That's the Truth Backgrounder: Episodes 14-16

Episode 14: "Hydration for Generations"

(We drink the same water our ancestors did!)

Episode 15: "Watering it Down"

(Water Cycle)

Episode 16: "H2Oh No!"

(Water States – Solid, Liquid, Gas)

CURRICULUM CONNECTIONS

Kindergarten: Environment and Community Awareness

Grade 1 Science Topic B: Seasonal Changes

Grade 2 Science Topic A: Exploring Liquids

Grade 4 Science Topic A: Waste and Our World

Grade 4 Science Topic E: Plant Growth and Changes

Grade 5 Science Topic C: Classroom Chemistry

Grade 5 Science Topic D: Weather Watch

Quick Facts:

- We all share the same water and planet. We always did and we always will.
- Water is **continuously mixed and recycled**
- The earth is a **closed thermodynamic system** with finite resources such as water
- Water is a **chemical substance with a chemical formula of H2O**, meaning that its molecule contains one oxygen and two hydrogen atoms connected by covalent bonds.
- Although the absolute amount of water remains stable, it is **chemically changed**. **Plants convert water and carbon dioxide to oxygen and sugars. Respiration reverses the process and makes CO2 and energy.** We know that plants take 12,000 billion kg of water a year and that the total amount of water on earth is 1400 billion billion kg. That means that water changes chemically over time.[7]
- We are drinking some of the same water as our ancestors, but much is different water on a molecular level.
- 96.5% of our planet's water is **saltwater**, and most of the other 3.5% of our water supply is in the form of ice in glaciers. Earth's liquid fresh water is well under 1% of the water supply.[8]
- **The planet recycles water using the water cycle**. Water **evaporates** from oceans, rivers, and lakes; **condensation** causes clouds; **precipitation** falls and refills the bodies of water.
- **Water is part of Earth's hydrosphere**, which includes all water on the planet except water vapor in the atmosphere**. Water vapor** is the most common **greenhouse gas** and has tremendous heat-trapping potential and a role in **global warming**.[10]
- 40% of the people on earth live in places where there is a greater demand than supply of water.
- Matter can change from one state to another when physical conditions change; when energy, such as heat, is added or removed, a substance can change from a solid to a liquid, or from a liquid to a gas.
- Water is unique because the properties of water allow it to exist in all three states of matter!
- Clean water is essential to humans and only about one per cent of all the water on the planet is available for consumption. This means we must all do our part to **conserve** clean water and to safely return it to the ecosystem.

Discussion Questions:

- Are we drinking the same water today as our ancestors? Explain why.
- What are the various stages of the water cycle?
- What forms can water take?
- What are the three main states of water and what factors can lead to the changes between states?
- How can we conserve water? What are some everyday steps we can take?

Activity Ideas & Links:

- Explore the Alberta Water Portal Society webpage for great facts and videos about the water nexus, why we should care about water, and how are everyday water decisions can make a difference. Fill out this scavenger hunt as you explore:

  https://docs.google.com/document/d/12_4HzE5nawQeTxBioQAljpf5Skuu02kXLnM-2vUk7j8/edit

- Water is an essential part of life on earth and it is especially important to farmers. The seven, hands-on activities in the Come Alive Module from GreenLearning will help you to understand how water influences farmers and the food they grow. It will also help you to understand the ways in which climate change impacts water and farming and what this all means for you!

  See also the Storm Water Challenge!

- Inside Education's "**Running Water"** education kit explores the science and issues related to water use in Alberta and the "**Wise Kit"** is designed to enhance water literacy and conservation. **"Wetland Wonders"** delves into pond dipping and more.

- Check out the "Our Water Matters" Conservation Resource Kits:

  https://www.ourwatermatters.ca/files/File/WaterConservation/Water_Conservation_Resource_Kit_2-3.pdf

  https://www.ourwatermatters.ca/files/File/WaterConservation/Water_Conservation_Resource_Kit_4-5.pdf

- For an extensive list of links/resources related to water & aquatic wildlife, visit: Alberta Council for Environmental Education

- Water Cycle lesson plans and activities:

  http://www.thewaterpage.com/ultimate-water-cycle.htm

- 40+ STEM Water Science Experiments and STEM Projects for Kids

https://www.steampoweredfamily.com/activities/water-projects-for-kids/

Source Articles & Links:

Are We Drinking the Same Water our Ancestors Drank?

Water is continuously mixed and recycled, so the odds favor us sharing at least some molecules of it with Socrates, Jesus, Buddha, or anyone from past eras.

All Matter and Water on Earth is Recycled; So We all Share the Same Water

Here is the logic behind us drinking the same water that our ancestors drank:

- **The earth is a closed system with finite resources; one such resource is water.**[1]
- **That means we don't get new water or lose water on average; instead, it mixes and recycles. The same is somewhat true for air, and most everything else on earth, although each substance has its own considerations.**[2]
- **Water is a chemical substance with a chemical formula of H2O, meaning that its molecule contains one oxygen and two hydrogen atoms connected by covalent bonds.**
- People drink an average amount of two quarts of water a day.
- Each quart of water contains 3.1634653 x 10^24th power of molecules.[3]
- If a person lives for 75 years, we can calculate them needing roughly 365x75x2=54,750 quarts of water over their lifetime.
- That means, the average person drinks [very roughly] 54,750 x 3.1634653 x 10^24th power of molecules in their lifetime.
- There are about 326 million trillion gallons of fresh water on Earth. We have approximately 4.72 X 10^46 molecules of fresh water in total.[4]
- **Thus, there is a fair chance you shared water molecule or two with the Dinosaurs, Jesus, Buddha, Confucius, Julius Caesar, Socrates, or any historical water drinker.**

We all share the same water and planet. We always did and we always will. That is why climate change is so critical. Asteroids and sources of water from beyond our planet aside, the water that is here has always been here.

Anything that happened in the water, from the birth of early life forms in oceans to a **Dinosaurs taking a pee in a stream**, to a corporation dumping toxic waste in our rivers to save money is a story of the same water.

The same thing is true for most other substances on earth, including the combination of molecules we call air. It is possible to share an atom of air with Socrates, but less likely than it is with water. See Breathing Ancient Air.[5]

All the atoms in our bodies and the earth have been around since the start of the universe; we are all made of star stuff.

We only have one earth and one water supply. Our resources are finite.

FUN FACT: That means if you take Communion, there is a slim (but real) chance you are eating and drinking a molecule or two shared between bread and wine and body and blood.

TIP: This article assumes that historical figures like Socrates, Jesus, Buddha, or Lao Tzu, were real people. We could say, Plato, Augustine, or Sima Qian instead. The science is clear, the historical accuracy of any individual's existence could perhaps be debated. Forgive the clickbait. "Earth is a closed system with finite resources" just didn't have the same ring to it.

Earth is a Closed System With Finite Resources

The planet Earth is a closed **thermodynamic system**. **That means it does not lose or gain much matter.**

Solar radiation comes through our atmosphere. We occasionally get hit by meteors and gain matter, or launch spacecraft and satellites, but the amount of matter in our system remains relatively stable.[6]

All matter and water on earth is recycled so, in absolute terms, the supply remains stable and is repeatedly reused.

Although the absolute amount of water remains stable, it is chemically changed. Plants convert water and carbon dioxide to oxygen and sugars. Respiration reverses the process and makes CO2 and energy. We know that plants take 12,000 billion kg of water a year and that

the total amount of water on earth is 1400 billion billion kg. That means that water changes chemically over time.[7]

We are drinking some of the same water as our ancestors, but much is different water on a molecular level. To further complicate matters, Hydrogen atoms move between water molecules, so molecules themselves change over time.

Like coal and oil, water is a finite resource. **Fresh water is even more limited**. **96.5% of our planet's water is saltwater, and most of the other 3.5% of our water supply is in the form of ice in glaciers. Earth's liquid fresh water is well under 1% of the water supply.**[8]

Of all available fresh water on Earth, underground aquifers hold about 30% while lakes and streams hold about 0.3%.[9]

Earth's Hydrosphere

We know that the **planet recycles water using the water cycle**. You probably learned about it in school. Water evaporates from oceans, rivers, and lakes; condensation causes clouds; precipitation falls and refills the bodies of water.

For a refresher, see the following video:

Bill Nye the Science Guy: Water Cycle.

Water is part of Earth's hydrosphere, which includes all water on the planet except water vapor in the atmosphere. **Water vapor is the most common greenhouse gas and has tremendous heat-trapping potential and a role in global warming.**[10]

The amount of fresh water on Earth remains approximately the same over time, but frequently it is neither available where people can use it nor at the time they need it.

We have **droughts, floods**, and other catastrophic climate events. 40% of the people on earth live in places where there is a greater demand than supply of water. The percentage of people in water scarce areas is projected to grow to nearly 50% by 2050.[11]

We need to pay attention to our water use and to keeping our finite supply clean.

Conclusion

There is much we don't know about water. We don't know whether Earth formed as a dry planet and meteors brought water to it or whether Earth developed water along with other matter as it formed.

For all we don't know, there is a lot we do know.

We know that the earth's water cycle (the hydrologic cycle) continuously recycles our water; we know is that earth is a closed system; we know we have finite resources; we know we all breath the same air (roughly speaking) and drink the same water today as we always have.

http://factmyth.com/factoids/we-drink-the-same-water-that-socrates-jesus-and-buddah-drank/

Do we drink the same water as dinosaurs drank?

Yes. **The water on our Earth today is the same water that's been here for nearly 5 billion years.** Only a tiny bit of it has escaped out into space. As far as we know, new water hasn't formed either. That means there's a very high chance the water in your glass is what thirsty dinosaurs were gulping about 65 million years ago.

It's possible that you could drink the same water as a stegosaurus or a T-Rex because of the way water circulates around our planet. **A dinosaur, you, and I are actually part of this water cycle, too.**

As water on the surface of lakes, oceans, and rivers warms up, it travels into the sky as very tiny droplets, or vapor. When the water vapor gets colder, it turns back to liquid to help form clouds.

When the liquid gets so heavy it can't stay in the atmosphere anymore, it falls, or "precipitates," as rain, snow, sleet, hail, or, my favorite, graupel. Once the precipitation reaches the ground or lands in lakes, oceans, and rivers, the cycle continues.

You, a dinosaur, and I drink water, and eat foods that contain this water, too. It's so refreshing to lap it up from my bowl. We get rid of some water as fluids or gases, such as the ones we let out when we breathe.

That's what I found out from my friend Kent Keller who investigates the water beneath Earth's surface. He's a geologist with Washington State University's School of the Environment. He said water also moves in ways we don't always think about. **Scientists have found water trapped in minerals deep within the Earth's mantle and crust, he explained. This water is even older than dinosaurs. It doesn't look like liquid water that's in your glass, but it still made of the same stuff.**

“We’ve realized there is a lot of water down there,” Keller said. “There’s as much water chemically speaking, more or less, as there is in the oceans. It’s just in a different form.” Another place we find water from dinosaur days is in organic matter. When the dinosaurs died, their bodies broke down to become part of the Earth. Over time, some of this organic matter became shale, coal, and oil we use for fuel.

The water dinosaurs drank is in more than just the water we drink, minerals, and organic matter. It’s also what we use to shower, cook, and water plants for food.

Right now, Keller is visiting with fellow scientists at the Global Institute for Water Security in Saskatchewan, Canada. They are curious about **how we’ll take care of our water for the future.**

“Life as we know it – every cell in every plant and animal — is mostly water. To say it requires water is an understatement,” Keller said.

The water in your glass may be the same water dinosaurs drank, but it’s also the same water that’s going to keep life on our planet in the years to come.

Sincerely,
Dr. Universe

https://askdruniverse.wsu.edu/2016/04/10/drink-water-dinosaur-days/

Water: States of Matter

All things are made up of matter (matter is any physical thing that has mass and takes up space).

Matter can exist in three different forms: solid, liquid, and gas.

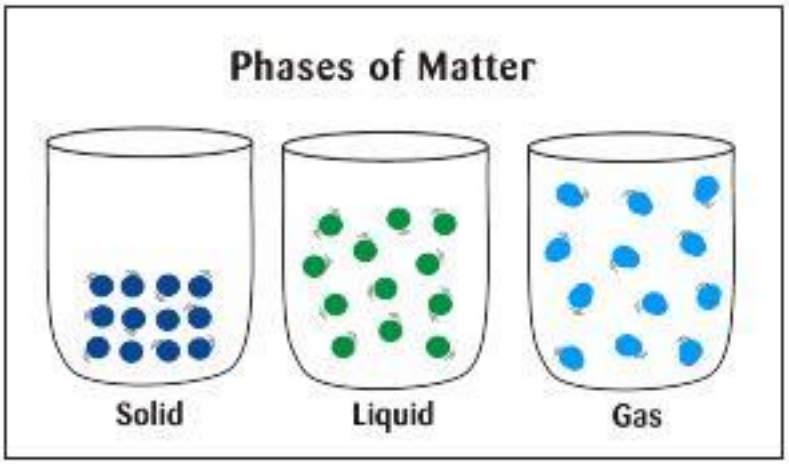
When an object is a solid, its molecules are arranged in a pattern and can’t move around much.

In a liquid, molecules are farther apart, can move around, and are not arranged in a pattern.

The movement is what makes a liquid fluid (or pourable) and take the shape of a container it is in.

The molecules in a gas are even farther apart than in a liquid and move freely with no pattern at all.

Go here to see what the molecules of substances look like as a solid, liquid, and gas.



Matter can change from one state to another when physical conditions change; when energy, such as heat, is added or removed, a substance can change from a solid to a liquid, or from a liquid to a gas.

For example, peanut butter does not flow like a liquid. It acts more like a solid even though it is very soft.

However, if you use heat (i.e., add energy) to melt peanut butter, its state will change and it will flow like a liquid!

Note that not all substances can change states just by adding or removing heat—sometimes other physical changes, such as increased pressure, are needed to change the state of a substance.

Water is unique because the properties of water allow it to exist in all three states of matter!

Water is usually a liquid, but when it reaches to 32° Fahrenheit (F), it freezes into ice.

(Ice is the solid state of water.)

When water reaches 212° F, it boils. When it begins to boil, some of the water turns into steam.

(Steam is the gas state of water, and is also called water vapor.)

When steam comes into contact with cool air (which reduces energy), it can condense back into water droplets (liquid again).

Those water droplets could then freeze into (solid) ice.

Even with all of these state changes, it is important to remember that the substance stays the same—it is still water, which consists of two hydrogen atoms and one oxygen atom.

Changing states of matter are only physical changes; the chemical properties of the matter stays the same regardless of its physical state!

Normally, when water reaches 32° F it begins to freeze.

As you learned in the super-cooled water experiment, water needs a nucleation site, or a spot for the first ice crystals to form.

When there isn't one, water can reach a temperature below the freezing point without turning into ice. When that happens, the water is said to be super-cooled.

Can you think of any other ways to keep water from freezing when temperatures are below freezing?

Salt lowers the freezing point of water and is often used to melt dangerous ice off of roads and sidewalks in the winter.

To learn more about salt and ice, check out these snow and ice experiments.

To learn more about frozen science, see how to make a frozen bubble and super-cooled water that freezes in an instant!

https://learning-center.homesciencetools.com/article/states-of-matter/