THE ULTIMATE GUIDE TO
Deuterium Depletion

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Deuterium depletion is a cutting-edge health practice for lowering deuterium levels in your body. It may result in higher energy levels, a faster metabolism, anti-cancer effects, and more.

People use deuterium-depleted water, the ketogenic diet, and other methods you’ll learn about in this article to reduce their deuterium levels.

By the time you finish reading, you’ll have a better understanding of why you might want to deplete deuterium, what to expect from it, and how to design your own deuterium depletion protocol.

What is Deuterium?

Deuterium is a stable isotope of hydrogen.

Unlike normal hydrogen (also called protium), deuterium has an extra neutron, doubling its atomic mass. For that reason, another name for deuterium is “heavy hydrogen.”
The big bang may have created most of the deuterium in the universe [1].

As a hydrogen isotope, deuterium can fit in any chemical or physical reaction where a hydrogen atom can fit. That means it’s in your body, in the foods you eat, and in the water you drink.

When deuterium substitutes for protium in a molecule of water (H2O), the result is called deuterium oxide or “heavy water.”

Here’s a key point we will revisit more than once: heavy water has different physical properties than regular water.

Heavy water has a higher melting point (3.82 °C), higher boiling point (101.4 °C), and evaporates more slowly than “light” water without deuterium[2].

And because of these properties, deuterium levels vary depending on where you are on earth. To learn why, let’s take a quick look at how the water cycle influences the distribution of deuterium.

**Deuterium and the Water Cycle**

On the surface of the earth, there is about one deuterium atom in ocean water for every 6420 hydrogen atoms on average. In other words, the deuterium concentration for most of our planet’s water is about 150-160 parts per million (ppm) or 0.000156%.

However, higher elevation and distance from the equator both reduce the heavy water concentration because of how the water cycle changes deuterium levels[3].

In other words, deuterium levels are usually lower farther from the ocean or where it’s cold. These differences occur because of the different melting point and evaporation rate of heavy water compared to normal water.

*Deuterium concentrations in the water cycle at mid-latitudes, with reported seasonal variations in parentheses*[4]
Deuterium depletion is any method of lowering deuterium levels.

Humans, animals, plants, and other living creatures can deplete deuterium naturally when they are young and healthy.

Unlike the 150-160 parts per million (ppm) levels found in ocean water, many organisms maintain levels as low as 100 ppm in their tissues by depleting deuterium[6].

Healthy cells, mitochondria (the “powerhouses of the cell”), and gut flora tend to excrete deuterium on their own. You can eliminate some of your excess deuterium by simply breathing, sweating, urinating, and evacuating solid waste[7].

Therefore, the deuterium content of water you drink and the foods you eat also vary depending on their origin[5].

Now that you know what deuterium is, it’s time to learn about deuterium and life.

What is Deuterium Depletion?

Deuterium depletion is any method of lowering deuterium levels.
Additionally, living organisms respond to variations in deuterium.

For example, E. coli bacteria grow faster in a mildly deuterium-enriched environment[8].

Your body may use deuterium strategically in some tissues to reduce damage to cells, and some researchers think early life on earth evolved thanks to this effect of deuterium[9].

On the other hand, high levels of deuterium are toxic to living organisms[10].

Studies of cells and plants show that deuterium depletion can slow cell growth, while deuterium enrichment can speed up fast-growing cells[10].

Therefore, while deuterium may be useful for development and normal cell growth, too much deuterium can also encourage cancer cell growth and cause cellular damage[6].

It appears that life has evolved to make use of deuterium, but also to keep it sequestered or contained when necessary.

Growing plants tend to store excess deuterium in their fruits, sugars, or leaves[11].

And a study of fruit flies also found that given the choice, they choose lower deuterium levels in drinking water[12].

However, in some cases these depletion, containment, or avoidance mechanisms don’t work properly.

For example, aging may impair deuterium depletion[7][13].

In other cases, the dietary or environmental deuterium levels are too high to deplete naturally.
Deuterium and Evolutionary Biology

As recently as 11,700 years ago, deuterium levels on earth may have been over 30% lower.

Why? Because that’s when the most recent ice age ended.

Ice core evidence suggests that during ice ages, colder temperatures and more ice and snow can remove deuterium from water[3].

In other words, deuterium levels in water and food were probably a lot lower during large stretches of our ancestors’ evolution.

And the deuterium content of modern, highly processed foods that contain grains, sugar, or corn is higher still[14].

It appears elevated deuterium levels may cause higher rates of obesity, cancer, and cardiovascular disease, which is consistent with increased rates of those diseases in modern people[15][16][17].

The deuterium hypothesis would also fit with evidence suggesting that lower-deuterium diets like the paleo diet and the ketogenic diet have anti-inflammatory properties and can help people with cancer, epilepsy, and type 2 diabetes[18][19][20][21][22].

To better understand why this might be the case, let’s focus on what deuterium does at the microscopic level—and even smaller at the subatomic level.
Deuterium Substitution in Molecules

Deuterium can fit anywhere in a molecule or reaction that hydrogen can fit. That means excess deuterium gets used during the synthesis of hormones, fats, enzymes, and cells.

And the abnormal properties of heavy water and deuterium can cause problems when your body uses deuterium in place of regular hydrogen.

In addition to higher boiling and melting points, heavy water has 25% greater viscosity than regular water. It also has a five-fold lower ionization constant, meaning that it donates and receives electrons more slowly than normal water[2].

For those reasons, deuterium incorporation reduces the stability of phospholipids, a key part of cell membranes[23].

It’s likely that other types of deuterated hormones and lipids (fats) behave abnormally, too. Basically, higher deuterium concentrations could disrupt normal functioning of biological molecules.

The Kinetic Isotope Effect

When it comes to living organisms, the biggest distinction between hydrogen and deuterium occurs due to the kinetic isotope effect.

Simply put, deuterium slows down chemical reactions when substituted in place of hydrogen.

Because it’s twice as heavy as hydrogen, a simple reaction with deuterium is usually seven- to ten-fold slower compared to the same reaction with regular hydrogen[2].

And the kinetic isotope effect has big implications for living things.

Many biological processes including DNA replication, DNA repair, and cytochrome P450 enzymatic reactions work on rapid timescales that are sensitive to the kinetic isotope effect[24][25][26][27].

Basically, deuterium can interfere with your body’s normal functioning by slowing down chemical reactions.

Mathematical models suggest that the kinetic isotope effect can cause system-wide metabolic changes[28].
In other words, slowing down a single reaction can have a “butterfly effect” elsewhere in your body and cause major disruptions.

Not only that, in other studies, deuterium slows the speed of reactions drastically—30- to 800-fold—by preventing a process called quantum tunneling[29][30][31][32].

Now that we’ve established the basics of how deuterium can affect your body, it’s time to take a closer look at the potential health benefits of depletion.

5 Health Benefits of Deuterium Depletion

#1: Less Fatigue, More Energy

Deuterium depletion has the potential to reverse fatigue and increase your energy levels.

Your mitochondria, which you may know as the “powerhouses of the cells,” provide your entire body with energy.

Deuterium slows down energy production, interferes with mitochondrial function, and increases the production of damaging free radicals[33].
And over time, elevated deuterium levels could also lead to mitochondrial damage[34].

Here’s why that’s a problem: damaged mitochondria and insufficient energy production can contribute to fatigue[35].

Research findings in people with chronic fatigue syndrome (CFS) confirm that impaired mitochondrial function is associated with fatigue[36][37][38].

That’s why some researchers think depleting deuterium could be a key step to reducing fatigue.

So far, one animal study has shown that deuterium depleted water (DDW) can increase energy production in mitochondria[24].

Bottom line: there’s excellent evidence that fatigue is a mitochondrial problem and good reason to suggest deuterium depletion can help fatigue.

#2: Faster, Healthier Metabolism

Depleting deuterium may boost your energy production and repair your mitochondria, and could be an excellent way to lose unwanted body fat and maintain a healthy weight.

Keep in mind that high deuterium levels damage your mitochondria.

As it turns out, with unhealthy mitochondria, you’ll have fat-burning difficulties, sugar cravings, and increased fat storage[39].

A thriving colony of mitochondria is also vital for healthy carbohydrate metabolism and preventing diabetes[40].

And according to a 2017 animal study, deuterium-depleted water can increase glucose transporter expression and aid glucose uptake, which could also prevent or aid diabetes[41].

The takeaway: people who have trouble losing weight, struggle with sugar addictions, or have metabolic problems like type 2 diabetes may benefit from depleting deuterium.
**#3: Better Mood and Brain Function**

Of all your organs, your brain uses the most energy relative to its mass\[42\]. As a result, it’s incredibly dense with energy-producing mitochondria\[43\].

Scientists think mitochondrial dysfunction may be responsible for numerous brain-related issues like psychiatric symptoms, migraine headaches, chronic traumatic encephalopathy (CTE), and even Alzheimer’s disease\[43\] [44][45][46].

But even if you don’t have any brain health issues, the colony of mitochondria in your brain still influences your mental function, cognition, and memory.

According to the authors of a 2014 scientific paper,

> **“The brain appears most vulnerable to mitochondrial defects, suggesting that neurons are particularly sensitive to bioenergetic fluctuations, and consequently, that mitochondria regulate fundamental aspects of brain function”** \[47\]

Therefore, it’s no surprise that depleting deuterium to enhance the function of brain mitochondria could boost your mood, prevent brain-based diseases, and increase your mental acuity.

A 2014 animal study also found that deuterium-depleted water improved the animals’ long-term memory\[48\].

Not only that, deuterium depletion may enhance the production of neurotransmitters in your brain.

According to the authors of a 2015 study, the deuterium-depleted water they provided to mice seemed to mimic the effects of antidepressant drugs\[49\].
#4: Anti-Cancer Effects

Deuterium depletion is a promising experimental cancer therapy. Relative to other possible health benefits of depletion, the anti-cancer effects of deuterium depletion are supported by the strongest clinical evidence.

Rather than a primary cancer treatment method, researchers mostly use it as an adjuvant therapy along with standard of care treatments[50].

Researchers in the field of deuterium depletion have documented dramatically increased survival times across multiple studies in the following types of cancer:

- Lung cancer[51]
- Breast cancer[52]
- Prostate cancer[34]
- Pancreatic cancer[34]
- Glioblastoma multiforme[34]

Here’s how the benefits probably work:
- Deuterium depletion may decrease DNA damage and single-strand breakage associated with cancerous mutations[52].
- Depletion therapies may induce oxidative stress in cancer cells by reversing the deuterium gradient in mitochondria and moving protons from the mitochondrial matrix to the intermembrane space[53].
- The Warburg metabolism (anaerobic glycolysis) of many cancer cells is associated with deuterium accumulation, but deuterium depletion may reverse this effect by promoting healthier metabolism and “recycling” of cancer cells[34].
- Deuterated lipids (fats) increase inflammatory and pro-cancer lipoxygenase metabolism, while deuterium depletion reverses it[54][55].

Essentially, deuterium depletion may be a non-invasive way to prevent cancer, slow its growth, or even reverse it.

And if you don’t have cancer, there’s also a good chance that deuterium depletion can reduce your cancer risk.
Your heart is dense with mitochondria, containing an astounding 35% mitochondria by weight\[56\].

Deuterium depletion may improve cardiovascular health and heart function by helping your mitochondria work better\[52]\[57\].

And as you’ll recall from earlier, deuterium can reduce the stability of phospholipids and may disrupt their function\[23\].

Some evidence shows that phospholipid alteration in the heart is linked to heart disease\[58\]. Therefore, deuterium depletion may also benefit your heart health by maintaining the orderly configuration of phospholipids.
Your diet is a major factor behind your body’s deuterium levels.

A low-carb, whole food-based-diet that’s high in fats, green vegetables, and animal products can lower your deuterium levels[59].

On the other hand, a diet high in sugar, starches, or processed foods can raise deuterium levels in your body[59].

The guiding principle behind a deuterium depletion diet is simple: eat foods low in deuterium and mostly avoid high-deuterium foods.

As you may have noticed, the low deuterium foods mentioned above have plenty of overlap with diets like the keto diet, paleo diet, and carnivore diet. (It’s probably no coincidence that these low deuterium diets may help prevent or treat conditions like obesity, diabetes, cancer, epilepsy and heart disease[21][60][61].)
Deuterium Content of Foods

Here's a sampling of the deuterium content of food, courtesy of Preventa:
- Wheat flour: 150 ppm
- Beet sugar: 146 ppm
- Corn: 145 ppm
- Potato: 143 ppm
- Oat: 141 ppm
- Pork meat: 138 ppm
- Beef meat: 138 ppm
- Spinach: 136 ppm
- Peanut butter: 131 ppm
- Olive oil: 130 ppm
- Butter: 124 ppm
- Beef fat: 121 ppm
- Lard: 116 ppm (also confirmed by Basov, et al. (2014))

However, you don’t need to know the precise deuterium content of every food to make wise decisions.

Here’s what you do need to consider:
- Ingredients
- Processing or preparation
- Location

As you can tell from the first list, ingredients make a significant difference

For the most part carbs, sugars, and starches have a higher deuterium content--naturally. Grass-fed animal products, fats, and leafy greens are the opposite.

Processing and preparation affect deuterium content too.

For one thing, refined flour, sugar, or other plant products have more deuterium because the manufacturing process removes the low-deuterium plant matter.

Another reason is because of evaporation. Many food preparation methods involve some form of heating (like boiling or dehydration) that results in evaporation, which concentrates deuterium in food.
At home, you can keep the deuterium content of foods lower by trapping steam and moisture during cooking or boiling.

Finally, as with water, altitude and latitude affect the deuterium content of plants and other foods. That means, for example, that if you live far from the equator, you probably shouldn’t eat imported foods from equatorial countries—particularly in winter. (There’s also an evolutionary argument for eating locally and seasonally, since global food transportation is a relatively recent invention.)
#2: Deuterium-Depleted Water (DDW)

Deuterium-depleted water is exactly what it sounds like: water with reduced deuterium content.

Different scientists define DDW differently, but statistically speaking, naturally-occurring water under 140 parts per million (ppm) is very rare and mainly occurs in the polar regions[5][62].

However, water with much lower deuterium content is commercially available. Using a process called fractional distillation that takes advantage of the boiling point differences between light water and heavy water, manufacturers produce water with deuterium content from 5-125 ppm.

**DDW vs. Deuterium Depleted Diet**

Compared to diet, commercial DDW is more effective in the short term for lowering your deuterium levels. Food and water are the main sources of deuterium in your body, but commercial DDW has much lower deuterium levels than natural deuterium-depleted foods, making it the faster method.

And unlike most other methods, DDW doesn’t rely on your body’s natural depletion mechanisms. Therefore, it’s a good choice for people with cancer or who have trouble achieving healthy deuterium levels by other means.

Whereas low-deuterium diets deplete deuterium from the inside out, drinking DDW lowers deuterium in cells and mitochondria through a process called isotopic shock[63].

The lower the deuterium concentration of DDW, the faster it depletes your body levels, but the more it costs.
How to Use Deuterium Depleted Water

Many people use 25-105 ppm deuterium depleted water as their sole method of hydration for 4-16 weeks. This type of DDW protocol typically costs between $200 USD and $3000 USD.

The most common way is to use DDW to achieve a target deuterium level in your body, then maintain the reduced deuterium level through a low-deuterium diet and other methods.

For maintenance, wellness purposes, and to potentially slow down aging, some people use water with 125-136 ppm long-term. You can achieve this concentration by diluting DDW or by using naturally deuterium-depleted glacial spring water.

Remember the water cycle illustration earlier? Deuterium levels are lower away from the equator, at high altitudes, and where it’s cold.

Low D is an affordable, naturally deuterium-depleted glacial spring water from Canada.

You don’t need to mix, measure, or titrate your dosage. Just drink Low D like you would regular water. It’s an ideal way to try out deuterium depletion, follow up a medical DDW protocol for maintenance, or pair up with other inexpensive methods.

Not only that, but you can also mix Low D with 25 ppm DDW for a cleaner deuterium-depleted drinking experience.
Deuterium Depleted Water Dilution Chart

Use the chart below to obtain the proper ratio of Low D to DDW when mixing. The calculations provide 2 liters of water, which is plenty to meet most people’s daily water needs and still deplete deuterium economically.

<table>
<thead>
<tr>
<th>Final Concentration</th>
<th>Low D</th>
<th>Preventa-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 ppm</td>
<td>1805 ml</td>
<td>195 ml</td>
</tr>
<tr>
<td>105 ppm</td>
<td>1445 ml</td>
<td>555 ml</td>
</tr>
<tr>
<td>85 ppm</td>
<td>1095 ml</td>
<td>905 ml</td>
</tr>
<tr>
<td>65 ppm</td>
<td>710 ml</td>
<td>1290 ml</td>
</tr>
<tr>
<td>50 ppm</td>
<td>460 ml</td>
<td>1540 ml</td>
</tr>
</tbody>
</table>

Note: Most measuring containers are imprecise, and you can also round up or down to the nearest 10 as needed for convenience. These variations only affect the final concentration by 1-2 parts per million.

#3: Fasting and Dry Fasting

Regular fasting can deplete deuterium by shifting your body’s metabolism towards fat-burning.

When you burn fat (whether stored or eaten recently), your mitochondria make 1.1 kilograms of water for every 1000 grams of fat you burn[64]. This “metabolic water” is deuterium-depleted, typically to approximately 115 ppm.

And similar to the keto diet, fasting can help treat obesity, cancer, and type 2 diabetes[65][66][67]. These benefits may be due, at least in part, to deuterium depletion.

Dry fasting is similar to fasting but along with avoiding food, you don’t drink any water, either.

A 2013 study found that a five-day dry fast was safe for ten healthy adults. That small study doesn’t prove it’s safe for everyone, but it does prove that dry fasting isn’t reckless[68].

In fact, metabolic water production could help explain why dry fasting appears to be safe. Also, note that you don’t necessarily need to dry fast for five days in a row!
When it comes to deuterium depletion, the logic behind dry fasting is sound. By temporarily avoiding water along with food, you're eliminating the two main sources of deuterium, which can accelerate depletion as your body runs on stored fat.

Fasting and the other practices you'll learn about in a moment are unlikely to dramatically reduce deuterium by themselves. Nonetheless, they work well combined with other methods or to maintain low deuterium levels.

#4: Infrared Light and Sunlight

Infrared light (IR) boosts your energy production by supercharging your mitochondria[69].

You can obtain infrared light from light therapy devices or from sunlight, which is approximately 49.4% infrared light[70].

As a result of the increased energy production, your mitochondria also make extra metabolic water, which is deuterium-depleted[71].

It's worth noting that some researchers have an alternative theory for how IR aids your mitochondria[72][73]. They think that infrared might work by reducing the viscosity of the water surrounding mitochondria to increase energy production[74].

If correct, the reduced water viscosity from IR would also mimic the benefits of deuterium depletion due to the fact that deuterium can increase water viscosity[75].

Last but not least, infrared light, sunlight, and sauna heat all increase your sweating. Sweating is one of your body’s natural deuterium depletion mechanisms, so that’s good news for reducing your levels, too[76].

#5: Cold Exposure

Exposing your body to cold increases your metabolic rate through non-shivering thermogenesis, which generates heat by dissipating protons[77].

Proton dissipation during heat production is favorable to deuterium depletion.

It also increases levels of brown adipose tissue, a special type of fat with the ability to dissipate protons to create even more heat[78].
Cold exposure works well for deuterium depletion, but with one caveat. Some people’s bodies can adapt to cold better than others[79].

Most likely, if your ancestors lived far from the equator, you’ll get better results with cold exposure and cold adaptation.

#6: Exercise

Exercise depletes your deuterium levels by increasing your deuterium-depleted metabolic water production and making you sweat[80].

Aerobic exercise under 65% VO2 max (maximum oxygen volume) is the best form of exercise to boost your metabolic water production because it burns the most fat[81].

Pairing aerobic exercise with fasting or the keto diet allows you to attain fat oxidation levels of 1.5 grams of fat or more per minute[81]. Put differently, that’s 99 milliliters of 115 ppm deuterium-depleted metabolic water per hour.
Breathing clean air isn’t enough to reduce deuterium levels alone, but air pollution can make it harder to deplete deuterium.

Air contaminants found in buildings, roadways, and agricultural applications can increase the risk of obesity, diabetes, and mitochondrial damage as well as make weight loss difficult.[82][83][84][85].

And low blood oxygen levels from pollution may increase reliance on sugar, cause insulin resistance, and result in the loss of mitochondria[86][87][88].

Remember that when your body relies on carbs and can’t burn fat effectively, the result is higher deuterium levels[14].

Essentially, you need clean air for optimal mitochondrial function and to maintain healthy deuterium levels.

Along with ensuring you breathe clean air, you can also enhance mitochondrial function (and thus deuterium depletion) by breathing slowly to get plenty of oxygen.

Slow breathing at six breaths per minute increases oxygen saturation in your blood, which may help reduce your deuterium levels[89].
The majority of deuterium depletion methods are fantastic for your health, even before taking deuterium into account.

Everyone can benefit from practices like a whole food diet, fasting, sunlight, exercise, and breathing clean air.

Using DDW is the fastest way to deplete deuterium, but also the most expensive. Most people don’t use DDW long-term.

As a less expensive alternative for long-term health and wellness, Low D is the only commercially available, natural spring water that’s deuterium depleted.

Don’t forget that food and drinking water are the main sources of deuterium in your body. That means if you’re keto but still drinking water that has the usual 150-155 ppm deuterium content, your depletion results won’t be as good.

NourishMe Organics tests Low D to ensure it has:
- 136 ppm or lower deuterium-to-hydrogen ratio
- No heavy metals or arsenic
- No chlorine
- No fluoride
- No glyphosate (Roundup)
- Alkaline pH (7.2)

Conclusion
Natural deuterium-depleted glacial spring water is a more economical choice than DDW for wellness purposes, trying out deuterium depletion for the first time, or to get more mileage out of a deuterium-depleted diet (especially paired with other methods like infrared, cold, and exercise).

Want to try Low D? Click here to buy it from Nourishme Organics while supplies last.

Low D is also the perfect choice to dilute 25 ppm DDW for a cleaner DDW experience. In case you missed it, check out the easy-to-use DDW dilution chart.

Image credits: Dirk Hünniger, Daniel Dawson