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Understanding Shifting Soils in Changing Seasons Early Signs of Drainage Issues in Wet Climates Identifying Freeze and Thaw Patterns in Foundation Movement Monitoring Summer Drought Effects on Concrete Recognizing the Role of Poor Grading in Soil Settlement Observing Spring Rains That Affect Foundation Stability Evaluating Temperature Fluctuations and Their Impact on Slab Integrity Addressing Expanding Clay in Variable Weather Managing Water Accumulation Around Foundation Walls Tracking Seasonal Rainfall Data for Preventive Measures Comparing Different Regional Climate Patterns for Foundation Health Avoiding Oversaturation With Proper Yard Drainage
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Monitoring Summer Drought Effects on Concrete

Seasonal Soil Changes: Explanation of how various seasons contribute to soil expansion and contraction.

Understanding the intricate relationship between soil moisture levels and foundation stability is crucial, especially when monitoring the effects of summer drought on concrete structures. Sump pumps help keep basements dry and stable **Basement Damage Repair** Georgia. As climate patterns continue to shift, with prolonged periods of heat and reduced rainfall becoming more common in many regions, the impact on both natural and built environments becomes increasingly pronounced. One area that deserves particular attention is how these conditions affect the integrity of foundations, which are vital for maintaining structural stability.

Soil acts as a foundational cushion for buildings; its moisture content plays a pivotal role in determining how well it can support a structure. During times of adequate rainfall, soil remains relatively stable as it retains moisture, providing consistent support to foundations. However, during summer droughts, soil moisture levels can drop significantly. This decrease leads to soil contraction, which may cause ground shifting and create voids beneath concrete foundations.

The effects of this process manifest in various ways. For instance, homeowners might notice cracks in walls or uneven floors—symptoms indicating potential shifts in the building's foundation due to changes in soil volume. Commercial structures might face similar challenges but on a larger scale. Without timely intervention or monitoring

systems in place, these issues could escalate into significant structural damage over time.

Monitoring technologies have thus become essential tools in assessing and mitigating these risks. Advances such as soil moisture sensors provide real-time data that help property owners understand current conditions and predict future changes. By integrating these technologies with predictive modeling software, engineers can simulate different scenarios under varying moisture levels and design appropriate mitigation strategies.

Moreover, understanding local geological conditions helps tailor specific solutions for foundation stability problems caused by drought-induced soil moisture variation. Areas with expansive clay soils are particularly vulnerable because they experience dramatic volume changes based on their moisture content. Therefore, customizing engineering approaches to account for local soil types ensures better resilience against the adverse impacts of drought.

In conclusion, addressing the challenges posed by summer drought requires a comprehensive understanding of how reduced soil moisture affects foundation stability. Through technological advancements and site-specific strategies, we can mitigate potential damages and ensure that our built environment remains safe and sound amidst changing climatic conditions. As we continue to adapt to new environmental realities, fostering robust monitoring systems will be key to preserving structural integrity across diverse landscapes.

Summer droughts present a significant challenge to homeowners and builders, particularly when it comes to maintaining the integrity of concrete foundations. As water levels in the soil decrease, foundations can suffer from various issues that may lead to costly repairs if not promptly addressed. Understanding the key indicators of foundation cracks due to drought conditions is crucial for effective monitoring and maintenance.

One of the primary indicators of foundation distress during droughts is visible cracking on the outside and inside of homes. These cracks often appear along exterior walls or near windows and door frames, where stress tends to accumulate as the soil contracts. Homeowners might notice hairline fractures that gradually widen over time, signaling a potential problem beneath the surface.

Another telltale sign is uneven floors. As the soil shrinks away from the foundation due to lack of moisture, different sections may settle at varying rates, leading to an unbalanced structure. This can manifest as sloping or sagging floors, making it difficult to close doors properly or causing gaps between floors and baseboards.

Gaps around windows and doors are also common indicators of foundation issues caused by drought conditions. When a foundation shifts due to changing soil moisture levels, it can cause frames to become misaligned. Homeowners might notice that doors no longer latch correctly or windows become increasingly difficult to open and close.

Furthermore, chimney movement is another indicator worth noting. A leaning or separating chimney can suggest that one side of a foundation has settled more than the other due to uneven soil contraction. This poses not only structural integrity concerns but also potential safety risks if left unattended.

Monitoring these symptoms requires vigilance throughout periods of prolonged dry weather. Regular inspections during summer months should be part of any homeowner's maintenance routine, allowing for early detection before problems escalate into major repair projects. Additionally, maintaining proper drainage systems around properties helps mitigate some effects by directing water away from foundations when rain does occur.

In conclusion, recognizing key indicators such as wall cracks, uneven floors, misaligned windows and doors, and chimney movement plays a critical role in monitoring summer drought effects on concrete foundations. Proactive steps towards early identification enable timely interventions which preserve home value while preventing extensive damage resulting from neglecting foundational health amidst changing environmental conditions brought about by persistent dryness each year without fail!

Posted by on

Posted by on

Posted by on

Impact of Climate on Soil and Foundations: Discussing the

influence of weather patterns and climate change on soil stability.

Monitoring and assessing drought-induced damage in concrete structures is an evolving field of study that is gaining increasing importance as climate change continues to alter weather patterns globally. Concrete, a ubiquitous material used in infrastructure, can be severely affected by extreme weather conditions such as prolonged periods of drought. This essay explores various methods for monitoring the effects of summer drought on concrete structures, highlighting their significance in ensuring structural safety and longevity.

Concrete's susceptibility to drought stems from its porous nature. During extended dry spells, moisture within the concrete evaporates, leading to shrinkage and the development of micro-cracks. Over time, these micro-cracks can expand and compromise the integrity of the structure. Moreover, the lack of moisture reduces the curing process's effectiveness, weakening new constructions or repairs.

One effective method for monitoring these changes is through non-destructive testing (NDT) techniques. These techniques allow engineers to assess a structure's condition without causing any damage. Ground-penetrating radar (GPR), for instance, can detect internal anomalies such as voids or cracks within a concrete slab by emitting radio waves into the structure and analyzing the reflected signals. Similarly, ultrasonic pulse velocity tests measure wave speed through concrete; slower speeds often indicate potential flaws like cracks or voids exacerbated by drying conditions.

Another promising approach involves using fiber optic sensors embedded within concrete structures during construction. These sensors provide real-time data on temperature fluctuations and strain levels within concrete elements when subjected to environmental stressors like heatwaves or droughts. By continuously monitoring these parameters, engineers can detect early signs of distress and implement corrective measures before significant damage occurs.

Moisture content measurement is also crucial in evaluating drought impact on concrete surfaces. Devices such as electrical resistance meters give insights into how much water remains in a structure compared to expected levels under normal conditions. A significant drop could signal increased vulnerability due to dehydration effects caused by prolonged dry weather.

In addition to technological solutions, visual inspections play a vital role in assessing surface-level damages induced by summer droughts. Trained professionals examine exterior surfaces for visible signs such as cracking patterns that typically result from excessive drying shrinkage or differential movement between different sections exposed unevenly to sun exposure or shading elements nearby.

The integration of remote sensing technologies has broadened capabilities further—with satellite imagery providing macro-scale assessments over large areas—helping pinpoint regions where infrastructures might be at risk due not only directly but also indirectly through associated land subsidence phenomena triggered under specific climatic scenarios involving severe dryness episodes influencing soil behaviors underneath foundational layers supporting them aboveground too eventually sometimes unfortunately so if left unchecked long enough indeed unfortunately still possibly though sometimes hopefully too rarely now thankfully less frequently nowadays perhaps thanks partly due largely mostly actually importantly definitely significantly substantially more often than not increasingly widely adopted successfully employed effectively deployed proactively managed monitored evaluated assessed adequately appropriately correctly efficiently effectively successfully satisfactorily sufficiently safely securely reliably

dependably consistently repeatedly continually constantly regularly routinely periodically
cyclically seasonally annually biannually biennially triennially quadrennially quinquennially
septennially decennially centennially millennially perennially eternally perpetually
infinitely forever timelessly endlessly ceaselessly unceasingly unstoppably inexorably
irrevocably irreversibly permanently indelibly immortally everlastingly enduringly durably
sustainably robustly resiliently enduringly staunchly steadfastly unwaveringly resolutely
firmly determinately unyieldingly unrelentingly obstinately persistently doggedly
tenaciously indefatigably tirelessly industriously assiduously diligently laboriously





Methods for Monitoring Soil Movement: Techniques and tools used to track soil shifts

around foundations.

As the world grapples with the intensifying effects of climate change, one area that has garnered significant attention is the impact of prolonged droughts on infrastructure. In particular, summer droughts pose a unique set of challenges for concrete foundations, which are integral to the stability and safety of buildings. The need to detect early signs of foundation distress has never been more critical, prompting a surge in advanced technologies and tools designed for this purpose.

Concrete foundations are susceptible to environmental conditions such as temperature fluctuations and moisture levels. During summer months, extended periods without rain can lead to soil shrinkage beneath these foundations. This shrinkage creates voids and gaps that may cause the concrete above to crack or shift.

Monitoring Summer Drought Effects on Concrete - sidewalk

1. sidewalk
2. Brentwood
3. wall

If undetected, these minor imperfections can escalate into major structural problems over time.

In response to this growing concern, engineers and researchers have turned their focus toward developing innovative methods for monitoring foundation health. One such advancement is the use of remote sensing technology. Equipped with high-resolution imagery and spectral analysis capabilities, remote sensors can identify changes in soil moisture levels around concrete structures from afar. This technology provides valuable

data that helps pinpoint areas at risk even before visible signs of distress appear.

Another promising development is the integration of Internet of Things (IoT) devices into construction materials themselves. Smart concrete imbued with sensors can offer real-time insights into stress levels, temperature changes, and other factors indicative of potential foundation issues. These sensors communicate wirelessly with central monitoring systems, enabling immediate alerts when anomalies are detected.

Moreover, ground-penetrating radar (GPR) has emerged as an effective tool in assessing subsurface conditions without invasive procedures. GPR sends electromagnetic waves into the ground and analyzes their reflections to map underground features such as cavities or uneven soil layers that could compromise foundation integrity during dry spells.

Alongside these technological advancements, machine learning algorithms are being employed to analyze vast datasets collected from various sources like weather stations, satellite imagery, and sensor networks. By identifying patterns and correlations between environmental conditions and structural responses, these algorithms enhance predictive capabilities—anticipating which structures might encounter problems due to summer droughts.

The implementation of these advanced technologies not only aids in detecting early signs of foundation distress but also plays a crucial role in preventative maintenance strategies. Property owners armed with accurate assessments can take proactive measures such as adjusting irrigation practices or reinforcing vulnerable areas before severe damage occurs.

In conclusion, as climate change continues to drive extreme weather patterns including prolonged summer droughts, safeguarding infrastructure becomes increasingly essential.

Through innovative approaches harnessing cutting-edge technologies like remote sensing, IoT-enabled smart materials, ground-penetrating radar systems, and artificial intelligence-driven analytics, we stand better equipped than ever before, to confront challenges posed by environmental stressors on concrete foundations. By embracing these solutions today, we lay down robust pathways towards ensuring resilient infrastructures capable of enduring future adversities while maintaining public safety and economic stability alike. This ongoing commitment to leveraging science and ingenuity underscores our collective resolve in addressing the infrastructural imperatives of tomorrow's cities sustainably and effectively..

Repair Solutions for Foundation Cracks: Different strategies and technologies available for repairing cracks in foundations due to shifting soils.

Drought stress is an increasingly prevalent issue impacting various aspects of our environment, and one area where its effects are particularly evident is in the structural integrity of buildings. Specifically, foundation cracks caused by prolonged periods of

drought pose a significant challenge to property owners and require effective strategies for repair and prevention. Understanding these strategies is crucial for maintaining the longevity and safety of structures exposed to summer drought conditions.

The first step in addressing foundation cracks due to drought stress involves thorough monitoring. Regular inspections during dry summer months can help identify early signs of damage. Property owners should look for visible cracks in the foundation, uneven floors, or doors and windows that are difficult to open or close. Early detection allows for timely intervention, which can prevent more severe damage from occurring.

Once identified, repairing foundation cracks should be approached methodically. One effective strategy is using epoxy injections or polyurethane foam sealants to fill the cracks. These materials not only seal the gaps but also strengthen the surrounding concrete, preventing further deterioration. For larger or more complex damages, hiring a professional contractor who specializes in foundation repair may be necessary to ensure proper restoration techniques are applied.

Beyond immediate repairs, addressing underlying issues that contribute to drought-induced cracking is essential for long-term stability. Managing moisture levels around the foundation can significantly reduce stress on concrete structures during dry periods. This might involve installing soaker hoses or drip irrigation systems around the perimeter of a building to maintain consistent soil moisture levels without over-saturating it.

Landscaping also plays a vital role in mitigating drought effects on foundations. Planting drought-resistant vegetation can help minimize water competition with trees and shrubs that draw moisture away from the soil near foundations. Additionally, creating proper drainage systems ensures that excess water does not accumulate near the building during sudden rainfalls after extended dry spells.

Finally, proactive measures such as applying waterproof coatings or membranes on foundations can provide an extra layer of protection against moisture loss during droughts while reducing vulnerability to future cracking.

In conclusion, repairing foundation cracks caused by drought stress necessitates a combination of immediate repairs and preventive strategies aimed at managing environmental factors contributing to structural vulnerabilities. By adopting comprehensive approaches that include regular monitoring, targeted repairs with appropriate materials, moisture management practices, and strategic landscaping changes—property owners can effectively safeguard their buildings against the damaging effects of summer droughts on concrete foundations.

Monitoring Summer Drought Effects on Concrete - Brentwood

1. Davidson County
2. water
3. Hoffman Estates

Preventative Measures: Tips for homeowners to minimize

the risk of foundation damage from seasonal soil changes.

In recent years, the increasing frequency and intensity of droughts have posed significant challenges to infrastructure, particularly affecting concrete foundations. As we aim to build resilient structures capable of withstanding environmental stresses, it becomes imperative to explore long-term maintenance practices that can mitigate future drought effects on concrete foundations.

Concrete, a widely used construction material, is known for its durability and strength. However, it is not impervious to environmental changes. During prolonged dry spells, the soil moisture content decreases significantly, leading to soil shrinkage and increased subsidence. This phenomenon can cause considerable stress on concrete foundations, resulting in cracks and structural instability. To address these issues effectively, adopting proactive maintenance practices is essential.

One crucial approach is regular monitoring of soil conditions around concrete foundations. By installing moisture sensors and utilizing advanced technology like ground-penetrating radar (GPR), engineers can track changes in soil moisture levels over time. Early detection of potential problems allows for timely interventions before severe damage occurs. Furthermore, implementing predictive modeling tools can help anticipate drought-induced stress points, enabling preemptive measures to safeguard structures.

Another vital practice involves maintaining proper drainage systems around buildings. Ensuring efficient water management helps prevent excessive drying out of surrounding soils during hot months while avoiding excess water retention during rainfalls. Grading the landscape appropriately and installing reliable gutters and downspouts are practical steps that contribute significantly to maintaining stable soil conditions.

Additionally, the use of drought-resistant landscaping techniques should be considered as part of a comprehensive strategy for protecting concrete foundations. Xeriscaping—landscaping designed specifically for arid climates—can reduce water dependency while still providing aesthetic value to properties. By selecting native plants with deep root systems that stabilize soils naturally without requiring frequent irrigation, property owners can enhance foundation resilience against drought impacts.

Furthermore, incorporating specialized materials into construction processes can greatly aid in mitigating future risks associated with summer droughts on concrete structures. The development of innovative admixtures designed specifically for enhancing the flexibility and water resistance of concrete ensures durability even under extreme weather conditions.

Regular inspection programs must also be established as part of any long-term maintenance plan aimed at minimizing future damages caused by prolonged dry periods on existing structures' foundations made from traditional or new composite materials alike! Routine checks allow professionals not only detect emerging issues early but also evaluate overall structure health periodically thus enabling corrective actions promptly if necessary which ultimately prolongs building lifespan ensuring safety inhabitants within them too!

Ultimately though no single method alone guarantees complete protection against all possible adverse effects arising due changing climate patterns worldwide today; combination multiple strategies outlined herein offers best chance success when

implemented holistically across board empowering communities stay resilient face increasingly unpredictable environment tomorrow holds store us all collectively together now more than ever before perhaps!

About water

For other uses, see Water (disambiguation).

"H2O" redirects here. For other uses, see H2O (disambiguation).

Water

The water molecule has this basic geometric structure

Image not found or type unknown

Hydrogen, H

Ball-and-stick model of a water molecule

Image not found or type unknown

Ball-and-stick model of a water molecule

Space filling model of a water molecule

Image not found or type unknown

Space filling model of a water molecule

A drop of water falling towards water in a glass

Oxygen, O

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NamesPreferred IUPAC name

Water

Systematic IUPAC name

Oxidane (not in common use)^[3]

Other names

- Hydrogen oxide
- Hydrogen hydroxide (H₂O or HOH)
- Hydroxylic acid
- Dihydrogen monoxide (DHMO) (parody name^[1])
- Dihydrogen oxide
- Hydric acid
- Hydrohydroxic acid
- Hydroxic acid
- Hydroxoic acid
- Hydrol^[2]
- ~~Ø~~-Oxidodihydrogen
- ¹~~Ø~~-Hydroxylhydrogen(0)
- Aqua
- Neutral liquid
- Oxygen dihydride (may be considered incorrect)

Identifiers

- 7732-18-5 Image not found or type unknown
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CAS Number

- Interactive image

3D model (JSmol)

Beilstein Reference 3587155

- CHEBI:15377 Image not found or type unknown
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ChEBI

- ChEMBL1098659 Image not found or type unknown
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ChEMBL

- 937 Image not found or type unknown
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ChemSpider

- DB09145

DrugBank

ECHA InfoCard100.028.902 Image not found or type unknown
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- 231-791-2

EC Number

Gmelin Reference 117

- C00001

KEGG

- 962

PubChem CID

- ZC0110000

RTECS number

- 059QF0K00R Image not found or type unknown
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UNII

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CompTox Dashboard (EPA)

InChI

InChI=1S/H2O/h1H2 Image not found or type unknown

Key: XLYOFNOQVPJJNP-UHFFFAOYSA-N Image not found or type unknown
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SMILES

O

Properties

Chemical formula

H

H_2O Molar mass 18.01528(33) g/mol Appearance Almost colorless or white crystalline solid, almost colorless liquid, with a hint of blue, colorless gas^[4] Odor Odorless

- Liquid (1 atm, VSMOW):
 - 0.999 842 83(84) g/mL at 0 °C^[5]
 - 0.999 974 95(84) g/mL at 3.983 035(670) °C (temperature of maximum density, often 4 °C)^[5]
 - 0.997 047 02(83) g/mL at 25 °C^[5]
 - 0.961 887 91(96) g/mL at 95 °C^[6]
- Solid:
 - 0.9167 g/mL at 0 °C^[7]

Density

Melting point 0.00 °C (32.00 °F; 273.15 K) ^[b] Boiling point 99.98 °C (211.96 °F; 373.13 K)^[17] ^[b] Solubility Poorly soluble in haloalkanes, aliphatic and aromatic hydrocarbons, ethers.^[8]

Improved solubility in carboxylates, alcohols, ketones, amines.

Miscible with methanol, ethanol, propanol, isopropanol, acetone, glycerol, 1,4-dioxane, tetrahydrofuran, sulfolane, acetaldehyde, dimethylformamide, dimethoxyethane, dimethyl sulfoxide, acetonitrile.

Partially miscible with diethyl ether, methyl ethyl ketone, dichloromethane, ethyl acetate, bromine. Vapor pressure 3.1690 kilopascals or 0.031276 atm at 25 °C^[9] Acidity (pK_a) 13.995^[10]^[11]^[a] Basicity (pK_b) 13.995 Conjugate acid Hydronium H_3O^+ ($pK_a = 0$) Conjugate base Hydroxide OH^- ($pK_b = 0$) Thermal conductivity 0.6065 W/(m·K)^[14]

Refractive index (n_D)

1.3330 (20 °C)^[15] Viscosity 0.890 mPa·s (0.890 cP)^[16] Structure

Crystal structure

Hexagonal

Point group

C_{2v}

Molecular shape

Bent

Dipole moment

1.8546 D^[18] Thermochemistry

Heat capacity (C)

75.385 ± 0.05 J/(mol·K)^[17]

Std molar

entropy (S_{298}°)

69.95 ± 0.03 J/(mol·K)^[17]

Std enthalpy of formation ($\Delta_f H^\circ_{298}$)

-285.83 ± 0.04 kJ/mol [8][17]

Gibbs free energy ($\Delta_f G^\circ$)

-237.24 kJ/mol [8] Hazards **Occupational safety and health (OHS/OSH):**

Main hazards

Drowning

Avalanche (as snow)

Water intoxication **NFPA 704** (fire diamond)

NFPA 704 four-colored diamond

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Flash point Non-flammable Safety data sheet (SDS) SDS Related compounds

- Hydrogen sulfide
- Hydrogen selenide
- Hydrogen telluride
- Hydrogen polonide
- Hydrogen peroxide

Other anions

- Acetone
- Ethanol

- Methanol
- Hydrogen fluoride
- Ammonia

Related solvents

Supplementary data pageWater (data page)

Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa).

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 Infobox references

Water is an inorganic compound with the chemical formula H₂O. It is a transparent, tasteless, odorless,^[C] and nearly colorless chemical substance. It is the main constituent of Earth's hydrosphere and the fluids of all known living organisms (in which it acts as a solvent^[20]). It is vital for all known forms of life, despite not providing food energy or organic micronutrients. Its chemical formula,

H₂O, indicates that each of its molecules contains one oxygen and two hydrogen atoms, connected by covalent bonds. The hydrogen atoms are attached to the oxygen atom at an angle of 104.45°.^[21] In liquid form,

H₂O is also called "water" at standard temperature and pressure.

Because Earth's environment is relatively close to water's triple point, water exists on Earth as a solid, a liquid, and a gas.^[22] It forms precipitation in the form of rain and aerosols in the form of fog. Clouds consist of suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapor.

Water covers about 71% of the Earth's surface, with seas and oceans making up most of the water volume (about 96.5%).^[23] Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%), and in the air

as vapor, clouds (consisting of ice and liquid water suspended in air), and precipitation (0.001%).^{[24][25]} Water moves continually through the water cycle of evaporation, transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea.

Water plays an important role in the world economy. Approximately 70% of the fresh water used by humans goes to agriculture.^[26] Fishing in salt and fresh water bodies has been, and continues to be, a major source of food for many parts of the world, providing 6.5% of global protein.^[27] Much of the long-distance trade of commodities (such as oil, natural gas, and manufactured products) is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating in industry and homes. Water is an excellent solvent for a wide variety of substances, both mineral and organic; as such, it is widely used in industrial processes and in cooking and washing. Water, ice, and snow are also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, diving, ice skating, snowboarding, and skiing.

Etymology

[edit]

The word *water* comes from Old English ***wæter***, from Proto-Germanic **watar* (source also of Old Saxon *watar*, Old Frisian *wetir*, Dutch *water*, Old High German *wazzar*, German *Wasser*, *vatn*, Gothic *𐌿𐌿𐌰𐌿𐌳𐌰*) from Proto-Indo-European **wod-or*, suffixed form of root **wed-* ('water'; 'wet').^[28] Also cognate, through the Indo-European root, with Greek *ἵδωρ*, from Ancient Greek *ἡδω- (h₂éwod)*, whence English 'hydro-', Russian *водá*, Irish *uisce*, and Albanian *ujë*.

History

[edit]

Main articles: Origin of water on Earth § History of water on Earth, and Properties of water § History

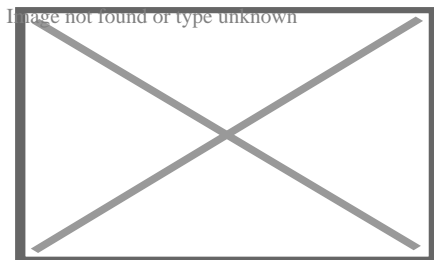
On Earth

[edit]

This section is an excerpt from Origin of water on Earth § History of water on Earth. [edit]

One factor in estimating when water appeared on Earth is that water is continually being lost to space. H_2O molecules in the atmosphere are broken up by photolysis, and the resulting free hydrogen atoms can sometimes escape Earth's gravitational pull. When the Earth was younger and less massive, water would have been lost to space more easily. Lighter elements like hydrogen and helium are expected to leak from the atmosphere continually, but isotopic ratios of heavier noble gases in the modern atmosphere suggest that even the heavier elements in the early atmosphere were subject to significant losses.^[29] In particular, xenon is useful for calculations of water loss over time. Not only is it a noble gas (and therefore is not removed from the atmosphere through chemical reactions with other elements), but comparisons between the abundances of its nine stable isotopes in the modern atmosphere reveal that the Earth lost at least one ocean of water early in its history, between the Hadean and Archean eons.^[30] *[clarification needed]*

Any water on Earth during the latter part of its accretion would have been disrupted by the Moon-forming impact (~4.5 billion years ago), which likely vaporized much of Earth's crust and upper mantle and created a rock-vapor atmosphere around the young planet.^[31]^[32] The rock vapor would have condensed within two thousand years, leaving behind hot volatiles which probably resulted in a majority carbon dioxide atmosphere with hydrogen and water vapor. Afterward, liquid water oceans may have existed despite the surface temperature of 230 °C (446 °F) due to the increased atmospheric pressure of the CO_2 atmosphere. As the cooling continued, most CO_2 was removed from the atmosphere by subduction and dissolution in ocean water, but levels oscillated wildly as new surface and mantle cycles appeared.^[33]



This pillow basalt on the seafloor near Hawaii was formed when magma extruded underwater. Other, much older pillow basalt formations provide evidence for large bodies of water long ago in Earth's history.

Geological evidence also helps constrain the time frame for liquid water existing on Earth. A sample of pillow basalt (a type of rock formed during an underwater eruption) was recovered from the Isua Greenstone Belt and provides evidence that water existed on Earth 3.8 billion years ago.^[34] In the Nuvvuagittuq Greenstone Belt, Quebec, Canada, rocks dated at 3.8 billion years old by one study^[35] and 4.28 billion years old by another^[36] show evidence of the presence of water at these ages.^[34] If oceans existed earlier than this, any geological evidence has yet to be discovered (which may be because such potential evidence has been destroyed by geological processes like crustal recycling). More recently, in August 2020, researchers reported that sufficient water to fill the oceans may have always been on the Earth since the beginning of the planet's formation.^{[37][38][39]}

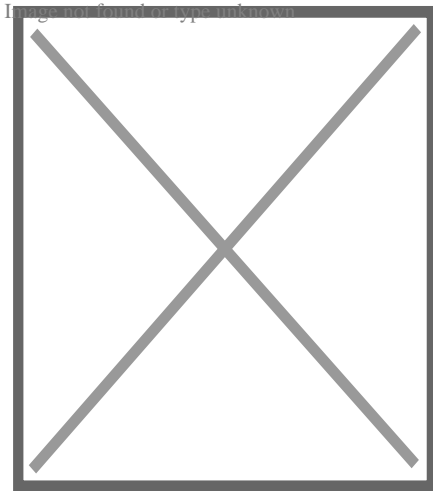
Unlike rocks, minerals called zircons are highly resistant to weathering and geological processes and so are used to understand conditions on the very early Earth. Mineralogical evidence from zircons has shown that liquid water and an atmosphere must have existed 4.404 ± 0.008 billion years ago, very soon after the formation of Earth.^{[40][41][42][43]} This presents somewhat of a paradox, as the cool early Earth hypothesis suggests temperatures were cold enough to freeze water between about 4.4 billion and 4.0 billion years ago. Other studies of zircons found in Australian Hadean rock point to the existence of plate tectonics as early as 4 billion years ago. If true, that implies that rather than a hot, molten surface and an atmosphere full of carbon dioxide, early Earth's surface was much as it is today (in terms of thermal insulation). The action of plate tectonics traps vast amounts of CO₂, thereby reducing greenhouse effects, leading to a much cooler surface temperature and the formation of solid rock and liquid water.^[44]

Properties

[edit]

Main article: Properties of water

See also: Water (data page) and Water model



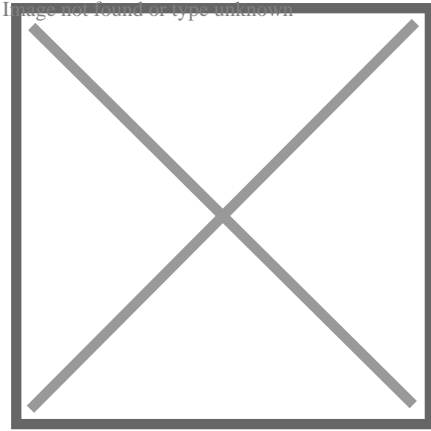
A water molecule consists of two hydrogen atoms and one oxygen atom.

Water (

H_2O) is a polar inorganic compound. At room temperature it is a tasteless and odorless liquid, nearly colorless with a hint of blue. The simplest hydrogen chalcogenide, it is by far the most studied chemical compound and is sometimes described as the "universal solvent" for its ability to dissolve more substances than any other liquid,^[45]^[46] though it is poor at dissolving nonpolar substances.^[47] This allows it to be the "solvent of life":^[48] indeed, water as found in nature almost always includes various dissolved substances, and special steps are required to obtain chemically pure water. Water is the only common substance to exist as a solid, liquid, and gas in normal terrestrial conditions.^[49]

States

[edit]



The three common states of matter

Along with *oxidane*, *water* is one of the two official names for the chemical compound H

H_2O ; ^[50] it is also the liquid phase of H

H_2O . ^[51] The other two common states of matter of water are the solid phase, ice, and the gaseous phase, water vapor or steam. The addition or removal of heat can cause phase transitions: freezing (water to ice), melting (ice to water), vaporization (water to vapor), condensation (vapor to water), sublimation (ice to vapor) and deposition (vapor to ice). ^[52]

Density

[edit]

See also: Frost weathering

Water differs from most liquids in that it becomes less dense as it freezes. ^[d] In 1 atm pressure, it reaches its maximum density of 999.972 kg/m^3 (62.4262 lb/cu ft) at $3.98 \text{ }^\circ\text{C}$ ($39.16 \text{ }^\circ\text{F}$), or almost $1,000 \text{ kg/m}^3$ (62.43 lb/cu ft) at almost $4 \text{ }^\circ\text{C}$ ($39 \text{ }^\circ\text{F}$). ^[54]^[55] The density of ice is 917 kg/m^3 (57.25 lb/cu ft), an expansion of 9%. ^[56]^[57] This expansion can exert enormous pressure, bursting pipes and cracking rocks. ^[58]

In a lake or ocean, water at $4 \text{ }^\circ\text{C}$ ($39 \text{ }^\circ\text{F}$) sinks to the bottom, and ice forms on the surface, floating on the liquid water. This ice insulates the water below, preventing it from freezing solid. Without this protection, most aquatic organisms residing in lakes would perish during the winter. ^[59]

Magnetism

[edit]

Water is a diamagnetic material.^[60] Though interaction is weak, with superconducting magnets it can attain a notable interaction.^[60]

Phase transitions

[edit]

At a pressure of one atmosphere (atm), ice melts or water freezes (solidifies) at 0 °C (32 °F) and water boils or vapor condenses at 100 °C (212 °F). However, even below the boiling point, water can change to vapor at its surface by evaporation (vaporization throughout the liquid is known as boiling). Sublimation and deposition also occur on surfaces.^[52] For example, frost is deposited on cold surfaces while snowflakes form by deposition on an aerosol particle or ice nucleus.^[61] In the process of freeze-drying, a food is frozen and then stored at low pressure so the ice on its surface sublimates.^[62]

The melting and boiling points depend on pressure. A good approximation for the rate of change of the melting temperature with pressure is given by the Clausius–Clapeyron relation:

$$\frac{dT}{dP} = \frac{T}{L} (v_L - v_S)$$

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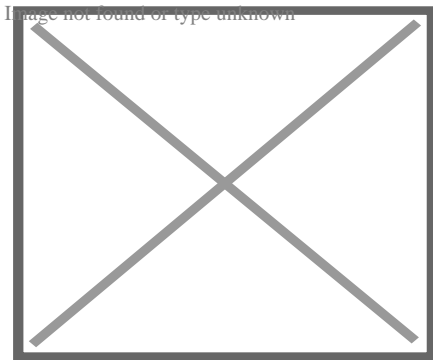
where v_L and v_S are the molar volumes of the liquid and solid phases, and L is the molar latent heat of melting. In most substances, the volume increases when melting occurs, so the melting temperature increases with pressure. However, because ice is less dense than water, the melting temperature decreases.^[53] In glaciers, pressure melting can occur under sufficiently thick volumes of ice, resulting in subglacial lakes.^{[63][64]}

The Clausius–Clapeyron relation also applies to the boiling point, but with the liquid/gas transition the vapor phase has a much lower density than the liquid phase, so the boiling point increases with pressure.^[65] Water can remain in a liquid state at high temperatures in the deep ocean or underground. For example, temperatures exceed 205 °C (401 °F) in Old Faithful, a geyser in Yellowstone National Park.^[66] In hydrothermal vents, the temperature can exceed 400 °C (752 °F).^[67]

At sea level, the boiling point of water is 100 °C (212 °F). As atmospheric pressure decreases with altitude, the boiling point decreases by 1 °C every 274 meters. High-altitude cooking takes longer than sea-level cooking. For example, at 1,524 metres (5,000 ft), cooking time must be increased by a fourth to achieve the desired result.^[68]] Conversely, a pressure cooker can be used to decrease cooking times by raising the boiling temperature.^[69] In a vacuum, water will boil at room temperature.^[70]

Triple and critical points

[edit]



Phase diagram of water

On a pressure/temperature phase diagram (see figure), there are curves separating solid from vapor, vapor from liquid, and liquid from solid. These meet at a single point called the triple point, where all three phases can coexist. The triple point is at a temperature of 273.16 K (0.01 °C; 32.02 °F) and a pressure of 611.657 pascals (0.00604 atm; 0.0887 psi);^[71] it is the lowest pressure at which liquid water can exist. Until 2019, the triple point was used to define the Kelvin temperature scale.^[72]^[73]

The water/vapor phase curve terminates at 647.096 K (373.946 °C; 705.103 °F) and 22.064 megapascals (3,200.1 psi; 217.75 atm).^[74] This is known as the critical point. At higher temperatures and pressures the liquid and vapor phases form a continuous phase called a supercritical fluid. It can be gradually compressed or expanded between gas-like and liquid-like densities; its properties (which are quite different from those of ambient water) are sensitive to density. For example, for suitable pressures and temperatures it can mix freely with nonpolar compounds, including most organic compounds. This makes it useful in a variety of applications including high-temperature electrochemistry and as an ecologically benign solvent or catalyst in chemical reactions involving organic compounds. In Earth's mantle, it acts as a solvent during mineral formation, dissolution and deposition.^{[75][76]}

Phases of ice and water

[edit]

Main article: Ice

The normal form of ice on the surface of Earth is ice I_h, a phase that forms crystals with hexagonal symmetry. Another with cubic crystalline symmetry, ice I_c, can occur in the upper atmosphere.^[77] As the pressure increases, ice forms other crystal structures. As of 2024, twenty have been experimentally confirmed and several more are predicted theoretically.^[78] The eighteenth form of ice, ice XVIII, a face-centred-cubic, superionic ice phase, was discovered when a droplet of water was subject to a shock wave that raised the water's pressure to millions of atmospheres and its temperature to thousands of degrees, resulting in a structure of rigid oxygen atoms in which hydrogen atoms flowed freely.^{[79][80]} When sandwiched between layers of graphene, ice forms a square lattice.^[81]

The details of the chemical nature of liquid water are not well understood; some theories suggest that its unusual behavior is due to the existence of two liquid states.^{[55][82][83][84]}

Taste and odor

[edit]

Pure water is usually described as tasteless and odorless, although humans have specific sensors that can feel the presence of water in their mouths,^[85]^[86] and frogs are known to be able to smell it.^[87] However, water from ordinary sources (including mineral water) usually has many dissolved substances that may give it varying tastes and odors. Humans and other animals have developed senses that enable them to evaluate the potability of water in order to avoid water that is too salty or putrid.^[88]

Color and appearance

[edit]

Main article: Color of water

See also: Electromagnetic absorption by water

Pure water is visibly blue due to absorption of light in the region c. 600–800 nm.^[89] The color can be easily observed in a glass of tap-water placed against a pure white background, in daylight. The principal absorption bands responsible for the color are overtones of the O–H stretching vibrations. The apparent intensity of the color increases with the depth of the water column, following Beer's law. This also applies, for example, with a swimming pool when the light source is sunlight reflected from the pool's white tiles.

In nature, the color may also be modified from blue to green due to the presence of suspended solids or algae.

In industry, near-infrared spectroscopy is used with aqueous solutions as the greater intensity of the lower overtones of water means that glass cuvettes with short path-length may be employed. To observe the fundamental stretching absorption spectrum of water or of an aqueous solution in the region around $3,500\text{ cm}^{-1}$ ($2.85\text{ }\mu\text{m}$)^{90]} a path length of about $25\text{ }\mu\text{m}$ is needed. Also, the cuvette must be both transparent around 3500 cm^{-1} and insoluble in water; calcium fluoride is one material that is in common use for the cuvette windows with aqueous solutions.

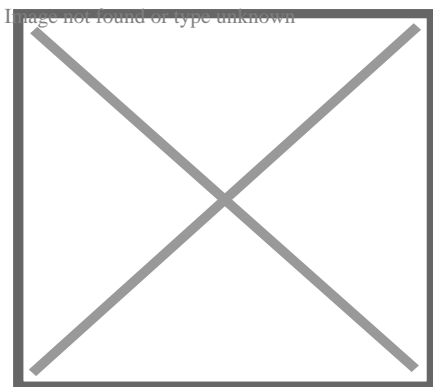
The Raman-active fundamental vibrations may be observed with, for example, a 1 cm sample cell.

Aquatic plants, algae, and other photosynthetic organisms can live in water up to hundreds of meters deep, because sunlight can reach them. Practically no sunlight reaches the parts of the oceans below 1,000 metres (3,300 ft) of depth.

The refractive index of liquid water (1.333 at 20 °C (68 °F)) is much higher than that of air (1.0), similar to those of alkanes and ethanol, but lower than those of glycerol (1.473), benzene (1.501), carbon disulfide (1.627), and common types of glass (1.4 to 1.6). The refraction index of ice (1.31) is lower than that of liquid water.

Molecular polarity

[edit]



Tetrahedral structure of water

In a water molecule, the hydrogen atoms form a 104.5° angle with the oxygen atom. The hydrogen atoms are close to two corners of a tetrahedron centered on the oxygen. At the other two corners are *lone pairs* of valence electrons that do not participate in the bonding. In a perfect tetrahedron, the atoms would form a 109.5° angle, but the repulsion between the lone pairs is greater than the repulsion between the hydrogen atoms.^{[91][92]} The O–H bond length is about 0.096 nm.^[93]

Other substances have a tetrahedral molecular structure, for example methane (CH₄) and hydrogen sulfide (H₂S). However, oxygen is more electronegative than most other elements, so the

oxygen atom has a negative partial charge while the hydrogen atoms are partially positively charged. Along with the bent structure, this gives the molecule an electrical dipole moment and it is classified as a polar molecule.^[94]

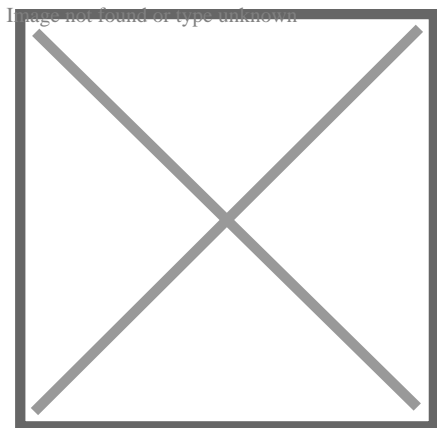
Water is a good polar solvent, dissolving many salts and hydrophilic organic molecules such as sugars and simple alcohols such as ethanol. Water also dissolves many gases, such as oxygen and carbon dioxide—the latter giving the fizz of carbonated beverages, sparkling wines and beers. In addition, many substances in living organisms, such as proteins, DNA and polysaccharides, are dissolved in water. The interactions between water and the subunits of these biomacromolecules shape protein folding, DNA base pairing, and other phenomena crucial to life (hydrophobic effect).

Many organic substances (such as fats and oils and alkanes) are hydrophobic, that is, insoluble in water. Many inorganic substances are insoluble too, including most metal oxides, sulfides, and silicates.

Hydrogen bonding

[edit]

See also: Chemical bonding of water

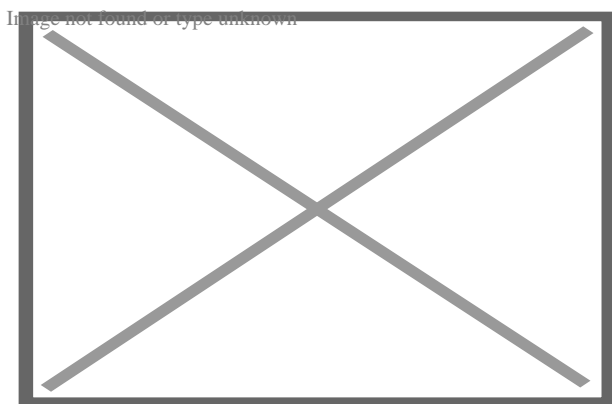


Model of hydrogen bonds (1) between molecules of water

Because of its polarity, a molecule of water in the liquid or solid state can form up to four hydrogen bonds with neighboring molecules. Hydrogen bonds are about ten times as strong as the Van der Waals force that attracts molecules to each other in most liquids. This is the reason why the melting and boiling points of water are much

higher than those of other analogous compounds like hydrogen sulfide. They also explain its exceptionally high specific heat capacity (about 4.2 J/(g·K)), heat of fusion (about 333 J/g), heat of vaporization (2257 J/g), and thermal conductivity (between 0.561 and 0.679 W/(m·K)). These properties make water more effective at moderating Earth's climate, by storing heat and transporting it between the oceans and the atmosphere. The hydrogen bonds of water are around 23 kJ/mol (compared to a covalent O–H bond at 492 kJ/mol). Of this, it is estimated that 90% is attributable to electrostatics, while the remaining 10% is partially covalent.^[95]

These bonds are the cause of water's high surface tension^[96] and capillary forces. The capillary action refers to the tendency of water to move up a narrow tube against the force of gravity. This property is relied upon by all vascular plants, such as trees.^[citation needed]



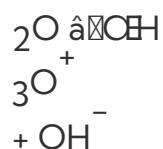
Specific heat capacity of water^[97]

Self-ionization

[edit]

Main article: Self-ionization of water

Water is a weak solution of hydronium hydroxide—there is an equilibrium $2\text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OH}^-$



, in combination with solvation of the resulting hydronium and hydroxide ions.

Electrical conductivity and electrolysis

[edit]

Pure water has a low electrical conductivity, which increases with the dissolution of a small amount of ionic material such as common salt.

Liquid water can be split into the elements hydrogen and oxygen by passing an electric current through it—a process called electrolysis. The decomposition requires more energy input than the heat released by the inverse process (285.8 kJ/mol, or 15.9 MJ/kg).^[98]

Mechanical properties

[edit]

Liquid water can be assumed to be incompressible for most purposes: its compressibility ranges from 4.4 to $5.1 \times 10^{-10} \text{ Pa}^{-1}$ in ordinary conditions.^[99] Even in oceans at 4 km depth, where the pressure is 400 atm, water suffers only a 1.8% decrease in volume.^[100]

The viscosity of water is about $10^{-3} \text{ Pa}\cdot\text{s}$ or 0.01 poise at 20 °C (68 °F), and the speed of sound in liquid water ranges between 1,400 and 1,540 metres per second (4,600 and 5,100 ft/s) depending on temperature. Sound travels long distances in water with little attenuation, especially at low frequencies (roughly 0.03 dB/km for 1 kHz), a property that is exploited by cetaceans and humans for communication and environment sensing (sonar).^[101]

Reactivity

[edit]

Metallic elements which are more electropositive than hydrogen, particularly the alkali metals and alkaline earth metals such as lithium, sodium, calcium, potassium and cesium displace hydrogen from water, forming hydroxides and releasing hydrogen. At

high temperatures, carbon reacts with steam to form carbon monoxide and hydrogen.^[citation needed]

On Earth

[edit]

Main articles: Hydrology and Water distribution on Earth

Hydrology is the study of the movement, distribution, and quality of water throughout the Earth. The study of the distribution of water is hydrography. The study of the distribution and movement of groundwater is hydrogeology, of glaciers is glaciology, of inland waters is limnology and distribution of oceans is oceanography. Ecological processes with hydrology are in the focus of ecohydrology.

The collective mass of water found on, under, and over the surface of a planet is called the hydrosphere. Earth's approximate water volume (the total water supply of the world) is 1.386 billion cubic kilometres (333 million cubic miles).^[24]

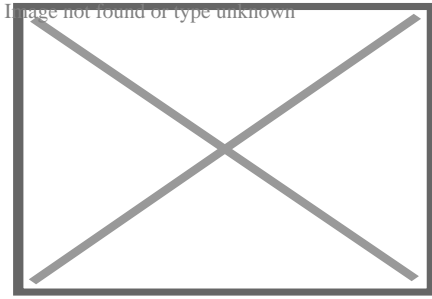
Liquid water is found in bodies of water, such as an ocean, sea, lake, river, stream, canal, pond, or puddle. The majority of water on Earth is seawater. Water is also present in the atmosphere in solid, liquid, and vapor states. It also exists as groundwater in aquifers.

Water is important in many geological processes. Groundwater is present in most rocks, and the pressure of this groundwater affects patterns of faulting. Water in the mantle is responsible for the melt that produces volcanoes at subduction zones. On the surface of the Earth, water is important in both chemical and physical weathering processes. Water, and to a lesser but still significant extent, ice, are also responsible for a large amount of sediment transport that occurs on the surface of the earth. Deposition of transported sediment forms many types of sedimentary rocks, which make up the geologic record of Earth history.

Water cycle

[edit]

Main article: Water cycle



Water cycle

The water cycle (known scientifically as the hydrologic cycle) is the continuous exchange of water within the hydrosphere, between the atmosphere, soil water, surface water, groundwater, and plants.

Water moves perpetually through each of these regions in the *water cycle* consisting of the following transfer processes:

- evaporation from oceans and other water bodies into the air and transpiration from land plants and animals into the air.
- precipitation, from water vapor condensing from the air and falling to the earth or ocean.
- runoff from the land usually reaching the sea.

Most water vapors found mostly in the ocean returns to it, but winds carry water vapor over land at the same rate as runoff into the sea, about 47 Tt per year while evaporation and transpiration happening in land masses also contribute another 72 Tt per year. Precipitation, at a rate of 119 Tt per year over land, has several forms: most commonly rain, snow, and hail, with some contribution from fog and dew.^[102] Dew is small drops of water that are condensed when a high density of water vapor meets a cool surface. Dew usually forms in the morning when the temperature is the lowest, just before sunrise and when the temperature of the earth's surface starts to increase.^[103] Condensed water in the air may also refract sunlight to produce rainbows.

Water runoff often collects over watersheds flowing into rivers. Through erosion, runoff shapes the environment creating river valleys and deltas which provide rich soil and level ground for the establishment of population centers. A flood occurs when an area of land, usually low-lying, is covered with water which occurs when a river

overflows its banks or a storm surge happens. On the other hand, drought is an extended period of months or years when a region notes a deficiency in its water supply. This occurs when a region receives consistently below average precipitation either due to its topography or due to its location in terms of latitude.

Water resources

[edit]

Main article: Water resources

Water resources are natural resources of water that are potentially useful for humans,^[104] for example as a source of drinking water supply or irrigation water. Water occurs as both "stocks" and "flows". Water can be stored as lakes, water vapor, groundwater or aquifers, and ice and snow. Of the total volume of global freshwater, an estimated 69 percent is stored in glaciers and permanent snow cover; 30 percent is in groundwater; and the remaining 1 percent in lakes, rivers, the atmosphere, and biota.^[105] The length of time water remains in storage is highly variable: some aquifers consist of water stored over thousands of years but lake volumes may fluctuate on a seasonal basis, decreasing during dry periods and increasing during wet ones. A substantial fraction of the water supply for some regions consists of water extracted from water stored in stocks, and when withdrawals exceed recharge, stocks decrease. By some estimates, as much as 30 percent of total water used for irrigation comes from unsustainable withdrawals of groundwater, causing groundwater depletion.^[106]

Seawater and tides

[edit]

Main articles: Seawater and Tides

Seawater contains about 3.5% sodium chloride on average, plus smaller amounts of other substances. The physical properties of seawater differ from fresh water in some important respects. It freezes at a lower temperature (about $-1.9\text{ }^{\circ}\text{C}$ ($28.6\text{ }^{\circ}\text{F}$)) and its density increases with decreasing temperature to the freezing point, instead of reaching maximum density at a temperature above freezing. The salinity of water in

major seas varies from about 0.7% in the Baltic Sea to 4.0% in the Red Sea. (The Dead Sea, known for its ultra-high salinity levels of between 30 and 40%, is really a salt lake.)

Tides are the cyclic rising and falling of local sea levels caused by the tidal forces of the Moon and the Sun acting on the oceans. Tides cause changes in the depth of the marine and estuarine water bodies and produce oscillating currents known as tidal streams. The changing tide produced at a given location is the result of the changing positions of the Moon and Sun relative to the Earth coupled with the effects of Earth rotation and the local bathymetry. The strip of seashore that is submerged at high tide and exposed at low tide, the intertidal zone, is an important ecological product of ocean tides.

The Bay of Fundy at high tide and low tide

High tide

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High tide

Low tide

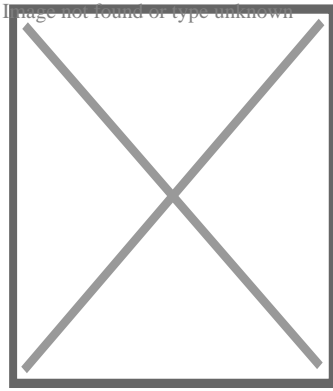
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Low tide

Effects on life

[edit]



Overview of photosynthesis (green) and respiration (red)

From a biological standpoint, water has many distinct properties that are critical for the proliferation of life. It carries out this role by allowing organic compounds to react in ways that ultimately allow replication. All known forms of life depend on water. Water is vital both as a solvent in which many of the body's solutes dissolve and as an essential part of many metabolic processes within the body. Metabolism is the sum total of anabolism and catabolism. In anabolism, water is removed from molecules (through energy requiring enzymatic chemical reactions) in order to grow larger molecules (e.g., starches, triglycerides, and proteins for storage of fuels and information). In catabolism, water is used to break bonds in order to generate smaller molecules (e.g., glucose, fatty acids, and amino acids to be used for fuels for energy use or other purposes). Without water, these particular metabolic processes could not exist.

Water is fundamental to both photosynthesis and respiration. Photosynthetic cells use the sun's energy to split off water's hydrogen from oxygen.^[107] In the presence of sunlight, hydrogen is combined with CO₂ (absorbed from air or water) to form glucose and release oxygen.^[108] All living cells use such fuels and oxidize the hydrogen and carbon to capture the sun's energy and reform water and CO₂ in the process (cellular respiration).

Water is also central to acid–base neutrality and enzyme function. An acid, a hydrogen ion (H⁺, that is, a proton) donor, can be neutralized by a base, a proton acceptor such as a hydroxide ion (OH⁻

) to form water. Water is considered to be neutral, with a pH (the negative log of the hydrogen ion concentration) of 7 in an ideal state. Acids have pH values less than 7 while bases have values greater than 7.

Aquatic life forms

[edit]

Further information: Hydrobiology, Marine life, and Aquatic plant

Earth's surface waters are filled with life. The earliest life forms appeared in water; nearly all fish live exclusively in water, and there are many types of marine mammals, such as dolphins and whales. Some kinds of animals, such as amphibians, spend portions of their lives in water and portions on land. Plants such as kelp and algae grow in the water and are the basis for some underwater ecosystems. Plankton is generally the foundation of the ocean food chain.

Aquatic vertebrates must obtain oxygen to survive, and they do so in various ways. Fish have gills instead of lungs, although some species of fish, such as the lungfish, have both. Marine mammals, such as dolphins, whales, otters, and seals need to surface periodically to breathe air. Some amphibians are able to absorb oxygen through their skin. Invertebrates exhibit a wide range of modifications to survive in poorly oxygenated waters including breathing tubes (see insect and mollusc siphons) and gills (*Carcinus*). However, as invertebrate life evolved in an aquatic habitat most have little or no specialization for respiration in water.

Some of the biodiversity of a coral reef

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Some of the biodiversity of
a coral reef

Some marine diatoms are a key phytoplankton group

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Some marine diatoms – a
key phytoplankton group

Squat lobster and Alvinocarididae shrimp at the Von Damm hydrothermal field survive b

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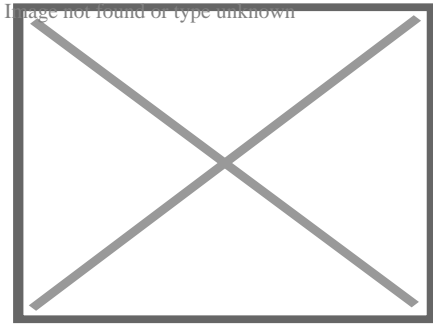
Squat lobster and
Alvinocarididae shrimp at
the Von Damm
hydrothermal field survive
by altered water chemistry.

Effects on human civilization

[edit]



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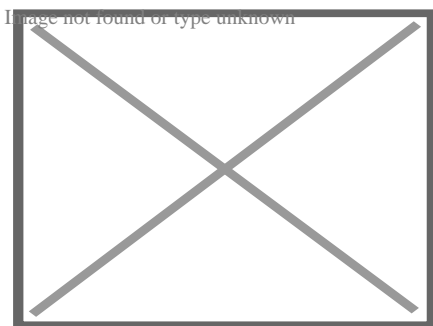


Water fountain

Civilization has historically flourished around rivers and major waterways; Mesopotamia, one of the so-called cradles of civilization, was situated between the major rivers Tigris and Euphrates; the ancient society of the Egyptians depended entirely upon the Nile. The early Indus Valley civilization (c. 3300 BCE – c. 1300 BCE) developed along the Indus River and tributaries that flowed out of the Himalayas. Rome was also founded on the banks of the Italian river Tiber. Large metropolises like Rotterdam, London, Montreal, Paris, New York City, Buenos Aires, Shanghai, Tokyo, Chicago, and Hong Kong owe their success in part to their easy accessibility via water and the resultant expansion of trade. Islands with safe water ports, like Singapore, have flourished for the same reason. In places such as North Africa and the Middle East, where water is more scarce, access to clean drinking water was and is a major factor in human development.

Health and pollution

[edit]



An environmental science program – a student from Iowa State University sampling water

Water fit for human consumption is called drinking water or potable water. Water that is not potable may be made potable by filtration or distillation, or by a range of other methods. More than 660 million people do not have access to safe drinking water.^[109]
^[110]

Water that is not fit for drinking but is not harmful to humans when used for swimming or bathing is called by various names other than potable or drinking water, and is sometimes called safe water, or "safe for bathing". Chlorine is a skin and mucous membrane irritant that is used to make water safe for bathing or drinking. Its use is highly technical and is usually monitored by government regulations (typically 1 part per million (ppm) for drinking water, and 1–2 ppm of chlorine not yet reacted with impurities for bathing water). Water for bathing may be maintained in satisfactory microbiological condition using chemical disinfectants such as chlorine or ozone or by the use of ultraviolet light.

Water reclamation is the process of converting wastewater (most commonly sewage, also called municipal wastewater) into water that can be reused for other purposes. There are 2.3 billion people who reside in nations with water scarcities, which means that each individual receives less than 1,700 cubic metres (60,000 cu ft) of water annually. 380 billion cubic metres (13×10^{12} cu ft) of municipal wastewater are produced globally each year.^[111]^[112]^[113]

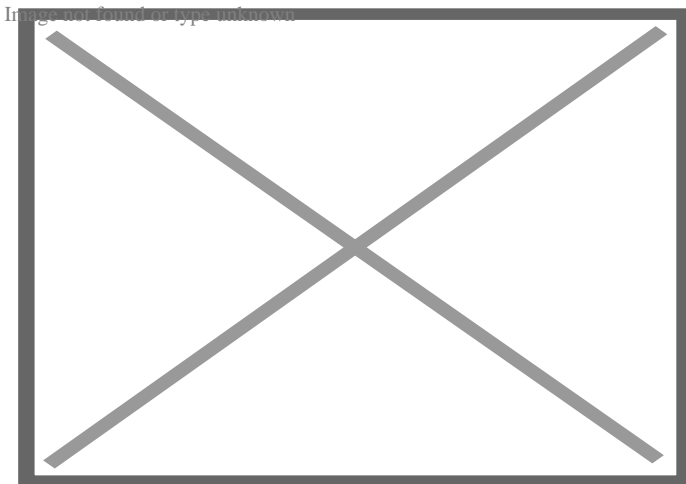
Freshwater is a renewable resource, recirculated by the natural hydrologic cycle, but pressures over access to it result from the naturally uneven distribution in space and time, growing economic demands by agriculture and industry, and rising populations. Currently, nearly a billion people around the world lack access to safe, affordable water. In 2000, the United Nations established the Millennium Development Goals for water to halve by 2015 the proportion of people worldwide without access to safe water and sanitation. Progress toward that goal was uneven, and in 2015 the UN committed to the Sustainable Development Goals of achieving universal access to safe and affordable water and sanitation by 2030. Poor water quality and bad sanitation are deadly; some five million deaths a year are caused by water-related diseases. The World Health Organization estimates that safe water could prevent 1.4 million child deaths from diarrhea each year.^[114]

In developing countries, 90% of all municipal wastewater still goes untreated into local rivers and streams.^[115] Some 50 countries, with roughly a third of the world's population, also suffer from medium or high water scarcity and 17 of these extract more water annually than is recharged through their natural water cycles.^[116] The strain not only affects surface freshwater bodies like rivers and lakes, but it also degrades groundwater resources.

Human uses

[edit]

Further information: Water supply



Total water withdrawals for agricultural, industrial and municipal purposes per capita, measured in cubic metres (m³) per year in 2010^[117]

Agriculture

[edit]

The most substantial human use of water is for agriculture, including irrigated agriculture, which accounts for as much as 80 to 90 percent of total human water consumption.^[118] In the United States, 42% of freshwater withdrawn for use is for irrigation, but the vast majority of water "consumed" (used and not returned to the environment) goes to agriculture.^[119]

Access to fresh water is often taken for granted, especially in developed countries that have built sophisticated water systems for collecting, purifying, and delivering water, and removing wastewater. But growing economic, demographic, and climatic pressures are increasing concerns about water issues, leading to increasing competition for fixed water resources, giving rise to the concept of peak water.^[120] As populations and economies continue to grow, consumption of water-thirsty meat expands, and new demands rise for biofuels or new water-intensive industries, new water challenges are likely.^[121]

An assessment of water management in agriculture was conducted in 2007 by the International Water Management Institute in Sri Lanka to see if the world had sufficient water to provide food for its growing population.^[122] It assessed the current availability of water for agriculture on a global scale and mapped out locations suffering from water scarcity. It found that a fifth of the world's people, more than 1.2 billion, live in areas of physical water scarcity, where there is not enough water to meet all demands. A further 1.6 billion people live in areas experiencing economic water scarcity, where the lack of investment in water or insufficient human capacity make it impossible for authorities to satisfy the demand for water. The report found that it would be possible to produce the food required in the future, but that continuation of today's food production and environmental trends would lead to crises in many parts of the world. To avoid a global water crisis, farmers will have to strive to increase productivity to meet growing demands for food, while industries and cities find ways to use water more efficiently.^[123]

Water scarcity is also caused by production of water intensive products. For example, cotton: 1 kg of cotton—equivalent of a pair of jeans—requires 10.9 cubic metres (380 cu ft) water to produce. While cotton accounts for 2.4% of world water use, the water is consumed in regions that are already at a risk of water shortage. Significant environmental damage has been caused: for example, the diversion of water by the former Soviet Union from the Amu Darya and Syr Darya rivers to produce cotton was largely responsible for the disappearance of the Aral Sea.^[124]

Water requirement per tonne of food product

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Water requirement
per tonne of food
product

○

Water distribution
in subsurface drip
irrigation
Irrigation of field crops

○

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Irrigation of field
crops

As a scientific standard

[edit]

On 7 April 1795, the gram was defined in France to be equal to "the absolute weight of a volume of pure water equal to a cube of one-hundredth of a meter, and at the temperature of melting ice".^[125] For practical purposes though, a metallic reference standard was required, one thousand times more massive, the kilogram. Work was

therefore commissioned to determine precisely the mass of one liter of water. In spite of the fact that the decreed definition of the gram specified water at 0 °C (32 °F)—a highly reproducible *temperature*—the scientists chose to redefine the standard and to perform their measurements at the temperature of highest water *density*, which was measured at the time as 4 °C (39 °F).^[126]

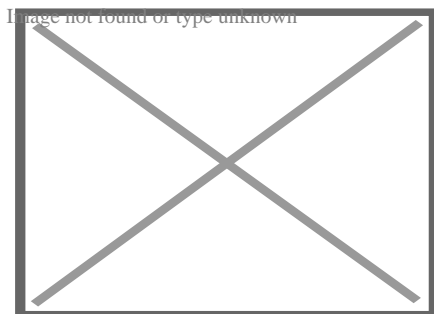
The Kelvin temperature scale of the SI system was based on the triple point of water, defined as exactly 273.16 K (0.01 °C; 32.02 °F), but as of May 2019 is based on the Boltzmann constant instead. The scale is an absolute temperature scale with the same increment as the Celsius temperature scale, which was originally defined according to the boiling point (set to 100 °C (212 °F)) and melting point (set to 0 °C (32 °F)) of water.

Natural water consists mainly of the isotopes hydrogen-1 and oxygen-16, but there is also a small quantity of heavier isotopes oxygen-18, oxygen-17, and hydrogen-2 (deuterium). The percentage of the heavier isotopes is very small, but it still affects the properties of water. Water from rivers and lakes tends to contain less heavy isotopes than seawater. Therefore, standard water is defined in the Vienna Standard Mean Ocean Water specification.

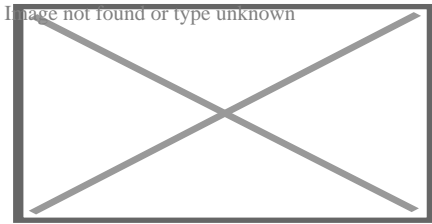
For drinking

[edit]

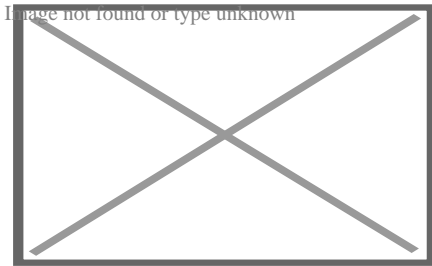
Main article: Drinking water



A young girl drinking bottled water



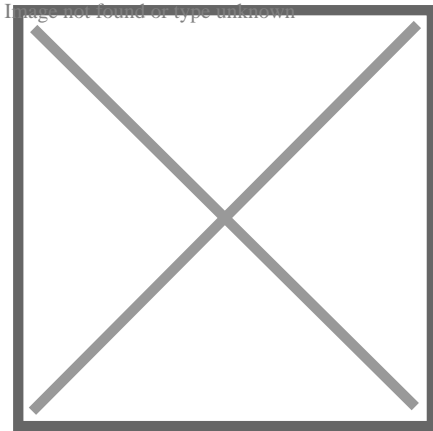
Water availability: the fraction of the population using improved water sources by country



Roadside fresh water outlet from glacier, Nubra

The human body contains from 55% to 78% water, depending on body size.^[127]^[user-generated] To function properly, the body requires between one and seven litres (0.22 and 1.54 imp gal; 0.26 and 1.85 US gal)^[citation needed] of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors. Most of this is ingested through foods or beverages other than drinking straight water. It is not clear how much water intake is needed by healthy people, though the British Dietetic Association advises that 2.5 liters of total water daily is the minimum to maintain proper hydration, including 1.8 liters (6 to 7 glasses) obtained directly from beverages.^[128] Medical literature favors a lower consumption, typically 1 liter of water for an average male, excluding extra requirements due to fluid loss from exercise or warm weather.^[129]

Healthy kidneys can excrete 0.8 to 1 liter of water per hour, but stress such as exercise can reduce this amount. People can drink far more water than necessary while exercising, putting them at risk of water intoxication (hyperhydration), which can be fatal.^[130]^[131] The popular claim that "a person should consume eight glasses of water per day" seems to have no real basis in science.^[132] Studies have shown that extra water intake, especially up to 500 millilitres (18 imp fl oz; 17 US fl oz) at mealtime, was associated with weight loss.^[133]^[134]^[135]^[136]^[137]^[138] Adequate fluid intake is helpful in preventing constipation.^[139]



Hazard symbol for non-potable water

An original recommendation for water intake in 1945 by the Food and Nutrition Board of the U.S. National Research Council read: "An ordinary standard for diverse persons is 1 milliliter for each calorie of food. Most of this quantity is contained in prepared foods."^[140] The latest dietary reference intake report by the U.S. National Research Council in general recommended, based on the median total water intake from US survey data (including food sources): 3.7 litres (0.81 imp gal; 0.98 US gal) for men and 2.7 litres (0.59 imp gal; 0.71 US gal) of water total for women, noting that water contained in food provided approximately 19% of total water intake in the survey.^[141]

Specifically, pregnant and breastfeeding women need additional fluids to stay hydrated. The US Institute of Medicine recommends that, on average, men consume 3 litres (0.66 imp gal; 0.79 US gal) and women 2.2 litres (0.48 imp gal; 0.58 US gal); pregnant women should increase intake to 2.4 litres (0.53 imp gal; 0.63 US gal) and breastfeeding women should get 3 liters (12 cups), since an especially large amount of fluid is lost during nursing.^[142] Also noted is that normally, about 20% of water intake comes from food, while the rest comes from drinking water and beverages (caffeinated included). Water is excreted from the body in multiple forms; through urine and feces, through sweating, and by exhalation of water vapor in the breath. With physical exertion and heat exposure, water loss will increase and daily fluid needs may increase as well.

Humans require water with few impurities. Common impurities include metal salts and oxides, including copper, iron, calcium and lead,^[143]^[full citation needed] and harmful bacteria, such as *Vibrio*. Some solutes are acceptable and even desirable for taste

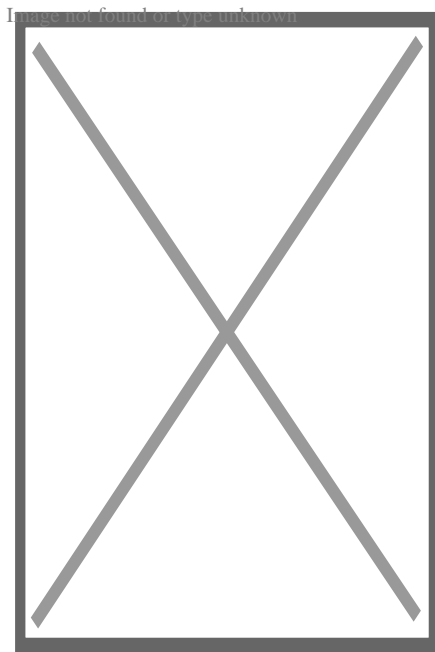
enhancement and to provide needed electrolytes.[¹⁴⁴]

The single largest (by volume) freshwater resource suitable for drinking is Lake Baikal in Siberia.[¹⁴⁵]

Washing

[edit]

This section is an excerpt from Washing.[edit]



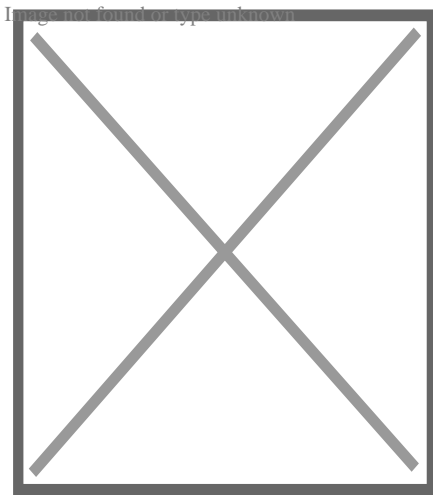
A woman washes her hands with soap and water.

Washing is a method of cleaning, usually with water and soap or detergent. Regularly washing and then rinsing both body and clothing is an essential part of good hygiene and health.[¹⁴⁶][¹⁴⁷][¹⁴⁸]

Often people use soaps and detergents to assist in the emulsification of oils and dirt particles so they can be washed away. The soap can be applied directly, or with the aid of a washcloth or assisted with sponges or similar cleaning tools.

In social contexts, washing refers to the act of bathing, or washing different parts of the body, such as hands, hair, or faces. Excessive washing may damage the hair, causing dandruff, or cause rough skin/skin lesions.^[149]^[150] Some washing of the body is done ritually in religions like Christianity and Judaism, as an act of purification.

Washing can also refer to washing objects. For example, washing of clothing or other cloth items, like bedsheets, or washing dishes or cookwear. Keeping objects clean, especially if they interact with food or the skin, can help with sanitation. Other kinds of washing focus on maintaining cleanliness and durability of objects that get dirty, such as washing one's car, by lathering the exterior with car soap, or washing tools used in a dirty process.



A private home washing machine

Transportation

[edit]

These paragraphs are an excerpt from Maritime transport.[edit]

Maritime transport (or ocean transport) or more generally waterborne transport, is the transport of people (passengers) or goods (cargo) via waterways. Freight transport by sea has been widely used throughout recorded history. The advent of aviation has diminished the importance of sea travel for passengers, though it is still popular for

short trips and pleasure cruises. Transport by water is cheaper than transport by air or ground,^[151] but significantly slower for longer distances. Maritime transport accounts for roughly 80% of international trade, according to UNCTAD in 2020.

Maritime transport can be realized over any distance by boat, ship, sailboat or barge, over oceans and lakes, through canals or along rivers. Shipping may be for commerce, recreation, or military purposes. While extensive inland shipping is less critical today, the major waterways of the world including many canals are still very important and are integral parts of worldwide economies. Particularly, especially any material can be moved by water; however, water transport becomes impractical when material delivery is time-critical such as various types of perishable produce. Still, water transport is highly cost effective with regular schedulable cargoes, such as trans-oceanic shipping of consumer products – and especially for heavy loads or bulk cargos, such as coal, coke, ores, or grains. Arguably, the Industrial Revolution had its first impacts where cheap water transport by canal, navigations, or shipping by all types of watercraft on natural waterways supported cost-effective bulk transport. Containerization revolutionized maritime transport starting in the 1970s. "General cargo" includes goods packaged in boxes, cases, pallets, and barrels. When a cargo is carried in more than one mode, it is intermodal or co-modal.

Chemical uses

[edit]

Water is widely used in chemical reactions as a solvent or reactant and less commonly as a solute or catalyst. In inorganic reactions, water is a common solvent, dissolving many ionic compounds, as well as other polar compounds such as ammonia and compounds closely related to water. In organic reactions, it is not usually used as a reaction solvent, because it does not dissolve the reactants well and is amphoteric (acidic *and* basic) and nucleophilic. Nevertheless, these properties are sometimes desirable. Also, acceleration of Diels–Alder reactions by water has been observed. Supercritical water has recently been a topic of research. Oxygen-saturated supercritical water combusts organic pollutants efficiently.

Heat exchange

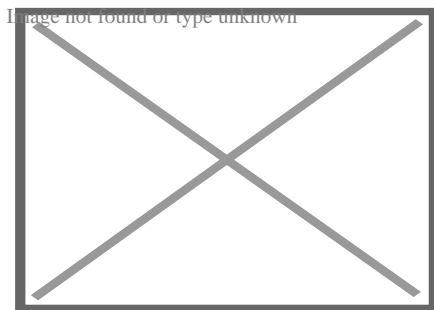
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Water and steam are a common fluid used for heat exchange, due to its availability and high heat capacity, both for cooling and heating. Cool water may even be naturally available from a lake or the sea. It is especially effective to transport heat through vaporization and condensation of water because of its large latent heat of vaporization. A disadvantage is that metals commonly found in industries such as steel and copper are oxidized faster by untreated water and steam. In almost all thermal power stations, water is used as the working fluid (used in a closed-loop between boiler, steam turbine, and condenser), and the coolant (used to exchange the waste heat to a water body or carry it away by evaporation in a cooling tower). In the United States, cooling power plants is the largest use of water.^[152]

In the nuclear power industry, water can also be used as a neutron moderator. In most nuclear reactors, water is both a coolant and a moderator. This provides something of a passive safety measure, as removing the water from the reactor also slows the nuclear reaction down. However other methods are favored for stopping a reaction and it is preferred to keep the nuclear core covered with water so as to ensure adequate cooling.

Fire considerations

[edit]



Water is used for fighting wildfires.

Water has a high heat of vaporization and is relatively inert, which makes it a good fire extinguishing fluid. The evaporation of water carries heat away from the fire. It is dangerous to use water on fires involving oils and organic solvents because many organic materials float on water and the water tends to spread the burning liquid.

Use of water in fire fighting should also take into account the hazards of a steam explosion, which may occur when water is used on very hot fires in confined spaces, and of a hydrogen explosion, when substances which react with water, such as certain metals or hot carbon such as coal, charcoal, or coke graphite, decompose the water, producing water gas.

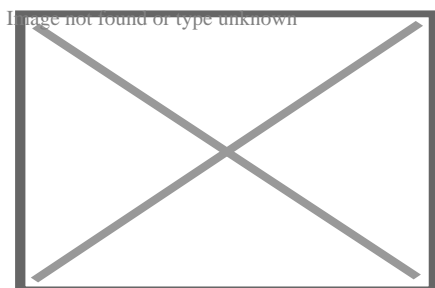
The power of such explosions was seen in the Chernobyl disaster, although the water involved in this case did not come from fire-fighting but from the reactor's own water cooling system. A steam explosion occurred when the extreme overheating of the core caused water to flash into steam. A hydrogen explosion may have occurred as a result of a reaction between steam and hot zirconium.

Some metallic oxides, most notably those of alkali metals and alkaline earth metals, produce so much heat in reaction with water that a fire hazard can develop. The alkaline earth oxide quicklime, also known as calcium oxide, is a mass-produced substance that is often transported in paper bags. If these are soaked through, they may ignite as their contents react with water.^[153]

Recreation

[edit]

Main article: Water sport (recreation)



San Andrés island, Colombia

Humans use water for many recreational purposes, as well as for exercising and for sports. Some of these include swimming, waterskiing, boating, surfing and diving. In addition, some sports, like ice hockey and ice skating, are played on ice. Lakesides, beaches and water parks are popular places for people to go to relax and enjoy recreation. Many find the sound and appearance of flowing water to be calming, and fountains and other flowing water structures are popular decorations. Some keep fish and other flora and fauna inside aquariums or ponds for show, fun, and companionship. Humans also use water for snow sports such as skiing, sledding, snowmobiling or snowboarding, which require the water to be at a low temperature either as ice or crystallized into snow.

Water industry

[edit]

The water industry provides drinking water and wastewater services (including sewage treatment) to households and industry. Water supply facilities include water wells, cisterns for rainwater harvesting, water supply networks, and water purification facilities, water tanks, water towers, water pipes including old aqueducts. Atmospheric water generators are in development.

Drinking water is often collected at springs, extracted from artificial borings (wells) in the ground, or pumped from lakes and rivers. Building more wells in adequate places is thus a possible way to produce more water, assuming the aquifers can supply an adequate flow. Other water sources include rainwater collection. Water may require purification for human consumption. This may involve the removal of undissolved substances, dissolved substances and harmful microbes. Popular methods are filtering with sand which only removes undissolved material, while chlorination and boiling kill harmful microbes. Distillation does all three functions. More advanced techniques exist, such as reverse osmosis. Desalination of abundant seawater is a more expensive solution used in coastal arid climates.

The distribution of drinking water is done through municipal water systems, tanker delivery or as bottled water. Governments in many countries have programs to

distribute water to the needy at no charge.

Reducing usage by using drinking (potable) water only for human consumption is another option. In some cities such as Hong Kong, seawater is extensively used for flushing toilets citywide in order to conserve freshwater resources.

Polluting water may be the biggest single misuse of water; to the extent that a pollutant limits other uses of the water, it becomes a waste of the resource, regardless of benefits to the polluter. Like other types of pollution, this does not enter standard accounting of market costs, being conceived as externalities for which the market cannot account. Thus other people pay the price of water pollution, while the private firms' profits are not redistributed to the local population, victims of this pollution. Pharmaceuticals consumed by humans often end up in the waterways and can have detrimental effects on aquatic life if they bioaccumulate and if they are not biodegradable.

Municipal and industrial wastewater are typically treated at wastewater treatment plants. Mitigation of polluted surface runoff is addressed through a variety of prevention and treatment techniques.

A water-carrier in India, 1882. In many places where running water is not available, water

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A water-carrier in India,
1882. In many places where
running water is not
available, water has to be
transported by people.

A manual water pump in China

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A manual water pump in
China
Water purification facility

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Water purification facility
Reverse osmosis (RO) desalination plant in Barcelona, Spain

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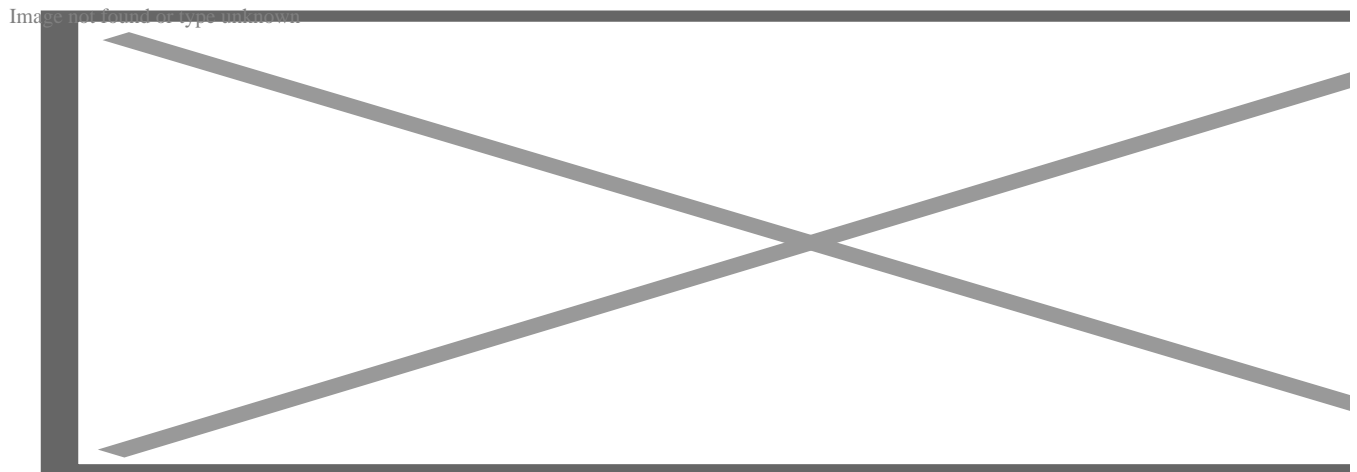
Reverse osmosis (RO)
desalination plant in
Barcelona, Spain

Industrial applications

[edit]

Many industrial processes rely on reactions using chemicals dissolved in water, suspension of solids in water slurries or using water to dissolve and extract substances, or to wash products or process equipment. Processes such as mining, chemical pulping, pulp bleaching, paper manufacturing, textile production, dyeing, printing, and cooling of power plants use large amounts of water, requiring a dedicated water source, and often cause significant water pollution.

Water is used in power generation. Hydroelectricity is electricity obtained from hydropower. Hydroelectric power comes from water driving a water turbine connected to a generator. Hydroelectricity is a low-cost, non-polluting, renewable energy source. The energy is supplied by the motion of water. Typically a dam is constructed on a river, creating an artificial lake behind it. Water flowing out of the lake is forced through turbines that turn generators.



Three Gorges Dam is the largest hydro-electric power station in the world.

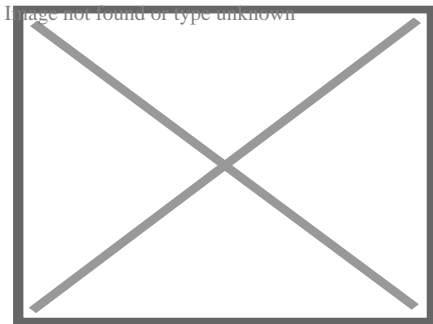
Pressurized water is used in water blasting and water jet cutters. High pressure water guns are used for precise cutting. It works very well, is relatively safe, and is not harmful to the environment. It is also used in the cooling of machinery to prevent overheating, or prevent saw blades from overheating.

Water is also used in many industrial processes and machines, such as the steam turbine and heat exchanger, in addition to its use as a chemical solvent. Discharge of untreated water from industrial uses is pollution. Pollution includes discharged solutes (chemical pollution) and discharged coolant water (thermal pollution). Industry

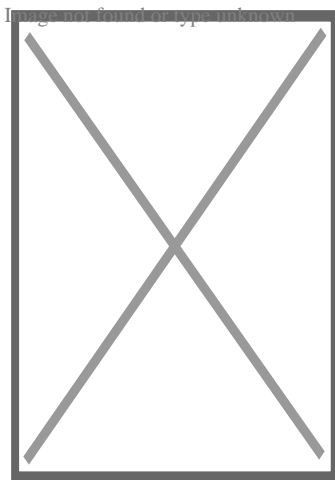
requires pure water for many applications and uses a variety of purification techniques both in water supply and discharge.

Food processing

[edit]



Water can be used to cook foods such as noodles.



Sterile water for injection

Boiling, steaming, and simmering are popular cooking methods that often require immersing food in water or its gaseous state, steam.^[154] Water is also used for dishwashing. Water also plays many critical roles within the field of food science.

Solutes such as salts and sugars found in water affect the physical properties of water. The boiling and freezing points of water are affected by solutes, as well as air pressure, which is in turn affected by altitude. Water boils at lower temperatures with the lower air pressure that occurs at higher elevations. One mole of sucrose (sugar) per kilogram

of water raises the boiling point of water by 0.51 °C (0.918 °F), and one mole of salt per kg raises the boiling point by 1.02 °C (1.836 °F); similarly, increasing the number of dissolved particles lowers water's freezing point.^[155]

Solutes in water also affect water activity that affects many chemical reactions and the growth of microbes in food.^[156] Water activity can be described as a ratio of the vapor pressure of water in a solution to the vapor pressure of pure water.^[155] Solutes in water lower water activity—this is important to know because most bacterial growth ceases at low levels of water activity.^[156] Not only does microbial growth affect the safety of food, but also the preservation and shelf life of food.

Water hardness is also a critical factor in food processing and may be altered or treated by using a chemical ion exchange system. It can dramatically affect the quality of a product, as well as playing a role in sanitation. Water hardness is classified based on concentration of calcium carbonate the water contains. Water is classified as soft if it contains less than 100 mg/L (UK)^[157] or less than 60 mg/L (US).^[158]

According to a report published by the Water Footprint organization in 2010, a single kilogram of beef requires 15 thousand litres (3.3×10^3 imp gal; 4.0×10^3 US gal) of water; however, the authors also make clear that this is a global average and circumstantial factors determine the amount of water used in beef production.^[159]

Medical use

[edit]

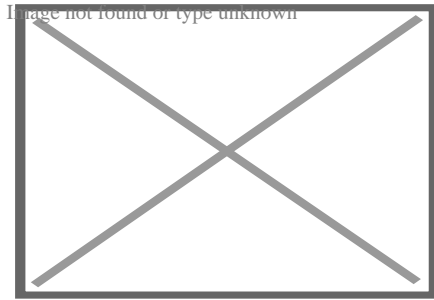
Water for injection is on the World Health Organization's list of essential medicines.^[160]

Distribution in nature

[edit]

In the universe

[edit]



Band 5 ALMA receiver is an instrument specifically designed to detect water in the universe.^[161]

Much of the universe's water is produced as a byproduct of star formation. The formation of stars is accompanied by a strong outward wind of gas and dust. When this outflow of material eventually impacts the surrounding gas, the shock waves that are created compress and heat the gas. The water observed is quickly produced in this warm dense gas.^[162]

On 22 July 2011, a report described the discovery of a gigantic cloud of water vapor containing "140 trillion times more water than all of Earth's oceans combined" around a quasar located 12 billion light years from Earth. According to the researchers, the "discovery shows that water has been prevalent in the universe for nearly its entire existence".^[163]^[164]

Water has been detected in interstellar clouds within the Milky Way.^[165] Water probably exists in abundance in other galaxies, too, because its components, hydrogen, and oxygen, are among the most abundant elements in the universe. Based on models of the formation and evolution of the Solar System and that of other star systems, most other planetary systems are likely to have similar ingredients.

Water vapor

[edit]

Water is present as vapor in:

- Atmosphere of the Sun: in detectable trace amounts^[166]

- Atmosphere of Mercury: 3.4%, and large amounts of water in Mercury's exosphere^[167]
- Atmosphere of Venus: 0.002%^[168]
- Earth's atmosphere: 0.40% over full atmosphere, typically 1–4% at surface; as well as that of the Moon in trace amounts^[169]
- Atmosphere of Mars: 0.03%^[170]
- Atmosphere of Ceres^[171]
- Atmosphere of Jupiter: 0.0004%^[172] – in ices only; and that of its moon Europa^[173]
- Atmosphere of Saturn – in ices only; Enceladus: 91%^[174] and Dione (exosphere)^{[citation r}
- Atmosphere of Uranus – in trace amounts below 50 bar
- Atmosphere of Neptune – found in the deeper layers^[175]
- Extrasolar planet atmospheres: including those of HD 189733 b^[176] and HD 209458 b,^[177] Tau Boötis b,^[178] HAT-P-11b,^[179]^[180] XO-1b, WASP-12b, WASP-17b, and WASP-19b.^[181]
- Stellar atmospheres: not limited to cooler stars and even detected in giant hot stars such as Betelgeuse, Mu Cephei, Antares and Arcturus.^[180]^[182]
- Circumstellar disks: including those of more than half of T Tauri stars such as AA Tauri^[180] as well as TW Hydrae,^[183]^[184] IRC +10216^[185] and APM 08279+5255,^[163]^[164] VY Canis Majoris and S Persei.^[182]

Liquid water

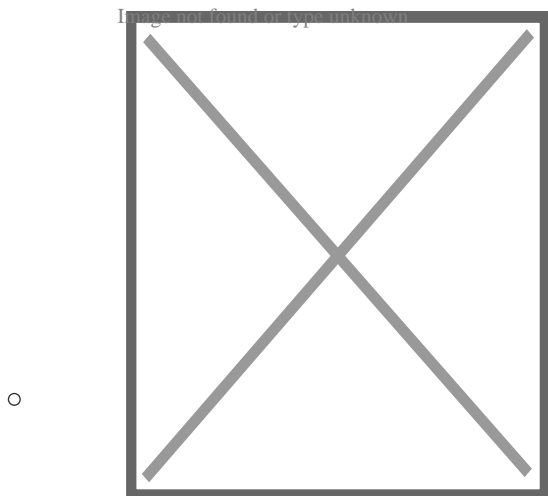
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Liquid water is present on Earth, covering 71% of its surface.^[23] Liquid water is also occasionally present in small amounts on Mars.^[186] Scientists believe liquid water is present in the Saturnian moons of Enceladus, as a 10-kilometre thick ocean approximately 30–40 kilometers below Enceladus' south polar surface,^[187]^[188] and Titan, as a subsurface layer, possibly mixed with ammonia.^[189] Jupiter's moon Europa has surface characteristics which suggest a subsurface liquid water ocean.^[190] Liquid water may also exist on Jupiter's moon Ganymede as a layer sandwiched between high pressure ice and rock.^[191]

Water ice

[edit]

Water is present as ice on:



Water ice in the Korolev crater on Mars

- Mars: under the regolith and at the poles.^{[192][193]}
- Earth–Moon system: mainly as ice sheets on Earth and in Lunar craters and volcanic rocks^[194] NASA reported the detection of water molecules by NASA's Moon Mineralogy Mapper aboard the Indian Space Research Organization's Chandrayaan-1 spacecraft in September 2009.^[195]
- Ceres^{[196][197][198]}
- Jupiter's moons: Europa's surface and also that of Ganymede^[199] and Callisto^{[200][201]}
- Saturn: in the planet's ring system^[202] and on the surface and mantle of Titan^[203] and Enceladus^[204]
- Pluto–Charon system^[202]
- Comets^{[205][206]} and other related Kuiper belt and Oort cloud objects^[207]

And is also likely present on:

- Mercury's poles^[208]
- Tethys^[209]

Exotic forms

[edit]

Water and other volatiles probably comprise much of the internal structures of Uranus and Neptune and the water in the deeper layers may be in the form of ionic water in which the molecules break down into a soup of hydrogen and oxygen ions, and deeper still as superionic water in which the oxygen crystallizes, but the hydrogen ions float about freely within the oxygen lattice.^[210]

Water and planetary habitability

[edit]

Further information: Water distribution on Earth and Planetary habitability

The existence of liquid water, and to a lesser extent its gaseous and solid forms, on Earth are vital to the existence of life on Earth as we know it. The Earth is located in the habitable zone of the Solar System; if it were slightly closer to or farther from the Sun (about 5%, or about 8 million kilometers), the conditions which allow the three forms to be present simultaneously would be far less likely to exist.^[211]^[212]

Earth's gravity allows it to hold an atmosphere. Water vapor and carbon dioxide in the atmosphere provide a temperature buffer (greenhouse effect) which helps maintain a relatively steady surface temperature. If Earth were smaller, a thinner atmosphere would allow temperature extremes, thus preventing the accumulation of water except in polar ice caps (as on Mars).^[citation needed]

The surface temperature of Earth has been relatively constant through geologic time despite varying levels of incoming solar radiation (insolation), indicating that a dynamic process governs Earth's temperature via a combination of greenhouse gases and surface or atmospheric albedo. This proposal is known as the Gaia hypothesis.^[citation needed]

The state of water on a planet depends on ambient pressure, which is determined by the planet's gravity. If a planet is sufficiently massive, the water on it may be solid

even at high temperatures, because of the high pressure caused by gravity, as it was observed on exoplanets Gliese 436 b^[213] and GJ 1214 b.^[214]

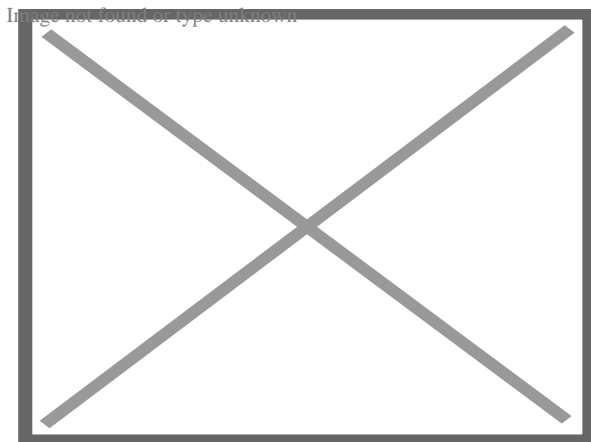
Law, politics, and crisis

[edit]

Main articles: Water law, Water right, and Water scarcity



This section needs to be **updated**. Please help update this article to reflect recent events or newly available information. (*June 2022*)



An estimate of the proportion of people in developing countries with access to potable water 1970–2000

Water politics is politics affected by water and water resources. Water, particularly fresh water, is a strategic resource across the world and an important element in many political conflicts. It causes health impacts and damage to biodiversity.

Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation.^[215] However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability.^[216] A report, issued in November 2009, suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%.^[217]

1.6 billion people have gained access to a safe water source since 1990.^[218] The proportion of people in developing countries with access to safe water is calculated to

have improved from 30% in 1970^[219] to 71% in 1990, 79% in 2000, and 84% in 2004.^[215]

A 2006 United Nations report stated that "there is enough water for everyone", but that access to it is hampered by mismanagement and corruption.^[220] In addition, global initiatives to improve the efficiency of aid delivery, such as the Paris Declaration on Aid Effectiveness, have not been taken up by water sector donors as effectively as they have in education and health, potentially leaving multiple donors working on overlapping projects and recipient governments without empowerment to act.^[221]

The authors of the 2007 Comprehensive Assessment of Water Management in Agriculture cited poor governance as one reason for some forms of water scarcity. Water governance is the set of formal and informal processes through which decisions related to water management are made. Good water governance is primarily about knowing what processes work best in a particular physical and socioeconomic context. Mistakes have sometimes been made by trying to apply 'blueprints' that work in the developed world to developing world locations and contexts. The Mekong river is one example; a review by the International Water Management Institute of policies in six countries that rely on the Mekong river for water found that thorough and transparent cost-benefit analyses and environmental impact assessments were rarely undertaken. They also discovered that Cambodia's draft water law was much more complex than it needed to be.^[222]

In 2004, the UK charity WaterAid reported that a child dies every 15 seconds from easily preventable water-related diseases, which are often tied to a lack of adequate sanitation.^{[223][224]}

Since 2003, the UN World Water Development Report, produced by the UNESCO World Water Assessment Programme, has provided decision-makers with tools for developing sustainable water policies.^[225] The 2023 report states that two billion people (26% of the population) do not have access to drinking water and 3.6 billion (46%) lack access to safely managed sanitation.^[226] People in urban areas (2.4 billion) will face water scarcity by 2050.^[225] Water scarcity has been described as endemic, due to overconsumption and pollution.^[227] The report states that 10% of the world's

population lives in countries with high or critical water stress. Yet over the past 40 years, water consumption has increased by around 1% per year, and is expected to grow at the same rate until 2050. Since 2000, flooding in the tropics has quadrupled, while flooding in northern mid-latitudes has increased by a factor of 2.5.^[228] The cost of these floods between 2000 and 2019 was 100,000 deaths and \$650 million.^[225]

Organizations concerned with water protection include the International Water Association (IWA), WaterAid, Water 1st, and the American Water Resources Association. The International Water Management Institute undertakes projects with the aim of using effective water management to reduce poverty. Water related conventions are United Nations Convention to Combat Desertification (UNCCD), International Convention for the Prevention of Pollution from Ships, United Nations Convention on the Law of the Sea and Ramsar Convention. World Day for Water takes place on 22 March^[229] and World Oceans Day on 8 June.^[230]

In culture

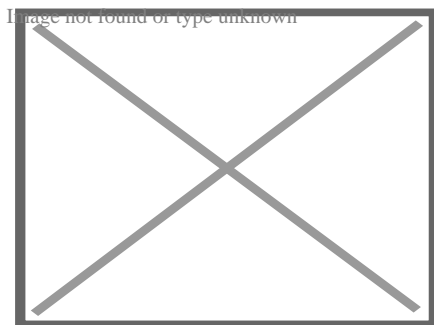
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Religion

[edit]

Main article: Water and religion

See also: Sacred waters



People come to Inda Abba Hadera spring (Inda Sillasie, Ethiopia) to wash in holy water.

Water is considered a purifier in most religions. Faiths that incorporate ritual washing (ablution) include Christianity,^[231] Hinduism, Islam, Judaism, the Rastafari movement, Shinto, Taoism, and Wicca. Immersion (or aspersion or affusion) of a person in water is a central Sacrament of Christianity (where it is called baptism); it is also a part of the practice of other religions, including Islam (*Ghusl*), Judaism (*mikvah*) and Sikhism (*Amrit Sanskar*). In addition, a ritual bath in pure water is performed for the dead in many religions including Islam and Judaism. In Islam, the five daily prayers can be done in most cases after washing certain parts of the body using clean water (*wudu*), unless water is unavailable (see *Tayammum*). In Shinto, water is used in almost all rituals to cleanse a person or an area (e.g., in the ritual of *misogi*).

In Christianity, holy water is water that has been sanctified by a priest for the purpose of baptism, the blessing of persons, places, and objects, or as a means of repelling evil.^{[232][233]}

In Zoroastrianism, water (𐬀𐬎) is respected as the source of life.^[234]

Philosophy

[edit]

Icosahedron as a part of Spinoza monument in Amsterdam.

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Icosahedron as a part of Spinoza monument in Amsterdam

The Ancient Greek philosopher Empedocles saw water as one of the four classical elements (along with fire, earth, and air), and regarded it as an ylem, or basic substance of the universe. Thales, whom Aristotle portrayed as an astronomer and an

engineer, theorized that the earth, which is denser than water, emerged from the water. Thales, a monist, believed further that all things are made from water. Plato believed that the shape of water is an icosahedron – flowing easily compared to the cube-shaped earth.^[235]

The theory of the four bodily humors associated water with phlegm, as being cold and moist. The classical element of water was also one of the five elements in traditional Chinese philosophy (along with earth, fire, wood, and metal).

Some traditional and popular Asian philosophical systems take water as a role-model. James Legge's 1891 translation of the *Dao De Jing* states, "The highest excellence is like (that of) water. The excellence of water appears in its benefiting all things, and in its occupying, without striving (to the contrary), the low place which all men dislike. Hence (its way) is near to (that of) the Tao" and "There is nothing in the world more soft and weak than water, and yet for attacking things that are firm and strong there is nothing that can take precedence of it—for there is nothing (so effectual) for which it can be changed."^[236] *Guanzi* in the "Shui di" 水地 chapter further elaborates on the symbolism of water, proclaiming that "man is water" and attributing natural qualities of the people of different Chinese regions to the character of local water resources.^[237]

Folklore

[edit]

"Living water" features in Germanic and Slavic folktales as a means of bringing the dead back to life. Note the Grimm fairy-tale ("The Water of Life") and the Russian dichotomy of living [ru] and dead water [ru]. The Fountain of Youth represents a related concept of magical waters allegedly preventing aging.

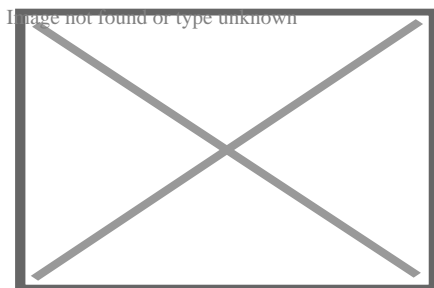
Art and activism

[edit]

In the significant modernist novel *Ulysses* (1922) by Irish writer James Joyce, the chapter "Ithaca" takes the form of a catechism of 309 questions and answers, one of which is known as the "water hymn".^[238] According to Richard E. Madtes, the hymn is not merely a "monotonous string of facts", rather, its phrases, like their subject, "ebb and flow, heave and swell, gather and break, until they subside into the calm quiescence of the concluding 'pestilential fens, faded flowerwater, stagnant pools in the waning moon.'"^[238] The hymn is considered one of the most remarkable passages in Ithaca, and according to literary critic Hugh Kenner, achieves "the improbable feat of raising to poetry all the clutter of footling information that has accumulated in schoolbooks."^[238] The literary motif of water represents the novel's theme of "everlasting, everchanging life," and the hymn represents the culmination of the motif in the novel.^[238] The following is the hymn quoted in full.^[239]

What in water did Bloom, waterlover, drawer of water, watercarrier
returning to the range, admire?
Its universality: its democratic equality and constancy to its nature in
seeking its own level: its vastness in the ocean of Mercator's projection: its
unplumbed profundity in the Sundam trench of the Pacific exceeding 8,000
fathoms: the restlessness of its waves and surface particles visiting in turn all
points of its seaboard: the independence of its units: the variability of states
of sea: its hydrostatic quiescence in calm: its hydrokinetic turgidity in neap
and spring tides: its subsidence after devastation: its sterility in the
circumpolar icecaps, arctic and antarctic: its climatic and commercial
significance: its preponderance of 3 to 1 over the dry land of the globe: its
indisputable hegemony extending in square leagues over all the region
below the subequatorial tropic of Capricorn: the multiseular stability of its
primeval basin: its luteofulvous bed: its capacity to dissolve and hold in
solution all soluble substances including millions of tons of the most precious
metals: its slow erosions of peninsulas and downwardtending promontories:
its alluvial deposits: its weight and volume and density: its imperturbability
in lagoons and highland tarns: its gradation of colours in the torrid and
temperate and frigid zones: its vehicular ramifications in continental

lake-contained streams and confluent ocean-flowing rivers with their tributaries and transoceanic currents: gulfstream, north and south equatorial courses: its violence in seaquakes, waterspouts, artesian wells, eruptions, torrents, eddies, freshets, spates, groundswells, watersheds, waterpartings, geysers, cataracts, whirlpools, maelstroms, inundations, deluges, cloudbursts: its vast circumterrestrial a horizontal curve: its secrecy in springs, and latent humidity, revealed by rhabdomantic or hygrometric instruments and exemplified by the well by the hole in the wall at Ashtown gate, saturation of air, distillation of dew: the simplicity of its composition, two constituent parts of hydrogen with one constituent part of oxygen: its healing virtues: its buoyancy in the waters of the Dead Sea: its persevering penetrativeness in runnels, gullies, inadequate dams, leaks on shipboard: its properties for cleansing, quenching thirst and fire, nourishing vegetation: its infallibility as paradigm and paragon: its metamorphoses as vapour, mist, cloud, rain, sleet, snow, hail: its strength in rigid hydrants: its variety of forms in loughs and bays and gulfs and bights and guts and lagoons and atolls and archipelagos and sounds and fjords and minches and tidal estuaries and arms of sea: its solidity in glaciers, icebergs, icefloes: its docility in working hydraulic millwheels, turbines, dynamos, electric power stations, bleachworks, tanneries, scutchmills: its utility in canals, rivers, if navigable, floating and graving docks: its potentiality derivable from harnessed tides or watercourses falling from level to level: its submarine fauna and flora (anacoustic, photophobe) numerically, if not literally, the inhabitants of the globe: its ubiquity as constituting 90% of the human body: the noxiousness of its effluvia in lacustrine marshes, pestilential fens, faded flowerwater, stagnant pools in the waning moon.



The vast "water hymn" in James Joyce's novel *Ulysses* is occasioned when the protagonist Leopold Bloom fills a kettle with water from a kitchen faucet.^[239]

Painter and activist Fredericka Foster curated *The Value of Water*, at the Cathedral of St. John the Divine in New York City,^[240] which anchored a year-long initiative by the Cathedral on our dependence on water.^{[241][242]} The largest exhibition to ever appear at the Cathedral,^[243] it featured over forty artists, including Jenny Holzer, Robert Longo, Mark Rothko, William Kentridge, April Gornik, Kiki Smith, Pat Steir, Alice Dalton Brown, Teresita Fernandez and Bill Viola.^{[244][245]} Foster created Think About Water,^[246]^[full citation needed] an ecological collective of artists who use water as their subject or medium. Members include Basia Irland,^[247]^[full citation needed] Aviva Rahmani, Betsy Damon, Diane Burko, Leila Daw, Stacy Levy, Charlotte Coté,^[248] Meridel Rubenstein, and Anna Macleod.

To mark the 10th anniversary of access to water and sanitation being declared a human right by the UN, the charity WaterAid commissioned ten visual artists to show the impact of clean water on people's lives.^{[249][250]}

Dihydrogen monoxide parody

[edit]

Main article: Dihydrogen monoxide parody

'Dihydrogen monoxide' is a technically correct but rarely used chemical name of water. This name has been used in a series of hoaxes and pranks that mock scientific illiteracy. This began in 1983, when an April Fools' Day article appeared in a newspaper in Durand, Michigan. The false story consisted of safety concerns about the substance.^[251]





Music

[edit]

The word "Water" has been used by many Florida based rappers as a sort of catchphrase or adlib. Rappers who have done this include BLP Koshier and Ski Mask the Slump God.^[252] To go even further some rappers have made whole songs dedicated to the water in Florida, such as the 2023 Danny Towers song "Florida Water".^[253] Others have made whole songs dedicated to water as a whole, such as XXXTentacion, and Ski Mask the Slump God with their hit song "H2O".

See also

[edit]

-  [Ocean portal](#) Image of Ocean portal type unknown
-  [Renewable energy portal](#) Image of Renewable energy portal type unknown
-  [Water portal](#) Image of Water portal type unknown
-  [Weather portal](#) Image of Weather portal type unknown
- [Outline of water](#) – Overview of and topical guide to water
- [Water \(data page\)](#) – Chemical data page for water is a collection of the chemical and physical properties of water.
- [Aquaphobia](#) – Persistent and abnormal fear of water
- [Blue roof](#) – Roof of a building that is designed to provide temporary water storage
- [Catchwater](#) – Runoff catching or channeling device
- [Human right to water and sanitation](#)
- [Hydroelectricity](#) – Electricity generated by hydropower
- [Marine current power](#) – Extraction of power from ocean currents
- [Marine energy](#) – Energy available from oceans
- [Mpemba effect](#) – Natural phenomenon that hot water freezes faster than cold
- [Oral rehydration therapy](#) – Type of fluid replacement used to prevent and treat dehydration
- [Osmotic power](#) – Energy available from the difference in the salt concentration between seawater and river water
- [Oxyhydrogen](#) – Explosive mixture of hydrogen and oxygen gases
- [Properties of water](#) – Physical and chemical properties of pure water
- [Rainwater tank](#) – container used to collect rainwater
- [Thirst](#) – Craving for potable fluids experienced by animals

- Tidal power – Technology to convert the energy from tides into useful forms of power
- Water pinch analysis – A systematic technique for reducing water consumption and wastewater generation
- Wave power – Transport of energy by wind waves, and the capture of that energy to do useful work
- Water filter – Device that removes impurities in water
- Water heat recycling – Use of a heat exchanger to recover energy and reuse heat from drain water
- Water recycling shower
- Water-sensitive urban design – Integrated approach to urban water cycle

Notes

[edit]

1. ^ A commonly quoted value of 15.7 used mainly in organic chemistry for the pK_a of water is incorrect.^{[12][13]}
2. ^ **a b** Vienna Standard Mean Ocean Water (VSMOW), used for calibration, melts at 273.1500089(10) K (0.000089(10) °C, and boils at 373.1339 K (99.9839 °C). Other isotopic compositions melt or boil at slightly different temperatures.
3. ^ see the taste and odor section
4. ^ Other substances with this property include bismuth, silicon, germanium and gallium.^[53]

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[edit]

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External links

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-  Texts from Wikisource
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-  Resources from Wikiversity
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Water

Overviews

- Outline
- Data
- Model
- Properties

States

- Liquid
- Ice
- Vapor
- Steam
 - superheated
- Deuterium-depleted
- Semiheavy

Forms

- Heavy
- Tritiated
- Doubly labeled water
- Hydronium

Water droplet

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Water

droplet





- Cycle
- Distribution
- Hydrosphere
 - Hydrology
 - Hydrobiology
- Origin
- Pollution
- Resources
 - management
 - policy
- Supply
- Extraterrestrial liquid water
 - Asteroidal water
 - Planetary oceanography
 - Ocean world
 - Hycean planet
 - List of Candidates

On Earth

Extraterrestrial

- Specific
 - Europa
 - Mars
 - Moon
 - Enceladus
- Stratification
 - Ocean stratification
 - Lake stratification
- Ocean temperature

Physical parameters

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Food chemistry

- o Additives
- o Carbohydrates
- o Coloring
- o Enzymes
- o Essential fatty acids
- o Flavors
- o Fortification
- o Lipids
- o "Minerals" (Chemical elements)
- o Proteins
- o Vitamins
- o Water

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Natural resources

- o Ambient standards (US)
 - o Index
 - o Indoor
 - o Law
 - o Clean Air Act (US)
 - o Ozone depletion
 - o Airshed
 - o Trading
 - o Deforestation (REDD)
- Air**
- Pollution / quality
- Emissions

Energy

- Bio
- Law
- Resources
- Fossil fuels (gas, peak coal, peak gas, peak oil)
- Geothermal
- Hydro
- Nuclear
- Solar
 - sunlight
 - shade
- Wind

Land

- Agricultural
 - arable
 - peak farmland
- Degradation
- Field
- Landscape
 - cityscape
 - seascape
 - soundscape
 - viewshed
- Law
 - property
- Management
 - habitat conservation
- Minerals
 - gemstone
 - industrial
 - ore
 - metal
 - mining
 - law
 - sand
 - peak
 - copper
 - phosphorus
 - rights
- Soil
 - conservation
 - fertility
 - health
 - resilience
- Use
 - planning
 - reserve

- Biodiversity
 - Bioprospecting
 - biopiracy
 - Biosphere
 - Bushfood
 - Bushmeat
 - Fisheries
 - climate change
 - law
 - management
 - Forests
 - genetic resources
 - law
 - management
 - non-timber products
 - Game
 - law
 - Marine conservation
 - Meadow
 - Pasture
 - Plants
 - FAO Plant Treaty
 - food
 - genetic resources
 - gene banks
 - herbal medicines
 - UPOV Convention
 - wood
 - Rangeland
 - Seed bank
 - Wildlife
 - conservation
 - management
- Life**

Water

Types / location

- Aquifer
 - storage and recovery
- Drinking
- Fresh
- Groundwater
 - pollution
 - recharge
 - remediation
- Hydrosphere
- Ice
 - bergs
 - glacial
 - polar
- Irrigation
 - *huerta*
- Marine
- Rain
 - harvesting
- Stormwater
- Surface water
- Sewage
 - reclaimed water

Aspects

- Watershed
- Desalination
- Floods
- Law
- Leaching
- Sanitation
 - improved
- Scarcity
- Security
- Supply
- Efficiency
- Conflict
- Conservation
- Peak water

- Commons
 - enclosure
 - global
 - land
 - tragedy of
- Economics
 - ecological
 - land
- Ecosystem services
- Exploitation
 - overexploitation
 - Earth Overshoot Day
- Management
 - adaptive
- Natural capital
 - accounting
 - good
- Natural heritage
- Nature reserve
 - remnant natural area
- Systems ecology
- Urban ecology
- Wilderness
 - Common-pool
 - Conflict (perpetuation)
 - Curse
- Resource
 - Depletion
 - Extraction
 - Nationalism
 - Renewable / Non-renewable
 - Oil war
- Politics
 - Petrostate
 - Resource war

Related

○  Category

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Molecules detected in outer space

- Aluminium monochloride
- Aluminium monofluoride
- Aluminium(II) oxide
- Argonium
- Carbon cation
- Carbon monophosphide
- Carbon monosulfide
- Carbon monoxide
- Cyano radical
- Diatomic carbon
- Fluoromethylidynium
- Helium hydride ion
- Hydrogen chloride
- Hydrogen fluoride
- Hydrogen (molecular)
- Hydroxyl radical
- Iron(II) oxide

Diatomic

- Magnesium monohydride
- Methylidyne radical
- Nitric oxide
- Nitrogen (molecular)
- Imidogen
- Sulfur mononitride
- Oxygen (molecular)
- Phosphorus monoxide
- Phosphorus mononitride
- Potassium chloride
- Silicon carbide
- Silicon monoxide
- Silicon monosulfide
- Sodium chloride
- Sodium iodide
- Sulfanyl
- Sulfur monoxide
- Titanium(II) oxide
- Aluminium(I) hydroxide

**Deuterated
molecules**





- Ammonia
- Ammonium ion
- Formaldehyde
- Formyl radical
- Heavy water
- Hydrogen cyanide
- Hydrogen deuteride
- Hydrogen isocyanide
- Propyne
- N_2D^+
- Trihydrogen cation
- Anthracene
- Dihydroxyacetone
- Methoxyethane
- Glycine
- Graphene

Unconfirmed

- Hemolithin
- H_2NCO^+
- Linear C_5
- Naphthalene cation
- Phosphine
- Pyrene
- Silylidyne

- Abiogenesis
- Astrobiology
- Astrochemistry
- Atomic and molecular astrophysics
- Chemical formula
- Circumstellar dust
- Circumstellar envelope
- Cosmic dust
- Cosmic ray
- Cosmochemistry
- Diffuse interstellar band
- Earliest known life forms
- Extraterrestrial life
- Extraterrestrial liquid water
- Forbidden mechanism
- Homochirality
- Intergalactic dust
- Interplanetary medium
- Interstellar medium
- Photodissociation region
- Iron–sulfur world theory
- Kerogen
- Molecules in stars
- Nexus for Exoplanet System Science
- Organic compound
- Outer space
- PAH world hypothesis
- Pseudo–panspermia
- Polycyclic aromatic hydrocarbon (PAH)
- RNA world hypothesis
- Spectroscopy
- Tholin

Related

-  **Category: Astrochemistry**
-  **Outer space portal**
-  **Astronomy portal**
-  **Chemistry portal**

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Things To Do in Cook County

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Clarence F. Buckingham Memorial Fountain

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Glessner House

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Driving Directions From Hampton Inn & Suites Chicago/Hoffman Estates to United Structural Systems of Illinois, Inc

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Reviews for United Structural Systems of Illinois, Inc

United Structural Systems of Illinois, Inc

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Jim de Leon

(5)

It was a pleasure to work with Rick and his crew. From the beginning, Rick listened to my concerns and what I wished to accomplish. Out of the 6 contractors that quoted the project, Rick seemed the MOST willing to accommodate my wishes. His pricing was definitely more than fair as well. I had 10 push piers installed to stabilize and lift an addition of my house. The project commenced at the date that Rick had disclosed initially and it was completed within the same time period expected (based on Rick's original assessment). The crew was well informed, courteous, and hard working. They were not loud (even while equipment was being utilized) and were well spoken. My neighbors were very impressed on how polite they were when they entered / exited my property (saying hello or good morning each day when they crossed paths). You can tell they care about the customer concerns. They ensured that the property would be put back as clean as possible by placing MANY sheets of plywood down prior to excavating. They compacted the dirt back in the holes extremely well to avoid large stock piles of soils. All the while, the main office was calling me to discuss updates and expectations of completion. They provided waivers of lien, certificates of insurance, properly acquired permits, and JULIE locates. From a construction background, I can tell you that I did not see any flaws in the way they operated and this an extremely professional company. The pictures attached show the push piers added to the foundation (pictures 1, 2 & 3), the amount of excavation (picture 4), and the restoration after dirt was placed back in the pits and compacted (pictures 5, 6 & 7). Please notice that they also sealed two large cracks and steel plated these cracks from expanding further (which you can see under my sliding glass door). I, as well as my wife, are extremely happy that we chose United Structural Systems for our contractor. I would happily tell any of my friends and family to use this contractor should the opportunity arise!

United Structural Systems of Illinois, Inc

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Chris Abplanalp

(5)

USS did an amazing job on my underpinning on my house, they were also very courteous to the proximity of my property line next to my neighbor. They kept things in order with all the dirt/mud they had to excavate. They were done exactly in the timeframe they indicated, and the contract was very details oriented with drawings of what would be done. Only thing that would have been nice, is they left my concrete a little muddy with boot prints but again, all-in-all a great job

United Structural Systems of Illinois, Inc

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Sarah McNeily

(5)

USS was excellent. They are honest, straightforward, trustworthy, and conscientious. They thoughtfully removed the flowers and flower bulbs to dig where they needed in the yard, replanted said flowers and spread the extra dirt to fill in an area of the yard. We've had other services from different companies and our yard was really a mess after. They kept the job site meticulously clean. The crew was on time and friendly. I'd recommend them any day! Thanks to Jessie and crew.

Monitoring Summer Drought Effects on Concrete [View GBP](#)

Frequently Asked Questions

How does summer drought contribute to foundation cracks?

Summer drought can cause soil moisture levels to decrease significantly, leading to soil shrinkage. This shrinkage can result in uneven settling or movement of a buildings foundation, which may lead to cracks.

What signs indicate that a concrete foundation is affected by drought conditions?

Signs include visible cracks in the foundation walls or floors, doors and windows that stick or do not close properly, gaps between walls and ceilings or floors, and noticeable sloping of floors.

How can I monitor my homes foundation for potential damage during a drought?

Regularly inspect your home's exterior and interior for any new cracks or changes in existing ones. Also, monitor door frames and window alignment for shifts. Consider using measuring tools like crack monitors to track changes over time.

What preventive measures can be taken to protect foundations from drought-related damage?

Maintain consistent moisture levels around the foundation by watering the surrounding soil during dry periods. Ensure proper drainage away from the structure and consider installing root barriers if large trees are nearby.

When should I consult a professional for potential repairs due to drought-induced cracking?

If you notice significant or rapidly expanding cracks, misaligned doors/windows, or sloping floors, it is advisable to consult a structural engineer or qualified contractor promptly for assessment and repair recommendations.

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