Indoor Water Use

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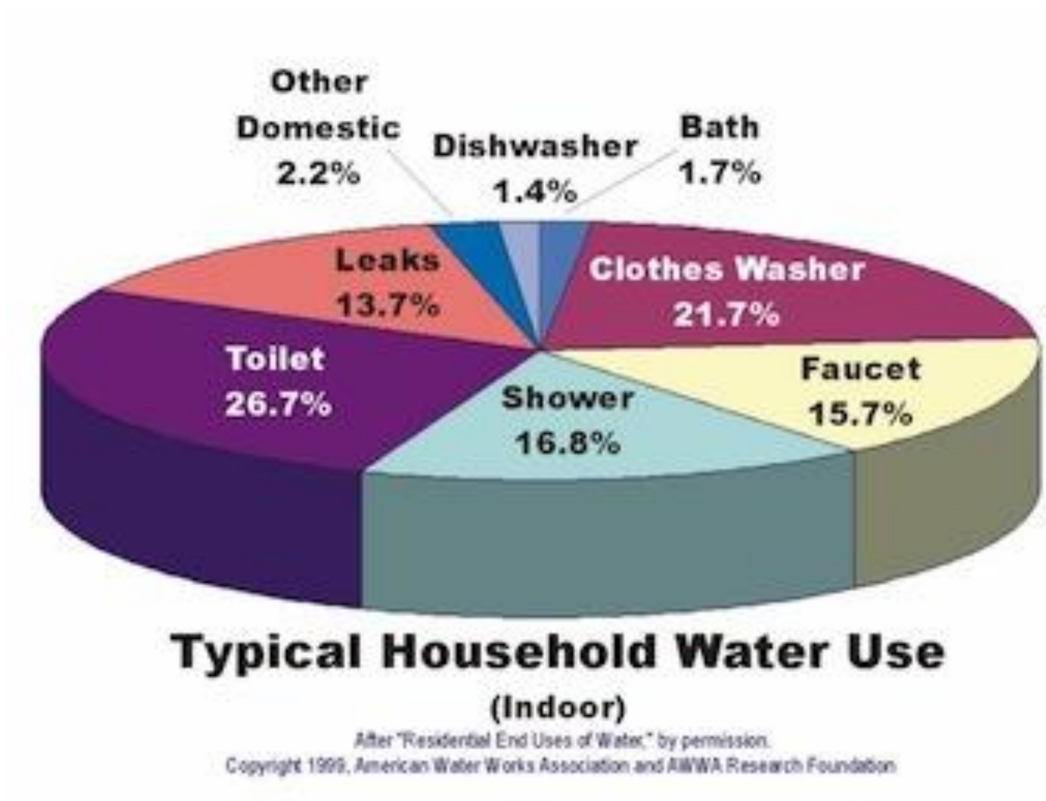
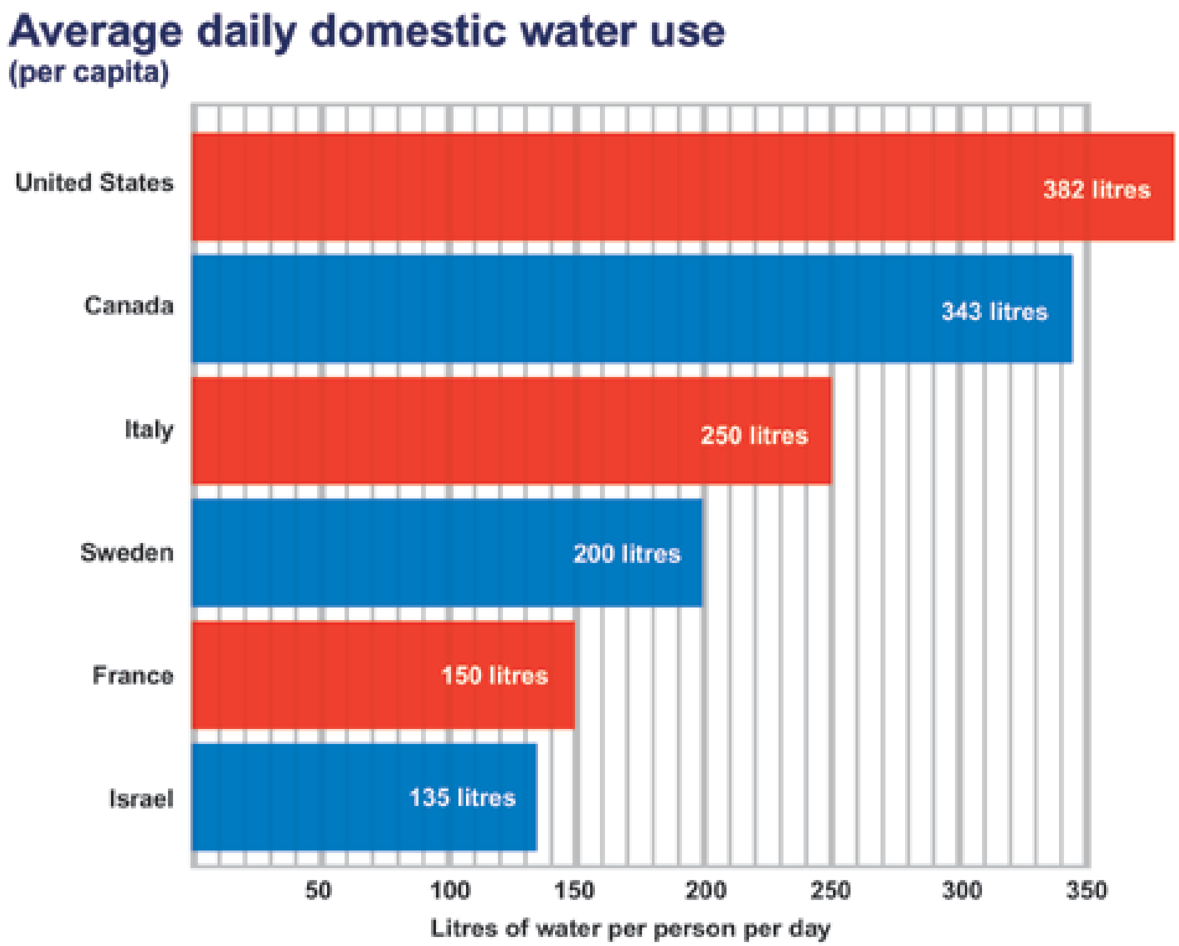
Americans use more water in our homes than any other nation...

We use water in and around our homes in numerous ways. It is used for indoors for drinking, food preparation, bathing, cleaning, and flushing toilets, and outdoors for watering landscaping and washing cars. The average North American (American or Canadian) uses roughly 100 gallons (375 L) of water a day, with approximately 70% of the usage indoors and 30% outdoors. While outdoor water use can vary widely between individuals (city dwellers use less than suburban/rural residents, residents of drier climates use more than residents of wetter climates) indoor water use follows the averages described in **Figure a** below.

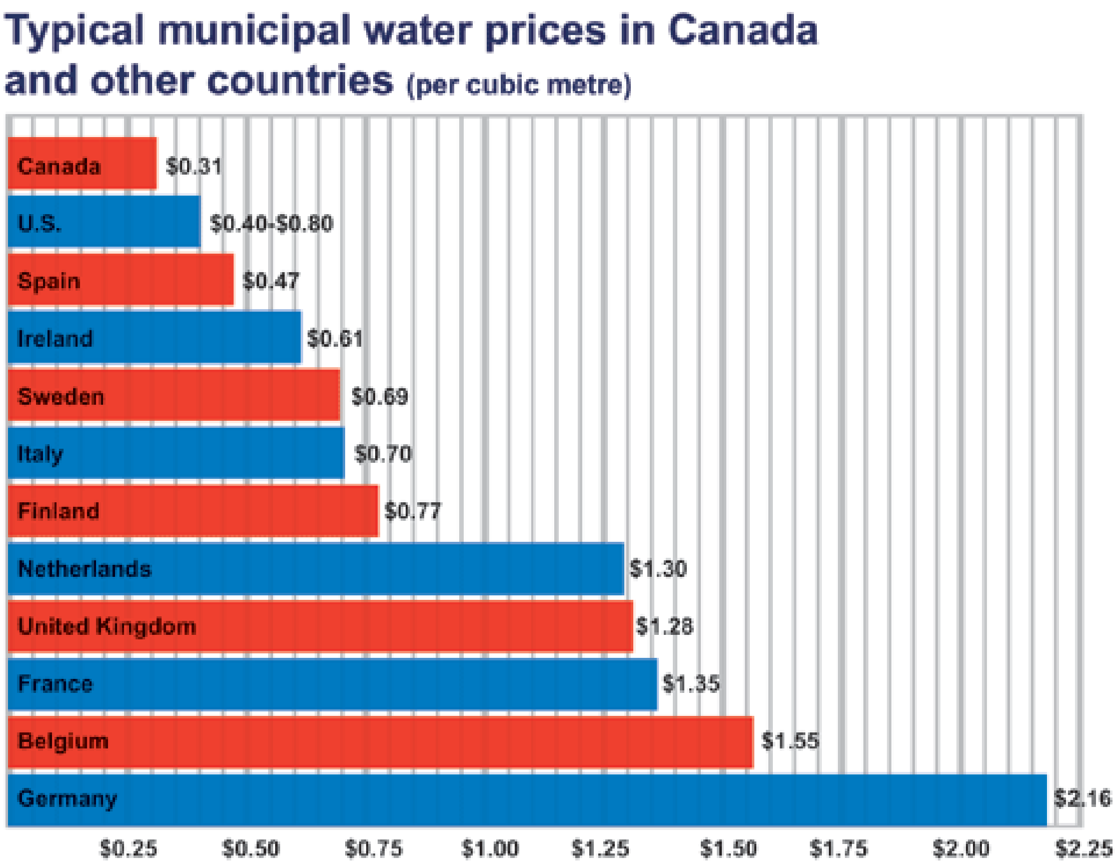


(a) Caption: Toilets are the largest indoor water use for the average American, but many other uses contribute significantly to overall water usage.
Source: http://www.pwsd2.org/static/ConservationTips.htm

This 100 gallon a day usage ranks North Americans among the highest per-capita water users in the world (**Figure b**), a factor likely due to the low price of water in the United States relative to other developed nations (**Figure c**). These low prices are facilitated by generous governmental support of water infrastructure in North America (e.g., constructing/maintaining dams for domestic water supplies, providing grants to local communities for drinking water/wastewater treatment), which artificially lowers the price paid for water by consumers and discourages conservation.



(b) Caption: Americans use large quantities of domestic water compared to other nations. To convert the chart values to gallons, divide by four because one gallon is roughly equal to 4 liters.
Source: https://www.ec.gc.ca/eau-water/default.asp?lang=en&n=00EEE0E6-1



(c) Caption: Americans use large quantities of domestic water compared to other nations. Roughly four liters equals one gallon, so divide the chart values by four to convert to gallons.
Source: https://www.ec.gc.ca/eau-water/default.asp?lang=en&n=00EEE0E6-1

...but not all people are as fortunate as Americans

We take for granted that every time we turn on the tap, we will receive as much clean, potable water as we desire. But not everyone around the globe is so fortunate with respect to water supplies. The poor in many developing countries do not have access to indoor plumbing and must carry water to their homes for domestic use. This laborious and time-consuming task often falls to women and girls in rural villages, and this restricts opportunities for females to pursue education and work outside the home. It is also very strenuous work as each gallon of water weighs around 8 lbs (3.8 kg). Aid organizations and environmental groups estimate that each person requires around 13 gallons (50 L) of clean, fresh water a day to maintain health and hygiene. A young girl carrying water for a family of five would therefore need to haul roughly 520 lbs of water – that's more than a quarter of a ton – each and every day from water sources that are sometimes a mile or more from the home.

Caption: The task of carrying water from its source to homes often falls to children in developing countries, like these children carrying water in the African nation of Togo.
Source: https://www.slideshare.net/acampbell/unicef-walk-for-water

Opportunities exist throughout the home to save water

In the pages that follow, we'll examine the major uses of water in the modern American home and illustrate approaches and technologies that accomplish the desired task while using less water. As a preview (or a capstone) to this module's content, consider visiting the California Urban Water Conservation Council's online "H_2OUSE". The site provides an interactive tour of a virtual home where users can identify areas in which to improve water use efficiency.

Caption: H2Ouse has abundant information for conserving water in homes.

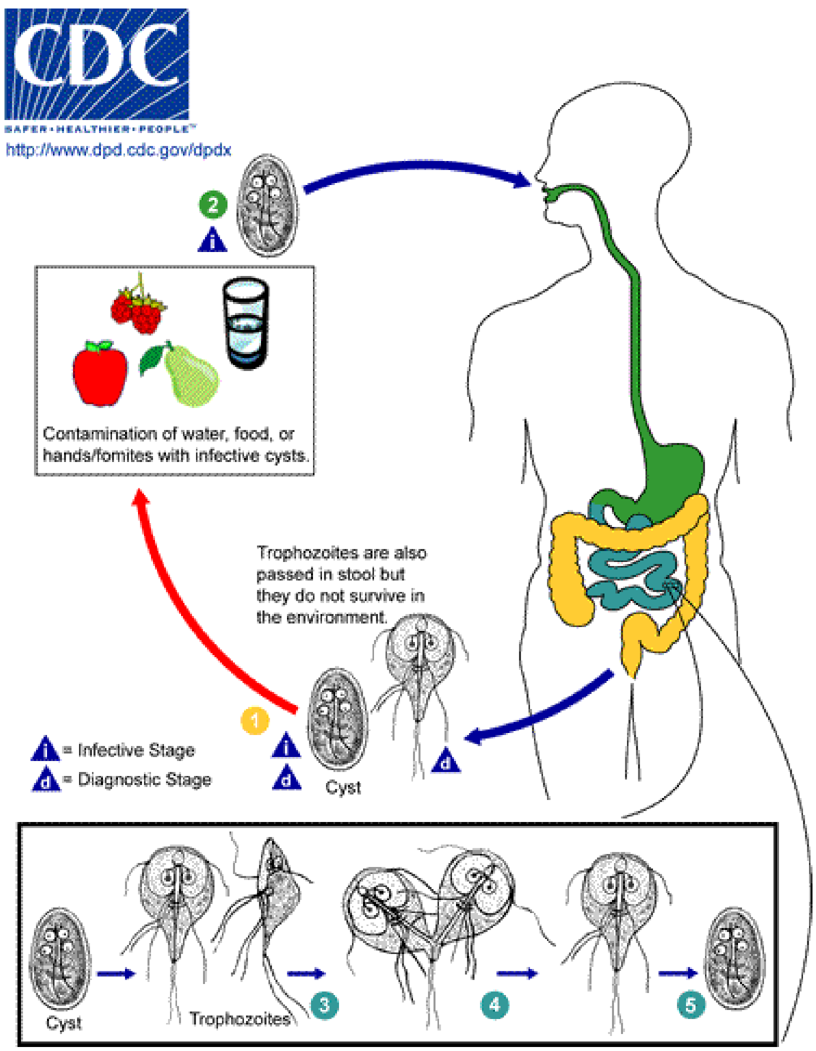
With large portions of our country grappling with pressure on water supplies from growing populations and more frequent and severe droughts, conserving water around the home and promote positive movement towards reducing the environmental footprint of the typical American residence. EPA's WaterSense program estimates that if all Americans were to update their bathrooms with water-conserving fixtures, we could save a stunning 74 billion gallons of water each year! Let's examine the major uses of water in order of the contributions to overall water use so we can see the many ways to save water in our homes.

One Step Beyond: "H_2OUSE"
Tour a virtual home to find ways to conserve water in and around the house.
http://www.h2ouse.org/

One Step Beyond: "Water Use It Wisely"
100 simple ways to save water in your home and workplace.
http://www.wateruseitwisely.com/100-ways-to-conserve/index.php

Toilets have facilitated massive improvements in public health

The modern toilet has done wonders for public health by providing people a safe, sanitary, and convenient way to dispose of our wastes. Many of the diseases that have historically ravaged human populations (such as cholera, typhoid, and dysentery) are spread when fecal wastes contaminate drinking water supplies. This is a *fecal-oral* mode of disease transmission, where the pathogen lives and reproduces in the intestinal tract of the host and then initiates its exit from the host by inducing diarrhea. This fecal material can then contaminate food or water supplies, allowing the pathogen entry into a new host to repeat the cycle. The fecal-oral life cycle for the protozoan flagellate *Giardia intestinalis* is shown below (**Figure**).



Caption: *Giardia* is a pathogenic protozoan with a fecal-oral transmission mode that is of concern in drinking water supplies.
Source: https://www.niaid.nih.gov/research/giardia-lamblia-life-cycle

Prior to the widespread use of toilets, humans came in frequent contact with wastes while handling the disposal of their own wastes or walking in streets strewn with human and animal feces. Under these conditions outbreaks of fecal-oral diseases could spread quickly and result in significant numbers of deaths. The modern toilet has therefore probably done more to improve quality of life than nearly any other invention in human history. Unfortunately, about 40% of the global human population, some 2.6 billion people, currently lack access to the advanced sanitation Americans enjoy, so fecal-oral diseases continue to affect many parts of the world today.

Conventional toilets are based on a few simple principles

Toilets are the biggest water user in a typical American home and are responsible for roughly one-fourth of total indoor water use. Toilets are designed to capture and evacuate human wastes in a sanitary fashion and their basic operation is simple. Water is stored in a tank behind the bowl, and is released into the bowl when flushed. The rushing water creates a siphon effect, which then pushes/pulls the wastes and water down into the sewer system or septic tank.

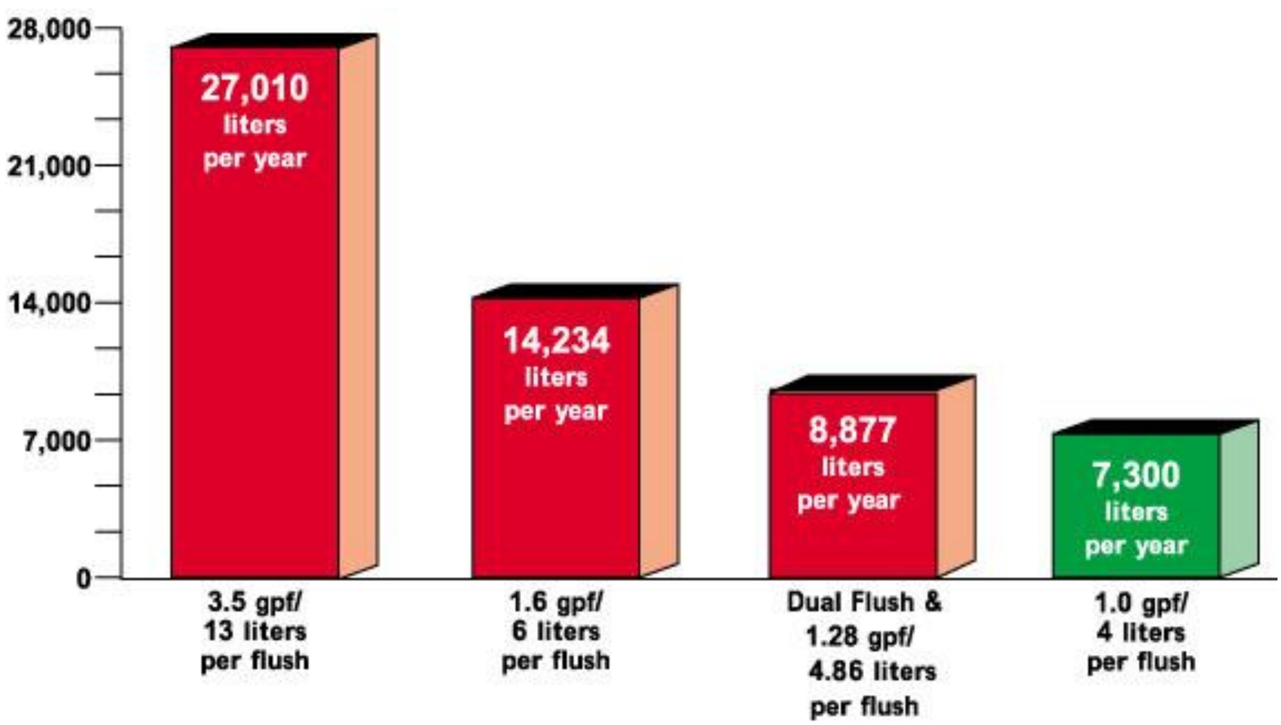
Caption: On average, toilets are the largest water user in the modern American home.
Source: https://blog.epa.gov/blog/2009/03/fix-a-leak-detecting-and-fixing-toilet-leaks/

Pressure-assist toilets use the same basic principles as conventional toilets, but use water pressure to send wastes down the drain more forcefully, reducing the amount of water required for flushing.

Toilets provide a big opportunity for water use savings

As you saw previously, water is used to force the wastes in the toilet bowl into the sewers and away from the home. Over time, toilets have been designed to use less and less water to accomplish this task. Toilets manufactured prior to 1980 typically used 5 -7 gallons (19 – 26 L) per flush (abbreviated "gpf"). Toilets made in the 1980s used 3.5 gpf (13 L) and a federal law in 1992 mandated that all new toilets manufactured after 1992 use a maximum of 1.6 gpf (6 L). Some toilets available today use as little as 1 gpf (3.8 L) and California and some other water-stressed states are considering legislation to mandate the use of these highly water-conserving toilets.

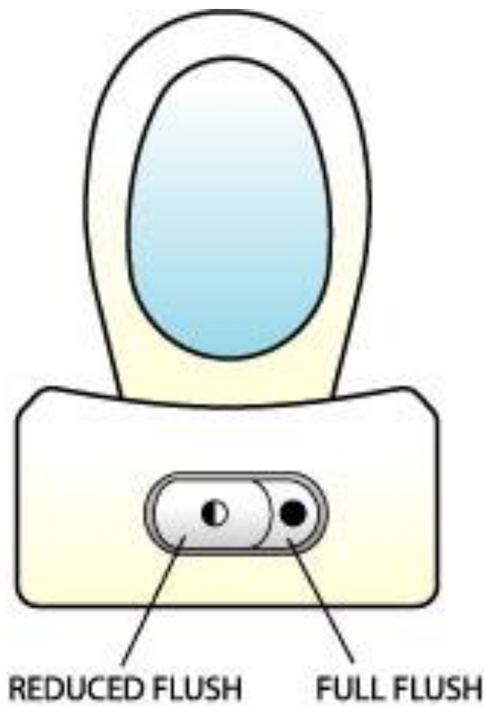
Despite the lesser amounts of water used, modern toilets outperform their older counterparts, dispelling the notion that toilets today are less reliable (that is, they clog more frequently) than those in the past. Consider that if you are a current college student you have, in all likelihood, been using low-flow, water conserving toilets for your entire life and undoubtedly did not find them wanting in their performance. As shown in the figure, the water savings accomplished over a year simply by using a higher-efficiency toilet are staggering. The U.S. Environmental Protection Agency estimates that if all of the older, less-efficient toilets in the U.S. were replaced with higher-efficiency models, we would use about 2 billion fewer gallons (7.6 billion L) of water a day than we currently use.



Caption: Estimated water use per year with toilets of differing efficiency.
Source: http://www.prnewsnow.com/how-much-water-does-a-public-toilet-use-per-flush/

Dual flush toilets: Two kinds of flushes for two kinds of wastes

The water savings inherent in conventional modern toilets (1.6 gpf) are positive, but we have the opportunity to save even more water with our toilets. Humans produce two kinds of wastes, so it only makes sense to have two flushes from which to choose. Dual flush toilets offer a choice between a liquid-waste flush that uses 0.8 – 1.2 gallons (3.0 – 4.5 L) and a solid waste flush that uses 1.6 gallons (6 L) (Figure). Dual flush toilets use a trapway at the bottom of the bowl to evacuate wastes, there is no need for siphoning and flushing can therefore be accomplished with less water. As liquid wastes require far less water to flush than do solid wastes, and because liquid waste flushes are more frequent than solid waste flushes, dual flush toilets can save up to 68% on water use compared to a 1.6 gpf toilet!



Caption: Dual flush toilets conserve water by using the minimum amount necessary for the type of waste.

Dual waste toilets have already been embraced in nations around the world that have limited water supplies and/or growing populations. The acceptance of dual flush toilets has been slower in the United States, but when you consider our nation has roughly 310 million residents and the average American flushes a toilet 5 – 8 times a day, the water savings inherent in widespread adoption of this technology would be stunning. Dual flush toilets usually cost more than conventional toilets, but save users money on their water/sewer fees due to lower rates of water usage. Rebates for the purchase of high-efficiency toilets are often available as well, further reducing the cost investments of adopting this technology.

When shopping for a new toilet, consider looking for the “Water Sense” label on models. This program, sponsored by the U.S. Environmental Protection Agency, certifies toilets that have been independently tested to provide both high performance and substantial water savings.

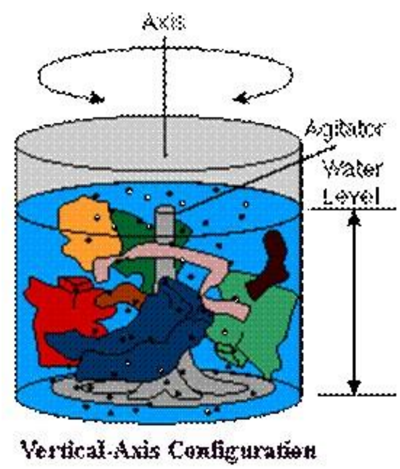
HSW Box: “How Dual Flush Toilets Work” (4 pp.)
Review detailed information on dual flush toilets in this tutorial.
http://home.howstuffworks.com/dual-flush-toilet.htm

One Step Beyond: “EPA’s WaterSense Program”
Learn more about EPA’s program for certifying high-performing, water-efficient products.
https://www.epa.gov/watersense

Clothes washers are the second largest water user in homes

The clothes washer, or washing machine, is a fantastic invention that has freed people from the once time-consuming task of washing clothes by hand. The basic operation of a modern washing machine is relatively simple. Clothes are placed in the tub within the washer and the tub is filled with water. Detergents are added and the clothes are agitated (shaken and moved around) to enable the detergent to attack stains on the clothes. The soapy water then drains, and the clothes are rinsed with clean water to remove the detergent. The water is drained again and the clothes are spun at a high rate of speed to remove much of the water from the clothes to facilitate drying.

In conventional, upright-style clothes washers ("top-loaders"), clothes are placed into the tub within the washing machine from the top of the machine and the tub fills with water to submerge the clothes. The tub rotates back and forth and a cylinder in the center of the tub turns to agitate the clothes and promote cleaning. The entire tub has to fill with water multiple times during a wash cycle, and this can use around 40 gallons (150 L) of water per load.

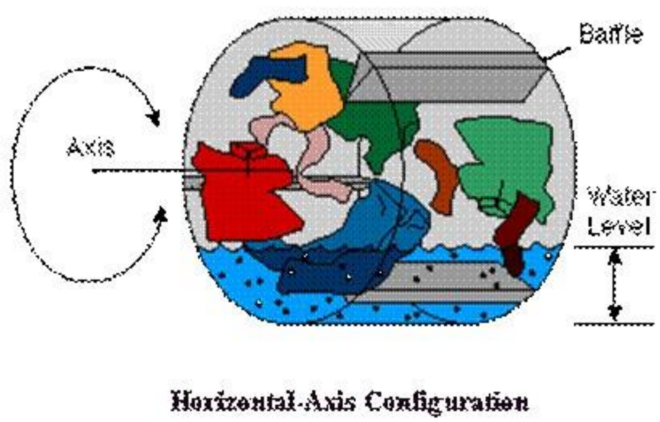


Caption: A top-loading washer has a vertical-axis configuration that requires sizable quantities of water to clean clothes.

HSW Box: "How washing machines work" (10 pp.)
A highly-detailed look at the components and operation of a modern washing machine.
http://tlc.howstuffworks.com/home/washer.htm

High-efficiency washers offer big water savings

Newer, high-efficiency clothes washers use a very different engineering approach that provides substantial savings of water and energy. In front-loading washing machines, clothes are placed in the washer's tub from the front of the machine, and the door seals tightly once the wash cycle is initiated. These models only fill with a small amount of water in the bottom of the tub, and the clothes are spun through the water at the bottom of the basin and agitated with baffles within the tub. Instead of the 40 gallons needed in a typical top-loading model, high-efficiency models need as little as 20 gallons (75 L) of water – a 50% reduction in water use in every load. Conversion to a high-efficiency washer could save a family up the cost of up to 7,000 gal (26,500 L) of water a year.



Caption: The horizontal-axis configuration of a front-loading washer requires far less water per load than the vertical-axis design of a top-loading washing machine.

“It’s like getting the dryer for free!”

High-efficiency washers have higher initial cost than conventional models, but pay back this difference very quickly due to savings in water and energy costs. They use only 30 - 50% of the energy of a conventional washer, saving consumers money. Much of these energy savings are from the need for less water to wash clothes, as up to 90% of the total cost of washing a load of clothes comes from the energy used to heat the water. Front-loading washers also provide less wear and tear on clothes from agitation and spin more water out clothes than conventional washers, drastically reducing drying time and the associated energy costs. According to the California Energy Commission, high-efficiency washers save consumers $850 over the life of the appliance from reduced needs for water and energy. Given these savings, it is often said that buying a high-efficiency clothes washer “gets you the dryer for free”.

HSW Box: “Are high-efficiency washers worth the expense?” (2 pp.)
See why high-efficiency washers pay off their added up-front costs quickly.
http://tlc.howstuffworks.com/home/high-efficiency-washers-worth-expense.htm

Little changes help *all* clothes washers save water and energy

Regardless of whether your washing machine is conventional or high-efficiency, there are simple steps you can take to conserve water while still getting your clothes clean. Whenever possible, only run the washer when you have a full load. This makes the water you use have the greatest return with regards to clothes cleaned. If you do run it when not full, select the feature for smaller loads if your model has such an option. Washing machines come in different sizes, so consider your washing needs when purchasing your model. If you live alone or have a smaller family with limited clothes washing demands, a smaller washing machine will meet your needs while using less water and energy than a larger model.

Save energy by washing only very dirty clothes in hot water and normal loads of clothes in cold water. Also, do not use too much detergent, as this forces your washing machine to use more energy while its operating.

With an estimated 55 billion loads of laundry washed in the United States each year, the savings from high-efficiency clothes washers could have profound benefits for conserving our nation's fresh water resources and reducing domestic energy use, greenhouse gas production, and air pollutant emissions.

There are many ways to save water with an automatic dishwasher

The automatic dishwasher is inherently a water-saver, as it uses less water to clean a load of dishes than typically would be used if those dishes were washed by hand. A dishwasher is designed to clean the dishes within it while minimizing the use of water and energy. Like a front-loading clothes washer, dishwashers do not fill with water, but rather spray water from collection basin at the bottom of the machine onto dishes to clean them.

Some models of dishwashers are more water–efficient than others, but there are many ways to save water with any dishwasher. First, choose the size of your dishwasher carefully. If you live alone or have a smaller family, a smaller dishwasher that uses less water per load will suit your needs better than a larger dishwasher. And as with clothes washers, wait to run the dishwasher until it is full to optimize the efficiency of the water and energy you use to clean your dishes.

Caption: Automatic dishwashers use relatively little water to wash a full load of dishes compared to hand-washing.

HSW Box: “How dishwashers work” (6 pp.)
See how an automatic dishwasher operates.
http://home.howstuffworks.com/dishwasher.htm

Low-flow showerheads decrease water use

Water use in showering is the third largest use in the average American home according to the American Water Works Association data, but it is often the second largest use of water behind toilets for college students, single people, and small families who use relatively little water for clothes washing. There are few things more comfortable in this world than a warm shower on a cold morning, but have you ever given thought to the amount of water you use while shower?

Caption: A modern low-flow showerhead uses about half the water of an older showerhead.
Source: http://www.wichitafallstx.gov/images/pages/N466/showerhead.gif

Older showerheads have flow rates as high as 6 gallons per minute (gal/min), but all showerheads installed in homes since 1995 are required by law to not exceed a flow rate of 2.5 gal/min. This mandated change has saved the United States massive quantities of water, and upgrading to a low-flow showerhead is inexpensive and relatively easy if you have an older home. Don't you're your showerhead's flow rate? Luckily, measuring it is easy. Simply turn your shower on full power and catch all the flow in a bucket of known volume. Measure in seconds how long it takes to fill the bucket and then calculate the flow rate per minute.

The water savings in newer showerheads are typically accomplished with aerators that mix air with the water as it leaves the showerhead. The air expands the perceived volume of the flow and enables new showerheads to use half the water of older showerheads without a noticeable loss in water quantity. The savings are substantial too. A $10 low-flow showerhead could reduce a family's water costs by up to $75 a year, paying for itself in a little over a month.

Faucets also use aerators to save water

Like showerheads, some faucets for your bathroom and kitchen use aerators and flow restrictors to conserve water. Older faucets have flow rates of 3.5 – 5 gal/min, while newer kitchen models reduce flow rates to 1 – 2 gal/min in kitchen faucets and 0.5 – 1 gal/min in bathroom faucets.

Water savings with these faucets can be substantial in larger households or those with small children where hand-washing is frequent. Homes where dishes are washed by hand also experience water savings from low-flow faucets.

Caption: Some faucets for the kitchen and bathroom use only a fraction of the water used by older faucets.

Behavioral changes save water with showers and faucets

In addition to the water savings from low-flow showerheads and faucets, simple changes in behavior can lead to big reductions in water use. Anything that reduces the amount of time a showerhead or faucet runs will save water.

Water savings in the shower are simple – just make them shorter than they are now. Standing under a warm shower is a pleasant feeling, but every minute you cut from your showering time saves 2.5 – 6 gallons of water. Multiply that by the number of showers you take in a month or year, and the water savings become apparent and substantial.

You can also save water in the shower by wetting your body thoroughly (and warming up the shower) and then turning off the water while you wash. Turn the water on again to rinse and you've saved many gallons of water in the process. Some low-flow showerheads provide a turn-off switch on the showerhead that allows the water to be shut off temporarily for this purpose.

Caption: Some showerheads provide a convenient shut-off button to facilitate further water savings.
Source: http://www.thealternative.in/lifestyle/15-stitches-in-time-to-save-20-litres/

Similarly, you can save water by turning off the bathroom faucet while you brush your teeth or lather your hands while washing them. One of the biggest uses of kitchen faucets is for washing dishes. Many people rinse their dishes thoroughly before placing them in a dishwasher. This is not needed for the vast majority of dishwashers, as they are designed to easily handle dirty dishes. If you are washing a large load of dishes by hand, water conservation groups recommend filling one side of the sink with soapy water and the other side with rinse water instead of running the faucet continuously while washing dishes.

All in all, anything you can do to reduce the number of seconds a tap runs in your house will save you water and water heating costs – and put money back into your pocket.

Addressing leaks prevents water waste

According to the U.S. EPA, Americans homes lose 1 trillion gallons of water each year – an average of 10,000 gallons per household – to leaky pipes, toilets, faucets, and other sources.
A single toilet with a leaky flapper could waste up to 200 gal (757 L) a day – the amount of used to flush a toilet 125 times. A leaky faucet wastes thousands of gallons of water each year, as could leaky pipes. The links on this page provide a wealth of resources on leaks and the approaches for addressing them – see them to diagnose if you have leaks in your home and to see ways to correct them if they are present.

Caption: EPA's WaterSense site has good information on leaks and water conservation.
Source: http://www.epa.gov/owm/water-efficiency/pubs/fixleak.html

FYI: "How to repair plumbing pipes" (3 pp.)
Learn how to spot and repair leaks associated with pipes in your home.
http://home.howstuffworks.com/home-improvement/plumbing/how-to-repair-plumbing-pipes.htm

FYI: "How to fix a showerhead" (1 pg.)
Showerheads can develop leaks, but these leaks are often easily addressed.
http://www.howstuffworks.com/home-improvement/plumbing/how-to-fix-a-showerhead.htm

FYI: "How to repair a toilet" (9 pp.)
A leaky toilet wastes tens of gallons of water a day – but as usually fixed cheaply and quickly.
http://home.howstuffworks.com/home-improvement/plumbing/how-to-repair-a-toilet.htm

FYI: "How to do faucet repairs" (6 pp.)
See the simple steps needed to stop a faucet from dripping.
http://home.howstuffworks.com/home-improvement/plumbing/how-to-do-faucet-repairs.htm

FYI: "EPA's WaterSense Fix-a-Leak"
Get facts about water leaks and ways to fix them.
http://www.epa.gov/owm/water-efficiency/pubs/fixleak.html