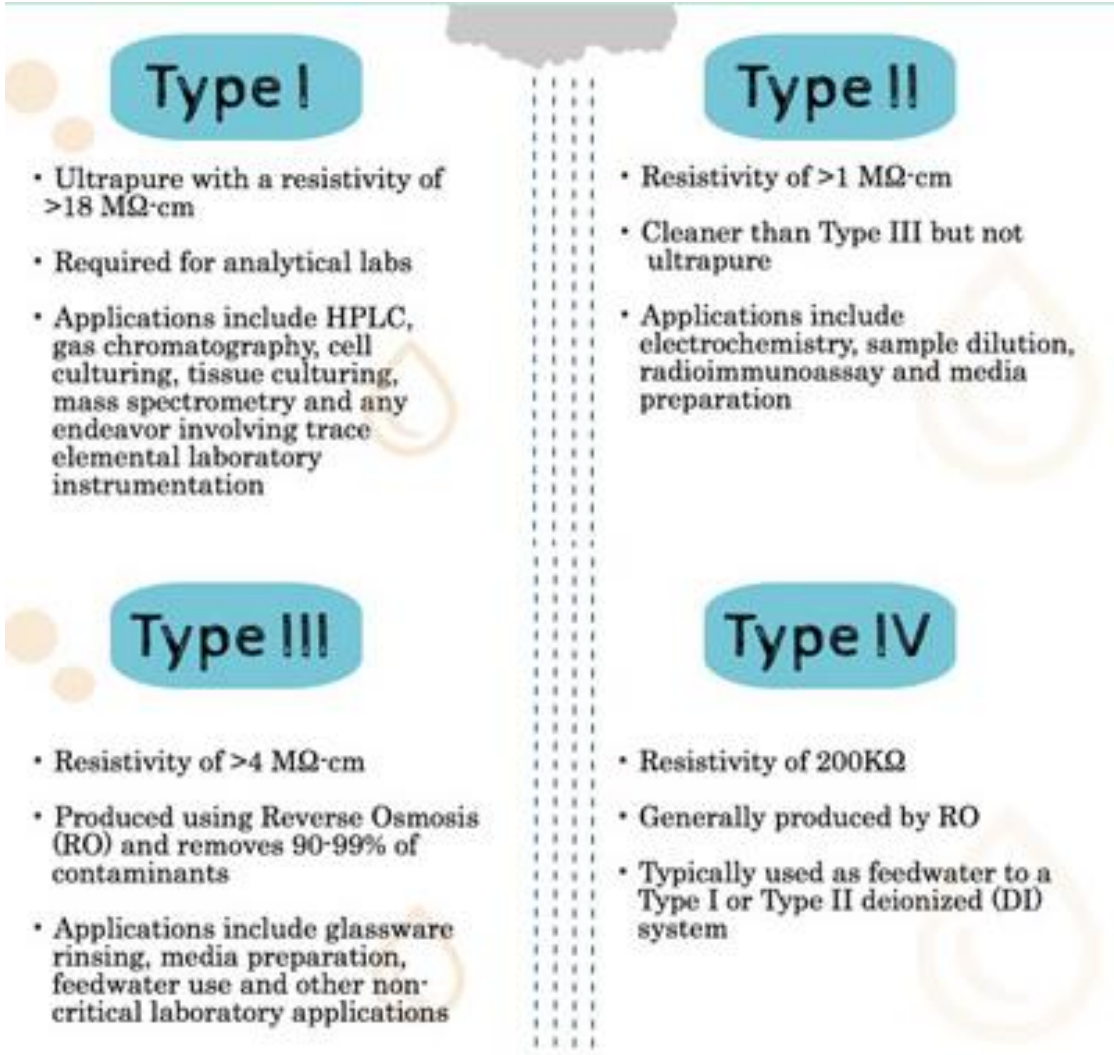
Purified Water

Purifying Water is NOT 100% efficient!

- Most RO water systems discard 50% or more of the water that goes in
- Distillation systems only yield about 11% of the water that went it
- It takes 3L of water to make 1L of DI water

Know what quality water you need

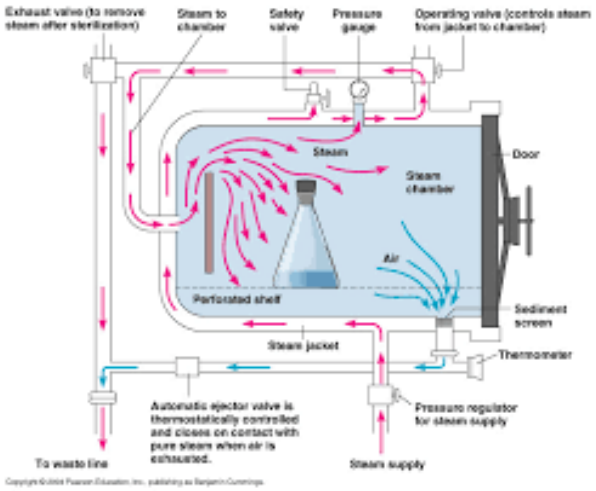
- Labconco: Infographic: What water type should I use?
  https://www.labconco.com/articles/water-type-difference
- Millipore webinar on environmental impact of water purification
  https://www.labmanager.com/webinars/webinar-water-purification-in-your-lab-how-it-can-impact-your-environmental-footprint-11833#.Vuxr8uIrJaQ
- Water tutorials – purification techniques and water grades
  https://www.emdmillipore.com/US/en/water-purification/learning-centers/tutorial/purification-techniques/M42b.qB.QHEAAAFAVVZkiQz9,nav



Autoclaves

Steam Jacketed vs Pressure Cooker

- Steam jacketed autoclaves can use 10x more water, mostly from:
  - Vacuum Drying
  - Cooling the discharge water



Best Practices

- Install a water saving device if you have steam jacketed
- Don't use vacuum drying
- If you run 5 or fewer cycles a day, get a pressure cooker type
- Run autoclaves when full
- Put in standby mode when not in use

	Steris model 1	Steris model 2	Priorclave*
Volume	510 L	540 L	500 L
Vessel Configuration	Rectangle	Round	Round
Steam Source	Stand alone	Internal Generator	Internal Generator
Average Cycles/day	0.46	0.56	1
Average Water Use (gal/day)	648	654	43.8

https://chesc.org/wp-content/uploads/UCR-Autoclave-study-2016-PROCUREMENT-DF.pdf

Single Pass Cooling - Equipment

Common Equipment That is Water Cooled

- X-ray machines
- Vacuum Pumps
- Ice machines - can use 2-3x as much water as is need to make the ice!

https://www.epa.gov/sites/default/files/2017-02/documents/watersense-at-work_final_508c3.pdf

https://www.i2sl.org/documents/toolkit/bp_water_508.pdf

Upgrade to air-cooled equipment or put them on a closed loop

Single Pass Cooling - Apparatus

The Problem

- University of California, Berkeley had just 6 labs that used single pass cooling in lab processes
- Estimated water usage was 3,600 liters of water for every 24 hours single passed cooling was used on a single column
- Labs ran single pass cooling for days at a time

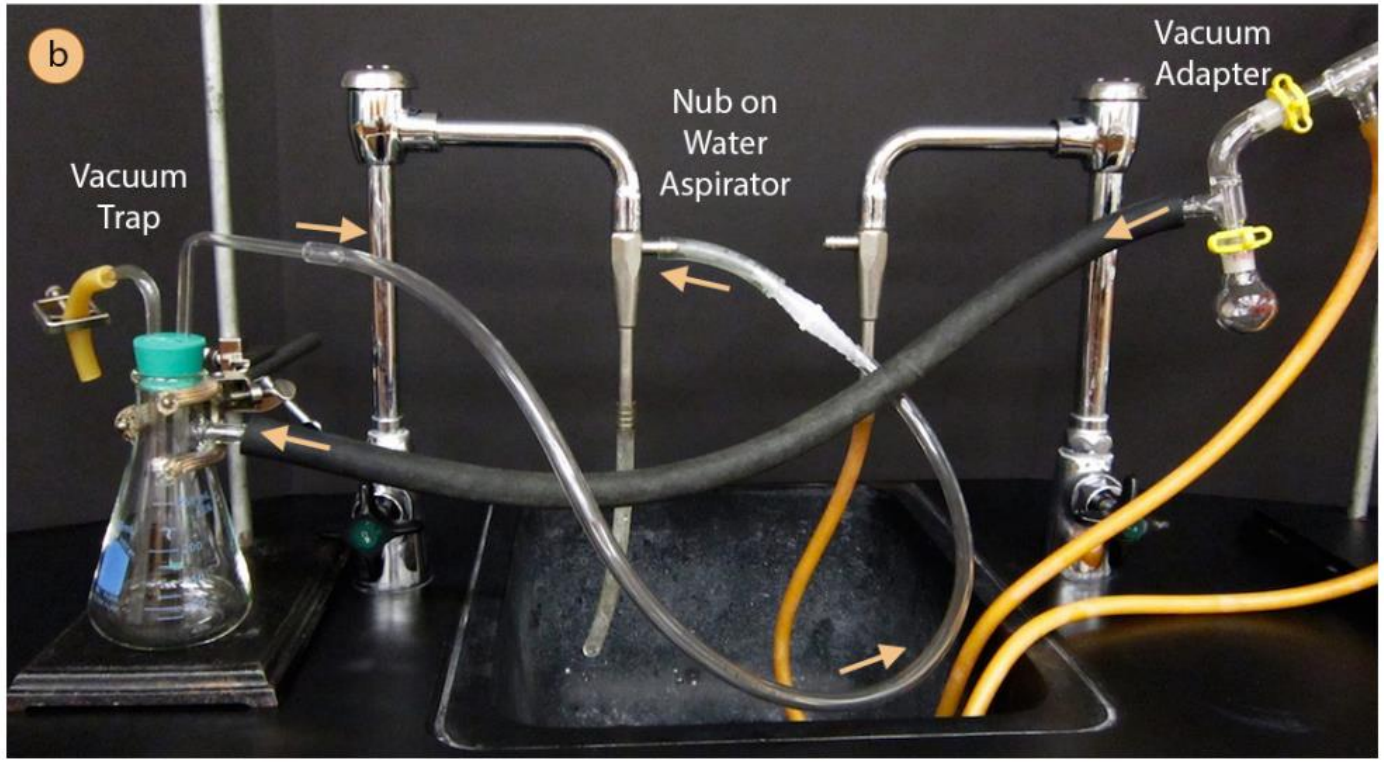
The Solution

- University invested in Findensers and fish pumps to replace single pass cooling setups

The Impact

- Saved 7.7 million gallons of water a year

Water-Vacuum Aspirators



Don’t do it!!! Use a pump!

- Typical water flow in a lab is about 9L per minute to get around 10 Torr
- Rotary vein or diaphragm pumps can achieve 1 Torr and use zero water

https://banebio.com/why-its-time-to-replace-your-water-aspirator-with-a-vacuum-pump/

Lab Processes

Reduce Water From the Tap

- Install low-flow aerators – these can save 50-70% of the water
- Report leaks promptly
- Run glassware washers when full
- Use water wisely when washing – install a foot pedal for easy off!
- Reuse water for running gels

Water Summary

Impact – High to Low

- Install low-flow aerators
- Install water saving devices on autoclaves or exchange steam-jacketed ones
- Replace single-pass cooling setups
- Don’t use water-vacuum aspirators
- Run autoclaves and glassware washers full
- Be efficient with water in lab processes
- Use the right quality water