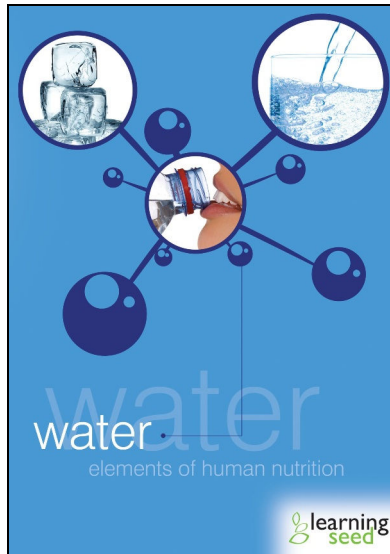


# Water

## Elements Of Human Nutrition



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Suite 301  
641 West Lake Street  
Chicago, IL 60661  
800.634.4941

[info@learningseed.com](mailto:info@learningseed.com)  
[www.learningseed.com](http://www.learningseed.com)

# Water

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Writer: Jennifer Guevin  
Kari Dean McCarthy  
Producer: Kathleen O. Ryan  
Director: Michel Poglitsch  
Editor: Michel Poglitsch  
Narrator: Erin Anderson

##### This Teaching Guide

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800.634.4941  
[info@learningseed.com](mailto:info@learningseed.com)

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# Summary

Water is the single most important nutrient for every form of life on earth. Water is all around us, in our daily lives, and it's also easy to take for granted. In this program we will explore water, learning its chemistry and nutrient functions in the human body. We will learn of the recommendations for how much water we need in different situations, learn ways to consume water, and explore the various sources of drinking water.

Key points:

- Chemically, water is made up of one oxygen and two hydrogen atoms that are held together with hydrogen bonds.
- Water can be a solid, a liquid, or a gas; it takes a lot of energy to change from one form to another.
- Water plays a crucial role in the function of the digestive system and major organs, like the heart and kidneys.
- On the microscopic level, cells are constantly working to maintain water balance.
- Eight to twelve cups, or 2 to 3 liters of water is the recommended daily amount for a healthy adult, but the exact amounts vary for men, women and children.
- There are times when humans should drink even more than the recommended amount, such as when there's hot weather, and after losing fluids due to exercise or hard work.
- When you do not get enough water it is called dehydration, and too much water is called over hydration and hyponatremia.
- Both conditions have outward appearance symptoms, changing in physical functions that can affect even the cellular level, and can even be fatal.
- Most drinking water comes from surface water- lakes, rivers, and reservoirs, or from groundwater- underground sources pumped from wells.
- Both can become contaminated with dangerous chemicals or disease-spreading bacteria.
- Water treatment facilities use additives to remove contaminants and pollution, making it safer to drink.
- All drinking water contains some minerals, and too much of these minerals can result in hard or soft water.
- We can get the water we need from other sources besides drinking water, such as food like juicy fruits and crunchy vegetables.
- Many popular drinks contain caffeine and large amounts of sugar or artificial sweeteners which can have negative side effects that outweigh the benefits of the water they provide.
- People can use in-home water filtration systems to extract additives and impurities in drinking water.
- Many people purchase bottled water due to claims of purity and exotic natural sources, but consumers should beware because some of these products use the exact same water that people can get from their taps.

# The Science Of Water

Water covers three-fourths of the earth, and is the most abundant substance on the planet. Everywhere that water is found, it exists in one of three physical states: solid, liquid, or gas. As water's temperature goes up or down, it transforms from one state to another. A molecule of water is made up of one oxygen atom and two hydrogen atoms. These atoms have oppositely charged ions that attract them to one another, and they form strong bonds called hydrogen bonds. Because of these bonds, it takes a lot of energy to change water's temperature. It's slow to transform to a solid, and back to a liquid, and then finally to a gas. To freeze water into its solid form ice, the temperature has to reach 32 degrees Fahrenheit or 0 degrees Celsius. The temperature of water needs to reach 212 degrees Fahrenheit or 100 degrees Celsius before it boils. A human's body weight is made of 60% water, and that large amount protects the body from drastic changes in temperatures. This allows us to survive in the most extreme conditions.

# Water And Nutrition

Water makes up about 60% of an adult human's body weight. It is in cells, blood, and organs. If the body is deficient in other nutrients, you might not become aware of it or ill from it for weeks, months, or even years, but without water, the human body will last less than one week. Water is vital to helping the body regulate its temperature. The human body needs to maintain a constant temperature of 98.6 degrees Fahrenheit, or 37 degrees Celsius to keep all of its major systems running properly. When the body is in danger of overheating, it uses water to cool it off in the form of perspiration, or sweat, which evaporates, cooling off the skin. Water also helps fight illness and disease, as it is found in lymph, a fluid that is part of the immune system. It helps move white blood cells around so they are better able to fight infections. Water is used to lubricate the joints between bones by creating a soft shock-absorbing cushion. It performs this function near the spinal cord as well, and keeps the eyes lubricated.

One of the most important functions of water is its assistance in running the digestive system. Water helps in the formation of digestive enzymes and juices, carries the enzymes that break down food, and dissolves minerals, vitamins, amino acids, glucose, and other nutrients. Water then helps carry them to the small intestine so the body can properly use them. When the body's nutrition needs are satisfied, water helps to get rid of the waste, working closely with the kidneys, the two bean-shaped organs located below the ribs, near the spine. Kidneys maintain the body's chemical balance by filtering waste and excess fluid from the blood, which is then passed out of the body through urine. Water is also the basis for blood, and helps carry oxygen to all the cells in the body, keeping the heart healthy by maintaining blood volume, concentration and pressure. If blood pressure or volume reaches too low of a level, or if bodily fluids start to get too concentrated and thick, the kidneys begin to slow down their filtering and excreting functions. When doing this, the kidneys retain water when the body needs it, and other times they remove any excess.

The human body is made up of trillions of cells, inside and surrounding them are fluids made of chemicals floating in water. Cells constantly attempt to maintain the perfect balance of the fluids, depending on what the cell needs to use. This is accomplished by water passing through the cell. Imbalances in the cell fluids can greatly affect the body's functions; the body is constantly adjusting the amount of water the cells let in and out. Your body does send you signals to help maintain that balance, such as thirst, a dry mouth, and sluggishness. These are signals your body sends when you need more hydration. Feeling bloated and frequent urination are signs that the body might have too much water.

# Recommendations

The U.S. Food and Nutrition Board offers some basic guidelines for recommended water intake. It recommends that the average adult drink 8 to 12 cups of water each day, which is about 2 to 3 liters. It is suggested that men drink closer to 12 cups and women closer to 8 cups. The human body actually needs a little more than that each day, but that is compensated by the water in food and other beverages. Water makes up 75% of a child's body weight until about the age of 10, so water is even more important to the nutrition of children. Children and toddlers should drink 3 to 6 cups per day depending on their weight.

There are some times when you should drink more than the recommended amount of water, such as when you have a runny nose or a fever that makes you sweat. Besides drinking more water during illness, hot weather also makes you sweat so water intake needs to be increased. The more you breathe, the more water you lose from your body, especially while exercising; it is important to drink more water while working out. For every pound lost, you need to drink about 2 more cups of water than usual. This is a general hydration guide for workouts and competitions. Physical activity can actually make you less sensitive to thirst, even though your body needs more water.

## Special Concerns

Dehydration is what occurs when water intake does not equal water loss. Dehydration stimulates the brain to tell you that you are thirsty, and if dehydration continues, the body will try to compensate by retaining fluids, sweating less and producing less urine. As dehydration becomes more severe, body tissues begin to dry out, causing cells to shrivel and malfunction. When the body loses water, it also loses some electrolytes along with it. Electrolytes are chemical elements in the blood and tissues that keep them functioning, such as sodium, potassium, chloride, calcium, and magnesium. When there is a shortage of electrolytes in the blood, water doesn't travel as fast from inside the cells to the bloodstream. Consequently, the amount of water in the bloodstream is not quickly replenished, causing blood pressure and volume to drop which then makes the heart work harder to move blood through the body. The most common ways the body loses too much water are sweating, vomiting, diarrhea, burns, diabetes, prolonged exposure to dry air, blood loss from an injury, excess in alcohol or drugs, certain infectious diseases, malnutrition, and a lack of available clean water.

Symptoms of dehydration usually appear after 1 to 2% of our normal water volume has been lost, causing thirst, discomfort, and possibly dry skin and constipation. Other symptoms of mild dehydration are decreased urine volume, abnormally dark urine, fatigue and irritability, lack of tears when crying, headache, dry mouth, dizziness, and in some cases insomnia. When the body reaches about 5% water loss, urination is greatly reduced (and may become painful), fatigue turns to extreme sleepiness, and dizziness turns to fainting. The body's temperature will rise further while blood pressure and volume decrease further. Symptoms include nausea, tingling in the limbs, and an appearance of sunken in eyes, with bouts of confusion, indicating dehydration has become severe. At 10% or more fluid loss, muscles spasm, the kidneys produce no urine, skin shrivels, vision dims, and seizures and delirium begin. At a loss of 15% or more of fluids, a severely dehydrated person will fall into a coma and die.

Infants and small children are more likely to become dehydrated more quickly because they can lose water faster, while their fluid requirement remains higher. You can tell if a child is dehydrated if there is decreased urination, no tears while crying, less saliva with a tacky texture to the mouth, and a gray or pale skin color. An infant's soft spot might also have a sunken in look to it. After the age of 50, our thirst sensation begins to diminish, making dehydration more common. Symptoms include sudden episodes of confusion, which is the most common indicator among the elderly.

The opposite of dehydration is overhydration when the body is carrying an excess of fluids. To exceed the body's ability to excrete water, an adult must drink more than 2 gallons of water a day regularly. When overhydration occurs, confusion, seizures or coma may develop. Sometimes an over abundance of sodium prevents the extra water from moving into the cells, rather than just accumulating around them, which can result in a swelling of the chest, abdomen, and lower legs. Severe cases of overhydration are called water intoxication, which can lead to a condition called hyponatremia, or low blood sodium. It occurs in one of two possible ways: if you sweat heavily for several hours, losing too much sodium through sweat, or when you drink large amounts of water, and the kidneys cannot get rid of the excess fast enough and the sodium in the blood becomes diluted. Nausea, muscle cramps, disorientation, slurred speech, and confusion are warning signs of hyponatremia, and severe cases are fatal.

# Drinking Water

The salt water from oceans can not be consumed without using expensive process to remove most of the salt, so surface water and ground water are the most common sources of drinking water. Surface water is found in lakes, rivers, and reservoirs, but it can easily be contaminated or polluted because it is exposed. Groundwater comes from underground sources and is usually pumped from wells. Groundwater can also be contaminated if toxic chemicals soak into the ground from landfills and hazardous waste sites. Public water is treated and filtered to remove contamination and pollution. Untreated water in lakes and streams can carry bacteria and other microorganisms that can spread disease, and a lack of clean drinking water can lead to widespread illness. The most common additive in treated water is chlorine, and depending on local conditions other additives such as bromine and carbon are used as well. Another common additive is fluoride. American cities began adding fluoride to water supplies in the 1940s. The American Dental Association believes water fluoridation led to the dramatic decrease in tooth decay in the United States. All natural water contains some dissolved minerals, which can give water some distinct characteristics. Sulfur will make water smell like rotten eggs, and iron can leave rust-colored stains on fixtures. Water that is high in calcium and magnesium is called hard water. Water that's high in sodium or potassium is called soft water. The sodium in soft water can be a problem for people with high blood pressure or heart disease.



## Water In Our Diets

Plain drinking water is the best way to hydrate your body, but there is water in every liquid that you drink as well as in many foods. Crunchy vegetables such as celery, cucumbers, lettuce, and carrots are often made of 75 to 90% water. Watermelons, grapes, and oranges are juicy fruits full of water. One of the best sources of water in a liquid is non-fat or low-fat milk. Coffee and sodas contain water, but they also contain caffeine, which acts as a diuretic, which means it stimulates the production of urine. Caffeine may also stimulate your kidneys to excrete extra liquid, as well as boost blood pressure and heart rate. Coffee also creates some acid in the digestive system, which can aggravate ulcers and acid reflux disease. Energy drinks contain a large amount of caffeine, so they have the same effects on the heart as coffee. Choosing juices can be tricky because there are so many kinds with different benefits and different amounts of sugar. Many juices, like orange and tomato, are filled with vitamins and minerals, but tomato juice is often high in sodium. One cup of orange juice can have both the juice and the sugar from two or three oranges. Sugary drinks can contribute to tooth decay. Many also contain “empty calories”, which means by drinking them you are getting more calories than nutritional value. All these beverages can contribute to your daily water needs but they have other effects on the body to consider before making them your main source of hydration.

Industrialized countries treat their water, but some people do their own filtering at home. Home filtration systems can come in many forms. They can be attached to your faucet or water pipes or as a handheld pitcher with a filter inside. There are also different kinds of filtering systems such as carbon, reverse osmosis, and distillation. These systems can remove unwanted additives such as bacteria and other contaminants such as arsenic and heavy metals. In the United States, the Environmental Protection Agency’s website is a good place to find local drinking water information.

The average American drinks more than 20 gallons of bottled water each year, and we’ve spent more than \$15 billion on it. The Food and Drug Administration sets standards for bottled water, which are the same for public water systems. Some bottled water comes from groundwater sources like springs or wells. It is most often purified with a gas called ozone, which in some instances is considered a pollutant, but is also an effective treatment for some contaminants. Sometimes bottled water comes from the exact same sources as tap water. Twenty-five percent of bottled water is estimated to come from municipal sources, the same places cities get tap water from.

Companies are required by law to state the source of the water they bottle, and despite being regulated by the FDA, contaminants like arsenic have been found in many brands of bottled water.

# Review

- Water is the most important nutrient to every living organism on our planet.
- Its all around us and inside of us. An adult's body weight is about 60% water.
- Two atoms of hydrogen connect one atom of oxygen with hydrogen bonds to create a water molecule. Due to these bonds, water is slow to change from cold to hot and between different physical states
- The 60% of water in our body weight helps people survive in both freezing and extremely hot conditions; maintaining a good water balance helps to sustain life.
- The body sends itself signals when it isn't getting enough or if it's getting too much water.
- Drinking water goes through several stages and must meet governmental standards before people can drink it. Bottled water also needs to meet the same standards.
- Some bottled water might come from municipal sources like tap water, just at a higher price.
- Water is found in many kinds of beverages and even some foods.

## Questions For Discussion

1. What is a hydrogen bond? How does it relate to water and how does it affect water's physical state?

*A hydrogen bond is what holds two hydrogen and one oxygen atom together. Water can be found in three physical states: liquid, solid, and gas; because of its chemical makeup it is difficult for water to change physical states.*

2. What is the importance of water on the cellular level?

*Water keeps the body at a healthy temperature. It is found in lymph, which helps the immune system fight disease. Water is the basis of the blood, and it helps carry oxygen to all the cells in the body. Cells try to constantly keep the perfect composition of fluids in and outside of the cell, and water is important to maintaining that balance.*

3. What is the recommended daily amount of water needed? What are some exceptions to the normal daily amount? How much of an adult and child's body weight is water?

*The basic guideline for the recommended intake of water for the average adult is 8 to 12 cups per day (12 cups for men and 8 cups for women). A child should drink 3 to 6 cups per day depending on their weight. Exceptions to the recommended daily intake might include when a person is working hard, is sick, or exercising causing the person to up the intake of water. An adult's body weight is about 60% water while a child's body is made of 75% .*

4. What are the signs and symptoms of the various stages of dehydration?

*Dehydration occurs when water intake does not equal water loss. Symptoms usually appear after 1 to 2% of the body's normal water volume has been lost, causing thirst, discomfort, and possibly dry skin and constipation. Other symptoms are decreased urine volume, abnormally dark urine, fatigue and irritability, lack of tears when crying, headache, dry mouth, dizziness, and in some cases insomnia. At 5% water loss, urination is greatly reduced, fatigue turns to extreme sleepiness, and dizziness turns to fainting. The body's temperature rises and blood pressure and volume decrease. Symptoms include nausea, tingling in the limbs, and an appearance of sunken in eyes, with bouts of confusion, indicating dehydration has become severe. At 10% or more fluid loss, muscles spasm, the kidneys produce no urine, skin shrivels, vision dims, and seizures and delirium begin. At loss of 15% or more of fluids, a severely dehydrated person will fall into a coma and die.*

5. Where do we get our drinking water?

*The two types of drinking water are surface water and groundwater. . Surface water is found in lakes, rivers, and reservoirs; it can easily be contaminated or polluted because it is exposed. Groundwater comes from underground sources and is usually pumped from wells. Groundwater can also be contaminated if toxic chemicals soak into the ground from landfills and hazardous waste sites.*

## Suggested Activities

1. Collect different brands of bottled water and examine the bottles to learn the characteristics and claims of each brand. Investigate the source of each brand of water.
2. Research the amount of water in different foods and popular drinks. Create a chart of which foods contain the most water and which drinks aren't as good for you as some people and commercials lead you to think. Try to create a daily amount of each to satisfy the recommended daily intake of water.

## Research Project

Investigate the condition of water in a third world country. Present the country's water needs and the problems the country faces in terms of obtaining water. Research whether any action has been taken to avert the problems. If none exist, suggest different ways to combat the problems of not having enough drinking water for the country.

# Water: Elements Of Human Nutrition

## Fill-In-The-Blank

Fill in the blanks with the correct words from the bank at the bottom of the page.

Water is held together by two hydrogen atoms and one oxygen atom by strong hydrogen \_\_\_\_\_.

Water covers \_\_\_\_\_ of the earth and is \_\_\_\_\_ percent of our body. Water helps keep the body temperature at \_\_\_\_\_ degrees F. Water helps the body perform many functions and can be found in \_\_\_\_\_, a fluid that is part of the immune system. It is also found in \_\_\_\_\_ in the digestive system that helps to break down food. To excrete waste and keep us healthy, water works closely with the \_\_\_\_\_. The recommended daily amount of water for an adult male is \_\_\_\_\_ cups per day. The average adult female needs \_\_\_\_\_ cups of water a day. A child's body is made up of \_\_\_\_\_ percent water and therefore needs more on a daily basis depending on the child's weight. There are times when we need even more water, and for every pound we lose we need to drink about \_\_\_\_\_ cups more water than usual. \_\_\_\_\_ is a lack of water in the body and \_\_\_\_\_ or \_\_\_\_\_ is having too much water in the body. Both can result in fatal conditions.

### Word Bank:

8	75	bonds	$\frac{3}{4}$	overhydration	enzymes	dehydration
12	lymph	60	2	hyponatremia	98.6	kidneys

# Water: Elements Of Human Nutrition

## Fill-In-The-Blank *Answer Key*

Fill in the blanks with the correct words from the bank at the bottom of the page.

Water is held together by two hydrogen atoms and one oxygen atom by strong hydrogen bonds. Water covers 3/4 of the earth and is 60 percent of our body. Water helps keep the body temperature at 98.6 degrees F. Water helps the body perform many functions and can be found in lymph, a fluid that is part of the immune system. It is also found in enzymes in the digestive system that helps to break down food. To excrete waste and keep us healthy, water works closely with the kidneys. The recommended daily amount of water for an adult male is 12 cups per day. The average adult female needs 8 cups of water a day. A child's body is made up of 75 percent water and therefore needs more on a daily basis depending on the child's weight. There are times when we need even more water, and for every pound we lose we need to drink about 2 cups more water than usual. Dehydration is a lack of water in the body and overhydration or hyponatremia is having too much water in the body. Both can result in fatal conditions.

# Water: Elements Of Human Nutrition

## Multiple Choice Worksheet

Circle the best available answer for each of the following:

- 1) The recommended daily amount of water for the average adult is:
  - a) 5-10 cups
  - b) 8-12 cups
  - c) 8-13 cups
  - d) 3 to 6 cups
- 2) A well known food that contains a lot of water is:
  - a) peanuts
  - b) corn
  - c) celery
  - d) squash
- 3) At what percent of body water loss is death a result:
  - a) 1-2%
  - b) 5%
  - c) 10%
  - d) 15%
- 4) The American Dental Association deems this additive to water has helped in the decrease of tooth decay in America:
  - a) chlorine
  - b) fluoride
  - c) sodium
  - d) magnesium
- 5) Water can become a gas at this temperature:
  - a) 200 degrees F
  - b) 212 degrees F
  - c) 223 degrees F
  - d) 235 degrees F
- 6) Water's chemical makeup is:
  - a) two hydrogen and one oxygen atom
  - b) two oxygen and one hydrogen atom
  - c) three hydrogen and three oxygen atoms
  - d) two hydrogen and three oxygen atoms
- 7) The human body is made up of about this much water:
  - a) 70%
  - b) 75%
  - c) 65%
  - d) 60%
- 8) Drinking water most often comes from this source:
  - a) groundwater
  - b) the ocean
  - c) rain
  - d) bottles
- 9) This group sets the standards for bottled as well as drinking water:
  - a) FBI
  - b) FDA
  - c) CSI
  - d) ADA
- 10) When your body needs water which of these is not a signal your brain sends to you:
  - a) thirst
  - b) having a dry mouth
  - c) feeling bloated
  - d) feeling sluggish



# Water: Elements Of Human Nutrition

## Multiple Choice Worksheet *Answer Key*

Circle the best available answer for each of the following:

- 1) The recommended daily amount of water for the average adult is:
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  - a) thirst
  - b) having a dry mouth
  - c) feeling bloated**
  - d) feeling sluggish

# Water: Elements Of Human Nutrition Quiz

Match the words in the first column to the best available answer in the second column.

- |       |   |                   |
|-------|---|-------------------|
| _____ | This occurs when your body does not have enough water   | 1) 8-12 cups      |
| _____ | Much of our drinking water comes from this source   | 2) fluoride       |
| _____ | The human body needs this much water a day  | 3) electrolytes   |
| _____ | Water helps the immune system function in this fluid  | 4) dehydration    |
| _____ | The adding of this in water helps prevent tooth decay   | 5) over hydration |
| _____ | This condition can result in feeling bloated and frequent trips to the bathroom               | 6) surface water  |
| _____ | At certain stages, the body loses these, which are chemical elements in our blood and tissues | 7) lymph          |
| _____ | Much of bottled water is collected from these sites   | 8) municipal      |

# Water: Elements Of Human Nutrition

## Quiz Answer Key

Match the words in the first column to the best available answer in the second column.

- |                          |   |
|--------------------------|---|
| <b>4) dehydration</b>    | This occurs when your body does not have enough water   |
| <b>6) surface water</b>  | Much of our drinking water comes from this source   |
| <b>1) 8-12 cups</b>      | The human body needs this much water a day  |
| <b>7) lymph</b>          | Water helps the immune system function in this fluid  |
| <b>2) fluoride</b>       | The adding of this in water helps prevent tooth decay   |
| <b>5) over hydration</b> | This condition can result in feeling bloated and frequent trips to the bathroom               |
| <b>3) electrolytes</b>   | At certain stages, the body loses these, which are chemical elements in our blood and tissues |
| <b>8) municipal</b>      | Much of bottled water is collected from these sites   |

# Glossary

Dehydration	What occurs when water intake does not equal water loss, can be caused by sweating, vomiting, diarrhea, burns, diabetes, prolonged exposure to dry air, blood loss, excess alcohol or drug intake, malnutrition, and a lack of available clean water
Electrolytes	Chemical elements in our blood and tissues that keep them functioning
Hard water	Water that is high in calcium and magnesium
Hyponatremia	Severe case of over hydration that can cause a drop in sodium in the blood
Lymph	A fluid that is part of the immune system that helps move blood cells around the body so they can fight infections
Overhydration	What occurs when the body is carrying an excess of fluid
Soft water	Water that is high in sodium or potassium

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<http://www.nlm.nih.gov/medlineplus/drinkingwater.html>

Hydration Research: The Kidney, Exercise, and Hydration

Gatorade Sports Science Institute

[http://www.gssiweb.com/Article\\_Detail.aspx?articleid=56&level=2&topic=1](http://www.gssiweb.com/Article_Detail.aspx?articleid=56&level=2&topic=1)

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Gatorade Sports Science Institute

[http://www.gssiweb.com/Article\\_Detail.aspx?articleid=618&level=2&topic=6](http://www.gssiweb.com/Article_Detail.aspx?articleid=618&level=2&topic=6)

Water: Meeting Your Daily Fluid Needs - Nutrition For Everyone

Department of Health and Human Services – Centers for Disease Control and Prevention

[http://www.cdc.gov/nccdphp/dnpa/nutrition/nutrition\\_for\\_everyone/basics/water.htm](http://www.cdc.gov/nccdphp/dnpa/nutrition/nutrition_for_everyone/basics/water.htm)

## General Nutrition Websites

American Dietetic Association – Eat Right  
<http://www.eatright.org>

American Heart Association  
<http://www.americanheart.org>

Arbor Nutrition Guide  
<http://arborcom.com>

Centers for Disease Control and Prevention – Healthy Living  
<http://cdc.gov./HealthyLiving>

Gatorade Sports Science Institute  
<http://www.gssiweb.com>

Harvard – School of Public Health  
<http://www.hsph.harvard.edu/nutritionsource>

Kids Health - Kids  
<http://kidshealth.org/kid>

Kids Health - Teen  
<http://kidshealth.org/teen>

Kids Health - Parent  
<http://kidshealth.org/parent>

Mayo Clinic - Food And Nutrition  
<http://www.mayoclinic.com/health/food-and-nutrition/NU99999>

National Dairy Council  
<http://www.nationaldairycouncil.org>

United States Department of Agriculture – My Pyramid  
<http://www.mypyramid.gov>

WebMD  
<http://www.webmd.com>